Appendix I

Selection and Implementation of Alternatives Report for Town of Harrison

Town of Harrison Combined Sewer Overflow Long Term Control Plan

Selection and Implementation of Alternatives Report

NJDEP Submission October 1, 2020

Town of Harrison

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Town of Harrison Combined Sewer Overflow Long Term Control Plan

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NJDEP Submission October 1, 2020

Town of Harrison

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
0	10/1/2020	J. Dening	J. Rolak	J. Dening	NJDEP Submission

Document reference: 389839 | 001 | 0

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Certification

Town of Harrison
Selection and Implementation of Alternatives Report

Approval of Report and **NJPDES Certification:**

"I certify under penalty of law that this document relating to the treatment and collection system owned and operated by the permittee and all attachments related thereto were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system owned and operated by the permittee, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information."

____________________ Date 9/15/2020

Town of Harrison: NJPDES Number NJ0108871
Rocco Russomanno, PE; Town of Harrison Engineer

TOWN OF HARRISON

Meeting Date: 07/30/2020

Resolution #: R-2020-118

Committee: Legal

Presented by Councilperson:
Ellen Mendoza

HUDSON COUNTY

A RESOLUTION REGARDING A LONG TERM CONTROL PLAN FOR COMBINED SEWER OVERFLOWS IN THE TOWN OF HARRISON

WHEREAS: The Town of Harrison ("Town") is a Combined Sewer Overflow ("CSO") municipality; and

WHEREAS: All CSO municipalities are authorized to use CSOs by the United States Environmental Protection Agency ("USEPA") pursuant to its National Pollutant Discharge Elimination System permitting program; and

WHEREAS: It is the national policy of USEPA and the state policy of the New Jersey Department of Environmental Protection ("NJDEP") to reduce and/or completely eliminate the volume of wastewater that flows out of CSOs and into local waterbodies without any treatment; and

WHEREAS: In accordance with its national CSO policy, USEPA has <u>required</u> all permitted entities to create "long term control plans," pursuant to which each permitted entity must identify all actions that the entity will implement to achieve the goals and level of CSO control that USEPA sets forth in its national CSO policy; and

WHEREAS: New Jersey is the last state in the United States to develop long term control plans in accordance with USEPA's national CSO policy; and

WHEREAS: Long term control plans most frequently require the completion of massive public infrastructure projects that are highly technically complex, take many years or even decades to develop and implement, and place severe economic burdens on the residents who live in the areas where implementation takes place; and

WHEREAS: In 2015, the NJDEP required all New Jersey CSO Municipalities to develop a CSO Long Term Control Plan ("LTCP") in order to comply with USEPA's national CSO policy.

NOW, THEREFORE, BE IT RESOLVED by the Mayor and Council of the Town of Harrison, Hudson County, New Jersey, as follows:

THAT: The Mayor and Council have selected Partial Sewer Separation with Supplemental Green Infrastructure as its long term control plan so as to comply with USEPA'S Combined Sewer Overflow Policy, and that the Mayor, Town Clerk, Town Engineer, Superintendent of Public Works and CFO may take any and all actions necessary and proper to effectuate the purposes of this Resolution

Town Council	Moved	Seconded	Yes	No	Abstain	Absent
L. BENNETT	☐	☒	☒	☐	☐	☐
M. CAMANO	☐	☐	☐	☐	☐	☒
M. DOLAGHAN	☒	☐	☒	☐	☐	☐
J. DORAN	☐	☐	☐	☐	☐	☒
J. HUARANGA	☐	☐	☒	☐	☐	☐
E. MENDOZA	☐	☐	☒	☐	☐	☐
F. NASCIMENTO	☐	☐	☒	☐	☐	☐
E. VILLALTA	☐	☐	☒	☐	☐	☐
J. FIFE	☐	☐	☒	☐	☐	☐

James A. Fife, Mayor

I hereby certify this to be a true and correct copy

Paul J. Zarbetski, Town Clerk

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APPENDICES

ABBREVIATIONS AND ACRONYMS

BCMR – Baseline Compliance Monitoring Report
BMP – Best Management Practices
CCI – Construction Cost Index
CSO – Combined Sewer Overflow
CSS – Combined Sewer Systems
CWA – Clean Water Act
DEAR – Development and Evaluation of Alternative Report
DWF – Dry Weather Flow
EDP – Effective Date of Permit
ENR – Engineering News Record
GI – Green Infrastructure
GP – General Permit
I/I – Infiltration/Inflow
KEH – Kearny-East Newark-Harrison
KHN - Kearny-Harrison-Newark
LTCP – Long Term Control Plan
MHW – Mean High Water
N.J.A.C – New Jersey Administrative Code
NJDEP – New Jersey Department of Environmental Protection
NJPDES – New Jersey Pollutant Discharge Elimination System
NMC – Nine Minimum Controls
PILOT – Payment in lieu of taxes
PVSC – Passaic Valley Sewerage Commission
QAPP – Quality Assurance Project Plan
SIAR – Selection and Implementation of Alternatives Report
SIU – Significant Indirect Users
STP – Sewage Treatment Plant
TGM – Technical Guidance Manual
TIDE – Transforming Infrastructure and Defending our Environment
TSS – Total Suspended Solids
USACE – United States Army Corps of Engineers
USEPA – United States Environmental Protection Agency
WQS – Water Quality Standards
WRRF – Water Resource Recovery Facility

EXECUTIVE SUMMARY

ES.1 BACKGROUND

The Town of Harrison (the Town) is in Hudson County and located immediately north and east of the City of Newark. It is bounded on the north by the Town of Kearny and the Borough of East Newark. The Passaic River separates the Town of Harrison from the City of Newark, see Figure A-1. Harrison has a population of 17,643 (2017 US Census Bureau estimate) and comprises an area of approximately 1.75 square miles.

The Town of Harrison which is served by a combined sewer system, is submitting this Selection and Implementation of Alternatives Report (SIAR) to meet certain conditions of the New Jersey Pollutant Discharge Elimination System (NJPDES) individual permits issued by the New Jersey Department of Environmental Protection (NJDEP) for Combined Sewer Overflow (CSO) control, referred herein as the NJPDES CSO Permit, or the Permit. This document has been compiled in fulfillment of the requirements under Part IV Section D.3, G.2 and G.5 through G.9 of the Town's NJPDES Permit No. NJ0108871, issued March 12, 2015.

This report has been developed cooperatively with the Passaic Valley Sewerage Commission (PVSC) Combined Sewer Overflow Group and is attached to the PVSC Regional Report (Regional Report). Accordingly, this report references the Regional Report and incorporates and makes use of information in the Regional Report without specifically duplicating that information.

ES.2 CONTROL APPROACH AND LEVEL OF CONTROL

The Town owns seven (7) outfall when the Permit was issued, subsequently Outfall 004A was eliminated. Based on modeling the 2004 typical year precipitation against the 2015 baseline year infrastructure, these outfalls discharge 46.4 million gallons (MG) over the course of 40 overflow events. Under 2015 baseline conditions the Town achieves a capture of 81.7% of the combined sewage entering its collection system during wet weather. The Town of Harrison's CSO discharge to the Passaic River, which is designated as SE-2. Sampling and modeling indicate that Passaic River is compliant with pathogen water quality standards. Under Part IV.G.4.f and the EPA's Combined Sewer Overflow Control Policy (1994) the Town has elected to comply with the Presumptive Approach's requirement for 85% capture of combined sewage entering the collection system during wet weather, as the targeted level of control. To increase the percent capture to 85%, overflow must be reduced to 38.1 MG. Additional detail on the targeted level of control can be found in Section D.2.1.

ES.3 Public Participation

The Town engaged the public through multiple venues and mediums including:

- Participation in the Region SCSO Team
- The activities of Harrison TIDE
- The Town website
- Maintaining a public CSO notification system

- Presentations at Town caucus meetings

Input provided by the public was used to inform the selection of the LTCP

ES.4 Selected Plan

Sewer Separation

The Town has been diligently separating sewers over the past decades and more recently through redevelopment over the past 5 years. The separation work represents a significant investment on the part of the Town, this includes investments made directly by the Town for offsite improvements and well as the value of concessions provided by developers that could have gone to other efforts. The Town will continue these separation efforts to achieve their LTCP goals.

Separation of CSO-004A's 3.3 acre drainage area has been completed. Harrison was issued a Minor Modification to their Permit on June 25, 2018 to reflect the separation and the removal of the outfall. The separation included the installation of water quality devices that the Town has assumed ownership of and maintenance responsibility for.

Separation of CSO-005A's 87.1 acre drainage area has been partially completed with new storm and sanitary sewers installed from the upstream end of the drainage area to South Second Street, effectively separating an area of 37.6 acres. The installation of new sanitary sewers connected directly to the PVSC interceptor has reduced the sanitary load, however there will not be a meaningful reduction in CSO volume or frequency until the new storm sewers are extended past the regulator to the outfall. This will be accomplished when the remaining 49.5 acres are separated. The impact of the separations is summarized below in Table ES-1, as can be seen the overflow volume is reduced below the required 38.1MG and wet weather capture in excess of 85% is achieved.

Table ES-1: Summary of Overflows, Typical Year 2015 Baseline and Alternative 1

	Baseline 2015 (Typical Year)			Alternative 1 (Typical Year)			Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	2.3	129	25	2.1	123	-1	-0.2	-6
H-002A	26	2.3	214	24	2.3	211	-2	0.0	-3
H-003A	40	14.1	158	40	13.9	157	0	-0.1	-1
H-004A	5	0.2	23.2	0	0.0	0.0	-5	-0.2	-23
H-005A	30	7.4	208	0	0.0	0.0	-30	-7.4	-208
H-006A	35	11.2	190	33	10.7	187	-2	-0.5	-3
H-007A	37	9.0	109	37	9.0	109	0	0.0	0
Total	40	46.4	281*	40	**38.0**	277*	--	-8.4	-4*

***Town Wide Total**

Green Infrastructure (GI)
GI was selected for inclusion in the LTCP based of its value for public outreach and education. The community's awareness, understanding and appreciation of combined sewers is a key component in the public participation component of the LTCP. Modeling during the DEAR showed green infrastructure, even if implemented on a large scale, would not to have a meaningful impact on CSO volumes or frequency. The community's awareness, understanding and appreciation of combined sewers and GI, is a key component in the public participation component of the LTCP. It also helps build support for the investment required for the other CSO LTCP elements. Accordingly, based on these factors, the Town will support the investment of $750,000 during the first 10-years of the LTCP to promote, install and support the installation of GI within the Town.

Water Conservation
Water conservation was included in the LTCP in response to comment from the public. The planned water conservation is largely an extension of the efforts already undertaken by the Town. However, a deliberate review process is included to periodically evaluate if current water conservation measures could be improved upon.

ES.5 Operational Plan and Schedule
The Town has experiences with separate sewers, green infrastructure and water conservation and is prepared to operate the LTCP facilities as they are implemented. The anticipated schedule for LTCP is presented in F.5 and is summarized as follows:

> Years 1-10 – Green Infrastructure Program
>
> Years 12-20 – Sewer separation of CSO-005A drainage area, provided it is not accomplished sooner through redevelopment.
>
> Years 20 and 21 – System monitoring and verification of performance.
>
> Each Permit Cycle – Review and update to Town Water Conservation ordinance(s)

Progress reports will be provided as required by future permits.

ES.6 Project Costs and Impact
The LTCP will have an impact on the Town's finances for many years. The construction costs of the project are expected to be approximately $16M (2020 dollars) this is in addition to the $11M already invested by the Town in sewer separation. These costs are assumed, to be financed through long term loans at the favorable rates provided by the I-Bank. Under projected conditions, the average sewer rate with the CSO LTCP included does not exceed the EPA recommended high burden threshold of 2% of median household income.

The impact on the average residential sewer bill and median household income was assessed, see Figure F-3. As can be seen the average sewer bill will experience annual increases of up to

12.5% before dropping once the Town stops assuming additional debt to finance the LTCP. The impact of the LTCP on average residential sewer bills is depicted in Figure F-4. As can be seen the greatest differential in sewer bills within this period with and without the LTCP is about 42% meaning that the average resident can expect their sewer bill to effectively go up by 42% as a result of the LTCP. This impact is not continuous, but rather ramps up during construction and then gradually declines as debt is retired and after the bonds are paid off. At this point the average sewer bill would only be 2% higher than without the LTCP. The 2% is the additional cost of maintaining the green infrastructure installed or funded as part of the LTCP.

The projections and conclusions concerning the affordability of the CSO control program proposed in this SIAR by the Permittee's financial capability to finance the CSO control program are premised on the baseline financial conditions of the Permittee as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the COVID-19 pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

Given the current and likely continuing uncertainties in New Jersey and national economic conditions, the Town will be reluctant to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls, proposed in this report, based on emergent economic conditions beyond the permittees' control. Considering the adaptive management practices noted above, a suitable approach to address likely financial challenges would be to develop a schedule for incremental improvements, and then revisit these improvements as financial conditions change or as new control technologies emerge.

Moreover, in September 2020, the United States Environmental Protection Agency (EPA) announced its proposed 2020 Financial Capability Assessment guidance document, describing changes to the existing assessment to include additional considerations for economically disadvantaged communities. Updates to the EPA guidance may impact the affordability analysis, and in turn the LTCP implementation schedule presented. As such, elements of the LTCP may be revised in the future to incorporate the EPA's proposed approach.

Although a complete implementation schedule is being proposed as part of this LTCP, based on the factors noted above, a revised affordability assessment should be performed during review of the next NJPDES permit to re-evaluate and validate financial capability and to identify any revisions to the proposed controls that may or may not be financially feasible during that next permit period.

ES.7 Post Construction Compliance Monitoring Plan (PCCMP) and Adaptive Management Plan

The Town is required under Section G.9 of the Permit to develop a compliance monitoring plan (CMP) that is “adequate to: verify baseline and existing conditions, the effectiveness of CSO controls, compliance with water quality standards, and protection of designated uses.“ The Town will evaluate the performance of the control measures through use of their sewer system model. The model output will be compared with actual CSO flow data for the post- construction monitoring period to determine whether recalibration is needed. Once the model has been determined to be adequately calibrated, a continuous simulation of the Typical Year (2004) will be run to compare the remaining CSO discharge volume to baseline conditions and determine whether the CSO control measures have achieved the Performance Criteria.

For the purposes of addressing the Permit PCCMP ambient monitoring requirements, the Town plans to utilize water quality sampling data collected by the existing NJ/NY Harbor Dischargers Group sampling program to supplement the findings of the collection system modeling and to support the water quality modeling efforts, to be performed upon the implementation of all CSO control measures to verify that the remaining CSOs are not precluding the attainment of water quality standards for pathogens. For purposes of defining the implementation of all CSO control measures, implementation of all CSO Control measures is defined as the implementation of all projects within the Town and all NJ CSO Group Permittees.

The Town is confident that the CSO control measures implemented prior to the post construction monitoring period will meet the 85% wet weather capture percentage Performance Criteria based on the simulation of the Typical Year (2004). The Town intends to implement the components of the CSO LTCP using an adaptive management approach to ensure that the decision-making process and investments are in line with changes in the financial environment, control technologies, water quality conditions and local support that may evolve over time.

Should the post construction monitoring suggest the CSO control measures exceed the performance criteria or do not perform as anticipated, performance factors and deficiencies responsible for this exceedance or shortfall will be identified. Modified, reduced, or additional control measures will then be implemented to allow the Town to meet the 85% Performance Criteria. An Adaptive Management Plan shall be developed that details this analysis, including the implementation plan and schedule of the additional or reduced controls. This Adaptive Management Plan will include any adaptive management modification based on Post-Construction Monitoring and evaluation. The Adaptive Management Plan shall be submitted to NJDEP, any required adaptive actions could then be included in the NJPDES Permit renewal, as applicable.

SECTION A - INTRODUCTION

A.1 REPORT BACKGROUND

The Town of Harrison (the Town) is submitting this *Selection and Implementation of Alternatives Report* (SIAR) to meet certain conditions of the New Jersey Pollutant Discharge Elimination System (NJPDES) individual permits issued by the New Jersey Department of Environmental Protection (NJDEP) for Combined Sewer Overflow (CSO) control, referred herein as the NJPDES CSO Permit, or the Permit. This document has been compiled in fulfillment of the requirements under Part IV Section D.3, G.2 and G.5 through G.9 of the Town's NJPDES Permit No. NJ0108871, issued March 12, 2015, with an effective date of July 1, 2015 and minor revisions issued October 9, 2015 and June 25, 2018 to reflect the removal of outfall CSO-004A (Dey Street). A Final Surface Water Major Modification Permit Action was issued May 1, 2020 clarifying certain permit condition and modifying others. In response to the COVID-19 pandemic, a stay of Permit Condition Part IV.D.3.b.vi was issued revising the submission of the LTCP from June 1, 2020 to October 1, 2020.

This report has been developed cooperatively with the Passaic Valley Sewerage Commission (PVSC) Combined Sewer Overflow Group and is attached to the PVSC Regional Report (Regional Report). Accordingly, this report references the Regional Report and incorporates and makes use of information in the Regional Report without specifically duplicating that information. References are also made to prior reports submitted by the PVSC CSO Group on behalf of Harrison including:

- Development and Evaluation of Alternatives Report (DEAR) – Town of Harrison, Approved January 17, 2020.
- Development and Evaluation of Alternatives Report – Regional Report, Approved January 17, 2020.
- Combined Sewer System Characterization Report, Approved April 12, 2019
- Public Participation Process Report, Approved March 29, 2019
- Identification of Sensitive Areas Report, Approved April 8, 2019
- Baseline Compliance Monitoring Program Report, Approved March 1, 2019
- Typical Year Hydrologic Report, Approved May 31, 2018

These documents have all been approved by the NJDEP.

The approval of the Development and Evaluation of Alternatives Report (DEAR) was conditioned on two items, in the January 17, 2020 approval letter, that were to be addressed in the SIAR:

- Comment 1 pertained to the details of the calculation of the percent capture.
  Response 1 The details of the municipal calculation are included in Section D.3.2. The regional calculation of percent capture is documented in the Regional Report.

- Comment 2 noted that the NJDEP was not commenting on cost analysis.

Response 2 This comment did not require any specific action in the SIAR.

Part IV.G Section 10 of the NJPDES permit requires that permittee is "responsible for submitting an LTCP that addresses all nine elements in Part IV.G". The nine elements are listed below:

1. Characterization Monitoring and Modeling of the Combined Sewer System [See SIAR Regional Report and Combined Sewer System Characterization Report]
2. Public Participation Process [See Public Participation Process Report, SIAR Regional Report and Section A.8]
3. Consideration of Sensitive Areas [See Identification of Sensitive Areas Report and SIAR Regional Report and Section A.6]
4. Evaluation of Alternatives [See Harrison and Regional DEARs Section C]
5. Cost/Performance Considerations [See Section C.2.8 and D.3.2]
6. Operational Plan [See Section F.3]
7. Maximizing Treatment at the existing STP [See Regional Report]
8. Implementation Schedule [See Section F.5]
9. Compliance Monitoring Program [See Section F.9, SIAR Regional Report, and Baseline Compliance Monitoring Report]

The PVSC CSO Group is coordinating and reporting on Items 1, 2, 3, 7, and 9 above in the PVSC Regional Report, some of which have been previously submitted and approved. Refer to the Regional Report for additional information on these items. This report will supplement the Regional Report's public participation information with Harrison's local efforts since the Public Participation Process Report in June 2018. This submission combined with the PVSC Regional Report fulfills the permit requirements for selection of a practical and technically feasible Long Term Control Plan (LTCP).

This SIAR presents the selected CSO control program, implementation schedule and financial capability analysis. The selection of the preferred control program incorporates a comprehensive review and analysis of applicable CSO control strategies based on the information gathered and presented in the previously submitted and NJDEP approved: System Characterization Report and the Development and Evaluation of Alternatives Report. The Town and PVSC have developed a thorough understanding of their wastewater collection and treatment systems, including the systems' responses to precipitation events of varying duration and intensity, and the capacity of these systems to capture and treat flows from the combined sewer system (CSS). The hydrologic and hydraulic models approved by the NJDEP, with subsequent modifications as discussed in this report and the Regional Report, have been used to simulate the system performance under the baseline conditions, as well as the system response with the selected CSO control alternatives included.

It is noted that subsequent to the DEAR, Harrison undertook additional combined sewer system monitoring under a NJDEP approved Quality Assurance Project Plan (QAPP). This metering was used to enhance the calibration of the Harrison portion of the PVSC districtwide InfoWorks ICM model. Details of the monitoring and recalibration can be found in Appendix C.

The program objectives addressed herein are:

- Summarize the evaluation process previously presented in the DEAR leading up to the selection of the CSO control program
- Present a selected CSO control program that is consistent with the NJPDES CSO permit and National CSO Control Policy;
- Present water quality benefit, technical merit, and implementation schedule for the CSO control program
- Present cost/performance considerations; and,
- Provide an update on the public participation process.

This report documents the process used to select a control program to cost-effectively meet the water quality-based requirements of the Clean Water Act. The selected control program has been developed by the Permittees, in consultation with NJDEP and the public, to best meet the needs of the public and conform to the various regulatory requirements.

A.2 PERMITTEE BACKGROUND

Passaic Valley Sewerage Commission (PVSC) provides wastewater treatment service to 48 municipalities, including Harrison, in northeast New Jersey, within Bergen, Hudson, Essex, Union and Passaic Counties. In total, PVSC services approximately 1.5 million people, 198 significant industrial users and 5,000 commercial customers. The PVSC District covers approximately 150 square miles from Newark Bay to regions of the Passaic River Basin upstream of the Great Falls in Paterson. PVSC's main interceptor sewer begins at Prospect Street in Paterson and generally follows the alignment of the Passaic River to the PVSC Water Resource Recovery Facility (WRRF) in the City of Newark. PVSC has assumed a lead role in the development of the certain permit requirements on behalf of these permittees.

The Town of Harrison is in Hudson County and located immediately north and east of the City of Newark. It is bounded on the north by the Town of Kearny and the Borough of East Newark. The Passaic River separates the Town of Harrison from the City of Newark, see Figure A-1. Harrison has a population of 17,643 (2017 US Census Bureau estimate) and comprises an area of approximately 1.75 square miles.

Eight of the municipalities within the PVSC District have combined sewer systems (CSSs) and have received authorization to discharge under their respective New Jersey Pollutant Discharge Elimination System (NJPDES) Permits for Combined Sewer Management. The Town of Harrison is one of these CSO Permittees. The other permittees are:

- Newark City
- East Newark Borough
- Kearny Town
- Paterson City
- Jersey City

- Bayonne
- North Bergen MUA

A.3 SEWER SYSTEM DESCRIPTION

The Town has approximately 770 acres contributing area to the PVSC system, of which approximately 420 acres are combined system and 350 acres are serviced by separate sanitary and storm systems. The Town's NJPDES permit initially included seven combined sewer outfalls. Due to ongoing sewer separation projects, NJDEP issued Harrison a minor modification on June 25, 2018 NJPDES permit action to remove the Dey Street outfall 004A. Since outfall 004A was abandoned following 2015, it was included as an active CSO in the baseline conditions, and its removal is incorporated in the LTCP. The Town is also in the process of separating the CSO 005 drainage area through redevelopment project which will affect the distribution of combined and separately sewered areas.

The outfalls are summarized below in Table A-1. The outfalls and CSO drainage basins are shown in the Figure A-1. It is noted that the drainage area to outfall 004A has been separated and the drainage area to 005A is proposed to become a separately sewered area and separation has been partially completed through redevelopment. Upon completion of the separation, the 005A CSO outfall will also be decommissioned, as discussed in more detail later in this report.

Table A-1: Summary of Harrison outfalls

NJPDES #	CSO Number	Regulator Number	Receiving Water Body
NJ0108871	001A	H-001A (Hamilton Ave.)	Passaic River
NJ0108871	002A	H-002A (Cleveland Ave.)	Passaic River
NJ0108871	003A	H-003A (Harrison Ave.)	Passaic River
NJ0108871	004A (Eliminated)	H-004A (Dey Street)	Passaic River
NJ0108871	005A (To be Eliminated)	H-005A (Middlesex St.)	Passaic River
NJ0108871	006A	H-006A (Bergen St.)	Passaic River
NJ0108871	007A	H-007A (Worthington Ave.)	Passaic River

In addition to the six CSO existing outfalls, the major facilities of the Town's sewer system include:

- Approximately 17 miles of combined sewer pipe with diameters generally ranging from 8 inches to 30"x45" inches.
- Six CSO Floatable Control Facilities owned and operated by the Town.
- Six active regulating chambers tributary to the PVSC interceptors, owned and operated by PVSC.

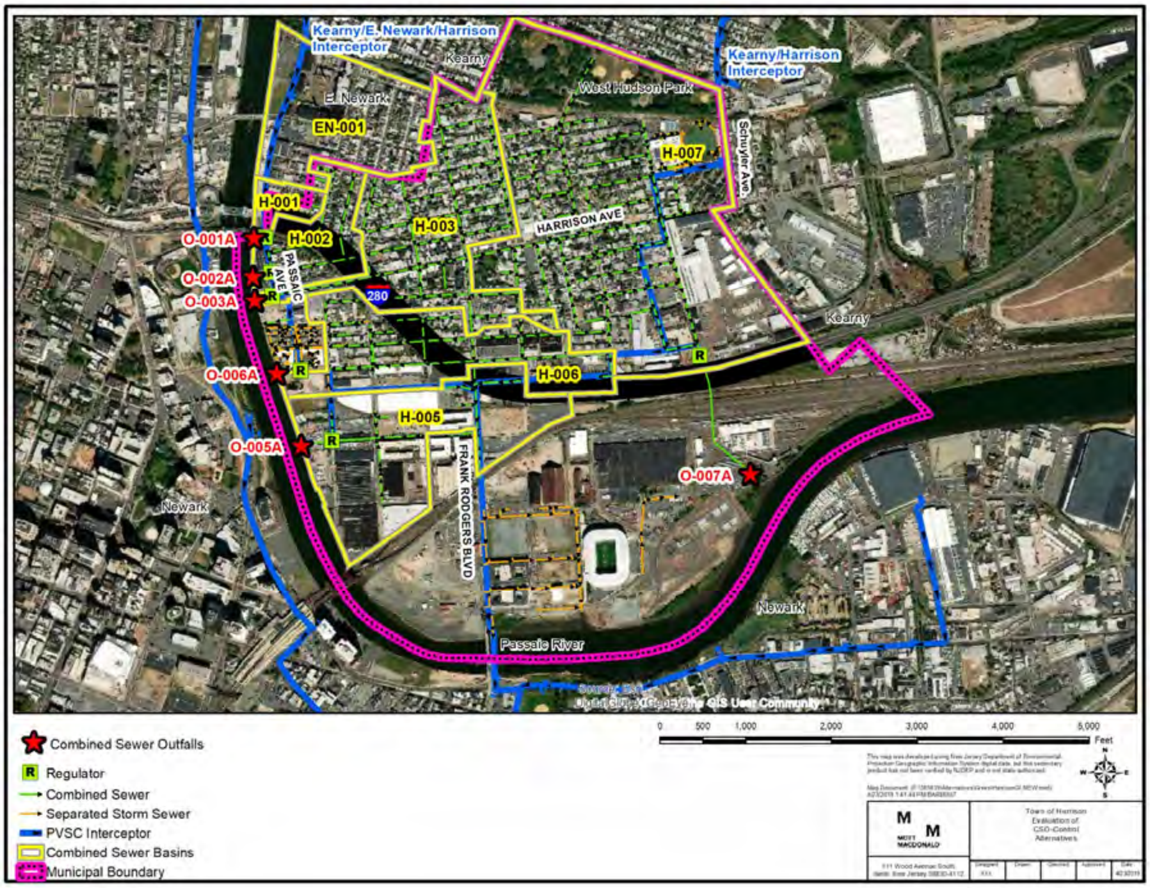


Figure A-1: Location of CSO Outfalls and drainage basin delineations in Town of Harrison

There are two PVSC branch interceptors that service and pass through Harrison, as shown in Figure A-1:

- Kearny-East Newark-Harrison (KEH) Branch Interceptor
- Kearny-Harrison-Newark (KHN) Branch Interceptor

The Kearny-East Newark-Harrison Branch Interceptor is approximately 8,948 feet long and extends from the Kearny-Harrison-Newark Branch Interceptor upstream of manhole KHN-5 on Frank E. Rogers Blvd. in Harrison, to the Nairn Avenue Regulator in Kearny. Flows are metered at two separate locations along the route, the East Newark Meter Chamber and the Johnston Avenue Meter Chamber.

The Kearny-Harrison-Newark Branch Interceptor is approximately 15,355 feet long and extends from the Main Interceptor at the intersection of Ferry Street and Van Buren Street to north of King Street on Schuyler Avenue in Kearny. Flow is metered at the South Fourth Street Venturi Meter located at the south end of Frank E. Rodgers Boulevard, just prior to the Passaic River crossing.

A.4 REGULATORY BACKGROUND

As a permittee of a hydraulically connected system, the Town of Harrison and PVSC are cooperating and collaborating on the development of a Long Term Control Plan (LTCP) for CSO control, per the permit conditions. The Town and PVSC communicate regularly, sharing information, and exchanging hydraulic models and have undertaken integrated modeling of the hydraulically connected system to effectively develop and evaluate the alternatives presented in this report.

In the current NJPDES CSO Permits, the NJDEP has mandated that the permittees prepare a CSO Long Term Control Plan, and has incorporated permit conditions that closely reflect the requirements of the National CSO Control Policy established by the United States Environmental Protection Agency (USEPA). A CSO LTCP involves a comprehensive study of the hydraulically connected sewer system and the evaluation of alternatives for reducing CSO impacts to receiving waters. It investigates the hydrologic and hydraulic relationships between precipitation, conveyance, treatment capacity, and overflows and evaluates the scope, costs, and performance of possible control alternatives for treating or reducing the frequency and volume of CSO discharges.

The EPA CSO Control Policy and the individual NJPDES CSO Permits describe nine elements or requirements for the development of a CSO Long Term Control Plan:

1. Characterization, monitoring, and modeling of the combined sewer systems to provide a thorough understanding of the hydraulically connected system, its response to various precipitation events, the characteristics of the overflows, and the water quality impacts that result from the CSOs;
2. A public participation process that actively involves the affected public in the decision-making process to select long term CSO controls;
3. Consideration of sensitive areas in identifying the highest priority for controlling overflows;
4. Evaluation of alternatives that consider a reasonable range of CSO control options that provide a level of control presumed (per the criteria given in the Policy and Permit) or demonstrated to meet the water quality-based requirements of the Clean Water Act (CWA);
5. Cost/performance considerations to demonstrate the relationships among a comprehensive set of reasonable control alternatives;
6. An operational plan that incorporates revisions to the operation and maintenance program necessary after approval of the LTCP to incorporate its associated CSO controls;
7. Maximizing treatment at the existing publicly owned treatment works (POTW) treatment plant during and after each precipitation event so that such flows receive treatment to the greatest extent practicable utilizing existing tankage for storage, while still meeting permit limits;

8. An implementation schedule addressing the construction and financing of proposed CSO controls; and
9. A post-construction compliance monitoring program adequate to verify compliance with water quality-based CWA requirements and designated uses as well as to ascertain the effectiveness of implemented CSO controls.

The NJPDES CSO Permits divided the above requirements into three sequential steps, providing an orderly progression for the development of the LTCP. The tasks undertaken and the documents submitted under each step, per the specified schedule, are:

- Step 1 incorporated LTCP elements 1, 2 and 3, which include the characterization, monitoring, and modeling element and components of the public participation process, consideration of sensitive areas, and baseline compliance monitoring program. These elements were due within 36 months of the effective date of permit (EDP) or July 1, 2018.
- Step 2 incorporated LTCP elements 4 and 5, which required permittees to submit a Development and Evaluation of Alternatives Report within 48 months from the EDP, or a due date of July 1, 2019. This step involved evaluating a broad range of control alternatives to meet CWA requirements and water quality standards (WQS) per the corresponding conditions prescribed in the permit. Maximizing treatment at the existing WRRF treatment plant and cost and performance considerations were also addressed in Step 2.
- Step 3 incorporated LTCP element 6, 7, 8, and 9, which require permittees to submit a Selection and Implementation of Alternatives Report that evaluates a sufficient number of control alternatives to guide the selection of a suitable and cost-effective long term control plan, and incorporates the final plan selection and implementation schedule for the construction and financing of proposed CSO controls. A proposed operational plan revision schedule and a post-construction compliance monitoring program also should be addressed. This submittal was due within 59 months from the EDP, which corresponded to a due date of June 1, 2020, this date was revised to October1, 2020 in response to the COVID-19 pandemic.

The required submittals were submitted collectively with the PVSC CSO Group, to date all required documents were submitted on time and subsequently approved by the NJDEP.

A.5 WATER QUALITY REQUIREMENTS AND BASELINE COMPLIANCE MONITORING

All six of the CSO outfalls discharge to the Passaic River. The portion of the Passaic River Basin which overlaps the PVSC service area is mainly in the Lower Basin. The 129 square miles of the Lower Passaic River Watershed are primarily urban/suburban. The section of the Lower Passaic River within the urban/suburban area has poor water quality conditions due to numerous point sources, significant nonpoint source contributions, and high sediment oxygen demands, (State of

New Jersey, 2014). The Lower Passaic River Watershed's water quality conditions are affected by hazardous waste sites and contamination issues that have resulted from a long history of industrialization (State of New Jersey, 2014).

NJAC Section 7:9B Surface Water Quality Standards classifies the Passaic River as SE3 in the Newark reach extending from the confluence with Second River to the mouth, which includes the Town of Harrison. SE3 refers to saline estuarine water bodies with standards as noted in Table A-2.

Table A-2: Passaic River Designated Uses and Water Quality Standards

Classification	Designated Use(s)	Indicator Bacteria	Criteria (per 100mL)
SE3 (saline water)	1. Secondary contact recreation; 2. Maintenance and migration of fish populations; 3. Migration of diadromous fish; 4. Maintenance of wildlife; 5. Any other reasonable uses.	Fecal Coliform	1500 Geometric Mean (GM)*

*Geometric mean calculated using a minimum of five samples collected over a thirty-day period.

Sampling of the Passaic River was conducted as part of the Baseline Compliance Monitoring Report (BCMR). Three sampling locations were located adjacent to Harrison or immediately upstream and downstream of Harrison, identified as Baseline Compliance Monitoring Points 10, 11, and B6, as depicted on Figure A-2. The data collected from these three monitoring locations is depicted on Figure A-3, Figure A-4, and Figure A-5. As discussed later, the receiving waters of the Passaic River adjacent to Harrison is meeting water quality standards for pathogens.

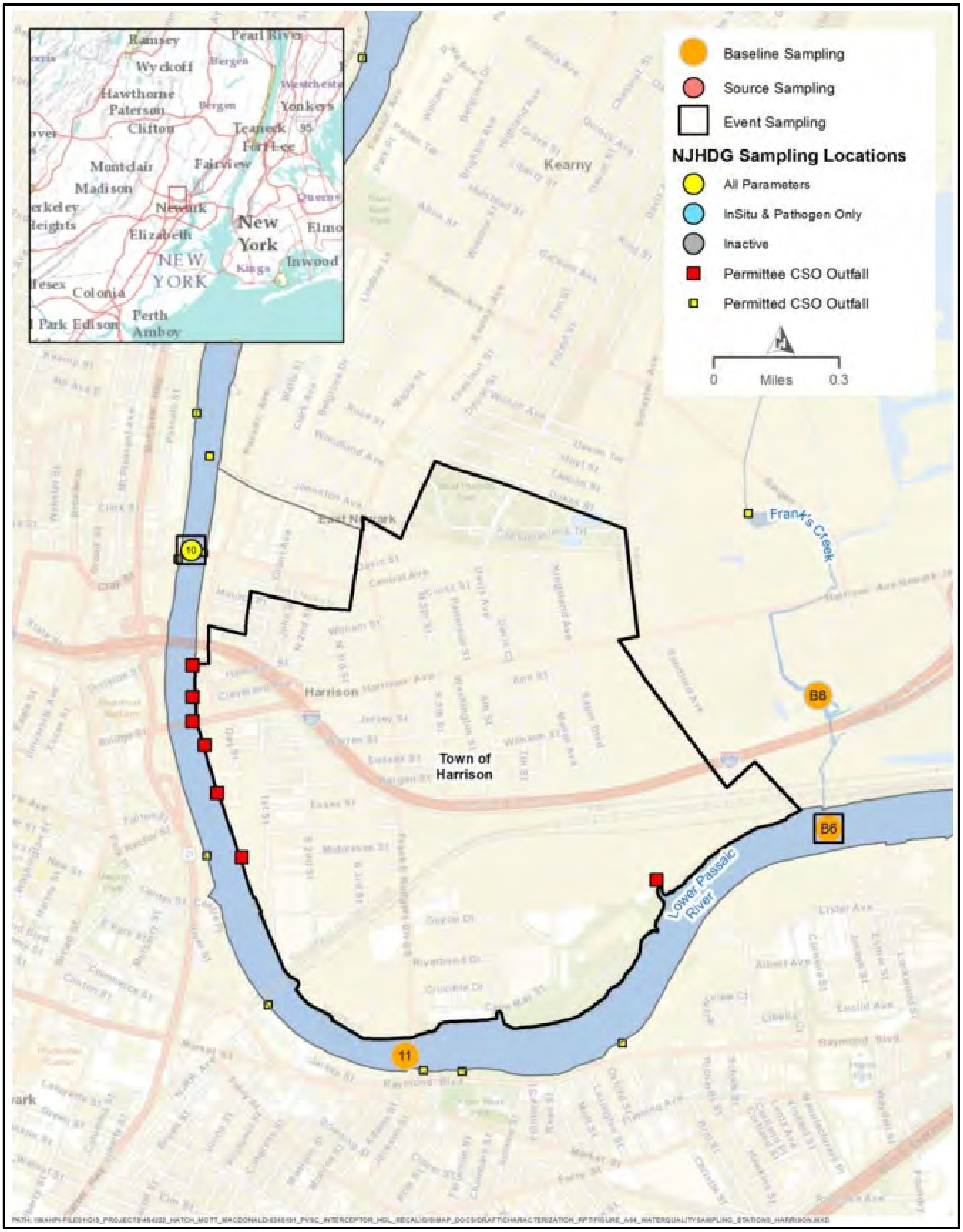


Figure A-2: Harrison Baseline Sampling Locations

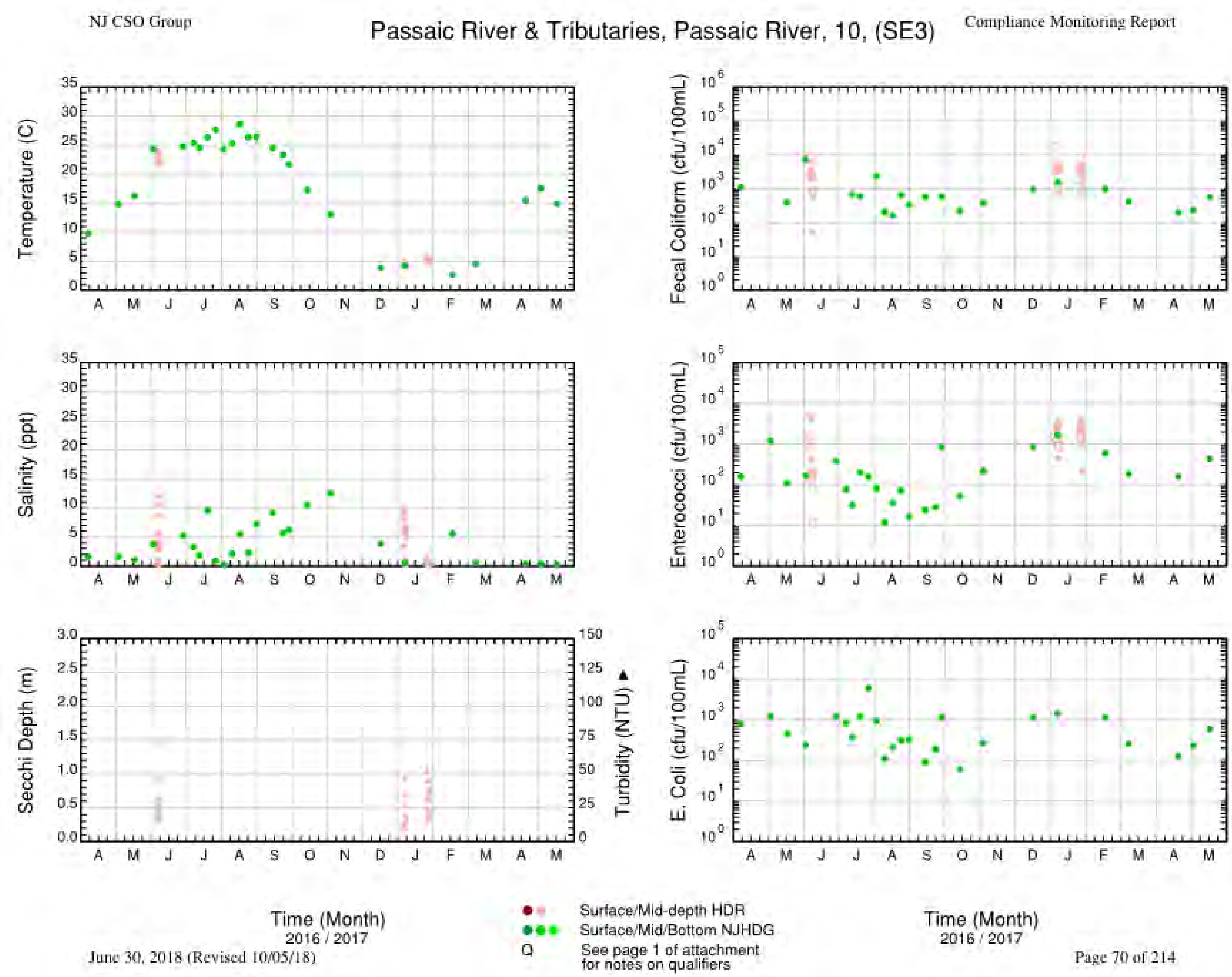


Figure A-3: Harrison Baseline Compliance Monitoring Point 10

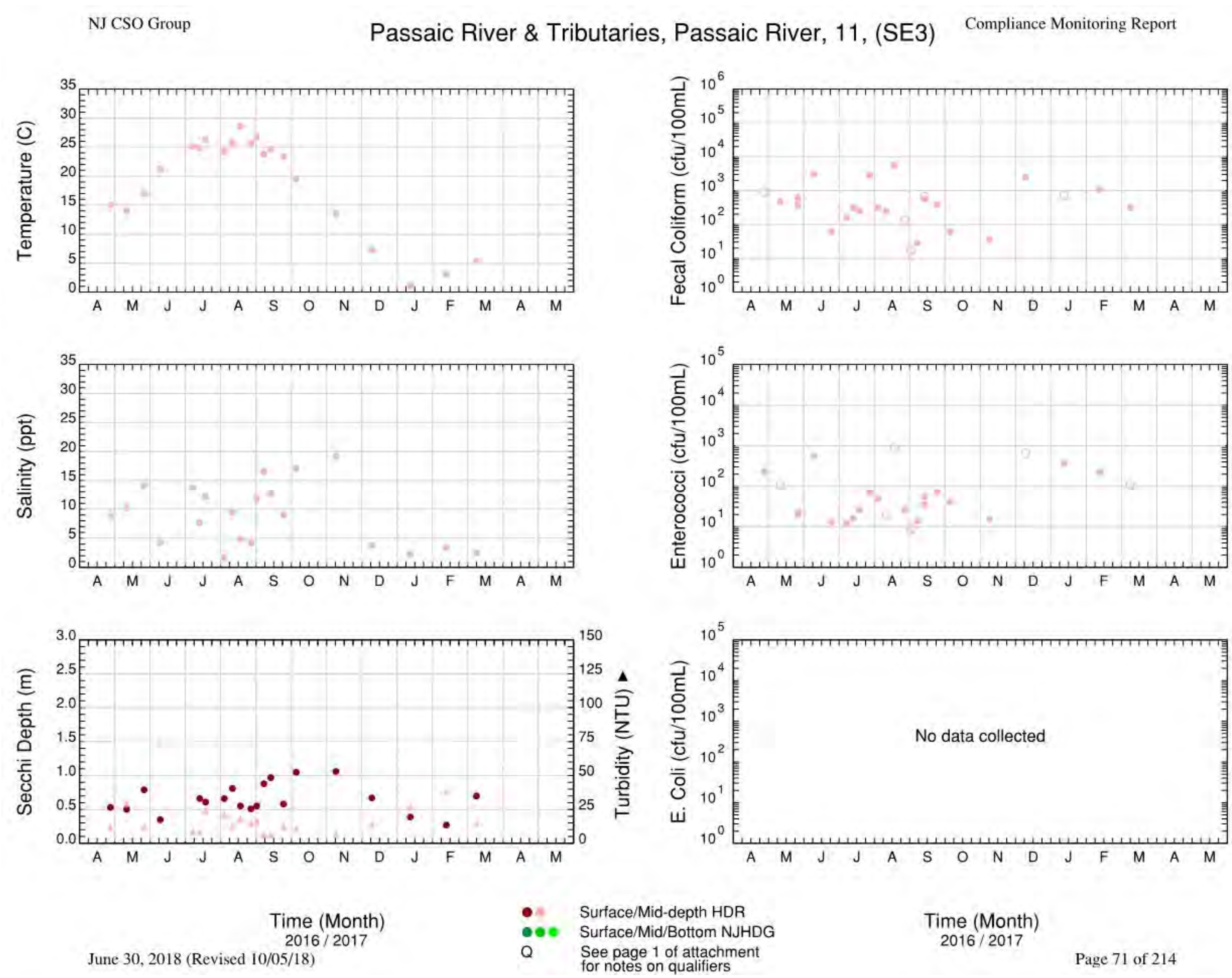


Figure A-4: Harrison Baseline Compliance Monitoring Point 11

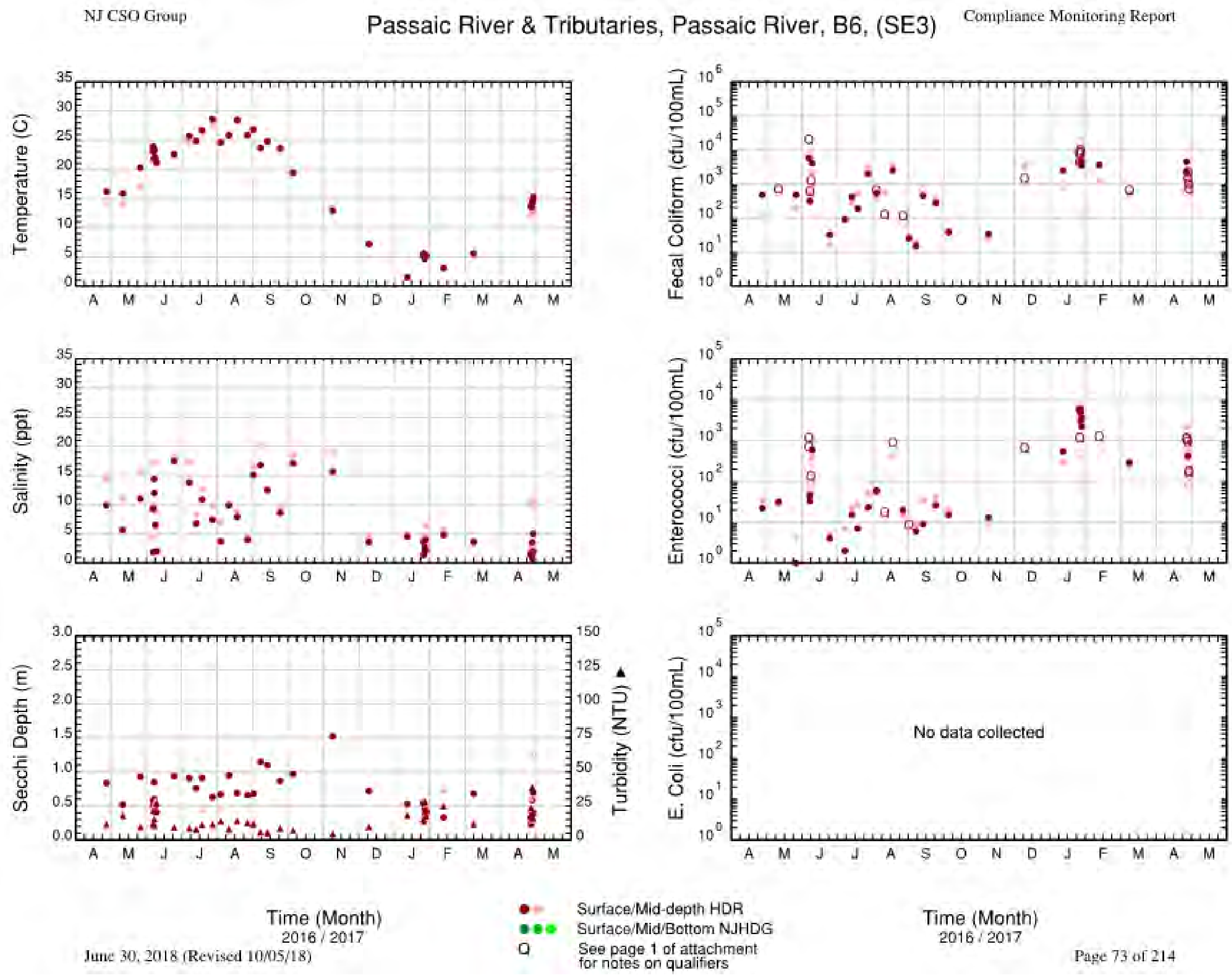


Figure A-5: Harrison Baseline Compliance Monitoring Point B6

A.6 SENSITIVE AREAS

The Permit calls for the Permittee to "give the highest priority to controlling CSOs to sensitive areas". As documented in the Sensitive Areas Report, and indicated by the NJDEP's April 8, 2019 approval letter, the Town of Harrison's combined sewer outfalls do not discharge to sensitive areas. Accordingly, the Harrison outfalls will be addressed uniformly with consideration to the overall reductions in systemwide volume and frequency of overflows.

A.7 SIGNIFICANT INDIRECT USERS

Significant Indirect Users (SIU) are regulated under the industrial pre-treatment program administered by the receiving WRRF, in this case PVSC. PVSC is working with the industrial discharges to address detention. The reader is referred to the Regional Report for additional details.

A.8 PUBLIC OUTREACH

Public outreach and input are an important component of the LTCP process, and the project team has provided opportunities for public education and awareness, as well as to gain feedback on the CSO control alternatives. Public outreach is one of the nine elements of the LTCP. The following section discusses the steps undertaken to accomplish the requirements of Part IV D.3.b.iv and Part IV G2 as they relate to the Selection and Implementation of Alternatives.

The Public Participation Process report was submitted by PVSC on behalf of the NJ CSO Group to NJDEP in June 2018, revised in January 2019, and approved in March 2019. Public participation activities up to June 2018 are documented in this report. Public participation activities between June 2018 and June 2019 are summarized in the Development and Evaluation of Alternatives Report which was submitted in July 2019, revised in November 2019 and approved by NJDEP in January 2020. Below is a summary of the Town of Harrison's activities since July 2019. Efforts by the overall PVSC CSO Group, of which Harrison is a part, are documented in the Regional Report.

A.8.1 Harrison TIDE

Much of the outreach took place through the monthly meetings of local community-based outreach groups, most notably Harrison TIDE ("Transforming Infrastructure and Defending our Environment"). While Harrison TIDE was not acting in an official capacity as a Supplemental CSO Team, several of its members are involved with CSOs and CSOs are almost always one of their meeting topics. Harrison TIDE has representation from municipal government, community, businesses, green infrastructure experts, academia, local utility authorities, and nonprofit groups. Engagement with these groups via Harrison TIDE is one of the main vehicles through which Harrison has addressed public outreach. Working closely with public officials, meetings have been specifically geared toward addressing LTCP awareness and the development of long-term CSO controls. Stakeholders are encouraged to ask questions and provide input during and after these meetings. Harrison TIDE also cross-advertised CSO related events such as PVSC CSO Group SCSO Team meetings and Bayonne's rain barrel workshop. Table A-3 summarizes the CSO related actives of TIDE(available meeting minutes are included in Appendix A). Due to COVID-19 the March Harrison TIDE meeting was postponed as were subsequent meeting.

Table A-3: Harrison TIDE - CSO Related Activities Summary

Date	CSO Related Activities and Discussions
01-10-19	• Discussion of rain gardens at Washington Middle School and the firehouse • Announcement of upcoming meetings on CSOs
02-14-19	• Discussion of plant selection for rain garden at Washington Middle School • Planning meeting on March 6 of Harrison, Kearny and East Newark residents to discuss CSOs • Announcement of upcoming meetings on CSOs and green infrastructure
04-11-19	• Updates on the rain gardens at Washington Middle School and the firehouse • Discussion of the public meeting on CSOs held on March 6
05-09-19	• Updates on the rain gardens at Washington Middle School – (maintenance agreement) and the firehouse (funding possibilities) • Promoting rain barrel workshop in Bayonne in May
06-13-19	• Updates on the rain gardens at Washington Middle School – (site visit by PVSC) and the firehouse (funding possibilities) • Discussion of draft “Development and Evaluation of Alternatives Report” • Report on Supplemental CSO Team meeting held on May 28
11-14-19	• Updates on the rain gardens at Washington Middle School and the firehouse • Report on Supplemental CSO Team meeting held of July 31 • Discussion of NJDEP’s comments on the submitted “Development and Evaluation of Alternatives Report” and of the responses to the comments
12-12-19	• Updates on the rain gardens at Washington Middle School and the firehouse.
03-18-20	• Updates on the rain gardens at Washington Middle School and the firehouse • Discussion of maintenance needs of the rain garden at the library • Discussion of the Long-Term Control Plan

A.8.2 PVSC CSO Group Supplemental CSO Team Meetings

The Town has been active at PVSC CSO Group Supplemental CSO Team meetings throughout the LTCP process. Three meetings have been held since the submission of the DEAR. A meeting was held on July 31, 2019 to review public comments received on the DEAR. The attendees were divided into groups to address specific themes in public comments. A SCSO TEAM meeting was held in Harrison on January 9, 2020 to present water quality modelling results, microbial source tracking study, review of public comments and responses from the DEAR, and next steps for the selection and implementation of alternatives. A SCSO Team was held virtually on June 17, 2020 during which municipal and regional plans were presented. Details on these meetings can be found in the Regional Report.

A.8.3 Town Council Meetings

To further involve the public and to inform the elected officials of the Town, presentations were periodically made at the Town caucus meetings. These meetings were attended by members of the public as well as elected officials and Town staff.

November 12, 2019

To further advance the public involvement, a presentation was made at the Town's November 12, 2019 Council meeting. The meeting included both town officials and members of the public. Mott MacDonald presented an overview of the combined sewer system, and summarized the alternatives analysis process, including available space, required alternatives, cost and performance. A copy of the slides from this meeting can be found in Appendix B. Comments received at this meeting are summarized as follows:

- Question: An attendee asked who would have to pay for all of this.

  Answer: The project team responded that the Town is responsible for the costs of implementing the Long Term Control Plan.

- Question: An attendee asked whether PVSC will still be able to operate the gates on their interceptor to control flow to the plant.

  Answer: The project team responded that if operation of the gates is part of their Long Term Control Plan, then they will be able to operate them in accordance with the plan and their permit.

- Question: An attendee asked what if we can't get to 4 overflow events a year, for example if we have 5.

  Answer: The project team responded that there are different methods for complying, which may allow for the WQ objectives to be met with more than 4 overflows.

- Question: An attendee asked what is used for stormwater management.

Answer: The project team responded that generally it would be a water quality device which is an underground chamber with devices to capture floatable and to cause solids to settle out.

- Question: An attendee asked whether it would be possible to drive or park on these devices.

  Answer: The project team responded that yes, they are usually in the right-of-way and the Town currently maintains several.

- Question: An attendee asked if additional renewal of infrastructure like water mains could be incorporated into sewer separation.

  Answer: The project team responded that yes, it would be possible to coordinate projects.

- Question: An attendee asked if sewer separation would get us a new sewer system.

  Answer: The project team responded that you would normally build only one new system, either storm or sanitary. The existing combined sewer would remain to service whatever the new system didn't cover.

- An attendee commented that tanks are the cheapest solution.

June 30, 2020 (Virtual)

On June 30, 2020 Mott MacDonald presented the tentatively selected plan to the Harrison Mayor and Council during the caucus meeting, the meeting was conducted virtually through the Zoom platform. The meeting included members of the public, all attendees were informed they could submit questions through the chat, members of the council also had the ability to ask questions verbally. A copy of the slides from this meeting can be found in Appendix B. Comments received at this meeting are summarized as follows:

- Question: What are the costs of the LTCP.

  Answer: The project team indicated the additional costs would $16.5M over the next 20-years, noting that this is a present worth cost that includes operation and maintenance costs. The bulk of this cost may be achieved through redevelopment and separation of 005A, otherwise the Town would need to complete this work.

- Question: If this is a long-term project can it be re-evaluated along the way?

  Answer: The project team indicated that the plan would be submitted to the State on October 1st, and elements of the plan will be included in the permit, which is re-issued on a 5-year cycle. He indicated that submission of the plan would be setting course for the next 20 years, and there would be greater difficulty in modifying the plan after the permit is in place.

- Question: Are there are any federal grants available for the $16.5M balance that still needs to be spent?

  Answer: The project team indicated that financing would most likely be pursued through the New Jersey Infrastructure Bank (IBank), which is a State revolving loan program. IBank offers low interest loans, which can be for up to 20 years. He indicated that there are other funding sources such as grants, but the most likely financing will come from NJ IBank, and other grants are possible and could be used if they are obtained, but these are not being considered as reliable funding sources for planning.

- Question: What would the total cost be?

  Answer: The project team indicated that the total value of the program over 20 years would be $27.6M, however about $11M of the work has already been completed. The remaining $16.5M would either be through redevelopment or would become the Town's responsibility to complete.

- Question: What would happen if the Town did not meet the IBank requirements to qualify for funding?

  Answer: The project team responded that the IBank is structured for water projects, and CSO control is generally given preference. The IBank funding would be reliable unless something very dramatic happened to the Towns funding. In this case, it may be possible to go back to the NJDEP to indicate that funding is not available to complete the projects.

A.8.4 CSO Identification Signs

The Town has continued to maintain signs at each CSO outfall to educate the public of the potential hazards associated with water contact during and following wet weather.

A.8.5 CSO Notification System

One of the Nine Minimum Control Requirements is "Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts". As part of NJ CSO Group, the Town has continued to utilize the online CSO notification system (https://njcso.hdrgateway.com/) as a public information tool advising on the status of CSO occurrences in the Town of Harrison and certain other communities participating in the NJ CSO Group.

A.8.6 Future Public Participation

PVSC and the Town of Harrison will continue to conduct public outreach through the detailed design and implementation phases for the selected CSO control program, to provide information and gain public input from the community. This outreach may be in the form of periodic meetings open to the public or selected representative community members to provide project updates, the circulation of informational flyers in the mail or on social media, interpretative signage, or public notices posted on the Town and PVSC websites or local newspaper. The Town of Harrison is committed to making information available to members of the public as well as providing an opportunity to comment throughout the duration of planning and implementation of the selected CSO control program.

SECTION B - SCREENING OF CSO CONTROL TECHNOLOGIES

B.1 INTRODUCTION

The evaluation of seven CSO control alternatives was mandated in Part IV.G.4.e of NJPDES CSO Permit. This list was not intended to be limiting, but rather set general categories of control alternatives to be considered. The list of control alternatives provided in the Permit was broad enough so that all the control alternatives explored fell within the list. The seven control alternatives listed in the Permit are:

1. Green infrastructure.
2. Increased storage capacity in the collection system.
3. Sewage Treatment Plant (STP) expansion and/or storage at the plant (an evaluation of the capacity of the unit processes must be conducted at the STP resulting in a determination of whether there is any additional treatment and conveyance capacity within the STP). Based upon this information, the permittee shall determine (modeling may be used) the amount of CSO discharge reduction that would be achieved by utilizing this additional treatment capacity while maintaining compliance with all permit limits. This was addressed in the PVSC DEAR.
4. Inflow/Infiltration (I/I) reduction in the entire collection system that conveys flows to the treatment works to free up storage capacity or conveyance in the sewer system and/or treatment capacity at the STP, and feasibility of implementing in the entire system or portions thereof.
5. Sewer separation.
6. Treatment of the CSO discharge.
7. CSO related bypass of the secondary treatment portion of the STP in accordance with N.J.A.C. 7:14A-11.12, Appendix C, II C.7. This was addressed in the PVSC DEAR.

For purposes of evaluation, potential CSO control technologies were generally organized into the following broad categories:

- Source Controls: Green infrastructure; public and private infiltration and inflow (l/l) reduction and removal; sewer separation; and best management practices (BMPs)/Nine Minimum Controls, including floatables control.
- Collection System Controls: Gravity sewers; pump stations; hydraulic relief structures; in-line storage; outfall relocation/consolidation; and regulator/diversion structure modification.
- Storage Technologies: Above and below ground tanks; and tunnels.
- Treatment Technologies: Screening and disinfection; vortex separation; retention/treatment basins; high rate clarification; and satellite sewage treatment.

A two-tiered approach was applied to the development of alternatives, starting with a screening analysis followed by an evaluation of the remaining CSO control alternatives. The intent was to give adequate attention to the breadth of alternatives available, but to limit the list of alternatives evaluated to a reasonable number. The complete screening can be found in the previously approved DEAR, prepared by Mott MacDonald for the Town of Harrison, dated July 2019, revised November 2019. The analysis in the DEAR was applied to the selection of a recommended LTCP.

B.2 SCREENING

The first step of the screening process was to identify the breadth of alternatives, which were then narrowed down to alternatives appropriate for the evaluation process. If necessary, a representative technology to apply to the evaluation was identified. A comprehensive list of CSO control alternatives was prepared by the NJCSO Group and was presented in the Regional PVSC CSO Group DEAR. The screening took place on several levels. In some cases, a general category was screened in or out based on its applicability to the Town. If the general category of technologies was applicable as were many sub-categories, the screening reduced the sub-categories to a reasonable number of representative sub-categories.

The screening was based on the requirement to "evaluate the practical and technical feasibility of the proposed CSO control alternative(s)" (Part IV.G.4.e) to determine if the alternative proceeded to a more detailed evaluation in Section D of the DEAR. The above requirement introduced three concepts that were addressed for each technology:

- Evaluate – can the alternative provide a measurable impact on water quality in terms of reduction in CSO volume or load.
- Practical – Can the alternative be implemented and accomplished by the Town.
- Technical Feasibility – Is the alternative a technology that is currently available and implementable on a scale suitable for a LTCP.

Details on each CSO control technology are presented below and the above criteria was subsequently applied in the screening process to determine the suitability of the control to the subject combined sewer system. The following matrixes in Table B-1, Table B-2, and Table B-3 summarize the results of the previously conducted alternatives screening process. Simply because an alternative was not selected for additional investigation under the DEAR does not exclude it from inclusion in the LTCP.

Table B-1: Source Control Technologies Summary Screening Table

Source Control Technologies									
Technology Group	Practice	Primary Goals		Potential Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction						
Stormwater Management	Street/Parking Lot Storage (Catch Basin Control)	Low	Low	- Reduced surface flooding potential	Flow restrictions to the CSS can cause flooding in lots, yards and buildings; potential for freezing in lots; low operational cost. Effective at reducing peak flows during wet weather events but can cause dangerous conditions for the public if pedestrian areas freeze during flooding.	No	No	No	Potential health hazard.
	Catch Basin Modification (for Floatables Control)	Low	None	- Water quality improvements - Reduced surface flooding potential	Requires periodic catch basin cleaning; requires suitable catch basin configuration; potential for street flooding and increased maintenance efforts. Reduces debris and floatables that can cause operational problems with the mechanical regulators.	No	Yes	No	Already in use
	Catch Basin Modification (Leaching)	Low	Low	- Reduced surface flooding potential - Water quality improvements	Can be installed in new developments or used as replacements for existing catch basins. Require similar maintenance as traditional catch basins. Leaching catch basins have minor effects on the primary CSO control goals.	No	No	No	Not suitable for soils or groundwater conditions.
Public Education and Outreach	Water Conservation	None	Low	- Reduced surface flooding potential - Align with goals for a sustainable community	Water purveyor is responsible for the water system and all related programs in the respective City. However, water conservation is a common topic for public education programs. Water conservation can reduce CSO discharge volume, but would have little impact on peak flows.	Yes	Yes	No	Minimal benefits, already being implemented.
	Catch Basin Stenciling	None	None	- Align with goals for a sustainable community	Inexpensive; easy to implement; public education. Is only as effective as the public's acceptance and understanding of the message. Public outreach programs would have a more effective result.	Yes	Yes	No	Already being implemented.
	Community Cleanup Programs	None	None	- Water quality improvements - Align with goals for a sustainable community	Inexpensive; sense of community ownership; educational BMP; aesthetic enhancement. Community cleanups are inexpensive and build ownership in the city.	Yes	Yes	No	Already being implemented.
	Public Outreach Programs	Low	None	- Align with goals for a sustainable community	Public education program is ongoing. Permittee should continue its public education program as control measures demonstrate implementation of the Nine Minimum Controls (NMC.)	Yes	Yes	No	Already being implemented.
	FOG Program	Low	None	- Water quality improvements - Improves collection system efficiency	Requires communication with business owners; Permittee may not have enforcement authority. Reduces buildup and maintains flow capacity. Only as effective as business owner cooperation.	Yes	Yes	No	Already being implemented.
	Garbage Disposal Restriction	Low	None	- Water quality improvements	Permittee may not be responsible for Garbage Disposal. This requires an increased allocation of resources for enforcement while providing very little reduction to wet weather CSO events.	Yes	No	No	Minimal benefit and unenforceable.
	Pet Waste Management	Medium	None	- Water quality improvements	Low cost of implementation and little to no maintenance. This is a low cost technology that can significantly reduce bacteria loading in wet weather CSO's.	Yes	Yes	No	Already being implemented.
	Lawn and Garden Maintenance	Low	Low	- Water quality improvements	Requires communication with business and homeowners. Guidelines are already established per USEPA. Educating the public on proper lawn and garden treatment protocols developed by USEPA will reduce waterway contamination. Since this information is already available to the public it is unlikely to have a significant effect on improving water quality.	Yes	No	No	Minimal benefit and unenforceable.
	Hazardous Waste Collection	Low	None	- Water quality improvements	The N.J.A.C. prohibits the discharge of hazardous waste to the collection system.	Yes	Yes	No	Already being implemented.
Ordinance Enforcement	Construction Site Erosion & Sediment Control	None	None	- Cost-effective water quality improvements	In building code; reduces sediment and silt loads to waterways; reduces clogging of catch basins; little O&M required; contractor or owner pays for erosion control. A Soil Erosion & Sediment Control Plan Application or 14-day notification (if Permittee covered under permit-by-rule) will be required by NJDEP per the N.J.A.C.	Yes	Yes	No	Already being implemented.
	Illegal Dumping Control	Low	None	- Water quality improvements - Aesthetic benefits	Enforcement of current law requires large number of code enforcement personnel; recycling sites maintained. Local ordinances already in place can be used as needed to address illegal dumping complaints.	Yes	Yes	No	Already being implemented.
	Pet Waste Control	Medium	None	- Water quality improvements - Reduced surface flooding	Requires resources to enforce pet waste ordinances. Public education and outreach is a more efficient use of resources, but this may also provide an alternative to reducing bacterial loads.	Yes	Yes	No	Already being implemented.
	Litter Control	None	None	- Property value uplift - Water quality improvements - Reduced surface flooding	Aesthetic enhancement; labor intensive; City function. Litter control provides an aesthetic and water quality enhancement. It will require city resources to enforce. Public education and outreach is a more efficient use of resources.	Yes	Yes	No	Already being implemented.
	Illicit Connection Control	Low	Low	- Water quality improvements - Align with goals for a sustainable community	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The primary goal of the LTCP is to meet the NJPDES Permit requirements relative to POCs. Illicit connection control is not particularly effective at any of these goals and is not recommended for further evaluation unless separate sewers are in place.	Yes	Yes	No	Already being implemented.

Table B-1 (Continued)

Source Control Technologies									
Technology Group	Practice	Primary Goals		Potential Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction						
Good Housekeeping	Street Sweeping/Flushing	Low	None	- Reduced surface flooding potential	Labor intensive; specialized equipment; doesn't address flow or bacteria; City function. Street sweeping and flushing primarily addresses floatables entering the CSS while offering an aesthetic improvement.	Yes	Yes	No	Already being implemented.
	Leaf Collection	Low	None	- Reduced surface flooding potential - Aesthetic benefits	Requires additional seasonal labor. Leaf collection maximizes flow capacity and removes nutrients from the collection system.	Yes	Yes	No	Already being implemented.
	Recycling Programs	None	None	- Align with goals for a sustainable community	Most Cities have an ongoing recycling program.	Yes	Yes	No	Already being implemented.
	Storage/Loading/Unloading Areas	None	None	- Water quality improvements	Requires industrial & commercial facilities designate and use specific areas for loading/unloading operations. There may be few major commercial or industrial users upstream of CSO regulators.	Yes	No	No	Minimal benefits.
	Industrial Spill Control	Low	None	- Protect surface waters - Protect public health	PVSC has established a pretreatment program for industrial users subject to the Federal Categorical Pretreatment Standards 40 CFR 403.1.	Yes	Yes	No	Already being implemented.
Green Infrastructure Buildings	Green Roofs	None	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Local jobs - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permittee or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof vegetation. Portions of Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	No	No	Not practical
	Blue Roofs	None	Medium	- Reduced heat island effect - Property value uplift - Local jobs - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permittees or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof debris. Portions of the Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	No	No	Not practical
	Rainwater Harvesting	None	Medium	- Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community - Water Saving	Simple to install and operate; low operational resource demand; will require the Permittees or private owners to implement; requires regular cleaning of gutters & pipes. Portions of the Cities have densely populated areas, but this technology is limited to capturing rooftop drainage. Capture is limited to available storage, which can vary on rainwater use. Can be difficult to require on private properties.	Yes	No	No	Not feasible

Table B-1 (Continued)

Source Control Technologies									
Technology Group	Practice	Primary Goals		Potential Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction						
Green Infrastructure Impervious Areas	Permeable Pavements	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Cost-effective water quality improvements - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Not durable and clogs in winter; oil and grease will clog; significant O&M requirements with vacuuming and replacing deteriorated surfaces; can be very effective in parking lots, lanes and sidewalks. Maintenance requirements could be reduced if located in low-traffic areas, and can utilize underground infiltration beds or detention tanks to increase storage.	Yes	No	Yes	Proceed to evaluation
	Planter Boxes	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltration and evapotranspiration of runoff in developed areas. Flexible and can be implemented even on a small-scale to any high-priority drainage areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	No	No	Not Practical
Green Infrastructure Pervious Areas	Bioswales	Low	Low	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Local jobs - Passive and active recreational improvements - Reduced surface flooding - Reduced basement sewage flooding - Community aesthetic improvements - Reduced crime - Align with goals for a sustainable community - Increased pedestrian safety through curb retrofits	Site specific; good BMP; minimal vegetation & mulch O&M requirements; not as flexible or infiltrate as much stormwater as planter boxes. Technology requires open space and is primarily a surface conveyance technology with additional storage & infiltration benefits. Can be modified with check dams to slow water flow. Limited open space in most Cities means land can be utilized in more effective ways with the existing infrastructure.	Yes	No	Yes	Proceed to evaluation
	Free-Form Rain Gardens	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Passive and active recreational improvements - Reduced surface flooding - Reduced basement sewage flooding - Community aesthetic improvements - Reduced crime - Align with goals for a sustainable community	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltration and evapotranspiration of diverted runoff. Rain Gardens are flexible and can be modified to fit into the previous areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	No	No	Incorporated into evaluation as bioswales

Table B-2: Collection System Technologies Summary Screening Table

Collection System Technologies									
Technology Group	Practice	Primary Goals		Potential Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction						
Operation and Maintenance	I/I Reduction	Low	Medium	- Water quality improvements - Reduced basement sewage flooding	Requires labor intensive work; changes to the conveyance system require temporary pumping measures; repairs on private property required by homeowners. Reduces the volume of flow and frequency; Provides additional capacity for future growth; House laterals account for 1/2 the sewer system length and significant sources of I/I in the sanitary sewer.	Yes	No	No	Regional Alternative
	Advanced System Inspection & Maintenance	Low	Low	- Water quality improvements - Reduced basement sewage flooding	Requires additional resources towards regular inspection and maintenance work. Inspection and maintenance programs can provide detailed information about the condition and future performance of infrastructure. Offers relatively small advances towards goals of the LTCP.	Yes	No	No	Minimal benefits
	Combined Sewer Flushing	Low	Low	- Water quality improvements - Reduced basement sewage flooding	Requires inspection after every flush; no changes to the existing conveyance system needed; requires flushing water source. Ongoing: CSO Operational Plan; maximizes existing collection system; reduces first flush effect.	Yes	No	No	Already being implemented.
	Catch Basin Cleaning	Low	None	- Water quality improvements - Reduced surface flooding	Labor intensive; requires specialized equipment. Catch Basin Cleaning reduces litter and floatables but will have no effect on flow and little effect on bacteria and BOD levels.	Yes	Yes	No	Already being implemented.
Combined Sewer Separation	Roof Leader Disconnection	Low	Low	- Reduced basement sewage flooding	Site specific; Includes area drains and roof leaders; new storm sewers may be required; requires home and business owner participation. The Cities are densely populated and disconnected roof leaders have limited options for discharge to pervious space. Disconnection may be coupled with other GI technologies but is not considered an effective standalone option.	Yes	No	No	Not likely to be effective.
	Sump Pump Disconnection	Low	Low	- Reduced basement sewage flooding	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The Cities are densely populated and disconnected sump pumps have limited options for discharge to pervious space. Disconnection may be coupled with other GI technologies but is not considered an effective standalone option.	Yes	Yes	No	Not Practical
	Combined Sewer Separation	High	High	- Water quality improvements - Reduced basement sewage flooding - Reduced surface flooding	Very disruptive to affected areas; requires homeowner participation; sewer asset renewal achieved at the same time; labor intensive.	No	Yes	Yes	Proceed to evaluation
Combined Sewer Optimization	Additional Conveyance	High	High	- Water quality improvements - Reduced basement sewage flooding	Additional conveyance can be costly and would require additional maintenance to keep new structures and pipelines operating.	No	No	No	Not cost effective
	Regulator Modifications	Medium	Medium	- Water quality improvements	Relatively easy to implement with existing regulators; mechanical controls requires O&M. May increase risk of upstream flooding. Permitees have an ongoing O&M program and system wide replacement program for CSO regulators and tide gates.	Yes	No	No	Not effective dues to interceptor capacity
	Outfall Consolidation/Relocation	High	High	- Water quality improvements - Passive and active recreational improvements	Lower operational requirements; may reduce permitting/monitoring; can be used in conjunction with storage & treatment technologies. Combining and relocating outfalls may lower operating costs and CSO flows. It can also direct flow away from specific areas.	Yes	No	Yes	As part of other alternatives
	Real Time Control	High	High	- Water quality improvements - Reduced basement sewage flooding	Requires periodic inspection of flow elements; highly automated system; increased potential for sewer backups. RTC is only effective if additional storage capacity is present in the system.	Yes	No	No	Not applicable to existing system

Table B-3: Storage and Treatment Technology Summary Screening Table

Storage and Treatment Technologies									
Technology Group	Practice	Primary Goals		Potential Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation	Notes
		Bacteria Reduction	Volume Reduction						
Linear Storage	Pipeline	High	High	- Water quality improvements - Reduced surface flooding potential - Local jobs	Can only be implemented if in-line storage potential exists in the system; increased potential for basement flooding if not properly designed; maximizes use of existing facilities. Pipe storage for a CSS typically requires large diameter pipes to have a significant effect on reducing CSOs. This typically requires large open trenches and temporary closure of streets to install.	No	Yes	No	Not cost effective
	Tunnel	High	High	- Water quality improvements - Reduced surface flooding potential	Requires small area at ground level relative to storage basins; disruptive at shaft locations; increased O&M burden.	No	No	Yes	Proceed to evaluation
Point Storage	Tank (Above or Below Ground)	High	High	- Water quality improvements - Reduced basement sewage flooding	Storage tanks typically require pumps to return wet weather flow to the system which will require additional O&M; disruptive to affected areas during construction. Several CSO outfalls have space available for tank storage. There may be existing tanks in abandoned commercial and industrial areas to be converted to hold stormwater. Tanks are an effective technology to reduce wet weather CSO's.	No	No	Yes	Proceed to evaluation
	Industrial Discharge Detention	Low	Low	- Water quality improvements	Requires cooperation with industrial users; more resources devoted to enforcement; depends on IUs to maintain storage basins. IUs hold stormwater or combined sewage until wet weather flows subside; there may be commercial or industrial users upstream of CSO regulators.	Yes	No	No	Regional alternative
Treatment-CSO Facility	Vortex Separators	None	None	- Water quality improvements	Space required; challenging controls for intermittent and highly variable wet weather flows. Vortex separators would remove floatables and suspended solids when installed. It does not address volume, bacteria or BOD.	Yes	No	No	Not effective alone, representative technology used as part of other alternatives
	Screens and Trash Racks	None	None	- Water quality improvements	Prone to clogging; requires manual maintenance; requires suitable physical configuration; increased O&M burden. Screens and trash racks will only address floatables.	Yes	No	No	Not effective alone, include as part of other alternatives
	Netting	None	None	- Water quality improvements	Easy to implement; labor intensive; potential negative aesthetic impact; requires additional resources for inspection and maintenance. Netting will only address floatables.	Yes	Yes	No	Already being implemented.
	Contaminant Booms	None	None	- Water quality improvements	Difficult to maintain requiring additional resources. Contaminant booms will only address floatables.	Yes	No	No	Not effective
	Baffles	None	None	- Water quality improvements	Very low maintenance; easy to install; requires proper hydraulic configuration; long lifespan. Baffles will only address floatables.	Yes	No	No	Not effective
	Disinfection & Satellite Treatment	High	High	- Water quality improvements - Reduced basement sewage flooding	Requires additional flow stabilizing measures; requires additional resources for maintenance; requires additional system analysis. Disinfection is an effective control to reduce bacteria and BOD in CSO's.	Yes	No	Yes	Proceed to evaluation
	High Rate Physical/Chemical Treatment (High Rate Clarification Process - ActiFlo)	None	None	- Water quality improvements	Challenging controls for intermittent and highly variable wet weather flows; smaller footprint than conventional methods. This technology primarily focuses on TSS & BOD removal, but does not help reduce the bacteria or CSO discharge volume.	Yes	No	Yes	Proceed to evaluation
	High Rate Physical (Fuzzy Filters)	None	None	- Water quality improvements	Relatively low O&M requirements; smaller footprint than traditional filtration methods. This technology primarily focuses on TSS removal, but does not help reduce the bacteria or CSO discharge volume.	Yes	No	No	Representative technology being applied.
Treatment-WRTP	Additional Treatment Capacity	High	High	- Water quality improvements - Reduced surface flooding - Reduced basement sewage flooding	May require additional space; increased O&M burden.	No	No	No	Regional alternative
	Wet Weather Blending	Low	High	- Water quality improvements - Reduced surface flooding - Reduced basement sewage flooding	Requires upgrading the capacity of influent pumping, primary treatment and disinfection processes; increased O&M burden. Wet weather blending does not address bacteria reduction, as it is a secondary treatment bypass for the POTW. Permittee must demonstrate there are no feasible alternatives to the diversion for this to be implemented.	Yes	No	No	Regional alternative
Treatment-Industrial	Industrial Pretreatment Program	Low	Low	- Water quality improvements - Align with goals for a sustainable community	Requires cooperation with Industrial User's; more resources devoted to enforcement; depends on IU's to maintain treatment standards. May require Permits.	Yes	No	No	Regional alternative

B.2.1 Siting of CSO Facilities

The EPA document "Combined Sewer Overflows: Guidance for Long-Term Control Plans" (EPA 832-B-95-002 September 1995) lists preliminary siting considerations as a screening mechanism for evaluating CSO control alternatives and recommends evaluation of the following:

- Availability of sufficient space for the facility on the site
- Distance of the site from CSO regulator(s) or outfall(s) that will be controlled
- Environmental, political, or institutional issues related to locating the facility on the site.

To identify potential sites in the vicinity of CSS regulators and outfalls where CSO control measures might be installed based on the criteria above, the following publicly available geographic information system (GIS) information was utilized:

- Aerial photography
- Land use / land cover
- Parcel data, including vacant land, land ownership, property value information
- Open Space / Green Acres
- Soil Type
- Topography
- Known Contaminated Sites
- Brownfields

Potential sites were identified, as were the constraints on each site. Some sites were eliminated from consideration due to their unsuitability for siting CSO control facilities. Additional detail of the siting analysis can be found in Section D.1.1 of the Harrison DEAR.

SECTION C - EVALUATION OF ALTERNATIVES

C.1 INTRODUCTION

This section summarizes the key elements of the development and evaluation of CSO control alternatives process. The detailed evaluation is provided in the previously approved "Development and Evaluation of CSO Control Alternatives" report, prepared by Mott MacDonald for the Town of Harrison, dated July 2019, revised November 2019.

Since the DEAR, the Town performed additional system monitoring and model recalibration of the Harrison portion of the PVSC districtwide collection system model, these modeling updates are discussed in more detail in Appendix C. The revisions to the modeling resulted in changes in both overflow volumes as well as inflow volumes for percent capture calculation. The information and results in this section are extracted from the DEAR and reflect the modeling at the time of the DEAR. They should be reflective of the magnitude of facility required and relative costs for purposes of narrowing the range of alternatives. The selected plan is based on the revised modeling as well as new costing information.

The Development and Evaluation of Alternatives Report addressed the requirements of Part IV.G.4 of the NJPDES CSO Permit. This step involved evaluation of a reasonable range of CSO control alternatives that will meet the water quality-based requirements of the CWA. It used hydrologic, hydraulic and water quality modelling to simulate existing conditions as well as conditions incorporating CSO controls. It evaluated CSO control programs based on meeting the water quality-based requirements of the CWA, National CSO Policy and the Permit, as well as practical and technical feasibility, and cost/performance considerations.

C.2 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

Seven control programs were developed for the Town of Harrison:

- Control Program 1 – Point Storage at Individual Outfalls
- Control Program 2 – Consolidated Tank Storage
- Control Program 3 – Tunnel Storage
- Control Program 4 – End-of-Pipe Treatment
- Control Program 5 – Consolidated End-of-Pipe Treatment
- Control Program 6 – Sewer Separation
- Control Program 7 – Green Stormwater Infrastructure

All control programs included the completed separation of outfall 004A and planned separation of outfall 005A. The control programs are summarized in Section C.2 and are described in greater detail in the Harrison DEAR. Alternatives were evaluated for their ability to control systemwide overflows to 0, 4, 8, 12 and 20 overflows. Previous analyses indicated that the only means of assuring zero overflows per year required either full sewer separation or extremely large storage units, both of which would be difficult to accomplish and/or would be cost prohibitive. It was thus determined that the initial screening should be made consistent with the

Presumptive Approach of 4 overflows per year since this would provide a conservative assessment of the maximum level of control layout practical for each alternative.

C.2.1 Control Program 1 – Point Storage at Individual Outfalls

This control program consisted of siting storage tanks at the end of each outfall. Operationally, a storage tank captures overflows until it is full. Once it is full, excess volumes are discharged as overflows. When the storm is over, the storage volume is dewatered back to the interceptor at a set flow rate. A schematic representation of the potential point storage facilities, achieving 4 overflows during the Typical Year are shown in Figure C-1 through Figure C-4.

Installation of storage tanks in urban areas can be challenging. Excavation will be needed for subsurface tanks, which requires costly support of excavation, dewatering and protection and monitoring for adjacent buildings, and utilities relocation. The tanks to be sited at outfalls 001A and 002A/003A are in proximity to existing buildings, whereas the tanks at 006A and 007A are further from buildings.

Control of groundwater will be a significant challenge; groundwater is thought likely to be shallow throughout the Town. With the exception of site 007A, all the tank sites are in close proximity to the Passaic River which creates additional risks. Tanks may need to be situated on piles due to potential soil conditions or high groundwater. The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. The tank at outfall 006A is located on the site of a planned park. The tank must be installed prior to creation of the park, at which time the site will become encumbered by Green Acres. It may be possible to write the Green Acres agreement to allow for the tank to be installed after the park is constructed, however there is no guarantee that Green Acres would approve this arrangement.

The construction required for storage tanks is large and invasive making public acceptance of the project a concern. This is particularly true for Outfalls 001A and 002A/003A, which are located in heavily trafficked areas and on private property. The tank on 006A is located on a parcel of land slated for redevelopment and the construction may be more acceptable in terms of public acceptance. The construction at 007A is in an industrial area and may raise fewer concerns from the public; however, there would be a significant impact on the property owner. Once construction is completed, tanks are generally preferable from the standpoint of public acceptance since most of the facility is underground. There may also be concerns with odors, particularly at 001A, 002A/003A and 006A, which will be in commercial and residential areas. These locations may require significant odor control facilities on the surface. The land above the outfall 006A tank could be converted to a park to enhance acceptance, thus providing a public amenity and enhancing public acceptance.

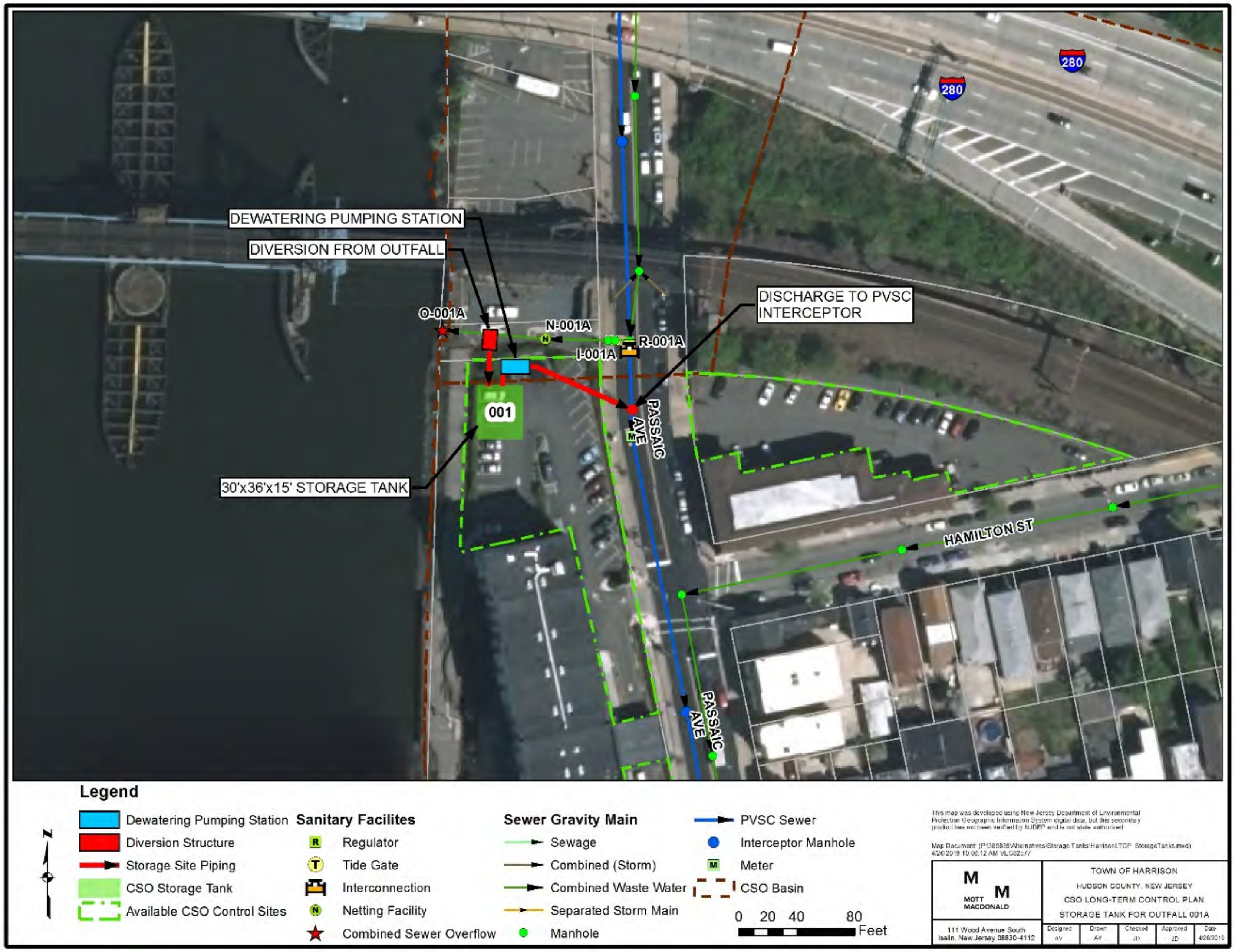


Figure C-1: Point Storage - Outfall 001A (Site 001B)

Figure C-2: Point Storage - Outfall 002A and 003A (Site 002A/003A)

Figure C-3: Point Storage Outfall 006 (Site 006B)

Figure C-4: Point Storage - Outfall 007A (Site 007C)

C.2.2 Control Program 2 – Consolidated Tank Storage

Control Program 2 was the same as Control Program 1 except that consolidation piping will be run to consolidate the overflows from H-001A, 002A, 004A and 006A to the site of the future park, the existing outfalls will be abandoned, and a new outfall will be created. This control program offers some advantages over Control Program 1:

- The result will be only leave two active discharge outfalls; the consolidated outfall and outfall 007A. This will simplify future permitting and effectively eliminate three outfalls.
- This control program will result in fewer facilities for the town to site, build and maintain.
- It makes greater use of public rights-of-way and land that will be under the control of the town.
- The park can be sited over the tank with minimal surface disturbance after construction.

There are also some potential disadvantages:

- There will be more disturbance and interruptions to local streets as a result of the consolidation piping.
- There will be additional costs associated with the consolidation piping, which may be offset by fewer pumping stations and the greater efficiency of a larger tank.

A schematic representation of the consolidated storage facilities, achieving 4 overflows during the Typical Year as shown in Figure C-5 and Figure C-6, the facilities for Outfall 007A remain the same as previously shown in Figure C-4.

The institutional issues surrounding Control Program 2 are typically similar to Control Program 1 for large scale construction projects in an urban area.

The consolidated tank at 005A and the tank at 007A are some distance from other buildings. Installing the large diameter consolidation piping within Harrison Street could be challenging. There are numerous other utilities in the street including an existing stormwater outfall that must be crossed and the Kearny-East Newark-Harrison Branch Interceptor which must be avoided.

The construction required for storage tanks is large and invasive making public acceptance of the project a concern. The consolidated tank near 006A is located on a parcel of land slated for redevelopment and the construction may be more acceptable in terms of public acceptance. The construction at 007A is in an industrial area and may raise fewer concerns from the public, however, there would be a significant impact on the property owner. Once construction is completed, tanks are generally preferable from the standpoint of public acceptance since the facility is primarily underground. Aboveground features will still be required such as electrical facilities, odor control facilities and access points to pumps, flushing systems and the tank.

There may be concerns with odors, at the consolidated tank, which will be in a residential area. It is anticipated that the land above the consolidated tank at 006A will be converted to a park providing a public amenity and enhancing public acceptance, but this makes odor control more important.

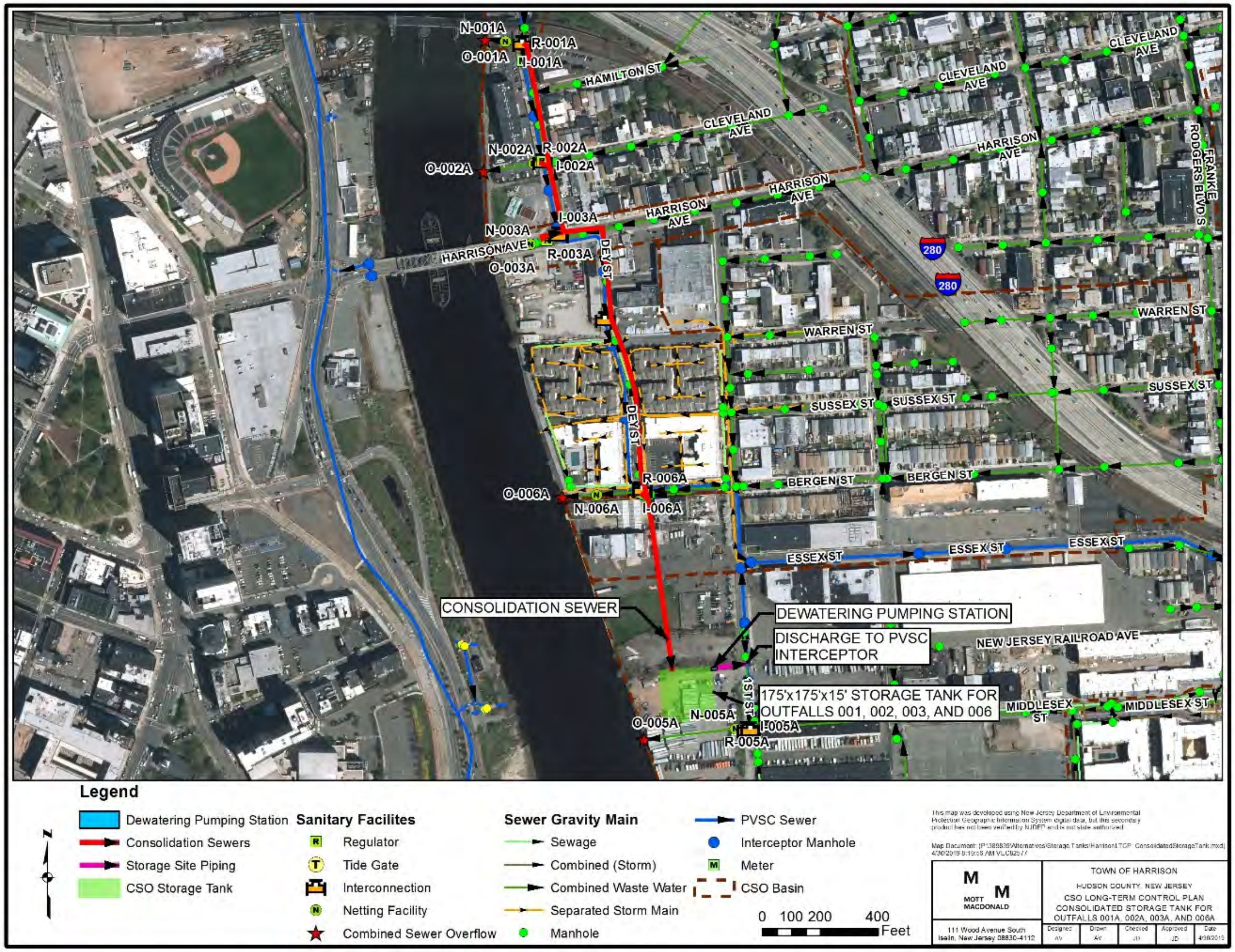


Figure C-5: Consolidation Piping for Outfalls 001A, 002A, 003A and 006A

Figure C-6: Consolidated Storage Tank for Outfalls 001A, 002A, 003A and 006A

C.2.3 Control Program 3 – Tunnel Storage

This Control Program consisted of a tunnel to follow Bergen Street and for the consolidation of H-001A, 002A, 004A and 006A into the tunnel at the west end and H-007A at the east end. The tunnel will be dewatered into the interceptor and include an overflow to the river. The result will be only one outfall at 006A. Since there was no feasible route parallel to the Passaic River to collect Outfalls 001A, 002A, 003A and 006A with the tunnel, an east-west alignment along Bergen Street was selected. Outfalls 001A, 002A, 003A and 006A were consolidated through piping to the west end of the tunnel and Outfall 007A was diverted to the east end of the tunnel. The available route between the consolidation piping and Outfall 007A fixed the tunnel length at 3,900 feet. The tunnel system is sized to limit the Typical Year to 4 overflows which is a 12-foot diameter tunnel. A schematic representation of the consolidated tunnel facility, achieving 4 overflows during the Typical Year as shown in Figure C-7 and Figure C-8. It is noted that development is underway on the dewatering pumping station site shown in the DEAR, if a storage tunnel is part of the selected alternative, a new site will need to be identified.

Implementing a tunnel within the confines of a dense urban area is challenging. Mining and recovery shaft areas are required for this alternative to be feasible, and available area in Harrison for this purpose is minimal. This alternative also requires area to site a dewatering pumping station and a tunnel overflow, and available area in this highly urbanized town is limited. The site identified during the DEAR is already under development further complicating a tunnel alternative. The layout and feasibility of tunnels is highly dependent on geotechnical information. Based on available information, bedrock is deep, greater than 100 feet, thus the tunnel will need to be a soft ground tunnel. This will increase the costs and carries a greater risk of subsidence due to soil loss, potentially damaging nearby buildings and other surface infrastructure. The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce, with the periodic requirement for highly specialized and trained personnel.

The construction required for tunnels is large and invasive making public acceptance of the project a concern. The tunnel shaft site would be located on a parcel of land currently slated for redevelopment and there may be concerns related to such heavy mechanical facilities in an area intended for residential development. Following construction, tunnels are generally preferable from the standpoint of public acceptance since the majority of the facility is underground. Aboveground features will still be required such as air release, electrical facilities, odor control facilities and access points to pumps.

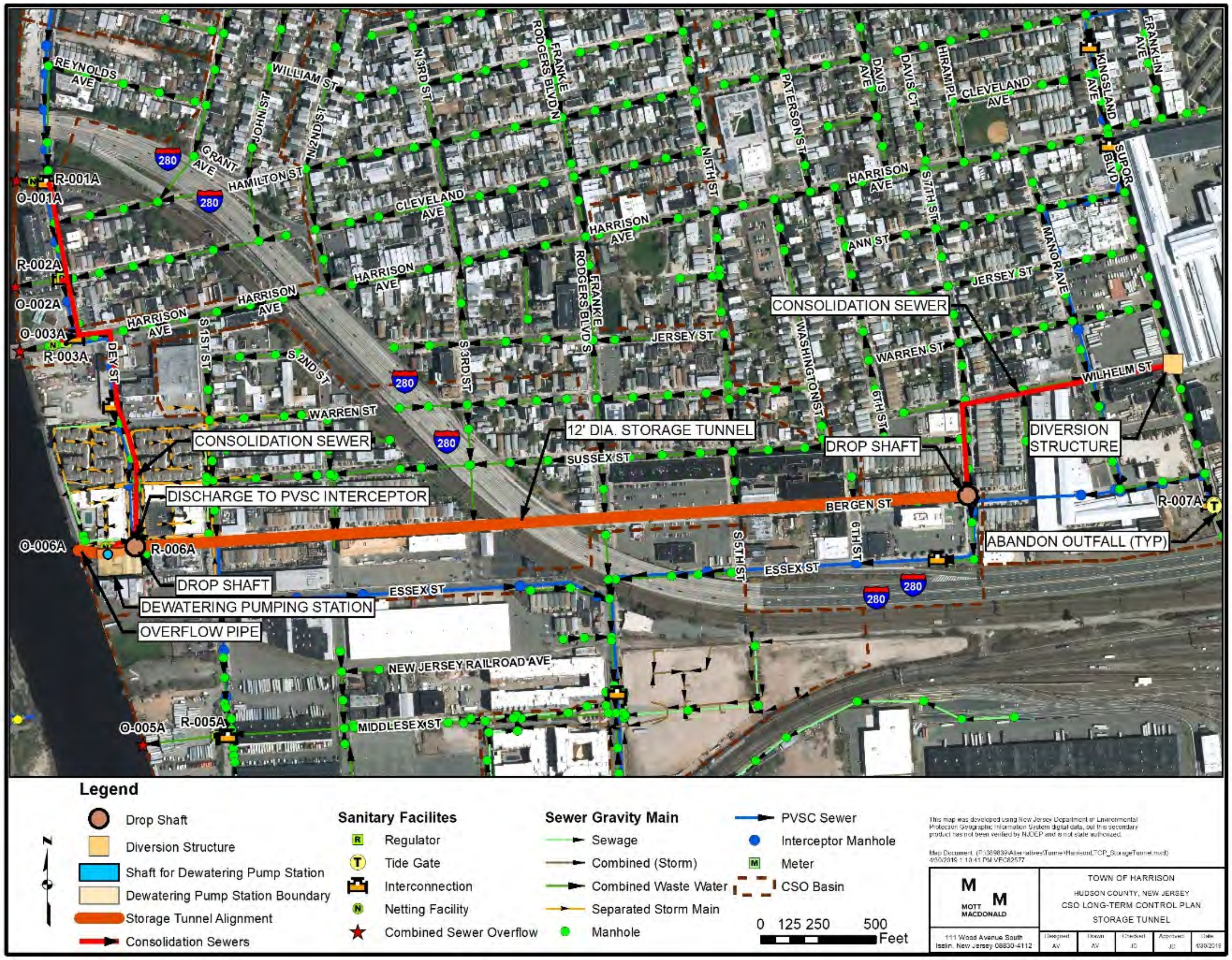


Figure C-7: Tunnel Storage Conceptual Layout

Figure C-8: Tunnel Storage Conceptual Dewatering Layout

C.2.4 Control Program 4 – End-of-Pipe Treatment

This control program consisted of siting a treatment facility at the end of each outfall. By providing a treatment train capable of providing disinfection and the accompanying solids removals, the number of overflows can be reduced (per the National CSO policy definition of overflow) by removing all overflows that discharge at flow rates less than the treatment capacity provided. A schematic representation of the treatment facilities, equivalent to achieving 4 overflows during the Typical Year as shown in Figure C-9 through Figure C-13.
Potential site considerations are as follows:

- At Outfall 001A, while the facilities can be sited in the parking areas, since they are above grade, they would have a severe impact on the businesses and may require taking the residential property in its entirety.
- At Outfall 002A, it appears the treatment facilities could be sited within the available footprint, shown below.
- It would not be feasible to place treatment facilities at Outfall 003A as there is no land available. Facilities for Outfall 003A could not be consolidated with Outfall 002A as there would be insufficient space.
- At Outfall 006A, there appears to be sufficient space available; however, the impact to the future park will be significant. Conveyance piping will be required to bring the flow from the 006A outfall to the available land. There could be some reduction in piping by creating a new outfall for the treated discharge or by relocating the existing outfall.
- At Outfall 007A, there appears to be sufficient space available. However, there would be a substantial impact on the industrial facility as the space required for the treatment facilities is currently used and these operations would need to be relocated within the existing industrial complex.

The sizing for treatment facilities are often the same to achieve 4, 8 and 12 overflows, and sizing is difficult to combine with storage-based control programs. This is because sizing of end-of-pipe treatment facilities is driven by peak flows, whereas sizing of end-of-pipe storage facilities are driven by overflow volume.

Installation of end-of-pipe treatment facilities in an urban area like Harrison is challenging due to space and access limitations. Unlike end-of-pipe storage tanks, end-of-pipe treatment facilities are generally above-grade. As such, deep excavation is generally not required, reducing the complexity of excavation in proximity to other foundations. The facilities may need to be situated on piles if soil conditions are poor. It does not appear to be feasible to implement end of pipe treatment at Outfall 001A due to the impact to the hotel and residential complex. At Outfall 003A there is insufficient space for end of pipe treatment. The facility at Outfall 006A will need to be essentially entirely below grade to allow for construction of the planned park. The facility must be installed prior to creation of the park, at which time the site will become encumbered by Green Acres. It may also be possible to write the Green Acres agreement to allow for the facility to be installed, but this may come with additional requirements. In addition, there could be significant public resistance to disturbing a newly established park.

The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. End of pipe facilities tend to require greater level of operations and maintenance resources when compare to the other alternatives.

Because the facilities proposed are generally above-grade, they have the potential to produce odors and noise, making them more difficult to site in residential and commercial areas. There may be concerns with odors, particularly at 001A, 002A/003A (as noted there does not appear to be adequate space to address outfall 03A at this location) and 006A which are in commercial and residential areas. Following construction, end-of-pipe facilities are less preferable than tanks due to the permanent visibility of the structure. It also uses land area that could otherwise be utilized by the community for other purposes. In terms of public acceptance, strong opposition would be expected to placing end-of-pipe treatment at Outfall 001A as it would result in taking the two commercial parking lots. The construction required for end-of-pipe treatment is large and invasive, making public acceptance of the project a concern. This is particularly true for Outfalls 001A and 002A/003A (as noted there does not appear to be adequate space to address outfall 03A at this location) which are located in heavily trafficked areas and on private property. The facility on 006A is located on a parcel of land slated for redevelopment and the construction may be more acceptable in terms of public acceptance. The construction at 007A is in an industrial area and may raise fewer concerns from the public; however, there would be a significant impact on the property owner.

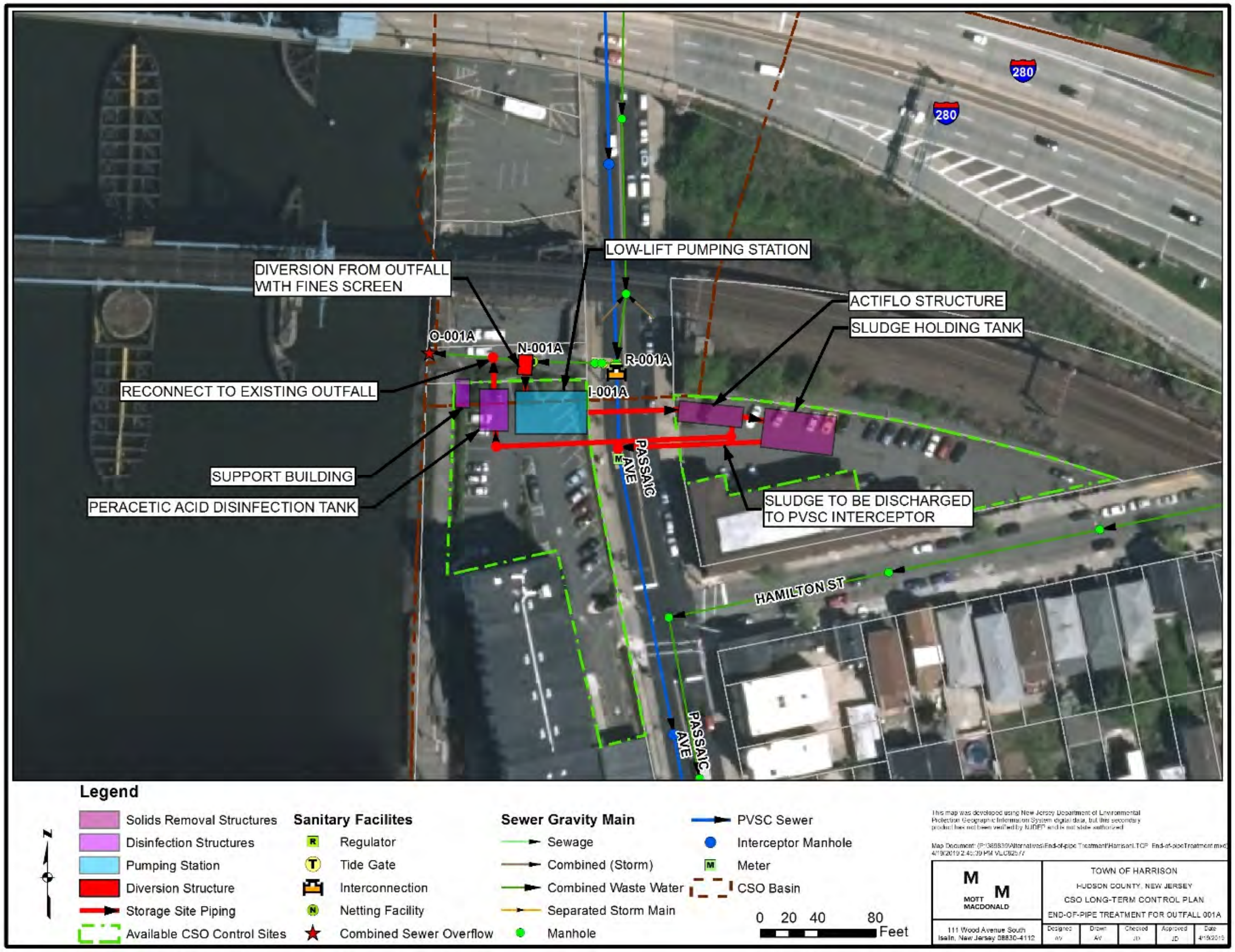


Figure C-9: End-of-Pipe Treatment - Outfall 001A

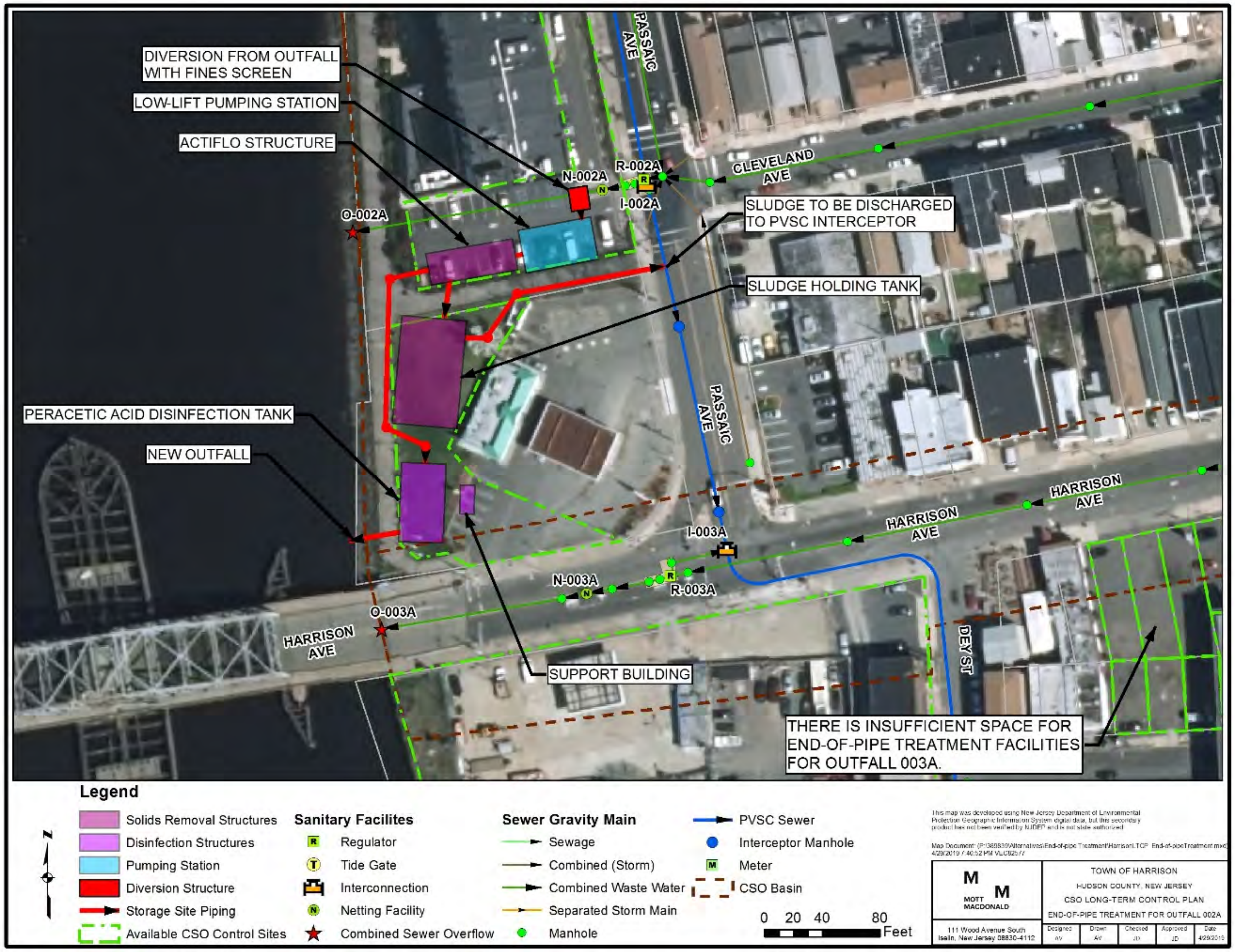


Figure C-10: End-of-Pipe Treatment - Outfall 002A

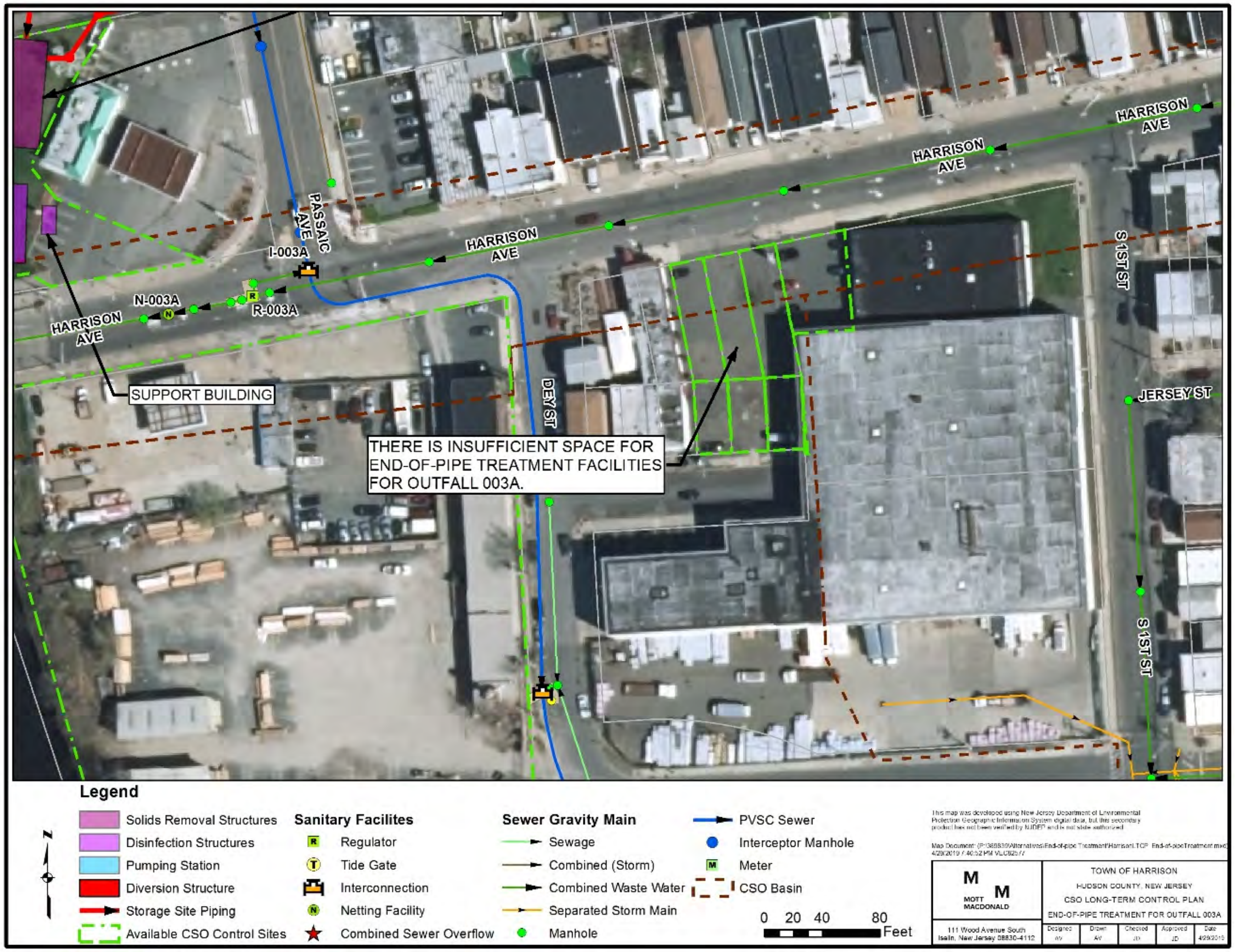


Figure C-11: End-of-Pipe Treatment - Outfall 003A insufficient space

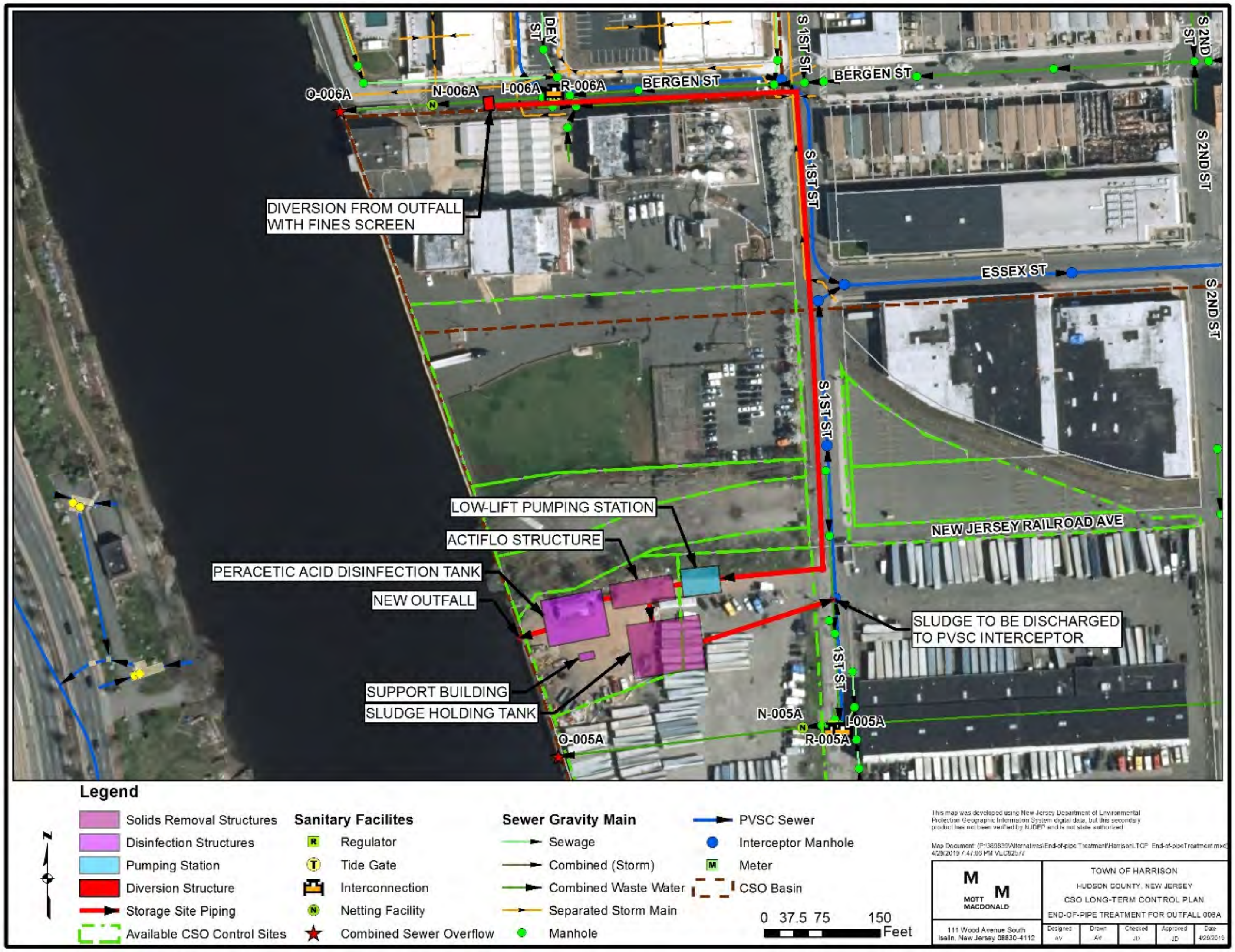


Figure C-12: End-of-Pipe Treatment - Outfall 006A

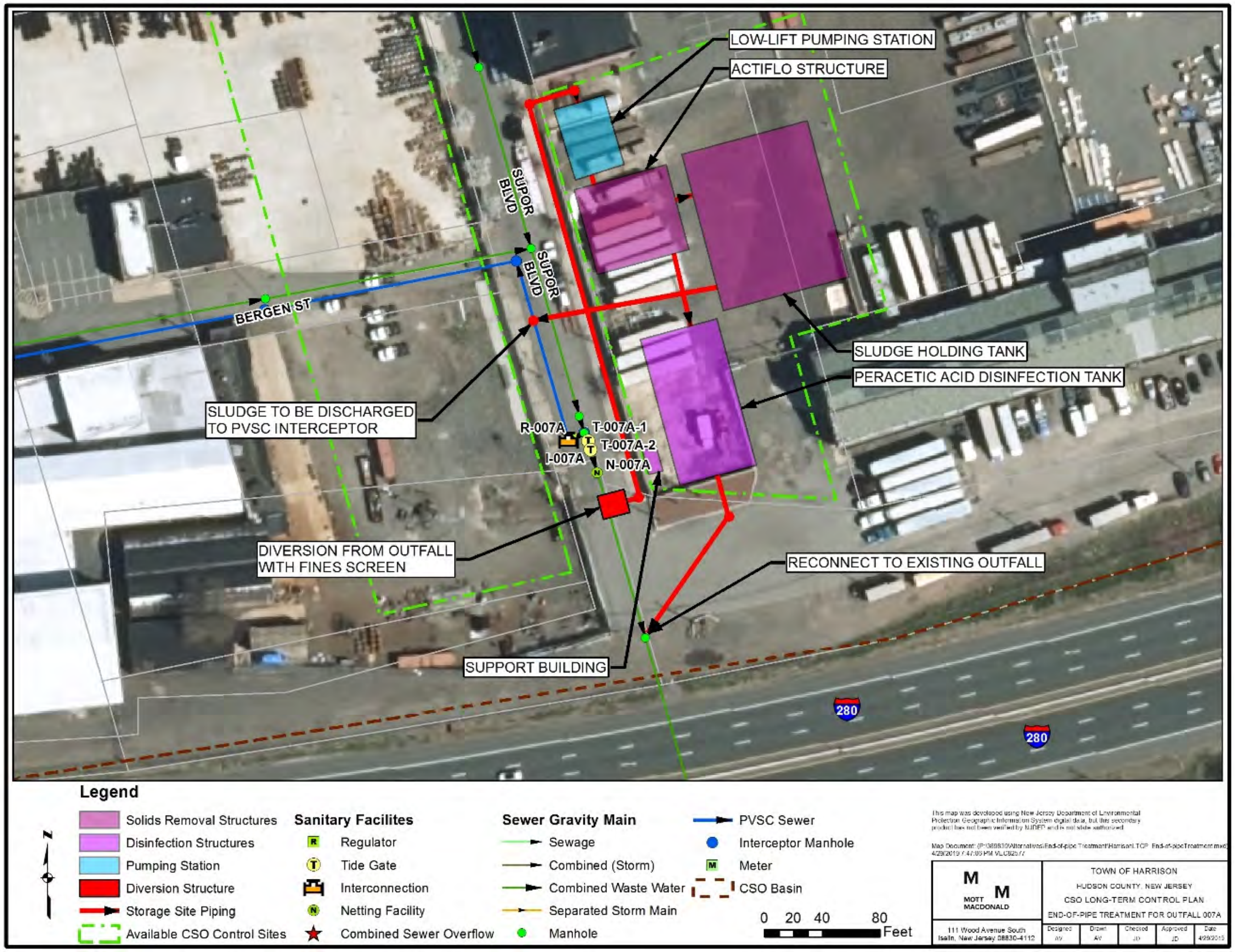


Figure C-13: End-of-Pipe Treatment - Outfall 007A

C.2.5 Control Program 5 – Consolidated End-of-Pipe Treatment

Control Program 5 was the same as Control Program 4 except that consolidation piping will be run to consolidate the overflow from H-001A, 002A, 003A and 006A to the site of the future park, where more space is available. There would be no change to Outfall 007A, and consolidation piping would be required to connection to H-001A, 002A, 003A and 006A. This control program offers some advantages over Control Program 4:

- The result will be only two outfalls: the consolidated outfall and outfall 007A. This will simplify future permitting and effectively eliminate three outfalls.
- This control program will result in fewer facilities for the town to site, build, maintain and operate.
- It makes use of public rights-of-way and land that will be under the control of the town.

There are also some potential disadvantages:

- There will be more disturbance to local streets as a result of the consolidation piping.
- There will be additional costs associated with the consolidation piping.
- The larger above ground facility would have a greater impact, reducing the usable area available for the park.
- To construct the park this facility will need to be essentially entirely underground, which will increase project costs.

A schematic representation of the consolidated storage facilities, achieving equivalent to 4 overflows during the Typical Year as shown in Figure C-14. Consolidation piping is the same as shown in Figure C-5. The facilities for Outfall 007A remain the same as shown in Figure C-13.

Installation of end-of-pipe treatment facilities in urban areas can be challenging due to space and access limitations. Unlike end-of-pipe storage tanks, end-of-pipe treatment facilities are generally above-grade. As such, deep excavation is not generally required, reducing the complexity of excavation in proximity to the foundation of nearby buildings. The facilities may need to be situated on piles if soil conditions are poor. The consolidated end-of-pipe facility at outfall 006A is located on the site of a planned park. The tank must be installed prior to creation of the park at which time the site will become encumbered by Green Acres. It may also be possible to write the Green Acres agreement to allow for the tank to be installed, but this may come with additional requirements and may not be acceptable. In addition, there most likely will be significant public resistance to disturbing a newly established park.

Installing the large diameter consolidation piping within the Harrison Street could be challenging. There are numerous other utilities in the street, including an existing stormwater outfall that must be crossed and the Kearny-East Newark-Harrison Branch Interceptor which must be avoided. The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. End of pipe facilities tend to require greater level of operations and maintenance resources when compare to the other alternatives.

The construction required for an end-of-pipe facility is large and invasive, making public acceptance of the project a concern. Because the facilities proposed are generally above-grade, they have the potential to produce odors and noise, making them more difficult to site in residential and commercial areas. There may be concerns with odors at the proposed site near Outfall 006A due to proximity to commercial and residential areas. Following construction, end-of-pipe treatment facilities are less preferable than tanks due to the permanent visibility of the structure. They also use land area that could otherwise be utilized by the community for other purposes. The consolidated site is located on a parcel of land slated for redevelopment and the construction may be more acceptable in terms of public acceptance than other sites.

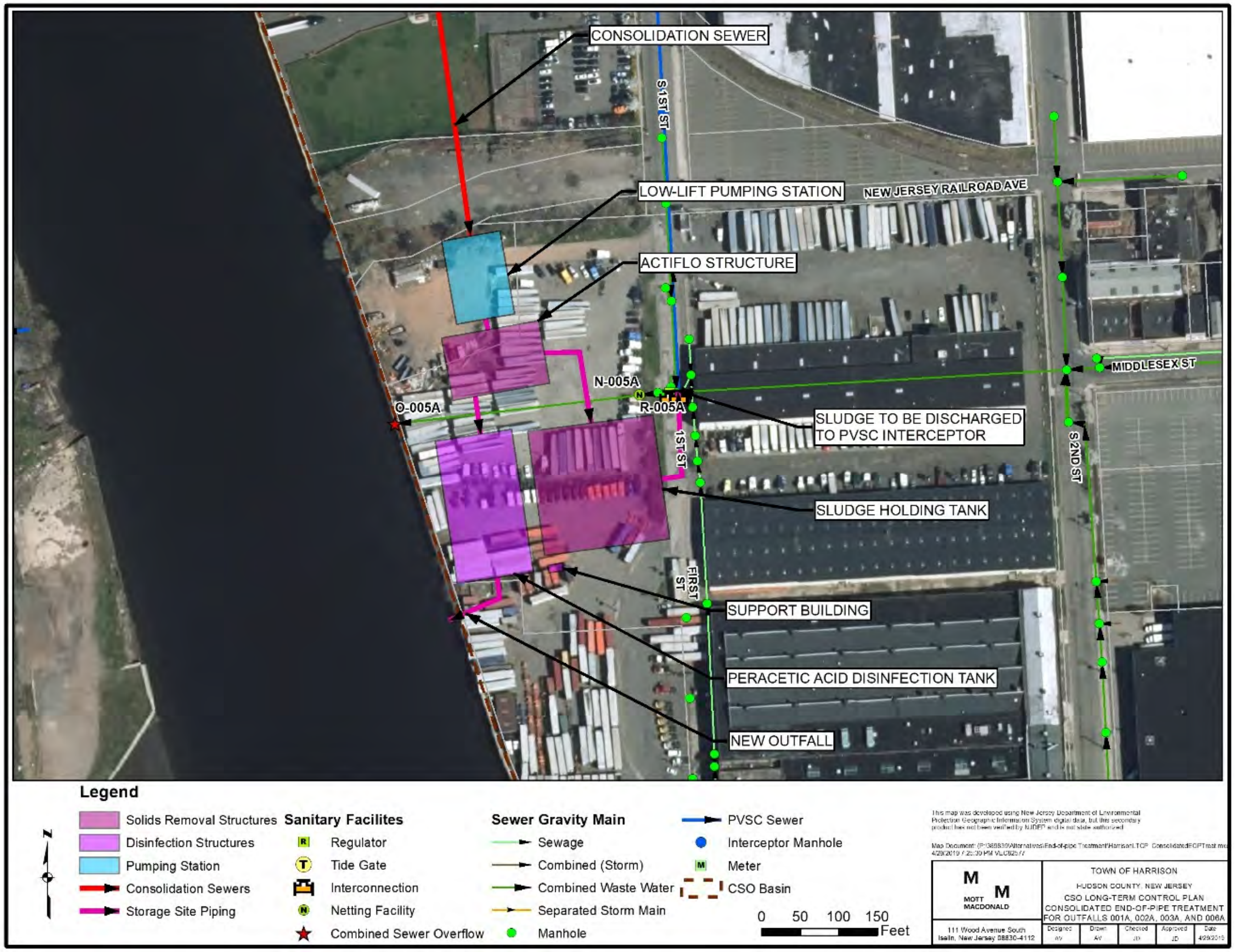


Figure C-14: Consolidation Treatment of Outfalls, for 001A, 002A, 003A and 006A

C.2.6 Control Program 6 – Sewer Separation

This control program consisted of constructing a new sanitary sewer system and converting the existing combined sewer into a storm sewer, for the entire combined sewer area. This would effectively remove Harrison from being a CSO community. This alternative specifically addresses separation beyond the completed separation of Outfall 004A and planned separation of Outfall 005A, through redevelopment.

The benefits of this alternative include:

- Work remains in public right-of-way, no new land required
- Opportunity for system renewal, reconstruction
- Elimination of combined sewer outfalls

The challenges include:

- Highly disruptive to roads and traffic
- Need to redirect every sanitary service connection on each street
- Possible regulatory requirements stormwater controls and treatment in the future.
- High expense

In terms of land acquisition, this alternative ranked highly, because the proposed work would be completed within the existing right-of-way. However, installation of separate sewers in Harrison would be challenging due to traffic impacts and space limitations. Such an undertaking will result in road closures across the town and resulting traffic redirection over the course of construction. Unlike the separation of H-004 and H-005, there is little likelihood the separation could be accomplished through redevelopment. Installation of new sanitary lateral connections to each residence and business will be a very extensive undertaking. At least initially, the separate sewers would require minimal maintenance except for where siphons are required. However, in the long term there would be two systems for the town to maintain rather than one.

The construction required for sewer separation is extensive and invasive, making public acceptance of the project a significant concern. Installation of a new sanitary sewer system and connections will result in road closures and resulting impacts on traffic as well as access to local business and institutions during construction, which will not be received favorably by residents. This is also a very costly alternative, and as such may not be preferred. Following construction, sewer separation might be preferable from the standpoint of public acceptance since the resulting facilities would be underground.

C.2.7 Control Program 7 – Green Stormwater Infrastructure

This control program consisted of installing green infrastructure to provide storage or detention to contribute to meeting the overflow requirements. Green infrastructure (GI) refers to practices which reduce stormwater volume or flow rate by allowing the stormwater to infiltrate, be stored, or be treated by vegetation or soils. The anticipated green infrastructure is expected to consist primarily of bioswales and permeable pavement.

For purposes of evaluation, directing 2.5%, 5%, 7.5%, 10%, and 15% of the impervious area within the combined sewer area to green stormwater infrastructure were evaluated. The available data on soils and groundwater levels in Harrison indicate that ground conditions are likely not conducive to infiltrating green stormwater infrastructure, thus bioswales were assumed to be non-infiltrating and equipped with a sub-drain to drain back into the collection system. The public right-of-way offers the best opportunity for green stormwater infrastructure, but is limited by curb space consumed with driveway entrances, walkways to houses, and mature trees. Suitability of a site for green infrastructure was determined at a high-level based on desktop studies of land use, areas of impervious cover, groundwater information and publicly owned land. Experience from New York City has shown that the vast majority of sites identified through a desktop GIS study are deemed unsuitable once field investigations and geotechnical (infiltration) testing are conducted. An analysis conducted of sites in one basin showed that of the sites identified at the planning level, only 17% were found suitable to proceed to construction.

A typical street segment within the town was examined to estimate the potential for implementing green stormwater infrastructure. Accordingly, it was assumed that only one bioswale could be installed per each side of the street segment (see Figure C-15). Hence, a typical street segment would have two bioswales (one on each side), and a typical street segment would have one on each side. The other feasible green stormwater infrastructure practice is permeable pavement. The recommended practice is to apply the permeable paving to parking lanes. Again, referring to a typical street segment which is approximately 340 feet long. It was assumed that the last 50 feet at either end of the block would be reserved for turning lanes, resulting in 240 linear feet of parking area available for permeable pavement on each side of the street.

When the above assumptions, including estimated installation success due to field conditions, were applied to the 256 street segments in Harrison, bioswales and permeable paving could treat 9.4 acres of impervious area out 345 acres of total impervious area in the existing combined sewer area, representing 2.7% of the total impervious area in the Town’s combined sewer service area.

GI has a very minimal impact on both peak flow and volume mitigation. As such, it is understood that an unattainably high level of proliferation of GI is required to provide a significant improvement in CSO reduction. Any meaningful reduction in CSO volume would require more GI than the Town has space to accommodate.

Figure C-15: Typical street segment with green stormwater infrastructure

From a land acquisition standpoint, green infrastructure would rate highly. However, there are other implementability challenges associated with green stormwater infrastructure to be considered. There are myriad of field conditions that can prevent construction of green stormwater infrastructure on a site identified through a desktop study, including soil conditions, utility locations, and proximity to trees, building entrances, or bus stops. A high level of attrition has been reflected in the estimate of green stormwater infrastructure proposed, in an effort to realistically reflect implementability challenges. The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. Green infrastructure requires frequent, but often lower skill personnel, rather than requiring additional training and skills as is the case with the other control programs.

It is generally assumed that public acceptance of green stormwater infrastructure will be high, since it serves as an amenity to the community. This is likely true for implementation of bioswales as they provide additional green space and the construction footprint is relatively small. The implementation of permeable pavement, on which the green infrastructure alternative relies heavily, may be less accepted by the public as the construction is more invasive and it does not produce a visual amenity. However, upon completion of the project, the area will closely resemble the existing condition. Accordingly, the likelihood of public acceptance for green stormwater infrastructure should be considered high.

C.2.8 Evaluation

Each alternative was simulated in the approved InfoWorksICM 2050 baseline model and the modeled facilities scaled to achieve each of the performance objectives (0, 4, 8, 12 and 20 overflows) for the Typical Year rainfall. The exception was green infrastructure which was implemented to address 2.5%, 5%, 7.5%, 10% and 15% of the modeled directly connected impervious areas.

20-year net present worth costs were generated for each alternative using capital costs and operations and maintenance costs from the CSO Technical Guidance Manual (TGM). For comparison purposes, each alternative was normalized to represent the cost to remove one gallon of CSO during the Typical Year. Results are summarized below in Table C-1 through Table C-4. As can be seen, the number of overflows within Harrison often had to be reduced below the targeted level of control for the overall PVSC districtwide hydraulically connected system.

Table C-1: Overall Summary of Alternatives and Percent Capture[1]

Alternative	% Capture[2]	Volume Captured[3] (MG)	CSO Events	Capital Cost[4] ($M)
2015 Baseline	74.3%	NA	53	--
2050 Baseline[3]	82.1%	NA	52	NA
CP-1 Point Storage 0 Overflows	100.0%	42.8	0	$65.1
CP-1 Point Storage 4 Overflows	98.1%	38.3	4	$46.5
CP-1 Point Storage 8 Overflows	98.0%	37.9	6	$45.4
CP-1 Point Storage 12 Overflows	95.5%	31.9	8	$35.7
CP-1 Point Storage 20 Overflows	93.1%	26.2	15	$29.6
CP-2 Consolidated Storage 0 Overflows	100.0%	42.8	0	$59.1
CP-2 Consolidated Storage 4 Overflows	98.4%	39	3	$44.6
CP-2 Consolidated Storage 8 Overflows	98.3%	38.8	3	$44.1
CP-2 Consol. Storage 12 Overflows	95.9%	33	8	$35.9
CP-2 Consol. Storage 20 Overflows	94.4%	29.4	11	$31.7
CP-3 Tunnel Storage 0 Overflows	100.0%	42.8	0	$124.1
CP-3 Tunnel Storage 4 Overflows	99.5%	41.7	2	$117.1
CP-3 Tunnel Storage 8 Overflows	98.4%	38.9	3	$112.6
CP-3 Tunnel Storage 12 Overflows	96.1%	33.4	6	$109.1
CP-3 Tunnel Storage 20 Overflows	93.7%	27.8	12	$106.6
CP-4 Outfall Treatment 0 Overflows	100.0%	42.8	0	$153.1
CP-4 Outfall Treatment 4 Overflows	99.7%	42	1	$117.6
CP-4 Outfall Treatment 8 Overflows	99.7%	42	2	$115.5
CP-4 Outfall Treatment 12 Overflows	99.5%	41.5	5	$110.3
CP-4 Outfall Treatment 20 Overflows	97.2%	36.1	11	$80.6
CP-5 Consol. Treatment 0 Overflows	100.0%	42.8	0	$118.6
CP-5 Consol. Treatment 4 Overflows	99.7%	42	1	$90.4
CP-5 Consol. Treatment 8 Overflows	99.7%	42	1	$90.4
CP-5 Consol. Treatment 12 Overflows	99.4%	41.4	3	$84.0
CP-5 Consol. Treatment 20 Overflows	97.1%	35.9	10	$57.4
CP-6 Sewer Separation 0 Overflows	100.0%	42.8	0	$180.7
CP-7 Green Infrastructure 2.5%	82.2%	0.1	50	$1.8
CP-7 Green Infrastructure 5%	82.2%	0.2	49	$3.7
CP-7 Green Infrastructure 7.5%	82.3%	0.3	49	$5.5
CP-7 Green Infrastructure 10%	82.3%	0.3	49	$7.4
CP-7 Green Infrastructure 15%	82.3%	0.5	49	$11.0

Notes:

1. **Results are from DEAR and do not reflect revised modeling.**
2. **Percent capture is based on 239.6 MG inflow during typical year, prior to model revisions.**
3. **Volume captured is relative to 2050 Baseline with reflects completed and planned sewer separation for Outfalls 004A and 005A**
4. **Capital costs do not include completed and planned separation costs.**

Table C-2: Summary of CSO control program CSO volume reductions (DEAR Values)

	Volume Reduction per # of Overflows/Year (MG)				
Control Plan	0	4	8	12	20
1) Point Storage	42.8	38.3	38	32	26.2
2) Consolidated Storage	42.8	39	38.8	33	29.4
3) Tunnel	42.8	41.7	38.9	33.5	27.8
4) Treatment (Individual Sites)	42.8	42	42	41.5	36.1
5) Consolidated Treatment	42.8	42	42	41.4	35.9
6) Sewer Separation	42.8	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	0.1	0.2	0.3	0.4	0.5

Table C-3: 20-Year net present worth for all control plans

	NPW Summary - Overflows per Year ($M)				
Control Plan	0	4	8	12	20
1) Point Storage	$88	$63	$61	$48	$40
2) Consolidated Storage	$78	$59	$58	$47	$41
3) Tunnel	$160	$152	$146	$142	$139
4) Treatment (Individual Sites)	$174	$136	$134	$128	$96
5) Consolidated Treatment	$134	$103	$103	$96	$67
6) Sewer Separation	$181	NA	NA	NA	NA
	NPW Summary - % of Impervious Area Managed ($M)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$6	$12	$18	$23	$35

Class 5 estimate -50%/+100%. Costs indexed to January 2019 ENR CCI 11,205.

Table C-4: Net present worth costs normalized by gallon of CSO reduction

	Cost per Gallon of CSO Volume Reduction ($/gal)				
Control Plan	0	4	8	12	20
1) Point Storage	$2.1	$1.7	$1.6	$1.5	$1.5
2) Consolidated Storage	$1.8	$1.5	$1.5	$1.4	$1.4
3) Tunnel	$3.7	$3.6	$3.8	$4.2	$5.0
4) Treatment (Individual Sites)	$4.1	$3.2	$3.2	$3.1	$2.6
5) Consolidated Treatment	$3.1	$2.4	$2.4	$2.3	$1.9
6) Sewer Separation	$4.2	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$58	$58	$58	$58	$70

Class 5 estimate -50%/+100%. Costs indexed to January 2019 ENR CCI 11,205.

Each alternative was ranked on a scale of 1 to 5, with 5 being the highest and 1 being the lowest, for each of the six criteria listed below. The criteria were weighted to reflect the relative importance assigned to each. Greater detail can be found on the Harrison DEAR. The six criteria each alternative was ranked on were:

- Cost
- CSO Reduction
- CSO Frequency Reduction
- Institutional Issues
- Implementability
- Public Acceptance

The results are summarized in Table C-5. The overall ratings indicate that, in general, options that include consolidation may be preferable to options that address each outfall individually and that storage options may be preferable to end of pipe treatment options.

Table C-5: Summary Rating of Control Programs

Control Program	Cost	CSO Volume Reduction	CSO Frequency Reduction	Institutional Issues	Implement-ability	Public Acceptance	Weighted Score
1) Point Storage	4	5	5	3	1	2	3.40
2) Consolidated Storage	**4**	**5**	**5**	**4**	**3**	**3**	**4.00**
3) Tunnel Storage	2	5	5	4	2	2	3.20
4) End of Pipe Treatment	2	5	5	2	1	1	2.60
5) Consolidated End of Pipe Treatment	3	5	5	2	3	2	3.30
6) Sewer Separation	1	5	5	3	2	2	2.80
7) GI - 10% of Impervious	1	1	1	5	4	5	2.65
Weighting	25%	15%	15%	15%	15%	15%	100%

SECTION D - SELECTION OF RECOMMENDED LTCP

D.1 INTRODUCTION

The CSO LTCP constitutes a major undertaking for the Town of Harrison. The Town has been diligently separating sewers over the past decades and more recently through redevelopment over the past 5 years. The separation work represents a significant investment on the part of the Town, this includes investment made directly by the Town for offsite improvements and well as the value of concessions provided by developers that could have gone to other efforts. The Town has funded its share of offsite improvements through municipal bonds, which are being paid with "payment in lieu of taxes" (PILOT) revenues.

As will be discussed, the Passaic River adjacent to Harrison is compliant with water quality standards 100% of the time, therefore, the LTCP projects will have little impact to water quality in the Passaic River in term of frequency of attainment of water quality standards. There may be some reduction in terms of overall pollutant load. In light of this, and the Town's obligations under the Permit, the following sections will discuss the decision-making process that was applied to select the LTCP and document that plan.

D.2 LTCP SELECTION PROCESS

By necessity the LTCP will start with the completed and planned separation work as detailed in this Section. The Town has invested an estimated $11.1M in separation, and through redevelopment intends to achieve an additional investment of $15.3M for a total investment of $26.4M. If necessary, additional elements will be added to the LTCP to bridge the gap between the CSO improvements achieved by completed sewer separations and the improvements required for the selected regulatory level of control.

D.2.1 Performance Objective

The magnitude of the facilities in terms of CSO volume managed is the primary driver of both their cost and effectiveness. Accordingly, during the DEAR a procedure was developed to achieve the desired range of control objectives, in this case limiting the overflows to 0, 4, 8, 12 or 20 during the Typical Year. The permit requires the levels of control to be established on the basis of the hydraulically connected system, thus, when evaluating the number of overflows, it was not adequate merely to achieve the desired number of overflows at each individual outfall, or within Harrison. Prior to the evaluation it was necessary to determine the storm events for each level of control that produced the required overflow frequency based on all combined sewer systems tributary to the entire PVSC interceptor sewer system. The storms to control were selected by ranking the overflow events in terms of total overflow volume systemwide. Nevertheless, since the LTCP for some communities may incorporate volume-based controls (storage), and others peak flow-based controls (treatment), using the same sets of storms systemwide to evaluate either control methodology did cause some disparity in the magnitude of control facilities that were needed based on the individual event characteristics of the storm's intensity versus total volume.

As noted, the Harrison DEAR performance objectives were based primarily on controlling the frequency of overflows. As per the Permit requirements, evaluation of overflow frequency was established across the entire hydraulically connected system of PVSC. However, upon review of the results, controlling to a specific number of overflows regionally led to a recommendation for excess facility capacity in Harrison, with increased costs and minimal additional reductions in CSO volume or overflow frequency. This is evidenced in the fact that nearly identical facilities were required to control to 4 and 8 overflows in the typical year. This is thought to be due to the differences in the characteristics of the drainage areas to each outfall, which caused different responses to the various rainfall intensities and volumes. Drainage area size and, by extension, time of concentration was thought to be one of the driving parameters behind the variety of responses. Thus, the selected alternative performance objective will not be based on the prior regional performance objectives used in the DEAR.

The Town of Harrison has elected to use the Presumptive Approach to comply with Part IV.G.4.f criteria ii of the NJPDES permit, more specifically to achieve 85% capture by volume of wet weather inflow, as follows:

- Elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the Combined Sewer System (CSS) during precipitation events on a hydraulically connected system-wide annual average basis.

Part IV G.4.f states:

> "A program that meets any of the criteria listed below will be presumed to provide an adequate level of control to meet the water quality-based requirements of the CWA, provided the Department determines that such presumption is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas described above."

The presumptive approach is reasonable as the Passaic River is consistently meeting the water quality standards in the waters adjacent to it. Thus, under any program, the water quality-based requirements of the CWA will be met. Greater discussion of the ability of the LTCP to meet water quality standards is provided in Section D.3.3 of this report.

It is understood that for purposes of the LTCP formulation, compliance with the above requirements is model based, by applying the approved Typical Year rainfall (2004 Newark Liberty International Airport gage) to the approved landside and receiving water models. Specifically, this report will make use of the InfoWorks ICM model created as part of the Characterization Report, and subsequent updates. The model version is InfoWorks ICM 7.5 to be consistent with the modeling performed under the characterization and within the PVSC district.

It is noted that the DEAR addressed an alternative to achieve 85% capture based on a fraction reduction of overflow for the interceptor communities. The municipal LTCP will be based on the percent capture within Harrison, with the understanding that by achieving 85% capture within each municipality that the overall hydraulically connected system will achieve 85% capture.

Once the overall approach for a municipal-level performance objective was selected as described above, the approach was then refined to align the performance with the required level of control at minimal cost.

D.3 SELECTION OF ALTERNATIVES

The selection process will start by evaluating the gap between the existing level of control and the 85% capture level of control targeted by the presumptive approach. Under the 2015 baseline condition, the Town has a wet weather inflow of 253.8 MG and an overflow volume of 46.4 MG, giving a percent capture of 81.7%. To increase the percent capture to 85%, overflow must be reduced to 38.1 MG.

First, consideration will be given to activities the Town has completed since 2015 or has plans to complete. The key activities undertaken or planned by the Town are:

- Separation of the CSO-004 drainage area which has been completed.
- Separation of the CSO-005 drainage area – partially completed at the time of this report.

These activities were completed or will be completed through redevelopment projects. While separation is often a more expensive CSO control alternative, by working with the redevelopers the Town was able to achieve these projects with minimal direct impact to the residents. Since the redevelopment areas are former industrial areas the number of sanitary laterals is considerably lower than residential areas, reducing costs. However, the industrial history increases the likelihood of soil contamination which could drive the costs up. It must be noted that there was significant work performed and costs incurred to accomplish these projects. The concessions from the redevelopment corporations to separate the sewers offset other concessions that could have been provided.

Once the completed and planned work was considered, if necessary, additional measures based on the top ranked alternative from the DEAR were evaluated to determine if additional benefits could be achieved for a reasonable cost. Finally, input from the public was considered to refine the plan including the addition of green stormwater infrastructure and water conservation.

D.3.1 Description of Selection Factors

The key driving factor in the selection process was compliance with the requirements of the Town's CSM Permit. Once preferred facilities were identified that met the permit requirements, in this case the Presumptive Approach's 85% wet weather volume capture, additional factors were considered to select an alternative. The Town is highly sensitive to the costs of the CSO LTCP. As noted previously, the Town has invested heavily in sewer separation through redevelopment efforts and has achieved a partial separation in some areas and full separation in others. The evaluation factors, summarized below, were carried forward from the DEAR, greater detail of each is provided in the DEAR.

The process of selecting additional plan elements relied heavily on the evaluations performed to develop the DEAR. From those evaluations, summarized in Table C-5, Control Program 2 - Consolidated Storage, emerged as the top ranked followed by Control Program 1 Point Storage and then Control Program 5 Consolidated End-of-Pipe Treatment. Subsequent to the submission of the DEAR, additional discussions were held with the Town and between the PVSC CSO Group and NJDEP regarding the End-of-Pipe Treatment alternative. Concerns were raised regarding the need for sampling during overflow events and the potential for future regulatory limits. The input from these discussions when coupled with the greater construction and maintenance costs lead to the elimination of the End-of-Pipe Treatment control program from consideration. The decision was also informed by comments and input from residents who noted the lower cost of tanks. Again, these control technologies would only be considered following the evaluation of the planned sewer separation work, with the intent of closing the gap between the results of the separations and the regulatory requirements. As will be discussed later, the planned separations achieved the targeted level of control and no addition measures such as tanks were required to reach the required 85% capture.

D.3.1.1 Additional Factors Influencing Performance

The Harrison combined sewer system is a component of the overall PVSC system and associated municipal system. Actions by other entities to address their own CSO discharges may impact the performance of the Harrison system. There are also additional anticipated system modifications that may impact conveyance from Harrison to PVSC's WRRF. It is generally thought that these impacts will be positive. Some of these impacts will be accounted for in the regional report. Factors that may further reduce the magnitude, location, or frequency of Harrison CSO overflows are:

1. Proposed storage and sewer separations in Kearny and East Newark. In general, these will reduce the hydraulic load on the local interceptors allowing additional combined flow to enter the interceptors.
2. Proposed modifications to the Fourth Street Venturi meter. The flow meter located on Frank E. Rodgers Boulevard at the south end of Harrison creates a restriction during high flows. PVSC is in the process of replacing this meter. Depending on the replacement meter, reducing the hydraulic restriction could reduce overflows.
3. Increased capacity at PVSC WRRF through implementing a wet weather blending protocol. If PVSC implements wet weather blending as intended, modeling has shown that the resulting reduction in hydraulic grade will propagate up into Harrison providing an additional reduction in overflows.
4. Green Infrastructure implemented by Harrison under the LTCP will also produce positive benefits, providing additional safety factor on the proposed 85% capture through sewer separation.

It is anticipated that the systemwide impacts of these planned projects by others will further reduce Harrison's overflows and increase the calculated percent capture to improve receiving water quality.

D.3.2 Remaining Overflows

The first preferred alternative designated "Alternative 1 – Sewer Separation of CSO-005A" consists of completing the sewer separation already started in the CSO-005A drainage area, ideally through the planned redevelopment. Table D-1 below summarizes the reduction in overflows associated with Alternative 1 when modeled in the 2050 baseline model.

Table D-1: Summary of Overflows, Typical Year 2015 Baseline and Alternative 1

	Baseline 2015 (Typical Year)			Alternative 1 (Typical Year)			Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	2.3	129	25	2.1	123	-1	-0.2	-6
H-002A	26	2.3	214	24	2.3	211	-2	0.0	-3
H-003A	40	14.1	158	40	13.9	157	0	-0.1	-1
H-004A	5	0.2	23.2	0	0.0	0.0	-5	-0.2	-23
H-005A	30	7.4	208	0	0.0	0.0	-30	-7.4	-208
H-006A	35	11.2	190	33	10.7	187	-2	-0.5	-3
H-007A	37	9.0	109	37	9.0	109	0	0.0	0
Total*	40	46.4	281	40	**38.0**	277	--	-8.4	-4

*Town Wide

To be consistent within the PVSC CSO Group the group members coordinated with each other to standardize the components that would go into the percent capture calculation and how that calculation would be performed. The following is a summary of the key components and a description of how the available data is being applied to the Harrison percent capture calculation:

- Community contributing to the percent capture calculation - the flow contributions to the percent capture calculations were limited to flows generated in Harrison.
- Wet weather flow contributions within Harrison - The entire wet weather flow contribution from within Harrison was used in the calculation of percent capture. This includes the separate areas within the Town.
- Wet weather definition - wet weather periods were identified through an analysis of the 2004 typical year rainfall record, see Figure D-1.
    - The analysis used a 15-minute date interval.
    - Any data interval during which the precipitation in the prior 12 hours totaled 0.1 inches or more was considered wet. Effectively, the procedure used a 12-hour intra-storm interval, and a minimum storm threshold precipitation of 0.1 inches.
    - It excluded the early parts of storms before the cumulative rainfall reached 0.1 inches as this was thought a reasonable threshold for when runoff would start.

- The period following the precipitation was extended 12 hours from the start of the last 0.1 inches of precipitation to capture the extended impact of the precipitation. This is more conservative (provides a shorter wet period) than using 12 hours following the end of the precipitation.
- This method produces just under 1150 wet hours during the 2004 Typical Year.
- This methodology is also consistent with the approach of most if not all members of the NJ CSO Group.

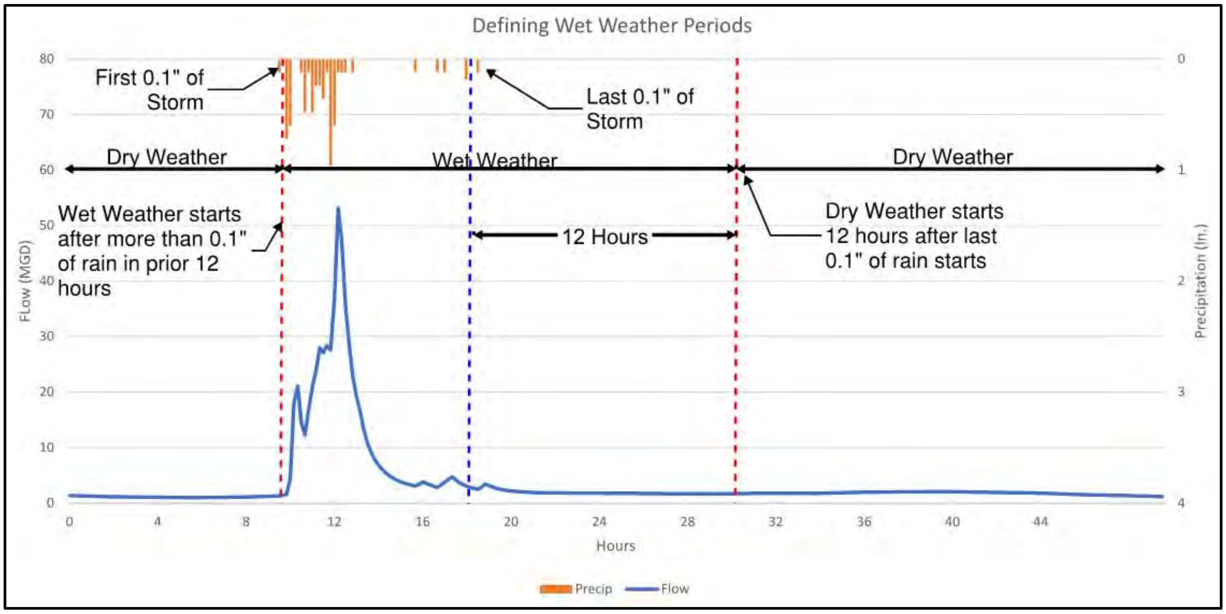


Figure D-1: Sample Wet Weather Periods Graph

- Total Wet Weather Volume Entering CSS – calculated from 2015 Baseline modeling results:

  Formula:

$$\%\ Capture = 1 - \left(\frac{Overflow\ Volume}{Total\ Wet\ Weather\ Volume\ Entering\ CSS}\right)$$

  - Total Wet Weather Volume Entering CSS = 255.6 MG
  - 2015 $Baseline\ \%\ Capture = 1 - \left(\frac{46.4\ MG}{253.8\ MG}\right) = 81.7\%$
  - $Alternative\ 1\ \%\ Capture = 1 - \left(\frac{38.0\ MG}{253.8\ MG}\right) = 85.0\%$

Accordingly, with the completed and planned separations under Alternative 1, the Town of Harrison achieves the targeted 85% capture.

D.3.3 Ability to Meet Water Quality Standards

The CSOs in the Town of Harrison discharge to two assessment units or sub-watersheds (also referred to as HUC 14 watershed) of the Passaic River, see Figure D-2:

- Passaic River Lower (4th Street Bridge to Second River) Hydrologic Unit Code 02030103150040
- Passaic River Lower (Newark Bay to 4th Street Bridge) Hydrologic Unit Code 02030103150050

The Pathogen Water Quality Model (PWQM) report produced by PVSC through their consultants, indicates that the Passaic River adjacent to Harrison consistently meets water quality standards, as shown in Figure D-3. On the basis of a rolling 30-day geometric mean of hourly data from the PWQM, the waterbody achieves compliance 100% of the time. Greater detail of the assessment of attainment of water quality can be found in the "Calibration and Validation of the Pathogen Water Quality Model (PWQM) for the Passaic Valley Sewerage Commission".

The water quality in the Passaic River adjacent to Harrison was assessed at Station 10 as shown on Figure D-4. At this location a component analysis was performed to evaluate the sources of pathogen to the water course, see Figure D-5. The figure is color coded to illustrate the impact from various sources as noted in the legend and as illustrated in separate individual graphs. Graphs that illustrate no color shown no influence from that particular source.

The component analysis indicates that there is minimal contribution from New York City and effectively no contribution from WRRFs or the Hudson River. Much of the time the load is dominated by dry weather sources and upstream sources. During wet weather the sources are primarily NJ CSOs, upstream sources and stormwater runoff. CSOs were generally, but not exclusively, the higher of the wet weather sources by a small margin, with approximately equal contributions from stormwater runoff and upstream sources. In general, the CSOs represent a small component of the pathogen loadings, and only for brief periods do the CSOs make up 50% or more of the loadings.

The conclusion gathered from the PWQM is that the portion of the Lower Passaic River, which the Harrison CSOs discharge into is achieving pathogen water quality standards, and of the pathogen loadings, CSOs are a relatively small component. Accordingly, by providing one of the Presumptive levels of control it is expected that the waterbody will continue to meet water quality standards, and that the application of the Presumptive Approach is justified.

Figure D-2: Town of Harrison Sub-watersheds

Table 6-4. AU Attainment in SE3 Waterbodies under Baseline and 100% Control Conditions

Assessment Unit Name	Assessment Unit Number	Baseline % Attainment	100% Control % Attainment
Passaic R Lwr (4th St br to Second R)	02030103150040-01	100.0	100.0
Passaic R Lwr (Nwk Bay to 4th St br)	02030103150050-01	100.0	100.0
Hackensack R (below Amtrak bridge)[1]	02030104010020-01	100.0	100.0
Kill Van Kull West	02030103180080-01	100.0	100.0
Upper NY Bay / Kill Van Kull (74d07m30s)[1]	02030104010030-01	100.0	100.0
Elizabeth River (below Elizabeth CORP BDY)[1]	02030104020030-01	100.0	100.0
Morses Creek/Pile Creek	02030104030010-01	100.0	100.0
Arthur Kill waterfront (below Grasselli)[1]	02030103180070-01	100.0	100.0

1 This Assessment Unit had to be divided into two pieces because it spanned two waterbody classifications.

Figure D-3: Summary of SE3 Waterbody WQS Attainment from 2020 Calibration and Validation of PWQM

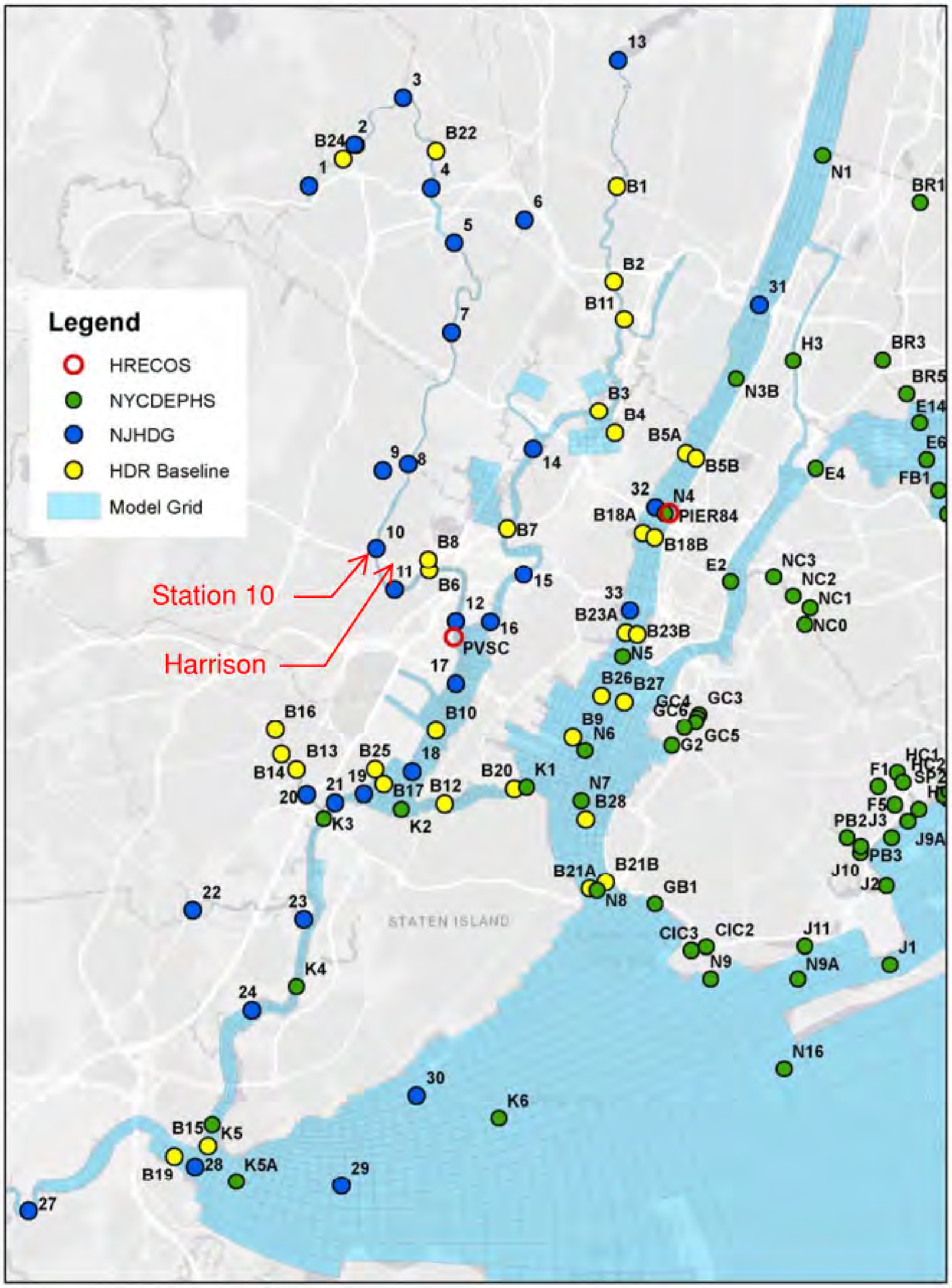


Figure D-4: NJ Dischargers Group, HDR, and MERI Water Quality Survey Stations

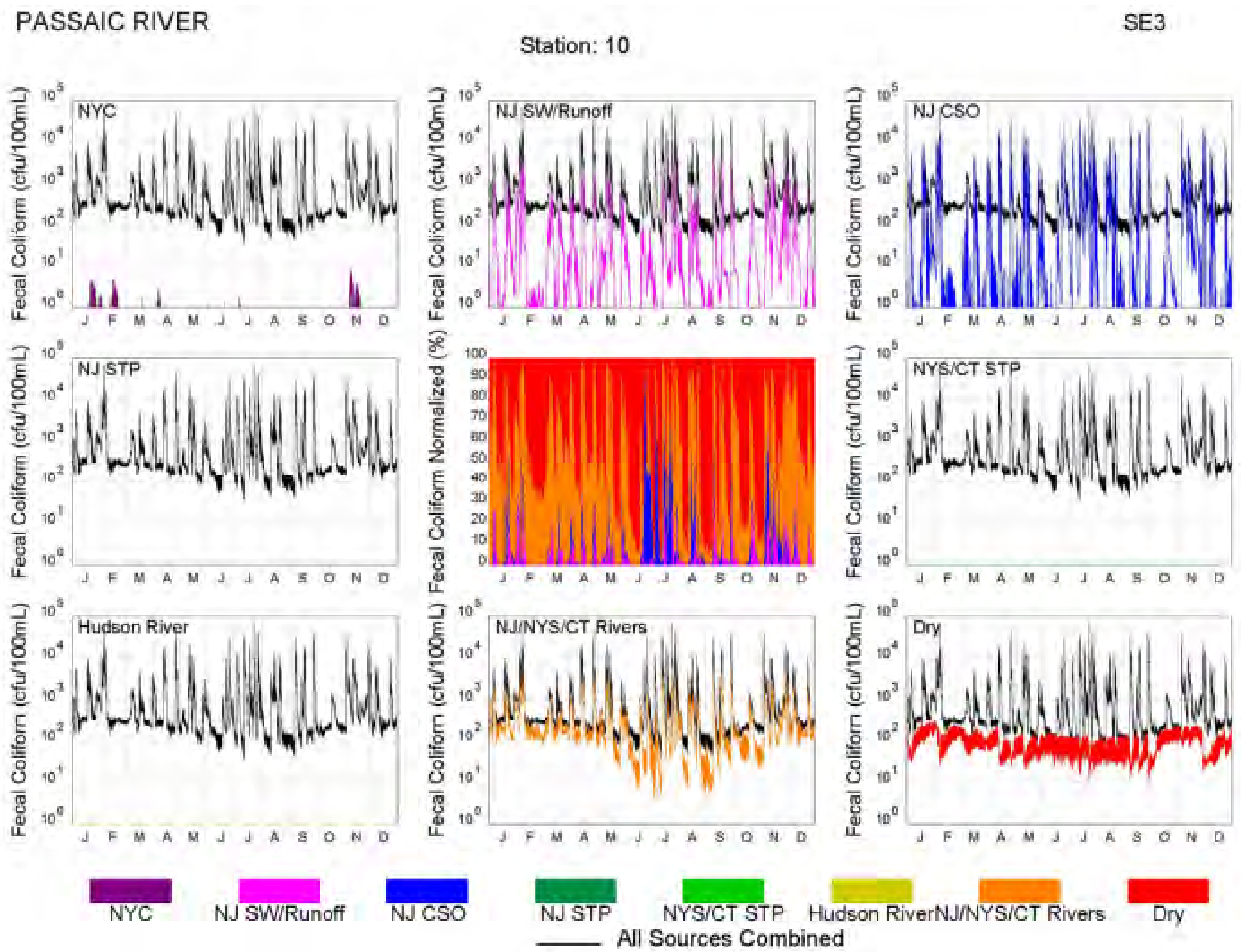


Figure D-5: Pathogen (Fecal Coliform) Component Load for Station 10 (Harrison)

D.3.4 Non-Monetary Factors for Evaluation of CSO Control Alternatives

The non-monetary factors, impacting the evaluation and ultimately the selection of the recommended alternative, were discussed in detail in the DEAR. These factors, which were used in other sections to select or discard alternatives are summarized below.

D.3.4.1 Siting

Siting is both a monetary and non-monetary factor, since even if the Town owns the property, it still has a value which will be impacted by the presence of CSO control facilities. "Preliminary siting issues" is listed in USEPA's Combined Sewer Overflow – Guidance for Long Term Control Plans (EPA 832-B-95-002 September 1995) as a screening mechanism and evaluation of the following is recommended:

- Availability of sufficient space for the facility on the site
- Distance of the site from CSO regulator(s) or outfall(s) that will be controlled
- Environmental, political, or institutional issues related to locating the facility on the site.

An analysis was undertaken to identify locations where end-of-pipe facilities might be installed for CSO control. The following publicly available GIS information was utilized:

- Aerial photography
- Land Use / Land Cover
- Parcel data, including vacant land, land ownership, and property value information
- Open Space / Green Acres
- Soil Type
- Topography
- Known Contaminated Sites
- Brownfields

This information was layered into GIS and analyzed to identify candidate sites for storage or end-of-pipe treatment, which was used in the analysis of the DEAR alternatives and selection of the LTCP. The first step of the analysis was to eliminate residential areas, transportation corridors and water bodies, as it was reasoned that these areas would not be suitable candidates for the extensive disturbance that would be required for a storage or end-of-pipe treatment facility. The overall land use of Harrison is shown in Figure D-6, with residential, transportation corridors and water bodies subtracted out. The remaining areas were analyzed based on aerial photography, with sites prioritized based on public ownership and vacant land, as well as potential underutilized sites such as parking areas or possible abandoned sites. It is noted that much is unknown at this time and use is made of existing data and reasonable interpretation and inferences where appropriate.

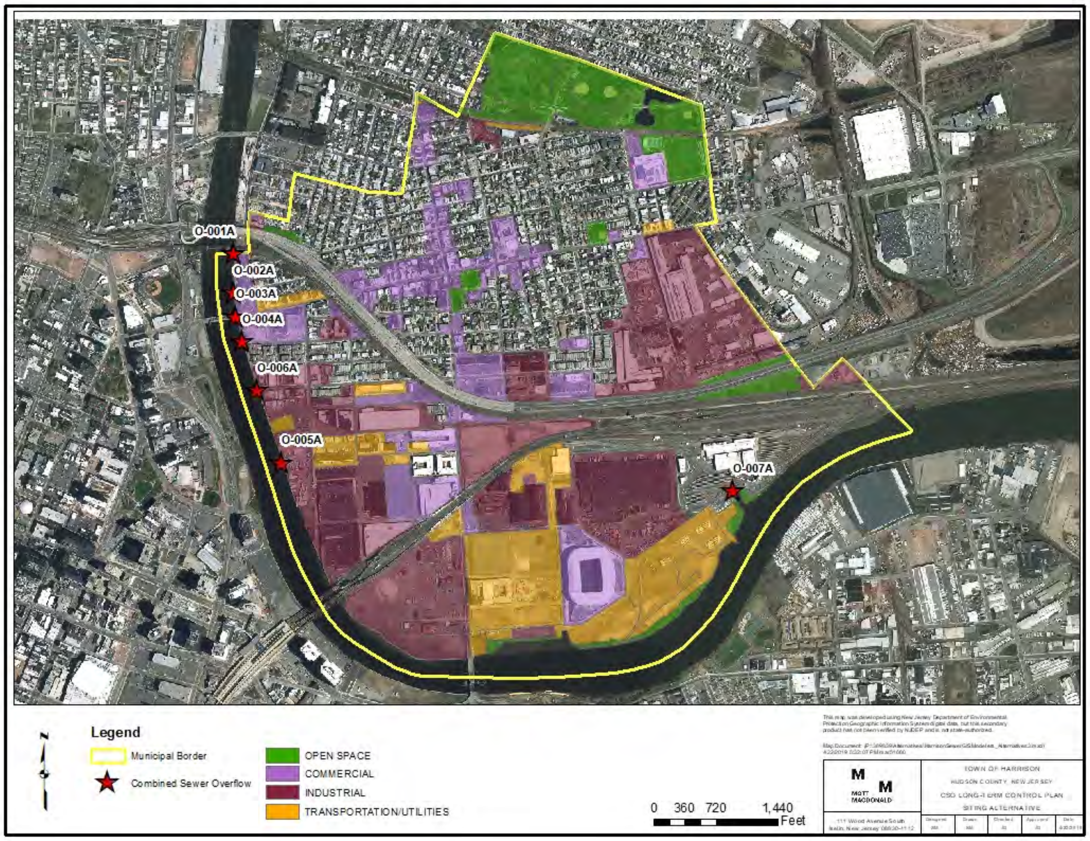


Figure D-6: Town of Harrison Land Use Map, non-residential areas

The Table D-2 below summarizes the characteristics that were considered at each site:

Table D-2: Siting Criteria Table

Evaluation Factor	Favorable	Unfavorable
Land Cover	Open paved or grass areas, vacant land	Buildings / Structures
Land Use	Industrial, Commercial, Open Space	Green Acres, Residential, Transportation Corridors
Ownership	Publicly owned	Privately owned
Elevation Change	Small elevation change relative to outfall or regulator	Large elevation change relative to outfall or regulator
Proximity	Close to outfall or regulator	Far from outfall and regulator
Contamination	No known soil or groundwater contamination	Known contaminated site or brownfield site

More detail on the siting analysis can be found in the DEAR. Location specific factors for the selected plan will be discussed in Section D.4 of this report.

D.3.4.2 Institutional Issues

Institutional issues refer to permitting requirements, likelihood of receiving permits, and timeline to receive permits, regulatory compliance in terms of water quality improvements, and ownership of the site (public vs. private). Regulatory considerations such as Green Acres, flood hazard area, wetlands, and threatened or endangered species are also evaluated, as well as zoning/planned development of the site by the municipality, and whether the site could be re-purposed for multiple-use (such as a parking facility over a storage tank). Institutional issues also refer to built-in limitations such as capacity in the PVSC interceptor and WRRF.

Permitting is a major Institutional Issue and is typically a critical factor in a project's design schedule. The following is a list of anticipated major permits applicable to the alternatives being analyzed:

- Waterfront Development Permit
- Flood Hazard Area Permit
- Treatment Works Approval
- Stormwater Management
- Army Corps of Engineer Nationwide 404 Permit
- Wetlands Permits
- Tidelands
- Local Permits
- Green Acres
- County and State Highway Permits
- Railroad Occupancy

More detail on institutional issues can be found in the DEAR. Location specific factors for the selected plan will be discussed in Section D.4 of this report.

D.3.4.3 Implementability

Implementability refers to considerations that could present challenges or prevent the construction of an alternative. This includes such factors as:

- Site access
- Ownership and ease of acquisition or easement
- Land area available
- Environmental considerations
- Compatibility with existing infrastructure

More detail on implementability can be found in the DEAR. Location specific factors for the selected plan will be discussed in Section D.4 of this report.

D.3.4.4 Public Acceptance

Public acceptance refers to the degree to which community residents, businesses and institutions would be impacted or perceive the alternative to be favorable or unfavorable. This includes considerations such as:

- Construction disturbance
- Visibility
- Impact to community spaces
- Community character
- Traffic impacts
- Cultural resources
- Environmental justice
- Community resources

Public acceptance can take many forms. In some areas residents and business may not be concerned and accept the construction, however, it is also possible for stronger levels of community opposition to occur. Opposition groups can be extremely vocal, active and well-funded. There is also the possibility that opposition groups can influence local election in favor of those that oppose the CSO LTCP or mount legal challenges. While public outreach such as the CSO Supplemental Team and public meetings can mitigate these challenges, it cannot altogether eliminate them as risks to the project.

More detail on public acceptance can be found in the DEAR. Location specific factors for the selected plan will be discussed in Section D.4 of this report.

D.3.4.5 Performance Considerations

There is no guarantee that a proposed technology will work until it is implemented. This uncertainty can be greatly mitigated through the selection of the technology. Some considerations are:

- Past performance – Is the technology well tested with a history of successful applications to CSO, with reliable data supporting its performance.
- Performance Flexibility – CSO flows are known for rapid changes in both quantity and quality, the technology selected must not only be able to accommodate the design conditions, but also the rapid changes that take place prior to reaching design conditions. CSOs can occur anytime of the year and under a variety of meteorological conditions and must function properly under all such conditions.
- Operational Flexibility – Most municipalities cannot afford highly specialized staff to operate and maintain facilities that are used intermittently. Thus, the technology must be simple to operate for available staff that must also fulfill other duties. Specialized skills should only be required infrequently and then under planned conditions.

- Reliability – While a technology may be successful, it must function consistently. CSO flows create harsh environments for equipment. Equipment typically functions best under continual use, whereas CSOs are intermittent, and thus can lead to operational issues between events.

More detail on performance considerations can be found in the DEAR. Location specific factors for the selected plan will be discussed in Section D.4 of this report.

D.3.5 Cost Opinion

The Town of Harrison's LTCP consists of several elements, each of which is attributed a cost or an equivalent value. Below is a summary of the cost or value of each element of the recommended LTCP. Value of work accomplished is presented with the same assumptions as estimated future costs.

D.3.5.1 Cost Estimating Approach

Cost estimates for the CSO control alternatives have been developed as part of the LTCP process. The costs provided are meant to provide an order of magnitude estimate, referred to as Class 5 estimates with an accuracy of -50% to +100%, and generally include a 25% contingency to reflect the planning level, with additional contingencies on items of higher uncertainty. The estimates have been developed specifically for the configurations of the alternatives that have been described. It is noted that any modifications to these alternatives or their configurations may impact the cost. The information and costs presented in this report is for planning purposes only, and all assumptions and information must be verified in subsequent planning and design stages.

The costs are presented as follows:

- Capital cost – including equipment cost, installation, training, labor, electrical and water connections, structural platforms, land acquisition, design, administrative costs, construction management, etc.
    - Design costs were assumed to be 10% of the construction cost.
    - Construction Management Costs were assumed to be 10% of the construction costs.
    - Administrative/Legal costs were assumed to be 5% of the construction cost.
- Operations & Maintenance (O&M) – annual power, chemical dosing, labor, etc. Since a 20-year planning period has been selected, it does not include any larger-scale overhauls or replacements/repairs that would be completed of the life of the facility.
- Present worth – for a period of twenty years, with a discount rate of 2.75%, as described below.

D.3.5.2 Present Worth Calculations

To be consistent with other permittees, guidance from the TGM was used to develop present worth costs for all alternatives including O&M and full capital costs for each control technology. A discount rate of 2.75% was used (Rate of Federal Water Projects, NRCS Economics, Department of the Interior) with a life span of 20 years. The following equation was then utilized to calculate the present worth factor to convert from annual O&M costs to present worth.

$$(P/A, i\%, n) = ((1+i)^n-1)/((i(1+i)^n)$$

The above was multiplied by the annual O&M costs and added to the construction costs to obtain the total life cycle cost. For the given life cycle and interest rate the P/A factor is 15.227. Salvage value was assumed to be $0, as it is assumed no resale value will result from the Control Technologies utilized.

D.3.5.3 Land Acquisition Costs

There is a great deal of uncertainty when estimating land acquisition costs, as the dramatic rise in prices leading up to 2008 and the subsequent drop in real estate values demonstrated. Currently, the impacts of COVID-19 on land values and the general economy are still being resolved. These impacts may be felt more profoundly by a residential commuter community such as Harrison. For planning purposes, it was assumed that commercial and residential properties could be acquired for $75 per square foot while industrial areas could be acquired for $50 per square foot. It was assumed easements could be acquired for $35 per square foot. This approach provides a consistent basis of cost comparison. The actual acquisition cost will depend on the owner's willingness to sell, with additional legal costs incurred if it is necessary to acquire the property through condemnation. The site's history of contamination and future plans for redevelopment will also factor in the final price of acquisition.

D.3.5.4 Cost Index

The costs for the LTCP were indexed to the Engineering News Record (ENR) Construction Cost Index (CCI) for March 2020 based on the 20-City Average CCI of 11,397. DEAR costs were indexed to January 2019 CCI of 11,205.

D.3.5.5 Sewer Separation Costs

Sewer separation costs are presented in three pieces:

- Estimated value of completed separation of CSO-004A.
- Estimated value of separation work already completed in CSO-005A drainage area.
- Estimated cost of work to complete separation of CSO-005A drainage area.

Costs for the separation of CSO-004A were evaluated using a rate of $300,000 per acre on the 3.3 acre drainage area for a total of $1M.

Sewer separation costs for CSO-005A were developed using as-built plans and design plans from redevelopment projects. Unit costs were developed from recent values from bid canvases. Quantities were estimated from the plans and using typical pay widths and estimates for:

- Mobilization
- Pipe quantities
- Drainage and sewer structures
- Excavation

- Soil disposal
- Backfill
- Trench surface restoration
- Miscellaneous restoration
- Traffic Control
- Dewatering

Quantities for planned separation costs were developed by creating a conceptual storm and sanitary sewer system to complete the separation.

The cost estimates are summarized in Table D-3 through Table D-5. Based on the cost estimates the Town has invested $11.1M in sewer separation ($1M to separate CSO-004A and $10.1M for partial separation of CSO-005A to date). The estimated value of the separation to be completed by the redevelopment is an additional $15.3M. Thus, the Town is about 40% through making the total investment. If the redevelopment does not come to pass in a timely manner as discussed later in this report, the Town would be required complete the separation. If the Town completes the separation, they may elect to only install a new storm or sanitary sewer system to complete the separation, rather than both a storm and sanitary sewer system as is being done through redevelopment. It is assumed that maintenance costs on the new systems would be similar to the cost of maintaining the existing system. There would however be additional costs associated with maintaining the water quality devices required at the stormwater discharge locations.

Maintenance of water quality devices is driven by the requirements of the New Jersey Stormwater Best Management Practices Manual. This calls for inspection after every rainfall in excess of 1” which occurred 14 times in the typical year. However, for evaluation purposes it is assumed the stormwater treatment maintenance costs will be offset by the reduced maintenance costs associated with abandoning the netting facilities which require similar levels of maintenance.

Table D-3: Outfall 005A Completed Separation Costs

HARRISON OUTFALL 005 COMPLETED SEPARATION CONCEPTUAL COST ESTIMATE					
ITEM No.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
1	MOBILIZATION	1	LS	$157,000	$157,000
2	UTILITY RELOCATION	1	LS	$400,000	$400,000
3	EXCAVATION	23153	CY	$10	$231,528
4	DEWATERING	1	LS	$100,000	$100,000
5	TRAFFIC CONTROL	1	LS	$200,000	$200,000
6	UNCONTAMINATED SOIL DISPOSAL	12000	CY	$30	$360,000
7	CONTAMINATED SOIL	19000	TON	$75	$1,425,000
8	DGA	17366	CY	$30	$520,967
9	AASHTO #2 CLEAN STONE FOR PIPE BEDDING	2440	CY	$40	$97,597
10	CONCRETE CURB	1097	LF	$50	$54,838
11	PAVEMENT RESTORATION	4176	SY	$75	$313,211
12	MILL AND REPAVE	12064	SY	$60	$723,856
13	CONCRETE SIDEWALK	975	SY	$80	$77,991
14	4' DIA DRAINAGE MANHOLE	39	EA	$5,000	$195,000
15	Catch Basin	36	EA	$5,000	$180,000
16	Custom Manholes (Special Structures)	10	EA	$15,000	$150,000
17	18" DIP	5	LF	$132	$670
18	12" DIP	59	LF	$85	$4,989
19	10" HDPE	282	LF	$25	$7,044
20	15" HDPE	48	LF	$43	$2,044
21	18" HDPE	643	LF	$60	$38,591
22	21" HDPE	519	LF	$78	$40,223
23	36" HDPE	51	LF	$150	$7,679
24	42" HDPE	644	LF	$185	$119,108
25	48" HDPE	474	LF	$220	$104,280
26	8" PVC	903	LF	$40	$36,124
27	12" PVC	1262	LF	$60	$75,695
28	12" RCP	53	LF	$145	$7,613
29	15" RCP	1361	LF	$168	$228,656
30	18" RCP	515	LF	$190	$97,850
31	24" RCP	1593	LF	$235	$374,456
32	29" x 45" HERCP	33	LF	$350	$11,381
33	30" RCP	330	LF	$260	$85,800
	SUBTOTAL				$6,429,193
	CONTINGENCY (25%)				$1,607,300
	SUBTOTAL				$8,036,493
	DESIGN (10%)				$803,600
	CONSTRUCTION MANAGEMENT (10%)				$803,600
	ADMINISTRATIVE/LEGAL (5%)				$401,800
	TOTAL (SAY)				$10,100,000

Class 5 estimate -50%/+100%. Costs indexed to March 2020 ENR CCI 11,397.

Table D-4: Outfall 005A Separation Costs Required to Complete Separation

HARRISON OUTFALL 005 WORK TO BE COMPLETED FOR SEPARATION
CONCEPTUAL COST ESTIMATE

ITEM No.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
1	MOBILIZATION	1	LS	$191,000	$191,000
2	UTILITY RELOCATION	1	LS	$500,000	$500,000
3	EXCAVATION	19017	CY	$10	$190,172
4	DEWATERING	1	LS	$100,000	$100,000
5	TRAFFIC CONTROL	1	LS	$132,000	$132,000
6	UNCONTAMINATED SOIL DISPOSAL	10000	CY	$30	$300,000
7	CONTAMINATED SOIL	15000	TON	$75	$1,125,000
8	DGA	11281	CY	$30	$338,433
9	AASHTO #2 CLEAN STONE FOR PIPE BEDDING	3268	CY	$40	$130,713
10	Sewer Service Reconnect	317	EA	$1,700	$538,900
11	CONCRETE CURB	2463	LF	$50	$123,172
12	PAVEMENT RESTORATION	8041	SY	$75	$603,064
13	MILL AND REPAVE	17844	SY	$60	$1,070,644
14	CONCRETE SIDEWALK	1442	SY	$80	$115,356
15	4' DIA DRAINAGE MANHOLE	90	EA	$5,000	$450,000
16	Catch Basin	72	EA	$5,000	$360,000
17	12' Diameter WQ Structures	1	LS	$233,900	$233,900
18	8" PVC	6730	LF	$40	$269,200
19	24" RCP	2848	LF	$235	$669,163
20	30" RCP	1616	LF	$260	$420,160
21	36" RCP	900	LF	$320	$288,000
22	48" RCP	884	LF	$470	$415,480
	SUBTOTAL				$8,564,355
	CONTINGENCY (25%)				$2,141,100
	SUBTOTAL				$10,705,455
	DESIGN (10%)				$1,070,500
	CONSTRUCTION MANAGEMENT (10%)				$1,070,500
	ADMINISTRATIVE/LEGAL (5%)				$535,300
	LAND ACQUISITION	1.26	Ac	$1,500,000	$1,890,000
	TOTAL (SAY)				$15,300,000

Class 5 estimate -50%/+100%. Costs indexed to March 2020 ENR CCI 11,397.

Table D-5: Summary of LTCP Sewer Separation Costs

Project	Area (ac)	Capital Cost	Annual Maintenance Costs	20-Year Net Present Worth
CSO-004 Separation (completed)	3.3	$1.0M	Similar to Existing Costs	$1.0M
CSO-005 Separation (completed)	37.6	$10.1M	Similar to Existing Costs	$10.1M
CSO-005 Separation (to be completed)	49.5	$15.3M	Similar to Existing Costs	$15.3M
Total	90.4	$26.4M	--	$26.4M

Class 5 estimate -50%/+100%. Costs indexed to March 2020 ENR CCI 11,397.

D.3.5.6 Green Infrastructure Costs

Green infrastructure (GI) was shown, during the DEAR evaluation, not to be effective at controlling CSOs in terms of overflow volume reduction or reduction in frequency. However, the Town recognizes that it has value to the CSO control program in terms of public education and acceptance as well as other benefits not related to CSO control. The Town of Harrison is setting aside a specific amount of $750,000 for GI over the first 10-years of the CSO LTCP. It is estimated this would allow for the installation of approximately 20 rain gardens.

Maintenance of GI is driven by the requirements of the New Jersey Stormwater Best Management Practices Manual. This calls for inspection after every rainfall in excess of 1" which occurred 14 times in the typical year.

Estimated number of GI installations = 20
Estimated inspection visits = 14 per year
Estimated time to inspect and document = 1 hour per event per GI installation
Total inspection time = 280 hours per year.

Estimated annual maintenance = 8 hours per GI installation
Total maintenance time = 160 hours

Total time = 440 hours
Estimate labor rate = $60/hr
Estimated labor costs = $26,400/year

Estimated maintenance cost for equipment and replacement plants = $250 per GI installation
Estimated maintenance cost for equipment and replacement plants = $5,000/year

Total Estimated GI Maintenance Costs = $31,400/year

Table D-6: Summary of LTCP GI Costs

Project	Capital Cost	Annual Maintenance Costs	20-Year Net Present Worth
Green Infrastructure	$0.75M	$31,400	$1.23M

Class 5 estimate -50%/+100%. Costs indexed to March 2020 ENR CCI 11,397.

D.3.5.7 Water Conservation Costs

The Town's ongoing efforts to conserve water through low flow household fixtures is an ongoing part of the Town's code enforcement. It is estimated that the plumbing code official spends a portion of their time on enforcement Chapter 221 Article 2. The Town intends to continue its water conservation efforts and will consider amending its ordinance if improved methods of conservation become available. The cost of reviewing the ordinance is considered nominal.

D.3.6 Selection of Recommended Alternative

Alternative 1 was selected for the following reasons:

- The planned work meets the CSO control requirements in the permit.
- If the work can be achieved through redevelopment the Town may be able to accomplish its goals with reduced capital outlay.
- Additional measures require high initial costs to convey flow to sites with adequate space to treat or store it.
- The GI provides opportunities for public outreach and education.
- Water conservation provides additional benefits of reducing both water and sewer demand.

The performance of the Recommended Alternative is summarized below in Table D-7.

Table D-7: Summary of Recommended Alternative (Including Work Already Completed)

Selected Alternative	% Capture	CSO Events	CSO Volume (MG)	Construction Cost	20-Year NPW
Alternative 1 – Completed and planned sewer separation, plus GI program	85.0%	40	38.0	$27.2M	$27.6M

Class 5 estimate -50%/+100%. Costs indexed to March 2020 ENR CCI 11,397.

D.4 DESCRIPTION OF RECOMMENDED LTCP

The recommended alternative has been selected to meet the requirements of the Permit and to accommodate select input from the public. The recommended plan consists of elements described in the following subsections.

D.4.1 Separation of the CSO-004A Drainage Area (completed)

Separation of the 3.3 acre drainage area has been completed. Harrison was issued a Minor Modification to their Permit on June 25, 2018 to reflect the separation and the removal of the outfall. The separation included the installation of water quality devices that the Town has assumed ownership of and maintenance responsibility for.

D.4.1.1 Non-monetary factors

The separation of the CSO-004A drainage area is already complete and non-monetary factors are not applicable.

D.4.2 Separation of the CSO-005A drainage area

Separation of the 87.1 acre drainage area has been partially completed with new storm sewers installed from the upstream end of the drainage area to South Second Street, effectively separating an area of 37.6 acres. The installation of new sanitary sewers connected directly to the PVSC interceptor has reduced the sanitary load, however there will not be a meaningful reduction in CSO volume or frequency until the new storm sewers are extended past the regulator to the outfall. This will be accomplished when the remaining 49.5 acres are separated. Figure D-7 depicts the areas of Harrison that are currently separated or will undergo sewer separation in the future.

D.4.2.1 Non-monetary Factors

D.4.2.1.1 Siting

Siting was considered in the selection of separating the CSO-005A drainage area. Generally, separation is preferable in terms of siting since the work is almost exclusively within the public right-of-way. However, in this case the existing outfall runs beneath a building and is not within the public right-of-way, nor is there an easily accessible public road to route a new outfall along. If this work is done through redevelopment, the building will be removed, and Angelo Cifelli Drive will be extended. It the Town completes the project they will need to acquire right-of-way. The estimated cost and schedule impacts of doing so have been accounted for in the overall project costs and budget.

D.4.2.1.2 Institutional Issues

The separation work is subject to institutional issues common to projects of this magnitude. As part of prior separation work, PVSC has encouraged the separation. It is anticipated that since flow is being removed from the system that PVSC will not object to the selected alternative. There will be several permits required prior to implementation of sewer separation. Based on current regulations and expected project elements and scope, the permits and approvals listed below are required. It is noted that regulatory thresholds and definitions change regularly and permitting requirements may differ when the project proceeds towards design and construction.

- Waterfront Development Permit
- Flood Hazard Area
- Stormwater Management
- Treatment Works Approval
- United States Army Corps of Engineers Nationwide 404 Permit
- Wetlands Permit
- Tidelands

D.4.2.1.3 Implementability

The separation of the CSO-005A drainage area is viable, albeit with some challenges. As previously noted, there could be property acquisition issues given that there are no public roads between the previously separated area and the Passaic River. Conflicts from existing utilities should also be expected, however these have been anticipated and costs have been included in project estimates for utility relocations.

D.4.2.1.4 Public Acceptance

Public acceptance of the separation could be mixed. Much of the work will be taking place in industrial areas which should mitigate some impacts, although recent redevelopment has introduced residential areas adjacent to the proposed separation areas. However, some affected streets are more frequently traveled, and residents will be more highly impacted. However, these are not unique circumstance given that utility work is frequent in urban areas. Proper public outreach will be required.

D.4.2.1.5 Performance Considerations

Past Performance - Sewer separation has been used extensively to reduce CSO and has been show effective in doing so. Its effectiveness is enhanced when water quality controls are implemented on the stormwater discharge as will be required under the New Jersey Stormwater Management Rules.

Performance Flexibility – Separate storm and sanitary sewers can be sized for the anticipated peak flow conditions and are well suited for the rapidly changing conditions associated with storm flows.

Operational Flexibility – The Town is experienced in the operation of separate storm and sanitary sewers, which operationally are similar to combined sewer systems. It has the resources and experience to properly maintain and operate the separated sewers without major changes to personnel or equipment.

Reliability – When properly maintained separate storm sewers will function reliably and, given the that they will be new and constructed of modern materials, should be more reliable and less prone to issues than the existing system.

D.4.2.1.6 Environmental Justice

No environmental justice issues are anticipated with the sewer separation project. The work will result in an overall reduction in pollution and will not divert pollution to disadvantaged areas. The work is primarily in an industrial area that is under redevelopment and the construction is not expected to create an undue burden on the nearby residents.

D.4.3 Green Stormwater Infrastructure

GI was selected for inclusion in the LTCP based of its value for public outreach and education. The community's awareness, understanding and appreciation of combined sewers is a key component in the public participation component of the LTCP. Modeling during the DEAR showed green infrastructure, even if implemented on a large scale, would not to have a meaningful impact on CSO volumes or frequency. The community's awareness, understanding and appreciation of combined sewers and GI, is a key component in the public participation component of the LTCP. It also helps build support for the investment required for the other CSO LTCP elements. Accordingly, based on these factors, the Town will support investment to promote, install and support the installation of GI within the Town.

D.4.3.1 Non-monetary Factors

D.4.3.1.1 Siting

Siting of GI can be accomplished within the public right-of-way, or on other publicly owned land. Siting of GI on private property can be problematic to maintain the necessary control over maintenance. However, this can be mitigated by accepting GI that has been constructed on private property as part of an approved stormwater management plan, with an approved and enforceable maintenance plan.

D.4.3.1.2 Institutional Issues

Institutional issues with GI are expected to be minimal, however, there may still be permits required including:

- Waterfront Development Permit
- Flood Hazard Area
- Stormwater Management
- Tidelands

D.4.3.1.3 Implementability

GI should be implementable; however, experience has shown a high level of attrition in sites initially identified when compare to sites found suitable for installation. Common challenges include existing utilities, poor performing soils and proximity to existing structures. These challenges are often overcome by converting the GI installation from infiltrating facilities to filtering facilities by lining the GI and adding an underdrain to connect to the existing sewer system.

D.4.3.1.4 Public Acceptance

Inclusion of GI in the LTCP is expected to be met with public approval. The Regional SCSO team has repeatedly indicated a preference for GI and TIDE has been active in creating GI installations in Harrison. The benefits to the public are generally easily seen in the form of additional green space and numerous co-benefits.

D.4.3.1.5 Performance Considerations

It is noted that while performance benefits may be achieved by GI, none are being claim as part of the numerical reduction in combined sewer overflows, any benefits will serve as a safety factor to the performance of the sewer separations. The performance objectives of the GI are in the area of public education and acceptance.

Past Performance – GI has been implemented on a large scale by several municipalities, and its ability to impact the runoff characteristics both in term of quantity and quality have been demonstrated. It has also been shown to produce educational, health, and societal benefits however, GI performance is both highly variable and highly dependent on existing soils and good maintenance and, thus proper design is important.

Performance Flexibility – GI intercept flow prior to reaching the combined sewer and is suited to the rapidly changing flow conditions of urban surface runoff. GI is typically designed to accept surface runoff up to a design flow rate and volume, at which point flow will bypass the GI.

Operational Flexibility – The Town already has several GI installations that it cares for and has the ability to properly maintain GI. GI is also well suited for intermittent use functioning like normal planted surfaces between storms and then accepting stormwater when required to do so. In general, minimal specialized skills or equipment are required when compared to other CSO controls.

Reliability – When properly maintained GI can provide reliable performance, provided they are properly designed. There are no mechanical parts that can deteriorate or fail between usage. Nevertheless, prolonged periods of drought can potentially kill plants, as can winter salting. Maintenance is required to retain plantings, which enhance the filtering of stormwater and maintain the porosity of the soil. Over long periods, renewal of soils and mulch layers is required to preserve performance. As was previously noted the LTCP is not dependent on GI to produce measurable reduction in CSO volumes. However, it will serve as a safety factor on the other elements of the LTCP.

D.4.3.1.6 Environmental Justice

No environmental justice issues are anticipated with the green infrastructure project. The planned projects will bring additional green space to the community and provide positive benefits to all residents.

D.4.4 Water Conservation

Water conservation was included in the LTCP in response to comment from the public. The planned water conservation is largely an extension of the efforts already undertaken by the Town. However, a deliberate review process is included to periodically evaluate if current water conservation measures could be improved upon.

D.4.4.1 Non-monetary Factors

Water conservation is a procedural element of the LTCP and is not relied upon for numerical performance. As such non-monetary factors are generally not applicable. It was discussed by members of the SCSO team and is generally expected to be met with public acceptance.

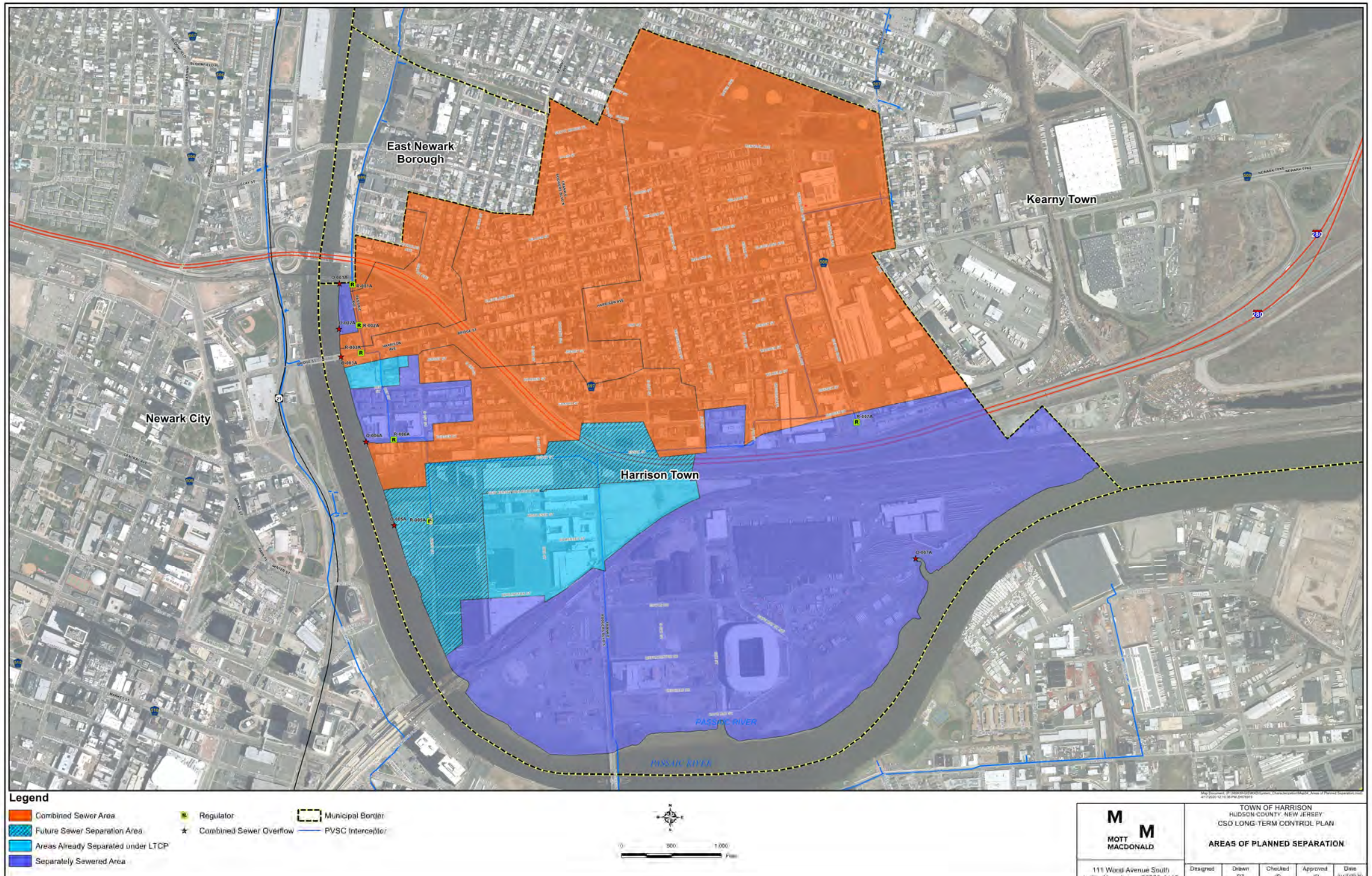


Figure D-7: Areas of Completed and Planned Sewer Separation

SECTION E - FINANCIAL CAPABILITY

E.1 INTRODUCTION

This section of the Town of Harrison's Selection and Implementation of Alternatives Report (SIAR) quantifies the projected affordability impacts of the Town of Harrison's proposed long term CSO controls for its combined sewer system (CSS) and updates the 2019 preliminary FCA memo that was intended to guide the development and selection of long term controls. This section is excerpted from a memorandum prepared by the Passaic Valley Sewerage Commission (PVSC) which is incorporated as Appendix P of PVSC's SELECTION AND IMPLEMENTATION OF ALTERNATIVES FOR LONG TERM CONTROL PLANNING FOR COMBINED SEWER SYSTEMS - REGIONAL REPORT (Regional Report).

The Financial Capability assessment is a two-step process including ***Affordability*** which evaluates the impact of the CSO control program on the residential ratepayers and ***Financial Capability*** which examines a permittee's ability to finance the program. Affordability is measured in terms of the Residential Indicator (RI) which is the percentage of median household income spent on wastewater services. Total wastewater services exceeding 2.0% of the median household income are considered to impose a high burden by USEPA. The financial capability analysis uses metrics similar to the municipal bond rating agencies.

USEPA encourages the use of additional information and metrics to more accurately capture the impacts of the proposed CSO controls on the permittee and its residents. Therefore, this FCA includes information on the impacts of future costs among lower income residents and within the context of local costs of living.

Detailed discussion of the FCA for the PVSC service area and Permittees can be found in the Regional Report and a detailed analysis of the Town of Harrison's FCA can be found in the FCA Memorandum specifically written for Harrison attached as part of Appendix P of the Regional Report.

E.2 BASELINE CONDITIONS (WITHOUT CSO CONTROLS)

The estimated annual cost for wastewater services for a typical single-family residential user for 2019 is $395, including $210 from sewer rents and $185 in Town property taxes going towards sewer system operation, maintenance and improvements. This estimate is based on typical residential potable water usage is 4,100 gallons monthly. Based on the estimated MHI of $63,600 the Residential Indicator was approximately 0.6% in 2019, what the EPA guidance defines as a low burden. By definition the current residential indicator for one half of the households is greater than the 0.6%.

In Harrison, 16.2% of the population was living below the poverty line. The total Census households are broken out by income brackets on Table E-1 below, along with the respective current Residential Indicators by income bracket. The RI for each bracket was calculated from the mid-point income within the bracket. At the lowest income levels, the current RI is already between 3.2% and 7.9%.

Table E-1: Analysis of the Current Residential Indicator

Income Bracket	Households		Bracket Average Income	Bracket RI at Typical Cost per Household
	Number	Cumulative		
Less than $10,000	330	330	$5,000	7.9%
$10,000 to $14,999	186	516	$12,500	3.2%
$15,000 to $24,999	434	950	$20,000	2.0%
$25,000 to $34,999	493	1,443	$30,000	1.3%
$35,000 to $49,999	820	2,263	$42,500	0.9%
$50,000 to $74,999	1,238	3,501	$62,500	0.6%
$75,000 to $99,999	621	4,122	$87,500	0.5%
$100,000 to $149,999	822	4,944	$125,000	0.3%
$150,000 to $199,999	381	5,325	$175,000	0.2%
$200,000 or more	297	5,622	$200,000	0.2%
Total	5,622	*Costs per household include sewer rents and municipal taxes supporting wastewater services		

PVSC has developed a time-based model that calculates annual costs and revenue requirements based on assumed program costs, schedules and economic variables such as interest and inflation rates. The residential indicator is calculated for each year based upon the costs per typical residential users which changes annually based on the annual system revenue requirements. The estimated inflationary impacts on wastewater costs per typical single-family residential user without additional CSO control costs are shown on Table E-2. The costs are projected to the year 2041 based on the LTCP implementation schedule in Section F of this SIAR report, which targets the completion of capital improvements through 2040. The projected cost per typical single-family residential user are projected to increase from $395 in 2019 to $1,008 in 2041 due to inflation.

Table E-2: Projected Residential Indicator in 2041 Without CSO Controls

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2041
RI	0.6%	1.2%
Annual $	$395	$1,008

E.3 SUMMARY AND CONCLUSION

E.3.1 Affordability Impacts of the Proposed CSO Controls

Harrison has identified a long term CSO control strategy that will achieve 85% capture of wet weather flows during the typical year. These controls are summarized on Table E-3.

Table E-3: Harrison's Selected CSO Controls

Wet Weather Control Types	Capital Costs	Incremental Annual O&M Costs
Green Infrastructure Program (future)	$750,000	$31,400
Sewer Separation (if not completed through redevelopment	$15,300,000	$0.0
Total	$16,100,000	$31,400

Implementation of the $16.1 million Harrison Municipal Control Alternative results in projected annual costs per typical single-family user of $832 (without inflation) and a residential indicator of 1.2% in 2041, the first year after the projected full implementation of the controls ending in 2040. Accounting for inflation, annual costs would grow to $1,460 with a residential indicator of 1.5% in 2041 as shown in Table E-4.

Table E-4: Harrison's Projected Residential Indicator Upon Full Implementation of the Municipal Control Alternative in 2041

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2041			
		No LTCP		LTCP Implementation Completed in 2040	
		With Inflation	Without Inflation	With Inflation	Without Inflation
RI	0.6%	1.0%	0.8%	1.2%	1.5%
Annual $	$395	$1,008	$509	$754	$1,460

Note: This table is based on a generic distribution of project costs for the purpose of assessing capability, see Section F.6 for project specific estimates including an estimate of permit maintenance costs.

This analysis does not reflect the current and lingering financial impacts as a result of the COVID -19 pandemic and should be revisited upon memorializing the LTCP implementation schedule in the Town's next NJPDES Permit.

E.3.2 Financial Capability Assessment

The second part of the financial capability assessment - calculation of the financial capability indicator for the permittee - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment.

As shown on Table E-5, the overall score for the financial indicators is 2.0 yielding an EPA Qualitative Score of "midrange". This calculation is based on the use of the indicators that are applicable to Harrison. The derivation of this score is presented in the detailed FCA memorandum presented in Appendix P of the PVSC Regional Report. As each of the financial indicators are generally based upon publicly available data from 2017 or earlier, this analysis does not reflect the current and lingering impacts of the COVID -19 pandemic and should be revisited upon memorializing the LTCP implementation schedule in the Town's next NJPDES Permit.

Table E-5: Permittee Financial Capability Indicator Benchmarks

Indicator	Rating	Numeric Score
Bond Rating	Midrange	2
Overall Net Debt as a Percent of Full Market Property Value	Midrange	2
Unemployment Rate	Weak	1
Median Household Income	Midrange	2
Property Tax as a Percent of Full Market Property Value	Midrange	2
Property Tax Collection Rate	Strong	3
	Total	12
	Overall Indicator Score: (numeric score / number of applicable indicators)	2.0
	EPA Qualitative Score	Midrange

E.3.3 Implementation Feasibility Implications

The affordability analysis detailed above has documented that the $16.1 million (current dollars) in capital expenditures under Harrison's Municipal Control Alternative along with related operation and maintenance costs would result in a Residential Indicator of 1.6%, within the EPA "medium burden" criterion.

Additional economic factors are presented in the Harrison FCA Memorandum presented in Appendix P of the SELECTION AND IMPLEMENTATION OF ALTERNATIVES FOR LONG TERM CONTROL PLANNING FOR COMBINED SEWER SYSTEMS - REGIONAL REPORT enforcing the limits to the affordability of CSO controls and the Town's financial capability.

While the affordability analysis detailed above has documented that the selected $16.1 million (current dollars) Municipal Control Alternative along with related operation and maintenance costs would result in a Residential Indicator of "medium impact" under EPA's criteria; the reality of the high poverty rates, low household incomes compared to the rest of New Jersey and nationally and the high costs of living in Harrison argue strongly that the EPA metric understates the impacts of the CSO control costs on the residents of the Town. Harrison is likely to remain financially distressed due to structural economic factors beyond its direct control and its ability to afford and finance future CSO control facilities is restricted. As evidenced by its New Jersey Municipal Revitalization Index score in the top 15th percentile, Harrison's capacity for additional CSO controls, beyond those proposed in the SIAR, is limited.

E.3.4 Potential Impacts of the COVID-19 Pandemic in Affordability

The projections and conclusions concerning the affordability of the Municipal Control Alternative proposed in this SIAR by Harrison and Harrison's financial capability to finance the CSO control program are premised on the baseline financial conditions of Harrison as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, Harrison will be reticent to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this SIAR based on emergent economic conditions beyond the permittees' control. As detailed in Section F of Harrison's SIAR, these provisions could include scheduling the implementation of specific CSO control measures to occur during the five-year NJPDES permit cycles. A revised affordability assessment should be performed during review of the next NJPDES permit to identify controls that are financially feasible during that next permit period.

SECTION F - RECOMMENDED LONG-TERM CONTROL PLAN

F.1 INTRODUCTION

The Town of Harrison in effect has already started implementation of their LTCP through their redevelopment plans and agreements made with developers. Since the redevelopment process began, the CSO 004 drainage area has been separated, outfall 004A eliminated, and new storm and sanitary sewers have been installed in approximately half of the CSO-005 drainage area. The completion of the separation will bring Harrison to the desired level of control of 85% capture. This completed and planned work will form the backbone of the LTCP and will be supplemented with green stormwater infrastructure and water conservation.

F.2 RECOMMENDED LTCP

The recommended LTCP was selected to achieve the desired 85% capture level of control. It consists of several elements detailed below.

F.2.1 Separation of CSO-004 Drainage Area

The CSO-004A drainage area is 3.3 acres, see Figure D-7. The separation of this area has been completed and acknowledge by NJDEP through the issuance of a minor modification on June 25, 2018 NJPDES permit action to remove the Dey Street outfall 004A. The elimination of this combined outfall had minimal impact on Harrison's annual overflow volume during the typical year.

F.2.2 Separation of CSO-005 Drainage Area

The CSO-005A drainage area is 87.1 acres, the separation of this area is approximately 45% complete, with new storm and sanitary sewers installed in an area of 37.6 acres. The separation completed to date has had minimal impact to annual CSO volumes as the separation thus far has consisted of installing new storm and sanitary sewers in the upstream portion of the drainage area. There are however, some immediate benefits, as the sanitary sewage in the separated area is now conveyed directly to the PVSC interceptor, thus reducing the concentration of sanitary sewage in the outfall. The elimination of this combined outfall when complete, will reduce Harrison's annual overflow volume during the typical year by an additional 8.4 MG, reducing it to 38.0 MG. To complete the separation stormwater water quality treatment would be required. Under current conditions only a small portion of the New Jersey Stormwater Quality Storm is conveyed to the WRRF and it is anticipated that 50% TSS removal would be required. Providing stormwater quality treatment will provide additional benefits to the Passaic River beyond just the removal of sanitary sewage. This will be especially true for TSS, and pollutants associated with TSS.

There are two options for completing the separation under the LTCP:

- Option 1 – The work is completed through the redevelopment of the former industrial area.
- Option 2 – Under this option the Town would complete the separation by constructing either new storm or sanitary sewers to complete the installation. If the Town has to

complete the sewer separation project directly it will also need to acquire approximately 1 acre of easements on private property since the planned redevelopment calls for the demolition of existing buildings and the creation and dedication of newly developed streets to the Town needed to transport stormwater flows to the river. If the redevelopment does not proceed, the Town will need to secure property or easements to route sewers.

F.2.3 Green Infrastructure Program

Modeling during the DEAR showed green infrastructure, even if implemented on a large scale, would not to have a meaningful impact on CSO volumes or frequency. However, that does not mean that GI has no value to CSO control or the LTCP. The community's awareness, understanding, and appreciation of combined sewers and GI are often key elements in the public participation component of the LTCP. It may also help build support for the investment required for the other CSO LTCP elements. Accordingly, based on these factors, the Town will support the investment of $750,000 during the first 10-years of the LTCP to promote, install and support the installation of GI within the Town. This investment may take several forms, including, but not limited to:

- Funding Harrison TIDE or other community groups' GI projects.
- Funding and installing projects recommended in Rutgers' "Green Infrastructure Feasibility Study, Harrison"
- Installation of GI in planned parks
- Installation of GI by public or private entities, with proper provisions for maintenance.
- Installation of GI in the public ROW or Town-owned properties.
    - Rain gardens
    - Bioswales
    - Planter boxes
    - Permeable pavement

For purposes of creating a funding plan, it is assumed the $750,000 will be provided by the Town, however the funding directly by the Town may be reduced if grants or other forms of funding, such as in-kind donations, or investments by third parties, such as developors, are provided. This may include taking credit for the monetary value of installations on private property, which are covered by an enforceable maintenance plan, such as GI installed along a public road as part of a Major Development. It is estimated that this will result in about 20 GI installations, however, the actual number of installations will depend on the size and type of the individual installations. Unless impractical, each GI installation will be equipped with an interpretive sign explaining the GI practice and its water quality benefits. The Town will assume maintenance responsibility for the GI installations it funds or installs on public property. Qualifying installations on private land must be covered by an enforceable maintenance plan that complies with the NJ Stormwater Management Rules.

F.2.4 Water Conservation

The Town's efforts to conserve water through low flow fixtures is an ongoing part of the Town's code enforcement. It is estimated that the plumbing code official spends a portion of their time on enforcement Chapter 221 Article 2 - Water-Saving Fixtures. The Town intends to continue its water conservation efforts and will consider amending its ordinance if improved methods of conservation become available. Each permit cycle the Town will review its Water-Saving Fixtures ordinance and recommend revisions if it deems necessary. The Town is also implementing a water conservation software to alert users of potential leaks.

F.3 Operational Plan

Part IV G.6a of the Permit requires:

"Upon Departmental approval of the final LTCP and throughout implementation of the approved LTCP as appropriate, the permittee shall modify the O&M Program and Manual in accordance with D.3.a and G.10, to address the final LTCP CSO control facilities and operating strategies, including but not limited to, maintaining Green Infrastructure, staffing and budgeting, I/I, and emergency plans."

The Town of Harrison is prepared to operate and maintain the facilities associated with the LTCP. There are two primary elements to the plan:

1. Sewer Separation – The Town currently operates and maintains both storm and sanitary sewers and has the capacity to maintain the new sewers, which will be replacing existing sewers. Given the renewal of the infrastructure, this is not expected to add significant cost to Town's maintenance budget. The Town also maintains existing water quality devices and anticipates that similar devices will be used on the new storm sewers. The cost of maintaining the water quality devices will be largely offset by no longer needing to maintain the netting facilities.
2. Green Infrastructure – The Town currently maintains several GI installations including the rain garden at the public library. The Town is aware of the maintenance requirements of GI and the associated costs are incorporated into the LTCP.

Accordingly, the operation and maintenance requirements and costs for the LTCP facilities have been considered by the Town and it is prepared to undertake those responsibilities. As the facilities are implemented, the Town will modify its operation and maintenance program and manuals to accommodate them.

F.4 IMPLEMENTATION COST OPINION

As discussed in Section D.3.5 the estimated capital costs associated with the LTCP are $16.1M. The costs incurred by the Town as part of the LTCP will not occur all at once, but will rather be spread out over time, as a function of both the project schedule and financing plan. The following is a summary of the anticipated project costs and when they will occur. Estimated costs associated with ongoing maintenance of permit requirements such as report and the notification system are included, see Table F-1.

Table F-1: Annual Costs of CSO LTCP expressed in 2020 Dollars

Year	Design and Construction	Permit Requirements	O&M	Total
2021	$ 75,000	$ 40,000	$ 2,000	$ 117,000
2022	$ 75,000	$ 40,000	$ 5,300	$ 120,300
2023	$ 75,000	$ 40,000	$ 8,600	$ 123,600
2024	$ 75,000	$ 40,000	$ 11,800	$ 126,800
2025	$ 75,000	$ 40,000	$ 15,100	$ 130,100
2026	$ 75,000	$ 40,000	$ 18,300	$ 133,300
2027	$ 75,000	$ 40,000	$ 21,600	$ 136,600
2028	$ 75,000	$ 40,000	$ 24,900	$ 139,900
2029	$ 75,000	$ 40,000	$ 28,100	$ 143,100
2030	$ 75,000	$ 40,000	$ 31,400	$ 146,400
2031	$ -	$ 40,000	$ 32,600	$ 72,600
2032	$ 214,000	$ 40,000	$ 32,600	$ 286,600
2033	$ 127,000	$ 40,000	$ 32,600	$ 199,600
2034	$ 423,000	$ 40,000	$ 32,600	$ 495,600
2035	$ 2,196,000	$ 40,000	$ 32,600	$ 2,268,600
2036	$ 268,000	$ 40,000	$ 32,600	$ 340,600
2037	$ 3,051,000	$ 40,000	$ 32,600	$ 3,123,600
2038	$ 3,997,000	$ 40,000	$ 32,600	$ 4,069,600
2039	$ 3,997,000	$ 40,000	$ 32,600	$ 4,069,600
2040	$ 999,000	$ 165,000	$ 32,600	$ 1,196,600
2041	$ -	$ 190,000	$ 32,600	$ 222,600
2042	$ -	$ 40,000	$ 32,600	$ 72,600
2043	$ -	$ 40,000	$ 32,600	$ 72,600
2044	$ -	$ 40,000	$ 32,600	$ 72,600
2045	$ -	$ 40,000	$ 32,600	$ 72,600
2046	$ -	$ 40,000	$ 32,600	$ 72,600
2047	$ -	$ 40,000	$ 32,600	$ 72,600
2048	$ -	$ 40,000	$ 32,600	$ 72,600
2049	$ -	$ 40,000	$ 32,600	$ 72,600
2050	$ -	$ 40,000	$ 32,600	$ 72,600

Class 5 estimate -50%/+100%. Costs indexed to March 2020 ENR CCI 11,397.

F.5 IMPLEMENTATION SCHEDULE

The implementation of the LTCP will commence upon NJDEP acceptance of the recommended LTCP. The schedule is provided relative to that date, for scheduling purposes, it is assumed the plan will be accepted January 1, 2021. Information on planned activities is provided in 5-year segments to align with the assumed cycle of permit renewals. The overall LTCP is based on a 20-year implementation, with follow up monitoring, Figure F-1. It is understood that within the overall schedule the NJDEP may request some form of annual reporting to document the completion of milestones or to document progress towards milestone separated by more than one year.

F.5.1 Years 1-5

During Years 0-5 the Town will commence its GI program. With the goal of achieving an investment of $375,000, the Town will document the investments made through direct expenditures, as well as grants, in-kind donations and investments made by other entities in the public space or on private land with appropriate maintenance agreements.

The Town will review its water conservation ordinance(s) and determine if updates or additions could provide enhanced water conservation.

F.5.2 Years 6-10

During Years 6-10 the Town will continue its GI program, including the maintenance of GI installations during the first 5 years. With the goal bringing the total investment in GI planning, design and construction to $750,000, the Town will document the investments made through direct expenditures, as well as grants, in-kind donations and investments made by other entities in the public space or on private land with appropriate maintenance agreements.

The Town will review its water conservation ordinance(s) and determine if updates or additions could provide enhanced water conservation.

Based on the progress of prior redevelopment work, it is assumed that the work to complete the separation of the CSO-005A drainage area will be commenced during this time period. However, the LTCP is only committing to completion of the separation by the end of the 20-year planning period not a definitive start date, see the schedule for years 10 through 20 for how the Town plans to conduct the separation work if the redevelopment does not proceed as anticipated.

F.5.3 Years 11-15

During years 11-15 the Town will continue its maintenance of GI installed under the proposed program.

The Town will review its water conservation ordinance(s) and determine if updates or additions could provide enhanced water conservation.

Provided the separation of the CS-005A drainage area has not been completed, the Town will conduct an assessment during Year 12 of the progress made by redevelopers to complete the work. If the developer is not scheduled to complete the separation work within the 20-year LTCP, the Town will begin the process of assuming the work themselves, which will consist of the following steps:

- Year 12 – Commence a feasibility study to determine a route for the new sewer. The study will likely consist of:

    - Collection of field and utility information
    - Site review and sampling for potential contamination
    - Alternatives for pipe routes
    - Preliminary pipe sizing
    - Property acquisition issues
    - Cost estimates
    - Community impacts
    - Permit identification
- Year 13 – Commence property acquisition and the necessary fieldwork such as survey for the detailed design process.
- Year 14 – Commence the detailed design process.
- Year 15 – Acquire necessary property or easements. Continue with detailed design process including funding and permitting

F.5.4 Years 16-20

During Years 16-20 the Town will continue its maintenance of GI installed under the proposed program.

The Town will review its water conservation ordinance(s) and determine if updates or additions could provide enhanced water conservation.

Provided the separation of the CS-005A drainage area has not been completed, the Town will continue its efforts to achieve the separation:

- Year 16 – Complete detailed design process
- Year 17 – Received bids and award construction contract.
- Years 18-20 – Construction of separate sewer system.
- Year 20 – Monitor system for 2 quarters and commence model recalibration.

F.5.5 Years 21-25

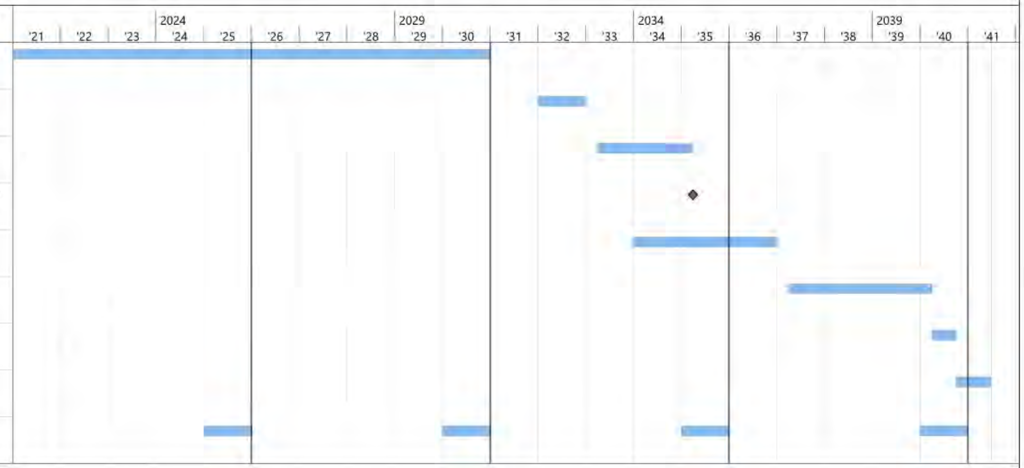
During Years 21-25 the Town will continue its maintenance of GI installed under the proposed program as well as the completed sanitary sewers, storm sewers and stormwater quality controls.

The Town will review its water conservation ordinance(s) and determine if updates or additions could provide enhanced water conservation.

- Year 21 – Complete collection system model calibration and performance verification. This will not only confirm the performance of the sewer separation, it will also provide an opportunity to assess if the GI installed as part of the LTCP is providing measurable benefits.

Harrison CSO LTCP
Implementation Schedule

ID	Task Name	Start	Finish	Duration
1	Green Infrastructure Program	01/01/2021	12/31/2030	10 y
2	Sewer Separation Feasibility Study	01/01/2032	12/31/2032	1 y
3	Property Acquisition Process	04/01/2033	03/31/2035	2 y
4	Acquire Property	03/31/2035	03/31/2035	Milestone
5	Sewer Separation Design-Funding-Permitting	01/01/2034	12/31/2036	3 y
6	Sewer Separation Construction	04/01/2037	03/31/2040	3 y
7	Post Construction Monitoring	04/01/2040	09/30/2040	2 q
8	Recalibrate model and verify LTCP performance	10/01/2040	06/30/2041	3 q
9	Review Water Conservation Ordinances(s)	Re-Occurring	Re-Occurring	1 y



Note: Start and Finish dates are approximate, and are provided to give an anticipated general time frame for projects.

Project: Harrison LTCP
Date: 09/21/2020

Task | Inactive Summary | Manual Summary Rollup | Finish-only | Deadline
Split | Manual Task | Manual Summary | External Tasks | Progress
Milestone | Duration-only | Start-only | External Milestone | Manual Progress

Page 1

Figure F-1: Harrison LTCP Implementation Schedule

F.6 BASES FOR LTCP DEVELOPMENT AND IMPLEMENTATION SCHEDULE

F.6.1 COVID-19 Impact Statement

The projections and conclusions concerning the affordability of the CSO control program proposed in this SIAR by the Permittee's financial capability to finance the CSO control program are premised on the baseline financial conditions of the Permittee as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

F.6.1.1 Potential Wastewater Utility Revenue Impacts

This Financial Capability Assessment cannot reflect the currently unknowable impacts on wastewater utility revenues stemming from the national economic upheaval resulting from the COVID-19 pandemic. It is however extremely likely that the Permittees, as well as municipal wastewater utilities in general across the United States will face significant and potentially permanent declines in revenues from households unable to pay their taxes and/or sewer bills and the sudden decline in industrial and commercial demands for wastewater treatment.
On March 20, 2020 the National Association of Clean Water Agencies (NACWA) issued a press release stating that:

> "*NACWA conservatively estimates the impact to clean water utilities nationwide of lost revenues due to coronavirus at $12.5 Billion. This is a low-end estimate, assuming an average loss of revenue of 20% which is well within the range of what individual utilities are already projecting. Some utilities are anticipating closer to a 30% or 40% loss in revenue. This estimate is based on the substantial historical utility financial data NACWA has on file through its Financial Survey and recent reports from NACWA members on the decrease in usage they are observing in their systems over the last few weeks."* NACWA press release: Coronavirus Impacting Clean Water Agencies; Local Utilities and Ratepayers Need Assistance March 20, 2020

The impact of a 20% to 40% revenue loss, along with increased costs that have been and will continue to be experienced by municipalities and wastewater utilities such as overtime and the writing off of customer accounts receivable, could have a profound impact on the affordability of the proposed CSO controls and the Permittee's ability to finance them.

Most of the costs of municipal and regional wastewater systems are relatively fixed within broad operating ranges. Debt service and other capital costs are fixed once incurred. Some operating costs are somewhat variable with wastewater flows, e.g. chemical and electrical power usage but these are relatively minor when compared to other fixed costs. Labor costs are not directly variable, e.g. a twenty percent reduction in billed flow would not result in a need for twenty percent less labor. Maintenance costs might go down slightly as equipment operating times may be lower, however maintenance costs are typically tied to set schedules and not necessarily to flow.

As costs do not decline proportionately to billed flow, it can be expected that user charge rates and/or taxes must be raised to generate sufficient revenue to sustain current operations. The relationship between changes in costs and revenues and the resultant changes in user charge rates is complex and has not yet been fully analyzed. At this point it can be assumed that user rate increases may be necessary to simply maintain current operations, and these rate increases will likely erode the financial capability of the Permittees to fund the CSO LTCP.

F.6.1.2 Potential Median Household Income Impacts

The impacts of the pandemic on median household incomes of the Permittees cannot be determined at this point. Historical analogies may provide some useful, albeit disturbing, context but are not presented as predictive:

- U.S. median household income fell by 6.2% from $53,000 in 2007 to $49,000 in 2010. In New Jersey, the MHI decreased by around 4.0% for the same period. Source: Fact Sheet: Income and Poverty Across the States, 2010 Joint Economic Committee, United States Congress, Senator Robert P. Casey, Jr. Chairman.
- The U.S. unemployment rates rose from 5.0% in December of 2007 to 9.9% in December of 2009. Source: Bureau of Labor Statistics data series LNS1400000
- Data on impacts of the Great Depression on median household income are not available. As a proxy, the personal income per capita data are available. For 1929 this was $700. By 1933 this figure bottomed out at $376, a decline of 46%. Unemployment for the same period rose from around 3.0% to 25%. Source: Federal Reserve Economic Data (FRED) data series: A792RC0A052NBEA

While a quantifiable assessment of the impact of the pandemic on median household income is not feasible at this time, reduction in base year MHI can be expected. This will further exacerbate the impacts of the revenue reductions described above on LTCP affordability, as higher base user charge rates will absorb an increased portion of lower MHI.

F.6.1.3 Implications for the Long Term CSO Control Program

The Permittees anticipate that the financial implications of the COVID-19 pandemic will continue to be reviewed and discussed with NJDEP during the review of the SIAR and as the 2021 – 2025 NJPDES permit is developed.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, the Permittees will be reticent to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this SIAR based on emergent economic conditions beyond the permittees' control. As detailed in Section F.5 of this Permittees' SIAR, these provisions could include scheduling the implementation of specific CSO control measures to occur during the five year NJPDES permit cycles. Although a complete implementation schedule is being proposed as part of this SIAR, a revised affordability assessment should be performed during review of the next NJPDES permit to re-evaluate and validate financial capability and to identify any revisions to the proposed controls that may or may not be are financially feasible during that next permit period.

F.6.2 Funding and Financing Plan

The Town will pursue multiple sources of funding for the LTCP. However, the bulk of the construction and thus the costs are over 10 years in the future. Given its long history and Federal and State backing the state revolving fund currently known as the I-Bank is expected to be available in some form for the duration of the LTCP. At this time no reasonable assessment can be made of additional funding opportunities such as grants. The goal of this funding analysis is to demonstrate the Town has a feasible means of funding the LTCP. Accordingly, this analysis will assume the LTCP will be funded through 20-year loans from the I-Bank, with loans closed annually for each year's expenses. It is possible that for years with smaller funding allocation the Town may fund those activities from the annual revenues. It is also possible that for higher outlay years the Town may elect a longer loan period such as a 30-year loan.

Note, this analysis projects historic trends into the future. Small variations in inflation and growth factors are magnified as they are compounded over long periods. The financing will need to be monitored and periodically reassessed and potentially adjusted as part of the adaptive management strategy to keep the project affordable.

The funding analysis made use of the inflation and income growth factors listed in the Financial Capabilities Assessment Memo attached as Appendix D. To evaluate the financing of the LTCP, the estimated capital, O&M and permit maintenance costs listed in Table F-1 were adjusted annually for inflation. The resulting capital costs and financing costs can be seen in Figure F-2, as can be seen the use of I-Bank funding dampens the high annual costs during construction. Following construction and completion of bond payment, the additional operations and maintenance costs of the LTCP will continue as can be seen in the years following 2040.

The impact on the average residential sewer bill and median household income was also assessed, see Figure F-3. As can be seen the average sewer bill will experience annual increases of up to 12.5% before dropping once the Town stops assuming additional debt to finance the LTCP. For the duration of the LTCP and through the amortization of the bonds, the residential household indicator remains under 2%. Ultimately, due to inflation exceeding income growth, the average sewer costs will exceed 2% of MHI, this is projected to happen until well after the LTCP has been completed and paid for.

The impact of the LTCP on average residential sewer bills is depicted in
Figure F-4. As can be seen the greatest differential in sewer bills with and without the LTCP is about 42% meaning that the average resident can expect their sewer bill to effectively go up by 42% as a result of the LTCP. This impact is not continuous rather it ramps during construction and then gradually declines as debt is retired and after the bonds are paid off, the average sewer

bill would only be 2% higher than without the LTCP. The 2% is the additional cost of maintaining the green infrastructure installed or funded as part of the LTCP.

When evaluating the LTCP financial impacts it is appropriate to consider not just the median household income. By definition, if the sewer bill is 2% of the median household income, for half the households the cost is higher than 2%. Accordingly, the income brackets used by the US Census were evaluated under 2019 conditions with an average sewer bill of $395 and in 2040 when the sewer bill is projected to be $1,525. As can be seen in Table F-2, approximately 790 households already pay more than 2% of their income for their sewer bill with some paying as high at 7.9%. For the same group, this will rise to 5.0% to 20% by 2040, and the number of households paying 2% or more of their income will rise to approximately 2080 households.

Table F-2: LTCP Financial Impact on Income Brackets

Year	2019				Year	2040		
Sewer Cost	$ 395				Sewer Costs	$ 1,525		
Income Bracket				Sewer Bill	Income Bracket			Sewer Bill
Low	High	Avg	Households	% MHI	Low	High	Avg	% MHI
$0	$10,000	$5,000	330	7.9%	$0	$15,000	$7,500	20%
$10,000	$14,999	$12,500	186	3.2%	$15,000	$23,000	$19,000	8%
$15,000	$24,999	$20,000	434	2.0%	$23,000	$38,000	$30,500	5.0%
$25,000	$34,999	$30,000	493	1.3%	$38,000	$53,000	$45,500	3.4%
$35,000	$49,999	$42,500	820	0.9%	$53,000	$76,000	$64,500	2.4%
$50,000	$74,999	$62,500	1,238	0.6%	$76,000	$114,000	$95,000	1.6%
$75,000	$99,999	$87,500	621	0.5%	$114,000	$152,000	$133,000	1.1%
$100,000	$149,999	$125,000	822	0.3%	$152,000	$227,000	$189,500	0.8%
$150,000	$199,999	$175,000	381	0.2%	$227,000	$303,000	$265,000	0.6%
$200,000	>$200,000	$200,000	297	0.2%	$303,000	>$303,000	$303,000	0.5%
Median Household		$63,600	5,622	0.6%			$96,500	1.6%

Source: US Census
Note: this analysis is based on projected expenses and other related permits costs and may differ from Table E-1 and Table E-2 which were based on a generic distribution of costs.

Based on this analysis the Town has the capacity to undertake the LTCP while maintaining its existing sewer system and wastewater treatment payments to PVSC. There is potential for much of the costs of LTCP to be borne by redevelopment, however, there is no guarantee. Periodically, the Town should review its finances to determine if conditions have changes which may impact the affordability of the proposed LTCP. If so, the issue should be brought the attention of the NJDEP and the schedule renegotiated.

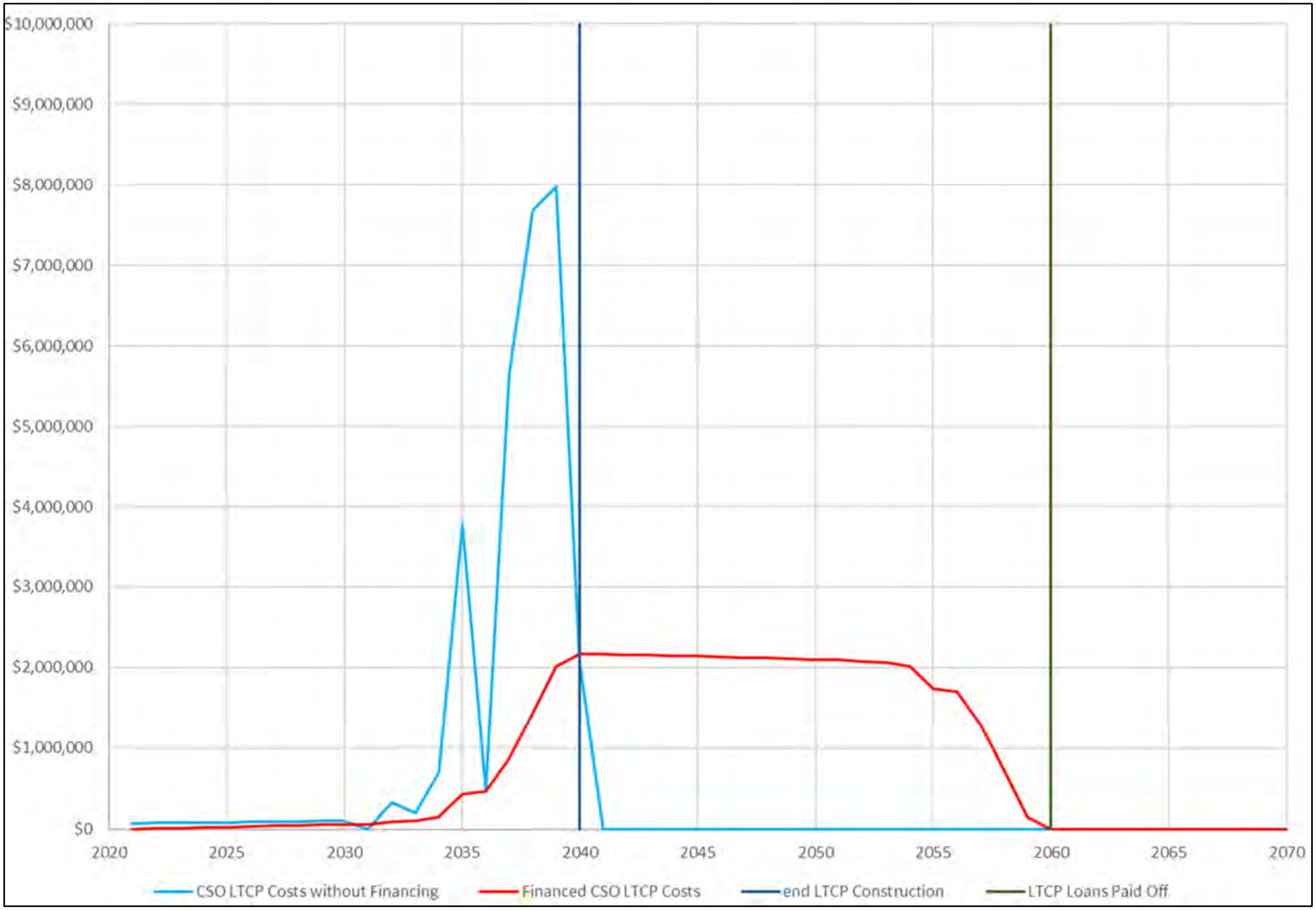


Figure F-2: LTCP Capital Costs and Financing Costs

Figure F-3: LTCP Sewer Rate Impact

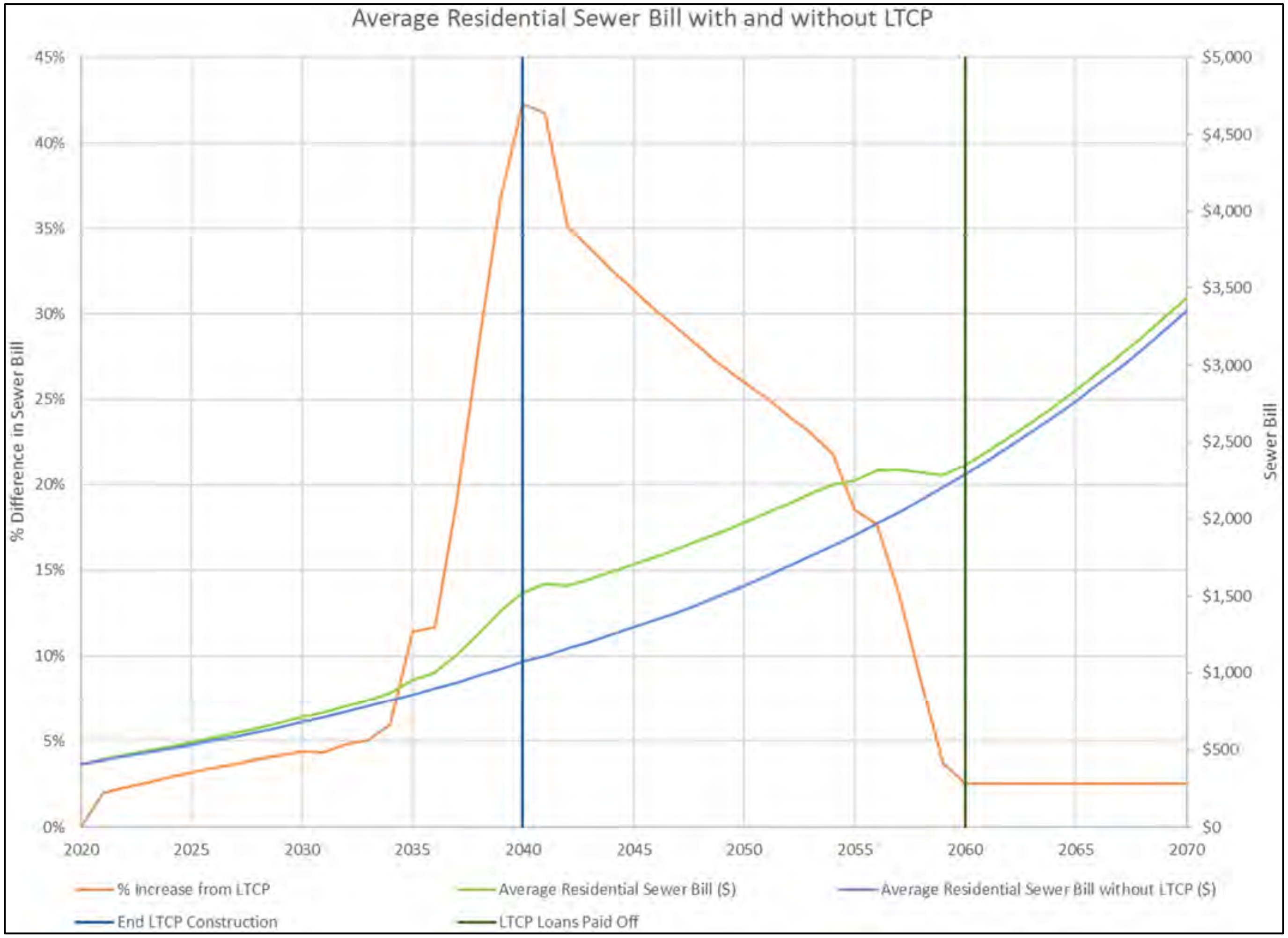


Figure F-4: Residential Sewer Bill with and without LTCP

F.7 CSO REDUCTION VERSUS TIME

The LTCP will take place over 20-years. The recommended LTCP is based on sewer separation and thus means that the CSO volume reduction benefits of the project will be experienced upon completion of the project and not incrementally over time. There will be some incremental benefits as the GI is brought online over the first 10-years of the project, however, the exact projects are not defined as a result, the benefit cannot be defined. Likely, there will be additional reductions from other system changes, particularly the replacement of the Fourth Street Venturi meter and increases to treatment rates at the PVSC WRRF. Upon completion of the separation there will be an 8.4 MG reduction in CSO volume for the typical year precipitation, see Figure F-5.

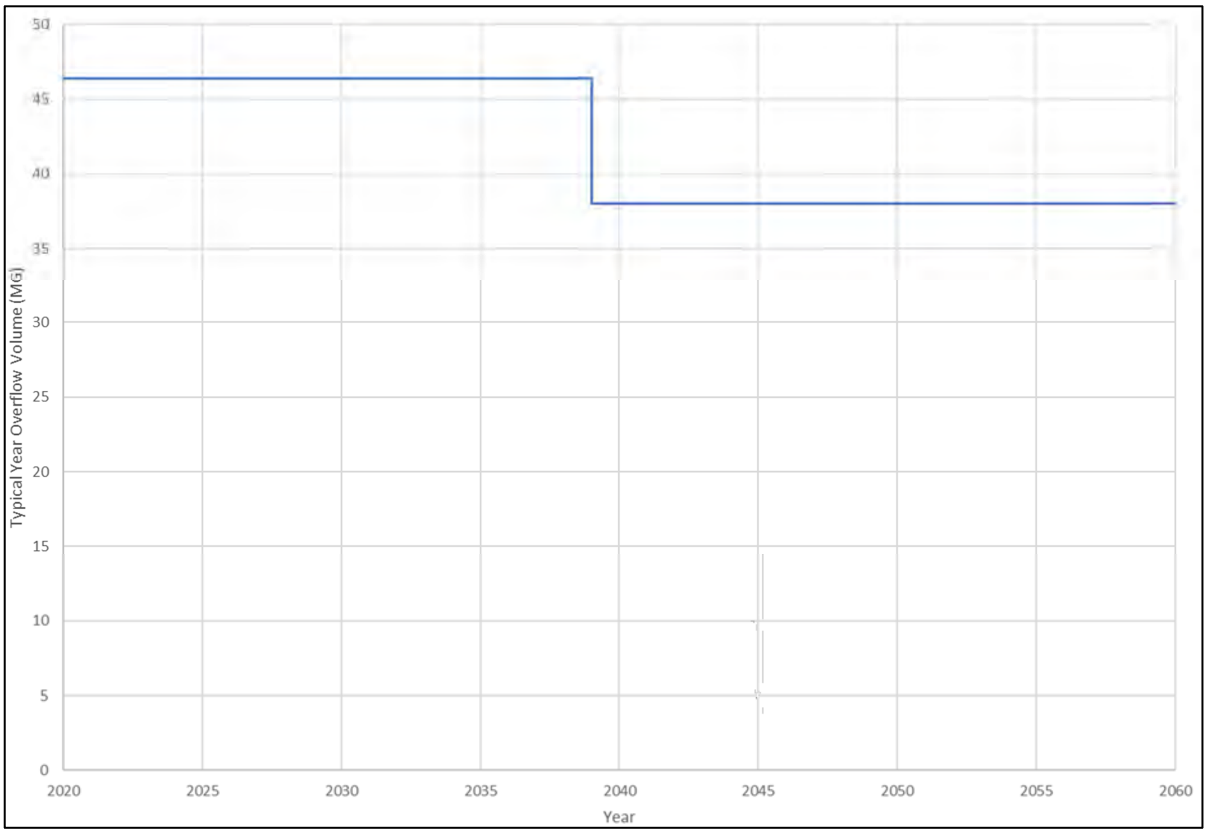


Figure F-5: Harrison Overflow Reduction with Respect to Time

F.8 ADAPTIVE MANAGEMENT PLAN

The Town is confident that the CSO control measures implemented prior to the post construction monitoring period will meet the 85% wet weather capture percentage Performance Criteria based on the simulation of the Typical Year (2004). However, should the post construction monitoring suggest the CSO control measures exceed the performance criteria or do not perform as anticipated, performance factors and deficiencies responsible for this exceedance or shortfall will be identified. Modified, reduced, or additional control measures will then be implemented to allow the Town to meet the 85% Performance Criteria. An Adaptive Management Plan shall be developed that details this analysis, including an implementation plan and schedule of the additional or reduced controls. This Adaptive Management Plan will include any adaptive management modifications based on Post- Construction Monitoring and evaluation. The Adaptive Management Plan shall be submitted to NJDEP, any required adaptive actions could then be included in the NJPDES Permit renewal, as applicable.

The Town intends to implement the components of the CSO LTCP using an adaptive management approach, in order to ensure that the Town's decision-making process and investments are in line with the financial environment, technological advances, and local support at the time. As additional data is obtained through activities such as flow monitoring, water quality monitoring, asset management analyses, and technology evaluation, this information will be used to refine future project planning, design, and implementation steps.

There are several factors that could affect the implementation schedule, which will require adaptive management to keep the implementation of the CSO projects on track. These include:

- Easements and land acquisition: The Town must be able to acquire (purchase) the property on which the facilities are sited or obtain permanent easements that will allow for maintenance, as well as potential future upgrades. Depending on factors such as the property owner (public, private, railroad, etc.), or the current or planned occupancy, the process of obtaining an easement or acquiring a property to site a project may have an impact on the implementation schedule.
- Permitting: The timeline to receive required permits can have a significant impact on the project schedule, particularly in areas where there are unique regulatory considerations such as Green Acres, flood hazard area, or wetlands. For example, green infrastructure implementation in existing green spaces may be impacted by Green Acres permitting projects, and sewer separation work may be subject to a lengthy permitting process requiring coordination between multiple permitting agencies or departments. If unforeseen circumstances related to permitting arise, the implementation schedule may need to be lengthened or project sequencing adapted accordingly. In addition, any future changes to environmental policy, such as potential treatment of stormwater discharges, is unknown at this time and increased regulatory requirements could impact the implementation of proposed projects.
- Public acceptance: Public acceptance refers to the degree to which community residents, businesses and institutions would be impacted or perceive the alternative to be favorable or unfavorable. The decision-making process and the components of the selected CSO control plan have been presented to the public throughout the development of the LTCP, including providing the public with several opportunities to comment and provide feedback. Even so, during implementation, new or renewed concerns may be introduced by the public, which could have an impact on project implementation. These concerns could include construction disturbance (traffic, noise, dust), visibility/aesthetics of the project and its fit into the surrounding community, impact to community spaces and cultural/historic resources, and considerations of environmental justice. Addressing these

concerns may require adaptation of project implementation, in terms of projects selected, project location, or construction methods.

- Environmental: There is significant uncertainty associated with the future potential impacts of climate change. Future conditions such as changes in precipitation patterns and sea level rise will impact the effectiveness of proposed CSO control projects. Current research on climate change impacts should be considered throughout the implementation schedule, and projects may be modified to consider these impacts, both to adjust capacities and ability to capture/treat CSO flows, as well as structural considerations to provide resiliency to potentially vulnerable infrastructure.
- Financial conditions: As demonstrated by the COVID-19 pandemic, financial situations can change dramatically in a short period of time. In general, if financial conditions change, the capital availability constraints will need to be identified and addressed, which may require changes to the implementation schedule. Implications specific to the COVID-19 pandemic are discussed in Section F.6.1.
- Financial capability assessment (FCA) guidance: In September 2020, the United States Environmental Protection Agency (EPA) announced its proposed 2020 Financial Capability Assessment guidance document, describing changes to the existing assessment to include additional considerations for economically disadvantaged communities. Updates to the EPA guidance may impact the affordability analysis, and in turn the LTCP implementation schedule presented. As such, elements of the LTCP may be revised in the future to incorporate the EPA's proposed approach.

The main components of the CSO LTCP implementation that are likely to be particularly impacted by the adaptive management approach are as follows:

- Changes in strategy or technology: The strategies and technologies available to address combined sewer overflows, and their associated costs, are constantly changing and evolving. Projects of the right type and size based on the best available information at the time should be implemented. If a new strategy is identified that achieves equal or better environmental benefits at a lower cost, then the plan should be adapted accordingly. The goal remains to provide the maximum benefit to the environment with the minimum impact to the citizens.
- Post-Construction compliance monitoring: The post-construction compliance monitoring (PCCM) is a continuous process to determine whether the CSO controls specified in the LTCP are meeting the regulatory requirements as planned (described further in Section F.9 of this report). Following the ongoing review of post construction performance data, the Town will evaluate the need for additional controls or revision of existing controls to meet WQS and will revise the LTCP to implement the appropriate controls.

The Town will consider multiple adaptive management actions for over- performing or under-performing CSO control measures, including eliminating or reducing the size of proposed facilities, revising technologies, or constructing infrastructure.

Additionally, the financial impacts of the recent SARS-CoV-2 virus Global Pandemic are yet to be fully realized and may not be fully realized for several years. These financial impacts may be due to several factors, which could be caused by a decrease in revenue or an impact on collection rates, among other items. The Town will continue to monitor these potential financial impacts and will include any negative impacts to their financial capability within the Adaptive Management Plan, which may include the need for a longer implementation schedule in order to reduce the financial burden as a result of lost revenue, a reduction in collection rates, or other financial factors.

Upon review and approval of the Adaptive Management Plan by the NJDEP, the Town will implement those measures in accordance with the schedule set forth in the Adaptive Management Plan.

F.9 POST CONSTRUCTION COMPLIANCE

F.9.1 Background

The Town is required under Section G.9 of its NJDPES permits to develop a compliance monitoring plan (CMP) that is “adequate to: verify baseline and existing conditions, the effectiveness of CSO controls, compliance with water quality standards, and protection of designated uses. This CMP shall be conducted before, during and after implementation of the LTCP and shall include a work plan to be approved by the Department that details the monitoring.”

The portion of the CMP conducted after implementation of the LTCP is specifically referred to as the Post Construction Compliance Monitoring Plan (PCCMP) and is the focus of this section. The monitoring plan proposed in this section satisfies the requirements of the Permittee’s NJDPES permits and is consistent with and informed by National CSO Control Policy and USEPA’s CSO Post Construction Compliance Monitoring Guidance, May 2012. The main elements of the PCCMP include the following:

- A process to determine whether the CSO control measures are meeting the Performance Criteria established in Section D.2.1.
- A monitoring schedule, regulator monitoring locations, receiving water sampling locations, and rain gauge locations.
- The approach for analysis of the PCCMP data for assessing the performance of CSO control measures and for reporting progress to regulatory agencies and the general public.
- A Public Notification System to notify the public of the occurrence of Combined Sewer Overflows for each receiving water body.

F.9.2 Overview of Approach

Upon completion of the CSO projects described in Section F.2, post-construction monitoring to evaluate the incremental reduction in overflow rates and volumes as CSO Control facilities are placed into operation. For the selected presumption approach, the National CSO Policy and the NJPDES Permit requires an 85% wet weather capture on an annual system wide basis for the Typical Year. It is anticipated that the Town will work with the NJ CSO Group to complete this work. Wet weather capture will be determined on a system wide basis using an updated H&H model that will be calibrated using post construction monitoring data and evaluated over the model Typical Year, which has been previously approved by the NJDEP. This is the performance criteria that will be used for the LTCP capital projects.

Post-construction monitoring is a requirement of the NJPDES Permit and the approach provided herein has been developed for the purposes of providing enough data to evaluate the effectiveness of the CSO control measures constructed during the implementation of the LTCP. The evaluation of the control measures will be based on the Performance Criteria established in Section D.2.1 and will be used to verify that Town is in compliance with their NJPDES Permit. The general scope of the PCCMP will include the implementation of a rainfall and hydraulic monitoring program, as well as a detailed analysis and evaluation of the CSO control measures' efficacy. The program will be conducted during the LTCP implementation to corroborate that the completed CSO control measures are performing effectively, while providing sufficient data to identify and remedy underperforming control measures.

Post construction monitoring will serve its role in demonstrating that CSOs will be reduced to the levels predicted in the recommended plan based on the typical year conditions to meet the CWA requirements. Pathogen loads, contributed by the remaining CSOs, based on post construction monitoring will be compared to non-CSO loads to the receiving waters estimated in the LTCP (or Baseline Compliance Monitoring Report previously approved by NJDEP). Any reductions in non-CSO loads as a result of then-current water quality compliance requirements in the receiving waters will also be considered. This information, as developed and made available during post construction monitoring, will be used to assess CSOs compliance with the current NJPDES Permit and WQS.

As rainfall varies substantially from year to year and from storm to storm, it will require normalizing rainfall to the typical year to assess performance. The same is true for receiving water monitoring where the variables include other pollutant sources that are also driven by wet weather conditions. For these reasons and in accordance with the CSO Policy, the LTCP is based on the 2004 "typical year" conditions as previously approved by the NJDEP.

F.9.3 Landside monitoring

It is anticipated that receiving water monitoring and modeling will be completed thru the NJ CSO Group, however similarly to the recently completed CMP landside monitoring and modeling for the Town will be conducted and the results incorporated into the existing InfoWorks ICM model. The Town will evaluate the performance of the control measures through use of the H&H model. The model output will be compared with actual CSO flow data for the post-construction monitoring period to determine whether recalibration of the H&H

model is needed. Once the H&H model has been determined to be adequately calibrated, a continuous simulation of the Typical Year (2004) will be run to compare the remaining CSO discharge volume to baseline conditions and determine whether the CSO control measures have achieved the Performance Criteria.

Periodically, progress towards the CSO reduction goals will be evaluated and if necessary, the LTCP revised to keep the project on track. The Town has scheduled system monitoring and allocated the estimated costs based on the overall LTCP schedule. It is assumed that the monitoring of the system and model recalibration will be based on a Quality Assurance Project Plan (QAPP) that will be approved by the NJDEP.

F.9.4 Receiving Water Monitoring

For the purposes of addressing the NJPDES Permit PCCMP ambient monitoring requirements, the Town plans to utilize water quality sampling data collected by the existing NJ/NY Harbor Dischargers Group sampling program to supplement the findings of the collection system modeling and to support the water quality modeling efforts, to be performed upon the implementation of all CSO control measures to verify that the remaining CSOs are not precluding the attainment of water quality standards for pathogens. For purposes of defining the implementation of all CSO control measures, implementation of all CSO Control measures is defined as the implementation of all projects by all NJ CSO Group Permittees.

F.9.5 Performance Assessment

To demonstrate compliance under the Presumption Approach, the Town Will continue to update and calibrate the H&H model after the implementation of CSO control measures and post-construction monitoring phase data has been collected. The model will be used to simulate CSS performance in the Town's system and to demonstrate compliance with the performance criteria identified, a minimum of 85% capture by volume of the system-wide wet weather volume during the Typical Year (2004). As may be required under future permits permittees will submit a series of milestone reports to the NJDEP detailing the implementation and performance of CSO control measures. An Adaptive Management Plan shall be developed in the event that CSO control measures exceed or do not meet the Performance Criteria.

SECTION G - REFERENCES

New Jersey Department of Environmental Protection. (2017). 2014 New Jersey Integrated Water Quality Assessment Report: Appendix B: Final 303(d) List of Water Quality Limited Waters with Sublist 5 Subpart and Priority Ranking for TMDL Development. Division of Water Monitoring and Standards, Bureau of Environmental Analysis, Restoration and Standards.

HDR. (June 2020) Calibration and Validation of the Pathogen Water Quality Model (PWQM) for the Passaic Valley Sewerage Commission.

Appendix A – Harrison TIDE Agendas, Minutes and Flyers

Harrison TIDE
Meeting Agendas and Minutes

Summary Table

Date	Agenda	Minutes	Highlights
01-10-19	X	X	• Discussion of rain gardens at Washington Middle School and the firehouse • Announcement of upcoming meetings on CSOs
02-14-19	X	X	• Discussion of plant selection for rain garden at Washington Middle School • Planning meeting on March 6 of Harrison, Kearny and East Newark residents to discuss CSOs • Announcement of upcoming meetings on CSOs and green infrastructure
04-11-19	X		• Updates on the rain gardens at Washington Middle School and the firehouse • Discussion of the public meeting on CSOs held on March 6
05-09-19	X	X	• Updates on the rain gardens at Washington Middle School – (maintenance agreement) and the firehouse (funding possibilities) • Promoting rain barrel workshop in Bayonne in May
06-13-19	X		• Updates on the rain gardens at Washington Middle School – (site visit by PVSC) and the firehouse (funding possibilities) • Discussion of draft "Development and Evaluation of Alternatives Report" • Report on Supplemental CSO Team meeting held on May 28
11-14-19	X		• Updates on the rain gardens at Washington Middle School and the firehouse • Report on Supplemental CSO Team meeting held of July 31 • Discussion of NJDEP's comments on the submitted "Development and Evaluation of Alternatives Report" and of the responses to the comments
12-12-19	X		• Updates on the rain gardens at Washington Middle School and the firehouse
03-18-20		X	• Updates on the rain gardens at Washington Middle School and the firehouse • Discussion of maintenance needs of the rain garden at the library • Discussion of the Long-Term Control Plan

AGENDAS

Transforming Infrastructure & Defending our Environment

Harrison TIDE Meeting
Thursday, January 10, 2019, 2pm – 3pm
Mayor's Conference Room, 318 Harrison Ave

Meeting Agenda

GI Projects:

- Washington Middle School project – school input on design plan (Mike, Steven)
- Firehouse project – design plan feedback (Group)
- Public library rain gardens – sign design (Lou)
- Future projects – public parks (Group)

Community outreach:

- PTA meeting presentation in Feb/March
- Public meeting – forum with Harrison, Kearny and East Newark to discuss CSOs
    - Location at Harrison HS
    - CSOs, what it means, Long Term Control Plan, focus on basics
    - Reach out to Paul to speak at meeting

CSO LTCP update/discussion:

- Next Supplemental CSO Team meeting – Tuesday, Jan. 22 – East Newark
- Next CSO group meeting at PVSC – Tuesday, Jan. 22

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- NJ Future Redevelopment Forum: Friday, March 8th at the Hyatt Regency in New Brunswick

Harrison TIDE Meeting
Thursday, February 14, 2019, 2pm – 3pm
Mayor's Conference Room

Meeting Agenda

GI Projects updates:

- Washington Middle School
- Firehouse
- Public library

Community outreach:

- PTSO meeting presentation – Wed., March 6th 6:00pm-7:00pm
- Finalize event details – agenda, presentations, flyers, etc.

CSO LTCP updates:

- Last Supplemental CSO Team meeting held on Tues., Jan. 22nd in East Newark
- Last CSO group meeting held on Thurs., Feb. 7th at PVSC
- Next Supplemental CSO Team meeting – tentatively scheduled for early March
    - Venue TBD
    - Permittees to present their alternatives to the group
- Mid-May Supplemental CSO Team meeting
    - Venue TBD
    - Preview of Evaluation of Alternatives Report by PVSC consultants

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- Rutgers/PVSC "GI Planning and Implementation Workshop" – Tues., March 19th 6:00pm-8:00pm at the Montclair Fire Department Headquarters, Montclair Community Room, 1 Pine Street, Montclair, NJ 07042

TIDE HARRISON
Transforming Infrastructure & Defending our Environment

Harrison TIDE Meeting
Thursday, April 11, 2019, 2pm – 3pm
Mayor's Conference Room

Meeting Agenda

Project updates:
- Washington Middle School
- Firehouse - funding
- Public library – sign/maintenance

Community outreach:
- West Hudson Forum – comments/discussion

Group discussion:
- 1st quarter achievements
- 2nd quarter goals/objectives

CSO LTCP updates:
- Last Supplemental CSO Team meeting held on Thurs., March 7th in Newark
    - Permittees presented to group on alternatives considered
- Last CSO group meeting held on Thurs., April 4th at PVSC
    - Baseline Compliance Monitoring Report approved by NJDEP
    - Identification of Sensitive Areas Report approved by NJDEP
- Next Supplemental CSO Team meeting mid-May
    - Further update on alternatives considered
- June Supplemental CSO Team meeting
    - Preview of Evaluation of Alternatives Report by PVSC consultants

Media:
- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:
- Next TIDE meeting May 9th
- Bayonne rain barrel workshop May 22nd

Harrison TIDE Meeting
Thursday, May 9, 2019, 2pm – 3pm
Mayor's Conference Room

Meeting Agenda

Project updates:
- Washington Middle School
    - Draft maintenance agreement - John
    - Schedule site visit - John
- Firehouse – funding - Rocco
- Public library – sign - Lou

Group discussion:
- Goals/objectives – Keep current projects moving forward!
- Future meeting schedule
- Flood Defense Act – "rain tax"

Media:
- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:
- Next TIDE meeting June 13th
- Bayonne rain barrel workshop May 22nd
- Next Supplemental CSO Team meeting May 28th
- North Bergen Health & Green Family Festival June 1st
- Newark Recycling Summit June 19th

TIDE HARRISON
Transforming Infrastructure & Defending our Environment

Harrison TIDE Meeting
Thursday, June 13, 2019, 2pm – 3pm
Mayor's Conference Room

Meeting Agenda

Project updates:
- Washington Middle School
    - PVSC/Rutgers site visit June 18th
- Firehouse – funding - Rocco
- Public library – sign - Lou

Group discussion:
- Goals/objectives – Keep current projects moving forward!
- Future meeting schedule - July/August meetings
- Draft of Evaluation of Alternatives Report – comments by June 21st

CSO LTCP updates:
- Last Supplemental CSO Team meeting held on Tues., May 28th in Bayonne
    - Harrison and Newark presented to group on alternatives considered
    - Breakout session and polling questions
    - Next CSO Group meeting at PVSC Thurs., June 20th
    - Next Supplemental CSO Team meeting – July - venue TBD

Media:
- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:
- Next TIDE meeting September 12th
- Newark Recycling Summit June 19th
- Jersey Water Works Membership Meeting Thurs., July 11th – American Water Headquarters, Camden, NJ

TIDE HARRISON
Transforming Infrastructure & Defending our Environment

Harrison TIDE Meeting
Thursday, November 14, 2019, 2pm – 3pm
Mayor's Conference Room

Meeting Agenda

Project updates:

- Washington Middle School – Matt
- Firehouse – funding - Rocco
- Public library – sign - Lou

Group discussion:

- Goals/objectives – Keep current projects moving forward!

CSO LTCP updates:

- Last Supplemental CSO Team meeting held on Wed., July 31st in Newark
    - Next CSO Group meeting at PVSC Thurs., November 21st
    - Next Supplemental CSO Team meeting – TBD Dec.? Dec 13th ? 6p
    - July 1, 2019 – submitted Development and Evaluation of Alternatives Report to NJDEP
    - Sept. 25, 2019 – NJDEP commented on Report in a series of letters to permittees
    - Nov. 22, 2019 – modified Report to address comments made by NJDEP
    - June 1, 2020 – Selection and Implementation of Alternatives for the final LTCP

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- Next TIDE meeting December 12th
- Jersey Water Works Conference Fri., December 13th – Hyatt Regency , New Brunswick, NJ

Harrison TIDE Meeting
Thursday, December 12, 2019, 2pm – 3pm
Mayor's Conference Room

Meeting Agenda

Project updates:

- Washington Middle School – Matt
- Firehouse – funding - Rocco
- Public library – sign - Lou

Group discussion:

- Goals/objectives – Keep current projects moving forward!

CSO LTCP updates:

- Last Supplemental CSO Team meeting held on Wed., July 31st in Newark
- Next CSO Group meeting at PVSC – Thurs., Jan. 2, 2020 (permittees)
- Next Supplemental CSO Team meeting – Thurs., Jan. 9, 2020, Harrison High School, 401 Kingsland Ave., Harrison, NJ 07029, 5:30pm – 8:00pm (public)
    - July 1, 2019 – submitted Development and Evaluation of Alternatives Report to NJDEP
    - Sept. 25, 2019 – NJDEP commented on Report in a series of letters to permittees
    - Nov. 22, 2019 – modified Report to address comments made by NJDEP
    - June 1, 2020 – Selection and Implementation of Alternatives for the final LTCP

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- Next TIDE meeting January 9th (tentative)
- Jersey Water Works Conference Fri., December 13th – Hyatt Regency , New Brunswick, NJ

MINTUES

TIDE HARRISON
Transforming Infrastructure & Defending our Environment

Harrison TIDE Meeting
Thursday, January 10, 2019, 2pm – 3pm
Mayor's Conference Room, 318 Harrison Ave

<u>Meeting Notes</u>

Actions Items:
- Confirm date of community forum (Mo)
- Put together flyer for community forum (Mo/Lou)
- Provide draft sign at next meeting (Lou)
- Provide school with plant list to select rain garden plants (Matt)
- Determine details for outdoor classroom/greenhouse (Matt/John)
- Send Paul invite to basecamp

GI Projects:
- Washington Middle School project
  - Renderings shown and added to basecamp
  - Estimated rain garden cost: $5,300
  - Paul may be able to help with materials
  - Matt to provide school with plant list to allow students to select plants
- Firehouse project
  - Rough cost estimate: $30,000
  - Rocco out of funding currently
  - Other possible funding sources
    - 319(h)
    - NJ Infrastructure group (typically funds larger projects, would need to be lumped with other projects)
- Public library rain gardens
  - Lou still working on sign, should have something for next meeting
- Future projects – public parks (Group)
  - Possible opportunity on 9 acres of land along river bank being redeveloped at park land
  - Revisit sites in Feasibility Study

Community outreach:
- West Hudson Community Forum – forum with Harrison, Kearny and East Newark to discuss CSOs

- Location at Harrison HS after PTA meeting
- March 7th, 7:00-8:30 PM (tentatively, Mo to confirm)
- East Newark on board, Mo to follow up with Kearny to confirm
- Mo to put together flyer and send to Lou to revise
- Put together printed materials for meeting
- Lottery for a rain barrel
- Lions Club to provide coffee and cake
- Presentation (45 min + 15min Q&A)
  - CSOs (PVSC)
  - State of the River (Liz)
  - Hope for the River
  - What you can do
- Break-out Sessions (30 min)
  - Print outs of municipality with sewersheds to identify flooding areas
  - Fill out index cards of issues important to residents

CSO LTCP update/discussion:

- Next Supplemental CSO Team meeting – Tuesday, Jan. 22 – East Newark
- Next CSO group meeting at PVSC – Tuesday, Jan. 22

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- NJ Future Redevelopment Forum: Friday, March 8th at the Hyatt Regency in New Brunswick

Next Meeting: 2-3PM on Thursday, February 14th

Harrison TIDE Meeting
Thursday, February 14, 2019, 2pm – 3pm
Mayor's Conference Room, 318 Harrison Ave

Meeting Minutes

Attendees: Mayor James Fife, Rocco Russomanno (Harrison), Moriah Kinberg (NJ Future), Lou Lambe (Lion's Club), John Pietrykoski (PVSC), Matthew Leconey (Rutgers WRP), Paul Lerin (Friends of the Passaic River)

Actions Items:

- Put together flyer for community forum (Mo/Lou)
- Put together presentation and materials for community forum
- Schedule conference call week before community forum (John)
- Work on draft sign for Harrison Library RGs (Lou)
- Provide Washington Middle School with plant list to select rain garden plants (Matt)
- Determine details for outdoor classroom/greenhouse (Matt/John)

GI Projects: (No updates)

- Washington Middle School project
- Firehouse project
- Public library rain gardens

Community outreach:

- West Hudson Community Forum – forum with Harrison, Kearny and East Newark to discuss CSOs
    - Location at Harrison HS before PTA meeting
    - Wed., March 6th, 6:00-7:00 PM
    - Mo to put together flyer and send to Lou to revise
    - Put together printed materials for meeting
    - Lottery for a rain barrel (Lou organizing)
    - Lions Club to provide coffee and cake
    - Presentation
        - Opening [5min]
        - CSOs (PVSC) [10min]

        - State of the River (Liz) [10min]
        - Hope for the River (Paul) [10min]
        - Karny AWAKE [10min]
        - Q&A [15min]

    - Break-out Sessions (30 min)
        - Print outs of municipality with sewersheds to identify flooding areas
        - Paul to run "Match Game," fill out index cards of issues important to residents and prioritize them
        - Outreach tables for each group
            - TIDE, AWAKE, PVSC, NJ Future, Rutgers, NJ/NY HEP, Statewide Sewage Free Campaign, Friends of Passaic River

CSO LTCP update/discussion:

- Last Supplemental CSO Team meeting held on Tues., Jan. 22nd in East Newark
- Last CSO group meeting held on Thurs., Feb. 7th at PVSC
- Next Supplemental CSO Team meeting – tentatively scheduled for early March
    - Venue TBD
    - Permittees to present their alternatives to the group
- Mid-May Supplemental CSO Team meeting
    - Venue TBD
    - Preview of Evaluation of Alternatives Report by PVSC consultants

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- NJ Future Redevelopment Forum: Friday, March 8th at the Hyatt Regency in New Brunswick
- Rutgers/PVSC "GI Planning and Implementation Workshop" – Tues., March 19th 6:00pm-8:00pm at the Montclair Fire Department Headquarters, Montclair Community Room, 1 Pine Street, Montclair, NJ 07042

Next Meeting: 2-3PM on Thursday, April 14th

TIDE HARRISON
Transforming Infrastructure & Defending our Environment

Harrison TIDE Meeting
Thursday, May 9th, 2019, 2pm – 3pm
Mayor's Conference Room, 318 Harrison Ave

Meeting Minutes

Attendees: Mayor James Fife, Rocco Russomanno (Harrison), John Pietrykoski (PVSC), Matthew Leconey (Rutgers WRP), Paul Lerin (Friends of the Passaic River)

Project updates:

- Washington Middle School
  - Draft maintenance agreement
    - John to work with school to put together
  - Schedule site visit
    - John, Matt, and Brian Davenport (PVSC) to schedule meeting at school to go over project
- Firehouse – funding
  - Rocco to review plans and look at possible funding
- Public library – sign
  - Lou to finish working on sign design

Group discussion:

- Goals/objectives
  - Keep current projects moving forward!
  - Think about how to get more people to attend meetings/public outreach
- Future meeting schedule
  - Decided to skip some of the meetings for the summer unless needed
- Flood Defense Act (Stormwater Utility Fee)
  - Discussed the possibility of how this could be implemented and how it has been done in other places

Media:

- NJ Future Green Infrastructure Municipal Toolkit website https://gitoolkit.njfuture.org/
- Sewage-Free Streets and Rivers campaign website https://sewagefreenj.org/
- Clean Waters, Healthy Neighborhoods website https://www.njcleanwaters.com/
- NJDEP Division of Water Quality website https://www.nj.gov/dep/dwq/cso.htm

Upcoming Events:

- Next TIDE meeting June 13th
- Bayonne rain barrel workshop May 22nd
- Next Supplemental CSO Team meeting May 28th
- North Bergen Health & Green Family Festival June 1st
- Newark Recycling Summit June 19th

Next Meeting: 2-3PM on Thursday, June 13th

Harrison TIDE Meeting
Wednesday, March 18th, 2020, 11am – 12pm
Conference Call

Meeting Minutes

Attendees: Patricia Lopes (PVSC), Gregory Alber (PVSC), Mo Kinburg (NJ Future), Lou Lambe (Lion's Club), Rocco Russomanno (Harrison), Mattew Leconey (Rutgers WRP)

Project updates:

- Washington Middle School
  - Rocco to get update from Mike about Washington Middle School
- Harrison Library
  - Needs some TLC. Matt will send Lou most up to date plant info for maintenance and can assist with identifying before next Harrison TIDE meeting
  - Lou will work on sign, frame inside library
- Fire House
  - Rocco to look to see if there are fund he can allocate to get project going

Long Term Control Plan:

- Long Term Control Plan (Rocco gave updates)
  - Extensive discussions are being had between an individual municipality or regional approach
  - 2-3 weeks ago a meeting of mayors discussed individual or regional approach
  - Greeley and Hansen sharing with Mott McDonald back and forth to see the benefits in cost. Issues with data caused some delay.
  - Regional approach. Parallel interceptors (Harrison, East Newark Karney), Storage Tanks in other municipalities. Green Infrastructure incorporated into plan, but the degree of which is unclear.
  - Savings may be better on regional case, but requires mayor's to decide and come to agreements
  - Do these match the DEAR report?
    - Greeley and Hansen took report, and created regional report in collaboration with municipality consultants
      - Plant upgrades to accept additional flow, need to get the additional flow there.
      - For Harrison: parallel interceptor (~80%), tank for other CSOs, some GI
      - Includes elements that only work on regional scale, incorporated into

        - Some questions/concerns with regional approach
            - How does O&M work with this?
            - If one falls out of compliance, how does it affect the group
    - Draft plan available in April?
        - Depends on governing bodies to decide, likely delayed until then
    - Mott McDonald proceeding for Harrison as if doing individually as precaution
- Public outreach
    - Any done on these regional alternatives.
    - Will public be surprised? Is there anything the public should know about this approach that hasn't been discussed?

Possible change to regular meeting time:

- Suggested Thursday, 2:30-3:30 PM

Next Meeting (Time tentative based on Mayor's office): 2:30-3:30 PM on Thursday, April 9th

Appendix B –Town Council Meeting Presentation Slides

November 12, 2019 Meeting

June 30, 2020 Meeting

MOTT MACDONALD

Town of Harrison Development and Evaluation of Alternative Controls

Town Caucus Meeting

November 12, 2019

Town of HARRISON

1

Alternatives Evaluation Overview

- Review of Prior Meeting (March 12, 2019)
- System Overview
- Alternatives Analysis
  - Available Space Analysis
  - Required Alternatives
  - Cost and Performance
- Next Steps

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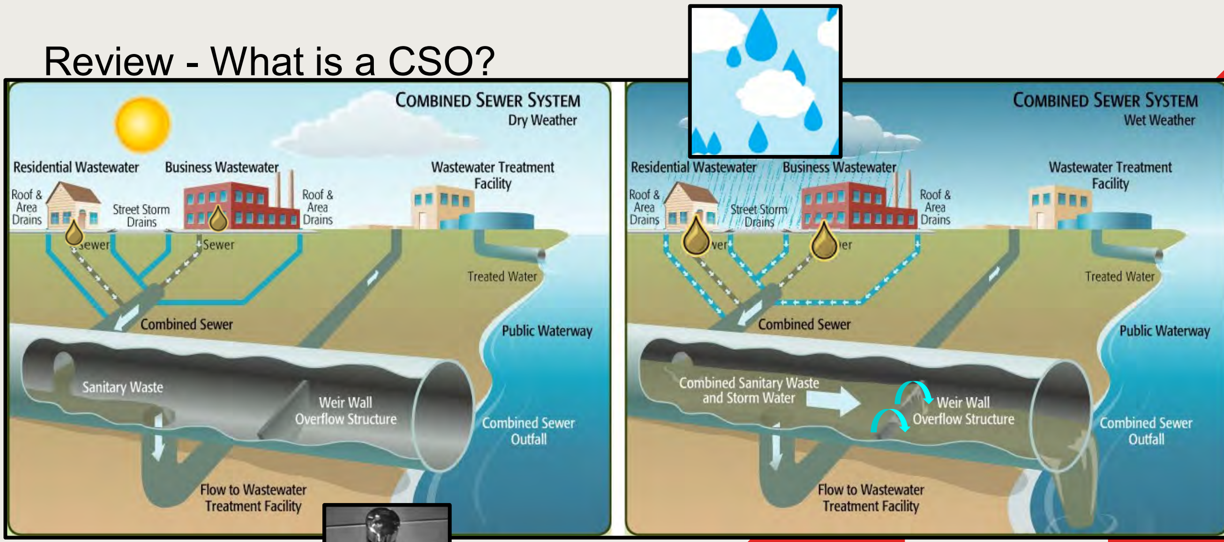
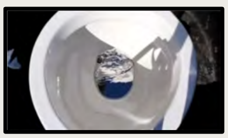
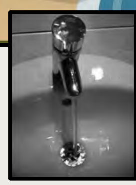
2

Review - What is a CSO?







3

Regulatory Background

1994: US EPA issues *National CSO Control Policy*

1995: NJDEP regulates all CSO discharges under General Permit for combined sewer systems

1998-2000: Town addresses Solids/Floatables Control Facilities and Nine Minimum Controls

2004-2007: Initial System Characterizations & Cost and Performance Analysis Work for LTCP

2015: NJDEP issues Individual NJPDES permits

2020: LTCPs must be submitted to NJDEP

- Development of **Long Term Control Plans (LTCP)** per EPA National CSO Control Policy
- Regional coordination: PVSC CSO Group
- Other permit conditions for system operation and maintenance and reporting
- 5-year permit cycle

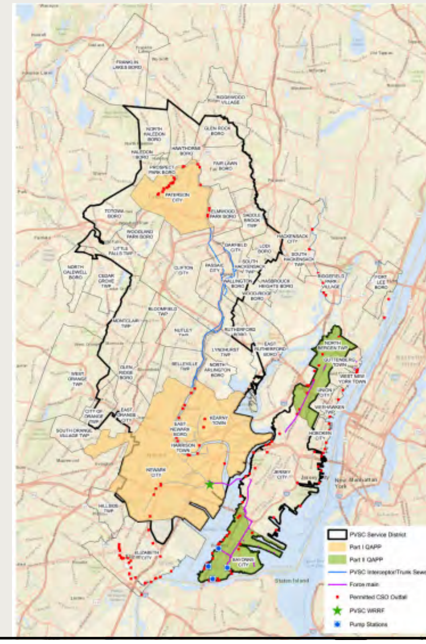
November 2019

4

4

Review – PVSC's hydraulically Connected System

- Passaic Valley Sewerage Commission (PVSC) manages wastewater treatment for 48 municipalities within Bergen, Essex, Union, and Passaic Counties.
  - ~1.5 Million People
  - ~150 square miles
- 8 Combined sewer municipalities
  - Harrison
  - Newark City
  - East Newark Borough
  - Kearny Town
  - Paterson City
  - Jersey City
  - Bayonne
  - North Bergen



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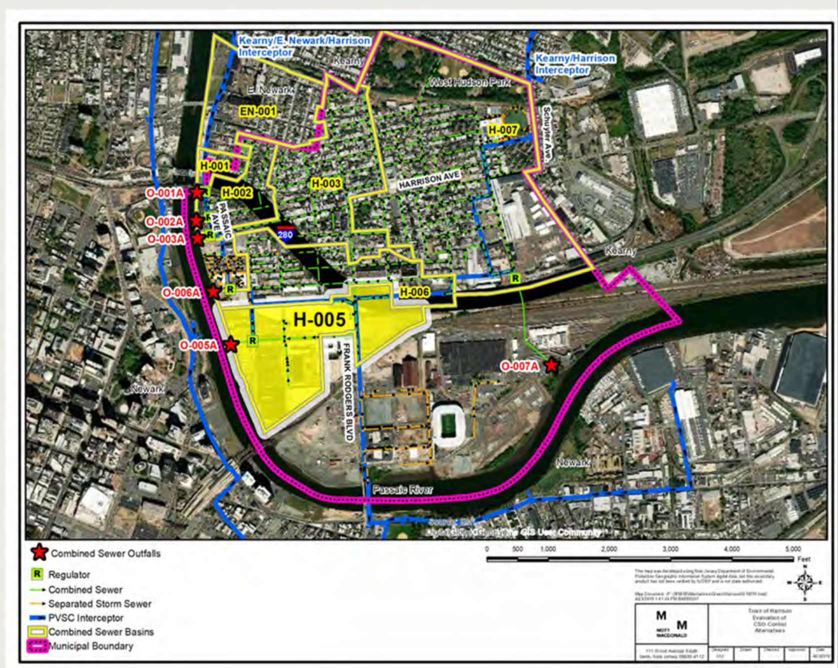
5

Harrison Outfalls

- Outfall 004A – Eliminated
- Outfall 005A – To be Eliminated
- Remaining Outfalls
  - 001A
  - 002A
  - 003A
  - 006A
  - 007A



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Combined Sewer Overflow Existing Conditions Typical Year Performance

2004
NJDEP approved Typical Hydrologic Year

48.4”
Total rainfall depth in 2004 Typical Year

61.5
Million gallons per year Total combined sewer overflow volume Town-wide

53
Total number of overflow events Town-wide

73
Storm events in 2004 Typical Year with greater than 0.1” of rainfall

3,000
Million gallons per year Total combined sewer overflow volume PVSC System-wide

42.8
Million gallons overflow once H-005 is separated

52
Total number of overflow events Town-wide, once H-005 is separated

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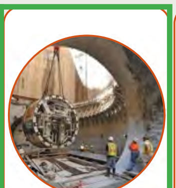
Alternative Evaluation

Range of Alternatives

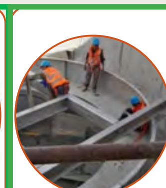

Green Infrastructure


Storage


PVSC
Treatment Plant Expansion


Infiltration / Inflow Reduction


Sewer Separation


End-of-Pipe Treatment


PVSC
WWTP Bypass

Range of alternatives, different levels of control, numerous combinations

8

8

Control Approach Options for Permit Compliance

Option 1
Presumption Approach

a) Reduce number of overflows system-wide to no more than 4 per year
b) Capture no less than 85% of annual overflow volume
c) Remove pollutant mass equivalent to 85% volume capture

Option 2
Demonstration Approach

a) Show that control level will meet or not prevent attainment of water quality criteria
b) Uses water quality modeling data

- Evaluated range of control levels for demonstration approach (0, 4, 8, 12, and 20 overflows per year and 85% capture)
- Analysis based on 2004 precipitation record as typical year

City Council Presentation 9 November 2019

9

Available Space Analysis

Objective: Identify potential sites for storage or end-of-pipe treatment

GIS Analysis

Aerial Imagery, Sewer Facilities (pipes, outfalls, etc.), Land Use/Cover, Parcel Data, Contours, Contaminated Sites

Site Considerations

What is on the site?
What is the site use for?
Who owns the property?
How close is it to the outfall?
Is the soil potentially contaminated?

CSO - 005

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Green Infrastructure

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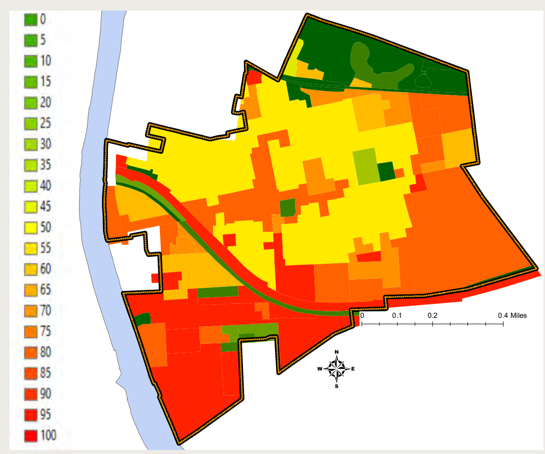
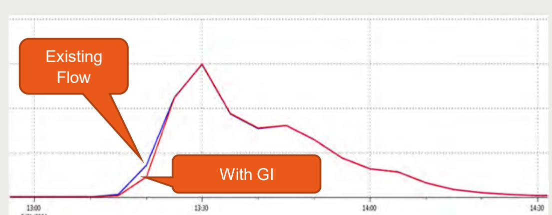
Green Infrastructure

- Maximum % of impervious that can be treated by GSI?
- Evaluate 2.5%, 5%, 7.5%, 10% and 15% of directly connected impervious. (2.7% max obtainable)
- Minimal benefits
- $5.8M-$35M
- $58 – $70 per gallon CSO removed.





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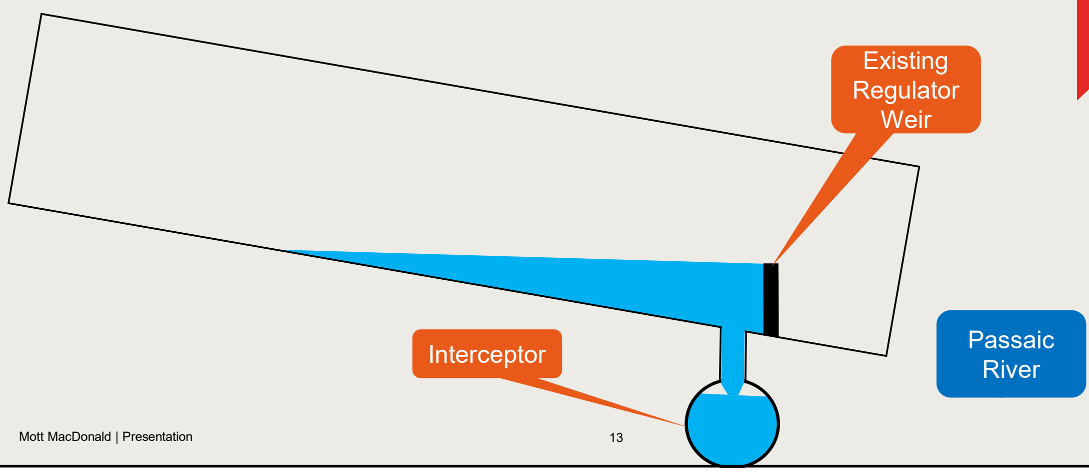
12

Inline Storage

Existing Inline Storage

Maximize inline storage capacity



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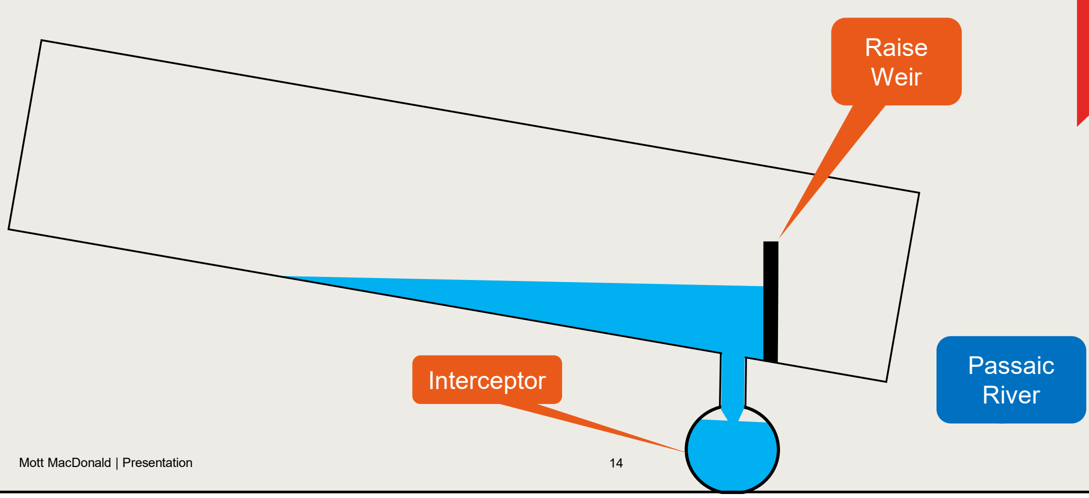
Inline Storage

Existing Inline Storage

Maximize inline storage capacity



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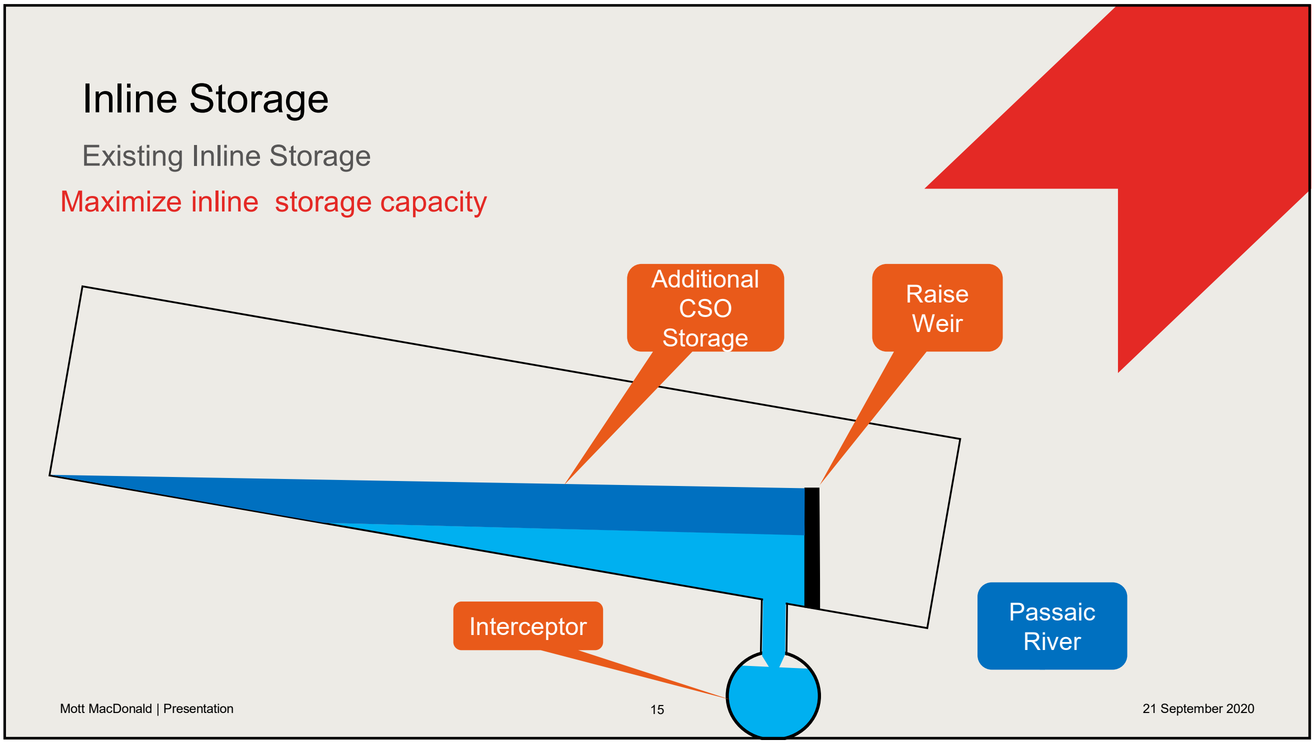
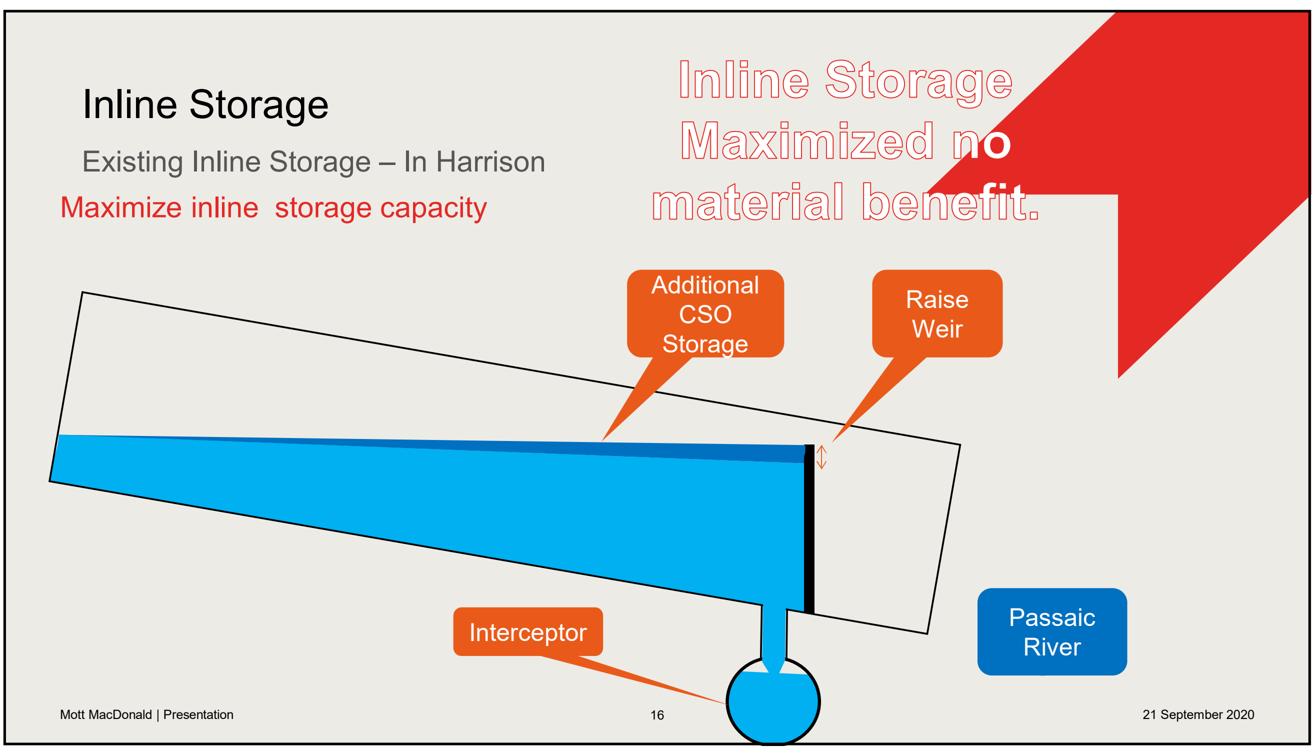

Inline Storage
Existing Inline Storage
Maximize inline storage capacity
Additional CSO Storage
Raise Weir
Interceptor
Passaic River
Mott MacDonald | Presentation
15
21 September 2020

15


Inline Storage
Existing Inline Storage – In Harrison
Maximize inline storage capacity
Inline Storage Maximized no material benefit.
Additional CSO Storage
Raise Weir
Interceptor
Passaic River
Mott MacDonald | Presentation
16
21 September 2020

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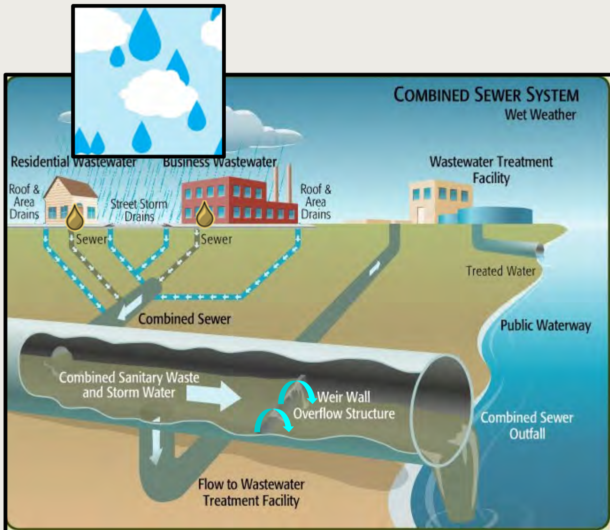
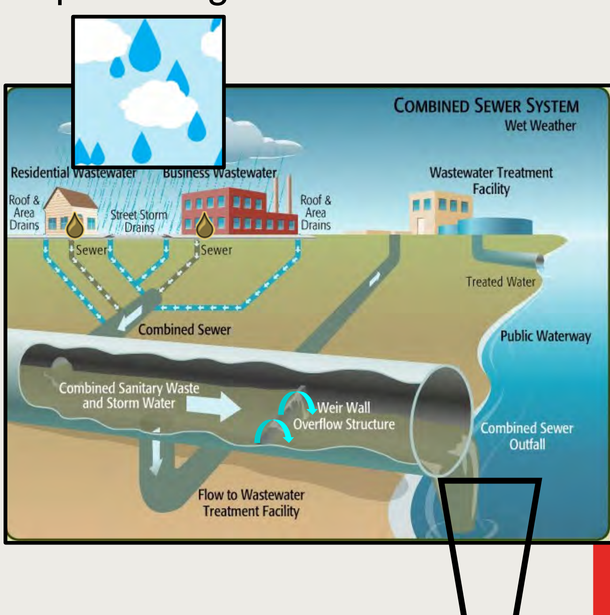
End of Pipe Storage



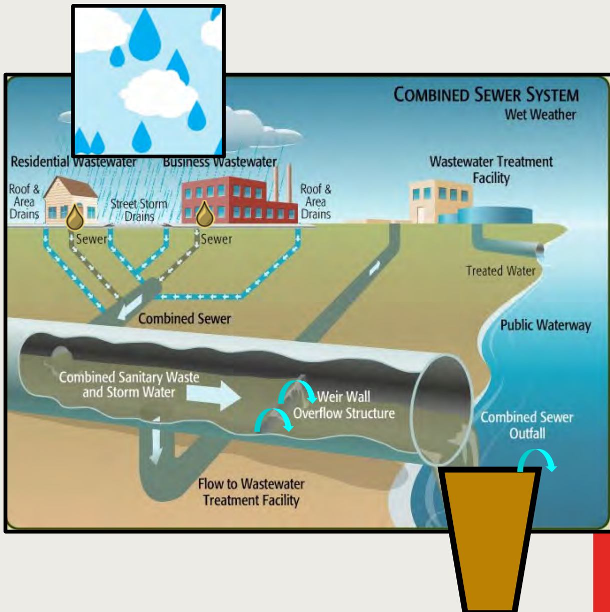
17

End of Pipe Storage



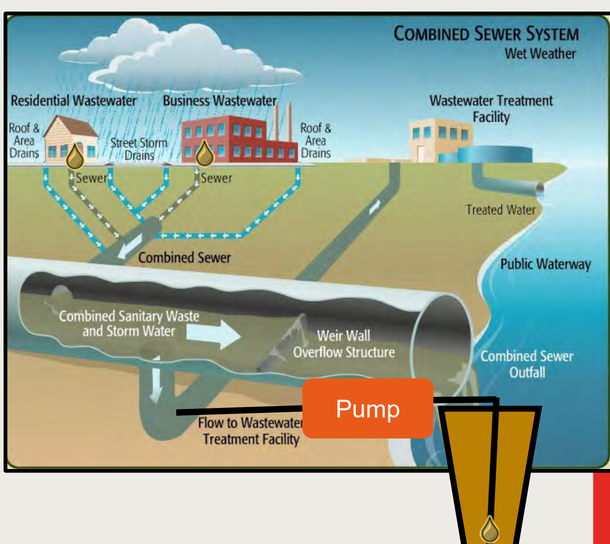
18

End of Pipe Storage



19

End of Pipe Storage



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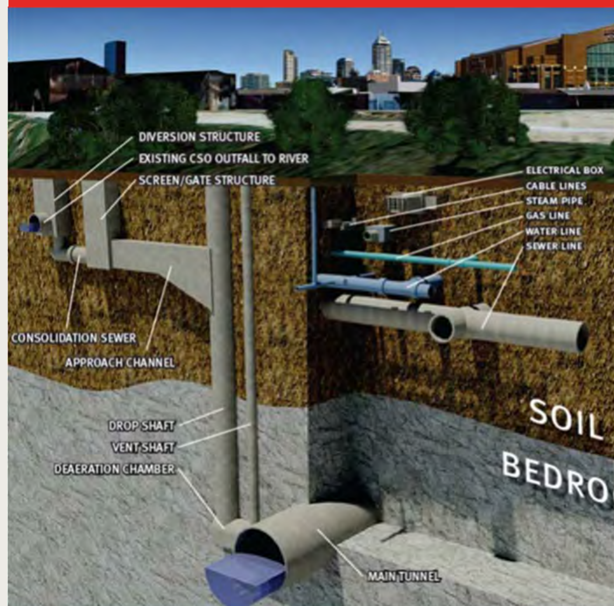
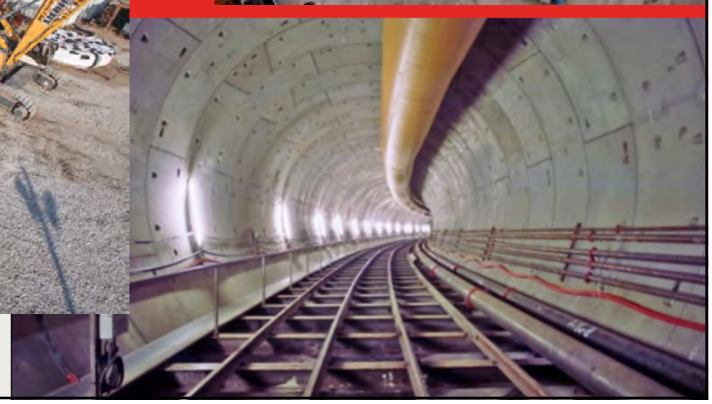
Tunnel Storage



21

Tunnel Storage



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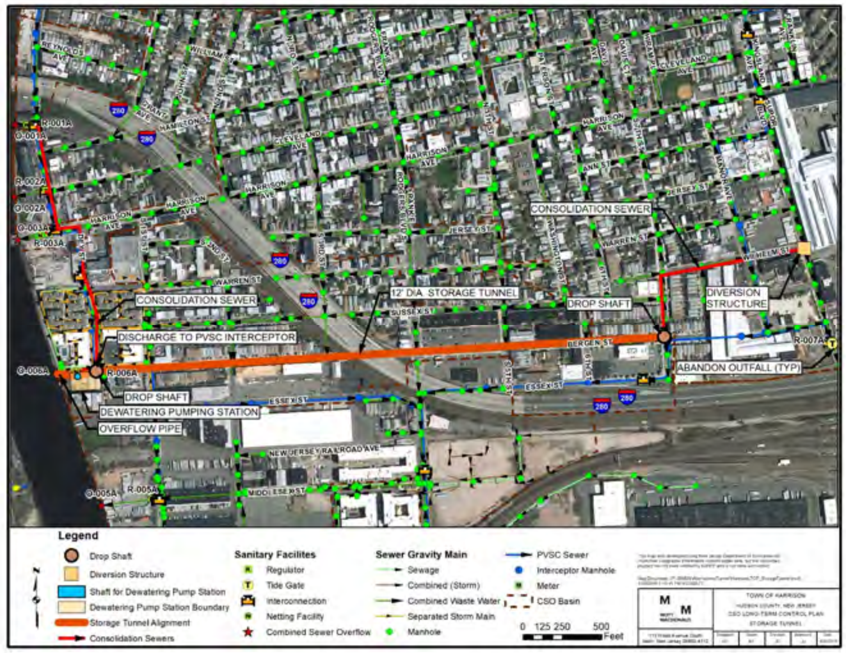
Tunnel Storage

New Offline Storage – Tunnel

- Requires consolidation piping
- Difficult Construction
  - Soft Ground
  - Tight working space
- 001A, 002A, 003A and 006A Consolidated



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Tunnel Storage

New Offline Storage – Tunnel

- Requires consolidation piping
- Difficult Construction
  - Soft Ground
  - Tight working space
- $139M-$160M
- $3.70 – $5.00 per gallon CSO removed.

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Tank Storage

Tanks retain overflows and return them to sewer and WWTP

Consists of:

- Diversion structures with fine screens;
- Consolidation piping
- An offline below grade tank equipped with:
  - flushing system
  - odor control;
- Tank overflow to an outfall;
- Dewatering pumping station; and
- Discharge connection back to the interceptor.

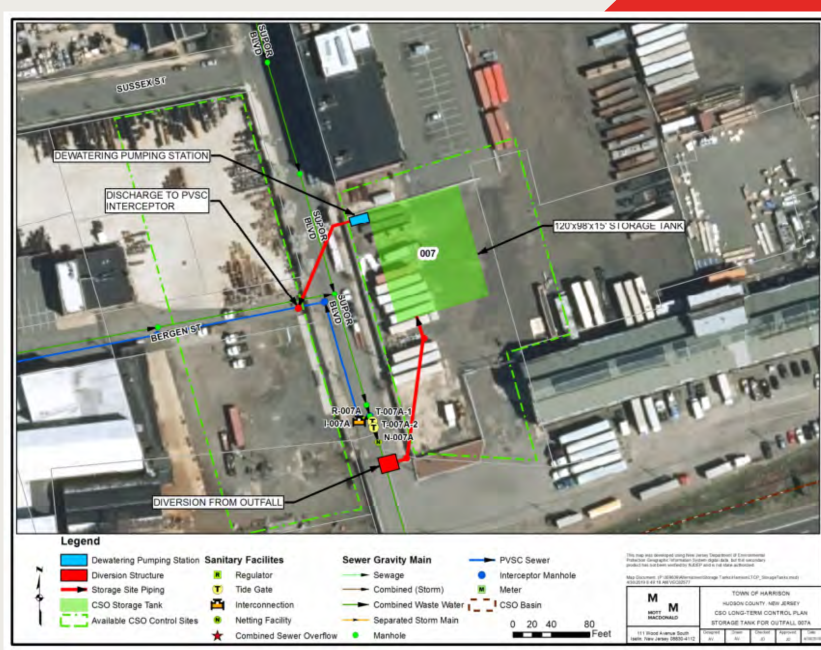
25

25

Tank Storage

New Offline Storage – Tanks

- Construction Challenges
- Potential Consolidation
- 007A Tank
- Alternate location across street.



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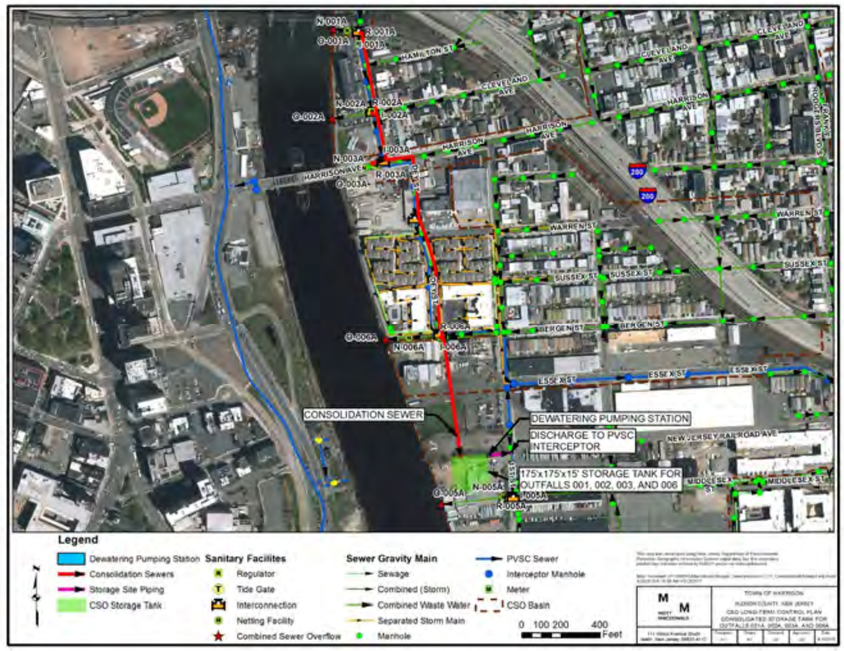
21 September 2020

26

Tank Storage

New Offline Storage – Tanks

- Construction Challenges
- Potential Consolidation
- 001A, 002A, 003A and 006A Consolidated



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Tank Storage

New Offline Storage – Tanks

- Construction Challenges
- Potential Consolidation
- $41M-$78M
- $1.40 – $1.80 per gallon CSO removed.

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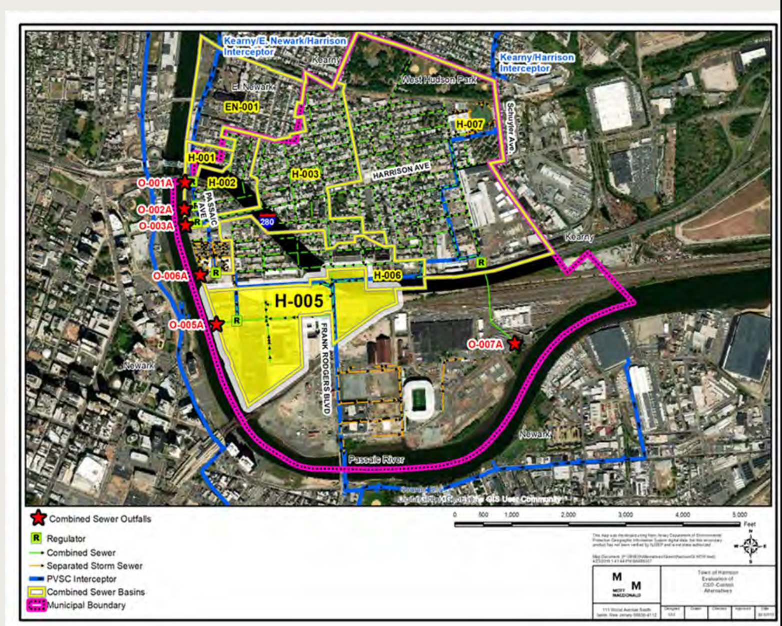
Sewer Separation

29

Sewer Separation

- WQ Impacts – Treatment
- Pending Stormwater Rule Changes
- CSO 005 along Angelo Cifelli Drive – Partially separated
- $181M
- $4.10 per gallon CSO removed.



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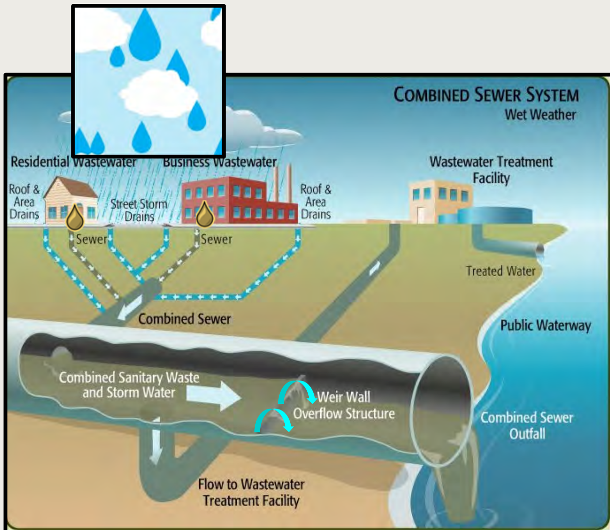
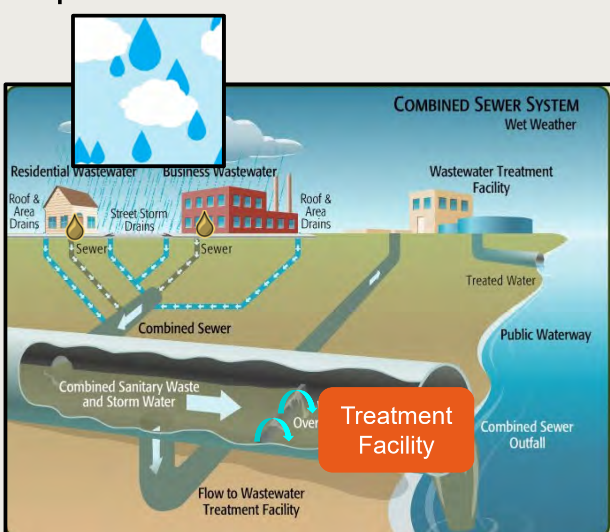
End of Pipe Treatment



31

End of Pipe Treatment



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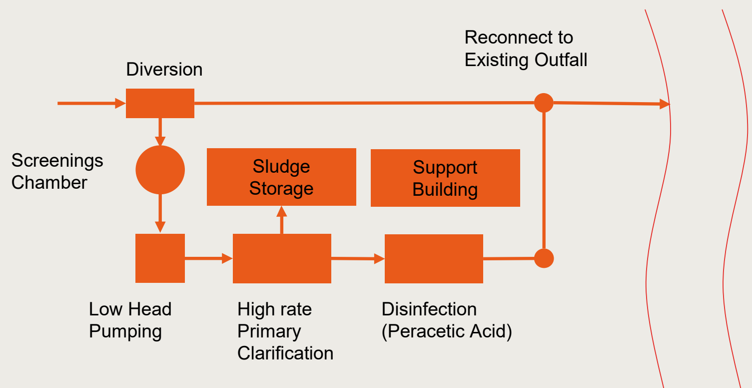
CSO Treatment

- Treatment capacity governed by flow rate.
- Divert and consolidate flow.
- Treatment process:
  - Fine Screening for floatable and course particles
  - Pump Station
  - High-rate primary treatment (i.e. ActiFlo)
  - Disinfection by peracetic acid
  - Storage of underflow

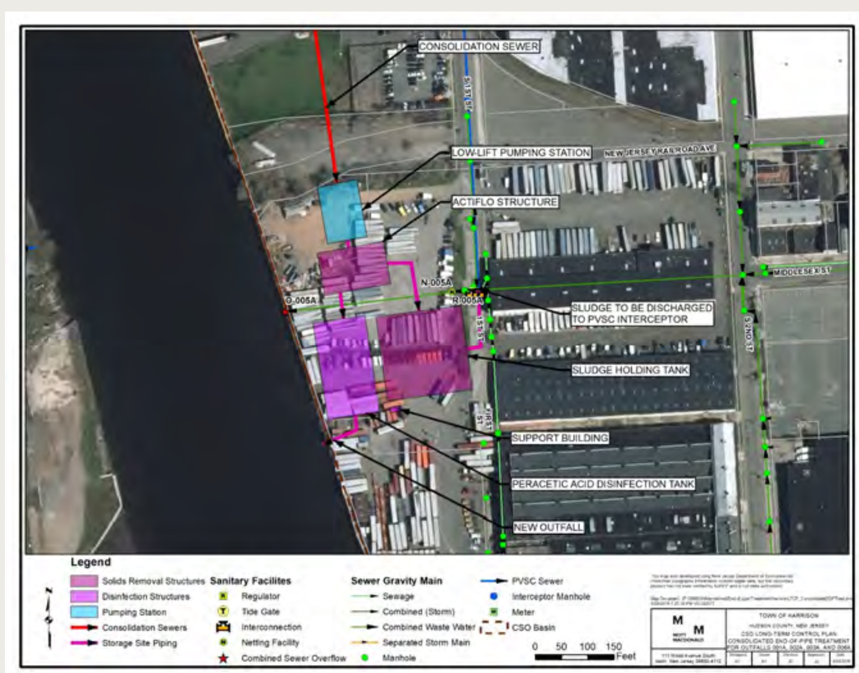


Example: High-Rate CSO Treatment Facility in Bremerton, WA

33

CSO Treatment

- Pumping
- Pretreatment
- Primary Clarification
- Disinfection
- Potential Consolidation
- 001A, 002A, 003A and 006A Consolidated.



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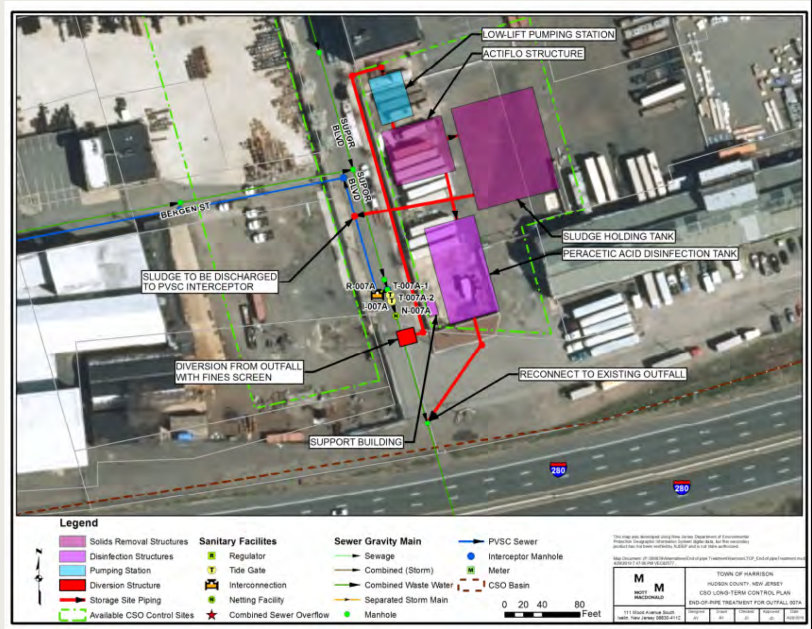
CSO Treatment

- Pumping
- Pretreatment
- Primary Clarification
- Disinfection
- Potential Consolidation
- $67M-$134M
- $1.90 – $3.10 per gallon CSO removed.



Costing

Present Worth – Planning Level -50% to +100%

	NPW Summary - Overflows per Year ($M)				
Control Plan	0	4	8	12	20
1) Point Storage	$88	$63	$61	$48	$40
2) Consolidated Storage	$78	$59	$58	$47	$41
3) Tunnel	$160	$152	$146	$142	$139
4) Treatment (Individual Sites)	$174	$136	$134	$128	$96
5) Consolidated Treatment	$134	$103	$103	$96	$67
6) Sewer Separation	$181	NA	NA	NA	NA
	NPW Summary - % of Impervious Area Managed ($M)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$6	$12	$18	$23	$35

Costing

Present Worth – Normalize per Gallon of CSO Removed

	Cost per Gallon of CSO Volume Reduction ($/gal)				
Control Plan	0	4	8	12	20
1) Point Storage	$2.1	$1.7	$1.6	$1.5	$1.5
2) Consolidated Storage	$1.8	$1.5	$1.5	$1.4	$1.4
3) Tunnel	$3.7	$3.6	$3.8	$4.2	$5.0
4) Treatment (Individual Sites)	$4.1	$3.2	$3.2	$3.1	$2.6
5) Consolidated Treatment	$3.1	$2.4	$2.4	$2.3	$1.9
6) Sewer Separation	$4.2	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$58	$58	$58	$58	$70

Next Steps

- **Revisions to Alternatives Analysis due to NJDEP 11/22.**
  - Harrison revisions have been submitted to PVSC
- **Public Participation**
  - Supplemental CSO Team Member
  - Additional Publicity
- **Level of Control**
  - Water quality
  - Financial Capabilities
- **LTCP Due June 1, 2020**
  - Need decision on plan by end of January
  - Endorsement of plan?

MOTT MACDONALD

Town of HARRISON

Thank you

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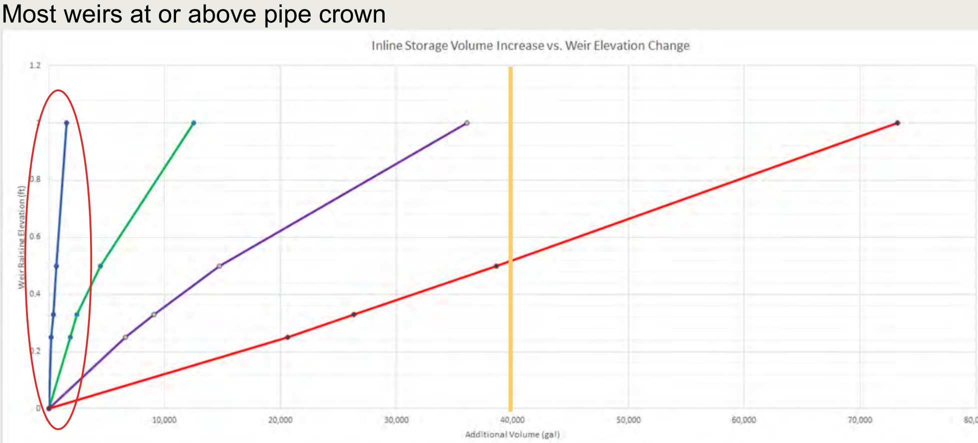
Storage

Existing Inline Storage

Inline Storage Maximized

Maximize inline storage capacity

Most weirs at or above pipe crown



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Review – Regulatory History

NJDEP Permit history

- 1994 EPA National CSO Policy
- 1995 Permit
  - Master General Permit (MGP)
  - Required to implement nine minimum controls
  - Begin sewer system characterization
- 1998-2000 Solids and Floatables Controls
- 2004 MGP Permit
  - Permittees required to address 4 additional components of LTCP
- 2015 Individual Permit
  - New permits address site-specific conditions and promote coordination between hydraulically connected systems

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Review – Permit Schedule

Summary of Reports Required to be Submitted to the Department

Permit Condition	Abbreviated Description of Requirement	59 Month LTCP Due Date
Part III	Discharge Monitoring Reports (due 25th day of the month following the reporting period) - Solids/Floatables and Precipitation	Monthly from July 1, 2015
Part IV.D.4.a	Submit Progress Reports (due 25th day of the month following the quarter)	Quarterly from July 1, 2015
Part III	Discharge Monitoring Report (due 25th day of the month following the reporting period) – Duration of Discharge	Monthly from January 1, 2016
Part IV.D.2.a	Submit GPS latitude and longitude for pump stations, CSO regulators and CSO outfalls	January 1, 2016
Part IV.D.3.b.i	Submit System Characterization Work Plan	January 1, 2016
Part IV.D.3.c	Submit Baseline Compliance Monitoring Program Work Plan	January 1, 2016
Part IV.D.2.b	Submit a map of combined and separate sewer areas	July 1, 2016
Part IV.D.3.b.ii	Submit System Characterization Report	July 1, 2018
Part IV.D.3.b.iii	Submit Public Participation Process Report	July 1, 2018
Part IV.D.3.d	Submit Compliance Monitoring Program Report	July 1, 2018
Part IV.D.3.b.iv	Submit Consideration of Sensitive Areas Plan	July 1, 2018
Part IV.D.3.b.v	Submit Development and Evaluation of Alternatives Report	July 1, 2019
Part IV.D.3.b.vi	Submit Selection and Implementation of Alternatives Report in the Final LTCP	June 1, 2020

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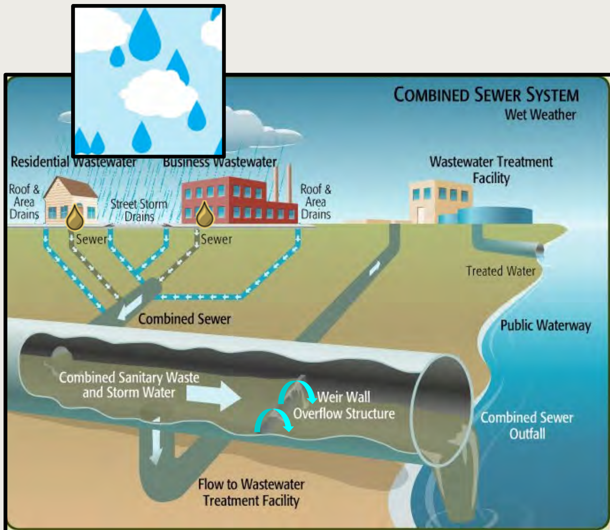
Inline storage



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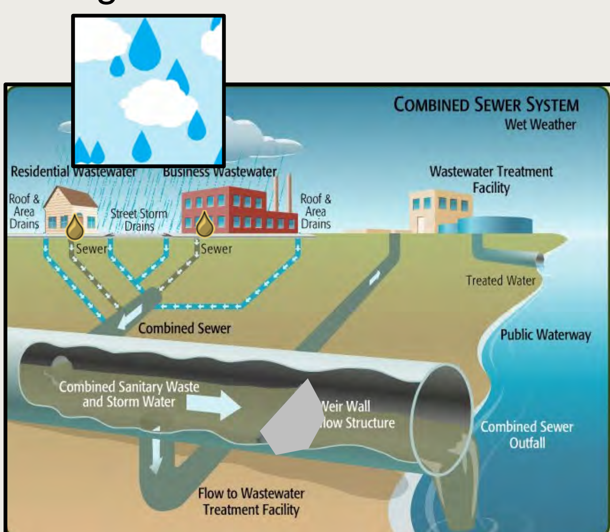
Inline Storage



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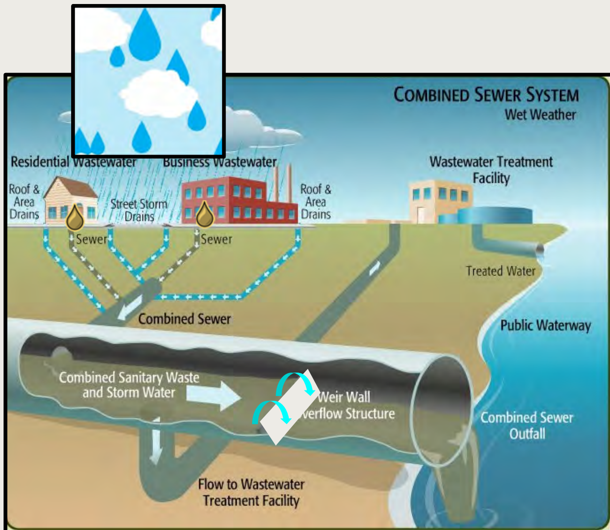
Inline Storage



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Town of Harrison Council Meeting – June 30, 2020

CSO Presentation Minutes

Speakers:

- Mayor James Fife - Town Mayor
- Eleanor Villalta, Ellen Mendoza, Jesus Huaranga, Maria Camao, Francisco Nascimento, James P. Doran, Laurence Bennett, Gabriela Simoes Dos Santos - Town Council
- Paul Zarbetski – Town Attorney
- Rocco Russomanno – Municipal Engineer
- John Dening - Mott MacDonald

Highlights of Discussion:

- JD introduced the presentation and noted that any questions can be submitted through the chat function, and that the Town would moderate the questions.
- PZ noted that the meeting is open to the public. JD confirmed he is aware of this.
- Following JD's presentation, RR indicated that the additional modelling work that the Town had commissioned Mott MacDonald to do had been beneficial because it indicated that the Town may need to do less work than was originally thought. The original model had indicated that a lot more infrastructure may be needed, but the more detailed model indicated that the sewer separation of CSO 005A through redevelopment could get the Town most of the way to the goal.
- LB asked what the long-term costs would be. JD indicated that the cost would be an approximately additional $16.5M over for next 20 years, noting that this is a present worth cost that includes operation and maintenance costs. The bulk of this cost may be achieved through redevelopment and separation of 005A, otherwise the Town would need to complete this work.
- FN asked, if this is a long-term project, whether it could be re-evaluated as the Town takes steps along the process. JD indicated that the plan would be submitted to the State on October 1st, and elements of the plan will be included in the permit, which is re-issued on a 5-year cycle. He indicated that submission of the plan would be setting course for the next 20 years, and there would be greater difficulty in modifying the plan after the permit is in place.
- LB asked whether there are any federal grants available for the $16.5M balance that still needs to be spent. JD indicated that financing would most likely be pursued through the New Jersey Infrastructure Bank (IBank), which is a State revolving loan program. IBank offers low interest loans, which can be for up to 20 years. He indicated that there are other funding sources such as grants, but the most likely financing will come from NJ IBank, and other grants are possible but not as reliable funding sources.
- MC asked what the total cost would be. JD indicated that the total value of the program over 20 years would be $27.6M, however about $11M of the work has already been completed. The remaining $16.5M would either be through redevelopment or would become the Town's responsibility to complete.
- EM asked what would happen if the Town did not meet the IBank requirements to qualify for funding. JD responded that the IBank is structured for water projects, and CSO control is generally given preference. The IBank funding would be reliable unless something very dramatic happened to the Towns funding. In this case, it may be possible to go back to the NJDEP to indicate that funding is not available to complete the projects.

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Town of Harrison CSO Long Term Control Plan Selection and Implementation

Town Council Meeting

June 30, 2020

Town of HARRISON

1

Meeting Overview

- Introduction to CSOs
- Regulatory Background
- Passaic River Water Quality
- Selected Level of Control
- Tentatively Selected CSO Control Plan
- Regional Approach
- Cost and Implementation Schedule

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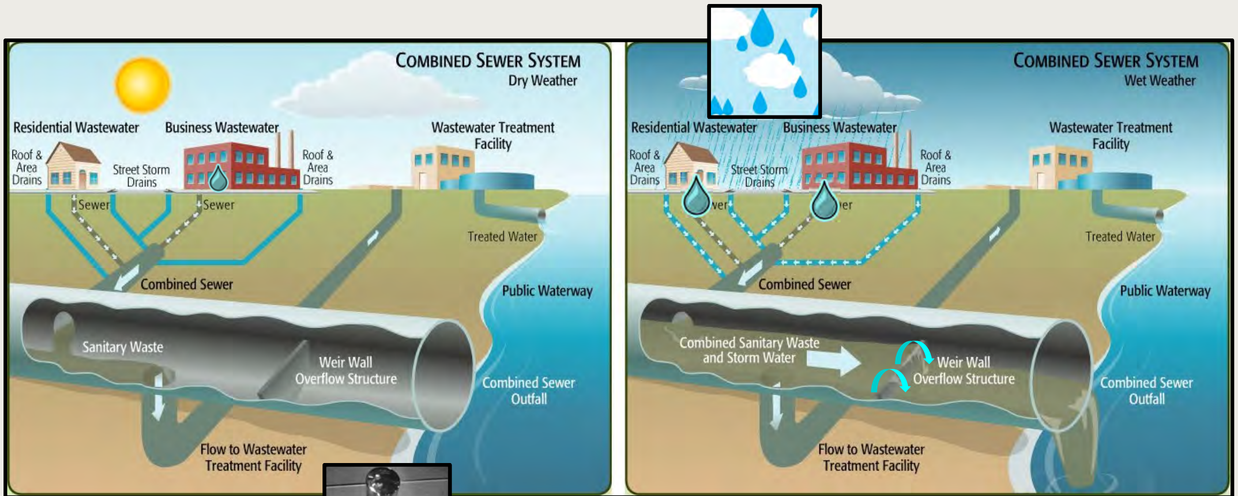

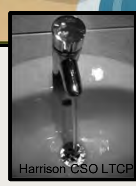

- CSOs provide hydraulic relief during wet weather, but are sources of water pollution

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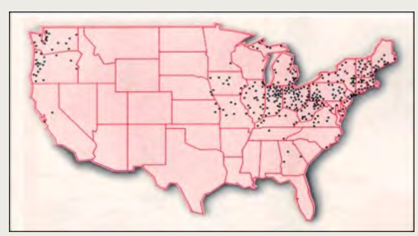
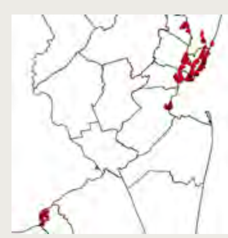
Introduction

- The Town of Harrison has a sanitary and stormwater collection system called a “Combined Sewer System” (CSS)
- Most CSS communities in US are located in Northeast and Great Lakes regions (early municipal development locations)
  - 770 communities in US, vast majority have LTCP in place already
  - 21 communities in NJ
- New Jersey Department of Environmental Protection (NJDEP) has issued permits requiring that this pollution be addressed, in order to improve water quality.





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Regulatory Background

1994: US EPA issues *National CSO Control Policy*

1995: NJDEP regulates all CSO discharges under General Permit for combined sewer systems

1998-2000: Town addresses Solids/Floatables Control Facilities and Nine Minimum Controls

2004-2007: Initial System Characterizations & Cost and Performance Analysis Work for LTCP

2015: NJDEP issues Individual NJPDES permits

October 1, 2020: LTCPs must be submitted to NJDEP

- Development of **Long Term Control Plans (LTCP)** per EPA National CSO Control Policy
- Regional coordination: PVSC CSO Group
- Other permit conditions for system operation and maintenance and reporting
- 5-year permit cycle

30 June 2020 Harrison CSO LTCP - Town Council Meeting 5

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Long term control plan submission

Step 1.

- System Characterization Report
- Baseline Compliance Monitoring Program Report
- Consideration of Sensitive Areas Report
- Public Participation Process Report

Step 2.

- Development and Evaluation of Alternatives Report

Step 3.

- Selection and Implementation of Alternatives
  Final LTCP – Due October 1st

(Extension from June 1 to October 1 due to COVID-19)

30 June 2020 Harrison CSO LTCP - Town Council Meeting 6

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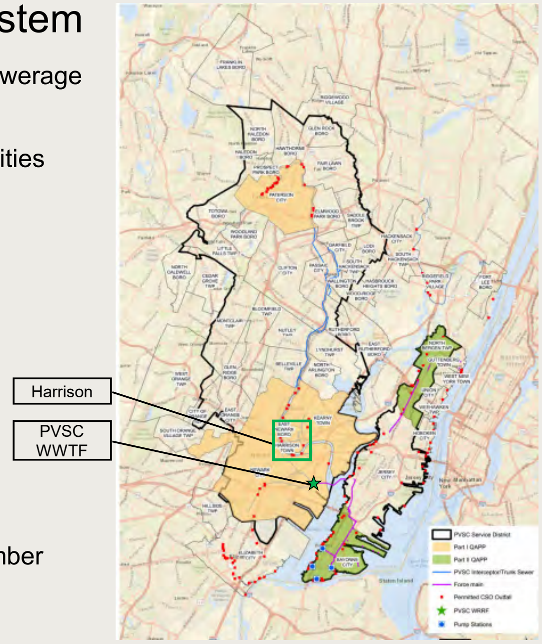
PVSC's Hydraulically Connected System

- Harrison's CSS flow is treated at the Passaic Valley Sewerage Commission (PVSC) wastewater facility
- PVSC manages wastewater treatment for 48 municipalities within Bergen, Essex, Union, and Passaic Counties.
  - ~1.5 Million People
  - ~150 square miles
- 8 combined sewer municipalities
  - Harrison
  - Newark City
  - East Newark Borough
  - Kearny Town
  - Paterson City
  - Jersey City
  - Bayonne
  - North Bergen
- Harrison is working with PVSC and the other CSS member communities to develop a Regional LTCP



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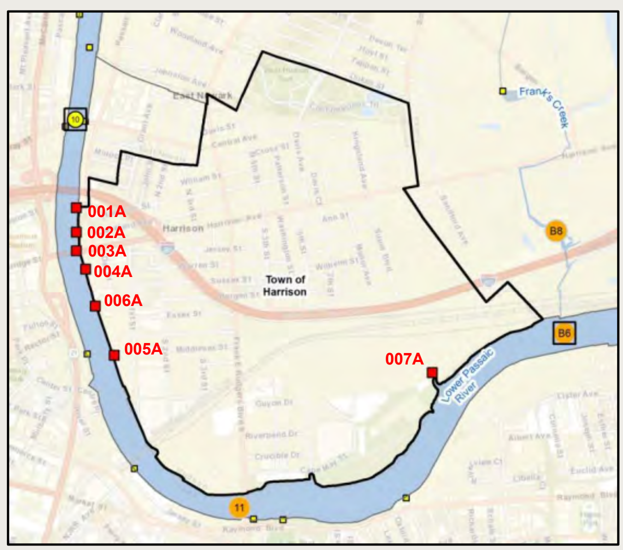
Harrison CSO Locations

- 7 permitted outfalls

Outfall	Status
001A	Remaining
002A	Remaining
003A	Remaining
004A	Eliminated
005A	To Be Eliminated
006A	Remaining
007A	Remaining



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Combined Sewer Overflow Existing Conditions Typical Year Performance

2004
NJDEP approved Typical Hydrologic Year

48.4”
Total rainfall depth in 2004 Typical Year

46.4
Million gallons per year Total combined sewer overflow volume Town-wide

40
Total number of overflow events Town-wide

73
Storm events in 2004 Typical Year with greater than 0.1” of rainfall

3,000
Million gallons per year Total combined sewer overflow volume PVSC System-wide

38.0
Million gallons overflow once H-005 is separated

40
Total number of overflow events Town-wide, once H-005 is separated

Water Quality Modeling

- Receiving water for Harrison is the Passaic River.
- A complex water quality model was developed with regional communities (NJ CSO Group) to determine water quality of receiving waters, based on typical year.
- Passaic River is an SE3 water:
  - Baseline loading does not exceed fecal coliform criterion of 1,500 cfu/100mL geometric mean → water quality criteria is attained in the baseline condition.

Table 6-4. AU Attainment in SE3 Waterbodies under Baseline and 100% Control Conditions

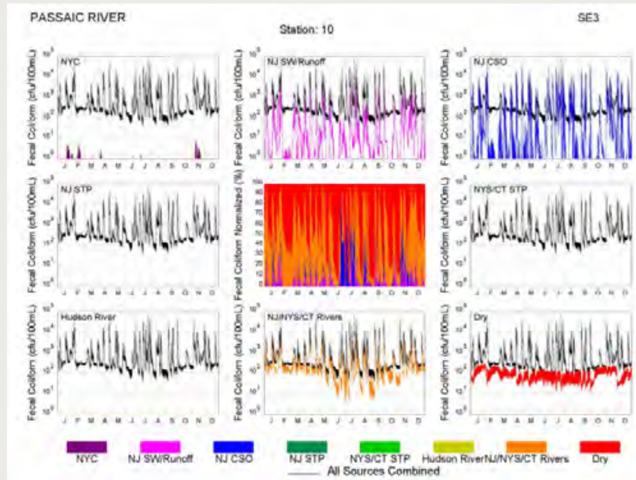
Assessment Unit Name	Assessment Unit Number	Baseline % Attainment	100% Control % Attainment
Passaic R Lwr (4th St br to Second R)	02030103150040-01	100.0	100.0
Passaic R Lwr (Nwk Bay to 4th St br)	02030103150050-01	100.0	100.0
Hackensack R (below Amtrak bridge)[1]	02030104010020-01	100.0	100.0
Kill Van Kull West	02030103180080-01	100.0	100.0
Upper NY Bay / Kill Van Kull (74d07m30s)[1]	02030104010030-01	100.0	100.0
Elizabeth River (below Elizabeth CORP BDY)[1]	02030104020030-01	100.0	100.0
Morses Creek/Pile Creek	02030104030010-01	100.0	100.0
Arthur Kill waterfront (below Grasselli)[1]	02030103180070-01	100.0	100.0

1 This Assessment Unit had to be divided into two pieces because it spanned two waterbody classifications.

Source: Calibration and Validation of Pathogen Water Quality Model” Report (Draft, produced by NJ CSO Group / PVSC in April 2020)

Water Quality Modeling

- Main pollutant sources in Passaic River near Harrison are NJ CSO, NJ stormwater, rivers, and dry weather discharge.
- Minimal contribution from other sources



Source: Calibration and Validation of Pathogen Water Quality Model" Report (Draft, produced by NJ CSO Group / PVSC in April 2020)

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Control Approach Selection

Presumption Approach Targeting 85 Percent Capture

Presumption Approach (performance based)	**Demonstration Approach** (water quality based)
• No less than 85 percent capture of annual overflow volume; • No less than the equivalent mass of the pollutants causing water quality impairment; or • No more than 4 overflows in the typical year	• Use receiving water model to identify control level needed to meet WQ-based requirements
SELECTED as best balance between permit compliance, water quality benefit and allocation of municipal funds.	**NOT SELECTED:** WQ modelling not very insightful in demonstrating WQ improvements in receiving waters.

- Alternatives evaluation included evaluation of range of control levels (0, 4, 8, 12, and 20 overflows per year and 85% capture), in typical year conditions

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Revisions to Hydrologic/Hydraulic Model

- Harrison portion of PVSC districtwide collection system model was revised after DEAR submission, to improve accuracy
- Includes greater detail (pipes, manholes, netting facilities, boundary conditions) and reclassifies areas previously considered combined sewer as sanitary sewer.
- Changes to model output:

Baseline Conditions	Overflow Volume (MG)	Number of Overflows	Percent Capture
Original	61.5	53	74.3
Updated	46.4	40	81.7

- Revised model indicates that fewer CSO controls are needed to achieve 85% capture than originally calculated in the DEAR.
- Selected plan is based on revised model and updated costs.

Original Model

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Tentatively Selected Plan - Major CSO Control Plan Components

Targeting 85% capture for Harrison

Sewer Separation (primary)

Green Infrastructure

Water Conservation

14 30 June 2020

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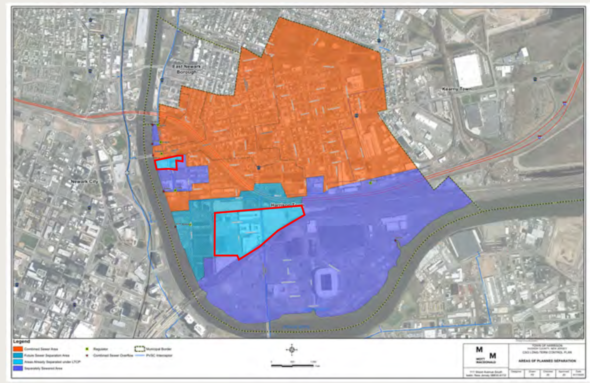
Sewer Separation

- Separate combined single-pipe sewer system into separate sewers for sanitary and storm water flows.
- CSO-004A sewer separation has been completed (3.3 acres)
- CSO-005A is in progress (37.6 acres completed, 49.5 acres remaining)
  - Option 1: Complete separation through redevelopment of former industrial area.
  - Option 2: Town to complete the separation by installing either storm or sanitary sewers. Acquire ~1 acre of easements on private property.



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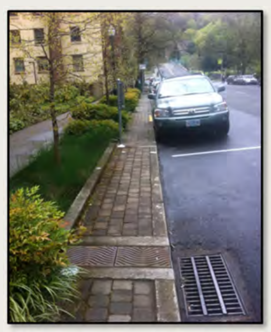
Green Infrastructure Program

- Propose $750,000 for GI over the first 10-years of LTCP implementation
  - Equivalent to installation of approximately 20 rain gardens.
  - Funding from Town may be reduced if grants or other supplementary forms of funding are obtained.
  - May include installations on private property that are accessible to the public and covered by an enforceable maintenance plan that complies with the NJ Stormwater Management Rules.



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Cost of Proposed CSO Control Program

Item	Area (ac)	Capital Cost	Annual Maintenance Costs	20-Year Net Present Worth
CSO-004A Sewer Separation (completed)	3.3	$1.0M	Similar to Existing Costs	$1.0M
CSO-005A Sewer Separation (completed)	37.6	$10.1M	Similar to Existing Costs	$10.1M
CSO-005A Sewer Separation (to be completed)	49.5	$15.3M	Similar to Existing Costs	$15.3M
Green Infrastructure	N/A	$0.75M	$31,400	$1.23M
Total	**90.4**	**$27.15**	**$31,400**	**$27.63**

- COVID-19 pandemic may impact affordability and implementation schedule for CSO LTCP projects
- Potentially reduced household incomes and sewer utility revenues, impacts to scheduling for redevelopment projects.

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Implementation Schedule (DRAFT)

20-year implementation sequence

Years 1-5
- Commence green infrastructure program.
- Review water conservation ordinance.

Years 6-10
- Continue green infrastructure program, including maintenance of first 5 yrs installations.
- Review water conservation ordinance.
- Complete separation of CSO-005A (depending on redevelopment schedule)

Years 11-15
- Green infrastructure maintenance.
- Review water conservation ordinance.
- If not done by redevelopers, Town to initiate completion of CSO-005A separation in Year 12.

Years 16-20
- Green infrastructure maintenance.
- Review water conservation ordinance.
- If CSO-005A separation has not been completed, Town to construct.

Funding/Affordability:
- Most investment (sewer separation) will be after the first permit cycle
- Relatively low overall cost to Town if redevelopment is completed

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Percent Capture

LTCP must achieve at least 85% capture

$$\text{Percent Capture} = 1 - \left(\frac{Overflow\ Volume}{Total\ Wet\ Weather\ Volume\ Entering\ CSS}\right)$$

2015 Baseline: $\text{Percent Capture} = 1 - \left(\frac{46.4\ MG}{253.8\ MG}\right) = 81.7\%$

With Sewer Separation: $\text{Percent Capture} = 1 - \left(\frac{38.0\ MG}{253.8\ MG}\right) = \boxed{85.0\%}$

- Additional volume reduction from green infrastructure and improvements in Newark provide a safety factor for the 85% capture achieved by sewer separation.

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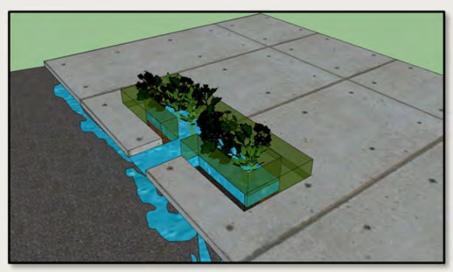
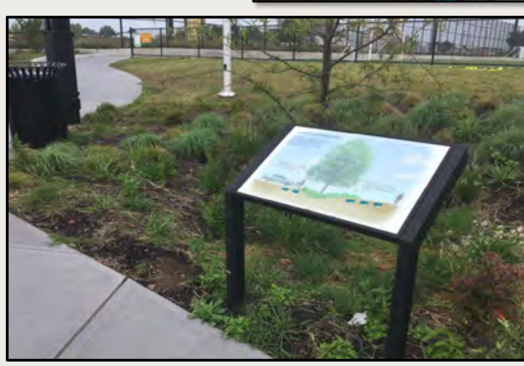
Green Infrastructure Program

- Benefits for public education, community green spaces, etc.
- Green infrastructure will have signage explaining the structure, function, and water quality benefits.
- Minimal impact on CSO overflow volume or frequency reduction
- Town will assume maintenance responsibility for GI on public property





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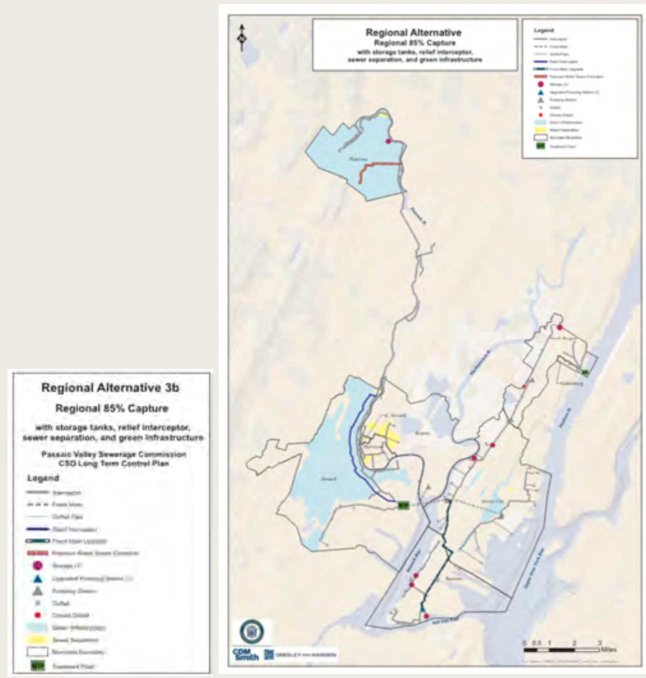
PVSC Regional Approach

- Regional 85% capture
- Combination of storage tanks, relief interceptor, sewer separation and green infrastructure
- Plan for work to be completed within Harrison is the same under the Regional vs. Municipal plan
- Potential opportunities for cost sharing with Regional approach (Mayors committee looking into this)



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Next Steps

- Finalize Cost Estimates and Financial Capability Assessment – With PVSC
- Finalize Implementation Sequence and Schedule
- Continue Public Participation
- LTCP Due October 1, 2020

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MOTT MACDONALD

Town of HARRISON

Thank you

Questions?

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Water Conservation

- Continue Town's water conservation efforts
- Use of low flow fixtures, review Water-Saving Fixtures ordinance each permit cycle
- Water conservation software to alert users of potential leaks.

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Sewer Separation

Benefits	Challenges
Work in public right-of-way, no new land required.	Disruption to roads and traffic.
Opportunity for system renewal, reconstruction.	Possible regulatory requirements stormwater controls and treatment in future.
Elimination of combined sewer outfalls.	High expense (aim to leverage redevelopment in Harrison)

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Appendix C – Town of Harrison Combined Sewer System Model Recalibration Report

Town of Harrison

Sewer System Recalibration Report

April 27, 2020

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United States of America

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mottmac.com

Town of Harrison

Sewer System Recalibration Report

April 27, 2020

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
0	4/27/2020	P. Zhinhel	B. Moore	J.Dening	Final

Document reference: 507389839 | 01 |

Information class: Standard

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Contents

Tables

Figures

Maps

Executive summary

The Town of Harrison is required to prepare a long-term control plan (LTCP) to address combined sewer overflows (CSO). Harrison is a member of and has been working cooperatively with the Passaic Valley Sewerage Commission (PVSC) CSO Group, which undertook initial tasks required under the permit. One of these tasks was the preparation of a hydraulic model of the PVSC service district. This model was initially developed by PVSC to evaluate wet weather impacts upon its transport system (interceptors), and thus limited flow data was collected from individual drainage areas such as those in Harrison. To the best of our knowledge, the PVSC collection system model, including the Town of Harrison's (Harrison) collection system, was originally developed in SWMM by HydroQual (currently HDR) in the late 1990s. The intent of the original SWMM model was to represent the PVSC Interceptor Sewer System to review flow and sediment transfer within the district. In the early 2000s additional, but limited, flow monitoring and water quality monitoring data were collected from the five CSO communities (Paterson, Newark, East Newark, Kearny, and Harrison) tributary to the PVSC Transport System and were then used to develop a more refined SWMM model, which was subsequently converted to InfoWorks by HydroQual in 2006. The model was again updated and recalibrated in 2016 by the PVSC program management team of Greely and Hansen/CDM. Harrison was represented in the model with one sub-catchments for each regulator drainage area which was directed to one segment of piping upstream of each regulator. Starting in late 2018 Mott MacDonald undertook an expansion of the Harrison portion of the InfoWorks model which included the addition of portions of the Town's collection system, to enhance the evaluation of alternatives.

In order to validate the expanded Infoworks model, Mott MacDonald prepared Quality Assurance Project Plan (QAPP) that was submitted to NJDEP in December 2019, see Appendix E. The QAPP outlined project responsibilities, monitoring methodology and procedures to ensure the quality of the analytical data generated meet the goals of the project. The monitoring program included the installation of seven flow meters measuring both depth and velocity, three depth-only and one rain gauge. Monitoring locations are provided in Section 3.1 of this report. The meters collected data at 5-minute frequency for three-month period.

The flow data collected from August 16, 2019 to November 18, 2019 was used to re-calibrate the expanded Infoworks model. The updated model will allow greater accuracy in outputs that support LTCP decision making process.

1 Introduction

The Town of Harrison, located in western Hudson County New Jersey, is bounded by the Town of Kearny and the Borough of East Newark to the north and the Passaic River to the south. The Town was incorporated in 1869 having previously been portion of Harrison Township. Nowadays Harrison remains an important logistical hub with large waterfront and proximity to rail lines. Several parts of Town currently undergo transition from industrial past to primarily residential use developments.

The Town of Harrison owns and operates the combined sewer system within the Town limits. Wastewater from the Town is transported through the Passaic Valley Sewage Commission's (PVSC) Kearny – East Newark – Harrison and Kearny – Harrison – Newark Branch

Interceptors, under Passaic River before discharging into the PVSC Main Interceptor, which flows to the PVSC Water Resource Recovery Facility (WRRF) in Newark, approximately two miles away. Harrison has six (6) combined sewer overflow (CSO) regulating facilities which are owned by PVSC. The regulators are connected to six (6) CSO discharge points. All six of these discharge points flow into the Passaic River as shown in Figure 1-1.

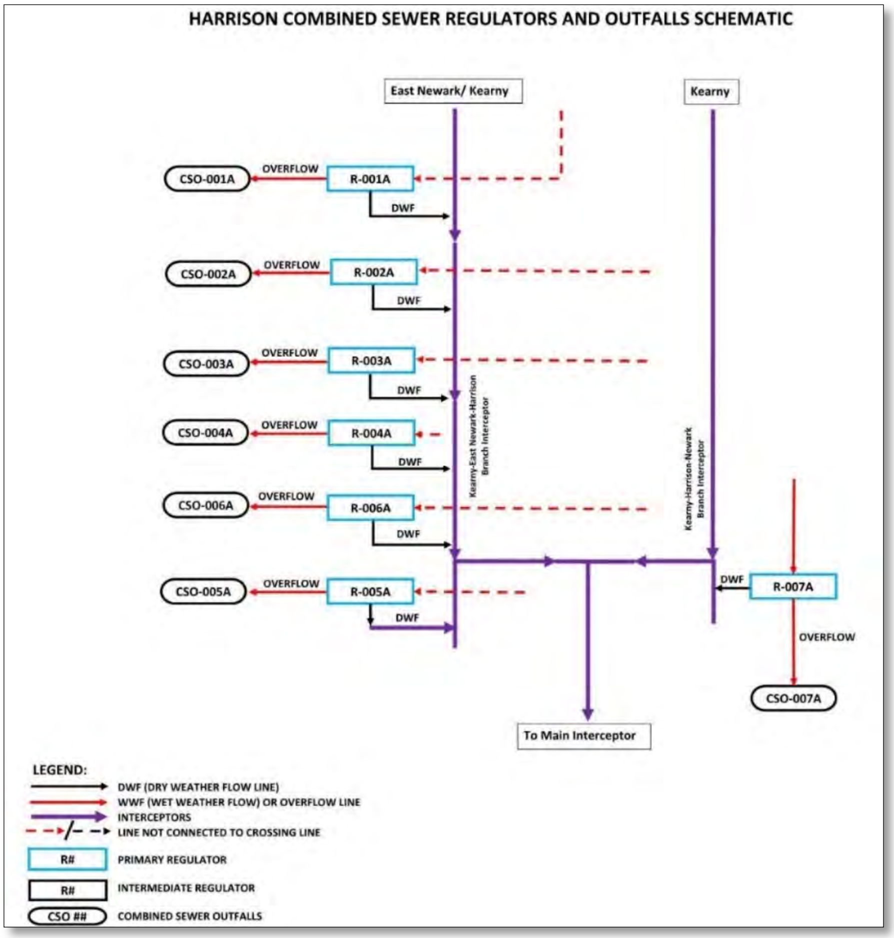


Figure 1-1 – Harrison Combined Sewer and Outfall Schematic

2 Combined Sewer System Summary

The Town has a population of 13,620 as per the 2010 census, with a total area of approximately 848 acres. The overall land use is essentially fully developed with about 62% of all land parcels being residential as shown in Figure 2-1. Approximately 420 acres directly connects to sewers tributary to the CSO regulator structures with the remaining sanitary areas primarily connect directly to the PVSC Interceptor and bypassing the CSO regulators. Characterization of the combined sewer system was undertaken in 2016, the findings of that work were documented in the June 2018 “Service Area System Characterization Report, Individual Permit No. NJ 0108871” prepared by Greeley and Hansen.

To assess the applicability of the prior work to the current system, certain key aspects of the Town were analyzed to evaluate if the Town had undergone any major changes since the prior work. The variables that were evaluated were land use, impervious cover and population. The Town of Harrison continues to show a robust population growth and development. Since 2010 US Census the population has increased by more than 30%. Future estimates indicate that the growth trend will continue with former industrial areas redevelopment.

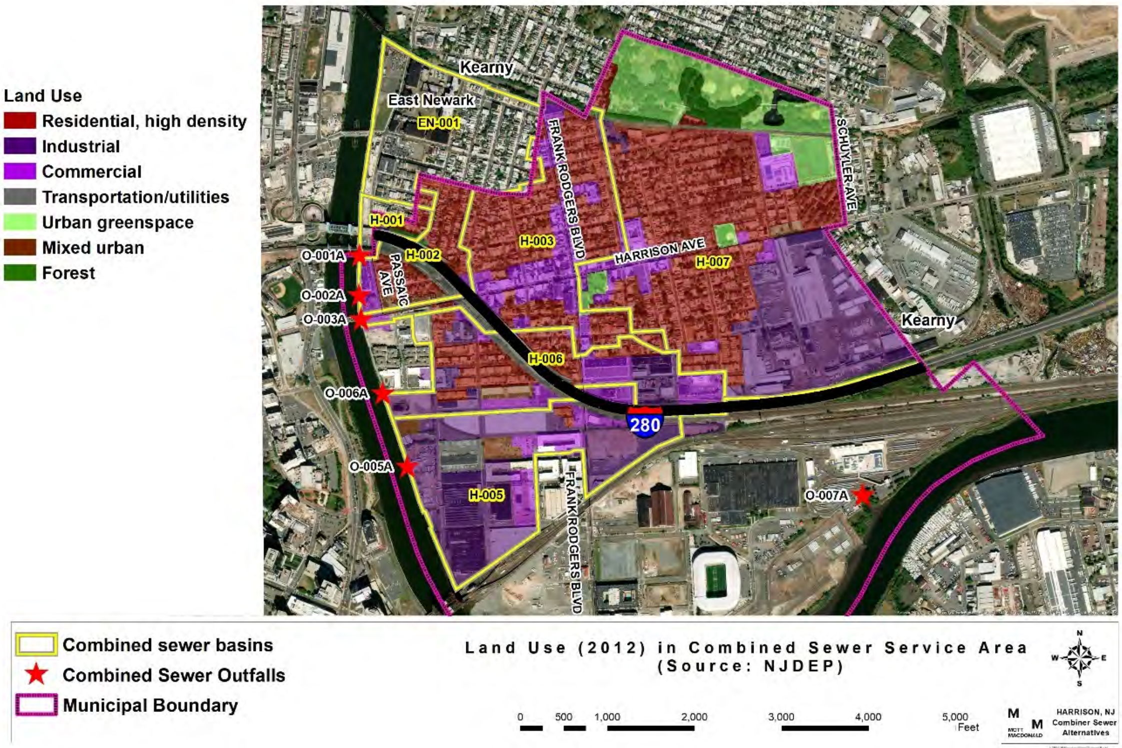


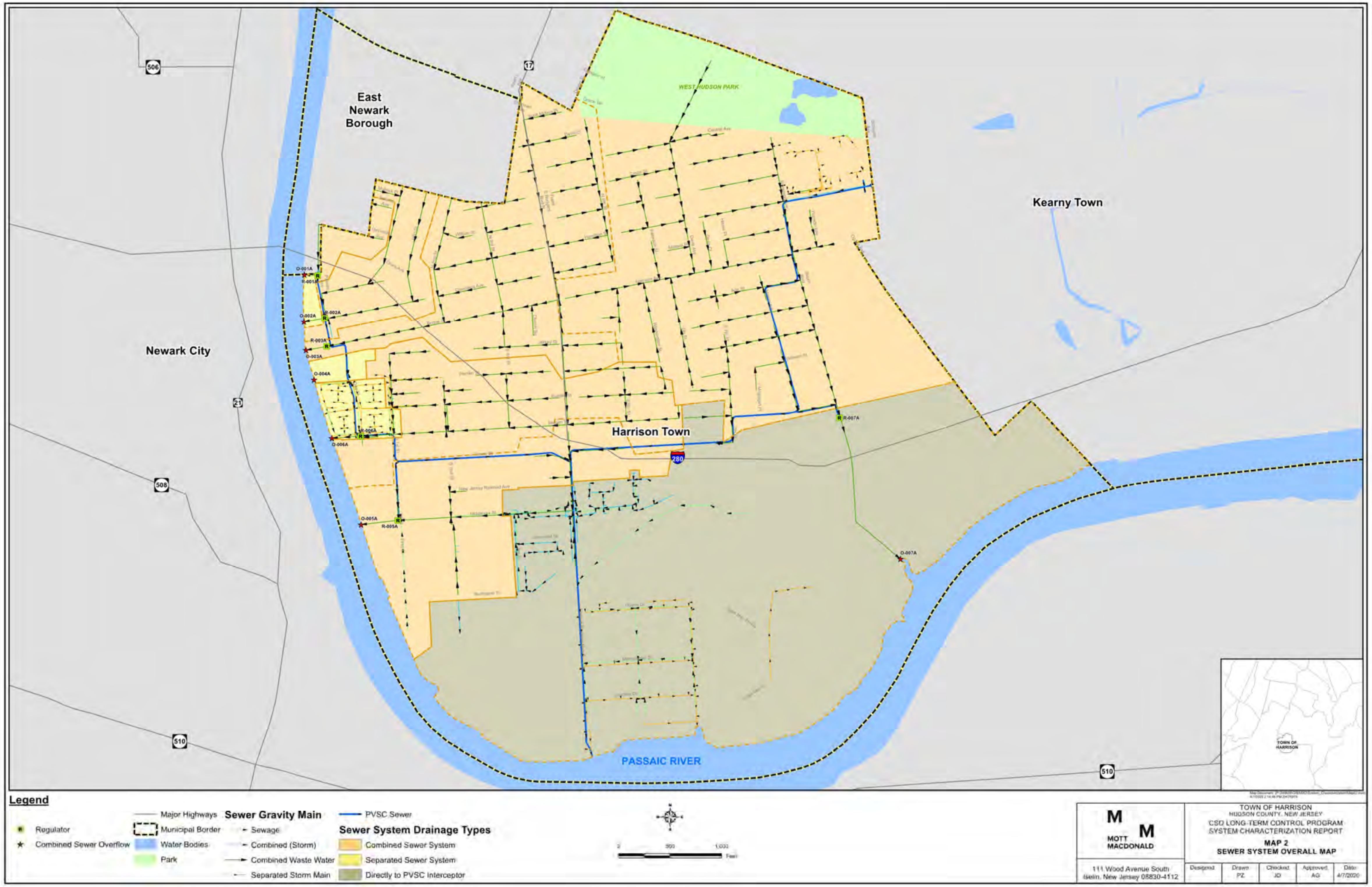
Figure 2-1 – Harrison Land Use

2.1 Sewer System Inventory Updates or Modifications

The model detail was greatly expanded to increase its accuracy. Since 2018 Characterization Report, the Town has undertaken a project to convert CAD and paper data on most junction manholes within the collection system including pipe sizes as well as rim and invert elevations. Limited field data was collected to verify and supplement historic and record plan data. Contributing subcatchment areas underwent further subdivision and routing changes. Expanded Harrison sewer system is shown in .

2.2 Sewer System Modifications

There have been no significant changes to the CSO regulators or control facilities from the prior characterization. However, additional information was collected on the system to update the GIS in 2018.



Map 1: Sewer System Overall Map

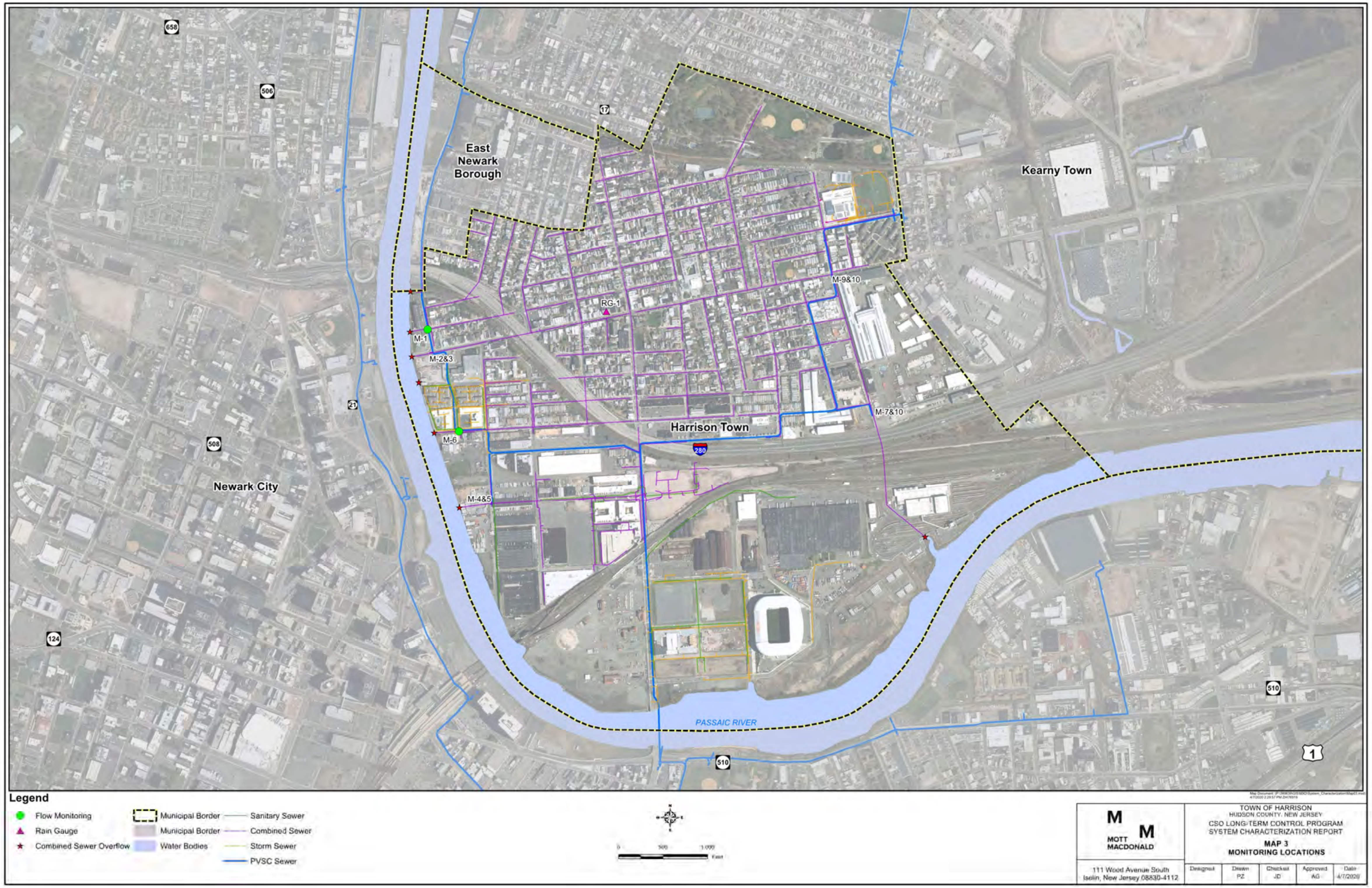
3 Collection System Monitoring

3.1 Monitoring Program Design

Available mapping of the Harrison combined sewer system was reviewed dry weather flow, wet weather flow, and monitoring locations were selected to capture flow data from as much of the combined sewer area as possible. The monitoring locations were chosen to provide information regarding the duration and magnitude of combined sewer overflows necessary and sufficient to develop a reliable hydraulic model. The best flow monitoring data is collected in conditions with uniform non-turbulent flow. The proposed meter locations were field investigated to try to avoid locations with adverse hydraulic conditions. After potential locations were vetted, all flow meters were tested for velocity and level accuracy prior to installation and were calibrated in place after installation. Seven flow meters measuring both depth and velocity and three depth-only sensors are installed within Harrison's sewer system. shows the location of metering sites. Five of the seven flow meters were installed in the pipe just upstream from their respective regulators and measure inflow to the regulators. The three water-level only sensors were installed above the overflow weir at regulators to measure when flow is entering the overflow pipe. The remaining two meters, #9 and #10 were located on branch sewers, near interconnections with PVSC's Kearney – Harrison Interceptor. The meters were in place for over 12 weeks period. Due to unexpected hydraulic conditions, flow data from Meter #9 was deemed inaccurate and the meter site was excluded from the monitoring program. All metering sites are summarized in :

Table 3-1 - Flow Monitor Installation Locations

Meter No.	Description	Manhole ID	Pipe Diameter (in)
1	Regulator 2 Inflow	MH-816 (R40)	21
2	Regulator 3 Inflow	MH-1201 (R041)	30x45
3	Regulator 3 Overflow Weir Depth Sensor	-	-
4	Regulator 5 Inflow	MH-1231 (R43)	24
5	Regulator 5 Overflow Weir Depth Sensor	-	-
6	Regulator 6 Inflow	MH-739 (R44)	24
7	Regulator 7 Inflow	MH-1026 (R45)	24
8	Regulator 7 Overflow Weir Depth Sensor	-	-
9	Supor Blvd. and Harrison Ave. (North)	MH_1009	24
10	Supor Blvd. and Harrison Ave. (West)	MH_1009	24



Map 2: Monitoring Locations

3.2 Rainfall Analysis

Rainfall depths were measured in 0.01 inch increments and logged at five (5) minute intervals. The unit was located on the roof of the Harrison Municipal Building at 326 Harrison Ave (see Map 3) which is open and free from outside influences such as trees or areas surrounded by tall buildings. Given that the Town is approximately 1.75 sq mi and the rain gauge was centrally located within the combined sewer area, one rain gauge was sufficient to accurately represent the rainfall within the calibration area.

Over the monitoring period, a total of 7 rainfall events over 0.5 inches were recorded, with three of those events recording over a total of 1 inch of rain. A total of 18 rain events in which there was at least 12 hours of no rain between events were captured during the 3-month flow monitoring period. The highest intensity rainfall took place on 8/22/19, when a total of 0.58 inches fell during a 15-minute interval yielding an intensity of 0.69 inches/hour. During the monitoring period a total of 9.32" of rain was recorded from 18 storms. The storms are summarized in Table 3-2:

Table 3-2 – 2019 Rainfall Summary

Rainfall Event No	Start Date/Time	End Date/Time	Maximum 15min intensity in/hr	Maximum 1hr intensity in/hr	Rainfall Depth in
1	8/21/2019 16:25	8/21/2019 16:45	0.8	0.24	0.24
2	8/22/2019 19:20	8/23/2019 9:15	2.32	0.69	1.09
3	9/2/2019 9:30	9/2/2019 13:40	0.92	0.26	0.58
4	9/12/2019 18:10	9/12/2019 21:00	0.08	0.04	0.09
5	9/23/2019 23:05	9/23/2019 23:25	0.08	0.03	0.03
6	9/30/2019 22:25	9/30/2019 22:40	0.08	0.03	0.03
7	10/2/2019 16:45	10/2/2019 17:30	0.16	0.06	0.06
8	10/3/2019 1:15	10/3/2019 23:20	0.12	0.07	0.40
9	10/7/2019 18:05	10/8/2019 2:20	0.52	0.36	0.73
10	10/9/2019 9:35	10/9/2019 12:35	0.2	0.15	0.35
11	10/16/2019 13:35	10/16/2019 22:45	1.08	0.67	2.31
12	10/20/2019 12:05	10/20/2019 22:40	0.32	0.24	0.61
13	10/22/2019 16:10	10/23/2019 0:10	0.2	0.13	0.46
14	10/27/2019 5:45	10/27/2019 13:35	0.64	0.53	0.02
15	10/29/2019 10:25	10/30/2019 5:20	0.08	0.03	0.10
16	10/30/2019 23:00	10/31/2019 11:25	0.12	0.10	0.10
17	10/31/2019 22:40	11/1/2019 1:05	0.4	0.21	0.77
18	11/7/2019 17:35	11/7/2019 19:40	0.04	0.04	0.07

Based on experience with local rainfall patterns and definitions in the QAPP, rainfall events with a broad distribution of total rainfall volume and peak 15 min intensities were used for calibration. A preference was applied towards larger events that would allow the model to be calibrated most accurately around events similar to the 5th largest storms event. Events were selected for calibration based on:

- Depth
  - Low <0.50 inches
  - Medium 0.50-1.50 inches
  - High >1.50 inches
- 15 min intensity
  - Low intensity <0.25 in/hr
  - Medium Intensity 0.25>0.65 in/hr
  - High intensity >0.650 in/hr

The following storms were selected for calibration:

Table 3-3 - Rainfall Analysis Summary

Classification	Date	Rainfall Depth in	Depth Range	Maximum 15min intensity in/hr	Intensity Range
Calibration	8/22/2019	1.09	Medium	2.32	High
Validation	9/2/2019	0.58	Medium	0.92	High
Calibration	10/7/2019	0.73	Medium	0.52	Medium
Calibration	10/16/2019	2.31	High	1.08	High
Validation	10/27/2019	1.3	Medium	0.64	High

3.3 Flow Monitoring

The supplemental system flow monitoring was not meant to replace monitoring conducted in 2016 but to provide more detail in areas previously not monitored. To validate the model's response and to enhance the calibration, seven flow meters, three level sensors and one rain gauge were installed in the collection system.

Flow Assessment Services was retained as a sub-consultant by Mott MacDonald and was responsible for the installation, operation, maintenance, and extraction of flow information from the temporary meters. The meters were area velocity meters installed by Flow Assessment services on August 16, 2019 and removed on November 18, 2019. For velocity measurement, these meters use a continuous wave Doppler ultrasonic beam that provides an average of the entire flow profile. Levels were measured using a pressure sensor which converts the pressure measured at the sensor into a depth of the water column over the sensor. The pressure level sensor has the added advantage of measuring surcharge levels and will operate accurately even if debris is present. All monitoring locations also had a supplementary ultrasonic down-looking sensor to provide redundant level information. The sensor measurements for the velocity and depth were converted into a flow rate taking into account the pipe diameter where the flow meter is installed.

4 Model Development

The updated Town of Harrison collection system model was built and simulated using the InfoWorks ICM collection system modeling software. InfoWorks ICM is a sophisticated, fully dynamic collection system model that can characterize a broad spectrum of hydrologic and hydraulic conditions, including backwater effects, flow reversal, surcharging and tidal influences. Also, since the regional PVCS model is also being developed using InfoWorks ICM, this approach will make integration with that model straightforward.

4.1 Modeling Framework

The same modeling framework that was utilized in the 2018 Combined Sewer System Characterization model was carried over to this update. The primary changes including adding significantly greater detail to the model. The pipes and manholes added enhance municipal system representation. The revised model features netting facilities that were previously disregarded. This addition allowed the modeler to reflect on current boundary conditions which depend on maintenance timing. Figure 4-1 below provides a comparison of how the original model compares to the updated model. To be consistent with the PVSC Group and to allow for easier integration, InfoWorksICM V 7.5 was utilized for the recalibration.

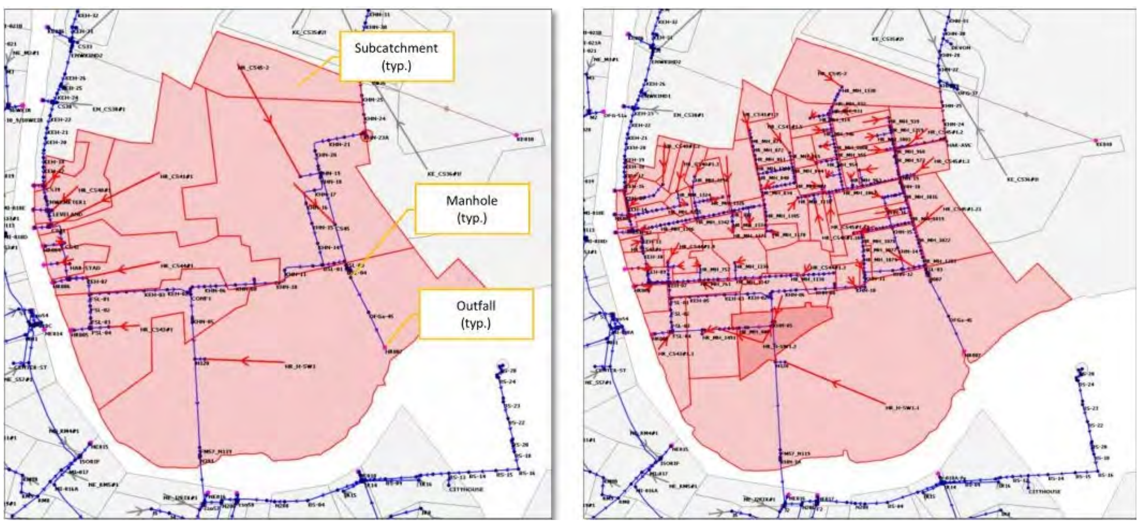


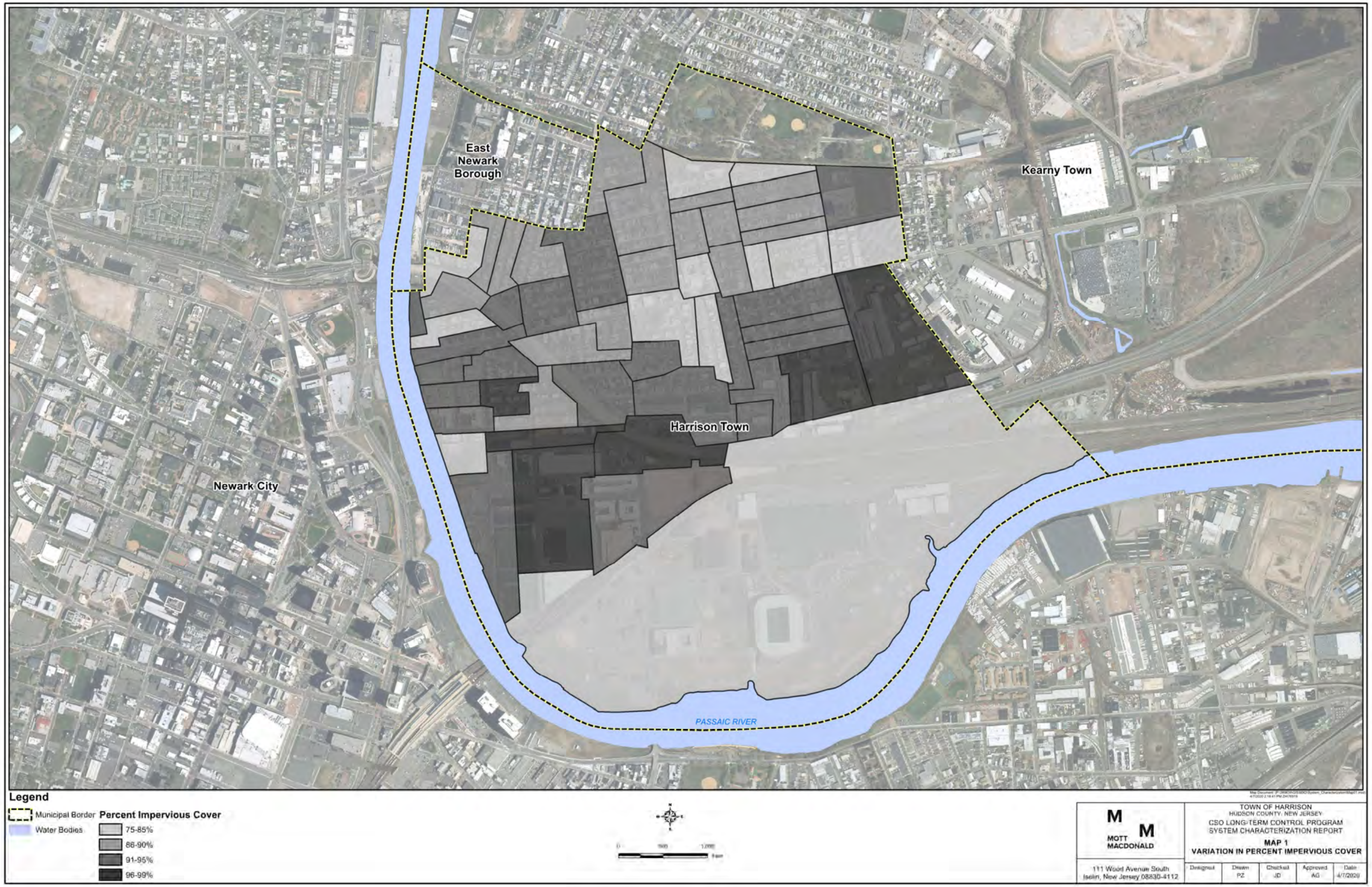
Figure 4-1 Original Model Detail (Left) vs. Updated Model Detail (Right)

The updated model includes a much larger portion of the pipes in the Town of Harrison collection system than the original model. As a result, there are many more and smaller contributing drainage areas (subcatchments) directing flow to the collection system.

In addition to the greater model detail, the updated model includes new sanitary sewer areas and reclassifies select areas that were previously considered combined sewer as sanitary sewer. **Error! Reference source not found.** highlights the sanitary sewer areas in the updated model.

4.2 Impervious Cover

Statewide land use/land cover data is publicly available through the New Jersey Department of Environmental Protection (NJDEP), Bureau of GIS. Hudson County Impervious Surface (2015) dataset was used to estimate percent impervious surface for the Town of Harrison. This data was used to compute subcatchment imperviousness using area weighted average and GIS spatial analysis as shown in Map 3 . The overall area is about 89% impervious. The detailed subcatchment area description is in Appendix C.



Map 3 - Variation in Percent Impervious Cover

5 Model Calibration and Verification

Model calibration generally consists of changing the model variables of the sewer network and subcatchments to achieve an acceptable agreement between model predicted and observed flows, depths, and volumes from the flow meters. Sewer systems are dynamic systems and have variables that are difficult to predict with complete accuracy, including basic items such as dry weather flows which can change somewhat from day to day and week to week. Historically the calibration and verification process has involved making manual adjustments to individual variables, simulating the model, and evaluating whether the model to flow meter match improved or not. Based on experience of the modeler, the process is continued for several different periods to find the adjustments that provide the best fit between monitored and modelled peak flows and flow volumes for both dry and wet weather periods. This section describes the model calibration and verification process and the criteria used to gage agreement with acceptable modeling standards.

5.1 Calibration Criteria

The most common way to evaluate collection system model performance is through the application of numerical criteria to individual storm events. This approach isolates individual storm events with distinct start and end times from a continuous model simulation and evaluates metrics such as agreement between modeled and observed peak flow, overall volume, and peak depth against a numerical standard. The most widely used standard of this kind comes from the Chartered Institution of Water and Environmental Management (CIWEM) Urban Drainage Group Code of Practice for the Hydraulic Modeling of Urban Drainage Systems. Table 5-1 summarizes the numerical calibration/validation criteria that are part of this standard.

Table 5-1- CIWEM Calibration and Validation Criteria

Category	Dry weather flow	Wet weather flow
Peak flow	±10%	+25% to -15%
Volume	±10%	+20% to -10%
Unsurcharged depth	±4 inches	±4 inches
Surcharged depth	N/A	+20 inches to -4 inches
Time of peaks	Within 1 hour	Similar

Additional non-numeric criteria from CIWEM include the following:

- Known flooding experienced during flow monitoring should be reasonably reproduced by the model.
- The location, frequency, and severity of historical flooding locations should be reasonably reproduced by the model.
- The model should accurately reproduce the activation frequency and overall discharge volume of known significant CSOs and SSOs.

For dry and wet weather events, CIWEM recommends that a sufficient number of time periods within the flow meter data are selected to reasonably calibrate and validate the results. A single continuous flow record should be used where there is significant rainfall induced variation in inflow and infiltration. CIWEM also recommends that for at least two-thirds of the rain events selected, the measured results should match model results within CIWEM Standards for all flow meter sites with suitable data.

5.2 Dry Weather Calibration

The dry weather flow (DWF) contribution for the Town of Harrison was originally calculated by taking flow data measured at the PVSC billing meter at most southside downstream interceptor and subtracting upstream flow contributions from the Town of Kearny at East Hamilton Street and East Newark at Passaic Avenue. This computed flow time series represented the total flow contribution from Harrison to the PVSC interceptor system. After the total flow time series from Harrison it needed to be divided into its dry weather and wet weather flow contributions. This step was accomplished using the USEPA's SSOAP software tool which is a commonly used tool for this type of flow decomposition. Its capabilities also include identifying storm events from a rainfall time series and generating statistics on those storm events. After DWF periods were identified from the rainfall analysis, the resulting DWF days were separated into weekdays and weekends. The DWF days are separated in this way because weekdays and weekends typically have distinctly different diurnal DWF patterns. After the DWF days are separated into these two categories, average daily flows were calculated for each and then they were further analyzed to calculate the 24-hourly factors to develop the corresponding DWF diurnal factors. Figure 5-1 and Figure 5-2 show a graphical overlay of the weekday and weekend days identified to reveal the average response of all the days and the shape of the diurnal patterns.

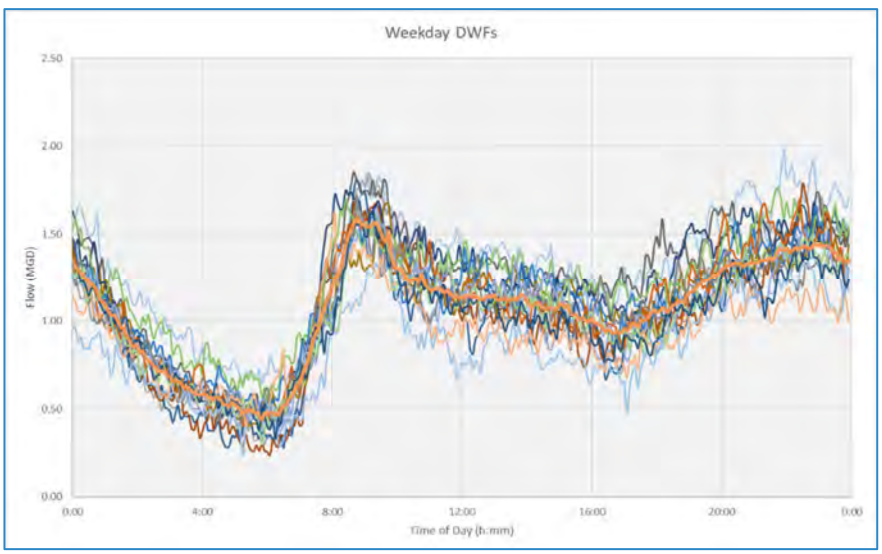


Figure 5-1 Overlay of calculated weekday DWF days

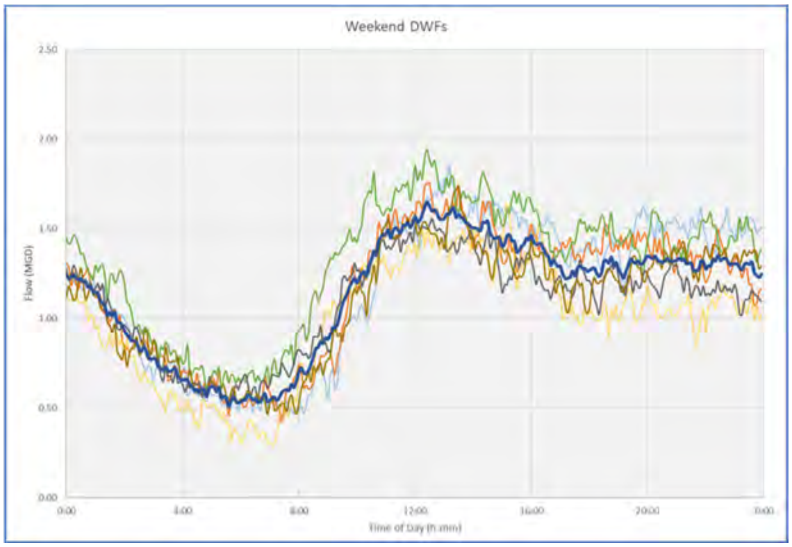


Figure 5-2 Overlay of calculated weekend DWF days

The total DWF is composed of both a groundwater infiltration (GWI) component and a base sanitary flow (BSF) flow component. The GWI represents a near constant infiltration of flow into the collection system typically through pipe, manhole and lateral defects. The BSF is the sanitary sewage contribution which would apply the diurnal DWF hourly factors previously calculated. The total DWF from Harrison was determined to be 1.0 MGD, with 0.25 MGD of that total being GWI and 0.75 MGD calculated to be BSF. During model calibration, the GWI was further adjusted to provide the best overall match to the flow meter data.

The GWI and BSF flows are incorporated into the model through the model's subcatchments (drainage areas). The modeled GWI is assumed to scale proportionally with the length and diameter of pipes in a subcatchment (i.e. more pipe surface area is assumed to allow more infiltration into the collection system from the surrounding soil). Available GIS data was used to compute the number of "-in-miles" of pipe in each subcatchment (based on pipe length and diameter) to allocate the total computed GWI. The modeled BSF is distributed to the model subcatchments based on population (i.e. greater population in an area will result in greater sanitary flow contribution). Current US Census data was used to determine the populations for each of the model subcatchments and to calculate the corresponding gallon per capita values applied in the collection system model.

A seven-day DWF period was identified during flow monitoring period to evaluate the model's DWF calibration performance. Comparing the model's DWF results to an extended dry weather period in the flow monitoring period is a more robust comparison than simply comparing selected DWF days pulled from the flow monitoring record. The dry weather period was selected due to the high frequency of wet weather events throughout the flow monitoring period. The total volume over the entire DWF week was used for the volume comparison while each day's peak flows were averaged together for the peak flow comparison. Because the DWF weeks are selected from different seasons throughout the year, they can reveal any seasonal GWI variations. The flow depths appear reasonable using a Manning's N-value of 0.013 for all pipes which is in line with literature values for VCP, RCP and brick sewers.

DWF calibration was conducted using dry period from May 4th, 2018 through May 9th, 2018.

The average of the daily peak flows were within -3.4 % and the total DWF volume was within -0.2 %. These values are within the ±10% calibration criteria for both DWF peak flow and volume indicating an acceptable DWF model calibration.

After the original calibration the model using the 2018 flow metering data, additional flow metering data collection was performed in 2019. The original DWF calibration was checked against this new flow metering data, representing an independent validation of the model's DWF performance. This independent check also confirmed an acceptable DWF model performance. was verified with 2019 temporary meter data shown in the appendix.

5.3 Wet Weather and Verification Calibration

Table 5-2 includes a breakdown of the calibration and validation storms used including various attributes of the storm events. The overall goal was to get storms that represented a variety of durations, peak intensities, total rainfalls.

Table 5-2 - Calibration/Validation Storm Events

Classification	Start Date/Time	Rainfall in	Duration hr	Maximum 15min intensity in/hr	Maximum 1hr intensity in/hr
Calibration	8/22/2019 19:20	1.09	13.92	0.58	0.69
Validation	9/2/2019 9:30	0.58	4.17	0.23	0.26
Calibration	10/7/2019 18:05	0.73	8.25	0.13	0.36
Calibration	10/16/2019 13:35	2.31	9.17	0.27	0.67
Validation	10/27/2019 5:45	1.3	7.83	0.16	0.53

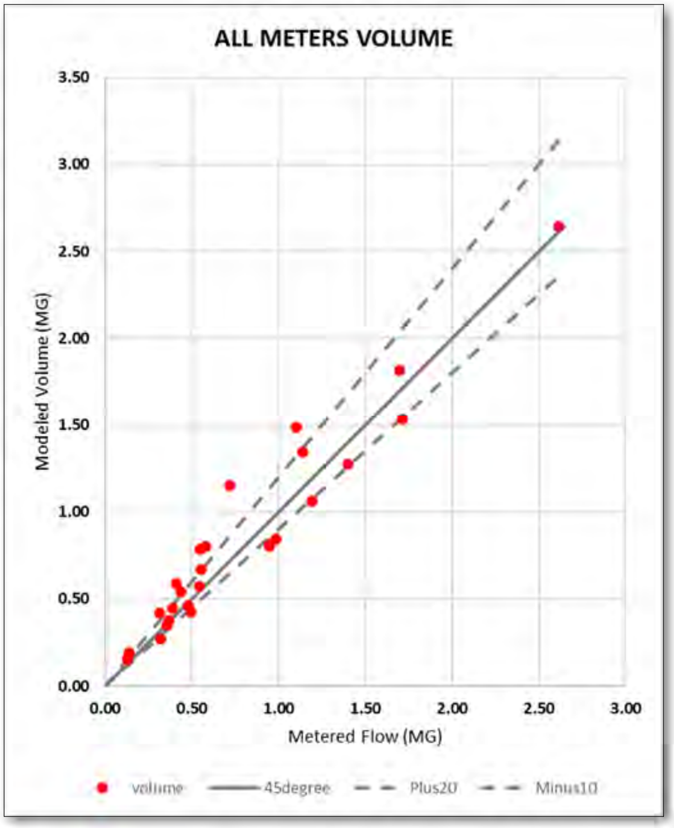
Three storm events were selected as calibration events. These events were both greater than 0.5 inch of precipitation and produced a response in the system. August 22, 2019 was 1.09 -inches in almost 14 hours, October 7^{th}, 0.73-inches in over 8 hours and August 16^{th}, 2.31-inches in over 9 hours. Providing a suitable range of storm peak intensities, durations and volumes.

The wet weather calibration charts for all flow meters across the calibration events show that the model generally provided acceptable simulation of flow generation and overall system hydraulics and performed well under varied rainfall totals, durations and intensities. An example of the calculated WWF calibration statistics are shown in **Error! Reference source not found.**. WWF calibration charts for each flow meter are provided in Appendix B.

Table 5-3 - October 7, 2019 Rainfall Event Wet Weather Calibration

Meter#	Metered volume (MG)	Modeled volume (MG)	Error for volume	Metered peak (MGD)	Modeled peak (MGD)	Error for peak flows
M-1	0.14	0.19	41.30%	2.27	2.41	6.10%
M-2	0.58	0.8	38.50%	11.16	11.94	7.03%
M-4	0.49	0.42	-14.20%	4.04	3.77	-6.54%
M-6	0.31	0.42	33.90%	4.04	5.18	28.21%
M-7	0.48	0.46	-4.20%	4.77	4.8	1%
M-10	0.44	0.54	24.00%	8.09	7.61	-5.91%

As can be seen in Figure 5-3, the overall model results match the metered data closely for the five (5) rainfall events that were captured during the monitoring period. Some outliers can be observed in the plots above which may be expected, but the majority of the simulated flow values fall on the 45-degree line which indicates a good correlation between the simulated and measured flows. Outliers are typically higher modeled volumes or peak flows indicating the model is conservative. Flow hydrographs for all meters across all calibration and validation storms are included in Appendix C.



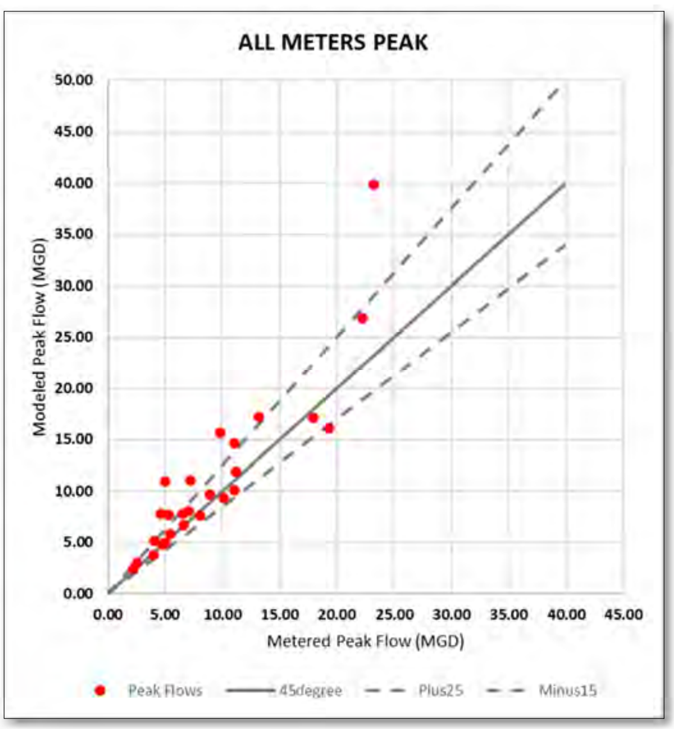


Figure 5-3 Goodness of Fit Plots for Measured Wet Weather Events

Conclusion

The Town of Harrison combined sewer model was expanded and re-calibrated to the current industry standard (CIWEM) guidelines. Mott MacDonald coordinated its model revision efforts with NJDEP in QAPP submittal. The model will be used in the baseline and alternatives evaluation of the typical year. As such the calibration was focused on the rainfall similar to those occurring in the typical year i.e. the model was not calibrated around high-return period storms. The model is expected to have increased accuracy that will support LTCP informed decision-making process.

Appendices

A. Dry Weather Flow Calibration

Table A-1 - Summary of Dry and Wet Weather Days for the Monitoring Period

Date	Rainfall (in)	Dry/Wet	Weekday/Weekend
8/18/2019	0.00	Dry	Weekend
8/19/2019	0.00	Dry	Weekday
8/20/2019	0.00	Dry	Weekday
8/21/2019	0.24	Wet	Weekday
8/22/2019	1.00	Wet	Weekday
8/23/2019	0.09	Wet	Weekday
8/24/2019	0.00	Wet	Weekend
8/25/2019	0.00	Dry	Weekend
8/26/2019	0.00	Dry	Weekday
8/27/2019	0.00	Dry	Weekday
8/28/2019	0.00	Dry	Weekday
8/29/2019	0.00	Dry	Weekday
8/30/2019	0.00	Dry	Weekday
8/31/2019	0.00	Dry	Weekend
9/1/2019	0.00	Dry	Weekend
9/2/2019	0.58	Wet	Weekday
9/3/2019	0.00	Wet	Weekday
9/4/2019	0.00	Wet	Weekday
9/5/2019	0.00	Dry	Weekday
9/6/2019	0.00	Dry	Weekday
9/7/2019	0.00	Dry	Weekend
9/8/2019	0.00	Dry	Weekend
9/9/2019	0.00	Dry	Weekday
9/10/2019	0.00	Dry	Weekday
9/11/2019	0.00	Dry	Weekday
9/12/2019	0.09	Wet	Weekday
9/13/2019	0.00	Wet	Weekday
9/14/2019	0.00	Dry	Weekend
9/15/2019	0.00	Dry	Weekend
9/16/2019	0.00	Dry	Weekday
9/17/2019	0.00	Dry	Weekday
9/18/2019	0.00	Dry	Weekday
9/19/2019	0.00	Dry	Weekday

Date	Rainfall (in)	Dry/Wet	Weekday/Weekend
9/20/2019	0.00	Dry	Weekday
9/21/2019	0.00	Dry	Weekend
9/22/2019	0.00	Dry	Weekend
9/23/2019	0.03	Wet	Weekday
9/24/2019	0.00	Wet	Weekday
9/25/2019	0.00	Dry	Weekday
9/26/2019	0.00	Dry	Weekday
9/27/2019	0.00	Dry	Weekday
9/28/2019	0.00	Dry	Weekend
9/29/2019	0.00	Dry	Weekend
9/30/2019	0.03	Wet	Weekday
10/1/2019	0.00	Wet	Weekday
10/2/2019	0.06	Wet	Weekday
10/3/2019	0.40	Wet	Weekday
10/4/2019	0.00	Wet	Weekday
10/5/2019	0.00	Wet	Weekend
10/6/2019	0.00	Dry	Weekend
10/7/2019	0.68	Wet	Weekday
10/8/2019	0.05	Wet	Weekday
10/9/2019	0.35	Wet	Weekday
10/10/2019	0.00	Wet	Weekday
10/11/2019	0.00	Wet	Weekday
10/12/2019	0.00	Dry	Weekend
10/13/2019	0.00	Dry	Weekend
10/14/2019	0.00	Dry	Weekday
10/15/2019	0.00	Dry	Weekday
10/16/2019	2.31	Wet	Weekday
10/17/2019	0.00	Wet	Weekday
10/18/2019	0.00	Wet	Weekday
10/19/2019	0.00	Dry	Weekend
10/20/2019	0.64	Wet	Weekend
10/21/2019	0.00	Wet	Weekday
10/22/2019	0.46	Wet	Weekday
10/23/2019	0.02	Wet	Weekday
10/24/2019	0.00	Wet	Weekday
10/25/2019	0.00	Dry	Weekday
10/26/2019	0.00	Dry	Weekend
10/27/2019	1.30	Wet	Weekend
10/28/2019	0.00	Wet	Weekday
10/29/2019	0.10	Wet	Weekday
10/30/2019	0.10	Wet	Weekday
10/31/2019	0.77	Wet	Weekday

Date	Rainfall (in)	Dry/Wet	Weekday/Weekend
11/1/2019	0.01	Wet	Weekday
11/2/2019	0.00	Wet	Weekend
11/3/2019	0.00	Dry	Weekend
11/4/2019	0.00	Dry	Weekday
11/5/2019	0.00	Dry	Weekday
11/6/2019	0.00	Dry	Weekday
11/7/2019	0.07	Wet	Weekday
11/8/2019	0.00	Wet	Weekday
11/9/2019	0.00	Dry	Weekend
11/10/2019	0.00	Dry	Weekend
11/11/2019	0.00	Dry	Weekday
11/12/2019	0.02	Wet	Weekday
11/13/2019	0.00	Dry	Weekday
11/14/2019	0.00	Dry	Weekday
11/15/2019	0.00	Dry	Weekday
11/16/2019	0.00	Dry	Weekend
11/17/2019	0.00	Dry	Weekend

Table A-2 Dry Weather Flow Allocations

DWF Allocations								
Component	Total Area (ac)	Population	Inch-Mile	GWI (MGD)	BSF (MGD)	BSF (gpcpd)	DWF (gpcpd)	GWI (gpimpd)
Meter MH028H029	777.36	13,707	240.1	0.25	0.75	54.7	80.4	1,041

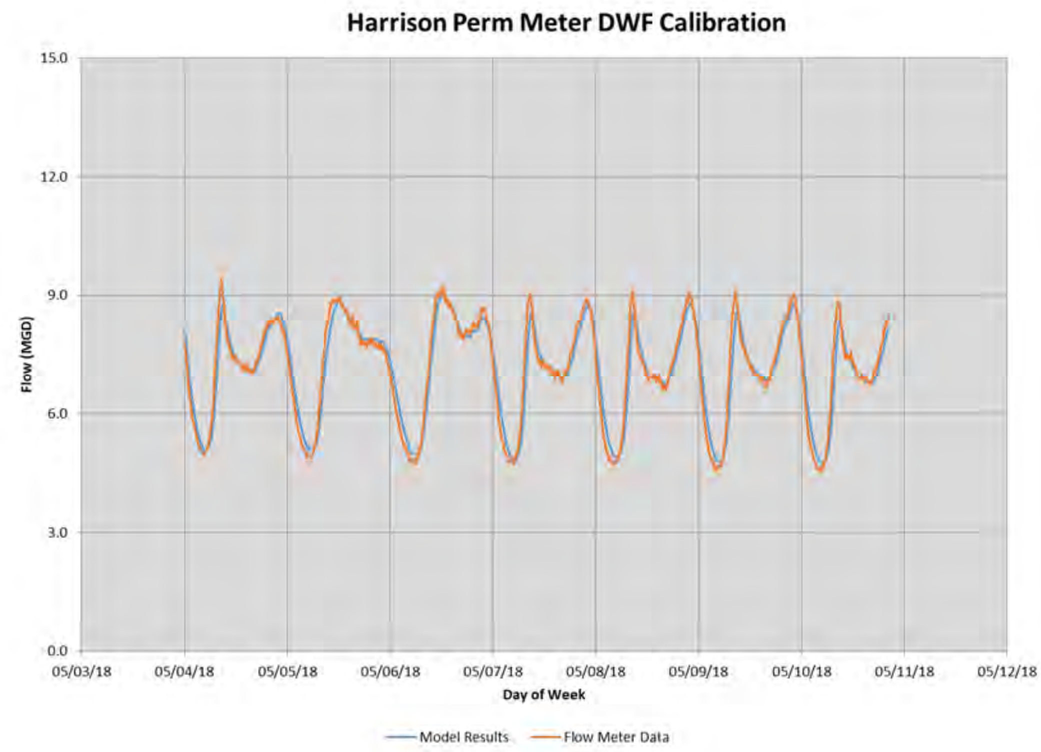


Figure A-1 2018 Permanent Meter Calibration

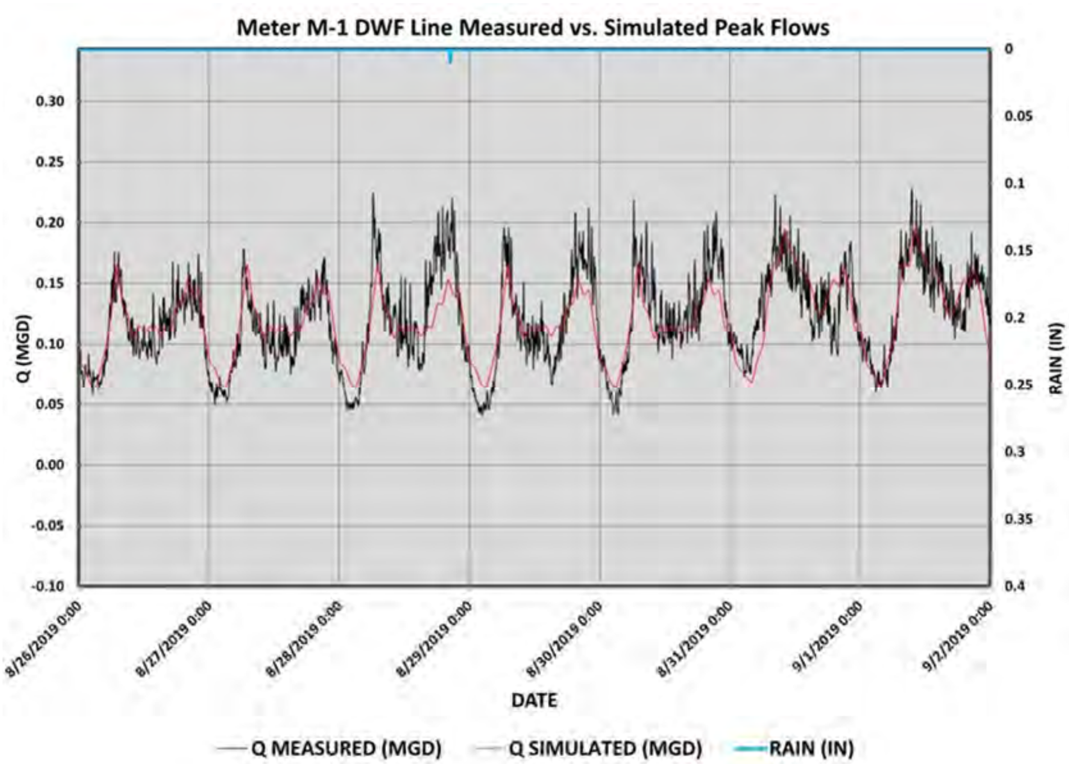


Figure A-2 2019 Temporary Meter Verification

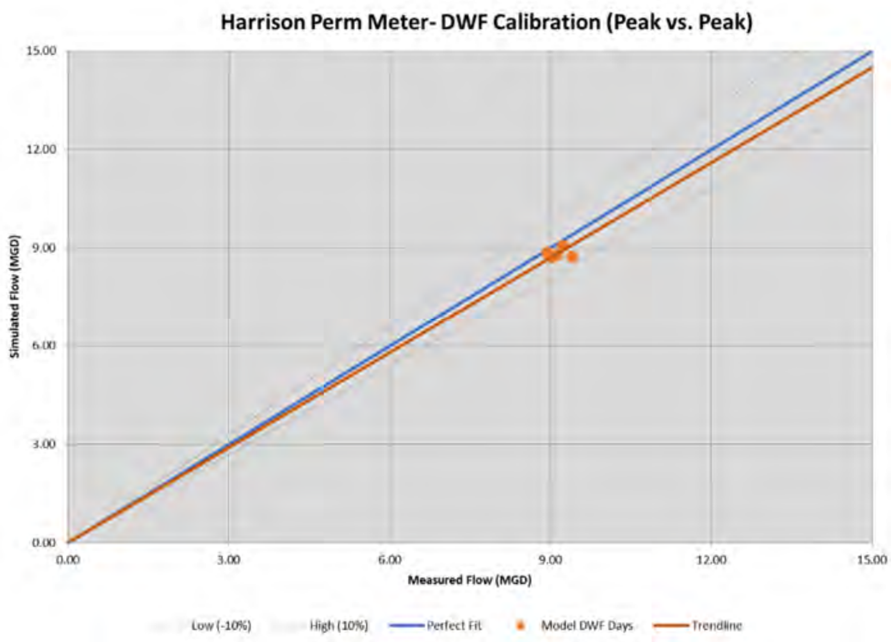


Figure A-3 Permanent Meter Calibration Peak vs. Peak

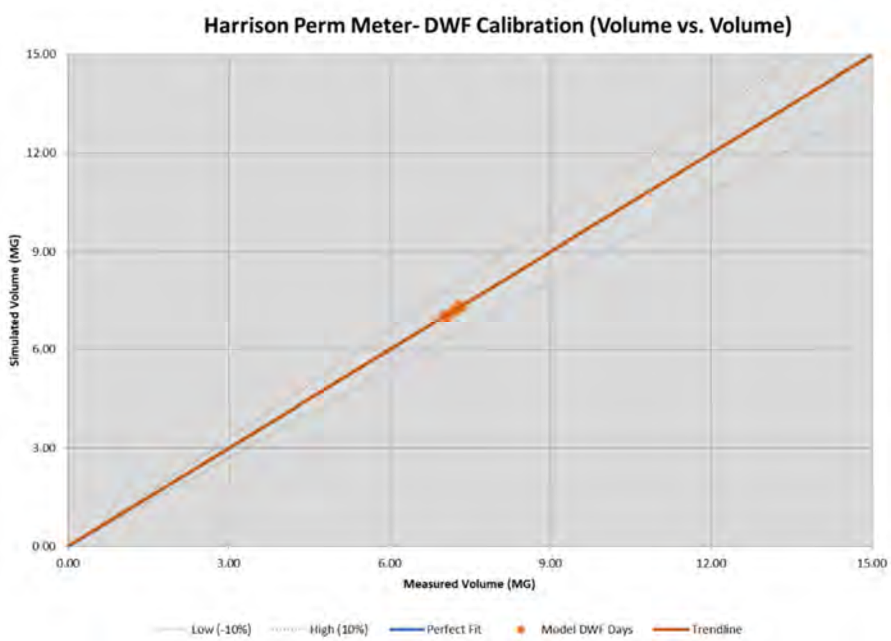
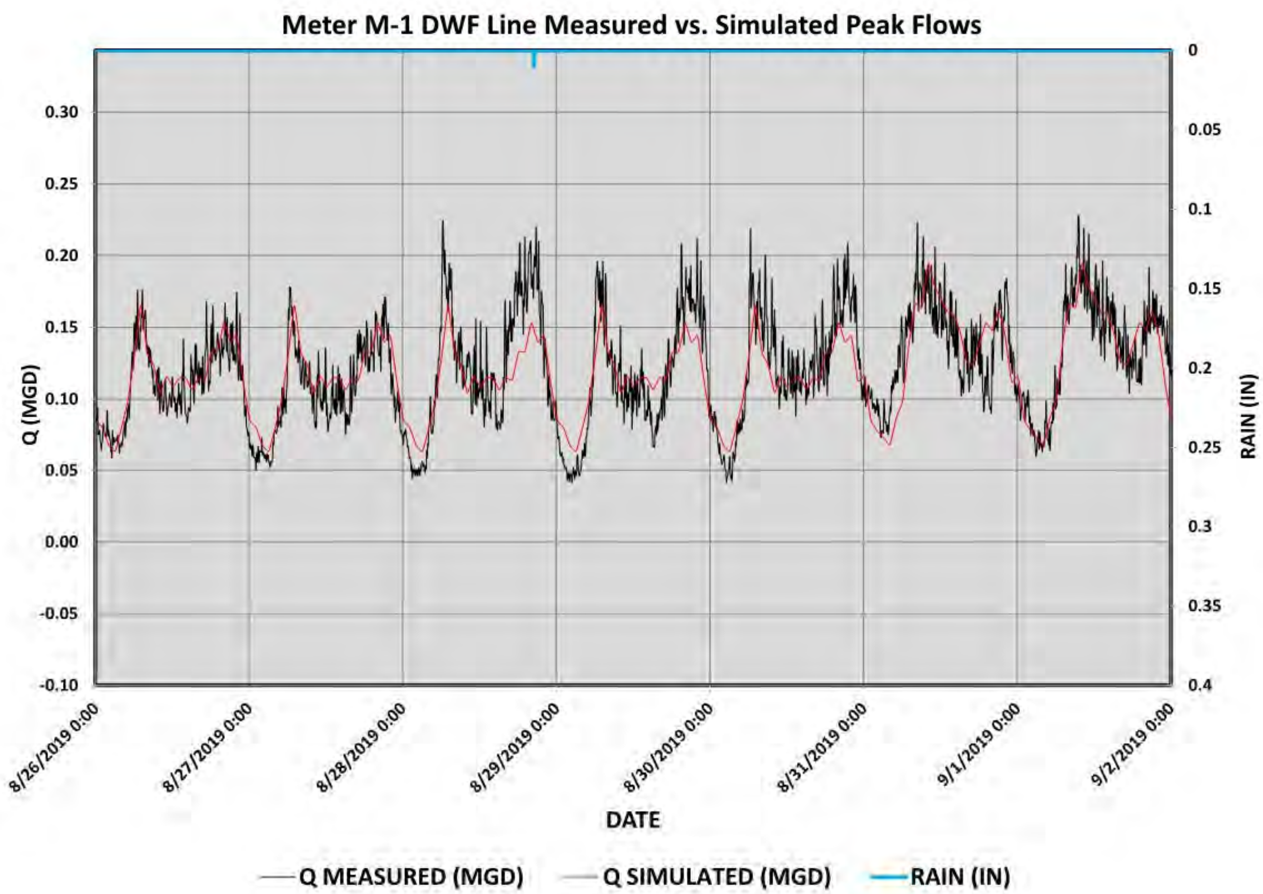
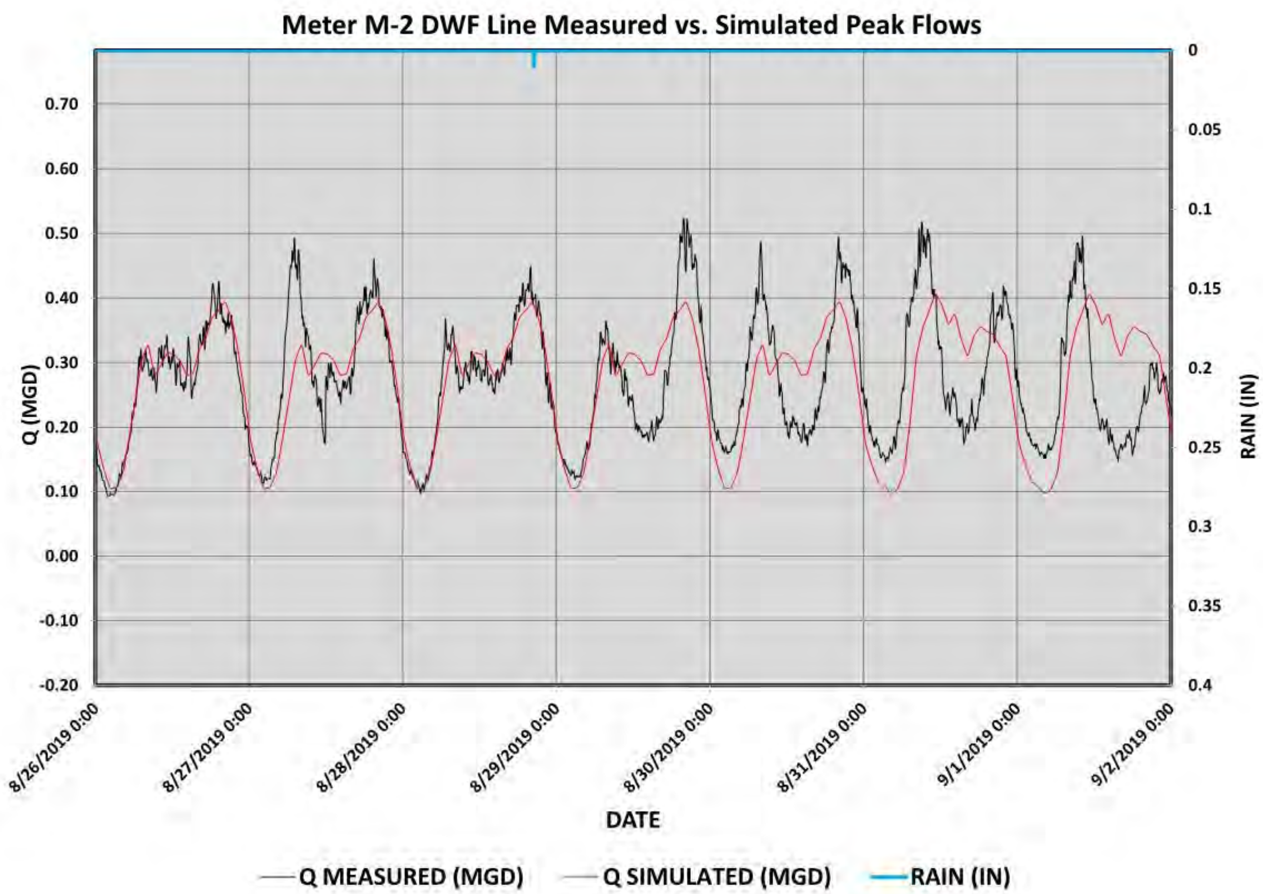
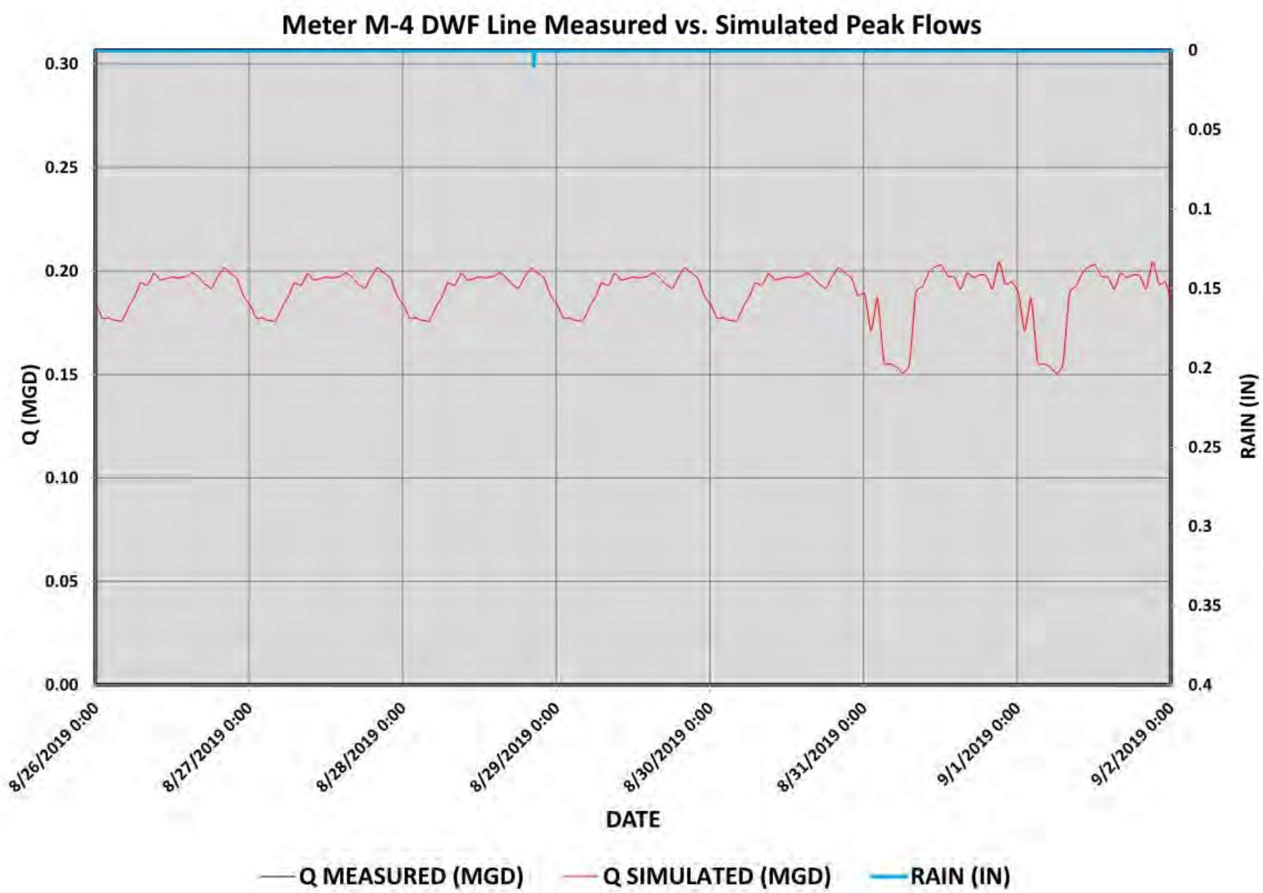


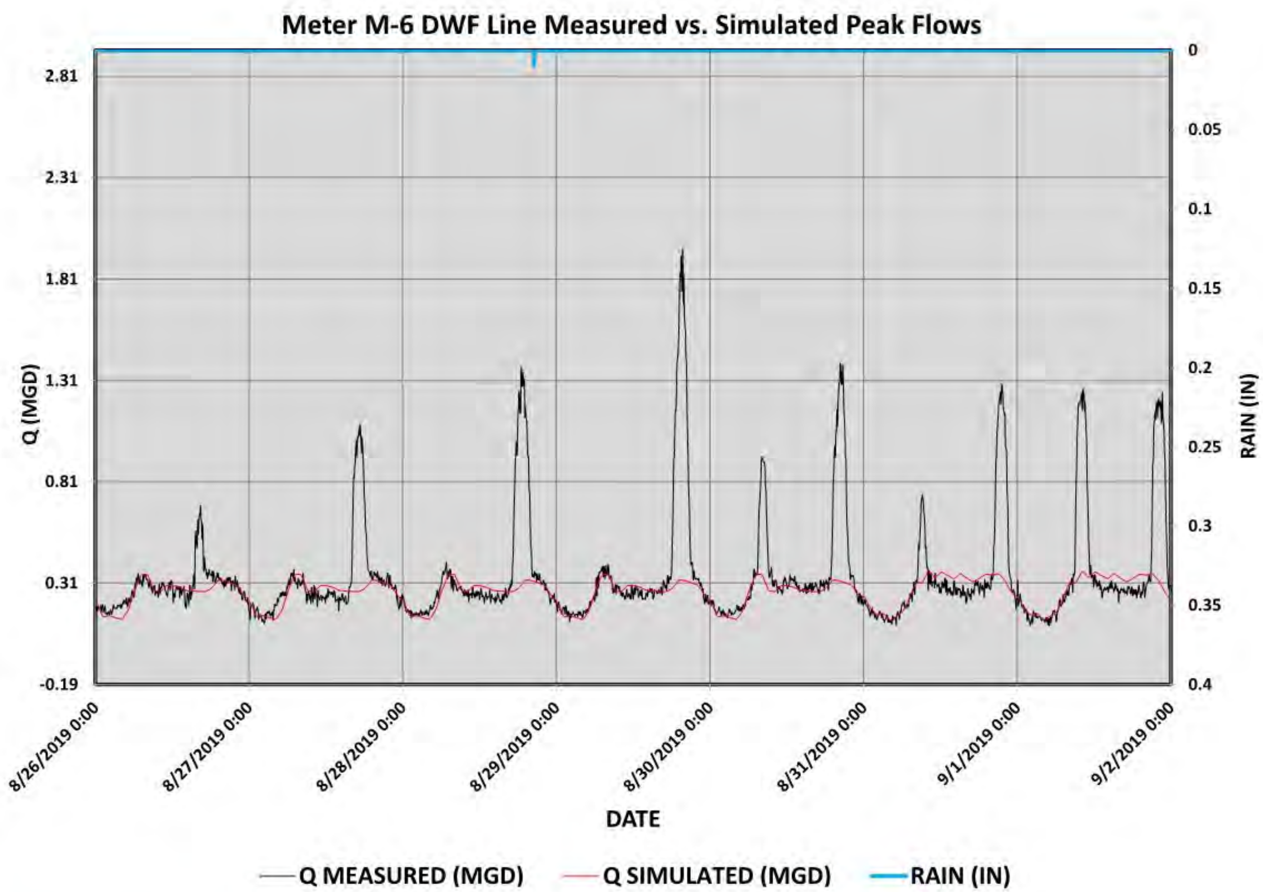
Figure A-4 Permanent Meter Calibration Volume vs. Volume


Meter M-1 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
RAIN (IN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/26/2019 0:00
8/27/2019 0:00
8/28/2019 0:00
8/29/2019 0:00
8/30/2019 0:00
8/31/2019 0:00
9/1/2019 0:00
9/2/2019 0:00
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)


Meter M-2 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
RAIN (IN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/26/2019 0:00
8/27/2019 0:00
8/28/2019 0:00
8/29/2019 0:00
8/30/2019 0:00
8/31/2019 0:00
9/1/2019 0:00
9/2/2019 0:00
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)

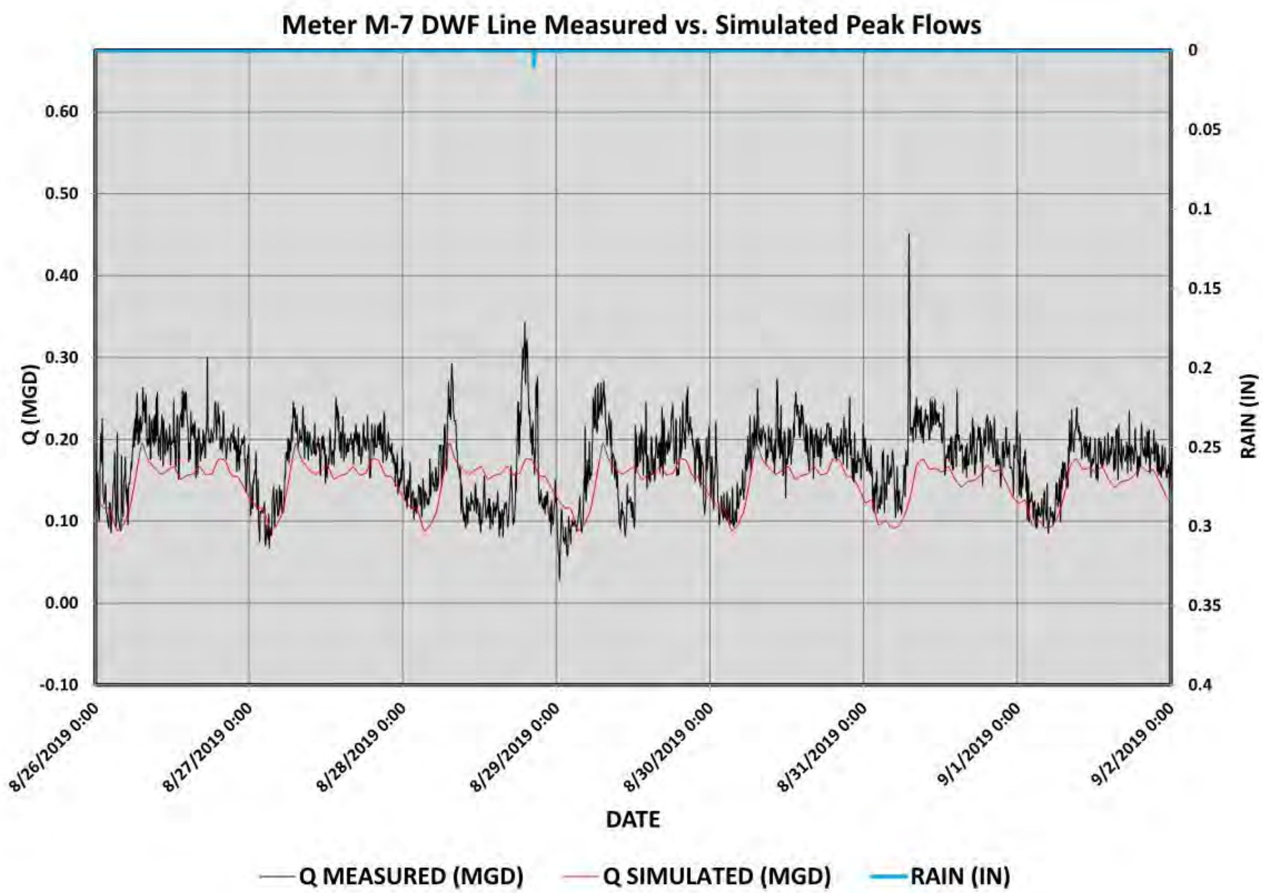


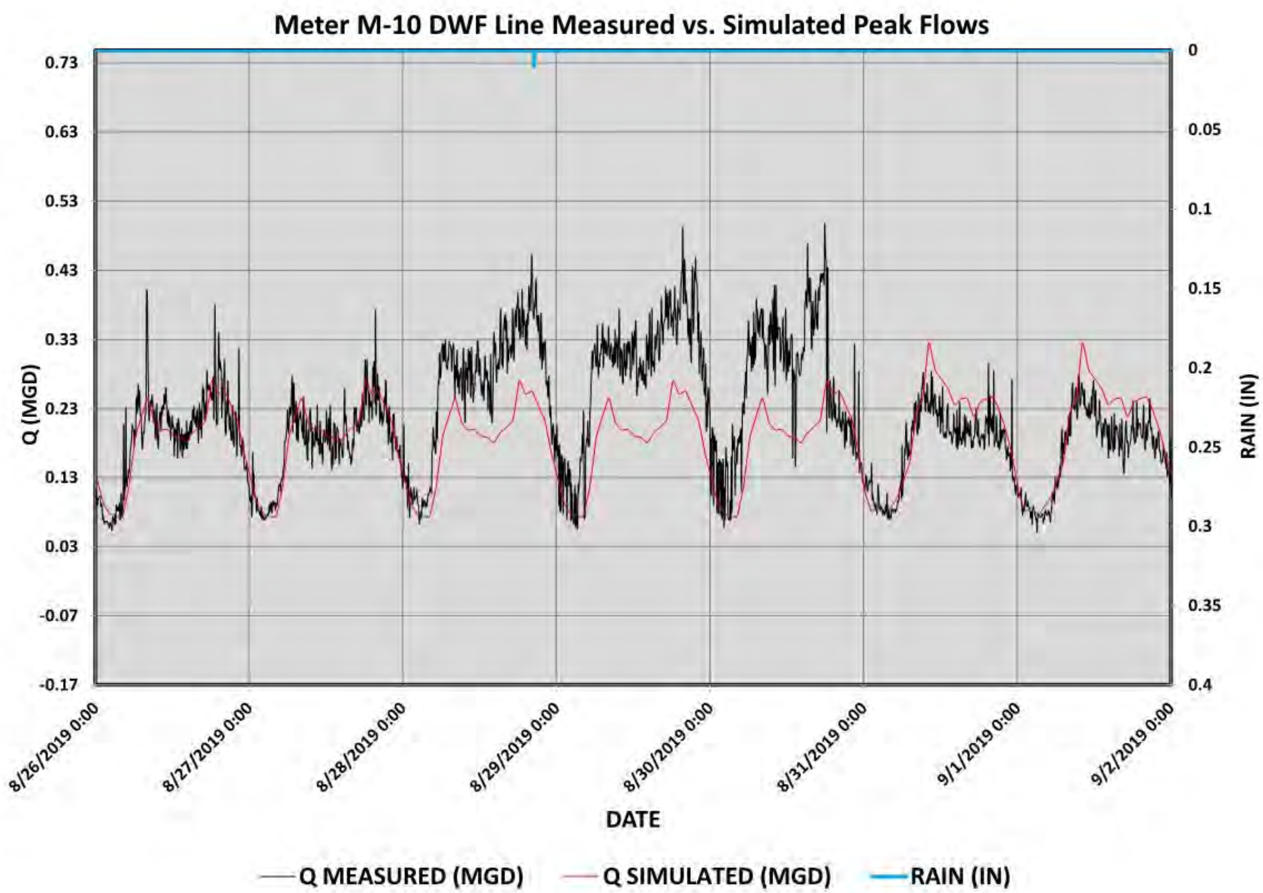
NO METER DATA



Note:

The source of measured flow spikes was not found. Its irregular appearance and magnitude prevent the model from making accurate predictions. The spikes were also observed during 2016 study.


Meter M-7 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
RAIN (IN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/26/2019 0:00
8/27/2019 0:00
8/28/2019 0:00
8/29/2019 0:00
8/30/2019 0:00
8/31/2019 0:00
9/1/2019 0:00
9/2/2019 0:00
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)

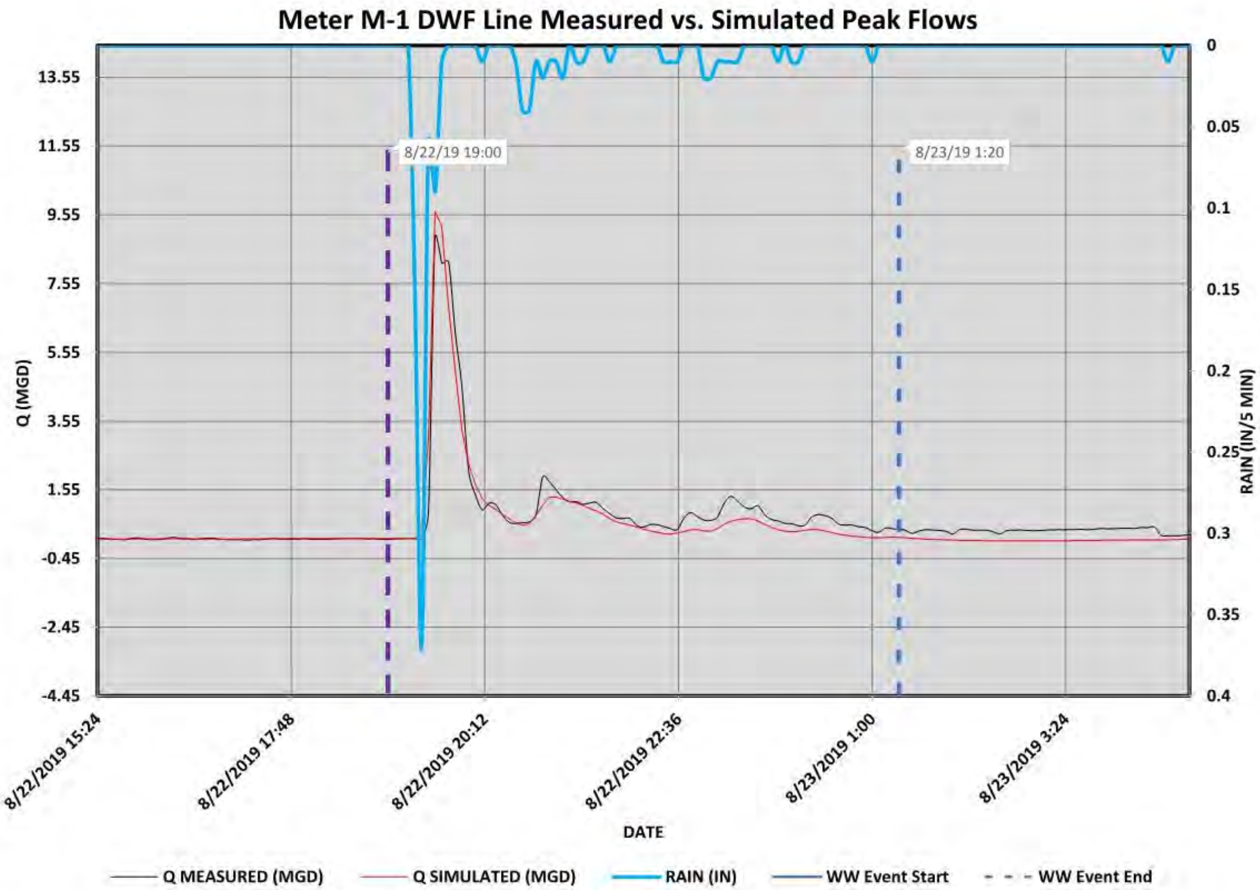

Meter M-10 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
0.73
0.63
0.53
0.43
0.33
0.23
0.13
0.03
-0.07
-0.17
RAIN (IN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/26/2019 0:00
8/27/2019 0:00
8/28/2019 0:00
8/29/2019 0:00
8/30/2019 0:00
8/31/2019 0:00
9/1/2019 0:00
9/2/2019 0:00
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)

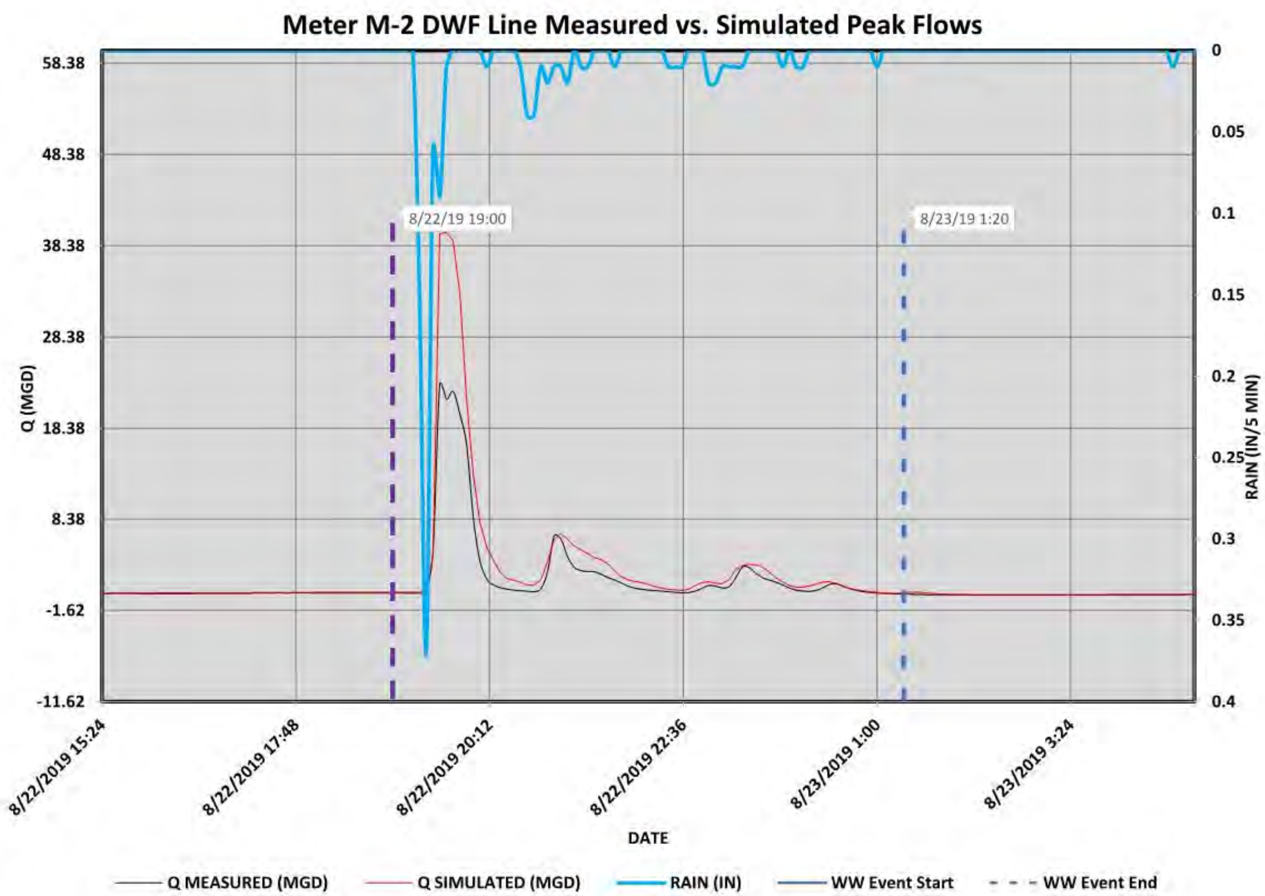
B. Wet Weather Flow Calibration

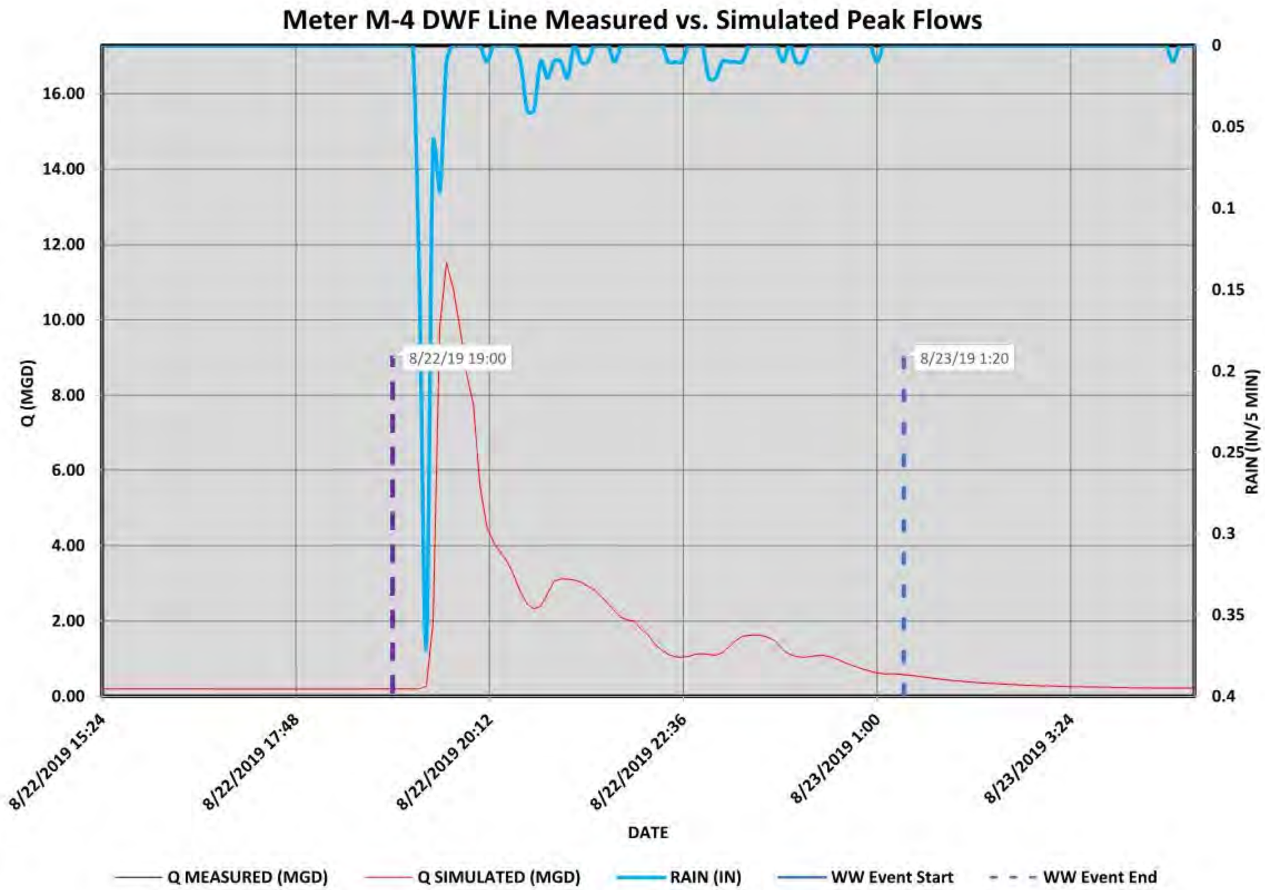
Table 5-4 – Wet Weather Calibration Results Summary

Meter#	Date	Metered Volume (MG)	Modeled Volume (MG)	Error for Volume	Metered Peak Flow (MGD)	Modeled Peak Flow (MGD)	Error for Peak Flow
M-1	8/22/2019	NO METER DATA					
M-1	9/2/2019	0.32	0.27	-14.62%	8.90	9.65	8.52%
M-1	10/7/2019	0.14	0.19	41.26%	2.27	2.41	6.10%
M-1	10/16/2019	NO METER DATA					
M-1	10/27/2019	0.13	0.16	22.33%	2.53	2.99	17.84%
M-2	8/22/2019	1.71	1.53	-10.52%	19.33	16.09	-16.74%
M-2	9/2/2019	0.72	1.15	60.15%	23.23	39.87	71.61%
M-2	10/7/2019	0.58	0.80	38.51%	11.16	11.94	7.03%
M-2	10/16/2019	2.61	2.65	1.27%	22.19	26.84	20.97%
M-2	10/27/2019	0.55	0.67	21.26%	17.97	17.15	-4.59%
M-4	8/22/2019	0.99	0.84	-14.44%	6.50	7.83	20.46%
M-4	9/2/2019	NO METER DATA					
M-4	10/7/2019	0.49	0.42	-14.17%	4.04	3.77	-6.54%
M-4	10/16/2019	1.10	1.49	34.72%	4.58	7.78	70.07%
M-4	10/27/2019	NO METER DATA					
M-6	8/22/2019	0.95	0.81	-13.91%	5.33	7.72	45.01%
M-6	9/2/2019	0.41	0.59	44.06%	9.81	15.68	59.87%
M-6	10/7/2019	0.31	0.42	33.88%	4.04	5.18	28.21%
M-6	10/16/2019	1.14	1.34	17.86%	4.97	10.93	119.80%
M-6	10/27/2019	0.36	0.35	-2.13%	5.44	5.83	7.12%

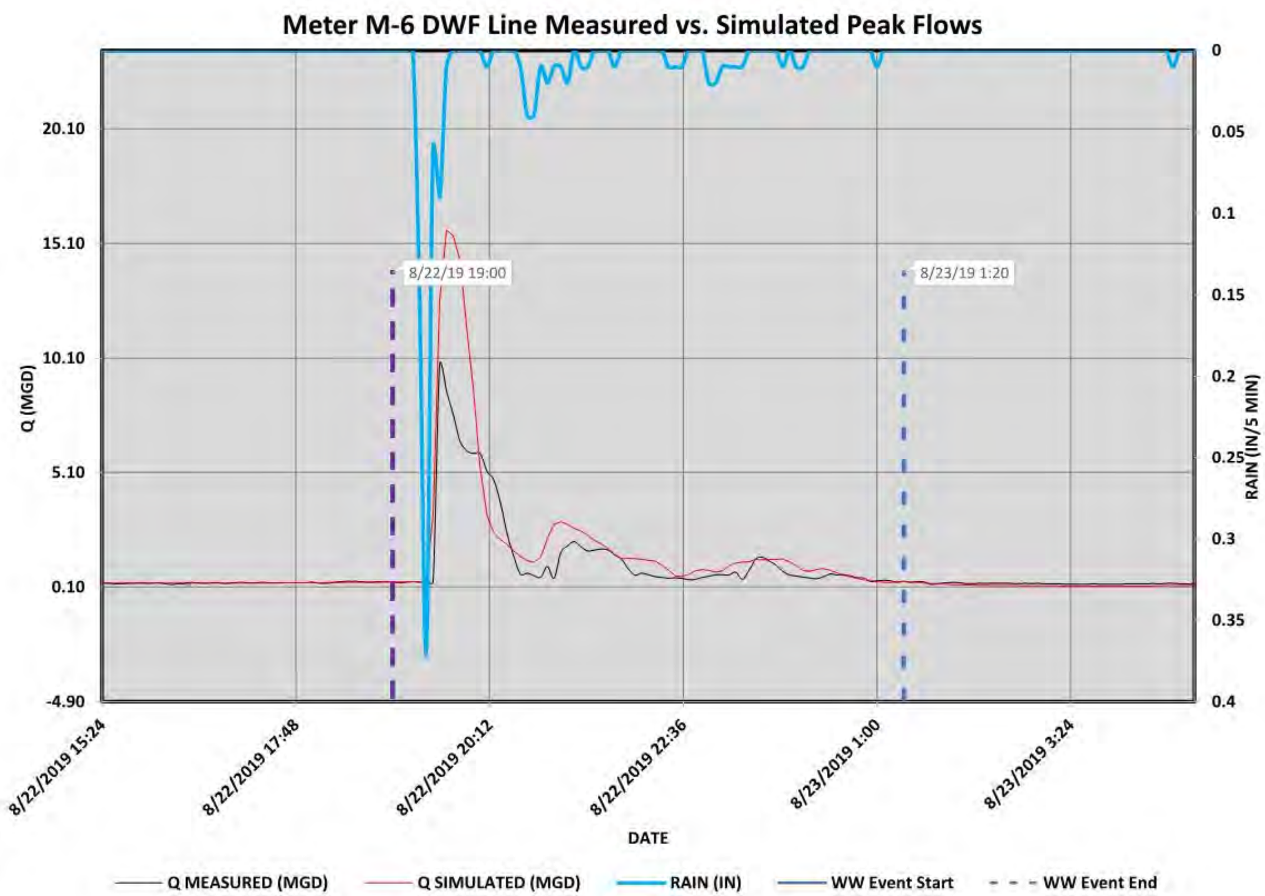
Meter#	Date	Metered Volume (MG)	Modeled Volume (MG)	Error for Volume	Metered Peak Flow (MGD)	Modeled Peak Flow (MGD)	Error for Peak Flow
M-7	8/22/2019	0.95	0.80	-15.40%	6.58	6.66	1.29%
M-7	9/2/2019	0.54	0.57	6.08%	7.25	11.04	52.40%
M-7	10/7/2019	0.48	0.46	-4.24%	4.77	4.80	0.66%
M-7	10/16/2019	1.40	1.27	-9.21%	7.07	8.08	14.32%
M-7	10/27/2019	0.36	0.38	2.95%	5.00	5.01	0.32%
M-10	8/22/2019	1.19	1.06	-11.05%	11.01	10.13	-7.94%
M-10	9/2/2019	0.55	0.79	43.72%	13.17	17.21	30.64%
M-10	10/7/2019	0.44	0.54	23.96%	8.09	7.61	-5.91%
M-10	10/16/2019	1.70	1.82	6.98%	11.02	14.60	32.46%
M-10	10/27/2019	0.39	0.44	14.25%	10.09	9.36	-7.24%

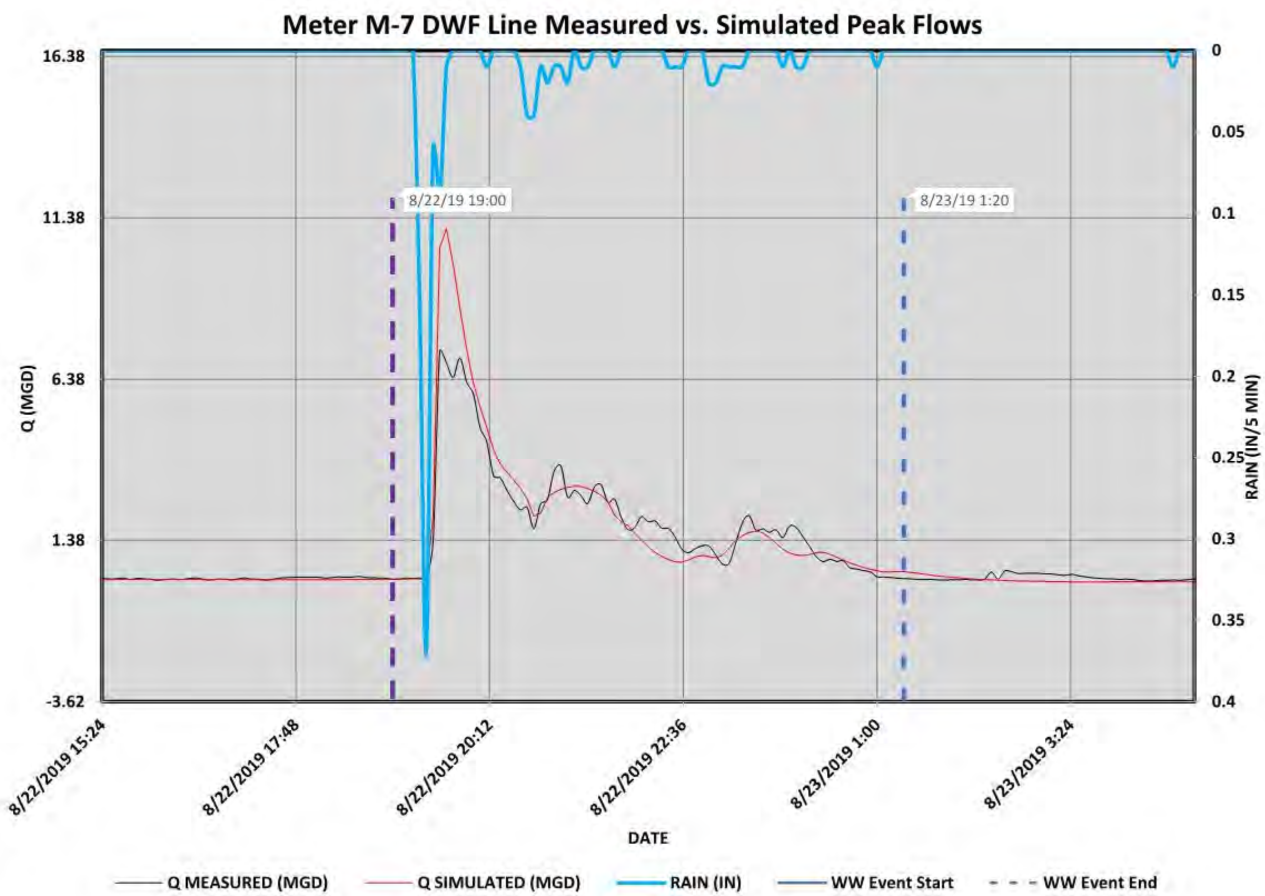

Meter M-1 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
13.55
11.55
9.55
7.55
5.55
3.55
1.55
-0.45
-2.45
-4.45
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/22/19 19:00
8/23/19 1:20
8/22/2019 15:24
8/22/2019 17:48
8/22/2019 20:12
8/22/2019 22:36
8/23/2019 1:00
8/23/2019 3:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

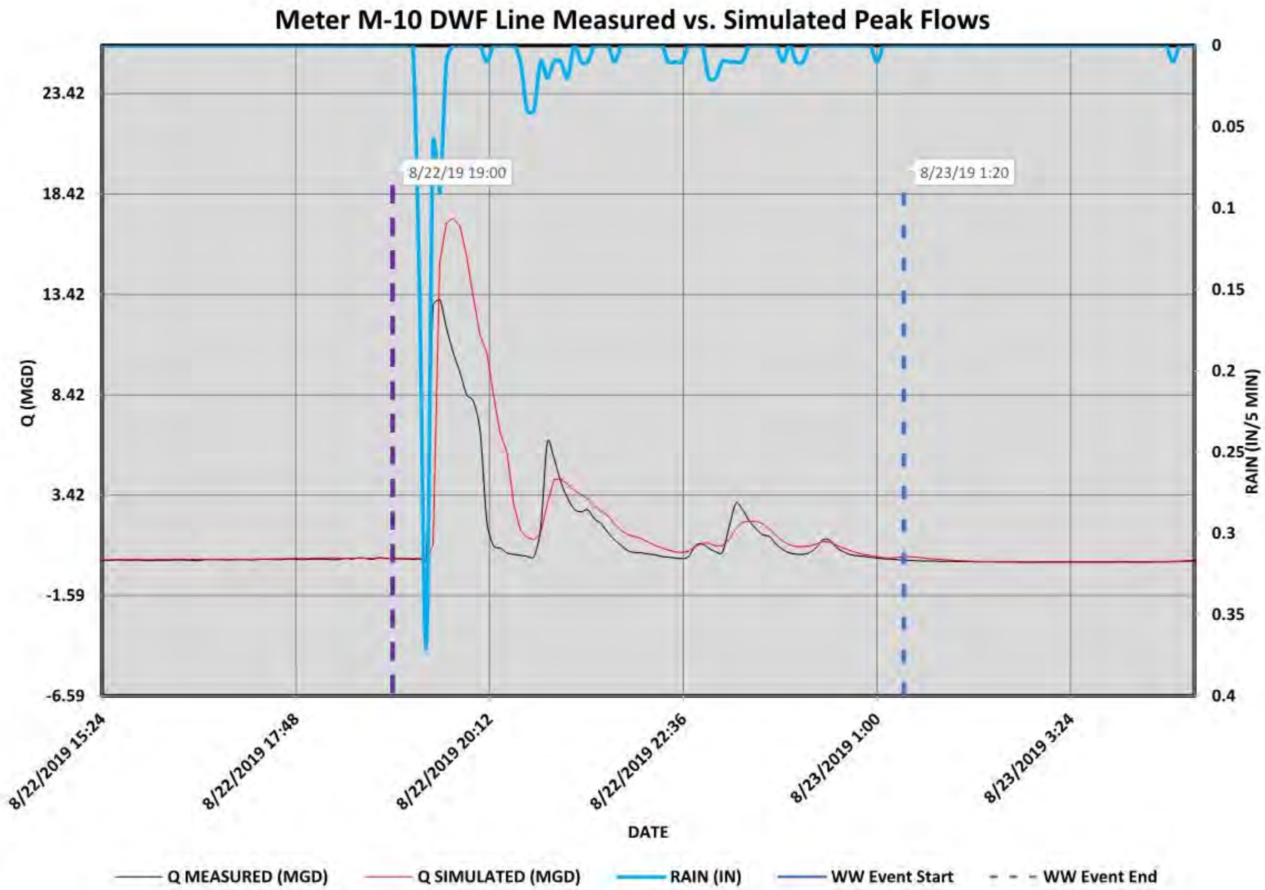

Meter M-2 DWF Line Measured vs. Simulated Peak Flows
58.38
48.38
38.38
28.38
18.38
8.38
-1.62
-11.62
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
8/22/19 19:00
8/23/19 1:20
8/22/2019 15:24
8/22/2019 17:48
8/22/2019 20:12
8/22/2019 22:36
8/23/2019 1:00
8/23/2019 3:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

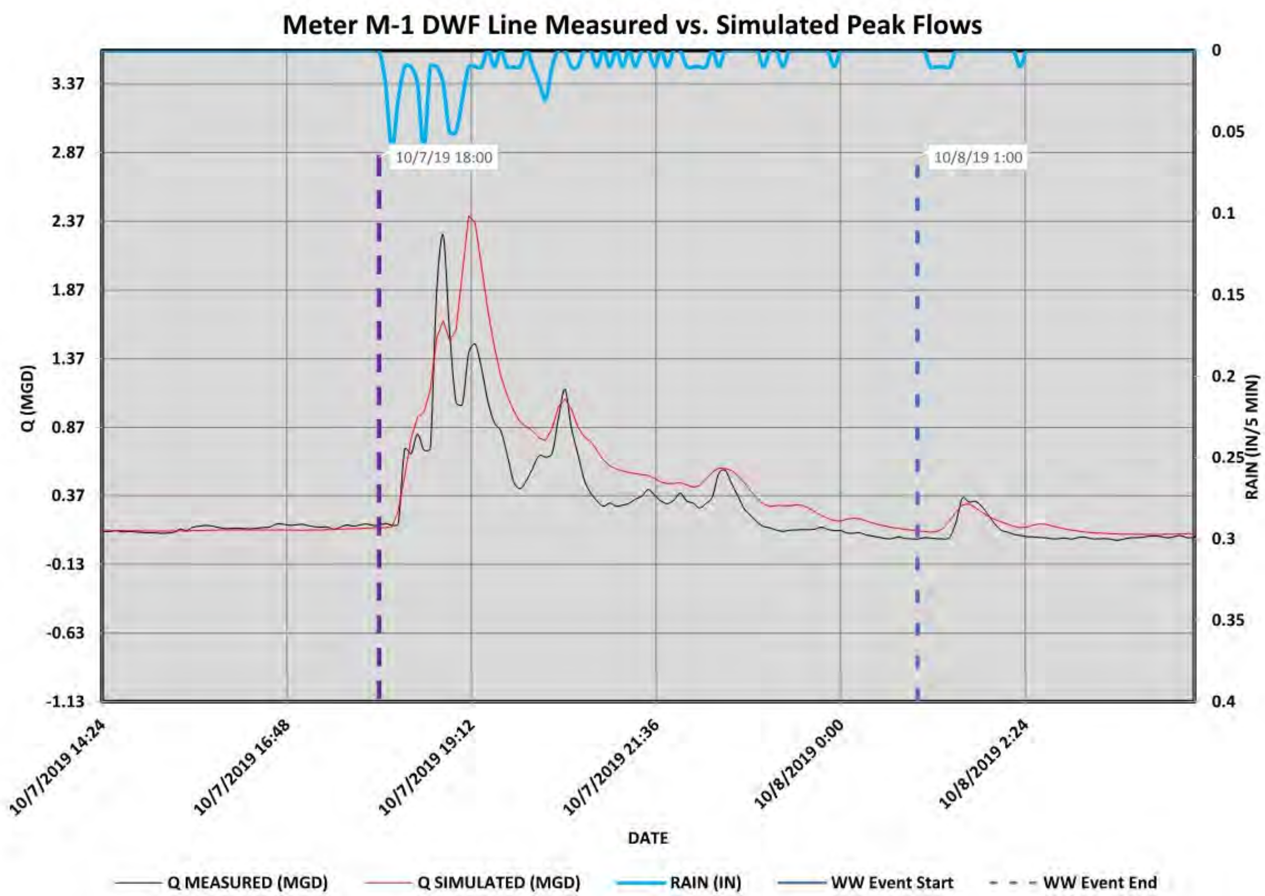


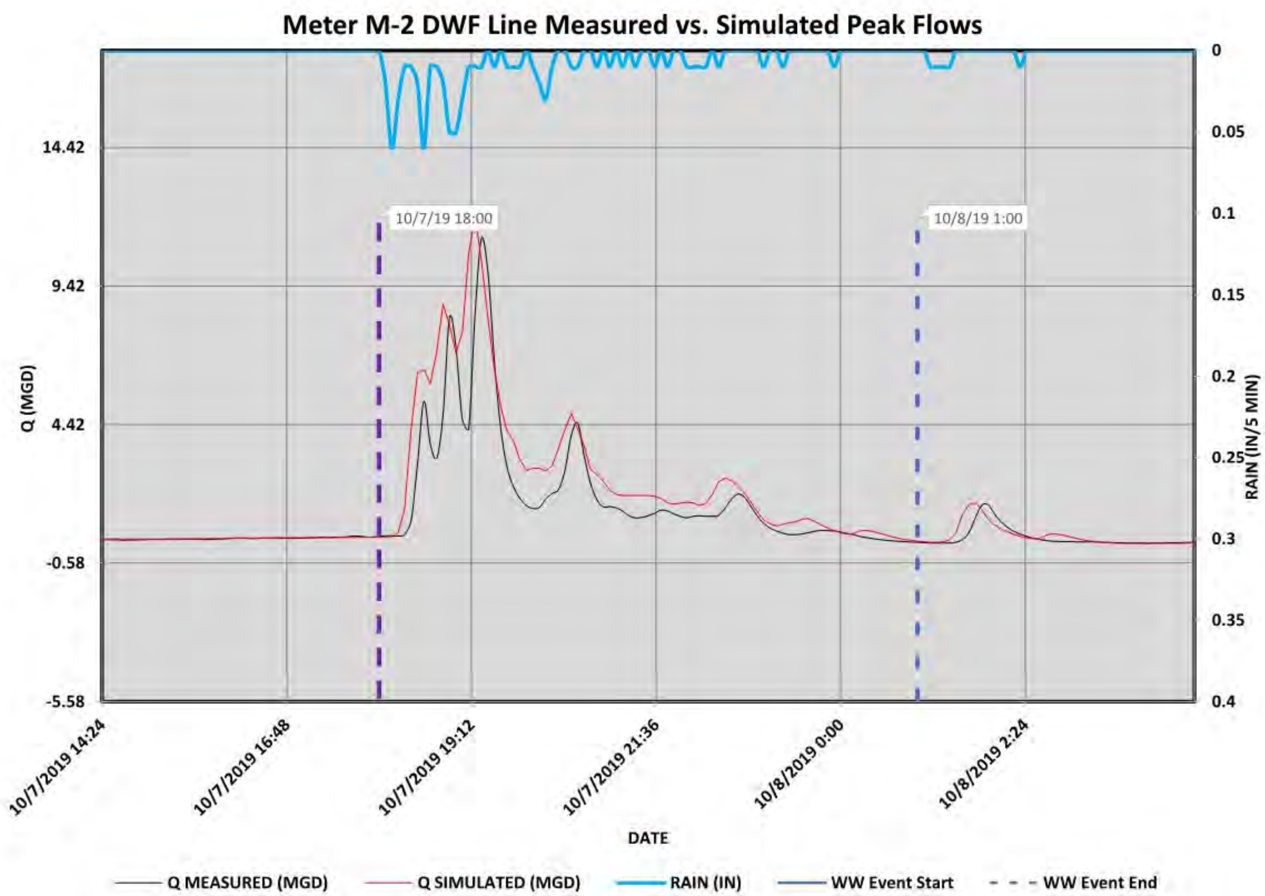
NO METER DATA

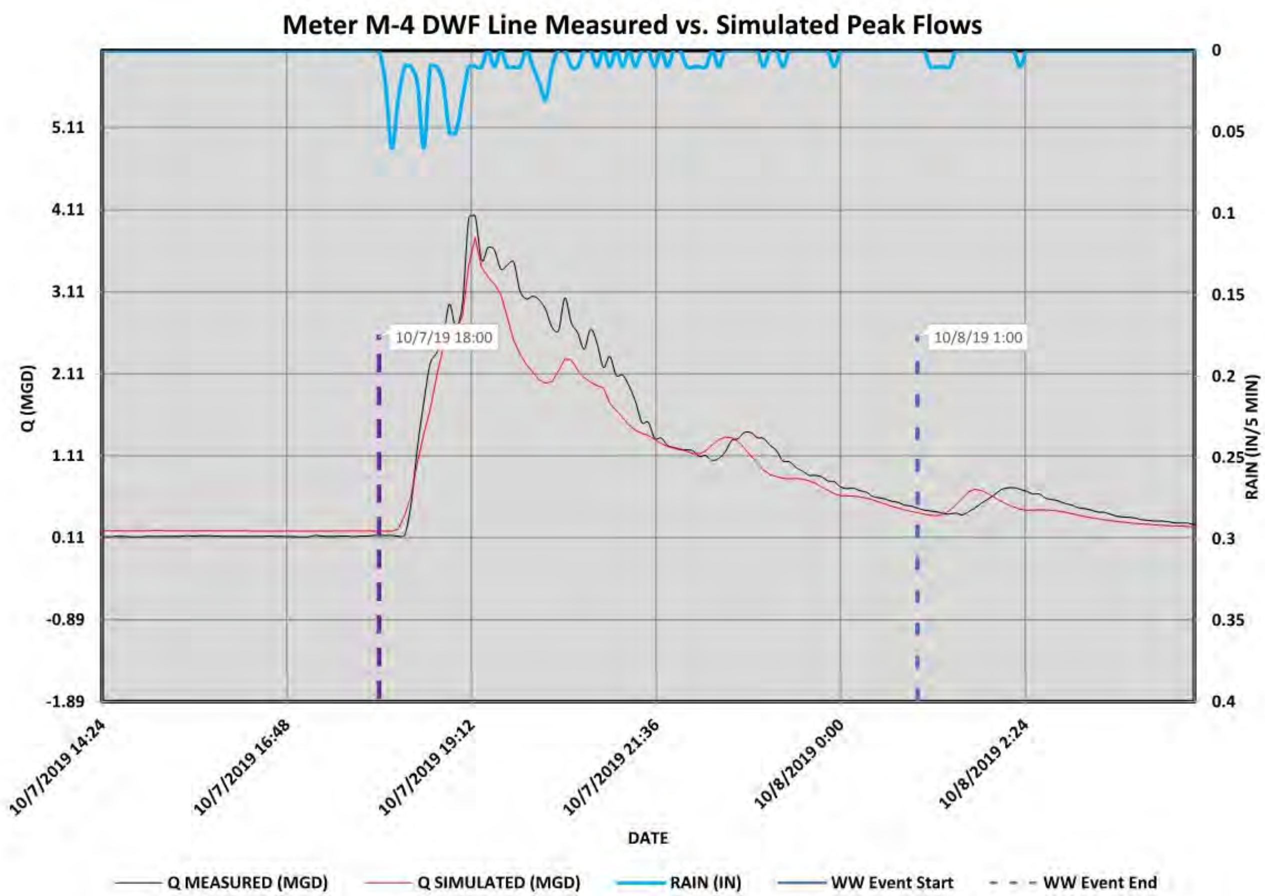

Meter M-6 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
20.10
15.10
10.10
5.10
0.10
-4.90
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/22/19 19:00
8/23/19 1:20
8/22/2019 15:24
8/22/2019 17:48
8/22/2019 20:12
8/22/2019 22:36
8/23/2019 1:00
8/23/2019 3:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

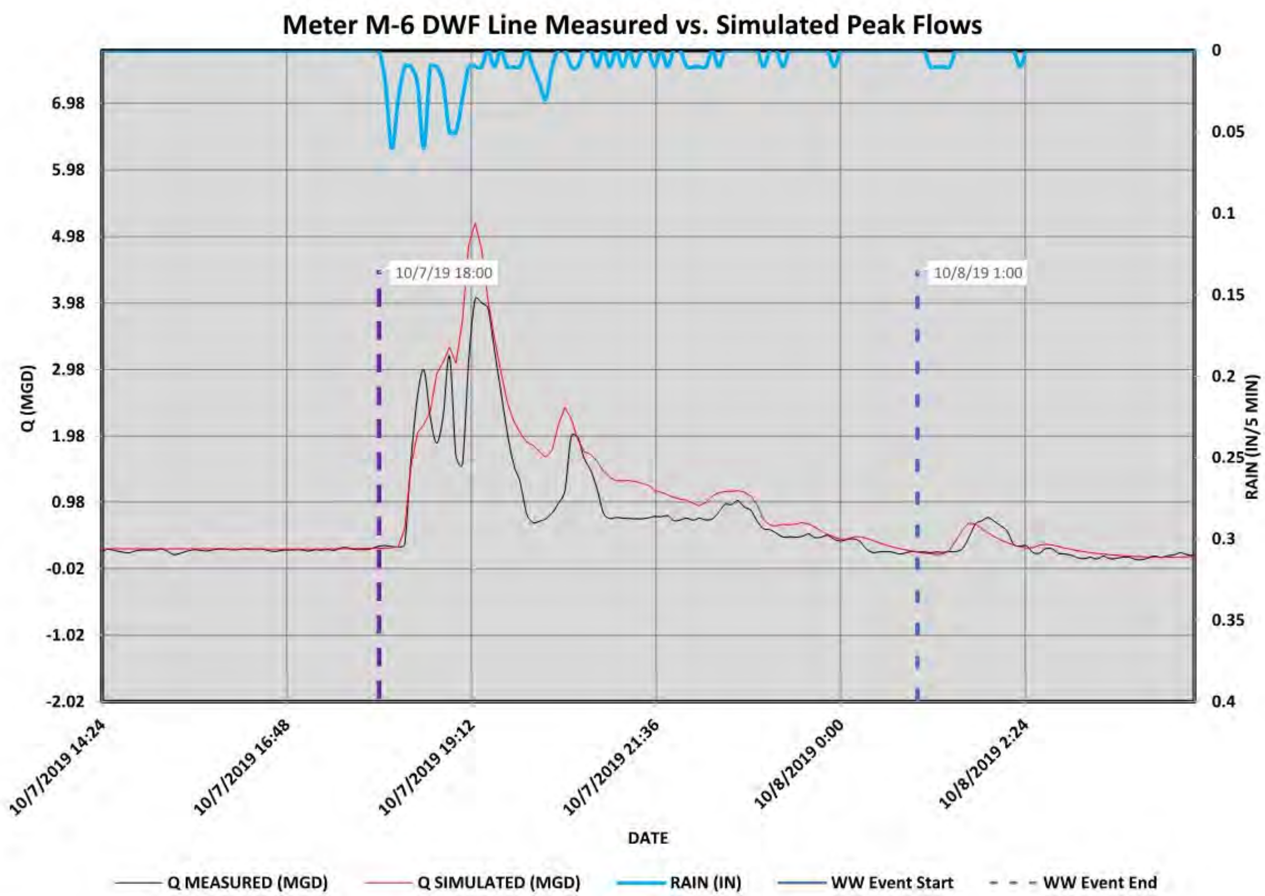

Meter M-7 DWF Line Measured vs. Simulated Peak Flows
16.38
11.38
6.38
1.38
-3.62
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
8/22/19 19:00
8/23/19 1:20
8/22/2019 15:24
8/22/2019 17:48
8/22/2019 20:12
8/22/2019 22:36
8/23/2019 1:00
8/23/2019 3:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

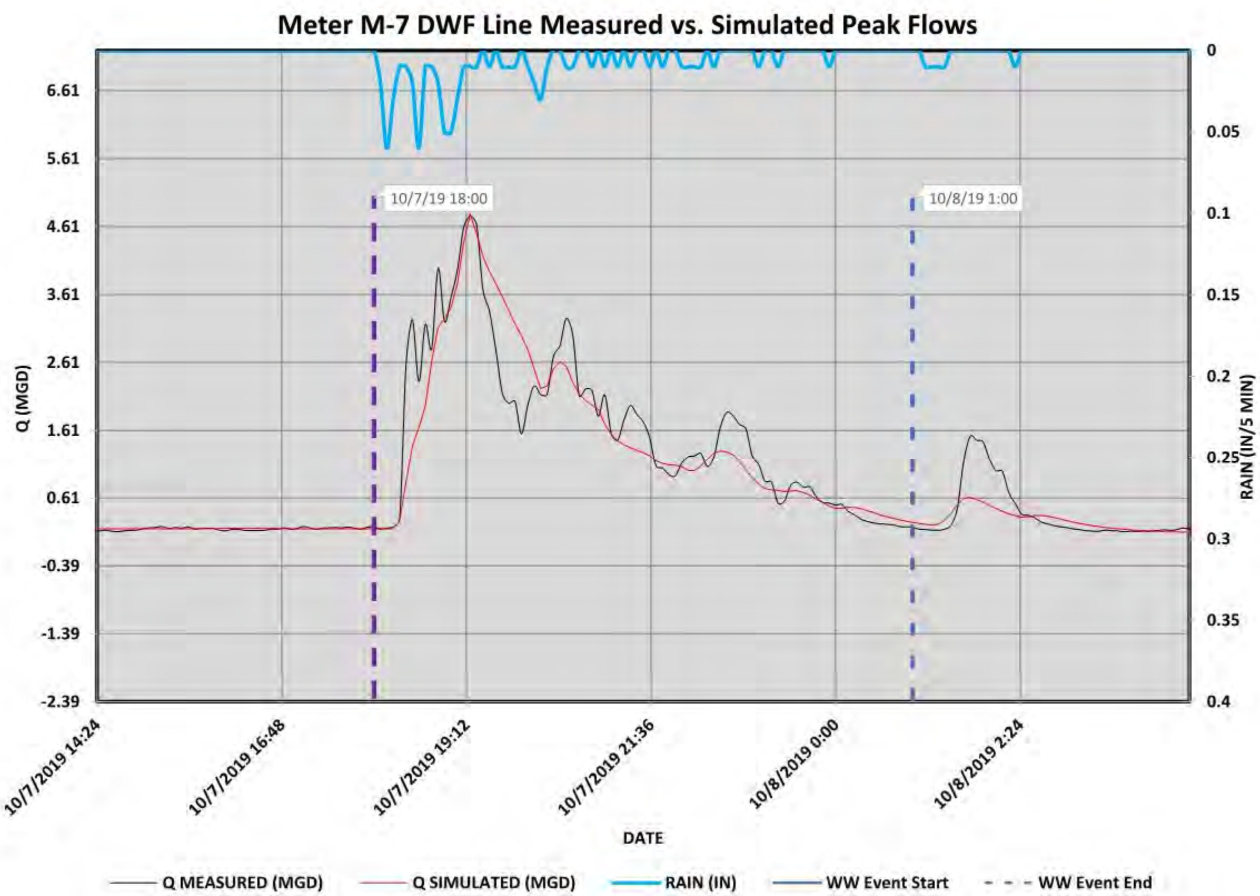

Meter M-10 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
23.42
18.42
13.42
8.42
3.42
-1.59
-6.59
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
8/22/19 19:00
8/23/19 1:20
8/22/2019 15:24
8/22/2019 17:48
8/22/2019 20:12
8/22/2019 22:36
8/23/2019 1:00
8/23/2019 3:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

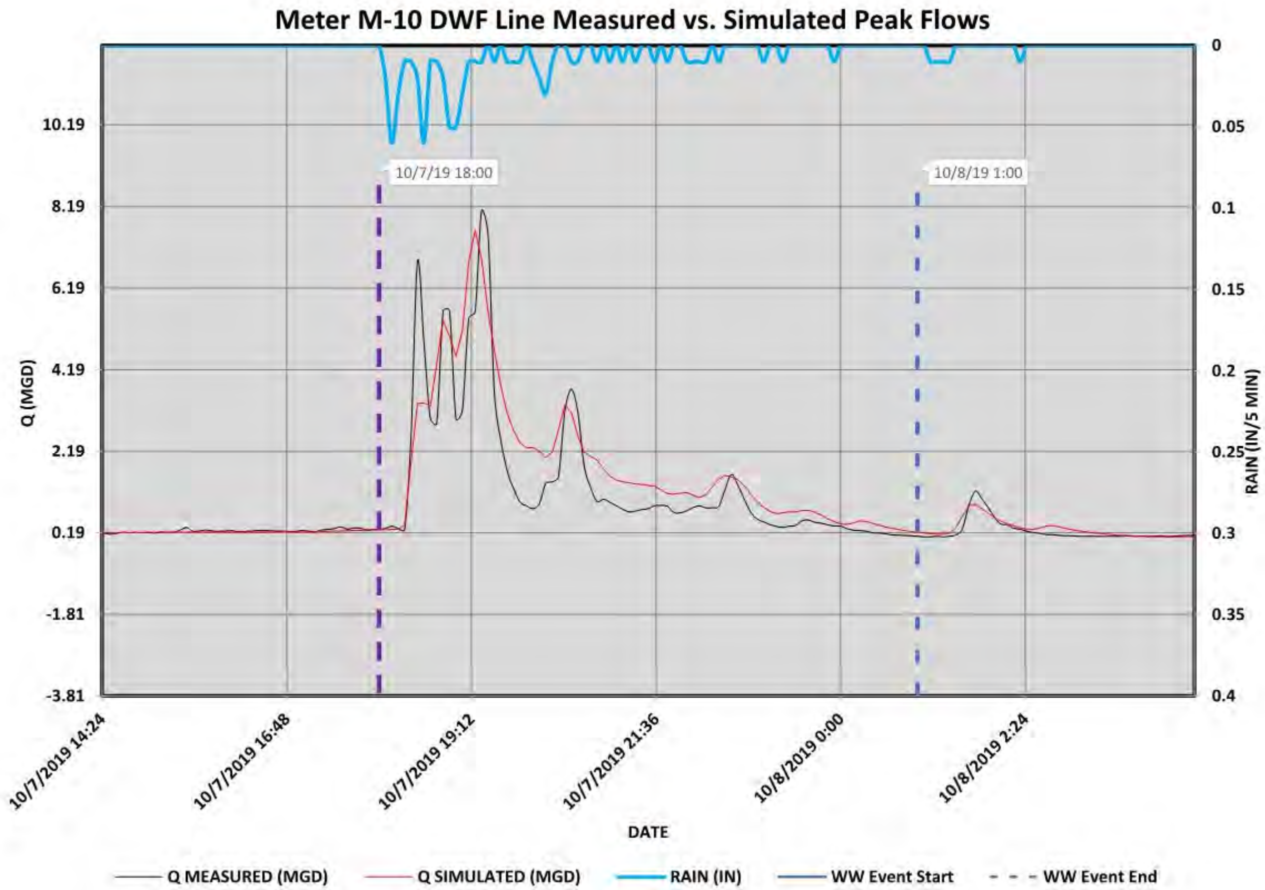

Meter M-1 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
3.37
2.87
2.37
1.87
1.37
0.87
0.37
-0.13
-0.63
-1.13
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/7/19 18:00
10/8/19 1:00
10/7/2019 14:24
10/7/2019 16:48
10/7/2019 19:12
10/7/2019 21:36
10/8/2019 0:00
10/8/2019 2:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

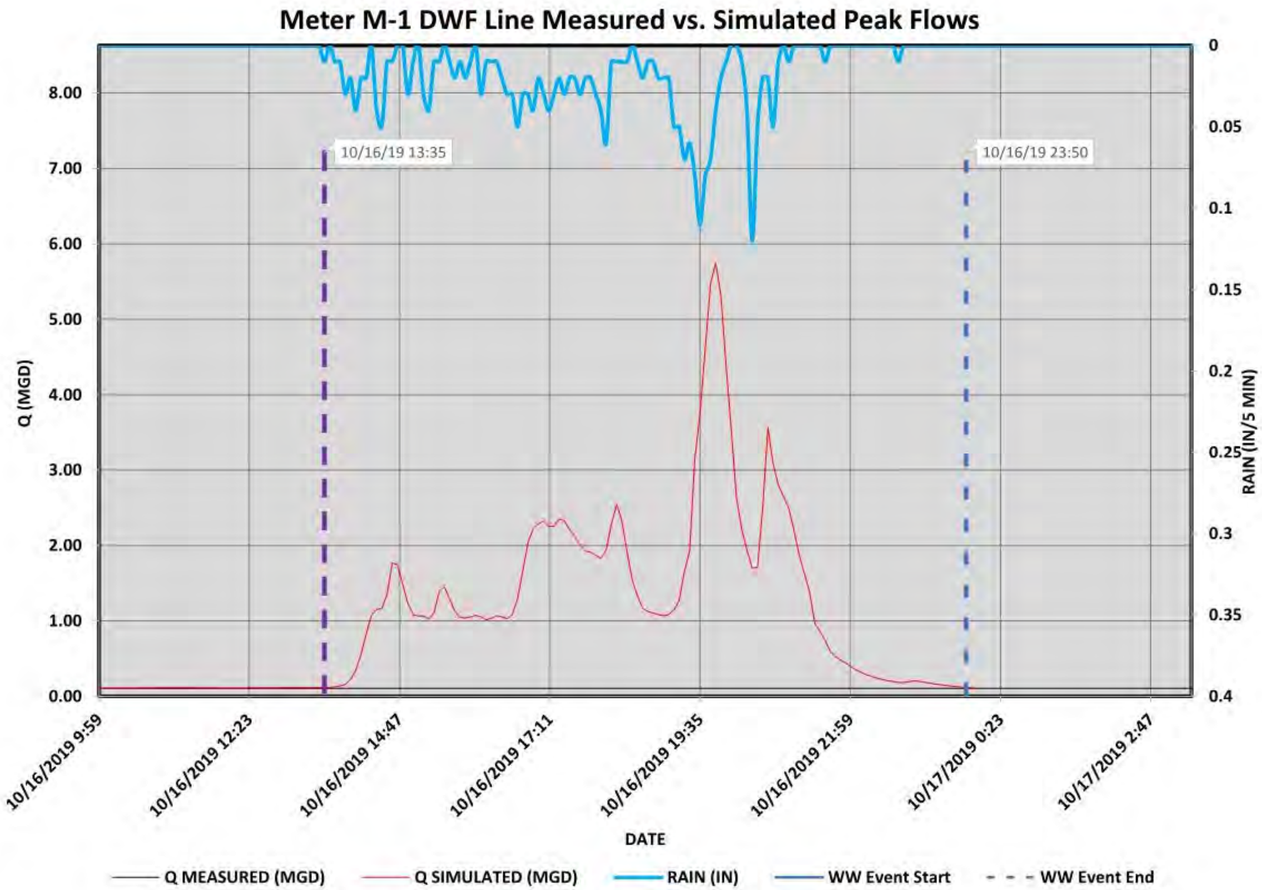

Meter M-2 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
14.42
9.42
4.42
-0.58
-5.58
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/7/19 18:00
10/8/19 1:00
10/7/2019 14:24
10/7/2019 16:48
10/7/2019 19:12
10/7/2019 21:36
10/8/2019 0:00
10/8/2019 2:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End


Meter M-4 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
5.11
4.11
3.11
2.11
1.11
0.11
-0.89
-1.89
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/7/19 18:00
10/8/19 1:00
10/7/2019 14:24
10/7/2019 16:48
10/7/2019 19:12
10/7/2019 21:36
10/8/2019 0:00
10/8/2019 2:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

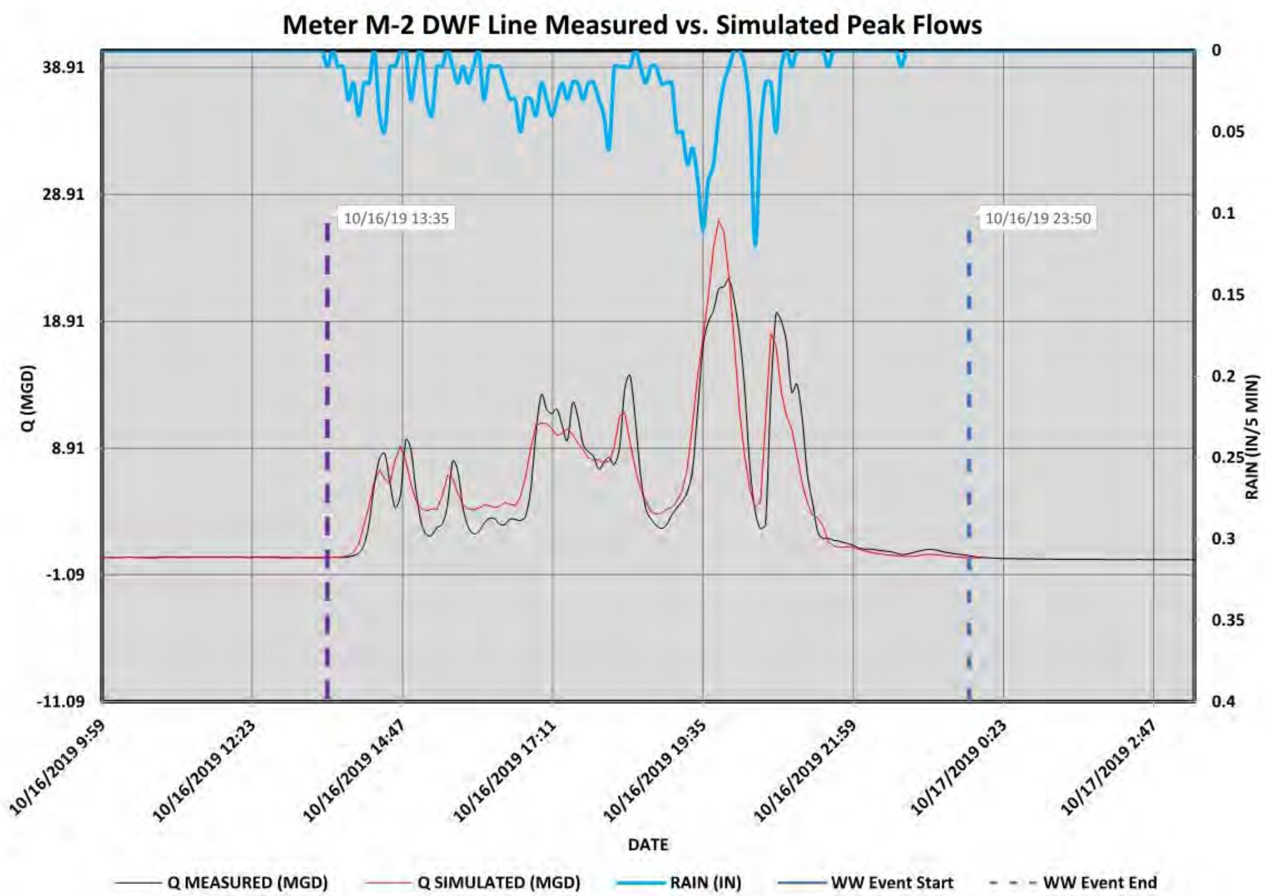

Meter M-6 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
6.98
5.98
4.98
3.98
2.98
1.98
0.98
-0.02
-1.02
-2.02
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/7/19 18:00
10/8/19 1:00
10/7/2019 14:24
10/7/2019 16:48
10/7/2019 19:12
10/7/2019 21:36
10/8/2019 0:00
10/8/2019 2:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

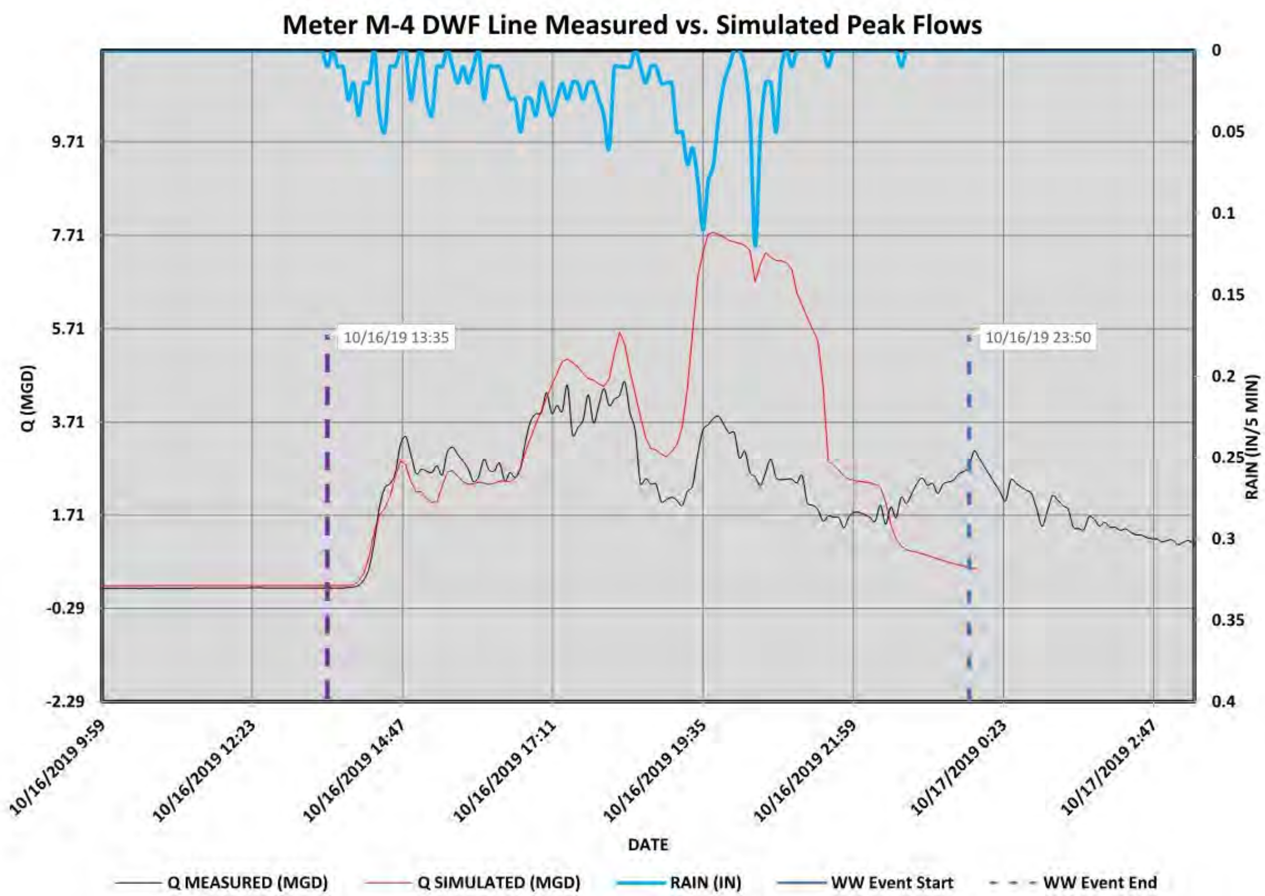

Meter M-7 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
6.61
5.61
4.61
3.61
2.61
1.61
0.61
-0.39
-1.39
-2.39
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/7/19 18:00
10/8/19 1:00
10/7/2019 14:24
10/7/2019 16:48
10/7/2019 19:12
10/7/2019 21:36
10/8/2019 0:00
10/8/2019 2:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

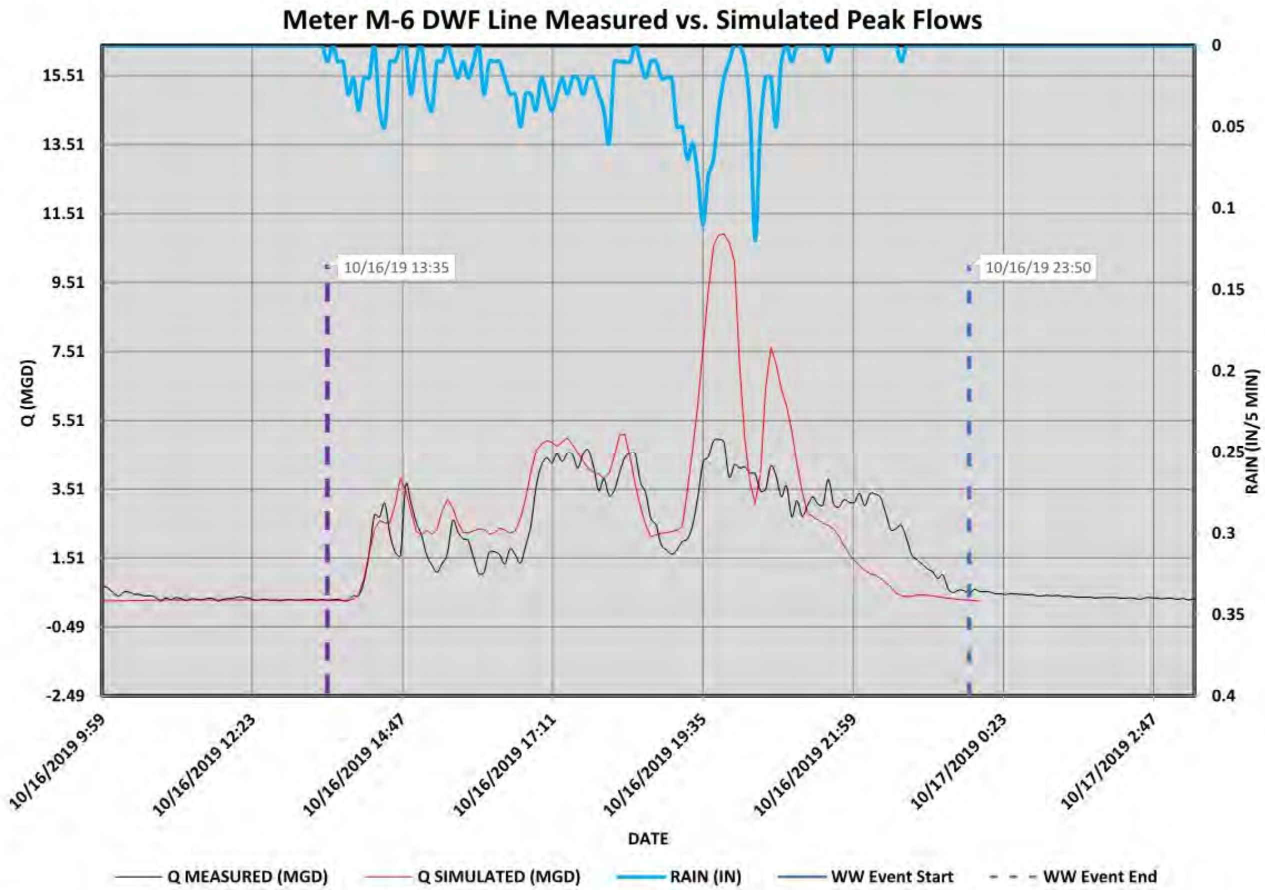

Meter M-10 DWF Line Measured vs. Simulated Peak Flows
10.19
8.19
6.19
4.19
2.19
0.19
-1.81
-3.81
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
10/7/19 18:00
10/8/19 1:00
10/7/2019 14:24
10/7/2019 16:48
10/7/2019 19:12
10/7/2019 21:36
10/8/2019 0:00
10/8/2019 2:24
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

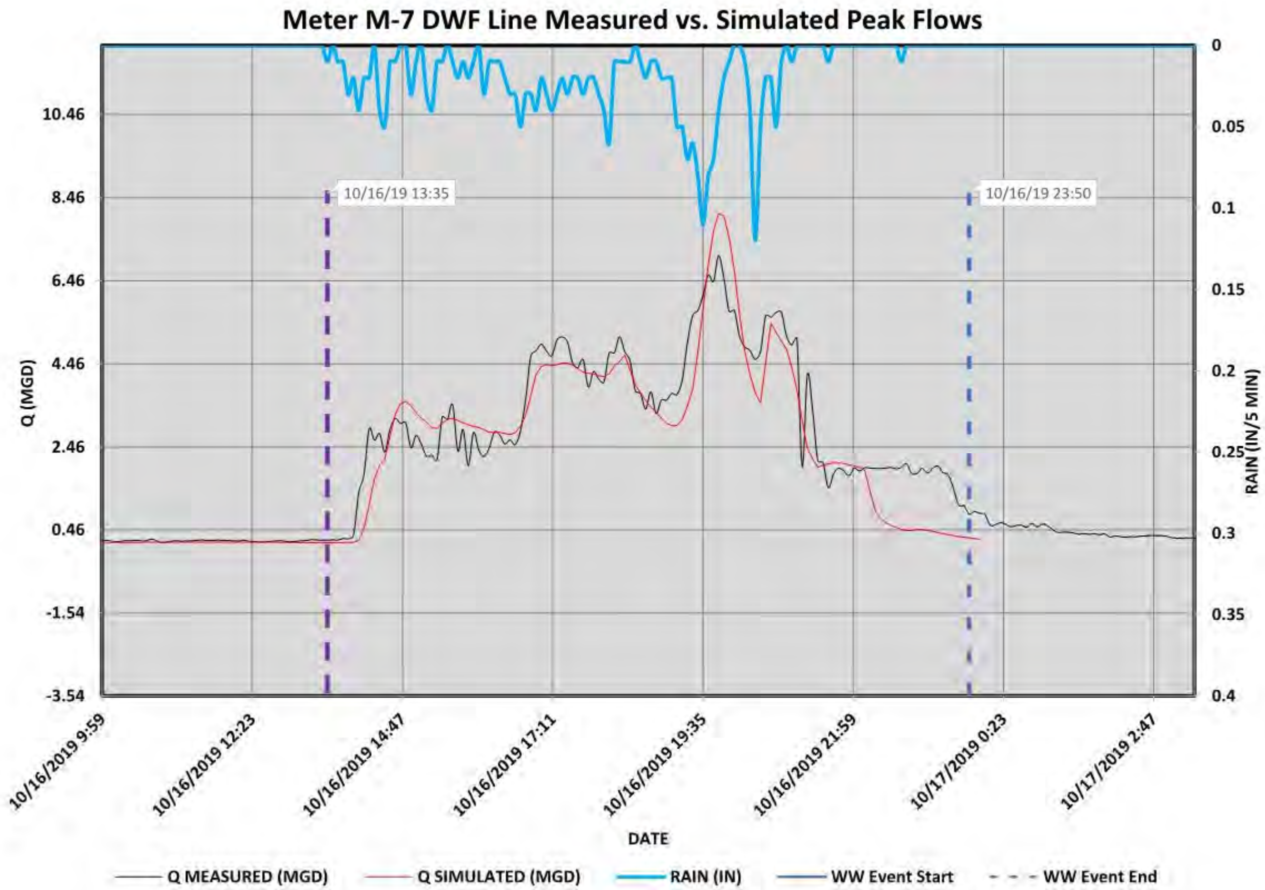


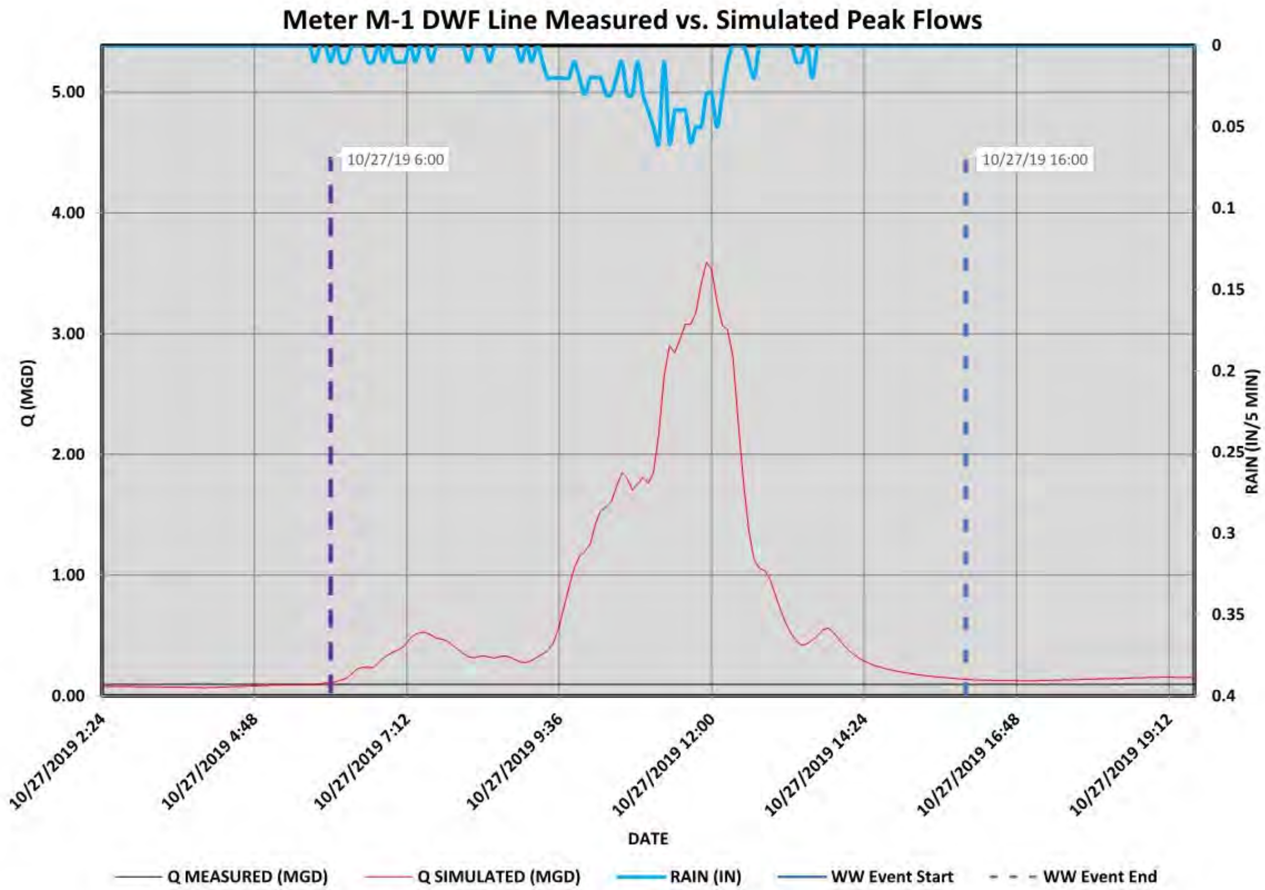
NO METER DATA


Meter M-2 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
38.91
28.91
18.91
8.91
-1.09
-11.09
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/16/19 13:35
10/16/19 23:50
10/16/2019 9:59
10/16/2019 12:23
10/16/2019 14:47
10/16/2019 17:11
10/16/2019 19:35
10/16/2019 21:59
10/17/2019 0:23
10/17/2019 2:47
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

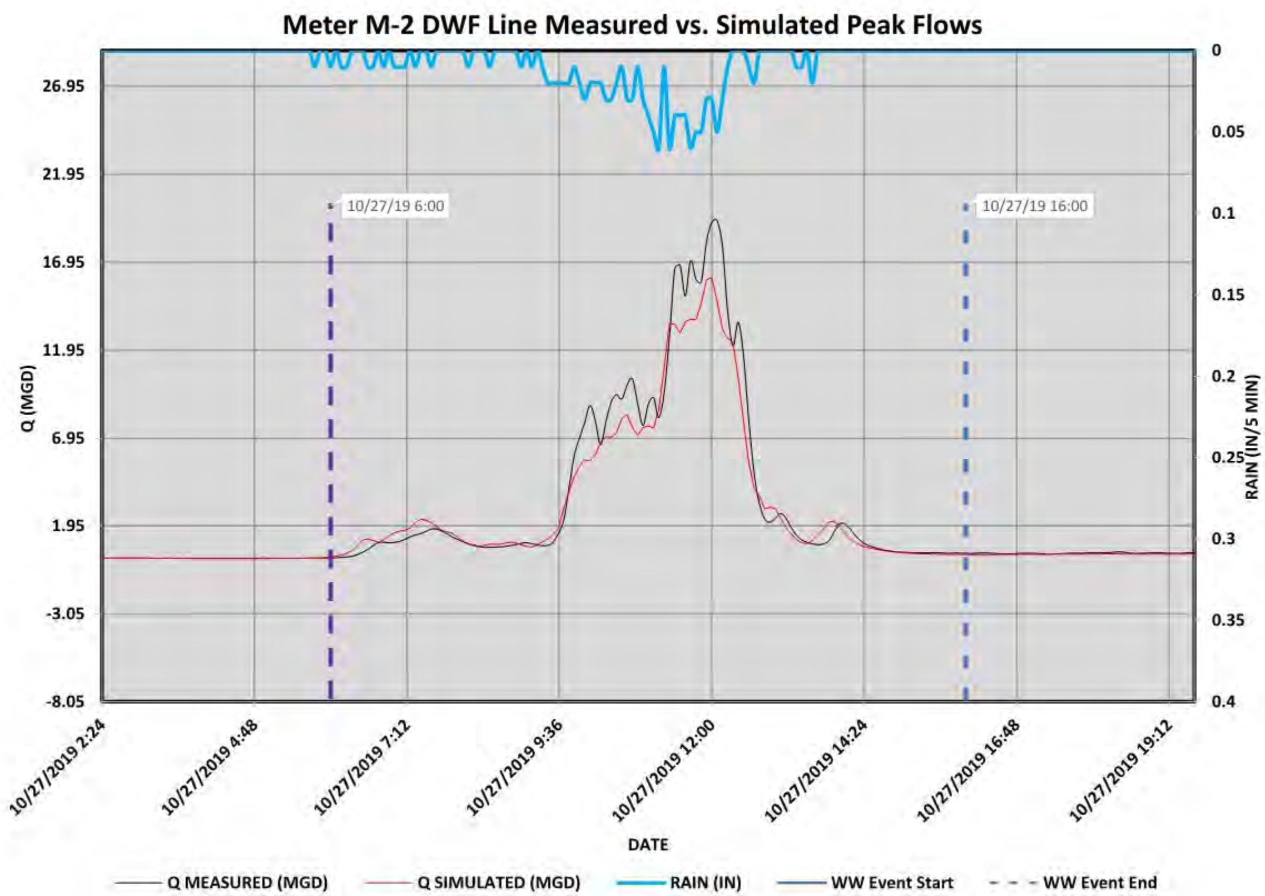

Meter M-4 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
9.71
7.71
5.71
3.71
1.71
-0.29
-2.29
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/16/19 13:35
10/16/19 23:50
10/16/2019 9:59
10/16/2019 12:23
10/16/2019 14:47
10/16/2019 17:11
10/16/2019 19:35
10/16/2019 21:59
10/17/2019 0:23
10/17/2019 2:47
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

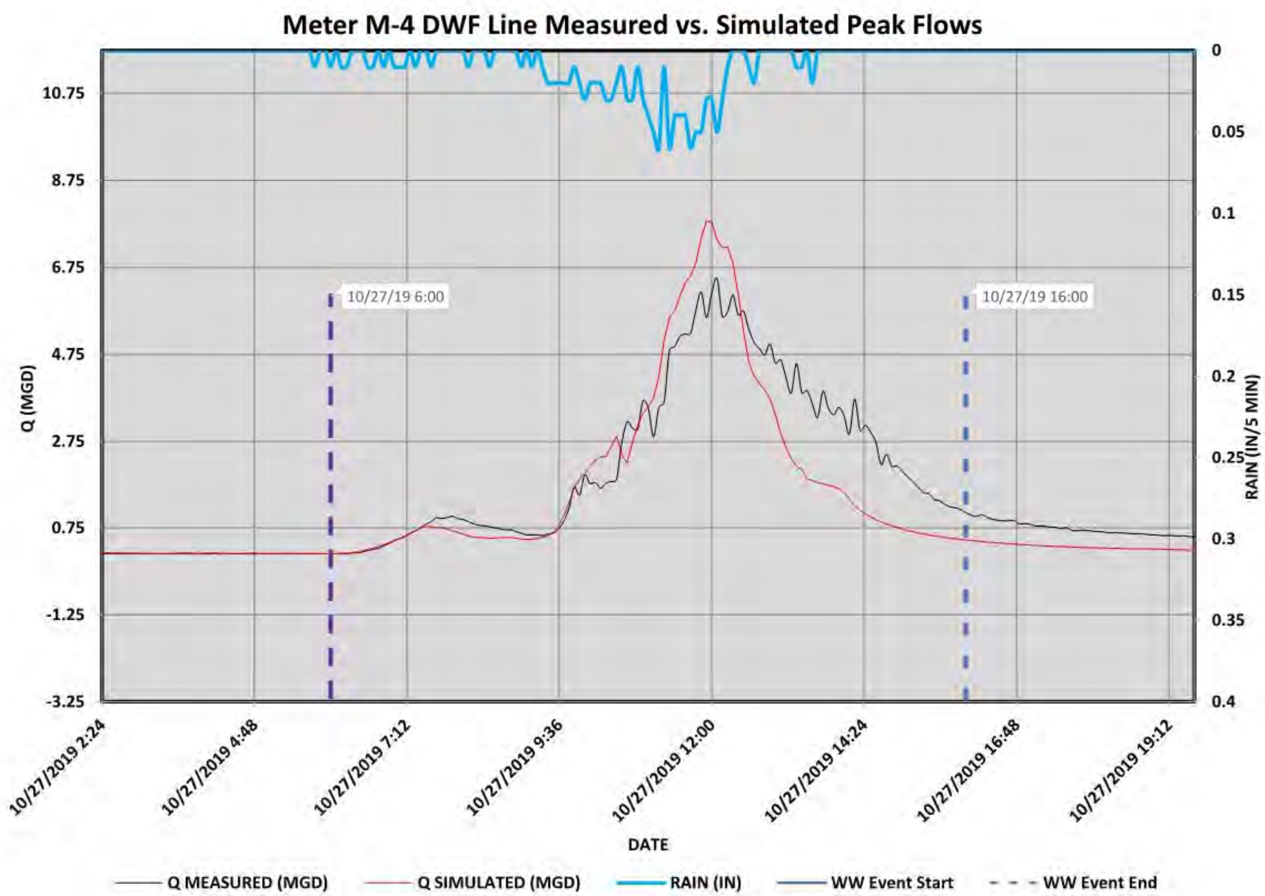

Meter M-6 DWF Line Measured vs. Simulated Peak Flows
15.51
13.51
11.51
9.51
7.51
5.51
3.51
1.51
-0.49
-2.49
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
10/16/19 13:35
10/16/19 23:50
10/16/2019 9:59
10/16/2019 12:23
10/16/2019 14:47
10/16/2019 17:11
10/16/2019 19:35
10/16/2019 21:59
10/17/2019 0:23
10/17/2019 2:47
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

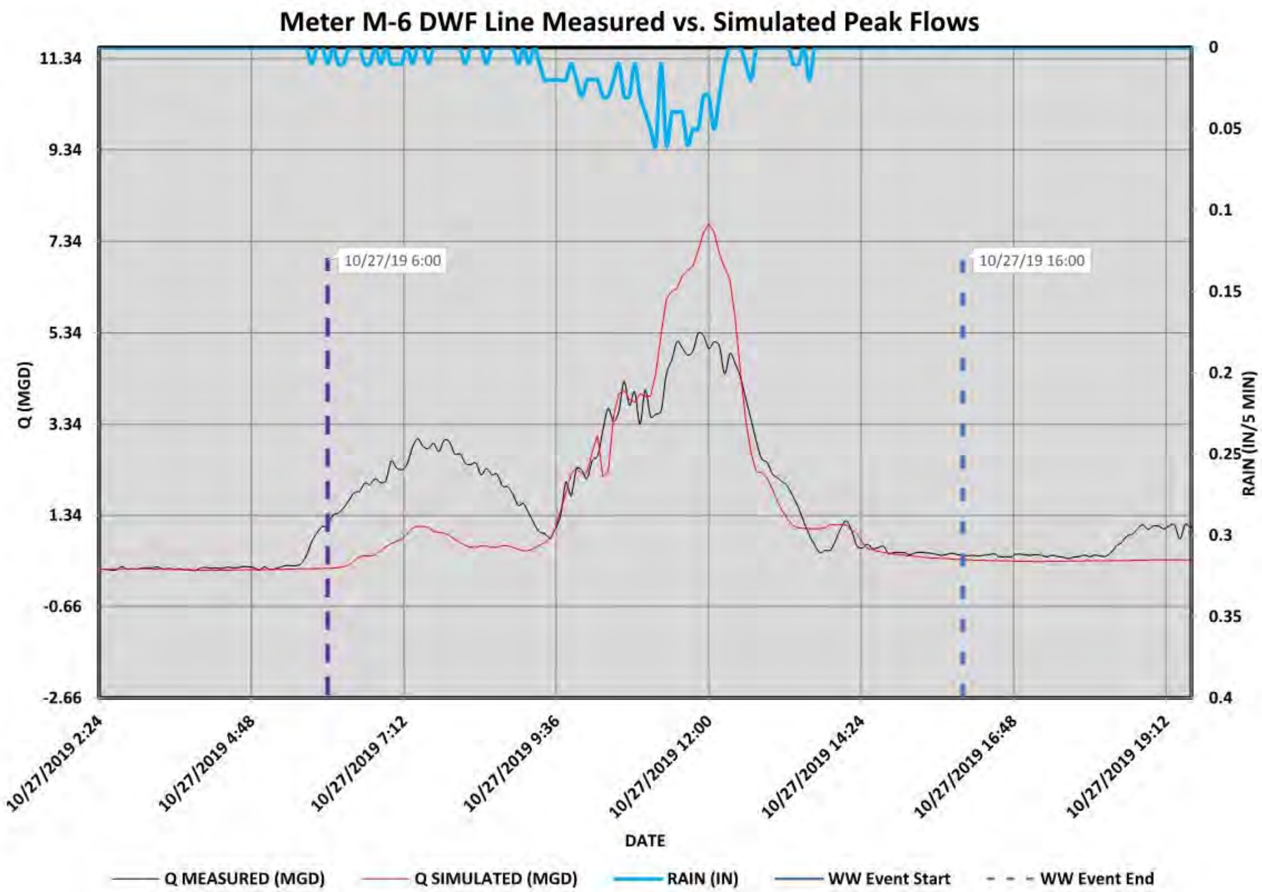

Meter M-7 DWF Line Measured vs. Simulated Peak Flows
10.46
8.46
6.46
4.46
2.46
0.46
-1.54
-3.54
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
10/16/19 13:35
10/16/19 23:50
10/16/2019 9:59
10/16/2019 12:23
10/16/2019 14:47
10/16/2019 17:11
10/16/2019 19:35
10/16/2019 21:59
10/17/2019 0:23
10/17/2019 2:47
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

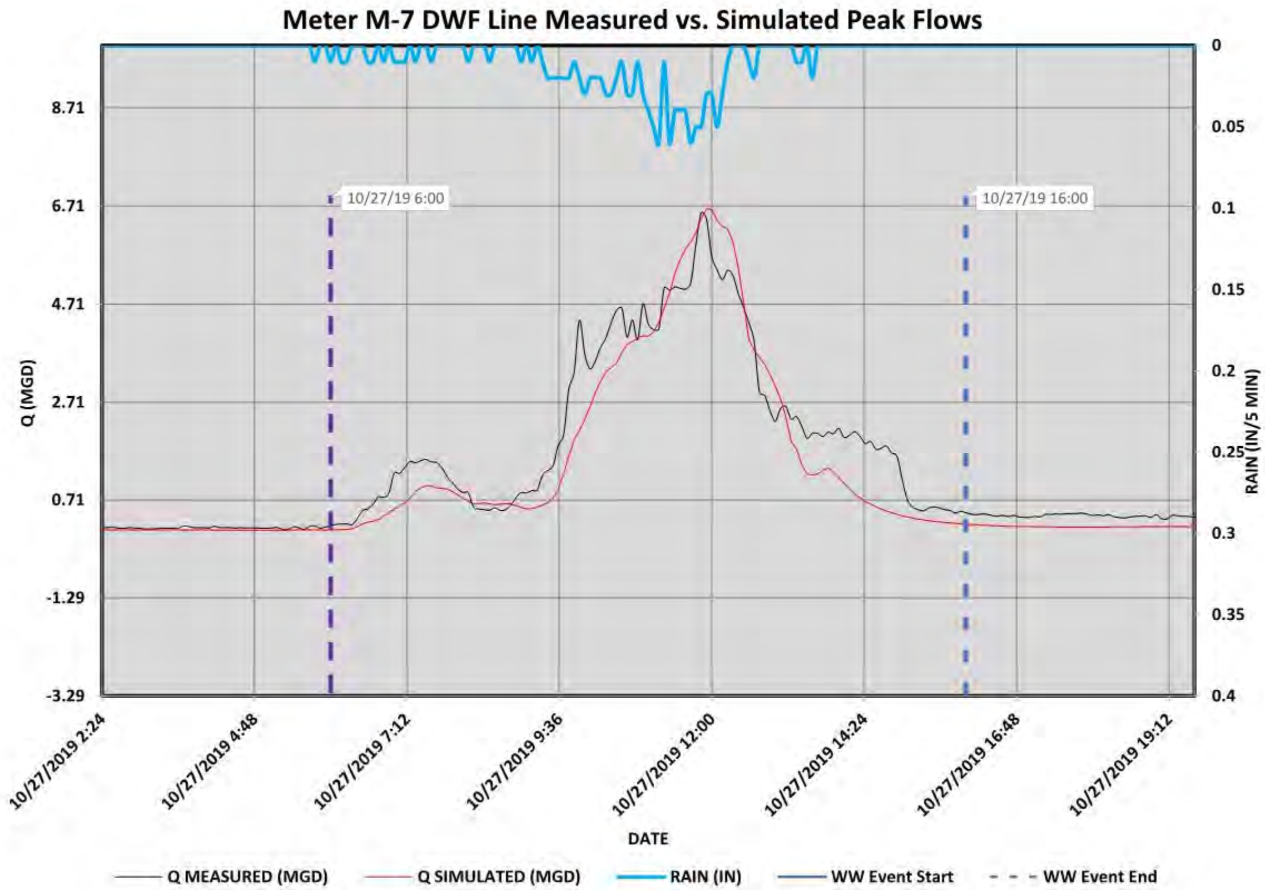


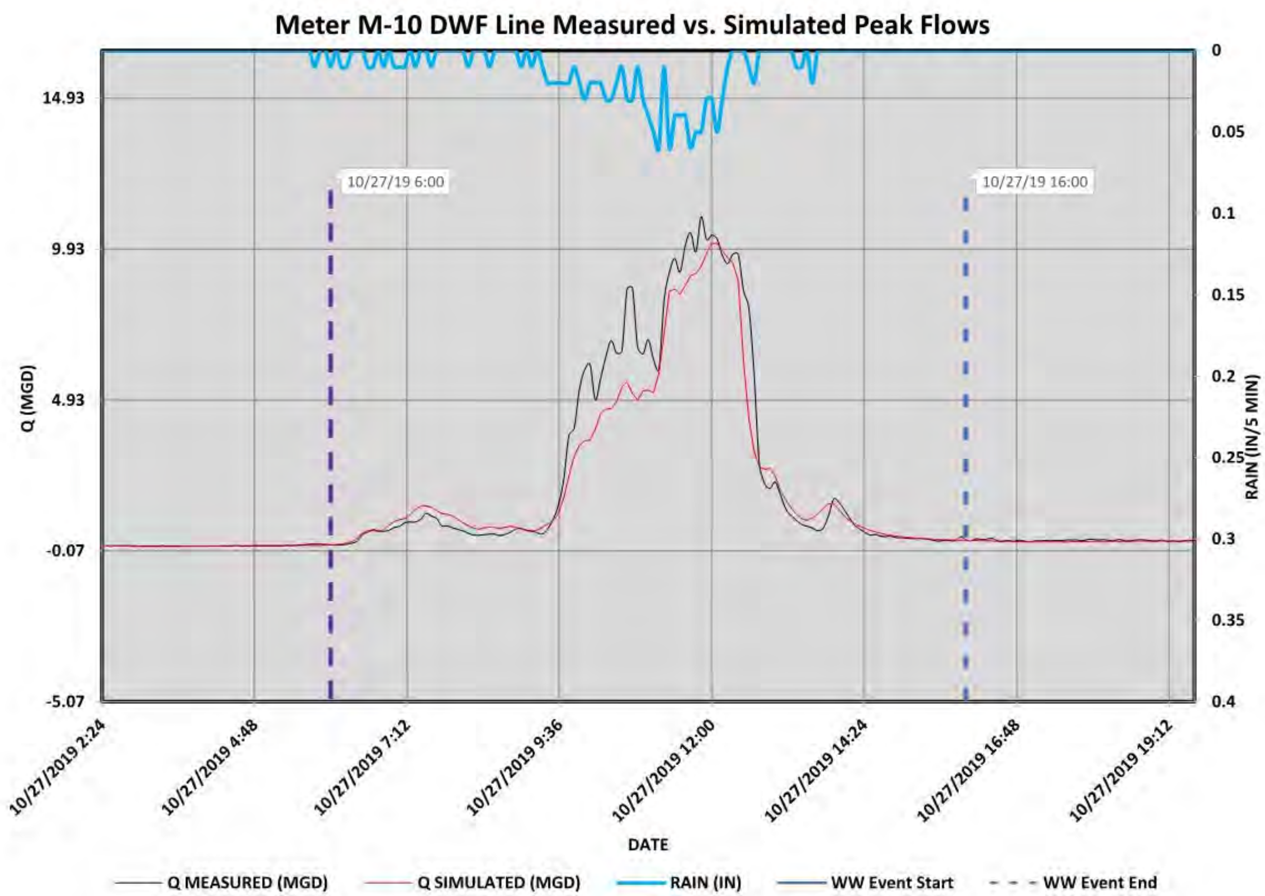
NO METER DATA

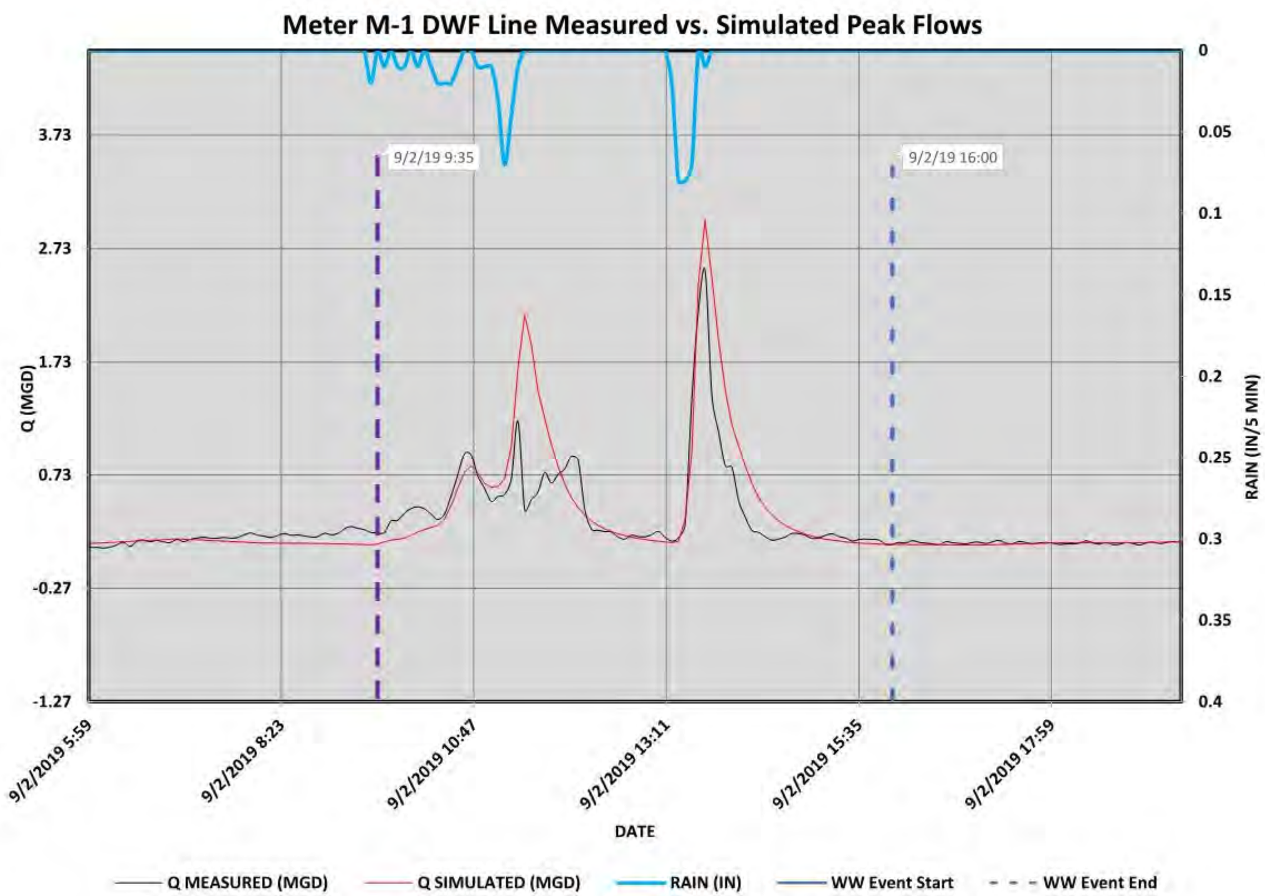

Meter M-2 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
26.95
21.95
16.95
11.95
6.95
1.95
-3.05
-8.05
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/27/19 6:00
10/27/19 16:00
10/27/2019 2:24
10/27/2019 4:48
10/27/2019 7:12
10/27/2019 9:36
10/27/2019 12:00
10/27/2019 14:24
10/27/2019 16:48
10/27/2019 19:12
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

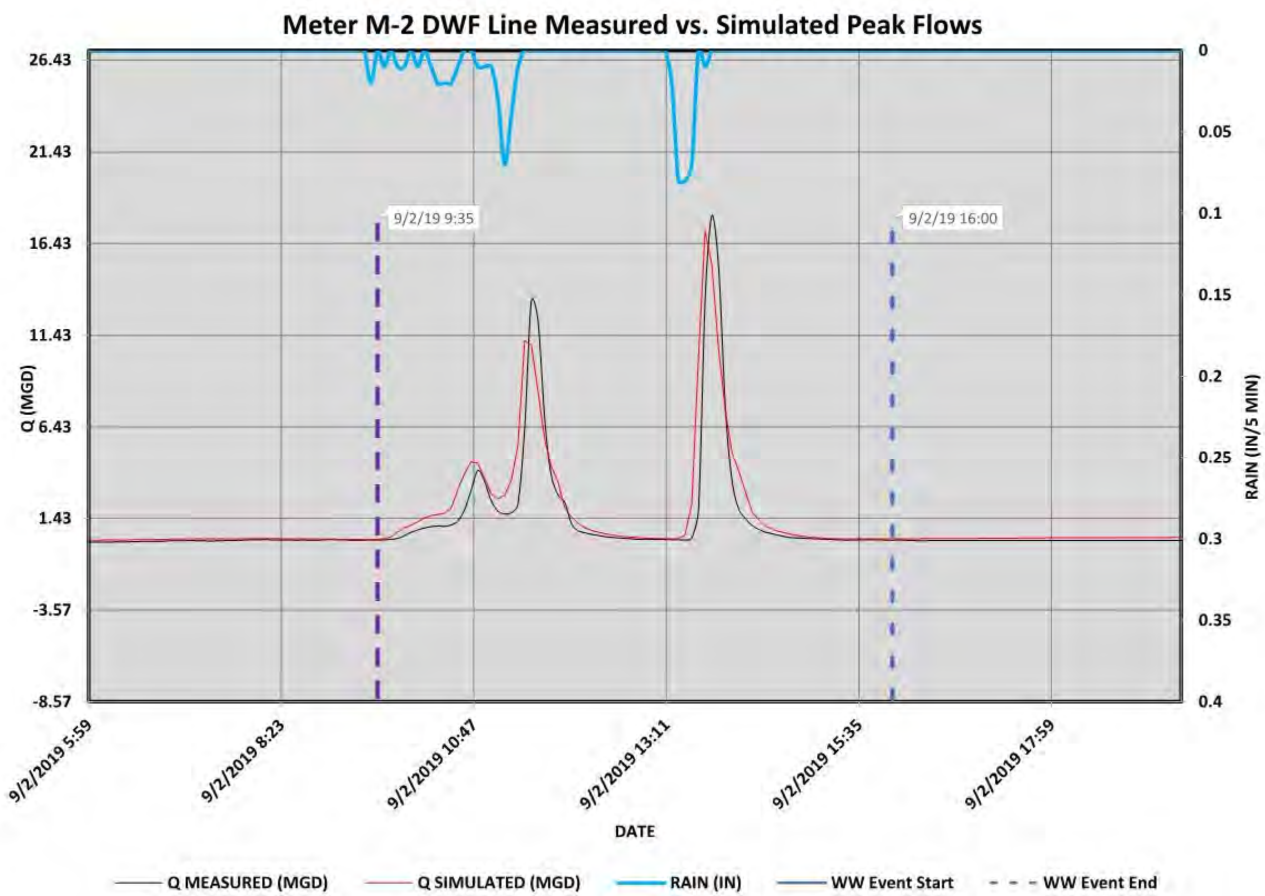

Meter M-4 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
10.75
8.75
6.75
4.75
2.75
0.75
-1.25
-3.25
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
10/27/19 6:00
10/27/19 16:00
10/27/2019 2:24
10/27/2019 4:48
10/27/2019 7:12
10/27/2019 9:36
10/27/2019 12:00
10/27/2019 14:24
10/27/2019 16:48
10/27/2019 19:12
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

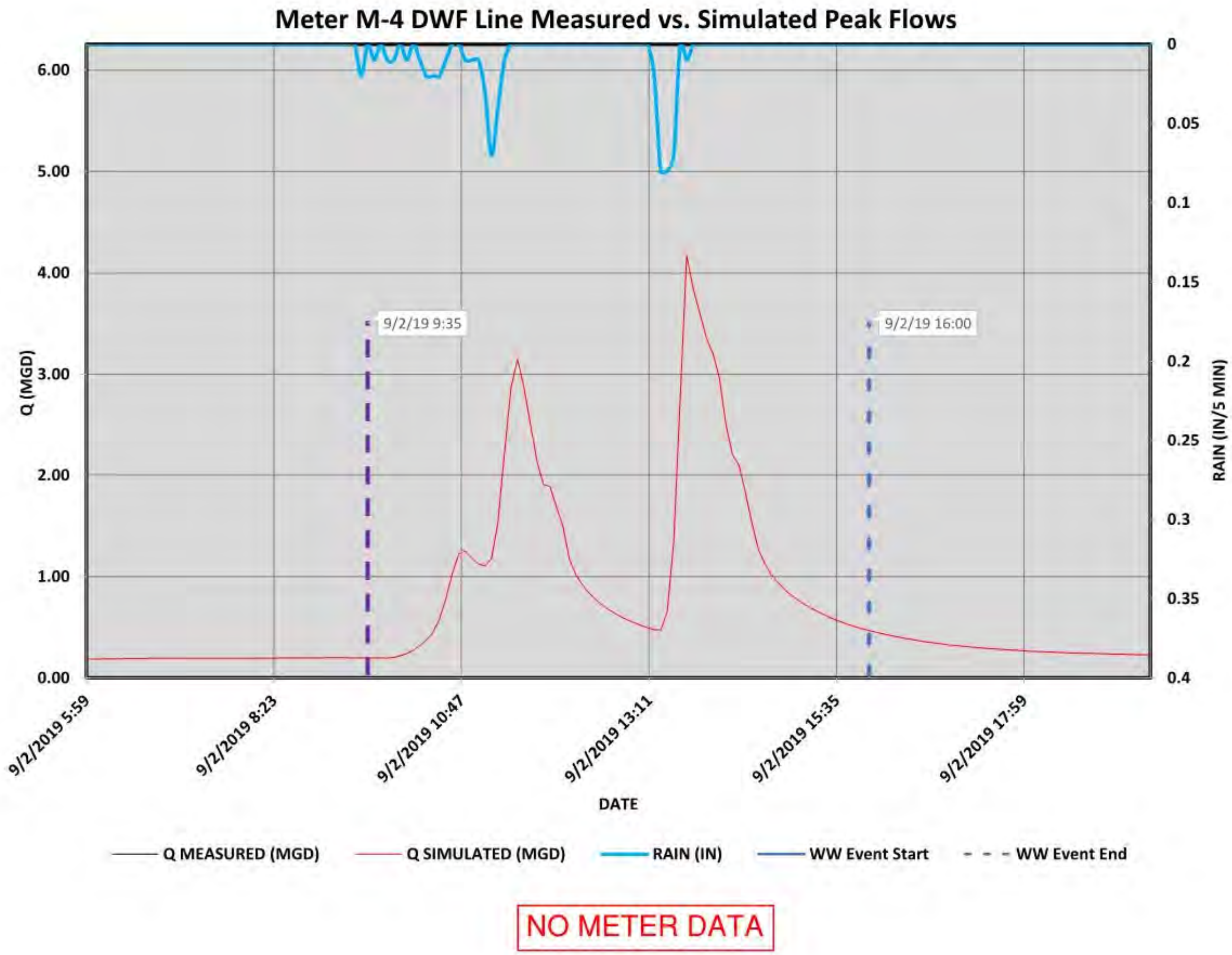

Meter M-6 DWF Line Measured vs. Simulated Peak Flows
11.34
9.34
7.34
5.34
3.34
1.34
-0.66
-2.66
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
10/27/19 6:00
10/27/19 16:00
10/27/2019 2:24
10/27/2019 4:48
10/27/2019 7:12
10/27/2019 9:36
10/27/2019 12:00
10/27/2019 14:24
10/27/2019 16:48
10/27/2019 19:12
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

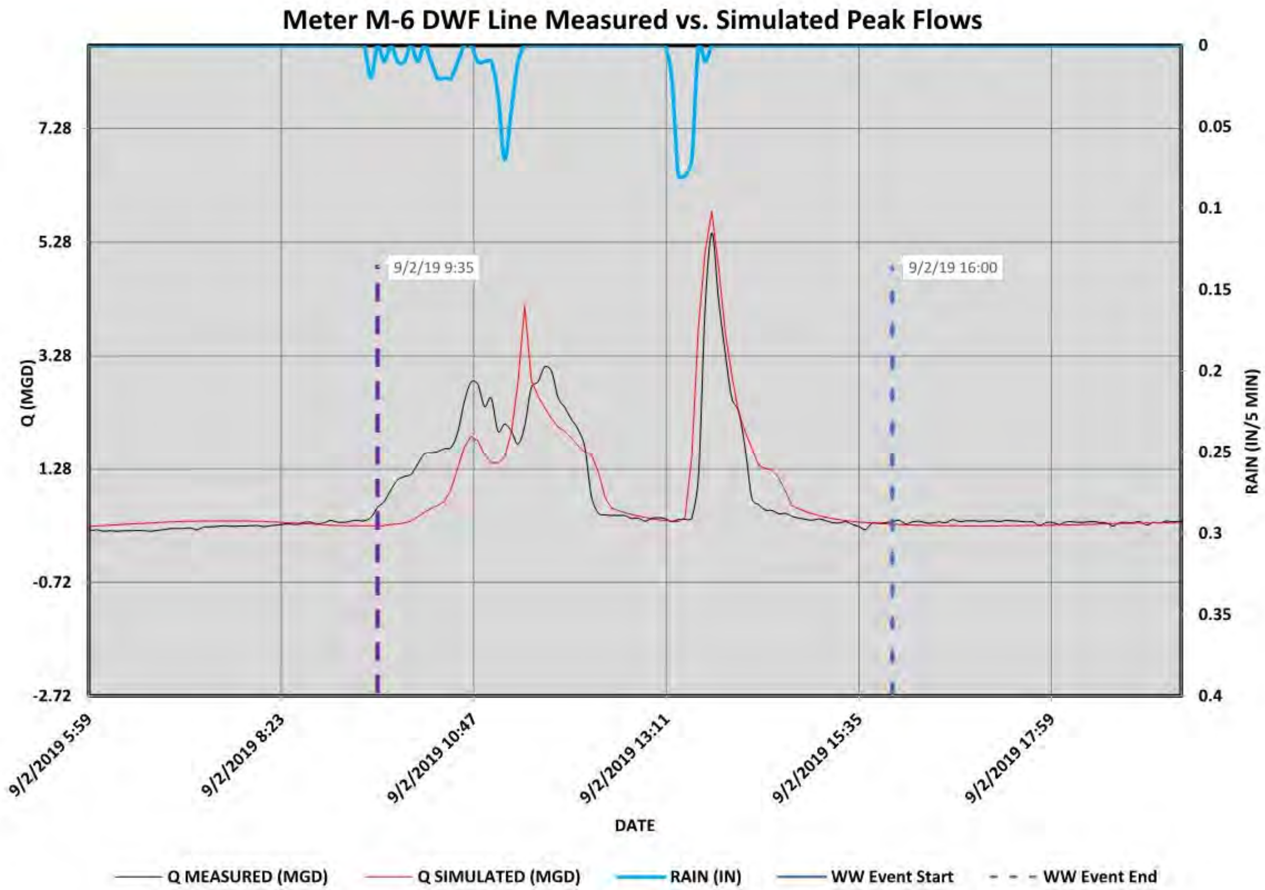

Meter M-7 DWF Line Measured vs. Simulated Peak Flows
8.71
6.71
4.71
2.71
0.71
-1.29
-3.29
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
10/27/19 6:00
10/27/19 16:00
10/27/2019 2:24
10/27/2019 4:48
10/27/2019 7:12
10/27/2019 9:36
10/27/2019 12:00
10/27/2019 14:24
10/27/2019 16:48
10/27/2019 19:12
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

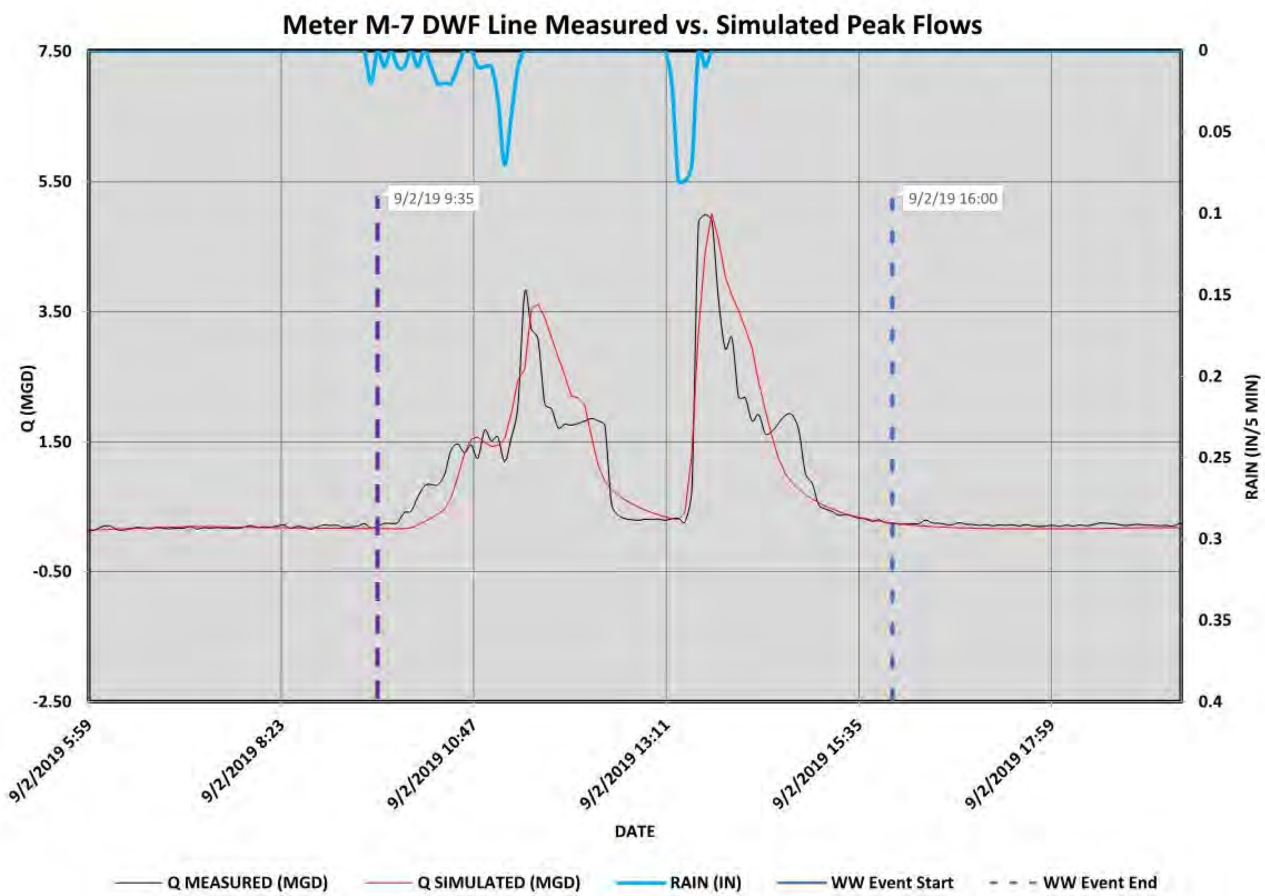

Meter M-10 DWF Line Measured vs. Simulated Peak Flows
10/27/19 6:00
10/27/19 16:00
14.93
9.93
4.93
-0.07
-5.07
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
10/27/2019 2:24
10/27/2019 4:48
10/27/2019 7:12
10/27/2019 9:36
10/27/2019 12:00
10/27/2019 14:24
10/27/2019 16:48
10/27/2019 19:12
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End


Meter M-1 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
3.73
2.73
1.73
0.73
-0.27
-1.27
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
9/2/19 9:35
9/2/19 16:00
9/2/2019 5:59
9/2/2019 8:23
9/2/2019 10:47
9/2/2019 13:11
9/2/2019 15:35
9/2/2019 17:59
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End


Meter M-2 DWF Line Measured vs. Simulated Peak Flows
26.43
21.43
16.43
11.43
6.43
1.43
-3.57
-8.57
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
9/2/19 9:35
9/2/19 16:00
9/2/2019 5:59
9/2/2019 8:23
9/2/2019 10:47
9/2/2019 13:11
9/2/2019 15:35
9/2/2019 17:59
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End


Meter M-4 DWF Line Measured vs. Simulated Peak Flows
Q (MGD)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
RAIN (IN/5 MIN)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
9/2/19 9:35
9/2/19 16:00
9/2/2019 5:59
9/2/2019 8:23
9/2/2019 10:47
9/2/2019 13:11
9/2/2019 15:35
9/2/2019 17:59
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End
NO METER DATA


Meter M-6 DWF Line Measured vs. Simulated Peak Flows
7.28
5.28
3.28
1.28
-0.72
-2.72
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
9/2/19 9:35
9/2/19 16:00
9/2/2019 5:59
9/2/2019 8:23
9/2/2019 10:47
9/2/2019 13:11
9/2/2019 15:35
9/2/2019 17:59
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End


Meter M-7 DWF Line Measured vs. Simulated Peak Flows
7.50
5.50
3.50
1.50
-0.50
-2.50
Q (MGD)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
RAIN (IN/5 MIN)
9/2/19 9:35
9/2/19 16:00
9/2/2019 5:59
9/2/2019 8:23
9/2/2019 10:47
9/2/2019 13:11
9/2/2019 15:35
9/2/2019 17:59
DATE
Q MEASURED (MGD)
Q SIMULATED (MGD)
RAIN (IN)
WW Event Start
WW Event End

C. Subcatchment Data Table

Subcatchment ID	System type	Area (ac)	Width (ft)	Impervious (%)	Impervious (ac)	Effective Impervious (ac)	Effective Impervious (%)	Slope (%)	Manning's N Impervious	Manning's N Pervious	Maximum Infiltration Rate (in/hr)	Minimum Infiltration Rate (in/hr)	Decay Constant (1/hr)	Depression Storage Impervious (in)	Depression Storage Pervious (in)
HR_CS45#1.19	combined	5.15	203.2	91.91	4.73	1.89	36.8	3.915	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.21	combined	29.78	3150.2	99.37	29.59	11.84	39.7	1.541	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.22	combined	10.32	378.3	91.88	9.49	3.79	36.8	2.416	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.23	combined	5.10	266	93.40	4.77	1.91	37.4	2.317	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS40#1.2	combined	4.09	241.1	86.27	3.53	1.41	34.5	5.244	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS40#1.3	combined	4.48	249.3	89.12	4.00	1.60	35.6	3.134	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS40#1.4	combined	3.52	220.9	91.98	3.24	1.30	36.8	5.5	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS40#1.5	combined	5.67	302.3	88.05	5.00	2.00	35.2	5.5	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS39#1	combined	5.85	211.1	76.27	4.46	1.78	30.5	5.244	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS40#1.1	combined	4.85	319.1	84.77	4.11	2.88	59.3	5.915	0.02	0.05	3	0.5	4	0	0.1
HR_CS41#1.1	combined	13.68	1481.2	91.35	12.49	6.64	48.5	3.791	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS42#1	sanitary	0.00	181.3	0.00	0.00	0.00	0.0	2.782	0	0	3	0.5	4	0	0
HR_CS44#1.1	combined	8.23	753.5	90.01	7.41	2.96	36.0	6.505	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.1	combined	15.78	935.6	97.45	15.38	6.15	39.0	2.622	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45-2	sanitary	12.36	1567	29.10	3.60	1.44	11.6	2.1	0.02	0.05	3	0.5	4	0.025	0.1
HR_H-HSW3	sanitary	0.00	362.1	0.00	0.00	0.00	0.0	3.852	0	0	3	0.5	4	0	0
HR_CS45#1.2	combined	12.55	2503.2	91.50	11.48	4.59	36.6	2.103	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.3	combined	9.80	486.6	84.48	8.28	3.31	33.8	2.667	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.4	combined	5.66	280.1	89.17	5.05	2.02	35.7	2.729	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.5	combined	5.81	283.9	86.44	5.02	2.01	34.6	2.263	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.6	combined	3.61	223.7	88.66	3.20	1.28	35.5	2.075	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.7	combined	8.07	669.2	79.73	6.44	2.57	31.9	2.221	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.8	combined	3.02	204.6	84.56	2.55	1.02	33.8	2.663	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.9	combined	3.75	185.3	81.86	3.07	1.23	32.7	3.049	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.11	combined	6.76	612.4	83.23	5.63	3.94	58.3	6.115	0.02	0.05	3	0.5	4	0	0.1
HR_CS45#1.12	combined	2.59	148	86.17	2.23	0.89	34.5	5.029	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.13	combined	4.06	474.4	90.12	3.66	1.46	36.0	3.476	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.14	combined	4.30	488.4	87.72	3.77	1.51	35.1	3.596	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.15	combined	10.68	769.6	79.82	8.52	5.97	55.9	2.939	0.02	0.05	3	0.5	4	0	0.1
HR_CS45#1.16	combined	6.10	290.8	81.06	4.94	1.98	32.4	4.373	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.17	combined	5.08	531	87.60	4.45	1.78	35.0	4.696	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.18	combined	4.28	243.7	84.02	3.60	2.52	58.8	2.078	0.02	0.05	3	0.5	4	0	0.1
HR_CS41#1.2	combined	6.58	894.4	88.92	5.85	3.13	47.6	3.316	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS41#1.3	combined	8.53	397.15	86.86	7.41	3.99	46.7	8.353	0.02	0.05	3	0.5	4	0.013	0.1
HR_CS41#1.4	combined	6.73	1148.7	87.88	5.91	3.17	47.2	2.587	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS41#1.5	combined	14.08	870.74	87.84	12.37	6.64	47.1	4.928	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS43#1.3	combined	5.76	595.4	91.22	5.25	2.10	36.5	2.919	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.24	combined	5.35	272.3	91.48	4.89	1.96	36.6	2.838	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS45#1.25	combined	6.74	611.2	93.97	6.33	2.53	37.6	3.425	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS41#1.6	combined	8.09	718.64	90.75	7.34	3.91	48.3	3.662	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS41#1.7	combined	5.20	644.02	92.72	4.82	2.55	49.1	2.038	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS41#1.8	combined	6.38	449.41	92.60	5.91	4.14	64.8	3.641	0.02	0.05	3	0.5	4	0	0.1
HR_CS41#1.9	combined	8.62	699.92	89.61	7.72	4.12	47.8	5.082	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS41#1.11	combined	5.23	785.2	88.69	4.64	2.48	47.5	2.526	0.02	0.05	3	0.5	4	0.014	0.1
HR_CS44#1.2	combined	3.84	230.7	94.54	3.63	1.45	37.8	3.335	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS44#1.3	combined	15.97	815	90.69	14.49	5.79	36.3	3.712	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS44#1.4	combined	3.92	1361	92.96	3.64	1.46	37.2	5.369	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS44#1.5	combined	6.58	302.1	96.83	6.37	4.46	67.8	3.159	0.02	0.05	3	0.5	4	0	0.1
HR_CS44#1.6	combined	11.75	1393.8	91.21	10.71	4.28	36.5	6.17	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS44#1.7	combined	2.74	324	96.37	2.64	1.06	38.5	2.192	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS44#1.8	sanitary	0.00	231.5	0.00	0.00	0.00	0.0	4.053	0	0	3	0.5	4	0	0
HR_CS43#1.1	combined	21.67	1205.2	95.77	20.75	8.30	38.3	1.634	0.02	0.05	3	0.5	4	0.025	0.1
HR_H-SW1.1	sanitary	0.00	5614.6	0.00	0.00	0.00	0.0	4.642	0	0	3	0.5	4	0	0
HR_CS43#1.2	combined	10.80	2942	98.13	10.60	4.24	39.3	3.7	0.02	0.05	3	0.5	4	0.025	0.1
HR_CS40#1.6	sanitary	0.00	435.5	0.00	0.00	0.00	0.0	5.502	0	0	3	0.5	4	0	0
HR_H-SW1.2-storm	storm	24.54	203.5	93.74	23.00	9.20	37.5	2.91	0.02	0.05	3	0.5	4	0.025	0.1
HR_H-HSW3.1	sanitary	0.00	7943.6	0.00	0.00	0.00	0.0	6.535	0	0	3	0.5	4	0	0
HR_H-SW1.2	sanitary	0.00	527.3	0.00	0.00	0.00	0.0	2.91	0	0	3	0.5	4	0	0

D. Flow Monitoring Locations

FLOW ASSESSMENT SERVICES

RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** August 9, 2019	**JOB #:** 19088
LOCATION: 318 Harrison Avenue, City Hall		
GPS/COMMENTS: 40.746525, -74.157218		

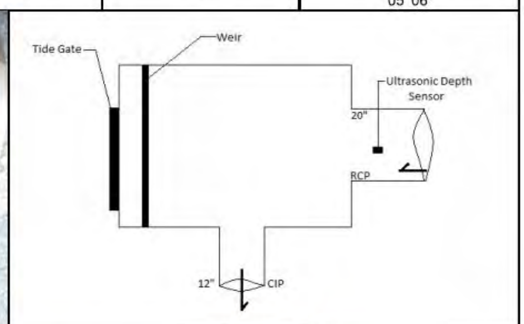
LOCATION

FLOW ASSESSMENT SERVICES

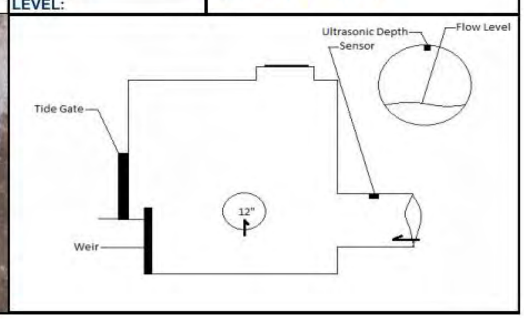
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 31, 2019	**JOB#:** 19088
LOCATION: Passaic Avenue and Cleveland Avenue	**MH#:**	**METER SITE:** 1
GPS/COMMENTS: 40.746094, -74.164412		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	20	RCP	3	0	Circular	05' 10"
Incoming						
Outgoing	12	CIP	3	0	Circular	06' 10"
Overflow	Weir					05' 06"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Frame	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

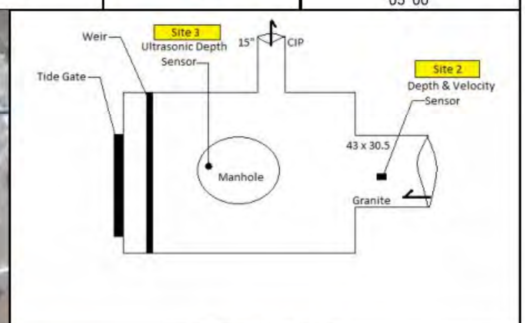


FLOW ASSESSMENT SERVICES

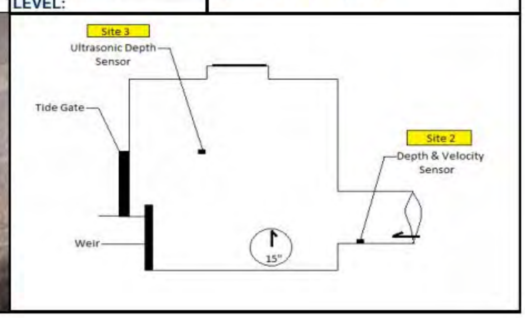
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 31, 2019	**JOB#:** 19088
LOCATION: Harrison Avenue and Passaic Avenue	**MH#:**	**METER SITE:** 2
GPS/COMMENTS: 40.745337, -74.164348		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	43 x 30.5	Granite	4.7	0	Egg	05' 00"
Incoming						
Outgoing	15	CIP	5	0	Circular	07' 01"
Overflow	Weir	Wood				05' 00"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 54.8"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Rim	**BREADTH:** 2.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

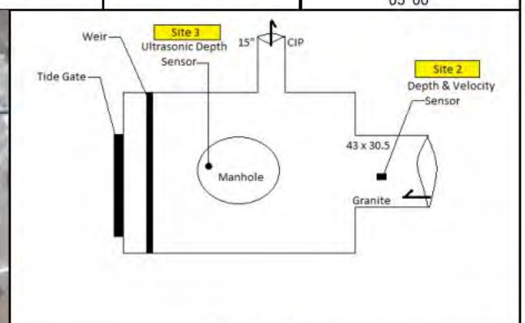


FLOW ASSESSMENT SERVICES

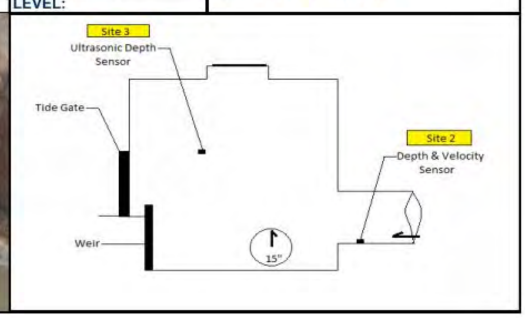
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 31, 2019	**JOB#:** 19088
LOCATION: Harrison Avenue and Passaic Avenue	**MH#:**	**METER SITE:** 3
GPS/COMMENTS: 40.745337, -74.164348		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	43 x 30.5	Granite	4.7	0	Egg	05' 00"
Incoming						
Outgoing	15	CIP	5	0	Circular	07' 01"
Overflow	Weir	Wood				05' 00"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 54.8"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Rim	**BREADTH:** 2.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

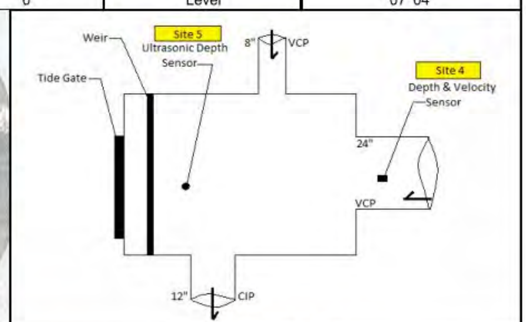


FLOW ASSESSMENT SERVICES

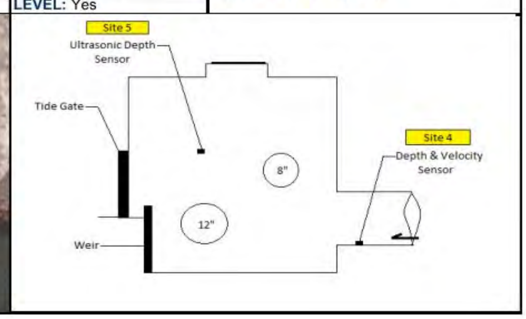
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 25, 2019	**JOB#:** 19088
LOCATION: 1st Street	**MH#:**	**METER SITE:** 4
GPS/COMMENTS: 40.740716, -74.161870		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	6	0	Circular	09' 00"
Incoming	8	VCP	Dry	11	Circular	06' 00"
Outgoing	12	CIP	4	0	Circular	09' 00"
Weir	54.25	Wood	0	0	Level	07' 04"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:** 54.25"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:** 06"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:** Yes	

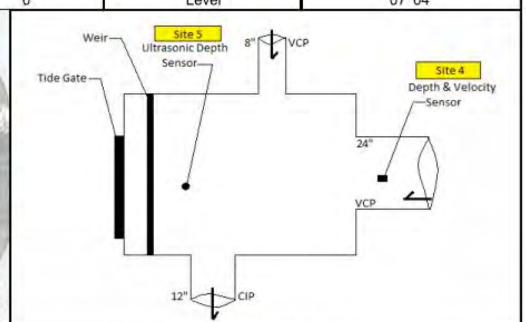


FLOW ASSESSMENT SERVICES

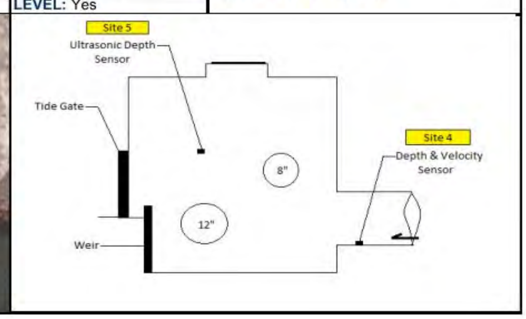
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 25, 2019	**JOB#:** 19088
LOCATION: 1st Street	**MH#:**	**METER SITE:** 5
GPS/COMMENTS: 40.740716, -74.161870		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	6	0	Circular	09' 00"
Incoming	8	VCP	Dry	11	Circular	06' 00"
Outgoing	12	CIP	4	0	Circular	09' 00"
Weir	54.25	Wood	0	0	Level	07' 04"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:** 54.25"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:** 06"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:** Yes	

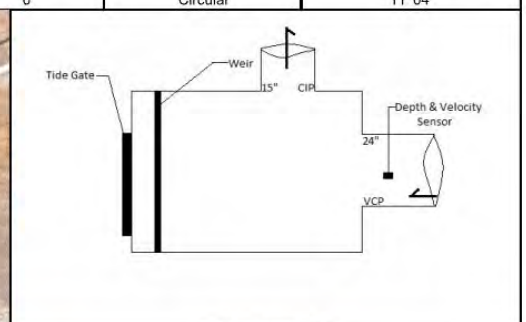


FLOW ASSESSMENT SERVICES

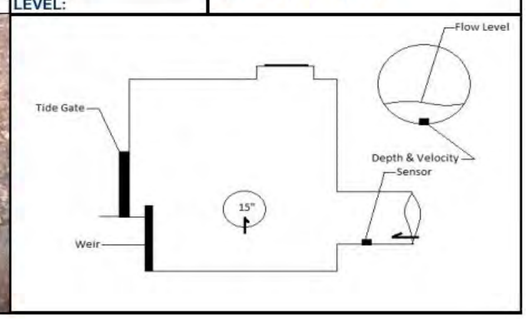
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 24, 2019	**JOB#:** 19088
LOCATION: Bergen Street and Dey Street	**MH#:**	**METER SITE:** 6
GPS/COMMENTS: 40.742943, -74.163164		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	4	2	Circular	11' 05"
Incoming						
Incoming						
Outgoing	15	CIP	3	0	Circular	11' 04"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

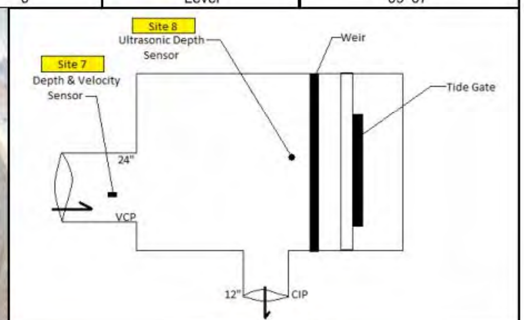


FLOW ASSESSMENT SERVICES

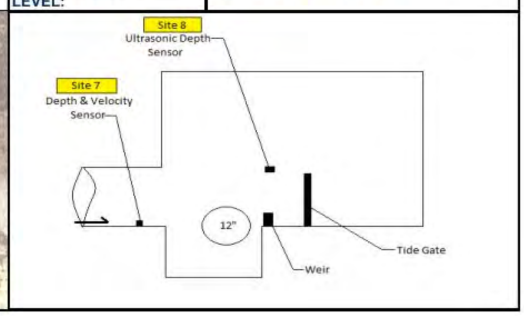
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	DATE: July 24, 2019	JOB#: 19088
LOCATION: Supor Boulevard	MH#:	METER SITE: 7
GPS/COMMENTS: 40.743388, -74.146371		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	3	0	Circular	10' 02"
Incoming						
Outgoing	12	CIP	4	0	Circular	10' 08"
Weir	53		0	0	Level	09' 07"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH: 53"	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO: Manhole cover	BREADTH: 6.5"	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	

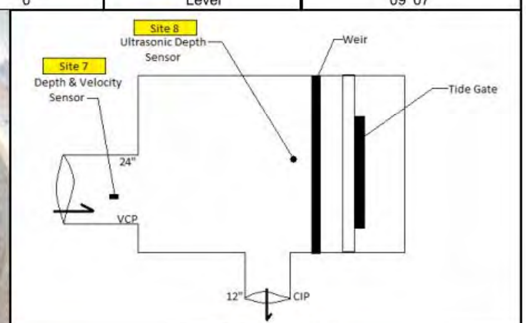


FLOW ASSESSMENT SERVICES

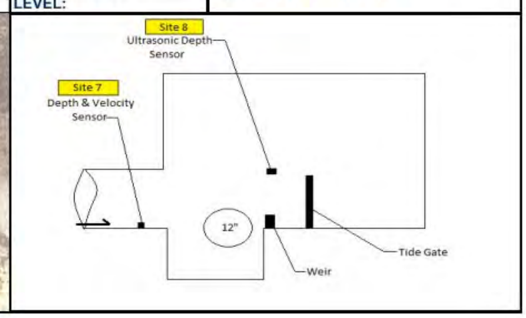
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 24, 2019	**JOB#:** 19088
LOCATION: Supor Boulevard	**MH#:**	**METER SITE:** 8
GPS/COMMENTS: 40.743388, -74.146371		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	3	0	Circular	10' 02"
Incoming						
Outgoing	12	CIP	4	0	Circular	10' 08"
Weir	53		0	0	Level	09' 07"



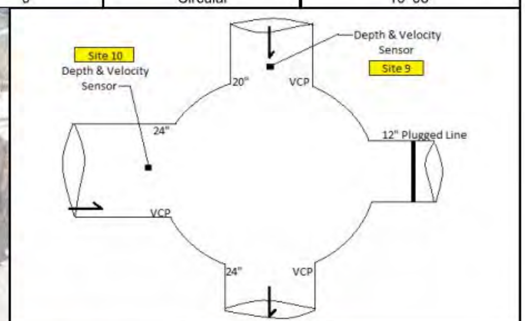
SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 53"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Manhole cover	**BREADTH:** 6.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



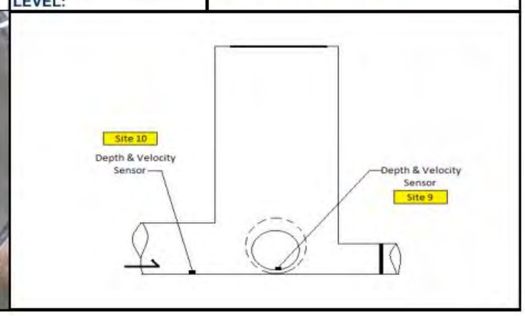
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** August 16, 2019	**JOB#:** 19088
LOCATION: Harrison Avenue and Kingsland Avenue	**MH#:**	**METER SITE:** 9
GPS/COMMENTS: 40.747734, -74.147997		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	6	0	Circular	10' 06"
Incoming	20	VCP	6	2	Circular	10' 06"
Incoming	12	Plugged				
Outgoing	24	VCP	6	0	Circular	10' 06"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 10'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

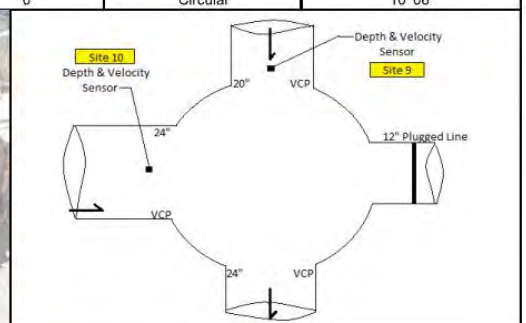


FLOW ASSESSMENT SERVICES

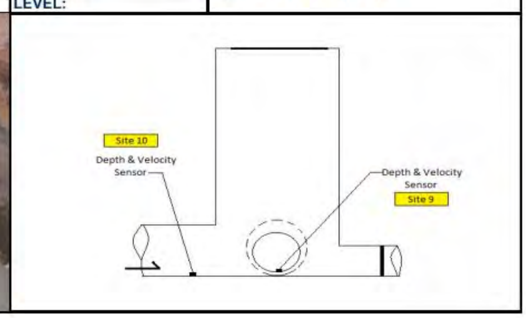
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** August 16, 2019	**JOB#:** 19088
LOCATION: Harrison Avenue and Kingsland Avenue	**MH#:**	**METER SITE:** 10
GPS/COMMENTS: 40.747734, -74.147997		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	6	0	Circular	10' 06"
Incoming	20	VCP	6	2	Circular	10' 06"
Incoming	12	Plugged				
Outgoing	24	VCP	6	0	Circular	10' 06"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: 10'	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



E. Approved Flow Monitoring QAPP

Town of Harrison, Hudson County, NJ

Quality Assurance Project Plan
Supplemental Sewer Flow Monitoring and Update to Hydraulic Model Calibration

NJPDES Permit No. 0108871
CSM – Combined Sewer Management

December 2019

Prepared by

MOTT MACDONALD

111 Wood Avenue South
Iselin, NJ 08830

SECTION A – PROJECT MANAGEMENT

A.0 SUMMARY

This Quality Assurance Project Plan (QAPP) was prepared for and is being submitted by the Town of Harrison ("the Town" or "Harrison") regarding supplemental sewer flow monitoring to refine the Town's portion of the Passaic Valley Sewerage Commission's (PVSC) districtwide hydraulic model. The information obtained will be used in analysis of alternatives regarding the long-term control plan (LTCP) for combined sewer overflows (CSOs). This QAPP is consistent with QAPPs previously approved by the Department. It makes use of the same flow metering devices used in those previously approved plans.

A.1 TITLE OF PLAN AND APPROVAL

Title: Supplemental Sewer Flow Monitoring and Update to Hydraulic Model Calibration
Town of Harrison, Hudson County
Permit No. NJ 0108871

Approvals:

Permittee: Rocco Russomanno, P.E.
Date 12/27/19.
Town Engineer
Town of Harrison

Project Manager: John Dening 12/29/2019
John Dening, P.E. Date
Mott MacDonald

Project Officer: John Dening 12/29/2019
John Dening, P.E. Date
Mott MacDonald

QA Officer: Kirk R. Barrett 12/30/19
Kirk Barrett, Ph.D., P.E. Date
Mott MacDonald

NJ DEP: 1/14/2020
Marzooq Alebus Date
NJDEP Division of Water Quality

A.2 DISTRIBUTION LIST

Town of Harrison
Rocco Russomano, P.E., Town Engineer

New Jersey Department of Environmental Protection
Nancy Kempel, Surface Water Permitting
Joseph Mannick, Surface Water Permitting
Dwayne Kobesky, Harrison Team Leader
Marzooq Alebus, Division of Water Quality

Mott MacDonald
John Dening, P.E.
Kirk Barrett, PhD, P.E.

A.3 PROJECT CONTACT INFORMATION

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Marzooq Alebus
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Surface Water Permitting
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401 E. State St., 2nd Floor
Trenton, NJ 08625-0420

A.4 TABLE OF CONTENTS

A.5 PROJECT ORGANIZATION

A.5.1 Key Individuals and Responsibilities

Portions of this Supplemental Sewer Flow Monitoring (the "Project") will be executed by contractors. The work under this QAPP will thus be executed by entities other than the listed permittee. Ultimate responsibility for the implementation of the Project is with the positions listed below:

Project Manager

The Project Manager (PM) is responsible for the coordination and management of the Project, including

- Communicating with the Town and the NJDEP to set delivery dates for reports and preparation of milestones for the project;
- Fiscal accountability to the Town.
- Communicating with Town operational staff to provide periodic updates on progress and schedules.
- Ensuring the availability of resources as needed to complete each task.
- Overall review and coordination of the project.

Project Officer

The Project Officer (PO) is responsible for the implementation of the Project and its associated QAPP. In addition, the PO is responsible for:

- Working with Quality Assurance (QA) Officer and Project staff to implement corrective action for any quality control problems with personnel, technical content and procedures;
- Ensuring that documents/products are presented to the QA Officer as well as to the Town and NJDEP;
- Working with QA Officer and project staff to ensure compliance with applicable NJDEP procedures;
- Taking corrective actions for any quality control problems with personnel, technical content, or procedures;
- Tracking and maintaining compliance with applicable EPA and NJDEP procedures; and
- Coordinating team resources.

Quality Assurance Officer

The Quality Assurance Officer has the following responsibilities:

- Confirming that the requirements of the QAPP are implemented through effective organizing and planning to meet the project and quality objectives;

- Monitoring and auditing QC/QA processes and performance;
- Co-authoring and approving the QAPP;
- Verifying that all data products are reviewed and approved according to accepted policies and guidelines before being released;
- Conducting an independent QA review of data and completed draft documents;
- Authoring or co-authoring quarterly progress reports;
- Communicating any problems to the Project Manager; and
- Maintaining the official QAPP.

A.5.2 Principal Data Users

The principal users of the data will be the Town and the engineering consultants supporting the Town. Other primary users of the data may include the NJDEP and PVSC District. Other primary users of the data are responsible for evaluating the data using quality criteria appropriate for their use and/or decision-making process.

A.5.3 Decision Makers

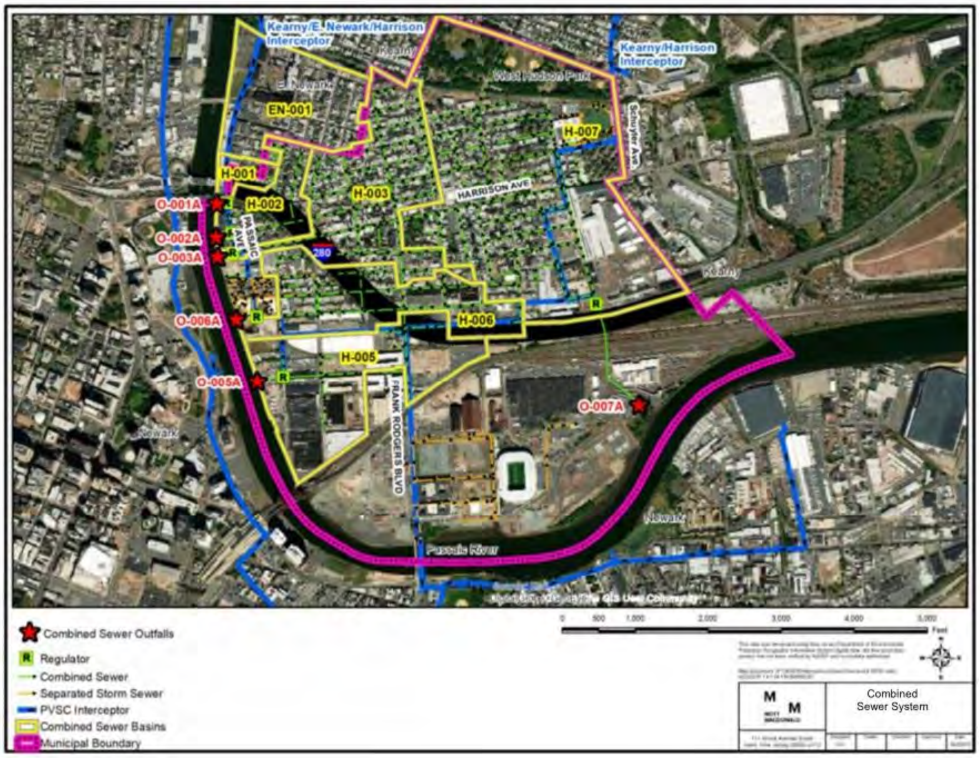
The Town has decision-making authority. The Program Manager is ultimately responsible for all technical, financial, and resource related elements of the program, and is the main contact for interagency communications. Any changes made to the program as outlined in this QAPP will be reported in writing for signatory approval and associated amendments to the QAPP will be submitted as necessary.

A.6 PROBLEM DEFINITION AND BACKGROUND

The Town of Harrison is working to complete its long-term control plan for overflows from its combined sewers (Figure 1). Harrison is a member of and has been working cooperatively with the PVSC CSO Group, which undertook certain initial tasks required under the permit. One of these tasks was the preparation of a hydraulic model of the PVSC service district. This model was initially developed by PVSC to evaluate wet weather impacts upon its transport system (interceptors), and thus limited flow data was collected from individual drainage areas such as those in Harrison. These efforts are described in the PVSC District Service Area System Characterization Report (2018).

The model was provided to PVSC member municipalities with combined sewers for their used in developing their LTCPs. To improve the evaluation, Mott MacDonald expanded the model detail within Harrison. Additional flow monitoring will allow greater accuracy and confidence in outputs from the model regarding CSO peak flow and volume. Therefore, the Town is pursuing this Project to collect additional sewer flow data and to refine the hydraulic model.

Figure 1: Combined Sewer System in Harrison



Quality Assurance Project Plan for Supplemental Flow Monitoring; Town of Harrison *Page 7*

A.7 PROJECT DESCRIPTION

The Project consists of installing seven flow meters measuring both depth and velocity and three depth-only sensors at strategic locations within Harrison's sewer system, plus one rain gauge. Monitoring locations are provided in Section B1 of this QAPP The meters will collect data at 5-minute frequency for 12 weeks. After monitoring has concluded, the data will be used to refine the hydraulic model of sewer flow in Harrison.

A.8 QUALITY OBJECTIVES AND CRITERIA

A hydraulic and hydrologic collection system model (model) is a virtual representation of a physical collection system that ideally closely matches the operation and performance of the actual collection system. A model provides the ability to understand the flow, level, and velocity conditions anywhere in the collection system under any actual or arbitrary conditions. Since a model is a primary tool for assessing current collection system performance as well as evaluating potential system improvements, having high confidence in the model's results is paramount. By further refining the Town's existing collection system model (the "Model"); the Town will be able to evaluate system improvements that will meet operational and regulatory goals.

A.8.1 Model Objective and Development Overview

The primary goals for the Model are:

- Predicting the performance of the existing collection system under various storm and system conditions;
- Identification of any collection system locations that are susceptible to frequent surcharge, flooding, and general hydraulic overloading; and
- Understanding how the performance of the PVSC interceptors affects CSO activations and volumes within the Town.

The development of an accurate model is dependent on the following two key datasets:

- Physical collection system inputs (pipes, manholes, pump stations (none), other flow control elements (regulators), contributing drainage areas, etc.). The Town has recently (2018) undertaken a project to convert CAD and paper data on most junction manholes within the collection system including pipe sizes as well as rim and invert elevations. Limited field data was collected to verify and supplement historic and record plan data. This data was then transformed into a GIS map, which will form the basis for the updated InfoWorks model.
- Environmental inputs (rainfall data, flow data, debris and sediment data, river/tide elevation data, pollutant data, groundwater/antecedent moisture conditions, etc.).

A.8.2 Flow Model Development

The collected environmental data, specifically rainfall and flow monitoring data, provide both inputs to the model and data for evaluating the Model's performance. Since rainfall drives the dominate runoff response in combined sewered areas, having accurate rainfall data is critical to properly understanding the peak flows and volumes experienced in the collection system in response to storm events. By performing various analyses, flow monitoring data also provide key model inputs and is itself the principal means of validating the Model's performance. Rainfall and flow monitoring data directly relate to the development of the Model's dry weather and wet weather responses that are discussed in greater detail below.

A.8.3 Dry Weather Flow Model Development

Dry weather flows in a combined sewer include the following two components and can be determined from analyzing the relevant flow monitoring data:

- Wastewater generation from households, municipal, commercial, and industrial facilities, often following a diurnal time variable pattern, typically referred to as a base sanitary flow (BSF), and
- Groundwater infiltration (GWI), which is a continuous infiltration to the collection system from the surrounding soil, typically entering through sewer laterals, pipe defects, etc.

Since these two components cannot be measured independently, various approaches are typically used to separate the measured dry weather flow into these two components. Many of these methods are largely based on rules of thumb or simplistic assumptions. For the Town's model the Stephen-Schutzbach equation will be used to separate these two DWF components. This method was developed based on flow monitoring data collected in many different collection systems and has proven reliable over a wide range of drainage area sizes and flow conditions. This equation is shown below and uses the average daily dry weather flow (ADF) and the minimum daily dry weather flow (MDF).

$$GWI = \frac{0.4(MDF)}{1 - 0.6\,(\frac{MDF}{ADF})\text{^}ADF\text{^}0.7}$$

In order to determine the DWF components for each flow meter, dry weather flow periods will be extracted based upon a minimum of two (2) days antecedent dry time. Each period will be reviewed and DWF periods that exhibit anomalous flow data will be manually removed from the analysis. Using the reviewed DWF periods, an average DWF diurnal pattern will be determined for both weekdays and weekends. The DWF diurnal pattern is a repeatable "description" of DWF generation throughout the flow meter service area. The diurnal pattern typically differs between weekdays and weekends and is typically consistent over the course of the year.

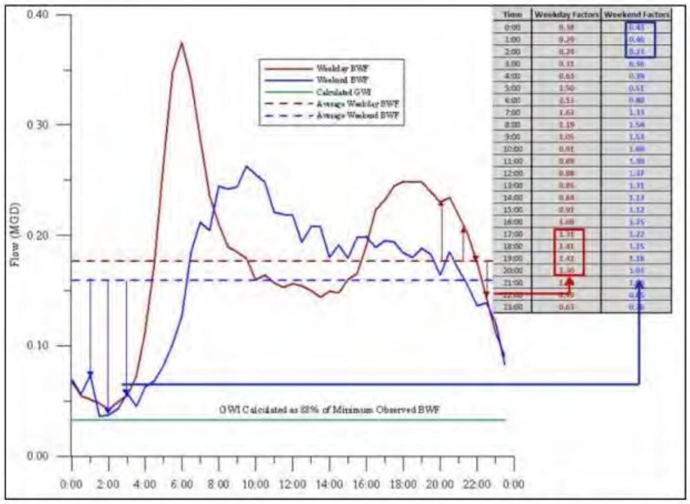


Figure 2. Sample Average BSF and Diurnal Flow Factors

The BSF is calculated as the average flow over the course of an entire day. The diurnal flow factors will be determined for each hour based upon the deviation from the average daily BSF. Figure 2 visually depicts the BSF and the accompanying diurnal flow factors.

A.8.4 Wet Weather Flow Model Development

The wet weather response from combined sewer systems is typically dominated by short term (rapid) direct runoff. However, intermediate and long-term wet weather responses also can also have meaningful contributions to the total wet weather volumes. These different wet weather responses are further described below:

1. Short term inflows such as storm water system catch basins, cross connections and roof leaders directly connected to the sewage collection system. Typically, these flows peak in an hour or less after peak rainfall.
2. Intermediate term inflow from groundwater such as basement sump pumps and foundation drains directed to the sanitary system and leaking house laterals. These flows typically peak within a few hours after peak rainfall.

3. Long term GWI enters the sanitary system through leaking sewer joints and manholes. This flow peaks after many hours or even days after peak rainfall. The second and third pathways are more prominent in separate sanitary areas.

The Town's wet weather response is expected to be dominated by short-term events, as evidenced in prior metering and modeling. The next sections detail how these different wet weather responses will be incorporated into the Model.

A.8.5 Combined Sewer System

In combined sewer systems, inflow predominantly enters the collection system due to direct overland flow into directly connected stormwater catch basins and roof leaders. Intermediate term inflow and long term GWI entering the system will normally be relatively small by comparison. The response in combined sewer systems is typically a quick spike in flows within an hour or less of the start of the storm event. It is not uncommon for these peak flows to be on the order of 10-50 times the average DWF, depending on the size of the contributing area and its respective land use properties.

The importance of the land use properties within combined collection systems cannot be understated. Since runoff in a combined sewer system is purposely directed to the sewer, accurately calculating the directly connected impervious area is the most critical aspect of modeling combined sewer systems. Another reason for this is that losses from impervious surfaces due to infiltration, initial abstractions and evapotranspiration are generally minimal.

To convert rainfall into flow in a combined sewer system, a portion of raw rainfall is removed due to different losses and then the remaining volume is routed overland to an entry point into the collection system. The physical means of lost water include the following:

- Initial abstractions sometimes referred to as depression storage,
- Evapotranspiration
- Infiltration

System losses primarily reduce the volume of runoff that is then routed overland. In contrast the model variables for overland routing typically affect the speed at which that flow enters the collection system.

- Surface Roughness (n)
- Drainage Area
- Ground Slope
- Width

The following paragraphs briefly describe these variables and how they will be implemented in the Model.

Initial Abstractions

The initial abstraction is the total depth of rainfall lost to surface depressions, surface runoff gullies, storage in the soil, etc. Initial abstraction is used to more accurately model the delay in the start of infiltration and the total volume infiltrated. This loss decreases the available volume of water available for runoff into the collection system. For an impervious surface the initial abstraction is often the first 0.05" – 0.10" of rainfall and initial abstractions are typically larger for pervious surfaces. The initial abstraction will be initially estimated by using the values from the original model and refined during calibration.

Evapotranspiration

During continuous model simulations, it is important to regenerate the initial abstraction value in between storm events using evapotranspiration. The factors that impact evapotranspiration are regional and thus are not expected to vary across the combined sewer systems being modeled. For this reason, the evapotranspiration will be modeled using a monthly evapotranspiration rate across the entire model, as developed and implemented in the PVSC regional model.

Infiltration

Infiltration is the process of rainfall penetrating the ground surface into the unsaturated soil zone of pervious subcatchment areas. Numerous infiltration modeling approaches are available including: Fixed Percentage, Horton Method, Green-Ampt Method, and the Curve Number Method. The following approach will be used in the Model:

- Horton Method to calculate infiltration across all pervious area subcatchments, and
- Fixed Percentage to calculate infiltration across all impervious area subcatchments (the fixed percentage for all impervious surfaces will be assumed to be 100%).

The Horton method is based on certain parameters that will initially be set to the values used in the PVSC regional model. The impervious and pervious fractions for the municipal contributing drainage areas will be estimated using available GIS data including, but not limited to geological data and orthophotography. In the event that the Horton Method provides poor results for meeting required modeling accuracy, other infiltration methods may be explored.

Surface Manning's Roughness (n)

Subcatchments require input of Manning's surface roughness (n) for both pervious and impervious subareas. During the calibration process, Manning's n values can be adjusted to affect the timing and attenuation of the runoff from the subcatchment without impacting the runoff volume.

Drainage Area

The Drainage Area for each subcatchment defines the total area that is susceptible to overland runoff mechanisms. This area for each municipal drainage area will be determined from available GIS data. Large unconnected and unsewered areas such as parks and wooded areas will be subtracted from the Drainage Area GIS calculation since the rainfall respond in these areas is drastically different and thus will not significantly impact peak runoff volumes or times of concentrations within the combined sewer system.

Ground Slope

The Ground Slope parameter (aka Percent Slope) is the steepness of the overland flow path and is given in percent slope. Average percent slope values will be estimated using available GIS data by taking the average elevation difference across the subcatchment and dividing it by the maximum overland flow length. Adjustments to the slope subcatchment parameter affect the timing of the runoff from a subcatchment and therefore are used to adjust the time to peak and duration of the runoff hydrograph.

Width

The width parameter is based on the length of the overland flow path for sheet flow runoff in a subcatchment. An initial estimate of the width will be determined by dividing the subcatchment area by the average overland flow length. The overland flow length is the length of the flow path from the furthest drainage point of the subcatchment to the point where the flow enters a pipe, stream, gutter or other conveyance.

Since the width parameter best represents the physical process of flow attenuation, adjustments will be made to the width parameter to improve the modeled hydrograph shape compared to the measured hydrograph.

A.8.6 Model Calibration and Verification

Any collection system model is only as valuable as the level of confidence in its results. Using a rigorous process to calibrate and then validate the Model's performance will increase the confidence that the model realistically mimics the performance of the actual collection system. The existing model will be updated under this QAPP and georeferenced to the data recently collected. The following sections describe the calibration and validation methodology that will be applied.

Calibration Methodology and Parameters

To calibrate and then validate the Model, various model parameters will be adjusted and refined in an iterative process after the model building phase is complete. This iterative calibration process is needed for any collection system model due to various assumptions and uncertainties embedded in the model inputs. After the Model has been successfully calibrated, it will undergo a validation phase to approximate how it will perform under arbitrary rainfall conditions (such as design storms). During validation a completely different set of storm events, not used for calibration, will be simulated and the results compared to flow meter data. If the model successfully completes the validation phase, the Model will be considered verified and can then be used with confidence. The validation phase is important because it is possible for a model to perform acceptably under calibration and then poorly under validation. If the calibrated Model performs poorly during validation, the model would undergo additional calibration and then a second validation would be performed.

The calibration of the Model will adhere to the following sequential order:

1. Dry Weather Flow and Diurnal Patterns
2. Wet Weather Volume
3. Peak Flow and General Hydrograph Shape
4. Depth in Sewer During Wet Weather Events

The quality objectives for the model are criteria taken from the "Code of Practice for the Hydraulic Modeling of Sewer Systems" (CIWEM, 2002). These model evaluation criteria are widely utilized throughout the collection system modeling community and were specified in the PVSC group's approved QAPP for the System Characterization and Landside Modeling Program (PVSC, 2016).

Dry Weather Flow Criteria

1. The timing of the peaks and troughs should be within 1 hour.
2. The peak flow rate should be in the range ± 10%.
3. The volume of flow should be in the range ±10%.

Wet Weather Flow Criteria

1. Modeled peak flows should be within -10 percent and +25 percent of the observed peak flows,
2. Modeled flow volumes should be within -10 percent and +20 percent of the observed flow volumes,
3. Modeled depths of flow in surcharged sewers should be within -4 inches and +18 inches in sewers 21 inches in diameter and larger (within -4 inches and +6 inches in sewers smaller than 21 inches in diameter) of the observed depths of flow,
4. Modeled depths of flow at unsurcharged critical point in the system (i.e. CSO structures) should be within 4 inches of the observed depths of flow, and
5. Shape and timing of the hydrographs should be similar.

In addition to the guidelines above, after running each simulation, the continuity calculations of the simulation will be checked. The target continuity error for each simulation is 2% or less.

The primary model parameters that impact the calibration of the Model are the collection system hydraulics and runoff mechanisms within the combined system.

Factors that impact system hydraulics that also have a degree of uncertainty that might require adjustment during calibration include:

- Manning's Roughness Coefficients,
- Manhole Entry Loss Coefficients (particularly at sharp bends and at drop manholes),
- Sediment Depths (if applicable).

The physical attributes of the collection system such as pipe diameters, pipe lengths, pipe/manhole inverts, etc. will remain unchanged during calibration because these data are fixed having come from field inspections and or as-built records.

Dry weather calibration is typically a straightforward exercise since the BSF, GWI and diurnal factors are calculated directly from the flow meter data. The DWF calibration criteria that will be used for evaluating the Model are listed in Section A.8.6.

Factors that impact wet weather runoff mechanisms within the combined system, in order of typical greatest influence on the results, are as follows:

- Percent Impervious (Volume)
- Width
- Slope
- Initial Abstractions
- Horton's Infiltration Coefficients
- Surface Roughness

During wet weather calibration efforts, the goal is to evaluate the model under a wide variety of storm and antecedent moisture conditions. So, the selected calibration storm events will include storms of different depths, durations, and intensities. By calibrating to a wide spectrum of storm events, the Model will then be able to continuously simulate the wide spectrum of storms experienced during the typical year with confidence.

Ideally when selecting storm events for calibration purposes, three different types of storms should be selected: short duration events (1-2 hours or less) with high intensities (thunderstorms), storms lasting a significant portion of a day (12 to 24 hours), and storms of relatively low intensity stretching over the course of more than one day. Evaluating short, intense storms is intended to test the model's response to immediate surface runoff and other direct inflows. The moderate duration storms are intended to test the model response for less direct flows to the sewers such as infiltration and flows through storage areas. The long duration storms test the model response for deep infiltration. An additional consideration for storm selection is the intensity of the storm. Lower intensity storms aid in estimating the infiltration rates and the storage capacities. Higher intensity storms aid in estimating slopes, percent impervious, and sewer capacity. Selecting varying storm characteristics will ensure the H&H Model is calibrated for the peak as well as the recession of the storm.

A.9 DOCUMENTATION AND RECORDS

This element addresses management of project documents and records, including this QA Project Plan. Management of project data is covered later in Element B.4, Data Management. The QAPP will be distributed to each of persons listed in A.2 DISTRIBUTION LIST. The QA Officer will be responsible for any updates to the QAPP.

Raw and processed flow data and reports will be stored electronically on Mott MacDonald's SharePoint site for a minimum of 10 years. The model input and output will be stored on computers under the control of the Project Officer at the offices of Mott MacDonald in Iselin, NJ. Computers are automatically backed-up regularly via cloud-based service.

SECTION B – DATA GENERATION AND ACQUISITION

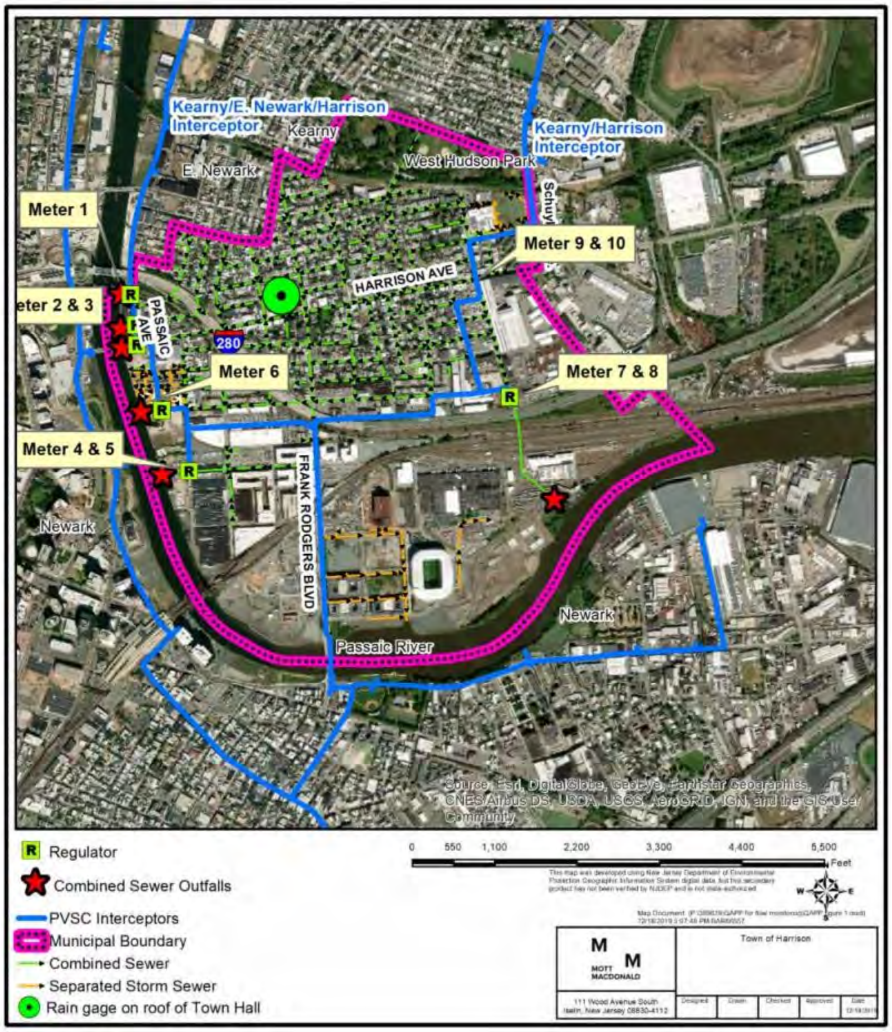
B.1 MONITORING DESIGN

The locations of the sensors were chosen to provide information regarding the duration and magnitude of combined sewer overflows that is necessary and sufficient to develop a reliable hydraulic model. Seven flow meters measuring both depth and velocity and three depth-only sensors are installed within Harrison's sewer system, plus one rain gauge located on the roof of the Harrison Municipal Building. Table 1 includes descriptions, manhole IDs and pipe diameters where the flow and level monitors will be installed. Figure 3 maps their locations. Five of the seven flow meters will be in the pipe just upstream from their respective regulators and measure inflow to the regulators. The three water-level only sensors will be installed above the overflow weir at regulators to measure when flow is entering the overflow pipe. The meters will collect data at 5-minute frequency. The remaining two meters, #9 and #10 will be located on branch sewers, near an interconnections with PVSC's Kearney – Harrison Interceptor. Since the model must simulate response to wet weather, the monitoring period will last 12 weeks, intending to catch at least three storms in excess of 0.75" of rain, at least one exceeding 1".

Table 1: Flow Monitor Installation Locations

Meter No.	Description	Manhole ID	Pipe Diameter (in)
1	Regulator 2 Inflow	MH-816 (R40)	21
2	Regulator 3 Inflow	MH-1201 (R41)	30x45
3	Regulator 3 Overflow Weir Depth Sensor	-	-
4	Regulator 5 Inflow	MH-1231 (R43)	24
5	Regulator 5 Overflow Weir Depth Sensor	-	-
6	Regulator 6 Inflow	MH-739 (R44)	24
7	Regulator 7 Inflow	MH-1026 (R45)	24
8	Regulator 7 Overflow Weir Depth Sensor	-	-
9	Kingsland Ave. and Harrison Ave. (North)	MH_1009	24
10	Kingsland Ave. and Harrison Ave. (West)	MH_1009	24

Figure 3: Map of flow monitoring locations



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B.2 MONITORING METHODS

Flow monitoring will be conducted using a continuous wave area-velocity flow monitor as manufactured by Teledyne Isco (Model 2150). These measure flow velocity and flow area simultaneously and compute volumetric flow rate by velocity times area. For velocity measurement, these meters use a continuous wave Doppler ultrasonic beam that provides an average velocity of the entire flow profile. Flow area is derived from the level, or head, of the flow, which is measured with a microprocessor-based pressure level sensor, and the dimensions of cross-section of the pipe. The pressure level sensor will operate accurately during surcharge and even if covered with debris. The three depth-only locations will not have a velocity sensor. All monitoring locations will be supplemented with an independent, ultrasonic, down-looking sensor to provide redundant measurement of water level for better reliability and accuracy.

The rain gauge will be a recording, tipping-bucket type, recording rainfall depth in 5-minute increments measured to 0.01", installed on the roof of Town Hall.

B.3 QUALITY ASSURANCE/QUALITY CONTROL

Flow monitoring will be conducted Flow Assessment Services, LLC (FAS), which specializes in this service. All flow meters will be tested for velocity and level accuracy prior to installation and are calibrated in the field once they are installed via hand-held level and electronic velocity sensors. If any sensor readings do not calibrate to tolerance, they are removed and replaced immediately. Within the first 24-48 hours of installation and at least biweekly thereafter, FAS technicians will return to sites to check each sensor for proper calibration and operation. Each visit will consist of a visual inspection of all meter and sensor components; a review of previous period data to search for anomalies in the meter performance; and physical calibration of level. Any equipment that is defective will be replaced on the spot.

Data from the meters will be collected via telemetry, allowing real-time QC of the sensors. All sites will be viewed online at least twice a week and a maintenance crew dispatched if problems are observed. Preliminary and final QA/QC of the data will include checking the validity of each data point, flow balance, and comparison of observed flow to expected flow (pipe rating curve).

B.4 DATA MANAGEMENT

Flow Assessment Services has been contracted to install, operate and maintain the meters. They will retrieve data via telemetry and store it in an internet-based system after a comprehensive QA/QC process. The data can then be reviewed, analyzed and downloaded by the Mott MacDonald and the Town.

FAS will develop a report for each location that will include a summary of daily flow information for each day during the monitoring time period. The summary presents, for each day, the minimum flow rate, peak flow rate, total daily flow, total rain, peak hourly rain, and peak 5-minute rainfall, if applicable. The summary also includes the total flow volume, average daily flow, and total rainfall quantity, if applicable. Detailed flow reports of the flow rate data in 5-minute time increments will also be prepared and submitted. The detailed report will include depth of flow, velocity of flow, incremental flow rate, cumulative flow rate and recorded rainfall. In addition, flow hydrographs will be prepared for each flow monitoring location, which present a plot of the recorded flow rates for a selected time period. A bar graph of rainfall recorded during the selected time period is also plotted on the hydrograph.

Mott MacDonald will download the raw and processed data and store the data and reports in Sharepoint for a minimum of 10 years.

The hydraulic model was developed using InfoWorks ICM developed by Innovyze Software. InfoWorks ICM is an effective tool for dynamic hydrologic, hydraulic and water quality modeling, and provides integrated asset and business planning tools with fast and accurate urban drainage network modeling. It is accepted by numerous agencies and is widely used across the United States and internationally. The model is georeferenced and linked to the GIS data previously developed as part of the system characterization. The model resides on computers under the control of the Project Officer in the offices of Mott MacDonald in Iselin, NJ. The model input and output are automatically backed-up regularly via cloud-based service.

REFERENCES

CIWEM (Chartered Institution of Water and Environmental Management). 2002. Code of Practice for the Hydraulic Modeling of Sewer Systems, Version 3.001;. CIWEM. London, UK

PVSC (Passaic Valley Sewerage Commission). 2016. System Characterization and Landside Modeling Program Quality Assurance Project Plan (QAPP) Part 1. Passaic Valley Sewerage Commission

PVSC. 2018. Service Area System Characterization Report. PVSC (Passaic Valley Sewerage Commission).

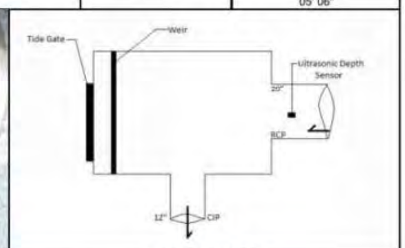
Appendix A – Flow Meter Installation Reports

FLOW ASSESSMENT SERVICES

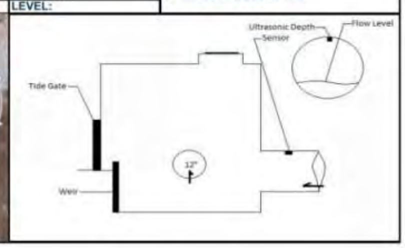
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 31, 2019	**JOB#:** 19088
LOCATION: Passaic Avenue and Cleveland Avenue	**MH#:**	**METER SITE:** 1
GPS/COMMENTS: 40.746094, -74.164412		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	20	RCP	3	0	Circular	05' 10"
Incoming						
Outgoing	12	CIP	3	0	Circular	06' 10"
Overflow	Weir					05' 06"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:**	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Frame	**BREADTH:**	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

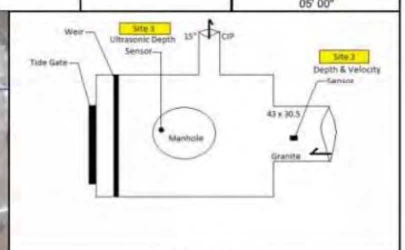


FLOW ASSESSMENT SERVICES

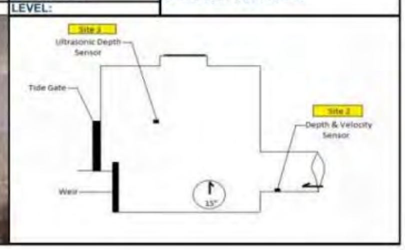
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 31, 2019	**JOB#:** 19088
LOCATION: Harrison Avenue and Passaic Avenue	**MH#:**	**METER SITE:** 2
GPS/COMMENTS: 40.745337, -74.164348		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	43 x 30.5	Granite	4.7	0	Egg	05' 00"
Incoming						
Outgoing	15	CIP	5	0	Circular	07' 01"
Overflow	Weir	Wood				05' 00"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 54.8"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Rim	**BREADTH:** 2.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



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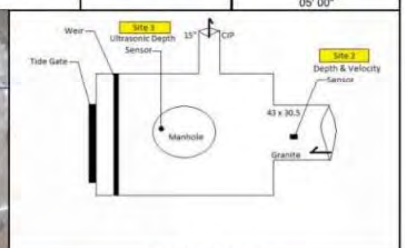
FLOW ASSESSMENT SERVICES

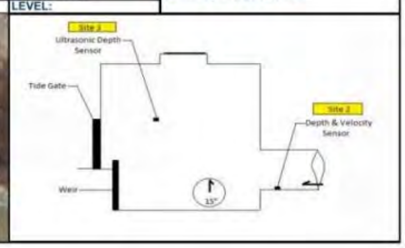
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 31, 2019	**JOB#:** 19088
LOCATION: Harrison Avenue and Passaic Avenue	**MH#:**	**METER SITE:** 3
GPS/COMMENTS: 40.745337, -74.164348		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	43 x 30.5	Granite	4.7	0	Egg	05' 00"
Incoming						
Outgoing	15	CIP	5	0	Circular	07' 01"
Overflow	Weir	Wood				05' 00"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 54.8"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Rim	**BREADTH:** 2.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



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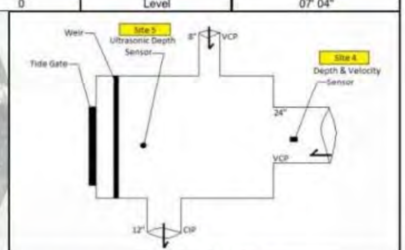
ASSESSMENT SERVICES

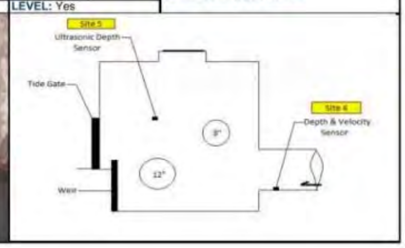
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 25, 2019	**JOB#:** 19088
LOCATION: 1st Street	**MH#:**	**METER SITE:** 4
GPS/COMMENTS: 40.740716, -74.161870		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	6	0	Circular	09' 00"
Incoming	8	VCP	Dry	11	Circular	06' 00"
Outgoing	12	CIP	4	0	Circular	09' 00"
Weir	54.25	Wood	0	0	Level	07' 04"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:** 54.25"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:** 06"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:** Yes	



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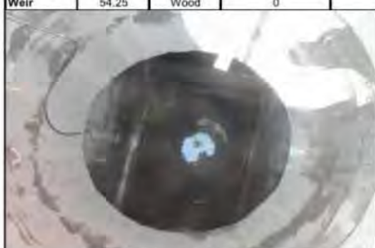
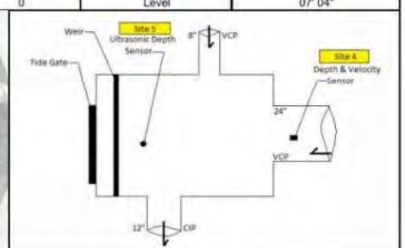
ASSESSMENT SERVICES

METER SITE INFORMATION FIELD LOG

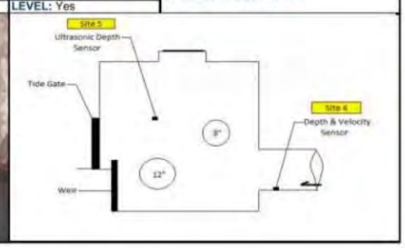
PROJECT: Harrison, NJ	**DATE:** July 25, 2019	**JOB#:** 19088
LOCATION: 1st Street	**MH#:**	**METER SITE:** 5
GPS/COMMENTS: 40.740716, -74.161870		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	6	0	Circular	09' 00"
Incoming	8	VCP	Dry	11	Circular	06' 00"
Outgoing	12	CIP	4	0	Circular	09' 00"
Weir	54.25	Wood	0	0	Level	07' 04"





SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	**LENGTH:** 54.25"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO:	**BREADTH:** 06"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:** Yes	



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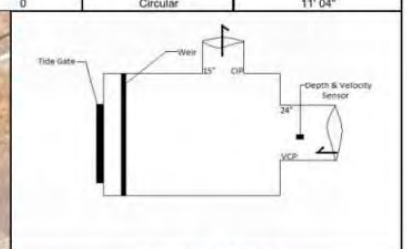
FLOW ASSESSMENT SERVICES

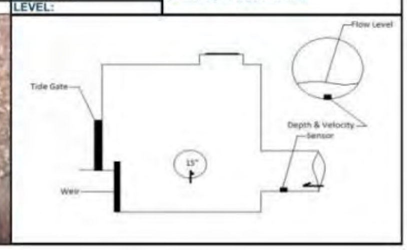
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 24, 2019	**JOB#:** 19088
LOCATION: Bergen Street and Dey Street	**MH#:**	**METER SITE:** 6
GPS/COMMENTS: 40.742943, -74.163164		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	4	2	Circular	11' 05"
Incoming						
Incoming						
Outgoing	15	CIP	3	0	Circular	11' 04"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	



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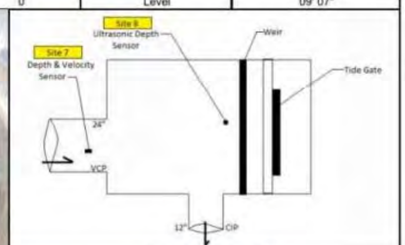
FLOW ASSESSMENT SERVICES

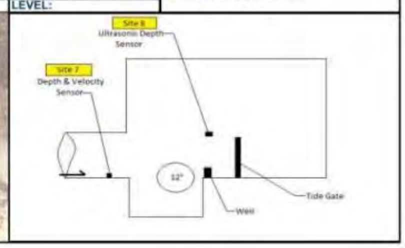
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 24, 2019	**JOB#:** 19088
LOCATION: Supor Boulevard	**MH#:**	**METER SITE:** 7
GPS/COMMENTS: 40.743388, -74.146371		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	3	0	Circular	10' 02"
Incoming						
Outgoing	12	CIP	4	0	Circular	10' 08"
Weir	53		0	0	Level	09' 07"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 53"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Manhole cover	**BREADTH:** 6.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	

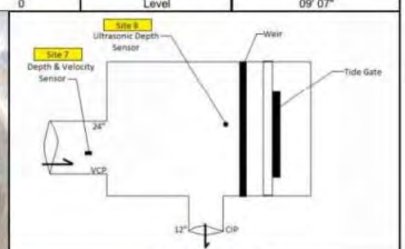


FLOW ASSESSMENT SERVICES

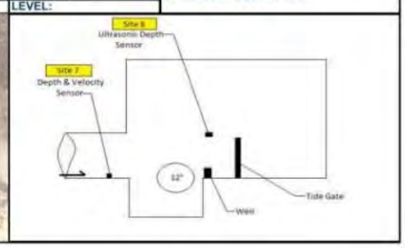
METER SITE INFORMATION FIELD LOG

PROJECT: Harrison, NJ	**DATE:** July 24, 2019	**JOB#:** 19088
LOCATION: Supor Boulevard	**MH#:**	**METER SITE:** 8
GPS/COMMENTS: 40.743388, -74.146371		

	Size (")	Material	Flow Depth (")	Debris (")	Shape	MH Depth
Incoming	24	VCP	3	0	Circular	10' 02"
Incoming						
Outgoing	12	CIP	4	0	Circular	10' 08"
Weir	53		0	0	Level	09' 07"



SURCHARGE INFORMATION	WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	**LENGTH:** 53"	**HEIGHT ABOVE WEIR:**
SURCHARGED MARKS TO: Manhole cover	**BREADTH:** 6.5"	**OVERFLOW OCCURS AT:**
SURCHARGE CURRENTLY TO:	**LEVEL:**	



Quality Assurance Project Plan for Supplemental Flow Monitoring; Town of Harrison *Page 30*

Appendix D – Financial Capabilities Memo from PVSC CSO Group

Memorandum

To: *Town of Harrison*

Copy: *Thomas Laustsen, Sheldon Lipke, Mike Hope, Tim Dupuis, Scott Craig*

From: *Tom Schevtchuk*

Date: *September 23, 2020*

Subject: *Final Financial Capability Assessment for the Town of Harrison*

1.0 Executive Summary

This Financial Capability Analysis (FCA) memorandum is in support of the Municipal Control Alternative identified in the Selection and Implementation of Alternatives Report (SIAR) developed by the Town of Harrison. It quantifies the projected affordability impacts of Town of Harrison's proposed long term CSO controls for the Harrison combined sewer system (CSS) and updates the 2019 preliminary FCA memo that was intended to guide the development and selection of long term controls.

Table E-1 - Projected Impacts of CSO Controls at a Glance

Typical Household 2019		
Annual Wastewater Costs		
From Sewer Rents		$210
Through Municipal Taxes		$185
	Total	$395
Residential Indicator (RI)*		0.6%
Median Household Income (MHI)		$63,600
LTCP Control Program		
CSO Control Capital Costs ($ millions)		$16.1
First Year After Full Implementation		2041
Projected LTCP Impact on Typical Household Cost		
MHI in 2041		$98,400
Annual Costs Without LTCP		$1,008
Residential Indicator		1.0%
Annual Costs With LTCP		$1,460
Residential Indicator		1.5%

As summarized in Table E-1, this FCA includes the projected impacts if the Municipal Control Alternative is undertaken by Harrison based on the costs and implementation schedule included in Harrison's SIAR Section F.

While a regional alternative would result in lowered overall costs for the control of CSOs within the PVSC service area, the basis of this allocation remains under discussion as of the writing of this memorandum. Under this approach, both the costs of the regional facilities such as a relief interceptor and the resultant savings would be allocated amongst the PVSC municipalities with combined sewer systems. As the basis of this allocation remains under discussion as of the writing of this SIAR, this FCA memorandum focuses on implementation of the Municipal Control Alternative. Should the permittees come to agreement on the cost allocation for the Regional Control Plan, the FCA will be revisited to reassess the affordability and schedule for implementation of the LTCP.

The Financial Capability assessment is a two-step process including ***Affordability*** which evaluates the impact of the CSO control program on the residential ratepayers and ***Financial Capability*** which examines a Town of Harrison's ability to finance the program. Affordability is measured in terms of the Residential Indicator (RI) which is the percentage of median household income spent on wastewater services. Total wastewater services exceeding 2.0% of the median household income are considered to impose a high burden by USEPA. The financial capability analysis uses metrics similar to the municipal bond rating agencies.

The 2019 preliminary FCA determined that future capital expenditures for CSO controls and all other capital expenditures of approximately $31 million (current dollars) over a twenty-year period (2022 through 2041) would result in a RI exceeding 2.0% using a dynamic (time sensitive) model which accounts for future inflation. Along with the calculated debt service costs associated with the $31 million in capital costs an annual incremental operations and maintenance (O&M) cost of $310,000 1.0% of the capital cost value was estimated.

Harrison's SIAR projects future capital costs for the Municipal Control Alternative totaling $16.1 million through 2040 and incremental annual O&M costs of around $31,400. This would result in a projected residential indicator in 2041, the first year after full implementation of the controls of 1.5% which would constitute a moderate burden under the USEPA analytical guidelines.

The second step of the financial capability analysis documents that Town of Harrison's current financial capability strength is "moderate" These two metrics combine on EPA's Financial Capability Matrix to indicate a medium burden under the USEPA guidance for the $16.1 million in capital expenditures proposed under Harrison's Municipal Control Alternative.

This draft memorandum is based on information provided by Town of Harrison, PVSC and external sources such as the on-line fiscal reports available through the New Jersey Department of Community Affairs.[1]

The projections and conclusions concerning the affordability of the Municipal Control Alternative proposed in this SIAR by the Town of Harrison and Harrison's financial capability to finance the CSO control program are premised on the baseline financial conditions of Harrison as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues, household incomes, and property tax collection rate, and increased unemployment.

2.0 Introduction

2.1 Intent of the Financial Capability Analysis

This document presents the final Financial Capability Analysis (FCA) relating to the development of the CSO Long Term Control Plan (LTCP) required under Paragraph G(8)(a) of the Combined Sewer Management section of the Town of Harrison's NJPDES discharge permit. The assessment is based upon the EPA document "Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development," (EPA Guidance Document)

1 https://www.nj.gov/dca/divisions/dlgs/resources/fiscal_rpts.shtml

published February 1997[2], as supplemented by EPA's November 2014 memorandum entitled "Financial Capability Assessment Framework for Municipal Clean Water Act Requirements".[3] A preliminary FCA memorandum was provided by PVSC to Harrison and the other combined sewered municipal permittees within its service area in August of 2019, with a subsequent update in December of 2019.

This final FCA and last year's preliminary version support the twofold purposes of the FCA as envisioned in the 1994 CSO Control Policy[4] (Policy). First, the FCA is intended to identify the upper limits of what could constitute an affordable future investment strategy as defined by the Policy and related guidance documents under an assumed LTCP implementation schedule; thereby informing the development of CSO, SSO, MS4, TMDL, and other necessary control alternatives. Second, the financial and user cost (affordability) impacts of the selected CSO controls must be assessed to support the development of a workable implementation schedule for the LTCP.[5]

2.2 EPA's Two Step Analysis Process

The Financial Capability assessment is a two phased process. The residential indicator (RI) is the percentage of median household income (MHI) expended on wastewater (including stormwater) management. The upper limit of affordability for wastewater services within Harrison will be the point where total wastewater management costs for the typical residential user in Town of Harrison exceed 2.0% of the Median Household Income (MHI). This metric of total wastewater management costs as a percentage of MHI is termed the Residential Indicator (RI) by USEPA.

The financial capability indicator is an assessment of the Town of Harrison's debt burden, socioeconomic conditions, and financial operations. These two measures are subsequently entered into a *financial capability matrix*, suggested by EPA, to determine the level of financial burden placed on residential customers and the Town of Harrison by the existing and projected future expenditures to operate, maintain, and enhance the wastewater management system. The EPA matrix appears in Table 5.1 of this document.

The projected future expenditures driving the RI and imposing demands upon the financial capability of Town of Harrison will include the implementation of CSO controls, stormwater controls, conveyance / collection system rehabilitation, in addition to the current debt service and other operational, maintenance, and planned capital improvements to the Town of

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2 EPA 832-B-97-004

3 November 24, 2014 memorandum from Ken Kopocis, Deputy Assistant Administrator, Office of Water (OW) and Cynthia Giles, Assistant Administrator, Office of Enforcement and Compliance (OECA) to Regional Administrators

4 Combined Sewer Overflow Policy Section II-C(8) 59 FR 18694

5 "Schedules for implementation of the long-term CSO control plan may be phased based on the relative importance of adverse impacts upon water quality standards and designated uses, and on a Town of Harrison's financial capability." (59 FR 18688)

Harrison sewer system that have been identified and provided by the Town for inclusion into this analysis.

2.3 Limitations to the EPA Analytical Framework

EPA's 1997 financial capability guidance calls for the use of a simplistic "snap shot" model which assumes that all future expenditures are incurred simultaneously and that costs and incomes should be based on current dollars. This approach has the advantage of eliminating the need to estimate future rates of inflation and income growth. However, this approach can understate the affordability impact of long-term programs since income growth has not kept pace with and is not projected to keep pace with wastewater utility capital and O&M cost inflation. For example, for the period of 1999 through 2013, the national costs for typical household wastewater services increased at a rate of 4.8%.[6] The national Consumer Price Index increased at an annual rate of around 2.4%[7] for the period while the US median household income increased from around $42,000 to $52,250 at an annual rate of 1.6%.[8]

An affordability analysis that does not account for the continuing divergence between wastewater utility costs and income growth over course of a long term implementation schedule will overstate the "affordability" of the LTCP as future costs are recovered from the residential and other system users. Conversely, including current Town of Harrison expenditures or debt service payments which would end before the costs from the CSO controls are paid can understate future affordability.

EPA's November 24, 2014 memorandum encourages the use of a time-based ("dynamic" model per the memo) model to supplement the snapshot approach. PVSC has developed a time-based model that calculates annual costs and revenue requirements based on assumed program costs, schedules and economic variables such as interest and inflation rates. The residential indicator is calculated for each year based upon the costs per typical residential users which changes annually based on the annual system revenue requirements.

An additional limitation to the EPA methodology is its focus on the median household income (MHI) which therefore does not address the affordability impacts of wastewater service costs on the lower income households in Town of Harrison's or any service area. By definition, one half of the households in Town of Harrison would be paying more than 1.0% of their household income for wastewater services when the residential indicator for the MHI equals 1.0%.

Three of the six EPA financial capability metrics focus on general obligation (G.O.) bond rating criteria which are amortized through property tax or other general revenue streams:

- Overall Net Debt as a Percentage of Full Market Property Value;
- Property Tax Revenues as a Percent of Full Market Property Value; and
- Property Tax Revenue Collection Rate.

6 NACWA 2013 Cost of Clean Water Index

7 US Bureau of Labor Statistics

8 US Census

The assumption that G.O. bonds will be used would not be appropriate for financing by municipal authorities.

For this analysis only, it is assumed that financing through the New Jersey Environmental Finance Program will be used as necessary to meet projected construction draw requirements. The actual size and timing of financing necessary to implement the CSO controls will be determined by the eventual construction schedules for the various components of the CSO Controls and other wastewater capital improvement needs and are therefore beyond the scope of this document.

In addition to following guidelines for the affordability and financial capability metrics, EPA encourages inclusion of any information that would have a financial impact on the Town of Harrison in the capability report. This assessment, therefore, includes additional discussion of socioeconomic trends in Town of Harrison because of the financial challenges that the municipality faces.

3.0 Affordability Assessment

3.1 Baseline (2019) Wastewater Services Affordability

The Residential Indicator is an approximation of households' abilities to pay their total wastewater costs and is derived by dividing the total annual wastewater costs for the typical household within Harrison by the median household income within the service area. The Residential Indicator is compared to EPA-defined criteria to determine whether total annual wastewater costs impose a low, mid-range, or high impact on residential users. Table 3-1 shows U.S. EPA's Residential Indicator criteria, which define a "low" impact as a cost per household (CPH) less than 1.0% median household income (MHI), a "mid-range" impact between 1.0 and 2.0%, and "high" impact as greater than 2.0% of MHI.

Table 3-1. EPA Residential Indicator

Residential Indicator	Cost per Household
Low Burden	Less than 1.0 percent of MHI
Mid-Range Burden	1.0-2.0 percent of MHI
High Burden	Greater than 2.0 percent of MHI

The estimated annual cost for wastewater services for a typical single-family residential user for 2019 is $395, including $185 through municipal taxes and $210 from sewer rents. This estimate is based on typical residential potable water usage is 4,100 gallons monthly. Based on the estimated MHI of $63,600 the Residential Indicator is approximately 0.6%, or what the EPA guidance defines as a low burden. By definition, the current residential indicator for one half of the households is greater than the 0.6%.

In Harrison, 16.2% of the population was living below the poverty line. The total Census households are broken out by income brackets on Table 3-2 below, along with the respective current Residential Indicators by income bracket. The RI for each bracket was calculated from the mid-point income within the bracket. As may be noted, the calculated 2019 RI for around 950 households was at or greater than 2.0%.

Table 3-2. Analysis of the Current Residential Indicator

Income Bracket	Households		Bracket Average Income	Bracket RI at Typical Cost per Household
	Number	Cumulative		
Less than $10,000	330	330	$5,000	7.9%
$10,000 to $14,999	186	516	$12,500	3.2%
$15,000 to $24,999	434	950	$20,000	2.0%
$25,000 to $34,999	493	1,443	$30,000	1.3%
$35,000 to $49,999	820	2,263	$42,500	0.9%
$50,000 to $74,999	1,238	3,501	$62,500	0.6%
$75,000 to $99,999	621	4,122	$87,500	0.5%
$100,000 to $149,999	822	4,944	$125,000	0.3%
$150,000 to $199,999	381	5,325	$175,000	0.2%
$200,000 or more	297	5,622	$200,000	0.2%
Total	5,622	*Costs per household include sewer rents and municipal taxes supporting wastewater services		

3.2 Affordability Impacts of the Selected CSO Control Alternatives

The Town of Harrison has identified a long term CSO control strategy that will achieve 85% capture of wet weather flows during the typical year. These controls are summarized on Table 3-3.

Table 3-3 – Town of Harrison's Selected CSO Controls

Wet Weather Control Types	Capital Costs	Incremental Annual O&M Costs
Green Infrastructure Program (future)	$750,000	$31,400
Sewer Separation (if not completed through redevelopment	$15,300,000	
Total	$16,100,000	

Implementation of the $16.1 million Municipal Control Alternative results in projected annual costs per typical single family user of $832 (without inflation) and a residential indicator of 1.2% in 2041, the first year after the projected full implementation of the controls ending in 2040. Accounting for inflation, annual costs would grow to $1,620 with a residential indicator of 1.5% in 2041.as shown in Table 3-4.

Table 3-4 – Town of Harrison Projected Residential Indicator Upon Full Implementation of the Municipal Control Alternative

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2041			
		No LTCP		LTCP Implementation Completed in 2040	
		With Inflation	Without Inflation	With Inflation	Without Inflation
RI	0.6%	1.0%	0.8%	1.2%	1.5%
Annual $	$395	$1,008	$509	$754	$1,460

Key points from Table 3-4 are:

- The base year (2019) cost per typical single family wastewater user in Harrison was calculated to be $395 based on a monthly water consumption of 4,100 gallons. Based on a 2019 median household income of $63,600 this works out to a RI of 0.6%.
- The costs per typical single family user in Harrison is projected to increase to $1,008 annually without implementing the CSO controls due to inflation. This would represent a RI of 1.0%.
- Implementing a $16.1 million Municipal Control Alternative completed in 2040 years would result in annual costs per typical single family user of $1,460 in 2041 which works out to a 1.5% RI.
- Excluding inflation, the projected cost per typical single family user with the CSO controls would be around $754 in 2041, a RI of 1.2%
- The analysis does not reflect the current and lingering financial impacts as a result of the COVID -19 pandemic and should be revisited upon finalizing the LTCP implementation schedule.

3.3 Underlying Assumptions

Key assumptions used in the above analysis are summarized on Table 3-5. An annotated complete list of all data and assumptions used in the affordability model is provided as an appendix to this memorandum.

Table 3-5 – Affordability Model Key Inputs and Assumptions

Item	Value	Notes
Finance		
Bond Term		
Market Interest Rate	6.0%	NJEIT Financing – Smart Growth program offers 75% funding at 0% interest and 25% funding at market rates for 20 years for CSO control projects.
NJDEP	0.0%	
Blended Interest Rate	1.5%	
Target Coverage	125.00%	

Table 3-5 – Affordability Model Key Inputs and Assumptions

Item	Value	Notes
O&M as % of Capital Cost	1.0%	
Economic		
LTCP O&M Inflation	4.0%	Based on national rates of wastewater system O&M costs in 2017 NACWA study.
LTCP Construction Inflation	3.7%	Based on 1984 – 2015 ENR Construction Cost Index for New York City (80%) and Philadelphia (20%).
Estimate Base Year		
MHI Data Year	2015	
Typical Household Monthly Consumption	4,100	Typical urban water consumption.
Demographic		
Residential Share of Billed Water Consumption		Municipal account data.

4.0 Analysis of Financial Capability Indictors

The second part of the financial capability assessment - calculation of the financial capability indicator for the Town of Harrison - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment). Table 4-1 contains the six criteria and the ratings that categorize the Town of Harrison as strong, mid-range, or weak in each category. A discussion of each item follows.

Table 4-1 Town of Harrison Financial Capability Indicator Benchmarks

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Bond Rating	AAA-A (S&P) or Aaa-A (Moody's)	BBB (S&P) or Baa (Moody's)	BB-D (S&P) of Ba-C (Moody's)
Overall Net Debt as a Percent of Full Market Property Value	Below 2%	2% to 5%	Above 5%

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Unemployment Rate	More than 1% below the National Average	+/- 1% of the National Average	More than 1% above the National Average
Median Household Income	More than 25% above National MHI	+/- 25% above National MHI	More than 25% below National MHI
Property Tax as a Percent of Full Market Property Value	Below 2%	2% to 4%	Above 4%
Property Tax Collection Rate	Above 98%	94% to 98%	Below 94%

4.0 Financial Capability Indictors

The second part of the financial capability assessment - calculation of the financial capability indicator for the permittee - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment). Table 4-1 contains the six criteria and the ratings that categorize the permittee as strong, mid-range, or weak in each category. A discussion of each item follows.

Table 4-1 Permittee Financial Capability Indicator Benchmarks

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Bond Rating	AAA-A (S&P) or Aaa-A (Moody's)	BBB (S&P) or Baa (Moody's)	BB-D (S&P) of Ba-C (Moody's)
Overall Net Debt as a Percent of Full Market Property Value	Below 2%	2% to 5%	Above 5%
Unemployment Rate	More than 1% below the National Average	+/- 1% of the National Average	More than 1% above the National Average

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Median Household Income	More than 25% above National MHI	+/- 25% above National MHI	More than 25% below National MHI
Property Tax as a Percent of Full Market Property Value	Below 2%	2% to 4%	Above 4%
Property Tax Collection Rate	Above 98%	94% to 98%	Below 94%

4.1 Bond Rating – Indicator 1

Harrison's bond rating is Baa1 by Moody's Investor Services as of 2016.

4.2 Overall Net Debt as a Percent of Full Market Value – Indicator 2

Debt Burden is measured by overall net debt as a percent of full market property value, which evaluates the ability of local government to issue additional debt. Overall Net Debt is defined as current total liability to be repaid by property taxes divided by the municipality's full market property value. This indicator is relevant as a metric for municipalities issuing general obligation bonds which are substantially repaid through property tax revenues.

Overall net debt includes overlapping debt, which is the indebtedness of Harrison and the local school district. The Harrison Direct Net Debt for 2017 totaled $29.8 million.[9] The percent of total net debt to the three-year average property valuation of $1.22 billion[10] was 2.45% places Harrison in the midrange range on this measure.

4.3 Unemployment Rate – Indicator 3

The unemployment rate is used as an assessment of the economic well-being of residential users in the service area. The dataset for the municipal unemployment rates is taken from the US Census American Community Survey 2013-2017 estimates. The American Community Survey gathers data over a 5-year period.[11]

The prevailing unemployment rate provided by the ACS for that timeframe more closely represents the actual strength of the economy in a municipality. The unemployment rate for Harrison at 8.6% compared to the national rate of 6.6% for the same time period. It may be noted that the "weak" rating is triggered in the EPA table when the local unemployment rate is one percent above the national average. It should also be noted that the above statistics are for Harrison and should not be confused with Bureau of Labor Statistics data for the New York – Newark SMSA.

4.4 Median Household Income – Indicator 4

Median Household Income (MHI) divides the relevant incomes of a population into two parts so that half of the incomes are below the median and half of the incomes are above the median. Unlike average income, median income is not skewed by extremely high or extremely low

9 Source: 2017 NJDCA User Friendly Budget Sheet USB-10

incomes in the dataset. Table 4-2 shows that the MHI within the Harrison is slightly higher than the national average, resulting in a midrange rating per the EPA metric.

Table 4-2 Median Household Income

	Median Household Income[10]
Harrison	$61,200
United States	$57,650
% Difference	+6%
Categorization	Midrange

4.5 Property Tax Revenues as a % of Full Market Value – Indicator 5

The three year average property valuation in Harrison was $1.22 billion.[11] A tax of $34.3 million is levied on the assessed valuation. Therefore, the property tax levy is approximately 2.9%. This value is considered midrange in the USEPA metrics.

4.6 Property Tax Collection Rate

The EPA criterion for a strong rating in this category is a collection rate of more than 98%. Harrison's rate is estimated to be 98.5%, which places it in the strong range for real estate tax collections.

4.7 Financial Indicator Score

As shown on Table 4-3, the overall score for the financial indicators is 2.0, yielding an EPA Qualitative Score of midrange. This calculation is based on the use of all six of the indicators that are applicable to Harrison.

Table 4-3 – Permittee Financial Capability Indicator Benchmarks

Indicator	Rating	Numeric Score
Bond Rating	Midrange	2
Overall Net Debt as a Percent of Full Market Property Value	Midrange	2
Unemployment Rate	Weak	1
Median Household Income	Midrange	2
Property Tax as a Percent of Full Market Property Value	Midrange	2
Property Tax Collection Rate	Strong	3
Total		12
Overall Indicator Score: (numeric score / number of applicable indicators)		2.0
EPA Qualitative Score		Midrange

10 Source: US Census – National Community Survey estimates for 2013 - 2017
11 Source: 2017 User Friendly Budget – sheet USB 10

5.0 Financial Capability Matrix

In this section the results of the step 1 affordability analysis which goes towards the residential ratepayers' ability to afford CSO controls within the context of other capital investment needs is integrated with the step 2 (Financial Capability) analysis which goes towards the permittee's ability to finance the implementation of the LTCP.

It was established previously that $16 million capital expenditures for the Harrison Municipal Control Alternative through 2040 would result in a Residential Indicator of 1.6% of median household income, within the EPA definition of a medium burden.

The overall Harrison financial capability rating considered to be midrange under the EPA framework. The intersection of these two ratings on the EPA financial capability matrix places the Harrison sewer system in the category of high financial burden, as shown on Table 5-1.

Table 5.1 The Financial Capability Matrix - (Shaded areas Indicate Harrison's Ratings)

Permittee Financial Capability Indicators Score	Residential Indicator		
(Socioeconomic, Debt and Financial Indicators)	Low (Below 1.0%)	Mid-Range (Between 1.0 and 2.0%)	High (Above 2.0%)
Weak (Below 1.5)	Medium Burden	High Burden	High Burden
Mid-Range (Between 1.5 and 2.5)	Low Burden	**Medium Burden**	High Burden
Strong (Above 2.5)	Low Burden	Low Burden	Medium Burden

6.0 Additional Economic Factors

In addition to following EPA guidelines for completion of the financial capability assessment matrix, a discussion of socioeconomic trends in the Town of Harrison sewer system area is essential to the consideration of scheduling and compliance levels with CSO guidelines.

6.1 Cost of Living Factors

6.1.1 Cost of Living Index

Specific cost of living comparisons of Harrison and national averages are not available. However, the cost of living for the Cities of Elizabeth and Newark is approximately 30% higher than the national average.[12] Using this value as a proxy, households in Harrison face costs of living that are about 30% higher than the national average while earning an income that is

12 http://www.infloplease.com/business/economy/cost of living - index.us-cities html

about 6% higher than the national median income. Put another way, adjusting for the cost of living, the effective MHI in Harrison is about 81% of the national MHI.

6.1.2 Housing Costs

One of the major drivers in the higher cost of living in Harrison is the cost of housing. Housing costs in Harrison are approximately 169%[13] of the national average. The Residential Indicator is a national screening parameter and does not account for localized factors which erode the effective household income. Based upon a 2017 study[14] by the National Low Income Housing Coalition, the fair market value of a two bedroom apartment in Hudson County was $1,519 per month which works out to 33.5% of the Harrison median household income.

6.1.3 Local Tax Burdens

The property tax burdens within the combined sewered municipalities of the PVSC service area are substantial. The average residential tax for 2017 in Harrison was $10,954. This includes Harrison taxes of $5,706 along with Hudson County and school district taxes.[15] This compares with a national average local property tax levy of $3,500 for a similarly priced home. Moreover, as housing prices are higher in the New York – Newark metropolitan area than nationally, houses costing well over the national median value of $193,500 are purchased by families of modest incomes.

The high housing costs and tax burdens facing Harrison households reduces their effective household income. Consequently, measuring the household burden imposed by wastewater costs as a percentage of the median household income may underestimate the financial burden of the projected wastewater costs per household. As was noted in an analysis of the impacts of CSO controls in the Boston region:

> *"The greater are the costs of other necessities as a share of MHI, the greater will be the economic burden associated with sewer charges equal to a given percent of MHI."* [16]

6.2 Poverty Factors

6.2.1 Poverty Rate[17]

In 2017 16.2% of the population in Harrison was living below the poverty line. This compares to the national average poverty rate of 14.6%.

6.2.2 Household Income Brackets

When the Residential Indicator is 1.6% of median household income, by definition half of the households in Harrison would be paying more than 1.6% of their household incomes for

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13 Using the Newark – Elizabeth cost of living indices.

14 Out of Reach 2017 – The High Cost of Housing National Low Income Housing Coalition.

15 Source: 2017 NJDCA User Friendly Budget sheet UFB-1

16 Assessment of the Economic Impact of Additional Combined Sewer Overflow Controls in the Massachusetts Water Resource Authority Service Area (page 13) prepared by Robert N. Stavins, Genia Long, and Judson Jaffee. Analysis Group Incorporated, August 2004.

17 Source: US Census – National Community Survey 2013 - 2017

wastewater services. The impacts of a 1.5% municipality wide RI can be severe on low income households. As shown on Table 6-1 around 1,440 households would be paying 2.2% or more of their household incomes for wastewater services.

Table 6-1 – Impact of the Municipal Control Alternative on the Residential Indicator

Income Bracket	Households		Estimated Population		RI @ Resulting from $16.1 Million in Capital Expenditures through 2040	Bracket Average Income
	Number	Cumulative	Number	Cumulative		
Less than $10,000	330	330	933	933	13.0%	$5,000
$10,000 to $14,999	186	516	526	1,459	5.2%	$12,500
$15,000 to $24,999	434	950	1,227	2,686	3.3%	$20,000
$25,000 to $34,999	493	1,443	1,394	4,081	2.2%	$30,000
$35,000 to $49,999	820	2,263	2,319	6,399	1.5%	$42,500
$50,000 to $74,999	1,238	3,501	3,501	9,900	1.0%	$62,500
$75,000 to $99,999	621	4,122	1,756	11,656	0.7%	$87,500
$100,000 to $149,999	822	4,944	2,324	13,981	0.5%	$125,000
$150,000 to $199,999	381	5,325	1,077	15,058	0.4%	$175,000
$200,000 or more	297	5,622	840	15,898	0.3%	$200,000
Total	5,622		15,898			

6.2.2 Income Growth Trends

In Harrison MHI growth was about 2.0% average annually 2000 to 2017. This is comparable to the 1.9% growth rates for New Jersey and the U.S. for the same period.

6.2.3 New Jersey Department of Community Affairs Municipal Revitalization Index

New Jersey's Municipal Renewal Index[6-18] measures the social, economic, physical and financial conditions of the 565 municipalities within New Jersey. The MRI is compiled by the NJ Department of Community Affairs and is used in the distribution of needs based funding. Six primary along with four secondary criteria are used:

Primary Criteria

- Children on TANF (Temporary Assistance for Needy Families) per 1,000 persons
- Unemployment Rate
- Poverty Rate
- High school diploma or higher

[6-18] Measuring Distress in New Jersey: the 2017 Municipal Revitalization Index Office of Policy and Regulatory Affairs, New Jersey Department of Community Affairs.

- Median Household Income
- Percent of households receiving SNAP (food stamps)

Secondary Criteria

- Ten year rate of change in population
- Non-seasonal housing vacancy rate
- Equalized three year effective property tax rate
- Equalized property valuation per capita

The 2017 state-wide MRI rankings for the combined sewered municipalities within the PVSC service area are shown on Table 6-2. The Town of Harrison has a ranking of 87th most distressed municipality out of 565 which puts it in the top (least resourced) 15% of all New Jersey municipalities.

Table 6-2 – Municipal Renewal Index for the PVSC Combined Sewered Municipalities

Municipality	2017 Municipal Revitalization Index			Percentile of Least Resourced Municipalities
	MRI Score	MRI Distress Score	MRI Rank	
Bayonne	-4.56	40.2	82	15%
East Newark	-5.71	43.4	65	12%
Guttenberg	-5.12	41.8	70	12%
Harrison	**-4.49**	**40.0**	**87**	**15%**
Jersey City	-5.80	43.7	64	11%
Kearny	-3.67	37.7	106	19%
Newark	-16.53	73.5	12	2%
North Bergen	-4.65	40.5	80	14%
Paterson	-19.43	81.6	8	1%

6.3 Implications of the Additional Economic Factors

The additional economic factors presented above were intended to provide additional context to the affordability and financial capability scores determined in this initial FCA. The context of this FCA and of the implementation of the LTCP is a combined sewered community with household incomes well below the federal and state levels, high poverty rates, and high local tax burdens. Town of Harrison is and is likely to remain financially distressed due to structural economic factors beyond its direct control and its ability to afford and finance future CSO control facilities is restricted.

7.0 Potential Impacts of the COVID-19 Pandemic on Affordability

The projections and conclusions concerning the affordability of the CSO control program proposed in this SIAR by the Town of Harrison and Harrison's financial capability to finance the CSO control program are premised on the baseline financial conditions of Town of Harrison as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be impacts, potentially significant impacts. There are several dimensions to these potential impacts, including both potentially reduced utility revenues, and potentially reduced household incomes.

7.1 Potential Wastewater Utility Revenue Impacts

This Financial Capability Assessment cannot reflect the currently unknowable impacts on wastewater utility revenues stemming from the national economic upheaval resulting from the COVID-19 pandemic. It is however extremely likely that Town of Harrison and municipal wastewater utilities in general across the United States will face significant and potentially permanent declines in revenues from households unable to pay their water and sewer bills and the sudden decline in industrial and commercial demands for potable water and wastewater treatment.

On March 20, 2020 the National Association of Clean Water Agencies (NACWA) issued a press release stating that:

> **"NACWA conservatively estimates the impact to clean water utilities nationwide of lost revenues due to coronavirus at $12.5 Billion.** This is a low-end estimate, assuming an average loss of revenue of 20% which is well within the range of what individual utilities are already projecting. Some utilities are anticipating closer to a 30% or 40% loss in revenue. This estimate is based on the substantial historical utility financial data NACWA has on file through its Financial Survey and recent reports from NACWA members on the decrease in usage they are observing in their systems over the last few weeks."[19]

The impact of a 20% to 40% revenue loss, along with increased costs that have been and will continue to be experienced by water and wastewater utilities such as overtime and the writing off of customer accounts receivable could have a profound impact on the affordability of the proposed CSO controls and Town of Harrison's ability to finance them.

Most of the costs of a municipal wastewater system are relatively fixed within broad operating ranges. Debt service and other capital costs are fixed once incurred. Some operating costs are somewhat variable with wastewater flows, e.g. chemical and electrical power usage but this variability is lessened by the reality that inflow, infiltration and stormwater flow in a combined system are not affected by billed water consumption. Labor costs are not directly variable, e.g. a

[19] NACWA press release: Coronavirus Impacting Clean Water Agencies; Local Utilities and Ratepayers Need Assistance March 20, 2020

twenty percent reduction in billed flow would not result in a need for twenty percent less labor. Maintenance costs might go down minimally as equipment operating times may be reduced.

As costs do not decline proportionately to billed flow, it can be expected that user charge rates must be raised to generate sufficient revenue to sustain current operations. The relationship between changes in costs and revenues and the resultant changes in user charge rates is complex and has not yet been fully analyzed. At this point it can be assumed that user rate increases may be necessary to simply maintain current operations, and these rate increases will likely erode the financial capability of Town of Harrison to fund the CSO LTCP.

7.2 Potential Median Household Income Impacts

The impacts of the pandemic on median household incomes in Town of Harrison cannot be determined at this point. Historical analogies may provide some useful, albeit disturbing, context but are not presented as predictive:

- U.S. median household income fell by 6.2% from $53,000 in 2007 to $49,000 in 2010. In New Jersey, the MHI decreased by around 4.0% for the same period.[20]
- The U.S. unemployment rates rose from 5.0% in December of 2007 to 9.9% in December of 2009.[21]
- Data on impacts of the Great Depression on median household income are not available. As a proxy, the personal income per capita data are available. For 1929 this was $700. By 1933 this figure bottomed out at $376, a decline of 46%. Unemployment for the same period rose from around 3.0% to 25%.[22]

While a quantifiable assessment of the impact of the pandemic on median household income is not feasible at this time, reduction in base year MHI can be expected. This will further exacerbate the impacts of the revenue reductions described above on LTCP affordability, as higher base user charge rates will absorb an increased portion of lower MHI.

7.3 Implications for the Long Term CSO Control Program

Town of Harrison anticipates that the financial implications of the COVID-19 pandemic will be discussed with NJDEP during the review of the SIAR and as the 2021 – 2025 NJPDES permit is developed. Based on the October 1, 2020 revised due date for the SAIR, additional revenue data should be available to support a more specific refinement of this analysis in the SIAR.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, Town of Harrison will be reticent to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this SIAR based on emergent economic conditions beyond the Town of Harrisons' control. As detailed in Section F of Town of Harrison's SIAR these provisions could include scheduling the

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[20] Source: Fact Sheet: Income and Poverty Across the States, 2010 Joint Economic Committee, United States Congress, Senator Robert P. Casey, Jr. Chairman.

[21] Source: Bureau of Labor Statistics data series LNS1400000

[22] Source: Federal Reserve Economic Data (FRED) data series: A792RC0A052NBEA

implementation of specific CSO control measures to occur during the five year NJPDES permit cycles. A revised affordability assessment should occur be performed during review of the next NJPDES permit to identify controls that are financially feasible during that next permit period.

8.0 Conclusion

While the affordability analysis detailed above has documented that the selected $16 million (current dollars) Municipal Control Alternative along with related operation and maintenance costs would result in a Residential Indicator of "medium impact" under EPA's criteria; the reality of the higher than national average poverty rates, low household incomes compared to the rest of New Jersey and nationally and the high costs of living in Town of Harrison argue strongly that the EPA metric understates the impacts of the CSO control costs on the residents of the Town. As evidenced by its New Jersey Municipal Revitalization Index score in the top 85^{th} percentile Town of Harrison's capacity for additional CSO controls beyond those proposed in the SIAR is limited.

Appendix

PVSC LTCP Affordability Model

Inputs, Assumptions, and Summary Outputs

Town of Harrison

	Item	Value	Notes / Sources
1	**Finance**		
2	Bond Interest Rate		
3	Market	6.00%	Bond Buyer 20 bond (Revenue Bonds) rolling average interest rate 1986 - 2015
4	NJDEP	0.00%	NJ Environmental Infrastructure Financing Program - Smart Growth program offers 75% funding at 0% interest and 25% funding at market rates for 20 years for CSO control projects.
5	Interest Rate Blend		
6	Market	25%	
7	NJDEP	75%	
8	Blended Interest Rate	1.50%	
9	Bond Term	20	
10	Target Coverage	125.00%	Input
11	O&M as % of Capital Cost	2.0%	General estimate for CSO controls - To be revised with the development of control alternative cost estimates.
12	Capital Fund Balance		Establishes a capital fund from retained earnings in the model.
13	Use Retained Earnings?	Yes	If "Yes", the Capital Fund is used towards annual capital expditures.
14	Beginning Balance	$0	
15	% Beginning Fund Balance Available for Capital Improvements	50.0%	Determines the percentage of Capital Fund beginning balance that can be used for capital expenditures.
16	**Economic**		
17	Inflation On or Off	**on**	
18	Collection System O&M Inflation		
19	NACWA or Local Data	NACWA	NACWA 2017 National Survey
20		3.9%	
21	PVSC Service Charge Inflation	3.9%	
22	NACWA or Local Data	PVSC	PVSC Expenditures 2014 (audit) - 2016 (budget)
23		2.7%	
24	Capital Improvement Inflation	3.7%	Based on the 1984 - 2015 ENR Construction Cost Indices for New York City (80%) and Philadelphia (20%)
25	Estimate Base Year	2016	
26			
27	**Demographic**		
28	Census Households	4,869	Census (American Fact Finder)
29	Residential Connections	4,500	Estimate based on ratio of residential customers and Census households in Philadelphia. Subject to replacement if actual number is available.
30	Median Household Income		
31	Base Year MHI	$61,168	2013 - 2017 National Community Survey Five Year Estimate - 2015 dollars
32	Base Year	2017	
33	Income Growth	2.000%	Annualized rate of change for Harrison MHI 2000- 2017 (US Census)
34			

	Item	Value	Notes / Sources
35	**Current Municipal System Costs & Revenues**		
36	Annual Costs		Cost analysis of 2019 provided by Gabriela Simoes, CFO of Harrison.
37	Sewer Utility O&M and Minor Capital		
38	Social Security	$10,000	
39	(S&W)	$107,500	
40	Other Expenses	$132,850	
41	Capital Improvement Fund	$25,000	
42	Capital Outlay	$2,230	
43	Subtotal	277,580	
44	PVSC Service Charge	$900,000	
45	Municipal Costs Apportioned to Sewer Services		
46	Worker's Comp Insurance	$56,352	
47	General Liability Insurance	$49,218	
48	Unemployment	$11,000	
49	(S&W)	$21,270	
50	(S&W)	$15,670	
51	(S&W)	$53,700	
52	(S&W)	$24,861	
53	Public Works Vehicle Maint	$12,165	
54	Gas/Electric Street Dept / Essex	$3,645	
55	Town Diesel & Gasoline	$23,205	
56	Subtotal	$271,085	
57	Other Sewer System Costs		
58	Sewer Cleaning - 50% of Town per year	$9,400	
59	Sewer Repair	$6,000	
60	Sewer Repair - Material (Black Top/Cement)	$1,000	
61	CSO Monthly Inspection	$7,200	
62	CSO Bag Changes	$2,000	
63	Street Sweeping	$19,600	
64	Catch Basin Rebuilds	$10,800	
65	Fringe Benefits (Health & PERS)	$94,520	
66	CSO Net Disposal Costs	$36,360	
67	Subtotal	$186,880	
68	Capital Expenditures		
69	Jet Vac Truck - 5 Year Useful Life	$78,000	
70	Street Sweeper - 5 Year Useful Life	$14,000	
71	Pick Up Trucks - 2 Year Useful Life	$25,000	
72	Mott MacDonald CSO Contract	$0	
73	Subtotal	$117,000	
74	Total O&M	$1,752,546	
75			
76	Debt Service		
77	Bond Principal	$125,000	
78	Bond Interest	$16,363	
79	NJEIT	$30,058	
80	Total Debt Service	$171,420	
81	Grand Total Annual Cost	$1,923,966	

	Item	Value	Notes / Sources
82			
83	Last Year Existing Debt	2029	
84			
85	2019 Revenues		
86	Sewer Rents	$1,349,000	
87	Other Non-Tax Revenues	$21,398	
88	Tax Revenues	$574,966	
89	Total	$1,923,966	
90			
91	**Current Cost per Residential Connection**		
92	From Sewer Rents		
93	Unit Cost	(per 100 cubic ft.)	
94	Municipal Collection System	$3.20	
95	PVSC		Harrison Code of Ordinances 13.04.150: $32/1,000 cubic foot
96	Total	$3.20	
97	Typical Household Consumption (gallons)	4,100	Typical urban water consumption
98	Billing Units	ccf	
99	Billing Frequency	monthly	
100	Billing Volume	5.48	Convert gallons (row 65) to hundred cubic feet.
101	Annual Cost	$210	
102	Total Annual per Typical Household		
103	From Property Taxes		
104	Average Residential Assessment	$153,649	
105	2019 Municipal Purpose Tax Rate	3.5320	
106	Municipal Purpose Tax	$5,427	
107	2019 Municipal Purpose Tax Levy	$16,871,968	
108	Sewer Related Muni Tax Levy	$574,966	
109	Sewer Related as % of Muni Levy	3.41%	
110	Tax Supported Sewer Related	$185	
111	Total Annual per Typical Residential Connection	$395	
112			
113	**Future Capital Costs & Scheduling**		
114	CSO Control Costs		
115	Estimated Capital Costs (millions)	$31.7	Input - LTCP capital costs that trigger a 2.0% residential indicator one year after full implementation.
116	Percent Pay-As-You-Go	0%	
117	Cost Estimate Year	2019	Base year for cost estimates.
118	Start Date	2021	Per NJPDES due date for LTCP in 2020
119	Planning Duration (years)	1	Input
120	Design Duration (years)	3	Input
121	Construction Duration (years)	17	Input
122	Total	21	
123	Capital Cost Breakout		
124	Planning	2%	Based on the old USEPA Construction Grants Program regulations (40 CFR 35 appendix A), which used ASCE cost curves.
125	Design	5%	
126	Construction	93%	
127	Total	100%	

	Item	Value	Notes / Sources
128	Other Capital Improvements		
129	Cost per Year	$500,000	Planning number based on discussions with Harrison
130	Target Percent Finance	0%	Allows for annual non-LTCP capital projects to be funded through operating budget or through new debt.
131	Target Percent Cash Funded	100%	
132	Start Year	2020	
133	End Year	2050	
134			

Memorandum

To: *Town of Harrison*

Copy: *Thomas Laustsen, Sheldon Lipke, Mike Hope, Tim Dupuis, Scott Craig*

From: *Tom Schevtchuk*

Date: *September 23, 2020*

Subject: *Final Financial Capability Assessment for the Town of Harrison*

1.0 Executive Summary

This Financial Capability Analysis (FCA) memorandum is in support of the Municipal Control Alternative identified in the Selection and Implementation of Alternatives Report (SIAR) developed by the Town of Harrison. It quantifies the projected affordability impacts of Town of Harrison's proposed long term CSO controls for the Harrison combined sewer system (CSS) and updates the 2019 preliminary FCA memo that was intended to guide the development and selection of long term controls.

Table E-1 - Projected Impacts of CSO Controls at a Glance

Typical Household 2019	
Annual Wastewater Costs	
From Sewer Rents	$210
Through Municipal Taxes	$185
Total	$395
Residential Indicator (RI)*	0.6%
Median Household Income (MHI)	$63,600
LTCP Control Program	
CSO Control Capital Costs ($ millions)	$16.1
First Year After Full Implementation	2041
Projected LTCP Impact on Typical Household Cost	
MHI in 2041	$98,400
Annual Costs Without LTCP	$1,008
Residential Indicator	1.0%
Annual Costs With LTCP	$1,460
Residential Indicator	1.5%

As summarized in Table E-1, this FCA includes the projected impacts if the Municipal Control Alternative is undertaken by Harrison based on the costs and implementation schedule included in Harrison's SIAR Section F.

While a regional alternative would result in lowered overall costs for the control of CSOs within the PVSC service area, the basis of this allocation remains under discussion as of the writing of this memorandum. Under this approach, both the costs of the regional facilities such as a relief interceptor and the resultant savings would be allocated amongst the PVSC municipalities with combined sewer systems. As the basis of this allocation remains under discussion as of the writing of this SIAR, this FCA memorandum focuses on implementation of the Municipal Control Alternative. Should the permittees come to agreement on the cost allocation for the Regional Control Plan, the FCA will be revisited to reassess the affordability and schedule for implementation of the LTCP.

The Financial Capability assessment is a two-step process including ***Affordability*** which evaluates the impact of the CSO control program on the residential ratepayers and ***Financial Capability*** which examines a Town of Harrison's ability to finance the program. Affordability is measured in terms of the Residential Indicator (RI) which is the percentage of median household income spent on wastewater services. Total wastewater services exceeding 2.0% of the median household income are considered to impose a high burden by USEPA. The financial capability analysis uses metrics similar to the municipal bond rating agencies.

The 2019 preliminary FCA determined that future capital expenditures for CSO controls and all other capital expenditures of approximately $31 million (current dollars) over a twenty-year period (2022 through 2041) would result in a RI exceeding 2.0% using a dynamic (time sensitive) model which accounts for future inflation. Along with the calculated debt service costs associated with the $31 million in capital costs an annual incremental operations and maintenance (O&M) cost of $310,000 1.0% of the capital cost value was estimated.

Harrison's SIAR projects future capital costs for the Municipal Control Alternative totaling $16.1 million through 2040 and incremental annual O&M costs of around $31,400. This would result in a projected residential indicator in 2041, the first year after full implementation of the controls of 1.5% which would constitute a moderate burden under the USEPA analytical guidelines.

The second step of the financial capability analysis documents that Town of Harrison's current financial capability strength is "moderate" These two metrics combine on EPA's Financial Capability Matrix to indicate a medium burden under the USEPA guidance for the $16.1 million in capital expenditures proposed under Harrison's Municipal Control Alternative.

This draft memorandum is based on information provided by Town of Harrison, PVSC and external sources such as the on-line fiscal reports available through the New Jersey Department of Community Affairs.[1]

The projections and conclusions concerning the affordability of the Municipal Control Alternative proposed in this SIAR by the Town of Harrison and Harrison's financial capability to finance the CSO control program are premised on the baseline financial conditions of Harrison as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues, household incomes, and property tax collection rate, and increased unemployment.

2.0 Introduction

2.1 Intent of the Financial Capability Analysis

This document presents the final Financial Capability Analysis (FCA) relating to the development of the CSO Long Term Control Plan (LTCP) required under Paragraph G(8)(a) of the Combined Sewer Management section of the Town of Harrison's NJPDES discharge permit. The assessment is based upon the EPA document "Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development," (EPA Guidance Document)

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1 https://www.nj.gov/dca/divisions/dlgs/resources/fiscal_rpts.shtml

published February 1997[2], as supplemented by EPA's November 2014 memorandum entitled "Financial Capability Assessment Framework for Municipal Clean Water Act Requirements".[3] A preliminary FCA memorandum was provided by PVSC to Harrison and the other combined sewered municipal permittees within its service area in August of 2019, with a subsequent update in December of 2019.

This final FCA and last year's preliminary version support the twofold purposes of the FCA as envisioned in the 1994 CSO Control Policy[4] (Policy). First, the FCA is intended to identify the upper limits of what could constitute an affordable future investment strategy as defined by the Policy and related guidance documents under an assumed LTCP implementation schedule; thereby informing the development of CSO, SSO, MS4, TMDL, and other necessary control alternatives. Second, the financial and user cost (affordability) impacts of the selected CSO controls must be assessed to support the development of a workable implementation schedule for the LTCP.[5]

2.2 EPA's Two Step Analysis Process

The Financial Capability assessment is a two phased process. The residential indicator (RI) is the percentage of median household income (MHI) expended on wastewater (including stormwater) management. The upper limit of affordability for wastewater services within Harrison will be the point where total wastewater management costs for the typical residential user in Town of Harrison exceed 2.0% of the Median Household Income (MHI). This metric of total wastewater management costs as a percentage of MHI is termed the Residential Indicator (RI) by USEPA.

The financial capability indicator is an assessment of the Town of Harrison's debt burden, socioeconomic conditions, and financial operations. These two measures are subsequently entered into a *financial capability matrix*, suggested by EPA, to determine the level of financial burden placed on residential customers and the Town of Harrison by the existing and projected future expenditures to operate, maintain, and enhance the wastewater management system. The EPA matrix appears in Table 5.1 of this document.

The projected future expenditures driving the RI and imposing demands upon the financial capability of Town of Harrison will include the implementation of CSO controls, stormwater controls, conveyance / collection system rehabilitation, in addition to the current debt service and other operational, maintenance, and planned capital improvements to the Town of

[2] EPA 832-B-97-004

[3] November 24, 2014 memorandum from Ken Kopocis, Deputy Assistant Administrator, Office of Water (OW) and Cynthia Giles, Assistant Administrator, Office of Enforcement and Compliance (OECA) to Regional Administrators

[4] Combined Sewer Overflow Policy Section II-C(8) 59 FR 18694

[5] "Schedules for implementation of the long-term CSO control plan may be phased based on the relative importance of adverse impacts upon water quality standards and designated uses, and on a Town of Harrison's financial capability." (59 FR 18688)

Harrison sewer system that have been identified and provided by the Town for inclusion into this analysis.

2.3 Limitations to the EPA Analytical Framework

EPA's 1997 financial capability guidance calls for the use of a simplistic "snap shot" model which assumes that all future expenditures are incurred simultaneously and that costs and incomes should be based on current dollars. This approach has the advantage of eliminating the need to estimate future rates of inflation and income growth. However, this approach can understate the affordability impact of long-term programs since income growth has not kept pace with and is not projected to keep pace with wastewater utility capital and O&M cost inflation. For example, for the period of 1999 through 2013, the national costs for typical household wastewater services increased at a rate of 4.8%.[6] The national Consumer Price Index increased at an annual rate of around 2.4%[7] for the period while the US median household income increased from around $42,000 to $52,250 at an annual rate of 1.6%.[8]

An affordability analysis that does not account for the continuing divergence between wastewater utility costs and income growth over course of a long term implementation schedule will overstate the "affordability" of the LTCP as future costs are recovered from the residential and other system users. Conversely, including current Town of Harrison expenditures or debt service payments which would end before the costs from the CSO controls are paid can understate future affordability.

EPA's November 24, 2014 memorandum encourages the use of a time-based ("dynamic" model per the memo) model to supplement the snapshot approach. PVSC has developed a time-based model that calculates annual costs and revenue requirements based on assumed program costs, schedules and economic variables such as interest and inflation rates. The residential indicator is calculated for each year based upon the costs per typical residential users which changes annually based on the annual system revenue requirements.

An additional limitation to the EPA methodology is its focus on the median household income (MHI) which therefore does not address the affordability impacts of wastewater service costs on the lower income households in Town of Harrison's or any service area. By definition, one half of the households in Town of Harrison would be paying more than 1.0% of their household income for wastewater services when the residential indicator for the MHI equals 1.0%.

Three of the six EPA financial capability metrics focus on general obligation (G.O.) bond rating criteria which are amortized through property tax or other general revenue streams:

- Overall Net Debt as a Percentage of Full Market Property Value;
- Property Tax Revenues as a Percent of Full Market Property Value; and
- Property Tax Revenue Collection Rate.

6 NACWA 2013 Cost of Clean Water Index

7 US Bureau of Labor Statistics

8 US Census

The assumption that G.O. bonds will be used would not be appropriate for financing by municipal authorities.

For this analysis only, it is assumed that financing through the New Jersey Environmental Finance Program will be used as necessary to meet projected construction draw requirements. The actual size and timing of financing necessary to implement the CSO controls will be determined by the eventual construction schedules for the various components of the CSO Controls and other wastewater capital improvement needs and are therefore beyond the scope of this document.

In addition to following guidelines for the affordability and financial capability metrics, EPA encourages inclusion of any information that would have a financial impact on the Town of Harrison in the capability report. This assessment, therefore, includes additional discussion of socioeconomic trends in Town of Harrison because of the financial challenges that the municipality faces.

3.0 Affordability Assessment

3.1 Baseline (2019) Wastewater Services Affordability

The Residential Indicator is an approximation of households' abilities to pay their total wastewater costs and is derived by dividing the total annual wastewater costs for the typical household within Harrison by the median household income within the service area. The Residential Indicator is compared to EPA-defined criteria to determine whether total annual wastewater costs impose a low, mid-range, or high impact on residential users. Table 3-1 shows U.S. EPA's Residential Indicator criteria, which define a "low" impact as a cost per household (CPH) less than 1.0% median household income (MHI), a "mid-range" impact between 1.0 and 2.0%, and "high" impact as greater than 2.0% of MHI.

Table 3-1. EPA Residential Indicator

Residential Indicator	Cost per Household
Low Burden	Less than 1.0 percent of MHI
Mid-Range Burden	1.0-2.0 percent of MHI
High Burden	Greater than 2.0 percent of MHI

The estimated annual cost for wastewater services for a typical single-family residential user for 2019 is $395, including $185 through municipal taxes and $210 from sewer rents. This estimate is based on typical residential potable water usage is 4,100 gallons monthly. Based on the estimated MHI of $63,600 the Residential Indicator is approximately 0.6%, or what the EPA guidance defines as a low burden. By definition, the current residential indicator for one half of the households is greater than the 0.6%.

In Harrison, 16.2% of the population was living below the poverty line. The total Census households are broken out by income brackets on Table 3-2 below, along with the respective current Residential Indicators by income bracket. The RI for each bracket was calculated from the mid-point income within the bracket. As may be noted, the calculated 2019 RI for around 950 households was at or greater than 2.0%.

Table 3-2. Analysis of the Current Residential Indicator

Income Bracket	Households		Bracket Average Income	Bracket RI at Typical Cost per Household
	Number	Cumulative		
Less than $10,000	330	330	$5,000	7.9%
$10,000 to $14,999	186	516	$12,500	3.2%
$15,000 to $24,999	434	950	$20,000	2.0%
$25,000 to $34,999	493	1,443	$30,000	1.3%
$35,000 to $49,999	820	2,263	$42,500	0.9%
$50,000 to $74,999	1,238	3,501	$62,500	0.6%
$75,000 to $99,999	621	4,122	$87,500	0.5%
$100,000 to $149,999	822	4,944	$125,000	0.3%
$150,000 to $199,999	381	5,325	$175,000	0.2%
$200,000 or more	297	5,622	$200,000	0.2%
Total	5,622	*Costs per household include sewer rents and municipal taxes supporting wastewater services		

3.2 Affordability Impacts of the Selected CSO Control Alternatives

The Town of Harrison has identified a long term CSO control strategy that will achieve 85% capture of wet weather flows during the typical year. These controls are summarized on Table 3-3.

Table 3-3 – Town of Harrison's Selected CSO Controls

Wet Weather Control Types	Capital Costs	Incremental Annual O&M Costs
Green Infrastructure Program (future)	$750,000	$31,400
Sewer Separation (if not completed through redevelopment	$15,300,000	
Total	$16,100,000	

Implementation of the $16.1 million Municipal Control Alternative results in projected annual costs per typical single family user of $832 (without inflation) and a residential indicator of 1.2% in 2041, the first year after the projected full implementation of the controls ending in 2040. Accounting for inflation, annual costs would grow to $1,620 with a residential indicator of 1.5% in 2041.as shown in Table 3-4.

Table 3-4 – Town of Harrison Projected Residential Indicator Upon Full Implementation of the Municipal Control Alternative

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2041			
		No LTCP		LTCP Implementation Completed in 2040	
		With Inflation	Without Inflation	With Inflation	Without Inflation
RI	0.6%	1.0%	0.8%	1.2%	1.5%
Annual $	$395	$1,008	$509	$754	$1,460

Key points from Table 3-4 are:

- The base year (2019) cost per typical single family wastewater user in Harrison was calculated to be $395 based on a monthly water consumption of 4,100 gallons. Based on a 2019 median household income of $63,600 this works out to a RI of 0.6%.
- The costs per typical single family user in Harrison is projected to increase to $1,008 annually without implementing the CSO controls due to inflation. This would represent a RI of 1.0%.
- Implementing a $16.1 million Municipal Control Alternative completed in 2040 years would result in annual costs per typical single family user of $1,460 in 2041 which works out to a 1.5% RI.
- Excluding inflation, the projected cost per typical single family user with the CSO controls would be around $754 in 2041, a RI of 1.2%
- The analysis does not reflect the current and lingering financial impacts as a result of the COVID -19 pandemic and should be revisited upon finalizing the LTCP implementation schedule.

3.3 Underlying Assumptions

Key assumptions used in the above analysis are summarized on Table 3-5. An annotated complete list of all data and assumptions used in the affordability model is provided as an appendix to this memorandum.

Table 3-5 – Affordability Model Key Inputs and Assumptions

Item	Value	Notes
Finance		
Bond Term		
Market Interest Rate	6.0%	NJEIT Financing – Smart Growth program offers 75% funding at 0% interest and 25% funding at market rates for 20 years for CSO control projects.
NJDEP	0.0%	
Blended Interest Rate	1.5%	
Target Coverage	125.00%	

Table 3-5 – Affordability Model Key Inputs and Assumptions

Item	Value	Notes
O&M as % of Capital Cost	1.0%	
Economic		
LTCP O&M Inflation	4.0%	Based on national rates of wastewater system O&M costs in 2017 NACWA study.
LTCP Construction Inflation	3.7%	Based on 1984 – 2015 ENR Construction Cost Index for New York City (80%) and Philadelphia (20%).
Estimate Base Year		
MHI Data Year	2015	
Typical Household Monthly Consumption	4,100	Typical urban water consumption.
Demographic		
Residential Share of Billed Water Consumption		Municipal account data.

4.0 Analysis of Financial Capability Indictors

The second part of the financial capability assessment - calculation of the financial capability indicator for the Town of Harrison - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment). Table 4-1 contains the six criteria and the ratings that categorize the Town of Harrison as strong, mid-range, or weak in each category. A discussion of each item follows.

Table 4-1 Town of Harrison Financial Capability Indicator Benchmarks

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Bond Rating	AAA-A (S&P) or Aaa-A (Moody's)	BBB (S&P) or Baa (Moody's)	BB-D (S&P) of Ba-C (Moody's)
Overall Net Debt as a Percent of Full Market Property Value	Below 2%	2% to 5%	Above 5%

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Unemployment Rate	More than 1% below the National Average	+/- 1% of the National Average	More than 1% above the National Average
Median Household Income	More than 25% above National MHI	+/- 25% above National MHI	More than 25% below National MHI
Property Tax as a Percent of Full Market Property Value	Below 2%	2% to 4%	Above 4%
Property Tax Collection Rate	Above 98%	94% to 98%	Below 94%

4.0 Financial Capability Indictors

The second part of the financial capability assessment - calculation of the financial capability indicator for the permittee - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment). Table 4-1 contains the six criteria and the ratings that categorize the permittee as strong, mid-range, or weak in each category. A discussion of each item follows.

Table 4-1 Permittee Financial Capability Indicator Benchmarks

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Bond Rating	AAA-A (S&P) or Aaa-A (Moody's)	BBB (S&P) or Baa (Moody's)	BB-D (S&P) of Ba-C (Moody's)
Overall Net Debt as a Percent of Full Market Property Value	Below 2%	2% to 5%	Above 5%
Unemployment Rate	More than 1% below the National Average	+/- 1% of the National Average	More than 1% above the National Average

Indicator	Strong (3)	Mid-Range (2)	Weak (1)
Median Household Income	More than 25% above National MHI	+/- 25% above National MHI	More than 25% below National MHI
Property Tax as a Percent of Full Market Property Value	Below 2%	2% to 4%	Above 4%
Property Tax Collection Rate	Above 98%	94% to 98%	Below 94%

4.1 Bond Rating – Indicator 1

Harrison's bond rating is Baa1 by Moody's Investor Services as of 2016.

4.2 Overall Net Debt as a Percent of Full Market Value – Indicator 2

Debt Burden is measured by overall net debt as a percent of full market property value, which evaluates the ability of local government to issue additional debt. Overall Net Debt is defined as current total liability to be repaid by property taxes divided by the municipality's full market property value. This indicator is relevant as a metric for municipalities issuing general obligation bonds which are substantially repaid through property tax revenues.

Overall net debt includes overlapping debt, which is the indebtedness of Harrison and the local school district. The Harrison Direct Net Debt for 2017 totaled $29.8 million.[9] The percent of total net debt to the three-year average property valuation of $1.22 billion[10] was 2.45% places Harrison in the midrange range on this measure.

4.3 Unemployment Rate – Indicator 3

The unemployment rate is used as an assessment of the economic well-being of residential users in the service area. The dataset for the municipal unemployment rates is taken from the US Census American Community Survey 2013-2017 estimates. The American Community Survey gathers data over a 5-year period.[11]

The prevailing unemployment rate provided by the ACS for that timeframe more closely represents the actual strength of the economy in a municipality. The unemployment rate for Harrison at 8.6% compared to the national rate of 6.6% for the same time period. It may be noted that the "weak" rating is triggered in the EPA table when the local unemployment rate is one percent above the national average. It should also be noted that the above statistics are for Harrison and should not be confused with Bureau of Labor Statistics data for the New York – Newark SMSA.

4.4 Median Household Income – Indicator 4

Median Household Income (MHI) divides the relevant incomes of a population into two parts so that half of the incomes are below the median and half of the incomes are above the median. Unlike average income, median income is not skewed by extremely high or extremely low

9 Source: 2017 NJDCA User Friendly Budget Sheet USB-10

incomes in the dataset. Table 4-2 shows that the MHI within the Harrison is slightly higher than the national average, resulting in a midrange rating per the EPA metric.

Table 4-2 Median Household Income

	Median Household Income[10]
Harrison	$61,200
United States	$57,650
% Difference	+6%
Categorization	Midrange

4.5 Property Tax Revenues as a % of Full Market Value – Indicator 5

The three year average property valuation in Harrison was $1.22 billion.[11] A tax of $34.3 million is levied on the assessed valuation. Therefore, the property tax levy is approximately 2.9%. This value is considered midrange in the USEPA metrics.

4.6 Property Tax Collection Rate

The EPA criterion for a strong rating in this category is a collection rate of more than 98%. Harrison's rate is estimated to be 98.5%, which places it in the strong range for real estate tax collections.

4.7 Financial Indicator Score

As shown on Table 4-3, the overall score for the financial indicators is 2.0, yielding an EPA Qualitative Score of midrange. This calculation is based on the use of all six of the indicators that are applicable to Harrison.

Table 4-3 – Permittee Financial Capability Indicator Benchmarks

Indicator	Rating	Numeric Score
Bond Rating	Midrange	2
Overall Net Debt as a Percent of Full Market Property Value	Midrange	2
Unemployment Rate	Weak	1
Median Household Income	Midrange	2
Property Tax as a Percent of Full Market Property Value	Midrange	2
Property Tax Collection Rate	Strong	3
	Total	12
Overall Indicator Score: (numeric score / number of applicable indicators)		2.0
	EPA Qualitative Score	Midrange

10 Source: US Census – National Community Survey estimates for 2013 - 2017
11 Source: 2017 User Friendly Budget – sheet USB 10

5.0 Financial Capability Matrix

In this section the results of the step 1 affordability analysis which goes towards the residential ratepayers' ability to afford CSO controls within the context of other capital investment needs is integrated with the step 2 (Financial Capability) analysis which goes towards the permittee's ability to finance the implementation of the LTCP.

It was established previously that $16 million capital expenditures for the Harrison Municipal Control Alternative through 2040 would result in a Residential Indicator of 1.6% of median household income, within the EPA definition of a medium burden.

The overall Harrison financial capability rating considered to be midrange under the EPA framework. The intersection of these two ratings on the EPA financial capability matrix places the Harrison sewer system in the category of high financial burden, as shown on Table 5-1.

Table 5.1 The Financial Capability Matrix - (Shaded areas Indicate Harrison's Ratings)

Permittee Financial Capability Indicators Score	Residential Indicator		
(Socioeconomic, Debt and Financial Indicators)	Low (Below 1.0%)	Mid-Range (Between 1.0 and 2.0%)	High (Above 2.0%)
Weak (Below 1.5)	Medium Burden	High Burden	High Burden
Mid-Range (Between 1.5 and 2.5)	Low Burden	**Medium Burden**	High Burden
Strong (Above 2.5)	Low Burden	Low Burden	Medium Burden

6.0 Additional Economic Factors

In addition to following EPA guidelines for completion of the financial capability assessment matrix, a discussion of socioeconomic trends in the Town of Harrison sewer system area is essential to the consideration of scheduling and compliance levels with CSO guidelines.

6.1 Cost of Living Factors

6.1.1 Cost of Living Index

Specific cost of living comparisons of Harrison and national averages are not available. However, the cost of living for the Cities of Elizabeth and Newark is approximately 30% higher than the national average.[12] Using this value as a proxy, households in Harrison face costs of living that are about 30% higher than the national average while earning an income that is

[12] http://www.infloplease.com/business/economy/cost of living - index.us-cities html

about 6% higher than the national median income. Put another way, adjusting for the cost of living, the effective MHI in Harrison is about 81% of the national MHI.

6.1.2 Housing Costs

One of the major drivers in the higher cost of living in Harrison is the cost of housing. Housing costs in Harrison are approximately 169%[13] of the national average. The Residential Indicator is a national screening parameter and does not account for localized factors which erode the effective household income. Based upon a 2017 study[14] by the National Low Income Housing Coalition, the fair market value of a two bedroom apartment in Hudson County was $1,519 per month which works out to 33.5% of the Harrison median household income.

6.1.3 Local Tax Burdens

The property tax burdens within the combined sewered municipalities of the PVSC service area are substantial. The average residential tax for 2017 in Harrison was $10,954. This includes Harrison taxes of $5,706 along with Hudson County and school district taxes.[15] This compares with a national average local property tax levy of $3,500 for a similarly priced home. Moreover, as housing prices are higher in the New York – Newark metropolitan area than nationally, houses costing well over the national median value of $193,500 are purchased by families of modest incomes.

The high housing costs and tax burdens facing Harrison households reduces their effective household income. Consequently, measuring the household burden imposed by wastewater costs as a percentage of the median household income may underestimate the financial burden of the projected wastewater costs per household. As was noted in an analysis of the impacts of CSO controls in the Boston region:

> *"The greater are the costs of other necessities as a share of MHI, the greater will be the economic burden associated with sewer charges equal to a given percent of MHI."* [16]

6.2 Poverty Factors

6.2.1 Poverty Rate[17]

In 2017 16.2% of the population in Harrison was living below the poverty line. This compares to the national average poverty rate of 14.6%.

6.2.2 Household Income Brackets

When the Residential Indicator is 1.6% of median household income, by definition half of the households in Harrison would be paying more than 1.6% of their household incomes for

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13 Using the Newark – Elizabeth cost of living indices.

14 Out of Reach 2017 – The High Cost of Housing National Low Income Housing Coalition.

15 Source: 2017 NJDCA User Friendly Budget sheet UFB-1

16 Assessment of the Economic Impact of Additional Combined Sewer Overflow Controls in the Massachusetts Water Resource Authority Service Area (page 13) prepared by Robert N. Stavins, Genia Long, and Judson Jaffee. Analysis Group Incorporated, August 2004.

17 Source: US Census – National Community Survey 2013 - 2017

wastewater services. The impacts of a 1.5% municipality wide RI can be severe on low income households. As shown on Table 6-1 around 1,440 households would be paying 2.2% or more of their household incomes for wastewater services.

Table 6-1 – Impact of the Municipal Control Alternative on the Residential Indicator

Income Bracket	Households		Estimated Population		RI @ Resulting from $16.1 Million in Capital Expenditures through 2040	Bracket Average Income
	Number	Cumulative	Number	Cumulative		
Less than $10,000	330	330	933	933	13.0%	$5,000
$10,000 to $14,999	186	516	526	1,459	5.2%	$12,500
$15,000 to $24,999	434	950	1,227	2,686	3.3%	$20,000
$25,000 to $34,999	493	1,443	1,394	4,081	2.2%	$30,000
$35,000 to $49,999	820	2,263	2,319	6,399	1.5%	$42,500
$50,000 to $74,999	1,238	3,501	3,501	9,900	1.0%	$62,500
$75,000 to $99,999	621	4,122	1,756	11,656	0.7%	$87,500
$100,000 to $149,999	822	4,944	2,324	13,981	0.5%	$125,000
$150,000 to $199,999	381	5,325	1,077	15,058	0.4%	$175,000
$200,000 or more	297	5,622	840	15,898	0.3%	$200,000
Total	5,622		15,898			

6.2.2 Income Growth Trends

In Harrison MHI growth was about 2.0% average annually 2000 to 2017. This is comparable to the 1.9% growth rates for New Jersey and the U.S. for the same period.

6.2.3 New Jersey Department of Community Affairs Municipal Revitalization Index

New Jersey's Municipal Renewal Index[6-18] measures the social, economic, physical and financial conditions of the 565 municipalities within New Jersey. The MRI is compiled by the NJ Department of Community Affairs and is used in the distribution of needs based funding. Six primary along with four secondary criteria are used:

Primary Criteria

- Children on TANF (Temporary Assistance for Needy Families) per 1,000 persons
- Unemployment Rate
- Poverty Rate
- High school diploma or higher

[6-18] Measuring Distress in New Jersey: the 2017 Municipal Revitalization Index Office of Policy and Regulatory Affairs, New Jersey Department of Community Affairs.

- Median Household Income
- Percent of households receiving SNAP (food stamps)

Secondary Criteria

- Ten year rate of change in population
- Non-seasonal housing vacancy rate
- Equalized three year effective property tax rate
- Equalized property valuation per capita

The 2017 state-wide MRI rankings for the combined sewered municipalities within the PVSC service area are shown on Table 6-2. The Town of Harrison has a ranking of 87th most distressed municipality out of 565 which puts it in the top (least resourced) 15% of all New Jersey municipalities.

Table 6-2 – Municipal Renewal Index for the PVSC Combined Sewered Municipalities

Municipality	2017 Municipal Revitalization Index			Percentile of Least Resourced Municipalities
	MRI Score	MRI Distress Score	MRI Rank	
Bayonne	-4.56	40.2	82	15%
East Newark	-5.71	43.4	65	12%
Guttenberg	-5.12	41.8	70	12%
Harrison	**-4.49**	**40.0**	**87**	**15%**
Jersey City	-5.80	43.7	64	11%
Kearny	-3.67	37.7	106	19%
Newark	-16.53	73.5	12	2%
North Bergen	-4.65	40.5	80	14%
Paterson	-19.43	81.6	8	1%

6.3 Implications of the Additional Economic Factors

The additional economic factors presented above were intended to provide additional context to the affordability and financial capability scores determined in this initial FCA. The context of this FCA and of the implementation of the LTCP is a combined sewered community with household incomes well below the federal and state levels, high poverty rates, and high local tax burdens. Town of Harrison is and is likely to remain financially distressed due to structural economic factors beyond its direct control and its ability to afford and finance future CSO control facilities is restricted.

7.0 Potential Impacts of the COVID-19 Pandemic on Affordability

The projections and conclusions concerning the affordability of the CSO control program proposed in this SIAR by the Town of Harrison and Harrison's financial capability to finance the CSO control program are premised on the baseline financial conditions of Town of Harrison as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be impacts, potentially significant impacts. There are several dimensions to these potential impacts, including both potentially reduced utility revenues, and potentially reduced household incomes.

7.1 Potential Wastewater Utility Revenue Impacts

This Financial Capability Assessment cannot reflect the currently unknowable impacts on wastewater utility revenues stemming from the national economic upheaval resulting from the COVID-19 pandemic. It is however extremely likely that Town of Harrison and municipal wastewater utilities in general across the United States will face significant and potentially permanent declines in revenues from households unable to pay their water and sewer bills and the sudden decline in industrial and commercial demands for potable water and wastewater treatment.

On March 20, 2020 the National Association of Clean Water Agencies (NACWA) issued a press release stating that:

> **"NACWA conservatively estimates the impact to clean water utilities nationwide of lost revenues due to coronavirus at $12.5 Billion.** This is a low-end estimate, assuming an average loss of revenue of 20% which is well within the range of what individual utilities are already projecting. Some utilities are anticipating closer to a 30% or 40% loss in revenue. This estimate is based on the substantial historical utility financial data NACWA has on file through its Financial Survey and recent reports from NACWA members on the decrease in usage they are observing in their systems over the last few weeks."[19]

The impact of a 20% to 40% revenue loss, along with increased costs that have been and will continue to be experienced by water and wastewater utilities such as overtime and the writing off of customer accounts receivable could have a profound impact on the affordability of the proposed CSO controls and Town of Harrison's ability to finance them.

Most of the costs of a municipal wastewater system are relatively fixed within broad operating ranges. Debt service and other capital costs are fixed once incurred. Some operating costs are somewhat variable with wastewater flows, e.g. chemical and electrical power usage but this variability is lessened by the reality that inflow, infiltration and stormwater flow in a combined system are not affected by billed water consumption. Labor costs are not directly variable, e.g. a

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[19] NACWA press release: Coronavirus Impacting Clean Water Agencies; Local Utilities and Ratepayers Need Assistance March 20, 2020

twenty percent reduction in billed flow would not result in a need for twenty percent less labor. Maintenance costs might go down minimally as equipment operating times may be reduced.

As costs do not decline proportionately to billed flow, it can be expected that user charge rates must be raised to generate sufficient revenue to sustain current operations. The relationship between changes in costs and revenues and the resultant changes in user charge rates is complex and has not yet been fully analyzed. At this point it can be assumed that user rate increases may be necessary to simply maintain current operations, and these rate increases will likely erode the financial capability of Town of Harrison to fund the CSO LTCP.

7.2 Potential Median Household Income Impacts

The impacts of the pandemic on median household incomes in Town of Harrison cannot be determined at this point. Historical analogies may provide some useful, albeit disturbing, context but are not presented as predictive:

- U.S. median household income fell by 6.2% from $53,000 in 2007 to $49,000 in 2010. In New Jersey, the MHI decreased by around 4.0% for the same period.[20]
- The U.S. unemployment rates rose from 5.0% in December of 2007 to 9.9% in December of 2009.[21]
- Data on impacts of the Great Depression on median household income are not available. As a proxy, the personal income per capita data are available. For 1929 this was $700. By 1933 this figure bottomed out at $376, a decline of 46%. Unemployment for the same period rose from around 3.0% to 25%.[22]

While a quantifiable assessment of the impact of the pandemic on median household income is not feasible at this time, reduction in base year MHI can be expected. This will further exacerbate the impacts of the revenue reductions described above on LTCP affordability, as higher base user charge rates will absorb an increased portion of lower MHI.

7.3 Implications for the Long Term CSO Control Program

Town of Harrison anticipates that the financial implications of the COVID-19 pandemic will be discussed with NJDEP during the review of the SIAR and as the 2021 – 2025 NJPDES permit is developed. Based on the October 1, 2020 revised due date for the SAIR, additional revenue data should be available to support a more specific refinement of this analysis in the SIAR.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, Town of Harrison will be reticent to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this SIAR based on emergent economic conditions beyond the Town of Harrisons' control. As detailed in Section F of Town of Harrison's SIAR these provisions could include scheduling the

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20 Source: Fact Sheet: Income and Poverty Across the States, 2010 Joint Economic Committee, United States Congress, Senator Robert P. Casey, Jr. Chairman.

21 Source: Bureau of Labor Statistics data series LNS1400000

22 Source: Federal Reserve Economic Data (FRED) data series: A792RC0A052NBEA

implementation of specific CSO control measures to occur during the five year NJPDES permit cycles. A revised affordability assessment should occur be performed during review of the next NJPDES permit to identify controls that are financially feasible during that next permit period.

8.0 Conclusion

While the affordability analysis detailed above has documented that the selected $16 million (current dollars) Municipal Control Alternative along with related operation and maintenance costs would result in a Residential Indicator of "medium impact" under EPA's criteria; the reality of the higher than national average poverty rates, low household incomes compared to the rest of New Jersey and nationally and the high costs of living in Town of Harrison argue strongly that the EPA metric understates the impacts of the CSO control costs on the residents of the Town. As evidenced by its New Jersey Municipal Revitalization Index score in the top 85th percentile Town of Harrison's capacity for additional CSO controls beyond those proposed in the SIAR is limited.