Long Term Control Plan Update

City of Zanesville, Ohio

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Prepared for:

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Acronyms and Abbreviations

AACE	American Association Of Cost Engineering
ADWF	Average Dry Weather Flow
AMC	Antecedent Moisture Control
BMP	Best Management Practice
BSF	Base Sanitary Flow
CEPT	Chemically Enhanced Primary Treatment
CIP	Cast Iron Pipe
CSO	Combined Sewer Overflow
CSSOP	Combined Sewer System Operation Plan
CWA	Clean Water Act
DWF	Dry Weather Flow
FCA	Financial Capability Analysis
FeCl	Ferric Chloride
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FM	Flow Meter
Ft	Feet
GIS	Geographic Information System
GPM	Gallons Per Minute
GWI	Groundwater Infiltration
HDD	Horizontal Directional Drilling
Hr	Hour
I/I	Inflow And Infiltration
LF	Linear Feet
LIDAR	Light Detection And Ranging
LTCP	Long-Term Control Plan
MG	Million Gallons
MGD	Million Gallons Per Day
MH	Manhole
MS4	Municipal Separate Storm Sewer System
NAVD	North American Vertical Datum
NFA	No Feasible Alternative
NMC	Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
O&M	Operation And Maintenance
O&P	Overhead And Profit
ODNR	Ohio Department Of Natural Resources

OEPA	Ohio Environmental Protection Agency
PCCM	Post Construction Compliance Monitoring
PCSWMM	Personal Computer Stormwater Management Model
PHF	Peak Hourly Flow
PI	Peak Intensity
POTW	Publicly Owned Treatment Works
PS	Pump Station
PTI	Permit To Install
RAS	Return Activated Sludge
RCP	Reinforced Concrete Pipe
RCSP	Reinforced Concrete Sewer Pipe
RDII	Rain-Derived Inflow/Infiltration
RL	River Level
ROW	Right Of Way
RWI	River Water Intrusion
SOR	Surface Overflow Rate
SRTC	Subcatchment Radio Tuning Calibration
TMDL	Total Maximum Daily Load
TY	Typical Year
USGS	United States Geological Survey
VSP	Vitrified Sewer Pipe
WAS	Waste Activated Sludge
WIB	Water In Basement
WIIA	Water Infrastructure And Improvements Act
WPCLF	Water Pollution Control Loan Fund
WQS	Water Quality Standards
WWF	Wet Weather Flow
WWTP	Wastewater Treatment Plant

1. Executive Summary

1.1 Background

The City of Zanesville, Ohio (City) submitted a Combined Sewer Overflow (CSO) Long-Term Control Plan (LTCP) in accordance with the Ohio Environmental Protection Agency (OEPA) National Pollutant Discharge Elimination System (NPDES) Permit in 2007. The LTCP included a phased approach to performing sewer separation, pump station upgrades, and sewer and pump station rehabilitation projects in the collection system and upgrades to increase the wet weather capacity at the City's Wastewater Treatment Plant (WWTP) to address the City's CSOs. The LTCP was approved by OEPA in 2008 and subsequently incorporated into the City's NPDES Permit (0PE00000) Schedule of Compliance.

Under the existing LTCP, the City has been performing sewer separation and sewer rehabilitation projects, upgrades to the WWTP, and a complete overhaul of the Y-Bridge Lift Station, investing over $41 Million on the LTCP implementation. Through implementation of the approved LTCP, the City has made substantial progress in reducing the amount of CSOs in the collection system and has already eliminated several CSO outfalls.

In 2018, the City began discussions with OEPA regarding evaluating and updating the LTCP. As the remaining projects to be completed under the existing LTCP are increasingly more complex and expensive, the City wanted to evaluate the current performance of their system and to consider new future alternatives and investigate potential sources of inflow to the system that were not previously evaluated. In 2018 OEPA provided approval for the City to perform investigations of the collection system and modified the City's NPDES Permit to require a LTCP Update be submitted in December 2020. The main objectives of the LTCP Update are to:

- Evaluate the performance of the separation projects completed to date
- Review the City's current financial ability to complete future projects
- Update the hydraulic model to be more robust and to incorporate additional areas of the collection system
- Collect flow monitoring data to evaluate the conditions of the existing collection system
- Evaluate future goals and alternatives, and
- Investigate potential factors not previously considered (i.e. river water intrusion, I/I).

The City began performing field investigations, GIS updates, flow monitoring, and hydraulic modeling to characterize the system and the thirteen (13) remaining active CSOs. The City refers to the CSO outfalls as 'racks' and has assigned a rack number (e.g. R2) to identify each CSO outfall. This report primarily utilizes the City's rack identification system when referring to CSO outfalls.

The City continues to implement separation projects from the LTCP, and separation of R6 and R8 through R11 along with Y Bridge Pump Station force main improvements are currently under construction. The City was nominated for $5.8 Million of 0% CSO Discount Loans through WPCLF for these separation projects which are scheduled to complete construction in 2024. The City also recently completed rehabilitating the Linden Avenue Pump Station, including the replacement of pumps to maintain existing design capacity.

1.2 Integrated Planning Approach

This LTCP Update has been developed in accordance with US EPA regulatory requirements and guidance utilizing an Integrated Planning Approach to address traditional CSO community requirements and the more recent integrated planning methodologies. In 2019, the Water Infrastructure and Improvements Act (WIIA) was signed into law which adds a new Section 402(s) to the Clean Water Act (CWA) to include the 2012 Integrated Municipal Stormwater and Wastewater Planning Approach Framework. In addition, US EPA also published a pre-publication of the 2021 Financial Capability Assessment Guidance (2021 FCA Guidance) for CWA schedule development in January 2021. The 2021 FCA Guidance allows communities to more accurately demonstrate the financial burden of funding CWA projects and programs and was used as guidance in the development of this LTCP Update.

The Integrated Planning Approach provides municipalities flexibility in addressing all of their CWA requirements to develop cost-effective solutions. The City developed a project team of City staff across several departments to aid in performing field investigations, reviewing data, identifying historical issues, documenting existing CWA regulatory efforts and developing the LTCP Update. As part of the LTCP Update the WWTP, combined sewer system, separate sewer system, and MS4 were evaluated as part of the system characterization.

1.3 LTCP Update Development

The LTCP Update included flow monitoring throughout the City to gain a better understanding of the system response to dry and wet weather flows. The flow monitoring data was used to calibrate the Personal Computer Stormwater Management Model (PCSWMM) hydraulic model created for the LTCP Update.

As part of the LTCP Update, the hydraulic model was constructed and calibrated using extensive field investigation and flow monitoring data. The collection system was delineated into sewershed basins and the model was used to develop alternative solutions to control overflows in the collection system and at the WWTP. Flow monitoring data was also used to identify areas of I/I and determine the effects on the system. Seventeen (17) flow monitors were installed and evaluated during the period from June 6, 2019 through November 7, 2019. To identify areas of river water intrusion (RWI), the City evaluated river gage data and flow monitoring data. These activities are an important component of the adaptive management strategy to optimize the selected CSO control alternatives.

Numerous potential solutions were evaluated in the collection system and at the WWTP to develop alternatives to provide the desired level of CSO control. Several types of information were considered during the development phase including City staff historical knowledge, data review, hydraulic modelling, and public input. The City evaluated the following potential control solutions as part of this LTCP Update:

- Source Controls
- I/I and Conveyance Upgrades
- Storage and Treatment Technologies
- Best Management Practices
- WWTP Upgrades

1.4 LTCP Update Selected Alternative and Cost

The City evaluated several city-wide alternatives that would meet or exceed the goal of reducing the number of CSO occurrence to four (4) or less during the typical year in accordance with the CSO Control policy presumptive approach. Post-construction monitoring will be performed to demonstrate the attainment of WQS in accordance with CWA requirements upon completion of this LTCP Update. The selected alternative has been simulated using the hydraulic model and is being recommended based on a planning level feasibility analysis and estimated costs of implementation.

The selected alternative includes Early Action, infiltration and inflow (I/I) and conveyance upgrades, storage, WWTP Upgrade projects, and programmatic reviews. The estimated cost of the selected alternative is $40.04 Million (2021 dollars) and is summarized in **Table 1-1**. These cost estimates are representative of total project costs including construction, engineering design and construction oversight, permitting costs and contingencies.

Table 1-1. LTCP Update Selected Alternative Summary

LTCP Update Projects	Description	Estimated Cost (2021 dollars)
Early Action Projects	Recently completed projects or projects in the planning or design phase including the Linden Avenue Lift Station upgrades, the Y-Bridge Pump Station improvements and NPDES Permit sewer separation projects (R6 and R8-11)	$10,994,000
I/I and Conveyance Upgrades	Sewer separation and RWI projects throughout the collection system along with regulator modifications	$1,479,000
Storage	In-line and off-line storage and associated pumping capacity	$12,262,000
WWTP Upgrades	Improvements to restore the WWTP peak primary treatment capacity to 36 MGD and the peak secondary treatment capacity to 27 MGD and upgrades for long term implementation	$15,180,000
Programmatic Reviews	Evaluation of system performance following each phase of LTCP Update (3 phases)	$120,000
Total		**$40,035,000**

**Project costs were developed in 2021 and are shown in 2021 dollars.*

Early Action Projects – The sewer separation projects in R6 and R8 through R11 are required to be completed under the City's existing NPDES Permit. The design of these projects was underway during the initial 2021 development of this LTCP Update and the construction of these plans are near completion in 2024 The City also plans to upgrade the pumping capacity of the Y-Bridge Pump Station from 14.4 MGD to 20 MGD by replacing the existing pumps and upsizing the effluent force main. Upsizing of the effluent force main is planned to be constructed in three phases and the City is currently completing construction of the downstream section of effluent force main under Phase I. In addition, the City has completed the Linden Avenue Lift Station upgrades project to maintain the existing design capacity of the lift station and was included in the Early Action project costs.

Infiltration and Inflow (I/I) and Conveyance Upgrades – Sewer separation in the R13 sewershed and R30 sewershed were included as viable inflow reduction projects. The City plans on completing R13 combined sewer separation by constructing the remaining sanitary sewer extents modifying the R13 outfall configuration to prevent separate storm flow conveyance into the combined system. In the R30 sewershed the City plans on removing the one known sanitary connection into the combined sewer and converting the R30 CSO outfall to a storm outfall. The City also plans on pursuing RWI remediation at R3, R13 and R14 via end-of-pipe solutions for additional inflow reduction in these areas. Proposed conveyance upgrades include CSO regulator modifications at R12 and R26. To maximize the existing capacity of the combined collection system, the City plans to raise the existing weir at R12.

Additionally, evaluation and removal of existing float gates at R13, R14, R21, R26 and R30 is included in this LTCP Update. Float gate removal would be evaluated during programmatic review periods and implemented concurrently with proposed sewer separation projects; specifically, the removal of the existing float gates at R14, R21, and R26 regulator structures would be performed as a dedicated project; the removal of the existing float gate at the R13 regulator structure would be performed during the R13 sewer separation project; and the removal of the existing float gate at the R30 regulator structure would be performed during the R30 sewer separation project.

Storage – Storage was considered the most cost-effective, feasible option for CSO control at R3 and R21. The City plans to provide in-line storage at R3 via an oversized gravity sewer. At R21 a storage array and 1 MGD pump station are proposed to provide required hydraulic relief.

WWTP Upgrades – The City's WWTP currently has a wet weather capacity of 25 MGD. The WWTP will be upgraded to restore the peak primary treatment capacity to 36 MGD and the peak secondary treatment capacity to 27 MGD and which will be achieved by removing existing hydraulic bottlenecks through upgrades and improving treatment efficiency of existing units.

Programmatic Reviews – Programmatic reviews will allow the City to evaluate the performance of constructed projects and determine whether adjustments are required for future phase projects. The City plans on conducting flow monitoring and a programmatic review following each phase of the three-phased LTCP Update Implementation Schedule.

Implementation of the Selected LTCP Update Alternative will reduce the total CSO volume during a typical year from approximately 57.4 MG/year estimated during the existing condition typical year to 15.4 MG/year estimated during the future selected alternative typical year. This results in a 73.1% system wide overflow volume reduction. This reduction is in addition to the estimated 8.9% system wide overflow volume reduction estimated from the typical year 2007 LTCP modeling to the typical year LTCP Update existing condition model. The Selected LTCP Update Alternative was modeled to predict the estimated number of overflows system-wide and the total volume from each CSO. **Table 1-2** provides a comparison of the existing conditions and the predicted LTCP Update modeling results for each CSO. The selected alternative is described in further detail in **Section 11**.

Table 1-2. Existing Condition and Predicted LTCP Update CSO Occurrence and Volume Modelling Results

CSO Outfall		Existing Condition		Predicted LTCP Update		
City Rack Number	NPDES Permit CSO Station Number	Number of Overflows (#/yr)	Overflow Volume (MG/yr)	Number of Overflows (#/yr)	Overflow Volume (MG/yr)	Overflow Volume % Reduction
R2	005			Closed		
R3	006	35	17.0	4	7.1	58%
R4	007			Closed		
R5	008			Closed		
R6	009	22	6.8	0	0	100%
R7	010			Closed		
R8	011	5	1.0	0	0	100%
R9	012	22	6.5	0	0	100%
R10	013	7	1.0	0	0	100%
R11	014	1	0.1	0	0	100%
R12	015	4	1.1	1	0.06	95%
R13	016	57	7.4	4	5.1	30.8%
R14	017	4	2.8	4	1.7	39.2%
R15	018			Closed		
R17	020			Closed		
R18	021			Closed		
R19	022			Closed		
R21	024	18	12.8	4	1.4	89%
R26	029	10	1.0	0	0	100%
R30	052	0	0	0	0	-
Total			**57.4**		**15.4**	**73.1%**

1.5 Implementation Schedule

The LTCP Update Implementation Schedule (Schedule) has been developed in consideration of several regulatory requirements including the CSO Control Policy, the Integrated Planning Approach and the US EPA Financial Capability Assessment. Based on these documents, the City has developed a 20-year implementation schedule utilizing a phased approach. Early Action Projects will be completed at the beginning of the implementation schedule followed by high priority/high impact projects. The Schedule has been developed in three phases each with a review period at the end of the phase to allow the City to evaluate the performance of the projects from the previous phase and serves as an evaluation mechanism for future phase projects. Upon completion of projects identified in the schedule, the City plans to perform post construction compliance monitoring (PCCM) at remaining CSO locations. During the review periods and the PCCM, the City will collect and review data, calibrate the hydraulic model and modify the LTCP Update as necessary. Modifications to the LTCP Update may include revision of selected project, future project sizing, and schedule modifications. A report detailing the review and any proposed modifications will be submitted to OEPA. The City’s 20-year implementation schedule is included in **Section 13**.

2. Background

The City submitted the CSO LTCP to OEPA on June 12, 2007. The LTCP was approved on June 17, 2008 and the City began completing projects identified in the plan. The LTCP included separation projects and infrastructure upgrades to be completed by December 1, 2022. The LTCP was later approved for amendment by OEPA in 2014 and 2016. The City continues to implement separation projects from the approved LTCP and has several ongoing projects in the planning, design or construction phase for sewer separation, WWTP modifications, and pump station upgrades. Twelve (12) racks (CSO outfalls) remain active. The following is a summary of past project performance and relevant studies performed by the City.

2.1 2007 LTCP Report

On July 23, 2003, the City of Zanesville was issued OEPA NPDES Permit No. OPE00000*ND, which required preparation of an LTCP to control CSOs. In 2007, the City submitted the LTCP to the OEPA to control CSOs by performing sewer separation and WWTP upgrades. The recommended alternative included a phased approach to completing sewer separation projects in addition to a wastewater treatment plant (WWTP) expansion, targeted river water intrusion protection and sewer rehabilitation for a total estimated cost of $68 Million (assumed to be in 2007 Dollars). The LTCP, which was approved in June 2008, provided the following key information and recommendations:

1. System characterization of the collection system for the interceptors, local sewers, CSO structures, river crossing siphon, and pump stations
2. Characterization of the WWTP on Moxahala Avenue in addition to the results of a stress test that showed the WWTP was capable of a maximum wet weather flow of 20 MGD
3. An EPA-SWMM based collection system hydraulic model that was calibrated with flow data collected during 1997 through 1999 and recalibrated with additional data collected from February to June of 2005
4. Pollutant loadings evaluation of the Licking and Muskingum Rivers for an assessment of the effects of CSOs on river conditions, which found that the Muskingum River does not attain Ohio Water Quality Standards for bacteria prior to reaching Zanesville, and that removal of all CSOs in the Zanesville system would have minimal impact on the river in achieving attainment for this parameter
5. Selection of the separation approach to control CSOs through the construction of new sanitary sewers and the conversion of existing combined sewers into storm sewers, in addition to the application of community standards to ensure that alternatives control odor, improve aesthetics, and protect public health
6. Selection of targeted sewer rehabilitation, river water intrusion prevention, and expansion of the WWTP to 36.2 MGD to provide additional CSO control
7. Analysis of the financial impacts to the community due to implementation of the LTCP, which concluded that the WWTP upgrade and sewer separation projects

totaling $68 million are a high burden for the City based on OEPA and US EPA guidelines

CSO sewershed separation prioritization was completed based on cost per gallon of CSO removed and the City's debt service, with separation projects being scheduled to coincide with the retirement of existing wastewater loans. **Table 2-1** depicts the schedule of completed projects and associated costs for completed projects. While it should be noted that although the majority of the R13 basin was separated by projects completed in 2004 and 2010, additional work is required before the CSO location can be eliminated.

Table 2-1. LTCP Schedule of Completed Projects

Project Name	Description	Year Completed	Cost*
R13 Separation**	R13 service area separation and CSO elimination	Phase I: 2004 Phase II: 2010	$1,880,744
Southend Sewer Rehabilitation	5-year program to remove rainfall derived I/I	2008	$1,085,616
WWTP Expansion, Phase I WWTP Expansion, Phase II	Completion of WWTP expansion to provide peak wet weather capacity of 36.2 MGD	2007 2009	$28,172,000
R17 and R19 Separation	R17 and R19 service area separation and CSO elimination	2010	$363,440
R18 Separation	R18 service area separation and CSO elimination	2011	$838,300
R21 River Water Intrusion Prevention	R21 river water intrusion prevention	2012	$49,000
R4 and R5 Separation	R4 and R5 service area separation and CSO elimination	2014	$1,442,450
Y-Bridge Lift Station Upgrades	Upgrade of Y-Bridge Lift Station capacity from 10 MGD to 14.4 MGD	2015	$3,337,000
R2 and R7 Separation	R2 and R7 service area separation and CSO elimination	2016	$1,028,000
		Total	**$38,196,550**

<u>Notes:</u>
* *Costs are actual dollars spent and are not in 2021 Dollars.*
** *Separation projects were performed in the R13 sewershed, however, due to the complexity of railroad crossings, this area was not completely separated and a portion remains combined.*

Table 2-2 summarizes the remaining projects in the 2007 LTCP including anticipated completion year and estimated cost in 2021 Dollars. It should be noted that project costs were adjusted from 2007 Dollars using a 4-percent annual compounding inflation rate except for the ongoing project for sewer separation at R6, R8, R9, R10, R11 and Y-Bridge Pump Station force main improvements. Costs for these ongoing projects are based on engineers estimates at the time this report was developed (2021).

Table 2-2. 2007 LTCP Schedule of Projects to be Completed

Project Name	Description	2007 LTCP Completion Year	Estimated Cost*
CSO R6, R8, R9, R10, R11 Separation and Y-Bridge PS Force Main Improvements	R6, R8 through R11 service area separation and CSO elimination	2021	$7,444,000**
CSO R3 Separation	R3 service area separation and CSO elimination	2022	$9,409,000
CSO R12 Separation	R12 service area separation and CSO elimination	2022	$6,030,000
CSO R14 Separation	R14 service area separation and CSO elimination	2022	$9,947,000
CSO R21 Separation	R21 service area separation and CSO elimination	2022	$15,040,000
CSO R26 Separation	R26 service area separation and CSO elimination	2022	$2,328,000
		Total	**$50,198,000**

Notes:
*   *Estimated costs are projected from 2007 LTCP to 2021 Dollars.*
**   *Based on Engineer's Opinion of Probable Cost for CSO R6, R8, R9, R10, R11 Separation and Y-Bridge Force Main Improvements Project currently under design.*

In 2014, the OEPA provided approval of a City requested amendment to the 2007 LTCP. The LTCP was amended to allow for the installation of new storm sewers in addition to new sanitary sewers to separate a CSO tributary basin and eliminate discharges during a typical year of rainfall.

In 2016, the City submitted a request to OEPA to modify the LTCP schedule in the NPDES Permit Part I,C – Schedule of Compliance. The request for modification was made to update the PTI submittal date for R3, R6, R12, R14, R21, and R26.

In 2018, the City began discussion with OEPA about evaluating and updating the LTCP. The City submitted correspondence to the OEPA regarding the status and objectives of the LTCP Update efforts. Key OEPA correspondence documents related to the LTCP Update process have been included **Appendix A**.

2.2 NPDES Permit Schedule of Compliance Summary

The City of Zanesville NPDES Permit effective April 1, 2016 provided a Schedule of Compliance for CSO LTCP implementation. The OEPA approved an update to the NPDES Permit Part I, C – Schedule of Compliance in June of 2018 to include the following language and compliance dates:

1. The City shall complete construction and obtain operation of the separation projects for sewer collection areas tributary to regulators R8, R9, R10 and R11 by December 31, 2019.
2. The City shall submit an updated LTCP by December 31, 2020.
3. The City shall complete construction of all LTCP projects and attain operation by December 1, 2022.

In August 2020, the City submitted an application to OEPA to renew the current NPDES Permit (0PE00000*SD) in accordance with the 5-year permit term which expired January 31, 2021. Once the terms of the LTCP Update are finalized, the City assumes that the LTCP Update will be incorporated in the NPDES Permit Schedule of Compliance and will submit all required applications to modify or renew the NPDES Permit accordingly.

In December 2020, the City submitted a request to the OEPA to modify the Schedule of Compliance under their existing NPDES Permit such that the LTCP Update shall be submitted no later than December 31, 2021.

The LTCP Update draft report was submitted to Ohio EPA for review in December 2021. This version of the report is being submitted for approval in July 2024 and includes the terms and changes negotiated during the Ohio EPA review and approval process.

2.3 Nine Minimum Controls Implementation

As part of the City's NPDES Permit, the City is required to implement the Nine Minimum Controls (NMC) under the US EPA CSO Control Policy. All communities with CSOs are required to create and submit a Combined Sewer System Operational Plan (CSSOP). The CSSOP is submitted to document how the community will execute the NMCs for CSOs. The City continues to implement the NMCs:

1. Routine inspection, operation and maintenance of the system
2. Maximize use of collection system for storage during wet weather
3. Review and modification of pretreatment program
4. Maximization of flow to Publicly Owned Treatment Works (POTW) for treatment
5. Elimination of dry weather overflows
6. Control of solid or floatable materials in CSO discharges

7. Monitoring, inspection and reporting of CSOs
8. Pollution prevention to reduce CSO impacts
9. Public notification of any areas that are affected by CSOs, especially beaches and water recreational areas

Each community with CSOs must provide documentation on specific actions that have been taken to implement all minimum controls in their CSSOP. If a minimum control is not applicable to a community, this must also be explained in the plan such that all controls have been identified and commented on.

The City of Zanesville prepared a CSSOP which was originally developed in 1988 and updated in 2005 as new system data became available. The CSSOP was developed to document the NMCs currently being implemented or proposed to be implemented by the City to reduce CSO discharges and maximize the existing system infrastructure. On July 23, 2019, OEPA performed a CSO/NMC Inspection to review the City's compliance with the requirements in the Zanesville WWTP NPDES Permit 0PE00000*SD. The inspection found that the City is in compliance with the NMCs in coordination with their CSSOP as summarized below.

1. <u>Operation and Maintenance Program</u>

   City staff operates and maintains the wastewater treatment plant (WWTP) and collection system, though operators and maintenance staff function as separate departments. The City owns a televising camera, and inspections are historically implemented on a complaint-driven basis. The City maintains O&M manuals for all unit processes and equipment at the WWTP, as well as for the CSO regulators. The City does not have an O&M manual for regular sewer cleaning and maintenance. The City is developing a GIS app to track assets and maintenance.

   The City owns four (4) pump stations which are inspected three (3) times per week. Three of the four have a dedicated backup generator, and the fourth received a backup generator following an upgrade in 2020. CSO regulators are inspected daily during dry weather and then repeatedly throughout the day during or following precipitation events. City staff documents inspection findings upon return to the facility.

2. <u>Maximum Use of the Collection System for Storage</u>

   The weirs at each of the CSOs are set to 2"-6" above the invert of the combined sewer. The combination of the low weirs and the bottleneck caused by 24" trunk sewer flowing into the interceptor connection pipe (8") allows CSOs to discharge relatively easily, and before the WWTP reaches peak capacity.

   The interceptor leading to the WWTP is approximately 9,000 linear feet of 60" sewer. When the WWTP reaches peak sustainable capacity, staff are able to partially close the influent gate and use the interceptor for storage. The City owns two vac trucks for sewer cleaning to remove deposited sediments.

   All of the CSOs have either an end of pipe duckbill or flap-gate to reduce river water intrusion (RWI). The City recently recalibrated flow meters to detect flow direction and discovered significant RWI, which occupies considerable sewer and treatment capacity. RWI is particularly problematic at R14 where, unless the CSO is discharging, RWI appears to be constant. The outfall is submerged and the regulator is likely below river level due to a dam immediately downstream and, while the duckbill prevents most RWI, the City staff suspects that river water is still infiltrating at pipe joints. Raising the weir elevation is unlikely to reduce RWI (though it would likely reduce CSO discharges and/or volume).

3. Review and Modification of Pretreatment Program

   The City has an OEPA approved pretreatment program. The City has 15 significant industrial users and 15 non-significant industrial users, though most are food processing facilities, so discharge of organic or metal pollutants via CSOs is not a major concern. The City has discussed discharge during wet weather events with its largest flow contributor, but the user has no ability to withhold flow.

4. Maximization of Flow to POTW for Treatment

   Wastewater received at the WWTP receives secondary treatment via trickling filter and activated sludge processes operated in series. The facility is designed to treat an instantaneous peak flow of 36 MGD, though stress tests have demonstrated that it can achieve an instantaneous peak of 30 MGD and sustainable peak of 27 MGD. At these peak flows, a hydraulic bottleneck near the head of the plant results in wastewater splashing out of the shallow channels of the primary screens. City staff believe that an upgrade to this portion of the facility would increase the overall treatment capacity.

   There is a secondary treatment bypass which diverts primary effluent directly to the chlorine contact tanks, bypassing both the trickling filters and aeration basins. This bypass is activated at 27 MGD and is used to redirect instantaneous peak flows that could disrupt secondary treatment operation. A second bypass allows wastewater to skip the trickling filters and flow directly to the aeration basins, though this bypass is rarely used.

5. Prohibition of Dry Weather Overflows

   Four outfalls are equipped with a flow meter to detect overflows, including during dry weather. The City visually inspects its outfall regulators daily during dry weather. City staff have not recorded a dry weather overflow in many years.

6. Control of Solid and Floatable Materials in CSO Discharges

   Sewers are cleaned primarily on a complaint-driven basis.

7. Required Inspection, Monitoring, and Reporting of CSOs

   Four of the CSOs (006, 009, 017, and 024) are equipped with a flow meter to record occurrences and volume. Reporting of occurrences at all other CSOs is dependent on inspections conducted daily and during precipitation events. All monitoring has been reported in accordance with the permit.

8. Pollution Prevention to Reduce CSO Impacts

The City owns two street sweepers which operate regularly and offers yard-waste removal in the fall. Catch basins and open ditches in known problem areas are cleaned frequently. Catch basins that flow directly to the river are appropriately labelled if they have been replaced recently, though this has not been completed city-wide.

9. Public Notification for Any Areas Affected by CSOs

The City has installed appropriate signage at its outfalls. The City website includes information on CSOs and brochures are frequently provided for public education in sewer bills and at event booths.

2.4 Fecal Coliform Study

The City's CSSOP included a Fecal Coliform Characterization Study Muskingum River and Area Tributaries dated November 1997. The report provided an analysis of the fecal coliform densities in the Muskingum River upstream and downstream of the City's CSOs. The City contracted Hull & Associates, Inc. to perform a similar study in 2018. The results of the Fecal Coliform Study Memorandum dated November 2019 presented the following conclusions:

- Comparison of the 2018 data to the 1997 data indicated an overall decrease in fecal coliform densities at a majority of the sampling locations
- During the period between sampling years E. Coli limits were lowered for water quality evaluation metrics (which could affect the attainment designation of the Muskingum and Licking Rivers)
- The bacteria impact on the Muskingum and Licking Rivers occurs upstream of the Zanesville POTW
- The CSO fecal coliform loading calculated using average values and streamflow estimates contributes less than 6% of the total fecal coliform load in the Muskingum River.

There is not currently an approved TMDL for the Muskingum River or the Licking River near the mouth. OEPA is in the process of studying the Muskingum River and collecting sampling data.

2.5 Y-Bridge Pump Station Capacity Study

In 2014 the City completed the Y-Bridge Pump Station Upgrades project which involved existing pump replacement to increase its wet weather capacity from 10 MGD to 14.4 MGD. In August 2015 CH2M Hill performed a capacity study and condition assessment of the upgraded Y-Bridge Pump Station and its associated 24-inch effluent force main. The study included a condition assessment of the 24-inch effluent force main, evaluation of the existing capacity at the Y-Bridge Pump Station, and development of recommendations for additional capacity.

A key finding from the 2015 study was that the 2014 upgrades project resulted in a maximum capacity of 14.4 MGD with three pumps in operation (and a fourth pump out of service to meet firm pumping capacity). Condition assessment of the effluent force main showed an estimated coefficient of friction (Hazen-Williams "C" Value) of 96-99, indicating that the existing 24-inch diameter effluent force main was in good condition considering its age. In addition, the study concluded that there is currently no additional capacity in the existing 24-inch effluent force main.

3. Purpose

The purpose of any LTCP is to provide site-specific, cost-effective CSO controls that will provide for attainment of water quality standards. According to US EPA Guidance Documents, a LTCP should provide flexibility to municipalities given the variable impacts of CSOs on water quality and the ability of different municipalities to afford varying levels of CSO control. The LTCP should evaluate a reasonable range of CSO control alternatives and varying control levels within those alternatives, using affordability as a consideration to help guide selection of the CSO control alternative.

As part of the LTCP Update, the City has used the Integrated Municipal Stormwater and Wastewater Planning Approach which will serve to address multiple City owned infrastructure issues at once by performing projects that have overlapping benefits to the WWTP, collection system, and storm sewer system.

The main components of this updated LTCP include the following items:

- Summary of the City's previous CSO program efforts, including review of the existing LTCP, LTCP Evaluation and NPDES Permit.
- Establishment of a site-specific LTCP planning approach and development of a decision-making process to review, evaluate, and select CSO control alternatives.
- Characterization of the existing system, to include the existing system components (WWTP, pump stations, interceptors, CSO structures/overflows, siphons), and preparation of a hydraulic model that accurately simulates wet weather impacts on the existing system.
- Alternative analysis that identifies, screens, and evaluates potential site-specific CSO control alternatives, including a performance evaluation of each alternative in conjunction with the presumption approach.
- Update of the City's financial affordability assessment to consider the impact of the CSO controls required to achieve compliance with the selected approach and determination of the City's financial capability to afford the plan and City-wide burden.
- CSO control selection based on affordability and the alternative performance evaluation including preparation of an implementation schedule and development of a compliance and monitoring program that achieves successful tracking of the program.

Furthermore, the LTCP Update will incorporate the U.S. EPA CSO Control Policy and guidance documents throughout development of the alternatives for affordable CSO control that provide the most benefit to water quality.

3.1 LTCP Update Key Tasks

The following key tasks have been performed to develop the LTCP Update.

1. Flow Monitoring: Perform flow monitoring to evaluate the performance of separated areas and to quantify wet weather volumes in the collection system in future project areas
2. River Water Intrusion Analysis: Review flow monitor data and river elevation data, and field verify locations of suspected river water intrusion to determine alternatives for mitigation
3. GIS Updates: Review existing as-builts, record drawings, and field inspection data to update the City's GIS database of the collection system
4. Hydraulic Modeling: Calibrate the existing SWMM model to the collected flow monitoring data, perform updates to reflect current field conditions and recent GIS updates, and expand the model to provide additional detail in areas planned for future projects
5. Alternative Analysis: Use the calibrated SWMM model results to right-size the scopes of planned sewer separation projects. Determine if upgrades to the WWTP or other solutions are more cost-effective to meet LTCP goals than planned separation projects. Update the LTCP program with the selected alternatives.
6. Financial Affordability Analysis: Evaluate the financial affordability of the City's LTCP program using the EPA affordability threshold of 2% of the median household income
7. Implementation Schedule: Develop an updated implementation schedule of the selected alternatives for the City's LTCP program
8. Public Outreach: Perform public outreach to solicit community input and incorporate stakeholder comments and feedback.

3.2 LTCP Update Purpose

Since the LTCP was approved in 2008, the City has spent over $40 million upgrading the WWTP and the Y-Bridge Pump Station, providing RWI protection, and closing various CSOs through sewer separation. As the remaining projects to be completed are increasingly more complex and expensive and mostly located in the downtown and historical areas of the City, the City would like to evaluate the current performance of their system to understand if alternative projects would be more cost-effective and feasible to construct. In addition, the City has evaluated new future alternatives and identified potential sources of inflow to the system that were not previously evaluated. The main objectives of the LTCP Update are:

1. Evaluate the performance of the separation projects completed to date
2. Update the hydraulic model to be more robust and to incorporate additional areas of the collection system

3. Collect flow monitoring data to evaluate the conditions of the existing collection system
4. Evaluate future goals and alternatives
5. Investigate potential factors not previously considered (i.e. river water intrusion, I/I)
6. Review the City’s current financial ability to complete future projects

4. Methodology

The LTCP Update is intended to recommend affordable CSO control strategies for the City of Zanesville that provide the most benefit to water quality. The following City of Zanesville documents were used to obtain background information in the development of this evaluation:

1. Combined Sewer System Operational Plan, City of Zanesville (BBS Corporation Consulting Engineers; 2005)
2. Combined Sewer Overflow Long-Term Control Plan, City of Zanesville (CH2M Hill; May 2007)
3. Wet Weather Plan, City of Zanesville (URS; June 2013)
4. Y-Bridge Pump Station Capacity Study and Force Main Assessment, City of Zanesville (CH2M Hill, August 2015)
5. Flood Insurance Study, Muskingum County, Ohio (FEMA, July 2010)
6. Linden Avenue Pump Station Facility Plan, City of Zanesville (Poggemeyer Design Group; March 2019)
7. Fecal Coliform Characterization Study Muskingum River and Area Tributaries (November, 1997)
8. City As-Built Maps and Atlas Maps
9. City GIS Information

The following US EPA and national guidance documents were referenced in the development of this evaluation:

1. Recommended Standards for Wastewater Facilities (2004)
2. NOAA's National Weather Service (NWS) Advanced Hydrologic Prediction Service
3. US EPA Combined Sewer Overflow Control Policy Federal Register (April, 1994)
4. US EPA Combined Sewer Overflows Guidance for Screening and Ranking (August, 1995)
5. US EPA Combined Sewer Overflows Guidance for Long-Term Control Plan (September, 1995)
6. US EPA Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development (February, 1997)
7. US EPA Combined Sewer Overflows Guidance for Monitoring and Modeling (January, 1999)
8. US EPA Integrated Municipal Stormwater and Wastewater Planning Approach Framework (June, 2012)

9. US EPA Financial Capability Assessment Framework for Municipal Clean Water Act Requirements (November, 2014)

10. US EPA Water Infrastructure and Improvement Act (January, 2019)

11. US EPA Financial Capability Assessment Guidance for Clean Water Act Obligations (January, 2021)

5. Planning Approach

The CSO Control Policy was issued by the US EPA on April 19, 1994 to establish a consistent approach for controlling CSO discharges to the Nation's waters through the NPDES permit program. The policy provides guidance for coordinating the planning, selection, and implementation of CSO controls that meet the requirements of the CWA. The main goal of the CSO Control Policy is to provide a national strategy to ensure that municipalities, regulating authorities, and the public cooperate in an effort to develop cost-effective CSO controls that meet the appropriate health and environmental objectives. The CSO Control Policy contains four key principles to ensure that CSO controls are cost-effective and meet the requirements of the CWA:

1. Provide clear levels of control that would be presumed to meet appropriate health and environmental objectives.
2. Provide sufficient flexibility to municipalities, especially those that are financially disadvantaged, to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements.
3. Allow a phased approach for implementation of CSO controls considering a community's financial capability.
4. Review and revise, as appropriate, WQS and their implementation procedures when developing long-term CSO control plans to reflect the site-specific wet weather impacts of CSOs.

Additionally, the CSO Control Policy outlines the expectations for the municipality and the EPA, which include the following:

1. Municipalities should implement the NMCs immediately, which are utilized to reduce CSOs and their effects on receiving water quality.
2. Municipalities should give priority to environmentally sensitive areas.
3. Municipalities should develop LTCPs for controlling CSOs, which may follow the guidance of the demonstrative or the presumption approach to meet the water quality requirements of the CWA.
4. The EPA should review and revise State WQS during the CSO LTCP planning process.
5. The EPA should consider the financial capability of the permittee when reviewing CSO control plans.

As part of the CSO Control Policy, the EPA states that it recognizes that financial considerations are a major factor affecting the selection and implementation of CSO controls within a community. Because of these factors, the policy allows for consideration of the municipalities' financial capability in connection with the LTCP recommended CSO controls and implementation schedule. The LTCP Update will include an updated financial capability analysis based on the estimated cost of the recommended CSO controls that balance both water quality impacts and scheduling considerations to identify the most cost-effective CSO control method.

The CSO Control Policy outlines the objectives for municipalities with active CSOs to complete, which includes characterizing their existing sewer systems, demonstrating their implementation of the NMCs, and developing a LTCP. The CSO Control Policy summarizes several required components of developing a LTCP, including preparation of a project implementation schedule and a financing plan to design and construct the CSO controls. The City's LTCP Update includes consideration of each of the CSO Control Policy goals and evaluation of the required components of a LTCP. In addition, public and regulatory agency input has been considered during development of the CSO control alternatives including evaluation of financial affordability in relation to water quality benefits.

Based on the tasks completed to date, the City has decided to move forward with a LTCP Update that will incorporate the recently codified Integrated Municipal Stormwater and Wastewater Planning Approach Framework (Integrated Planning Approach). The Integrated Planning Approach and US EPA CSO Control Policy have been utilized in developing alternatives, schedules and affordability of the City's LTCP Update.

6. System Characterization

The City's collection system and wastewater treatment plant were characterized in the 2007 LTCP and re-evaluated as part of the LTCP Update. A summary of this characterization for each of the key components is provided in this Section.

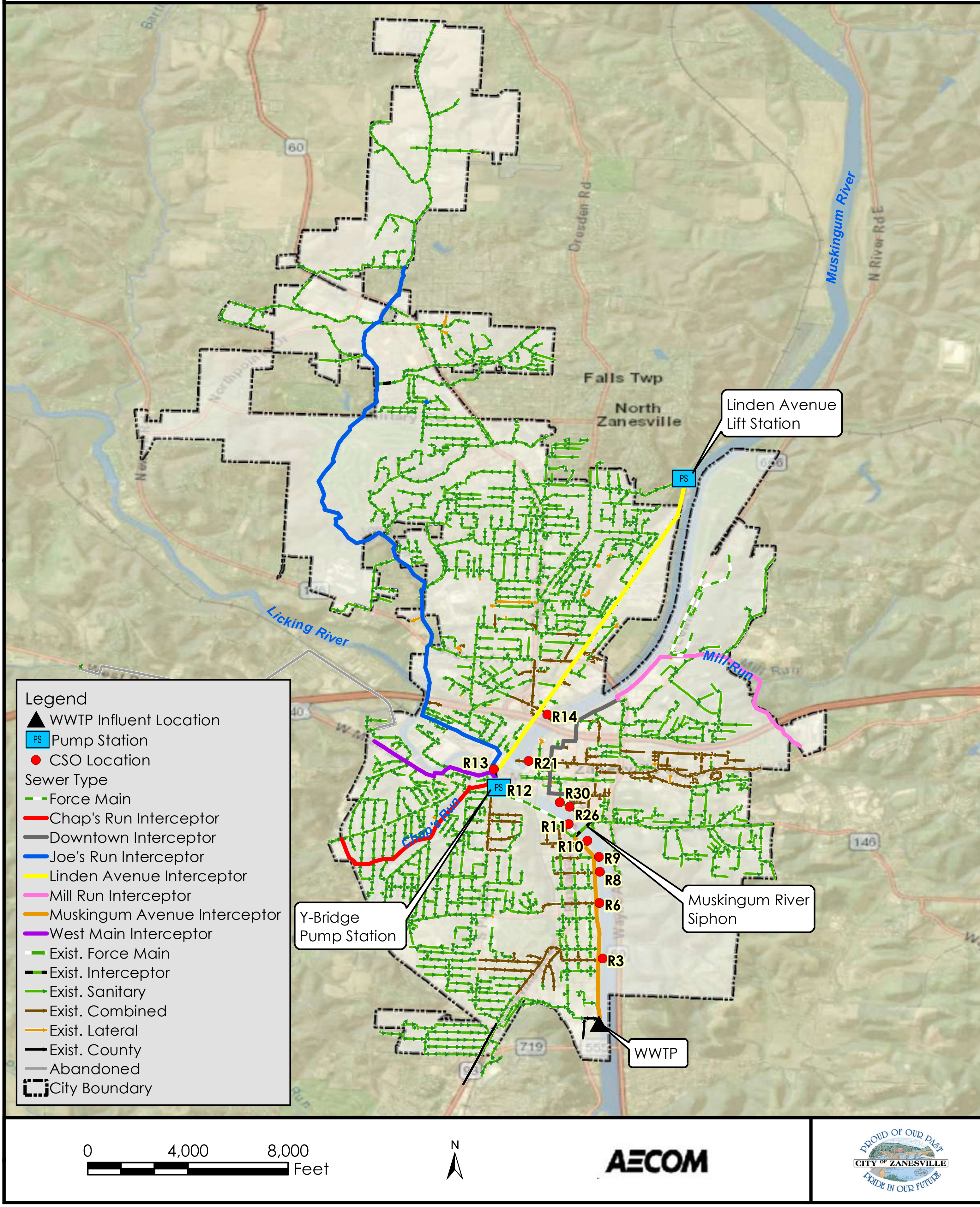
6.1 Gravity Collection System

The City of Zanesville service area consists of both combined and separate sanitary sewers. **Table 6-1** summarizes key data for each interceptor. Average daily flow parameters for each major interceptor were updated based on available LTCP Update flow monitoring results (refer to **Section 7** for further information). The City's combined collection system is depicted in **Figure 6-1** including major interceptors, force mains, rack locations (CSOs), and pump stations.

Table 6-1. Summary of Major Interceptors

Interceptor	Size (in)	Material	Average Daily Flow (MGD)	Discharge Location	Permitted CSOs
Joe's Run	30– 36	RCP	2.77	Y-Bridge Pump Station	R13
Mill Run	21 – 27	RCP	1.08	Downtown Interceptor	--
Downtown	24 – 48	VSP/RCSP	1.10	Muskingum River Siphon	R21, R26, R30
Linden Avenue	24 – 36	VSP	0.48	Joe's Run	R13, R14
West Main Street	8 – 21	VSP	Unavailable	Y-Bridge Pump Station	--
Chap's Run	18 – 24	VCP/CIP	0.62	Y-Bridge Pump Station	R12
Main (Muskingum Avenue)	60	Brick/CIP	4.50	WWTP	R3, R6, R8, R9, R10, R11

Figure 6-1
City of Zanesville LTCP Update
System Overview Map



6.2 Combined Sewer Overflows

The City has sixteen (16) permitted CSOs in the current NPDES Permit, twelve (12) of which are active. These CSOs are referred to as racks. The rack locations are shown in **Table 6-2.** In accordance with the City's NPDES Permit, flow meters collect flow data from the following rack numbers: R3, R6, R14 and R21. All other racks are visually inspected. All racks discharge to the Muskingum River, except for R13, which discharges at the mouth of the Licking River. **Table 6-2** includes the rack number, location, outfall size and current status of each CSO in the collection system.

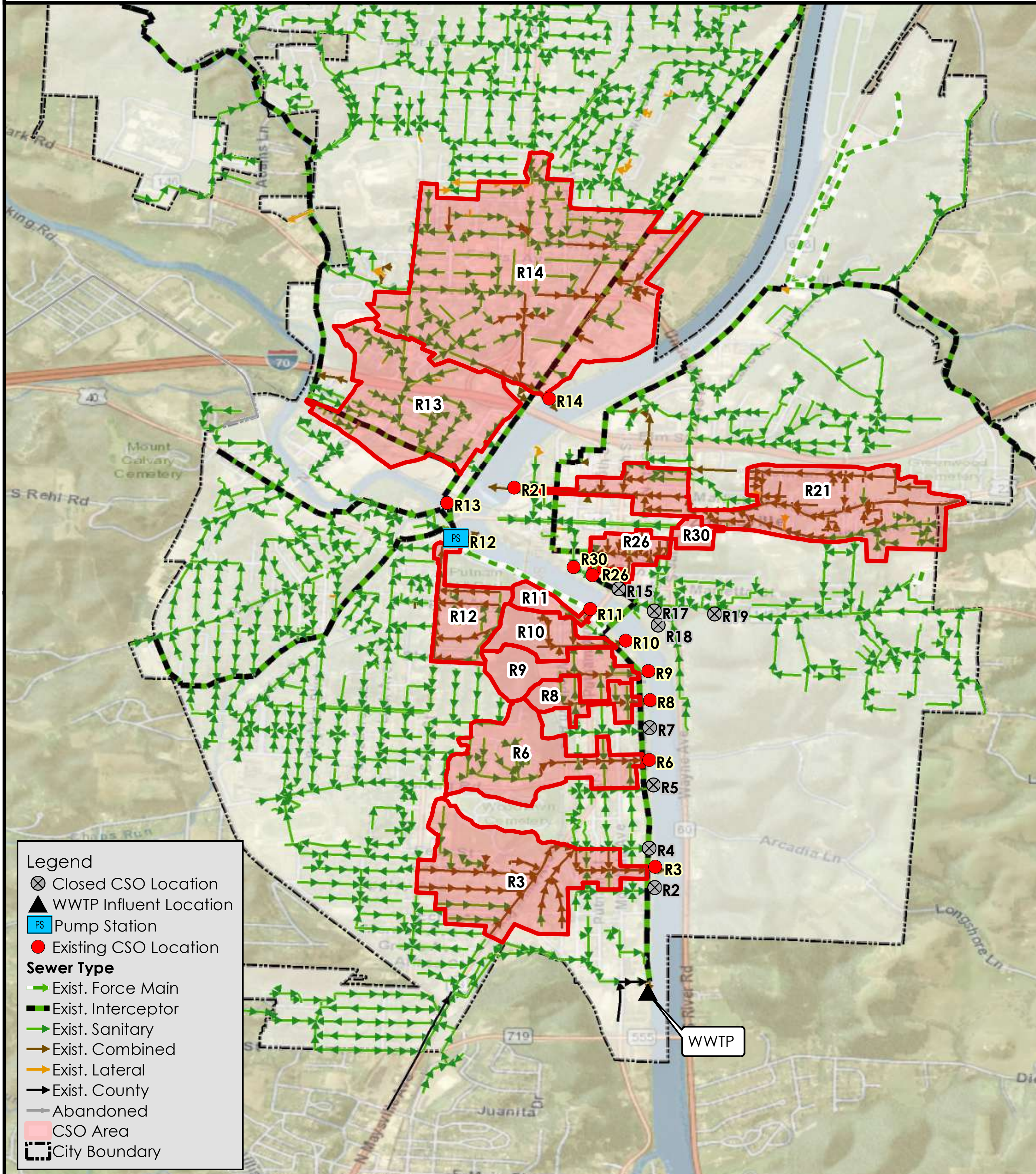
Table 6-2. Combined Sewer Overflow Description and Rack Numbers

City Rack Number	NPDES Permit CSO Station Number	Location Description	Overflow Outfall Sewer Size	Closed?
R2	005	Hoover St. at Muskingum Ave.	24”	Yes
R3	006	Johnson St. at Muskingum Ave.	48”	
R4	007	Lincoln St. at Muskingum Ave.	24”	Yes
R5	008	Pierce St. at Muskingum Ave.	24”	Yes
R6	009	Harrison St. at Muskingum Ave.	48”	
R7	010	Van Buren St. at Muskingum Ave.	24”	Yes
R8	011	Madison St. at Muskingum Ave.	18”	
R9	012	Jefferson St. at Muskingum Ave.	24”	
R10	013	Adams Ave. between Muskingum Ave. and Putnam Ave.	48”	
R11	014	Muskingum Ave. between Putnam Ave. and Washington St.	24”	
R12	015	Southwest of Y-Bridge PS in Alley	48”	
R13	016	Peters Alley behind Mee's	60”	
R14	017	McIntire Ave. east of Linden Ave.	60”x54” ellipse	
R15	018	Canal St. NE of 6th St. Bridge	30”	Yes
R17	020	8th St. North of Hughes St.	18”	Yes
R18	021	Wayne Ave. South of Hughes St.	18”	Yes
R19	022	Hughes St. West of Sharon Ave.	42”	Yes
R21	024	Market St. at 3rd	48”	
R26	029	5th St. North of Canal St.	42”	
R30	052	Main St. in Front of Courthouse	36”	

The 2-chambered CSO structures at R13, R14, R21, R26, and R30 all have separate float and regulator gate chambers and divert flow through a gate to an interceptor sewer. A float closes the gate as water levels are raised, and opens the gate as water levels are lowered, thus directing flow back into the interceptor. All other regulators are single chambered and utilize a diversion dam to direct high flows out to the Muskingum River.

Existing CSO locations are shown in **Figure 6-1** and **Figure 6-2**. CSOs that have been closed by completed sewer separation projects are depicted in **Figure 6-2** as well as existing CSO area boundaries.

Figure 6-2
City of Zanesville LTCP Update
CSO Areas



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6.3 River Water/Intrusion Prevention

Tideflex style gates or valves have been installed at R12, R13, R14, and R21 to prevent the intrusion of river water into the system during high river levels. A duckbill was installed at the R21 outfall in 2012 to mitigate river water intrusion. Routine inspections are conducted to ensure proper operation and maintenance of the installed devices for continued functionality. River water intrusion was evaluated at key infrastructure in **Section 8**.

6.4 Siphons

The Muskingum River Siphon, constructed in 1953, conveys combined wastewater from East Zanesville and the City's downtown area across the Muskingum River. The siphon begins at the east riverbank and conveys flows into the upstream point of the Main Interceptor. The siphon consists of two parallel conduits – one (1) 12-inch barrel and one (1) 24-inch barrel. An overflow weir was installed at the siphon to allow for emergency bypasses. There have been no documented overflows at this location.

6.5 Pump Stations

In addition to the pump stations located at the WWTP, the City owns and operates (2) remote wastewater pump stations – the Linden Avenue Pump Station and the Y-Bridge Pump Station. The Linden Avenue Pump Station serves a relatively small section of the City to the northwest with an estimated average dry weather flow of 0.3 MGD. This PS is being rehabilitated to continue to convey the existing design flow.

The City relies on the Y-Bridge Pump Station for conveyance of combined flows from the northwest portion of the City with a discharge point at the entrance to the Main Interceptor. According to 2019 flow monitoring data the estimated average dry weather flow is 3.9 MGD. The Y-Bridge Pump Station was constructed in 1953 along with approximately 3,550-feet of 24-inch effluent force main which runs parallel to the Muskingum River before discharging into the Main Interceptor (Muskingum Avenue Interceptor).

In 2014 the City completed the Y-Bridge Pump Station Upgrades project which involved replacement of existing pumps, increasing its wet weather capacity from 10 MGD to 14.4 MGD. During extreme conditions, the station is capable of pumping approximately 18 MGD prior to an overflow occurrence.

Table 6-3 summarizes key parameters for each remote pump station.

Table 6-3. Summary of Remote Pump Stations

	Linden Avenue Pump Station	Y-Bridge Pump Station
Year Built	1960	1959
Year Upgraded		2014
Type	Wet Well / Dry Pit	Wet Well / Dry Pit
Pumps		
Number	2	3
Capacity, each	400 gpm	7,000 gpm
TDH	30 ft	30 ft
Force Main		
Diameter	8 in	24 in
Material	CIP	RCPP
Length	250 LF	3,190 LF
Permitted Overflows	None	None
Influent Sewer		
Size	15 inch	48 inch
Capacity	6.7 MGD	14.4 MGD

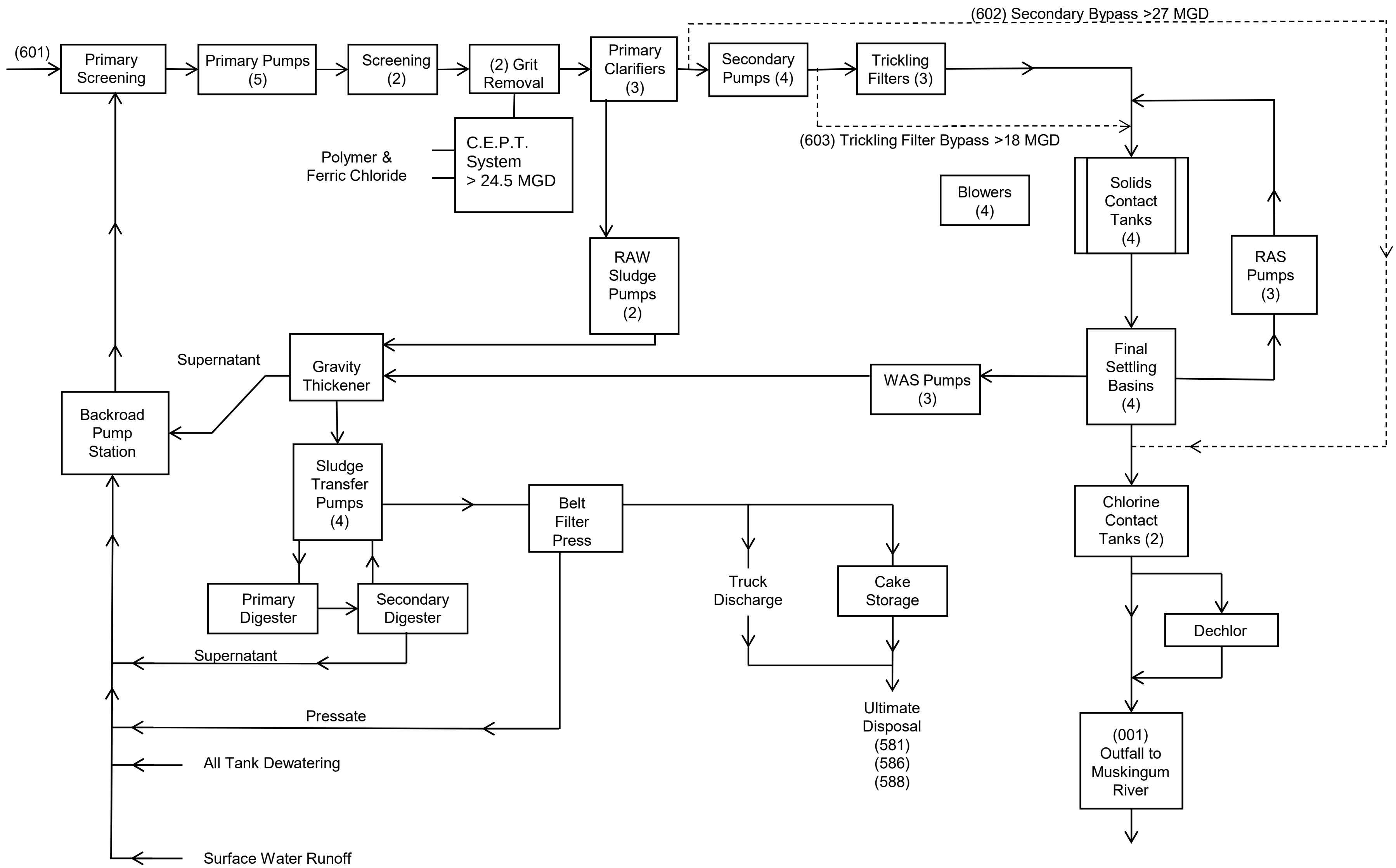
6.6 Wastewater Treatment Plant

The City of Zanesville operates a conventional trickling filter wastewater treatment plant (WWTP) on Moxahala Avenue that serves the City and adjacent systems from Muskingum County. The WWTP was constructed in 1959 and last upgraded in 2009. The City has continued to make operational adjustments at the WWTP to maximize flows through the plant.

Primary treatment processes include influent primary pumping and screening, secondary screening, grit removal and primary clarifiers. The WWTP is also equipped with a sludge dewatering system and anaerobic digestors. The secondary treatment processes include trickling filters, secondary clarifiers, chlorine disinfection, contact tanks, and aerobic digesters. **Figure 6-3** depicts the wet stream processes, while **Figure 6-4** depicts the sludge processes.

According to the City's current NPDES permit, the effluent loadings of the wastewater treatment plant (WWTP) are based on a wet weather flow rate of 18 MGD. The average daily design flow of the treatment plant is rated at 11 MGD.

Figure 6-3 WWTP Wet Stream Processes



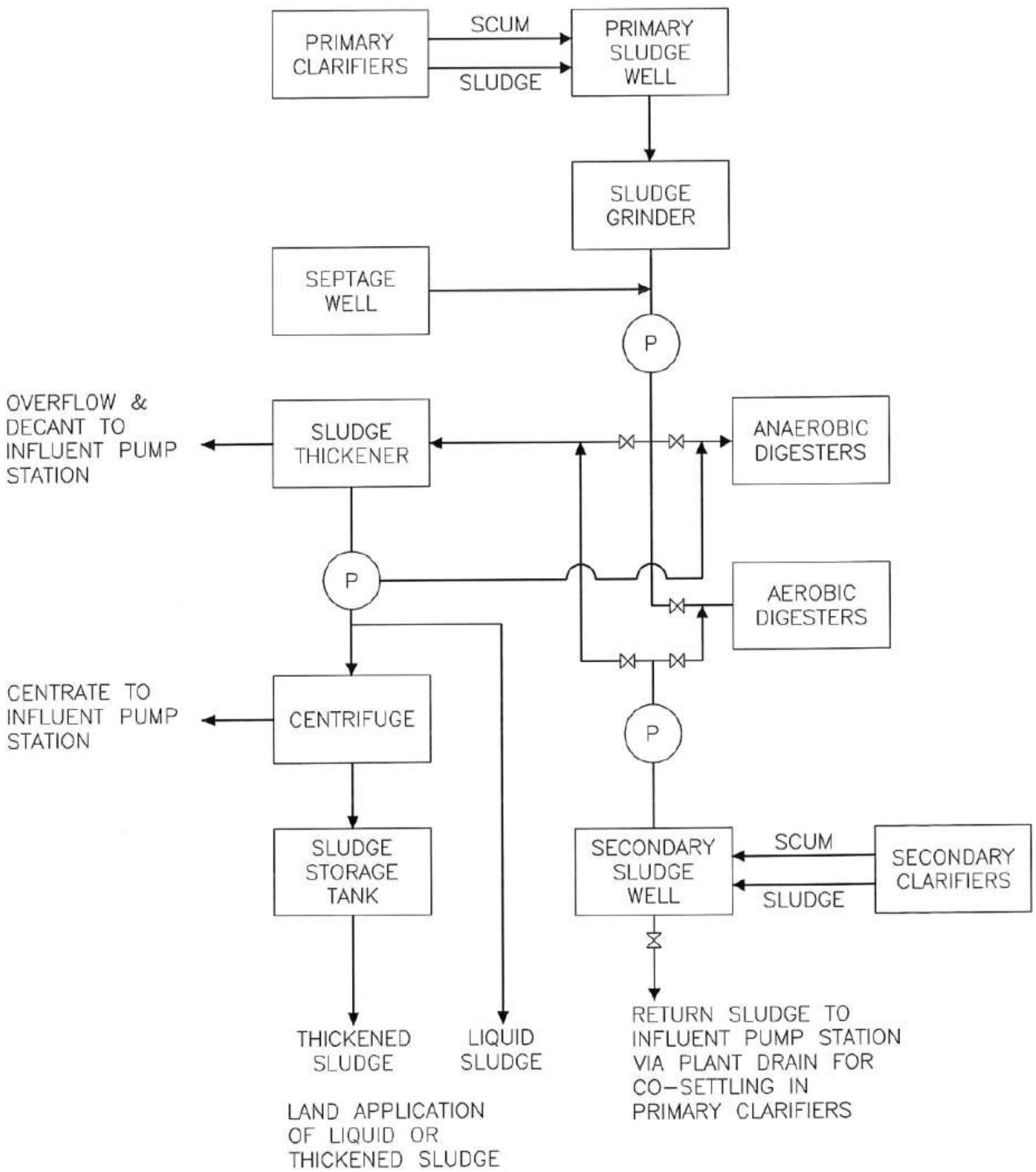


Figure 6-4. WWTP Sludge Processes

The City of Zanesville's WWTP performed upgrades in 2007 and 2009 to increase average daily plant capacity to 11.0 MGD and peak wet weather plant capacity to 36.2 MGD. There are 5 primary pumps which are all rated at 13 MGD. The pumps operate at 45-ft of head and discharge into a 42-inch ductile iron force main rated at 36.2 MGD. Flows up to 27.1 MGD were designed to receive full secondary treatment, and flows greater than this were designed to bypass secondary treatment after chemically enhanced primary treatment.

The WWTP was previously unable to treat sustained flows in excess of 25 MGD as the primary screens become blinded, submerging the trolley, which shuts off the rakes.

This caused flows to be diverted to the 1.5” bypass screens, which passed significant debris into the primary pump station wet well, causing pump failures due to seal failure and impeller damage. This result occurred during a stress test on March 1, 2017, in which 30 MGD was received by the plant.

As a result of this stress test and other events resulting in flows in excess of 25 MGD, the City has had to replace or rebuild all 5 of the primary pumps during 2017 and 2018. Due to this restriction at the primary screens, plant operators previously adjusted the influent sluice gate to throttle the flow coming into the plant when influent flow reaches 23.6 MGD. In 2022, the City removed the secondary screens and no longer throttles influent flows.

In 2013, URS (AECOM) completed an evaluation report of the City’s WWTP as part of a Wet Weather Plan and reached the following conclusions:

1. A reduction in WWTP capacity from 36.2 to 23.6 MGD results in an additional overflow volume of 0.9 MG (9.6 to 10.5 MG) during the 1-year design storm.
2. The chlorine contact basin does not provide adequate detention time (per 10 State Standards) at flows greater than 30 MGD.
3. With optimum secondary splitter weir gate settings, the secondary treatment system is hydraulically limited to 23.6 MGD. The hydraulic limitation is due to inadequate freeboard in the solids contact tank.

Furthermore, the evaluation made several operational recommendations, which are summarized as follows:

1. <u>Solids Contact Tank</u>: The secondary splitter weir gates need to be adjusted to properly split the flow between each secondary settling tank. The desired position of the weir gates is dependent on the total flow exiting the solids contact tank. Allowing for a minimum of 6 inches of freeboard at the entrance of the solids contact tank, the solids contact tank can convey 23.6 MGD. This assumes a Return Activated Sludge (RAS) flow of 18.9 MGD.
2. <u>Secondary Settling Tanks</u>: The three older and shallower settling tanks are known to experience solids washout during prolonged wet weather events. To minimize the occurrence of solids washout, settling tank No. 4 should be operated at a higher Surface Overflow Rate (SOR) than settling tanks Nos. 1, 2, and 3. Settings for the solids contact tank effluent weir gates are provided to allow settling tanks Nos. 1, 2, and 3 to be run at lower SORs than settling tank No. 4.
3. <u>Return Activated Sludge (RAS) Rate</u>: Historically, plant staff has maintained the RAS rate at approximately one times the influent rate. Operating in this manner, the RAS flow may be set unnecessarily high during wet weather events. Lowering the RAS rate will reduce headloss through secondary treatment and increase the amount of freeboard in the solids contact tank, but it may also risk the possibility of solids washout occurring—especially in the shallower secondary settling tanks. An appropriate, lower RAS rate shall be determined by plant staff during high flows.
4. <u>Waste Activated Sludge (WAS) Rate</u>: Currently, the WWTP is limited to wasting approximately 225 gpm of WAS due to the size and location of the opening

between the WAS and RAS wet wells. Installation of a second orifice, 6 inches in diameter and located 3 feet below the existing orifice would allow the WWTP to operate their WAS pumps continuously, if needed, to maximize use of the WAS pumps.

Upgrades to the City's WWTP wet weather capacity in 2007 and 2009 were designed to treat a peak flow of 36.2 MGD. The 2013 AECOM study of the post-upgrade peak wet weather capacity found that the WWTP is currently unable to treat sustained flows in excess of 25 MGD. Several bottlenecks were identified throughout the plant including the secondary splitter weir gate, the solids contact tank, and the headworks. Since the 2013 wet weather study, plant operators have made operational improvements to eliminate some of these bottlenecks.

When flows reach approximately 25 MGD, the plant begins to experience solids washout from three (3) of the four (4) secondary settling tanks. The 2013 wet weather study determined that the secondary splitter weir gate is hydraulically limited to 23.6 MGD due to inadequate freeboard in the solids contact tank. Based on recommendations, plant operators adjusted the sluice gates at the splitter box for each of the secondary settling tanks. The operational improvements have been successful in eliminating solids washout. As the influent flow continued to increase to 27 MGD, the solids contact tank filled to a level where water began to overflow the tank wall.

To eliminate overflows, in 2018 plant operators began operating the RAS at 50% when the influent exceeds 18 MGD. The 1984 headworks was designed and installed with a maximum capacity of 20 MGD, forcing plant operators to close the influent sluice gate in order to throttle the flow coming into the plant when influent flow reaches 25 MGD. The chlorine contact basin at the WWTP also has a peak capacity of 30 MGD based on 10 State Standards detention time. A detailed explanation of recent projects and operational changes implemented at the WWTP prior to 2020 is included in the *Wastewater Treatment Plant Improvements Memorandum* in **Appendix B**. The Memorandum also includes a summary of the proposed upgrades at the WWTP to increase the peak capacity. Since 2020, the City has completed removal of the primary bar screens and is currently in preliminary design phases of several Phase I projects listed in **Appendix B**.

Several capacity upgrades and operational modification upgrades were further investigated as part of this LTCP Update as described in the *Wastewater Treatment Plant Improvements Memorandum.* The planning level costs for the preferred upgrades for the WWTP are summarized below and are in 2021 dollars. Additional information regarding these upgrades is included in **Appendix B** and additional information on the options evaluated at the WWTP are included in **Section 10**. The proposed upgrades have been split into two phases as shown in **Table 6-4**.

Implementation of several of the proposed upgrades listed in **Table 6-4** would restore the existing WWTP primary treatment capacity to a peak hourly flow (PHF) of 36.2 MGD and a secondary treatment capacity of 27.1 MGD. As a result of these improvements, the WWTP secondary bypass (Station 602 in the City's existing NPDES Permit) is intended to remain as part of the WWTP's wet weather treatment system and is required to be in place for secondary flows above 27.1 MGD.

In 2024, AECOM completed a No Feasible Alternative (NFA) analysis to assess the feasibility of eliminating the secondary bypass. Based on the findings of the NFA analysis, AECOM recommended maintaining use of the WWTP secondary bypass for flows in exceedance of 27.1 MGD and utilizing the existing ferric chloride Chemically Enhanced Primary Treatment (CEPT) system in place at the WWTP for flows greater than 24.5 MGD. A detailed discussion of the secondary bypass elimination alternatives evaluation is included in the *Secondary Bypass Elimination No Feasible Alternatives Evaluation* as **Appendix I**.

Table 6-4. Preferred WWTP Upgrades and Estimated Costs

Proposed Items	Total Cost (2021 Dollars)
Phase I	
Removal of Primary Bar Screens*	-
Trickling Filter Improvements	$275,000
Secondary Clarifier Improvements	$2,700,000
UV Disinfection Improvements	$3,250,000
Plantwide Automation Improvements	$250,000
Plantwide PLC Upgrades	$500,000
Secondary Pump Station Improvements	$500,000
Phase I Construction Cost Subtotal	***$7,475,000***
Phase II	
Primary Pump Station Improvements	$1,600,000
Primary Clarifier Bypass (Process Improvement Modifications)	$150,000
Sludge Pumping Improvements	$50,000
Sludge Dewatering Improvements	$1,300,000
Digester Building Improvements	$200,000
Miscellaneous Improvements	$50,000
Phase II Construction Cost Subtotal	***$3,350,000***
Subtotal Construction Cost	***$10,825,000***
Permits, Legal and Miscellaneous	$25,000
Engineering Design & Construction Oversight (20%)	$2,165,000
Design Phase Construction Contingency (10%)	$1,083,000
Construction Contingency (10%)	$1,083,000
Total Project Cost	**$15,180,000**

**The City removed the secondary bar screens in 2022 following the development of the draft LTCP Update.*

7. Flow Monitoring and Rainfall Data

Since the start of the implementation of the 2007 LTCP, the City has not performed an analysis to evaluate the performance of completed sewer separation projects. Flow monitoring was necessary to evaluate flows from the separated areas in addition to quantifying wet weather volumes in planned project areas and to calibrate the new PCSWMM hydraulic model. As part of the LTCP Update, the City conducted flow monitoring throughout the collection system for a period of approximately six (6) months.

7.1 Purpose of Flow Monitoring

AECOM conducted flow monitoring and data collection to achieve the following objectives:

1. Quantify dry weather and wet weather flow rates at key locations across the City's collection system;
2. Calibrate the hydraulic model of the collection system (refer to **Section 9** of this report);
3. Identify sub-basins with excessive infiltration and inflow (I/I); and
4. Compare flow monitoring to river gage data to determine potential areas of river water intrusion (RWI) for further analysis.

7.2 Flow Monitoring Location Selection and Data Collection

The flow monitor locations were selected based on a review of the available GIS data, record plans, previous technical reports, historical knowledge, and discussions with the City. AECOM conducted the following steps to select and implement the flow monitoring sites:

1. Map Review
2. Flow Monitoring Location Selection
3. Meetings and Coordination with the City
4. Reconnaissance and Flow Monitor Location Adjustment
5. Coordination with Hydraulic Model
6. Flow Monitoring Installation

Various equipment configurations were reviewed for applicability of installation at each monitoring site. The variables that were assessed included: sewer size, distance of measurement site from access manhole, pipe junction points, drop pipes, and manhole alignment on the pipe. FL900 AV flow monitors were installed which use area-velocity flow monitors that record depth and velocity at 5-minute intervals. Depth was measured by a pressure transducer. Average velocity was measured by a doppler ultrasonic transducer.

The flow monitor locations have been selected to capture major flows to the interceptor in addition to flows draining to Racks 2, 3, 5, 7, 12, 13, 14, and 21. The provided data was used to calibrate the updated system hydraulic model. Racks 2, 5 and 7 have all been separated, so the flow monitors on these racks also provide data to evaluate the effectiveness of the separation. This data was used to anticipate the effectiveness of the planned remaining rack separations.

Seventeen (17) flow monitor locations were installed and evaluated during the period from June 6, 2019 through November 7, 2019. After installation, each site was visited regularly to assess flow monitor functionality. Cleaning and adjustments of the programming parameters were completed as needed. **Table** 7-1 provides a summary of the flow monitoring location selection including location description, installation date and removal date.

Several of the flow monitors were moved after initial installation to account for GIS inaccuracies or to target new flows.

- FM-3-12 was moved to site FM-16
- FM-6 was moved to site FM-17
- FM-8 was moved to site FM-8A
- FM-14 was moved to site FM-14A

Figure 7-1 shows the locations of flow monitors installed for purposes of the LTCP Update. Additional maps showing each individual flow meter location are included in **Appendix C**.

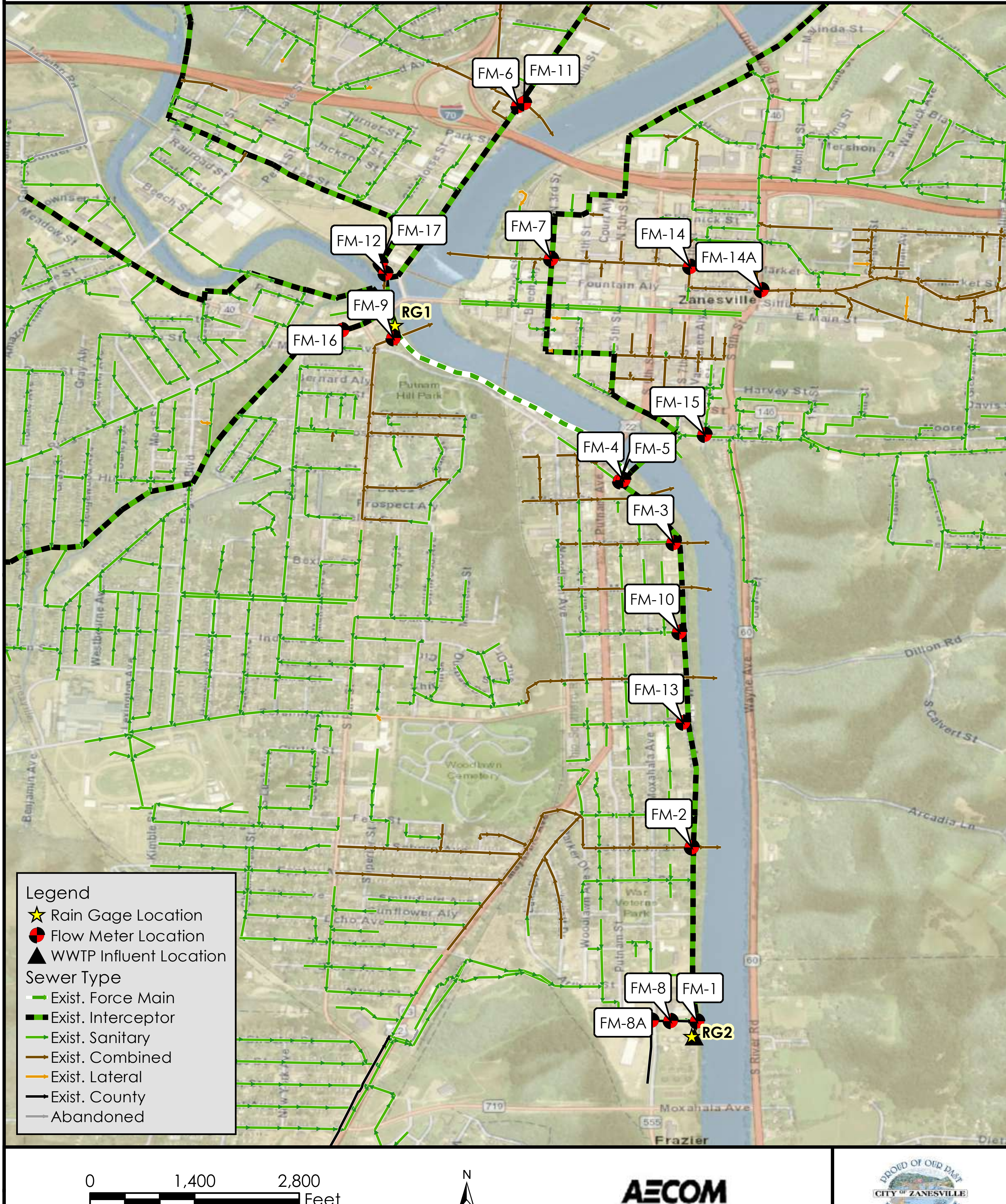
Table 7-1. Flow Monitoring Locations

Flow Monitor Site Number	Location	Installation Date	Removal Date
FM-1	Main Interceptor near Muskingum Ave. & Hoover St.	6/25/2019	11/7/2019
FM-2	Johnson St. & Muskingum Ave.	6/25/2019	11/7/2019
FM-3	Jefferson St. & Muskingum Ave.	6/25/2019	11/7/2019
FM-3-12[1]	Jefferson St.	6/25/2019	7/24/2019
FM-4	Downstream of 7th Ave. Siphon near Muskingum Ave. (Putnam Landing Park)	6/25/2019	11/7/2019
FM-5	Downstream of Y-Bridge Lift Station near Muskingum Ave. (Putnam Landing Park)	6/25/2019	11/7/2019
FM-6[2]	Linden Ave & McIntire Ave.	6/25/2019	7/4/2019
FM-7	Market St. & 3rd St.	6/25/2019	11/7/2019
FM-8[3]	Cleveland Ave. (County sewer)	6/25/2019	7/24/2019
FM-8A[3]	Cleveland Ave. & Moxahala Ave. (City sewer)	7/24/2019	10/27/2019
FM-9	Pine St. & Muskingum Ave.	6/25/2019	11/7/2019
FM-10	Van Buren St. & Muskingum Ave.	6/25/2019	11/7/2019
FM-11	Linden Ave & McIntire Ave.	6/25/2019	11/7/2019
FM-12	Peters Alley behind Mee's	6/25/2019	11/7/2019
FM-13	Pierce St. & Muskingum Ave.	6/25/2019	11/7/2019
FM-14[4]	N 7th St. & Market St.	6/25/2019	7/24/2019
FM-14A[4]	Greenwood Ave. & Underwood St.	7/24/2019	11/7/2019
FM-15	8th St. & Hughes St.	6/25/2019	11/7/2019
FM-16[1]	W Main St. (Chap's Run)	7/24/2019	11/7/2019
FM-17[2]	Peters Alley (Joe's Run)	7/24/2019	11/7/2019

Notes:

[1] *FM-3-12 was moved to site FM-16*
[2] *FM-6 was moved to site FM-17*
[3] *FM-8 was moved to site FM-8A*
[4] *FM-14 was moved to site FM-14A*

Figure 7-1
City of Zanesville LTCP Update
Flow Monitoring Location Map



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7.3 Flow Monitoring Period Rainfall Summary

Two (2) tipping bucket rain gages were utilized to measure precipitation during the same period as the flow monitoring. The rain gages were installed in strategic locations; Rain Gage 1 (RG1) was installed at the Zanesville WWTP and Rain Gage 2 (RG2) was installed at the Y-Bridge Pump Station as shown in **Figure 7-1**. Precipitation readings were recorded in 5-minute intervals to coincide with the flow monitor data collection interval. A rainfall analysis was conducted to quantify the number of events captured during the flow monitoring period.

Between June 2019 and November 2019, a total of twenty-nine (29) rainfall events were recorded between the two (2) rainfall gages. **Figure 7-2** shows a summary of the rainfall depth and peak hourly intensity across the flow monitoring period. The depth of rainfall is shown on the primary y-axis and hourly intensity is plotted in descending intensity on the secondary y-axis.

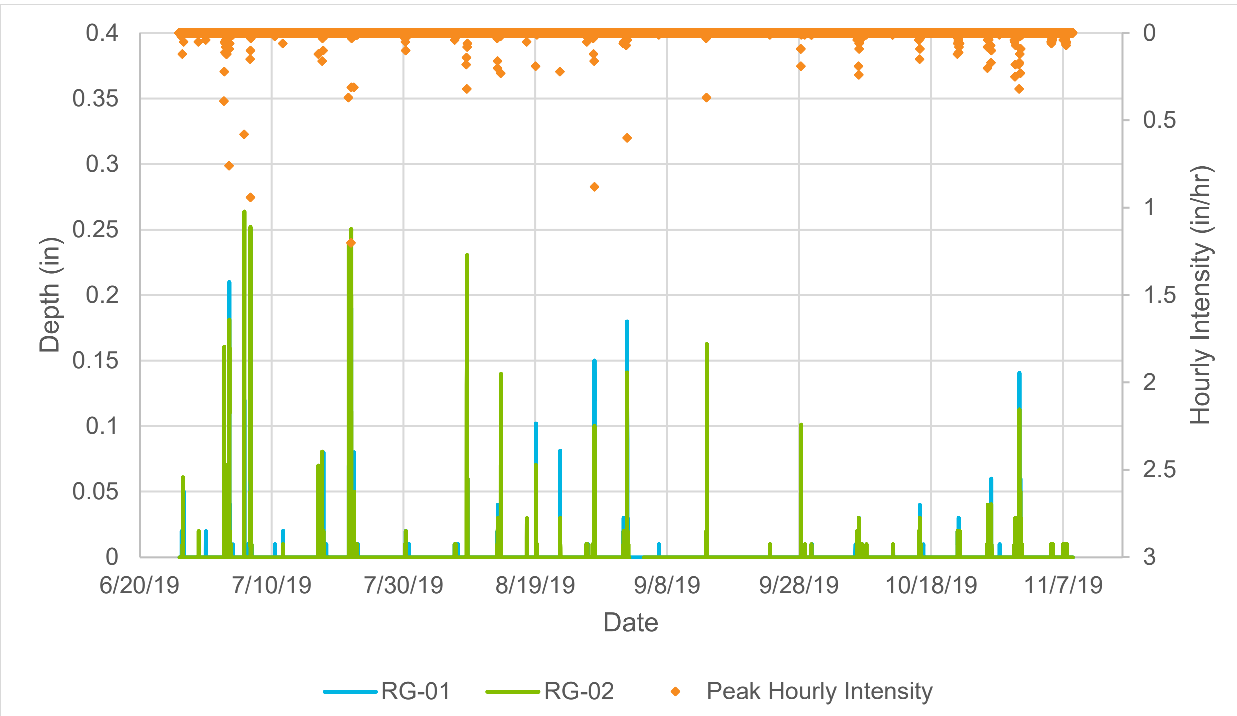


Figure 7-2. Rainfall Depth and Peak Hourly Intensity

Table 7-2 provides detailed information for the eleven (11) rainfall events received during the flow monitoring period which were used to calibrate the hydraulic model as part of this LTCP Update. The reported parameters are based on the more intense rainfall occurrence between the two rain gage locations. Individual events are identified as being separated by more than ten (10) hours of dry weather between one another and rainfall depth exceeding 0.05 inch. The return frequency for each precipitation event was determined using the Rainfall Frequency Atlas of the Midwest, Bulletin 71 (Huff and Angel, Midwestern Climate Center, 19).

Table 7-2. Flow Monitoring Rainfall Summary

Storm Event Rank	Storm Event Start Date	Duration (hr)	Total Rainfall (in)	Peak Intensity/ Duration	Return Frequency*
1	7/21/2019	29.0	2.05	1.39 in/ 1.0 hr	2-5 Year
2	7/2/2019	5.1	0.95	0.52 in/ 30 min	4 Month
3	7/3/2019	11.2	1.18	0.76 in/ 45 min	6-9 Month
4	7/5/2019	3.5	0.95	0.58 in/ 0.3 hr	1 Year
5	8/8/2019	3.3	0.72	0.23 in/ 5 min	9 Month
6	8/13/2019	12.9	0.64	0.25 in/ 35 min	2 Month
7	8/19/2019	0.3	0.19	0.19 in/ 20 min	<1 Month
8	10/6/2019	24.8	0.82	0.48 in/ 2.2 hr	<1 Month
9	10/16/2019	6.5	0.34	0.34 in/ 6.5 hr	<1 Month
10	10/22/2019	8.8	0.62	0.62 in/ 8.8 hr	<1 Month
11	10/30/2019	25.9	1.81	0.48 in/ 2.4 hr	<1 Month

Note:

* *Return frequency determined using the Rainfall Frequency Atlas of the Midwest, Bulletin 71 (Huff and Angel, Midwestern Climate Center, 19).*

The results of the rainfall analysis showed an array of rainfall events during the flow monitoring period, including one (1) 2-year to 5-year storm with 1.39 inches of rainfall over 1 hour, one (1) 1-year storm and several smaller storms. Based on the results of rainfall analysis it was assumed that the flow monitoring data collected from June 2019 to November 2019 was sufficient to perform the wet weather model calibration.

7.4 Summary of Flow Monitoring Data

For each flow monitoring location, rainfall data and flow monitoring data were evaluated to characterize Dry Weather Flow (DWF) periods and Wet Weather Flow (WWF) periods for utilization during the model calibration process. DWF is defined by a period of a minimum three (3) days without precipitation, and generally consists of base sanitary flow (BSF) in addition to groundwater infiltration (GWI). WWF is comprised of DWF in addition to rainfall dependent inflow/infiltration (RDII). Typically, the RDII response is a major component of peak WWF and is responsible for capacity-related issues in sanitary sewers.

Observed DWF periods were compiled and averaged for each flow monitoring location to determine the Average Dry Weather Flow (ADWF) during the flow monitoring period. A WWF analysis was also performed to characterize the response to wet weather events at each FM location. **Table 7-3** summarizes the results of the DWF and WWF analysis for each individual flow monitoring location

Table 7-3. Flow Monitor Dry and Wet Weather Flow Summary

Flow Monitoring Site	ADWF (MGD)	Peak WWF (MGD)	Peak Flow Ratio (Peak WWF*/ ADWF**)	Full Pipe Capacity (MGD)	Min. ADWF Pipe Utilization (%)	Peak Wet Weather Utilization (%)
FM-1	4.50	24.20	5.4	37.26	13%	65%
FM-2	0.09	45.55	506.1	125.92	0.1%	36%
FM-3	0.02	6.88	344.0	6.08	0.1%	100%
FM-4	1.59	16.84	10.6	37.75	3.5%	45%
FM-5	3.87	20.65	5.3	41.93	16.1%	49%
FM-6	0.32	7.40	23.1	9.18	3.2%	81%
FM-7	0.14	57.51	410.8	145.59	0.1%	40%
FM-8A	0.75	4.96	6.6	3.19	10.6%	100%
FM-9	0.01	16.15	1615.0	275.29	0.1%	6%
FM-10	0.00	0.08	-	6.58	0.0%	1%
FM-11	0.16	71.86	449.1	114.15	0.1%	63%
FM-12	0.02	49.41	2470.5	33.67	0.0%	100%
FM-13	0.03	0.15	5.0	17.70	14.6%	1%
FM-14A	0.19	3.78	19.9	39.32	3.5%	10%
FM-15	0.02	0.57	28.5	1.61	3.1%	35%
FM-16	0.62	2.45	4.0	8.41	5.8%	29%
FM-17	2.77	8.86	3	29.7	6.9%	30%

Notes:

* *WWF = wet weather flow*

** *ADWF = average dry weather flow*

7.5 Flow Monitoring Data Analysis Findings

Peak flow rates reached maximum pipe capacity at FM-3, FM-8A, and FM-12 during the flow monitoring period. In most cases, these peaks were attributed to the 1-year storm which occurred on July 6, 2019 with a total rainfall of approximately 1.6 inches in under two (2) hours. Low WWFs were observed in areas where the City has successfully completed sewer separation projects; FM-13 provides flow data for CSO Basin R5 which was separated in 2013 and FM-10 corresponds to the CSO Basin R7 Sewer Separation project completed in 2015.

The ratio of peak WWF-to-ADWF, or the ‘peak flow ratio’ was evaluated to indicate the level of I/I entering the collection system in response to wet weather events. The peak flow ratio is calculated by dividing the peak WWF by the ADWF for each location. Typically, the peak flow ratio is in the range of 40:1 for combined collection systems. A peak flow ratio was not presented for FM-10 due to the observed ADWF value of zero (0) MGD at the flow monitoring location. According to the flow monitoring data characterization, peak flow ratios were highest for the following CSO basins: R3 (FM-2), R12 (FM-9), R13 (FM-12), and R21(FM-7). As a result, these four (4) CSO Basins were evaluated for I/I reduction projects and related conveyance upgrades for inclusion into the LTCP Update. An elevated peak flow ratio was also observed at R9 (FM-3). It is assumed that the ongoing sewer separation project at R9 will address the high levels of I/I observed in this area.

8. River Water Intrusion Analysis

The City's collection system includes several areas where the river inundates the existing infrastructure during high river stage events. Typically, river water intrusion (RWI) can occur through three main sources when the river level reaches elevations above critical sewer system infrastructure:

- Inflow through the at-grade components of the system that are submerged (manholes, catch basins, siphons, pump station wet wells);
- Infiltration into the underground (or under-river siphon pipes) sewer system infrastructure components through defects, cracks, leaking joints, etc.; and
- Backflow into the regulator outfalls where backflow prevention is either not present or not operating properly.

Available data from the flow monitoring period was used to evaluate and identify potential RWI in the City's collection system, specifically at low elevations in the floodplain along the riverbanks. This RWI analysis consisted of several key parts:

1. Investigation of available flood stage profiles provided by the Federal Emergency Management Agency (FEMA) to assess the variation in river levels across the collection system to account for elevation differences caused by the Dillon Dam;
2. Development of flow monitoring hydrographs and comparison to U.S. Geological (USGS) river stage elevations, precipitation data and approximate rack invert elevations;
3. Development and evaluation of depth vs. velocity scatter plots from collected flow monitoring data; and
4. Field investigations of infrastructure susceptible to RWI during high river conditions.

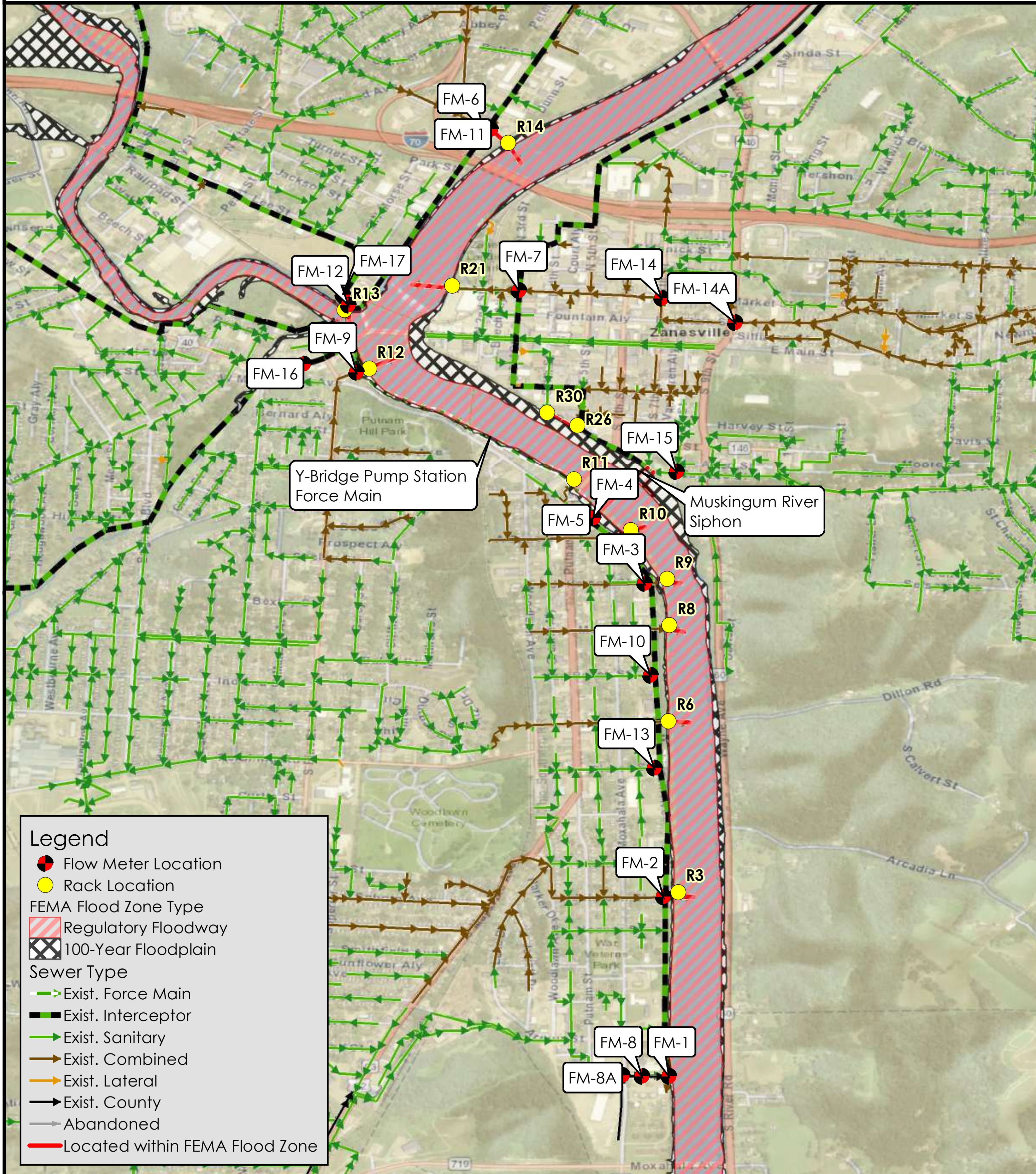
The findings of these data evaluations aid in the identification of specific locations where RWI is suspected to occur. Solutions were investigated to minimize RWI into susceptible areas and included in this LTCP Update.

8.1 River Stage Analysis

The extents of the Muskingum River inside the City's boundaries are subject to significant variation in river stages, largely due to the presence of the existing Dillon Dam. The Dillon Dam was built in 1959 to control flooding and regulate flows along the Licking and Muskingum Rivers. The riverbed slope also contributes to the variation in river stages across City boundaries. To correct for this variation in river stages, a river stage analysis was performed to identify an adjustment factor for each existing rack location across the City's collection system based on available FEMA flood profiles. The flood profile of the Muskingum River from FEMA's Flood Insurance Study No. 39119CV000A, Figure 06P was used to determine river stage adjustment factors. River mile locations and river stages were determined using the mouth of the Licking River as the baseline location.

The 100-year floodplain zone designation (1% annual chance of flooding) was mapped against flow metering locations to further evaluate these findings. The National Flood Hazard Layer Flood Insurance Rate Map (FIRM) tool, available from FEMA, was used to develop **Figure 8-1**. Areas identified as regulatory floodway represent the 100-year floodplain boundaries, also known as FEMA Flood Zone AE. Light blue shading represents 100-year floodplain areas. **Figure 8-1** was developed as a tool for identifying infrastructure within or near the edge of the 100-year floodplain zone which are susceptible to RWI during high river conditions.

Figure 8-1
City of Zanesville LTCP Update
FEMA Floodplain Map



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Available Flood Insurance Study (FIS) flood data for the Muskingum River included high-flow conditions with a 1% annual chance of flooding (100-year return frequency). As a result, the adjustment factors provided in this report are considered conservative and show higher variations in river stage compared to low flow river conditions. The associated adjustment factors, shown in **Table 8-1**, were applied to river stage data at USGS River Gage No. 03148000 along the Muskingum River to evaluate periods of potential RWI into the collection system.

Racks excluded from this RWI analysis are any racks that have been closed as listed in **Table 6-2**. R26 was not included in this analysis as it is not hydraulically connected to the river. Additionally, R30 was excluded from the analysis due to its location in a high-elevation area of the collection system and lack of associated flow monitoring data.

8.1.1 Flow Monitoring Hydrographs

Flow monitoring hydrographs were plotted with rainfall data and USGS river gage data to identify potential RWI locations in the collection system. Flow monitoring elevations were calculated by summing the flow monitoring depths and the approximate NAVD 1988 invert elevations obtained from City record plans. Using the USGS National Water System web-based interface, river stage data was obtained for the USGS River Gage No. 03148000, located along the Muskingum River southwest of South First Street. River elevation data was converted to NAVD 1988 datum.

Based on the desktop review of available data, potential RWI was evaluated at critical locations in the collection system during three (3) of the major storm events which occurred during the flow monitoring period**.** These events occurred on July 2, July 6, and July 22, 2019 which had 2-year, 1-year, and 5-year return frequencies, respectively. It should be noted that following the July 3 event, several of these locations did not recover to dry weather baseline flows until early August.

Detailed hydrographs were developed for each flow meter and categorized based on adjacent racks and related infrastructure (included as **Appendix D**). The hydrographs were evaluated based on the following RWI indicators:

- Post-precipitation response at each flow meter to identify flow monitoring locations where the data shows elevated flow for an extended period;
- Gradual increase in observed flow depths during dry weather periods which follow the same trend as the river; and
- Comparison of rack invert elevations (superimposed on each hydrograph) to observed river level data to determine whether estimated river levels were surcharged above the lowest point of RWI entry into the collection system.

Table 8-1 summarizes the findings of the RWI analysis for each flow monitoring location. The findings were categorized according to related infrastructure and are discussed below.

Table 8-1. Flow Monitoring Hydrographs RWI Analysis – July 2019

Flow Monitor Location	Associated Infrastructure*	River Stage Adjustment Factor (ft)**	Indication of RWI during Rain Event		
			7/3/19	7/6/19	7/22/19
FM-1	Main Interceptor	-1.5	✓	✓	✓
FM-2	R3	-0.9		✓	✓
FM-3/3-12	R9	-0.9	✓	✓	✓
FM-4	Muskingum River Siphon	-0.4	✓	✓	✓
FM-5	Y-Bridge PS Force Main	-0.4	✓	✓	✓
FM-6	R14	4.2			
FM-7	R21	3.1			
FM-8/8A	-	-1.5			
FM-9	R12	0.2		✓	
FM-10	-	-0.9			
FM-11	R14	4.2		✓	✓
FM-12	R13	1.0	✓	✓	✓
FM-13	-	-0.9			
FM-14/14A	-	N/A			
FM-15	-	-0.4			
FM-16	R12	0.2			
FM-17	R13	1.0			

Notes:
* Rack(s) or related infrastructure hydraulically connected to flow monitoring location(s). Flow monitoring locations significantly outside the floodplain were assumed to not be affected by RWI.
** River stage adjustment factor correlates to the flow monitor locations and may be independent of the associated rack(s) and related infrastructure.

R3 (FM-2): As previously mentioned, all racks have backflow prevention mechanisms except for R3. Observed river elevations did not approach the R3 invert elevation during the study period according to FM-2 flow monitoring data. Indication of RWI was observed in the FM-2 post-precipitation response for the July 6 and July 22, 2019 storms. R3 is suspected to be susceptible to RWI and was evaluated for RWI elimination solutions during development of LTCP Update alternatives.

R9 (FM-3): FM-3 is located directly upstream of R9. Following each of the studied rain events, FM-3 showed a delayed recovery indicating the potential occurrence of RWI into the adjacent collection system. Observed flow depths did not recover to base sanitary flow depths until early August. Based on these findings, R9 is considered susceptible to RWI. It assumed that the ongoing sewer separation project at R9, which includes CSO closure, will achieve RWI elimination at R9.

R12 (FM-5, FM-9, FM-16): FM-9 was installed directly upstream of R12. Following the July 6, 2019 rain event, FM-9 experienced a delayed recovery response with depths increasing alongside observed river levels, indicating the occurrence of RWI at this CSO. Although the adjusted peak river level was approximately 5 inches above the R12 weir invert during the flow monitoring period, the river level adjustments were based on high-flow conditions and therefore may not be representative of actual river levels at the R12 CSO structure. Based on these findings R12 is suspected to be susceptible to RWI. RWI elimination solutions were further evaluated for this CSO during the development of LTCP Update alternatives.

R13 (FM-5, FM-12, FM-17): FM-12 was located directly upstream of R13. Following the July 6, 2019 rain event, FM-12 experienced a delayed recovery response as well as an increase in flow depths following the river stage trend. FM-17 was not installed prior to these major rainfall events and was not included in the RWI analysis at R13. R13 is considered susceptible to RWI and was further investigated for RWI elimination during development of alternatives as part of this LTCP Update.

R14 (FM-11, FM-6): FM-11 was installed directly upstream of R14. The delayed recovery response during the July 6 and July 22, 2019 rain events indicate RWI occurrence at R14 during the study period. As a result, R14 is considered susceptible to RWI and was evaluated for RWI solutions during development of LTCP Update alternatives.

R21 (FM-7): The City performed RWI remediation at R21 in 2011. The flow monitoring hydrographs for FM-7 indicate that the 2011 RWI remediation project was effective at eliminating RWI at this CSO. Based on these analyses, RWI elimination at R21 was not considered necessary for inclusion into future alternatives.

Y-Bridge PS Force Main (FM-5): FM-5 was installed on the downstream portion of the Y-Bridge effluent force main. Flow trends are dictated primarily by upstream pump operation. The effluent force main is suspectable to RWI considering its location within the floodplain. Following the July 3, 2019 storm, FM-5 did not exhibit typical recovery depths until after the river crests at approximately 681 feet (adjusted using the correction factors listed above). For each rain event, FM-5 shows a delayed recovery response which suggests RWI occurrence within and/or upstream of the force main. These findings suggest that the Y-Bridge PS force main is susceptible to RWI. The City is currently in construction phases of the Y-Bridge PS force main improvements project to remove the force main from the floodplain which is assumed to address RWI in this area; this project is included in the LTCP Update alternatives.

Main Interceptor/ Muskingum Avenue Interceptor (FM-1): FM-1 was located at the downstream portion of this City's collection system along the Main Interceptor. Cumulative RWI occurring upstream in the collection system is assumed to be the source of RWI trends in the FM-1 hydrograph. Observed flow depths at FM-1 remained elevated for an extended period following each of the three study periods. The location of FM-1 in the Main Interceptor is not considered directly susceptible to RWI, but it is assumed that the RWI trends are indicative of cumulative RWI entering the upstream collection system.

Muskingum River Siphon (FM-4): FM-4 was installed on a gravity pipe downstream of the Muskingum River Siphon. Any RWI that enters the system upstream or within the river siphon would be assumed to be visible at FM-4. RWI would be expected to occur through pipe defects, joints, or structures along the siphon. Flow depths at FM-4 elevated for an extended period following each of the study periods and followed the river trends during subsequent dry weather periods. The Muskingum River Siphon is considered susceptible to RWI considering its age and location within the floodplain. Potential RWI solutions at the siphon were evaluated for inclusion into this LTCP Update.

8.1.2 Velocity-Depth Scatter Plots

To verify the preliminary findings of the flow monitoring hydrograph evaluations, further analyses were performed using scatter plots of depth versus velocity for each of the flow meters. As an example, the depth versus velocity data for FM-12 located upstream of R13 is shown in **Figure 8-2** for the July 6, 2019 rain event. Red trendlines are superimposed over the plotted data to indicate the chronological succession of the flow monitoring data throughout the event. The numbered circles represent the critical points in time when significant events begin within the interceptor, as well as the river level (R.L.) corresponding to that point. During the initial rainfall, there is a sharp increase in depth within the manhole that can be attributed to precipitation I/I (Points 1-2). As the rain subsides and river water levels rise, RWI is introduced into the interceptor, resulting in rising depths and decreasing velocity (Points 3-4). At Point 4, the velocity is negative indicating backflow conditions. Between Points 4 and 5, flow increases, and water levels continue to rise, indicating the presence of RWI in the interceptor. On July 7 around 2:00 AM the river crests at approximately 14.3 feet in recorded gage height (Point 5) and then begins to subside as depth returns to normal conditions (Point 6) and the secondary source of inflow is removed. Based on this data, R13 is suspected to be susceptible to RWI and was evaluated for RWI elimination as part of this LTCP Update.

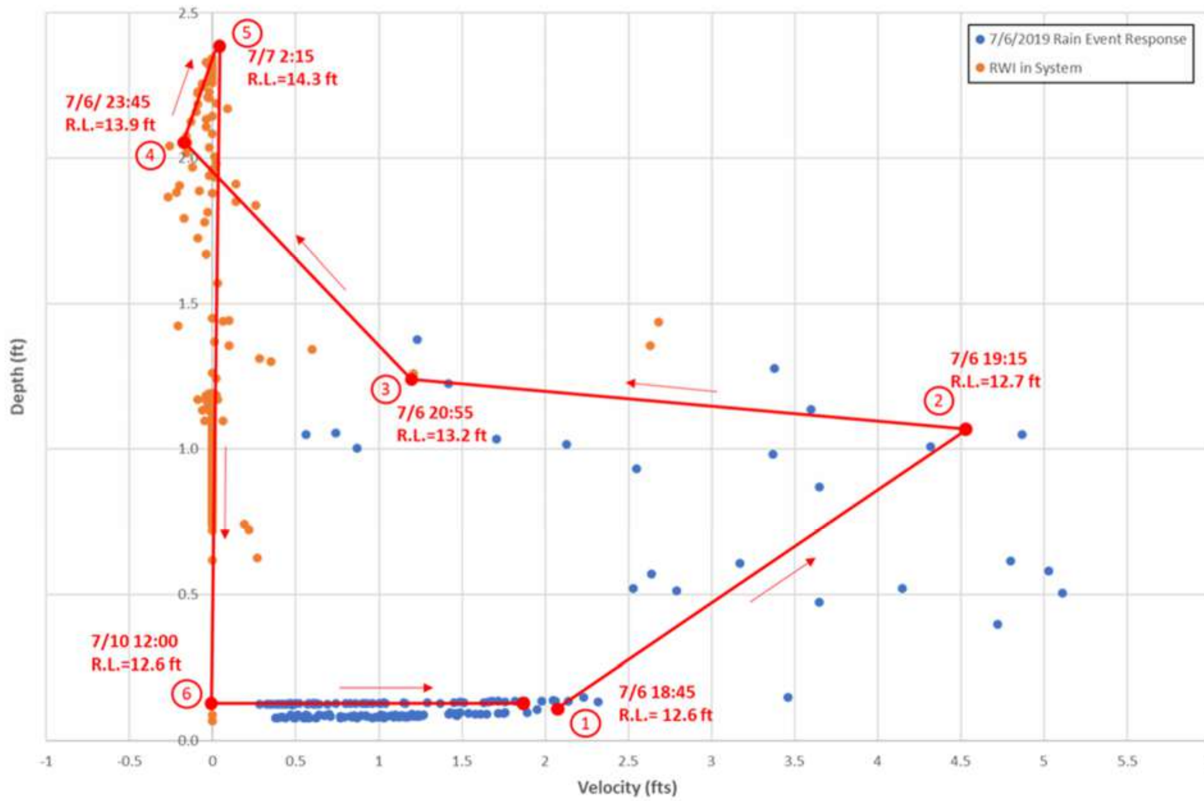


Figure 8-2. FM-12 Depth vs. Velocity Scatter Plot – RWI Event 7/6/2019

8.2 Field Observations

Field investigations were performed at RWI-susceptible locations to verify and expand upon findings from the flow monitoring data evaluation process. AECOM staff collected field data using pole cameras at the following RWI-susceptible infrastructure on September 17, 2020:

- CSO Regulator Structures at R3, R13 and R14
- Muskingum River Siphon

In addition, photos collected by field staff during the flow monitor installations on June 25, 2019 were reviewed for visual evidence of RWI. At the time of the flow monitor installation, river levels were trending relatively high according to USGS river gage data. River levels were slightly lower during the September 2019 field investigations; however, river levels were considered high enough to observe RWI entry at low-lying infrastructure. Findings from these field visits are discussed below.

8.2.1 R3 RWI Field Observations

Although indication of RWI was observed in the FM-2 hydrographs, field investigation documentation did not show presence of RWI at the R3 regulator structure or associated outfall. **Figure 8-3** shows a photo of the R3 regulator structure from the June 2019 site visit facing east which indicates little to no inflow during the late-June 2019 dry weather period.

Figure 8-3. R3 Regulator Structure Photo, Facing Upstream; June 2019

8.2.2 R13 RWI Field Observations

Photos from the June 2019 field visit showed several inches of standing water inside the R13 outfall pipe which is assumed to have entered the collection system via the R13 regulator structure.

Field data from the September 2020 field visit showed minimal intrusion into the collection system at the R13 regulator structure. **Figure 8-4** shows the observed RWI flow path from the R13 outfall pipe versus the base sanitary flow direction from the upstream collection system. Observed inflow from R13 outfall pipe suggests that surcharged river levels overtopped the R13 weir located upstream of the outfall pipe.

Figure 8-4. R13 Regulator Structure Photo, Facing Down; September 2020

8.2.3 R14 RWI Field Observations

The City operates a flow meter installed along the R14 outfall pipe which collects annual CSO flow data. Based on historical flow data at this location, the City has observed frequent RWI when the CSO is not actively discharging. Although a duckbill is installed on the outfall, it is suspected that infiltration is occurring at pipe joints.

During the September 2020 field visit, AECOM staff obtained photos and videos at the R14 regulator structure to identify potential RWI entry. As shown in **Figure 8-5**, RWI was identified as entering the system through the R14 outfall and backflowing into the collection system at the R14 regulator structure. Although a duckbill is installed on the outfall, it is suspected that infiltration is occurring at pipe joints along the outfall.

Figure 8-5. R14 Regulator Structure Photo, Facing Down; September 2020

8.2.4 Muskingum River Siphon

The September 2020 field investigations also included a visual inspection of the access structures located at the downstream end of the Muskingum River Siphon as a potential RWI entry location. Upon accessing the structure, field staff noted the structure to be surcharged as shown in **Figure 8-6.** The next downstream structure was sealed and therefore could not be accessed for further evaluation. Based on these findings the City was not able to draw conclusions regarding RWI along the Muskingum River Siphon.

Figure 8-6. Muskingum River Siphon Blow Off Structure, Facing Down; September 2020

8.3 River Water Intrusion Analysis Findings

The RWI analysis findings discussed in previous sections suggest that river water intrusion occurs at Racks 3, 9, 12, 13, and 14 during high river conditions along the Muskingum River and Licking River. Evidence of RWI was also found at FM-4, located at the end of the Muskingum River Siphon. While RWI was observed at the Main Interceptor (FM-1), this location is assumed to be indicative of cumulative RWI entry at upstream infrastructure.

The City plans on performing continued O&M of RWI-susceptible areas to mitigate river water intrusion through any defects in the pipe or related structures. Proposed RWI elimination projects for this LTCP Update were evaluated at the locations identified as potentially susceptible to RWI. **Table 8-2** summarizes the RWI analysis and conclusions for indications of RWI at the CSOs and infrastructure evaluated. RWI solutions are discussed in **Section 10** of this report.

Table 8-2. RWI Analysis Summary

City Rack Number	Associated Flow Meter(s)	River Stage Adjustment Factor (ft)[1]	Rack Invert Elevation	100-Year Flood Stage Elevation (ft, NAVD 1988)	Indication of RWI?
R14	FM-5, FM-6, FM-11	4.2	688.8	696.2	✓
R21	FM-7, FM-14, FM-14A	3.1	692.5	695.1	
R13	FM-5, FM-12, FM-17	1.0	678.6	693.0	✓
Licking River	-	0.3	-	692.3	
R12	FM-5, FM-9, FM-16	0.2	682.6	692.2	✓
River Gage	-	0.0	-	692.0	
R11	-	-0.4	695.7	691.6	
*	FM-4	-0.4	-		✓
-	FM-15	-0.4	-		
R10	-	-0.4	686.5	691.5	
R9	FM-3, FM-3-12	-0.9	683.8	691.3	✓
R8	-	-0.9	685.9	691.2	
-	FM-10	-0.9	-		
R6	-	-0.9	683.5	691.1	
-	FM-13	-0.9	-		
R3	FM-2	-0.9	683.3	690.8	✓
**	FM-1, FM-8, FM-8A	-1.5	-	690.5	✓

Notes:
1 Adjustment factors correlate to the given racks and may not correlate to the associated flow monitoring locations. Flow monitoring locations were associated with racks based on connectivity of the collection system.
* *RWI is assumed to be attributed to the Muskingum River Siphon.*
** *Cumulative RWI entering the upstream collection system is observed at downstream infrastructure (i.e. Main Interceptor).*

9. Hydraulic Modeling

A hydraulic model was developed and calibrated using PCSWMM to accurately represent the City's existing collection system. The purpose of the hydraulic model is to simulate the collection system and to estimate the quantity and volume of CSO occurrences based on various conditions. PCSWMM Version 7.3.3095 (PCSWMM 2020) was used to simulate complex flow processes in the current system including branched and looped networks, pressurized flow and backwater. PCSWMM combines GIS data with US EPA SWMM5 Version 5.1.015 as the hydrology and hydraulics calculation engine. The SWMM5 model engine also allows for the dynamic representation of the hydraulic grade line and viewing of hydraulic time series for any feature within the modelled collection system for the duration of the model simulation.

9.1 Combined Flow Components

Combined wastewater flow can be broken down into two main components: dry weather flow (DWF) and wet weather flow (WWF). DWF consists of base sanitary flow (BSF) as well as groundwater infiltration (GWI). Base sanitary flow is the residential, commercial, institutional, and industrial flow discharged into a collection system, and typically varies with water use patterns throughout a 24-hour period. Higher flows are usually observed during the day and lower flows at night. In most cases, the average daily BSF typically remains constant throughout the year but may vary slightly depending on the month or season. GWI enters the collection system through leaking pipes, pipe joints, and manhole walls. GWI varies throughout the year, often trending higher in late winter and spring as groundwater levels and soil moisture levels rise. GWI normally subsides in late summer or during an extended dry period. Although the amount of GWI is dependent on overall weather trends, GWI does not respond directly to rainfall events.

WWF, also known as rain-derived I/I (RDII) and is most commonly responsible for capacity-related issues in a combined sewer collection system. While RDII is associated with rainfall events, snowmelt may also be a source of WWF. RDII is typically nonexistent before the start of a rainfall event, increases during the event, and then recovers back to zero after the rain event subsides. For cases with less than saturated antecedent moisture conditions, surfaces and soils absorb a portion of the rainfall early in an event before a response is observed in the sewer. If the rainfall event is minimal, there may not be a visible response. The maximum amount of rainfall that does not produce a flow response in a collection system is termed the "initial abstraction."

Figure 9-1 depicts the various components of a wet weather flow response within a combined sewer system.

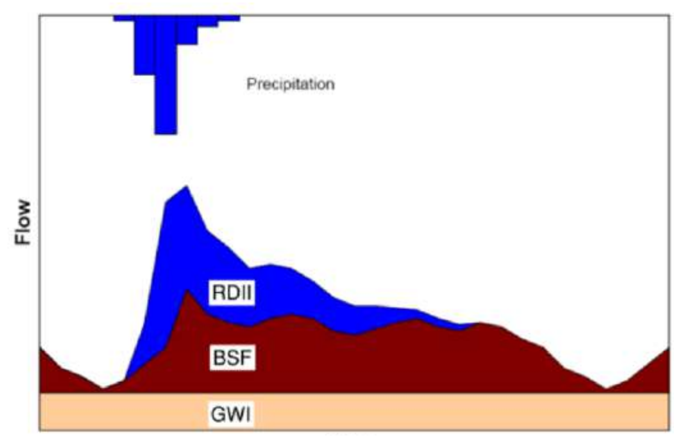


Figure 9-1. Components of Combined Wastewater Flow

9.2 Model Development

During the model development process, available data from the City's GIS database was imported into PCSWMM and supplemented with record plan drawings. Key geospatial data input to the model included sanitary pipes, siphons, manholes, pump stations, regulator structures, weirs, orifices, storage features and outfalls. Drainage basins were delineated and assigned to respective manholes based on light detecting and ranging (LIDAR) data and record drawings. Pipes equal to or smaller than 12-inches in diameter were generally eliminated from the hydraulic model, with exceptions in areas where sewer separation was completed. In instances where manhole rim elevations were unknown, LIDAR data was utilized to determine the approximate surface elevation.

Existing CSO regulator configurations were determined using a combination of field investigations, available record drawings, the CSO Operational Plan, and photo documentation and flow monitoring installation forms created when each of the 17 flow monitors were installed. As part of the September 2020 field investigations, depth-to-invert measurements were obtained at critical regulator structures and incorporated into the model. Based on the available information, the model was configured to reflect that orifice plates have been removed from the existing regulator structures along the Main Interceptor.

9.2.1 Subcatchment Delineation

Subcatchment delineation was performed using available GIS data including existing sewers, LIDAR data, and known service area boundaries. These subcatchments define the boundaries of the combined sewer collection system and its designated service areas. Subcatchments were further broken down by each associated sanitary manhole for purposes of DWF and WWF calibration. In the R13 basin, two layers of delineated subcatchments were developed to accurately represent the partially separated storm sewer drainage area as well as the combined sewer drainage area.

9.2.2 Dry Weather Flow Patterns

As discussed in **Section 7.4**, a DWF analysis was performed to characterize DWF in various locations across the City's collection system. A multi-step approach was used to build and characterize the DWF component of the City's hydraulic model. DWF distribution was performed by relating ADWF values to individual manhole nodes within each tributary flow meter area. A weighting was assigned to each manhole based on its delineated tributary area.

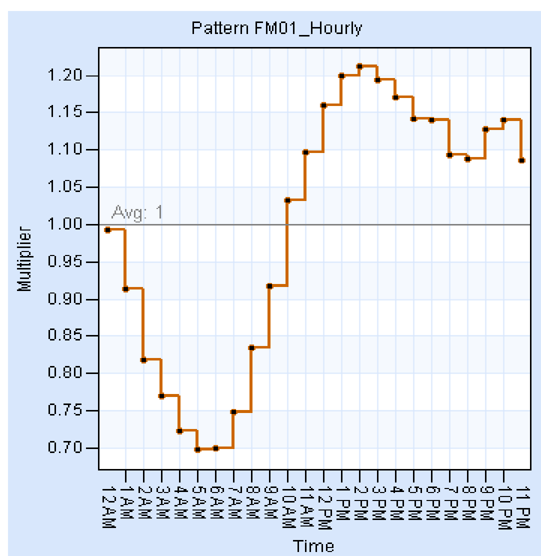


Figure 9-2. Example Diurnal Pattern

Diurnal patterns were developed for each individual flow monitoring location using DWF data. PCSWMM was used to generate normalized diurnal patterns which represent fluctuations in flow based on water usage. Patterns were created for hourly, daily, and weekend DWF at each flow monitoring location. An example of a diurnal flow pattern is shown in **Figure 9-2** and is based on DWF periods for FM-01.

Monthly variation of DWF was incorporated into the hydraulic model using a system wide monthly flow pattern. Seasonal variation in DWF is mainly attributed to the presence of GWI. WWTP influent flow data from 2018 to 2019 was used to generate normalized monthly DWF patterns and applied across the entire collection system.

9.3 Model Calibration

The hydraulic model calibration process involved incorporation of DWF and WWF data for accurate representation of flow responses throughout the collection system. First DWF calibration was performed using the process outlined in **Section 9.3.1** followed by WWF calibration discussed in **Section 9.3.2.** The calibrated model's ability to generate reasonable flow responses was then assessed using observed data at existing CSO locations and at the WWTP influent.

9.3.1 Dry Weather Flow Calibration

A multi-step approach was used to build and characterize the DWF component of the City's hydraulic model. DWF distribution was performed by relating ADWF values calculated from flow monitoring data (refer to **Section 7.4**) to individual manhole nodes within each tributary flow meter area. A weighting was assigned to each sanitary manhole based on its estimated drainage area. The ADWF values were then compared to flow rates experienced at upstream and downstream flow monitors and adjusted as necessary.

To quantify the accuracy of the model in producing real-time data, the following criteria were used:

- Predicted time of peaks and troughs are within one hour of observed flow,
- Predicted flow rates are within -15 percent and +25 of observed flow; and
- Predicted flow volumes over a 24-hour period are within -10 percent and +20 percent of observed flow volume.

Additional analyses were performed to ensure that the model accurately represents the system wide DWF experienced at the WWTP. Available WWTP influent flow data was also used to evaluate the accuracy of DWF values at FM-1. Influent flow data from the WWTP was compared to rainfall data to determine the average flow entering the plant on days without precipitation. These values were compiled and averaged for each month of the flow monitoring period. **Table 9-1** summarizes the average daily influent flow during dry weather and identifies the number of days without rainfall. It should be noted that unusually high WWTP influent flows observed during dry days was considered an outlier and therefore not included in this analysis.

Table 9-1. WWTP Influent Flow – Monthly DWF

Time Period	# of Dry Days	Average DWF (MGD)
July 2019	8	7.2
August 2019	16	5.6
September 2019	26	5.5
October 2019	20	5.1
Average DWF (MGD):		**5.84**

Theoretically, there should be a negligible difference between WWTP influent flows and the sum of ADWF values at FM-1 and FM-8A. The average monthly DWF at the WWTP was approximately 0.59 MGD higher than the total ADWF from FM-1 and FM-8A, which showed ADWF values of 4.50 MGD and 0.75 MGD, respectively. Based on these findings it is reasonable to assume that DWF was underestimated at FM-1 and is not an accurate representation of base sanitary flows through the downstream portion of the WWTP interceptor. FM-1 was installed in 60" pipe and when low flow conditions occur, the flow monitor can experience inaccurate readings when the transducer is partially submerged during low flow conditions. As a result, the system-wide DWF distribution was adjusted to match the average monthly DWF value of approximately 5.84 MGD observed at the WWTP. A monthly DWF flow pattern was also developed based on average WWTP influent flow during dry periods and applied to each sanitary inflow point.

9.3.2 Wet Weather Flow Calibration

Following DWF calibration, the model was calibrated for WWF using an iterative process of fine-tuning the RDII and runoff to the collection system. The wet weather events identified in **Table 7-2** were utilized as a basis for comparison. Each flow meter dataset was assessed for quality assurance and any false readings were eliminated. To quantify the amount of runoff from each sewershed, parameters such as impervious percentage, routing lengths and infiltration were adjusted for each subcatchment. PCSWMM's Subcatchment Radio Tuning Calibration (SRTC) tool was used to aid in calibration of subcatchment parameters based on estimated uncertainties.

Flow restrictions were implemented at the collection system's outfall to the WWTP at a setpoint of 25 MGD to replicate existing wet weather operational protocol at the influent sluice gates. Existing conditions at the Y-Bridge Pump Station were also configured based on observed pump discharge through the effluent force main at FM-5. Storm pump operation including on/off depths was configured to mimic observed flow responses.

The following quantitative criteria were used for achieving WWF calibration at each flow monitoring location:

- Predicted time of peaks and troughs are within one hour of observed flow;
- Predicted flow rates are within -15 percent and +25 percent of observed flow; and

- Predicted flow rates are within +20 percent and –10 percent of observed flow volume.

Hydrographs were developed to show the accuracy of the WWF calibration for each individual flow monitoring location during the evaluation period and are included as **Appendix E**.

9.4 Model Validation

Following DWF and WWF calibration, modelling results were compared with existing reports to confirm the accuracy in producing real-time data. Similar to the system-wide DWF calibration check, WWTP influent flow data was used to evaluate the model's ability to predict receiving flows at the plant throughout the flow monitoring period. **Figure 9-3** shows the total reported monthly influent volumes at the WWTP in million gallons in comparison to the modelling results at the WWTP outfall across the calibration period.

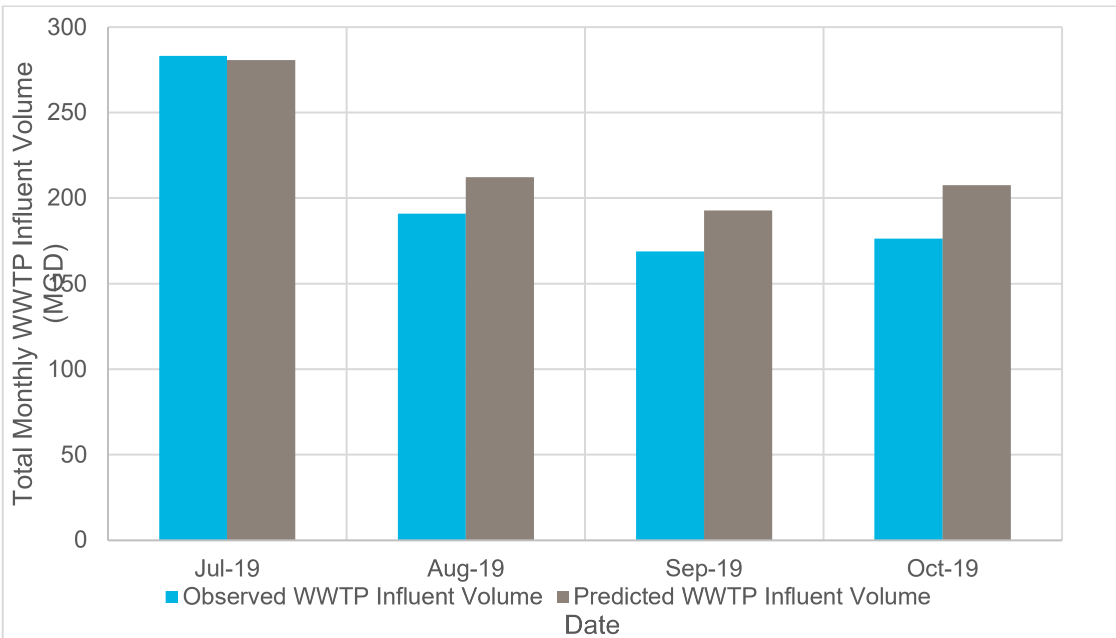


Figure 9-3. Observed Vs. Predicted WWTP Influent Flow, July-October 2019

Monthly WWTP influent volumes were comparable between the two datasets, with predicted volumes falling between +20% and -5% of observed volumes. Due to higher volumes of GWI and RWI entering the collection system in the summer months, the DWF component of the model may be slightly overestimated during the autumn months causing slight variations in total monthly WWTP influent volumes. As discussed previously, a monthly DWF pattern was developed based on historical WWTP dry weather influent flow data and applied to the hydraulic model inflow points to account for seasonal variations in DWF across the collection system.

Table 9-2 shows the total inflow volumes and peak flow rates at FM-1 for four (4) of the pre-identified major wet weather events in the calibrated model simulation. Observed values were calculated using flow monitoring data and are also included for comparison.

Table 9-2. Observed vs. Predicted Wet Weather Events Summary – FM-1

Event Date	Predicted Volume (MG)	Observed Volume (MG)	Predicted Peak Flow (MGD)	Observed Peak Flow (MGD)
7/5/2019	21.28	19.81	27.87	23.82
7/22/2019	17.61	15.42	27.54	23.68
8/13/2019	20.72	17.12	23.77	22.05
10/30/2020	18.24	16.53	25.38	23.57

Predicted inflow volumes and peak flows at the Main Interceptor in the hydraulic model were found to be generally consistent with flow monitoring data from FM-1. On average, the model predicted volume approximately 17% higher than observed FM data, and the model predicted peak flow rates approximately 14% higher than the observed FM data. Both percentages are considered within the acceptable range for calibration.

9.5 Typical Year Rainfall Analysis

A typical year analysis was performed to determine the representative precipitation year to be used for establishing a base case scenario and to perform future modelling. Two (2) sets of data were evaluated for the selection of a typical year: 1) the 50-year typical year was selected to represent long-term historical trends from 1963 to 2013, and 2) the 20-year typical year was selected to represent 1993-2013 historical rainfall data. These two options were then compared to determine if average wet weather conditions have seen an increasing or decreasing trend over time.

AECOM examined local precipitation datasets to identify the representative year for use in future model simulations. Several datasets were obtained and evaluated for completeness from 1963 through 2013. Digital daily and hourly rainfall data was obtained from the following USGS stations:

- USW00093824 Zanesville Municipal Airport
- COOP:339422 Zanesville WWTP
- COOP:331197 Cambridge Ohio
- COOP:331786 Port Columbus International Airport

The rain gage at the Zanesville Municipal Airport provided daily reporting frequency while Columbus Airport reported rainfall at an hourly reporting frequency for the period of interest. Average annual rainfall depths for both locations were compared to determine whether it was reasonable to utilize the Columbus Airport hourly dataset for the City's typical year analysis. It was discovered that there was a negligible difference between the 50-year average annual rainfall values at the Zanesville Airport (38.8 inches) and the Columbus Airport (39.0 inches). With the assumption that storm distribution characteristics were also similar, it was considered acceptable to utilize Columbus Airport data in the typical year storm distribution analysis.

Rainfall statistics were generated for each year including total annual rainfall, number of storms, average rainfall per storm, average storm duration, peak intensity, and maximum daily rainfall. Average statistics for both the 20-year and 50-year timeframes are presented in **Table 9-3**.

Table 9-3. Typical Year Analysis Statistics

Time Period	Total Rainfall (in)	# of Storms	Average Rainfall (in/event)	Average Duration (hr)	Average PI**	Max PI	Average AMC***	# of Rainy Days	Max Day
50-Year Average:	38.8*	126	0.31	7.0	0.13	1.33	2.7	138*	2.3*
50-Year Typical Year (1981)	37.8	127	0.30	7.1	0.12	0.96	2.6	142	2.6
20-Year Average:	38.5*	124	0.33	7.1	0.13	1.36	2.7	139*	2.3*
20-Year Typical Year (2012):	37.1	121	0.31	6.7	0.14	1.17	2.8	130	2.0

Notes:

* *Calculated using daily rainfall data from Zanesville Municipal Airport*

** *PI = Peak Intensity*

*** *AMC = Antecedent Moisture Control*

Generally, there was a negligible difference between the 50-year and 20-year average total rainfall, and slightly higher values of average rainfall per event, peak intensity and duration for the 20-year timeframe. The typical year options identified in **Table 9-3** were further evaluated for storm distributions including depth, intensity and reoccurrence interval of each rainfall event. Hourly rainfall data was also used to identify the top ten storms and respective recurrence frequencies. Years that contained storm events with total rainfall greater than 3 inches were not considered a reasonable typical year option as the recurrence level of this size event is considered atypical. **Table 9-4** presents the top ten storms that occurred in the (a) 50-year typical year and (b) 20-year typical year.

Table 9-4. 50-Year and 20-Year Typical Year Top Ten Storms

Rank	Date	Total Rainfall (in)	Dura-tion (hr)	Storm Category
1	6/13	2.15	8	2-yr
2	4/11	1.22	8	5-mo
3	9/14	0.79	2	3-mo
4	4/4	1.22	12	3-mo
5	7/20	1.2	17	3-mo
6	1/30	1.21	18	2-mo
7	2/18	1.02	15	2-mo
8	5/10	0.76	4	2-mo
9	12/21	0.78	10	1-mo
10	6/10	0.90	10	1-mo

(a) 50-Year Typical Year: 1981

Rank	Date	Total Rainfall (in)	Dura-tion (hr)	Storm Category
1	3/18	2.04	3	5-yr
2	1/26	1.71	19	7.5-mo
3	4/26	1.21	4	7.5-mo
4	5/8	1.43	16	5-mo
5	7/26	0.90	2	5-mo
6	10/26	0.98	17	2-mo
7	12/20	0.87	10	2-mo
8	3/8	0.81	10	1-mo
9	8/9	0.53	3	<1-mo
10	12/4	0.64	5	<1-mo

(b) 20-Year Typical Year: 2012

Based on the results of the above analyses, the City decided to move forward with utilizing 2012 as the selected typical year for LTCP Update model simulations. While total annual rainfall of 37.1 inches is slightly lower than long-term and short-term averages, the selected typical year includes a 5-year storm of 2.04 inches. It was assumed that relatively less annual rainfall is balanced by the presence of larger, higher intensity storms. It is also important to note that the previous LTCP Typical Year of 1982 which was selected during development of the 2007 LTCP experienced a total annual rainfall of 33.7 inches, approximately 5 inches lower than historical average annual rainfall. This observation provides further support for the selection of 2012 precipitation in lieu of the previous LTCP typical year.

The fifth largest storm in the selected typical year was used to determine sizing for the preferred CSO control projects based on the desired four-or-less systemwide overflow level of service for the City's LTCP Update. The fifth largest storm in the selected 2012 typical year is equivalent to a 5-month return frequency.

9.6 Existing Conditions Model Results

The calibrated hydraulic model, referred to as the Existing Conditions model, represents current conditions within the City's collection system and operating conditions at the WWTP and pump stations. The Y-Bridge PS wet weather capacity was configured to 18 MGD to represent maximum operating conditions. This model includes the calibrated DWF and WWF flow parameters and existing wet weather operating procedures. The Existing Conditions model was simulated using the selected typical year (2012) to evaluate the total number of CSO occurrences and total annual discharge volume under existing conditions.

Table 9-5 summarizes the results of the Existing Conditions model including annual CSO volume and frequency for each active rack location. It should also be noted that the completion of 2007 LTCP projects has resulted in a system wide overflow volume reduction from approximately 61.94 MG/year to 57.4 MG/year in the typical year based on current conditions.

Table 9-5. Existing Conditions Model Typical Year CSO Occurrence and Volume Summary

City Rack Number	NPDES Permit CSO Station Number	Number of Overflows (#/yr)	Overflow Volume (MG/yr)
R2	005	Closed	
R3	006	35	17.0
R4	007	Closed	
R5	008	Closed	
R6	009	22	6.8
R7	010	Closed	
R8	011	5	1.0
R9	012	22	6.5
R10	013	7	1.0
R11	014	1	0.1
R12	015	4	1.1
R13	016	57	7.4
R14	017	4	2.8
R15	018	Closed	
R17	020	Closed	
R18	021	Closed	
R19	022	Closed	
R21	024	18	12.8
R26	029	10	1.0
R30	052	0	0
Total:			**57.4**

10. Alternatives Analysis

10.1 Basis of Evaluation

The purpose of any LTCP is to provide site-specific, cost-effective CSO controls that provide attainment of water quality standards in accordance with the CWA. As stated in the CWA, a LTCP should be flexible and recognize 1) the financial capability of varying municipalities to afford differing levels of CSO control; and 2) CSOs have varying levels of impact on water quality. Furthermore, a LTCP should consider a reasonable range of alternatives and varying levels of control (for those alternatives), using cost-effectiveness as a consideration in selection of control alternatives and level of control. The EPA CSO Guidance for Long-Term Control Plans identifies two (2) general approaches to attainment of WQS and they include the demonstration approach and the presumption approach. Both approaches provide municipalities with targets for CSO controls that achieve compliance with the CWA. The City plans to attain WQS after implementation of this LTCP Update in accordance with the presumption approach.

Under the presumption approach, CSO controls adopted in a LTCP should be required to meet one of the following criteria:

Option 1: No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a combined sewer system as the result of a precipitation event that does not receive the minimum treatment specified; or

Option 2: The elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis; or

Option 3: The elimination or removal of no less than the mass of the pollutants identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort for the volumes that would be eliminated or captured for treatment under Option 2 above.

The City has developed the LTCP Update to achieve the performance criteria described in Option 1 of the presumption approach. Upon completion of the projects included in this LTCP Update, the City will perform post-construction monitoring and review attainment of WQS.

A characterization of the City's combined sewer system was performed as part of the LTCP Update including review of the nine minimum controls, existing system monitoring and modeling data, existing water quality goals and WQS data and effectiveness of CSO controls. Review of this characterization indicates that the presumption approach was the most feasible approach for the City's LTCP.

Typically, CSO control alternatives are developed during the LTCP process in accordance with the following steps:

- Definition of water quality goals

- Identification of a range of CSO control goals to meet water quality goals
- Development of alternatives to meet the CSO control goals

The recommended CSO control alternative for the City's 2007 LTCP was sewer separation in CSO areas. The recommended CSO control alternative was considered affordable at the time of LTCP preparation given the 23 year implementation schedule.

The costs spent to date on the projects completed from 2007 LTCP (over $40 Million) already exceeds the estimated amount for the overall LTCP $39 Million with several separation project remaining to be completed. The cost of implementation of the 2007 LTCP has significantly increased and the current LTCP goal of separation of all CSOs is not feasible in the remaining areas The existing NPDES Permit requires that the City submit a revised LTCP no later than December 31, 2021.

In developing this LTCP Update, the City has adopted the US EPA Integrated Planning Approach as discussed in **Section 5.** One of the main goals of the Integrated Planning Approach is to meet regulatory requirements and water quality standards while maximizing infrastructure investments. The City evaluated the existing infrastructure requirements including the MS4, WWTP and CSO/SSO regulatory requirements. Maximizing funds can be accomplished through developing alternatives that address multiple regulatory requirements established in the CWA and the City's MS4 and NPDES Permits. This is accomplished by addressing multiple City-owned infrastructure issues with one capital improvement project.

The financial capability assessment in **Section 12** of this report documents the current financial capability of the City and the need to evaluate varying CSO control levels and water quality goals that meet existing WQS except for the specified number of times per year. The City's previous discussions with Ohio EPA have focused on the development of a LTCP that is cost-effective and provides financial flexibility:

- A LTCP should be flexible and recognize 1) the financial capability of varying municipalities to afford differing levels of CSO control; and 2) that CSOs have varying levels of impact on water quality.
- A LTCP should consider a reasonable range of alternatives and varying control levels (for those alternatives), using cost-effectiveness as a consideration in selection of control alternatives.

The City has decided to pursue the presumption approach because of the escalated cost and the historical significance/complexity in the remaining separation areas of the current LTCP. The following alternative evaluation summarizes the process used to identify, screen, and evaluate various reasonable alternatives; cost-effectiveness and affordability were used in selection of control alternatives for the LTCP Update.

10.1.1 Definition of Water Quality Goals

In accordance with the CSO Control Policy presumption approach, attainment of water quality goals is assessed by achievement of one of the performance criteria specified in the CSO Control Policy. The Zanesville LTCP Update has been developed and evaluated to meet a specific number of untreated overflow events in a typical year which is presumed to be protective of water quality standards and meet the requirements of the CWA. The LTCP Update includes post-construction monitoring and review of water quality goals.

10.1.2 Attainment of Presumption Approach

Alternatives were developed and evaluated to achieve the performance criteria described in Option 1 of the presumption approach. The evaluation includes identification of control alternatives, sizing, identification of siting and operational issues, and cost versus performance comparisons. At the completion of the LTCP, post-construction compliance monitoring will be conducted at any remaining CSO outfalls. The flow monitors will be used to collect occurrence data to verify that the performance criteria to attain the water quality goals of the LTCP Update (approved number of overflow events) have been met. The attainment of the presumption approach is further discussed in **Section 12**.

10.1.3 Attainment of Affordable CSO Control

As part of the LTCP Update development, alternatives ranging from no action taken to zero (0) overflow events in a typical year were evaluated. This was done to evaluate the performance versus cost relationship to identify the most cost-effective alternatives. The cost-effectiveness of the alternatives was verified by performing a ‘knee of the curve’ analysis to pinpoint the level of control where the performance-cost ratio begins to diminish. The knee of the curve evaluation also provides information for evaluating the economic hardship imposed by the adoption of the LTCP Update with the selected level of control. The knee of the curve analysis is discussed in **Section 11.3**.

10.2 Identification of Potential Control Measures

The first step in the alternative evaluation process is to identify CSO control measures which can aid in achieving the desired CSO level of control. Potential control measures include source controls, infrastructure improvements, operational strategies, storage and treatment technologies, and implementation of local regulatory measures. For organizational purposes, potential control measures were organized into four (4) categories: 1) source controls 2) I/I or conveyance upgrades, 3) storage or treatment technologies, and 4) Best Management Practices (BMPs). Each of these CSO control types are detailed below.

10.2.1 Source Controls

Source controls have the potential to improve the quantity or quality of runoff entering the collection system through reduction of runoff volumes, peak flows, or pollutant loads. Implementation of these source controls can reduce the need for downstream control measures. **Table 10-1** identifies common source control measures.

Table 10-1. Source Controls

Control Measure	Description
Flow Detention	Detention areas can store stormwater runoff temporarily, delaying its introduction into the collection system and help attenuate peak wet weather flows in the collection system.
Area Drain and Downspout Disconnection	Used in highly developed areas where downspout and area drains are commonly connected directly to the combined sewer system. Rerouting of these connections to separate storm drains or available pervious areas can help reduce peak wet weather flows and volumes.

Control Measure	Description
Use of Pervious Areas for Infiltration	Detention of storm flow in pervious areas reduces runoff volume through infiltration into the soil. Grassed swales, infiltration basins, and subsurface leaching facilities can be used to promote infiltration of runoff. This type of control might be more appropriate as a requirement for future development or redevelopment areas.
Street Sweeping	Frequent street sweeping can prevent the accumulation of dirt, debris, and associated pollutants, which may wash off streets and other tributary areas to a combined collection system during a storm event.
Pervious Pavements	Pervious pavements reduce runoff by allowing stormwater to drain through the pavement to the underlying soil. Benefits are limited in cold weather climates.
Catch Basin Cleaning	The regular cleaning of catch basins can remove accumulated sediment and debris that could ultimately be contained in CSOs.

The source control measures listed above were considered as potential solutions for I/I across the City's collection system but were eliminated in early screening stages of the alternatives evaluation process due to constructability challenges and cost-performance effectiveness.

10.2.2 I/I and Conveyance Upgrades

I/I and conveyance upgrades can be performed in critical areas of the collection system to 1) reduce or eliminate CSO volume and frequency by removing of peak flows, 2) minimize the amount of I/I entering the collection system, or 3) maximize the capacity of existing infrastructure. **Table 10-2** identifies the various I/I and conveyance upgrades control measures considered by the City for inclusion into the LTCP Update.

Table 10-2. I/I and Conveyance Upgrades

Control Measure	Description
Maximizing Existing Infrastructure	Optimizing the capacity of existing infrastructure to collect and treat higher flows with the goal of CSO frequency reduction. Modifications or repairs to existing structures to capture higher amounts of storm flows within the collection system.
Sewer Separation	Conversion of a combined sewer system into separate stormwater and sanitary sewage collection systems. Typically implemented by communities to reduce or eliminate CSOs and associated impacts. In recent years, sewer separation has been reconsidered by many communicates due to high capital costs, disruption to traffic and related community impacts during construction.
Infiltration/Inflow Control (Inflow Reduction)	Control of excessive I/I to provide hydraulic relief, both in the collection system and at the WWTP. In combined sewer systems, surface runoff is the primary source of inflow. Other sources of inflow in combined sewers might be appropriate to control, including river water intrusion or groundwater infiltration.

Control Measure	Description
	Infiltration flow tends to be more constant but of lower volume than inflow. As a result, infiltration controls may have minimal impact on CSO volume compared to inflow controls.
Flow Diversion	Diversion or relocation of dry weather flow, wet weather flow, or both from one drainage basin to another through new or existing drainage basin interconnections. Flow diversion can relieve an overloaded regulator or interceptor reach, resulting in a more optimized operation of the collection system.
Relief Sewers/Interceptors	Installation of relief sewers or new interceptors to increase the hydraulic capacity within a collection system. Different types of relief sewers include full flow interception relief sewers, wet weather flow diversion relief sewers, and sewer replacement/upsizing. Full flow interception relief sewers will divert all flows from upstream of a specific interception point to a location downstream. Wet weather flow diversion relief sewers will only divert the portion of wet weather flow from the interception location. This type may also include a new sewer for the dry weather flow and utilize the existing sewer for wet weather flows.
Pump Station Upgrades	Improvements to increase the hydraulic capacity and improve performance of existing pump stations. Adding an additional pump is generally a simple improvement, as some pump stations have been designed with extra space for future expansion. Increasing impeller size or changing the belts and sheaves are additional methods for adding capacity at a pump station. Replacement with larger or higher speed pumps can also be a recommended improvement for gaining capacity. Force main modifications can also be considered to increase the hydraulic capacity of the pump station.
Inflow Redirection	Implementation of an express storm sewer to reduce the stormwater load to the combined sewer. Designed to convey storm flow directly to receiving waters. Typically implemented on public stormwater sources including catch basins, curb inlets, and surface drainage.

10.2.3 Storage and Treatment Technologies

Storage technologies are utilized to collect or convey high wet weather flows until the downstream collection system capacity has been restored. Treatment technologies may also be utilized to increase the volume of flow receiving treatment. **Table 10-3** identifies common storage and treatment technologies.

Table 10-3. Storage/Treatment Technologies

Storage/Treatment Technology	Description
In-Line Storage	Includes 1) construction of new tanks or oversized conduits to provide storage capacity, and 2) construction of a flow regulator to optimize storage capacity in existing conduits. The new tanks or oversized conduits are designed to allow dry weather flow to pass through, while flows above a specific design peak are restricted, causing the tank or oversized conduit to fill. A flow regulator on an existing conduit functions under the same principle, with the existing conduit providing the storage volume.
Off-Line Near Surface Storage/ Equalization	Reduces overflow quantity and frequency by storing all or a portion of diverted wet weather combined flows in off-line storage tanks. The storage arrangement is considered to be parallel with the sewer. Stored flows are returned to the interceptor for conveyance to the WWTP once system capacity is available.
Deep Tunnel Storage	Provides storage and conveyance of storm flows in large tunnels constructed well below the ground surface. Tunnels can provide large storage volumes with relatively minimal disturbance to the ground surface, which can be very beneficial in congested urban areas. Flows are introduced into the tunnels through drop shafts, and pumping facilities are usually required at the downstream ends for dewatering.
High Rate Treatment (HRT)	Provides advanced primary treatment and increases the peak design flow capacity at the WWTP and regulates the flow of wet weather peak flows. High rate treatment facilities settle concentrate and remove solids, while allowing filtered wastewater to pass over a weir. Though pilot testing is necessary, high rate treatment can be effective at removing suspended solids, with removal rates reported at up to 80-95 percent. High rate treatment facilities require a small area of land, and the modular construction also makes it easy to locate and expand.
Swirl/Vortex Technology	Designed to promote solids separation via a swirling motion. Solids are removed through the underdrain of the unit and effluent passes over a top weir.
Off-line Near Surface Sedimentation	Functions as off-line storage tanks and provides sedimentation for excess flow volumes. These units commonly require coarse screening, floatable control, and disinfection.
Activated Sludge Tank Step Feed Operation	Modifications to existing activated sludge tanks to provide additional operational flexibility and the addition of anaerobic, anoxic, swing, and oxic/aerobic zones. These improvements increase the treatment capacity of the tanks by retaining solids in specific zones while maximizing flows through the unit.

10.3 Screening of Alternatives

The City evaluated system improvements designed to reduce CSOs using a three-tiered screening process. The controls and technologies described in **Section 10.2** were evaluated with the following screening approach:

- Level 1 – Evaluate Non-Monetary Factors,
- Level 2 – Evaluate Feasibility and Preliminary Cost, and
- Level 3 – Evaluate Cost and Performance.

Under Level 1, each identified improvement option was screened to identify possible environmental impacts, technical difficulties, and implementation challenges that would eliminate the identified project as a viable option. Any improvements not eliminated are then screened under Level 2.

The second tier included a determination of each alternative size, scope, and feasibility. Each option was modeled using the updated hydraulic model. The alternatives were sized to meet the OEPA goals for system-wide overflow control during a typical year. The fifth largest storm was used to define the projects and included a range of system improvement opportunities including the following:

- The reduction of sources of I/I by use of sewer separation,
- The maximization of conveyance of flows to the WWTP by including additional pumps and improved pipes,
- The maximization of treatment capacity at the WWTP, and
- The minimization, consolidation, and appropriate placement of needed system storage with and without pump stations as required by the location of storage.

Additionally, Level 2 included a very preliminary cost opinion used to further screen alternatives. A Class 5 “Concept Screening” cost estimate as defined by the American Association of Cost Engineering (AACE) was used to determine the final three alternatives that would be further refined during Level 3. This cost estimate class has an expected range of accuracy of -50 to +100 percent.

In the third and final tier, the three remaining alternatives were further refined by including all necessary facilities and controls to confirm modeled system performance over the typical year. Once complete, the three selected alternatives’ preliminary cost analysis was updated to a Class 4 “Study of Feasibility” cost estimate as defined by the AACE with an accuracy range of -30 to +50 percent.

Table 10-4 summarizes the types of controls and technologies considered for the City’s LTCP Update followed by a discussion on the Level 1-3 Screening methodologies utilized to select the preferred alternative.

Table 10-4. Control and Technology Matrix

Control Measure/Technology	Description of Improvements	Comments
Maximizing Existing Infrastructure	• CSO weir modifications to increase hydraulic capacity in interceptor sewer • Real time control system optimization • RWI Improvements – install tideflex valves on regulators, install watertight covers on manholes, waterproof siphons and pump stations, relocation of infrastructure from influence area, rehabilitate main interceptors	• Cost-effective method to increase capacity with minimal disruption to existing system • Must perform analysis of weir modification and real-time control effects on system to avoid water in basement (WIB)
Sewer Separation	• New Sanitary Sewers • New Storm Sewers • Rehabilitation of Existing Combined Sewers	• Construction of new infrastructure is expensive and includes pavement restoration • Disruptive to surrounding area and existing collection system flows • This is a very expensive CSO elimination alternative
Infiltration/Inflow Control (Inflow Reduction)	• Catch basin and curb inlet disconnection • Rehabilitation of existing combined infrastructure	• Catch basin disconnection is a very effective inflow removal technique • Inflow removal reduces more significant flow loading than infiltration removal • Relocation of infrastructure can be an expensive alternative
Flow Diversion	• Divert wet weather flows to another drainage basin for conveyance to the WWTP	• Mid-cost alternative to relieve CSOs • Must consider downstream capacities of existing infrastructure so problem is not transferred
Relief Sewers/ Interceptors	• Parallel interceptor to convey peak wet weather flows • Combination gravity sewer/siphon under river	• Subject to river water intrusion in the locations near the existing interceptors • Expensive to construct adjacent to the existing interceptors due to topography, environmental concerns, and easement requirements

Control Measure/Technology	Description of Improvements	Comments
Pump Station Upgrades (Maximizing Flows to the WWTP)	• Upsizing the existing pumps • Additional pumps and pumping capacity for the wet weather flows in existing Lift Station • Complete Lift Station Replacement • Force main upgrade to increase pumping capacity	• Eliminates existing hydraulic bottlenecks • Improves the upstream interceptor hydraulic capacity during wet weather events by elimination of backwater condition • Mid-cost alternative
Inflow Redirection	• Express storm sewer to transfer stormwater flow from combined sewer system to receiving river • Public stormwater separation by constructing local storm sewers	• Provides a significant reduction in wet weather inflow • Conveys and discharges stormwater separately to the receiving water • Future retrofit options if stormwater treatment is required
In-Line Storage	• Install regulators on the interceptor sewers to maximize capacity • Construction of in-line storage to replace the existing sections of interceptors	• Evaluate interceptor to determine segments with available capacity • Must maintain existing flows during construction of in-line storage tanks • Construction in low areas near river/ floodplain presents constructability issue
Off-Line Near Surface Storage	• Storage tanks above grade (bolted steel or concrete) • Concrete tank below grade	• Land adjacent to existing pump station must be available • Maintenance is required after wet weather events • Doesn't impact the existing system operations during construction
Deep Tunnel Storage	• Construction of a deep tunnel parallel and below the existing interceptor for wet weather flow storage with flow added at drop structures	• Extremely high construction costs • Typical storage option in large municipalities
High Rate Treatment	• Install a high rate treatment train to treat peak wet weather flow at the WWTP	• High construction cost • Often requires chemical addition to increase efficiency • Only used during wet weather events

Control Measure/Technology	Description of Improvements	Comments
Swirl/Vortex Technology	• Install swirl/vortex technology unit(s)	• High construction cost • Grit sumps tend to clog and require high pressure water or air to loosen compaction
Off-line Near Surface Storage/ Sedimentation/ Equalization	• Construct storage tanks and weir regulators • Construct conveyance from the collection system to the storage tanks	• Maintenance is required after wet weather events • Doesn't impact the existing system operations during construction
Activated Sludge Tank Step Feed Modifications	• Modify weirs and flow splitters to achieve desired flow patterns to create treatment zones in activated sludge tanks.	• Increase flow capacity through activated sludge tanks • Low cost modifications

10.4 Level 1 Screening

Once projects with major environmental impacts, technical difficulties, and implementation challenges were eliminated, several types of projects were identified as conceptually feasible to improve the capacity of the City's collection and wastewater treatment systems. The list of potential alternatives remaining after Level 1 screening includes a variety of control strategies that were further investigated to develop the most beneficial alternatives based on a cost comparison and water quality benefits. In this initial stage, the project opportunities that remained included I/I reduction and conveyance upgrades, storage, WWTP upgrades, and high rate treatment. During Level 1 screening, potential options for each type of technology were developed. These options are further described in the subsequent sections.

10.4.1 I/I and Conveyance Upgrades

I/I reduction projects and conveyance upgrades could be implemented in targeted areas to remove or divert a portion of the high wet weather flows observed in collected flow monitoring data. These projects identified for further consideration were based on an evaluation of the following data sources:

- Existing infrastructure including GIS database and record drawings;
- Flow monitoring performed
- Calibrated hydraulic model; and
- City reported CSO data.

Types of I/I reduction projects considered included complete sewer separation and RWI remediation projects. Cost, location of I/I within the right-of-way, and potential inflow volume elimination are typically the driving factors for I/I reduction project selection. River water intrusion was identified at several locations throughout the City's collection system and should be eliminated in order to achieve adequate CSO control.

Conveyance upgrades were also considered along with I/I reduction projects which included upgrading pump stations and providing new pump stations. Installing additional conveyance to the WWTP can reduce the overflow quantity and frequency by conveying the additional flows directly to the WWTP for treatment or storage. The existing infrastructure conditions, conveyance capacity, and existing utility conflicts were important factors in identifying feasible conveyance upgrades projects.

Additionally, maximizing conveyance through the existing infrastructure was also analyzed. Projects to increase conveyance with existing infrastructure could include adjusting the overflow weir elevations in a regulator based on output from the calibrated hydraulic model during a typical year scenario.

10.4.2 Storage

Constructing new storage facilities were evaluated including upstream in-line storage and centralized storage in the collection system or at the WWTP. Installing new storage within the collection system can reduce the overflow quantity and frequency by storing all or a portion of the wet weather flows within a specific area. Land availability, floodplain considerations, and storage capacity requirements typically dictate the type of storage that can be utilized for each area. Storage facilities were found to be the most likely option within the R3 and R21 based on land availability and high overflow quantity in these two CSO basins.

10.4.3 High Rate Treatment (HRT)

Three types of HRT were evaluated including: ballasted flocculation, compressible media filtration, and detention treatment. HRT facilities can remove 80 to 95 percent of solids and require some type of disinfection of wet weather flows. Pilot testing is typically required for regulatory acceptance. HRT is most often utilized where land acquisition is limited and where wet weather flow volumes are high. These facilities require a small footprint and the modular construction also facilitates expansions. The City performed a feasibility analysis for the installation of HRT at the WWTP prior to the 2007 Expansion project and found that the existing land restrictions disqualified this technology from implementation at both the WWTP and at an HRT satellite location. HRT was considered to treat wet weather flows from the City's downtown area but was also eliminated as a viable option due to offsite maintenance requirements and land restrictions.

10.4.4 WWTP Upgrades

The City conducted a review of the current condition of each of the WWTP units to evaluate bottlenecks, operational issues, potential upgrades and replacement of existing technology.

Upgrades to the City's WWTP wet weather capacity in 2007 and 2009 were designed to treat a peak flow of 36.2 MGD. Since construction, peak capacity studies have indicated that the WWTP is currently unable to treat sustained flows in excess of 25 MGD. Several bottlenecks have been identified throughout the plant including the secondary splitter weir gate, the solids contact tank, and the headworks. The City has made operational changes to eliminate some of these bottlenecks.

When flows reach approximately 25 MGD, the plant begins to experience solids washout from three (3) of the four (4) secondary settling tanks. The 2013 wet weather study determined that the secondary splitter weir gate is hydraulically limited to 23.6

MGD due to inadequate freeboard in the solids contact tank. Based on recommendations, plant operators adjusted the sluice gates at the splitter box for each of the secondary settling tanks. The operational improvements have been successful in eliminating solids washout. As the influent flow continued to increase to 27 MGD, the solids contact tank filled to a level where water began to overflow the tank wall.

To eliminate overflows, in 2018 plant operators began operating the RAS at 50% when the influent exceeds 18 MGD. The 1984 headworks was designed and installed with a maximum capacity of 20 MGD, forcing plant operators to close the influent sluice gate in order to throttle the flow coming into the plant when influent flow reaches 25 MGD. The chlorine contact basin at the WWTP also has a peak capacity of 30 MGD based on 10 State Standards detention time

Based on the evaluation of the WWTP, upgrades evaluated at the WWTP were categorized as 1) upgrades to restore the WWTP peak primary treatment capacity to 36 MGD and the peak secondary treatment capacity to 27 MGD; and 2) upgrades for long term implementation. The selected alternative for the WWTP Upgrades is a combination of upgrades needed to remove bottlenecks restore the WWTP peak primary treatment capacity to 36 MGD and the peak secondary treatment capacity to 27 MGD and several upgrades to address the long term operation of the WWTP. These upgrades are detailed in the *Zanesville WWTP Condition Assessment Technical Memorandum* in **Appendix B**. The total estimated cost for the WWTP Upgrades is $15,180,000 in 2021 dollars.

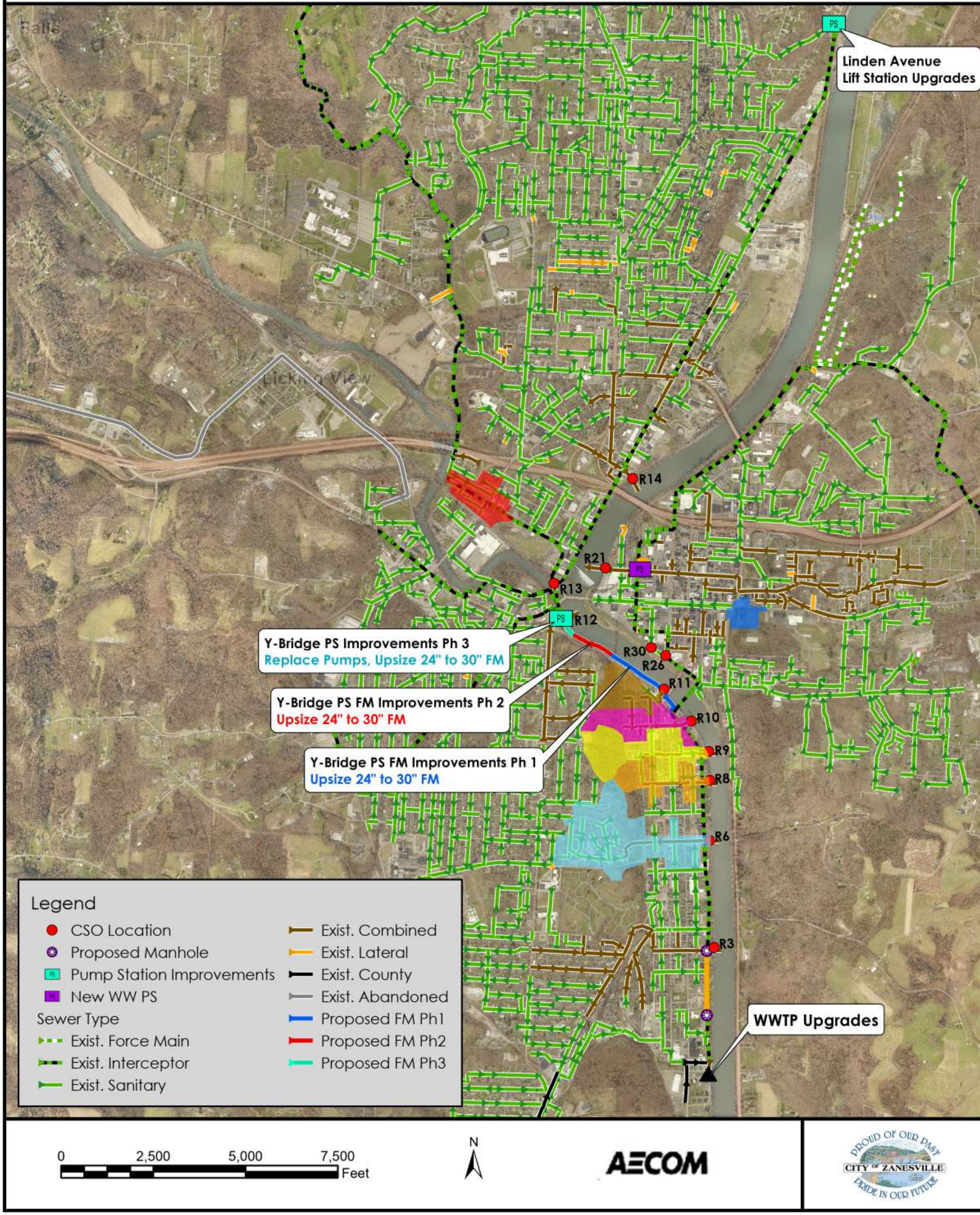
10.5 Level 2 Screening

Level 2 Screening involved a more detailed evaluation to determine the applicability and feasibility of potential control technologies. Site-specific projects were identified for each type of control technology, with the overarching goal of reducing CSOs to the desired control level. Cost and performance estimates were also developed to evaluate cost-effectiveness of potential improvement projects.

10.5.1 Early Action Projects

During the development of collection system alternatives, the City identified several “early action projects” which have recently been completed, or are currently in planning, design or construction phases and are expected to be completed in the next 1-3 years. These early action projects will be incorporated into the City’s LTCP Update regardless of the selected alternative. The Linden Avenue Lift Station upgrades were completed in 2021 and were also considered in the Early Action project costs. **Figure 10-1** presents a visual summary of the proposed LTCP Update Early Action Projects. The Early Action Projects are described below.

Figure 10-1
Zanesville LTCP Update
Early Action Projects



The LTCP Update Early Action Projects include:

1. Linden Avenue Lift Station Upgrades

   The City completed upgrades to the Linden Avenue Lift Station. These upgrades involved replacement of the existing pumps to maintain current design capacity.

2. Combined Sewer Separation at R6, R8, R9, R10, and R11

   Construction is wrapping up and expected to be complete in 2024 for sewer separation at CSO basins R6 and R8 through R11.

3. Y-Bridge Pump Station Improvements

   The City is currently completing construction of Phase 1 of the Y-Bridge Pump Station Improvements project. This phased project involves replacing the existing pumps, upsizing the existing 24-inch Y-Bridge Pump Station effluent force main to 30-inch and shifting the force main alignment out of the Muskingum River floodplain. The improvements will also include re-grading and re-paving Muskingum Avenue and Dug Road to improve roadway safety caused by existing grade conditions. The proposed Y-Bridge PS improvements will be included in the LTCP Update regardless of the selected alternative.

   The City's decision to upsize the effluent force main was based on findings from the August 2015 capacity study and condition assessment of the Y-Bridge Pump Station and its associated 24-inch effluent force main. A key conclusion of the study was that as of 2015, there was currently no additional capacity in the existing 24-inch effluent force main. Upsizing the effluent force main from 24-inch to 30-inch would result in an approximate capacity increase of 8.6 MGD. The new force main alignment will be located outside of the floodplain and will involve modifications to the existing force main profile due to elevation changes.

   The City also plans on increasing the capacity of Y Bridge PS from an existing firm capacity of 14.4 MGD to an increased capacity of 20 MGD. These upgrades are required to meet the desired CSO control level of four or less overflows in the typical year at R13. The existing pumps will also be replaced to meet the desired firm pumping capacity and will be suitable for the updated force main profile.

   To maximize capital improvement costs, the City plans to perform the Y-Bridge PS effluent force main improvements in concurrence with planned roadway and sewer separation projects with overlapping project areas. The portion of effluent force main along Dug Road shall be upsized during the Dug Road pavement installation and grading improvements, and the downstream portion near R11 shall be captured under the R11 sewer separation project. The City intends on completing the Y-Bridge PS improvements over the course of three (3) phases:

   1. Phase 1: Upsize existing 24" to 30" force main along Muskingum Avenue, from CSO Basin R11 to Railroad;

   2. Phase 2: Upsize existing 24" to 30" force main along Muskingum Avenue, from Railroad to Dug Road; and

3. Phase 3: Replace existing pumps and provide connection to 30" force main at Dug Road.

10.5.2 I/I and Conveyance Upgrades

10.5.2.1 Combined Sewer Separation

Each of the following CSO basins were identified as high I/I areas and evaluated for inflow reduction via cost-effective combined sewer separation:

R3 Combined Sewer Separation

Phased sewer separation was considered in the R3 basin to reduce high wet weather flows observed in available flow monitoring data. I/I reduction would involve constructing a separate storm sewer along Johnston Street, Luke Drive and Marysville Road. The project area involves several constructability challenges including an existing railroad crossing and construction in high-density residential neighborhoods, making combined sewer separation less cost-effective in this area.

R13 Combined Sewer Separation

In 2003, the City contracted DLZ to perform detailed design for the complete separation of the R13 basin under the GW Morse Sewer Separation project. New storm and sanitary sewers were constructed for approximately 80% of the total project area. The remaining 20% of the project area, or approximately 12 properties west of the Railroad, were omitted from project construction and thus continue to send wet weather to the combined system. Finalization of the combined sewer separation detailed in the GW Morse design plans is an extremely feasible option for inflow reduction at R13. After the separation in the R13 area is complete, the CSO regulator for this basin would be modified as described in **Section 10.5.2.3**.

R14 Combined Sewer Separation

Several properties within the R14 area have been deemed to have historical significance. Due to concerns of negative public perception, high constructability costs, and anticipated permitting challenges, sewer separation feasibility was extremely low for this area. As a result sewer separation in the R14 basin was not considered a viable option.

R21 Combined Sewer Separation

Approximately 9.9 acres of the City's urbanized downtown area is located within R21. Construction within this urbanized area would be highly difficult due to high traffic congestion, limited construction workspace, and existing utility crossings. The feasibility of combined sewer separation within the more residential portion of R21 was evaluated. The City identified a potential opportunity to re-purpose an existing 2-MGD water storage reservoir located southeast of the proposed R21 sewer separation area, making partial separation in the R21 basin an attractive control option. However, the hydraulic model showed that multiple lift stations would be required to convey storm flows from the R21 basin to the storage facility, resulting in high capital and O&M costs. In addition, the hydraulic model showed that R21 partial separation projects did not meet the desired CSO control level of four (4) or less overflows in the typical year at R21 and would require additional capacity upgrades downstream of the R21 basin.

R30 Combined Sewer Separation

Currently, the City's partially separated collection system along E Main Street takes an additional source of sanitary inflow which currently prevents the City from closing the R30 outfall. As a result the R30 basin was considered a potential inflow reduction project area and evaluated for combined sewer separation.

Two properties in the City's downtown area were investigated as potential cost-effective candidates for small scale sewer separation projects. Field investigation results indicated that (1) property at the intersection of E. Main Street and 9th Street sends sanitary flows into the combined sewer system that runs from E Main Street to S. 5th St. This area was previously separated, and the City has been conducting monitoring to determine if R30 could be eliminated. Dye testing performed at 925 Main Street showed that sanitary flow enters the 18-inch storm sewer and is conveyed towards the R30 outfall located at Canal Street and S. 5th Street. Findings from these field investigations including mainline inspection data and dye testing results are included in the **Appendix F**.

Further analysis and coordination with property owners at 20 9th Street needs to be conducted to determine whether sanitary connection relocation is necessary to complete sewer separation in the R30 basin. This project would also require extension of existing sanitary infrastructure along E Main Street and relocation of existing sanitary lateral(s). The R30 sewer separation project has been included in the alternatives evaluation.

Combined Sewer Separation Feasibility Analysis

Table 10-5 summarizes the estimated runoff volume removal, opinion of probable cost, and cost-effectiveness (cost per unit of runoff removed) for viable inflow reduction projects requiring further analysis. Future runoff rates in these areas were based on average observed hydrology parameters in areas of the collection system that have been separated.

Table 10-5. Combined Sewer Separation Project Cost Analysis

I/I Reduction Project Area	Volume of Runoff Removed (gal)*	Opinion of Probable Cost ($ Million, 2021 dollars)	Cost / Peak Runoff Removed ($/ gal)
R3	421,400	$7.6	$16.61
R13	478,800	$0.57	$1.19
R21, East of Greenwood	105,000	$14.3	$136.19

Note:
* *Wet weather volume reduction required to achieve desired CSO control level of four (4) or less overflows in the typical year.*

The R13 sewer separation project resulted in the lowest cost of I/I removal per dollar ($1.19 per gallon of runoff removed), which led to the inclusion of this project in the LTCP Update regardless of the selected alternative. **Table 10-5** shows that the sewer separation in the R21 basin resulted in the highest estimated inflow reduction unit cost ($136.19 per gallon), eliminating this project as a cost-effective option. Phased separation at R3 was also eliminated as a cost-effective alternative after preliminary cost screening compared to storage options.

10.5.2.2 River Water Intrusion Remediation

Indications of RWI were observed at R3, R9, R12, R13 and R14. It is assumed that the RWI suspected in the R9 area will be addressed following completion of the ongoing sewer separation project. The R12 weir is proposed to be modified. The only remaining RWI-susceptible locations which required future RWI control solutions were R3, R13 and R14.

End-of-pipe solutions were proposed at R3, R13 and R14 which will require installation of new duckbills and potential rehabilitation of the existing outfall piping. These solutions will be implemented regardless of the selected LTCP Alternative. Cost opinions for these improvements were included in Level 3 Screening.

10.5.2.3 Regulator Modifications

The City's existing collection system was evaluated using flow monitoring data and field investigation findings to identify areas with underutilized regulator structures. Site-specific projects were proposed for each existing CSO location where

1. The upstream collection system capacity is not fully utilized,
2. Proposed combined sewer separation projects will require the modification of the existing regulator configuration,
3. Combined sewer separation has been completed but CSO connections have yet to be removed, or
4. CSO storage has been proposed and requires an alternative overflow weir configuration.

Several regulator modification projects were included in each of the City's LTCP Update alternatives and are discussed herein.

<u>R12 Regulator Modifications</u>

This location was selected as a potential regulator modification project due to the high velocities experienced in the upstream pipe entering the structure, causing hydraulic jumps regardless of upstream system capacity. An iterative modelling process was utilized to determine optimal weir elevations. Upstream and downstream impacts were evaluated using the hydraulic model and aided in determining the feasibility of potential regulator modifications.

In addition, the R12 weir modifications will significantly decrease the likelihood of RWI entering the collection system at the regulator structure. Based on the river stage analysis performed (refer to **Section 8.1**), the peak river stage that occurred at R12 during the flow monitoring period was 682.2-feet (NAVD88). With plans to raise the R12 weir by approximately 12 inches from the existing weir elevation of 682.57-feet to 683.57-feet, it is reasonable to assume that future river levels will remain below the planned weir elevation, eliminating the need for RWI remediation at this location.

R13 Regulator Modifications

For planned sewer separation at R13, the receiving CSO regulator at Peter's Alley will need to be modified to allow direct conveyance of separate storm flows to the Licking River and to prevent wet weather inflows from entering the downstream combined system. The proposed regulator improvements include abandoning the existing 36-inch sanitary connection at the R13 regulator structure and installing a new 36-inch sanitary sewer from MH-1098 to tie in just upstream of the existing R13 outfall. A control structure will also need to be installed at MH-1098 to direct combined flows to the River when interceptor levels exceed an elevation of approximately 678.6 feet.

R26 Regulator Modifications

The City has performed daily visual inspections at the R26 regulator structure to assess whether CSO activations continue to occur during rain events. Woodchips were placed on the downstream side of the regulator weir and used to indicate CSO activation. From January to December 2019, there was one (1) observed CSO activation at R26 which occurred in October 2019. Based on the field report data and hydraulic model analysis performed in 2020, the CSO connection at R26 was modelled as being eliminated in the future and is highly dependent on the success of the proposed R21 improvements which is designed to reduce inflows to the downtown interceptor. Further study is required during the Phase 2 programmatic review to verify that R26 can be eliminated in the future. Regardless of whether the R26 CSO connection is removed in the future, upsizing of the 10-inch sanitary sewer which connects the R26 regulator structure to the downtown interceptor is recommended to increase improve the hydraulic bottleneck through the existing 10-inch pipe and was included in the R26 Regulator Modifications project.

In summary, the following regulator modification projects were included in the City's LTCP Update regardless of the selected alternative:

- R12 Regulator Modifications – Raise overflow weir
- R26 Regulator Modifications – Upsize existing 10-inch sanitary sewer to 24-inch and evaluate removal of CSO connection

Alternatives involving wet weather storage and wet weather pump stations will require constructing a side-weir at the existing regulator structure adjacent to the proposed wet weather facility to convey high flows into new wet weather facilities at a specified rate and elevation. Side-weir elevations were determined using the process described for R12 regulator weir optimization to achieve the desired control level of (4) or less CSO activations in the typical year.

Float Gate Evaluation and Removal

The evaluation and removal of existing float gates at the R13, R14, R21, R26, and R30 regulator structures was included in this LTCP to maximize flows to the collection system during peak flow conditions. Evaluation and removal of float gates would be performed concurrently with proposed I/I and conveyance improvements; specifically, the removal of the existing float gate at the R13 regulator structure would be performed during the R13 sewer separation project and the removal of the existing float gate at the R30 regulator structure would be performed during the R30 sewer separation project. Evaluation and removal of the float gates at the R14, R21 and R26 regulator structures was proposed as a dedicated project to allow the City to monitor interceptor flow impacts prior to designing downstream conveyance improvements or storage.

10.5.2.4 Downtown Interceptor and Muskingum River Siphon

The City relies on the Muskingum River Siphon to convey flows from the northeast portion of the City, including the City's downtown area, across the Muskingum River into the 60-inch Muskingum Avenue Interceptor. Hydraulic modelling analysis showed that the existing Muskingum River Siphon (12-inch and 24-inch in parallel) and the City's downtown interceptor are limited in capacity.

The total estimated capacity of the existing Muskingum Avenue Siphon and Downtown Interceptor is 18.6 MGD and 12.3 MGD, respectively. Based on future tributary flows, these structures are required to convey a minimum of 21.4 MGD in order to maintain four or less overflows at R21 in the typical year. Based on these findings the City considered options to increase the capacity through these structures as part of the LTCP Update.

<u>Downtown Interceptor Upsizing</u>

The hydraulic model was used to determine optimal sizing for the proposed Downtown Interceptor improvements.

Constructability was a critical factor in potential upsizing of the Downtown Interceptor. A majority of the interceptor runs along heavily trafficked urbanized roads with limited workspace for large-diameter pipe installation and construction. Along South 5th Street, a 24-inch diameter combined sewer runs parallel to the Downtown Interceptor. Another potential constructability hurdle was identified at the intersection of Canal Street and Putnam Avenue, where the Putnam Avenue bridge was constructed above grade.

New interceptor routing was proposed at the downstream portion of the interceptor to avoid construction along South 5th Street and near the Putnam Bridge. To minimize costs, this option involves installing a new smaller diameter sewer which will run east from the manhole at 5th Street and South Street. In turn, the City would continue to utilize the existing trunk sewers along South 5th Street and Canal Street.

Due to spatial constraints, downtown district disturbance, maintenance-of-traffic requirements, and ancillary infrastructure unknowns due to the age of the area the Downtown Interceptor upsizing project was limited to trenchless construction methods. Cost estimations were developed assuming microtunneling is the selected construction technology due to its high accuracy of finished pipe location which is considered necessary in the City's downtown area. Rock removal and dewatering were not included in preliminary costs.

<u>Muskingum River Siphon Upgrades</u>

Several options were considered to increase the capacity at the Muskingum River crossing which involved re-purposing the existing siphons, replacing the existing siphons entirely, or utilizing both siphons and constructing a new wet weather force main and associated pump station. It was assumed that the existing siphons are in fair condition and have an estimated 30-40 additional useful years, allowing the City to eliminate the option involving complete replacement. The concept of converting the 24-inch siphon into a force main was also eliminated based on hydraulic modelling showing that the required capacity of approximately 21.4 MGD was not met.

This project would also require that the City acquire the commercial property at the corner of Canal Street and 9th Street. This property was the preferred pump station location due to proximity to the existing siphon influent box as well as minimal wet well depth requirements. The City also considered locating the pump station at the City-owned property south of the river; however, has removed this option due to public perception of new construction in a highly utilized public park. This latter option would also require a significantly deeper wet well and larger lift station to tie into the existing collection system at the Muskingum Avenue Interceptor.

The City performed a feasibility evaluation for the proposed 20-inch force main river crossing. The force main would require crossing a canal owned and operated by ODNR. Aerial photography indicates that sheet piling was installed along the south side of the canal embankment, posing a potential constructability conflict. Trenchless construction via HDD was preliminarily recommended to minimize wetland disturbance and instream work at the Muskingum River and the ODNR canal. Microtunneling and jack-and-bore construction methods were also considered but not recommended due to high capital costs and increased dewatering of entrance and exit shafts. Rock removal and dewatering were not included in preliminary costs.

10.5.3 Storage

The City performed detailed feasibility analyses for proposed storage facilities serving the R3 and R21 basins. Potential storage sites were identified using updated GIS data and County property records.

Public perception was a key factor in selection of proposed siting and CSO storage type. The R21 area is located near highly utilized urban buildings, railroad tracks and equipment storage areas, and a recently renovated City park. Resultantly the City did not consider above-ground storage for this area. The City-owned parking lot adjacent to the R21 regulator structure was the preferred underground storage site due to proximity to existing infrastructure and avoidance of construction in the City park or near the railroad. Below-ground tanks and linear storage were both considered, but linear storage was selected based on preliminary cost comparison findings.

Similar to R21, public perception was a deciding factor for R3 storage selection. The R3 basin is categorized as a medium-high density residential area. As a result the City only considered below-ground storage technologies. The Buckingham Estates property was removed from consideration after development of preliminary cost opinions, which showed that multiple lift stations were required to convey stored flows from the site to the Muskingum Interceptor. The existing 60-ft ROW along Muskingum Avenue, parallel to the existing 60-inch trunk sewer, was considered the most cost-effective option. In addition, linear storage would eliminate the need for lift station installation, making this proposed project the most cost-effective CSO control solution at the R3 CSO Basin.

10.6 Level 3 Screening

Level 3 screening included detailed hydraulic modeling of numerous combinations of the control options described above. The iterative hydraulic modeling along with development of supporting preliminary comprehensive cost estimates were reviewed and refined several times throughout the alternative selection process. Below is a summary of the top three (3) combinations of options presented as Alternatives 1-3.

10.6.1 Alternative 1

Alternative 1 includes the projects and upgrades shown in **Figure 10-2.** The projects are summarized below:

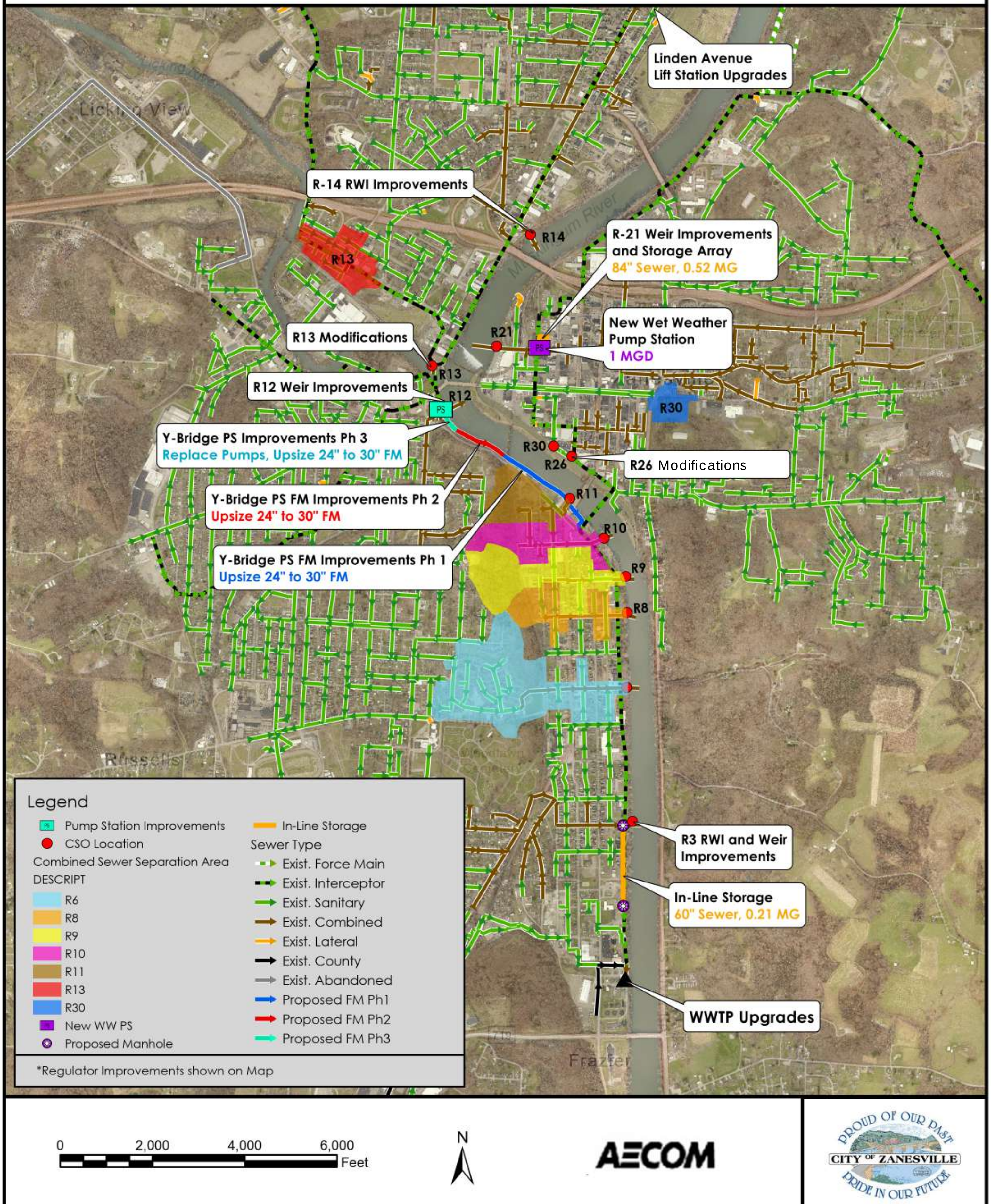
- WWTP Upgrades
- Early Action Projects (See Section 10.5.1)
- I/I and Conveyance Upgrades
  - R13 Combined Sewer Separation and Regulator Modifications
  - R30 Combined Sewer Separation
  - RWI Improvements at R3, R13 and R14
  - R12 Regulator Modifications
  - R26 Regulator Modifications
- Storage
  - R3 In-Line Storage (210,000 gallons) and Regulator Modifications
    - 1,400 LF of 60-inch Gravity Sewer along Muskingum Avenue
    - 30 LF of 8-inch Gravity Sewer
  - R21 Storage Array (520,000 gallons) and Regulator Modifications
    - 1,800 LF of 84-inch Gravity Sewer
    - 1 MGD Pump Station

Alternative 1 involves the WWTP Upgrades projects and completion of Early Action Projects which include the previously completed Linden Avenue Lift Station upgrades, ongoing combined sewer separation projects at R6, R8, R9, R10, and R11, increasing the Y-Bridge Pump Station capacity from 14.4 MGD to 20 MGD, and upsizing the existing 24-inch Y-Bridge Pump Station effluent force main to a 30-inch diameter force main. This alternative includes completion of sewer separation in the R13 Basin and R30 Basin, regulator modifications at R3, R12, R13, R21,and R26 and end-of-pipe solutions for RWI remediation at R3, R13 and R14.

Alternative 1 utilizes CSO storage to capture high wet weather flows in the R3 Basin and the R21 Basin. In the R3 area, Alternative 1 includes in-line storage providing approximately 210,000 gallons of wet weather storage via 1,400 LF of 60-inch pipe along Muskingum Avenue and 30 LF of 8-inch gravity sewer to control wet weather flow into the Main Interceptor.

The R21 storage array includes 1,800 LF of 84-inch gravity sewer and offers approximately 520,00 gallons of CSO storage for the R21 sewershed. A 1 MGD pump station is required at the R21 storage array to pump stored wet weather flows into the Downtown Interceptor at a controlled rate. Alternative 1 is the least expensive LTCP Update Alternative with a total project cost estimate of $39.02 Million in 2021 dollars. A detailed breakdown of the preliminary cost estimate is included in **Appendix G**.

Figure 10-2
Zanesville LTCP Update
Alternative 1



10.6.2 Alternative 2

Alternative 2 includes the projects and upgrades shown in **Figure 10-3.** The projects are summarized below:

- WWTP Upgrades
- Early Action Projects (See Section 10.5.1)
- I/I and Conveyance Upgrades
  - R13 Combined Sewer Separation and Regulator Modifications
  - R30 Combined Sewer Separation
  - RWI Improvements at R3, R13 and R14
  - R12 Regulator Modifications
  - R26 Regulator Modifications
  - R21 Wet Weather Conveyance Improvements and Regulator Modifications
    - 8 MGD Duplex Wet Weather Pump Station with Screening Unit
    - 3,000 LF of 18-inch along Market St.
    - New Wet Weather Force Main under Muskingum River upstream of existing dam - 600 LF of 20-inch (Horizontal Directional Drilling), tie-in at Linden Ave and Lee St
- Storage
  - R3 In-Line Storage (300,000 gallons) and Regulator Modifications
    - 1,400 LF of 72-inch Gravity Sewer along Muskingum Avenue
    - 30 LF of 8-inch Gravity Sewer

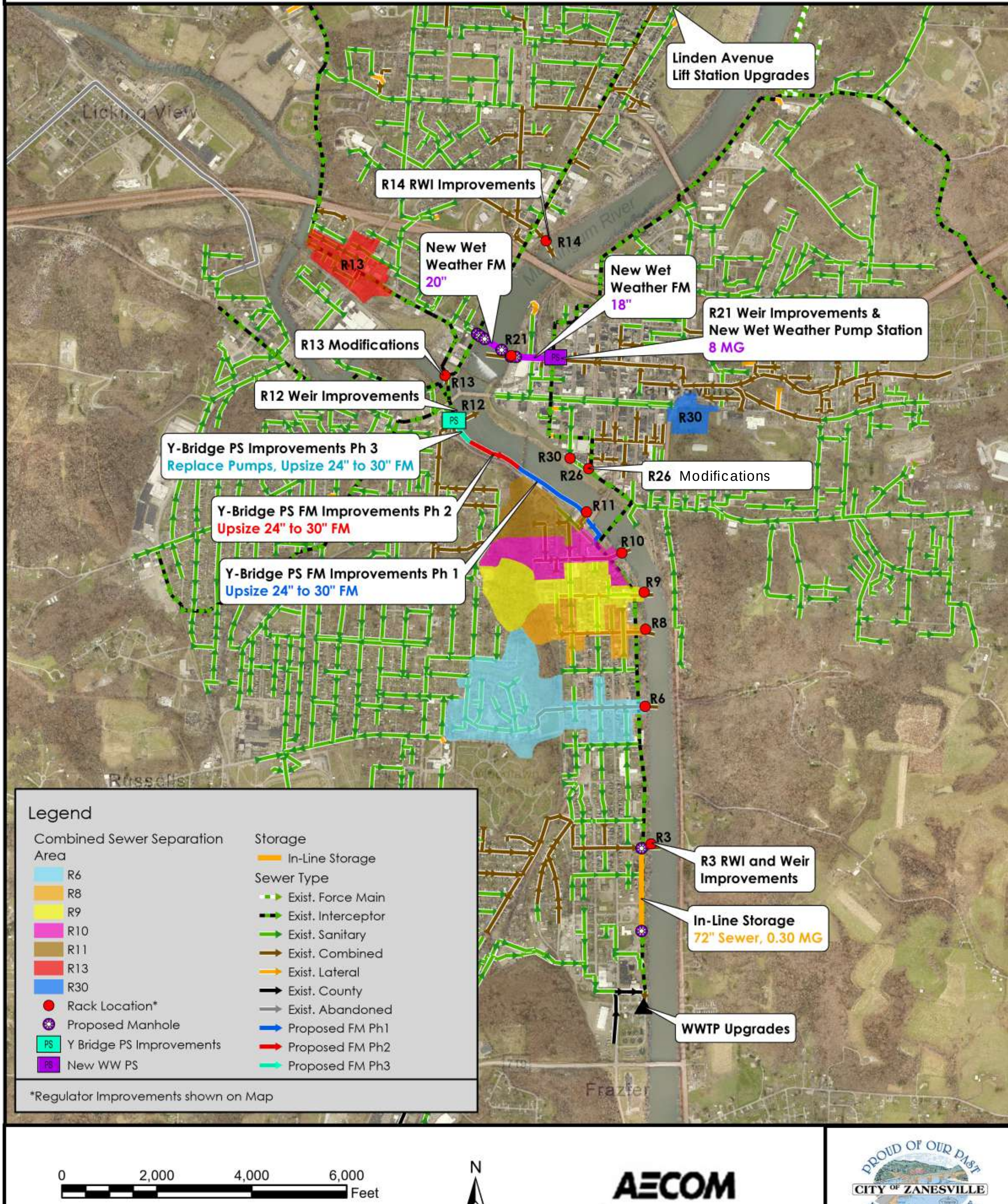
Alternative 2 includes the WWTP Upgrades projects and completion of Early Action Projects which include recently completed Linden Avenue Lift Station upgrades, ongoing combined sewer separation projects at R6, R8, R9, R10, and R11, increasing the Y-Bridge Pump Station capacity from 14.4 MGD to 20 MGD, and upsizing the existing 24-inch Y-Bridge Pump Station effluent force main to a 30-inch diameter force main. This alternative includes completion of sewer separation in the R13 Basin and R30 Basin, regulator modifications at R3, R12, R13, R21 and R26, as well as end-of-pipe solutions for RWI remediation at R3, R13 and R14.

To address high wet weather flows in the R3 Basin, Alternative 2 includes in-line storage via 1,400 LF of 72-inch gravity sewer along Muskingum Avenue and 30 LF of 8-inch gravity sewer to control wet weather flow into the Main Interceptor. It is important to note that the R3 in-line storage gravity sewer in Alternative 2 is slightly larger at 72-inch diameter compared to 60-inch diameter in Alternative 1 due to the presence of R21 peak flows in the Main Interceptor, resulting in less capacity for R3 Basin flows into the Main Interceptor and therefore higher in-line storage requirements.

Proposed wet weather conveyance improvements in the R21 basin include an 8 MGD wet weather pump station with screening unit, 3,000 LF of 18-inch gravity sewer along Market Street, and 600-LF 20-inch wet weather force main under the Muskingum River, located upstream of the existing dam. It was assumed that HDD would be performed to install the new wet weather force main, which would connect into the existing Linden Avenue Interceptor at Lee Street.

The total project cost estimate of Alternative 2 is $43.1 Million in 2021 dollars. A detailed breakdown of the preliminary cost estimate is included in **Appendix G**.

Figure 10-3
Zanesville LTCP Update
Alternative 2



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10.6.3 Alternative 3

Alternative 3 includes the projects and upgrades shown **Figure 10-4.** The projects are summarized below:

- WWTP Upgrades
- Early Action Projects (See Section 10.5.1)
- I/I and Conveyance Upgrades
    - R13 Combined Sewer Separation and Regulator Modifications
    - R30 Combined Sewer Separation
    - RWI Improvements at R3, R13 and R14
    - R12 Regulator Modifications
    - R26 Regulator Modifications
    - Downtown Interceptor Upsizing
        - 2,000 LF of 42-inch on 3rd St. and South St. (Microtunneling)
        - 1,700 LF of 36-inch on South St, 6th St, Marietta St., and 7th St. (Microtunneling)
    - Muskingum River Siphon Improvements
        - 12 MGD Wet Weather Pump Station with Screening Unit near existing Muskingum River Siphon
        - 900 LF of 20-inch HPDE under Muskingum River (Horizontal Directional Drilling)
- Storage
    - R3 In-Line Storage (300,000 gallons) and Regulator Modifications
        - 1,400 LF of 72-inch Gravity Sewer along Muskingum Avenue
        - 30 LF of 8-inch Gravity Sewer

Similar to the previous alternatives, Alternative 3 includes the WWTP Upgrades projects and completion of Early Action Projects which include the recently completed Linden Avenue Lift Station upgrades, ongoing combined sewer separation projects at R6, R8, R9, R10, and R11, increasing the Y-Bridge Pump Station capacity from 14.4 MGD to 20 MGD, and upsizing the existing 24-inch Y-Bridge Pump Station effluent force main to a 30-inch diameter force main. This alternative includes completion of sewer separation in the R13 Basin and R30 Basin, regulator modifications at R3, R12, R13, R21, and R26, as well as end-of-pipe solutions for RWI remediation at R3, R13 and R14.

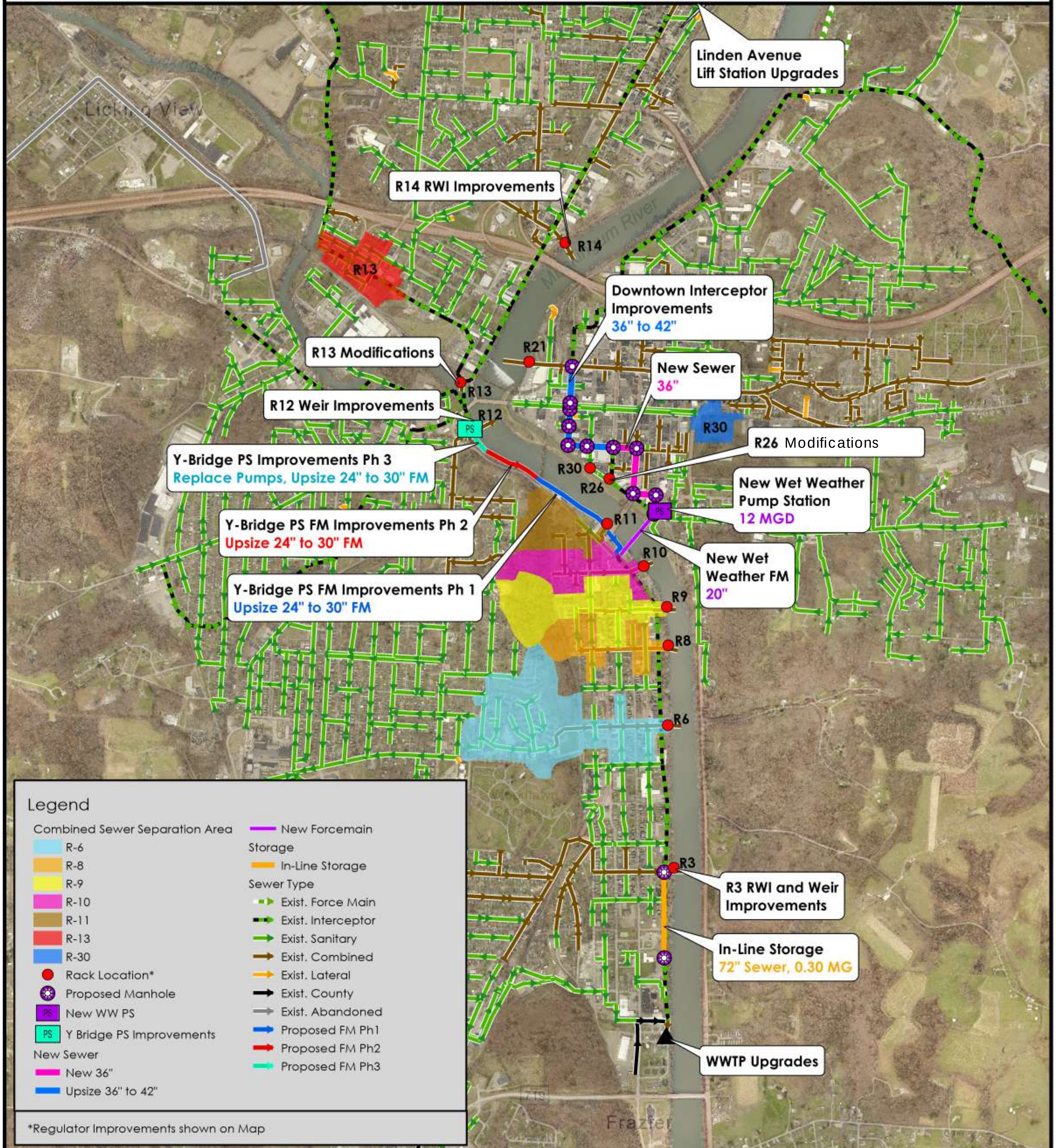
To capture high wet weather flows in the R3 Basin, Alternative 3 includes in-line storage via 1,400 LF of 72-inch gravity sewer along Muskingum Avenue and 30 LF of 8-inch gravity sewer to control wet weather flow into the Main Interceptor. Similar to

Alternative 2, this alternative requires slightly more in-line storage compared to Alternative 1 due to the presence of R21 peak flows in the Main Interceptor, resulting in less capacity for R3 Basin flows into the Main Interceptor and higher in-line storage requirements.

To achieve CSO control at R21, this alternative includes Downtown Interceptor improvements which involves 2,000 LF of 42-inch gravity sewer on 3rd Street and South Street, and 1,700 LF of 36-inch gravity sewer on South Street, 6th Street, Marietta Street, and 7th Street. Alternative 3 would also require the construction of a new 12 MGD wet weather pump station and installation of a new 20-inch HPDE force main across the Muskingum River parallel to the existing Muskingum River siphon. It was assumed that HDD would be performed to install the new wet weather force main at the river crossing, and microtunneling would be the preferred construction method for the proposed Downtown Interceptor improvements.

The total estimated project cost of Alternative 3 is $54.7 Million in 2021 dollars. A detailed breakdown of the preliminary cost estimate is included in **Appendix G**.

Figure 10-4
Zanesville LTCP Update
Alternative 3



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10.6.4 Alternative Evaluation Summary

Each of the finalized LTCP Update alternatives were evaluated based on the findings of the three-tiered screening process as summarized in **Table 10-6**.

Table 10-6. LTCP Update Alternative Evaluation

	Description	Estimated Cost ($Mil in 2021 dollars)	Advantages	Disadvantages
Alternative 1	• WWTP Upgrades • Early Action Projects • I/I and Conveyance Upgrades • R3 In-Line Storage • R21 Storage Array	$40.0	–Least expensive alternative –Utilizes City-owned land –Minimal O&M requirements at R3 and R21 Storage	–Potential negative public perception of underground CSO storage
Alternative 2	• WWTP Upgrades • Early Action Projects • I/I and Conveyance Upgrades • R3 In-Line Storage • New Wet Weather Pump Station & Force Main at North Muskingum River	$43.1	–Utilizes City-owned land –Provides redundancy for existing Muskingum River Siphon	–Potential permitting requirements due to instream work –Relatively high O&M costs to operate wet weather pump station –R21 flows pumped twice –Construction of new Force Main near existing lock and dam system
Alternative 3	• WWTP Upgrades • Early Action Projects • I/I and Conveyance Upgrades • R3 In-Line Storage • Downtown Interceptor Upsizing • New Wet Weather Pump Station & Force Main at Muskingum River	$54.7	–Provides redundancy for existing Muskingum River Siphon –Extends service life of Downtown Interceptor	–Most expensive alternative –Requires coordination with ODNR due to canal crossing –Potential permitting requirements due to instream work –Major construction in City's downtown area –Relatively high O&M costs to operate wet weather pump station –Dependent on City's ability to acquire additional land for new wet weather pump station

Alternative 1 is projected to be the least expensive LTCP Update alternative at an estimated $40.0 Million in total project costs, while Alternative 3 is projected as the most expensive option at an estimated $54.7 Million. Identified disadvantages of Alternative 2 and Alternative 3 include O&M requirements for a new wet weather pump station, major construction within the City's highly utilized downtown area, and potential permitting requirements due to instream work, resulting in the elimination of these alternatives as preferrable CSO solutions. Alternative 1 is the preferred LTCP Update alternative due to significant cost savings and minimal operational requirements under the proposed R3 and R21 CSO control solutions.

11. Selected Alternative

Alternative 1 is the selected alternative for the City's LTCP Update. Restoring the WWTP peak primary treatment capacity to 36 MGD and the peak secondary treatment capacity to 27 MGD will maximize the City's downstream collection system capacity, notably the Main Interceptor. Inflow reduction projects and conveyance upgrades including the ongoing R6, R8 through R11 sewer separation projects, the R13 sewer separation, and RWI remediation projects will reduce peak flows at downstream infrastructure, providing additional hydraulic relief to major interceptors. Installing storage at R3 and R21 allows the City to maximize the capacity of the existing collection system and provides hydraulic relief during high flow periods. Increasing the wet weather capacity of the Y-Bridge Pump Station will alleviate hydraulic capacity limitations in the eastern portion of the City's collection system.

Additionally, evaluation and removal of existing float gates at R13, R14, R21, R26 and R30 is included in this LTCP Update. Float gate removal would be evaluated during programmatic review periods and implemented concurrently with proposed sewer separation projects; the removal of the existing float gate at the R13 regulator structure would be performed during the R13 sewer separation project and the removal of the existing float gate at the R30 regulator structure would be performed during the R30 sewer separation project. Evaluation and removal of the existing float gates at R14, R21, and R26 regulator structures would be performed as a dedicated project prior to the subsequent programmatic review period.

Refer to **Section 12** for further details of the financial capability analysis performed as part of the LTCP Update.

The CSO control solutions included in this LTCP Update were developed based on the best technology available as of 2021, therefore the City reserves the right to deviate from this proposed plan as new technology or alternative acceptable solutions become available. In accordance with the Integrated Planning Approach, the LTCP Update Implementation Schedule was developed to include phases and programmatic reviews between LTCP phases as discussed in **Section 13**. Inclusion of these programmatic review periods allows the City to evaluate the performance of constructed projects and determine where adjustments are required for future phase projects. After proposed inflow reduction and conveyance upgrades projects have been implemented, the size and cost information developed to control to four (4) overflow events during the typical year will require further refinement and verification which shall be performed during programmatic reviews.

A summary of the selected LTCP Update alternative is shown as **Table 11-1** and discussed in subsequent sections.

Table 11-1. Selected LTCP Update Alternative Summary

CSO Control Measure	Project Name	Project Description
WWTP Upgrades		Improvements to restore the WWTP peak primary treatment capacity to 36 MGD and the peak secondary treatment capacity to 27 MGD and upgrades for long term implementation
Early Action Projects	Linden Avenue Lift Station Upgrades	Replacement of existing pumps to maintain existing pumping capacity
	Separations at R6, R8, R9, R10, R11 and Y-Bridge PS Improvements Phase 1	Construction of separate storm sewer at R6, R8, R9, R10 and R11; Upgrades to Y-Bridge PS force main from Railroad to R11 Sewershed
	Y-Bridge Bridge PS Improvements Phase 2	Upgrades to Y-Bridge PS force main from Railroad to Dug Road
	Y-Bridge Bridge PS Improvements Phase 3	Upgrades to Y-Bridge PS force main from Dug Road to Pump Station; Replacement of existing pumps to increase wet weather capacity from 14.4 MGD to 20 MGD
I/I and Conveyance Upgrades	R13 Combined Sewer Separation and Regulator Modifications	Construction of separate storm sewer west of Railroad and removal of sanitary connections; Conversion of R13 to dedicated storm outfall
	R30 Combined Sewer Separation	Disconnection of sanitary connections from E Main Street combined sewer and improvements to remove/evaluate existing sanitary connection and float gate
	R26 Regulator Modifications	Improvements to existing weir
	RWI Improvements at R3, R13 and R14	River water intrusion remediation at CSO outfall structures
	R12 Regulator Modifications	Improvements to existing weir
	R14, R21 and R26 Float Gate Removal	Evaluation and removal of existing float gates at R14, R21 and R26 regulator structures
Storage	R3 In-Line Storage and Regulator Modifications	Construction of in-line storage and related regulator modifications
	R21 Storage Array and Regulator Modifications	Construction of storage array and 1 MGD pump station
Programmatic Reviews	-	Evaluation of system performance following phased implementation of LTCP Update projects

11.1 Selected Alternative Model Results

The selected alternative was incorporated into the hydraulic model and optimized to meet the desired four (4) overflows during the 2012 typical year. The final model results for the selected alternative are summarized in **Table 11-2**.

Table 11-2. Existing Conditions vs. Selected Alternative Model Results Summary

CSO Outfall		Existing Conditions		Predicted LTCP Update		
City Rack Number	NPDES Permit CSO Station Number	Number of Overflows (#/yr)	Overflow Volume (MG/yr)	Number of Overflows (#/yr)	Overflow Volume (MG/yr)	Overflow Volume % Reduction
R2	005	Closed				
R3	006	35	17.0	4	7.1	58.0%
R4	007	Closed				
R5	008	Closed				
R6	009	22	6.8	0	0	100%
R7	010					
R8	011	5	1.0	0	0	100%
R9	012	22	6.5	0	0	100%
R10	013	7	1.0	0	0	100%
R11	014	1	0.1	0	0	100%
R12	015	4	1.1	1	0.06	95%
R13	016	57	7.4	4	5.1	30.8%
R14	017	4	2.8	4	1.7	39.2%
R15	018	Closed				
R17	020	Closed				
R18	021	Closed				
R19	022	Closed				
R21	024	18	12.8	4	1.4	89%
R26	029	10	1.0	0	0.0	100%
R30	052	0	0.0	0	0	-
Total:			**57.4**		**15.4**	**73.1%**

11.2 Selected Alternative Cost Estimates

Table 11-3 shows the preliminary cost estimates for each CSO control project included in the selected LTCP Update alternative. The total estimated cost is approximately $40.04 Million in 2021 Dollars.

Table 11-3. Selected Alternative Cost Estimates

CSO Control Measure	Project Name	Project Cost
WWTP Upgrades		$15,180,000
Early Action Projects	Linden Avenue Lift Station Upgrades	$770,000
	Separations at R6, R8, R9, R10, R11 and Y-Bridge PS Improvements Phase 1	$7,444,000
	Y-Bridge Bridge PS Improvements Phase 2	$780,000
	Y-Bridge Bridge PS Improvements Phase 3	$2,000,000
I/I and Conveyance Upgrades	R13 Combined Sewer Separation and Regulator Modifications	$1,113,000
	R30 Combined Sewer Separation	$27,000
	R26 Regulator Modifications	$123,000
	RWI Improvements at R3, R13 and R14	$202,000
	R12 Regulator Modifications	$14,000
	R14, R21 and R26 Float Gate Removal	-
Storage	R3 In-Line Storage and Regulator Modifications	$3,560,000
	R21 Storage Array and Regulator Modifications	$8,702,000
Programmatic Reviews	-	$120,000
Total LTCP Update Project Costs:		**$40,035,000**

11.2.1 Basis of Estimate

Cost estimates included in this LTCP Update are high level planning costs and considered to be Class 4 “Study of Feasibility” cost estimates as defined by the AACE with an accuracy range of -30 to +50 percent. The preliminary cost estimates are representative of total project costs including construction, engineering design and construction oversight, permitting and legal costs and contingencies.

Source data utilized during the cost estimate development process was adjusted for inflation using a 4-percent per year compounding inflation rate and include:

- Bid tabulation data and preliminary costing tools from similar project work
- City of Columbus Cost Estimating Methodology Report, 2011

For LTCP Update projects involving new sewer installation, a high-level cost estimating approach was utilized which involved applying a unit price to each linear feet of sewer installed. The unit price shown in final cost estimates encompasses anticipated restoration costs including pavement replacement, seeding, mulching, backfill and related sewer main appurtenances such as manholes and catch basins. It was assumed that new sewer installations will be constructed in City-owned streets and paved areas. Unit prices obtained from source documents were adjusted for inflation using a 4-percent per year compounding inflation rate.

Cost estimate markups were expressed as a lump sum or calculated as a percentage of the subtotal of estimated construction costs. Rates were adjusted based on project type and class of estimate. Costs for mobilization, maintenance of traffic, stormwater pollution prevention plan development, permitting and legal fees, engineering design and construction oversight, and additional contingencies were built into the project cost estimates. Detailed cost estimate breakdowns for each LTCP Update project are included as **Appendix G**. Descriptions of notable cost estimate markups are discussed below.

- General Contingency: Accounts for inherent uncertainties in the estimating process and is anticipated by the estimator as the relative stability of the design documents, project scope, and assumptions upon which the estimate is based.
- Site and Surface Contingency: Applied to proposed sewer separation project work to account for costs of sitework including grading, seeding and mulching, etc.
- Overhead and Profit (O&P): Costs associated with general contractor/subcontractor employees engaged in daily work activities tied to the project life throughout all construction phases, as well as compensation for risk and efforts to undertake and complete the project.
- Permitting, Legal and Miscellaneous: Accounts for costs associated with permitting and coordination with regulatory agencies, assessments, taxes, legal and development charges, or any other fees not specifically stated in the cost breakdowns.
- Engineering Design and Construction Oversight: Design and construction management fees applied to all projects at planning level phase (not currently in design or construction phases).
- Design Phase Construction Contingency: Serves as an additional reserve if the lowest bid exceeds the engineer's cost estimate by 10%.
- Construction Contingency: Accounts for the estimator's anticipated overrun of the estimate due to errors or omissions in the final bid documents and/or design that may not be complete enough to determine final quantities. This generally serves as a reserve for change orders during construction.

11.2.2 Exclusions

The preliminary cost estimates developed as part of this LTCP Update excluded the items listed below, as well as any scope items outside of what is stated in the cost breakdowns (refer to **Appendix G**).

1. Unforeseen subsurface conditions including rock excavation and dewatering;
2. Escalation;
3. Restoration costs unless specified as individual line item; and
4. Active utility relocation costs.

It is also important to note that this LTCP Update was developed during the COVID-19 pandemic and at the time of development, the construction market is experiencing major project delays, procurement issues, high unemployment rates and increased equipment and goods costs as a result of the ongoing pandemic. It is uncertain how the industry will continue to be affected by these issues, and therefore an escalation/uncertainty factor has not been assumed to account for these unknowns.

11.3 Selected Alternative Cost Curve Analysis

The CSO controls included in the selected LTCP Update alternative were further evaluated to determine sizing requirements and associated costs under various levels of service based on hydraulic modelling. This analysis allowed the City to compare total project costs to predicted number of CSO activations during the typical year. The resulting cost-performance curve was used to identify the “knee of the curve,” or the optimal level of CSO control where collection system performance reaches diminishing returns in terms of total project costs.

Performance levels evaluated as part of this analysis included zero (0), four (4), six (6), and nine (9) overflows in the typical year. **Figure 11-1** depicts the cost-performance curve with total project costs plotted on the x-axis and CSO frequency plotted on the y-axis.

Figure 11-1 shows the knee of the curve occurring at four (4) overflows in the typical year. Based on these findings the City plans on implementing this LTCP Update with four (4) overflow events during the typical year.

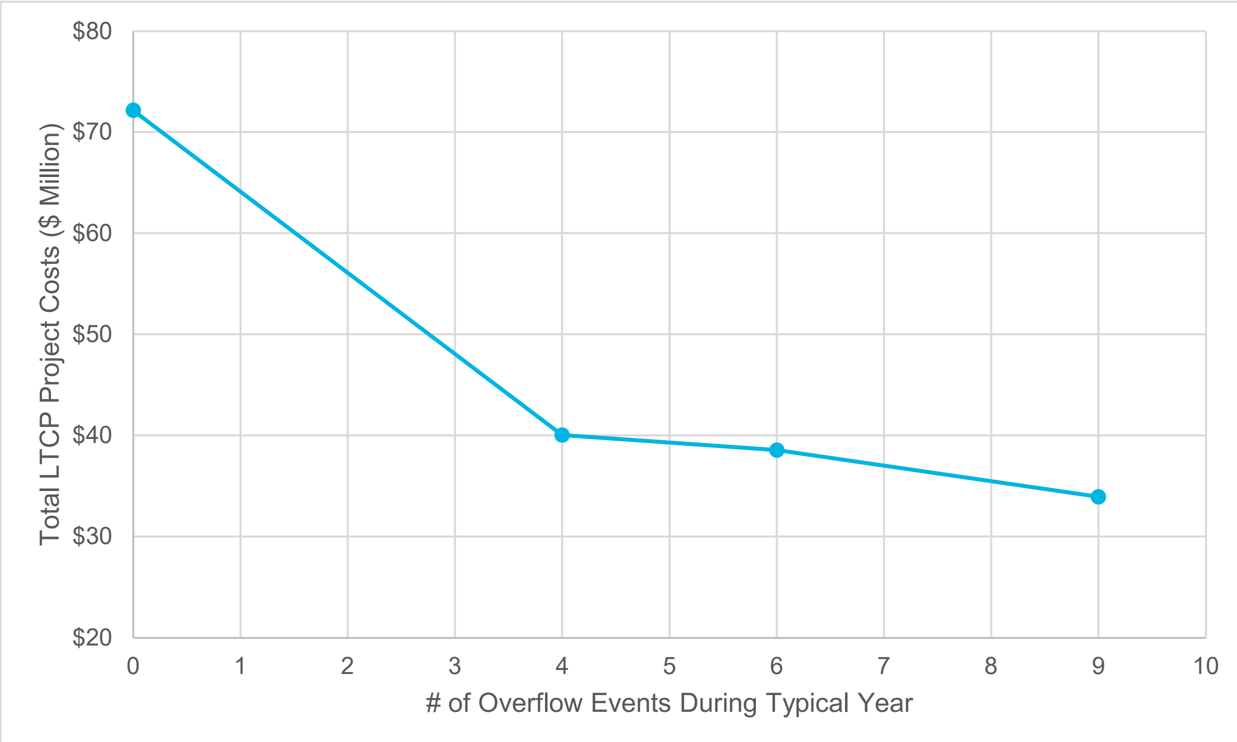

Figure 11-1. Selected Alternative Cost-Performance Curve

11.4 Additional Ongoing Efforts

The City is committed to continuous implementation of the NMCs in coordination with the NPDES Permit as discussed in **Section 2.3.** The City will continue to implement the CSSOP and update the document periodically as collection system improvements are performed during the implementation of this LTCP Update.

12. Financial Capability Analysis

The affordability of the City's LTCP Update program was evaluated, including performance of a Financial Capability Analysis in accordance with US EPA FCA guidance and regulations. Information utilized in the affordability analysis included the cost of the selected alternative, capital improvement plan/schedule to support the debt service calculations, and program operation and maintenance costs during implementation of the LTCP Update.

The Financial Capability Analysis performed as part of this LTCP Update is attached as **Appendix H**.

13. LTCP Update Implementation Schedule

The LTCP Update Implementation Schedule was developed given the financial affordability analysis of the selected LTCP Update alternative. The Schedule as shown in **Table 13-1** is considered feasible, affordable and adaptable to phased implementation of CSO control projects over the proposed 20-year period. The Gantt chart in **Figure 13-1** illustrates the proposed LTCP Update Implementation Schedule including project start and end dates.

Programmatic reviews were included following each phase of the Schedule to evaluate future project specifications and performance of constructed projects. This will allow the City to collect and evaluate flow monitoring data, calibrate the hydraulic model and update planned projects as necessary.

Table 13-1: LTCP Update Implementation Schedule

LTCP Update Project	Start	Finish	Project Cost (2021 Dollars)
Phase 1 (1/1/2024 to 12/31/2029)			
Linden Avenue Lift Station Upgrades	1/1/2019	12/31/2021	$770,000
Separations at R6, R8, R9, R10, R11 and Y-Bridge PS Improvements Phase 1	1/1/2017	5/1/2024	$7,444,000
Y-Bridge PS Improvements Phase 2	1/1/2024	12/31/2025	$780,000
RWI Improvements at R3, R13 and R14	1/1/2026	12/31/2027	$202,000
R12 Weir Modifications	1/1/2026	12/31/2027	$14,000
Y Bridge PS Improvements Phase 3	1/1/2027	12/31/2028	$2,000,000
R30 Sewer Separation	1/1/2027	12/31/2028	$27,000
Phase 1 Flow Monitoring/ Programmatic Review	1/1/2029	12/31/2029	$40,000
LTCP Update Phase 1 Cost:			**$11,277,000**
Phase 2 (1/1/2030 to 12/31/2037)			
R13 Sewer Separation	1/1/2030	12/31/2031	$1,113,000
R14, R21 and R26 Float Gate Removal	1/1/2033	12/31/2033	-
WWTP Upgrades Phase 1	1/1/2027	12/31/2032	$10,480,000
WWTP Upgrades Phase 2	1/1/2033	12/31/2036	$4,700,000
Phase 2 Flow Monitoring/ Programmatic Review	1/1/2037	12/31/2037	$40,000
LTCP Update Phase 2 Cost:			**$16,535,000**
Phase 3 (1/1/2038 to 12/31/2044)			
R21 Storage	1/1/2038	12/31/2041	$8,702,000
R3 Storage	1/1/2040	12/31/2043	$3,560,000
R26 Regulator Modifications	1/1/2043	12/31/2044	$123,000
Post-Construction Flow Monitoring / Programmatic Review	1/1/2045	12/31/2045	$40,000
LTCP Update Phase 3 Cost:			**$12,425,000**
LTCP Update Project Costs:			**$40,035,000**

ID	Project Name	Duration	Start	Finish
1	**LTCP Update Phase 1**	**6 years**	**1/1/24**	**12/31/29**
2	Linden Avenue Lift Station Upgrades		1/1/19	12/31/21
3	Separations at R6, R8, R9, R10, R11 and Y-Bridge PS Force Main Improvements Phase 1		1/1/17	5/1/24
4	Y-Bridge PS Force Main Improvements Phase 2		1/1/24	12/31/25
5	RWI Improvements at R3, R13 and R14		1/1/26	12/31/27
6	R12 Weir Modifications		1/1/26	12/31/27
7	Y-Bridge PS Force Main Improvements Phase 3		1/1/27	12/31/28
8	R30 Sewer Separation		1/1/27	12/31/28
9	Phase 1 Flow Monitoring/ Programmatic Review		1/1/29	12/31/29
10	**LTCP Update Phase 2**	**8 years**	**1/1/30**	**12/31/37**
11	R13 Sewer Separation		1/1/30	12/31/31
12	R14, R21 and R26 Float Gate Removal		1/1/33	12/31/33
13	WWTP Upgrades Phase 1		1/1/27	12/31/32
14	WWTP Upgrades Phase 2		1/1/33	12/31/36
15	Phase 2 Flow Monitoring/ Programmatic Review		1/1/37	12/31/37
16	**LTCP Update Phase 3**	**6 years**	**1/1/38**	**12/31/44**
17	R21 Storage		1/1/38	12/31/41
18	R3 Storage		1/1/40	12/31/43
19	R26 Regulator Modifications		1/1/43	12/31/44
20	Post-Construction Flow Monitoring/Programmatic Review		1/1/45	12/31/45

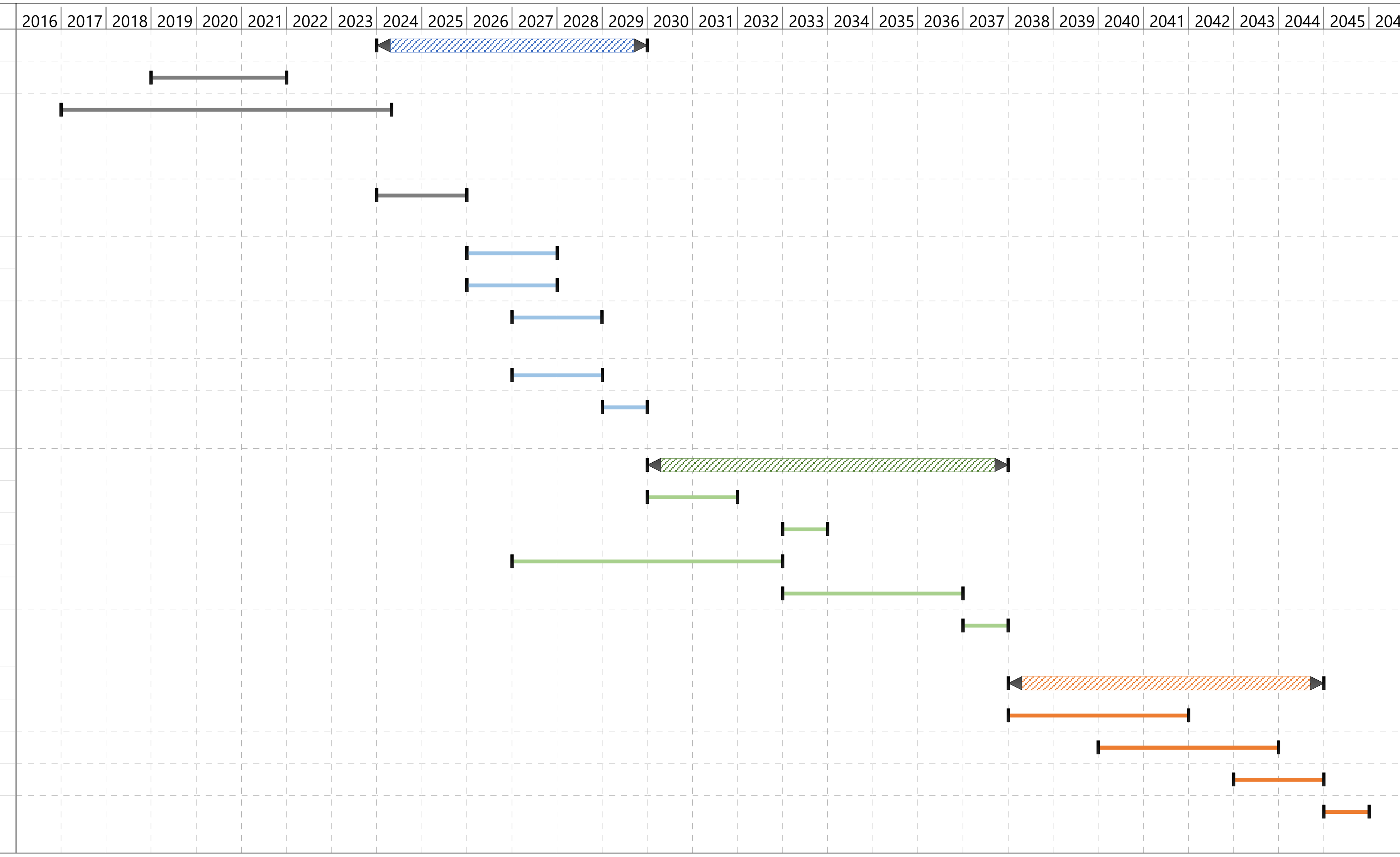

Figure 13-1 LTCP Update Implementation Schedule

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Appendix A
OEPA Correspondence
Documents

Appendix A Ohio EPA Correspondence Documents

The City of Zanesville

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Department of Public Service

Jay D. Bennett, DIRECTOR

April 6, 2016

Erin Sherer, NPDES Program Manager
Ohio EPA
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, OH 43216-1049

Re: City of Zanesville LTCP Compliance Schedule
NPDES Permit # 0PE0000*RD

Dear Ms. Sherer:

We are in receipt of the subject NPDES permit and wish to request modification to Part 1, C – Schedule of Compliance on page 19. During our review of the draft permit that was provided by the Ohio EPA for review prior to the official public notice period, Item A.2 with the provision for obtaining permits to install for the separation of sewers in basins R3, R6, R12, R14, R21, and R26 was not included and, therefore, we did not provide comment. However, this provision has been included in the final permit as issued and the City of Zanesville is unable to meet this provision.

Over the last two permit cycles the City of Zanesville has demonstrated a history of compliance with the Long Term Control Plan by completing improvements at the wastewater treatment plant, separating sewers in 7 Combined Sewer Overflow basins, and performing various required monitoring and studies. We are currently in the preliminary design stage for sewer separation of CSO basins R-8, R-9, R-10, & R-11 with an anticipated construction completion by December 31, 2018. Upon completion and submittal to Ohio EPA of the preliminary design phase of this project later this year, we would like to discuss the schedule and method of compliance for the remaining CSO basins. As discussed with OEPA Environmental Specialist 2, Christopher Kosto on 3/31/16, the City is still considering alternative treatment methods for a few CSO basins. We anticipate asking for a meeting with you and other appropriate OEPA staff this Fall to discuss our conclusions on that matter and anticipated long term completion dates. We would appreciate your feedback on this matter.

Sincerely,

Jay D. Bennett
Public Service Director

cc: Christopher Kosto, Ohio EPA
Bruce Goff, Ohio EPA

CITY OF ZANESVILLE 1797

Council-Mayor Government
Jeff Tilton, Mayor

The City of Zanesville

401 Market Street, Zanesville, Ohio 43701
Phone: (740) 617-4910
Email: jay.bennett@coz.org

Department of Public Service

Jay D. Bennett, DIRECTOR

May 7, 2018

Erin Sherer, NPDES Program Manager
Ohio EPA
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, OH 43216-1049

Re: City of Zanesville LTCP Compliance Schedule Update Request Letter

Dear Ms. Sherer,

The purpose of this letter is to request a modification to the schedule of compliance for the City of Zanesville's LTCP, as shown on page 19 of Zanesville WWTP NPDES permit 0PE00000*RD. The requested modifications reflect the changes discussed during the most recent meeting held between the Ohio EPA, City of Zanesville and AECOM on April 24, 2018. Part I,C.A of the NPDES permit language is shown below with the changes indicated in **bold**:

Part I, C - Schedule of Compliance
A. Combined Sewer System Long Term Control Plan
The permittee shall implement the "Combined Sewer System Long Term Control Plan" (LTCP) that was received by Ohio EPA June 12, 2007, approved by the Director June 17, 2008 as Plan Approval Number 06-278PW and amended on January 22, 2014 in accordance with the schedule below. The LTCP shall be implemented as expeditiously as possible, but not later than the dates below:

1. The permittee shall complete construction and attain operation of the separation projects as outlined in the approved long term control plan for sewer collection areas tributary to regulators R2,R4,R5,R7 by December 31, 2018 (Event Code 4599)

2. The permittee shall complete construction and attain operation of the separation projects as outlined in the approved long term control plan for sewer collection areas tributary to regulators R8,R9,R10, and R11 by December 31, **2019**. (Event Code 4599)

~~**2. No later than May 1, 2016, the permittee shall submit detailed plans and obtain a permit to install for construction of the sewer separation projects as outlined in the approved long term control plan for sewer collection areas tributary to regulators R3, R6, R12, R14, R21, and R26 (Event Code 1799).**~~

3. The permittee shall submit an updated LTCP by December 31, 2020.

4. The permittee shall submit three annual progress reports providing information regarding the implementation of activities in this compliance schedule according to the following schedule:

a. no later than 12 months after the effective of the permit; and

b. no later than 24 months after the effective of the permit.

c. no later than 36 months after the effective date of the permit.

d. no later than 48 months after the effective date of the permit.

5. Complete construction of all Long Term Control Plan projects and attain operation by December 1, 2022. (Event Code 4599)

6. This NPDES permit, Ohio EPA permit number 0PE00000*QD expires on January 31, 2021. This Schedule of Compliance includes items that extend beyond the term of the permit. The requirements of Schedule of Compliance, Item A2 will be included in permit 0PE00000 when it is renewed.

Should you require any more information, please call the number listed above.

Thank you.

Sincerely,

Jay D. Bennett
City of Zanesville
Public Service Director

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie Stevenson, Director

July 31, 2019

Re: Zanesville WWTP
Inspection
CSO/NMC
Muskingum County
0PE00000*SD

City of Zanesville
401 Market Street
Zanesville OH, 43701

Subject: Nine Minimum Control Implementation/Combined Sewer Overflow Inspection

Dear Mayor and Council:

On July 23, 2019, Ohio EPA staff Dustin Tschudy and I met with Scott Brown (WWTP Superintendent), and Kevin Allender (Pretreatment Coordinator) from the City of Zanesville (City) to conduct an inspection of the City's wastewater collection and treatment system. The purpose of the inspection was to determine compliance with Ohio's environmental laws and regulations as found in Chapter 6111 of the Ohio Revised Code (ORC) and Chapter 3745-33 of the Ohio Administrative Code (OAC) and the terms and conditions of the Zanesville WWTP NPDES Permit 0PE00000*SD. This letter focuses on the combined sewer overflows (CSOs), implementation of the nine minimum controls (NMCs) for reducing CSOs, and the status of the City's Long Term Control Plan (LTCP).

Findings

The City's LTCP was submitted on June 12, 2007 and approved by Ohio EPA on June 17, 2008 and was amended in 2014 and 2016. The LTCP recommended complete separation of the combined collection system by December 1, 2022. In 2016, the City completed separation projects and successfully eliminated CSOs 005, 007, 008, and 010. The City is currently working to separate sewers tributary to CSOs 009, 011, 012, 013, and 014, though it is expected that the projects will not be completed by the December 31, 2019 milestone.

The City has requested to develop an update to the LTCP, to be submitted to Ohio EPA by December 31, 2020 in accordance with Part I,C, Item B of the NPDES permit. With the considerable progress made through the separation work, the City would like to evaluate whether further separation is needed. Each of the CSO regulators have the same characteristic bottleneck; each 24" trunk sewer is connected to the interceptors by only an 8" pipe. Given the interceptor capacity freed by the completed separation projects, the City suspects that the remaining CSOs may be eliminated by simply increasing the size of the interceptor connection pipe. *During the inspection, it was recommended that the City research the recently codified Integrated Planning Framework developed by USEPA and evaluate whether Integrated Planning is an appropriate approach as they continue their LTCP development.*

Part II, Item W of the current NPDES permit (0PE00000*SD) lists the NMCs to be implemented in order to minimize pollutant loadings during wet weather events. Discussion regarding the City's efforts for each of the NMCs and recommendations for additional measures to improve upon current efforts is located in Attachment A.

Conclusion

Discussion and observations made during the inspection, as well as a review of information that you have submitted to this office, indicates that the City is in compliance with permit requirements calling for implementation of the NMCs at this time. Please note that continued implementation of the NMCs is critical to achieving compliance with your NPDES permit.

Recommendations

The recommendations below are not orders but are offered by Ohio EPA to provide compliance assistance to your facility.

- Evaluate the feasibility of raising the weir elevation at each CSO as high as possible without causing overflows or basement backups.
- Develop and implement a set schedule for routine sewer inspection and cleaning, such that the full system is inspected and cleaned at least every three to five years.
- Implement a mechanism for monitoring occurrences at all non-metered CSOs (such as chalk, floating block, etc.).
- Investigate alternatives for reducing or eliminating river water intrusion during development of the LTCP Update.
- Record inspection findings while in the field to ensure accuracy of inspection documentation.

If you have questions or concerns regarding this letter, I can be reached by telephone at (614) 644-2138 or e-mail at david.brumbaugh@epa.ohio.gov.

Sincerely,

David Brumbaugh
Environmental Specialist 2,
NPDES, Central Office
Ohio EPA, Division of Surface Water

encl: Attachment A: City of Zanesville Nine Minimum Controls Inspection Summary
Attachment B: NPDES Compliance Inspection Report (CSO/NMC)

ec: Scott Brown, Zanesville – Superintendent
Kevin Allender, Zanesville – Pretreatment Coordinator
Dustin Tschudy, Ohio EPA – DSW/SEDO

Attachment A
City of Zanesville Nine Minimum Controls Inspection Summary

On July 23, 2019, Ohio EPA Division of Surface Water (DSW) conducted an NMC/CSO Inspection at the Zanesville WWTP and collection system. Part II – Other Requirements Item W, in the permittee's NPDES permit (0PE00000*SD), indicates that the entire wastewater treatment system shall be operated and maintained so that the total loading of pollutants discharged during wet weather is minimized. This is to be accomplished through use of what is known as the Nine Minimum Controls (NMCs). Part II.B. of the National Combined Sewer Overflow (CSO) Control Policy discusses implementation requirements for these control measures, which are listed and discussed below.

1. <u>Proper operation & regular maintenance programs for the sewer system and CSOs.</u>
City staff operates and maintains the wastewater treatment plant (WWTP) and collection system, though operators and maintenance staff function as separate departments. The City owns a televising camera, though there is no regular schedule for sewer inspections; these activities have historically been implemented on a complaint-driven basis. With a recent increase in hiring, more inspection and cleaning activities have been conducted lately and, at the current pace, City staff project to inspect the full system in approximately 6 months. The City maintains O&M manuals for all unit processes and equipment at the WWTP, as well as for the CSO regulators. The City does not have an O&M manual for regular sewer cleaning and maintenance. The City is developing a GIS app to track assets and maintenance.
It is recommended that the City develop a set schedule for regular inspection of the sewers, such that the full system can be inspected at least every three to five years.

The City owns four pump stations which are inspected three times per week. Three of the four have a dedicated backup generator, and the fourth will receive one following an upgrade in 2020, based on a pending PTI. Additionally, all of the pump stations will receive a flow meter and be connected to the facility SCADA system upon completion of this project. CSO regulators are inspected daily during dry weather and then repeatedly throughout the day during or following precipitation events. City staff documents inspection findings upon return to the facility. **It is recommended that inspection findings be recorded in the field to improve the accuracy of inspection documentation.**

2. <u>Maximum use of the collection system for storage.</u>
The weirs at each of the CSOs is very low (perhaps 2"-6") above the invert of the combined sewer. The combination of the low weirs and the bottleneck caused by 24" trunk sewer flowing into the interceptor connection pipe (8") allows CSOs to discharge relatively easily, and before the WWTP reaches peak capacity. **It is recommended that the City evaluate whether and to what extent the weir elevation at each CSO can be raised without resulting in overflows or basement backups.**

The interceptor leading to the WWTP is approximately 9,000 linear feet of 60" sewer. When the WWTP reaches peak sustainable capacity, staff are able to partially close the influent gate and use the interceptor for storage. The City owns two vac trucks, though there is no regular schedule for sewer cleaning to remove deposited sediment on a regular basis. The City hopes to adopt such a schedule in the future. **It is recommended that the City develop a set schedule for routine cleaning of the sewer system, such that the full system can be cleaned at least every three to five years.**

All of the CSOs have either a duckbill or flapgate to reduce river water intrusion (RWI). The City recently recalibrated flow meters to detect flow direction and discovered significant RWI, which occupies considerable sewer and treatment capacity. RWI is particularly problematic at CSO 017 where, unless the CSO is discharging, RWI appears to be constant. The outfall is submerged and the regulator is likely below river level due to a dam immediately downstream and, while the duckbill prevents most RWI, the City staff suspects that river water is still infiltrating at pipe joints. Raising the weir elevation is unlikely to reduce RWI (though it would likely reduce CSO discharges and/or volume). **It is recommended that the City investigate alternatives for reducing or eliminating RWI during LTCP Update development.**

3. Review and modification of pretreatment requirements to assure CSO impacts are minimized.
The City has an Ohio EPA approved pretreatment program. The City has 15 significant industrial users and 15 non-significant industrial users, though most are food processing facilities, so discharge of organic or metal pollutants via CSOs is not a major concern. The City has discussed discharge during wet weather events with its largest flow contributor, but the user has no ability to withhold flow.

4. Maximize flow at the WWTP for treatment.
Wastewater received at the WWTP receives secondary treatment via trickling filter and activated sludge processes operated in series. The facility is designed to treat an instantaneous peak flow of 36 MGD, though stress tests have demonstrated that it can achieve an instantaneous peak of 30 MGD and sustainable peak of 27 MGD. At these peak flows, a hydraulic bottleneck near the head of the plant results in wastewater splashing out of the shallow channels of the primary screens. City staff believe that an upgrade to this portion of the facility would increase the overall treatment capacity.

There is a secondary treatment bypass which diverts primary effluent directly to the chlorine contact tanks, bypassing both the trickling filters and aeration basins. This bypass is activated at 27 MGD and is used to redirect instantaneous peak flows that could disrupt secondary treatment operation. A second bypass allows wastewater to skip the trickling filters and flow directly to the aeration basins, though this bypass is rarely used.

5. Prohibition of CSOs during dry weather.
Four outfalls are equipped with a flow meter to detect overflows, including during dry weather. The City visually inspects its outfall regulators daily during dry weather. City staff have not recorded a dry weather overflow in many years.

6. Control of solid and floatable materials in CSOs.
Sewers are cleaned primarily on a complaint-driven basis.

7. Pollution prevention.
The City owns two street sweepers which operate regularly and offers yard-waste removal in the fall. Catch basins and open ditches in known problem areas are cleaned frequently. Catch basins that flow directly to the river or lake are appropriately labelled if they have been replaced recently, though this has not been completed city-wide.

8. Notification to ensure the public receives adequate notification of CSO occurrences and impacts.
The City has installed appropriate signage at its outfalls. The City website includes information on CSOs and brochures are frequently provided for public education in sewer bills and at event booths.

9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.
Four of the CSOs (006, 009, 017, and 024) are equipped with a flow meter to record occurrences and volume. Reporting of occurrences at all other CSOs is dependent on inspections conducted daily and during precipitation events. All monitoring has been reported in accordance with the permit. **It is recommended that the City implement a mechanism for monitoring occurrences at the non-metered CSOs (such as chalking, floating block, etc.).**

Ohio Environmental Protection Agency

State of Ohio Environmental Protection Agency
Central Office

NPDES Compliance Inspection Report

Section A: National Data System Coding					
Permit #	**NPDES #**	**Month/Day/Year**	**Inspection Type**	**Inspector**	**Facility Type**
OH0028240	0PE00000*SD	July 23, 2019	CSO/NMC	S	1
Watershed:	Muskingum River				

Section B: Facility Data		
Name and Location of Facility Inspected	**Entry Time**	**Permit Effective Date**
Zanesville WWTP	10:00 am	September 1, 2018
1730 Moxahala Avenue	**Exit Time**	**Permit Expiration Date**
Zanesville, OH 43701	3:00 pm	January 31, 2021
Name(s) and Title(s) of On-Site Representatives	**Phone Number(s)**	
Scott Brown, Superintendent	740-455-0641, scott.brown@coz.org	
Kevin Allender, Pretreatment Coordinator	740-455-0641, kevin.allender@coz.org	
Name, Address and Title of Responsible Official	**Phone Number**	
City of Zanesville 401 Market Street Zanesville OH 43701	740-455-0601	

Section C: Areas Evaluated During Inspection (S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated)					
N	Permit	N	Flow Measurement	N	Pretreatment
S	Records/Reports	N	Laboratory	S	Compliance Schedule
S	Operations & Maintenance	N	Effluent/Receiving Waters	M	Self-Monitoring Program
N	Facility Site Review	N	Sludge Storage/Disposal	N	Other
S	Collection System				

Section D: Summary of Findings (Attach additional sheets if necessary)

- Evaluate raising the weir elevation at each CSO without causing overflows or basement backups.
- Develop a schedule for sewer inspection/cleaning, so the full system is inspected/cleaned at least every 3-5 years.
- Implement a mechanism for monitoring occurrences at non-metered CSOs (chalk, floating block, etc.).
- Investigate alternatives for reducing river water intrusion during development of the LTCP Update.
- Record inspection findings while in the field to ensure accuracy of inspection documentation.

Inspector	Reviewer
David Brumbaugh Environmental Specialist 2 NPDES Ohio EPA, Central Office Division of Surface Water	Dustin Tschudy Environmental Specialist 2 NPDES Ohio EPA, Southeast District Office Division of Surface Water
Signature: [signature] Date: 7-31-19	Signature: [signature] Date: 7/31/19

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
CSO IDENTIFICATION					
1. Are all CSO, SSO, and Bypass locations identified and permitted? Include the total number of each.	X				Part II, Item E: 16 CSOs 10/24/16 email: CSOs 005, 007, 008, and 010 closed in October 2016 **12 remaining** Secondary bypass = 602; TF bypass = 603
2. Does the facility have maps/schematics of the sewer system depicting Combined Sewer System (CSS) areas and Sanitary Sewer System (SSS) areas including CSO, bypass and SSO locations and receiving stream(s)?	X				Initiated GIS map 2-3 years ago, still filling it in
3. Are all CSOs identified by latitude/longitude, identification number, and receiving stream?	X				Part II, Item E
SANITARY SEWER OVERFLOWS (SSOs) & WATER IN BASEMENT (WIB)					
4. Have there been any SSOs since the last inspection?	X				Nothing chronic, though SSOs occur sporadically around system, typically due to roots Have had to pump-round an SSO due to a clog that occurred during a storm
5. Have there been any WIB complaints since the last inspection?	X				None in 3 years
6. Is there a WIB response plan?	X				Nothing formally documented. Calls directed to WWTP and a collections crew is dispatched to inspect lines, jet/vac if problem is in public sewers
DRY WEATHER OVERFLOWS (DWOs)					
7. How often does the facility check CSO locations during dry weather?					Daily, early in the day
8. If DWOs are identified, has the facility properly notified Ohio EPA of all DWO discharges? How?			X		None since perhaps early 2000s

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
9. If DWOs are occurring, does the facility have a corrective action plan to eliminate them? If yes, describe plan including defined tasks and schedules.			X		Same as WIB plan in #6 above
DESCRIPTION OF SYSTEM					
10. What percentage of the system has combined sewers?					~30%
11. Is there an inventory of the whole sewer system (e.g. sewer system map), and, if so, are the following items identified?					
a. All combined sewers and all sanitary sewers,	X				
b. All storm sewers connected to combined sewers,	X				
c. All major interceptors and trunk sewers,	X				
d. All sewer sizes, slopes and materials,	X				Sizes only in GIS map
e. All manholes and catch basins,	X				
f. All CSOs, SSOs, treatment plant bypasses and outfalls and the receiving stream(s).	X				
g. All control structures (regulators, diversion structures, weirs, valves....),	X				

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
h. All pump stations and their capacities,	X				
i. All locations for sampling, monitoring, and telemetering devices,	X				
j. All remote CSO treatment facilities including unit processes and capacities,			X		
12. Is the capacity of each interceptor sufficient to handle all dry weather flows?	X				
13. Is the peak treatment capacity known for each unit process at the WWTP? Include peak hydraulic flow, peak sustained treatable flow and average design flow.	X				ADDF = 11 MGD Instantaneous peak = 30 MGD attainable, though theoretically designed to 36 MGD Sustainable peak = 27 MGD Bottleneck = old primary screens have small channels – splashing on floor when flows peak Stress tests performed in 2014, 2016
14. Are portions of the interceptors or other lines adequately sized relative to the WWTP capacity? If not, identify undersized interceptors.	X				Interceptors deliver more than WWTP capacity, actually provide some storage capacity. The main trunk into the facility is 9000 LF of 60" sewer
15. Is the wet weather treatment capacity of the WWTP fully used before CSOs occur?		X			Most CSOs have same design – 24 trunk heading directly toward river; an 8" connection to interceptor directs dry weather flow, but nearly all else goes over a small weir (2"-6") and out the CSO. These are significant bottlenecks which almost certainly cause discharge prior to WWTP reaching peak. *LTCP update = have separations removed enough volume that the remaining CSOs can be eliminated/controlled by merely upsizing the connection to the interceptor?*
16. How many publicly owned pump stations are in the collection system?					4
17. Are all pump stations adequately sized and operating as designed? Are mechanisms in place to ensure the continuous pump operation? Does this include operable and/or telemetered alarms?	X				Y-bridge PS affects the most CSOs and will be assessed for efficiency/capacity during Update Was designed to accommodate a capacity upgrade, will decide whether now is appropriate time All PS are equipped with alarms with calling function. Pending PTI for Linden PS includes an upgrade to connect all PS to SCADA (2020)

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
18. Is standby power available for pump stations and CSO controls?	X				3 out of 4 have dedicated backup generator The last one, Linden PS has a portable generator hookup, but will receive a dedicated generator with the upgrade in 2020
OPERATION & MAINTENANCE					
19. Has the facility developed an Operational Plan or O&M manual? Does it address O&M of the collection system and overflows?	X				All O&M manuals maintained for individual unit processes & equipment Have O&M manual for CSO regulators, but not for standard sewer maintenance – goal for the future
20. When was the O&M manual last reviewed and updated?					
21. Is the facility implementing the O&M manual?	X				City has a maintenance division that is separate from the WWTP operators -maintenance generates daily, weekly, monthly, and annual worksheets for upkeep
22. Does the facility conduct regular inspections of the sewer system? What is the inspection method and frequency for the following:	X				
a. CSO (and SSO) outfall structures,	X				Daily
b. Regulator and diversion structures,	X				Daily, including pulling manhole lids
c. Pump/lift stations,	X				3x per week
d. Sewers (e.g. televise), and	X				City owns camera and 2 vac trucks Televising is historically complaint drive. Recent increased hiring has led to increased inspection activity. At current pace, should be able to see full system in 6 months
e. Surface water anti-intrusion devices (e.g. flapgates, etc.)?	X				City has either a duckbill or flapgate on each CSO (roughly half of each) - neither close very well Flow monitors have recently been calibrated to monitor flow direction, has shown lots of RWI, particularly at CSO 017 (observed during inspection) where outfall is always submerged due to dam just downstream
23. Are malfunctions of equipment repaired or replaced in a timely manner? If yes, give example.	X				City carries larger part inventory than before, allows in-house repairs more often: A sludge impeller failed recently, staff was able to rebuild that afternoon Long delays typically result from parts shipping internationally

Ohio EPA	CSO INSPECTION CHECKLIST	PAGE ___ OF 9

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
24. Does the facility check for and eliminate illegal connections? If yes, describe method and frequency.		X			City is not routinely inspecting, though they've done some smoke testing in the past New constructions required to have proper connection City is focusing on stormwater input before private connections
25. Does the facility properly operate all CSO control facilities during both dry and wet weather?			X		
26. Does the facility have schedules for routine maintenance such as catch basin cleaning and cleaning of trunk and interceptor sewers?	X				Done by maintenance division Catch basins = problem areas cleaned frequently, as well as open ditches Sewer cleaning = no routine schedule historically, hope to implement soon -- benefited greatly from DDAGW Asset Mgmt program, allowed tangential improvement on wastewater side; hope to fully implement for wastewater over next several years
27. Does the facility have schedules for pollution prevention measures such as: regular street cleaning in combined sewer areas with added emphasis on leaf removal, industrial flow control, drainage area marking, etc.?	X				Street dept has two sweepers that are regularly operated Leaf removal offered in fall Storm drains: new style are labeled 'drains to river' as they are installed, but are not yet installed city-wide 15 SIUs and 15 NSIUs, mostly food processing facilities, no organics/heavy metals to discharge via CSOs. Have discussed discharging with Kellogg's, which is located upstream of a CSO) but they have no capacity for storage
28. Are the stop planks, weirs, etc. set at the highest level practical without causing basement backups or excessive street flooding?		X			All weirs were only a few inches high (2-6"?), all could probably be raised **Recommend evaluating appropriate weir elevations during LTCP Update, including CSO 017**
29. Does the facility have (and describe) procedures for:					
a. Cleaning screening equipment after, and if necessary, during each storm,			X		
b. Regulating diversion and bypass valves, and	X				Clean after inspection if necessary
c. Reducing solids deposition in the CSS?	X				Remove clogs on irregular basis driven by complaints

Ohio EPA	CSO INSPECTION CHECKLIST				PAGE ___ OF 9
CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	**Y**	**N**	**N/A**	**UTD**	**(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:**
30. Can the overall condition of the entire sewer collection system and CSOs be described as good, if not, why?	X				Not a bad system for how old it is, still room for improvement
31. Are inspections documented, and, if so, does documentation include:	X				Log books maintained for individual operators
a. Results of various types of inspections,	X				CSO inspections typically documented upon return to facility **Recommend recording inspection findings while in the field to ensure accuracy of documentation**
b. Dates and times, and	X				
c. Corrective action taken if problems found?	X				
32. Is a log book of maintenance and repair on the sewer system and CSO structures maintained, and, if so, does the log book contain:	X				Operators conduct inspections, send report to maintenance division for remedies Long term plans to incorporate maintenance into GIS map
a. Identification of type of problems like collapsed and blocked sewers, basement backups, street flooding... (or indicate routine maintenance),	X				
b. Repair made (or maintenance activity conducted), and	X				
c. Time and date?	X				
RECORDS					
33. Are flow records kept for each lift station?	X				Run time only, flow meters to be installed at all PS as part of connection to SCADA

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
34. Are all overflows monitored in accordance with the permit?	X				City doing what permit requires, but permit is setup to only require reporting at 005 and 006 *Need to revise permit to include reporting at all stations?*
35. How are CSOs monitored (chalk, block, level sensor, etc.)?					Flow meters installed at 4 CSOs (006, 009, 017, and 024) Visual inspection at remaining 8 CSOs **Recommend implementing mechanism for monitoring occurrences (chalk, floating block, etc)**
36. Are the following records kept for each CSO location:					
a. Discharge frequency,	X				
b. Flow magnitude (volume); how is this measured?,	X				Documented at 4 CSOs with flow meters, not recorded at others
c. Pollutant characterization,	X				
d. Precipitation,	X				Gages at WWTP and airport
e. Specific causes of overflows,	X				Typically precipitation and roots
37. Are records of CSO control facilities (e.g., excess flow retention basin levels) maintained?	X				
38. Does the facility keep specific records on DWOs, SSOs and/or plant bypasses, and are they properly reported on the eDMRs?	X				
39. Is the facility implementing its Public Notification Plan? What records are being kept and where?			X		Lake Erie Basin only
40. Has notification signage been placed at all CSO outfalls ~~and impacted public access areas~~?	X				Signs often move (lean, fall over) when river is up for extended periods, but signs are rarely lost
41. Is the agency notified of all overflows in accordance with the permit?	X				

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
COMPLIANCE SCHEDULES					
42. Have there been any major repairs to the collection system since the last inspection?		X			Nothing unplanned
43. Is the facility meeting the terms and conditions of an enforcement action compliance schedule to correct sewers, CSOs, SSOs, DWOs, and/or bypassing? If no, describe.			X		

44. Is the facility meeting the compliance schedules established in the CSO Section of the facility's NPDES permit?	X				• Part I,C, Item A.2 – separate basins of CSOs 005, 007, 008, 010 - closed in October 2016
					• Part I,C, Item A.3 – separate basins of CSOs 011, 012, 013, 014 – due December 2019
					• Update LTCP 12/2020
					  ◦ Phase I – collection system characterization – 14 flow meters deployed through system (separate from CSO monitoring sensors)
					  ◦ Phase II – model analysis and alternatives development

45. Does a permit or enforcement agreement require implementation of each of the nine minimum controls?	X				Part II, Item W
46. Has documentation on the implementation of the nine minimum controls been submitted?	X				
47. Is the facility implementing the nine minimum controls as follows:					
a. Proper operation and regular maintenance programs for the sewer system and CSOs,	X				
b. Maximum use of the collection system for storage,	X				CSO 017 has near-constant RWI when CSO is not discharging. Raising the weir would likely not help reduce RWI because the outfall is submerged and the RWI is likely coming through pipe joints, not the duckbill/flapgate (but raising the weir would reduce CSO discharges). Other CSOs may have RWI issues too. **Recommend evaluating RWI fixes during LTCP development**

CHECK THE APPROPRIATE BOX (Y = YES, N = NO)	Y	N	N/A	UTD	(N/A = Not Applicable, UTD = Unable To Determine) COMMENTS:
c. Review and modification of pretreatment requirements to assure CSO impacts are minimized,	X				Local limits are to be reviewed upon permit renewal
d. Maximize flow to the WWTP for treatment,	X				
e. Prohibition of CSOs during dry weather,	X				
f. Control of solid and floatable materials in CSOs,	X				
g. Pollution prevention,	X				
h. Public notification to ensure that the public receives adequate notification of CSO occurrences and impacts,	X				Website provides information Brochures often included in bills and available at event booths Public access – boat ramp upstream of all CSOs, but can access area around 017 and 024. None below dam
i. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls?	X				
48. Has the facility developed (or is developing) a Long Term Control Plan (LTCP)?	X				Received June 12, 2007, approved June 17, 2008 – recommends complete separation Amended 1/22/14 and 12/12/16
49. Is the facility implementing the LTCP?	X				
50. Has the permittee requested an extension of time?	X				Requested additional year (to 12/2019) to complete separations in Item A.3 – likely will need another extension for this item, perhaps to summer 2020. Also requested to update LTCP, due December 2020

December 1, 2020

David Brumbaugh
NPDES Program Manager
Ohio EPA
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, OH 43216-1049

Re: City of Zanesville LTCP Update – Request to Modify Schedule of Compliance

Mr. Brumbaugh,

The purpose of this letter is to request a modification to the City of Zanesville's Schedule of Compliance as issued in the NPDES Permit No. 0PE0000*RD effective September 2, 2018. The existing Schedule of Compliance requires the City of Zanesville (City) to submit an update to the existing LTCP no later than December 31, 2020.

Since May 2019, the City has taken the necessary steps to review the performance of completed separation projects and WWTP improvements for the development of the LTCP Update. An adaptive management strategy was implemented to gather and assess extensive targeted data within the collection system. In March 2020, the City submitted the LTCP Phase II Technical Memorandum to Ohio EPA which provided an update on the ongoing efforts towards the LTCP Update, including preliminary findings of flow monitoring, river water intrusion analyses, field investigations, and development and calibration of a hydraulic model. The City and AECOM met with Ohio EPA in April 2020 to review Ohio EPA's comments and discuss future steps to effectively plan future capital improvement projects to address wet weather issues.

Since meeting with Ohio EPA earlier this year, the City and AECOM have been working towards completion of the LTCP Update by performing further field investigations, refining the hydraulic model, and developing a range of alternatives that include site-specific, cost-effective CSO controls with varying levels of control in accordance with the CWA.

Since our meeting with Ohio EPA, COVID-19 has disrupted daily operations across the nation. As a result, our City buildings were temporarily closed to the public and although we have recently put in place new operating procedures to hold public meetings virtually, we are requesting additional time to collect public feedback on the current alternatives being evaluated. Public perception is an integral part of assessing future capital improvement projects as part of the LTCP Update. It is anticipated that the LTCP Update projects will have a significant financial burden on residents as a result of the City's outstanding debt, population reduction and a median household income much lower than the national average.

The City has been tracking the latest developments with the 2020 FCA guidance and would also utilize the extension to provide time to analyze the impact of the new guidance on the LTCP Update.

In addition, a new Mayor was elected to office in November 2019. In order for the City to commit to new legislation as part of the LTCP Update it is critical for City Council to collect public input and to gain consensus from the community on the path moving.

The City is requesting a modification to the existing Schedule of Compliance Part I,C. Item B. We envision including this change under the ongoing NPDES Permit Renewal-the City's NPDES permit expires January 31, 2021. Specifically, the City is requesting to extend the LTCP Update submittal date to December 31, 2021. It is anticipated that a 12-month extension will be sufficient to:

1. Perform public outreach
2. Modify alternatives to incorporate public input
3. Update the FCA and utilize the adaptive management strategy to finalize a cost-effective CSO control strategy
4. Finalize a schedule for all phases and capital improvement projects in the selected alternative
5. Execute legislature to authorize submittal of the LTCP Update

The City continues to move forward with separation projects at R-6, R-8, R-9, R-10 and R-11 from the 2007 LTCP. The current NPDES Permit includes a compliance date for completion of construction on these separation projects by December 31, 2019. This missed milestone was discussed during the City's teleconference meeting with Ohio EPA on April 14, 2020 with a follow up letter submitted to Ohio EPA on April 27, 2020 describing the violation and the plan to complete the separation projects. Due to COVID-19, and inclusion of the R6 separation project into the WPCLF loan package, the schedule for these separation projects has been slightly delayed. The City anticipates that bids will be solicited, the loan application for the construction phase of the WPCLF 0% loan will be submitted to Ohio EPA, and construction will begin in 2021. We are requesting that as part of the NPDES Permit Renewal, Ohio EPA include a new compliance schedule date for these separation projects. We anticipate that the construction of these separation projects will be complete by July 31, 2022.

Please let me know if Ohio EPA would like to schedule a meeting between the City, AECOM and Ohio EPA to discuss the regulatory path moving forward in updating the LTCP.

Sincerely,

Scott Brown,
City of Zanesville, Public Service Director

cc: Chip Saunders – City of Zanesville
Caitlin Ruza, PE, ENV SP – AECOM
Kurt McGinnis – Ohio EPA

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie Stevenson, Director

December 22, 2020

Re: **Zanesville WWTP**
LTCP Correspondence
NPDES
Muskingum County
0PE00000

Charles Saunders, City Engineer
City of Zanesville
401 Market Street
Zanesville, OH 43071

Subject: City of Zanesville LTCP Extension Request

Dear Mr. Saunders:

This letter is in response to the City of Zanesville's December 1, 2020 letter, in which the City requested modifications to Zanesville WWTP's NPDES permit (0PE00000) schedule of compliance. The letter included extensions for two compliance milestones:

1. **Part I,C, Item B** - Update to Long Term Control Plan

   The current permit requires the City to submit an LTCP Update by the end of this month, December 31, 2020. The City cites a lack of opportunities for public participation in plan development due to COVID-19 impacts on the viability of public meetings. To adequately collect input from residents, the City requested a one-year extension for a new submission deadline of December 31, 2021. Public participation is a vital component to LTCP development, therefore the extension is granted.

2. **Part I,C, Item A.2** – Separation of regulators R6, R8-R11

   The original milestone for the separation of the R8-R11 sewersheds was December 31, 2018 and this is the <u>third extension request</u> the City has made for this project. The City has requested an additional eight months beyond the previous request, for a new completion deadline of July 31, 2022, citing COVID-19 and expansion of the project scope. The extension is granted, however action is required soon to maintain progress toward WPCLF approval, even under the new timeline. The City has not been in communication with the Division of Enforcement and Financial Assistance (DEFA) about this project in four months and a PTI has yet to be submitted. We recommend that the City contact DEFA directly to identify what outstanding deliverables are owed and when they are due to attain compliance with this milestone because additional extensions will not be forthcoming.

The current permit expires on January 31, 2021, therefore the above changes will be incorporated into the permit renewal (0PE00000*TD). We would like to meet regularly to ensure that Ohio EPA and the City are communicating effectively during the final stages of LTCP development. Please contact David Brumbaugh at david.brumbaugh@epa.ohio.gov to set a meeting date in January 2021.

Sincerely,

Ashley Ward, P.E.
NPDES Manager
Ohio EPA, Central Office
Division of Surface Water

ec: Chip Saunders, Zanesville – City Engineer
Scott Brown, Zanesville – WWTP Superintendent
Caitlin Ruza, AECOM – Consultant
Jennifer Witte, Ohio EPA – DSW/SEDO
Kurt McGinnis, Ohio EPA – DSW/SEDO
David Brumbaugh, Ohio EPA – DSW/CO

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie Stevenson, Director

October 20, 2022

Re: Zanesville WWTP
Permit - Long Term
NPDES
Muskingum County
0PE00000

Charles Saunders, City Engineer
City of Zanesville
401 Market Street
Zanesville, OH 43071

Subject: City of Zanesville Long Term Control Plan Update

Dear Mr. Saunders:

The City of Zanesville submitted a *Long Term Control Plan Update* (LTCP) to Ohio EPA for review and approval on December 30, 2021. The LTCP was submitted in accordance with Part I,C, Item B of the NPDES permit for Zanesville WWTP (0PE00000*SD) and an Ohio EPA letter dated December 22, 2020, which extended the submission deadline to December 31, 2021. For the LTCP, the City updated the hydraulic model of the collection system (previously presented in a technical memo submitted on March 24, 2020), evaluated a range of alternatives for combined sewer overflow (CSO) control, and proposed a plan to attain a level of control of four events per typical year with a 25-year implementation schedule.

Thank you for submitting the LTCP, Ohio EPA offers the following comments:

1. The City's current permit includes an authorization of anticipated CSO-related bypasses at Station 602 when flow rates exceed 27 MGD (Part I,B, Item 8, footnote g). However, footnote i requires that "Use of this bypass shall cease when the permittee has fully implemented the requirements of the approved CSO long-term control plan." Because the City does not intend to complete the approved LTCP, the basis for the bypass approval is no longer applicable.

   The recommended alternative in the LTCP Update includes restoring the peak hydraulic capacity of the WWTP to 36.2 MGD, suggesting that use of the bypass is to be an indefinite aspect of WWTP operations during wet weather. To support this and maintain approval of CSO-related bypasses in the permit, the LTCP must include a No Feasible Alternative (NFA) analysis.

   a. Has the City evaluated the treatment efficacy of the trickling filters and solids contact tanks separately? Can the WWTP feasibly be configured so that these two biological treatment systems can run in parallel during wet weather, rather than in series? Would the discharge meet effluent limits if these were run in parallel and blended?

2. In previous discussions, Ohio EPA acknowledged that the City's NPDES permit was drafted incorrectly, preventing the City from reporting CSO data from any outfall other than 005 and 006. In our March 24, 2020 letter, we stated that the problem had been corrected and that the City could report CSO data in eDMR as required by the permit. A review of recent electronic Discharge Monitoring Reports (eDMR) show that data required by Part I,B, Item 1 was only reported for a few

months in 2020. Please enter into eDMR all missing data for each CSO dating back to 2017. For the purposes of retroactively entering data, annual totals entered in each year's December eDMR is sufficient. For 2022 and going forward, please regularly enter the required data each month.

a. In the February 2020 eDMR, the City reported more than ten occurrences at seven CSOs that are not reflected in the report attached to the City's April 28, 2020 letter. Please review eDMR data during this time and make changes as appropriate. Alternatively, can the City explain why CSO occurrence numbers were so high during this period?

3. In Section 9.5, only one year (2012) is presented in the 20-year typical year analysis. Please provide statistics (as in Table 9-4) and top five storms (as in Table 9-5) for the next three most typical years in the 20-year evaluation period.

4. The 2020 Technical Memo provided a comparison between the CSO results predicted by the hydraulic model existing conditions and recent observed CSO activity. This comparison was not made in the LTCP. Using the existing conditions in the hydraulic model, please apply rainfall data for each of the last five years to the hydraulic model under existing conditions and compare the modeled CSO activity to observed CSO activity.

5. Using the same rainfall data collected for comment 4, please model CSO activity for each of the last five years using the hydraulic model under the recommended alternative conditions.

6. Appendix E showed the hydrographs for peak volume and peak flow rate, by which the hydraulic model was calibrated. Please also provide hydrographs showing peak depth for each calibration event.

7. Section 10.5.2.1 states that the remaining 20% of the R13 sewershed is to be separated but Section 10.5.2.3 states that the reconfigured overflow structure is to remain open to discharge. If there are no combined sewers tributary to an overflow structure, that outfall cannot be defined as a CSO and must be reclassified as a sanitary sewer overflow (SSO). Following separation for the remaining 12 properties, will there be any combined sewers upstream of R13? If not, with what frequency (i.e. storm return interval) is the interceptor expected to exceed 678.6 feet?

8. Please assign dates-certain to the implementation schedule.

9. The City initiated design of the current separation project in 2016 for an original completion date in 2018. The proposed completion date (the end of Year 1) constitutes a fourth extension of this project (notwithstanding the additional delay due to a recent DEFA finding, of which the City was notified after submission of the LTCP). Ohio EPA requires the following projects be completed in Phase 1:
   - R30 Separation and R26 modification
   - River Water Intrusion (RWI) improvements at R3, R13, and R14
   - R12 Modifications

   Each is relatively inexpensive and small in scope. The issues at for Racks 3, 12, 13, 14, and 26 (weir improvements and intrusion reduction) fall under the purview of the Nine Minimum Controls (specifically Part II, Item W.2 of NPDES permit) and should be implemented as soon as practicable.

10. The model predicts that R14 is already attaining the target performance of four occurrences in the typical year under existing conditions, thus no control projects are proposed. However, the model seems to be underpredicting discharge frequency, as the City reported 17 and 53 occurrences in 2020 and 2021, respectively. Moreover, the 5^{th} largest storm in the typical year (which was used for alternative design) is similar to (if not larger than) the August 13, 2019 observed during the calibration period, during which the City recorded a CSO occurrence. We acknowledge that the volumes are small and the apparently significant RWI at this outfall causes a considerable amount of uncertainty. Therefore, we recommend moving the RWI control to Phase 1, then re-evaluating the need to implement additional control in subsequent phases.

11. In Section 2.3, an excerpt from Ohio EPA's most recent CSO Inspection notes that operators use capacity in the Main Interceptor for storage when throttling plant influent is necessary. Please discuss and illustrate the hydraulic grade line in the Main Interceptor before the proposed plant improvements, then after the proposed plant improvements both with and without the proposed R3 in-line storage.

12. In Appendix B, several units were identified as needing improvement but were not included in the proposed projects, such as the grit dewatering equipment. How did the City determine whether projects were necessary or not?

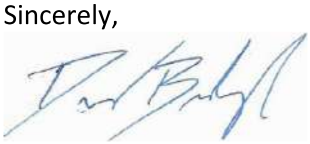
13. In Appendix B, do the estimated costs include demolition of abandoned systems, such as the secondary clarifiers and chlorine contact tanks?

14. The table on page 8 of Appendix G presents the WWTP projects separated into the two phases:
    a. The table does not include demolition of the secondary screens, which was identified as the plant's most significant hydraulic bottleneck. Ohio EPA recommends that this item be included in Phase 1 to restore plant capacity as soon as possible.
    b. The table indicates that the secondary pump station improvements are assigned to Phase 2, which was identified as necessary to reach 36 MGD. Ohio EPA recommends that this item be included in Phase 1 to restore plant capacity as soon as possible.

15. In Appendix H, the Financial Capability Analysis (FCA) identifies a Residential Factor of 90% as part of the Residential Indicator Analysis. Please describe how this value was determined.

Please consider the above comments and provide Ohio EPA with a timeline in which you anticipate providing a response. In the meantime, if there are any questions regarding this letter, please contact me at david.brumbaugh@epa.ohio.gov.

Sincerely,



David Brumbaugh
Environmental Specialist 3
Ohio EPA, Central Office
Division of Surface Water

ec: Scott Brown, Zanesville – WWTP Superintendent
Ashley Ward, Ohio EPA – DSW/CO
Marco Deshaies, Ohio EPA – DSW/SEDO
Jennifer Witte, Ohio EPA – DSW/SEDO
Kurt McGinnis, Ohio EPA – DSW/SEDO

AECOM
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Columbus OH, 43215
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aecom.com

September 12, 2023

David Brumbaugh
Environmental Specialist 3
Ohio EPA, Central Office DSW
50 W. Town St.
Columbus, Ohio 43215

Re: Long Term Control Plan Update OEPA Comment Response, City of Zanesville, Ohio

Encl: Attachment 1- Observed vs. Predicted Overflow Summary, 2018-2022 – Existing Conditions
Attachment 2- Predicted Overflow Summary 2018-2022 – Selected Alternative
Attachment 3- Hydraulic Model Calibration Depth Graphs
Attachment 4- LTCP Update Implementation Schedule
Attachment 5- Main Interceptor Peak HGL Profiles

Dear Mr. Brumbaugh,

The purpose of this letter is to respond to the questions and comments received from the Ohio EPA on October 20, 2022 regarding the City of Zanesville (City) LTCP Update. The following items include the comments received from the Ohio EPA and the City's response. A meeting is scheduled for September 19, 2023 to discuss these items.

1. **Ohio EPA Comment*:*** The City's current permit includes an authorization of anticipated CSO-related bypasses at Station 602 when flow rates exceed 27 MGD (Part I,B, Item 8, footnote g). However, footnote i requires that "Use of this bypass shall cease when the permittee has fully implemented the requirements of the approved CSO long-term control plan." Because the City does not intend to complete the approved LTCP, the basis for the bypass approval is no longer applicable.

   The recommended alternative in the LTCP Update includes restoring the peak hydraulic capacity of the WWTP to 36.2 MGD, suggesting that use of the bypass is to be an indefinite aspect of WWTP operations during wet weather. To support this and maintain approval of CSO-related bypasses in the permit, the LTCP must include a No Feasible Alternative (NFA) analysis.

   City Response: It appears that the requirement Ohio EPA referred to in the October 22, 2022 response (Part I, B, Item 8, footnote g) was included in the previous draft of the City's permit (0PE00000* RD) and is not included in the current version of the City's permit 0PE00000* TD authorized on March 6, 2023. Please advise whether the City needs to include a No Feasible Alternative (NFA) analysis in the LTCP Update if the requirement to "cease use of the Station 602 bypass when the permittee has fully implemented the requirements of the approved CSO long-term control plan" is no longer included in the City's permit under Station 602 bypass limitations and monitoring requirements (Part I,B, Item 7).

   a) **Ohio EPA Comment:** Has the City evaluated the treatment efficacy of the trickling filters and solids contact tanks separately? Can the WWTP feasibly be configured so that these two biological treatment systems can run in parallel during wet weather, rather than in series? Would the discharge meet effluent limits if these were run in parallel and blended?

      City Response: The WWTP employs the TF/SC (Trickling Filter/Solids Contact) treatment technology, which is a distinct process that relies on the TF and the SC operating in tandem, along with secondary clarification. The TF and SC units cannot therefore be run in parallel or decoupled while meeting the permitted effluent limits.

2. **Ohio EPA Comment:** In previous discussions, Ohio EPA acknowledged that the City's NPDES permit was drafted incorrectly, preventing the City from reporting CSO data from any outfall other than 005 and 006. In our March 24, 2020 letter, we stated that the problem had been corrected and that the City could report CSO data in eDMR as required by the permit. A review of recent electronic Discharge Monitoring Reports (eDMR) show that data required by Part I,B, Item 1 was only reported for a few months in 2020. Please enter into eDMR all missing data for each CSO dating back to 2017. For the purposes of retroactively entering data, annual totals entered in each year's December eDMR is sufficient. For 2022 and going forward, please regularly enter the required data each month.

   City Response: Required data will be reported for each month going forward.

   a. **Ohio EPA Comment:** In the February 2020 eDMR, the City reported more than ten occurrences at seven CSOs that are not reflected in the report attached to the City's April 28, 2020 letter. Please review eDMR data during this time and make changes as appropriate. Alternatively, can the City explain why CSO occurrence numbers were so high during this period?

      City Response: The City experienced several continuous days of antecedent precipitation/snowmelt in late-January to mid-February 2020 which likely contributed to increased groundwater levels and as a result, an increased number of CSO occurrences.

      In addition, the back-to-back, low-volume CSO occurrences reported at R3, R12, R13, and R14 during February 2020 were likely related to river water intrusion (refer to Section 8 of the LTCP Update for RWI analysis findings). **Figure 1** shows the maximum daily river stage reported at USGS River Gage No. 03148000 from January through December 2020. Maximum daily river levels trended relatively high from January through May 2020, fluctuating between daily high river levels of 11.0-ft and 20.9-ft, compared to later months (June through October) where daily high river levels rarely exceeded 10-ft. As a result, there was an increased number of RWI-related CSO occurrences at R3, R12, R13, and R14 from January through May 2020 compared to later months.

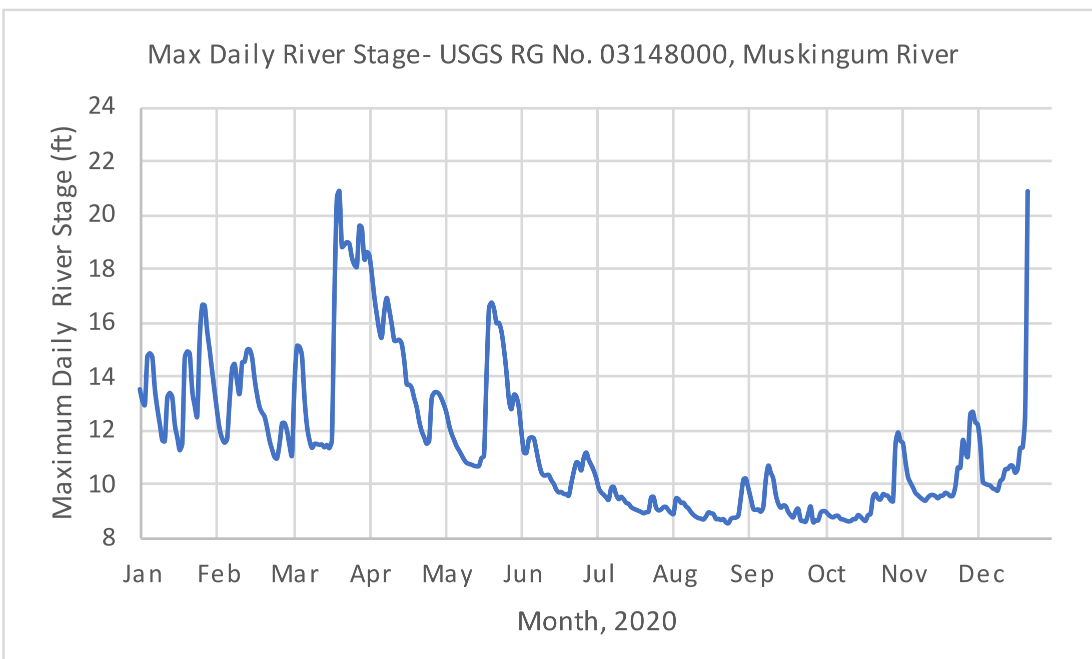


Figure 1: Daily Maximum River Stage at USGS Rain Gage 03148000, 2020

3. **Ohio EPA Comment:** In Section 9.5, only one year (2012) is presented in the 20-year typical year analysis. Please provide statistics (as in Table 9-4) and top five storms (as in Table 9-5) for the next three most typical years in the 20-year evaluation period.

   City Response: Table 1 shows the top five storms for the next three most typical years (representative precipitation year in the historical evaluation period) in the 20-year evaluation period.

Table 1: 20-Year Typical Year Alternatives – 1993, 1998, 2005

20-Year Typical Year: 1993				
Storm Rank	**Date**	**Total Rainfall (in)**	**Duration (hr)**	**Storm Category**
1	7/1/1993	2.94	57	2-yr 48-hr
2	11/17/1993	1.61	19	6-mo 18-hr
3	4/25/1993	1.50	16	6-mo 12-hr
4	7/19/1993	1.16	4	6-mo 3-hr
5	1/4/1993	1.35	15	4-mo 12-hr
20-Year Typical Year: 1998				
Storm Rank	**Date**	**Total Rainfall (in)**	**Duration (hr)**	**Storm Category**
1	12/21/1998	2.56	17	2-yr 12-hr
2	4/15/1993	2.20	11	2-yr 6-hr
3	6/21/1993	1.51	2	2-yr 2-hr
4	10/7/1993	1.61	12	6-mo 12-hr
5	6/29/1993	1.14	4	6-mo 3-hr
20-Year Typical Year: 2005				
Storm Rank	**Date**	**Total Rainfall (in)**	**Duration (hr)**	**Storm Category**
1	1/4/2005	3.03	34	2-yr 24-hr
2	8/30/2005	2.95	28	2-yr 24-hr
3	1/11/2005	2.13	25	1-yr 24-hr
4	4/22/2005	2.09	60	9-mo 48-hr
5	1/2/2005	1.97	37	9-mo 24-hr

4. **Ohio EPA Comment:** The 2020 Technical Memo provided a comparison between the CSO results predicted by the hydraulic model existing conditions and recent observed CSO activity. This comparison was not made in the LTCP. Using the existing conditions in the hydraulic model, please apply rainfall data for each of the last five years to the hydraulic model under existing conditions and compare the modeled CSO activity to observed CSO activity.

   City Response: Rainfall data was obtained for the 5-year period from January 1, 2018 through December 31, 2022 at the USGS rain gage located at the Zanesville Municipal Airport. Data was reported in 1-hour intervals and obtained using the Midwestern Regional Climate Center cli-MATE data portal and was imported into the Existing Conditions model as requested. **Figure 2** shows the observed versus predicted (modeled) total CSO volume for the four metered CSO locations (R3, R6, R14 and R21) during each of the 5 years evaluated.

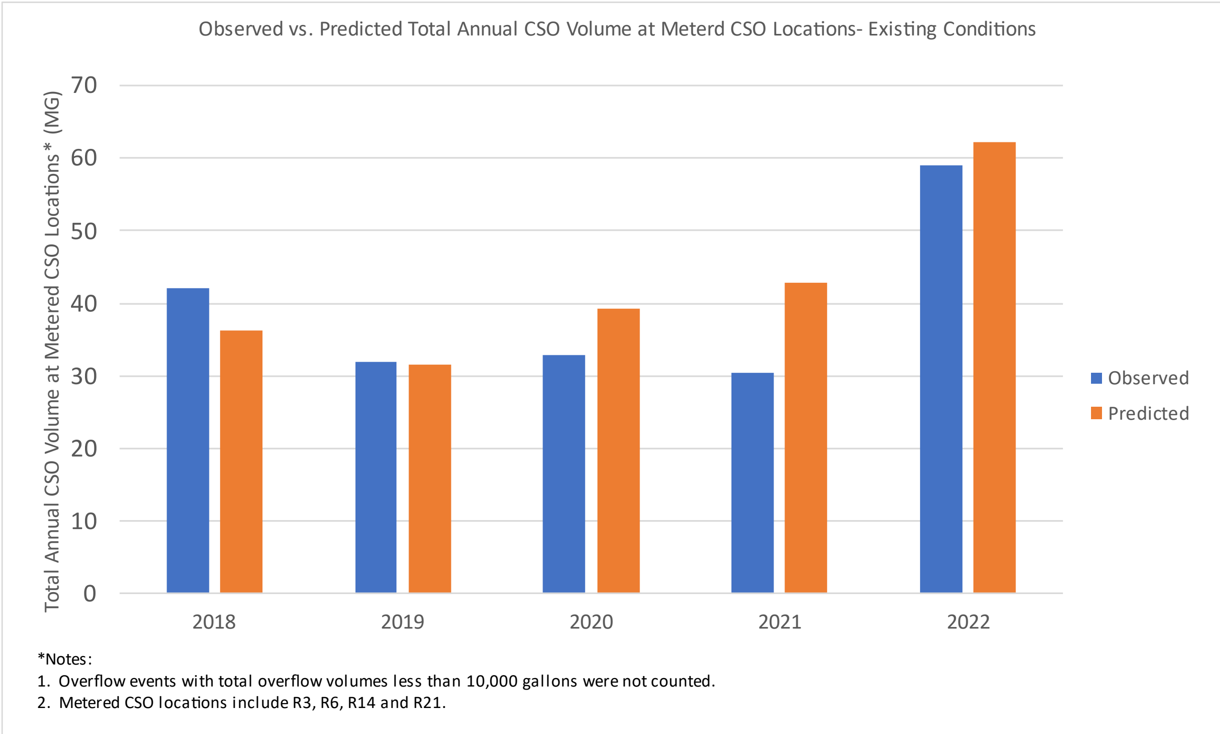


Figure 2: Observed vs. Predicted Total Annual CSO Volume at Metered CSO Locations, 2018-2022 – Existing Conditions

Attachment 1 also shows the observed vs. predicted number of overflow occurrences at each CSO location for each of the 5 years evaluated.

It should also be noted that there are several factors which may result in discrepancies between observed and predicted CSO activity including but not limited to:

1. The calibrated Existing Conditions model does not account for river water intrusion which is suspected to impact R3, R9, R12, R13 and R14 as discussed in Section 8 of the LTCP Update.
2. The calibrated Existing Conditions model was based on an empirical approach to groundwater infiltration, where groundwater infiltration was included in the baseline flow and varied using diurnal, weekly and monthly flow patterns as observed in the flow monitoring data. If actual groundwater levels and/or soil moisture levels varied substantially during one particular season or from one year to another, this may result in discrepancies between the predicted flow response and actual flow response in the collection system.
3. Available rainfall data applied to the model is based on observed rainfall at the Zanesville Municipal Airport, which is approximately 5 miles northeast of the northern boundary of the City's collection system. Any spatial or time variability between the precipitation observed at Zanesville Municipal Airport and the actual precipitation that occurred across the City's collection system may lead to variability in CSO occurrences.
4. Due to limited availability of refined rainfall data for the 5-year evaluation period, the modeled results included in this letter are based on 1-hour rainfall intensity intervals while the calibrated Existing Conditions model used for the LTCP Update was based on 5-minute rainfall intensity. The impact of these two varying intensity intervals can be significant, especially for storms with large rainfall volumes occurring over a short period of time.

   Figure 3 demonstrates the differences in hourly versus 5-min rainfall intensity intervals for a given rain event. The figure shows the observed 1-hour rainfall intensity at Zanesville Municipal Airport (ZaneAir) during the July 2, 2019 rain event compared to the 5-minute rainfall intensity recorded at the two rain gages installed during the calibration period (Zane01 and Zane02). The maximum rainfall intensity from the 5-minute rainfall data was significantly higher than the rainfall intensity from the hourly rainfall data, as the total hourly rainfall intensity is distributed evenly across each hour, resulting in reduced peak flows within smaller portions of the collection system where the time-of-concentration is less than the one hour increment. As a result, the observed versus predicted CSO occurrence frequency will likely be different when utilizing hourly rainfall data. This is important to note when comparing the calibrated Existing Conditions model data (calibrated using 5-minute rainfall) versus the Existing Conditions model simulated using 1-hour rainfall data.

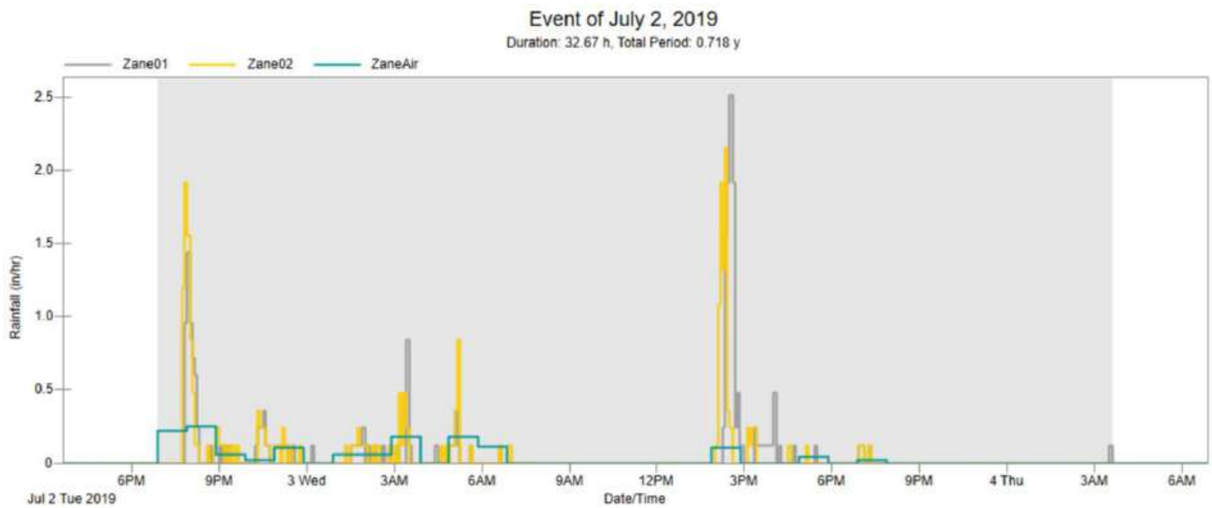


Figure 3: 5-min vs. Hourly Rainfall Intensity Hydrograph – 7/2/2019

5. **Ohio EPA Comment:** Using the same rainfall data collected for comment 4, please model CSO activity for each of the last five years using the hydraulic model under the recommended alternative conditions.

   City Response: Refer to **Attachment 2** for predicted CSO activity for the 5-year evaluation period under the Selected LTCP Update Alternative conditions. The results showed that the desired CSO control level of four-or-less system-wide CSO occurrences during the typical year would have theoretically been achieved with the Selected LTCP Update Alternative based on hourly rainfall obtained for 2019, 2020, and 2021 used in this analysis. The CSO control level of four-or-less system-wide overflows during the typical year would not have been achieved for 2018 and 2022 based on the hourly rainfall data used in the analysis.

   Note that the CSO control policy is based on evaluating the level of service during the 2012 Typical Year, or the representative precipitation year for the 20-year evaluation period. The 20-year typical year (2012) consisted of a total rainfall of 37.1-inches. The total annual rainfall that occurred in 2018 was both approximately 18.6% higher (44.0-in) than the 2012 Typical Year and the total annual rainfall that occurred in 2022 was 19.4% higher (44.3-in) than the 2012 Typical Year, which likely resulted in increased CSO occurrences in the future conditions model simulations during these years.

6. **Ohio EPA Comment:** Appendix E showed the hydrographs for peak volume and peak flow rate, by which the hydraulic model was calibrated. Please also provide hydrographs showing peak depth for each calibration event.

   City Response: Refer to **Attachment 3** for peak depth graphs showing observed vs. modeled peak depth for each calibration event at each flow monitoring location. Note that the peak depth graphs for FM-10 and FM-11 show that observed peak depths were higher than predicted peak depths for the calibration events. This is likely attributed to the fact that flow meter sensor accuracy is reduced during low flow/low depth periods, especially for larger pipes. The FM-10 flow meter sensor was installed on a 24-inch pipe which experienced extremely low peak flows/depths, with a maximum flow depth of just under 1-inch during the calibration period. Similarly, the flow meter sensor for FM-11 was installed on a 54-inch pipe at 3.3% slope. Observed peak depths at FM-11 ranged from 11% to 66% full during the calibration period, likely resulting in reduced accuracy in depth measurements.

7. **Ohio EPA Comment:** Section 10.5.2.1 states that the remaining 20% of the R13 sewershed is to be separated but Section 10.5.2.3 states that the reconfigured overflow structure is to remain open to discharge. If there are no combined sewers tributary to an overflow structure, that outfall cannot be defined as a CSO and must be reclassified as a sanitary sewer overflow (SSO). Following separation for the remaining 12 properties, will there be any combined sewers upstream of R13? If not, with what frequency (i.e. storm return interval) is the interceptor expected to exceed 678.6 feet?

   City Response: There will be no combined sewers in the R13 sewershed after the R13 sewer separation project is completed. However, the R13 overflow structure is currently hydraulically connected to key features of the City's combined collection system (Joe's Run Interceptor, the Linden Avenue Interceptor and the Y-Bridge Pump Station) to provide hydraulic relief when/if the Y-bridge Pump Station is offline or has exceeded its capacity during wet weather conditions. The R13 overflow connection activates before the Y-Bridge Pump Station screens are overtopped (the R13 overflow connection activates when wet well levels exceed approximately 678.6-ft and the screens are overtopped when the wet well elevation exceeds 689-ft), making the R13 overflow connection a critical feature in protecting basements along the downstream portions of the combined sewer interceptors.

   Figure 4 shows the existing configuration of the R13 combined sewer, the R13 overflow structure, and the combined sewer connections to the R13 overflow structure. The figure shows that during dry weather conditions, the R13 regulator structure currently conveys combined flows from the R13 sewershed to the Y-Bridge Pump Station through the existing 24" dry weather connection. However, during large rainfall events, it is expected that inflows to the Y-Bridge Pump Station will likely exceed the 20 MGD design capacity during future conditions, resulting in surcharged interceptor levels in the sanitary sewer system (specifically, at the downstream portions of Joe's Run and the Linden Avenue Interceptor). When interceptor levels exceed approximately 678.6-ft at MH 1098, combined sewer flow from Joe's Run and the Linden Avenue Interceptor is conveyed into the R13 overflow structure through the 24" sanitary sewer connection, resulting in an CSO occurrence at R13. AECOM recommends that elimination or modification of the R13 overflow connection to MH 1098 be evaluated after downstream capacity improvements (specifically the Y-Bridge pump station improvements) are completed to prevent water-in-basements during future conditions.

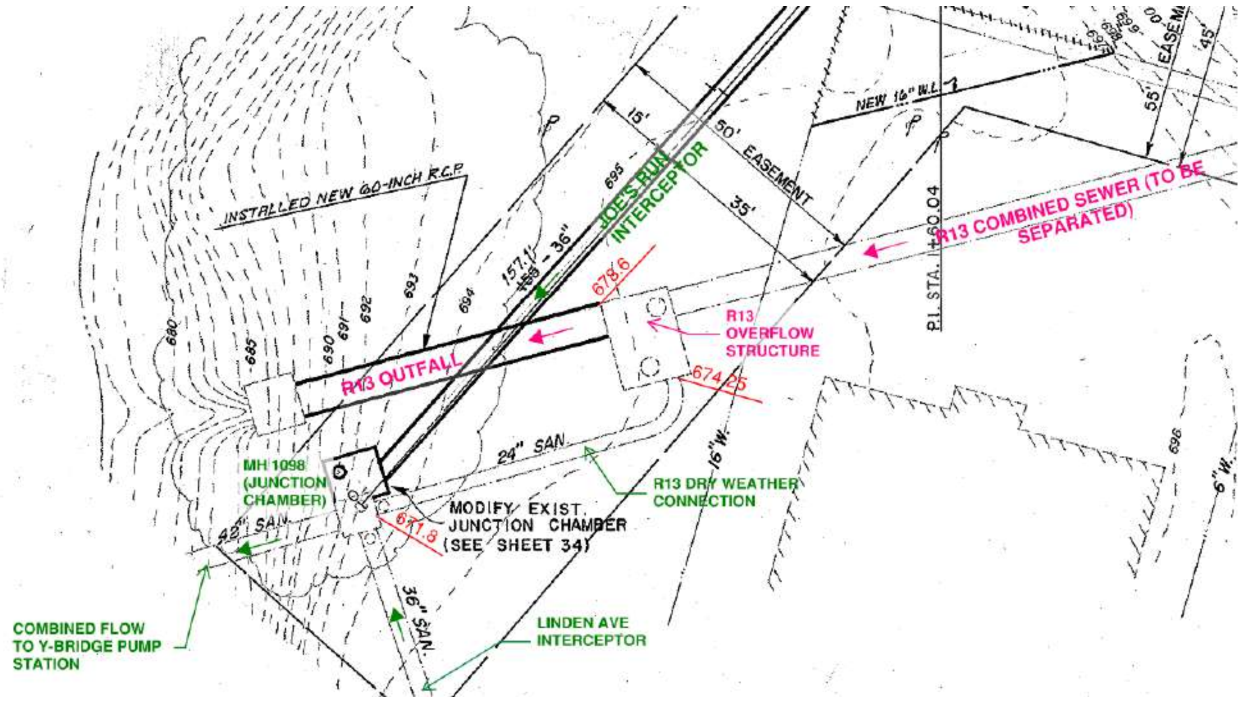


Figure 4: R13 Overflow Connection and Combined Sewers Overview (adapted from 1982 Joe's Run Interceptor Sewer Record Plans)

As a result of these recommendations, the City proposes that additional flow monitoring and hydraulic modelling be performed after the Y-Bridge Pump Station capacity improvements and the R13 and R14 RWI improvements projects to evaluate the feasibility of removing the R13 overflow structure connection during future conditions. This would allow the City to implement the findings from the R13 overflow connection evaluation into the design and construction of the R13 sewer separation project. The City has revised the proposed LTCP Update Implementation Schedule (**Attachment 4**) as follows:

1. Moved the R13 sewer separation project from Phase 3 to the beginning of Phase 2 of the LTCP Update (directly following the Y-Bridge pump station improvements and the Phase 1 programmatic review period).
2. Moved the R13 and R14 RWI improvements to Phase 1 of the LTCP Update.

The City anticipates that Y-Bridge pump station upgrades completion and re-evaluation of future flows using flow monitoring and hydraulic modelling will allow the City to determine whether the R13 overflow structure connection can be eliminated in the future.

8. **Ohio EPA Comment:** Please assign dates-certain to the implementation schedule.

   City Response: Dates have been added to the implementation schedule and are shown on the revised LTCP Update Implementation Schedule as **Attachment 4**.

9. **Ohio EPA Comment:** The City initiated design of the current separation project in 2016 for an original completion date in 2018. The proposed completion date (the end of Year 1) constitutes a fourth extension of this project (notwithstanding the additional delay due to a recent DEFA finding, of which the City was notified after submission of the LTCP). Ohio EPA requires the following projects be completed in Phase 1:
   - R30 Separation and R26 modification
   - River Water Intrusion (RWI) improvements at R3, R13, and R14
   - R12 Modifications

Each is relatively inexpensive and small in scope. The issues at for Racks 3, 12, 13, 14, and 26 (weir improvements and intrusion reduction) fall under the purview of the Nine Minimum Controls (specifically Part II, Item W.2 of NPDES permit) and should be implemented as soon as practicable.

City Response: The R30 Sewer Separation, R3, R13, and R14 RWI Improvements, and R12 Modifications projects will be moved to Phase I of the LTCP Update Implementation Schedule as requested.

Note that the proposed R26 modifications project was intended to be completed in the final phase of the LTCP Update because the R26 regulator currently acts as a relief point to prevent water-in-basements when hydraulic conditions in the downtown interceptor are elevated. If the hydraulic relief point at R26 is modified or removed early on in the LTCP Update Implementation Schedule (specifically prior to the construction of the R21 storage improvements which are designed to reduce inflows to the downtown interceptor), it may result in basement backups along Canal St. and S 5th St. To prevent future basement backups in the downtown area, it was recommended by AECOM that the R26 modifications project remain in Phase 3 of the LTCP Update to allow for additional flow monitoring and verification of planned inflow reduction in the downtown interceptor prior to modifying this critical relief point.

10. **Ohio EPA Comment:** The model predicts that R14 is already attaining the target performance of four occurrences in the typical year under existing conditions, thus no control projects are proposed. However, the model seems to be underpredicting discharge frequency, as the City reported 17 and 53 occurrences in 2020 and 2021, respectively. Moreover, the 5th largest storm in the typical year (which was used for alternative design) is similar to (if not larger than) the August 13, 2019 observed during the calibration period, during which the City recorded a CSO occurrence. We acknowledge that the volumes are small and the apparently significant RWI at this outfall causes a considerable amount of uncertainty. Therefore, we recommend moving the RWI control to Phase 1, then re-evaluating the need to implement additional control in subsequent phases.

    City Response: The R14 RWI Control project will be moved to Phase I of the LTCP Update implementation schedule.

11. **Ohio EPA Comment:** In Section 2.3, an excerpt from Ohio EPA's most recent CSO Inspection notes that operators use capacity in the Main Interceptor for storage when throttling plant influent is necessary. Please discuss and illustrate the hydraulic grade line in the Main Interceptor before the proposed plant improvements, then after the proposed plant improvements both with and without the proposed R3 in-line storage.

    City Response: The requested hydraulic grade line (HGL) profiles are included as **Attachment 5.** The predicted peak HGLs are shown for the fifth largest storm during the 2012 Typical Year which was used to size the R3 in-line storage features. For purposes of this analysis, it was assumed that the plant capacity before the proposed improvements is 25 MGD and the plant capacity after the proposed improvements is 36.2 MGD. Key conclusions from this analysis are as follows:

    1. The predicted peak HGL at MH 0236 (the farthest downstream MH along the Main Interceptor before the WWTP headworks) is the same (679.99-ft) <u>after the proposed Plant improvements</u> regardless of whether the proposed R3 in-line storage project is implemented.
    2. The predicted peak HGL at MH 0236 (the farthest downstream MH along the Main Interceptor before the WWTP headworks) <u>before the proposed Plant improvements</u> is just over 2 inches higher with the R3 in-line storage (686.71-ft) compared to the scenario without R3 in-line storage (686.52-ft). However, the scenario with R3 in-line storage does not result in a CSO occurrence, while the condition without R3 in-line storage results in a CSO occurrence with a predicted volume of 685,000 gallons.

12. **Ohio EPA Comment:** In Appendix B, several units were identified as needing improvement but were not included in the proposed projects, such as the grit dewatering equipment. How did the City determine whether projects were necessary or not?

AECOM

City Response: If the improvements are needed to meet capacity requirements for wet weather compliance, they were not included in the list of WWTP upgrades under the LTCP Update. If the projects involve replacing equipment reaching life expectancy and are otherwise not directly related to increasing capacity or process improvements needed for wet weather compliance, then they were not included in the list of WWTP upgrades under the LTCP Update. During the WWTP upgrades design phase, miscellaneous improvements such as the grit dewatering equipment will be reviewed and addressed.

13. **Ohio EPA Comment:** In Appendix B, do the estimated costs include demolition of abandoned systems, such as the secondary clarifiers and chlorine contact tanks?

    City Response: Yes, the estimated costs included demolition of abandoned systems including the secondary clarifiers and chlorine contact tanks.

14. **Ohio EPA Comment:** The table on page 8 of Appendix G presents the WWTP projects separated into the two phases:
    a. The table does not include demolition of the secondary screens, which was identified as the plant's most significant hydraulic bottleneck. Ohio EPA recommends that this item be included in Phase 1 to restore plant capacity as soon as possible.

       City Response: The City has since removed the secondary screens which has increased capacity however a stress test has not been performed since removing the screens.

    b. The table indicates that the secondary pump station improvements are assigned to Phase 2, which was identified as necessary to reach 36 MGD. Ohio EPA recommends that this item be included in Phase 1 to restore plant capacity as soon as possible.

       City Response: The secondary pump station improvements will be shifted to Phase 1 of the WWTP Upgrades as requested.

15. **Ohio EPA Comment:** In Appendix H, the Financial Capability Analysis (FCA) identifies a Residential Factor of 90% as part of the Residential Indicator Analysis. Please describe how this value was determined.

    City Response: The Residential Factor of 90% was determined by comparing the amount of utility bills mailed to residential addresses and commercial addresses by the City of Zanesville Financial Director in 2019. The split between bills was determined to be approximately 90%.

The City looks forward to discussing these items with you during the scheduled meeting on September 19, 2023. If you should have any questions regarding the enclosed information, my contact information is provided below. Alternatively, Chip Saunders, City of Zanesville Engineer, can be contacted via email at csaunders@coz.org or by phone at 740-617-4910.

Sincerely,

Maria DeLuca

Maria DeLuca, PE
AECOM, Project Manager
Maria.Deluca@aecom.com
440-836-2125

cc: Chip Saunders – City of Zanesville
Scott Brown – City of Zanesville

Attachment 1
Existing Conditions Observed vs. Predicted Overflow Summary, 2018-2022

2018 Existing Conditions Observed vs. Predicted Overflow Summary

CSO Outfall		Observed		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	32	18.58	22	17.75
R6	009	42	20.16	17	7.68
R8	011	4	-	12	-
R9	012	8	-	17	-
R10	013	13	-	12	-
R11	014	4	-	0	-
R12	015	18	-	4	-
R13	016	4	-	8	-
R14	017	6	0.87	4	0.33
R21	024	29	2.55	7	10.57
R26	029	1	-	1	-
R30	052	4	-	3	-
Total:		**-**	**42.16**	**-**	**36.33**

2019 Existing Conditions Observed vs. Predicted Overflow Summary

CSO Outfall		Observed		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	33	8.59	23	14.99
R6	009	47	16.55	20	6.91
R8	011	1	-	11	-
R9	012	3	-	20	-
R10	013	7	-	11	-
R11	014	0	-	0	-
R12	015	13	-	2	-
R13	016	5	-	7	-
R14	017	18	4.10	2	1.32
R21	024	30	2.73	16	8.28
R26	029	0	-	9	-
R30	052	3	-	2	-
Total:		**-**	**31.97**	**-**	**31.50**

*Notes:
-Overflow occurrences are counted such that if a discharge occurs on more than one day but is the result of a continuing precipitation event, it is counted as one occurrence.
-Overflow events with total overflow volumes less than 10,000 gallons were not counted.

Attachment 1
Existing Conditions Observed vs. Predicted Overflow Summary, 2018-2022

2020 Existing Conditions Observed vs. Predicted Overflow Summary

CSO Outfall		Observed		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	35	11.87	18	18.90
R6	009	42	12.18	19	8.17
R8	011	0	-	11	-
R9	012	5	-	19	-
R10	013	7	-	15	-
R11	014	0	-	1	-
R12	015	14	-	3	-
R13	016	1	-	6	-
R14	017	12	0.91	2	2.82
R21	024	48	7.94	14	9.41
R26	029	1	-	4	-
R30	052	0	-	2	-
Total:		**-**	**32.90**	**-**	**39.30**

2021 Existing Conditions Observed vs. Predicted Overflow Summary

CSO Outfall		Observed		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	34	8.47	20	16.52
R6	009	46	9.88	16	8.79
R8	011	4	-	8	-
R9	012	6	-	16	-
R10	013	11	-	8	-
R11	014	5	-	1	-
R12	015	14	-	3	-
R13	016	7	-	7	-
R14	017	31	4.25	3	6.41
R21	024	41	7.89	12	11.14
R26	029	0	-	6	-
R30	052	6	-	2	-
Total:		**-**	**30.50**	**-**	**42.86**

*Notes:
-Overflow occurrences are counted such that if a discharge occurs on more than one day but is the result of a continuing precipitation event, it is counted as one occurrence.
-Overflow events with total overflow volumes less than 10,000 gallons were not counted.

Attachment 1
Existing Conditions Observed vs. Predicted Overflow Summary, 2018-2022

2022 Existing Conditions Observed vs. Predicted Overflow Summary

CSO Outfall		Observed		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	39	23.10	30	31.21
R6	009	38	17.13	24	11.79
R8	011	1	-	11	-
R9	012	3	-	24	-
R10	013	13	-	12	-
R11	014	2	-	1	-
R12	015	16	-	4	-
R13	016	3	-	11	-
R14	017	29	3.32	3	3.21
R21	024	43	15.45	16	15.99
R26	029	0	-	10	-
R30	052	7	-	3	-
Total:		**-**	**58.99**	**-**	**62.20**

*Notes:
-Overflow occurrences are counted such that if a discharge occurs on more than one day but is the result of a continuing precipitation event, it is counted as one occurrence.
-Overflow events with total overflow volumes less than 10,000 gallons were not counted.

Attachment 2
Selected Alternative Predicted Overflow Summary, 2018-2022

2018 Existing Conditions Predicted Overflow Summary

CSO Outfall		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	5	3.62
R6	009	-	-
R8	011	-	-
R9	012	-	-
R10	013	-	-
R11	014	-	-
R12	015	2	0.08
R13	016	-	-
R14	017	3	0.60
R21	024	4	2.66
R26	029	-	-
R30	052	-	-
Total:		**-**	**6.95**

2019 Existing Conditions Predicted Overflow Summary

CSO Outfall		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	4	3.13
R6	009	-	-
R8	011	-	-
R9	012	-	-
R10	013	-	-
R11	014	-	-
R12	015	1	0.13
R13	016	-	-
R14	017	2	1.65
R21	024	2	2.45
R26	029	-	-
R30	052	-	-
Total:		**-**	**7.37**

*Notes:
-Overflow occurrences are counted such that if a discharge occurs on more than one day but is the result of a continuing precipitation event, it is counted as one occurrence.
-Overflow events with total overflow volumes less than 10,000 gallons were not counted.

Attachment 2
Selected Alternative Predicted Overflow Summary, 2018-2022

2020 Existing Conditions Predicted Overflow Summary

CSO Outfall		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	3	5.89
R6	009	-	
R8	011	-	
R9	012	-	
R10	013	-	
R11	014	-	
R12	015	2	0.38
R13	016	-	-
R14	017	2	3.56
R21	024	3	4.85
R26	029	-	-
R30	052	-	-
Total:		**-**	**14.68**

2021 Existing Conditions Predicted Overflow Summary

CSO Outfall		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	4	7.58
R6	009	-	-
R8	011	-	-
R9	012	-	-
R10	013	-	-
R11	014	-	-
R12	015	1	0.72
R13	016	-	-
R14	017	3	7.25
R21	024	3	6.38
R26	029	-	-
R30	052	-	-
Total:		**-**	**21.93**

*Notes:
-Overflow occurrences are counted such that if a discharge occurs on more than one day but is the result of a continuing precipitation event, it is counted as one occurrence.
-Overflow events with total overflow volumes less than 10,000 gallons were not counted.

Attachment 2
Selected Alternative Predicted Overflow Summary, 2018-2022

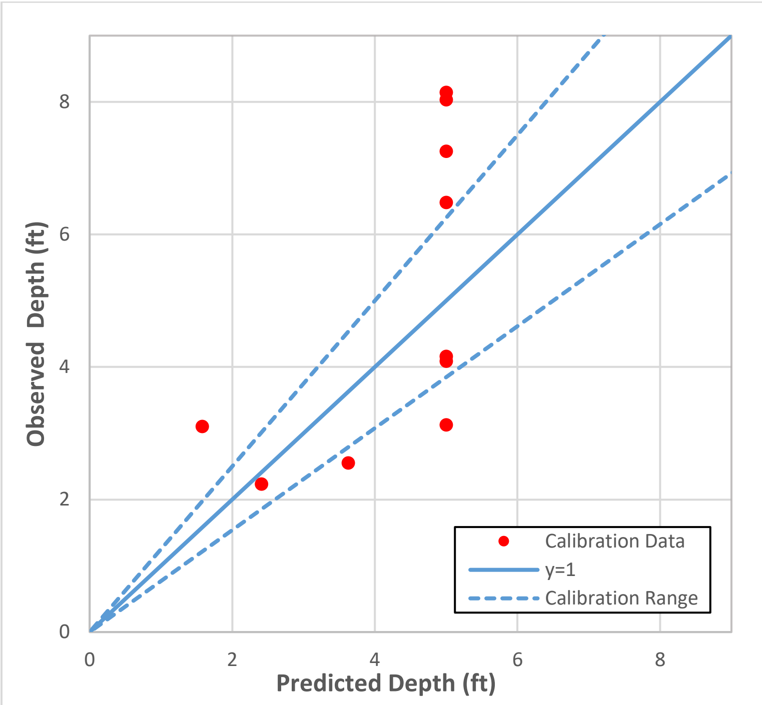
2022 Existing Conditions Predicted Overflow Summary

CSO Outfall		Predicted	
City Rack Number	NPDES Permit CSO Station Number	No. of Overflow Occurrences (#/yr)	Overflow Volume (MG/yr)
R3	006	9	11.49
R6	009	-	-
R8	011	-	-
R9	012	-	-
R10	013	-	-
R11	014	-	-
R12	015	3	0.55
R13	016	-	-
R14	017	5	4.39
R21	024	7	7.02
R26	029	-	-
R30	052	-	-
Total:		**-**	**23.46**

*Notes:
-Overflow occurrences are counted such that if a discharge occurs on more than one day but is the result of a continuing precipitation event, it is counted as one occurrence.
-Overflow events with total overflow volumes less than 10,000 gallons were not counted.

Attachment 3
Hydraulic Model Calibration Depth Graphs

FM1



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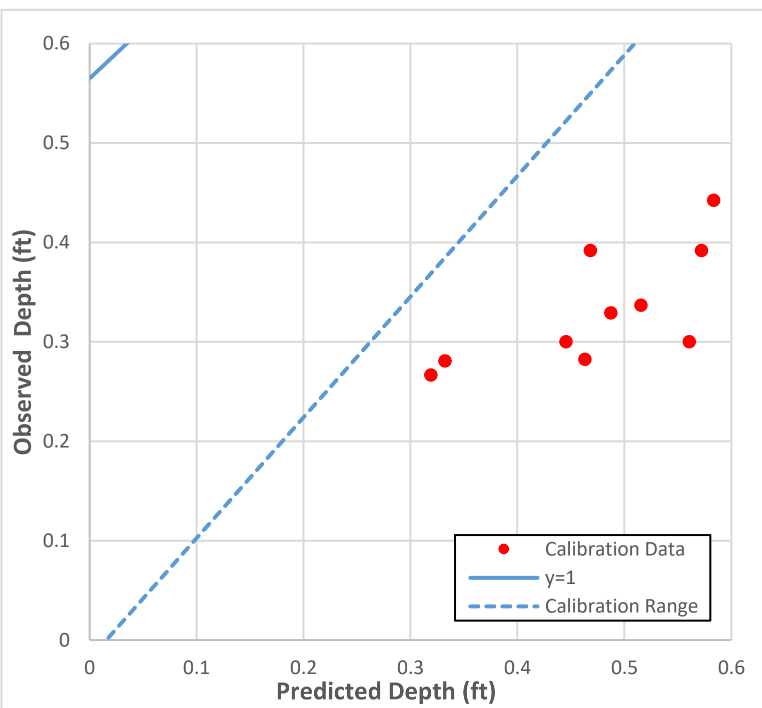
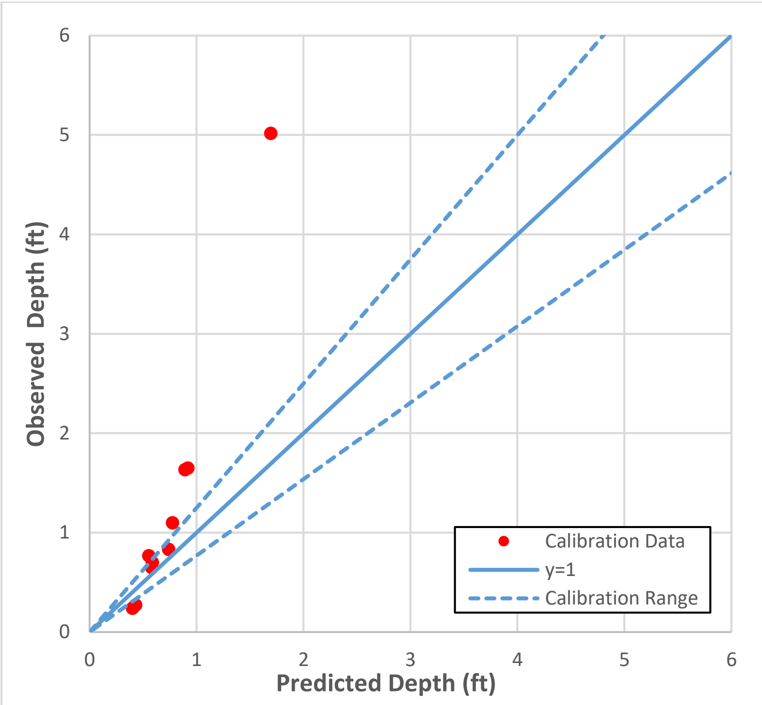


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM3



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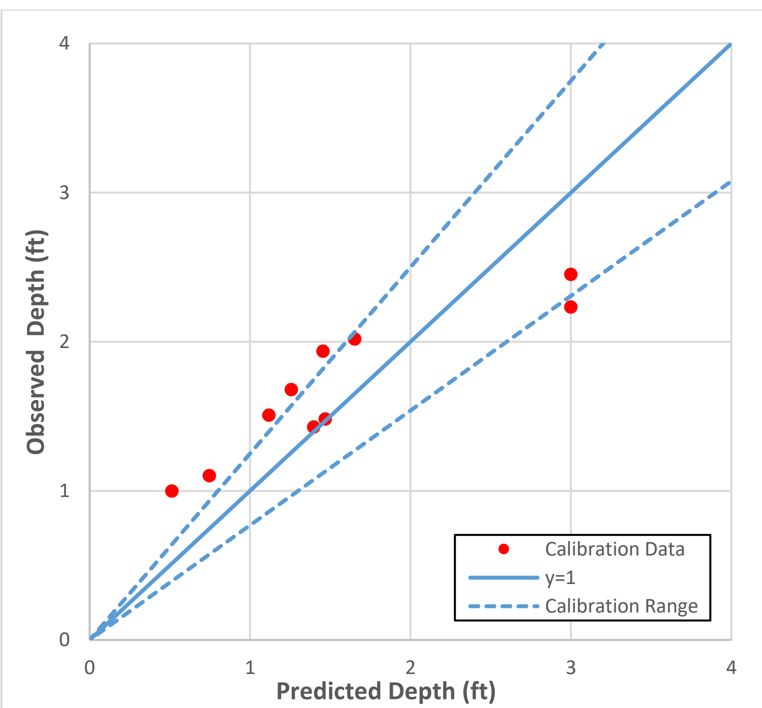
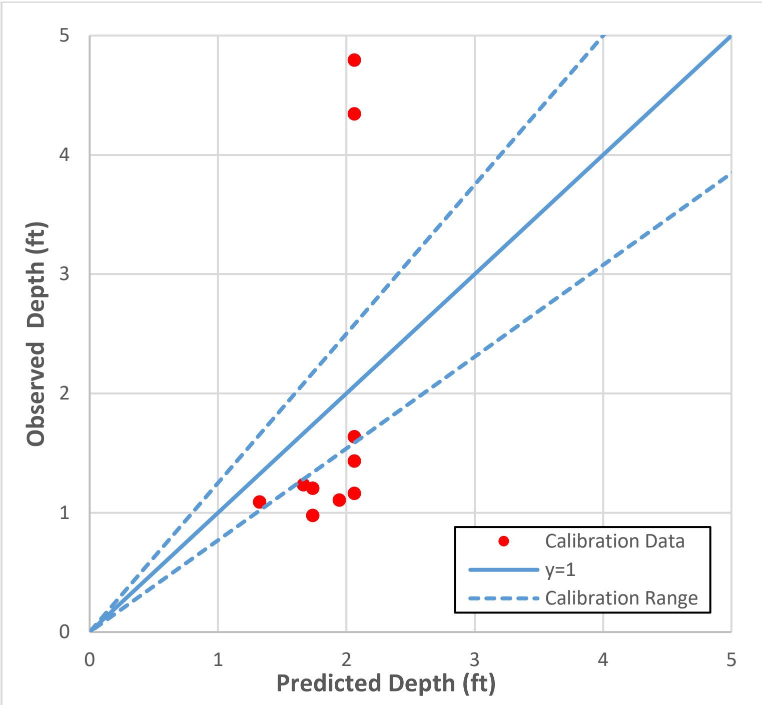


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM5



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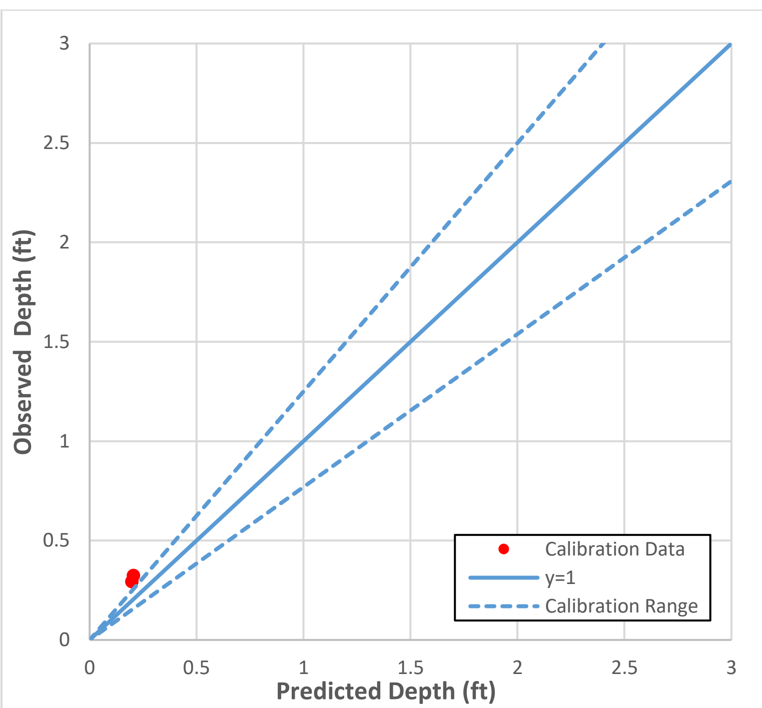
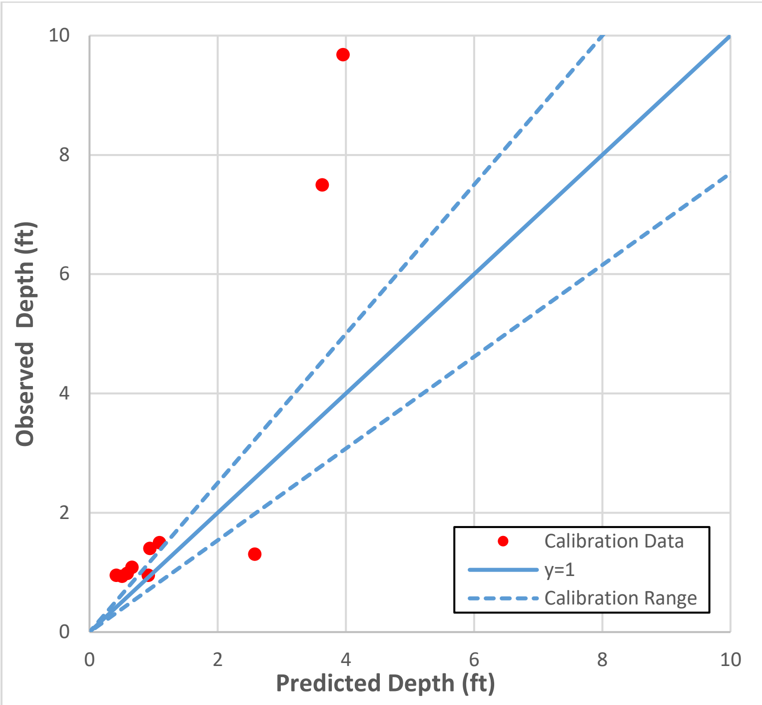


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM7



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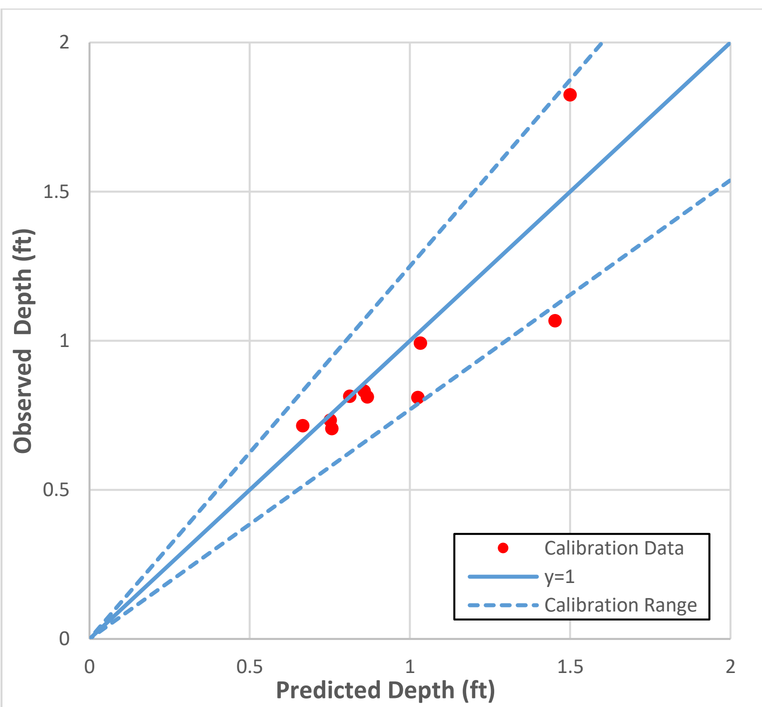
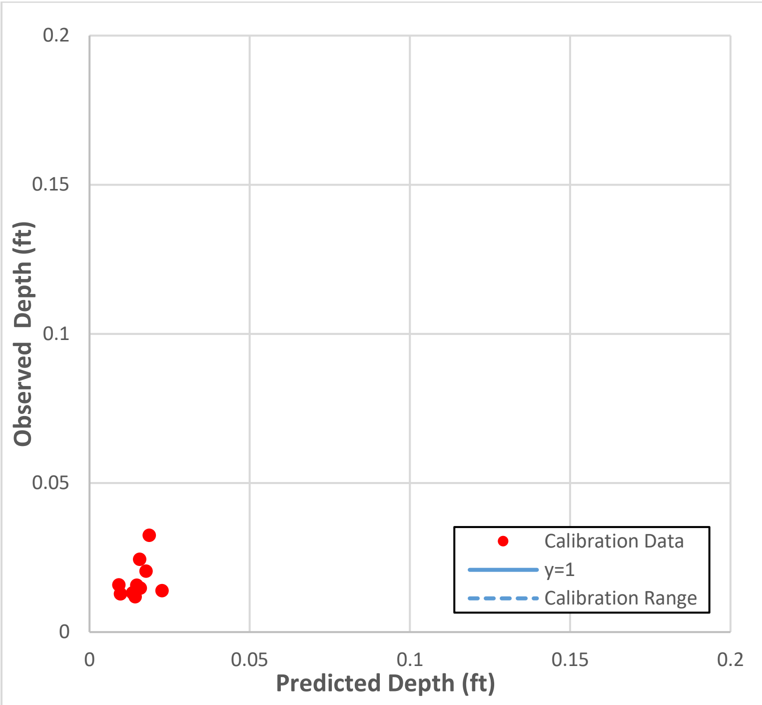
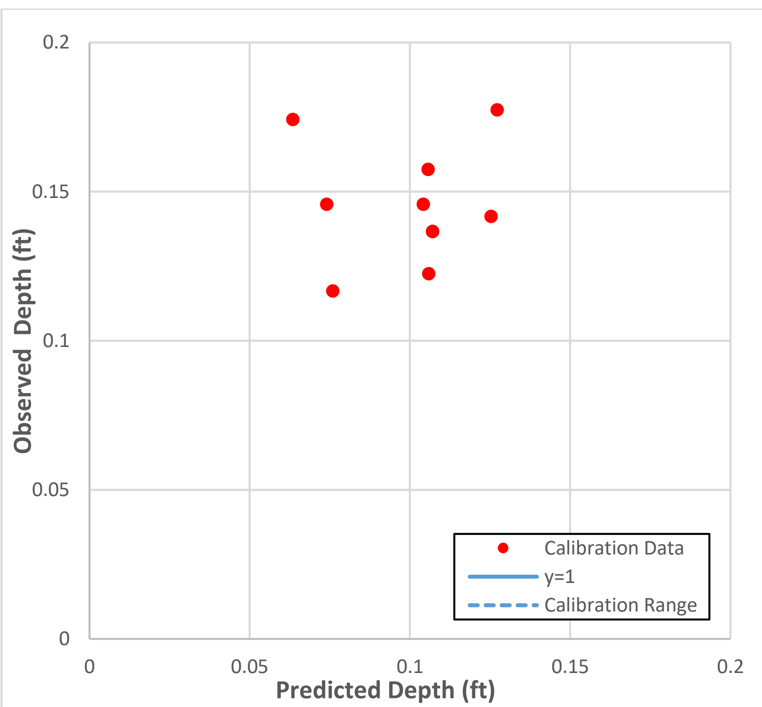


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM9

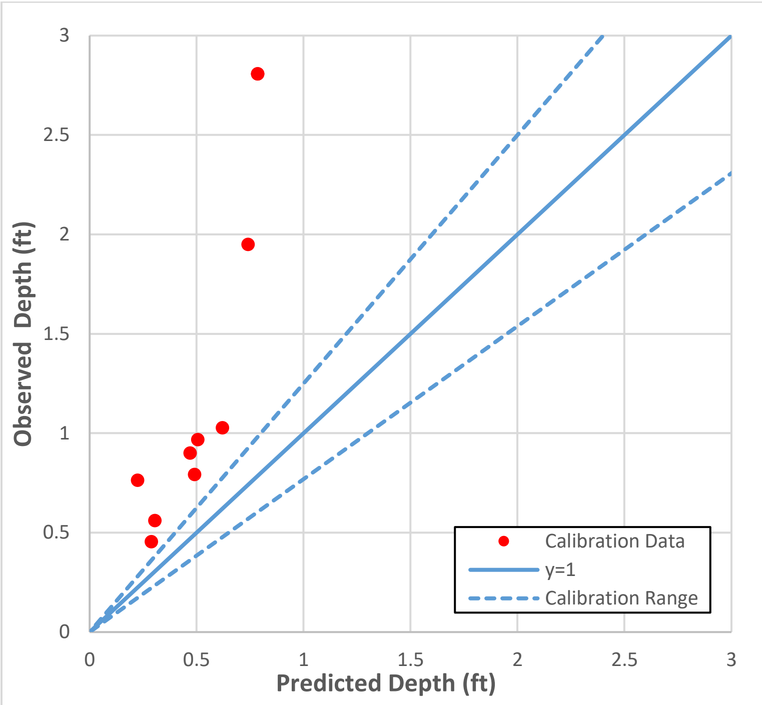


FM10



Attachment 3
Hydraulic Model Calibration Depth Graphs

FM11



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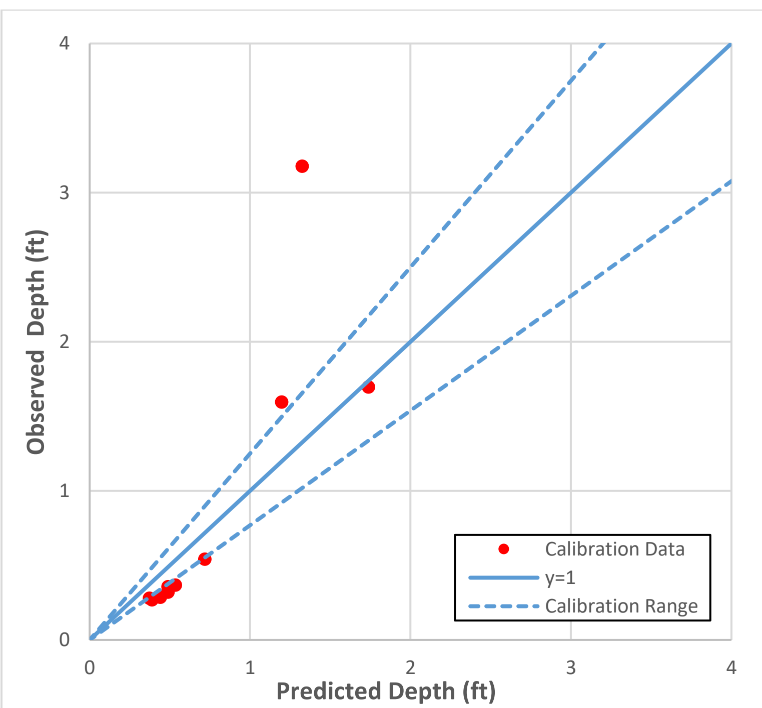
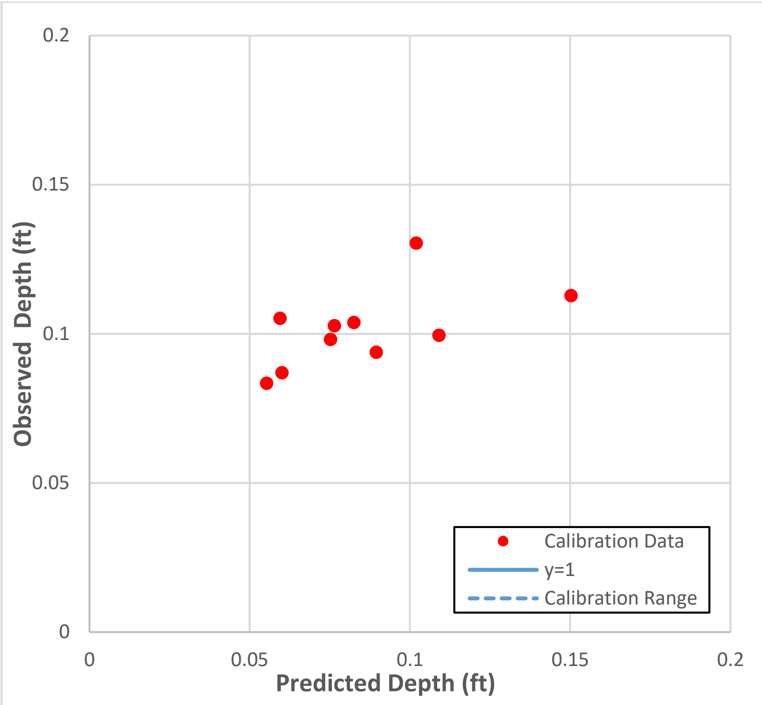


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM13



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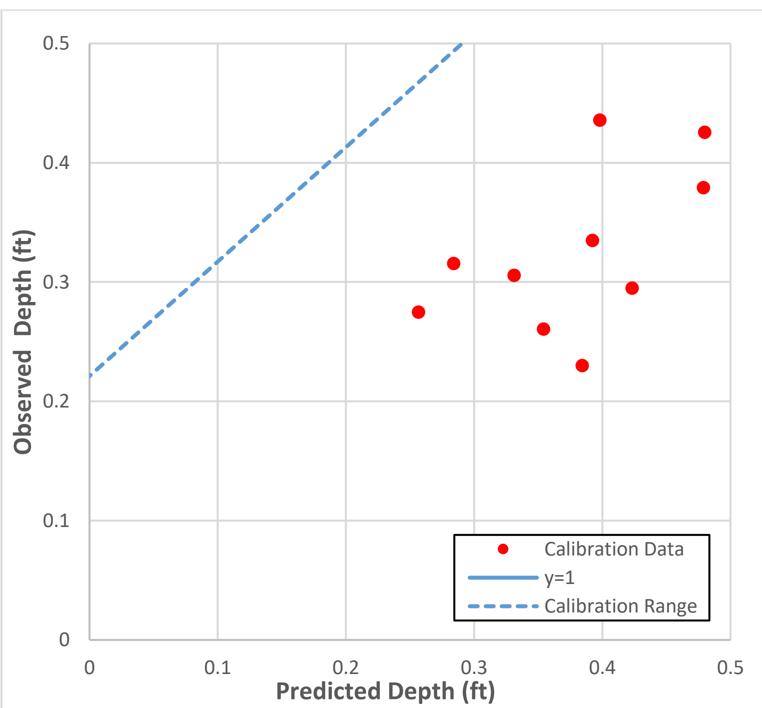
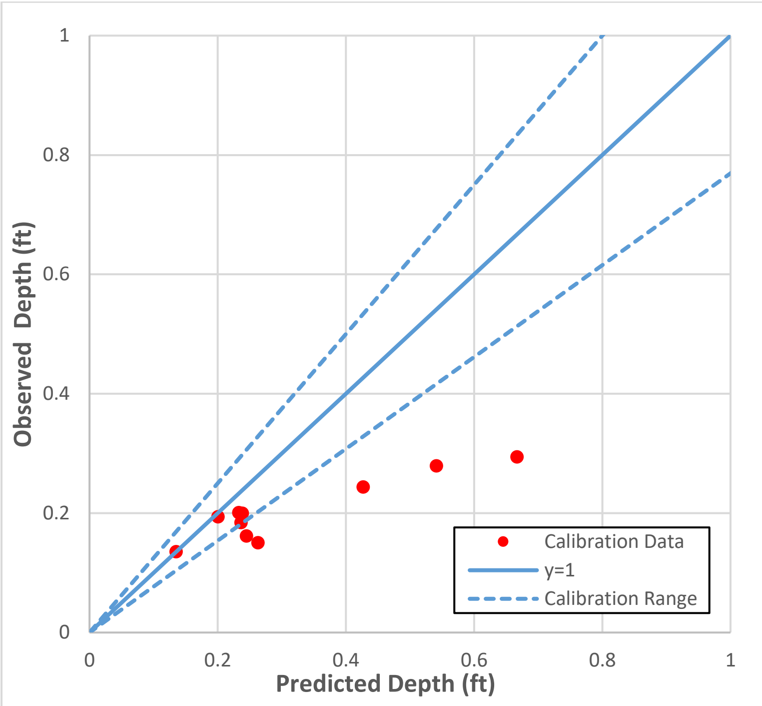


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM15



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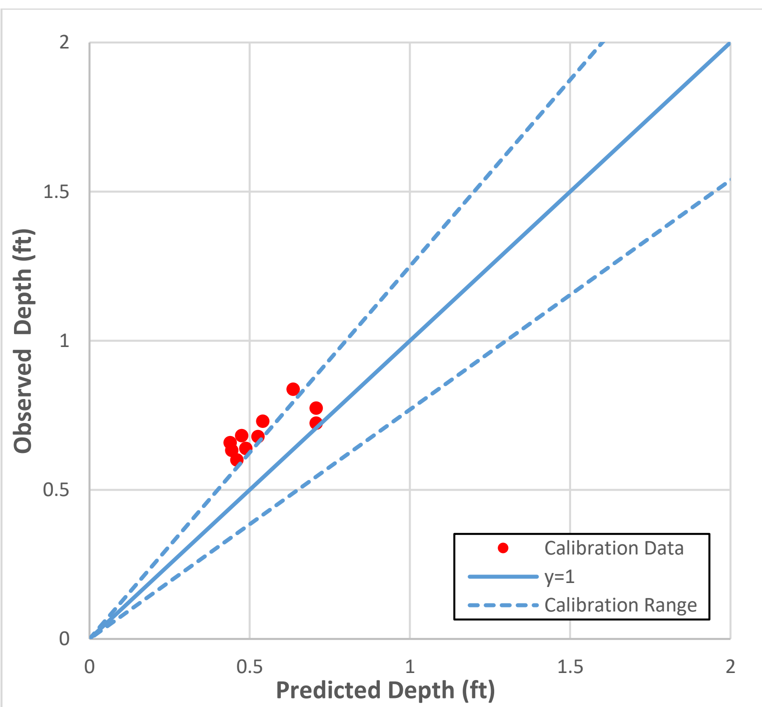
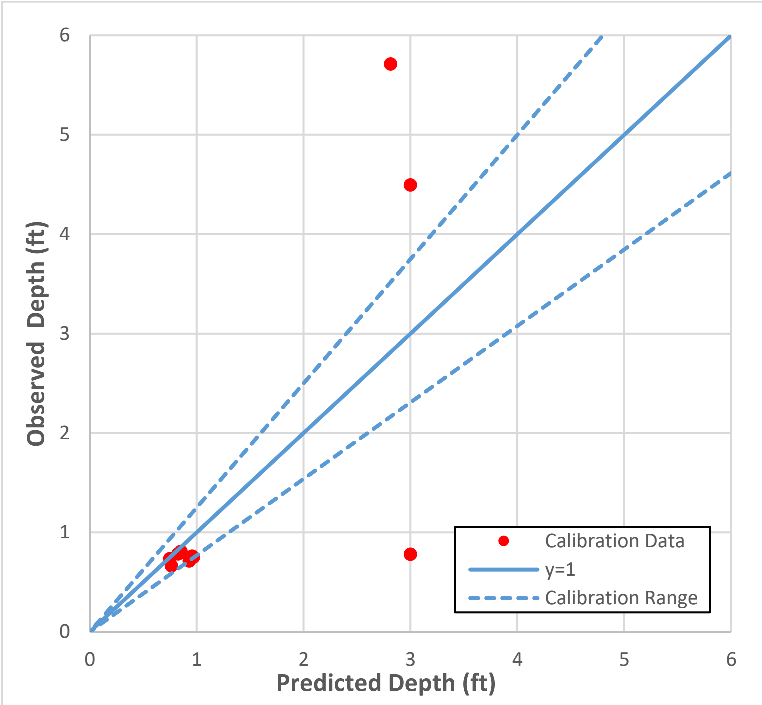


Attachment 3
Hydraulic Model Calibration Depth Graphs

FM17



ID	Task Name	Duration	Start	Finish
1	**LTCP Update Phase 1**	**7 years**	**2024**	**2031**
2	Linden Avenue Lift Station Upgrades		Completed	Completed
3	Separations at R6, R8, R9, R10, R11 and Y-Bridge PS Force Main Improvements Phase 1		Early Action	Early Action
4	Y-Bridge PS Force Main Improvements Phase 2		Early Action	Early Action
5	RWI Improvements at R3, R13, and R14		2025	2026
6	R12 Weir Modifications		2026	2027
7	Y Bridge PS Force Main Improvements Phase 3		2027	2030
8	R30 Sewer Separation		2029	2030
9	Phase 1 Flow Monitoring/Programmatic Review		2030	2031
10	**LTCP Update Phase 2**	**10 years**	**2031**	**2041**
11	R13 Sewer Separation		2031	2033
12	WWTP Upgrades Phase 1		2032	2037
13	WWTP Upgrades Phase 2		2036	2040
14	Phase 2 Flow Monitoring/Programmatic Review		2040	2041
15	**LTCP Update Phase 3**	**8 years**	**2041**	**2049**
16	R21 Storage		2041	2045
17	R3 Storage		2045	2049
18	R26 Regulator Modifications		2046	2048
19	Post-Construction Flow Monitoring/ Programmatic Review		Upon Completion	Upon Completion

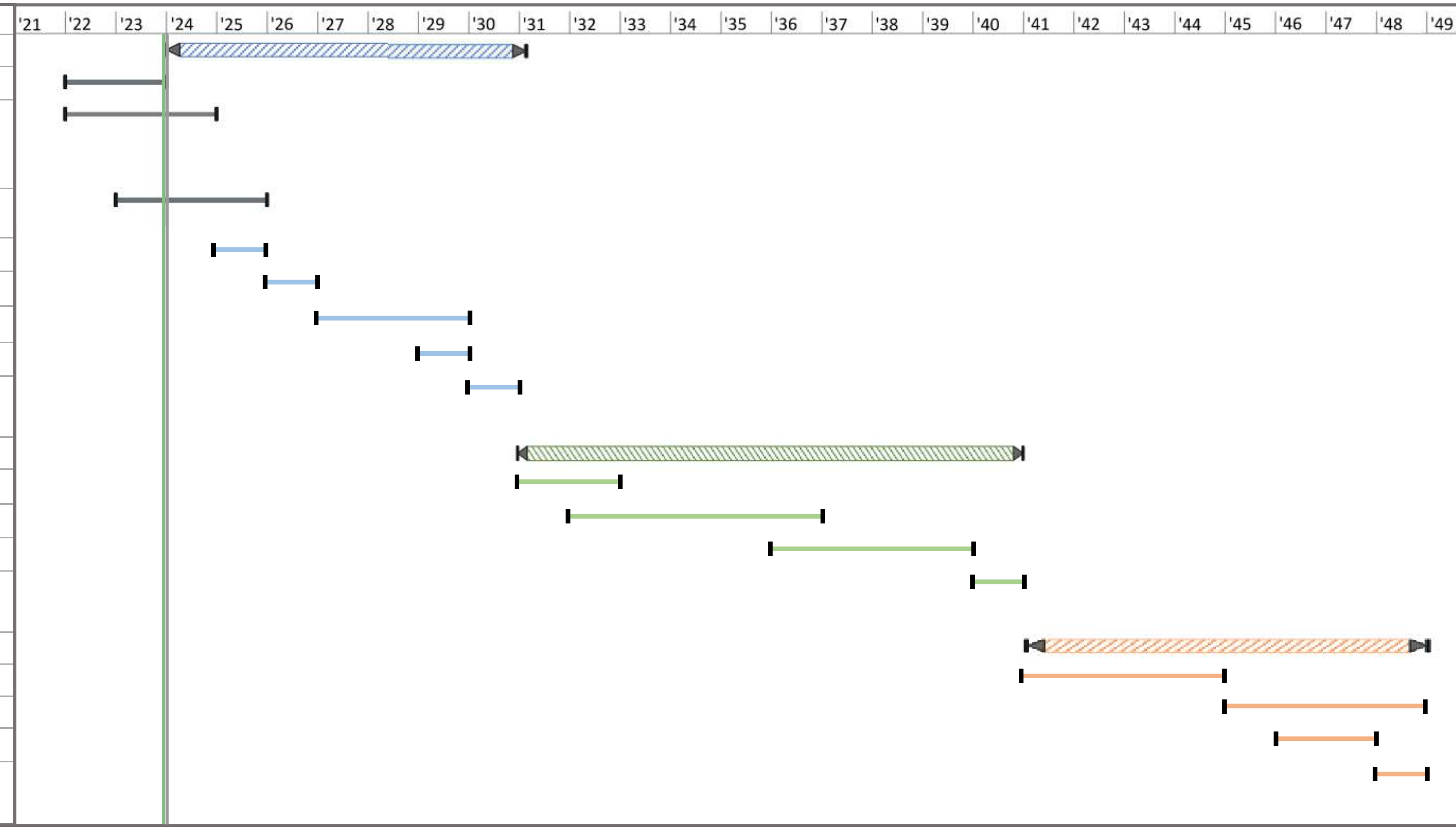
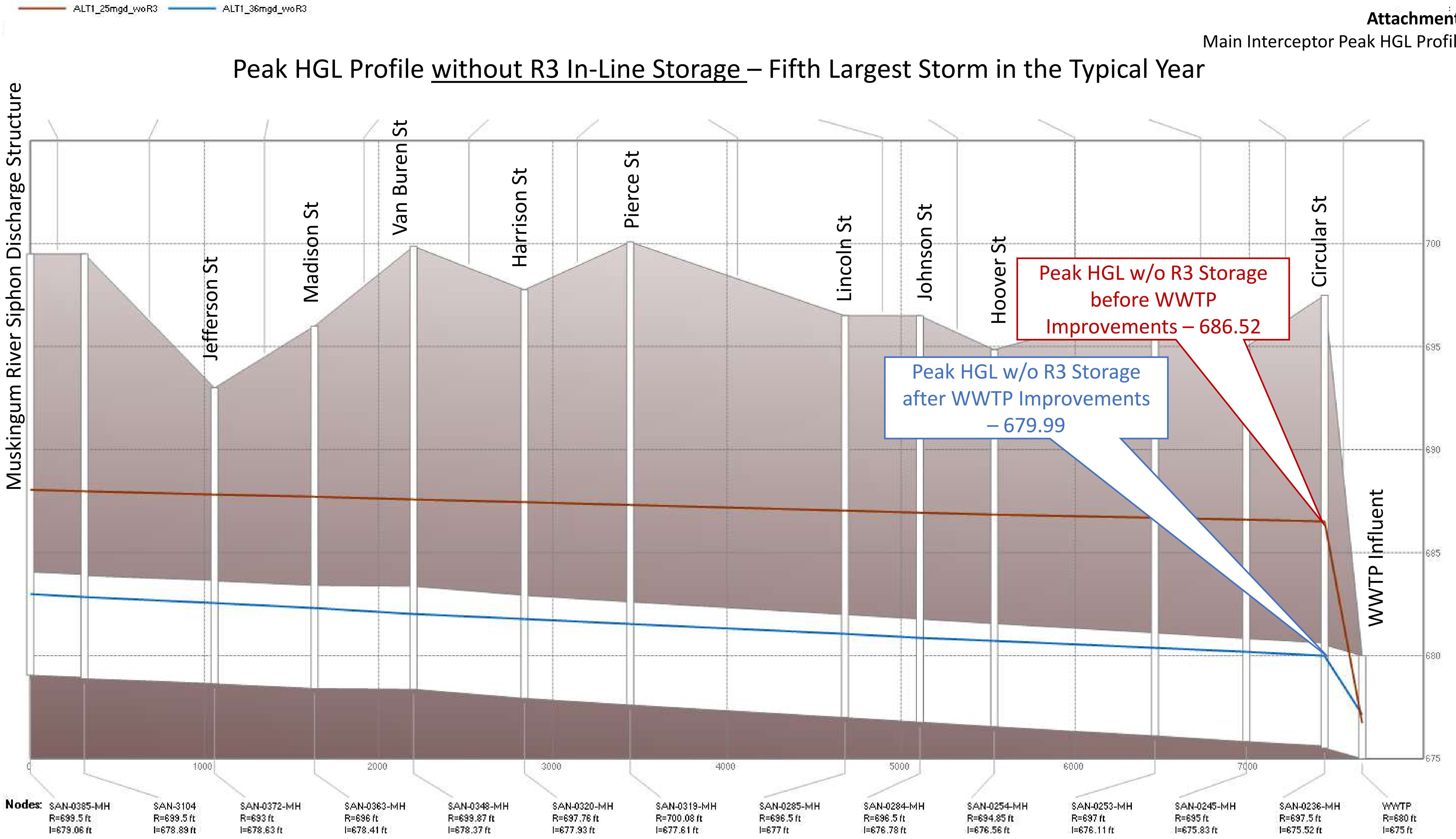
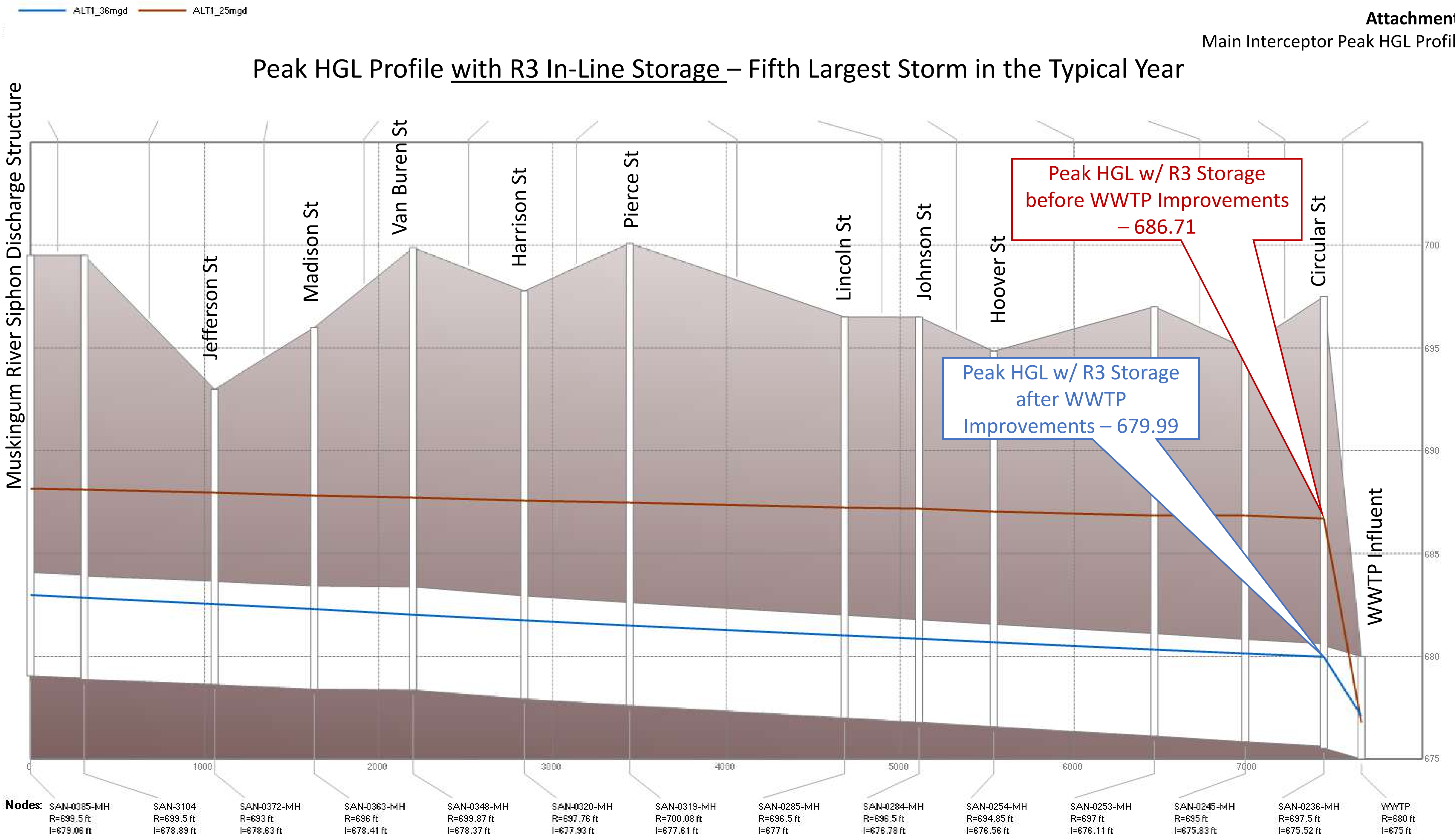


Figure 13-1 LTCP Update Implementation Schedule

Peak HGL Profile without R3 In-Line Storage – Fifth Largest Storm in the Typical Year



Peak HGL Profile with R3 In-Line Storage – Fifth Largest Storm in the Typical Year



October 6, 2023

Re: Zanesville WWTP
Permit - Long Term
NPDES
Muskingum County
0PE00000

Charles Saunders, City Engineer
City of Zanesville
401 Market Street
Zanesville, OH 43071

Subject: City of Zanesville Long Term Control Plan Update

Dear Mr. Saunders:

The City of Zanesville submitted a *Long Term Control Plan Update* (LTCP) to Ohio EPA on December 30, 2021. Thank you for the September 12, 2023 letter, in which you provided responses to our comments on the LTCP. We appreciate the productive conversation during our meeting on September 19th and wanted to provide this letter with additional comments as the City prepares additional materials for the LTCP. To track comments and responses, Ohio EPA's original comments are in bold, the City's responses are in black text, and Ohio EPA's follow-up comments are in blue text

1. **The City's current permit includes an authorization of anticipated CSO-related bypasses at Station 602 when flow rates exceed 27 MGD (Part I,B, Item 8, footnote g). However, footnote i requires that "Use of this bypass shall cease when the permittee has fully implemented the requirements of the approved CSO long-term control plan." Because the City does not intend to complete the approved LTCP, the basis for the bypass approval is no longer applicable.**

   The recommended alternative in the LTCP Update includes restoring the peak hydraulic capacity of the WWTP to 36.2 MGD, suggesting that use of the bypass is to be an indefinite aspect of WWTP operations during wet weather. To support this and maintain approval of CSO-related bypasses in the permit, the LTCP must include a No Feasible Alternative (NFA) analysis.

   It appears that the requirement Ohio EPA referred to in the October 22, 2022 response (Part I, B, Item 8, footnote g) was included in the previous draft of the City's permit (0PE00000* RD) and is not included in the current version of the City's permit 0PE00000* TD authorized on March 6, 2023. Please advise whether the City needs to include a No Feasible Alternative (NFA) analysis in the LTCP Update if the requirement to "cease use of the Station 602 bypass when the permittee has fully implemented the requirements of the approved CSO long-term control plan" is no longer included in the City's permit under Station 602 bypass limitations and monitoring requirements (Part I,B, Item 7).

   As noted, the condition to cease use of the bypass was removed but so was the authorization to use the bypass, which was replaced by a prohibition on discharges through the bypass "unless the three conditions specified in… Part III, Item 11.C.1 of the permit are met." The second of those three conditions is the demonstration that there is no feasible alternative to bypassing, therefore an analysis of feasible alternatives to eliminate the secondary bypass is necessary. If the City determines that elimination of the bypass is infeasible, we recommend reviewing Part II.C.7 of the 1994 CSO Policy and various CSO guidance documents produced by USEPA that discuss what demonstrations would be necessary to restore bypass authorization to the permit.

a. **Has the City evaluated the treatment efficacy of the trickling filters and solids contact tanks separately? Can the WWTP feasibly be configured so that these two biological treatment systems can run in parallel during wet weather, rather than in series? Would the discharge meet effluent limits if these were run in parallel and blended?**

The WWTP employs the TF/SC (Trickling Filter/Solids Contact) treatment technology, which is a distinct process that relies on the TF and the SC operating in tandem, along with secondary clarification. The TF and SC units cannot therefore be run in parallel or decoupled while meeting the permitted effluent limits.

OK

2. **In previous discussions, Ohio EPA acknowledged that the City's NPDES permit was drafted incorrectly, preventing the City from reporting CSO data from any outfall other than 005 and 006. In our March 24, 2020 letter, we stated that the problem had been corrected and that the City could report CSO data in eDMR as required by the permit. A review of recent electronic Discharge Monitoring Reports (eDMR) show that data required by Part I,B, Item 1 was only reported for a few months in 2020. Please enter into eDMR all missing data for each CSO dating back to 2017. For the purposes of retroactively entering data, annual totals entered in each year's December eDMR is sufficient. For 2022 and going forward, please regularly enter the required data each month.**

Required data will be reported for each month going forward. [the following is a summary of a comment from our recent call] The eDMR system will not allow an annual total to be entered into the field for one month. Zanesville has the data but would have to commit to many hours of data entry to provide the data that has been requested. Please advise if there is a method to upload the significant amount of data electronically.

After internal discussions, it is our understanding that the above approach of entering annual totals in the December DMR should be a viable option and would limit the amount of data entry required to update the City's electronic records. We would appreciate if you could work with Jacob Zink at Ohio EPA to resolve this issue; he can be reached at jacob.zink@epa.ohio.gov or (614) 644-2135.

a. **In the February 2020 eDMR, the City reported more than ten occurrences at seven CSOs that are not reflected in the report attached to the City's April 28, 2020 letter. Please review eDMR data during this time and make changes as appropriate. Alternatively, can the City explain why CSO occurrence numbers were so high during this period?**

The City experienced several continuous days of antecedent precipitation/snowmelt in late-January to mid-February 2020 which likely contributed to increased groundwater levels and as a result, an increased number of CSO occurrences. In addition, the back-to-back, low-volume CSO occurrences reported at R3, R12, R13, and R14 during February 2020 were likely related to river water intrusion (refer to Section 8 of the LTCP Update for RWI analysis findings).

Figure 1 shows the maximum daily river stage reported at USGS River Gage No. 03148000 from January through December 2020. Maximum daily river levels trended relatively high from January through May 2020, fluctuating between daily high river levels of 11.0-ft and 20.9-ft, compared to later months (June through October) where daily high river levels rarely exceeded 10-ft. As a result, there was an increased number of RWI-related CSO occurrences at R3, R12, R13, and R14 from January through May 2020 compared to later months.

OK

3. In Section 9.5, only one year (2012) is presented in the 20-year typical year analysis. Please provide statistics (as in Table 9-4) and top five storms (as in Table 9-5) for the next three most typical years in the 20-year evaluation period.

Table 1 shows the top five storms for the next three most typical years (representative precipitation year in the historical evaluation period) in the 20-year evaluation period.

To achieve a level of control of four events per typical year, the City has based its alternatives analysis on sizing projects to control the fifth largest storm in the typical year. In the selected typical year (2012), the fifth largest storm is a 2-month storm. By designing to control this storm, the City's systems will not be designed to control 3-month or 4-month storms, which are expected to occur on average four and three times a year, respectively, each of which will be expected to result in a CSO event. Ohio EPA doubts that the City will be able to achieve four events per typical year if the system is designed to control only a 2-month storm. Please select another of the years from the analysis which has a more protective fifth largest storm, then re-evaluate the alternatives necessary to achieve a level of control of four events per typical year.

4. The 2020 Technical Memo provided a comparison between the CSO results predicted by the hydraulic model existing conditions and recent observed CSO activity. This comparison was not made in the LTCP. Using the existing conditions in the hydraulic model, please apply rainfall data for each of the last five years to the hydraulic model under existing conditions and compare the modeled CSO activity to observed CSO activity.

Rainfall data was obtained for the 5-year period from January 1, 2018 through December 31, 2022 at the USGS rain gage located at the Zanesville Municipal Airport. Data was reported in 1-hour intervals and obtained using the Midwestern Regional Climate Center cli-MATE data portal and was imported into the existing Conditions model as requested. Figure 2 shows the observed versus predicted (modeled) total CSO volume for the four metered CSO locations (R3, R6, R14 and R21) during each of the 5 years evaluated.

Attachment 1 also shows the observed vs. predicted number of overflow occurrences at each CSO location for each of the 5 years evaluated. It should also be noted that there are several factors which may result in discrepancies between observed and predicted CSO activity including but not limited to:

1. The calibrated Existing Conditions model does not account for river water intrusion which is suspected to impact R3, R9, R12, R13 and R14 as discussed in Section 8 of the LTCP Update.

2. The calibrated Existing Conditions model was based on an empirical approach to groundwater infiltration, where groundwater infiltration was included in the baseline flow and varied using diurnal,

weekly and monthly flow patterns as observed in the flow monitoring data. If actual groundwater levels and/or soil moisture levels varied substantially during one particular season or from one year to another, this may result in discrepancies between the predicted flow response and actual flow response in the collection system.

3. Available rainfall data applied to the model is based on observed rainfall at the Zanesville Municipal Airport, which is approximately 5 miles northeast of the northern boundary of the City's collection system. Any spatial or time variability between the precipitation observed at Zanesville Municipal Airport and the actual precipitation that occurred across the City's collection system may lead to variability in CSO occurrences.

4. Due to limited availability of refined rainfall data for the 5-year evaluation period, the modeled results included in this letter are based on 1-hour rainfall intensity intervals while the calibrated Existing Conditions model used for the LTCP Update was based on 5-minute rainfall intensity. The impact of these two varying intensity intervals can be significant, especially for storms with large rainfall volumes occurring over a short period of time.

Figure 3 demonstrates the differences in hourly versus 5-min rainfall intensity intervals for a given rain event. The figure shows the observed 1-hour rainfall intensity at Zanesville Municipal Airport (ZaneAir) during the July 2, 2019 rain event compared to the 5-minute rainfall intensity recorded at the two rain gages installed during the calibration period (Zane01 and Zane02). The maximum rainfall intensity from the 5-minute rainfall data was significantly higher than the rainfall intensity from the hourly rainfall data, as the total hourly rainfall intensity is distributed evenly across each hour, resulting in reduced peak flows within smaller portions of the collection system where the time-of-concentration is less than the one hour increment. As a result, the observed versus predicted CSO occurrence frequency will likely be different when utilizing hourly rainfall data. This is important to note when comparing the calibrated Existing Conditions model data (calibrated using 5-minute rainfall) versus the Existing Conditions model simulated using 1-hour rainfall data.

As noted during the call, the volume data predicted by the model matches observed volume data but the model-predicted occurrences do not match occurrence data from electronically-metered outfalls. The City listed a few justifications for the discrepancies and Ohio EPA acknowledges these issues. Regarding these topics:

a. Rainfall data - Because the City noted that the rain gauge at the airport with 1-hour reporting intervals did not accurately capture the magnitude of short, intense events, the City should install at least one rain gauge within the collection system that provides data resolution to sufficiently characterize rainfall events of short duration.
b. River Water Intrusion - We appreciate that the City has agreed to advance the RWI projects in the schedule, to be completed before the first programmatic review.
c. Groundwater infiltration – Please describe the City's ongoing maintenance & operation program with regards to sewer condition inspections and sewer lining or replacement efforts.

We look forward to improved correlation between model and observed data at the first programmatic review, after these confounding factors are mitigated.

5. Using the same rainfall data collected for comment 4, please model CSO activity for each of the last five years using the hydraulic model under the recommended alternative conditions.

Refer to Attachment 2 for predicted CSO activity for the 5-year evaluation period under the Selected LTCP Update Alternative conditions. The results showed that the desired CSO control level of four or less system-wide CSO occurrences during the typical year would have theoretically been achieved with the Selected LTCP Update Alternative based on hourly rainfall obtained for 2019, 2020, and 2021 used in this analysis. The CSO control level of four-or-less system-wide overflows during the typical year would not have been achieved for 2018 and 2022 based on the hourly rainfall data used in the analysis.

Note that the CSO control policy is based on evaluating the level of service during the 2012 Typical Year, or the representative precipitation year for the 20-year evaluation period. The 20-year typical year (2012) consisted of a total rainfall of 37.1-inches. The total annual rainfall that occurred in 2018 was both approximately 18.6% higher (44.0-in) than the 2012 Typical Year and the total annual rainfall that occurred in 2022 was 19.4% higher (44.3-in) than the 2012 Typical Year, which likely resulted in increased CSO occurrences in the future conditions model simulations during these years.

OK

6. **Appendix E showed the hydrographs for peak volume and peak flow rate, by which the hydraulic model was calibrated. Please also provide hydrographs showing peak depth for each calibration event.**

   Refer to Attachment 3 for peak depth graphs showing observed vs. modeled peak depth for each calibration event at each flow monitoring location. Note that the peak depth graphs for FM-10 and FM-11 show that observed peak depths were higher than predicted peak depths for the calibration events. This is likely attributed to the fact that flow meter sensor accuracy is reduced during low flow/low depth periods, especially for larger pipes. The FM-10 flow meter sensor was installed on a 24-inch pipe which experienced extremely low peak flows/depths, with a maximum flow depth of just under 1-inch during the calibration period. Similarly, the flow meter sensor for FM-11 was installed on a 54-inch pipe at 3.3% slope. Observed peak depths at FM-11 ranged from 11% to 66% full during the calibration period, likely resulting in reduced accuracy in depth measurements.

   OK

7. **Section 10.5.2.1 states that the remaining 20% of the R13 sewershed is to be separated but Section 10.5.2.3 states that the reconfigured overflow structure is to remain open to discharge. If there are no combined sewers tributary to an overflow structure, that outfall cannot be defined as a CSO and must be reclassified as a sanitary sewer overflow (SSO). Following separation for the remaining 12 properties, will there be any combined sewers upstream of R13? If not, with what frequency (i.e. storm return interval) is the interceptor expected to exceed 678.6 feet?**

   There will be no combined sewers in the R13 sewershed after the R13 sewer separation project is completed. However, the R13 overflow structure is currently hydraulically connected to key features of the City's combined collection system (Joe's Run Interceptor, the Linden Avenue Interceptor and the Y-Bridge Pump Station) to provide hydraulic relief when/if the Y-bridge Pump Station is offline or has exceeded its capacity during wet weather conditions. The R13 overflow connection activates before the Y-Bridge Pump Station screens are overtopped (the R13 overflow connection activates when wet well levels exceed approximately 678.6-ft and the screens are overtopped when the wet well elevation exceeds 689-ft), making the R13 overflow connection a critical feature in protecting basements along the downstream portions of the combined sewer interceptors.

Figure 4 shows the existing configuration of the R13 combined sewer, the R13 overflow structure, and the combined sewer connections to the R13 overflow structure. The figure shows that during dry weather conditions, the R13 regulator structure currently conveys combined flows from the R13 sewershed to the Y-Bridge Pump Station through the existing 24" dry weather connection. However, during large rainfall events, it is expected that inflows to the Y-Bridge Pump Station will likely exceed the 20 MGD design capacity during future conditions, resulting in surcharged interceptor levels in the sanitary sewer system (specifically, at the downstream portions of Joe's Run and the Linden Avenue Interceptor). When interceptor levels exceed approximately 678.6-ft at MH 1098, combined sewer flow from Joe's Run and the Linden Avenue Interceptor is conveyed into the R13 overflow structure through the 24" sanitary sewer connection, resulting in an CSO occurrence at R13. AECOM recommends that elimination or modification of the R13 overflow connection to MH 1098 be evaluated after downstream capacity improvements (specifically the Y-Bridge pump station improvements) are completed to prevent water-in-basements during future conditions.

As a result of these recommendations, the City proposes that additional flow monitoring and hydraulic modelling be performed after the Y-Bridge Pump Station capacity improvements and the R13 and R14 RWI improvements projects to evaluate the feasibility of removing the R13 overflow structure connection during future conditions. This would allow the City to implement the findings from the R13 overflow connection evaluation into the design and construction of the R13 sewer separation project. The City has revised the proposed LTCP Update Implementation Schedule (Attachment 4) as follows:

1. Moved the R13 sewer separation project from Phase 3 to the beginning of Phase 2 of the LTCP Update (directly following the Y-Bridge pump station improvements and the Phase 1 programmatic review period).
2. Moved the R13 and R14 RWI improvements to Phase 1 of the LTCP Update.

The City anticipates that Y-Bridge pump station upgrades completion and re-evaluation of future flows using flow monitoring and hydraulic modelling will allow the City to determine whether the R13 overflow structure connection can be eliminated in the future.

OK

8. **Please assign dates-certain to the implementation schedule.**

Dates have been added to the implementation schedule and are shown on the revised LTCP Update Implementation Schedule as Attachment 4.

During the meeting, the City indicated that the line for each year represents January 1st. For example, the RWI improvements to R3, R13, and R14 is due to be complete January 1, 2026.

9. **The City initiated design of the current separation project in 2016 for an original completion date in 2018. The proposed completion date (the end of Year 1) constitutes a fourth extension of this project (notwithstanding the additional delay due to a recent DEFA finding, of which the City was notified after submission of the LTCP). Ohio EPA requires the following projects be completed in Phase 1:**

- **R30 Separation and R26 modification**
- **River Water Intrusion (RWI) improvements at R3, R13, and R14**
- **R12 Modifications**

Each is relatively inexpensive and small in scope. The issues at for Racks 3, 12, 13, 14, and 26 (weir improvements and intrusion reduction) fall under the purview of the Nine Minimum Controls (specifically Part II, Item W.2 of NPDES permit) and should be implemented as soon as practicable.

The R30 Sewer Separation, R3, R13, and R14 RWI Improvements, and R12 Modifications projects will be moved to Phase I of the LTCP Update Implementation Schedule as requested. Note that the proposed R26 modifications project was intended to be completed in the final phase of the LTCP Update because the R26 regulator currently acts as a relief point to prevent water-in-basements when hydraulic conditions in the downtown interceptor are elevated. If the hydraulic relief point at R26 is modified or removed early on in the LTCP Update Implementation Schedule (specifically prior to the construction of the R21 storage improvements which are designed to reduce inflows to the downtown interceptor), it may result in basement backups along Canal St. and S 5th St. To prevent future basement backups in the downtown area, it was recommended by AECOM that the R26 modifications project remain in Phase 3 of the LTCP Update to allow for additional flow monitoring and verification of planned inflow reduction in the downtown interceptor prior to modifying this critical relief point.

OK

10. **The model predicts that R14 is already attaining the target performance of four occurrences in the typical year under existing conditions, thus no control projects are proposed. However, the model seems to be underpredicting discharge frequency, as the City reported 17 and 53 occurrences in 2020 and 2021, respectively. Moreover, the 5th largest storm in the typical year (which was used for alternative design) is similar to (if not larger than) the August 13, 2019 observed during the calibration period, during which the City recorded a CSO occurrence. We acknowledge that the volumes are small and the apparently significant RWI at this outfall causes a considerable amount of uncertainty. Therefore, we recommend moving the RWI control to Phase 1, then re-evaluating the need to implement additional control in subsequent phases.**

    The R14 RWI Control project will be moved to Phase I of the LTCP Update implementation schedule.

    OK

11. **In Section 2.3, an excerpt from Ohio EPA's most recent CSO Inspection notes that operators use capacity in the Main Interceptor for storage when throttling plant influent is necessary. Please discuss and illustrate the hydraulic grade line in the Main Interceptor before the proposed plant improvements, then after the proposed plant improvements both with and without the proposed R3 in-line storage.**

    The requested hydraulic grade line (HGL) profiles are included as Attachment 5. The predicted peak HGLs are shown for the fifth largest storm during the 2012 Typical Year which was used to size the R3 in-line storage features. For purposes of this analysis, it was assumed that the plant capacity before the proposed improvements is 25 MGD and the plant capacity after the proposed improvements is 36.2 MGD. Key conclusions from this analysis are as follows:

1. The predicted peak HGL at MH 0236 (the farthest downstream MH along the Main Interceptor before the WWTP headworks) is the same (679.99-ft) after the proposed Plant improvements regardless of whether the proposed R3 in-line storage project is implemented.

2. The predicted peak HGL at MH 0236 (the farthest downstream MH along the Main Interceptor before the WWTP headworks) before the proposed Plant improvements is just over 2 inches higher with the R3 in-line storage (686.71-ft) compared to the scenario without R3 in-line storage (686.52-ft). However, the scenario with R3 in-line storage does not result in a CSO occurrence, while the condition without R3 in-line storage results in a CSO occurrence with a predicted volume of 685,000 gallons.

OK

12. In Appendix B, several units were identified as needing improvement but were not included in the proposed projects, such as the grit dewatering equipment. How did the City determine whether projects were necessary or not?

If the improvements are needed to meet capacity requirements for wet weather compliance, they were not included in the list of WWTP upgrades under the LTCP Update. If the projects involve replacing equipment reaching life expectancy and are otherwise not directly related to increasing capacity or process improvements needed for wet weather compliance, then they were not included in the list of WWTP upgrades under the LTCP Update. During the WWTP upgrades design phase, miscellaneous improvements such as the grit dewatering equipment will be reviewed and addressed.

OK

13. In Appendix B, do the estimated costs include demolition of abandoned systems, such as the secondary clarifiers and chlorine contact tanks?

Yes, the estimated costs included demolition of abandoned systems including the secondary clarifiers and chlorine contact tanks.

OK

14. The table on page 8 of Appendix G presents the WWTP projects separated into the two phases:

a. The table does not include demolition of the secondary screens, which was identified as the plant's most significant hydraulic bottleneck. Ohio EPA recommends that this item be included in Phase 1 to restore plant capacity as soon as possible.

The City has since removed the secondary screens which has increased capacity however a stress test has not been performed since removing the screens.

OK

b. The table indicates that the secondary pump station improvements are assigned to Phase 2, which was identified as necessary to reach 36 MGD. Ohio EPA recommends that this item be included in Phase 1 to restore plant capacity as soon as possible.

Appendix B Wastewater Treatment Plant Technical Memorandum

AECOM
AECOM
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614 464 4500 tel
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Preliminary Draft - Technical Memorandum

To:	Scott Brown, Public Service Director City of Zanesville, Ohio
From:	AECOM
Subject:	Zanesville WWTP Condition Assessment – Draft
Date:	12/9/2020

The City of Zanesville (City), Ohio is located in Muskingum County along the Muskingum River and the Licking River. The City owns and operates a Wastewater Treatment Plant (WWTP) permitted under the National Pollutant Discharge Elimination System (NPDES) Permit number 0PE00000.

The Zanesville WWTP was constructed in 1959 and was last upgraded in 2009. The average design flow is 11.0 million gallons per day (MGD). The Zanesville WWTP serves the City of Zanesville and Muskingum County, providing service to approximately 94,580 customers.

According to the City's current NPDES permit, the effluent loadings of the WWTP are based on a wet weather flow rate of 18 MGD.

The WWTP underwent significant improvements in the Phase 1 and 2 upgrades, completed between 2004 and 2009. The Phase 1 and 2 upgrades were designed to treat a peak hourly flow (PHF[1]) of 36.2 MGD, and provide complete secondary treatment up to a maximum day flow (MDF[1]) of 27.1 MGD. The City currently throttles flows into the plant at 25 MGD; flows greater than 25 MGD overflow through CSOs.

Process Overview

In September 2020, AECOM personnel walked through the existing WWTP with plant operations staff to review existing conditions of process equipment and discuss immediate needs for improvement to treatment processes. The following sections summarize the review of the different treatment process equipment and identify areas of concern for operations staff.

Influent Primary Screening

The influent mechanical screen underwent extensive rehabilitation in March of 2020. The screen functions well but has no redundancy. A manually raked bar rack is currently the only means for bypassing this equipment. While plant capacity is not limited by the primary screen, operations would be improved with the installation of a redundant mechanical screen, allowing each screen to be taken down for maintenance.

The pump station shows signs of corrosion due to inadequate ventilation. The current system operates intermittently[2], only when occupied. Occasional gas alarms have been noted by plant

[1] Ten State Standards Paragraph 11.241
[2] NFPA 820 - 30 ACH when occupied initially, reduced to 6 ACH after ten minutes

operators at the influent screen. A continuous low rate ventilation (approximately 4 ACH) of the pump station would reduce corrosion and improve operator safety. Ductwork should be updated to replace corroded sections with corrosion resistant materials.

Parameter	Value
Number of Screens	1
Capacity of each Screen	36.2 MGD
Bar Spacing	3/8 inches (10 mm)

The existing primary screen meets the Ohio Administrative Code[1] requirement for beneficial use of biosolids, and no further screenings of sewage is necessary.

Influent Primary Pumps

Five submersible pumps with VFDs are provided in the influent pump station. No significant issues exist with the primary pumps. Operations staff indicated that electrical surge protection is needed for reliable operation.

Parameter	Value
Number of Pumps	5
Capacity of each Pump	9.1 MGD @ 45 ft
Firm Capacity	36.2 MGD

Secondary Screens

Secondary screens are referred to as “fine screens” however, 1984 record drawings indicate a clear opening of 3/4 inch between bars. The fine screens were not part of the 2007 and 2009 plant upgrade projects and as such now operate as a coarse screen downstream of the primary influent pumps. Operators manually activate the screens several times each shift and note that a significant amount of blinding occurs from poor raking performance. The screens have been rendered ineffective due to age and design. As influent flows near 25 MGD, wastewater begins to splash out of the screen channels. Flows greater than 30 MGD result in complete flooding of the screen channels. This equipment presents the most significant bottleneck to the hydraulic capacity of the treatment plant.

Since the secondary screens are coarser than the primary screens, the only flow stream that gets effectively screened by these secondary screens is the discharge off the WWTP drain pump station (which includes septage hauled to the plant). Plant staff indicated that the secondary screens accumulate approximately two cubic yards of screenings every two weeks.

If the fine screens within the septage receiving station are properly operational, screening of the plant drain would not be necessary. Although upgrades to the secondary screens would provide screening redundancy, they may be demolished without any significant impact to the WWTP screening performance. This would result in the elimination of the most significant hydraulic bottleneck at the WWTP and the immediate restoration of the rated peak hourly hydraulic capacity. In order to prevent downstream issues in the plant, it is imperative that the septage

[1] OAC 3745-40-02(C)(3)

receiving screens are maintained if the secondary screens are demolished. Costs for self-cleaning secondary screens are included in this report should the City desire to provide redundant screening capacity.

Parameter	Value
Number of Screens	2
Screen channel width	5.0 ft
Screen channel SWD	5.0 ft
Capacity of each Screen	Unknown
Bar Spacing	3/4 inch
Firm Capacity	24 MGD

Figure 1 - Secondary Screen

<u>Grit Removal</u>

The existing grit removal system, consisting of two grit tanks with cyclones and classifiers, is now properly operated with one grit chamber out of service during low flow. This ensures velocities are kept high enough to prevent the unwanted removal of biological solids. Plant operators noted the only issues with the grit system are the occasional plugging of the grit cyclone and high-water content in the grit discharge during high plant flows.

Currently this grit removal system operates effectively and does not need a major overhaul at this time. However, the City feels that the grit dewatering equipment (cyclones, classifier) should be scheduled for replacement during the next WWTP upgrades, to ensure they are not past their useful life. The grit classifier and pumps can be seen in Figure 2.

Figure 2 - Grit Classifier

Although the second grit tank is a standby unit, plant staff stated that they prefer to operate it during peak wet weather flows. Otherwise the influent channel to the grit tank results in excessive headloss and causes overflows at the secondary screen channel.

Parameter	Value
Number of Grit Tanks	2
Capacity of each unit	36.2 MGD
Grit Size Removal	150 mesh
Firm Capacity	36.2 MGD

Primary Clarifiers

Primary clarification is achieved through the use of three circular clarifiers. Operation of the primary clarifiers has been modified in recent years to decrease sludge blanket depths and prevent solids washouts during high flows. During dry weather flows, one primary clarifier is taken out of service to improve performance and eliminate unnecessary BOD/TSS removal in the primary clarifiers. Current design does not allow for a complete bypass of primary clarifiers. Plant operators have indicated a desire to bypass all primary clarifiers during dry weather flows to ensure a healthy F/M ratio in the secondary treatment process.

It must be noted that at the time of the Phase 1 WWTP upgrades (2004), the primary clarifiers were designed for a surface overflow rate (SOR) of 3,000 gpd/ft^2. This was in accordance with the 1997 GLUMRB ten state standards. Since then, limits for SOR in primary clarifiers have been reduced to 2,000 gpd/ft^2. In 2006, the City's engineering consultant evaluated a chemically enhanced primary treatment (CEPT) system and a chemically enhanced high rate separation (CEHRS) system to address the reduced SOR limit. The City ultimately chose to install a CEPT system, which was the less expensive solution.

Parameter	Value
Number of Clarifiers	3
Diameter of each Clarifier	72 ft
SWD of each Clarifier	14 ft
Surface Overflow Rate (PHF)	2,964 gpd/ft^2
Rated Capacity	36.2 MGD

CEPT System

The ferric chloride CEPT system was added after the Phase 1 upgrades to accommodate the higher SORs. The CEPT system is not required to be operated at influent flows below 24 MGD[1]. Since the City currently throttles the WWTP influent flow to no more than 25 MGD, the CEPT system has not been operated in recent years. However, the ferric chloride feed system is available to be put into service when the hydraulic capacity of the plant is restored.

Parameter	Value
Coagulant and flocculating agent	Ferric Chloride
Coagulant / flocculant dosage	50 mg/L
Number of chemical tanks	1
Capacity of each tank	8,000 gal
Coagulant and flocculating aid	Polymer
Coagulant aid storage	55 gal drums
Polymer aid dosage	1 mg/L

Primary Sludge Well

[1] Below SORs of 2,000 gpd/ft^2

Primary sludge can be drawn from the clarifiers using telescoping valves or directly wasted using the primary sludge pumps. Plant operators typically waste between 10,000 and 15,000 gallons per day of primary sludge with the two VFD operated primary sludge pumps. No significant issues exist with primary sludge wasting equipment. Operations staff noted that the pump station ventilation system is inadequate, and they minimize entry to the station during daily operations.

Although the primary sludge withdrawal telescoping valves can be automatically controlled by SCADA, plant operators choose to keep these actuators set to local, rather than automatic. Some SCADA screens, such as the "lead/lag autorotate enable" button throw an error, so SCADA programming updates to the primary sludge pump station operation are necessary.

Secondary Pump Station

The SPS receives flow from the primary clarifiers and pumps up the trickling filters and solids contact tank. Four submersible pumps with VFDs are provided in the secondary pump station (SPS). The SPS wet well has a passive overflow weir, set at EL 697.50. A 42-inch pipe between the SPS and the Chlorine Contact Tank (CCT) allows WWTP influent flow above 27.1 MGD, to bypass secondary treatment and overflow the SPS wet well into the CCT. During dry weather flows, the same 42-inch pipe is used to recycle flow from the CCT back to the SPS to keep the hydraulic arms of the trickling filters operational.

The secondary pump station is not a major area of concern for plant operations although plant staff would like to evaluate the current wet well operating levels and determine if the wet well is undersized. At 27.1 MGD, the SPS wet well provides less than 2 minutes of detention. Because of the low detention times, the plant staff operate only the lead pump at lower speeds. The lag-1 and lag-2 pumps always turn-on at full speed to prevent the wetwell level rising rapidly and resulting in a reportable secondary bypass event.

Adding an actuated gate to the passive overflow weir could help raise the maximum water level in the SPS wet well (to 700.50 from 695.75) and alleviate issues associated with too short a detention time. An alternate way to accomplish the same is to add an actuated gate in the 42-inch yard piping between the SPS and the CCT.

During the Phase 1 upgrades, 7.0 MGD pumps were replaced with 9.0 MGD pumps, but the piping was not updated, resulting in higher than typical velocities (10 ft/sec in 16" pipe). It is recommended that the discharge piping size be evaluated, including the 30-inch yard pipe.

Parameter	Value
Wet Well Size	32.5 x 15 x 5
Wet Well Operating Volume	18,250 gal
Number of Pumps	4
Capacity of each Pump	9.0 MGD @ 58 ft
Firm Capacity	27.1 MGD

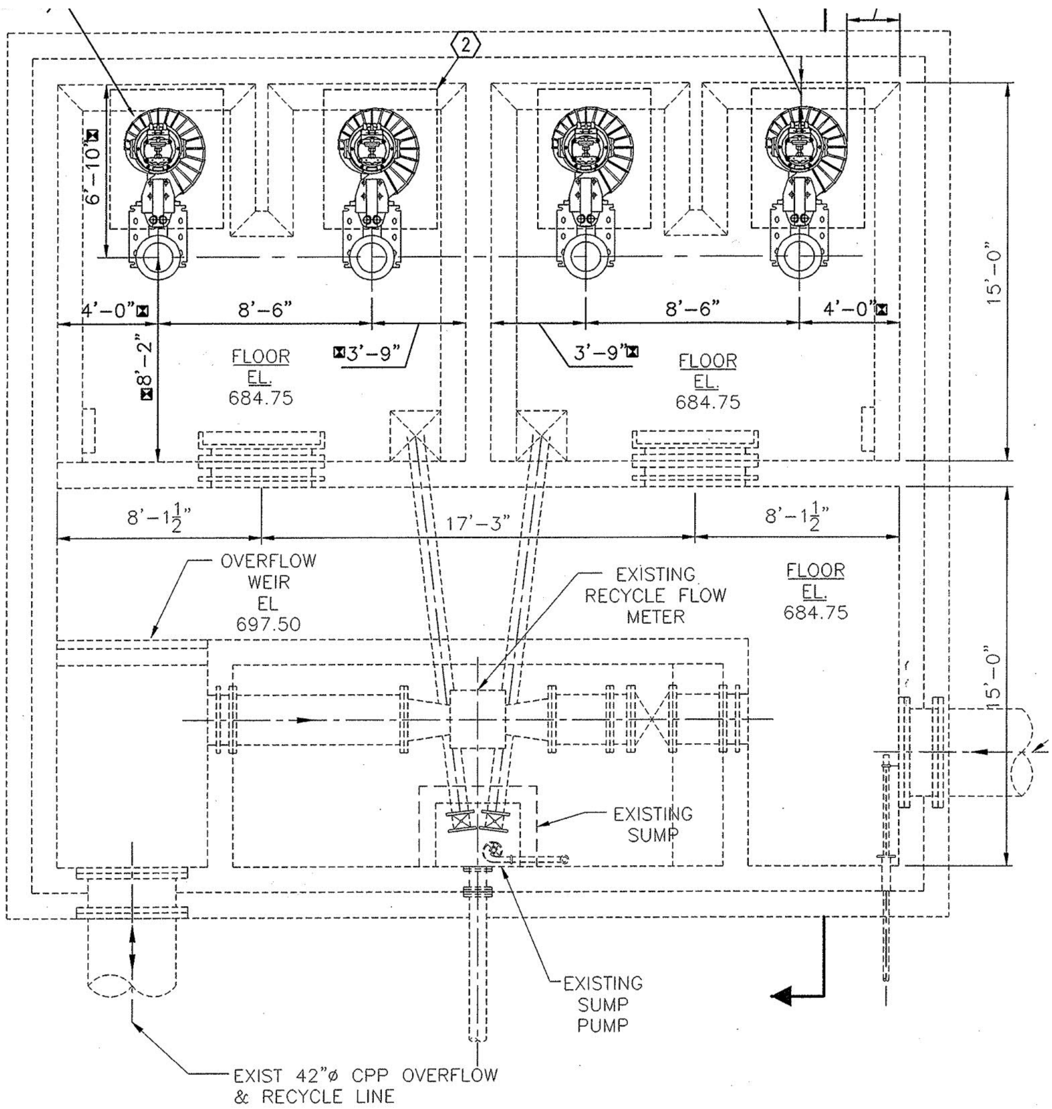


Figure 3 – Secondary Pump Station Plan

Trickling Filters

Three trickling filters (TRF) are utilized for secondary treatment. The TRF continue to be a major area of concern for plant operators. This is due to the large volume of snails produced in the trickling filters, along with filter flies and odor issues.

Record drawings indicate that the trickling filter splitter box was designed to handle a flow of 18 MGD with a bypass of 9.1 MGD sent directly to the Solids Contact Tank (SCT). A 16-inch actuated plug valve located in the trickling filter bypass meter vault diverts flows above 18 MGD from the SPS directly to the SCT. Plant operators believe the trickling filters are capable of higher loading rates but are restricted by the flow splitter box. The existing trickling filter splitter box consists of a single V-Notch weir in each splitter. Replacing the V-notch weirs with an adjustable downward opening weir gate and lowering the splitter box concrete invert (currently 731.25 ft) would significantly reduce the head loss over the splitter box and allow flows greater than 18 MGD to pass through the trickling filters. Another improvement required to increase the TRF splitter box capacity would be to replace the 18-inch flow meter and piping section (with 24-inch or larger) in the influent pipe. The flow goes from a 30-inch pipe to 18 inches through the flow meter section into the splitter box.

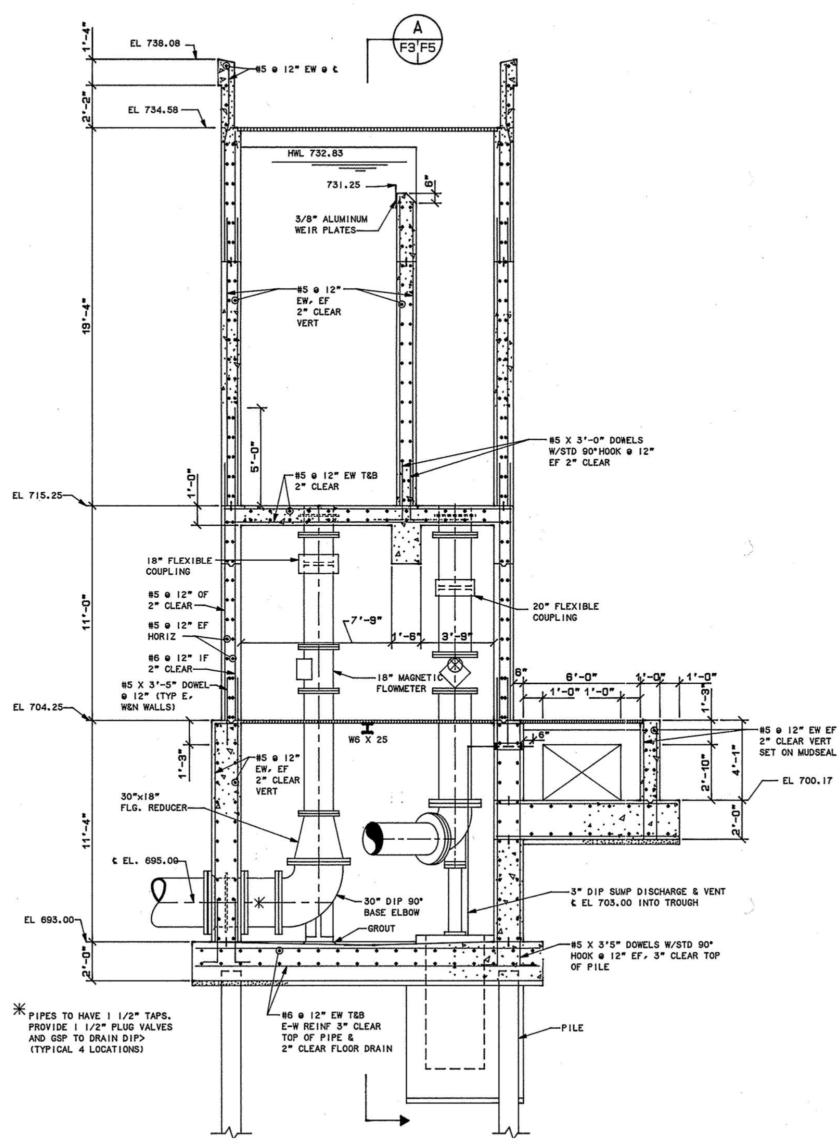


Figure 4 - Trickling Filter Splitter Box Section

The 16-inch trickling filter bypass pipe is undersized to carry 9.1 MGD of flow at typical design velocities (below 8.0 ft/s). It is possible to pump the designed 9.1 MGD, however, at a higher velocity (approximately 10.0 ft/s). If the elevated velocity is not desirable, it is recommended to install a parallel 24-inch force main from the SPS to the SCT, which would also allow a complete bypass of the trickling filters.

Plant operators note an increase in sludge production after trickling filters along with an increase of 1 to 1.5 mg/l in total phosphorus. Increased sludge production is likely a result of excessive snail sloughing; plant operators note that downstream solids contact tanks contain at least three feet of sludge from snails across all basins. After basins are taken down for snail removal, the sludge is readily replenished. If snails cannot be eliminated through operational changes then, at a minimum, a snail sludge collection system should be installed.

Plant staff have indicated that the minimum wetting flow across all the filters is 10 MGD. This flow rate prevents the plastic media from drying out and allows proper operation of the hydraulically driven distribution arms. This required flow rate proves to be problematic during dry weather flows when the treatment plant may only see less than 5.0 MGD of influent and no more than 2.0 MGD can be recirculated to the SPS, from the CCT. Operations staff would prefer capital improvements that would provide a larger trickling filter recirculation flow. Electrically driven trickling filter distribution arms could be one of the solutions to this issue.

Plant operators would also like to develop a standard operating procedure for taking trickling filters out of service and bringing them back online.

Parameter	Value
Number of Trickling Filters	3
Diameter	57.5 ft
Depth of Media	21 ft
Total Volume	172,825 ft^3
Organic Loading Rate	60 lb/1000 ft^3/day
Hydraulic Loading Rate	1.6 gpm/ft^2
Firm Capacity	18.0 MGD

<u>Solids Contact Tank</u>

As previously noted, solids contact tanks accumulate large quantities of snail shells from the trickling filters. If operational improvements to the trickling filters do not eliminate the snail problem, a vortex grit separator can be installed to degrit the RAS, before returning it to the solids contact tank.

The solids contact tanks were added as part of the 2009 plant upgrades and continue to operate effectively. The original diffusers are still in operation and plant staff indicate they are not yet in need of replacement. During dry weather flows, only one blower is used for aeration, it is still oversized according to plant staff. Dissolved oxygen levels increase through each of the solids contact tanks with a DO level of 3.5 and 8.0 mg/L in solids contact tank #3 and #4 respectively.

To reduce the high dissolved oxygen concentration in SCT basin #4, it is recommended to turn off aeration and installing submersible mixers for dry weather operation. With no turndown capacity left in the blower, a blow off valve may be needed for proper air control.

The original design provided enough space between the existing solids contact tanks and the secondary clarifiers for installation of an identical solids contact tank, if needed. The operations staff have expressed an interest in eliminating the existing trickling filter/solids contact (TF/SC) treatment process and installing an activated sludge treatment process. This would necessitate the installation of a second aeration tank, in the space between the existing SCT and the secondary clarifiers.

Parameter	Value
Number of Tanks	4
Dimensions, each	95 ft x 47 ft x 15 ft
Organic Loading	40 lb/day/1000ft^3
Number of Blowers	4
Total Aeration Capacity	12,750 scfm
Firm Capacity	27.1 MGD

Secondary Clarifiers

The secondary clarifiers (SEC) are a combination of three clarifiers from 1972 and one clarifier from the 2009 plant upgrades. The older clarifiers (clarifiers #1 to #3) are limited in treatment capacity due to shallower basin depths. The newer clarifier (clarifier #4) is deeper and treats approximately 40% of plant flow.

During dry weather operations one of the smaller clarifiers is taken out of service however, leaking valves and weirs create additional work for staff to maintain the clarifier out of service.

On the three older clarifiers, operators noted damage to rake arms and outdated solids baffling designs that prevent effective operation during wet weather flows. The equipment in the three older secondary clarifiers are from the original construction and past its useful life. Operations staff prefer that a larger clarifier (new concrete basin) be installed to replace two of the older clarifiers. While a new larger clarifier is desired, at a minimum, internal components should be replaced on all three clarifiers. Figure 5 shows the internal components typical of clarifiers #1 through #3.

Figure 5 - Secondary Clarifier

It must be noted that at the time of the Phase 2 WWTP upgrades, allowable peak solids loading rate for secondary clarifiers was 50 lb/day/ft^2. This was in accordance with the 1997 and 2004 GLUMRB ten state standards. Since then, limits for solids loading rates in secondary clarifiers have been reduced to 40 lb/day/ft^2. The existing clarifiers conform to the current standards (with 16.5 MGD RAS and 3,000 mg/L MLSS).

Parameter	Value
Number of Clarifiers	3
Diameter of each Clarifier	85 ft
SWD of each Clarifier	10 ft
Number of Clarifiers	1
Diameter of each Clarifier	115 ft
SWD of each Clarifier	14 ft
Surface Overflow Rate (PHF)	1,000 gpd/ft^2
Peak Solids Loading Rate	40 lb/day/ft^2
Weir Loading Rate (PHF)	29,852 gpd/LF
Rated Capacity	27.1 MGD

Secondary Sludge Pump Station

Return activated sludge flows by gravity from each secondary clarifier to the RAS wet well. The rate of RAS removal from each clarifier is controlled via one of four telescoping valves. Waste activated sludge (WAS) flows from the RAS wet well to the WAS wet well via a 4-inch tideflex check valve (coded note 8 on drawing in Figure 3) in the common wall between the two wet wells. This opening is drawn at an elevation of 687 ft, but called out as 697 ft in the drawing. It is unclear what the exact centerline of the 4-inch check valve is. Currently the WWTP is limited to wasting SEC skimmings if the RAS/WAS wet well level is not maintained below 691 ft because of insufficient fall in the gravity pipe.

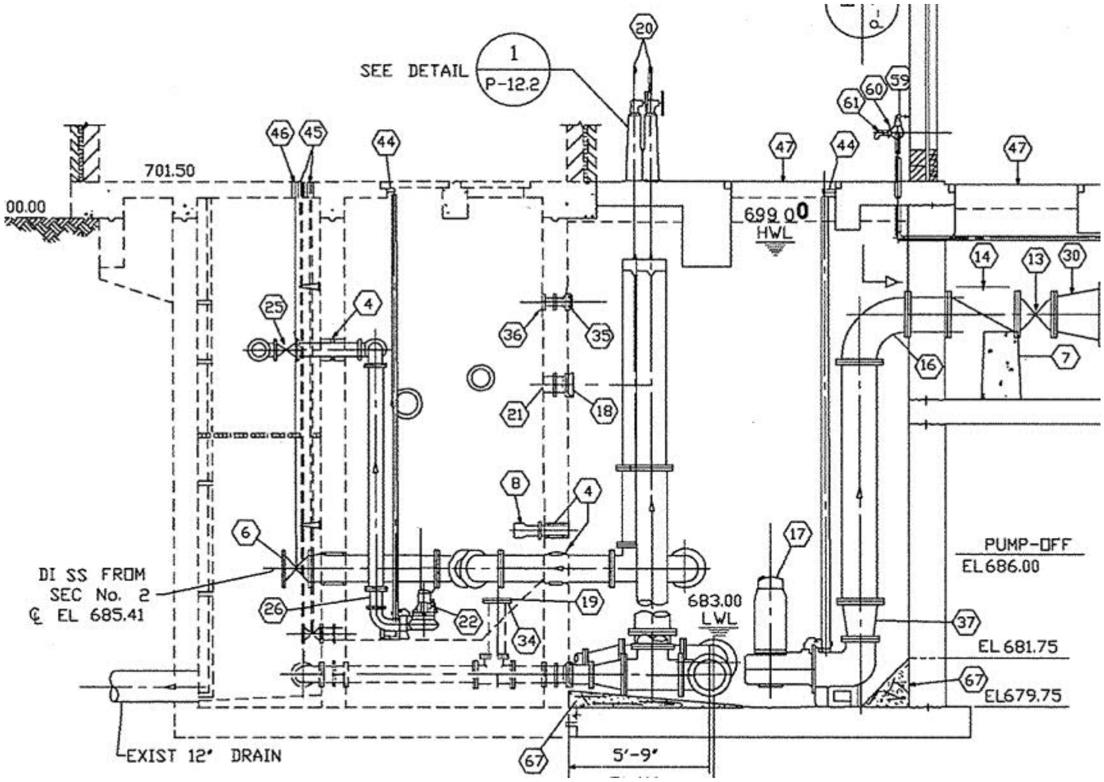


Figure 6 - Secondary Sludge Pump Station Section

Plant operators would prefer to eliminate the WAS pumps and split flow from the RAS to waste. WAS pumps do not operate on VFDs; the irregular flow rate upsets the gravity thickener. If WAS pumps are to remain, installation of VFDs would improve operations.

Chlorine Disinfection System

The existing disinfection system utilizes ton cylinders of chlorine gas. Two 3,000 lb/day chlorinators provide adequate disinfection capacity.

The existing chlorine contact tank might be undersized, providing only 12.7 minutes where 15 minutes are required by ten state standards. A letter dated 11/10/2006 from the design engineer to the Ohio EPA acknowledges the issue and notes that the chlorine feed point would be relocated to provide the required contact time. It is unclear if this was completed, as noted in the letter to the OEPA.

The CCT shows signs of spalling concrete and exposed rebar. Due to safety concerns, plant operators would like to eliminate the chlorine gas feed system with either liquid hypochlorite or a UV disinfection system. Disinfection system replacement would include the installation of appropriately sized chlorine contact tanks or channels for a UV disinfection system.

The plant staff attempted to repurpose the two submersible pumps in the CCT (installed for microwave dryer cooling water, currently non-operational) for TRF recirculation back to the SPS, but the pumps are too small to be of any help. Future improvements to TRF recirculation would allow for the abandonment of these pumps.

Parameter	Value
Number of contact tanks	2
Dimensions of each tank	135 ft x 15 ft x 11 ft
Number of chlorinators	2
Chlorinator Capacity, each	3,000 lb/day
Detention Time	15 minutes
Firm Capacity	36.2 MGD

Sludge Dewatering

The existing sludge belt filter press (BFP) operates effectively but will require extensive overhaul in the coming years due to its age. The existing belt filter press has new top and bottom belts, that were replaced in the last 4 months. Plant staff noted that the ventilation system in the BFP building is inadequate. The 2004 plans indicate 2,800 cfm of supply, which would be greater than 6.0 ACH. Two of the exhaust ducts are located above the BFP, so it is unclear why the ventilation system is not effective. Additional analysis, including HVAC duct balancing is recommended.

The treatment plant does not currently have a redundant sludge dewatering system on site. If the sludge press is taken out of service for maintenance, the City must rely on a mobile system from an outside source. Operations staff are open to pursuing other dewatering technologies such as fan presses, which require reduced operator attention and odor issues. The LTCP should include investment in these redundant dewatering technologies as the BFP approaches the end of its useful life.

Anaerobic Digestion

The WWTP digests its sludge anaerobically in two 70-ft diameter tanks (one primary and one secondary digester). The hot water boilers (Bryant Model CLM270-W-FDGG-KD3, installed in 2005) for the digester heating are located in the basement of the administration building. The two boilers can be operated using natural gas or digester gas. Typically, 50 to 70 percent of the digester gas production is used by the boilers, with the remaining gas flared off.

Plant staff would prefer to move the two boilers to the digester building or to a new digester building annex, so that hot water piping do not traverse the parking lot between the digester building and the administration building. The elimination of the buried gas piping and hot water piping between the two buildings would enhance personnel safety at the WWTP. Since the boilers heat the maintenance shop of the administration building, heating improvements (unit heaters) should be installed in the maintenance shop, when the boilers are relocated.

The two digesters have a fixed and floating cover that were installed in 2002 and are in good condition. Most of the piping and valves in the digester building basement are in good condition. The two heat exchangers in the basement are over 40 years old, although they appear to be operating well enough. The digester gas piping to the flare in the yard is less than 10 years old and does not need any improvements. The flare was part of the 1999 digester upgrades and meets current setback requirements.

Plant staff have a self-installed system of sight tubes to monitor digester supernatant levels, sludge level required to maintain the gas seal within.

Along with the relocation of the boilers, the City may consider digester gas scrubbing to reduce corrosive gas fractions and the moisture content in the digester gas, especially if beneficial reuse of the digester gas is pursued in the future. Digester gas sampling is recommended to determine the specific type of scrubbing necessary. Miscellaneous pump, piping and valve replacement in the digester building are recommend as part of a future CIP improvements project.

System Automation

The City's current systems integrators (Pro-Tech Systems Group) have revamped the SCADA screens and programming since the Phase 1 and 2 upgrades. The treatment plant contains several valves and gates that must be manually operated by plant staff. The operation of this equipment is not a concern during dry weather flows; however, during wet weather flows, operation of the valves and gates for all treatment equipment becomes a cumbersome task. Automation of gates at screen channels and flow splitter boxes is an immediate necessity to assure hydraulic capacity. Electric actuators should be added to all gates and select valves downstream of pump stations. Programming can be added to the existing SCADA system for automated control of these actuators. The existing Allen Bradley Control Logix PLCs are over 10 years old and should be considered for upgrades over the next few years.

Additionally, an automatic transfer switch should be provided for reliable operation during power outages. Currently, plant staff must manually switch to transfer AEP service. Upgrades to the electrical system should also include electrical surge protection as previously discussed.

Miscellaneous Improvements

Miscellaneous improvements to enhance WWTP operations are recommended in a future CIP project. The WWTP drain pump station (Backroad pump station) is not deep enough to drain approximately 4-ft of the secondary clarifier basins. Plant personnel currently use trash pumps to pump out the clarifier basins. The hydraulic grade lines of all the WWTP basins in relation to the drain pump station wet well should be evaluated and suitable modification/improvements should be constructed.

Conclusions

1. Improvements to plant operations in recent years have allowed for greater treatment capacity during high flow periods. Reducing sludge blankets and shutting treatment units during low flows has provided for stable food to mass ratios while allowing treatment capacity for wet weather flow surges.
2. Capacity at the WWTP is limited by the secondary "fine" screens. The screen channel overflow at an influent flow of 25 to 30 MGD indicates severe blinding or blockage of the screens.
3. The trickling filters are plagued by snails, filter flies, odor issues and insufficient recirculation flows.
4. Process equipment lacks necessary automation of weir gates and isolation valves for efficient plant operation.

Recommendations

Capital Improvement Projects (CIP) are required in order to eliminate hydraulic and process bottlenecks at the WWTP and restore the rated Peak Hourly Flow capacity of 36.2 MGD. Other long-term improvements to the WWTP are recommended for efficient and reliable operation and longevity of the WWTP.

WWTP Upgrades to Provide 36.2 MGD Capacity

1. Demolish the existing secondary screens. Although not necessary, replace with self-cleaning mechanical screens of adequate capacity, if redundant screening capacity is desired.
2. Evaluate and upgrade secondary pump station wet well and discharge piping.
3. Install electric actuators to multiple manually operated gates and valves, allowing remote monitoring and automatic operation controlled by the SCADA system.

WWTP Upgrades for Long-Term Implementation

1. Upgrade the primary pump station with a redundant mechanical screen and HVAC system improvements. Redundant primary screen will not be necessary, if secondary screens are installed upstream of the grit tanks.
2. Add piping to bypass primary clarifiers during low flow conditions.
3. Increase trickling filter recirculation capacity, splitter box capacity, and add electric drives for the distribution arms. Design and implement upgrades to address trickling filters snails, filter flies and odor issues.

    3a. An alternate option would be to eliminate the TF/SC process, build additional aeration basins and convert to an activated sludge plant.

4. Replace two of the smaller secondary clarifiers with one larger unit. Replace the internal components of the remaining clarifier.
5. Replace chlorine gas disinfection system with liquid sodium hypochlorite disinfection or UV disinfection.

6. Remove WAS pumps and add control valves to waste from a side stream off the RAS pump discharge. Alternatively, add VFDs to WAS pumps to control flow to gravity thickeners.
7. Upgrade sludge dewatering equipment and provide redundancy.
8. Digester building upgrades.

Planning Cost Estimate

A conservative planning level estimate of the recommended capital improvement projects is provided in the table below. These figures would vary depending on the treatment technologies and other details chosen during design. The numbers below are presented for planning purposes.

Capital Project	Cost
Secondary Screen Demolition	$ 25,000
New Secondary Screen Installation	$1,150,000**
Primary Pump Station Improvements	$1,600,000**
Secondary Pump Station Improvements	$500,000
Plantwide Automation Improvements	$250,000
Plantwide PLC Upgrades	$500,000
Primary Clarifier Bypass	$150,000
Trickling Filter Improvements	$275,000
Activated Sludge Conversion	$4,325,000*
Secondary Clarifier Improvements	$2,700,000
UV Disinfection Improvements	$3,250,000
Sludge Pumping Improvements	$50,000
Sludge Dewatering Improvements	$1,300,000
Digester Building Improvements	$200,000
Miscellaneous Improvements	$50,000

Notes: * - The estimated cost of the activated sludge conversion would include the alternate described as 3a under the WWTP Upgrades for Long-Term Implementation Recommendations. If this alternate is selected, the $4.3 Million would replace the estimate $275,000 for the Trickling Filter Improvements

** New secondary screens not required if redundant primary screens are installed. Likewise, primary screen improvements are not required if new secondary screens are installed.

References

Great Lakes Upper Mississippi River Board. (2014). *Recommended Standards for Wastewater Treatment Facilities.* Health Research Inc.

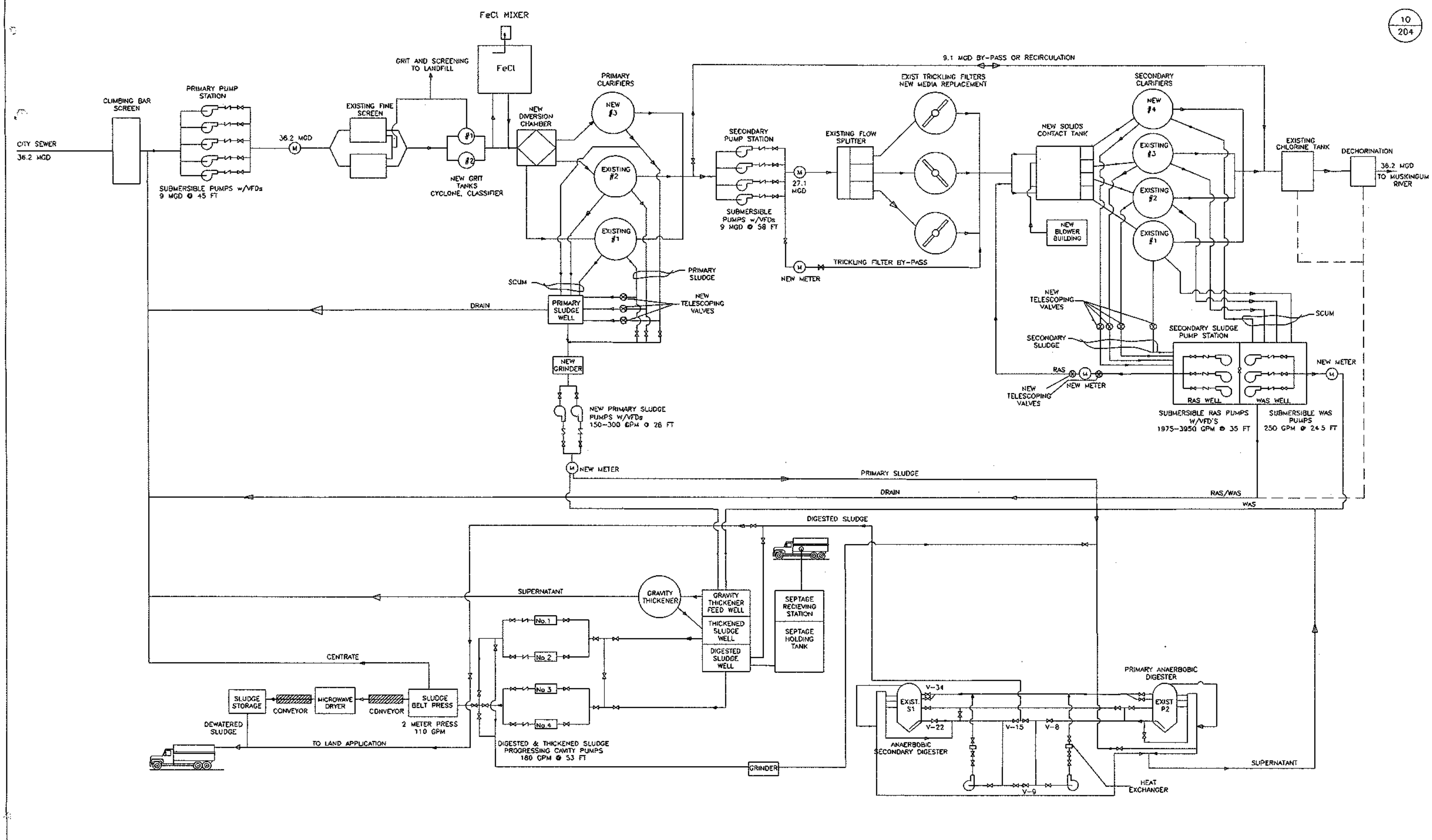
WEF Manual of Practice No. 11. (1996). *MOP 11: Operation of Municipal Wastewater Treatment Plants* (5th ed.). Water Environment Federation (WEF).

WEF Manual of Practice No. 35. (2011). *Biofilm Reactors.* Water Environment Federation (WEF).

WEF Manual of Practice No. 8. (2018). *Design of Water Resource Recovery Facilities* (6th ed.). Water Environment Federation (WEF).

ATTACHMENT-A

Pages from existing plans (16 pages)



NO.	BY Int.	DATE Mo./Dy./Yr.	REVISIONS Remarks

PROJ. PERSONNEL Initials	DATE Mo./Dy./Yr.
DES. AP	
DWN AP	12/22/04
CKD DAD	2/23/07

STATE OF OHIO — DAVID A. DAY — E-55870 — REGISTERED PROFESSIONAL ENGINEER

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

TREATMENT PLANT UPGRADE
PHASE 2
2007

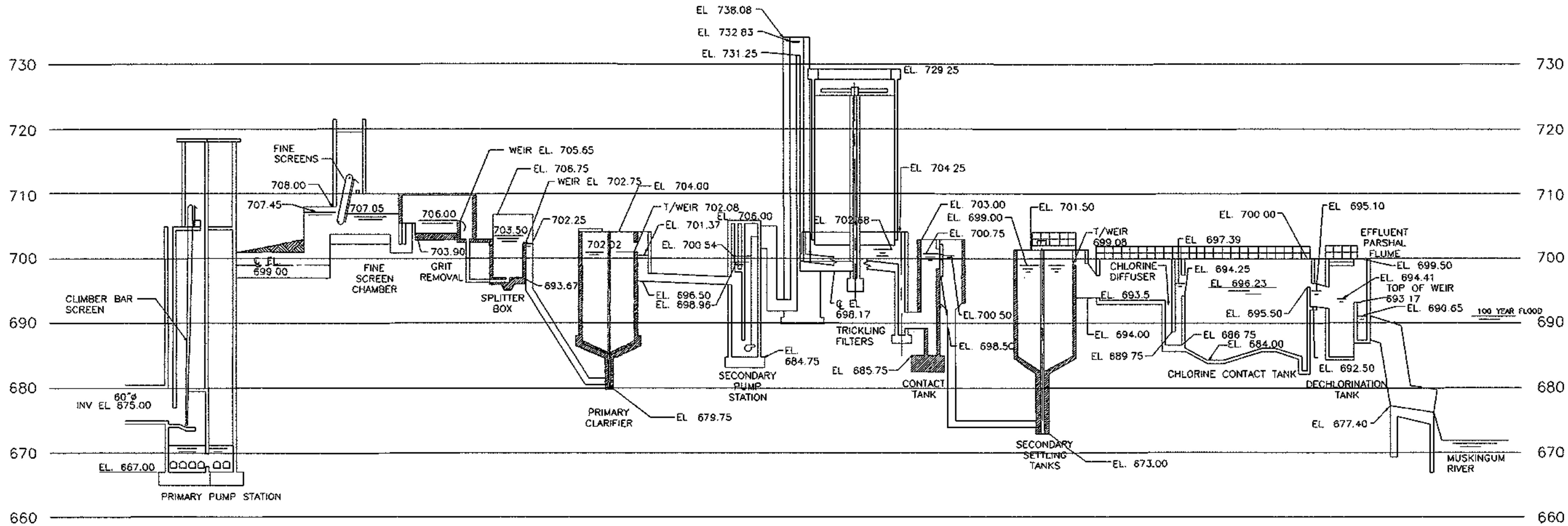
SCALE
NOT TO SCALE

GENERAL
PROPOSED FLOW SCHEMATIC

ISSUED STATUS: CTC
(See Legend Sheet for Explanation)

SHEET G-6 1

DATE ISSUED: 06/06/07 Mo./Dy./Yr.



11/204

ZANESVILLE WWTP HYDRAULIC PROFILE

100 YEAR FLOOD – 691.00 FT
25 YEAR FLOOD – 686.50 FT

NO.	BY Init.	DATE Mo./Dy./Yr.	REVISIONS Remarks

PROJ. PERSONNEL Initials	DATE Mo./Dy./Yr.
DES. AP	02/06/02
DWN. AP	12/22/04
CKD. DAD	2/23/07

STATE OF OHIO DAVID A DAY E-55870 REGISTERED PROFESSIONAL ENGINEER

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

TREATMENT PLANT UPGRADE
PHASE 2
2007

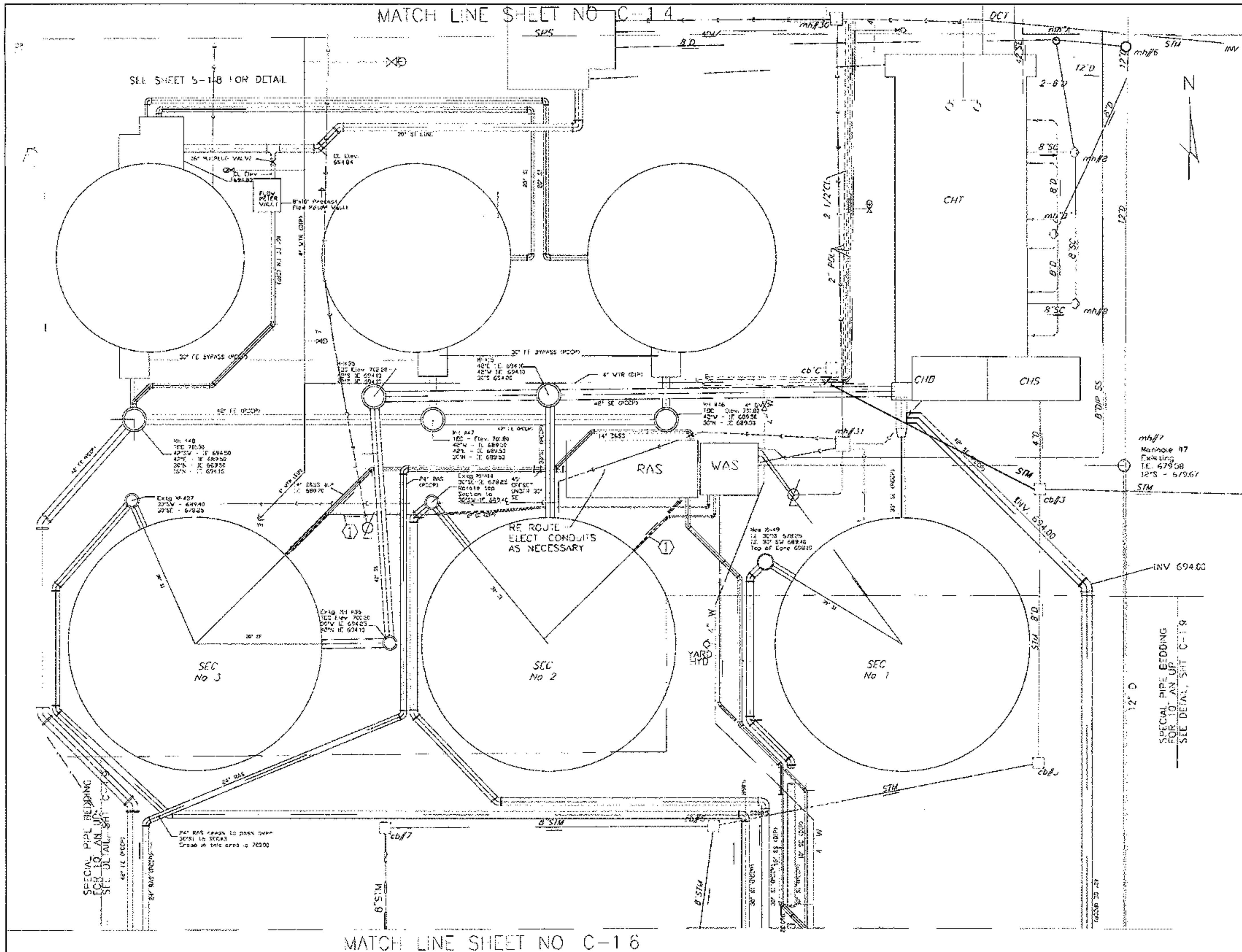
SCALE
NO SCALE

GENERAL
HYDRAULIC PROFILE

ISSUED STATUS: CTC
(See Legend Sheet for Explanation)

SHEET G-71

DATE ISSUED: 06/06/07 Mo./Dy./Yr.



CATCH BASIN SCHEDULE

C.B. NO.	TYPE	BUILD NEW	EXISTING: REMOVE	EXISTING: ABANDON	EXISTING: MODIFY	TOP OF CASTING ELEV.	PIPE INVERT ELEV.-DIRECTION-SIZE: INLETS "A"	INLETS "B"	INLETS "C"	OUTLET "D"	REMARKS
1	X				X	699	695.5(W)6"	695.00(N)6"		694.5(E)12"	CONNECT NEW C.B. 21 8" LINE
7						697.97	696.00(S)8"			695.57(E)8"	
7A		X				698.2				697.00(N)8"	ODOT STD CATCH BASIN 2-2B
8			X			697.06				694.76(N)8"	EXISTING OUTLET (E)8"
8A		X				697.5				694.76(N)8"	ODOT STD CATCH BASIN 2-2B
8B		X				698.25				696.25(S)8"	ODOT STD CATCH BASIN 2-2B
16					X	701.42	699.10(W)8"			699.00(E)8"	EXISTING OUTLET (E)8"
18					X	699.3	695.0(W)4"	696.00(W)4"		695.97(E)8"	CONNECT NEW A & B LINES
21	3	X				700				695.50 8"	ODOT STD CATCH BASIN 2-2B
24	2	X				700				697.00(E)"	ODOT STD CATCH BASIN 2-2B
25											
1262					X	701.56	699.33(N)8"			699.23(N)8"	PLUG EXISTING OUTLET(E)8"

MANHOLE SCHEDULE

M.H. NO.	TYPE	BUILD NEW	EXISTING: REMOVE	EXISTING: ABANDON	EXISTING: MODIFY	TOP OF CASTING ELEV.	PIPE INVERT ELEV.-DIRECTION-SIZE: INLETS "A"	INLETS "B"	INLETS "C"	OUTLET "D"	REMARKS
7					X	698.72	679.52(W)12"	679.57(S)12"		679.42(N)12"	
11		X				702.11	695.20(N)6"	696.40(SW)8"	697.00(N)6"	695.00(SE)8"	BUILD NEW MH# 11 WEST OF EXISTING THEN RECONNECT LINES A, B,C
12					X	702.63	697.00(NW)6"	697.00(N)6"	697.00(W)6"	696.90(NE)8:	
12A		X				702.5					FILED VERIFY INVERTS
14					X	700.38	689.40(N)30"			678.25(SE)30"	PLUG 30" FE (N)
25					X	704.15	692.71(N)42"	693.00(W)30"		692.48(S)42"	
37					X	701.49	689.40(SW)30"			678.25(SE)30"	PLUG 30" FE (N)
40					X	702.57	681.37(SW)8"	691.00(NW)8"	690.00(MW)6"	681.31(SE)8"	
41		X				702	690.10(NW)8"			686.00(SE)8"	
46		X				701	689.50(N)30"			695.50(W)42	
47		X				701.8	689.50(N)30"		695.50(E)42"	695.50(W)42"	
48		X				701	689.59(N)30"	696.75(NW)16"	695.50E)42"	694.50(SW)42"	
49		X				699.7	698.40(SW)30"			678.25(SE)30"	
51		X				695	682.70(W)12"			682.60(N)12"	
52		X				696	681.48(S)12"			681.38(NW)12"	
53		X				697.5	682.24(SE)12"			681.14(N)12"	

CODED NOTES

1 REMOVE AND REPLACE EXISTING 8" D & SS WITH NEW 12" & 14" LINES . SEE SHEET P-12.1

NOTES

1 USE CLASS 53 DIP WITH RESTRAINED JOINTS FOR ALL YARD PIPING SEE SPEC 1506

DLZ

NO.	BY INT.	DATE MO/DY/YR	REVISIONS REMARKS

PROJ. PERSONNEL	INITIALS	DATE MO/DY/YR
DES	MS	9/3/09
DWN	TLS	9/3/09
CKD	DAD	9/3/09

STATE OF OHIO
DAVID A DAY
E-55870
REGISTERED
PROFESSIONAL ENGINEER

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

TREATMENT PLANT UPGRADE
PHASE 2
2007

SCALE
0 1 2 4
FEET
OR AS NOTED

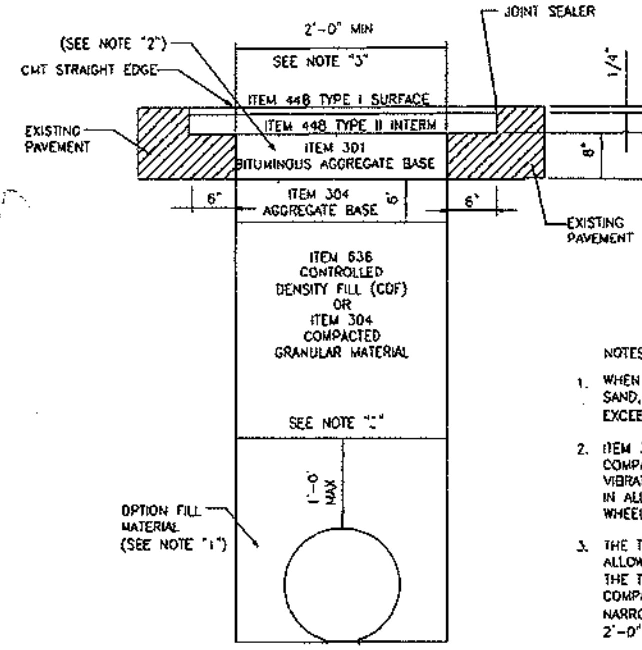
CIVIL SITE WORK

YARD PIPING PLAN - 3
PLANS AND SECTIONS

ISSUED STATUS: CTC

SHEET C-1.5 AS

DATE ISSUED 6/6/07 MO/DY/YR



FLEXIBLE ASPHALT REPAIR

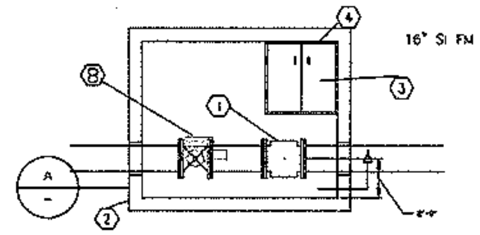
NOT TO SCALE

NOTES:

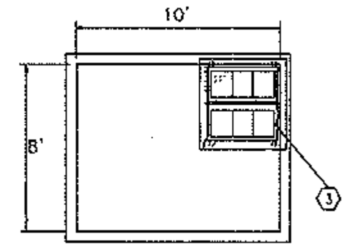
1. WHEN USING CDF, THE OPTIONAL FILL AREA OVER THE CONDUIT MAY BE BACKFILLED WITH SAND, GRANULAR MATERIAL, OR OTHER SUITABLE 304 MATERIAL FOR A DISTANCE NOT TO EXCEED 1'-0".

2. ITEM 301 HOT ASPHALT SHALL BE PLACED IN LIFTS NOT EXCEEDING THREE INCHES AND COMPACTED WITH A COMBINATION VIBRATORY PLATE COMPACTOR EQUIPMENT, OR A VIBRATORY STEEL WHEELED ROLLER WITH A MINIMUM CERTIFIED FORCE OF 2000 POUNDS. IN ALL CASES THE SURFACE LIFT SHALL BE COMPACTED WITH THE VIBRATORY STEEL WHEELED ROLLER.

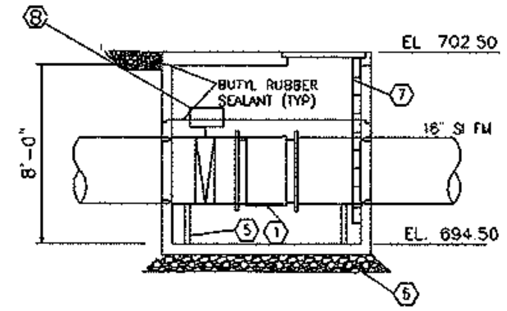
3. THE TRENCH WIDTH FOR SMALL PIPES AND CONDUITS SHALL BE SUFFICIENT WIDTH TO ALLOW FOR PROPER PLACEMENT OF THE BACKFILL MATERIAL. THE PAVEMENT PORTION OF THE TRENCH SHALL BE A MINIMUM OF 2'-0" IN WIDTH. THIS IS TO ALLOW FOR PROPER COMPACTION OF THE ASPHALT PAVEMENT. IF THE TRENCH FOR PLACING THE CONDUIT IS NARROWER THAN 2' THEN THE PAVMENT PORTION SHALL BE CUT BACK TO PROVIDE THE 2'-0" MINIMUM FOR PAVING OPERATIONS.



METER VAULT – PLAN



METER VAULT – TOP PLAN



SECTOPN A–A

CODED NOTES

1 – 16" MAGMETER, 0705-1

2 – 8'-0" X 10'-0" X 8'-0" HT (INTERIOR DIM) PRECAST CONCRETE METER VAULT (E.C. BABBERT INC., OR EQUAL)

3 – 42"X42" ALUMINUM ACCESS DOOR WITH CHANNEL FRAME AND SPRING ASSIST (HALLIDAY PRODUCTS INC MODEL W2C4242, OR EQUAL). ACCESS DOOR TO BE CAST WITH FLAT SLAB TOP AT TIME OF MANUFACTURE

4 – FACTORY INSTALLED RUBBER BOOT SLEEVE, CONFORMING TO ASTM C-923 (TYP OF 2) (PRESS-SEAL PSX-DIRECT DRIVE OR EQJAL)

5 – STANDON MODEL S92 SADDLE SUPPORT SECURE BASE PLATE TO CONCRETE USING SS ADHESIVE ANCHORS AS RECOMMENDED BY MANUFACTURER

6 – 6" COMPACTED BEDDING MATERIAL (ODOT ITEM 703.11, TYPE 3).

7 – 16" WIDE ALUMINUM LADDER (HALLIDAY PRODUCTS, INC. SERIES L1D, OR EQUAL) WITH ALUMINUM/STAINLESS LADDER SAFETY EXTENSION (HALLIDAY PRODUCTS, INC SERIES L1E, OR EQUAL)

8 – 16" Motor Operated Plug Valve

NO.	BY INT.	DATE MO/DY/YR	REVISIONS REMARKS

PROJ. PERSONNEL INITIALS		DATE MO/DY/YR
DES	MS	
DWN	TLS	
CKD	DAD	2/23/07

STATE OF OHIO DAVID A DAY E-55870 REGISTERED PROFESSIONAL ENGINEER

DLZ

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

TREATMENT PLANT UPGRADE
PHASE 2
2007

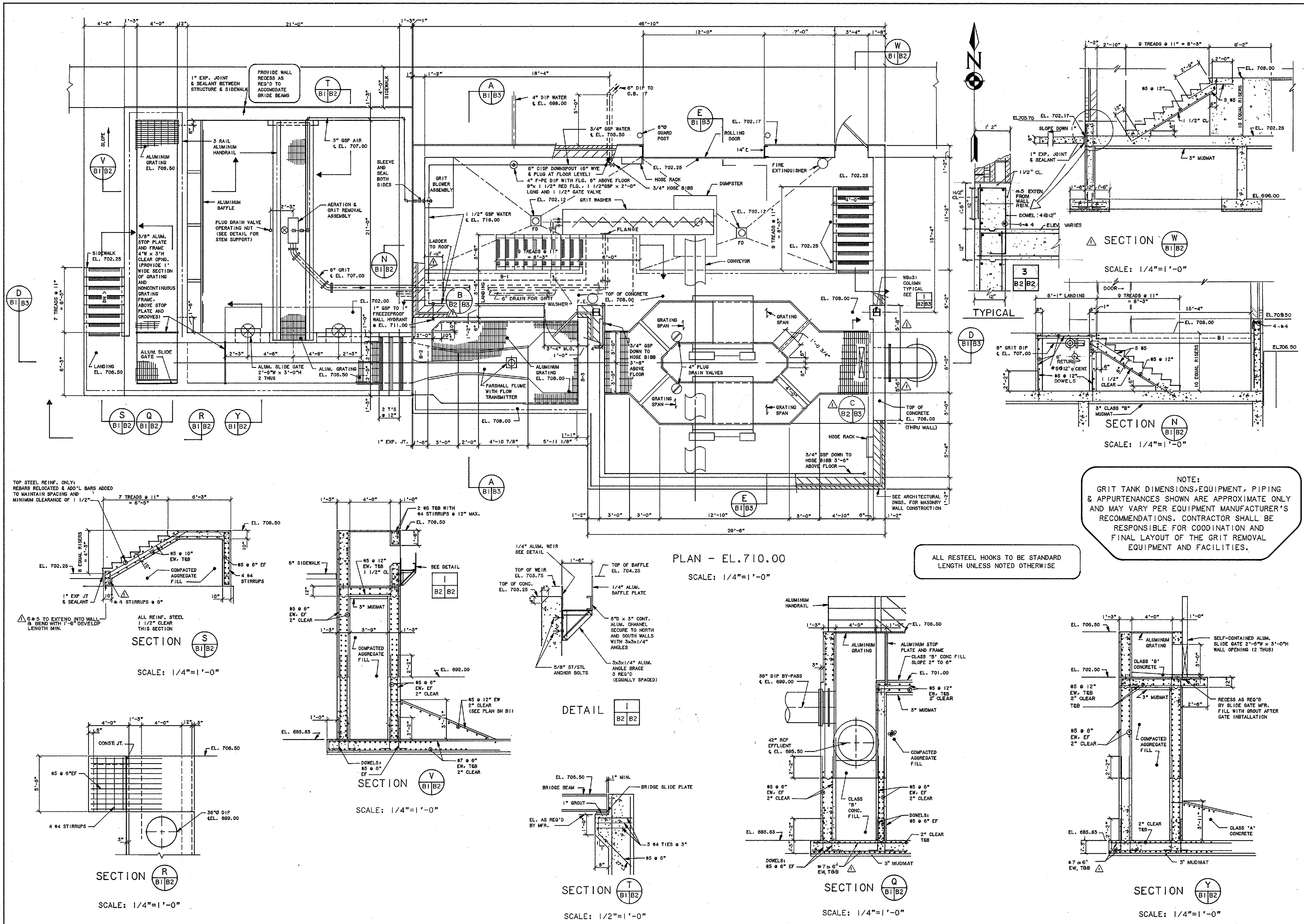
CIVIL SITE WORK

DETAILS – 1

ISSUED STATUS: CTC

SHEET C-1.8

DATE ISSUED 6/6/07 MO/DY/YR



NOTE:
GRIT TANK DIMENSIONS, EQUIPMENT, PIPING & APPURTENANCES SHOWN ARE APPROXIMATE ONLY AND MAY VARY PER EQUIPMENT MANUFACTURER'S RECOMMENDATIONS. CONTRACTOR SHALL BE RESPONSIBLE FOR COODINATION AND FINAL LAYOUT OF THE GRIT REMOVAL EQUIPMENT AND FACILITIES.

ALL RESTEEL HOOKS TO BE STANDARD LENGTH UNLESS NOTED OTHERWISE

Brundage, Baker & Stauffer, Limited
Consulting Engineers
Columbus, Ohio / Cincinnati, Ohio

No.	Date	By	REVISIONS
1	6/9/86	JDJ&A	

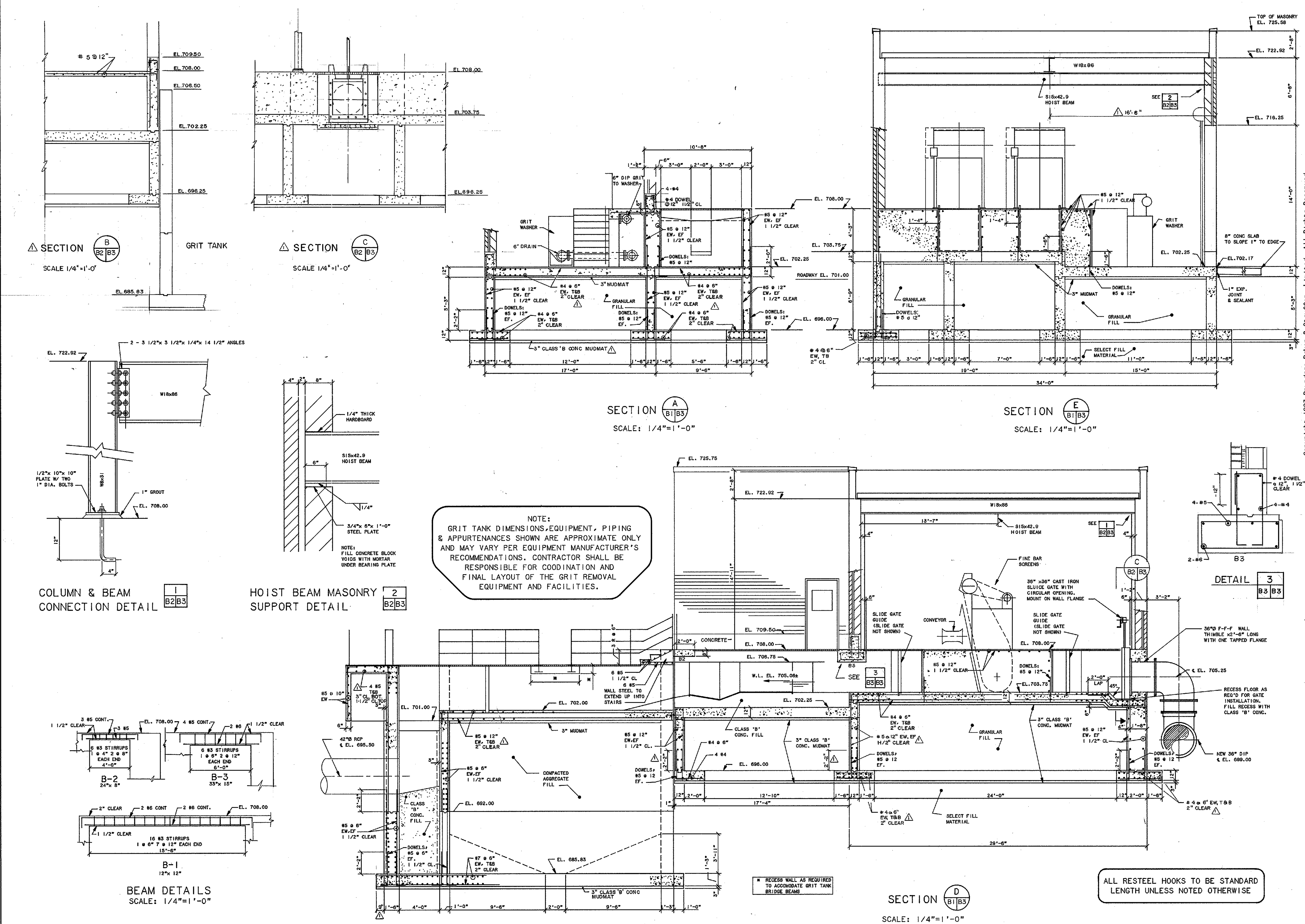
Designed SR · Drawn SGT · Proj. Eng. SR · Proj. No. 6506A

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

SCREENING, INFLUENT METERING AND GRIT REMOVAL BUILDING

PLAN AND SECTIONS

DRAWING No. B2



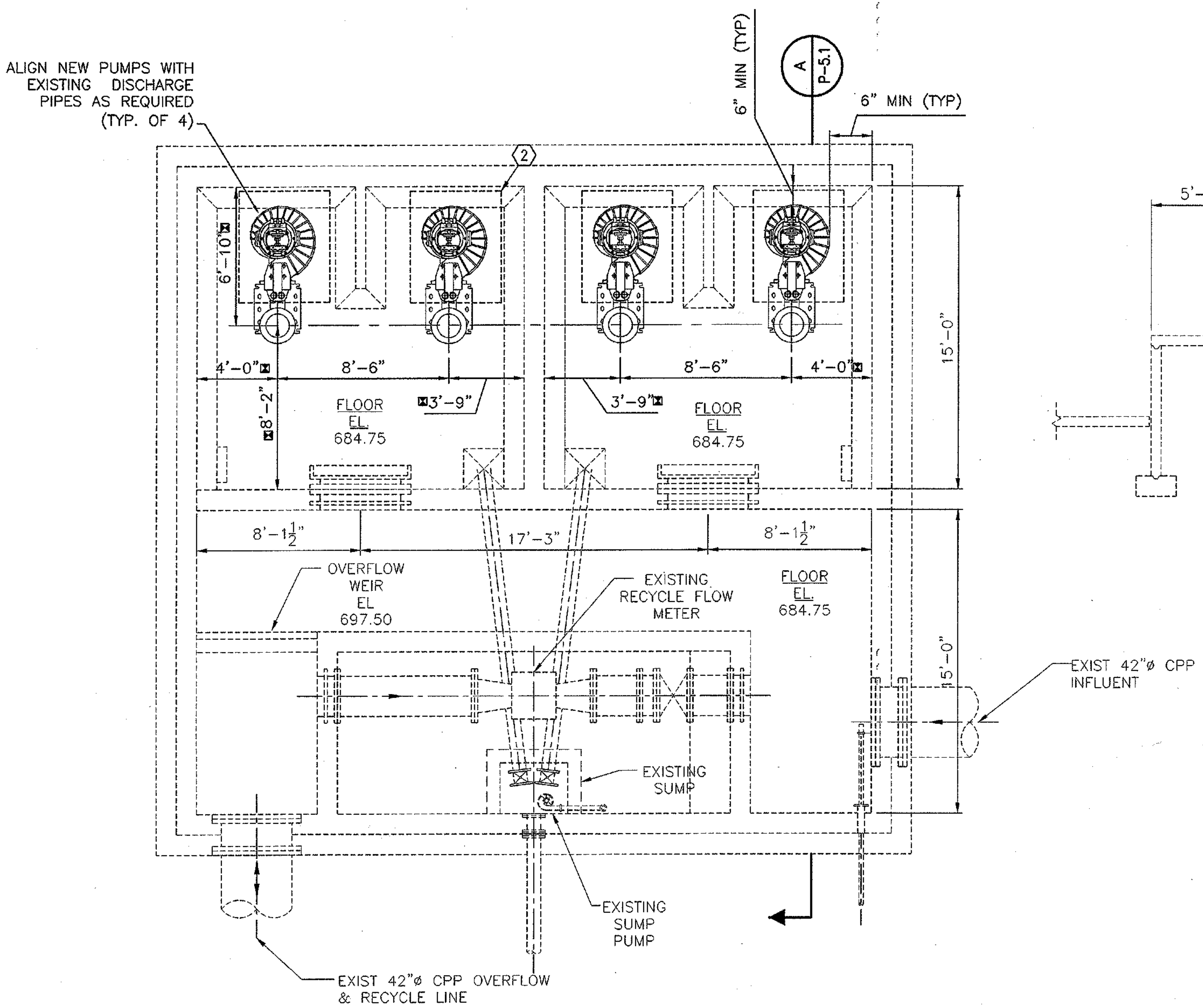
Brundage, Baker & Stauffer, Limited
Consulting Engineers
Columbus, Ohio / Cincinnati, Ohio

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

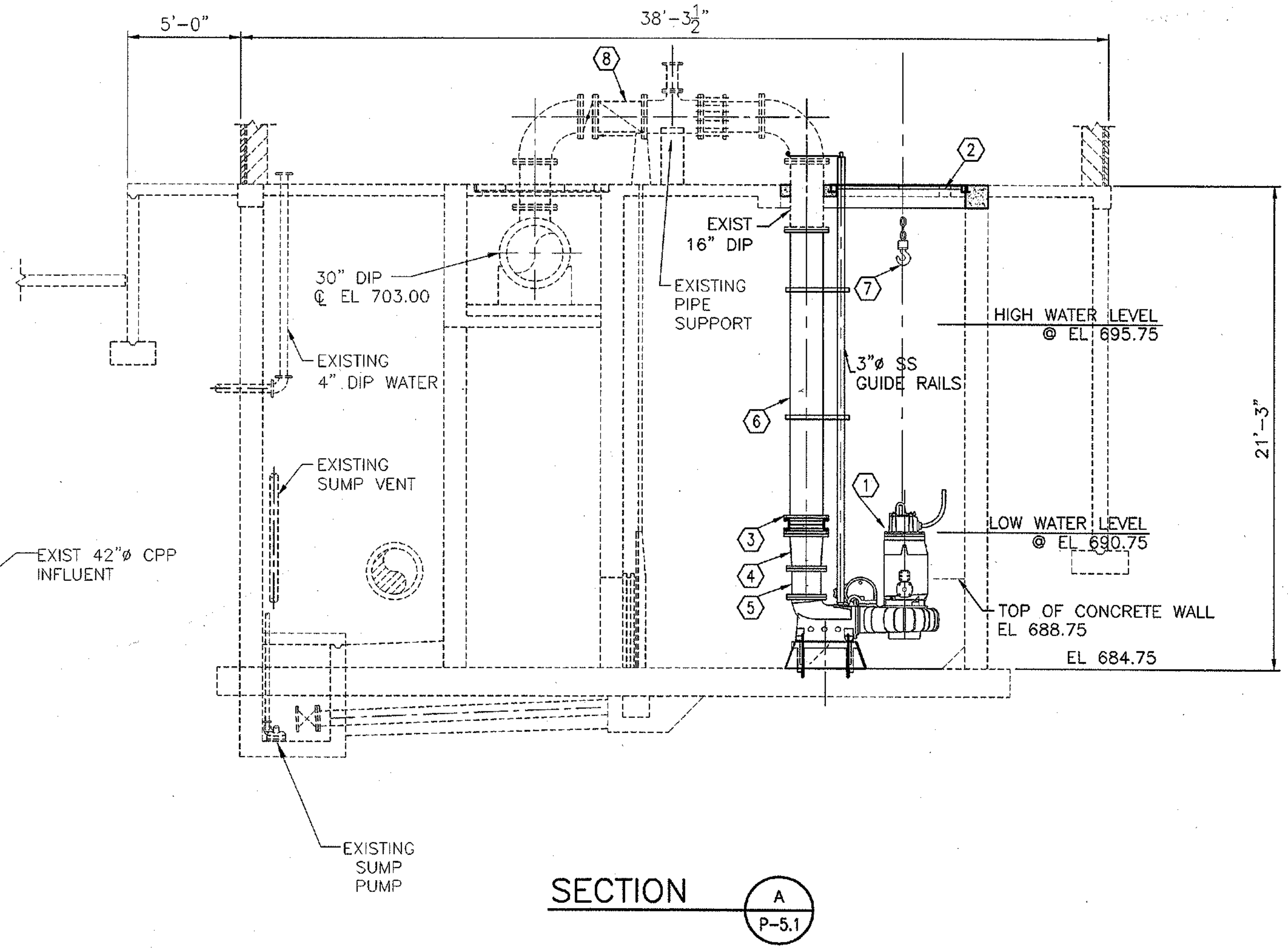
SCREENING, INFLUENT METERING AND GRIT REMOVAL BUILDING

SECTIONS

DRAWING No. B3



PLAN @ EL 697.50



SECTION A P-5.1

CODED NOTES

1 – NEW SUBMERSIBLE PUMP (TYP OF 4) SPS-W-SI-0125-1 THRU 4. SEE SECTION 11230
2 – 66"X48" CLR OPNG AL ACCESS COVER WITH SAFE HATCH SYSTEM (FDRND- 48X66AOSH BY FLYGT OR APPROVED EQUAL)
3 – 16" FLANGE COUPLING ADAPTOR
4 – 14" X 16" REDUCER
5 – 14" DIP
6 – 16" DIP
7 – 5 TON GEARED, LOW HEADROOM, INTEGRALLY BUILT TROLLEY AND CHAIN HOIST. 30' LIFT (COFFIN MODEL CTH5(G) OR APPROVED EQUAL) (ABOVE)
8 – EXIST CHECK VALVE TO REMAIN

N

41/207

NOTES

1. ALL EQUIPMENT AND VALVE TAGS ARE PROCEEDED BY "SPS-W-"
2. ⊠SEE SHT S-0.3
3. SEE SHEET S-5.5 FOR PUMP PAD DETAIL

NO.	BY Int.	DATE Mo./Dy./Yr.	REVISIONS Remarks
1		07/15/04	ADDENDUM NO. 1

PROJ. PERSONNEL Initials	DATE Mo./Dy./Yr.
DES. AP	02/02/04
DWN. AP	02/02/04
CKD. DWS	06/15/04

DLZ

STATE OF OHIO DAVID W. STEWART 58186 REGISTERED PROFESSIONAL ENGINEER

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

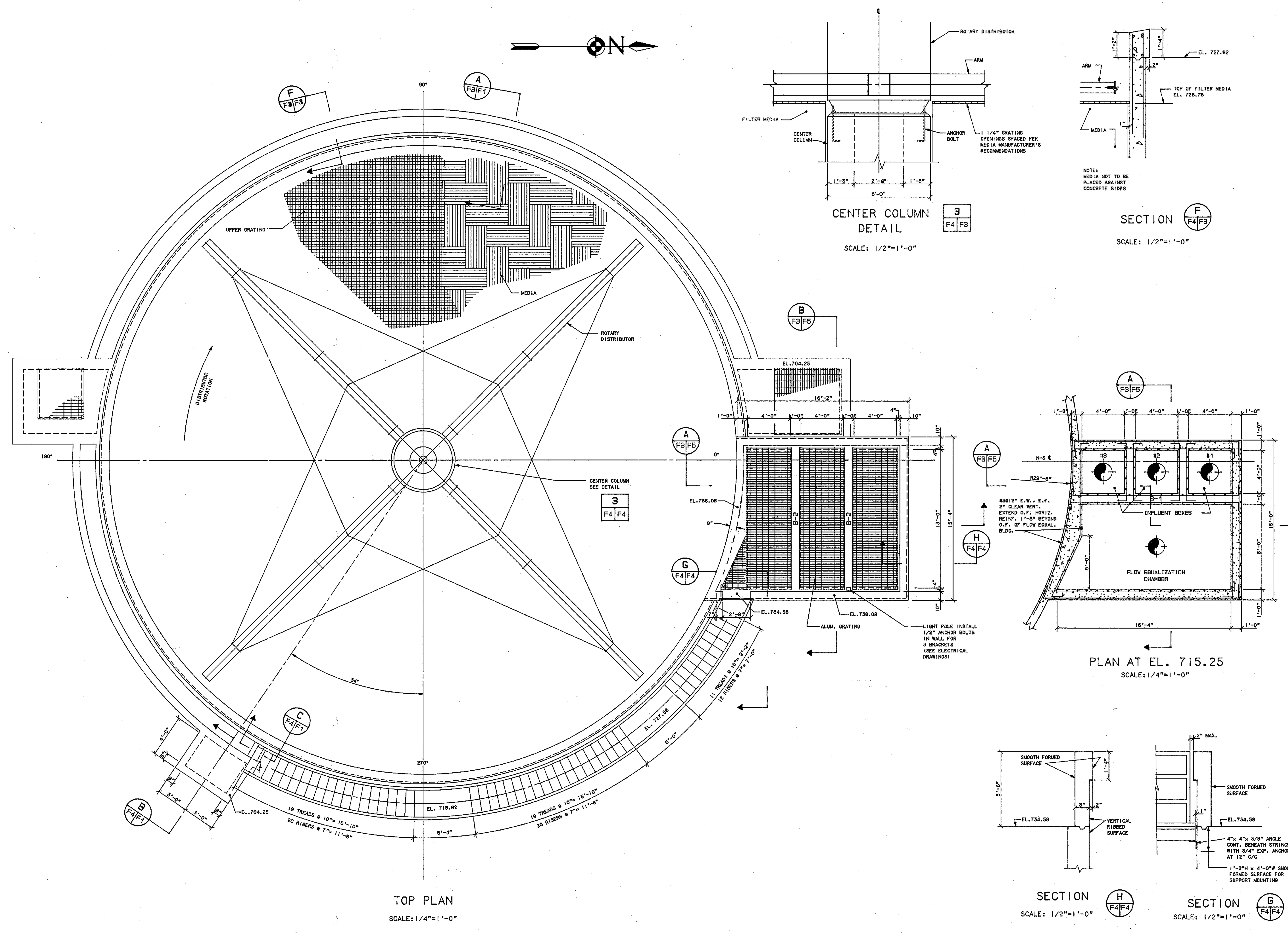
TREATMENT PLANT UPGRADE PHASE I 2004

SCALE 0 1 2 4 FEET

PROCESS
SECONDARY PUMP STATION PLAN AND SECTION

ISSUED STATUS: CTC (See Legend Sheet for Explanation)
SHEET P-5.1
DATE ISSUED: 09/24/04

[[AP]]M:\PROJ\9921\6009.01\PROCESS\P05-0.DWG – SEPT 24, 2004 – 10:09:08 – PLOT: 1=1

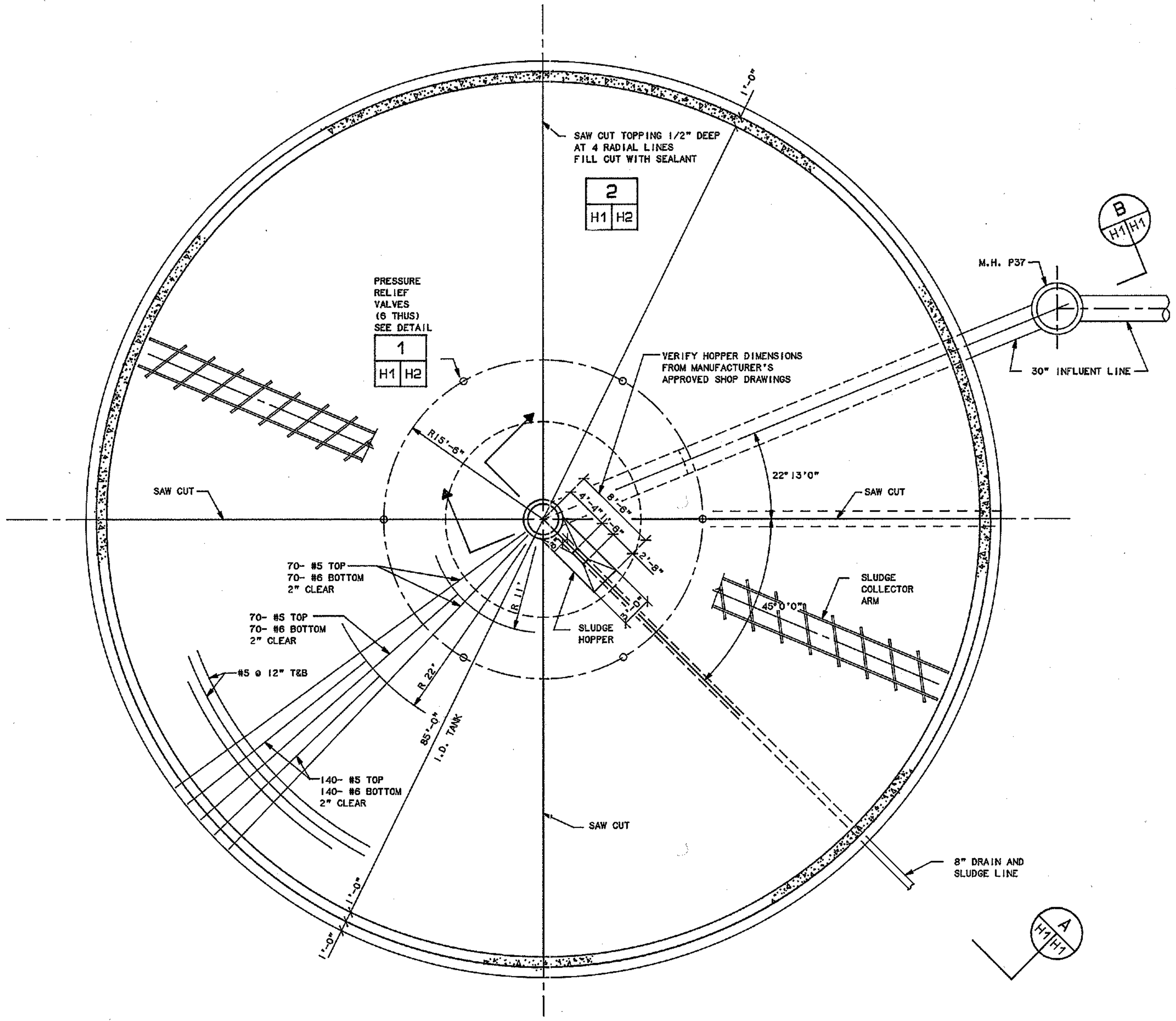


Brundage,Baker & Stauffer, Limited
Consulting Engineers
Columbus, Ohio / Cincinnati, Ohio

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

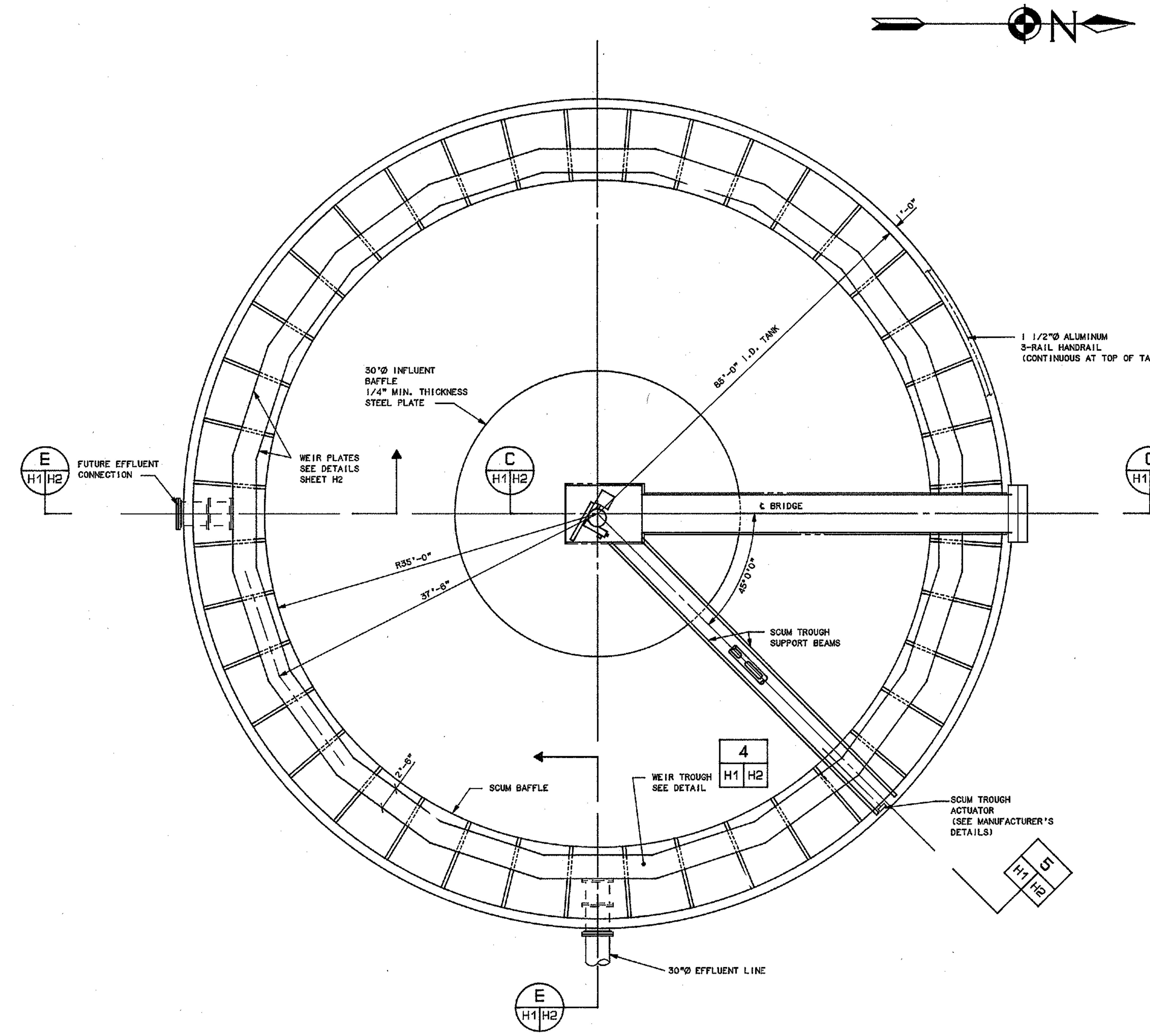
TRICKLING FILTER NO. 3
PLANS, SECTIONS AND DETAILS

DRAWING No.
F4



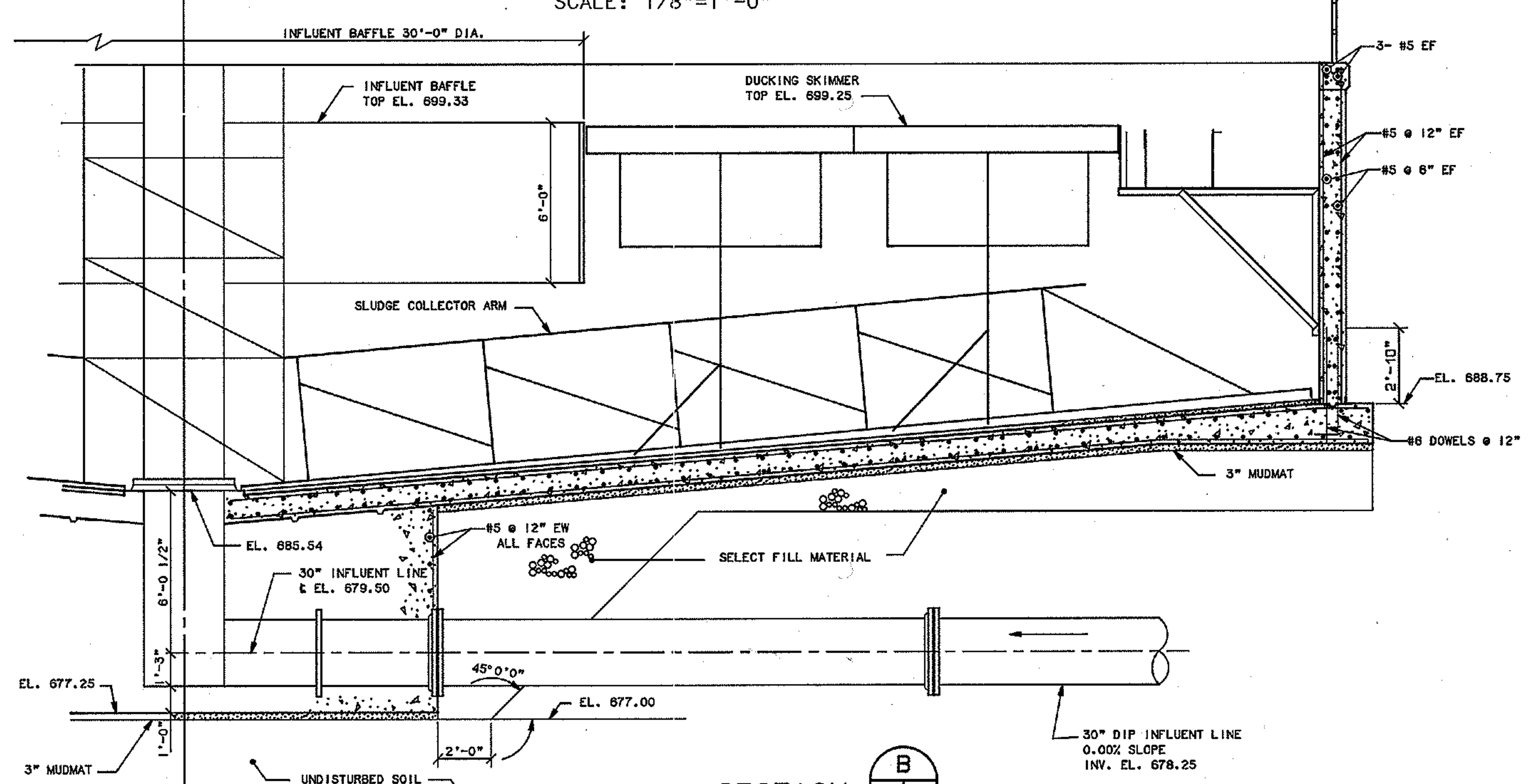
BOTTOM PLAN

SCALE: 1/8"=1'-0"



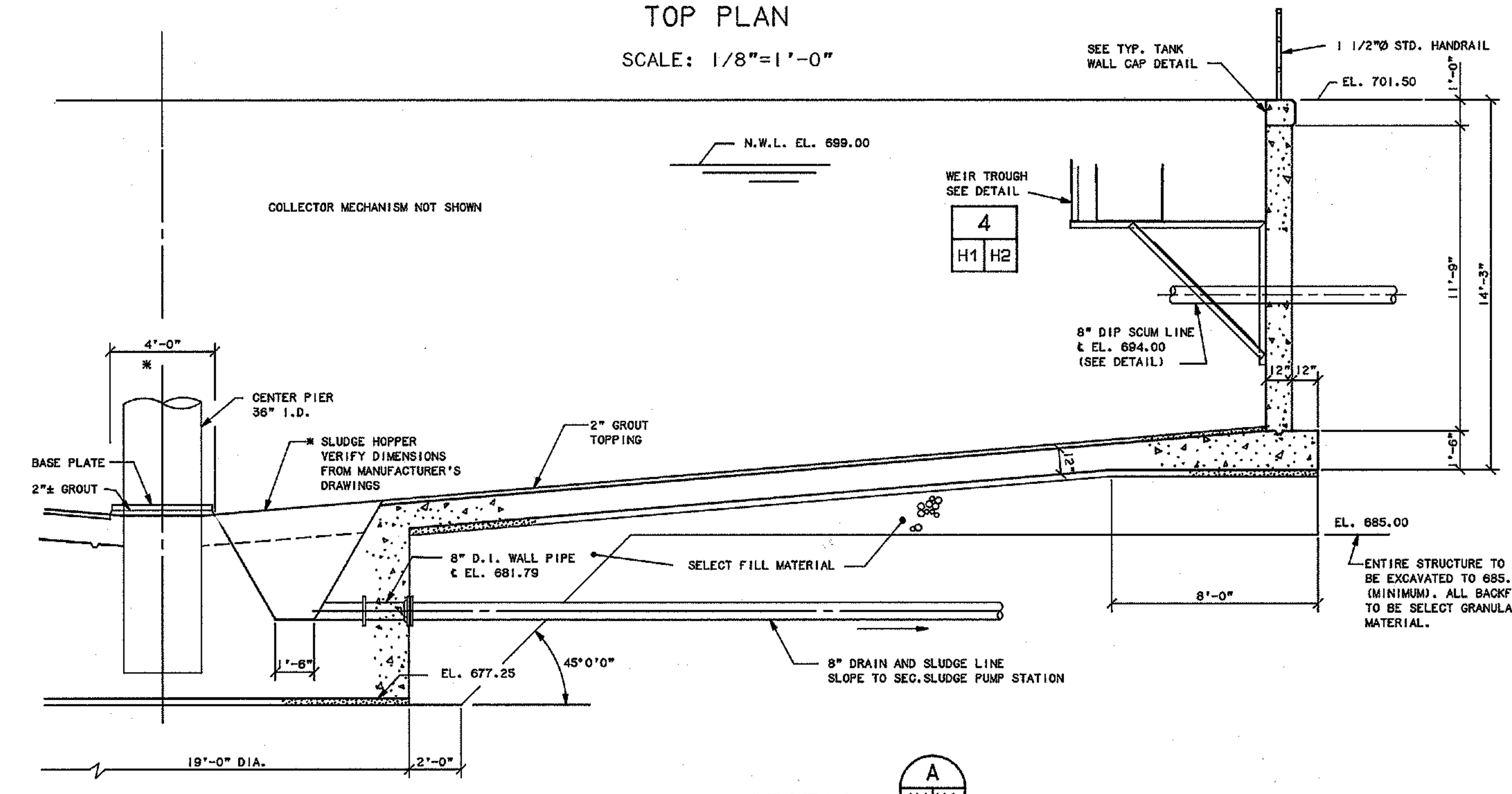
TOP PLAN

SCALE: 1/8"=1'-0"



SECTION B (H1 H1)

SCALE: 1/4"=1'-0"



* = VERIFY AS REQ'D BY EQUIPMENT MANUFACTURER

SECTION A (H1 H1)

SCALE: 1/4"=1'-0"

Brundage, Baker & Stauffer, Limited
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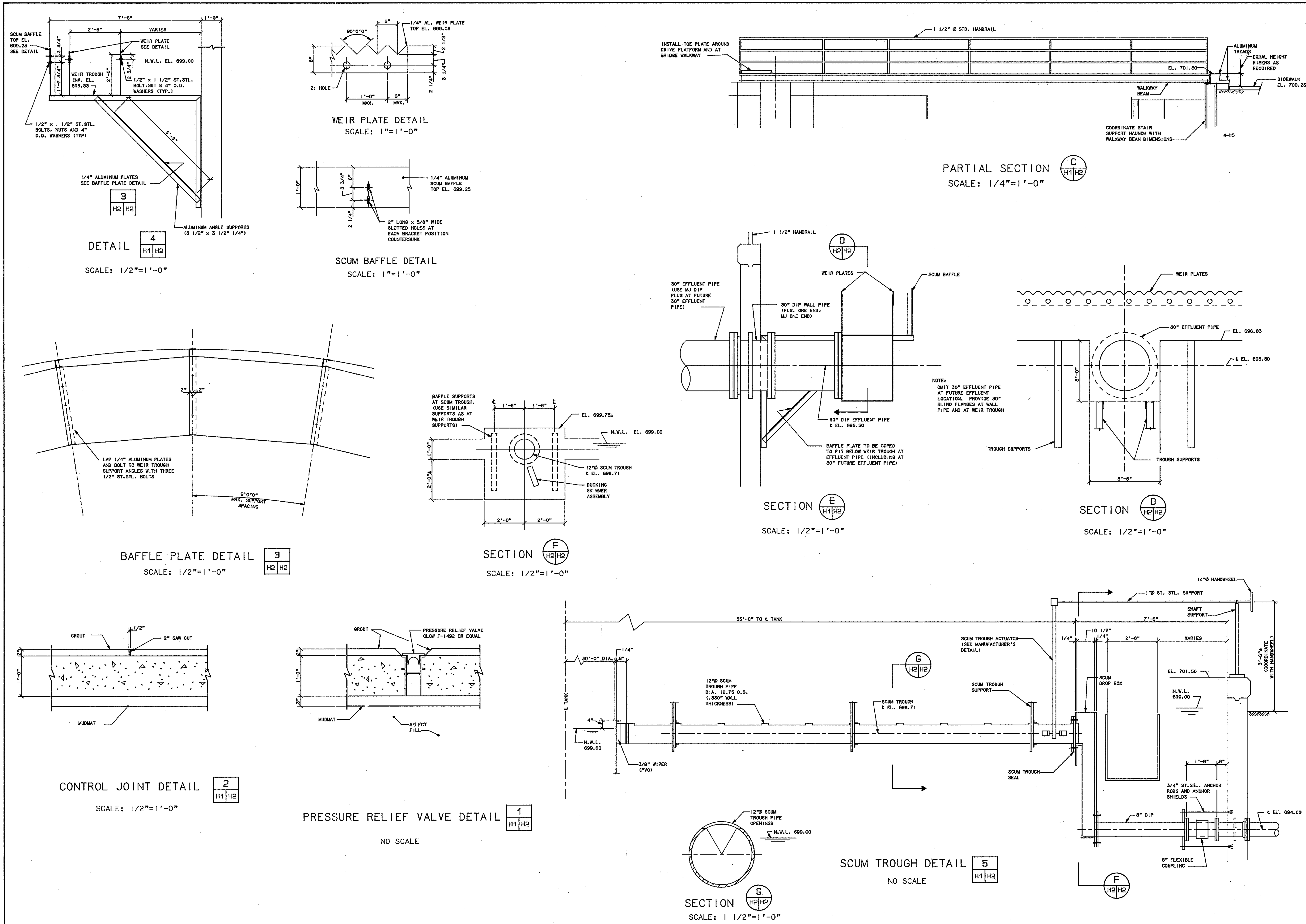
Columbus, Ohio / Cincinnati, Ohio

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

SECONDARY CLARIFIER No. 3

PLANS AND SECTIONS

DRAWING No. H1



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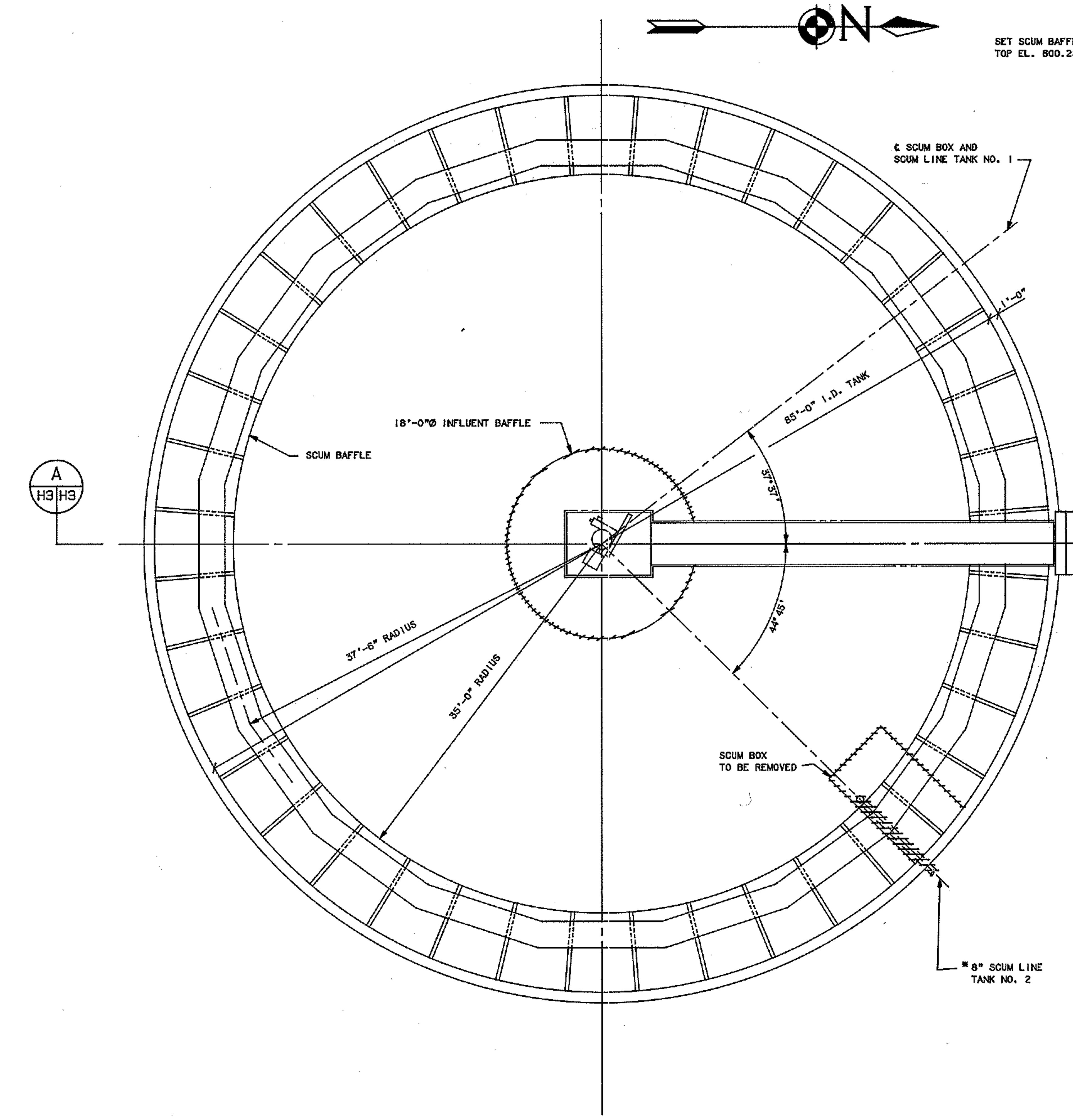
Columbus, Ohio / Cincinnati, Ohio

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

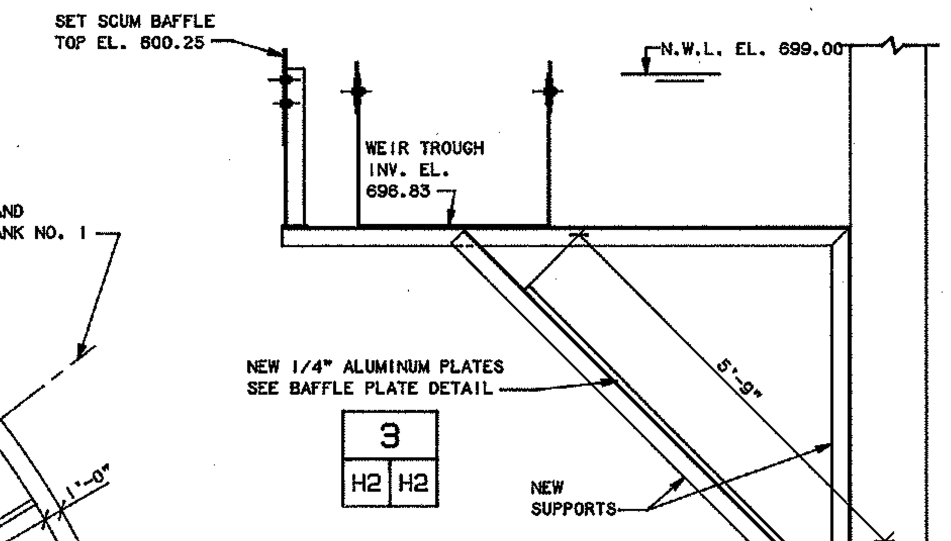
SECONDARY CLARIFIER NO. 3

SECTIONS AND DETAILS

DRAWING No.
H2

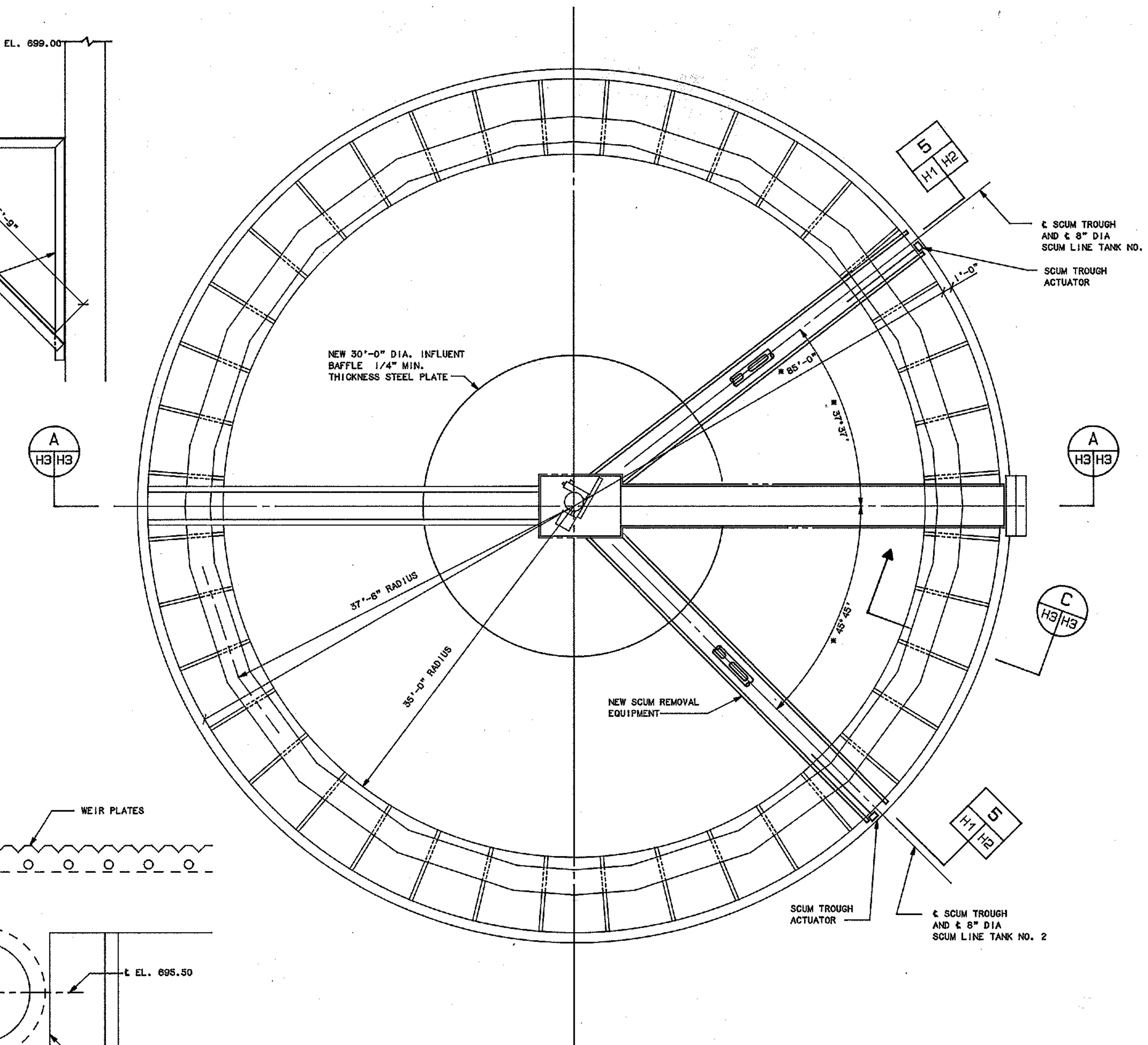


EXISTING TOP PLAN
TANKS NO.1 & 2
SCALE: 1/8"=1'-0"

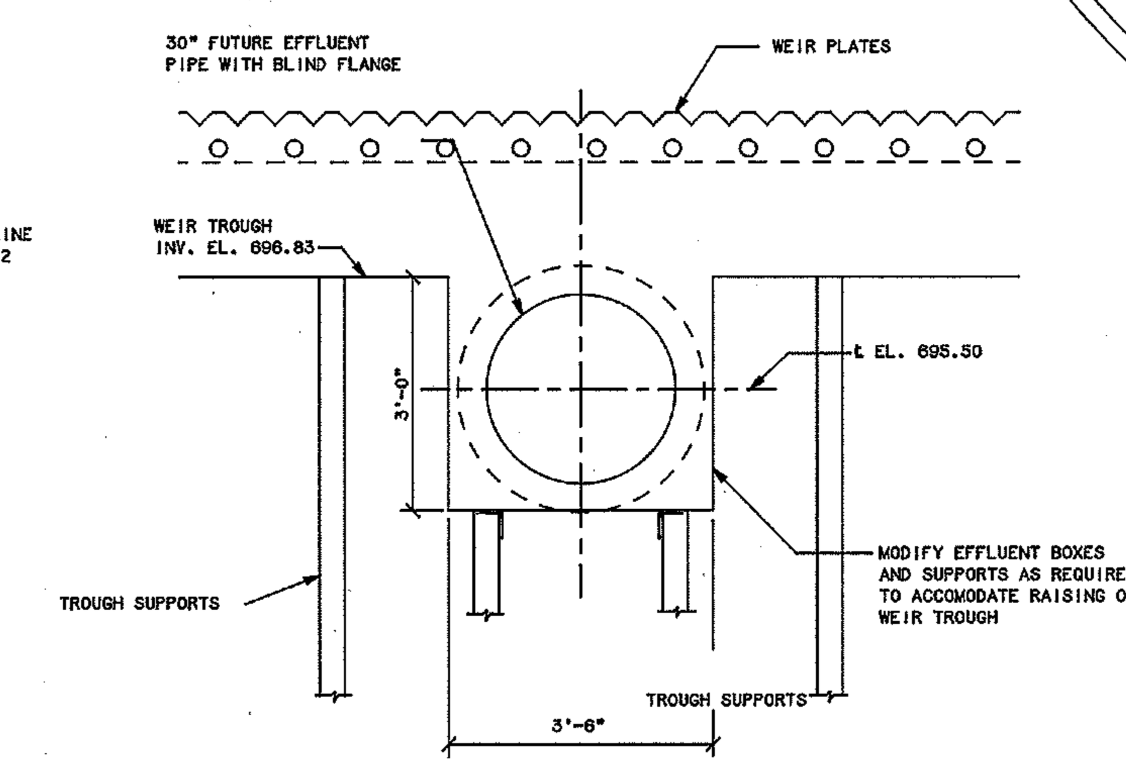


MODIFIED SECTION C (H3|H3)

SCALE: 1/2"=1'-0"



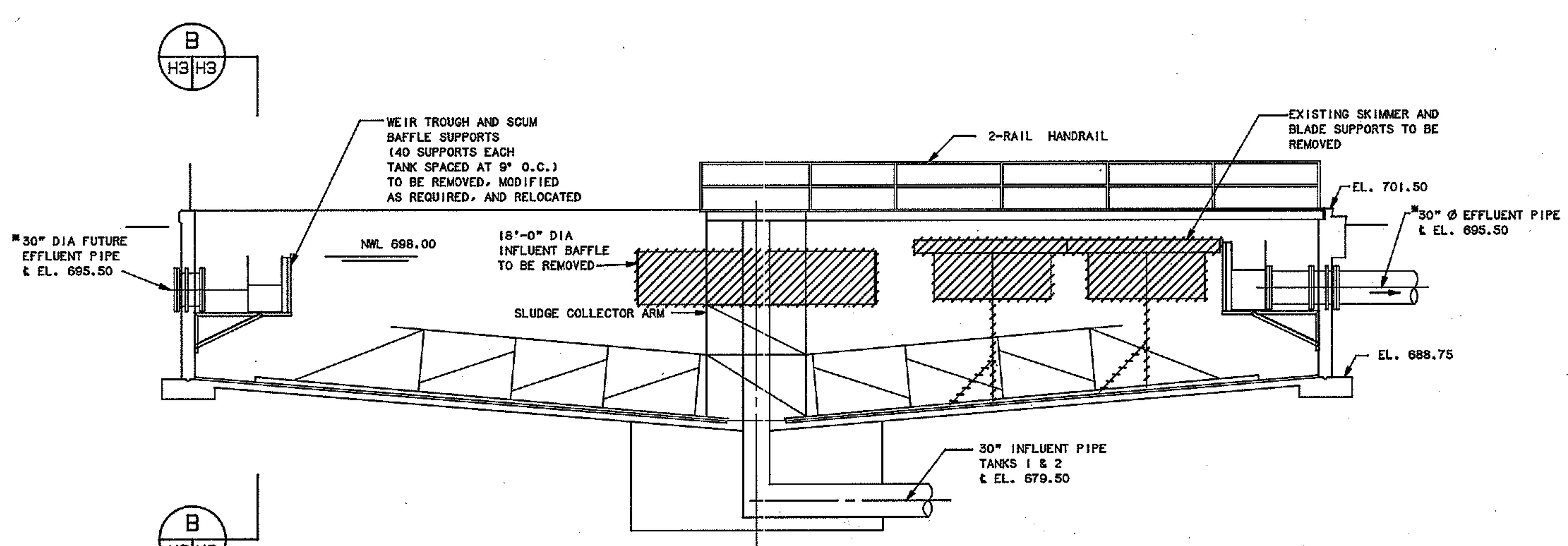
MODIFIED TOP PLAN
TANKS NO.1 & 2
SCALE: 1/8"=1'-0"



MODIFIED SECTION B (H3|H3)

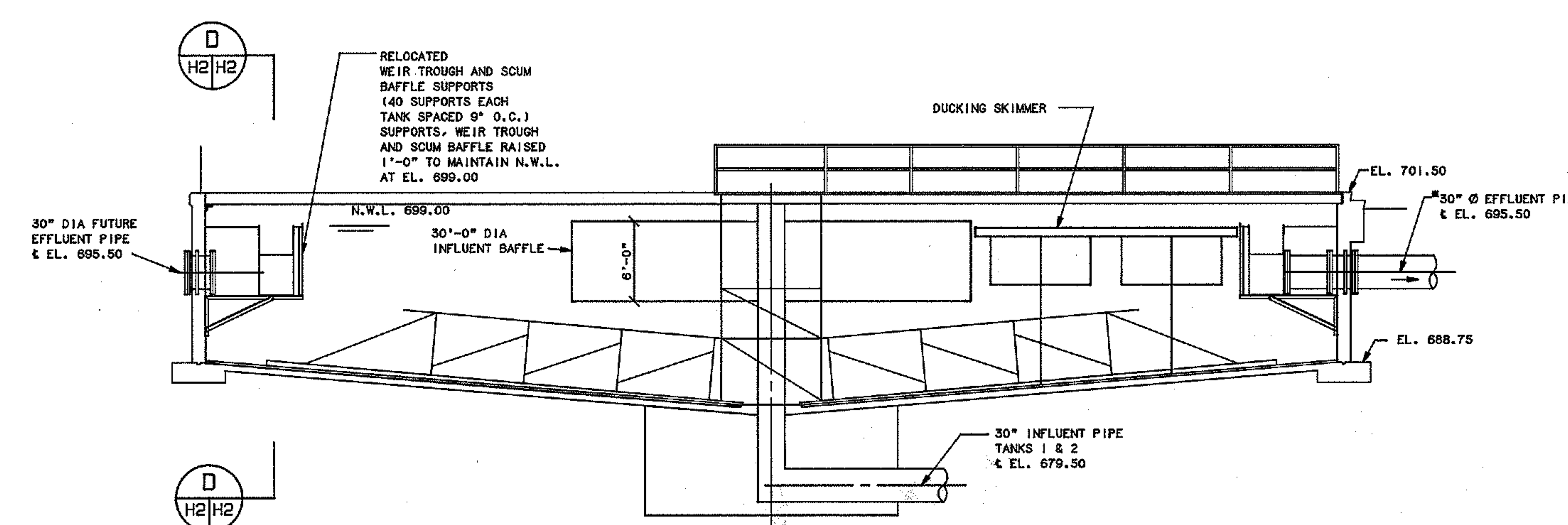
SCALE: 1/2"=1'-0"

* CONTRACTOR TO VERIFY ALL
PERTINENT TANK DIMENSIONS
PRIOR TO SUBMITTING EQUIPMENT
SHOP DRAWINGS



EXISTING SECTION A (H3|H3)

SCALE: 1/8"=1'-0"



MODIFIED SECTION A (H3|H3)

SCALE: 1/8"=1'-0"

No.	Date	By
REVISIONS		

Designed NJM
Drawn SGT
Proj. Eng. SR
Proj. No. 6508A

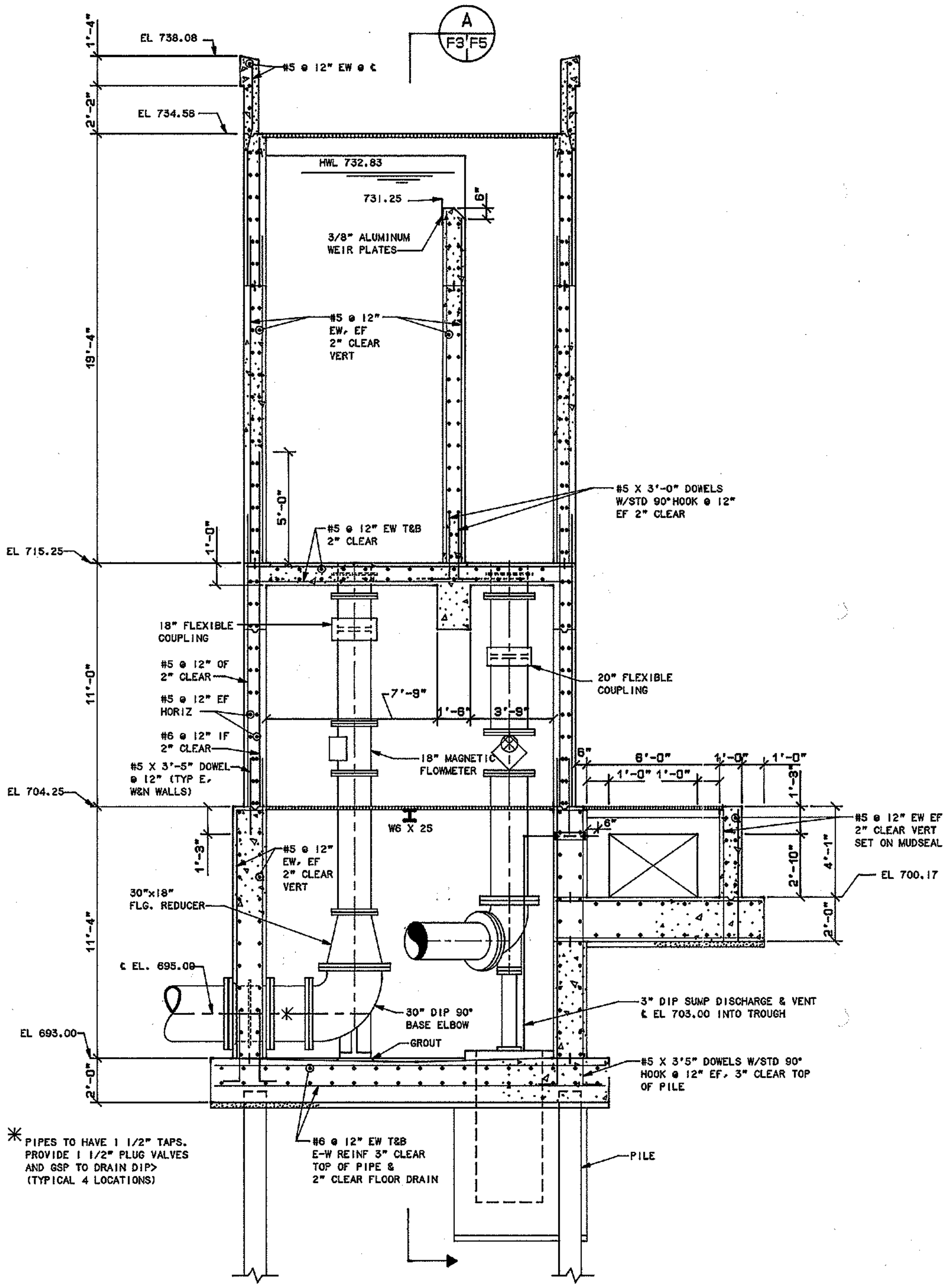
Brundage, Baker & Stauffer, Limited
Consulting Engineers
Columbus, Ohio / Cincinnati, Ohio

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

MODIFICATIONS TO
EXISTING SECONDARY CLARIFIERS

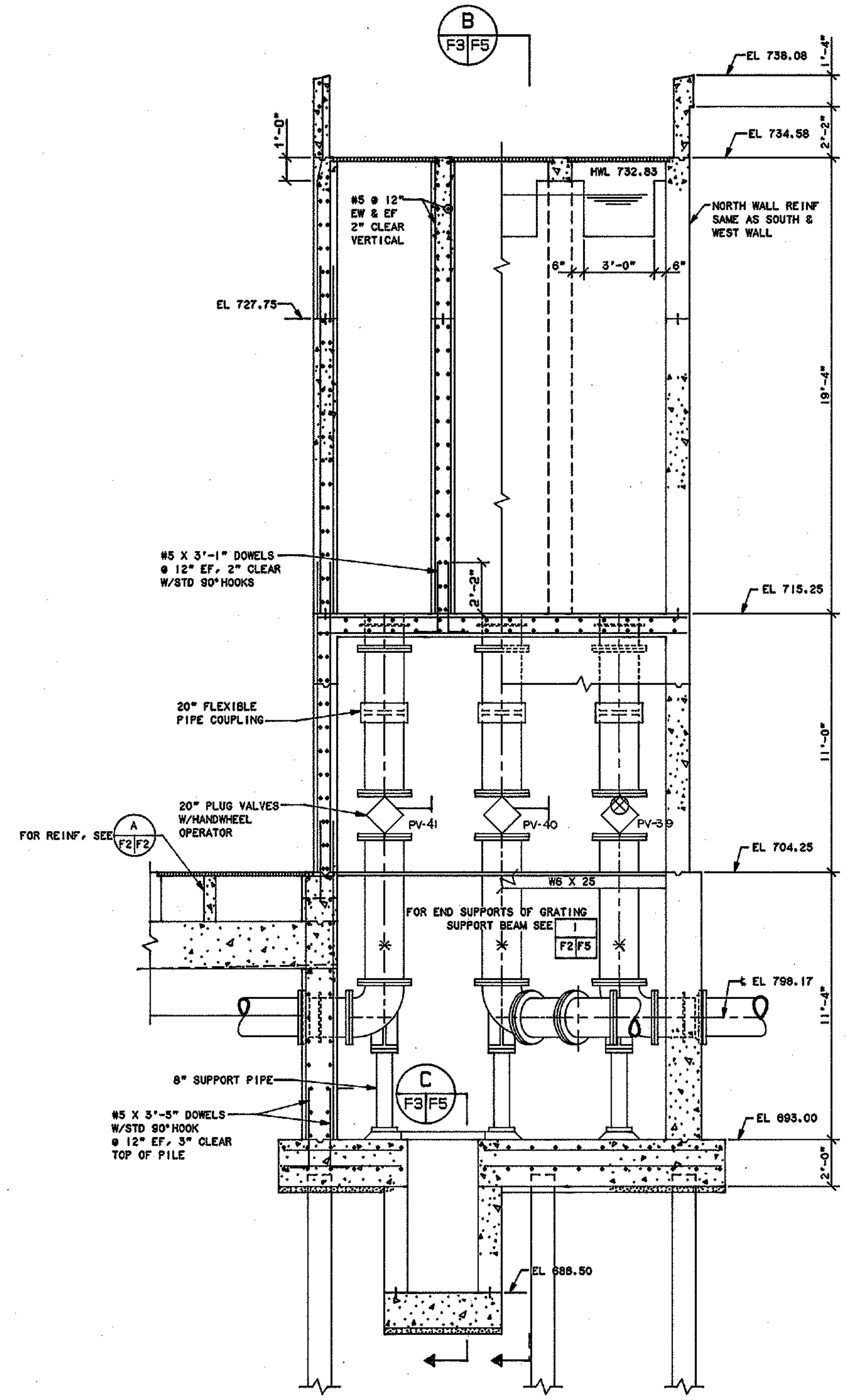
PLANS AND SECTIONS

DRAWING No.
H3



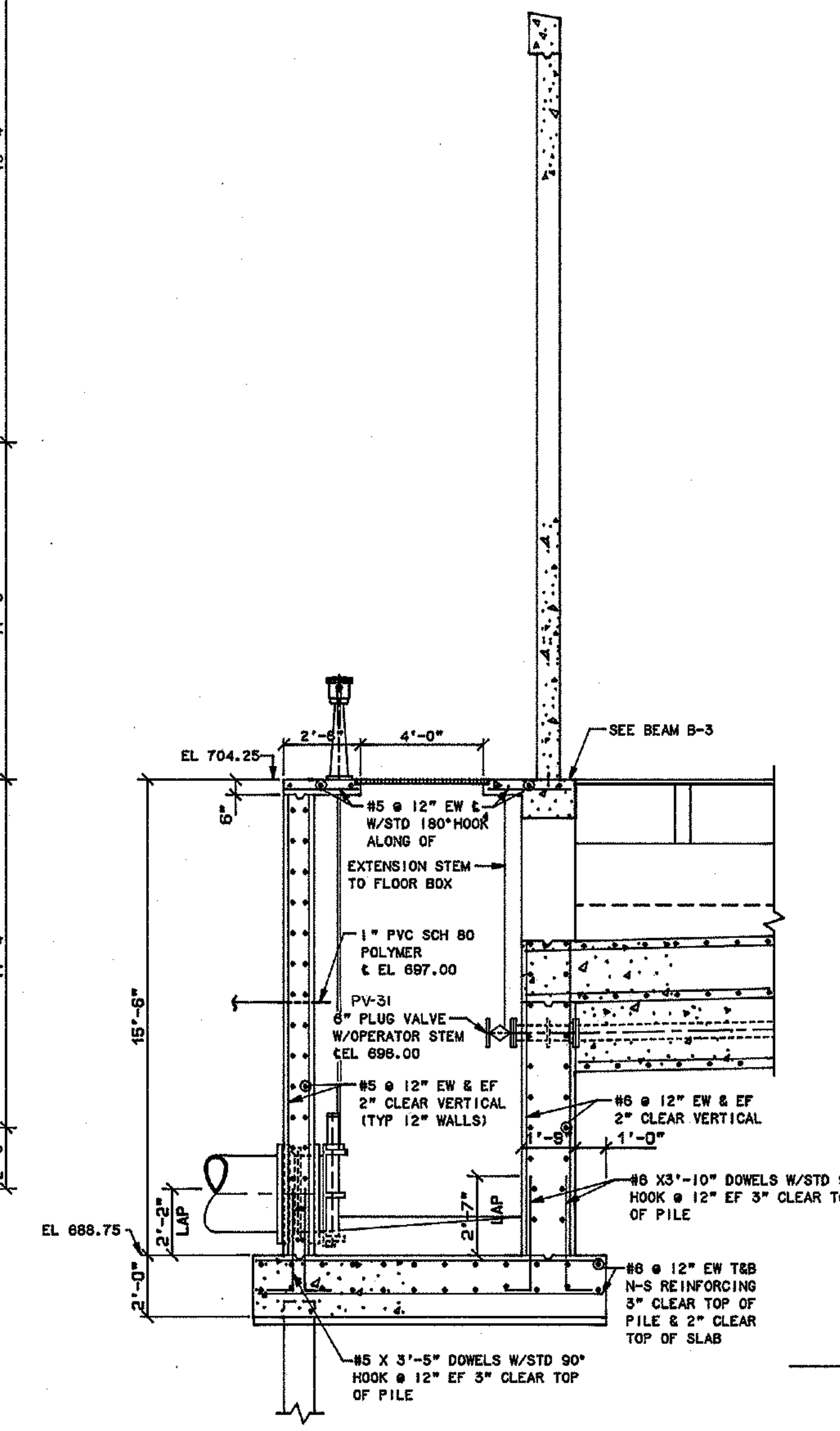
SECTION B F3/F5

SCALE: 1/4"=1'-0"



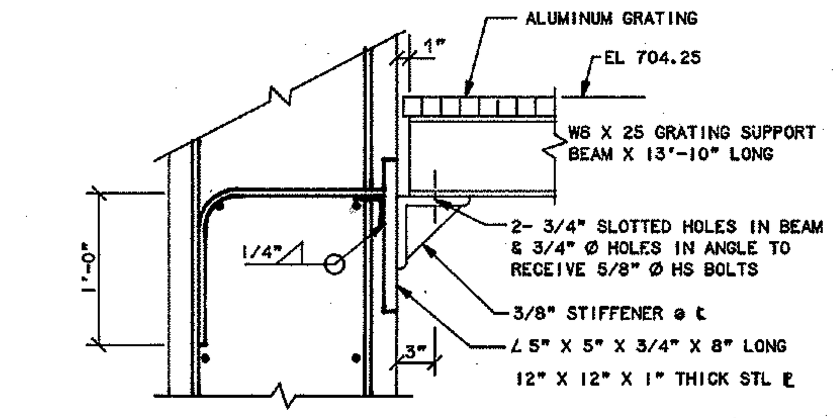
SECTION A F3/F5

SCALE: 1/4"=1'-0"

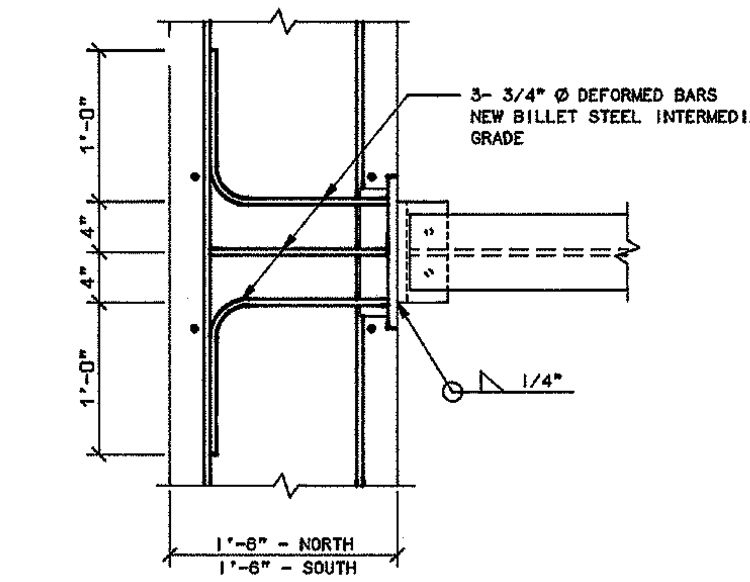


SECTION J F3/F5

SCALE: 1/4"=1'-0"



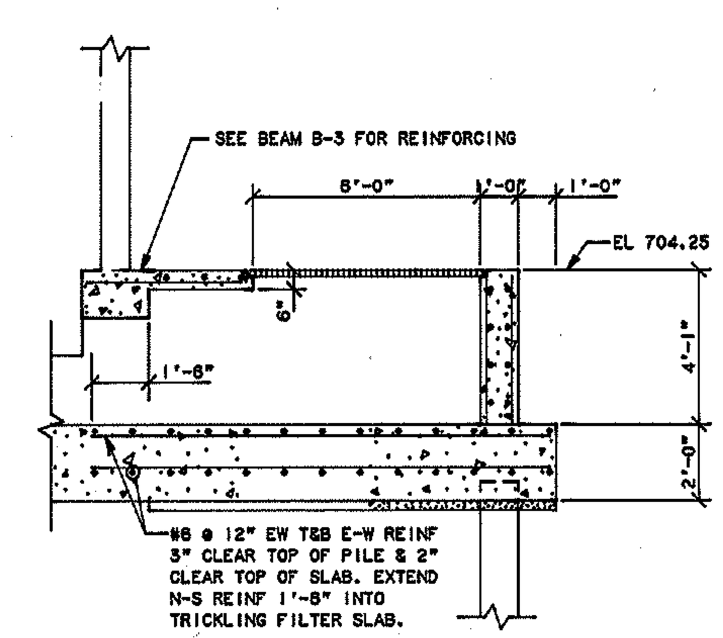
ELEVATION



PLAN

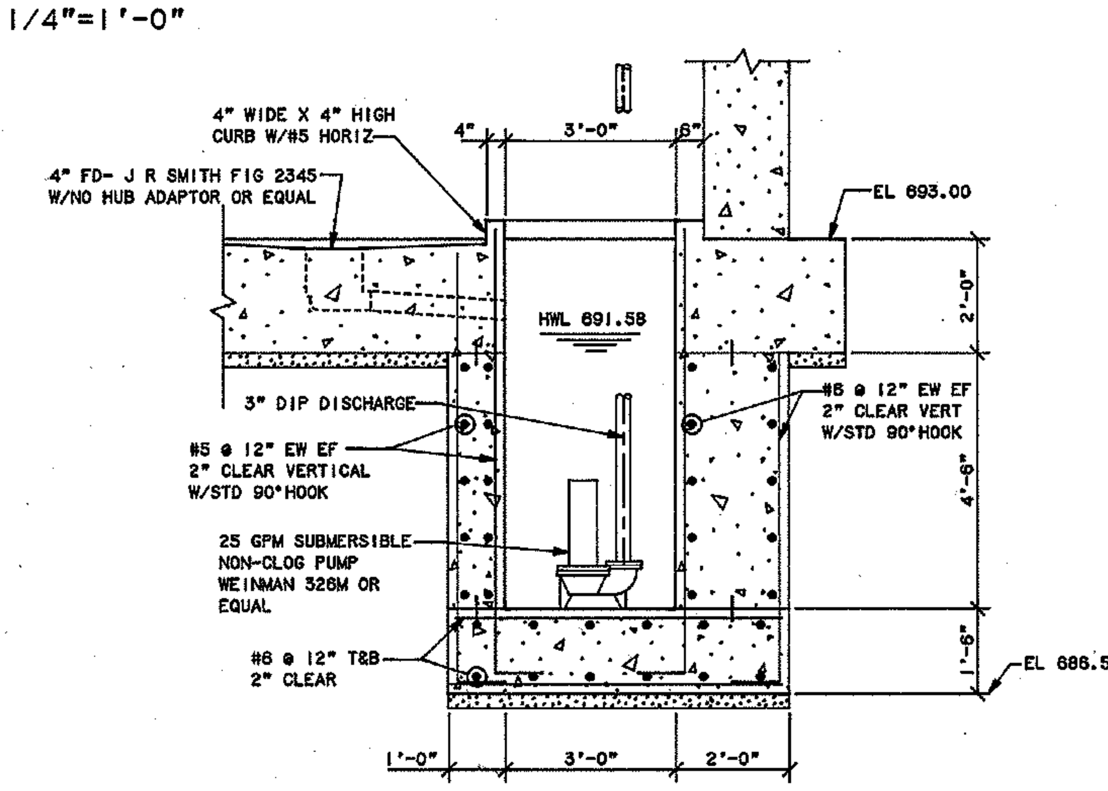
1 F2/F5

SCALE: 1/4"=1'-0"



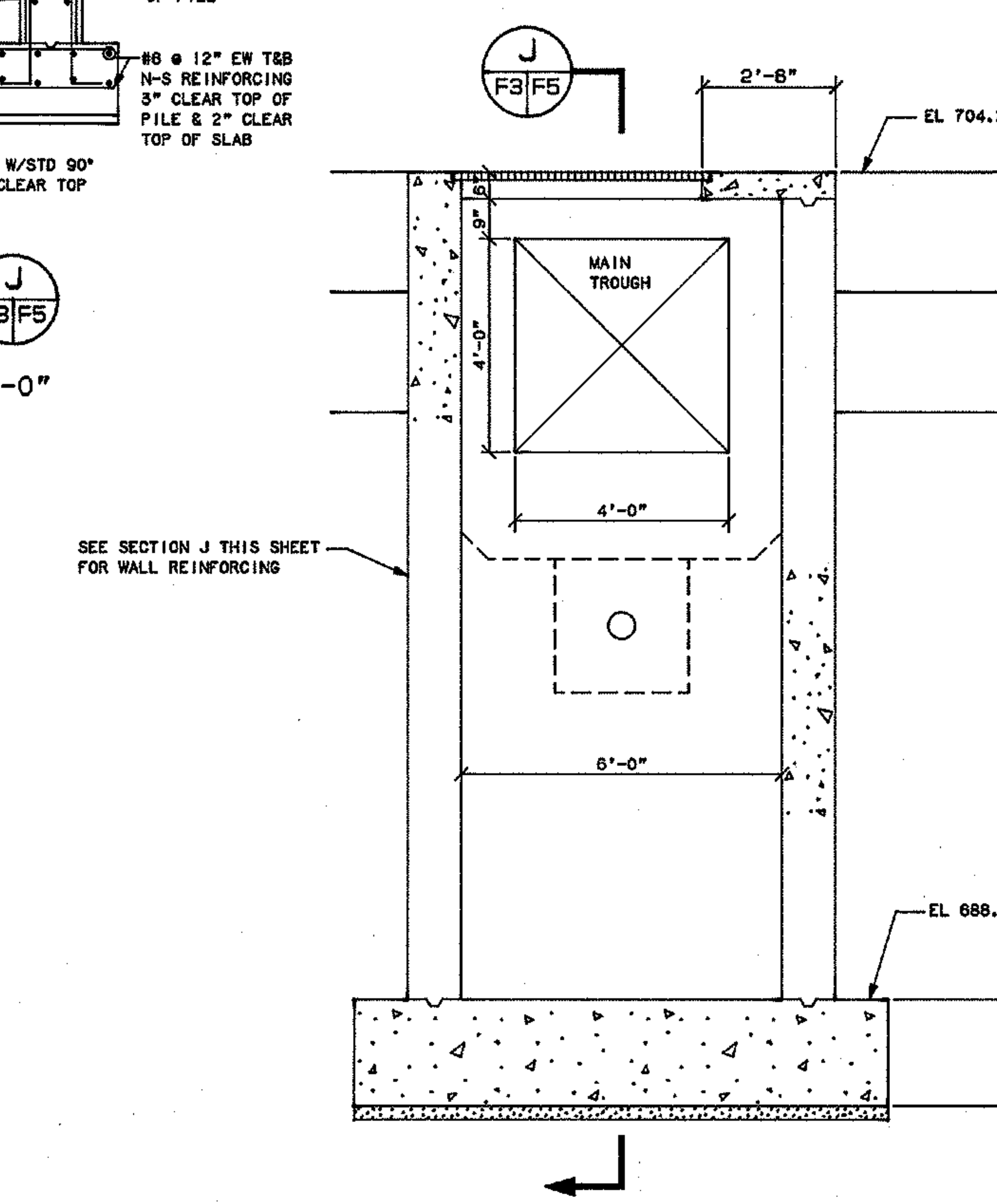
SECTION D F3/F5

SCALE: 1/4"=1'-0"



SECTION C F3/F5

SCALE: 3/8"=1'-0"



SECTION I F3/F5

SCALE: 3/8"=1'-0"

Brundage,Baker & Stauffer, Limited
Consulting Engineers
Columbus, Ohio / Cincinnati, Ohio

Designed SR | Drawn SGT | Proj. Eng. SR | Proj. No. 6508A

No. | Date | By | REVISIONS

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE
WASTEWATER TREATMENT PLANT IMPROVEMENTS
1984

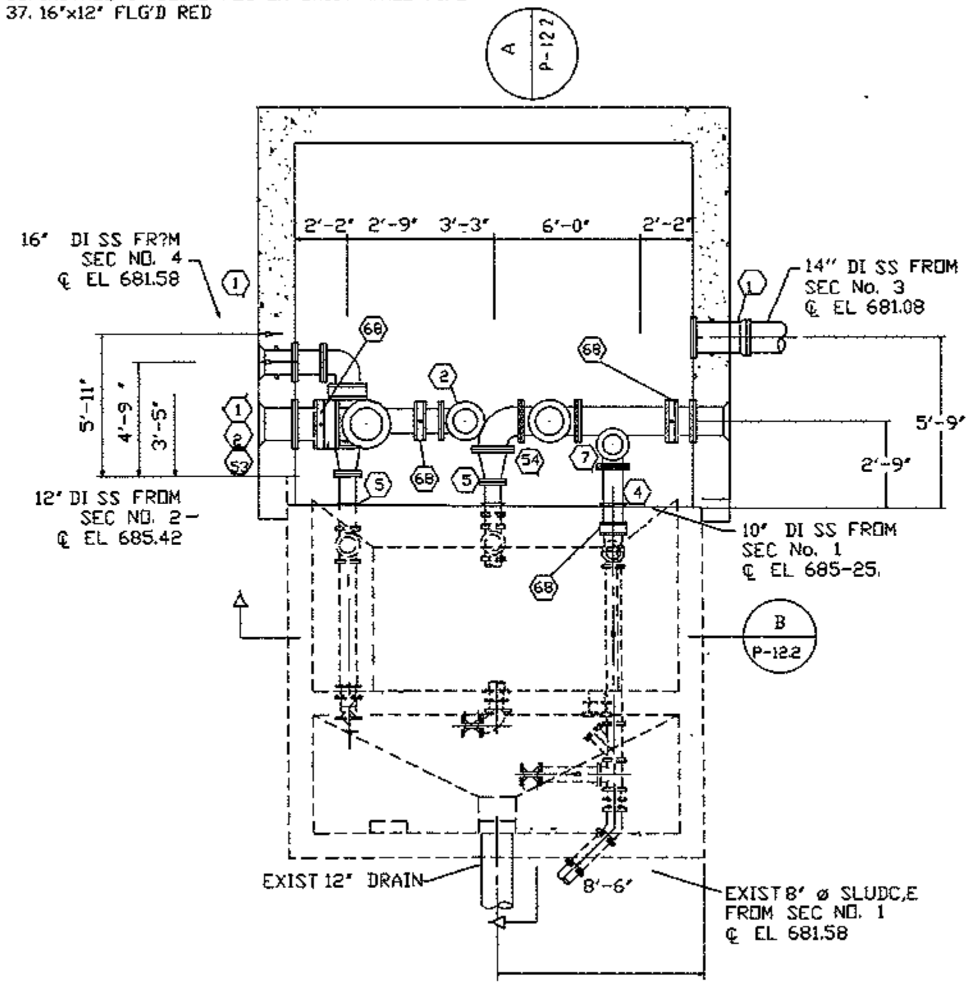
TRICKLING FILTER NO. 3

SECTIONS

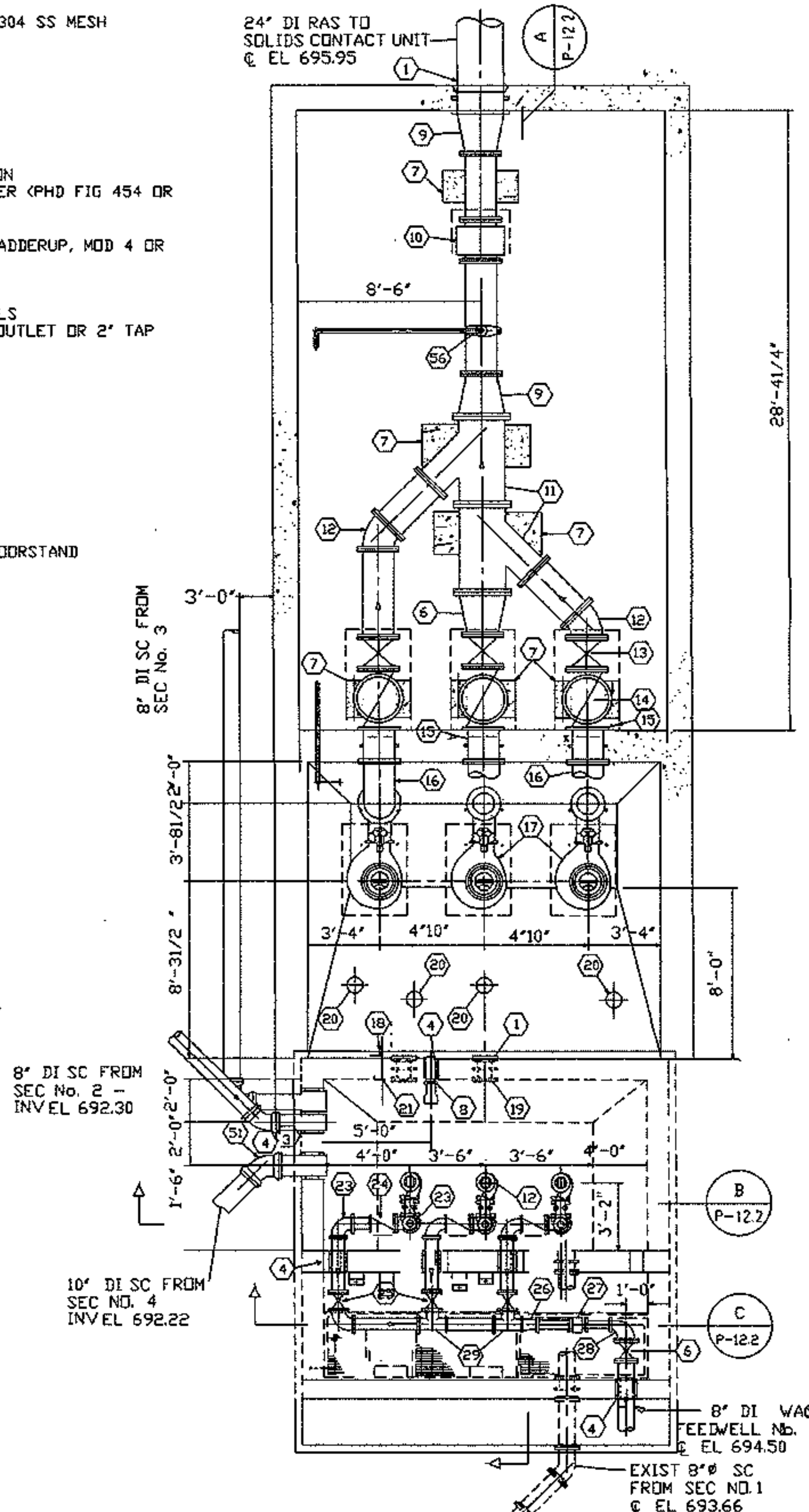
DRAWING No. F5

(#) CODED NOTES

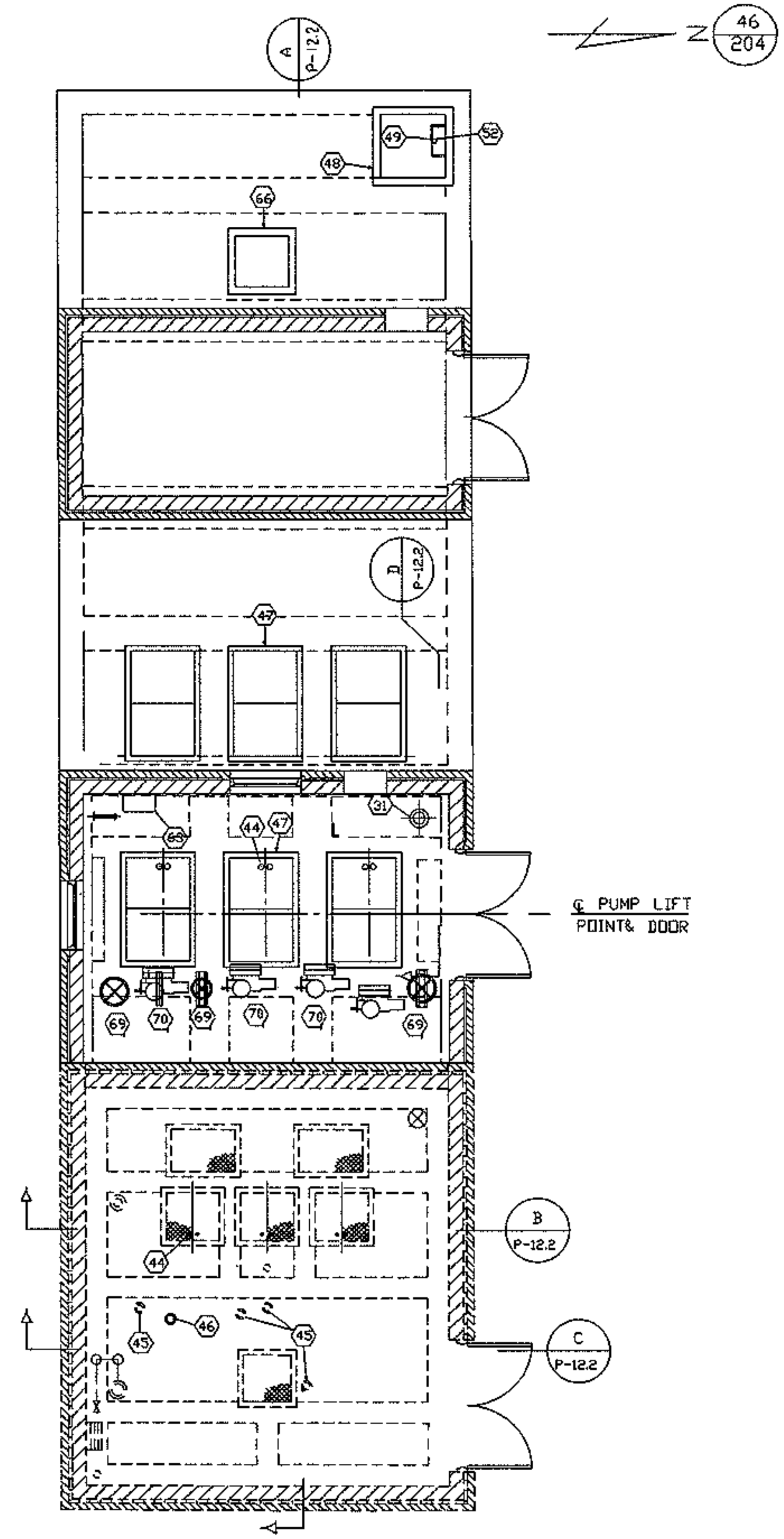
1. WALL PIPE (MJ & FLG)
2. FLG'D 90° ELBOW W/ TELESCOPING VALVE ABOVE
3. 10"x8" FLG'D RED 90° BEND
4. CORE DRILL EXIST WALL & INSTALL NEW PIPE W/ MECH SEAL
5. EXIST WALL PIPE (MJ & FLG), CONNECT DIP ON MJ SIDE
6. 8" PLUG VALVE
7. CONC SUPPORT
8. 4" FLG'D TIDEFLEX CHECK VALVE ℄ EL 697.00
9. 24"x16" FLG'D RED
10. 16" MAGNETIC FLOW METER
11. 24"x24"x16" WYE
12. 16" FLG'D 45° BEND
13. 16" PLUG VALVE
14. 16" AIR CUSHIONED SWING CHECK VALVE
15. 16" WALL PIPE (FLG & FLG)
16. 16" LR FLG'D 90° BEND
17. RAS SUBMERSIBLE PUMP
18. INSTALL 8" MJ PLUG ON EXIST WALL PIPE
19. 8" BLIND FLG
20. TELESCOPING VALVE
21. PLUG EXIST PE WALL PIPE W/ NON-SHRINK, NON-METALIC GROUT
22. WAS SUBMERSIBLE PUMP
23. 6" FLG'D 90° BEND
24. 6" CHECK VALVE
25. 6" PLUG VALVE
26. 6"x4" FLG'D RED
27. 4" MAGNETIC FLOW METER
28. 8"x4" FLG'D 90° BEND
29. 6" FLG'D TEE
30. 24"x18" FLG'D RED
31. 6" WALL PIPE (FLG & PE) AND DIP VENT (EXTEND ABOVE ROOF)
32. 8" MJ 45° BEND
33. 8" MJ 90° BEND
34. 8" ADAPTOR FLG
35. INSTALL 3" MJ PLUG ON EXIST WALL PIPE
36. INSTALL 3" BLIND FLG ON EXIST WALL PIPE
37. 16"x12" FLG'D RED
38. 4" SCHD 40 PVC DRAIN PIPING
39. 4" CHECK VALVE
40. 6" FLG'D 90° BEND W/ ⅜" SQ #304 SS MESH
41. NOT USED
42. NOT USED
43. NOT USED
44. PUMP GUIDE BARS
45. EXIST FLOOR BOX
46. NEW FLOOR BOX
47. 3'-0"x5'-0" AL ACCESS HATCH
48. 3'-0"x3'-0" AL ACCESS HATCH
49. AL LADDER W/ SAFETY EXTENSION
50. HANGER ASSEMBLY: CLEVIS HANGER (PHD FIG 454 OR EQUAL), ½ ATR & CONC INSERT
51. 10" MJ 45° BEND
52. LADDER SAFETY POST (BILCO LADDERUP, MOD 4 OR APPROVED EQUAL)
53. 16"x8" FLG'D RED
54. 14"x8" FLG'D RED
55. WALL SLEEVE W/ (2) MECH SEALS
56. 12"x2" PIPE SADDLE, 2" WELED OUTLET OR 2" TAP
57. 2" PLUG VALVE
58. 2" SCH 0 PVC SAMPLING PIPE
59. 2" FLG'D 3-WAY VALVE
60. 2"x6" OD PVC FLG
61. 2" PVC 90° BEND
62. LEVEL TRANSMITTER
63. PUMP CONTROLS AND VFDS
64. RESTRAINED MJ PLUG
65. WALL/FLOOR SLEEVE
66. 2'-6"x2'-6" AL ACCESS HATCH
67. GROUT
68. KNIFEGATE VALVE
69. KNIFEGATE VALVE OPERATOR/FLOORSTAND
70. MOTOR OPERATOR



PLAN @ EL 685.00



PLAN @ EL 695.00



PLAN @ EL 701.50

DLZ

NO.	BY INT.	DATE MO/DY/YR	REVISIONS REMARKS

PROJ. PERSONNEL	INITIALS	DATE MO/DY/YR
DES	MS	
DWN	KG	
CKD	DAD	2/23/07

STATE OF OHIO — DAVID A DAY — E-55870 — REGISTERED PROFESSIONAL ENGINEER

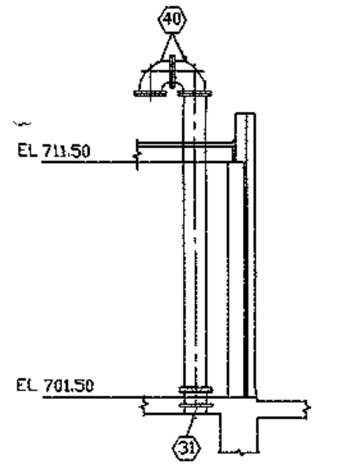
CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

TREATMENT PLANT UPGRADE
PHASE 2
2007

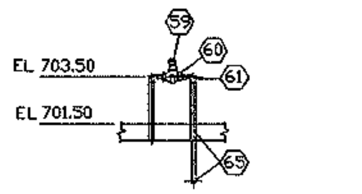
SCALE
0 1 2 4
FEET
OR AS NOTED

PROCESS
RAS & WAS PUMP STATIONS
PLANS

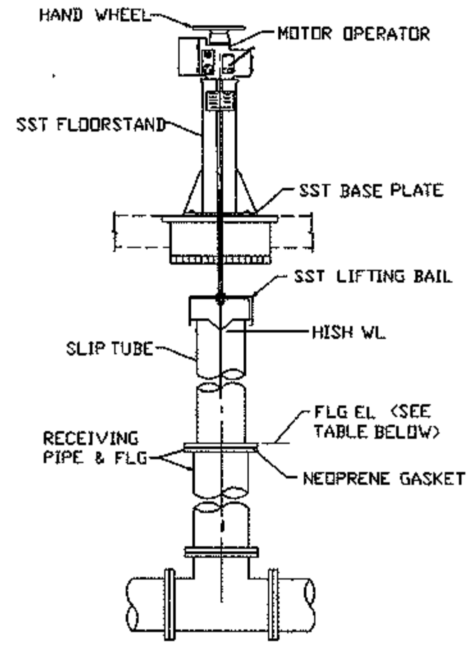
ISSUED STATUS: CTC
SHEET P-12.1
DATE ISSUED 6/6/07



SECTION D / P-12.1



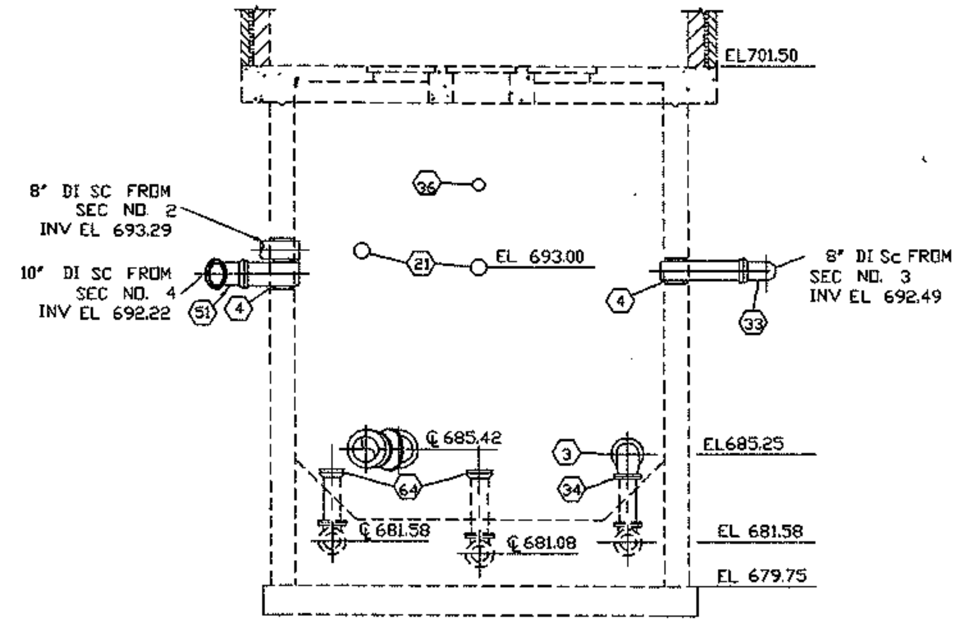
SECTION E / P-12.2



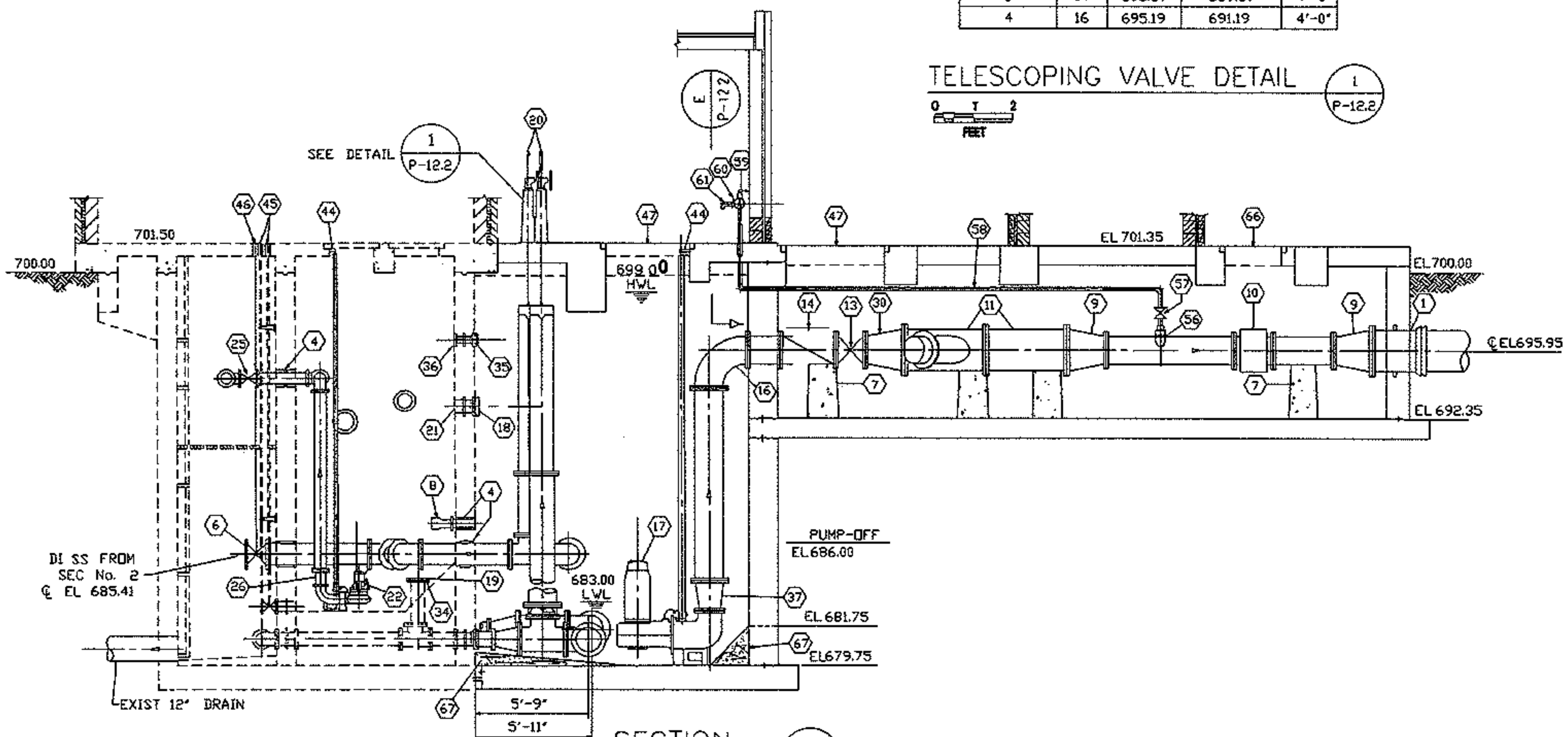
SECONDARY CLARIFIER No.	SIZE	HIGH WL	RECEIVING PIPE FLG EL	TRAVEL
1	10	694.45	690.45	4'-0"
2	12	693.58	689.58	4'-0"
3	14	693.57	689.57	4'-0"
4	16	695.19	691.19	4'-0"

TELESCOPING VALVE DETAIL 1 / P-12.2

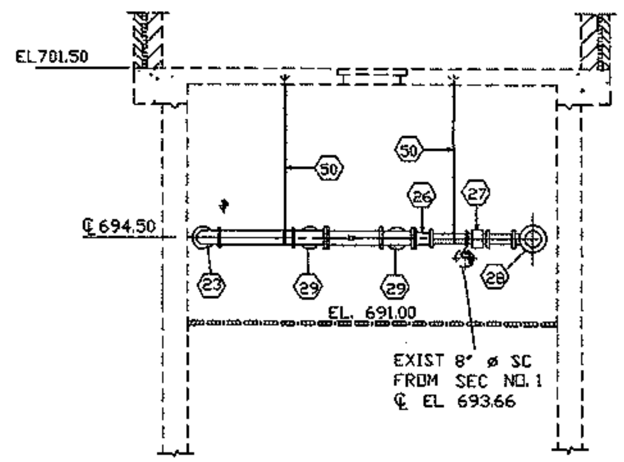
0 1 2 FEET



SECTION B / P-12.1



SECTION A / P-12.1



SECTION C / P-12.1

NOTES

1. SEE SHT P-12.1 FOR CODED NOTES
2. SEE SHT S-12-1 FOR STRUCTURAL DETAILS
3. LOCATION OF ACCESS HATCHES (CODED NOTE # 47& DOOR ARE BASED ON ITT FLYGT PUMP- IF ANOTHER PUMP IS USED, LOCATIONS MAY REQUIRE ADJUSTMENT.

DLZ

NO.	BY INT.	DATE MO/DY/YR	REVISIONS REMARKS	PROJ. PERSONNEL INITIALS	DATE MO/DY/YR
				DES MS	
				DWN KG	
				CKD DAD	2/23/07

STATE OF OHIO DAVID A DAY E-55870 REGISTERED PROFESSIONAL ENGINEER

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

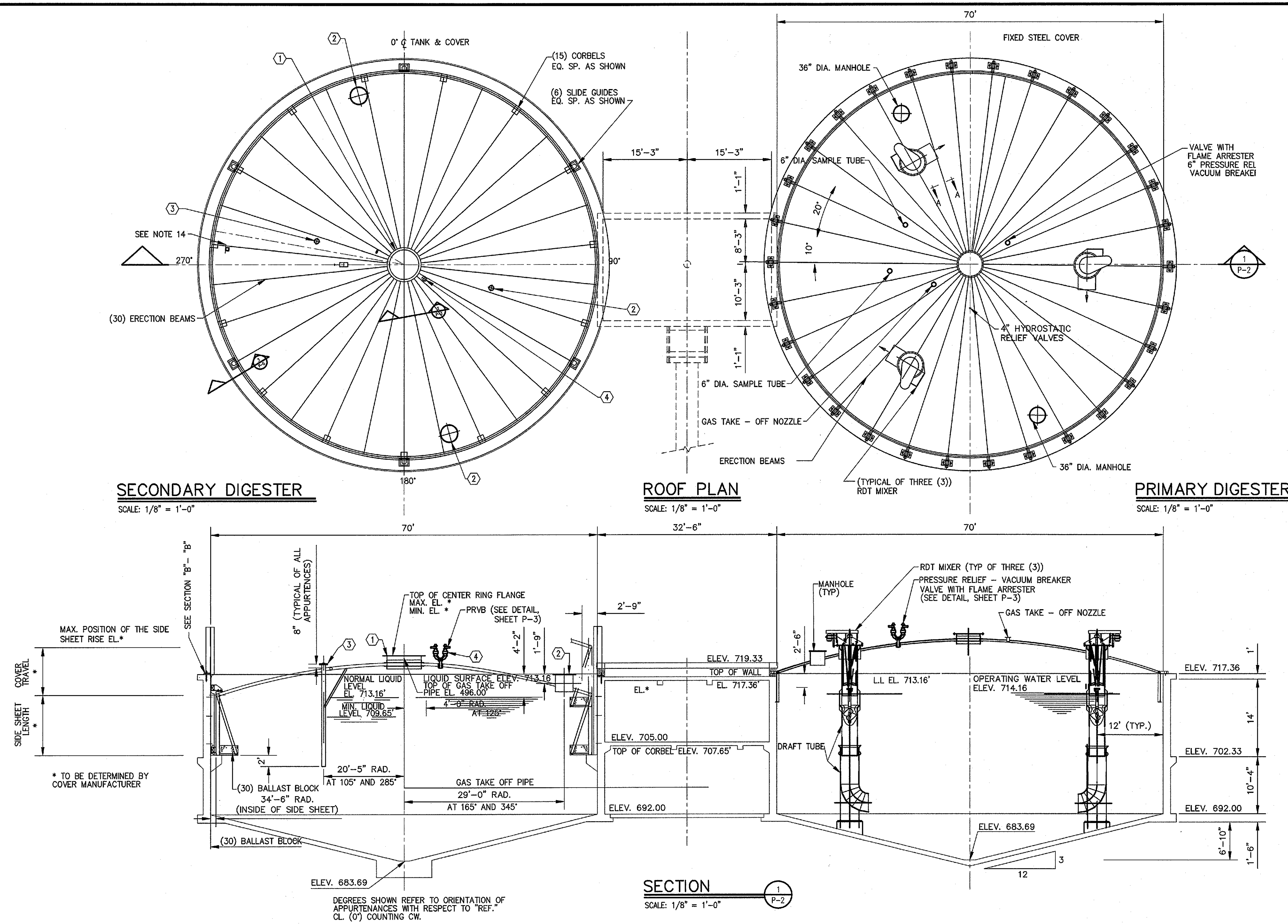
TREATMENT PLANT UPGRADE
PHASE 2
2007

SCALE 0 1 2 4 FEET
OR AS NOTED

PROCESS
RAS & WAS PUMP STATIONS

ISSUED STATUS: CTC
SHEET P-12.2
DATE ISSUED 6/6/07 MO/DY/YR

SCM-369 - P-2-COVERSPLAN-SECTION.PLT - 12/21/99 4:04:40 PM



APPURTENANCES

1. 102"ø CENTER COMPRESSION RING AND GAS BONNET.
2. 36"ø MANHOLE W/. BOLTED AND GASKETED COVER PLATES.
3. 6" SCH. 40 PIPE SAMPLE TUBE W/. OPEN FLANGED NOZZLES.
4. 6" NOZZLE (FOR PRESSURE RELIEF/VACUUM BREAKER WITH FLAME ARRESTER).

Dodson Stilson — Dodson-Stilson, Inc. ENGINEERS• ARCHITECTS• SCIENTISTS

DLZ COMPANY

ZANESVILLE WASTEWATER TREATMENT PLANT
ANAEROBIC DIGESTERS COVER REPLACEMENT

PRIMARY AND SECONDARY DIGESTER COVER REPLACEMENT PLAN AND SECTION

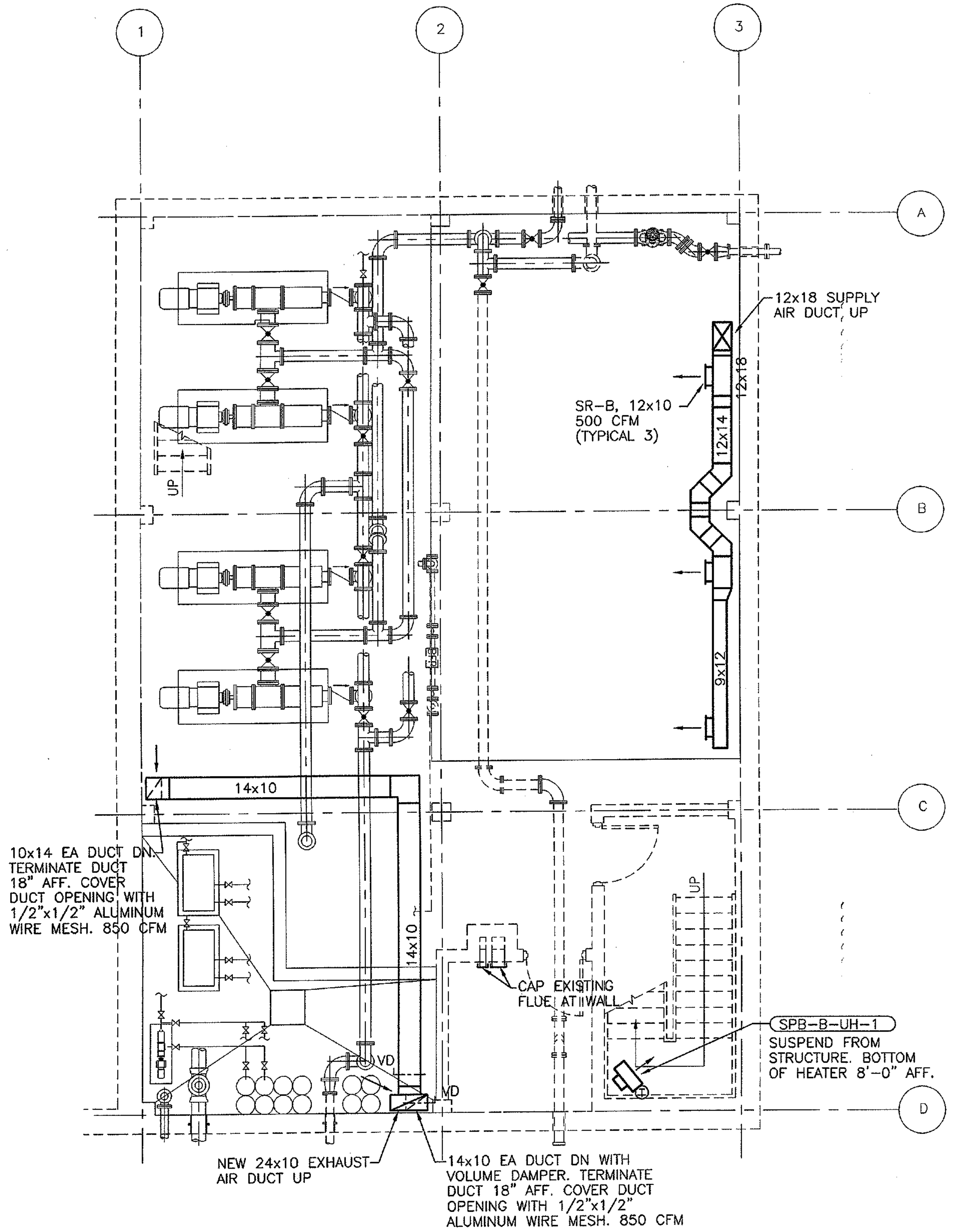
DRAWN	AAA
CHK'D.	AAA
APPRV'D	AAA
DATE	OCT. 1999
PROJECT NUMBER	9921-6009.00

NO.	REVISION	BY	DATE

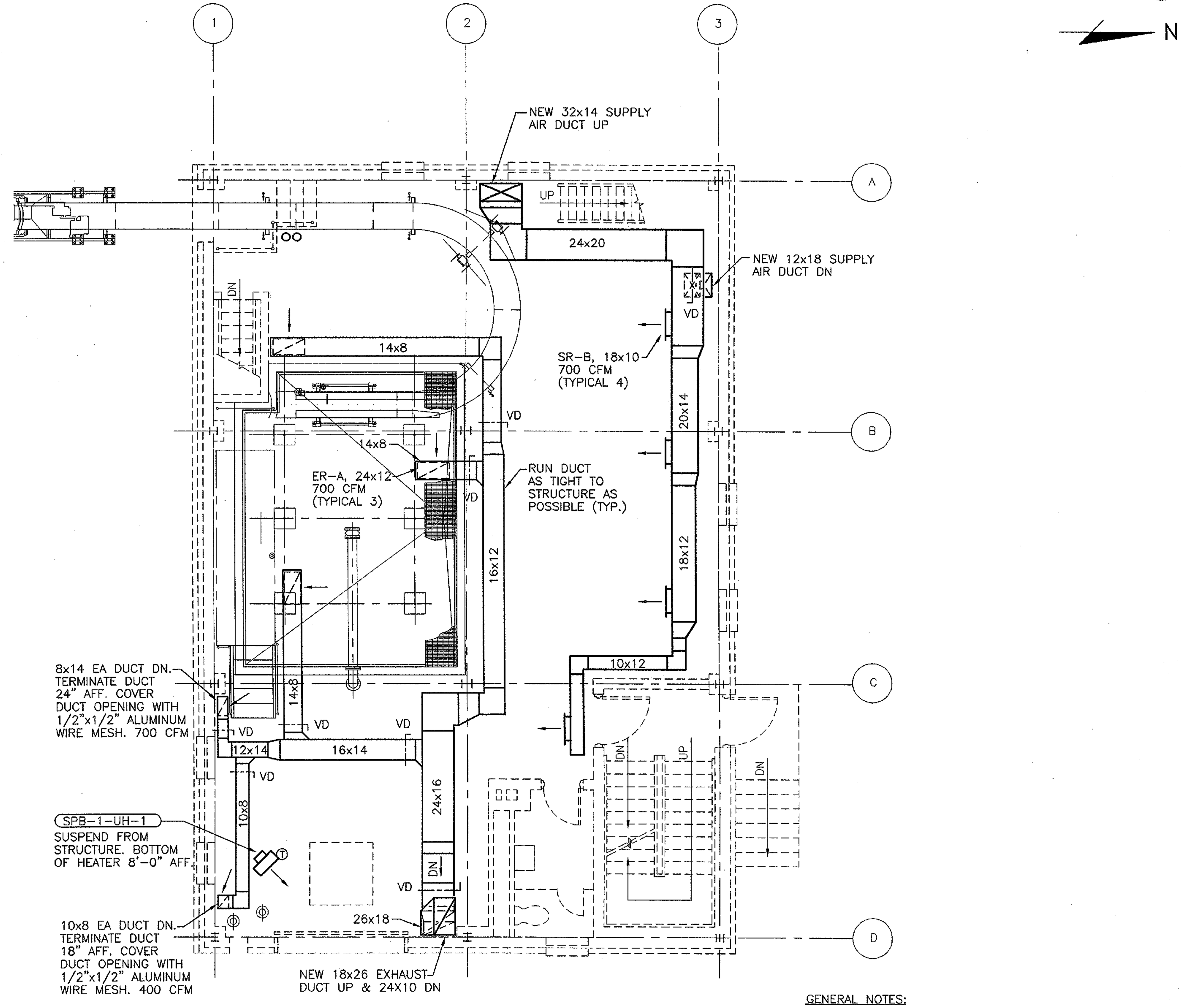
SHEET

OF

DRAWING NUMBER **P-2**



BASEMENT FLOOR @ 691.25
SCALE: 1/4"=1'-0"



FIRST FLOOR @ EL 703.75
SCALE: 1/4"=1'-0"

GENERAL NOTES:

1. FOR MECHANICAL LEGEND AND ABBREVIATIONS SEE DRAWING M-0.1.
2. FOR MECHANICAL DETAILS SEE DRAWING M-0.2.
3. FOR MECHANICAL EQUIPMENT SCHEDULES SEE DRAWING M-0.3.
4. COORDINATE ALL NEW MECHANICAL WORK WITH EXISTING CONDITIONS, NEW PROCESS PIPING AND EQUIPMENT.

DLZ

NO.	BY Int.	DATE Mo./Dy./Yr.	REVISIONS Remarks	PROJ. PERSONNEL Initials	DATE Mo./Dy./Yr.
				DES. SLS	-
				DWN. NJO	-
				CKD. ILP	-

STATE OF OHIO
JAMES M. CRANDALL
E-55898
REGISTERED PROFESSIONAL ENGINEER

CITY OF ZANESVILLE, OHIO
DEPARTMENT OF PUBLIC SERVICE

TREATMENT PLANT UPGRADE
PHASE I
2004

SCALE
0 1 2 4
FEET

MECHANICAL
SLUDGE PRESS BUILDING
BASEMENT & 1ST FLOOR
HVAC PLANS

ISSUED STATUS: CTC
(See Legend Sheet for Explanation)

SHEET M-14.3

DATE ISSUED: 09/24/04
Mo./Dy./Yr.

The secondary pump station improvements will be shifted to Phase 1 of the WWTP Upgrades as requested.

OK

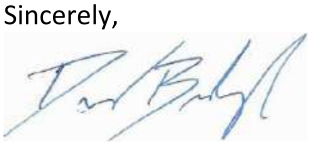
15. **In Appendix H, the Financial Capability Analysis (FCA) identifies a Residential Factor of 90% as part of the Residential Indicator Analysis. Please describe how this value was determined.**

The Residential Factor of 90% was determined by comparing the amount of utility bills mailed to residential addresses and commercial addresses by the City of Zanesville Financial Director in 2019. The split between bills was determined to be approximately 90%.

According to the USEPA *CSO Guidance for Financial Capability Assessment and Schedule Development*, the Residential Factor should be based on the proportion of flow from residential users, rather than the number of accounts. Please exclude industrial and commercial flows from this metric.
Additionally, we noted that several values used in the FCA are based on reports and information that are now several years old. We recommend updating the values, if the City has them available.

Please consider the above comments. We will be in contact to schedule a follow-up meeting to identify next steps and set a timeline for a revised LTCP submission. In the meantime, if there are any questions regarding this letter, please contact me at david.brumbaugh@epa.ohio.gov.

Sincerely,



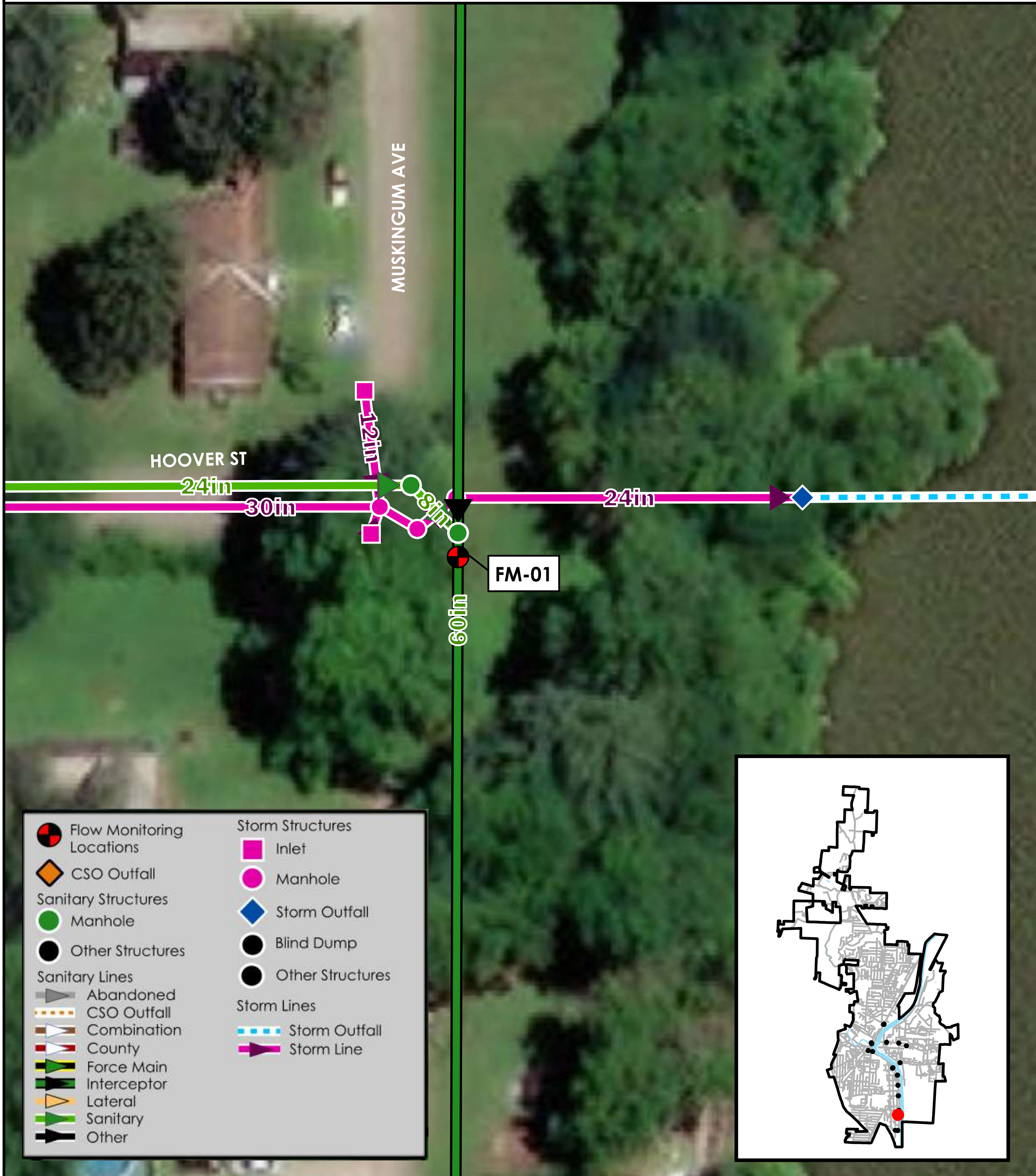
David Brumbaugh
Environmental Specialist 3
Ohio EPA, Central Office
Division of Surface Water

ec: Scott Brown, Zanesville
Maria DeLuca, AECOM
Ashley Ward, Ohio EPA – DSW/CO
Marco Deshaies, Ohio EPA – DSW/SEDO
Jennifer Witte, Ohio EPA – DSW/SEDO
Kurt McGinnis, Ohio EPA – DSW/SEDO

Appendix C Flow Meter Mapbook

Appendix C
Flow Meter Mapbook

AECOM Flow Monitor Detailed Locations



FM-01
Main interceptor near
Muskingum Ave. & Hoover St.

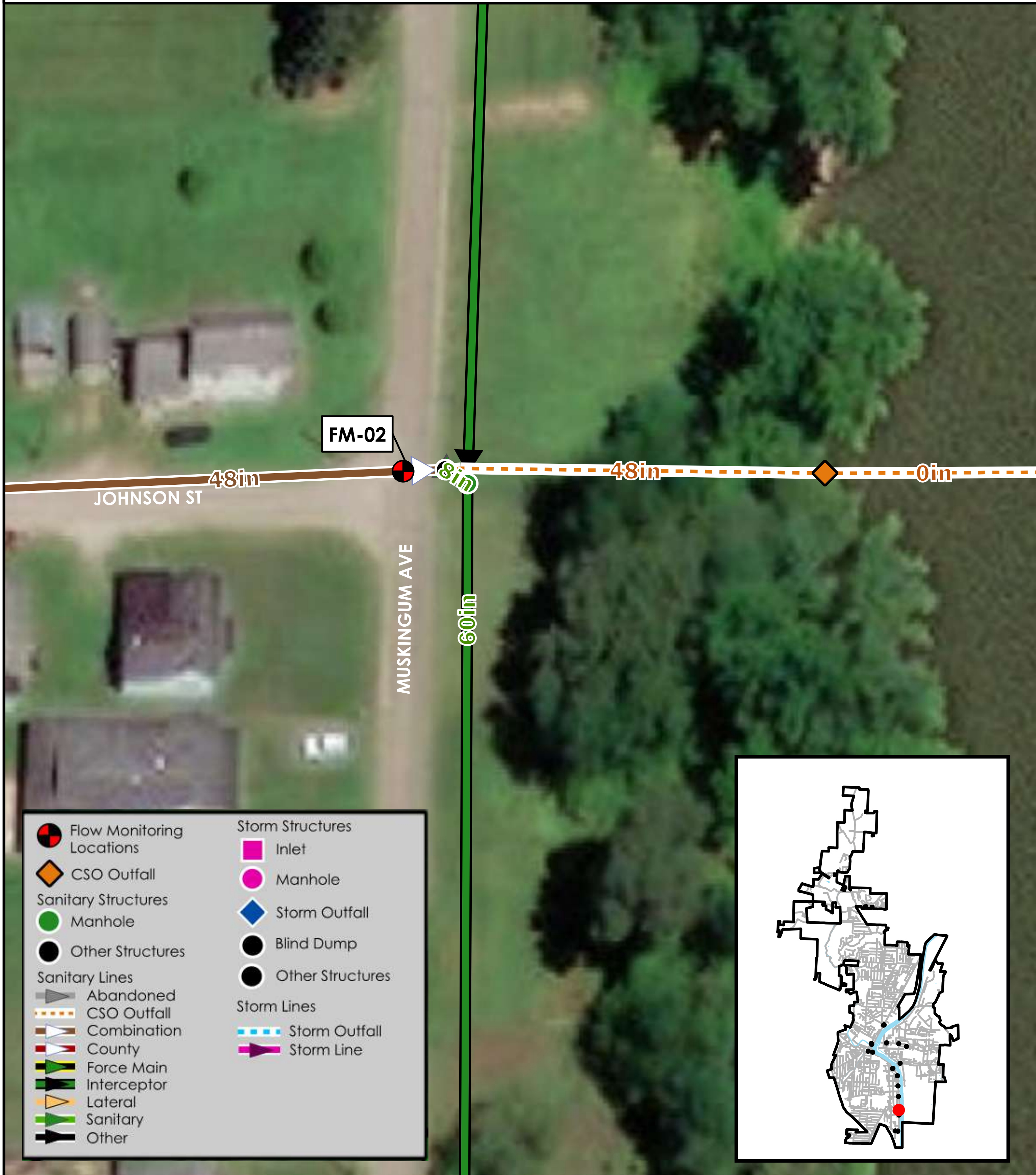
0 15 30 60
Feet

N

AECOM

PROUD OF OUR PAST
CITY OF ZANESVILLE
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-02

Johnson St. & Muskingum Ave.

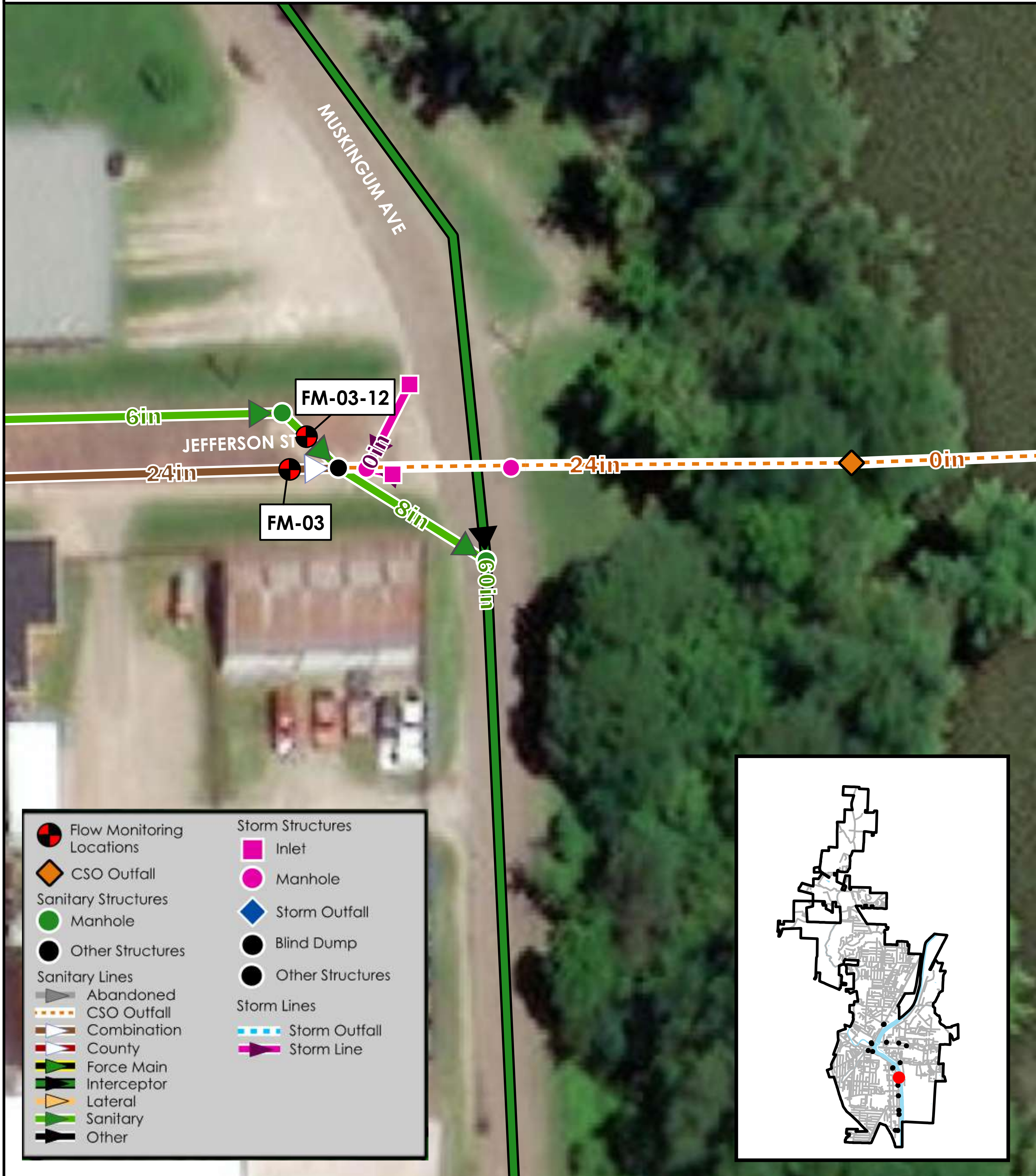
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST CITY OF ZANESVILLE PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-03

Jefferson St. & Muskingum Ave.

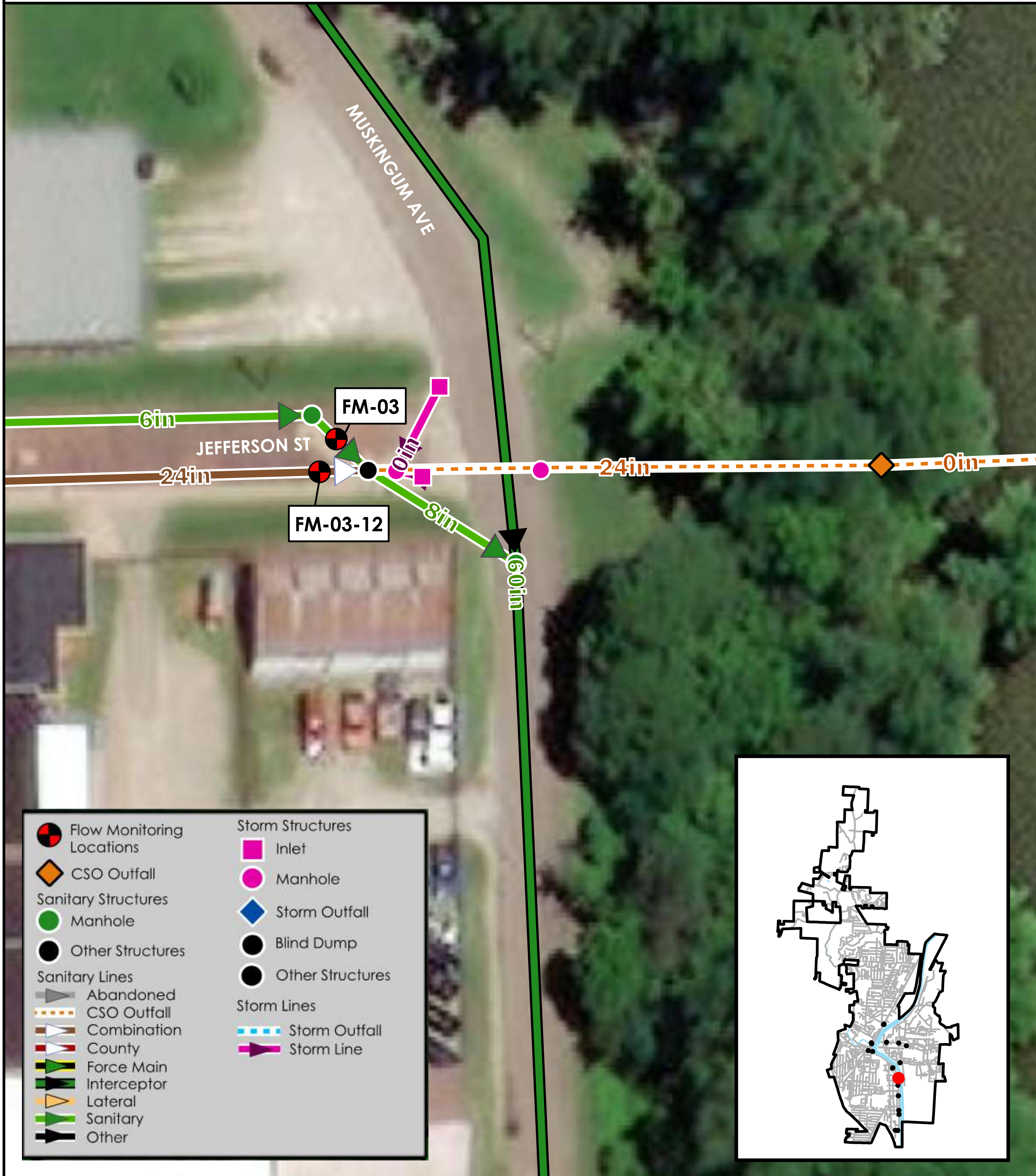
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST · CITY OF ZANESVILLE · PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-03-12

On 12 in at Jefferson St. & Muskingum Ave.

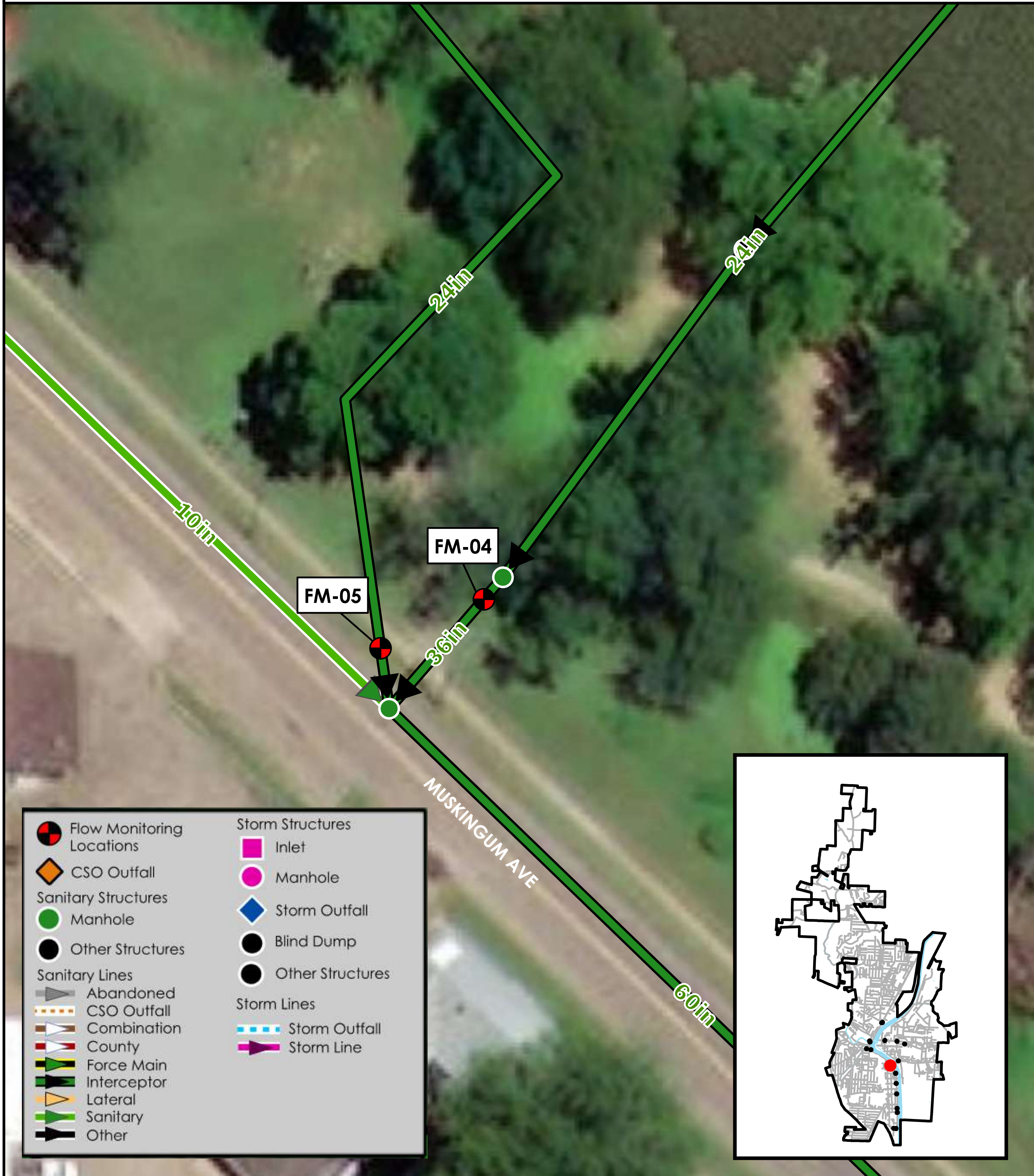
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST · CITY OF ZANESVILLE · PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-04

Downstream of 7th Ave. Siphon near Muskingum Ave. at Putnam Landing Park

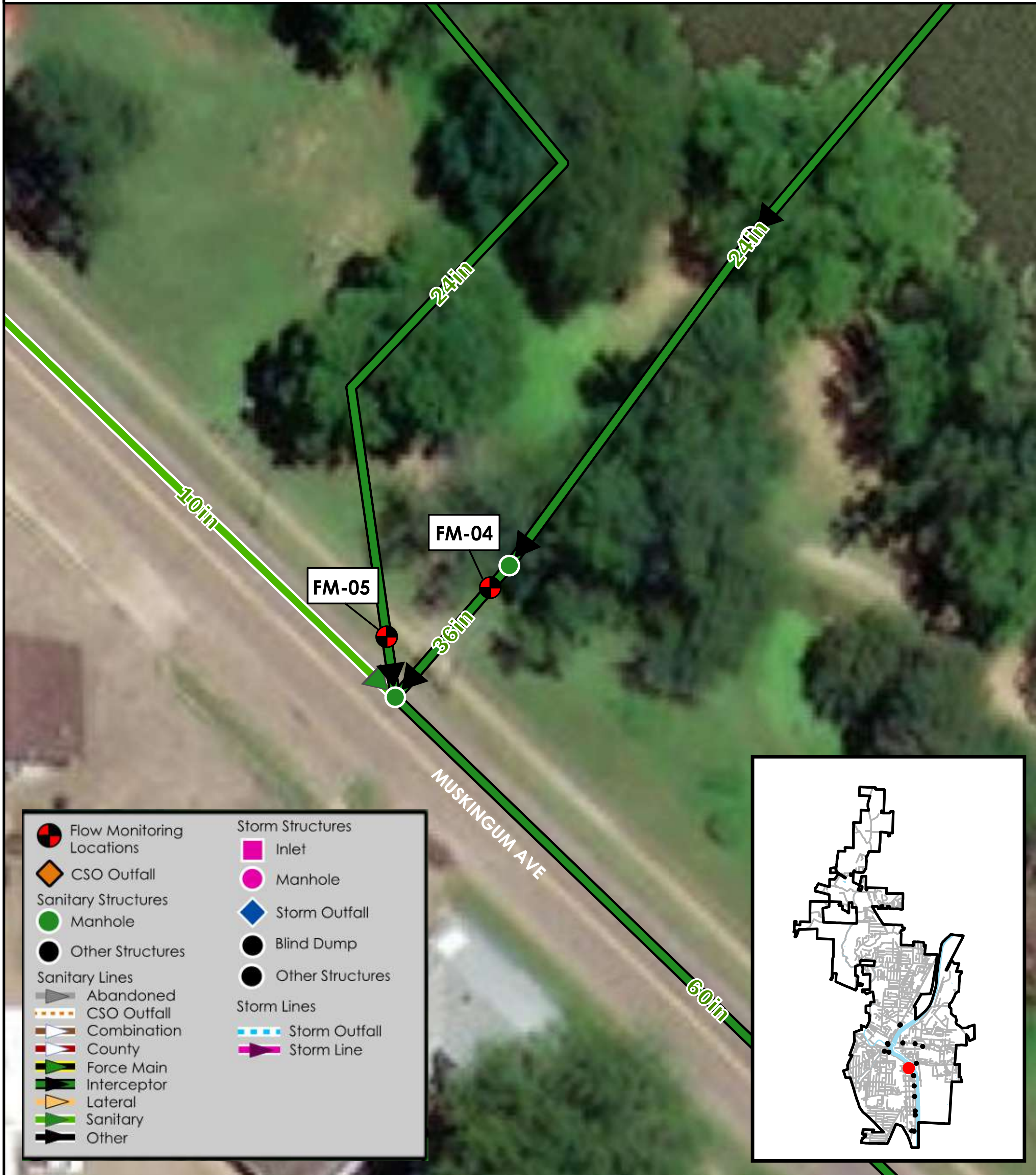
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST · CITY OF ZANESVILLE · PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-05

Downstream of Y-Bridge Lift Station
near Muskingum Ave.at Putnam Landing Park

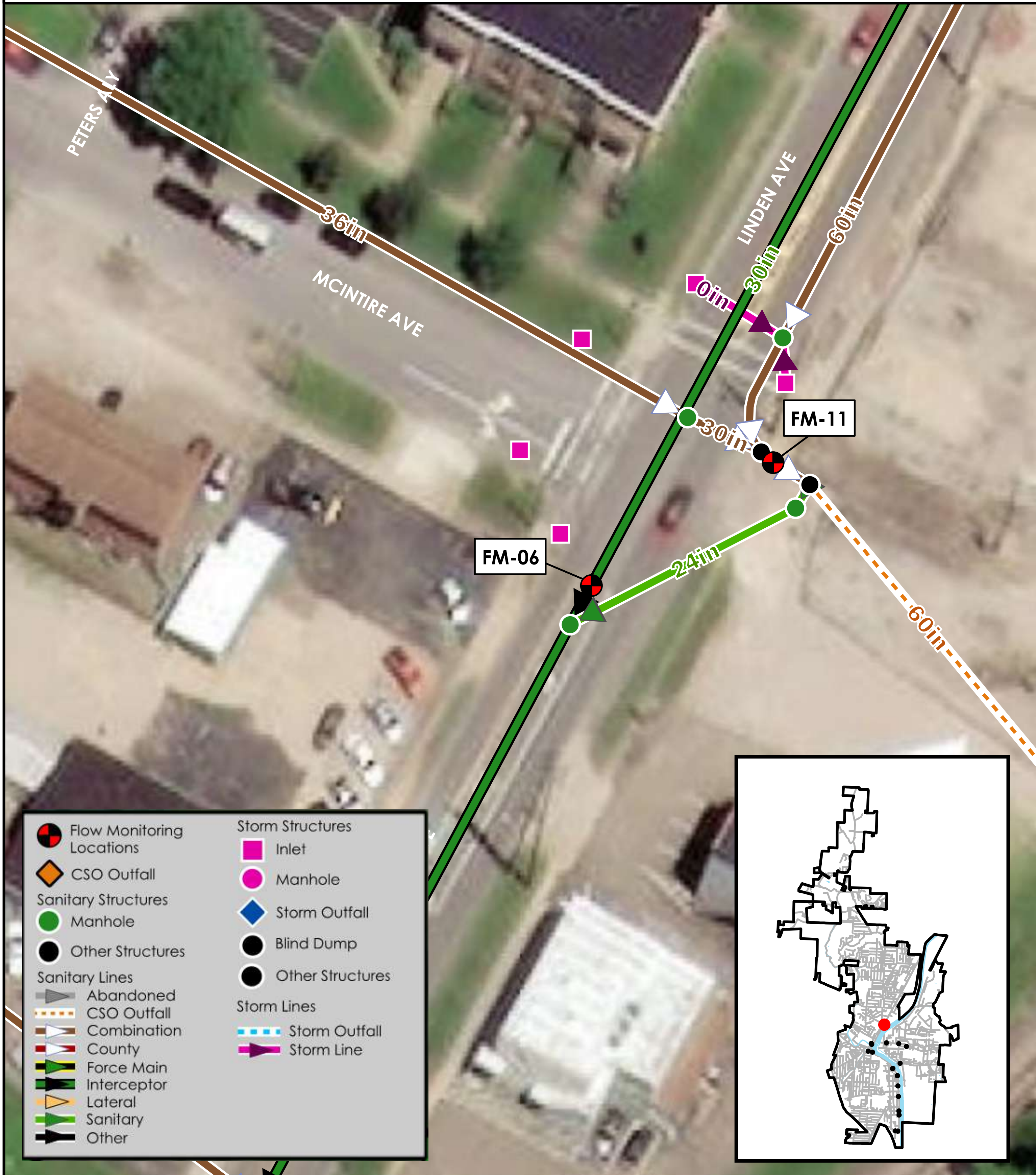
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST · CITY OF ZANESVILLE · PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



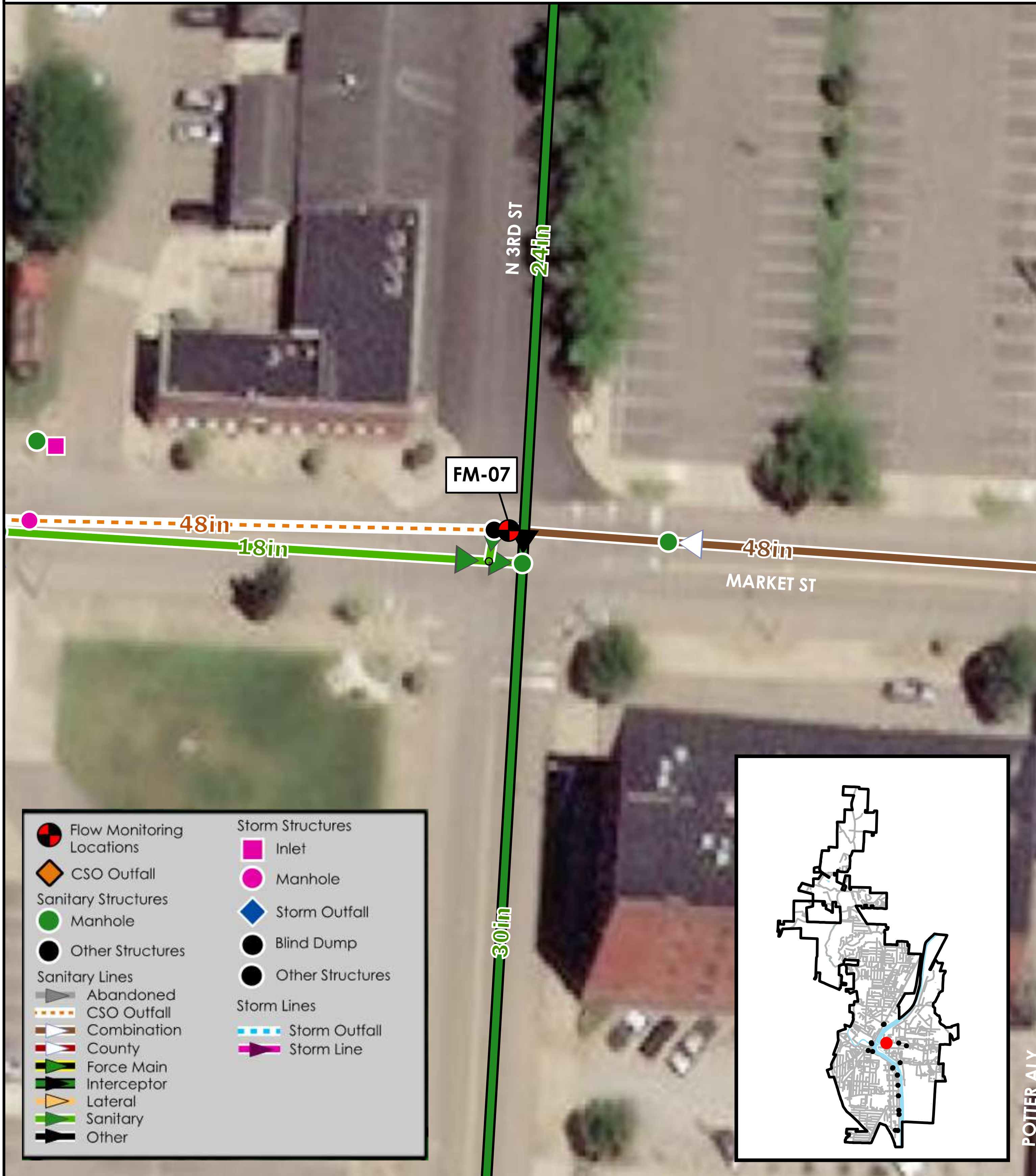
FM-06

Linden Ave. & McIntire Ave.

AECOM

PROUD OF OUR PAST CITY OF ZANESVILLE PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-07
Market St. & 3rd St.

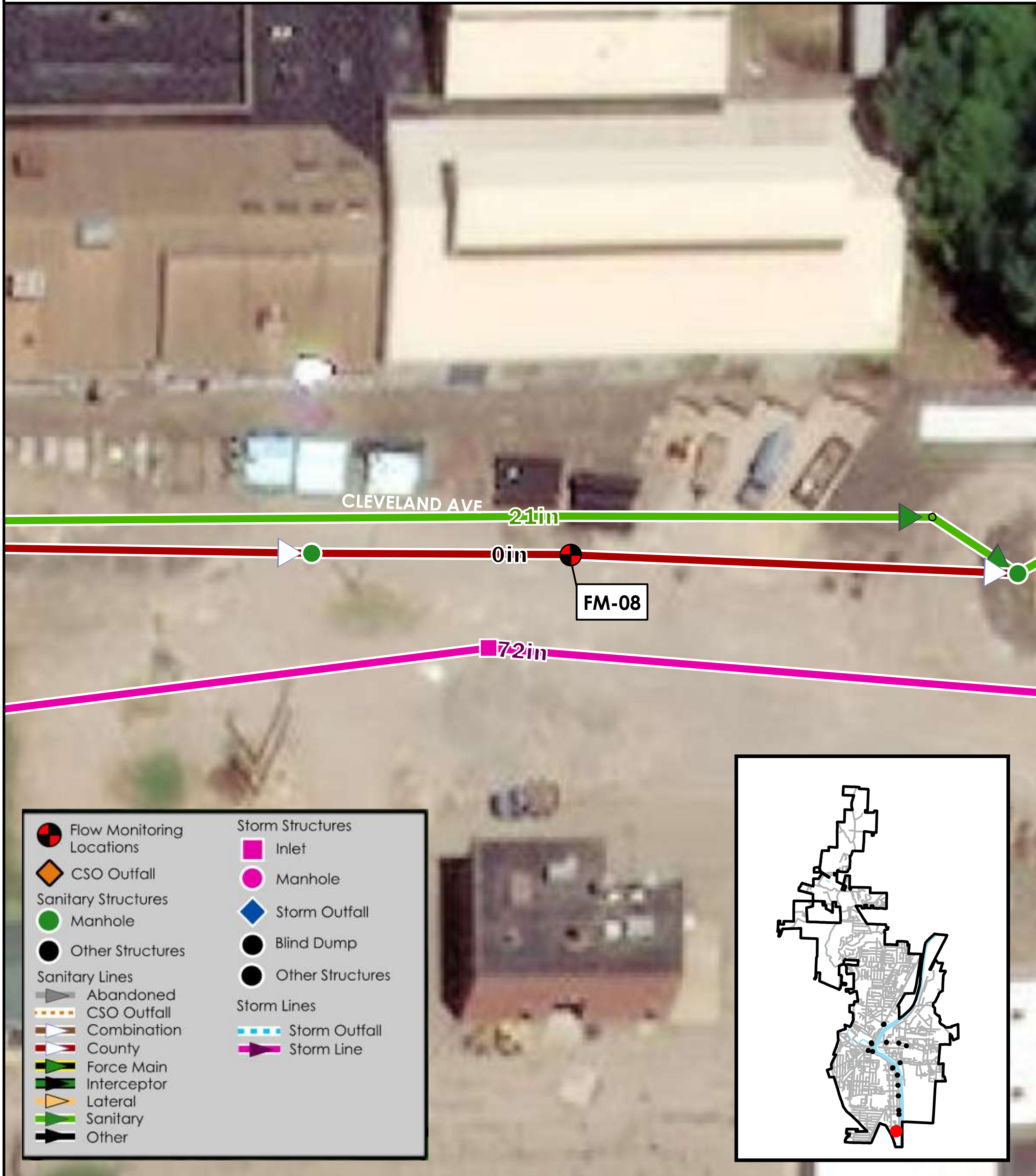
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST
CITY OF ZANESVILLE
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-08
East of Cleveland Ave.
& Moxahala Ave.

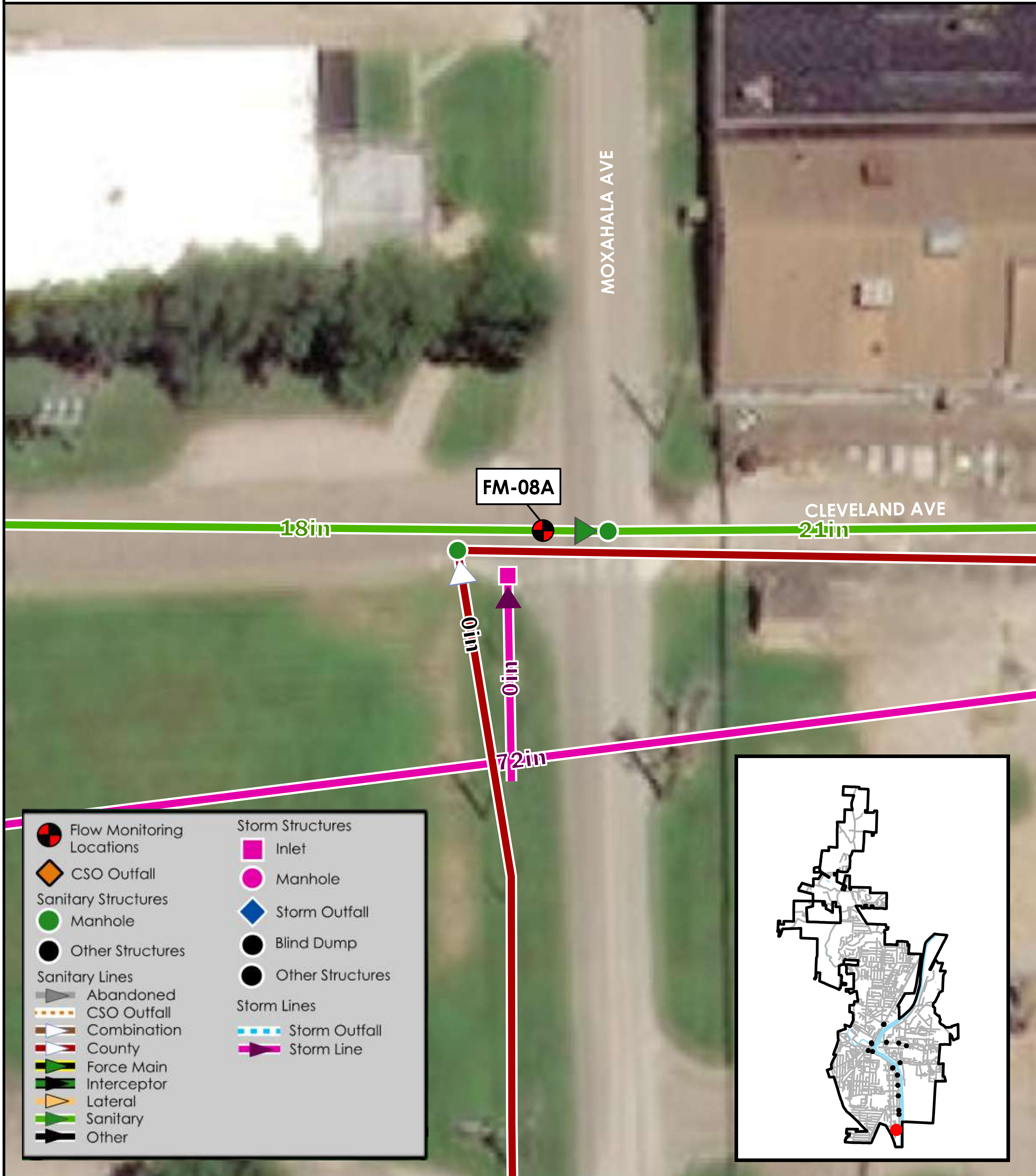
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST
CITY OF ZANESVILLE
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-08-A
Cleveland Ave. &
Moxahala Ave.

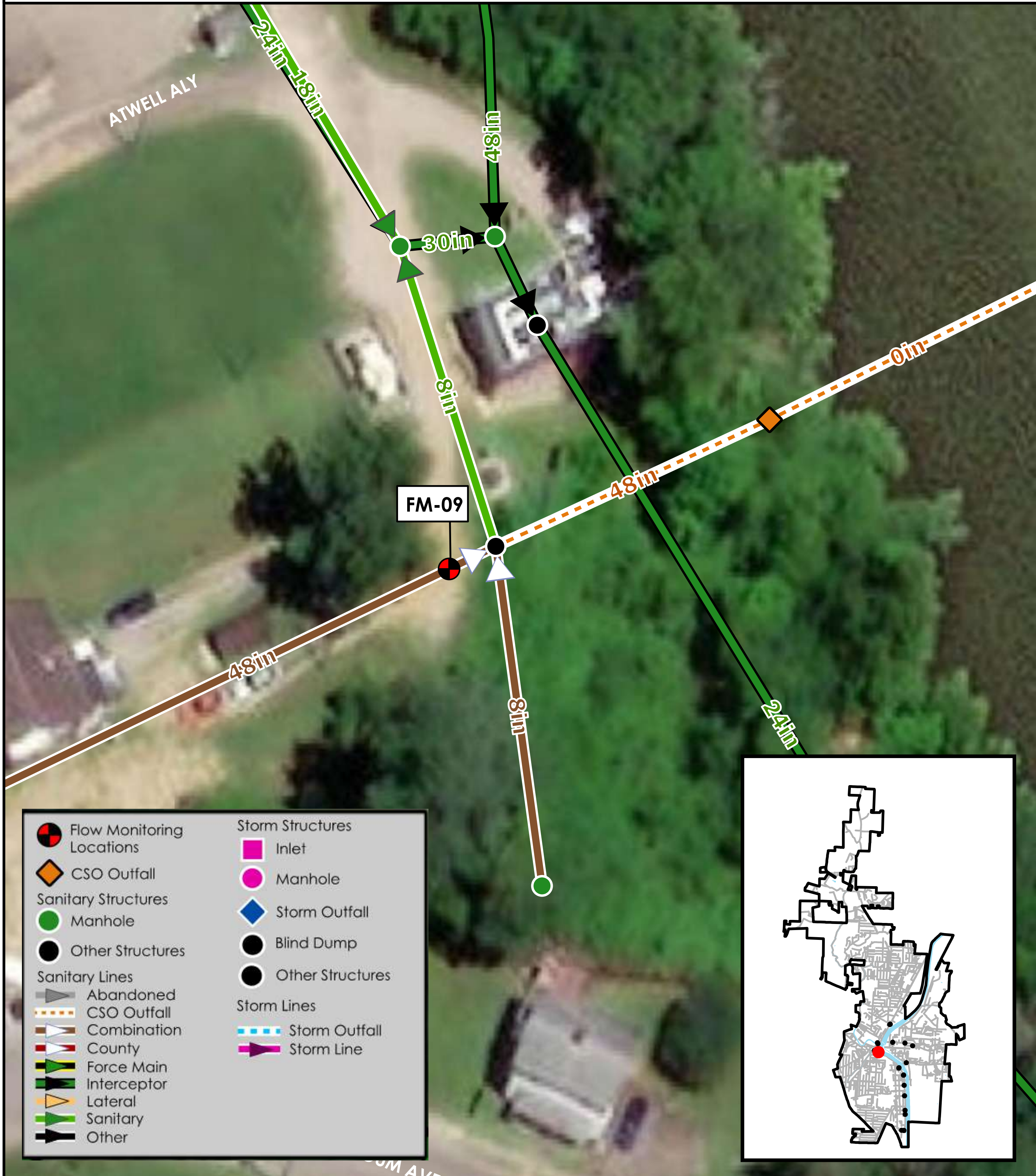
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST CITY OF ZANESVILLE PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-09
East of Pine St. &
Muskingum Ave.

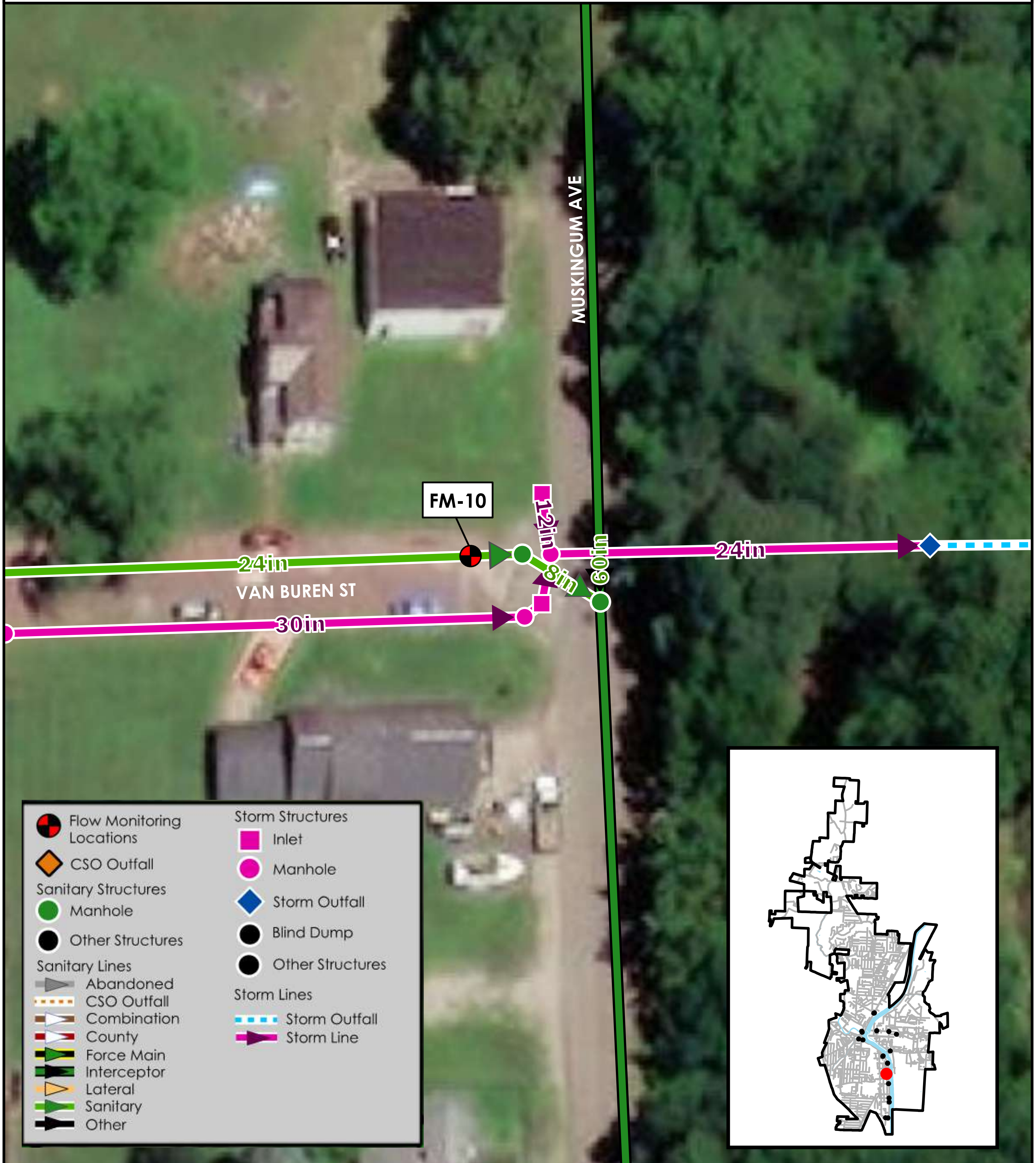
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST · CITY OF ZANESVILLE · PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations

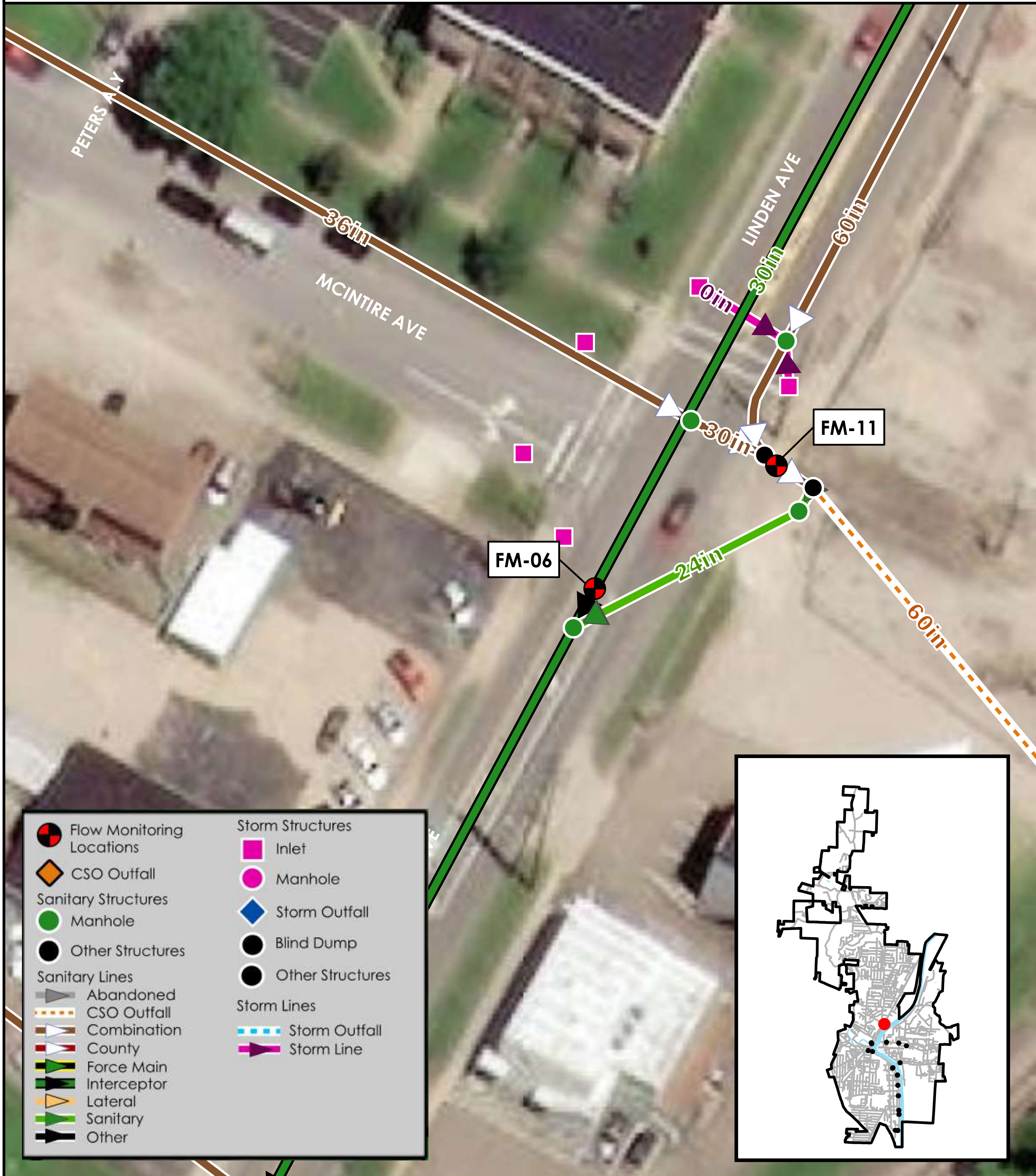


FM-10
Van Buren St. &
Muskingum Ave.

0 15 30 60
Feet

N

AECOM Flow Monitor Detailed Locations



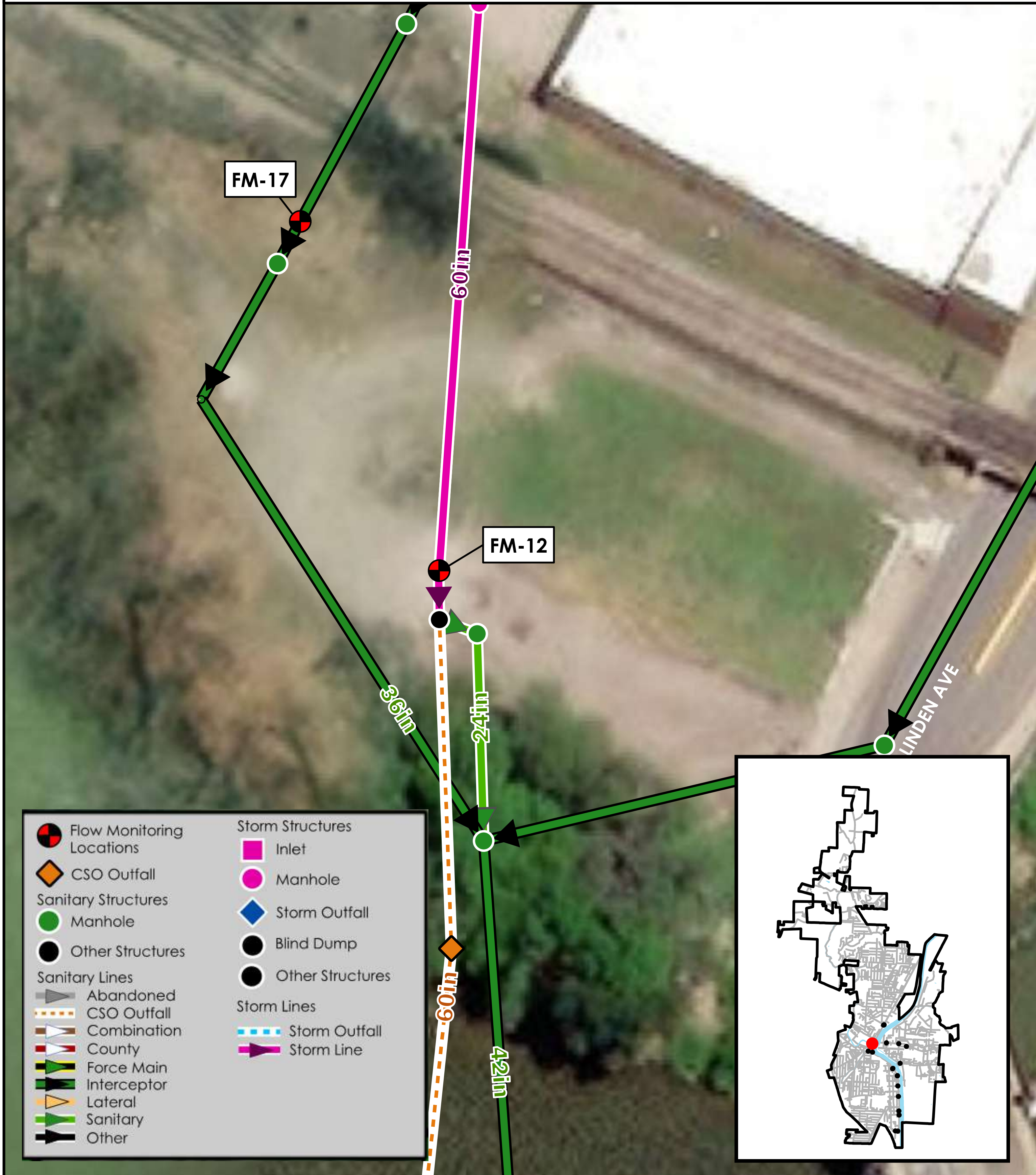
FM-11

Linden Ave. & McIntire Ave.

AECOM

CITY OF ZANESVILLE
PROUD OF OUR PAST
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-12

Peters Alley & Muskingum Ave.

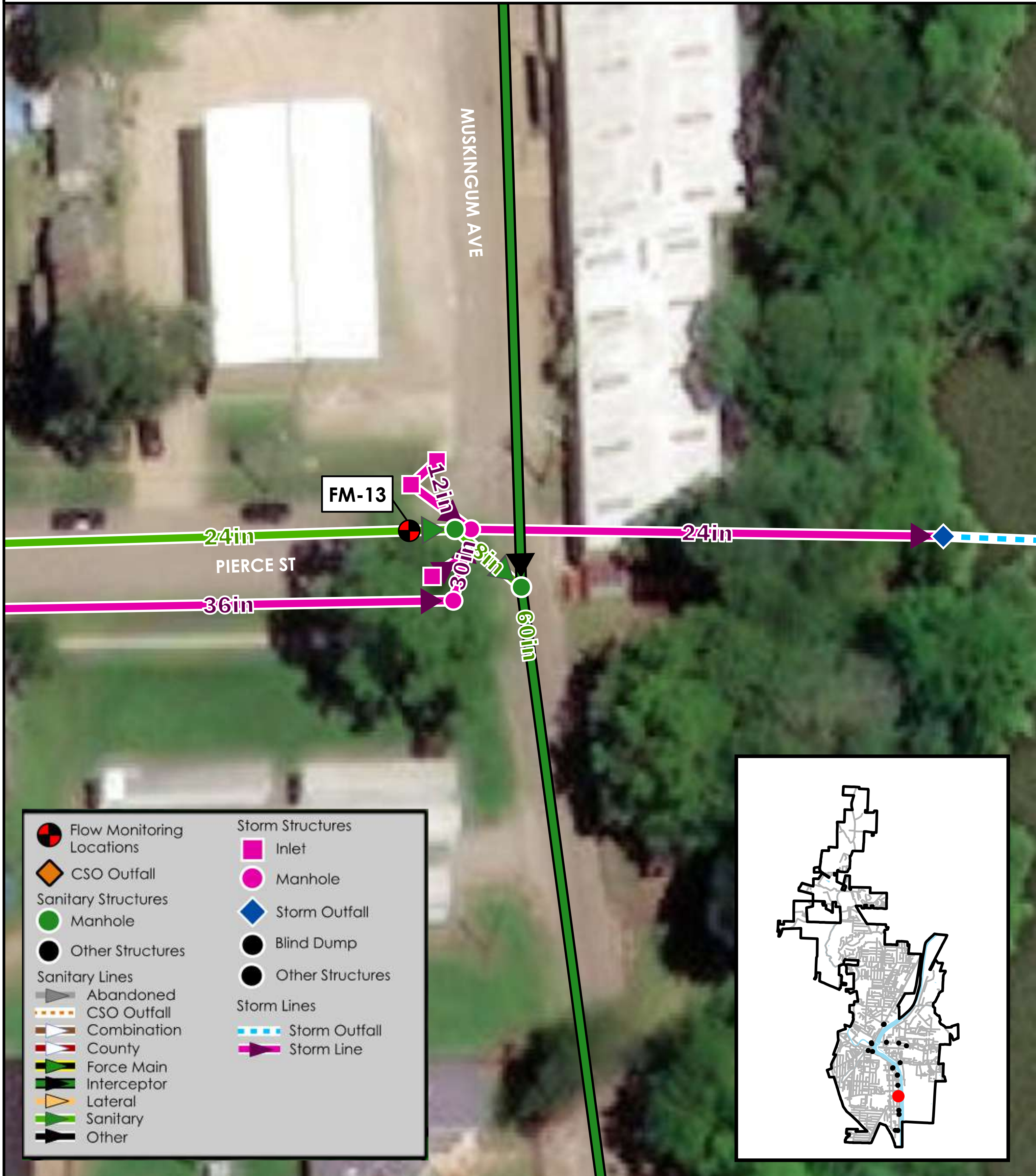
0 15 30 60
Feet

N

AECOM

CITY OF ZANESVILLE
PROUD OF OUR PAST
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-13

Pierce St. & Muskingum Ave.

0 15 30 60 Feet

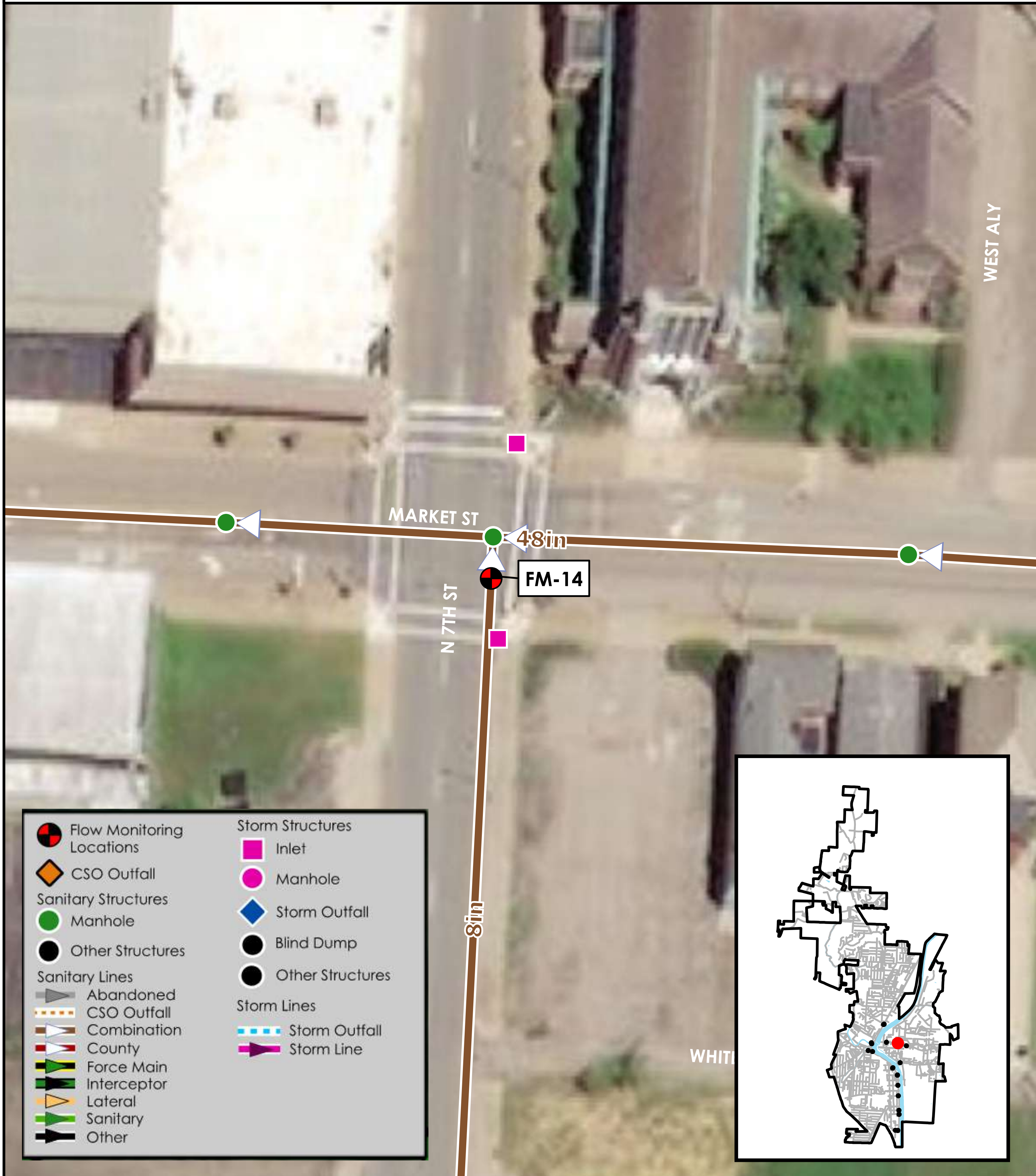
N

AECOM

CITY OF ZANESVILLE

PROUD OF OUR PAST PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-14

N 7th St. & Market St.

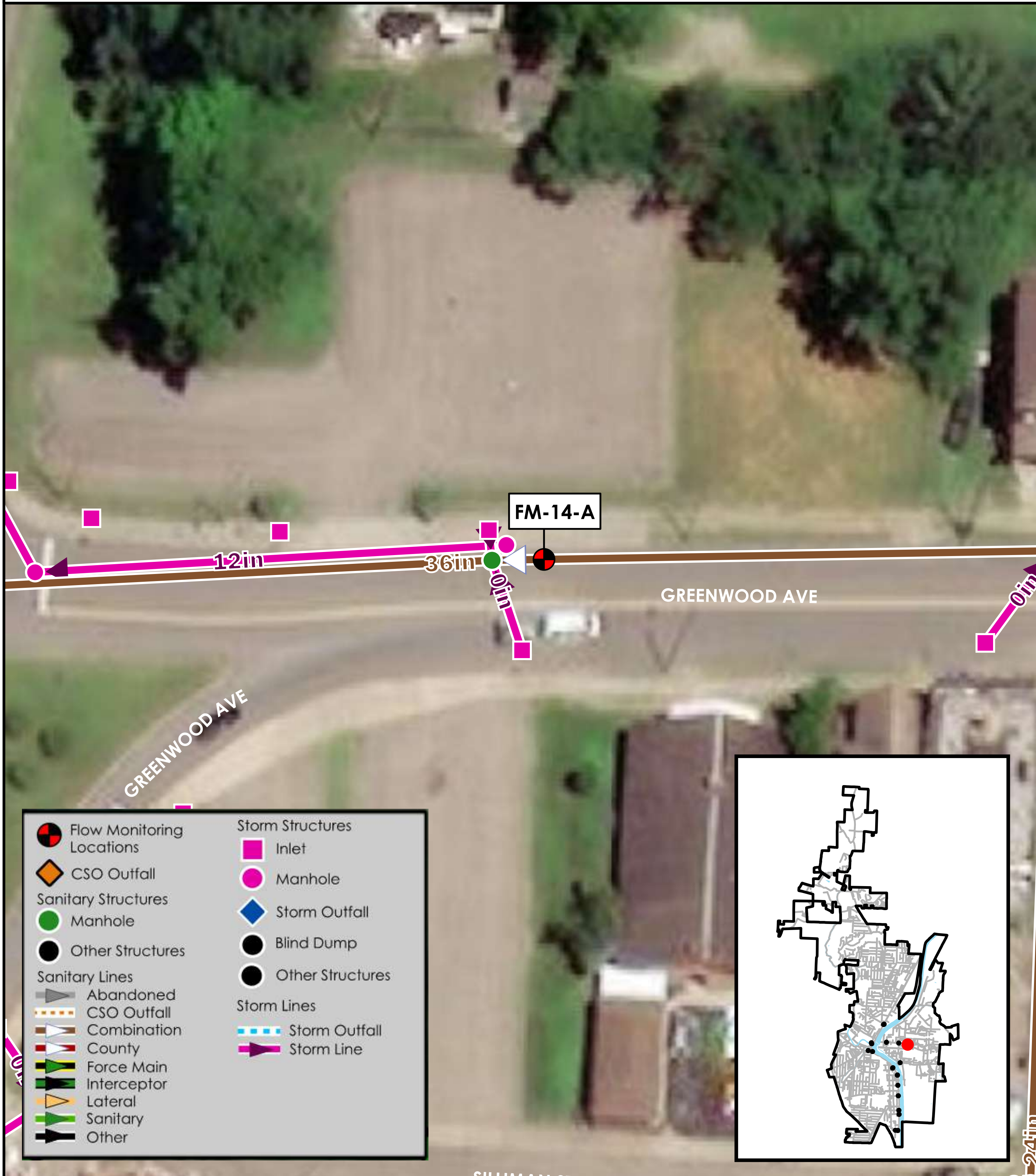
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST · CITY OF ZANESVILLE · PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-14-A
Greenwood Ave. &
Underwood St.

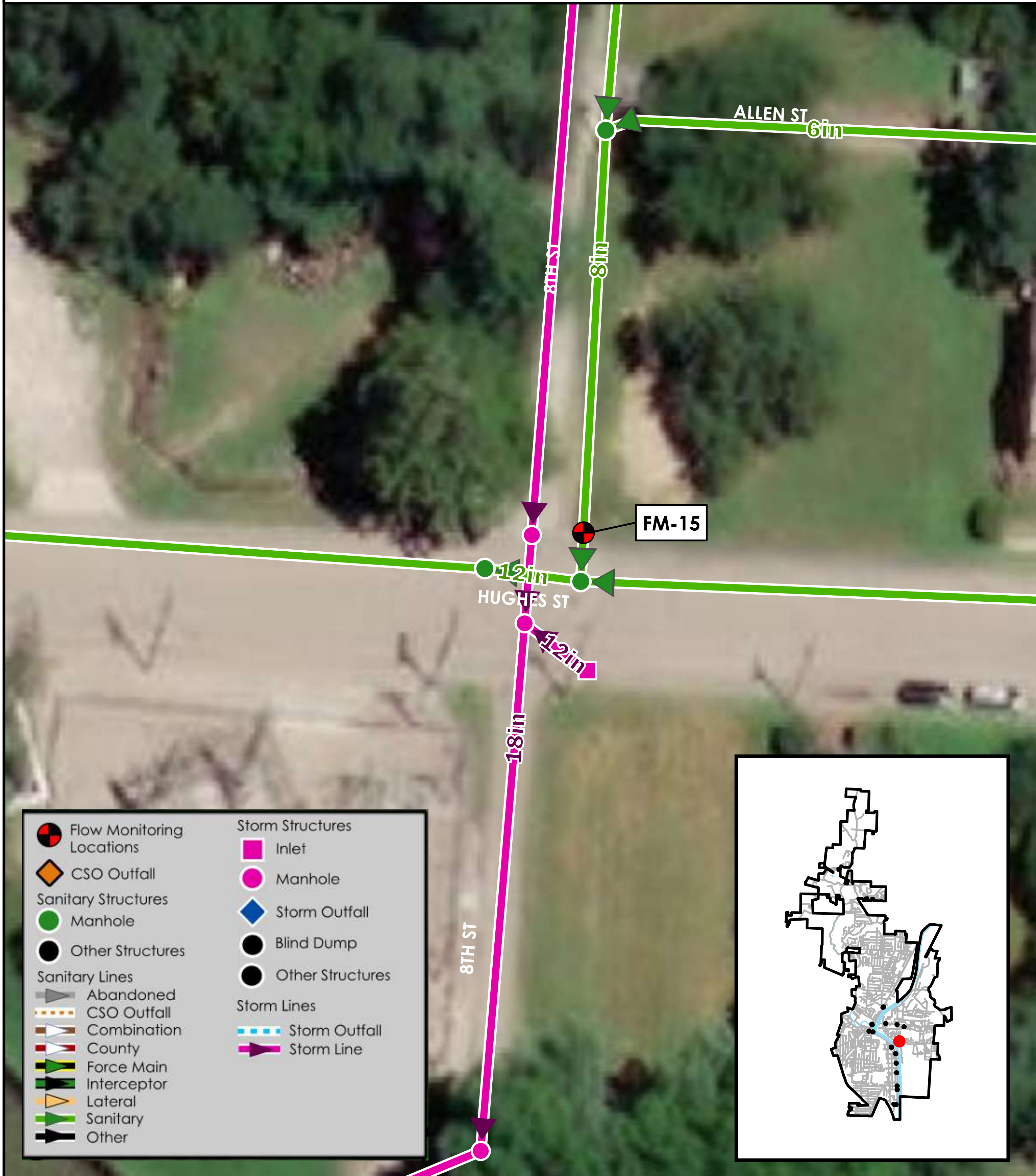
0 15 30 60
Feet

N

AECOM

PROUD OF OUR PAST
CITY OF ZANESVILLE
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-15

8th St. & Hughes St.

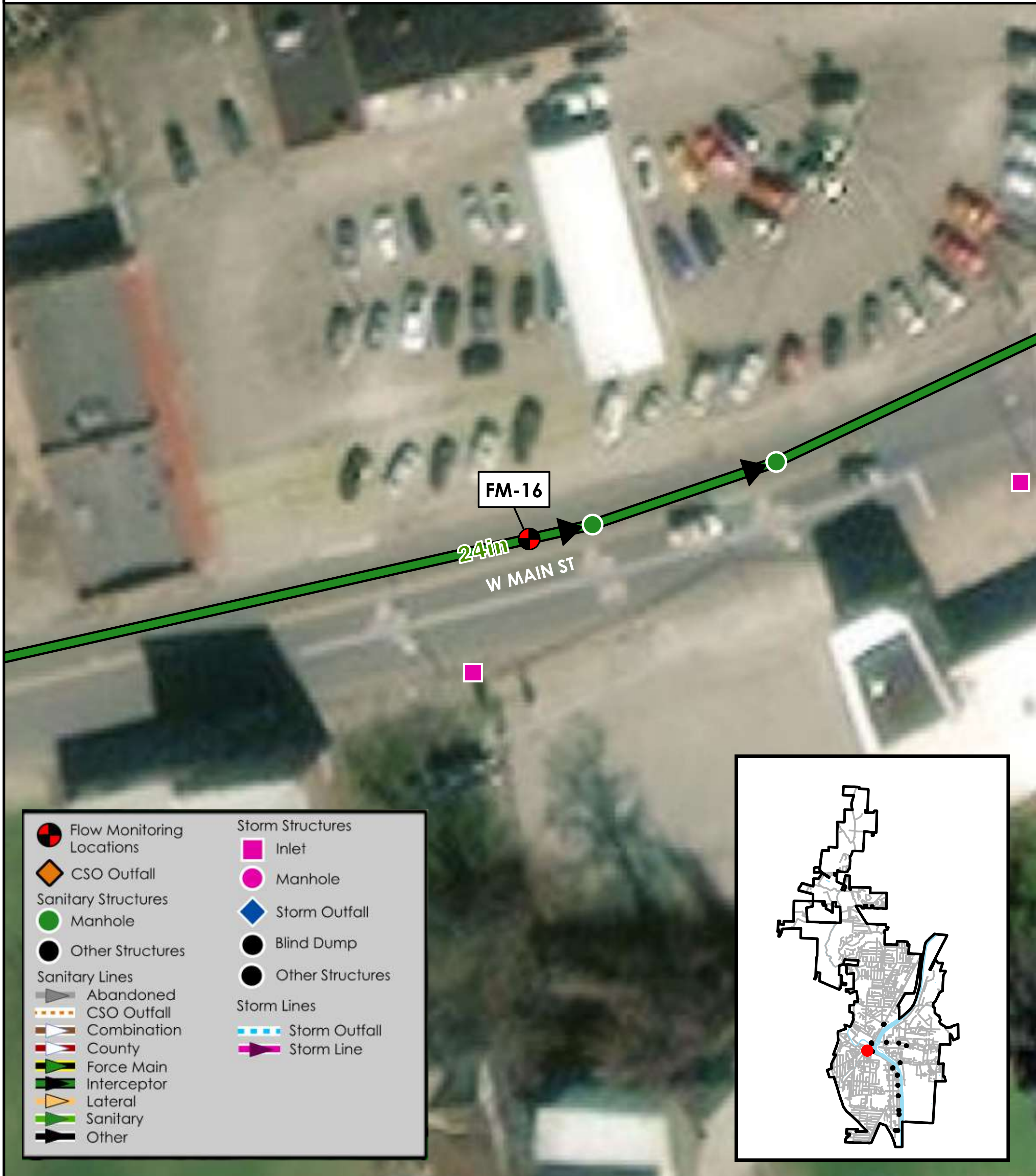
0 15 30 60 Feet

N

AECOM

PROUD OF OUR PAST CITY OF ZANESVILLE PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-16
W Main St. (Chap's Run)

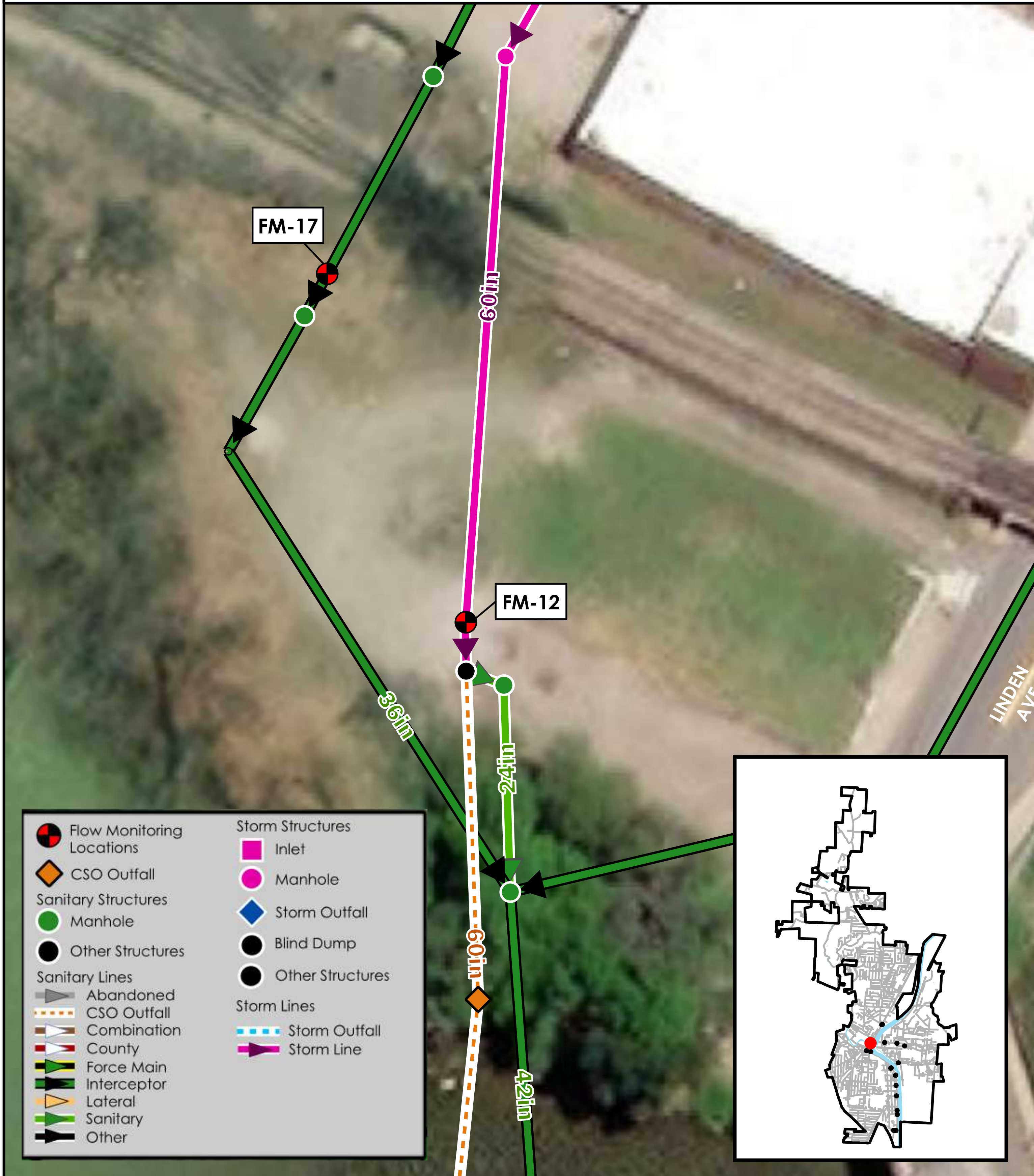
0 15 30 60
Feet

N

AECOM

PROUD OF OUR PAST
CITY OF ZANESVILLE
PRIDE IN OUR FUTURE

AECOM Flow Monitor Detailed Locations



FM-17

Peters Alley (Joe's Run)

0 15 30 60 Feet

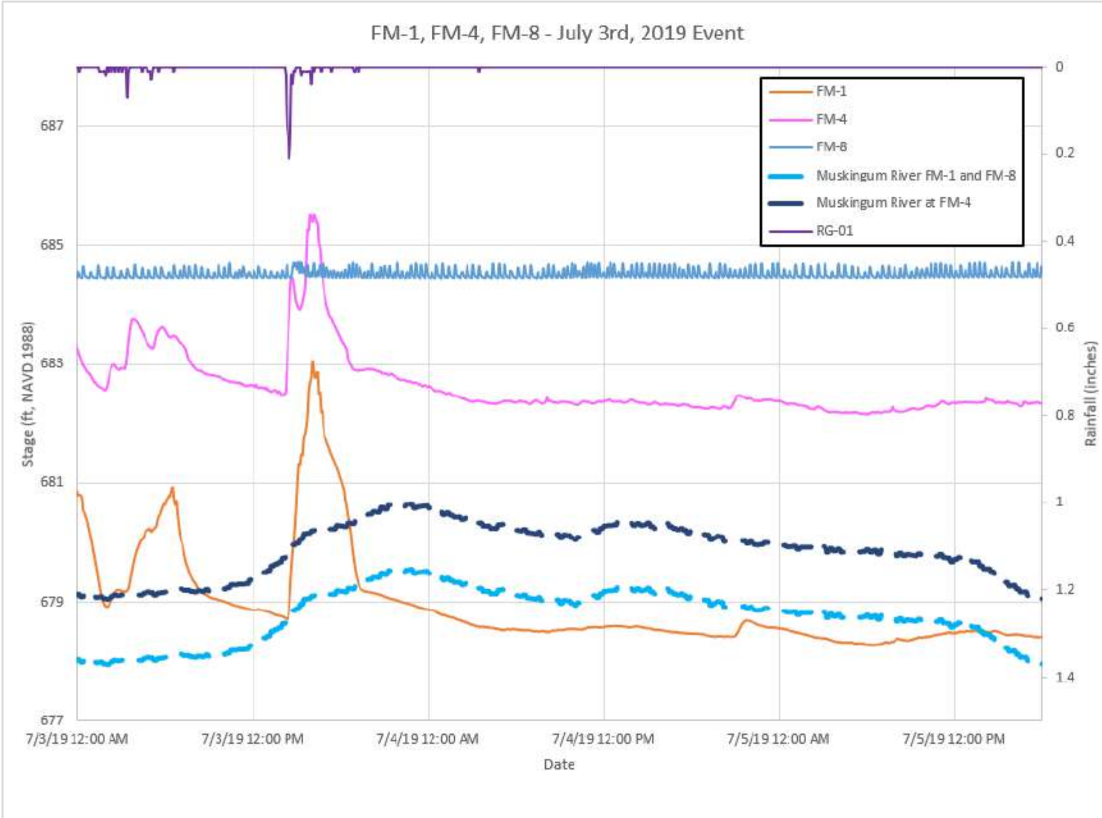
N

AECOM

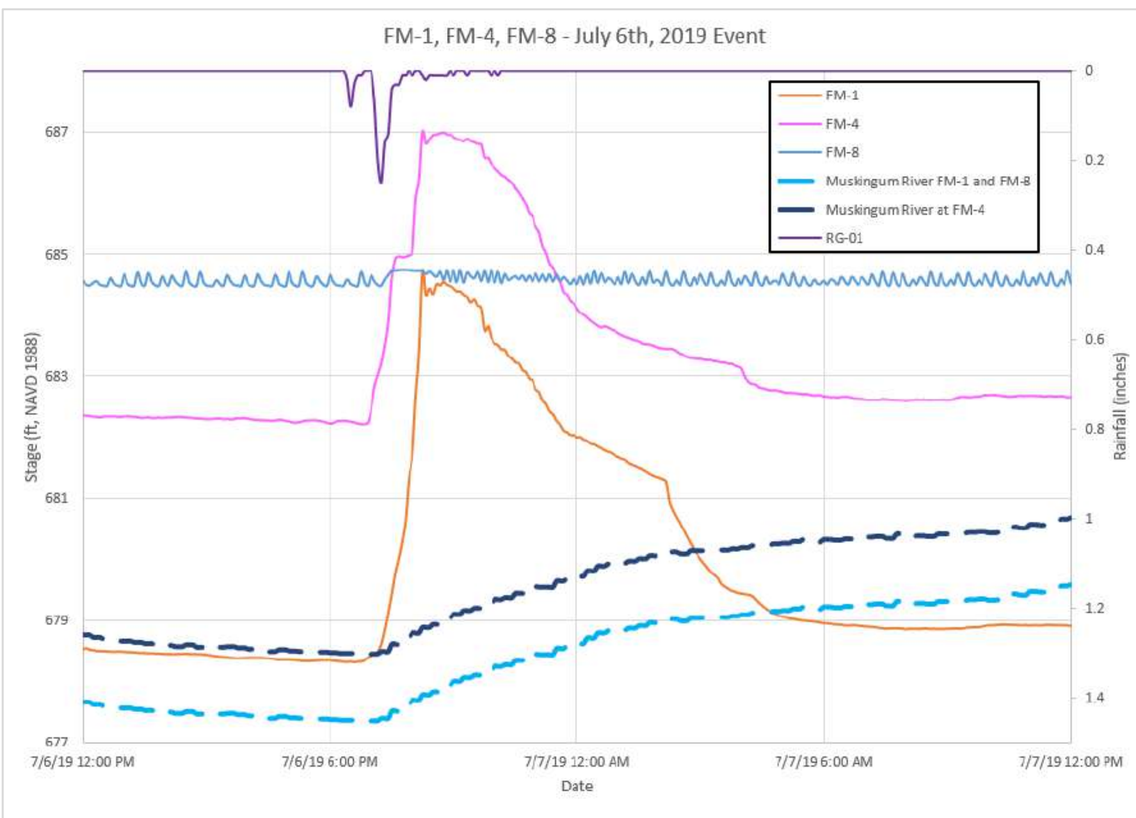
PROUD OF OUR PAST CITY OF ZANESVILLE PRIDE IN OUR FUTURE

Appendix D River Water Intrusion Hydrographs

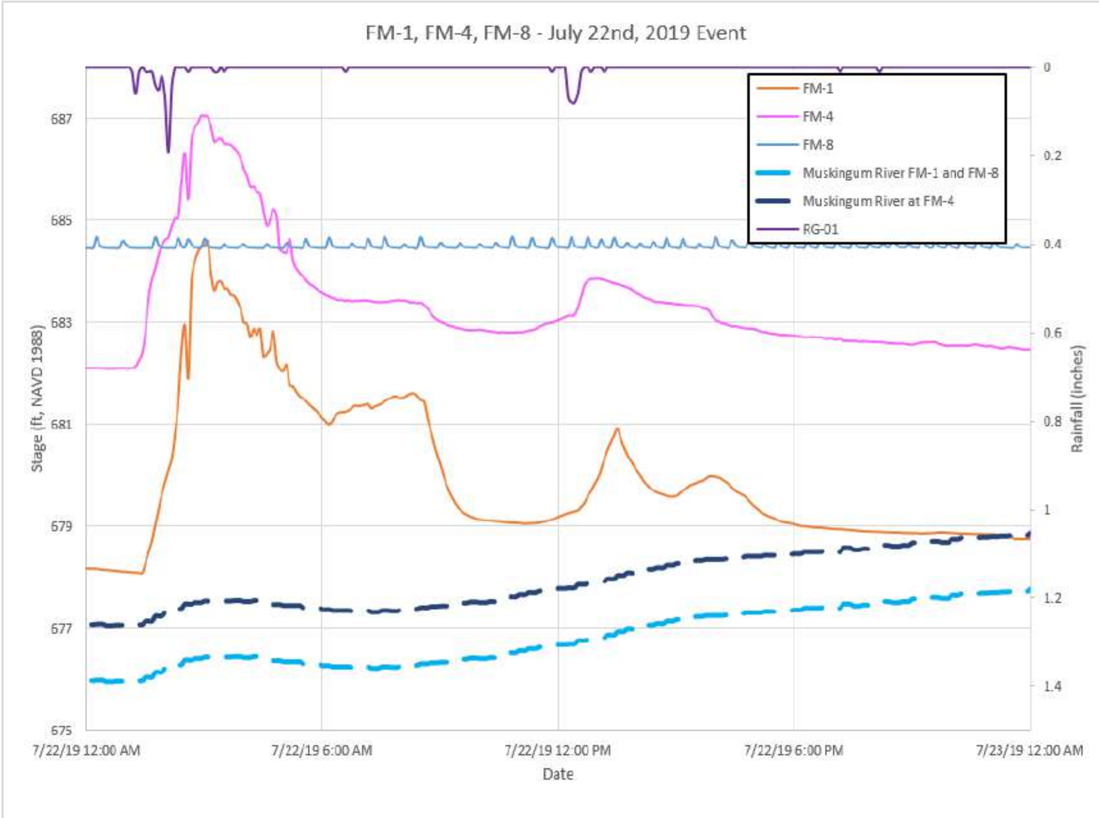
Appendix D
River Water Intrusion
Hydrographs



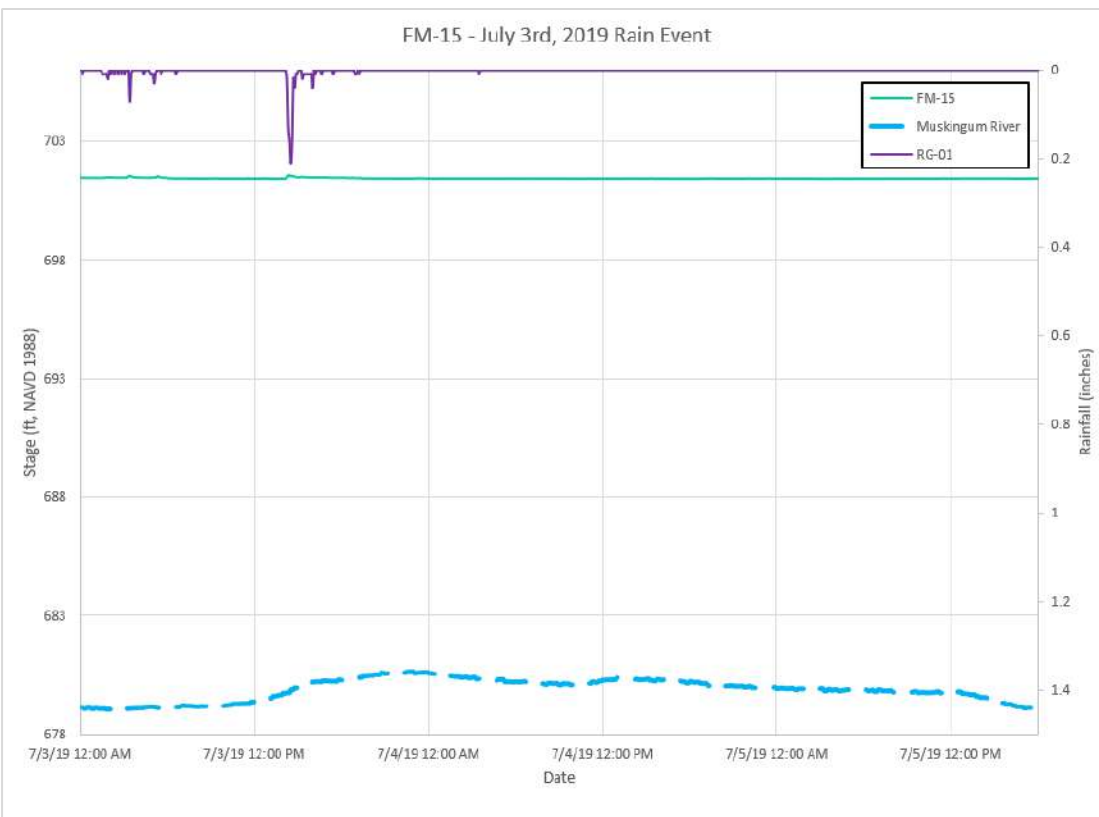
FM-1 and FM-4 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



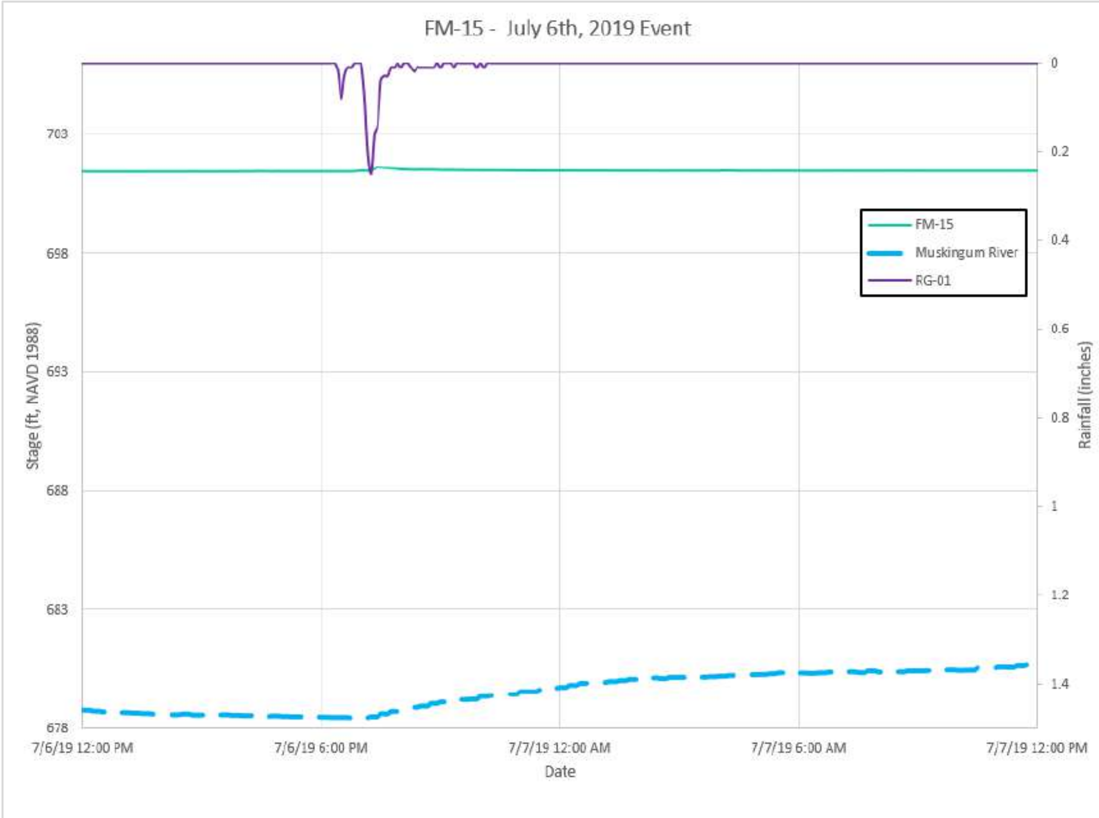
FM-1 and FM-4 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



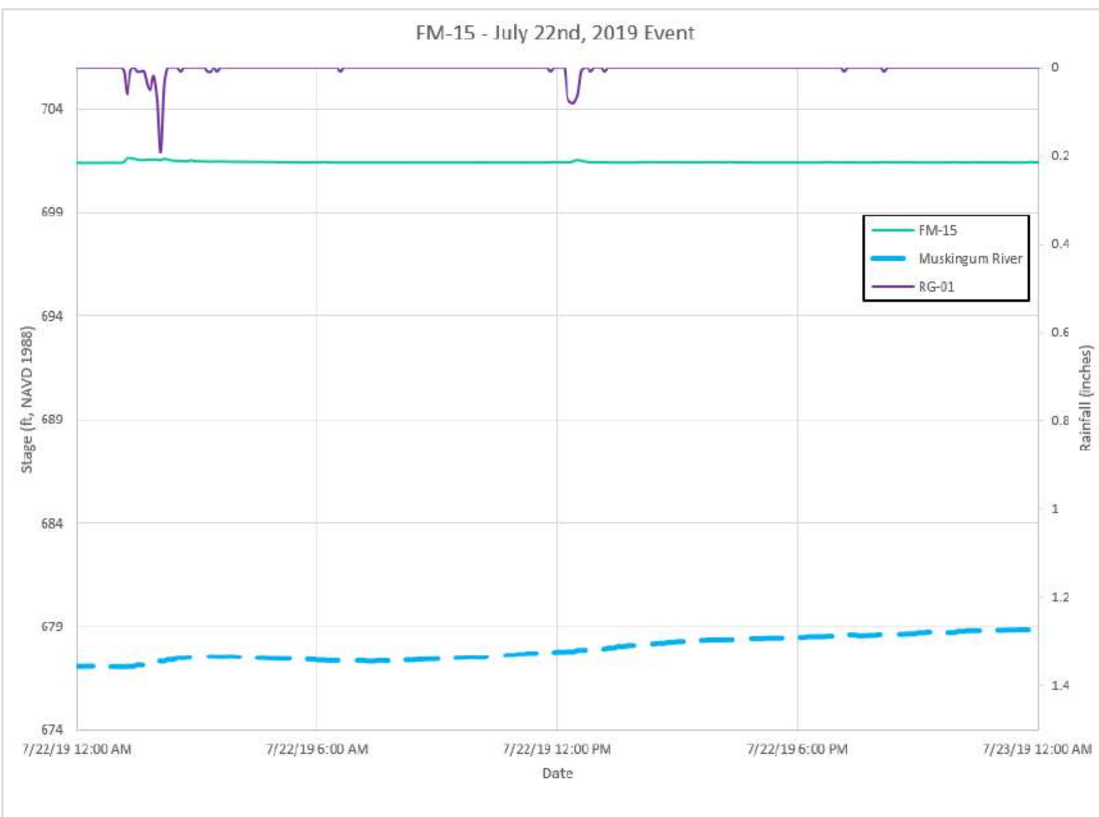
FM-1 and FM-4 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



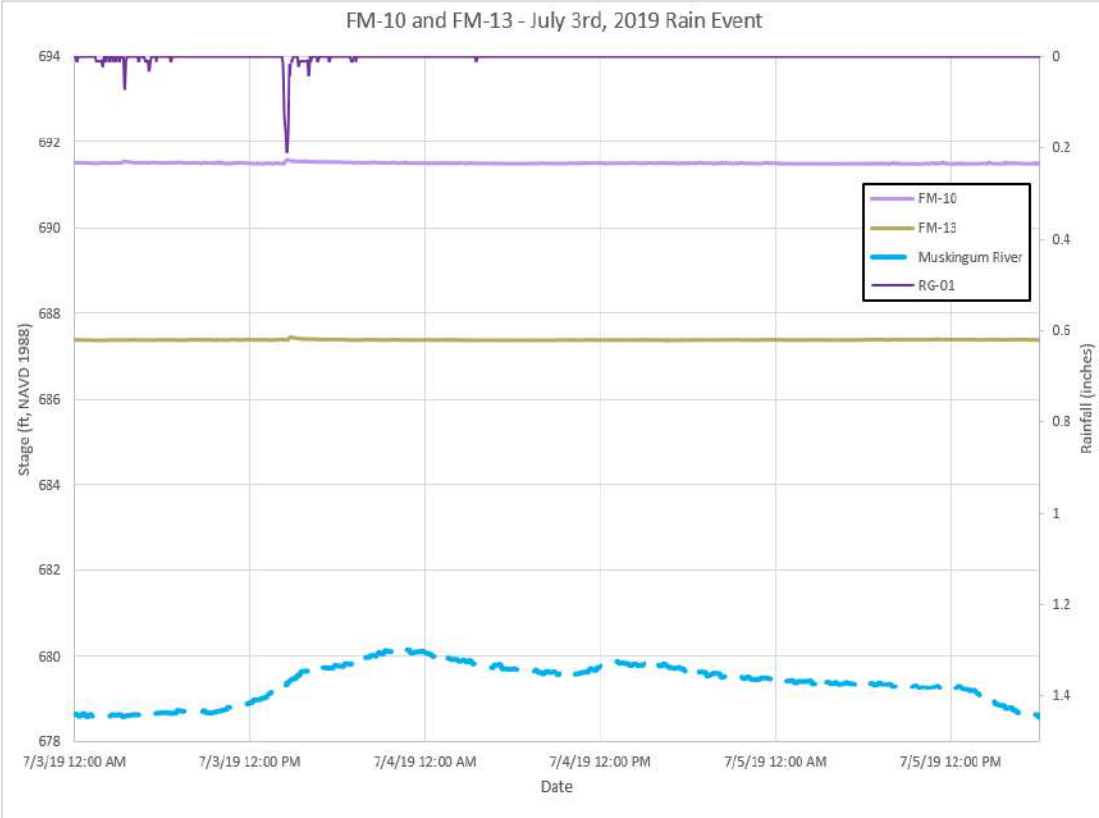
FM-15 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



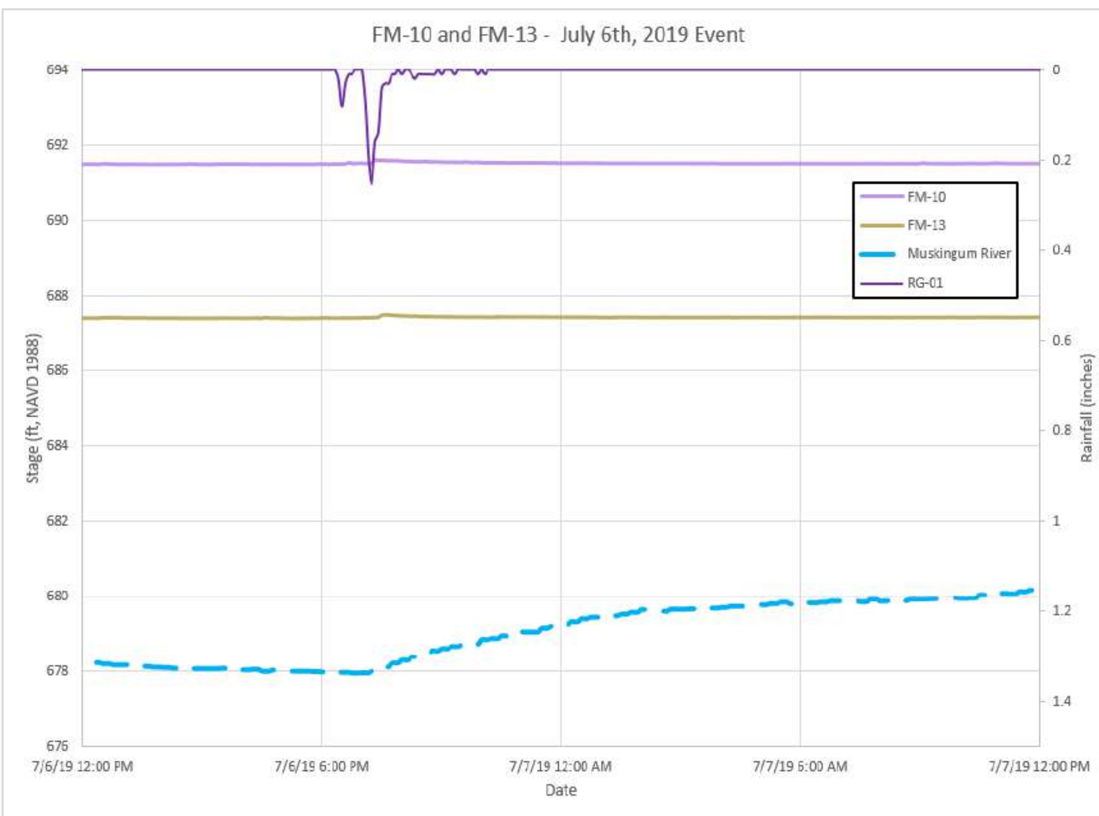
FM-15 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



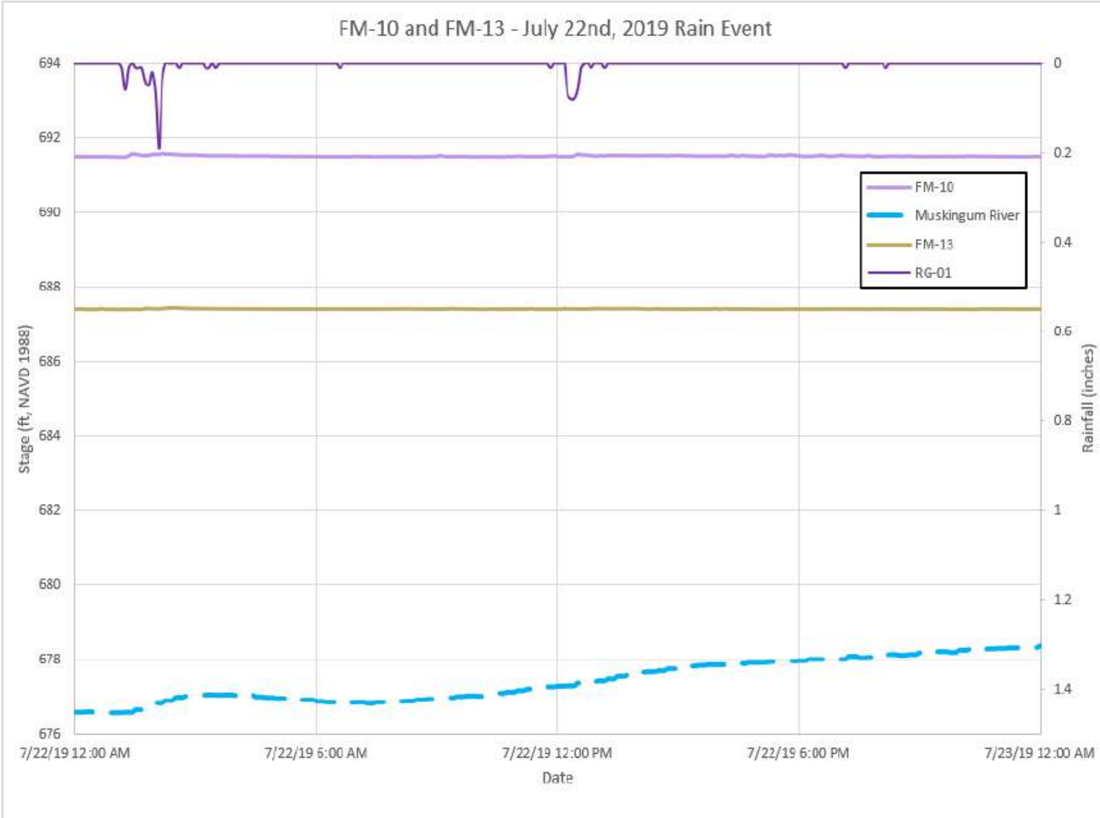
FM-15 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



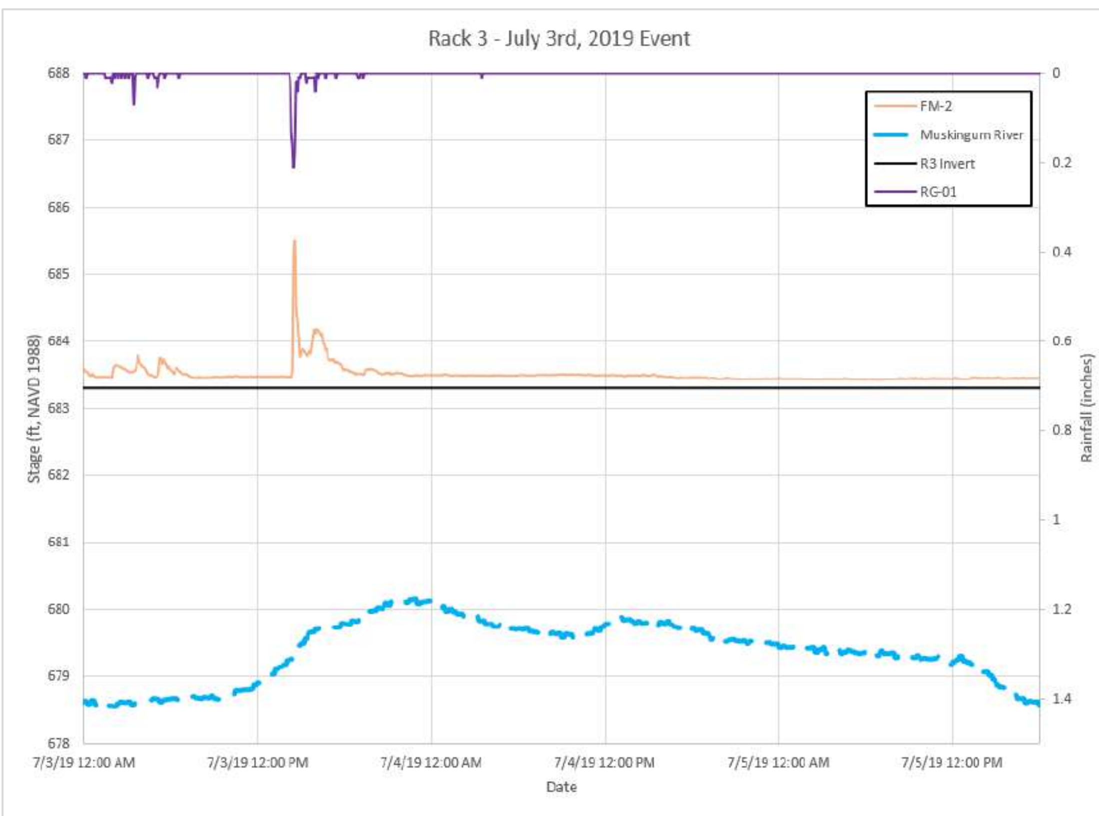
FM-10 and FM-13 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



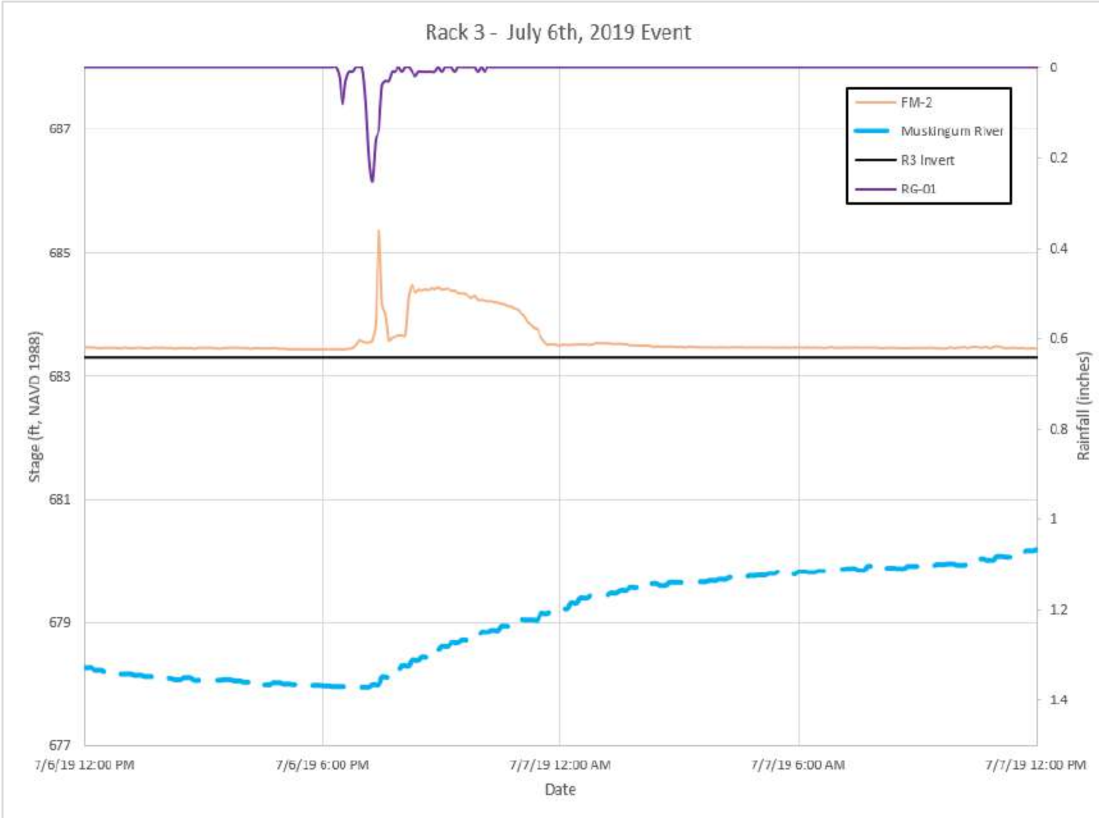
FM-10 and FM-13 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



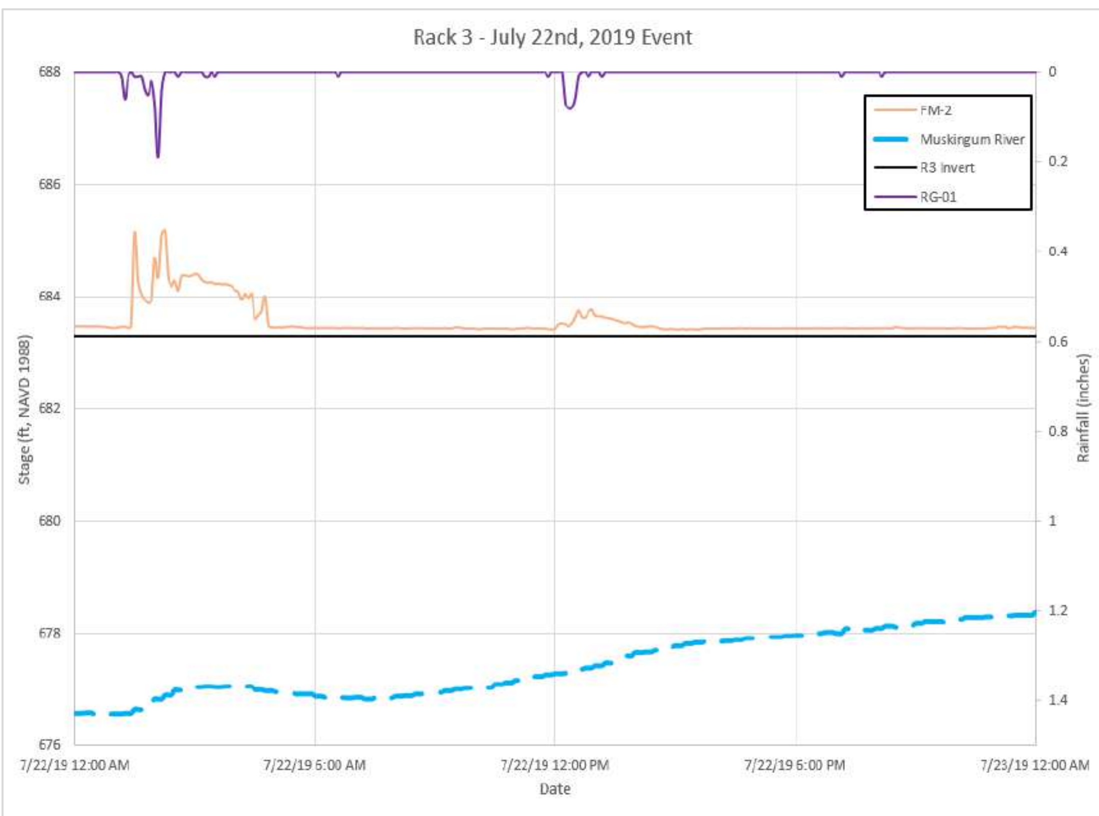
FM-10 and FM-13 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



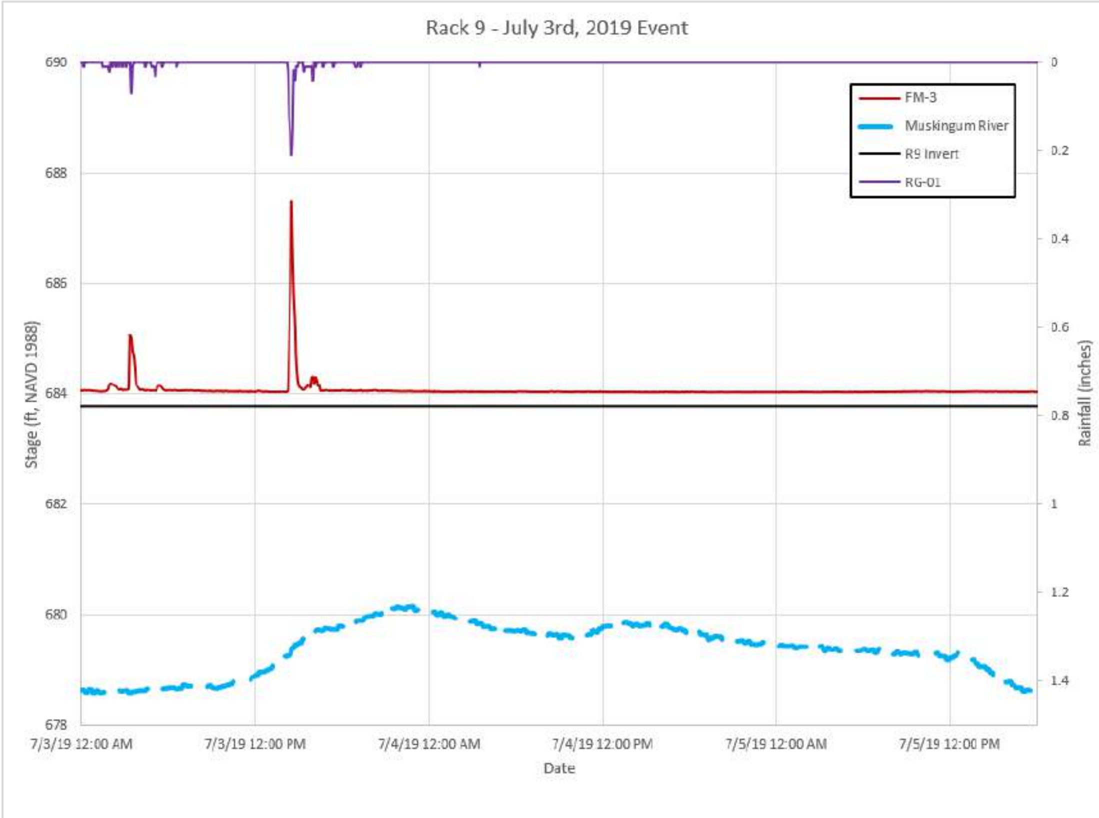
R3 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



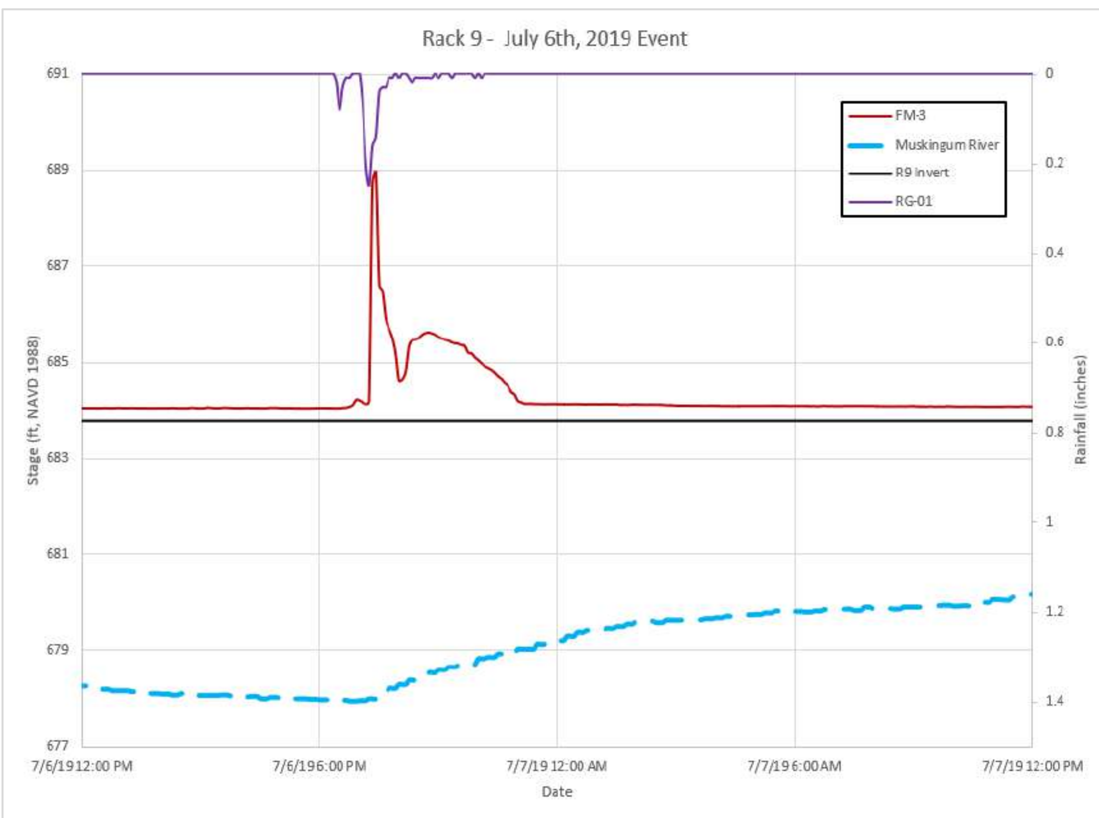
R3 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



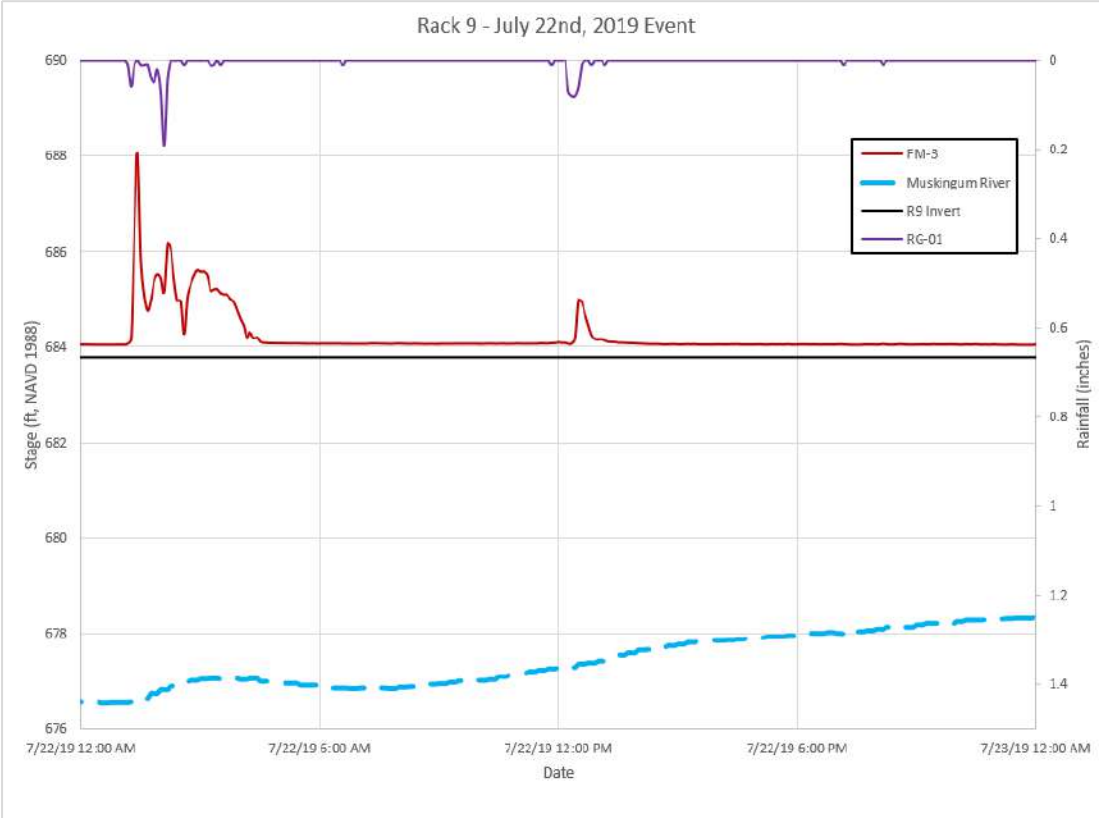
R3 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



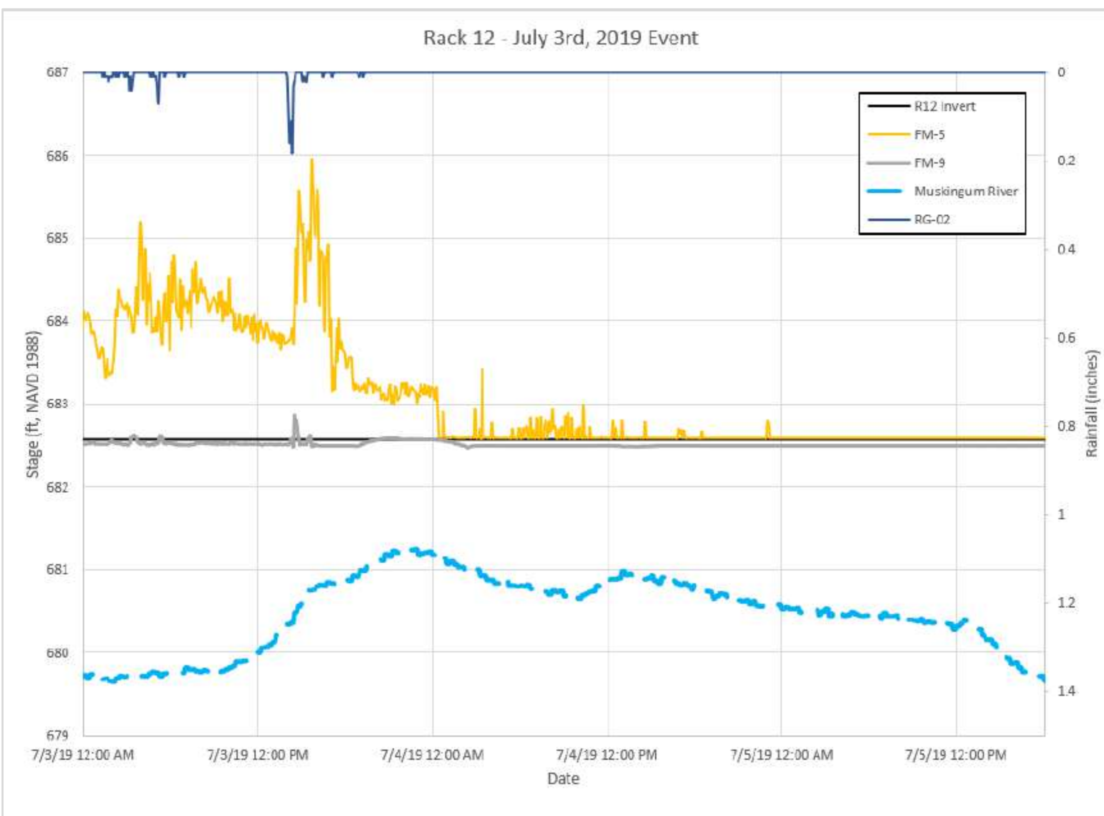
R9 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



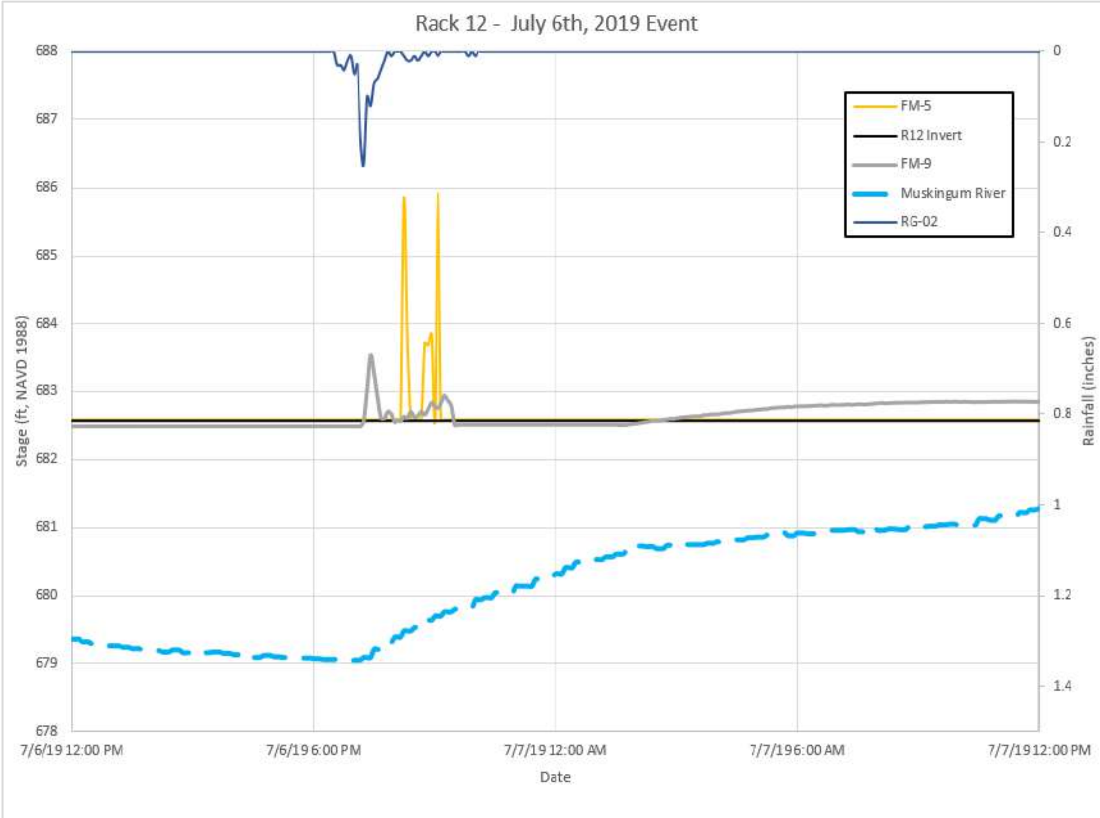
R9 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



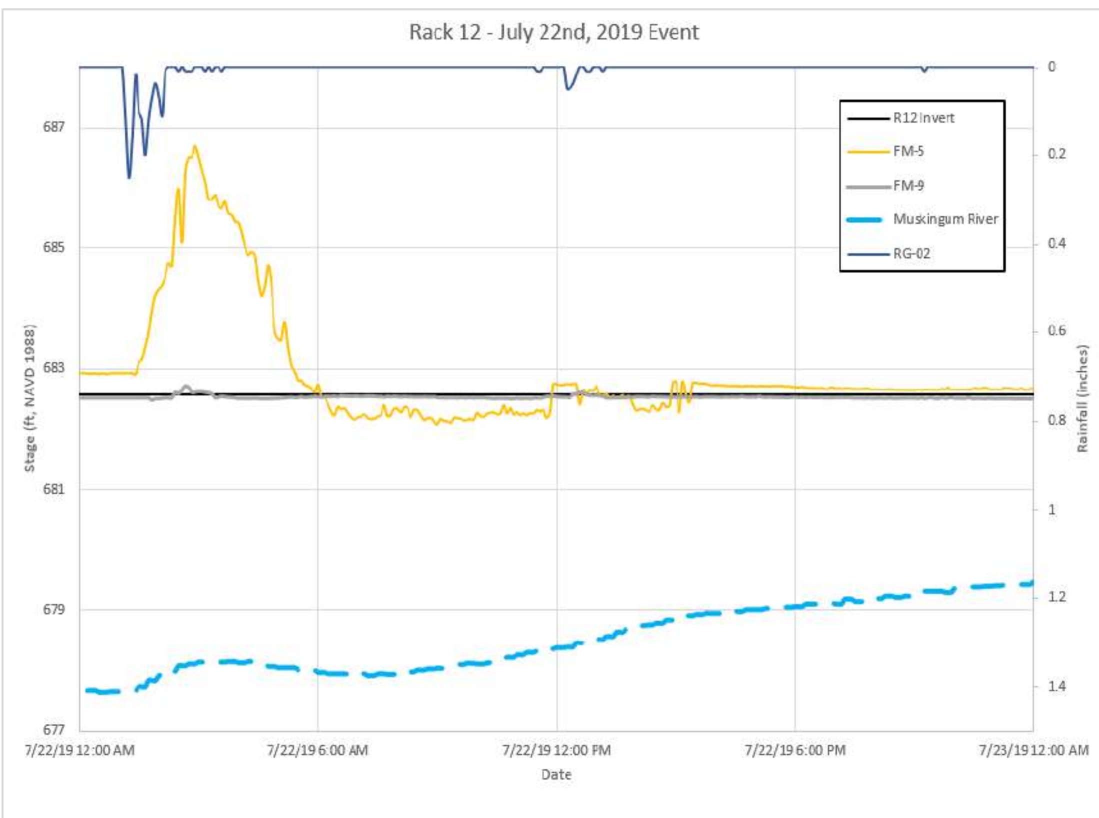
R9 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



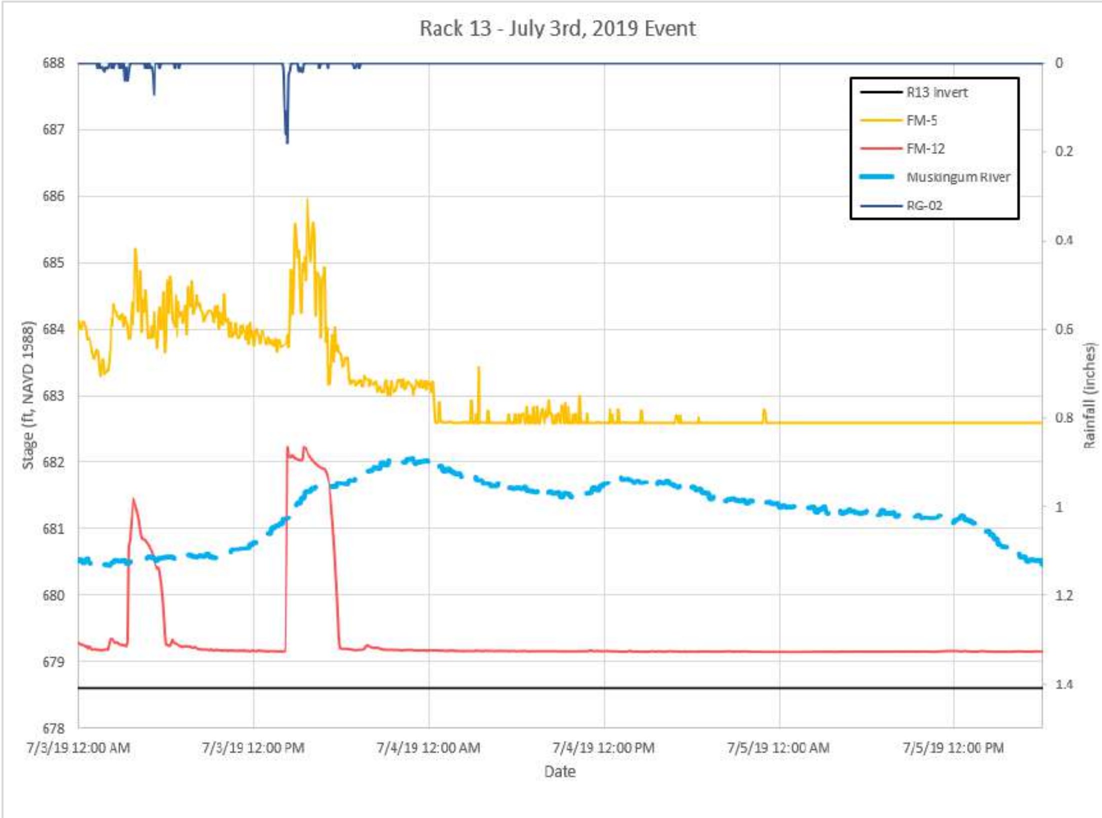
R12 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



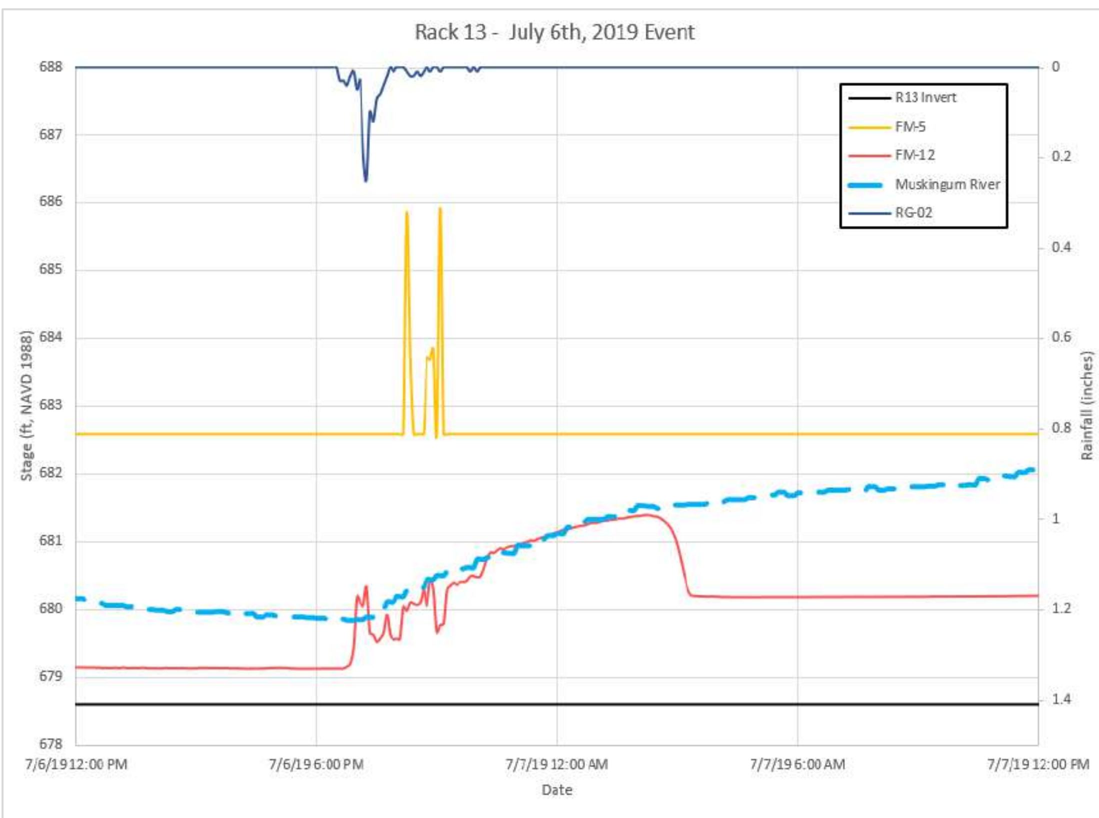
R12 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



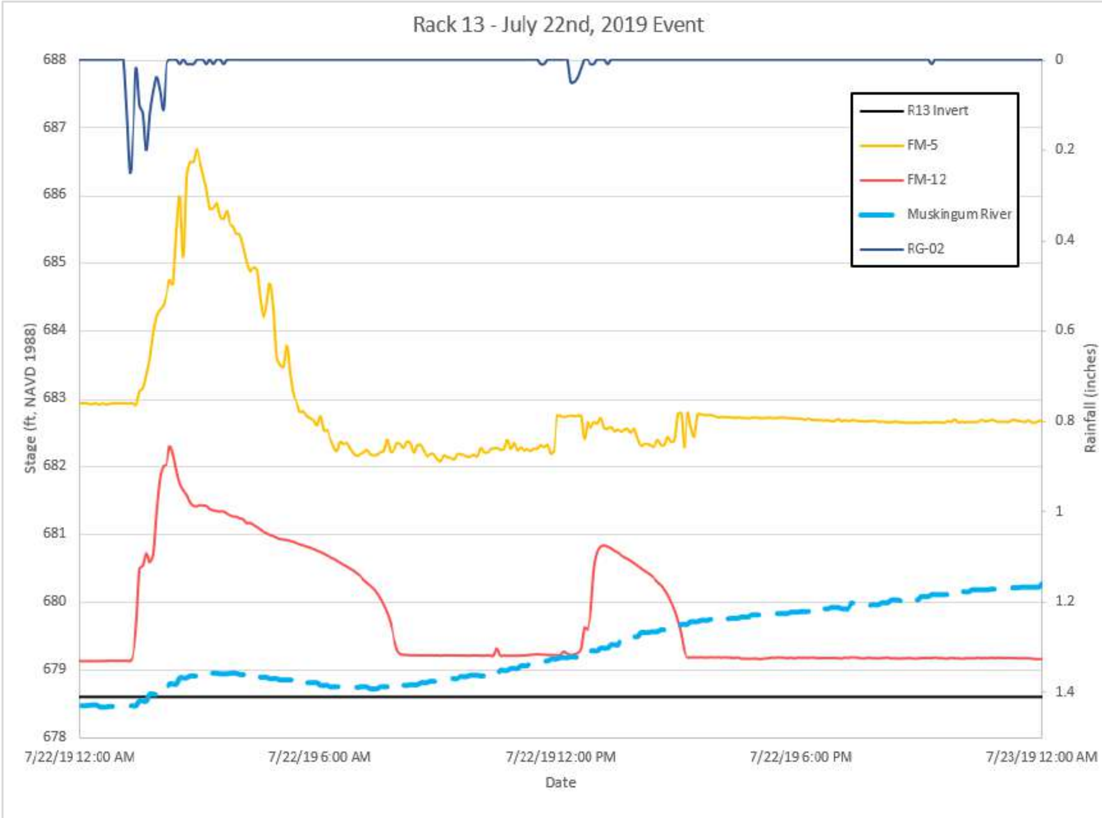
R12 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



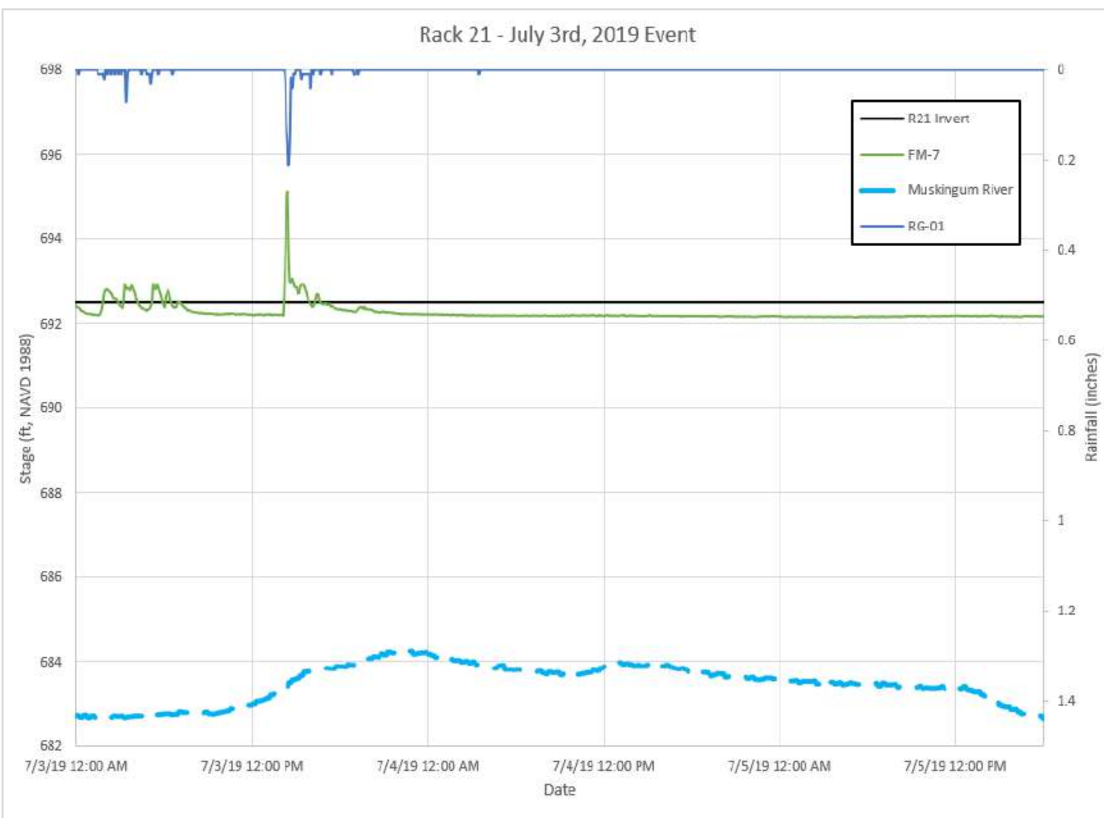
R13 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



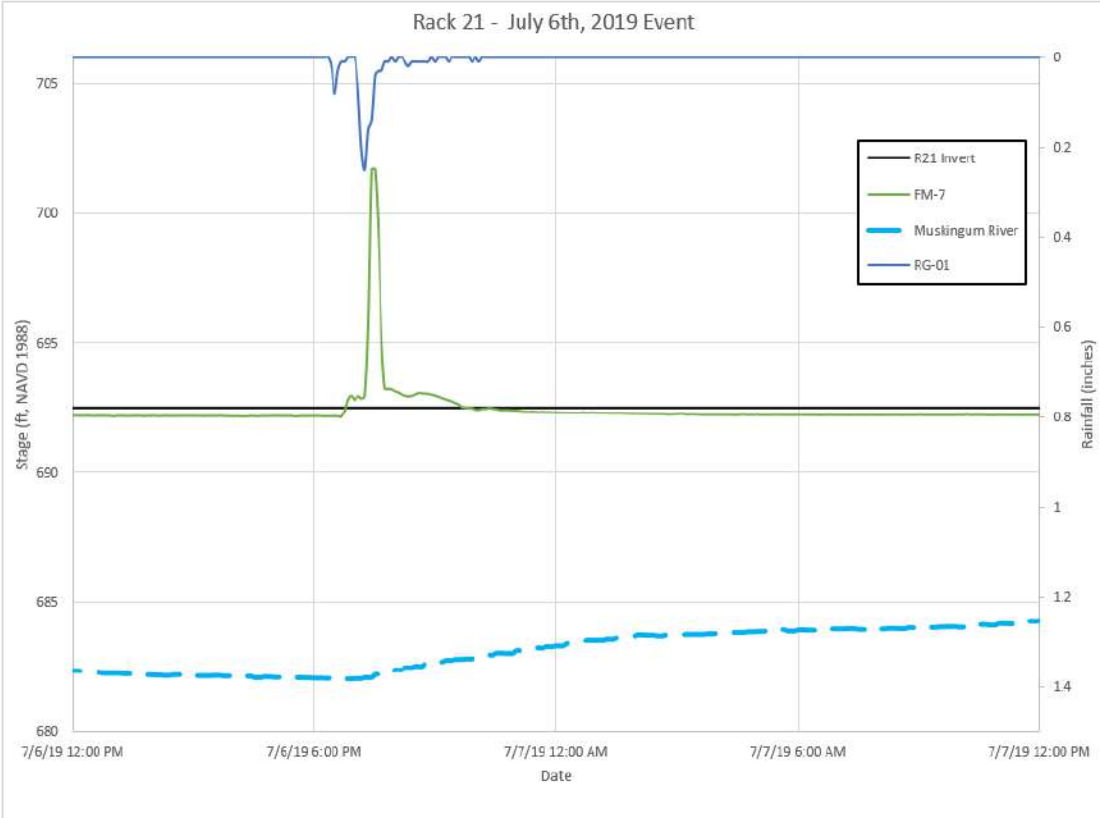
R13 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



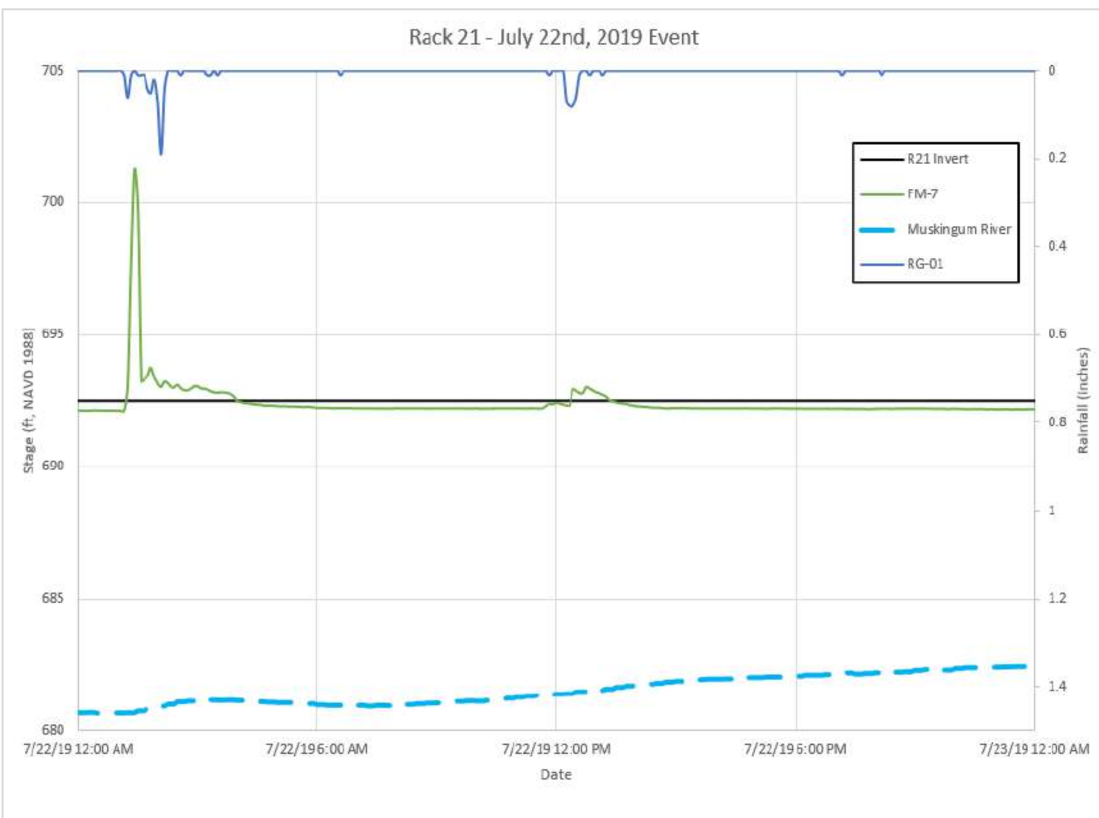
R13 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



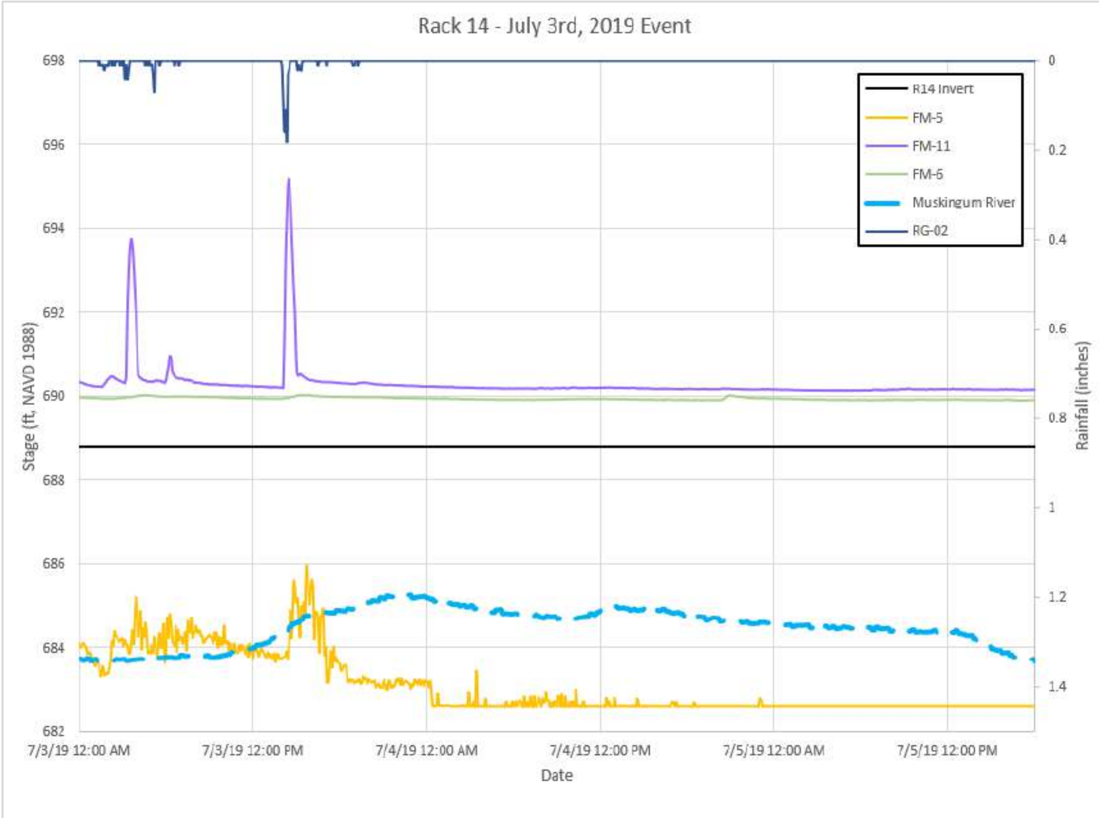
R21 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



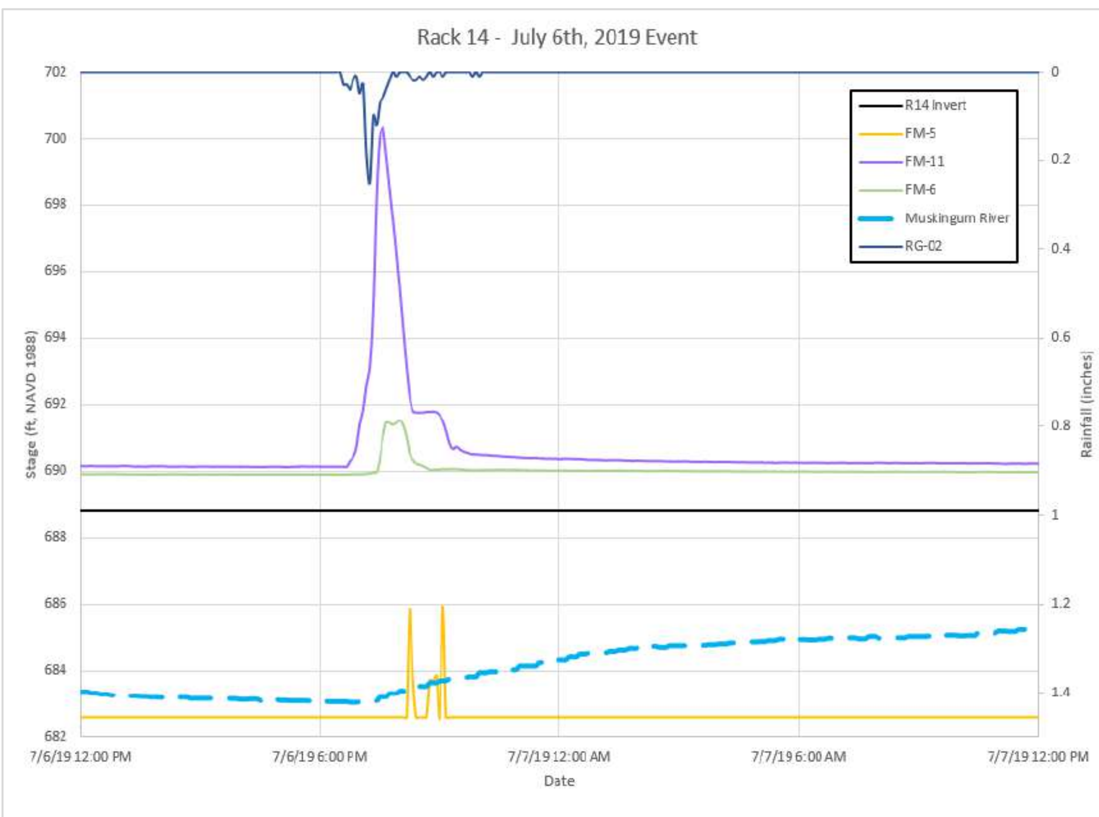
R21 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



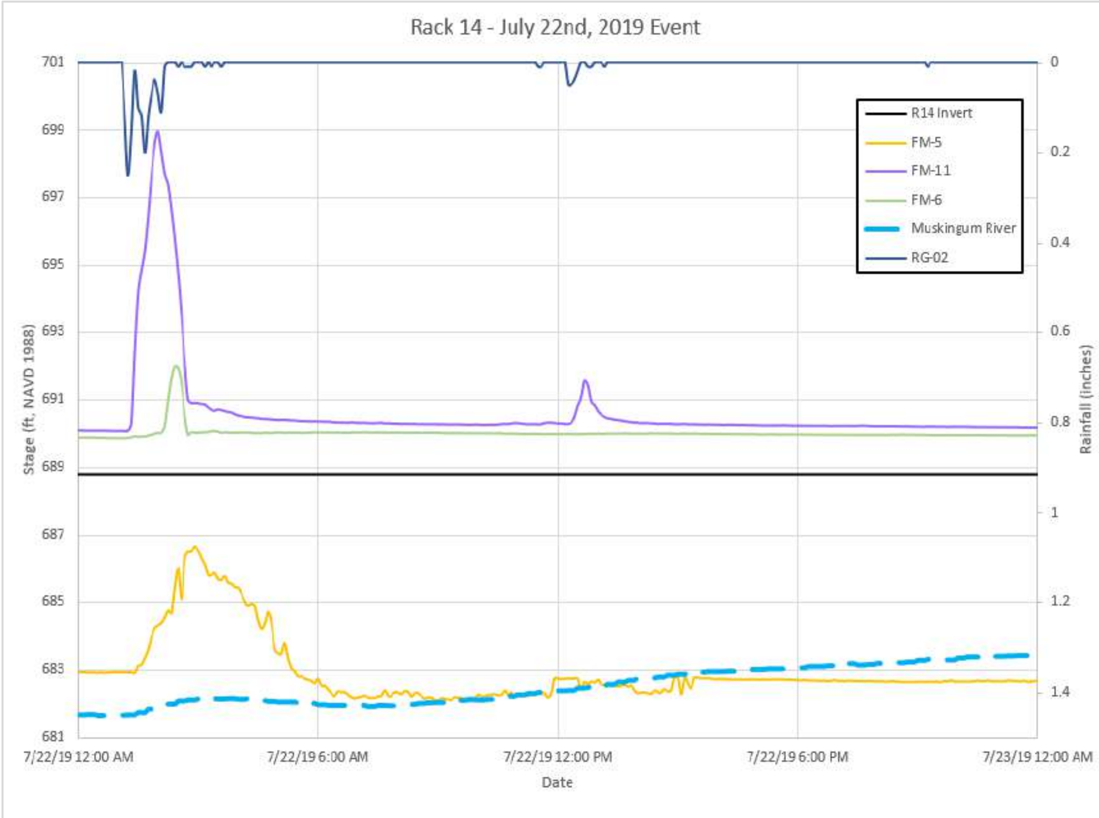
R21 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



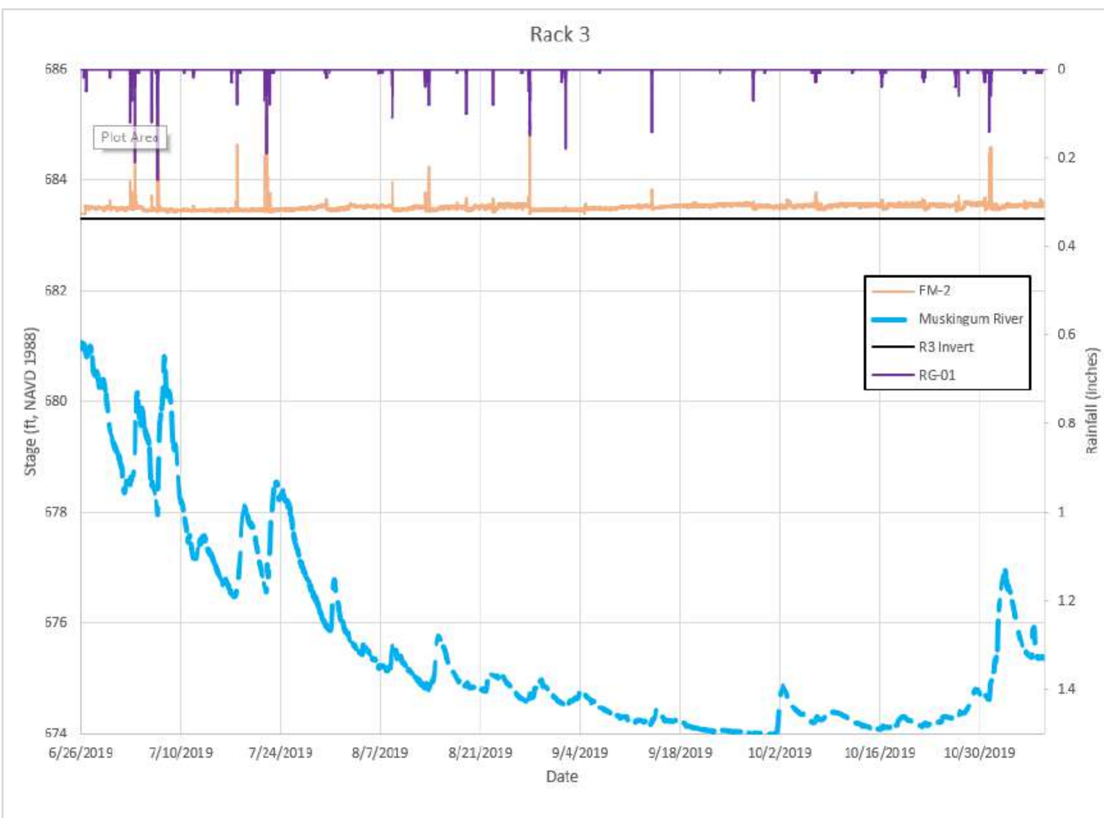
R14 Flow Monitoring Hydrograph for July 3, 2019 Rain Event



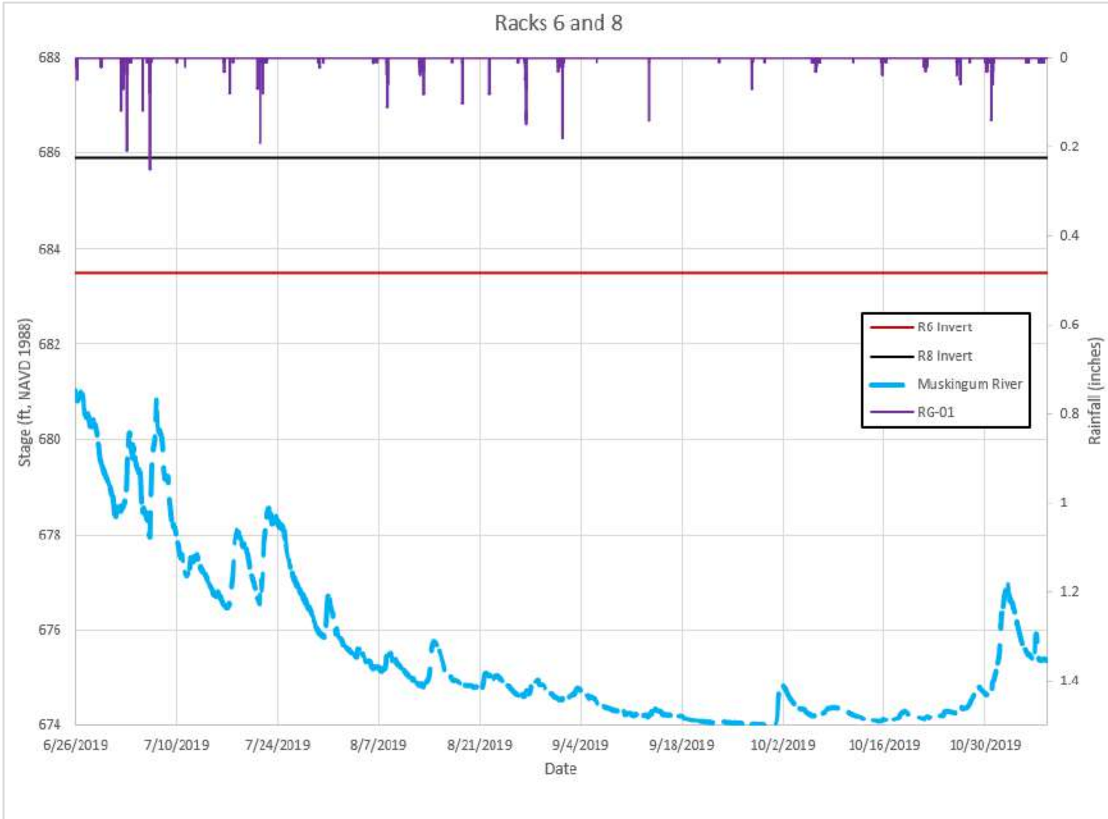
R14 Flow Monitoring Hydrograph for July 6, 2019 Rain Event



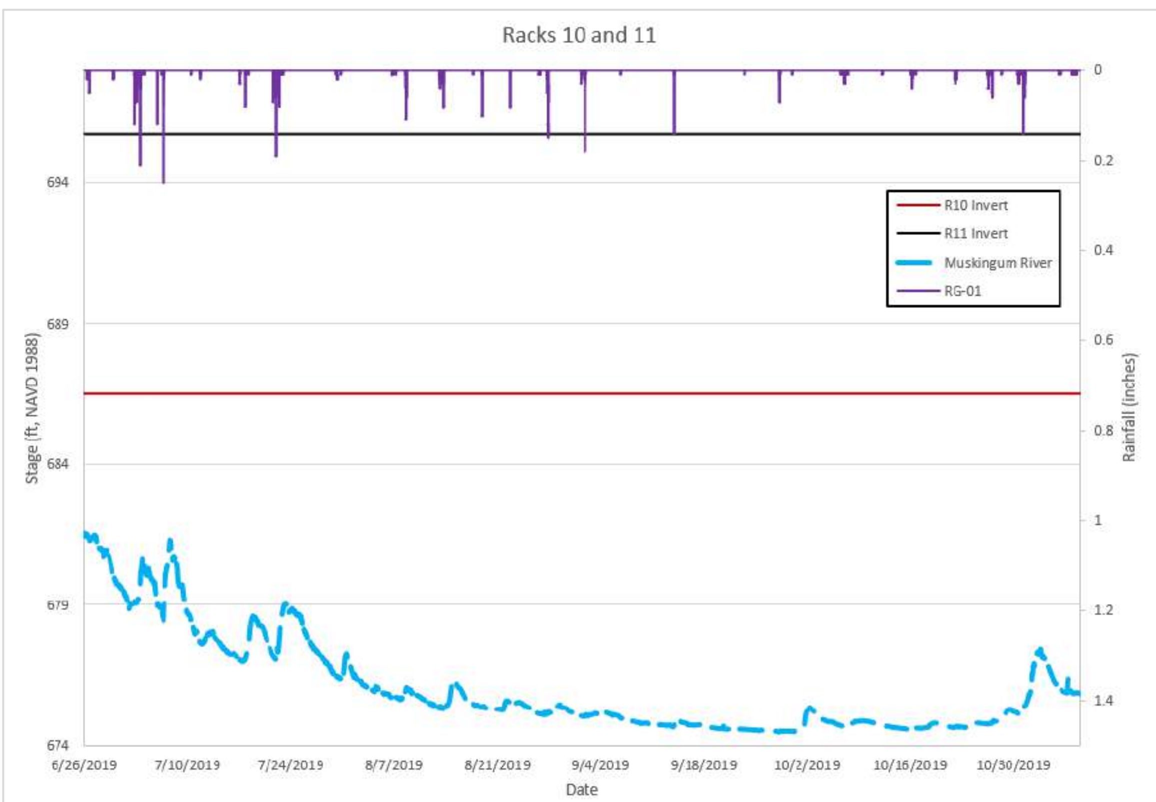
R14 Flow Monitoring Hydrograph for July 22, 2019 Rain Event



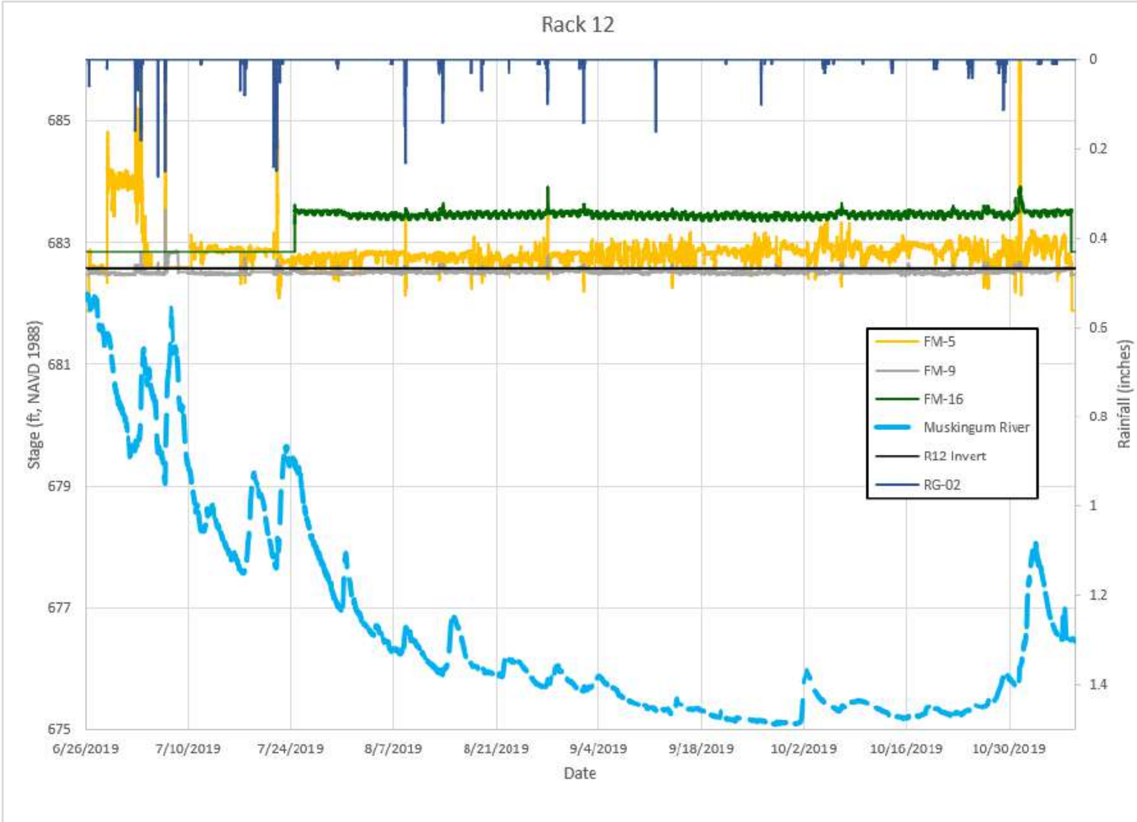
Rack 3 Hydrograph for Flow Monitoring Study Period



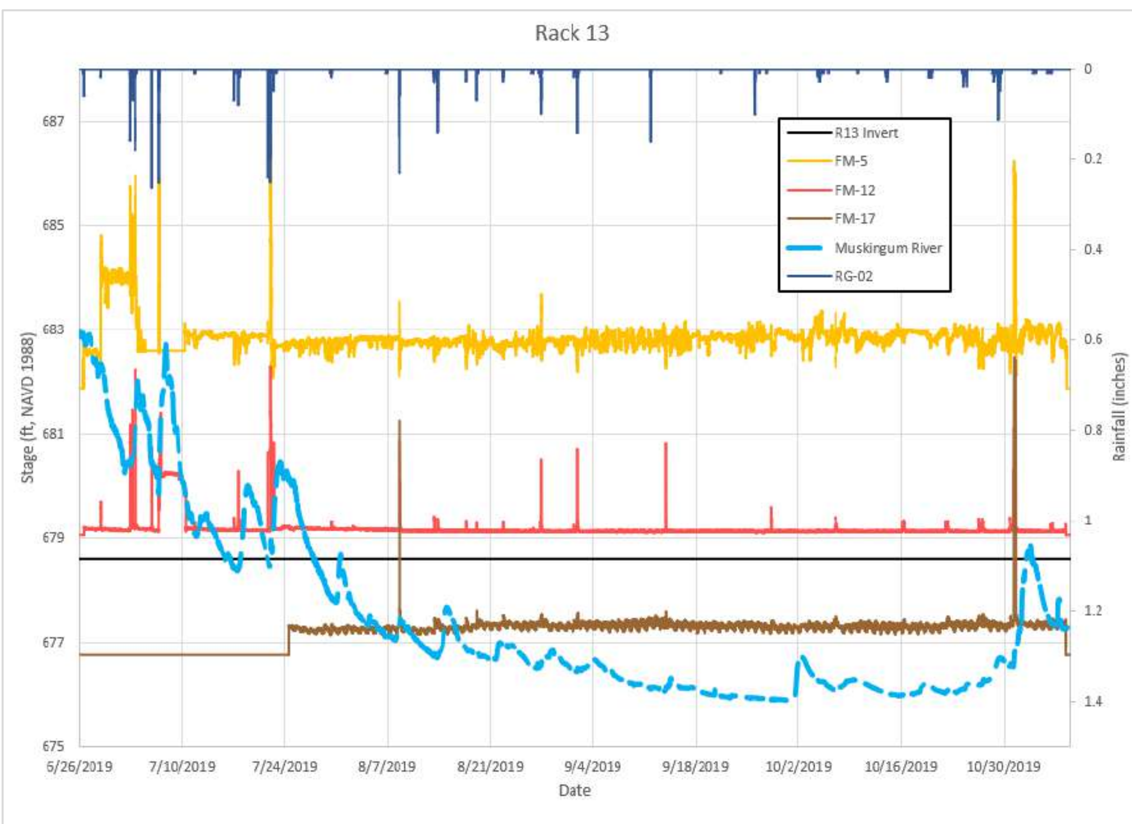
Racks 6 and 8 Hydrograph for Flow Monitoring Study Period



Racks 10 and 11 Hydrograph for Flow Monitoring Study Period

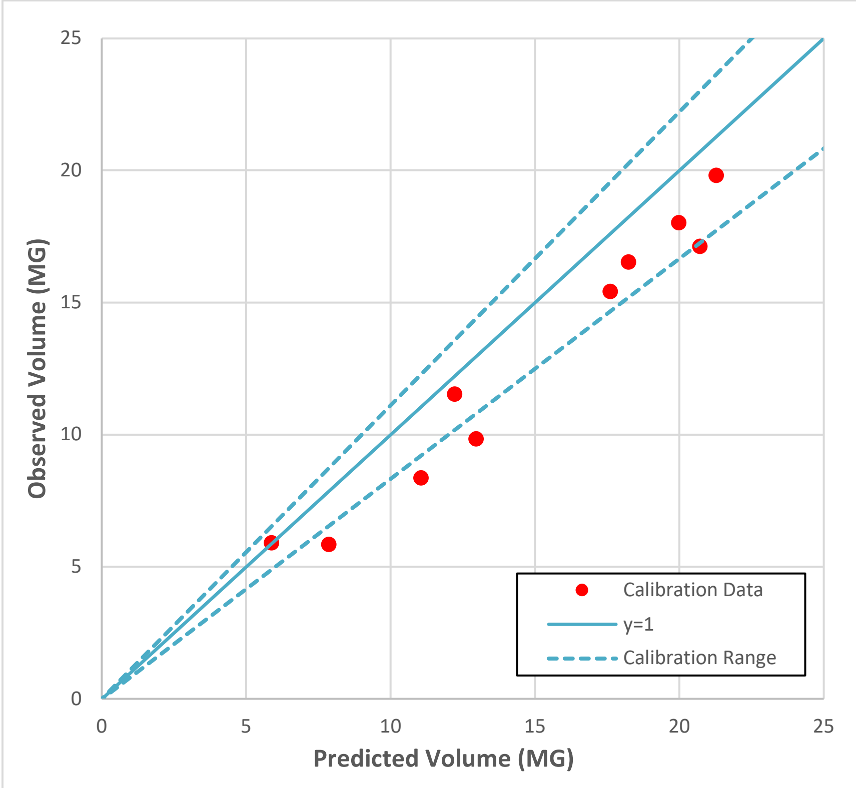


Rack 12 Hydrograph for Flow Monitoring Study Period

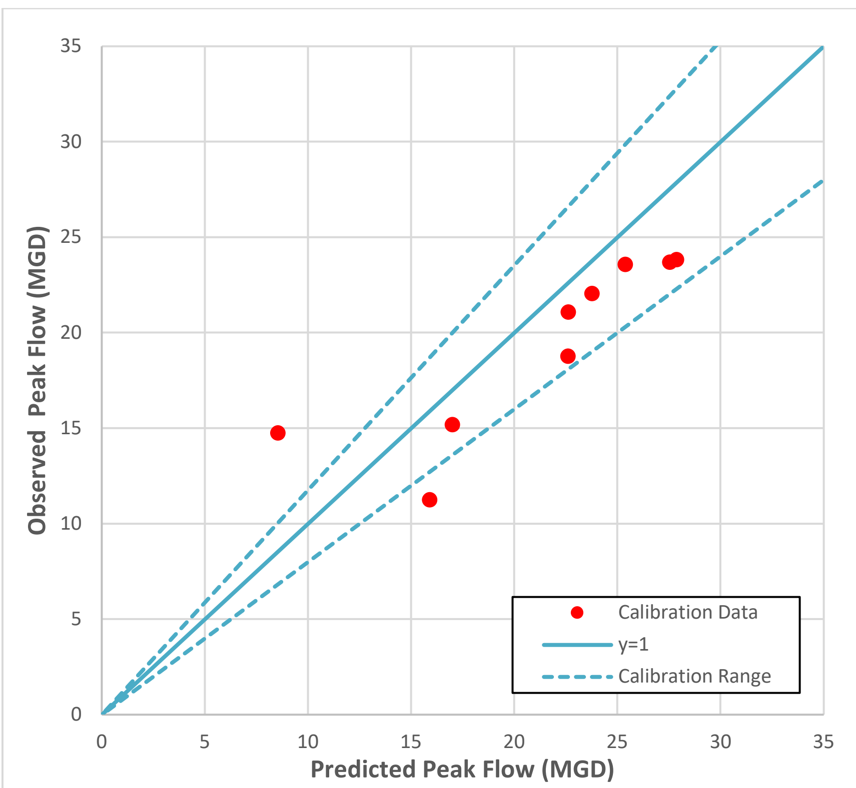


Rack 13 Hydrograph for Flow Monitoring Study Period

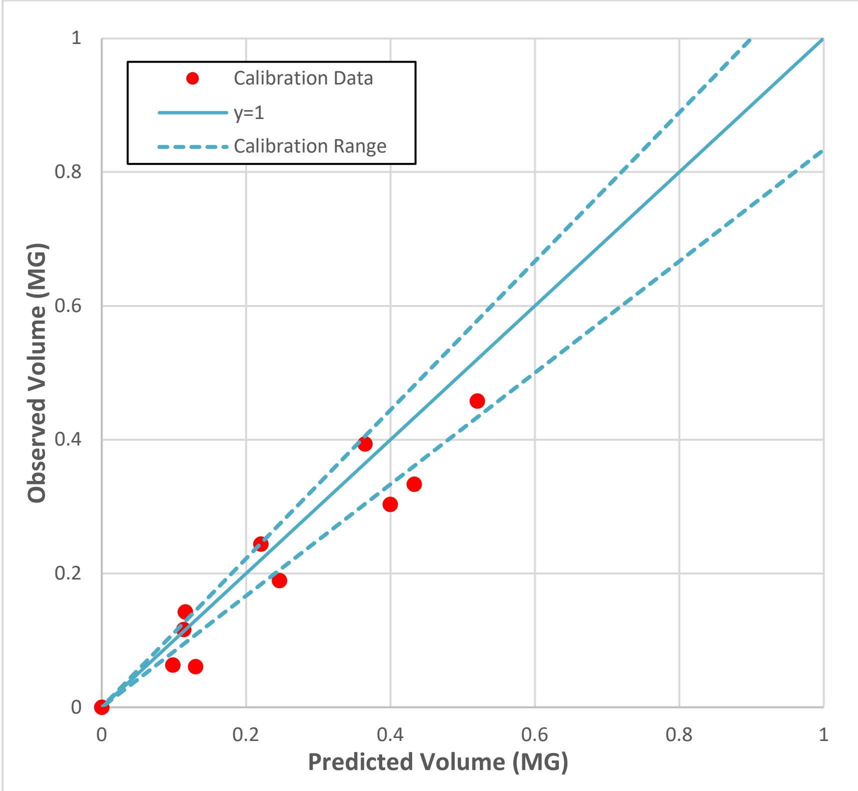
Appendix E Hydraulic Model Calibration Hydrographs



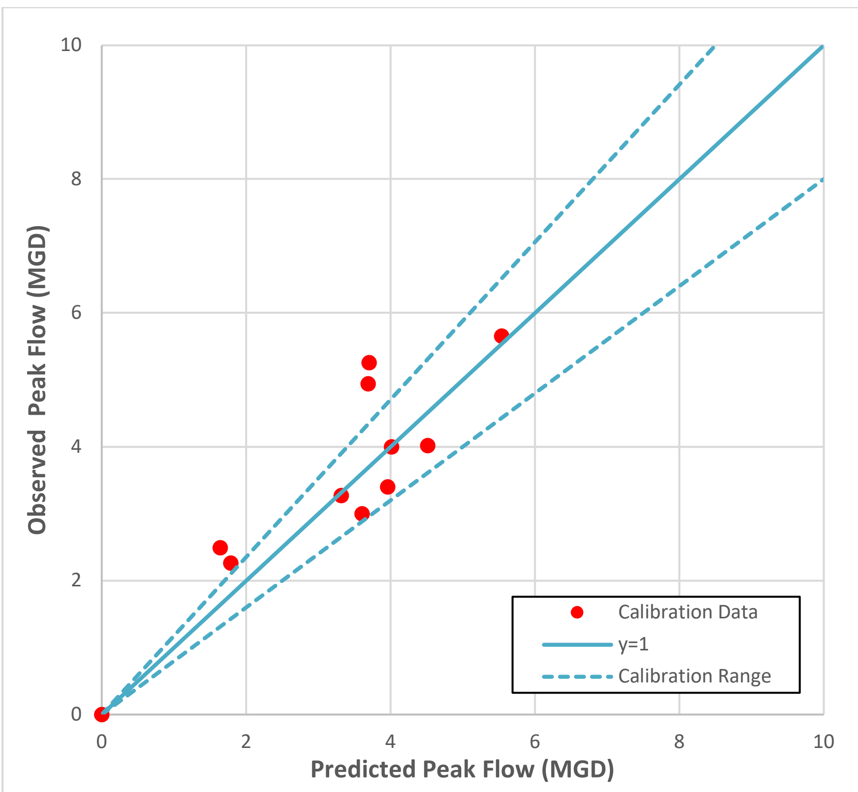
FM-1 Observed Vs. Predicted Volume– Wet Weather Calibration



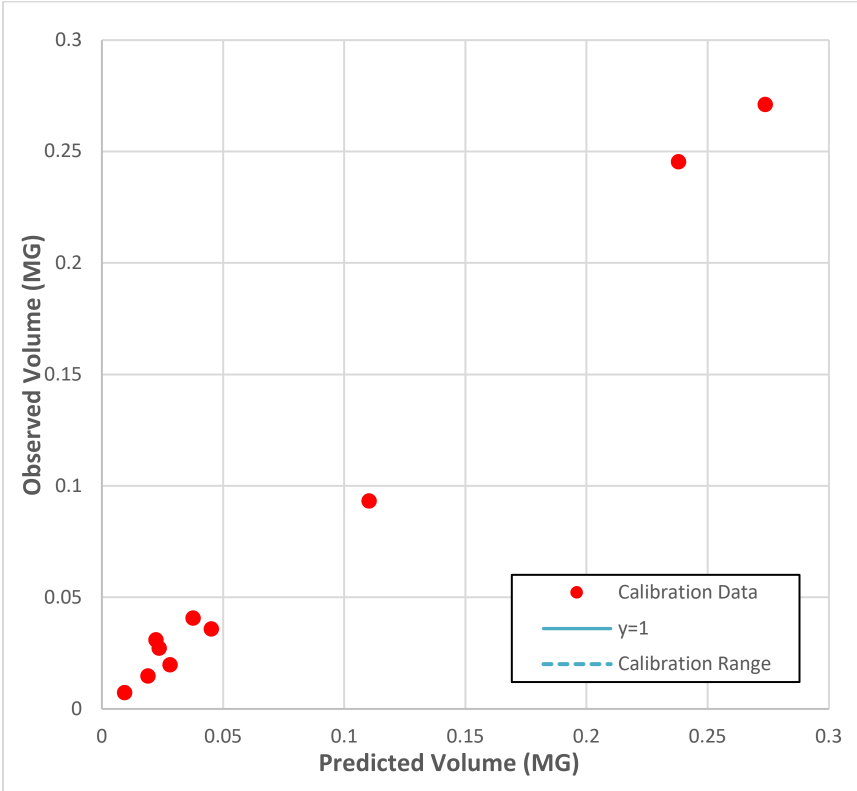
FM-1 Observed Vs. Predicted Peak Flow - Wet Weather Calibration



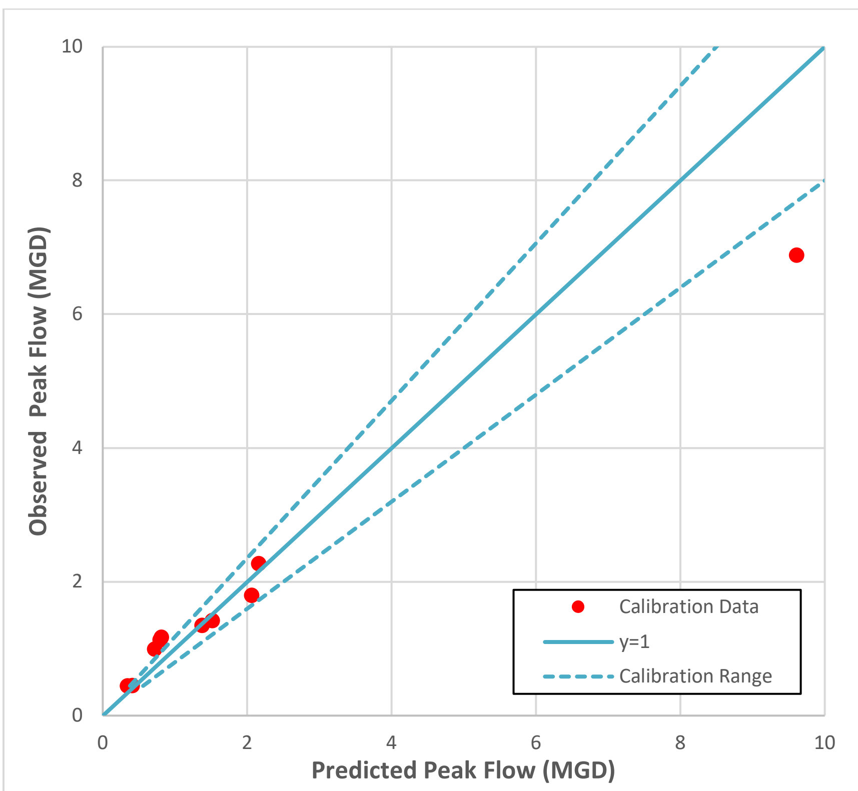
FM-2 Observed Vs. Predicted Volume – Wet Weather Calibration



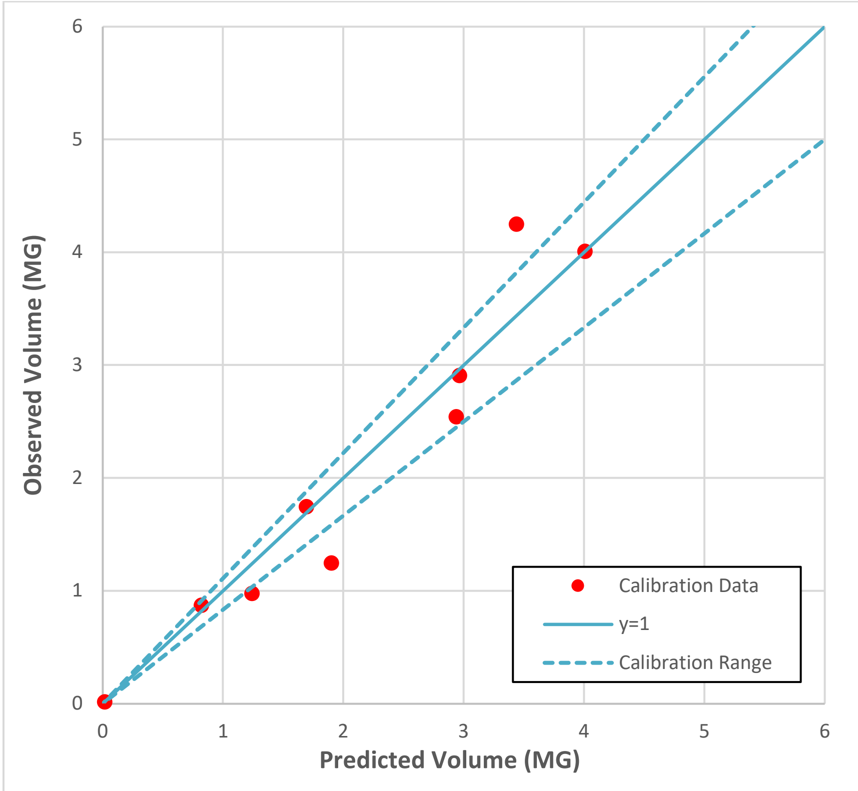
FM-2 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



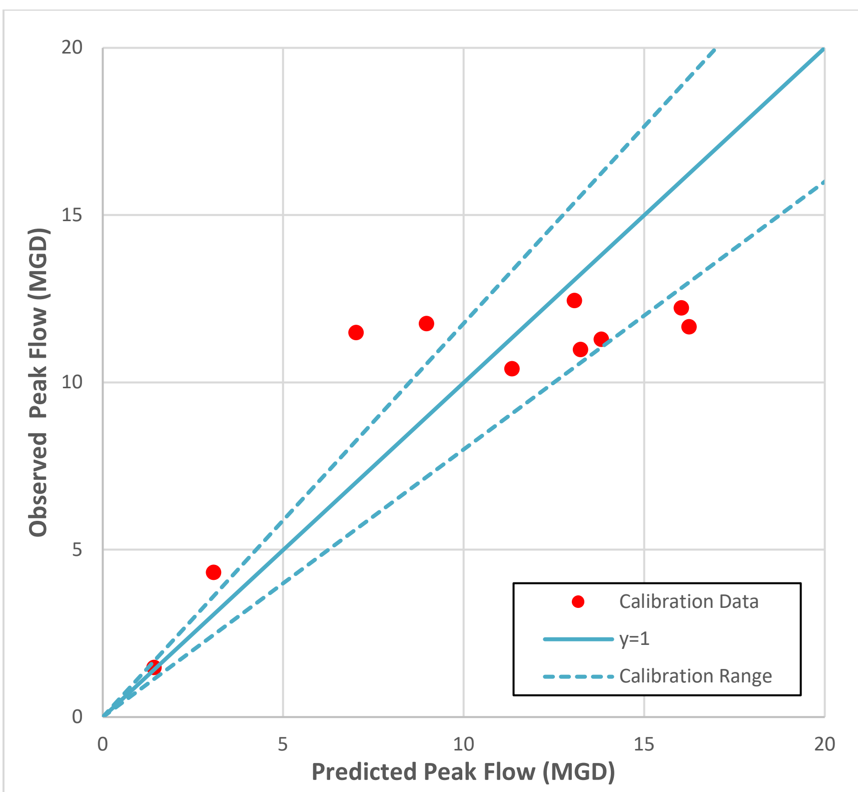
FM-3 Observed Vs. Predicted Volume – Wet Weather Calibration



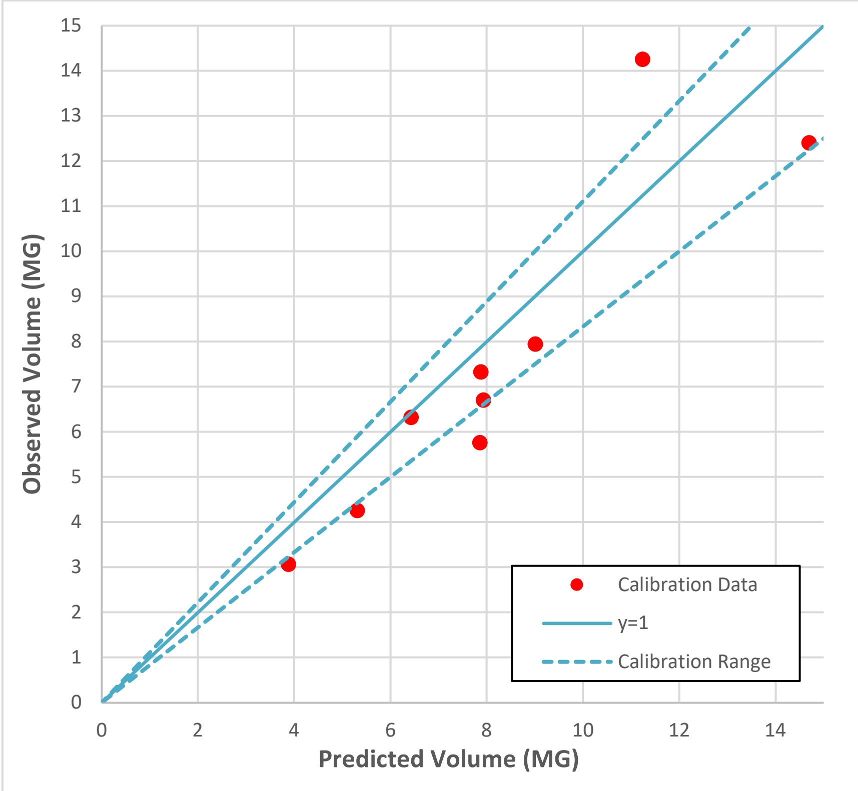
FM-3 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



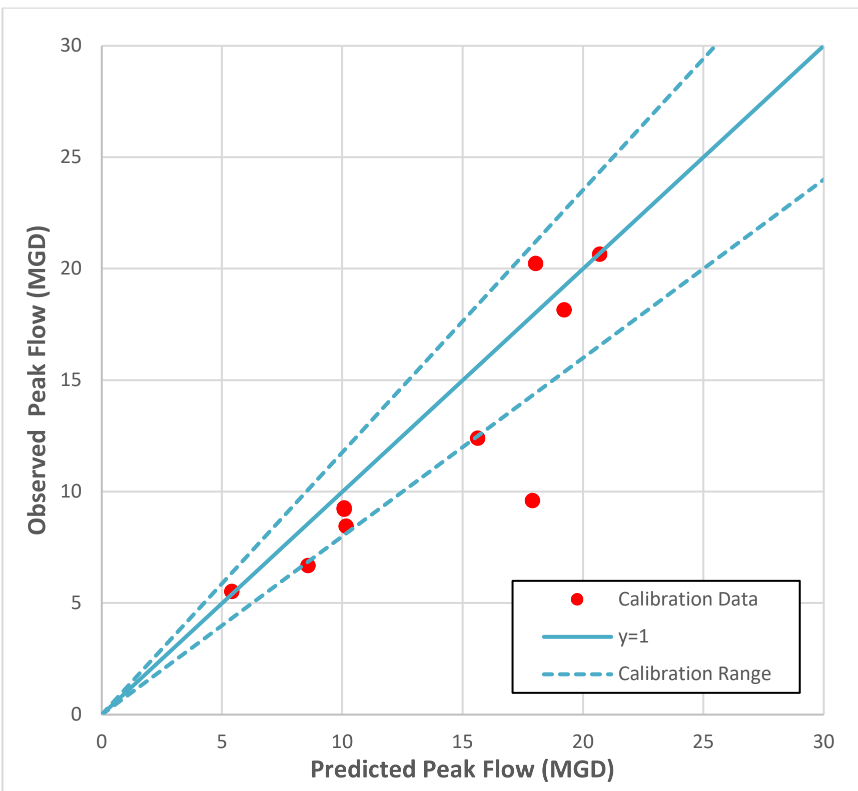
FM-4 Observed Vs. Predicted Volume – Wet Weather Calibration



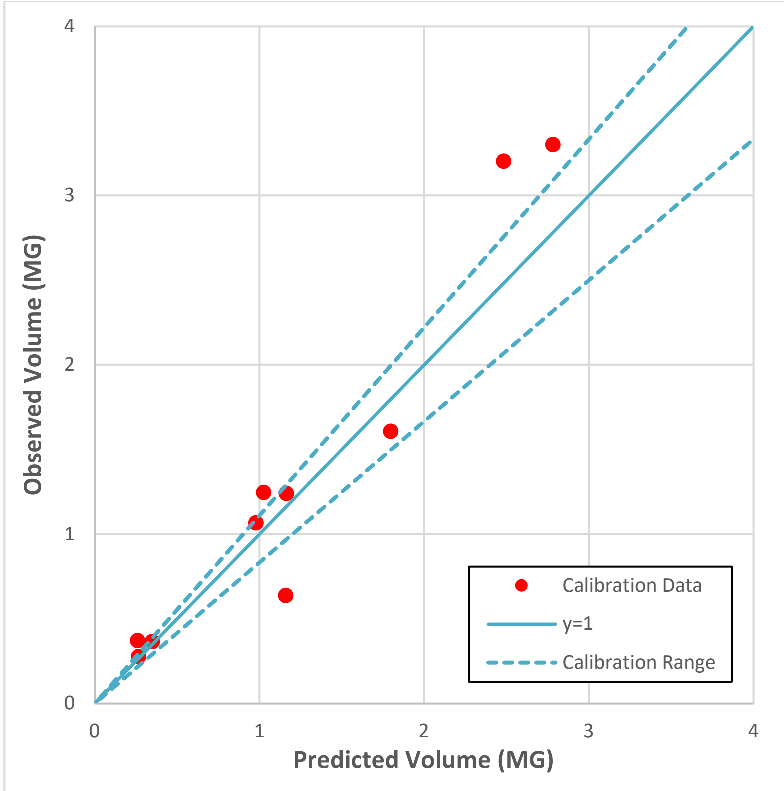
FM-4 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



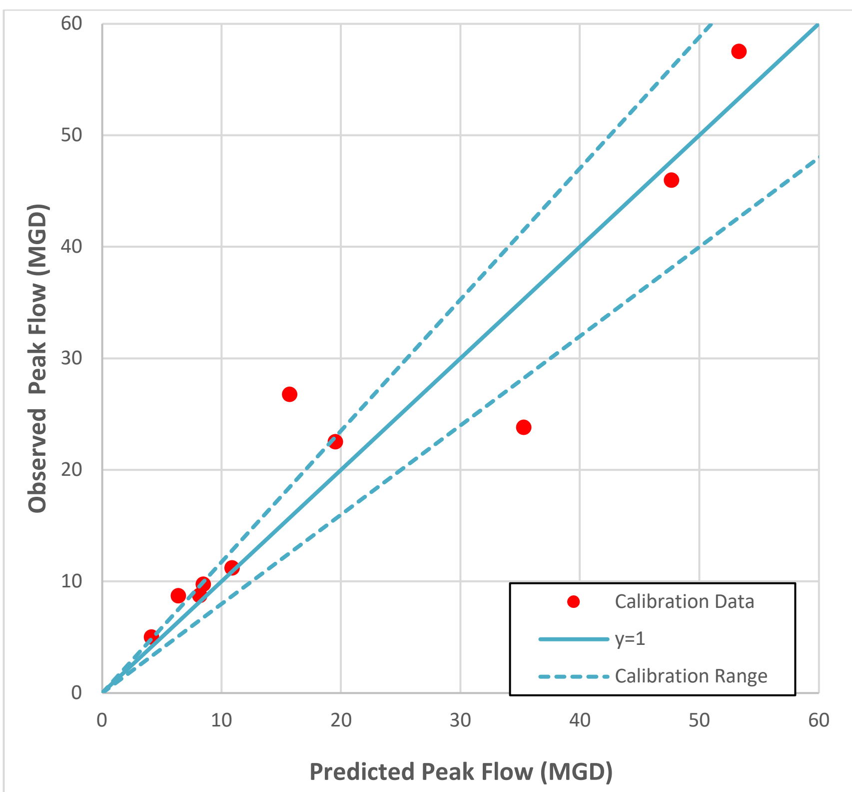
FM-5 Observed Vs. Predicted Volume – Wet Weather Calibration



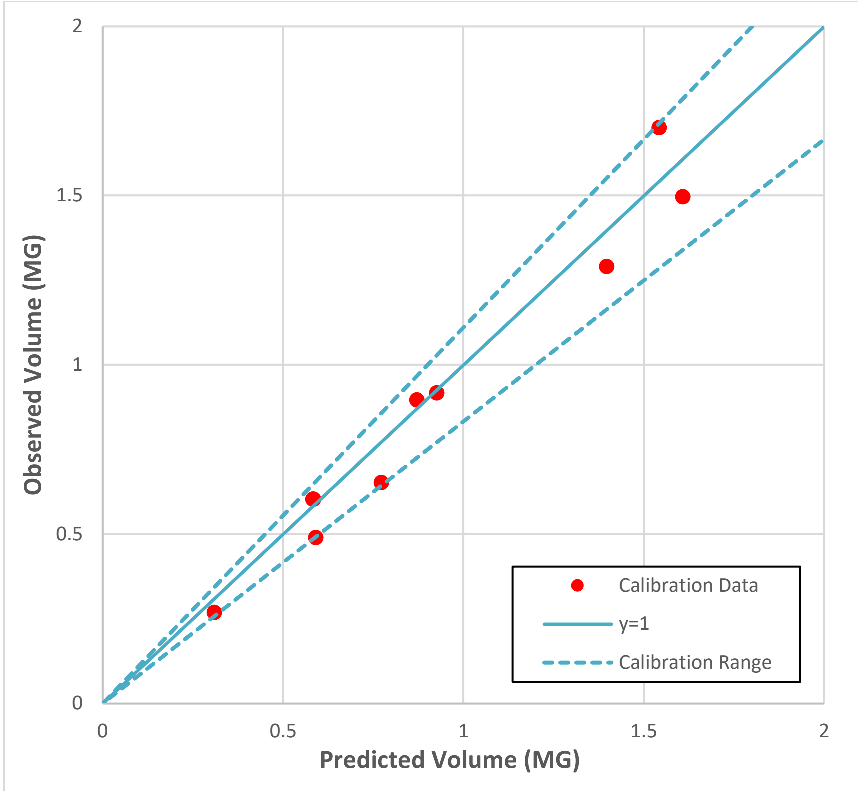
FM-5 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



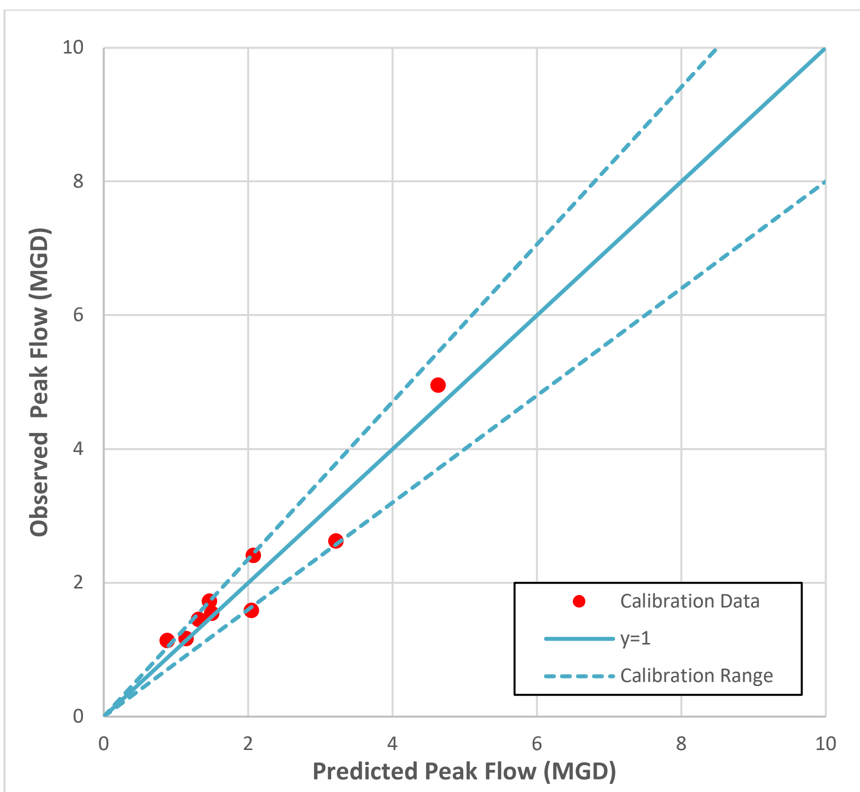
FM-7 Observed Vs. Predicted Volume – Wet Weather Calibration



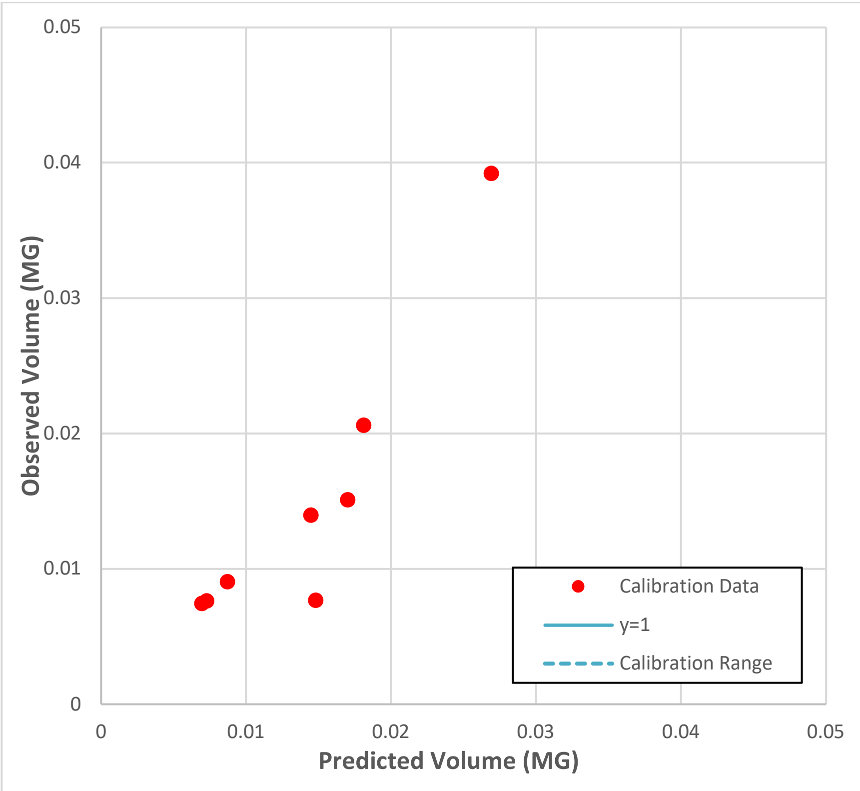
FM-7 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



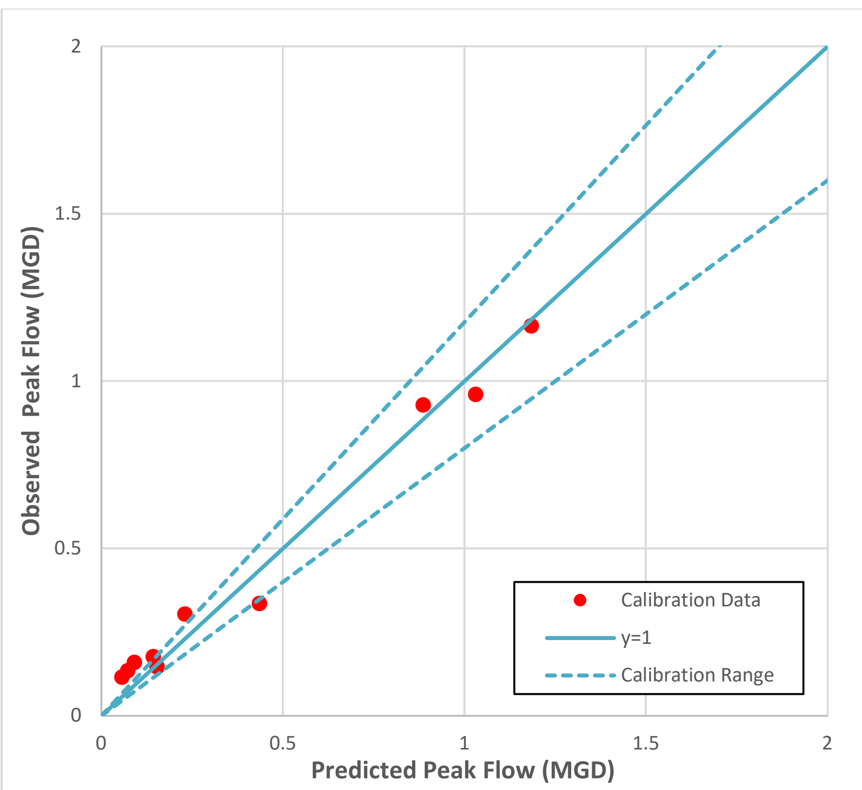
FM-8A Observed Vs. Predicted Volume – Wet Weather Calibration



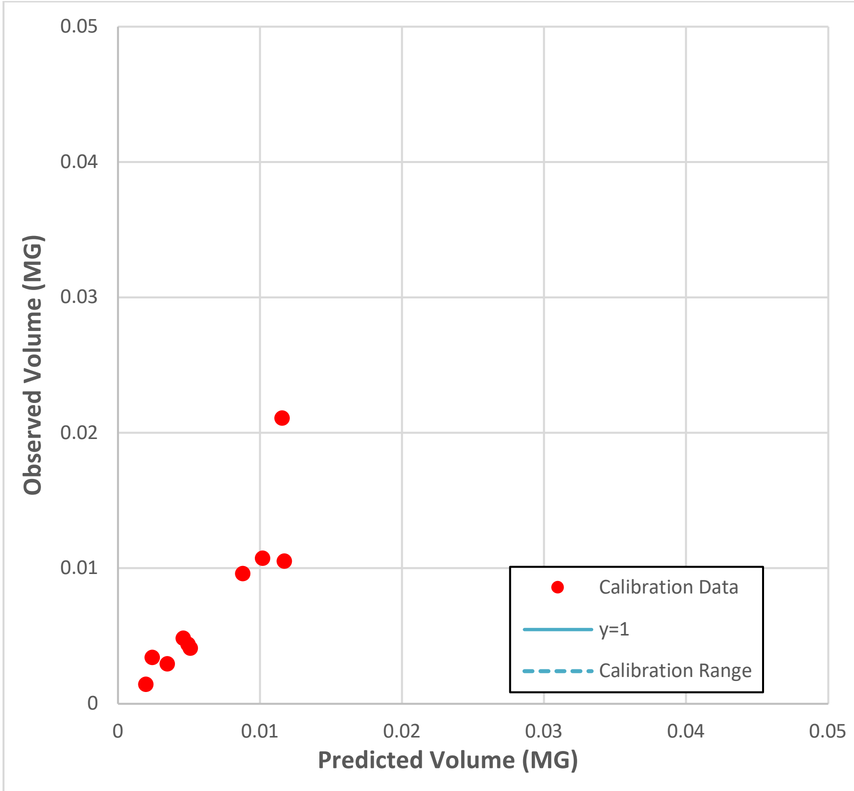
FM-8A Observed Vs. Predicted Peak Flow – Wet Weather Calibration



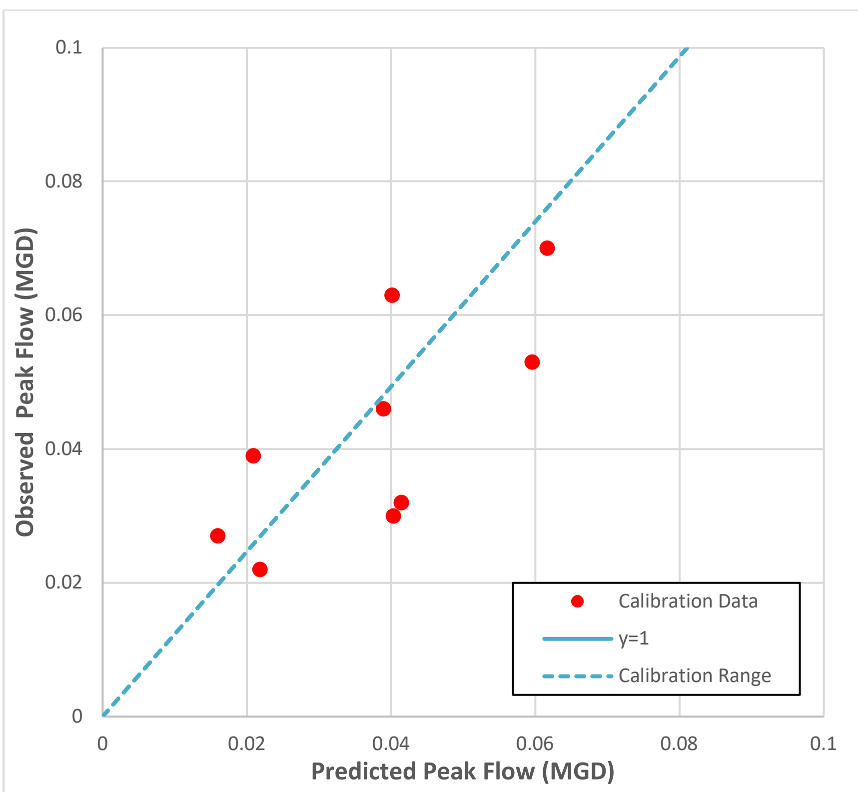
FM-9 Observed Vs. Predicted Volume – Wet Weather Calibration



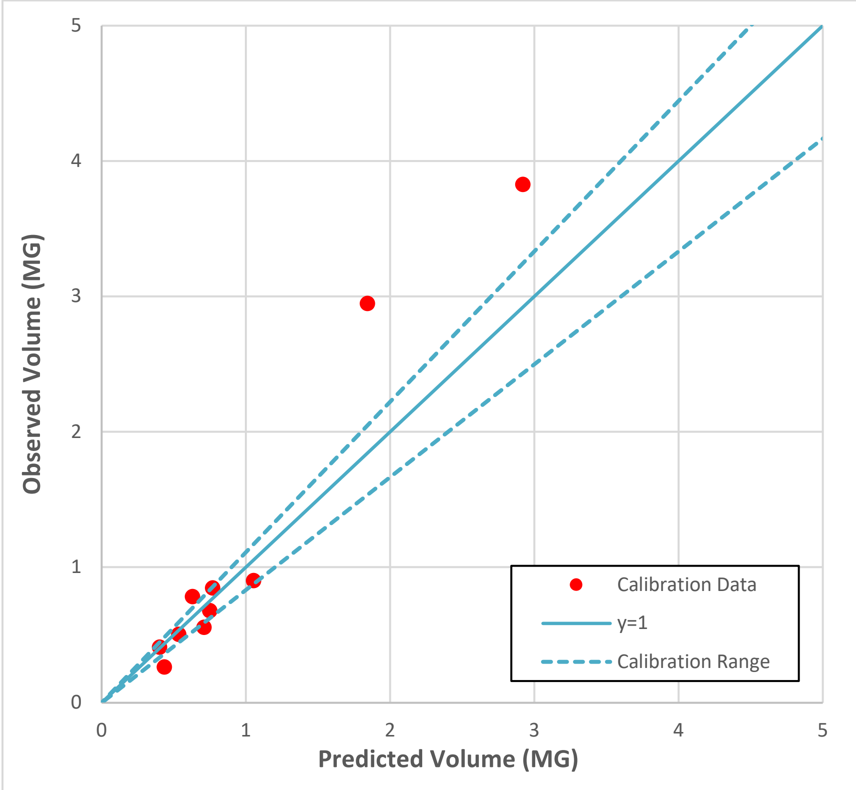
FM-9 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



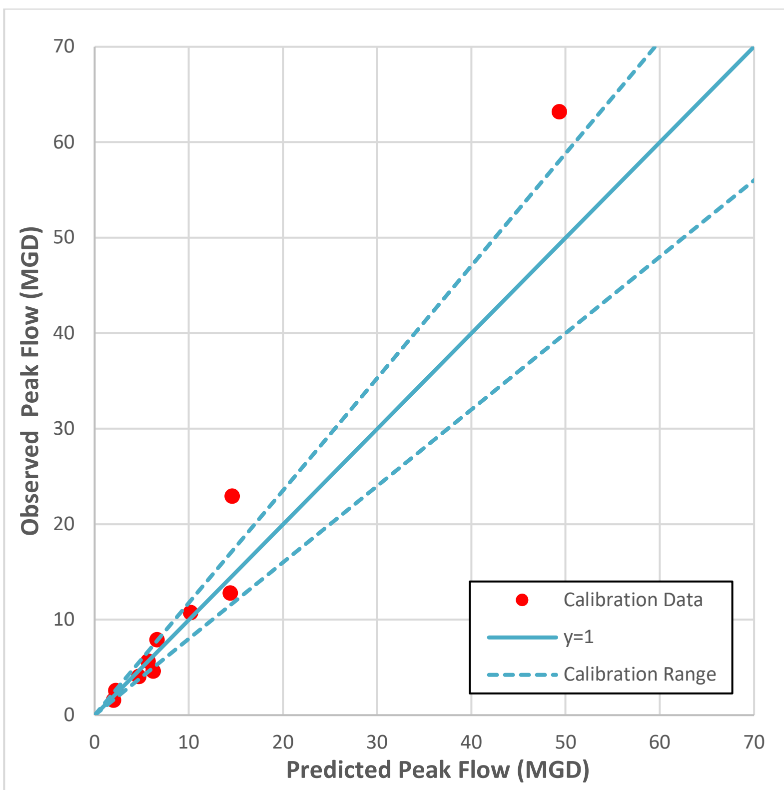
FM-10 Observed Vs. Predicted Volume – Wet Weather Calibration



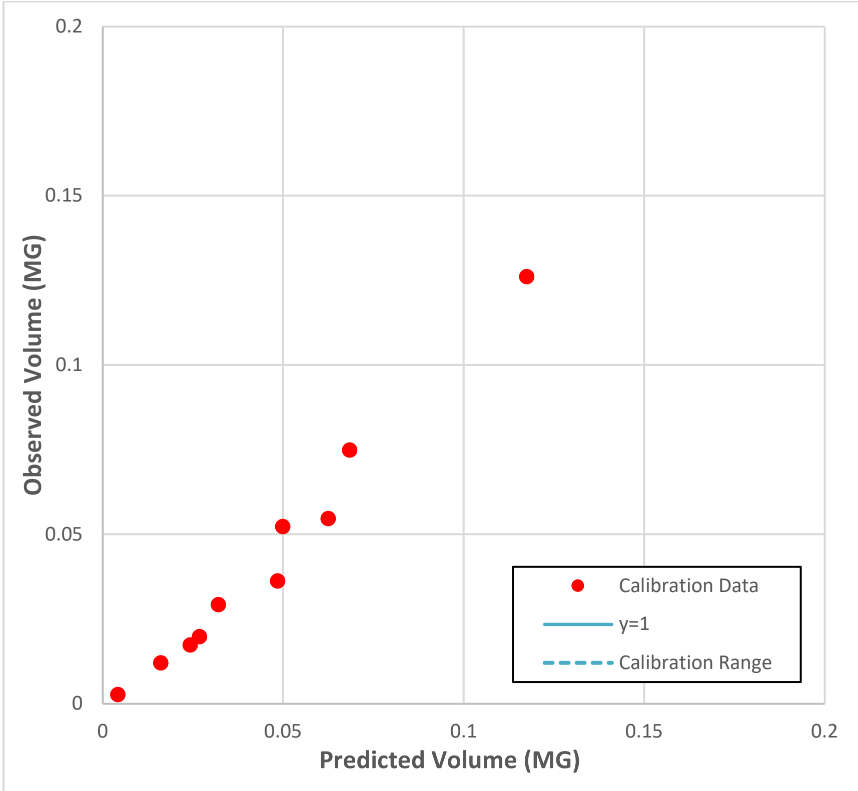
FM-10 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



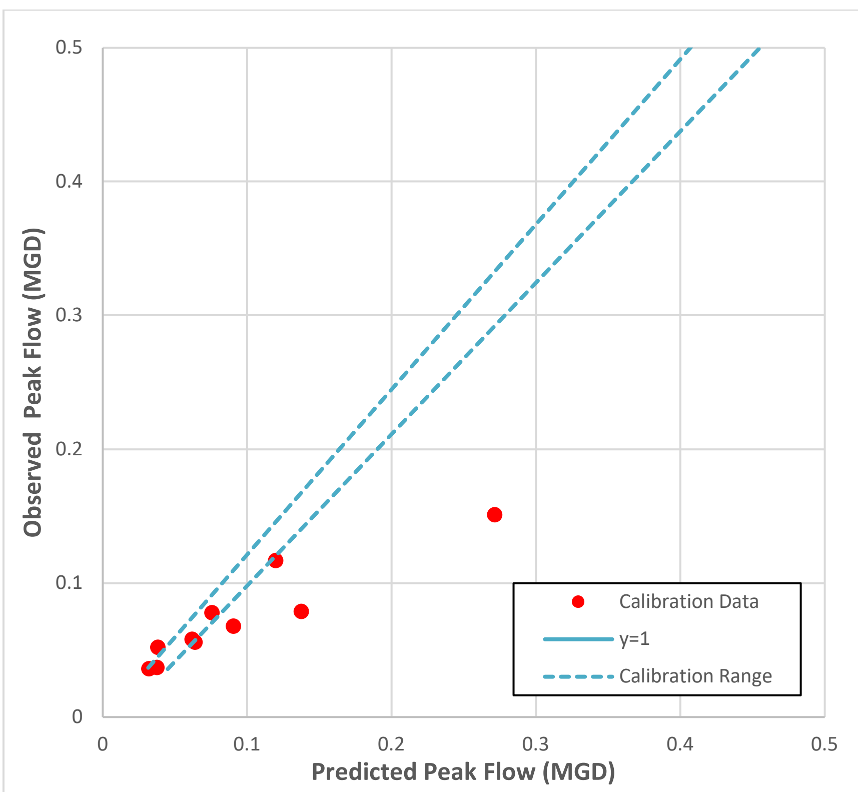
FM-11 Observed Vs. Predicted Volume – Wet Weather Calibration



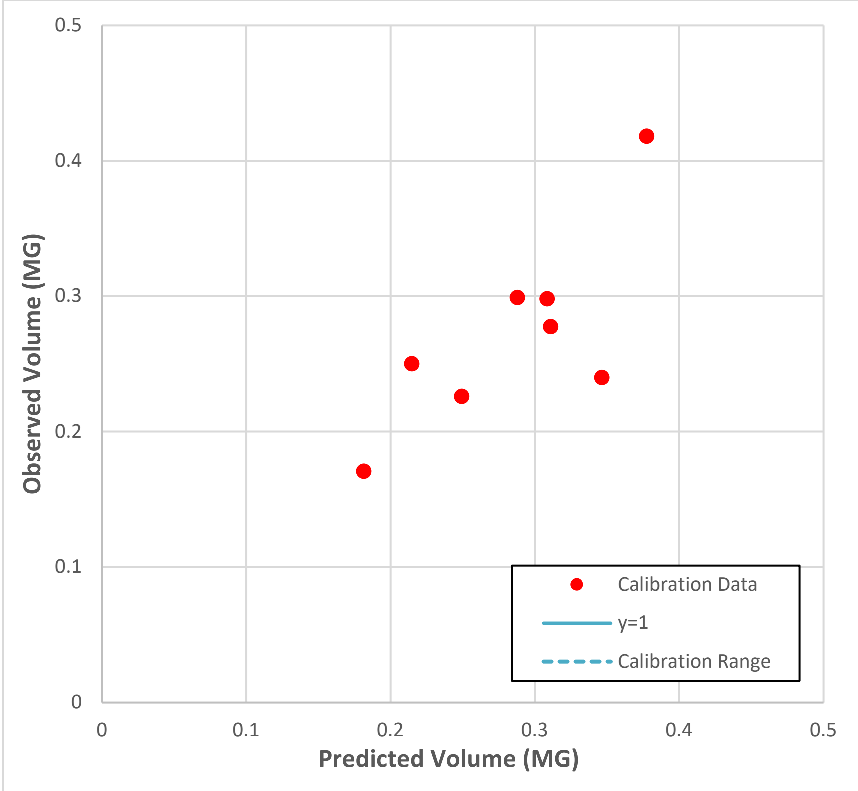
FM-11 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



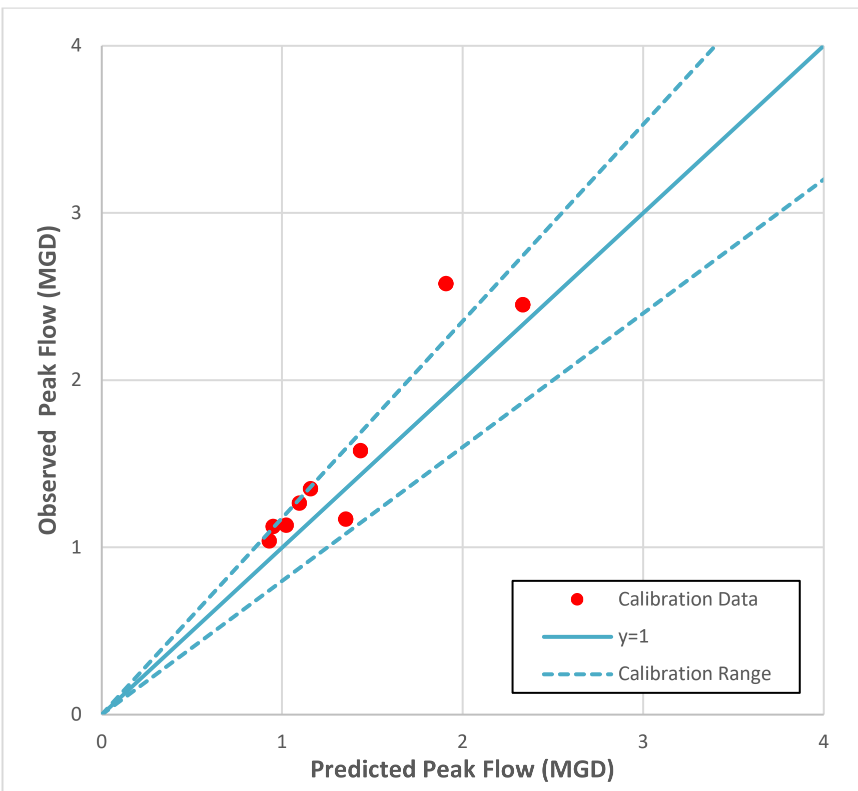
FM-13 Observed Vs. Predicted Volume – Wet Weather Calibration



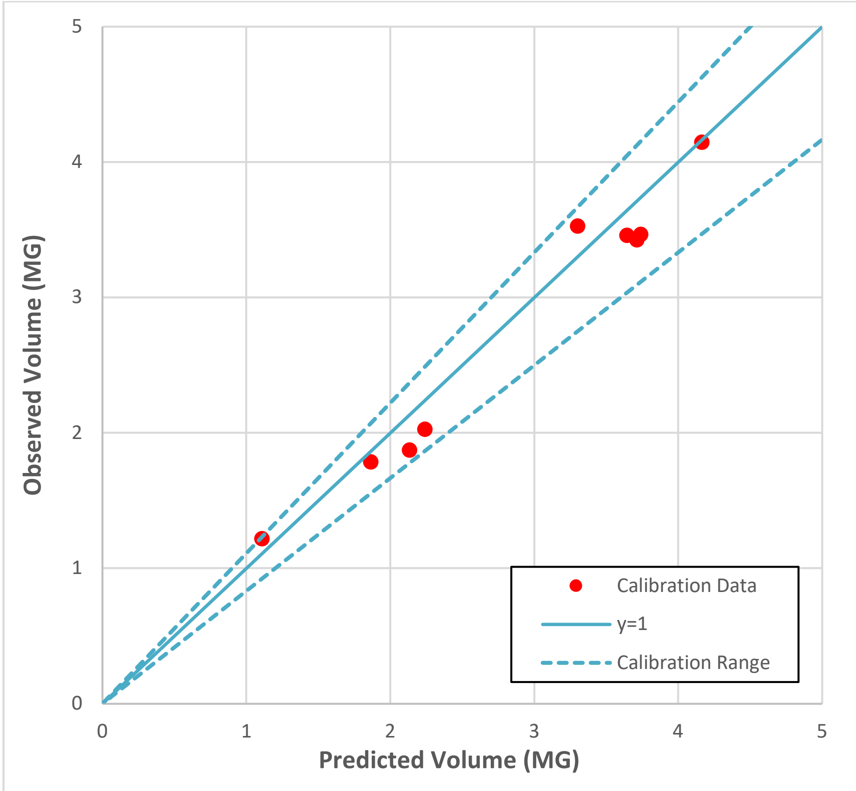
FM-13 Observed Vs. Predicted Volume – Wet Weather Calibration



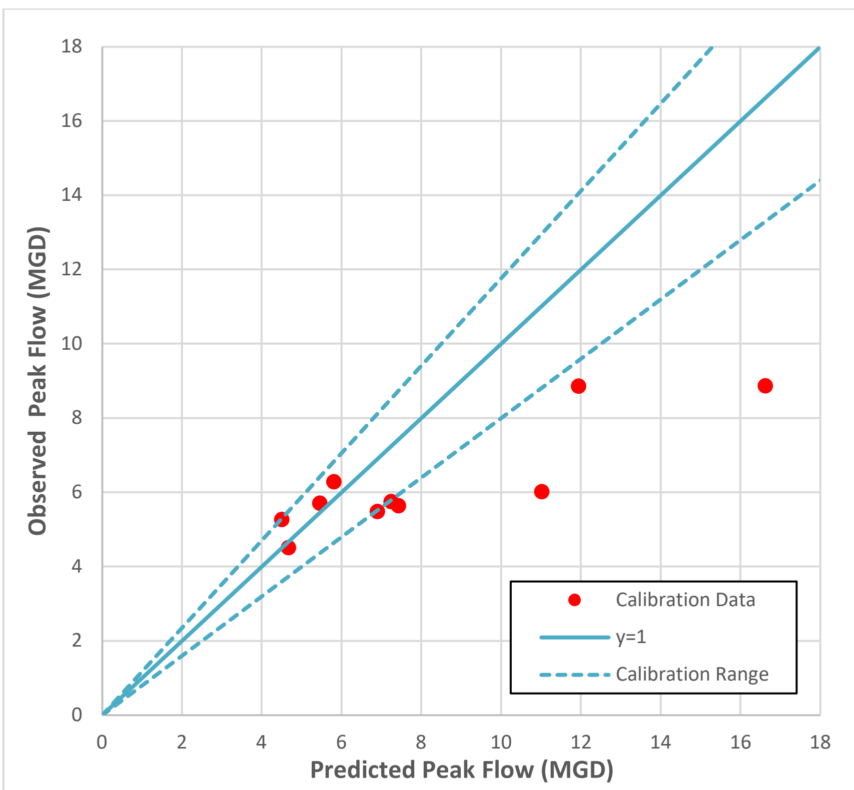
FM-16 Observed Vs. Predicted Volume – Wet Weather Calibration



FM-16 Observed Vs. Predicted Peak Flow – Wet Weather Calibration



FM-17 Observed Vs. Predicted Volume – Wet Weather Calibration



FM-17 Observed Vs. Predicted Peak Flow – Wet Weather Calibration

Appendix F Field Investigation Results

AECOM-CLEVELAND OFFICE AECOM - CLEVELAND OF
1300 E. 9TH ST 1300 E. 9th STREET
CLEVELAND, OH CLEVELAND, OH
Tel: 216-622-2300 216-622-2300
Fax: 216-622-2301 216-622-2328
E-mail: SCOTT.BELZ@AECOM.COM scott.belz@aecom.co

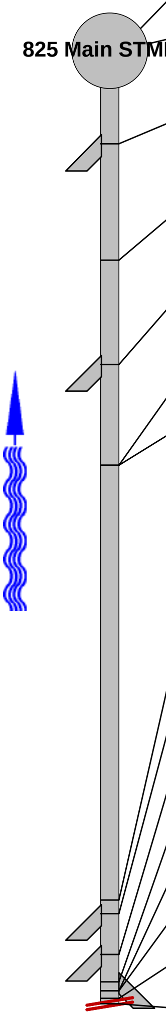
WPC Mainline Inspection

Date	Project No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
9/17/2020	**NA**	**Dry**	**Walker**	**R-30**	**1**
Certificate No.	Survey Customer	System Owner		Pre-Cleaning	
u0218070300337	**Zanesville**	**Zanesville**		**No Pre-Cleaning**	

Street	**825 Main St**	Use of Sewer	**Stormwater**	Upstream MH	**Unknown**
City	**Zanesville**			Dowstream MH	**825 Main STMMH**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code	**Easement/Right of way**	Length surveyed	**186.00 ft**	Section Length	**186.00 ft**

Purpose of Survey	**Routine Assessment**		
Weather	**Dry**	Dia./Height	**18 inch**
		Material	**Vitrified Clay Pipe**
Tape / Media No.	**1**	Lining Method	

Add. Information :



825 Main STMMH

1:450 Position		Code	Observation
0.00		AMH	Downstream Manhole, Survey Begins / STM MH Main and 9th St
0.00		MWL	Water Level, 0 %of cross sectional area
18.16		TB	Tap Break-In, at 02 o'clock, -, within 8 inches of joint: YES, 12"
40.91	S1	FL	Fracture Longitudinal, at 12 o'clock, within 8 inches of joint: YES, Start
61.26		TF	Tap Factory Made, at 03 o'clock, -, within 8 inches of joint: YES, 12"
80.89	F1	FL	Fracture Longitudinal, at 12 o'clock, within 8 inches of joint: YES, Finish
80.89	S2	CM	Crack Multiple, from 12 to 12 o'clock, within 8 inches of joint: YES, Start
165.73		B	Broken, from 05 to 07 o'clock, within 8 inches of joint: YES
168.40		TF	Tap Factory Made, at 03 o'clock, -, within 8 inches of joint: YES, 15"
176.40		TF	Tap Factory Made, at 02 o'clock, -, within 8 inches of joint: YES, 8"
181.72		TB	Tap Break-In, at 10 o'clock, -, within 8 inches of joint: NO, 6" / 925 E Main St
183.54	F2	CM	Crack Multiple, from 12 to 12 o'clock, within 8 inches of joint: YES, Finish
183.54		DSGV	Deposits Settled Gravel, 20 %of cross sectional area, from 04 to 08 o'clock, , within 8 inches of joint: YES
185.00		MYV	Dye Test Visible / Positive Dye from 925 E Main St .
186.00		MSA	Survey Abandoned / Could not advance

0 FT

0 FT

18.16 FT

40.91 FT

61.26 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
513E	**5131**	**92**	**8**	**100**	**3.07**	**4**	**3.13**

AECOM-CLEVELAND OFFICE AECOM - CLEVELAND OF
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CLEVELAND, OH CLEVELAND, OH
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Fax: 216-622-2301 216-622-2328
E-mail: SCOTT.BELZ@AECOM.COM scott.belz@aecom.co

WPC Mainline Inspection

City :	Street :	Date :	Pipe Segment Reference :	Section No :
Zanesville	**825 Main St**	**9/17/2020**	**R-30**	**1**

Photo: Unknown_825 Main STMMH_20200917_1310_AMH_17092020131028.JPG, 00:00:00
0FT, Downstream Manhole, Survey Begins / STM MH Main and 9th St

Photo: Unknown_825 Main STMMH_20200917_1310_MWL_17092020131049.JPG, 00:00:16
0FT, Water Level, 0 %of cross sectional area

Photo: Unknown_825 Main STMMH_20200917_1312_TB_17092020131216.JPG, 00:00:53
18.16FT, Tap Break-In, at 02 o'clock, -, within 8 inches of joint: YES, 12"

Photo: Unknown_825 Main STMMH_20200917_1314_FL_17092020131418.JPG, 00:02:43
40.91FT, Fracture Longitudinal, at 12 o'clock, within 8 inches of joint: YES, Start

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CLEVELAND, OH CLEVELAND, OH
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E-mail: SCOTT.BELZ@AECOM.COM scott.belz@aecom.co

WPC Mainline Inspection

City :	Street :	Date :	Pipe Segment Reference :	Section No :
Zanesville	**825 Main St**	**9/17/2020**	**R-30**	**1**

Photo: Unknown_825 Main STMMH_20200917_1315_TF_17092020131508.JPG, 00:03:18
61.26FT, Tap Factory Made, at 03 o'clock, -, within 8 inches of joint: YES, 12"

Photo: Unknown_825 Main STMMH_20200917_1316_CM_17092020131605.JPG, 00:04:03
80.89FT, Crack Multiple, from 12 to 12 o'clock, within 8 inches of joint: YES, Start

Photo: Unknown_825 Main STMMH_20200917_1320_B_17092020132033.JPG, 00:08:12
165.73FT, Broken, from 05 to 07 o'clock, within 8 inches of joint: YES

Photo: Unknown_825 Main STMMH_20200917_1321_TF_17092020132133.JPG, 00:08:44
168.4FT, Tap Factory Made, at 03 o'clock, -, within 8 inches of joint: YES, 15"

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1300 E. 9TH ST 1300 E. 9th STREET
CLEVELAND, OH CLEVELAND, OH
Tel: 216-622-2300 216-622-2300
Fax: 216-622-2301 216-622-2328
E-mail: SCOTT.BELZ@AECOM.COM scott.belz@aecom.co

WPC Mainline Inspection

City :	Street :	Date :	Pipe Segment Reference :	Section No :
Zanesville	**825 Main St**	**9/17/2020**	**R-30**	**1**

Photo: Unknown_825 Main STMMH_20200917_1323_TF_17092020132349.JPG, 00:09:46
176.4FT, Tap Factory Made, at 02 o'clock, -, within 8 inches of joint: YES, 8"

Photo: Unknown_825 Main STMMH_20200917_1326_TB_17092020132609.JPG, 00:10:33
181.72FT, Tap Break-In, at 10 o'clock, -, within 8 inches of joint: NO, 6" / 925 E Main St

Photo: Unknown_825 Main STMMH_20200917_1328_DSGV_17092020132818.JPG, 00:12:18
183.54FT, Deposits Settled Gravel, 20 %of cross sectional area, from 04 to 08 o'clock, , within 8 inches of joint: YES

Photo: Unknown_825 Main STMMH_20200917_1336_MYV_17092020133633.JPG, 00:16:19
185FT, Dye Test Visible / Positive Dye from 925 E Main St .

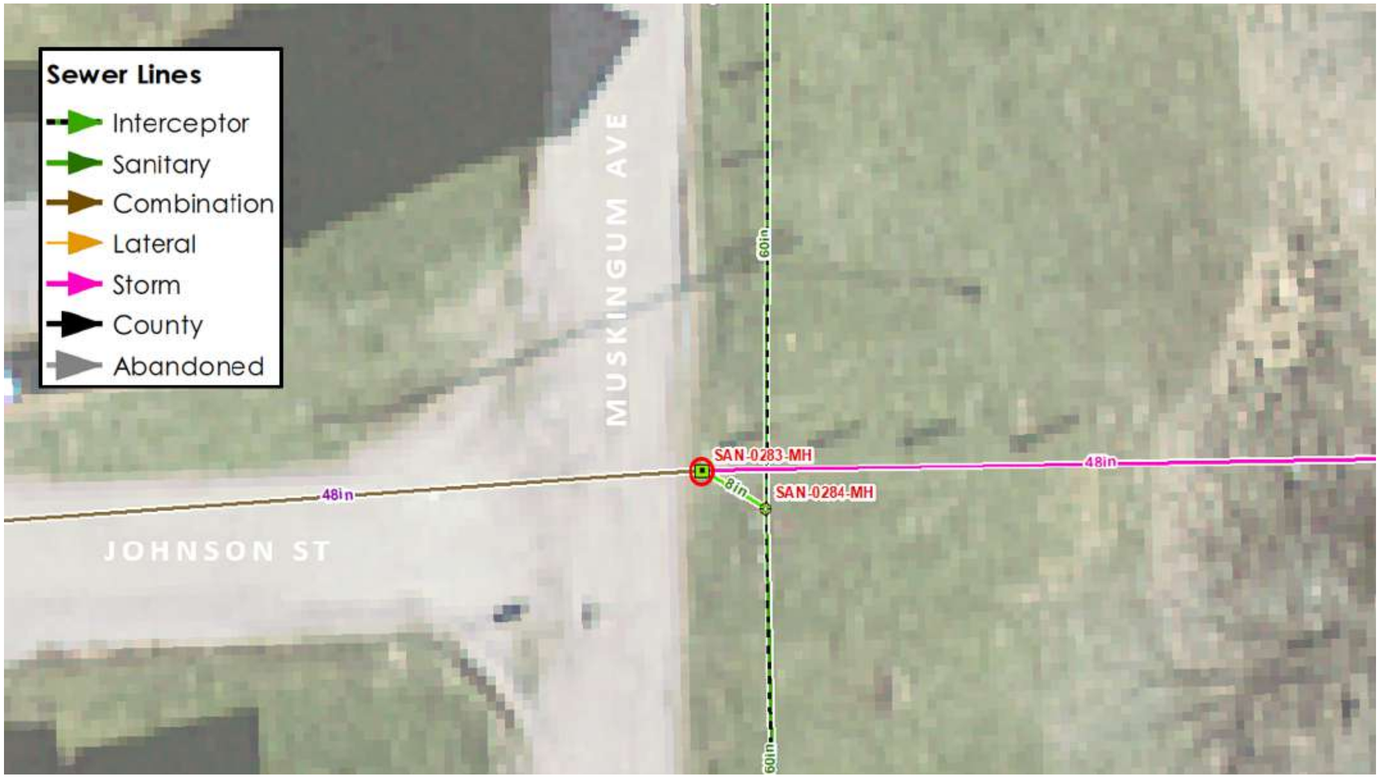
AECOM-CLEVELAND OFFICE AECOM - CLEVELAND OF
1300 E. 9TH ST 1300 E. 9th STREET
CLEVELAND, OH CLEVELAND, OH
Tel: 216-622-2300 216-622-2300
Fax: 216-622-2301 216-622-2328
E-mail: SCOTT.BELZ@AECOM.COM scott.belz@aecom.co

WPC Mainline Inspection

City :	Street :	Date :	Pipe Segment Reference :	Section No :
Zanesville	**825 Main St**	**9/17/2020**	**R-30**	**1**

Photo: Unknown_825 Main STMMH_20200917_1353_MSA_17092020135317.JPG, 00:20:44
186FT, Survey Abandoned / Could not advance

R-3 (Johnson St. at Muskingum Ave.):



FIELD DATA REQUESTED:

At Structure SAN-0283-MH (circled in red): RIM TO INVERT

- 48" W (in) Invert Elevation 15.0'
- 8" SE (out) Invert Elevation 16.4'
- 48" E (out) invert elevation 15.1'

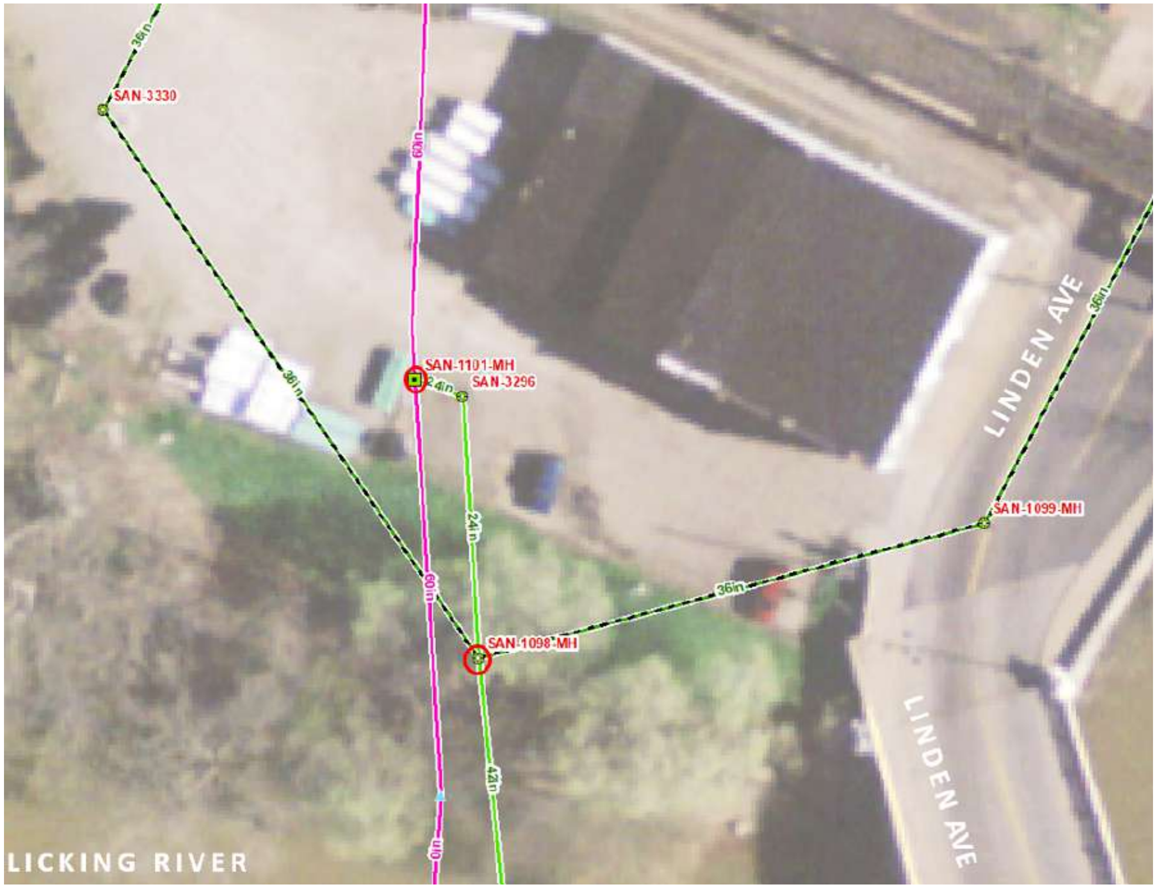
R-12 (Southwest of Y-Bridge PS in Alley):

FIELD DATA REQUESTED:

<u>At Regulator Structure SAN-0671-MH(circled in red):</u> RIM TO INVERT

- 48” SW (in) Invert Elevation 21.2'
- 8” S (in) Invert Elevation 17.9'
- 12” N (out) <u>w/ 8” orifice plate</u> Invert Elevation 22.1'
- 48” NE (out) Invert Elevation 21.3'

R-13 (Peters Alley behind Mee's):



FIELD DATA REQUESTED:

RIM TO INVERT

At Structure SAN-1098-MH (circled in red):

- 36" NW (in) Invert Elevation — 23.7'
- 36" ~~18"~~ NE (in) Invert Elevation — 21.3'
- 42" S (out) Invert Elevation — 25.42'
- 24" N (out) Invert Elevation — 23.2

At Structure SAN-1101-MH (circled in red):

- 60" N (in) Invert Elevation — 16.45'
- 60" S (out) Invert Elevation — 16.9'
- 24-in SE (out) Invert Elevation and Confirm Elevation — 18.0'

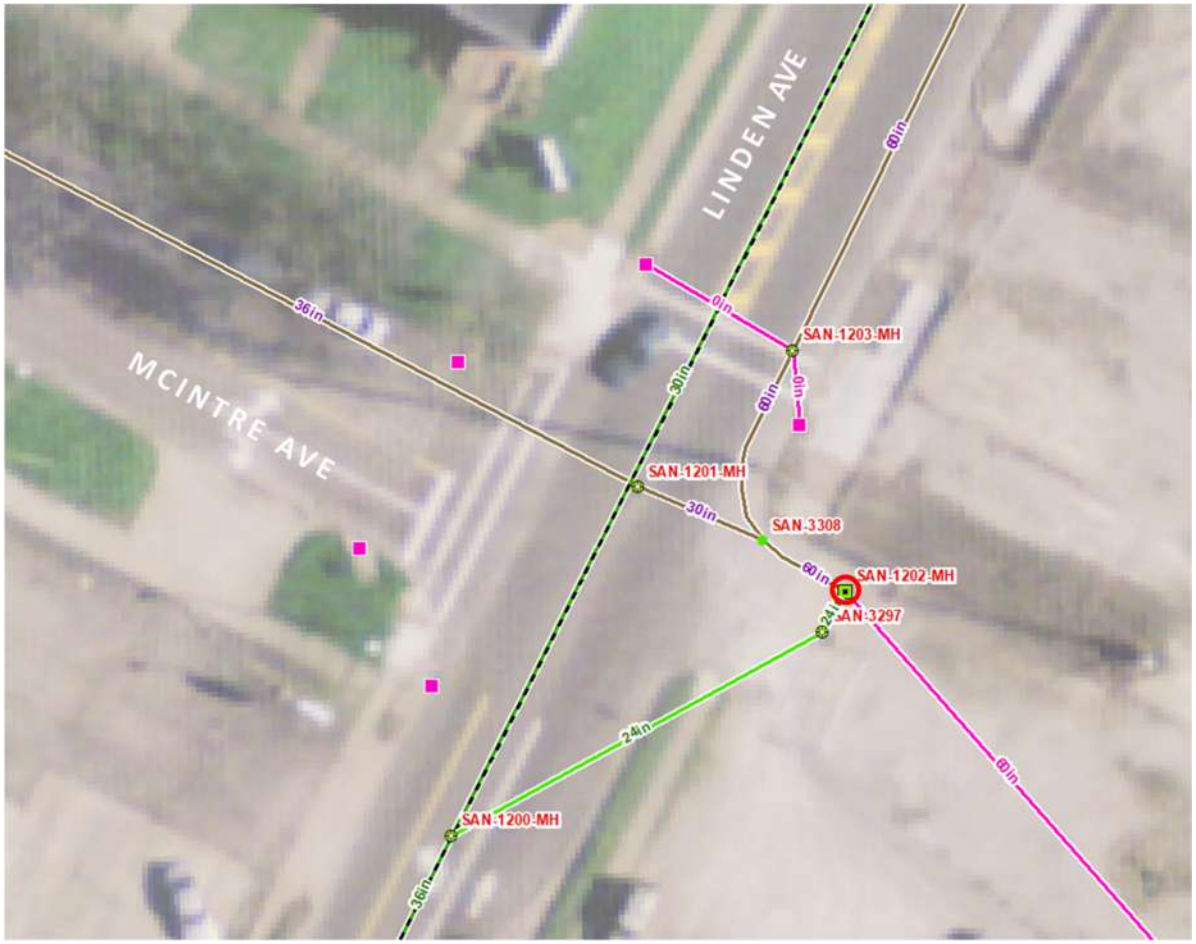
Please provide field drawing with sizing and invert elevations

SAN-1098-MH: The NE (in) pipe is 36" diameter.

SAN-1101-MH: The SE (out) is a 21" high x 36" wide rectangular opening.

The drawing provided on this sheet by the City accurately depicts the pipe alignments.

R-14 (McIntire Ave. East of Linden Ave.):



FIELD DATA REQUESTED:

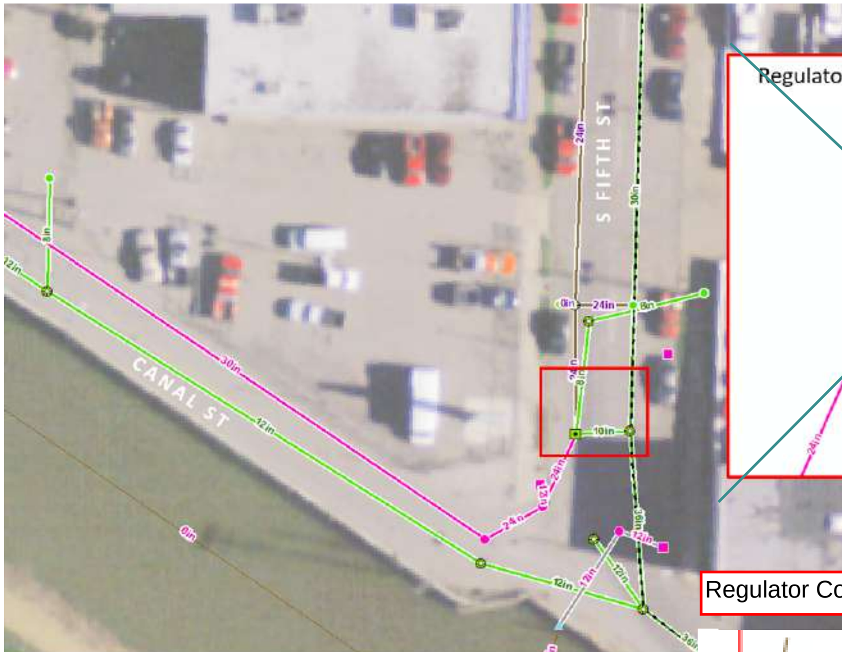
At Structure SAN-1202-MH (circled in red): RIM TO INVERT

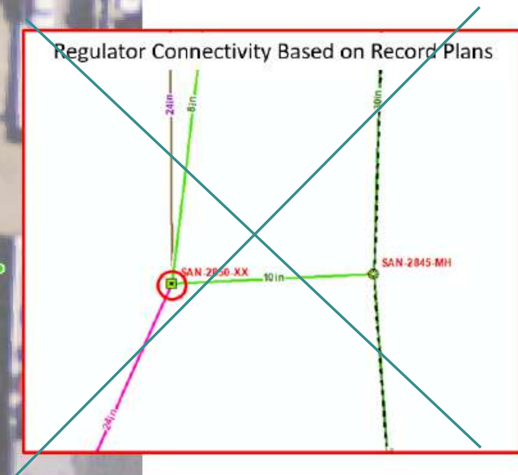
- 60" NW (in) Invert Elevation 14.3'
- 24" S (out) Invert Elevation 16.4'
- 60" SE (out) Invert Elevation 14.8'

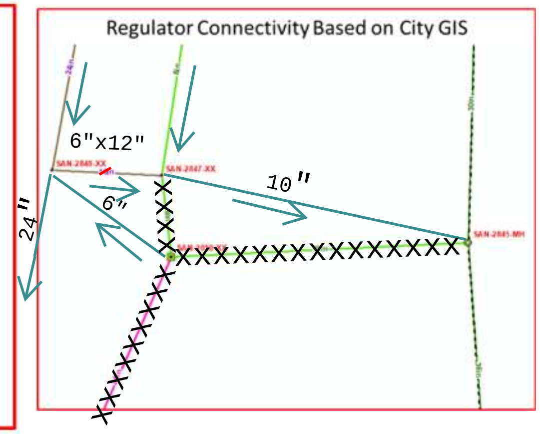
Please provide Video of flows at the regulator structure R-14

Video was taken by AECOM 9-17-20 with pole camera

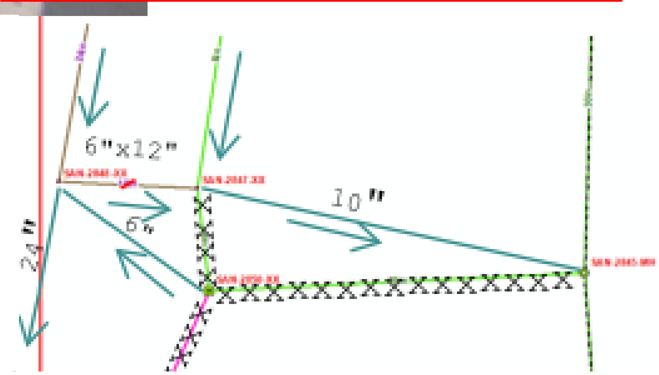
R-26 (S 5TH Street North of Canal):







Regulator Connectivity observed by AECOM 9-17-20



SAN-2848 INVERTS:
24" IN- 4.9'
24" OUT- 4.95'
6" IN- 4.95'
6" X 12" OUT- 6.05'

SAN-2847 INVERTS:
6" X 12" IN- 6.05'
10" OUT- 6.10'

SAN-2850 INVERTS:
6" OUT- 4.90'

FIELD DATA REQUESTED:

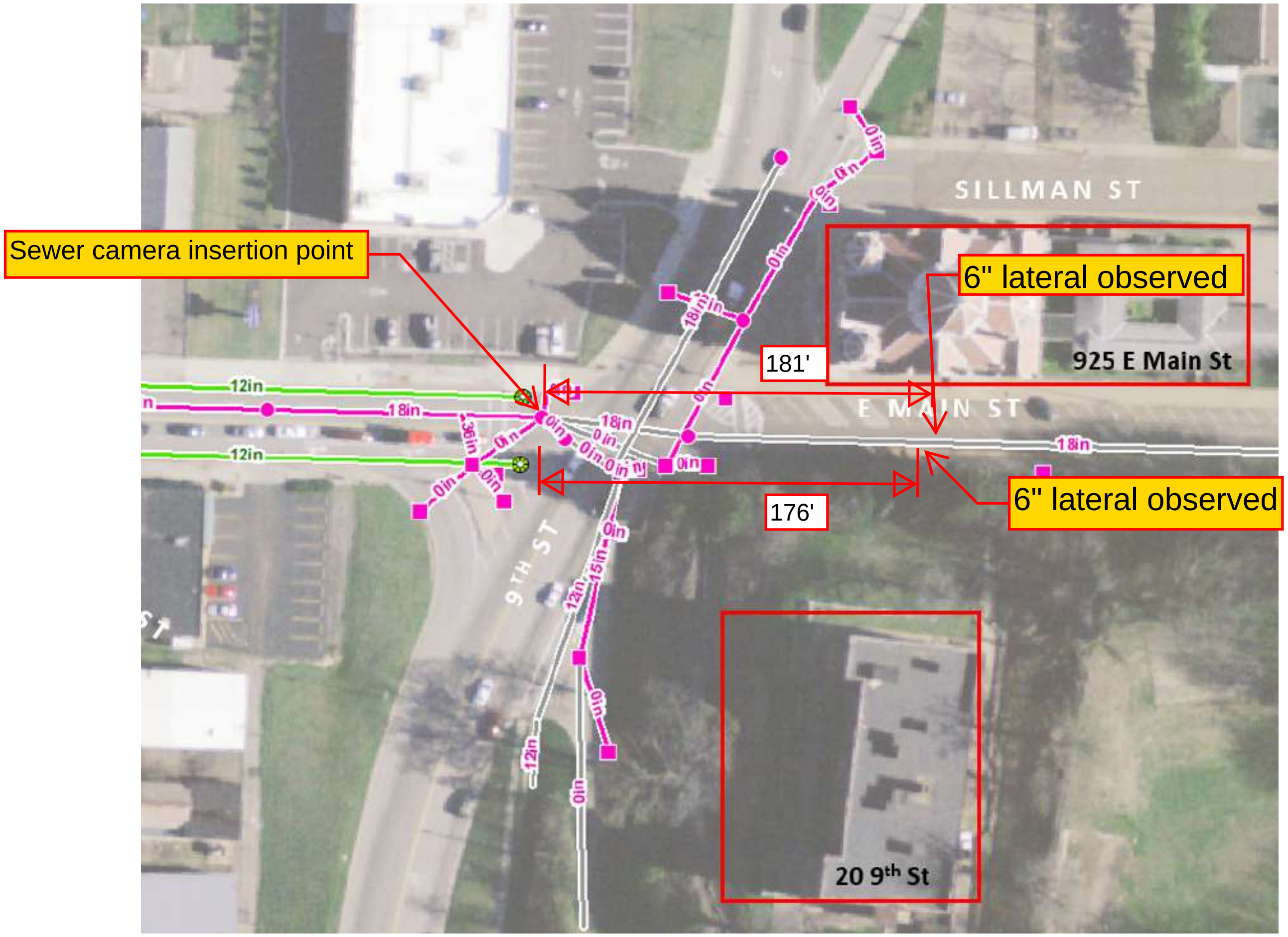
At Structure SAN-2850-XX (circled in red):

- 8" NE (in) Invert Elevation
- 24" N (in) Invert Elevation
- 10" E (out) Invert Elevation
- 24" SW (out) Invert Elevation

Please provide photo of Structure SAN-2850-XX

Please provide field drawing with sizing and invert elevations at regulator structure (Uncertain of connectivity – see City's GIS vs. Record Plans above)

R-30 (Main St. in front of Courthouse):



FIELD DATA REQUESTED:

- Location of existing sanitary connections into storm sewer on E Main St from the two following locations:
  1) Former Pioneer Elementary School (private location)
     Address: 20 9th Street
  2) St Nicholas Catholic Church
     Address: 925 E Main St, Zanesville, OH 43701

9-17-20:
City placed tracing dye in church toilet and flushed. Dye was not observed in lateral at 181'. However, dye was observed to be coming in upstream of this lateral. Debris in pipe at 183' prevented camera from seeing actual point of entry of dye.

School Bldg owner would not permit City to enter the building to place tracing dye. Owner stated he would put dye in a toilet and flush. After 20 minutes, no water was seen discharging from the lateral.

Downstream of Muskingum River Siphon

FIELD DATA REQUESTED:

- Photo of MH SAN-0387-XX (Blow Off Structure) during dry weather

Appendix G — LTCP Alternative Cost Estimates

LTCP Update Early Action, I/I and Conveyance Upgrades

Project Cost Estimates Summary

	Total Project Cost
LTCP Update Early Action Projects	
Linden Avenue Lift Station Upgrades	$770,000
Separations R6, R8, R9, R10, R11 and Y-Bridge PS Improvements Phase 1	$7,444,000
Y-Bridge PS Improvements Phase 2	$780,000
Y-Bridge PS Improvements Phase 3	$2,000,000
LTCP Update I/I and Conveyance Upgrades	
Finalize R13 Separation	$1,113,000
R12 Regulator Modifications	$14,000
R30 Separation	$27,000
R26 Regulator Modifications	$123,000
RWI Improvements at R3, R13 and R14	$202,000
Total Early Action, I/I and Conveyance Upgrades Project Costs:	**$12,473,000**

Separations R-6, R-8, R-9, R-10, R-11, &Y Bridge PS Improvements Phase 1
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Engineer's Opinion of Probable Cost - R-6, R-8, R-9, R-10, R-11 and Y Bridge PS FM Improvements Phase 1 **(Borrowed Funding)**	LS	$5,688,00	1	$5,688,000
Subtotal Construction Cost				$5,688,000
Permits, Legal and Miscellaneous **(Local Funding)**	LS	$50,000	1	$50,000
Engineering Design & Construction Oversight **(Local Funding)**	LS	20%	-	$1,000,000
Construction Contingency*	LS	10%	-	$500,000
TOTAL PROJECT COST				$7,444,000

Y Bridge PS Improvements Phase 2
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Upsize 24" to 30" Along Muskingum Ave	LS	$400,000	1	$400,000
Subtotal Construction Unit Costs				$400,000
Mobilization	LS	3%	-	$11,000
Maintenance of Traffic	LS	2%	-	$8,000
Stormwater Pollution Prevention Plan	LS	1%	-	$4,000
Contingency	LS	10%	-	$40,000
Overhead & Profit	LS	20%	-	$80,000
Subtotal Construction Cost				$543,000
Permits, Legal and Miscellaneous	LS	$20,000	1	$20,000
Engineering Design & Construction Oversight	LS	20%	-	$109,000
Design Phase Construction Contingency	LS	10%	-	$54,000
Construction Contingency	LS	10%	-	$54,000
TOTAL PROJECT COST				$780,000

Y Bridge PS Improvements Phase 3
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Tie-in to Dug Road Project	LS	$600,000	1	$600,000
New Pumps	EA	$88,500	4	$354,000
Electrical	LS	10%	-	$35,000
Installation	LS	15%	-	$53,000
Subtotal Construction Unit Costs				$1,043,000
Mobilization	LS	3%	-	$28,000
Maintenance of Traffic	LS	2%	-	$21,000
Stormwater Pollution Prevention Plan	LS	1%	-	$10,000
Contingency	LS	10%	-	$104,000
Overhead & Profit	LS	20%	-	$209,000
Subtotal Construction Cost				$1,414,000
Permits, Legal and Miscellaneous	LS	$20,000	1	$20,000
Engineering Design & Construction Oversight	LS	20%	-	$283,000
Design Phase Construction Contingency	LS	10%	-	$141,000
Construction Contingency	LS	10%	-	$141,000
TOTAL PROJECT COST				$2,000,000

CSO Basin R13 Separation
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
12-Inch RCP Storm Sewer w/Bedding & CGB	L.F.	$119	30	$3,600
18-Inch RCP Storm Sewer w/Bedding & CGB	L.F.	$162	150	$24,300
36-Inch RCP San w/Bedding & CGB	L.F.	$1,477	15	$22,200
8-Inch PVC Sanitary Sewer w/Bedding & CGB	L.F.	$151	1400	$211,700
Sanitary Service Relocation	EA.	$4,480	15	$67,200
Sanitary Manhole	EA.	$6,480	3	$19,400
Storm Manhole	EA.	$5,480	4	$21,900
Standard Catchbasin/ Curb Inlet < 21" Pipe	EA.	$3,024	1	$3,000
Storm Catchment Structure Abandoned	EA.	$800	4	$3,200
Abandon Existing Sewer (filled with CLSM)	L.F.	$58	80	$4,600
Modifications to Ex. Regulator	EA.	$23,200	1	$23,200
Modifications to Ex. MH SAN-1098-MH	EA.	$20,000	1	$20,000
Full Depth Pavement Repair above Trench	S.Y.	$162	100	$16,200
Site and Surface Contingency	L.S.	30%	-	$132,200
Subtotal Construction Unit Cost				$572,700
Mobilization	LS	3%	-	$15,000
Maintenance of Traffic	LS	2%	-	$11,000
Stormwater Pollution Prevention Plan	LS	1%	-	$6,000
Overhead & Profit	LS	20%	-	$115,000
Contingency	LS	10%	-	$57,000
Subtotal Construction Cost				$777,000
Permits, Legal and Miscellaneous	LS	$25,000	1	$25,000
Engineering Design & Construction Oversight	LS	20%	-	$155,000
Design Phase Construction Contingency	LS	10%	-	$78,000
Construction Contingency	LS	10%	-	$78,000
TOTAL PROJECT COST				$1,113,000
Note: Cost estimate does not include any rock excavation or dewatering.				

R12 Regulator Modifications
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Raise Weir	EA.	$4,480	1	$5,000
Subtotal Construction Unit Costs				$5,000
Mobilization	LS	3%	-	$200
Maintenance of Traffic	LS	2%	-	$100
Stormwater Pollution Prevention Plan	LS	1%	-	$100
Overhead & Profit	LS	20%	-	$900
Contingency	LS	10%	-	$500
Subtotal Construction Cost				$6,100
Permits, Legal and Miscellaneous	LS	$5,000	1	$5,000
Engineering Design & Construction Oversight	LS	20%	-	$1,300
Design Phase Construction Contingency	LS	10%	-	$700
Construction Contingency	LS	10%	-	$700
TOTAL PROJECT COST				$14,000

CSO Basin R30 Separation
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Sanitary Service Relocation	EA.	$4,480	2	$9,000
Site and Surface Contingency	L.S.	30%	-	$2,700
Subtotal Construction Unit Costs				$12,000
Mobilization	LS	3%	-	$400
Maintenance of Traffic	LS	2%	-	$300
Stormwater Pollution Prevention Plan	LS	1%	-	$200
Overhead & Profit	LS	20%	-	$2,400
Contingency	LS	10%	-	$1,200
Subtotal Construction Cost				$16,000
Permits, Legal and Miscellaneous	LS	$5,000	1	$5,000
Engineering Design & Construction Oversight	LS	20%	-	$3,000
Design Phase Construction Contingency	LS	10%	-	$2,000
Construction Contingency	LS	10%	-	$2,000
TOTAL PROJECT COST				$27,000

R26 Regulator Modifications
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Overflow Rehabilitation	EA	$38,367	1	$38,400
Upsize 10" Sanitary Sewer to 24" RCP	LF	$252.40	20	$5,100
Full Depth Pavement Repair above Trench	S.Y.	$162	15	$2,500
Abandon Existing Sewer (filled with CLSM)	LF	$58	30	$1,800
Site and Surface Contingency	L.S.	30%	-	$14,300
Subtotal Construction Unit Costs				$62,000
Mobilization	LS	3%	-	$1,600
Maintenance of Traffic	LS	2%	-	$1,200
Stormwater Pollution Prevention Plan	LS	1%	-	$600
Overhead & Profit	LS	20%	-	$12,400
Contingency	LS	10%	-	$6,200
Subtotal Construction Cost				$84,000
Permits, Legal and Miscellaneous	LS	$5,000	1	$5,000
Engineering Design & Construction Oversight	LS	20%	-	$17,000
Design Phase Construction Contingency	LS	10%	-	$8,000
Construction Contingency	LS	10%	-	$8,000
TOTAL PROJECT COST				$123,000

R3, R13 and R14 RWI Remediation
Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Overflow Rehabilitation - Duckbill R3	EA.	$38,693	1	$39,000
Overflow Rehabilitation - Duckbill R13	EA.	$38,693	1	$39,000
Overflow Rehabilitation - Duckbill R14	EA.	$38,693	1	$39,000
Subtotal Construction Unit Costs				$77,000
Mobilization	LS	3%	-	$3,000
Maintenance of Traffic	LS	2%	-	$2,000
Stormwater Pollution Prevention Plan	LS	1%	-	$1,000
Contingency	LS	10%	-	$12,000
Overhead & Profit	LS	20%	-	$23,000
Subtotal Construction Cost				$157,000
Permits, Legal and Miscellaneous	LS	$5,000	1	$5,000
Engineering Design & Construction Oversight	LS	10%	-	$16,000
Design Phase Construction Contingency	LS	5%	-	$8,000
Construction Contingency	LS	10%	-	$16,000
TOTAL PROJECT COST				$202,000

36 MGD WWTP Upgrades

Preliminary Cost Estimates

Proposed Sewer Items	Unit	Unit Cost	Quantity	Total Cost
Phase 1				
Trickling Filter Improvements	-	$275,000	1	$275,000
Secondary Clarifier Improvements	-	$2,700,000	1	$2,700,000
UV Disinfection Improvements	-	$3,250,000	1	$3,250,000
Plantwide Automation Improvements	-	$250,000	1	$250,000
Plantwide PLC Upgrades	-	$500,000	1	$500,000
Secondary Pump Station Improvements	-	$500,000	1	$500,000
Phase 1 Construction Cost Subtotal				**$7,475,000**
Phase 2				
Primary Pump Station Improvements	-	$1,600,000	1	$1,600,000
Primary Clarifier Bypass (Process Improvement Modifications)	-	$150,000	1	$150,000
Sludge Pumping Improvements	-	$50,000	1	$50,000
Sludge Dewatering Improvements	-	$1,300,000	1	$1,300,000
Digester Building Improvements	-	$200,000	1	$200,000
Miscellaneous Improvements	-	$50,000	1	$50,000
Phase 2 Construction Cost Subtotal				**$3,350,000**
Subtotal Construction Cost				$10,825,000
Permits, Legal and Miscellaneous	LS	$25,000	1	$25,000
Engineering Design & Construction Oversight	LS	20%	-	$2,165,000
Design Phase Construction Contingency	LS	10%	-	$1,082,500
Construction Contingency	LS	10%	-	$1,082,500
TOTAL PROJECT COST				$15,180,000

LTCP Update Alternatives Breakdown
Project Cost Estimates Summary

		Total Project Cost
WWTP Upgrades		$15,180,000
Early Action Projects		$10,994,000
I/I and Conveyance Upgrades		$1,479,000
Post Construction Programmatic Reviews		$120,000
Alternative	**Description**	**Total Project Cost**
Alternative 1	R-21 Storage + R-3 Storage	$40,035,000
Alternative 2	New Wet Weather Pump Station + Force Main at North Muskingum River + R-3 Storage	$43,140,000
Alternative 3	Downtown Interceptor Upsizing, New Wet Weather Pump Station + Force Main at Muskingum River + R-3 Storage	$54,693,000

LTCP Update Alternative 1 – Project Cost Estimates

WWTP Improvements				**$15,180,000**
Early Action Projects				**$10,994,000**
I/I and Conveyance Upgrades				**$1,479,000**
Post Construction Programmatic Reviews				**$120,000**
Alternative 1	**Unit**	**Unit Cost**	**Quantity**	**Total Cost (Rounded)**
R21 Collection System Improvements				
Modifications to Ex. Regulator (Raise Ex. Weir and Construct Side Weir)	EA.	$28,077	1	$28,000
1 MGD Pump Station	LS	$1,100,495	1	$1,100,000
Linear Storage - 84-in Sanitary Sewer, Open Cut w/ MH every 250'	LF	$2,294.38	1800	$4,130,000
Surface Restoration (Asphalt)	SY	$50	2885	$144,000
Mobilization	LS	3%	-	$5,000
Maintenance of Traffic	LS	2%	-	$108,000
Stormwater Pollution Prevention Plan	LS	1%	-	$54,000
Contingency	LS	10%	-	$540,000
Overhead & Profit	LS	20%	-	$34,000
R-21 Construction Cost Opinion Subtotal				$6,145,000
Design Phase Construction Contingency	LS	**10%**	-	$614,000
Construction Contingency	LS	**10%**	-	$614,000
Engineering (Design and Construction)	LS	**20%**	-	$1,229,000
Permits, Legal and Miscellaneous	LS	$100,000	1	$100,000
Subtotal Project Cost– R-21 Improvements				**$8,702,000**
R3 Collection System Improvements				
Modifications to Ex. Regulator (Raise Ex. Weir and Construct Side Weir)	EA.	$28,077	1	$28,000
Linear Storage -60-in Sanitary Sewer, Open Cut w/ MH every 250'	LF	$1,509.85	1400	$2,114,000
8" Gravity Pipe, Open Cut	LF	$184	30	$6,000
Mobilization	LS	3%	-	$1,000
Maintenance of Traffic	LS	2%	-	$43,000
Stormwater Pollution Prevention Plan	LS	1%	-	$21,000
Contingency	LS	10%	-	$215,000
Overhead & Profit	LS	20%	-	$7,000
R-3 Construction Cost Opinion Subtotal				**$2,435,000**
Design Phase Construction Contingency	LS	**10%**	-	$243,000
Construction Contingency	LS	**10%**	-	$243,000
Engineering (Design and Construction)	LS	**20%**	-	$487,000
Permits, Legal and Miscellaneous	LS	$150,000	1	$150,000
Subtotal Project Cost– R-21 and R-3 Improvements				**$12,262,000**
TOTAL LTCP PROJECT COST				**$40,035,000**

LTCP Update Alternative 2 – Project Cost Estimates

	Unit	Unit Cost	Quantity	Total Cost (Rounded)
WWTP Improvements				**$15,180,000**
Early Action Projects				**$10,994,000**
I/I and Conveyance Upgrades				**$1,479,000**
Post Construction Programmatic Reviews				**$120,000**
	Unit	**Unit Cost**	**Quantity**	**Total Cost (Rounded)**
R-21 Collection System Improvements				
Modifications to Ex. Regulator (Raise Ex. Weir and Construct Side Weir)	EA.	$28,077	1	$28,000
8 MGD Pump Station	LS	$5,089,954	1	$5,090,000
Screening Unit	LS	$254,498	1	$254,000
20-in forcemain HPDE, HDD under river (no rock assumed)	LF	$633	600	$380,000
18-in HPDE, Trench and Backfill	LF	$241	3000	$723,000
Bore/Jacking Pits	EA	$12,167	2	$24,000
Sanitary Manhole	EA	$6,480	4	$26,000
Drop Manhole at Lee St.	EA.	$6,490	1	$6,000
Mobilization	LS	3%	-	$38,000
Maintenance of Traffic	LS	2%	-	$131,000
Stormwater Pollution Prevention Plan	LS	1%	-	$65,000
Contingency	LS	10%	-	$653,000
Overhead & Profit	LS	20%	-	$288,000
R-21 Construction Cost Opinion Subtotal				**$7,710,000**
R-3 Collection System Improvements				
Modifications to Ex. Regulator (Raise Ex. Weir and Construct Side Weir)	EA.	$28,077	1	$28,000
Linear Storage - 72-in Sanitary Sewer, Open Cut w/ MH every 250'	LF	$1,924.32	1400	$2,694,000
8" Gravity Pipe, Open Cut	LF	$184.00	30	$6,000
Mobilization	LS	3%	-	$1,000
Maintenance of Traffic	LS	2%	-	$55,000
Stormwater Pollution Prevention Plan	LS	1%	-	$27,000
Contingency	LS	10%	-	$273,000
Overhead & Profit	LS	20%	-	$7,000
Subtotal Construction Cost– R-21 and R-3 Improvements				**$10,891,000**
Design Phase Construction Contingency	LS	**10%**	-	$1,080,000
Construction Contingency	LS	**10%**	-	$1,080,000
Engineering (Design and Construction)	LS	**20%**	-	$2,159,000
Permits, Legal and Miscellaneous	LS	$250,000	1	$250,000
Subtotal Project Cost– R-21 and R-3 Improvements				**$15,367,000**
TOTAL LTCP PROJECT COST				**$43,140,000**

LTCP Update Alternative 3 – Project Cost Estimates

WWTP Improvements				**$15,180,000**
Early Action Projects				**$10,994,000**
I/I and Conveyance Upgrades				**$1,479,000**
Post Construction Programmatic Reviews				**$120,000**
Alternative 3	**Unit**	**Unit Cost**	**Quantity**	**Total Cost (Rounded)**
R-21 Collection System Improvements				
Modifications to Ex. Regulator (Raise Ex. Weir and Construct Side Weir)	EA.	$28,077	1	$28,000
42-inch RCP Sanitary Sewer, Microtunneling (Downtown)	LF	$1,164	2000	$2,328,000
36-inch RCP Sanitary Sewer, Microtunneling (Downtown)	LF	$946	1700	$1,608,000
Modifications to Siphon Influent Chamber (Add Side Weir)	EA.	$28,077	1	$28,000
Commercial Property Acquisition	LS	$1,188,623	1	$1,189,000
12 MGD Pump Station	LS	$6,861,279	1	$6,861,000
Screening Unit	LS	$343,064	1	$343,000
20-in forcemain HPDE, HDD under river (no rock assumed)	LF	$633	900	$569,000
Bore/Jacking Pits	EA	$12,167	10	$122,000
Sanitary Manhole	EA	$6,480	7	$45,000
Mobilization	LS	3%	-	$152,000
Maintenance of Traffic	LS	2%	-	$239,000
Stormwater Pollution Prevention Plan	LS	1%	-	$119,000
Contingency	LS	10%	-	$1,312,000
Overhead & Profit	LS	20%	-	$1,014,000
R-21 Construction Cost Opinion Subtotal				**$15,960,000**
R-3 Collection System Improvements				
Modifications to Ex. Regulator (Raise Ex. Weir and Construct Side Weir)	EA.	$28,077	1	$28,000
Linear Storage - 72-in Sanitary Sewer, Open Cut w/ MH every 250'	LF	$1,924.32	1400	$2,694,000
8" Gravity Pipe, Open Cut	LF	$184.00	30	$6,000
Mobilization	LS	3%	-	$1,000
Maintenance of Traffic	LS	2%	-	$55,000
Stormwater Pollution Prevention Plan	LS	1%	-	$27,000
Contingency	LS	10%	-	$273,000
Overhead & Profit	LS	20%	-	$7,000
Subtotal Construction Cost– R-21 and R-3 Improvements				**$19,050,000**
Design Phase Construction Contingency	LS	**10%**	-	$1,905,000
Construction Contingency	LS	**10%**	-	$1,905,000
Engineering (Design and Construction)	LS	**20%**	-	$3,810,000
Permits, Legal and Miscellaneous	LS	$250,000	1	$250,000
Subtotal Project Cost– R-21 and R-3 Improvements				**$26,920,000**
TOTAL LTCP PROJECT COST				**$54,693,000**

Appendix H Financial Capability Analysis

EPA Financial Capability Analysis for the City of Zanesville, Ohio

City of Zanesville Long-Term Control Plan

January 2024

Prepared for:

City of Zanesville

Prepared by:

Maria DeLuca, P.E.

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Revision History:

AECOM - Updated August 2020
AECOM - Updated December 2021
AECOM - Updated January 2024

Table of Contents

Figures

Tables

1. Executive Summary

The City of Zanesville (City) Long Term Control Plan Update (LTCP Update) financial capability analysis (FCA) was developed in 2021 according to EPA's Financial Capability Assessment Guidance, Pre-Publication Notice (2021 FCA Guidance). Although the EPA issued new FCA guidance in 2023 entitled Final Updated Clean Water Act Financial Capability Assessment Guidance (2023 FCA Guidance) which replaced the 2021 FCA Guidance, this report only serves as an update to the previous analysis conducted in 2021 and, thus, does not reflect application of the new 2023 FCA Guidance. The purpose of this report is to assess the burden of the LTCP Update and associated capital and operating costs and to determine the appropriate implementation schedule.

The projected CSO capital expenses included in this study are based on the Long-Term Control Plan (LTCP) Update Selected Alternative and have been inflated to 2023 dollars using the US Bureau of Economic Analysis GDP price deflator. The total estimated project cost for the City's LTCP Update is $46.54 million in 2023 Dollars (escalated from $40.04 million in 2021 Dollars).

Alternative 1 from the EPA's 2021 FCA Guidance was used to assess the impact, "or burden" of the City's LTCP Update on the City of Zanesville and its residents. The results showed that the City's LTCP Update and its projected capital costs are predicted to have a **high burden** on the City based on the expanded financial capability matrix included in the 2021 FCA Guidance. A summary of the results of the EPA's 2021 FCA Guidance, Alternative 1 methodology is provided in Table 1. Details regarding the City's Residential Factor, or the estimated percentage of residential flow in the City's collection system, is provided in Appendix A. Critical metric calculations are provided in Appendix B.

Table 1: EPA 2021 FCA Guidance Results Summary, City of Zanesville LTCP Update

Description	Score	Impact
Lowest Quintile Residential Indicator (LQRI)	2.63% (Cost per household as a % of lower income median household income)	High
Poverty Indicators (PI)	1.20	High
LQRI Burden:		**High**
Residential Indicator (RI)	1.49% (Cost per household as a % of median household income)	Mid-Range
Financial Capability Indicators (FCI)	1.67	Mid-Range
FCA Burden:		**Medium**
Final Expanded Financial Capability Burden:		**High**

Based on the results of the EPA's 2021 FCA Guidance method, the appropriate LTCP Update implementation schedule duration is up to 25 years.

Supplemental data was also used to further assess the City's ability to fund the LTCP Update projects based on additional metrics not directly used in the expanded financial capability matrix summarized in Table 1-1. The following data analyses suggest that the medium-level FCA Burden calculated in Table 1-1 is overly optimistic and does not reflect the future burden from the LTCP Update capital costs on the City:

- Economic and Demographic Trends – Based on U.S. Census data, the City's population has shown a 3.1% decline over the past 13 years (2010-2022) compared to the rising population trends across Ohio and the U.S. Additionally, the City's unemployment rates are historically higher than average rates across Ohio and the U.S. These trends suggest that the future burden on the City and its residents will intensify over the lifetime of the LTCP Update due to potential decreases in the number and income level of future ratepayers.

- Industrial Structure – The City's employment base includes limited industrial diversification and relatively high percentage of individuals in retail trades, resulting in higher risks from potential sector-shocks.
- Residential Indicator (RI) Score Trend Analysis – A trend-based analysis of projected RI scores based on historical population and income trend levels for the City, state, and nation shows that the City's current RI score used in the financial capability assessment matrix is likely understating the impact of future LTCP Update costs on the City and its residents.
- Unemployment rates – Based on the U.S. Bureau of Land Statistics data, the City's unemployment rates have been consistently higher than state and national rates based on historical data. From January 2021 through October 2023, the average unemployment rate in the City was 4.75% compared to 3.84% in Ohio and 3.63% in the U.S. for the same timeframe.
- Income tax resilience – The low tax burden associated with the City's financial management indicators is based only on property tax, yet 88.6% of the City's tax revenues come from income tax based on 2022 financial data. Heavy reliance on a local income tax and struggles to materialize rate increases would add a volatility risk into the City's financial capabilities.

Sewer rates are expected to increase as a result of the LTCP Update projects and related operation and maintenance costs. Since 2019, the City has issued utility rate increases for sewer, water and storm water services to cover annual capital and operating expenses, however the projected costs associated with the LTCP Update will accelerate and intensify future rate increases and its burden on City residents.

Based on the EPA's 2021 FCA Guidance and other metrics including the City's historical and projected unemployment rates, population trends, income tax reliance, and industrial structure, the recommended implementation schedule for the City of Zanesville LTCP Update is 25 years. This is consistent with guidance and intentions of the 2021 FCA Guidance and with other schedules that have been granted to other Ohio communities experiencing high burden CSO rates.

2. Introduction

The City of Zanesville, OH (City) has developed a Long Term Control Plan Update (LTCP Update) to meet the EPA's Combined Sewer Overflow Control Policy (CSO Policy) under the Clean Water Act. The City's LTCP Update includes various CSO control projects which will be implemented over a multi-phased implementation schedule. The total estimated cost for the projects included in the City's LTCP Update is $46.54 million (in 2023 Dollars). The purpose of this report is to assess the City's financial capability to fund the projects included in the LTCP Update and to determine the appropriate compliance schedule that will not overly burden the community.

EPA's 2021 Financial Capability Assessment Pre-Publication Notice (2021 FCA Guidance) was used in development of this report. The 2021 FCA Guidance incorporated aspects of EPA's 1997 Combined Sewer Overflows-Guidance for Financial Capability Assessment and Schedule Development (1997 FCA Guidance) and EPA's 2014 Financial Capability Assessment framework for Municipal Clean Water Act Requirements (2014 FCA Framework) to provide options and flexibility to communities when assessing their capability to fund CWA control measures. The 2021 FCA Guidance expanded the two-phase approach from the 1997 FCA Guidance to also consider impacts to the population with lowest income in the subject region.

This report was initially developed in 2021 and was updated in 2023 to include more recent financial and demographic data based on Ohio EPA's request. Although the EPA issued new FCA guidance in 2023 entitled Final Updated Clean Water Act Financial Capability Assessment Guidance which replaced the 2021 FCA Guidance, this study follows the 2021 FCA Guidance and only serves as an update to the previous analysis conducted in 2021.

The following data sources were used in this analysis:

- City of Zanesville Annual Financial Report (City of Zanesville, December 2022) which reported outstanding debt, operations and maintenance expenses, revenue figures, and other financial data used in this analysis.
- U.S. Bureau of Labor Statistics
- U.S. Census Bureau's American Community Survey (ACS) 1-Year and 5-Year Estimates Detailed Tables
- Ohio EPA Sewer and Water Rate Surveys, 2018-2022
- City of Zanesville historical average flow rates, including industrial and total systemwide WWTP influent, 2016-2020

3. EPA Financial Capability Analysis

The expanded financial capability matrix included in EPA's 2021 FCA Guidance was used to evaluate the impact, or "burden" of the LTCP Update projected capital costs on the City. The expanded financial capability matrix was included as Alternative 1 in the EPA's 2021 FCA Guidance. Figure 3-1 shows the matrix and the two burden types assessed in Alternative 1 of the 2021 FCA Guidance: 1) the Financial Capability Assessment (FCA) Burden and the Lowest Quintile (LQ) Burden. Each burden type includes two recommended critical metrics used to assess the burden level (low, medium, or high) in which the LTCP Update is expected to have on the City and its residents.

		LQ Burden (LQRI and PI)		
		Low Burden	Medium Burden	High Burden
FCA Burden (RI and FCI)	Low Burden	Low Burden	Low Burden	Medium Burden
	Medium Burden	Low Burden	Medium Burden	High Burden
	High Burden	Medium Burden	High Burden	High Burden

Figure 3-1: Expanded Financial Capability Matrix (U.S. EPA, 2021)

EPA spreadsheet templates were used to determine the City's FCA Burden, LQ Burden, and final expanded financial capability burden associated with the projected capital costs under the LTCP Update based on the 2021 FCA Guidance. Refer to Appendix B for details on the critical metrics calculations including input data values and sources used to determine the metrics.

3.1 LQ Burden

The 2021 FCA Guidance added the LQ Burden and its two new metrics to the EPA's recommended guidance to also consider impacts to households in the lowest quintile of median household income (MHI). These metrics are critical for communities with a range of incomes and contiguous areas of population that have difficulties paying for their utility services. The two LQ metrics and established thresholds are as follows:

1. Lowest Quintile Residential Indicator (LQRI) – cost per low-income household as a percentage of the lowest quintile income
2. Poverty Indicator (PI) – five poverty indicators used to benchmark the prevalence of poverty throughout the service area.

The LQRI score based on the projected LTCP Update capital costs is **2.63%** (cost per household as a percentage of the lowest quintile medium household income) which is considered **high impact**. Table 2 provides a summary of the PI scores and the overall rating of 1.20 which is considered **high impact.** Refer to Appendix B for detailed calculations.

Table 2: Poverty Indicators (PI) Summary

Indicator	U.S.	Zanesville, OH	Score
Percentage of population with income below 200% of Federal Poverty level	28.80%	51.33%	1
Percentage of population with income below Federal Poverty level	12.50%	25.20%	1

Indicator	U.S.	Zanesville, OH	Score
Upper limit of lowest income quintile for service Area	$30,785	$17,030	1
Lowest quintile income as a percentage of aggregate income	3.07%	3.37%	2
Percentage of population receiving food stamps/SNAP Benefits	11.50%	31.50%	1
Poverty Indicators (PI) Score / Impact			**1.20 / High**

Based on the 2021 FCA Guidance, the LQ Burden from the City's LTCP Update is considered **high**. The LQ Burden portion of the 2021 FCA Guidance is critical in understanding the impact of the LTCP Update on lower income households in the City. This score suggests that there will be a significant impact on the City's residents in lower income households, particularly those with income below 200% of the federal poverty level, which is nearly twice the percentage of national levels (51.33% in the City compared to 28.80% in the U.S based on August 2022 data). Refer to Section 4.1 for more information on City unemployment rates compared to state and national levels.

3.2 FCA Burden

Two critical metrics were used to assess the FCA Burden included in the 2021 FCA Guidance. These metrics were initially introduced in the EPA's 1997 FCA Guidance and are as follows:

1. Residential Indicator (RI) score – Projected cost per household as a percentage of MHI.
2. Financial Capability Indicators (FCI) – six socioeconomic, debt, and financial indicators used to benchmark a community's financial strength.

An important factor in estimating the RI score is the Residential Factor, or the estimated percentage of residential flow in the City's collection system. Refer to Appendix A for detailed calculations of the City's Residential Factor.

The City's RI score based on projected LTCP Update capital costs was **1.49%** (cost per household as a percent of adjusted MHI) and was considered mid-range compared to EPA benchmark communities. Table 3 provides a summary of the FCI results and the overall score of **1.67** which is considered mid-range. Refer to Appendix B for detailed calculations.

Table 3: Financial Capability Indicators (FCI) Summary

Indicator	Value	Evaluation	Score
Bond Rating	A1 (Moody's)	Strong	3
Net debt as % of Full Market Value, 2022	8.09%	Weak	1
Unemployment Rate, 2022	4.9%	Weak	1
Median Household Income (MHI), adjusted to 2023	$42,909	Weak	1
Property Tax Revenue as % of Full Market Value, 2022	0.40%	Strong	3
Property Tax Collection Rate, 2022	88.60%	Weak	1
Financial Capability Indicator (FCI) Score			**1.67**

Source: EPA's 2021 FCA Guidance, U.S. Census 2018-2022 American Community Survey 5-Year Estimates, Moody's Municipal Finance, City of Zanesville 2022 Audited Financial Report.

Based on these two values, the City's FCA Burden was considered **medium** compared to EPA benchmark communities. However, the City's FCA Burden understates the financial burden facing the City from the future LTCP Update costs based on the following items:

1. The weak scores for household income and property tax collection rates shown in Table 3 suggest that residents in this community are already struggling to pay their obligations.
2. Bond ratings are designed to measure the risk of default, not the burden on ratepayers. Bond ratings often rise after a local tax increase because this strengthens the guarantee to bondholders, even as it hurts the pocketbooks of residents. Furthermore, a strong recent bond rating gauges only the risk associated with current, not future debt.
3. Although the City's total amount of outstanding general obligations cannot exceed 10.5% of the actual value of real and personal and properties as per Ohio Revised Code (ORC) section 133.05, ODWA and OPWC and any other loans for water and wastewater systems are excluded from this constraint. Currently, the City shows 8.09% of net debt as a percentage of the market value of properties, as indicated in Table 3.
4. The critical metrics for RI and FCI are based on MHI only; however, the burden is expected to be much greater on lower income households, as discussed in Section 2.1. Additionally, the City has a high unemployment rate compared to state and national rates (refer to Section 4.1). The FCA burden does not consider the impact on current and future lower income households throughout the City.
5. Due to the widening gap between the City's declining population and the nation's increasing population, the City's RI score might look worse relative to EPA's benchmark communities in the future than it does today. To evaluate this concept, a RI sensitivity analysis was performed as part of this study and is discussed in Section 4.4.

3.3 Expanded Financial Capability Matrix Burden

Based on the expanded financial capability matrix included in the EPA's 2021 FCA Guidance (Figure 3-1), the increased capital and operating expenses associated with the LTCP Update projects are expected to result in a **high burden** to the City compared to EPA benchmark communities.

4. Additional Considerations

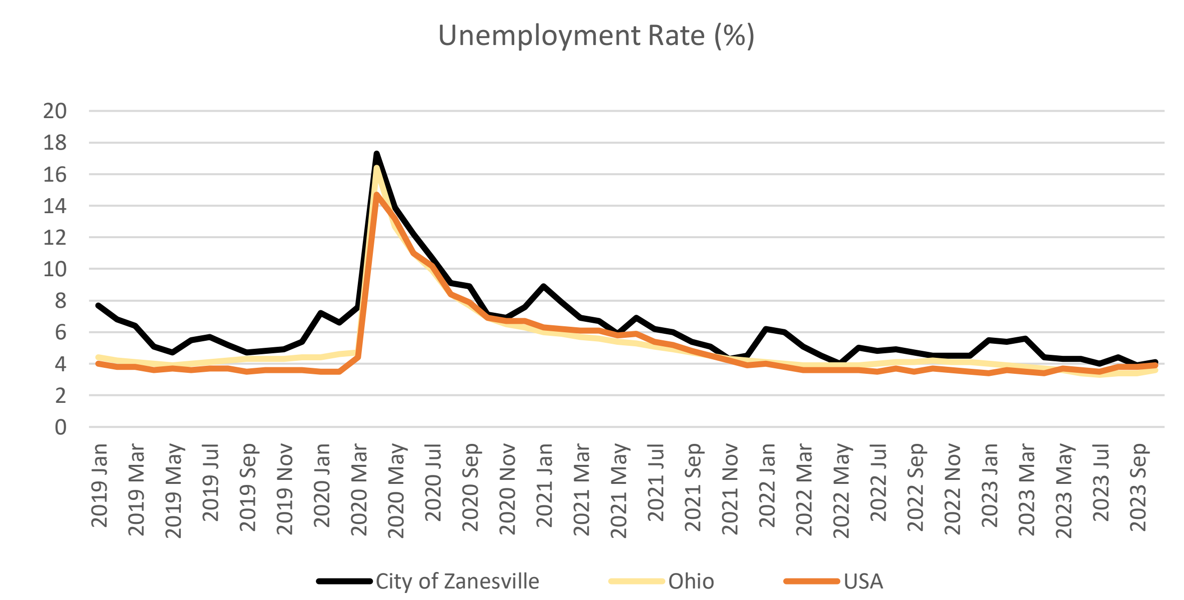
In addition to critical metrics evaluated using the 2021 FCA Guidance, additional data was used to assess the City's financial capability in funding the LTCP Update projects based on other metrics. These metrics are considered in accordance with the 2021 FCA Guidance which encourages communities to use other metrics to assess financial strength,[1] including historic population trends, unemployment trends, labor market indicators, historic rate data and other revenue streams.

4.1 Unemployment Rates

Unemployment trends are relevant to the community's ability to pay future debts and utility rate increases. Figure 4-1 shows that the City's unemployment rates were consistently higher than state and national levels for the evaluation period January 2019 through October 2023. City, state, and national unemployment rates rose to 17.3%, 16.4%, and 14.7%, respectively during the onset of the COVID-19 pandemic in April 2020 and returned to pre-pandemic levels in mid-to-late 2021. However, City unemployment rates over recent years have been consistently higher than state and national levels. From January 2022 to October 2023, the average unemployment rate in the City is 4.75% compared to the average rate in Ohio of 3.84% and the 3.63% across the nation.

The August 2022 unemployment rate used in this EPA financial capability study (Section 3) was at least 1% higher than the national average for the same period, and resultantly was considered a "weak" level according to the EPA's 2021 FCA Guidance. This value was consistent with the evaluation timeframe January 2022 to October 2023, which showed an average difference of 1.1% between City and national unemployment rates.

Figure 4-1: Unemployment Rate at Local, State, and National Levels, 2019-2023



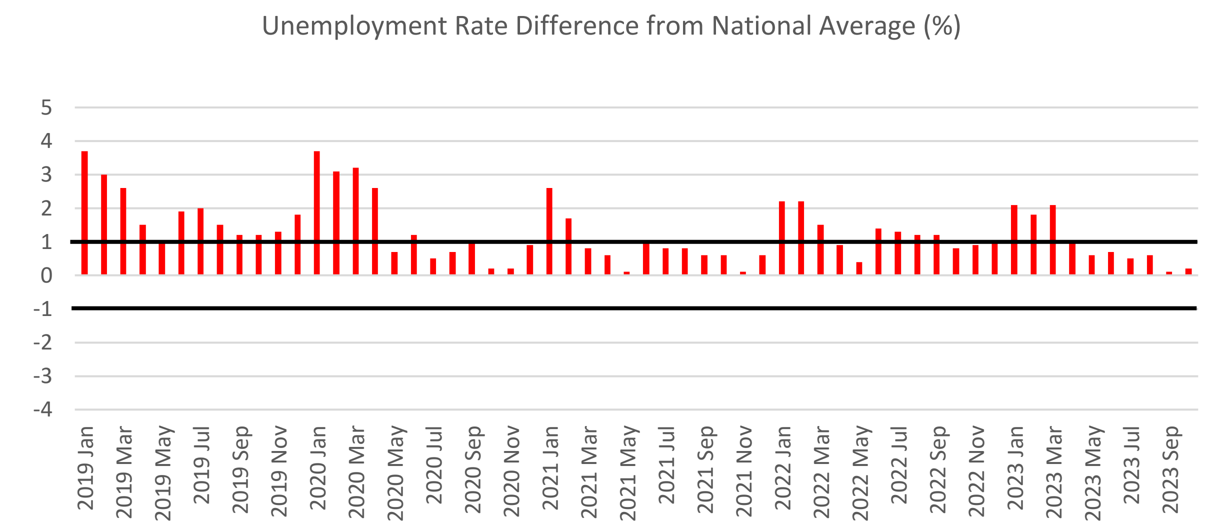
Source: U.S. Bureau of Labor Statistics

Figure 4-2 shows the difference between the City's unemployment rate and the national unemployment rate from January 2019 through October 2023. The August 2022 unemployment

[1] EPA 2021 Financial Capability Assessment Guidance. January 2021. Appendix C.

rate used in this EPA financial capability study (Section 3) was at least 1% higher than the national average for the same period, and resultantly was considered a “weak” level according to the EPA’s 2021 FCA Guidance. This value was consistent with the evaluation timeframe January 2022 to October 2023, which showed an average difference of 1.1% between City and national unemployment rates.

Figure 4-2: City Unemployment Rate Difference from National Average, 2019-2023



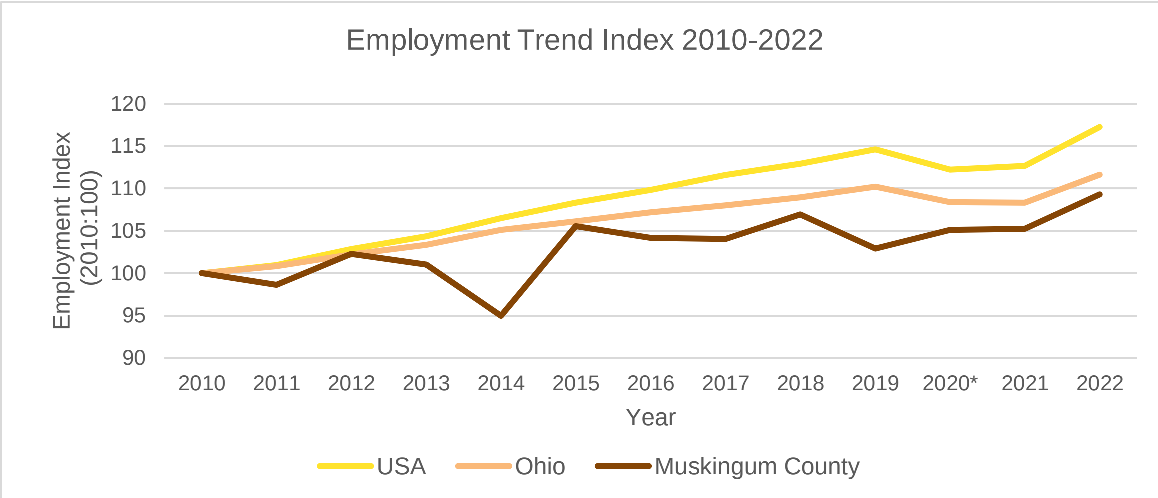
Source: U.S. Bureau of Labor Statistics

Historically high unemployment rates in the City compared to state and national levels suggest that the burden of future CSO projects on the City’s lower income households is higher compared to communities in the state and national. Although the EPA’s 2021 FCA Guidance showed a high LQ burden for lower income households, the severity of the future financial impact on lower income households facing unemployment is difficult to quantify.

4.2 Economic and Demographic Trends

Employment and population data was also used to assess historical trends in population and potential income growth across the City and Muskingum County compared to state and national levels. Figure 4-3 shows the employment trend index for Muskingum County from 2014- 2022 compared to State and National levels. Figure 4-3 also illustrates the oil and gas industry downturn in 2014, where County employment was affected.

Figure 4-3: Employment Trend Index 2010-2022

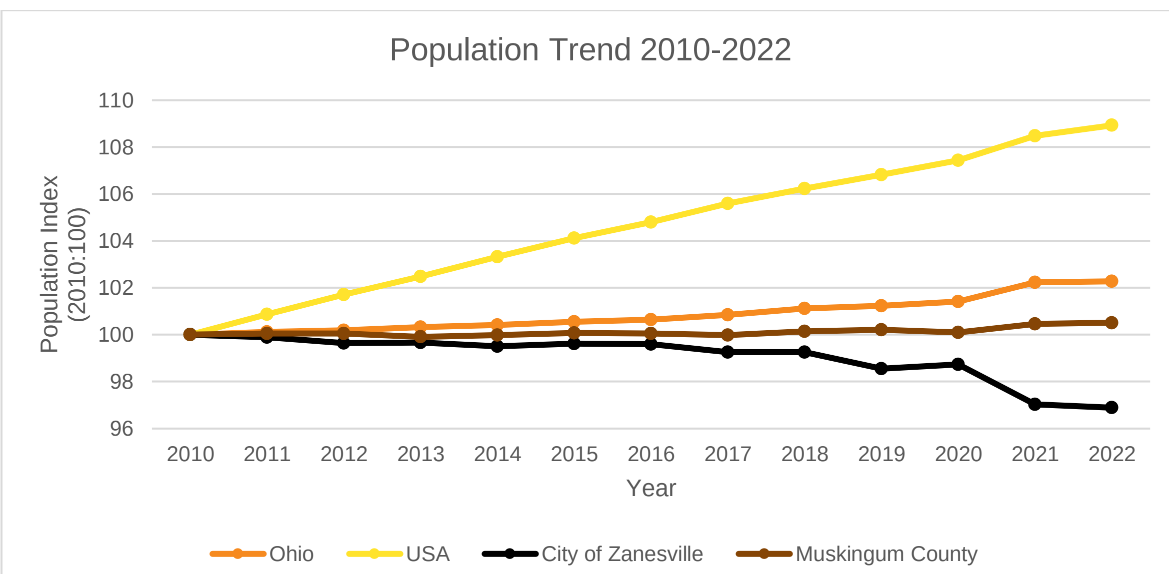


*Source: U.S. Census. 2010-2019, 2021-2022 ACS 1-Year Estimates Detailed Tables. Table ID: B08008; *U.S. Census. 2020 ACS 5-Year Estimates Detailed Tables. Table ID. DP03.*

Figure 4-3 shows that State and National employment trends have shown steady growth since 2010, despite the drop in employment during 2020-2021 as a result of the COVID-19 pandemic. However, the gap between Muskingum County employment levels and State and National employment levels has continued to increase over the past decade. Muskingum County has increased jobs by about 9.3% between the beginning of 2010 and end of 2022, while national and state employment have increased by 11.6% and 17.3%, respectively, for the same time period.

Population data was also evaluated for the same evaluation period 2010-2022. Figure 4-4 shows relative population growth during the evaluation period for the U.S., Ohio, Muskingum County, and the City.

Figure 4-4: Population Trend index 2010-2022



Source: U.S. Census. 2010-2022 ACS 5-Year Estimates Detailed Tables. S ID: DP05.

Figure 4-4 shows that the City population has decreased in the 13-year evaluation timeframe with an overall 3.1% decline in local population from the beginning of 2010 to the end of 2022.

Muskingum County population has only slightly decreased with an overall 0.5% decline over the same timeframe. In contrast, national, and state population trends increased, with an overall 8.9% rise in national population and an overall 3.1% rise in state population from 2010 through 2022.

At the county level, population trends are not following national growth, representing a challenge to the local economic base as employment has slightly increased over the past 13 years. The stagnant local population observed in Figure 4-4 would influence the forecast for the region as per the existing correlation with number of households in the service area.

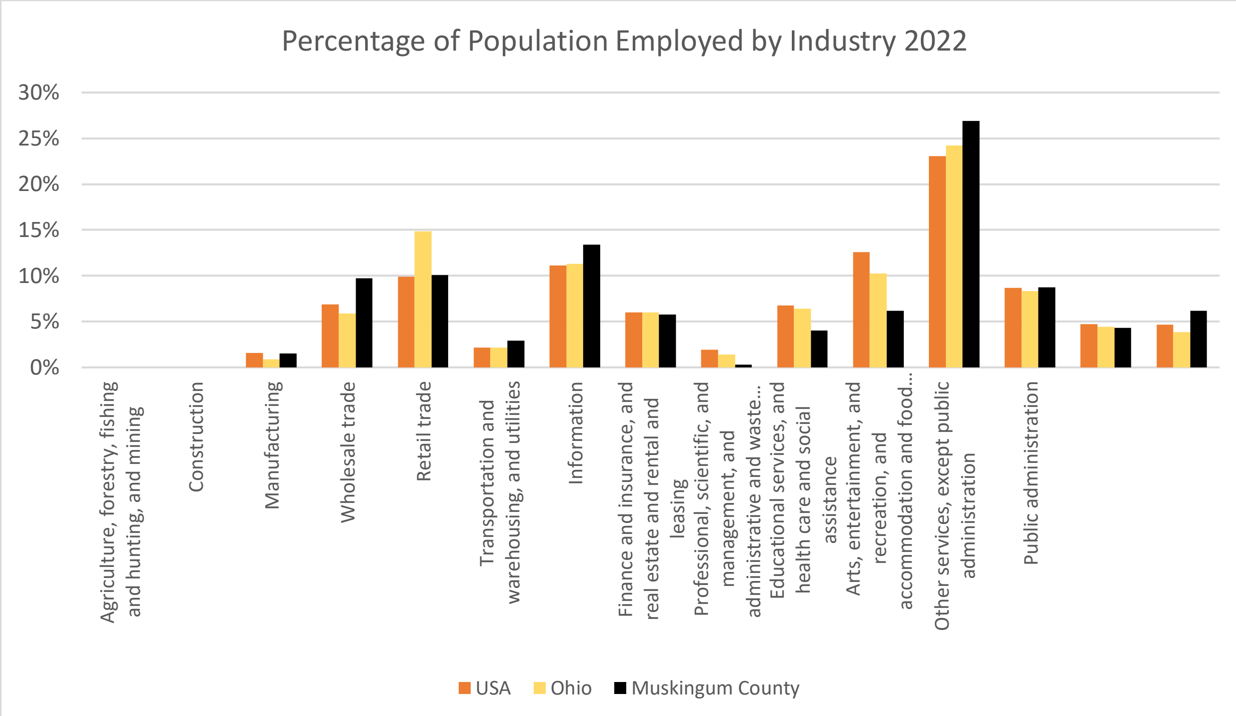
Figure 4-3 and Figure 4-4 show that the gap between the City and other communities has widened over time. Therefore, the City can expect to be less competitive now and even more so in the future relative to EPA's implicit benchmark communities. The projected impact of the City's declining population on the City's future CSO burden is further discussed in Section 4.4.

4.3 Industrial Structure

A key element of the local economic landscape is related to the industrial structure or the "diversification risk". States and localities that diversify employment across different industries are less likely to suffer from sector-specific shocks. Examples of shocks may include a collapse in natural resource prices or a sudden change in the terms of international trade. If a region does have a disproportionate amount of employment in a single sector, it is best if that sector is expected to have a promising future.

Compared to the nation, Ohio has a similar distribution of employment by industries as referenced in Figure 4-5. For the City, it is not only under-diversified, but it also depends disproportionately on industry sectors that were directly impacted by COVID-19 pandemic—retail, arts and entertainment industries. The retail industry was responsible for 16.8% of the City's jobs in 2022, compared to the national and state levels of 11.1% and 11.3%, respectively. In a similar trend, the arts and entertainment industry accounted for 12.1% of the City's jobs in 2022, compared to 8.7% and 8.4% for the national and state proportions.

Figure 4-5: Percentages of Population Employed by Industry, 2022



Source: U.S. Census. 2022 ACS 5-Year Estimates Detailed Tables. Table ID: S2405.

The relative lack of diversification across the City's employment base, which can be measured directly in a variety of ways, and the current outlook for these two key industries can create a challenging environment for an economically distressed area.

The economic risks posed by specialization in declining sectors, as well as lack of industry diversification, are used by rating agencies to evaluate municipal bond issues. Because of the City's industrial concentration, it is likely that the trends depicted in Figure 4-3 and Figure 4-4 will continue for as long as the City's CSO debt remains on the books.

4.4 Residential Indicator Score Trend Analysis

A trend analysis was performed to evaluate the potential impact of the City's RI score based on the historical decline in the City's population— and rate payers—over time. This trend-based analysis was encouraged by the 2021 FCA Guidance as a supplemental metric for assessing a community's ability to fund CWA control measures in addition to the EPA's expanded financial capability assessment presented in Section 3 of this report. Trend-based analyses are also especially useful in instances where there is a widening "gap" in population and income trends between the permittee and benchmark communities.

Table 4 shows a summary of the trend-based RI analysis including the projected RI scores if the City's income and population followed the same historical rates observed for state and national levels from 2010-2022. The City's RI score is also shown based on the City's historical population decline of 3.1% from 2010 to 2022.

Table 4: City of Zanesville RI Score Trend Analysis

	Population growth 2010-2022	Household forecast based on population growth 2010-2022	2023 MHI*	RI Score (CPH as a Percent of Adjusted MHI)	RI Category
City of Zanesville:	-3.1%**	10,330	$42,909	1.53%	Mid-Range
If Zanesville is measured at:					
Ohio levels:	2.3%	10,905	$70,235	0.89%	Low
National levels:	8.9%	11,614	$78,789	0.74%	Low

**2022 MHI adjusted by the GDP deflator to 2023 dollars.*

*** Zanesville, OH population growth 2010-2022.*

The findings of this analysis show that the City's relatively weak growth in household income and its historical decline in population is predicted to result in a future RI score that is (1) higher than it is today, and (2) higher than it would be if the City's population and household income grew at the same rate as Ohio communities and the U.S during the evaluation period 2010-2022. If the City's population grew at the same rate as Ohio and the U.S. (2.3% and 8.9% from 2010-2022, respectively), the resulting RI score would be 0.89% and 0.74%, respectively, and would fall into the low-impact RI category based on EPA's benchmarks.

The differences in projected RI scores shown in Table 4 show that the City's future CSO cost burden is underestimated by the RI scoring included in the EPA's expanded financial capability matrix, as it fails to consider the City's relatively weak economic and demographic trends. This analysis shows that a MHI level that can change the City's RI category from High to Mid-Range or Low would be the equivalent to almost the upper limit on the fourth quintile of the City's household income, suggesting a long path to reach that level for the City's economy in the short- and medium-term.

More specifically, the City's RI score presented in Section 3.2—mid-range—understates the City's burden from future CSO control measures under the LTCP Update. This is due to the relative decline in income and in the number of ratepayers across the City, resulting in a deterioration of the City's RI score relative to peer communities. Because cross-jurisdictional benchmarking is a common practice under financial risk assessment, this is crucial information for evaluating the City's LTCP Update implementation schedule duration.

4.5 Income Tax Reliance

The City of Zanesville, like many cities in Ohio, levies a municipal income tax. It is appropriate to look at the income tax burden when analyzing the City's financial capability for capital expenditures under the LTCP Update.

Municipal income tax revenue for the City was $22,036,664 in 2022.[2] This tax accounted for 80.8% of the City's general revenues. However, the EPA's 2021 FCA Guidance does not consider the tax burden when calculating the FCA Burden. According to Table 3, only 0.40% of the market value of the City's real property is being collected in property taxes. If the equivalent of the City's income tax revenue needed to be raised from real estate, as is the case in most small cities in the U.S., then this component of the expanded financial capability matrix would be

[2] City of Zanesville Annual Report for the Year Ended December 31, 2022, p.8

12 times as large. The larger number is the correct one, according to the Environmental Financial Advisory Board: “this metric should be calculated as the full burden of property taxes plus system charges plus other local taxes (e.g., wage taxes) as a percentage of the full market property value.”[3]

Communities that rely heavily on a local income tax are more exposed to risks to their finances. Taxes collected from local incomes disappear as soon as the jobs do. Property taxes, on the other hand, continue to be paid, even when a bank takes over a property. Changes in assessed value typically lag behind changes in market price, cushioning the community against the effects of a housing downturn. No such lag exists for an income tax, especially if it is collected by payroll deduction.

[3] EFAB Analysis and Recommendations on: Draft Financial Capability Assessment Framework, September 16, 2014, p.9

5. LTCP Update Residential Burden

5.1 Past and Projected Sewer and Water Rates

The City closely monitors its utility rates for sewer, water and storm water services and has increased rates in the past years to cover capital expenditures and annual operating expenses for these services. In 2022, the City's revenue from sewer, water, sanitation and stormwater services of $21.9 million was offset by the City's expenses for these services at $13.5 million. Increased net revenue for sewer, water and storm water services is mainly attributed to the City issuing rate increases for these services. The City has made the following increases to utility rates in recent years:

- Sewer rates – From 2018 to 2022, average annual sewer rates have increased by 11.1% based on a monthly average sewer usage rate of 4,000 gallons. Figure 2-1 shows the City's average sewer rates compared to state average sewer rates from 2018 to 2022.
- Water rates – From 2018 to 2022, average annual water rates have increased by 54.2% based on a monthly average water usage rate of 4,000 gallons.
- Storm water rates – The City increased its rates from $1.36 to $3.0 per equivalent residential unit (ERU) in 2019 and has continued to increase annual storm sewer service rates by $0.50 from 2019 through 2024. Starting in 2024, the City's storm sewer rates will be adjusted by 2.5% annually until further notice.

Although the City's utility rates have increased in recent years, recent sewer and water rate surveys show that the City's rates are low compared to the average Ohio rates based on data from 2018-2022. Average rate data for 2019 and 2022 was obtained from Ohio EPA's annual sewer and water rate surveys, and rate data for 2020 was obtained from the University of North Carolina's Environmental Finance Center Ohio Dashboard. In the latest sewer rate survey published (2022), the City's sewer rate was 39.8% lower than the average sewer rate for the State of Ohio. The City's water rate was 20.1% lower than the average water rate for the State of Ohio for the same time period.

Figure 5-1 shows the City's estimated annual sewer charges compared to the average Ohio annual sewer charges from 2018-2022. Note that rate data was unavailable for 2021.

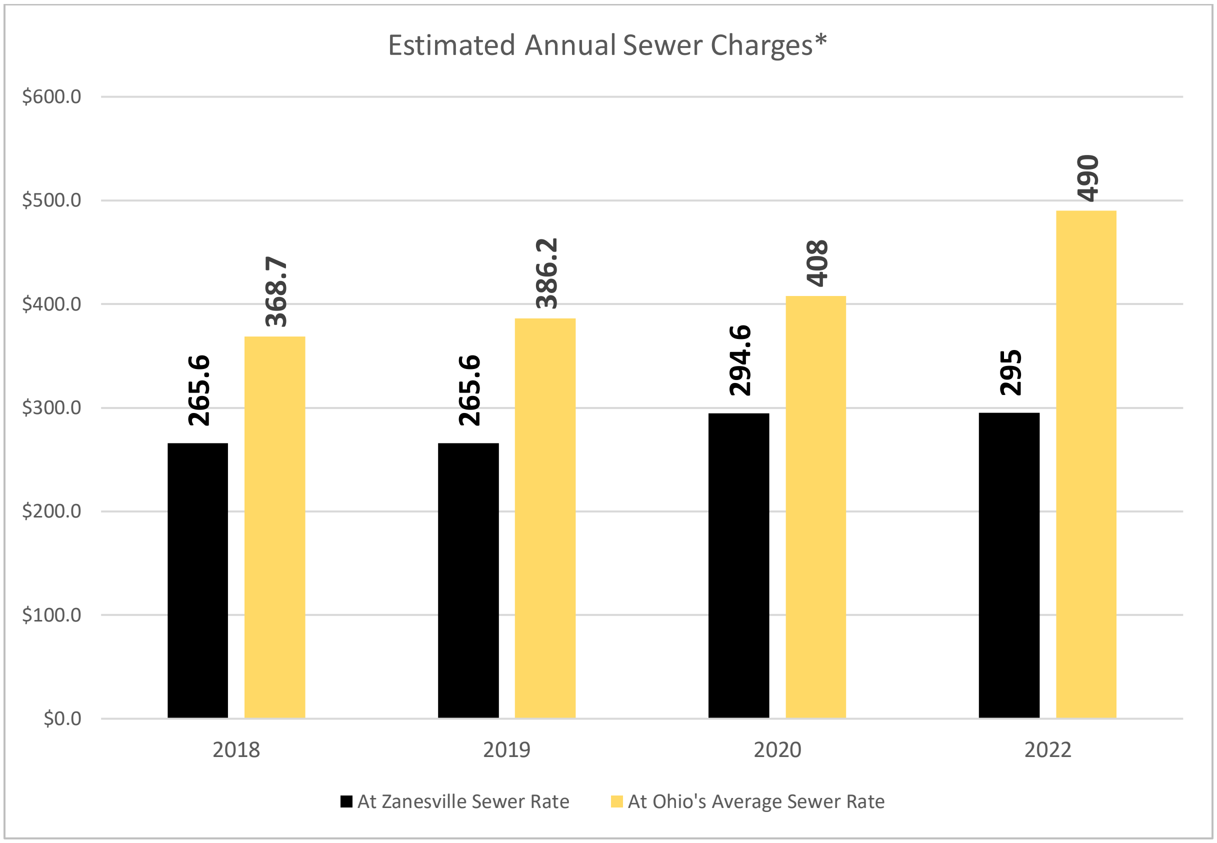


Figure 5-1: Estimated Annual Sewer Charges – City of Zanesville and Ohio

* Annual Sewer charges calculated based on an average monthly rate for 4,000 gallons of sewer flow.

Sources: Ohio EPA's 2019 Sewer and Water Rate Survey, Ohio EPA's 2022 Sewer and Rate Survey, University of North Carolina's Environmental Finance Center: Ohio Dashboard, 2020.

The high-level analysis of historical average sewer rates shows that the City has had historically lower sewer rates compared to Ohio municipalities based on the 2018-2022 evaluation period. However, as discussed in Section 4, the City has also experienced comparatively higher unemployment rates and lower population trends and household income levels when compared to Ohio communities for the same timeframe. Additional increases to the City's utility rates as a result of future LTCP Update capital and operating costs will impose and accelerate a new round of rate increases on a population that has not experienced a considerable rate shock over the last decade. Any construction schedule shorter than the recommended 25 year implementation period would increase rates on an annual basis even faster.

5.2 Impact on Lower Income Populations

As discussed in previous sections of this report, capital expenditures under the LTCP Update are anticipated to have a severe impact on the City's lower income populations which are shown to be more prevalent in the City than compared to other Ohio communities. According to the U.S. Census Bureau's ACS, 25.2% of the City's households lived in poverty in August 2022. The equivalent figure for the State of Ohio was 13.3%. These statistics show that a higher percentage of households in the City will have difficulty paying the projected sewer bills than would be the case in other municipalities in Ohio.

Furthermore 30.7% of the City's households earned less than $25,000 annually in August 2022, as opposed to 17.5% of the State of Ohio households at that level. However, this $25,000 income falls in the third quintile for household income across the City and is above the poverty rate. It is nevertheless convenient because it is used as a boundary for reporting local income distribution in the Census Bureau's ACS. Using the $25,000 breakpoint, the future sewer bill for these households would be a minimum of 2.33% of household income—this figure jumps to 3.42% when the upper limit of the City's lowest quintile household income is used. As a result, all households making less than $25,000 would pay a higher percentage of their income in sewer costs than 2.33%. Combined with the City's weak property tax collection rate, these statistics show the significant financial hardship likely to be experienced by the City and its residents due to the LTCP Update capital and operating costs.

6. Conclusions and Schedule Recommendations

Based on the Alternative 1 methodology included in EPA's 2021 FCA Guidance and the other metrics evaluated in Section 4, the City of Zanesville and its residents are expected to experience a **high burden** due to the financial requirements associated with the $46.2 million capital costs under the LTCP Update. While the EPA's 2021 FCA Guidance methodology also showed a medium-impact FCA Burden as a result of the LTCP Update, it is reasonable to conclude that this impact is severely understated based on the City's above-average poverty rates, relatively weak per-household income growth, gradual decline in population, and limited diversification compared to other communities in Ohio and across the U.S. If benchmarking a community's financial burden against its peers is important—as implied by the EPA's 2021 FCA Guidance burden thresholds—then the future outlook of the City's economic and demographic states should be considered in assessing its ability to fund future CWA measures.

The City's heavy reliance on retail and the arts and entertainment industries indicates that these trends are likely to continue over the period when the City must continue to pay debt service on its CSO liabilities. Because household income and population size directly affect the residential indicator, these trends will make the gap between the City's CSO cost burden even higher relative to other communities in the future than it is today. Heavy reliance on a local income tax and struggles to materialize rate increases would add a volatility risk into the City's financial capabilities.

Analysis of future projected sewer costs under the LTCP Update suggests that future sewer rates would increase once all LTCP Update costs are borrowed. Although the City's rates are 39.8% lower than the Ohio average based on 2022 data, acceleration of future rate increases to cover LTCP Update costs might not be considered affordable for a large portion of the City's households based on current poverty and household income levels.

Based on the EPA's 2021 FCA Guidance and other metrics including historical and projected unemployment rates, population trends, income tax reliance, and industrial structure, the recommended implementation schedule for the LTCP Update is 25 years. This is consistent with guidance and intentions of the 2021 FCA Guidance and with other schedules that have been granted to other Ohio communities experiencing high burden CSO rates.

Appendix A – Residential Factor Calculations

Table A1: City of Zanesville Historical Flow Data Summary

Flow Parameter	Value	Source
Average Total Systemwide Flow (Dry Weather)	5.84 MGD	WWTP average daily influent flow during dry weather, 2019 (Refer to Table 9-1 of LTCP Update)
Average Industrial Flow	444,487 gpd	City of Zanesville industrial flow records, 2016-2020
Average Non-Industrial Flow	**4.89 MGD**	**Average Total Systemwide Flow – Average Industrial Flow**

Table A2: Non-Flow Percentages Summary

Non-Industrial Flow Type	% of Non-Industrial Flow	Source	Average Daily Flow	Estimated % of Total Systemwide Flow
Residential	90.5%	City of Zanesville household billings, 2019	(90.5%* 4.89 MGD)= 4.57 MGD	4.57 MGD / 5.84 MGD = **83.6%**
Commercial	9.46%	City of Zanesville commercial billings, 2019	(9.46%* 4.89 MGD)= 0.48 MGD	0.48 MGD/ 4.57 MGD= 8.7%

Residential Factor = Estimated percentage of residential flow in the system

Residential Factor = 83.6%

Appendix B – EPA Critical Metric Calculations

Table B1: RI Analysis, 2021 FCA Guidance

Line	Description	Value / Input	Comments
Current Wastewater Costs - Excluding Revenue Funded Capital Projects			
100	Annual WWT Operations and Maintenance Expenses (less depreciation)	$3,580,975.00	Annual Financial Report. 2022 (p. 25)
101	Annual Debt Service (Principal & Interest)	$1,398,670.00	Annual Financial Report. 2022. (p. 26)
102	**Subtotal - Current Wastewater Costs**	**$4,979,645.00**	
Projected CSO Costs[4]			
	Total Proposed CSO Capital Expense	$40,035,000	Cost Estimate for the selected alternative in 2021 Dollars.
	Total Proposed CSO Capital Expense in 2023$	$46,541,490	Using the GDP deflator (Rounded)
	O&M as % of Total WWTP Investments	1.10%	Estimated at 1.1% of CAPEX
103	Projected Annual Operations and Maintenance Expenses	$511,956	Rounded
	Interest Rate for Debt Service	2.88%	Rate for a Zanesville 2023 OWDA sewer loan.
	Bond Term for Debt Service	25	
104	Annual Debt Service on CSO Projects to be Funded	$2,637,168	Rounded
105	**Subtotal - Projected CSO Costs**	**$3,149,124**	Line 103 + Line 104 (Rounded)
106	**Total Current and Projected Wastewater and CSO Annual Costs**	**$8,128,769**	Line 102 + Line 105 (Rounded)
Residential Factor Calculation			
	Residential Factor	83.6%	Estimated % of Residential Flow. Refer to Appendix A.
107	Residential Share of Wastewater and CSO Annual Costs	$6,795,651	
108	Total Number of Households in Service Area	10,662	Households, 2018-2022. Census.gov
109	**Annual Wastewater Cost Per Household (CPH)**	**$637**	Line 107 / Line 108
Calculation of Residential Indicator			
201	Median Household Income (MHI)	$40,927	MHI in $2022. Census.gov
202	MHI Adjustment, 2022 to 2023.	1.048	**Deflator**
203	Adjusted Median Household Income (retail service area)	$42,909	Line 201 x Line 202
204	Annual WWT and CSO control cost per Household	$637	Line 109
205	**CPH as a Percent of Adjusted MHI**	**1.49%**	**Line 204 / Line 203**
	Residential Indicator Category	**Mid-Range**	

[4] Projected CSO costs were rounded to the nearest thousand from line item 103 to 106.

Table B2: FCI Analysis, 2021 FCA Guidance

Line	Description	Value / Input			Comments
Debt Indicators					
Bond Rating					
	Rating Agency	Moody's			
301	**Bond Rating**	**A1**			
Overall Net Debt as a Percentage of Full Market Property Value					
401	Direct net debt	$34,478,671			Annual Financial Report 2002. Principal Outstanding 12/31/2022 (p. 75-77) Less Net Pension Liability Outstanding 12/31/2022.
402	Prop. Share of multijurisdictional debt	$0			
403	Overall net debt	$34,478,671.00			Line 401 + Line 402
404	Market value of real property	$426,067,130.00			Annual Financial Report 2022. Note 7
405	**Net debt as % of property value**	**8.09%**			**(Line 403 / Line 404) x 100**
Socioeconomic Indicators					
Unemployment Rate					
501	Unemployment rate for permittee	4.90%			Aug. 2022 BLS Unemployment Rate: Zanesville city, OH (U). Series ID LAUCT398808400000003
503	Average National unemployment rate	3.70%			Aug. 2022 BLS: https://data.bls.gov/timeseries/LNS14000000
Median Household Income (MHI)					
601	MHI of permittee	$42,909			Line 203
602	MHI of USA in $2018	$75,149			2018-2022 American Community Survey 5-Year Estimates
603	MHI adjustment factor, 2018 to 2019	1.0484			Line 202
604	Adjusted national MHI	$78,789			Line 602 x Line 603
Financial Management Indicators					
Property Tax Revenue Collection Rate					
701	Market value of real property	$426,067,130			Line 404
702	Property Tax Revenues	$1,708,000			Annual Financial Report. 2022. p8 (Prop. Taxes + Payment in Lieu of Taxes)
703	**Tax revenue as % of value**	**0.40%**			**(Line 702 / Line 701) x 100**
Property Tax Revenue as a percent of Full Market Property Value					
801	Property Tax revenue collected	$1,708,000			Line 702
802	Property tax levied	$1,927,683			Annual Financial Report 2022. p14 (Prop. Taxes Receivable + Payments in Lieu of Taxes)
803	**Revenue collection rate**	88.60%			**(Line 801 / Line 802) x 100**
Summary of Permittee Financial Capability Indicators					
901	Bond Rating	8.09%	Strong	3	Above Investment Grade
902	Net debt as % of value	4.90%	Weak	1	More than 5.0%
903	Unemployment rate	$42,909	Weak	1	More than 1% above National Average
904	Median household income (MHI)	0.40%	Weak	1	More than 25% below Adj. National MHI
905	Revenue as a % of market value	88.60%	Strong	3	Below 2% Market Value
906	Prop. tax revenue collection rate	8.09%	Weak	1	Below 94%
907	**Financial Capability Indicator (FCI) Score**			**1.67**	Average of lines 901-906

1001	Residential Score	1.49%	**Mid-Range**	
1002	Permittee Financial Capability Score	1.67	**Mid-Range**	
1003	**Capability Matrix Category (FCA Burden)**	**Medium Burden**		**Financial Capability Matrix - Table**

Table B3 LQRI and PI Analysis, 2021 FCA Guidance

Line	Description	Value / Input		
	Calculation of Lowest Quintile Residential Indicator (LQRI)			
1	Ratio of Lowest Quintile household size to Median HH Size	70.20%		
2	Cost of Median Household	$637		
3	Cost for Lowest Quintile Household	$447		
4	Upper Limit of Lowest Income Quintile for Service Area	$17,030		
5	**Cost as % of Low-Income Household**	**2.63%**		
	LQRI Impact Rating		**High Impact**	
	Calculation of Poverty Indicator (PI)	***Value / Input***	***Benchmark***	***Score***
PI#1	Percentage of population with income below 200% of Federal Poverty level		78%	1
	National Values - Percentage below poverty level	28.80%		
	Zanesville, OH	51.33%		
PI#2	Percentage of population with income below Federal Poverty level		102%	1
	National Values - Percentage below poverty level	12.50%		
	Zanesville, OH	25.20%		
PI#3	Upper limit of lowest income quintile for service Area		-45%	1
	National Values - Upper limit of lowest quintile	$30,785		
	Zanesville, OH	$17,030		
PI#4	Lowest quintile income as a percentage of aggregate income		10%	2
	National Values - Lowest quintile as a percentage of aggregate household income	3.07%		
	Zanesville, OH	3.37%		
PI#5	Percentage of population receiving food stamps/SNAP Benefits		174%	1
	National Values - Population receiving food stamps/SNAP benefits as a percentage	11.50%		
	Zanesville, OH	31.50%		
	Sum of Rating Scores			6
	Poverty Indicator Score (Average)			**1.20**
	PI Impact Rating		**High Impact**	
	LQ Burden (LQRI and PI)	**High Burden**		

Appendix I Secondary Bypass Elimination No Feasible Alternatives Evaluation

Appendix I
Secondary Bypass Elimination No Feasible
Alternatives Evaluation

AECOM
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Columbus, OH 43215-2566
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To:	David Brumbaugh Ohio EPA, Central Office Division of Surface Water
From:	Maria DeLuca, PE; Jacob Mix, PE (AECOM)
Subject:	Secondary Bypass Elimination No Feasible Alternatives Evaluation
Date:	7/11/2024

1 INTRODUCTION

1.1 Background

1.1.1 2009 WWTP Upgrades

The City's original Long Term Control Plan (LTCP) was approved by Ohio EPA in 2007. A key part of the original LTCP was the WWTP upgrades project which involved expanding the WWTP facilities to provide primary treatment for peak hourly flow (PHF) rates up to 36.2 MGD and provide secondary treatment for PHF rates up to 27.1 MGD. The design average daily flow for the WWTP upgrades was 11 MGD. Design flows were established based on 20-year flow projections completed by the City in 2000. The City completed the WWTP upgrades project in two phases between 2004 and 2009 in accordance with the City's original LTCP milestone date of 2010.

Major improvements performed during the WWTP upgrades project to increase the secondary treatment capacity from 27.1 MGD to 36.2 MGD include replacement of the four existing secondary pumps with larger pumps, installation of four solids contact tanks, and installation of a fourth secondary clarifier.

Another critical component of the WWTP upgrades project was the addition of the "secondary bypass," a 42-inch pipe located between the secondary pump station and the chlorine contact tank which was designed to overflow when the design capacity of the secondary pump station (27.1 MGD) was exceeded. Secondary bypasses would be conveyed directly to the chlorine contact tank for disinfection and blended with secondary effluent prior to discharge.

The 1997 version of Great Lakes – Upper Mississippi River Board (GLUMRB) 10 States Standards design guidelines recommended a minimum surface overflow rate (SOR) of 3,000 gpd/ft^2 for primary clarifiers. The existing 72-ft diameter primary clarifiers are rated for a PHF rate of 36.2 MGD and were designed for an SOR of 3,000 gpd/ft^2 in accordance with the 1997 GLUMRB Ten States Standards. In 2004, GLUMRB published an updated version of 10 States Standards which required a minimum SOR for primary clarifiers of 2,000 gpd/ft^2 for primary clarifiers. Resultantly, the WWTP upgrades project included installation of a Chemically Enhanced Primary Treatment (CEPT) system designed to meet the minimum primary clarifier surface overflow rate (SOR) of 2,000 gpd/ft^2 per the 2004 version of 10 States Standards. The CEPT system includes ferric chloride and polymer feed, storage and flash mix equipment.

After completion of the WWTP upgrades project, the secondary bypass was included in the City's WWTP NPDES Permit as "Station 602." The City is required to monitor and report Station 602 discharges to Ohio EPA under the existing NPDES Permit.

Figure 1 shows a flow schematic of the existing WWTP including major processes and design capacity following the completion of the WWTP upgrades project.

1.1.2 Post-Upgrades Capacity Limitations

While the WWTP upgrades project was designed to expand the WWTP primary to 36.2 MGD and restore the secondary treatment capacity to 27.1 MGD, several hydraulic bottlenecks and operational challenges have been observed since 2009 which have resulted in a limited hydraulic capacity at the existing WWTP.

Stress tests and evaluations performed in 2013 by URS showed that the WWTP capacity was limited due to several hydraulic bottlenecks including:

- Existing secondary splitter weir gate – the splitter weir gate causes an uneven flow split between each secondary clarifier, resulting in overflows from the secondary clarifiers.
- Solids contact tank – the solids contact tank capacity is limited to 23.6 MGD with optimum secondary settings based on a minimum of 6 inches of freeboard at the entrance to the solids contact tank. Chlorine contact basin – the chlorine contact basin does not provide adequate detention time (per 10 States Standards) at flows greater than 30 MGD.

Based on the 2013 study findings, the WWTP secondary treatment capacity was limited by the solids contact tank with a treatment capacity of 23.6 MGD based on a minimum 6 inches of freeboard.

In 2017, the City performed a 30 MGD stress test. The results showed that the secondary bar screens (the 3/4" bar screens located downstream of the 3/8" fine screens) became blinded at flows greater than 25 MGD.

As a result of historical stress tests and evaluations, the City previously throttled back influent flows to approximately 23.6 MGD. An additional evaluation was performed by AECOM in 2020 (included as Appendix B to the LTCP Update report) to further evaluate the existing capacity of the WWTP. This evaluation confirmed the findings from the 2013 study and also discussed several operational challenges which resulted in a treatment capacity reduction including manually operated gates and valves. The 2020 study was used as the basis of recommendations included in the City's LTCP Update.

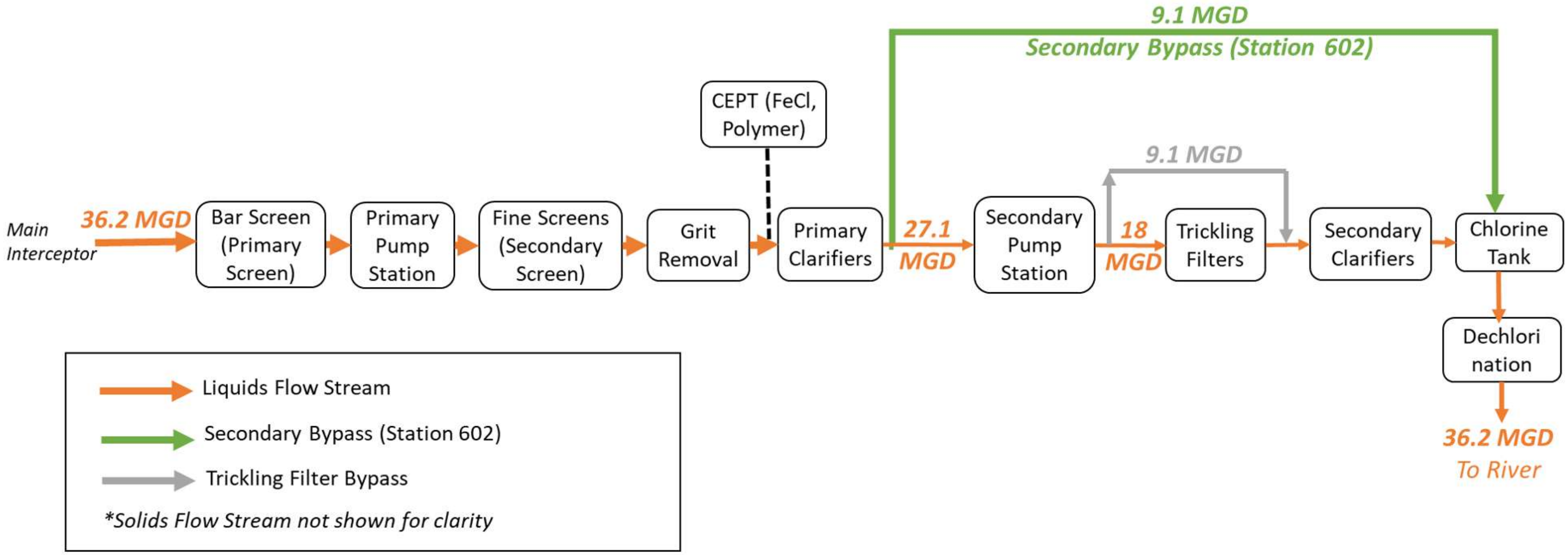

Figure 1: Existing WWTP Liquids Flow Stream Overview

1.2 LTCP Update WWTP Improvements

The City submitted a draft version of the LTCP Update to Ohio EPA in December 2021 for review. The proposed WWTP improvements included in the draft LTCP Update report included various projects to improve operations at the WWTP and restore the existing WWTP primary treatment capacity to the design capacity of 36.2 MGD and the secondary treatment capacity to the design capacity of 27.1 MGD. By restoring the intended design capacity of the WWTP, the secondary bypass (Station 602) would remain as part of the WWTP's wet weather treatment system as it is required to be in place for secondary flows above 27.1 MGD. The proposed LTCP Update WWTP Improvements projects are summarized in **Table 1-1**.

Since 2020, the City has made progress in performing the proposed WWTP improvements including:

1. Removal of the secondary bar screens, which allowed the City to no longer throttle flows to the influent pump station. This removed the influent flow restriction to the WWTP and allowed full flows to enter the WWTP for treatment.
2. Contracted with a design consultant to begin preliminary design of the LTCP Update WWTP improvements Phase I projects to address hydraulic bottlenecks and operational issues identified during development of the LTCP Update (refer to **Table 1-1** for proposed improvements).

Table 1-1 summarizes the LTCP Update WWTP Improvements projects included in the LTCP Update, corresponding status of completion, and the opinion of probable construction cost (OPCC) in 2023 dollars. For purposes of this No Feasible Alternatives (NFA) analysis, estimated costs from the LTCP Update were escalated from 2021 dollars to 2023 dollars using the U.S. BLS GDP deflator. Further detail on the specific components included in each project is included in **Appendix B** of the LTCP Update.

Table 1-1: LTCP Update WWTP Improvements Summary

Description		Status of Completion	OPCC (2023 Dollars)***
LTCP Update WWTP Improvements – Phase I	Removal of Primary Bar Screens*	Completed	-
	Trickling Filter Improvements	Ongoing	$320,000
	Secondary Clarifier Improvements		$3,139,000
	UV Disinfection Improvements		$3,778,000
	Plantwide Automation Improvements*	Future	$291,000
	Plantwide PLC Upgrades		$581,000
	Secondary Pump Station Improvements*		$581,000
LTCP Update WWTP Improvements – Phase II	Primary Pump Station Improvements	Future	$1,860,000
	Primary Clarifier Bypass (Process Improvement Modifications)		$174,000
	Sludge Pumping Improvements		$58,000
	Sludge Dewatering Improvements		$1,511,000
	Digester Building Improvements		$233,000
	Miscellaneous Improvements		$58,000
Subtotal Opinion of Probable Construction Cost:			**$12,584,000**
Engineering Design & Construction Oversight (20%):			$2,517,000
Construction Phase Contingency (10%):			$1,258,000
Design Phase Construction Contingency (10%):			$1,258,000
Permitting, Legal and Miscellaneous:			$30,000
Total Opinion of Probable Cost:			**$17,647,000**

**Required to restore the existing WWTP primary treatment capacity to a PHF of 36.2 MGD and the secondary treatment capacity to a PHF of 27.1 MGD*

***Includes permits, engineering design and construction administration, design phase construction contingency and contingency for change orders during construction.*

****Estimated costs included in the LTCP Update were escalated from 2021 dollars to 2023 dollars based on the U.S. BLS GDP deflator.*

The total opinion of probable cost (including construction, permits, engineering design and construction administration, and contingencies) for the proposed LTCP Update WWTP improvements is $17.65 million in 2023 dollars (escalated from $15.18 million in 2021 dollars using the U.S. BLS GDP deflator). These costs are in addition to the proposed sewer improvement projects included in the LTCP Update which are estimated to be approximately $28.89 million in 2023 dollars (escalated from $24.86 million in 2021 dollars), resulting in a total LTCP Update program cost of $46.54 million in 2023 dollars ($40.04 in 2021 dollars).

1.3 Purpose

As discussed in **Section 1.2**, the City's LTCP Update proposed that the capacity of the existing WWTP be restored to the intended design capacity (36.2 MGD primary treatment capacity and 27.1 MGD secondary treatment capacity). As a result of these proposed improvements, the secondary bypass (Station 602) would remain as part of the WWTP's wet weather treatment system as it is required to be in place for secondary flows above 27.1 MGD.

During September and October 2023, the Ohio EPA and the City exchanged comments on the draft City of Zanesville LTCP Update report including the proposed WWTP improvements. In the Ohio EPA response letter dated October 6, 2023, the Ohio EPA requested that a No Feasible Alternative (NFA) analysis be provided to support and maintain approval of CSO-related bypasses from the secondary bypass (Station 602) at the WWTP.

The purpose of this technical memorandum is to provide the NFA analysis to evaluate the feasibility of eliminating the existing secondary bypass (Station 602) at the City's WWTP. Potential alternatives were developed and evaluated to determine the most cost-effective solution for wet weather treatment at the WWTP for inclusion into the City's LTCP Update.

2 WWTP IMPROVEMENTS ALTERNATIVES

Alternatives were evaluated regarding the secondary bypass (Station 602). These include:

- Alternative 1: Complete WWTP improvements listed in **Table 1-1** and perform Full Secondary Treatment Upgrades to increase full treatment capacity to 36.2 MGD and eliminate the secondary bypass.
- Alternative 2: Complete WWTP improvements listed in **Table 1-1** to restore secondary treatment capacity to 27.1 MGD, install an Equalization Basin to provide storage for primary treated flows exceeding 27.1 MGD and eliminate the secondary bypass.
- Alternative 3: Complete WWTP improvements listed in **Table 1-1** to restore secondary treatment capacity to 27.1 MGD, keep the secondary bypass in place for flows above 27.1 MGD, and utilize the existing CEPT system for flows above 24.5 MGD.

The following subsections discuss the proposed improvements required to expand existing secondary treatment units from a design capacity of 27.1 MGD to 36.2 MGD. These improvements would be in addition to the improvements included in the LTCP Update and discussed in **Section 1.2**.

2.1 Alternative 1: Full Secondary Treatment Upgrades

2.1.1 Secondary Pump Station

The four existing secondary pumps each rated for approximately 9 MGD at 58' TDH provide a firm capacity of 27.1 MGD. Increasing firm secondary pumping capacity to 36.2 MGD would require either an additional ~9 MGD pump, or the replacement of all four existing ~9 MGD pumps with ~12 MGD pumps. Additionally, piping and valving would need to be replaced/upsized and/or parallel piping installed to maintain adequate velocities across the entire range of flow.

The addition of a fifth 9 MGD secondary pump would require significant structural modifications to allow expansion of the wet well structure as well as additional modifications to influent and effluent piping.

2.1.2 Trickling Filters

As indicated in the technical memorandum included in **Appendix B** of the LTCP Update**,** the existing trickling filters were designed to handle a flow of 18 MGD through the trickling filter splitter box with a bypass of 9.1 MGD sent directly to the solids contact tank. In addition to the LTCP Update WWTP improvements discussed in **Section 1.3**, a fourth trickling filter would need to be constructed to increase the trickling filter capacity to 36.2 MGD (27.1 MGD through filters with 9.1 MGD bypassing to the solids contact tanks). Consequently, modifications must be made to increase the trickling filter splitter box capacity as well as the recirculation capacity across all filters. If the splitter box is unable to be easily expanded, a separate trickling filter influent line would be required with flow metering and control valves for even flow distribution across in-service filters. Additional piping and/or pumps may be necessary to provide recirculation rates up to a ratio of 4:1 (recirculation rate versus design average flow) as required by Section 91.55 of the 2014 GLUMRB Ten States Standards.

2.1.3 Solids Contact Tanks

The existing solids contact tanks were installed as part of the WWTP upgrades project and are limited to a firm capacity of 27.1 MGD. Mirroring the tanks would provide increased capacity, however, the current site leaves minimal space between the existing solids contact tanks and the secondary clarifiers. **Section 2.1.5** discusses the site constraints in further detail. Plant staff have indicated they have sufficient blower capacity to negate the need for additional aeration blowers.

2.1.4 Secondary Clarifiers

Expanding secondary treatment capacity to 36.2 MGD will require an additional 9.1 MGD of secondary clarifier capacity. Section 72.231 of the 2014 GLUMRB Ten States Standards limits surface overflow rates for settling tanks following trickling filters to 1,200 gallons per day per square foot at PHF. The City currently operates three aging 85-ft diameter, 10-ft deep clarifiers and one newer 115-ft diameter, 14-ft deep clarifier, providing a total surface area of 27,410 ft^2. To meet Ten States Standards, the minimum required total surface area across all clarifiers at 36.2 MGD is 30,167 ft^2.

While a total design capacity of 36.2 MGD could be reached with two 85-ft diameter units and two 115-ft diameter units, Alternative 1 includes replacing all three existing 85-ft diameter clarifiers with two 115-ft diameter units. Two new 115-ft clarifiers in conjunction with the existing 115-ft diameter clarifier would provide a total surface area of 31,161 ft^2, allowing a peak surface overflow rate of 1,162 gpd/ft^2, which is just under the maximum surface overflow rate of 1,200 gpd/ft^2 per Ten States Standards. New clarifiers should have a side water depth of 14-ft to 16-ft to help alleviate the current issues with solids washout at higher flow rates seen in the existing 10-ft deep clarifiers.

2.1.5 Alternative 1 Conceptual Site Layout

The existing WWTP is land-locked between the Muskingum River to the east and Moxahala Ave to the west, as well as OH-555 to the south. Little additional space exists for the potential expansion of secondary treatment facilities. Increased costs would be incurred during construction due to sheeting and soil stabilization requirements to prevent undermining the structural integrity of existing structures.

Figure 2 shows a conceptual site layout for the additional WWTP improvements included in Alternative 1. This figure does not include new piping layouts that would be required to accommodate the new basins or impacts to existing piping and utilities. The expanded facilities would also require the elimination of the secondary access driveway between the existing secondary clarifiers and solids contact tanks.

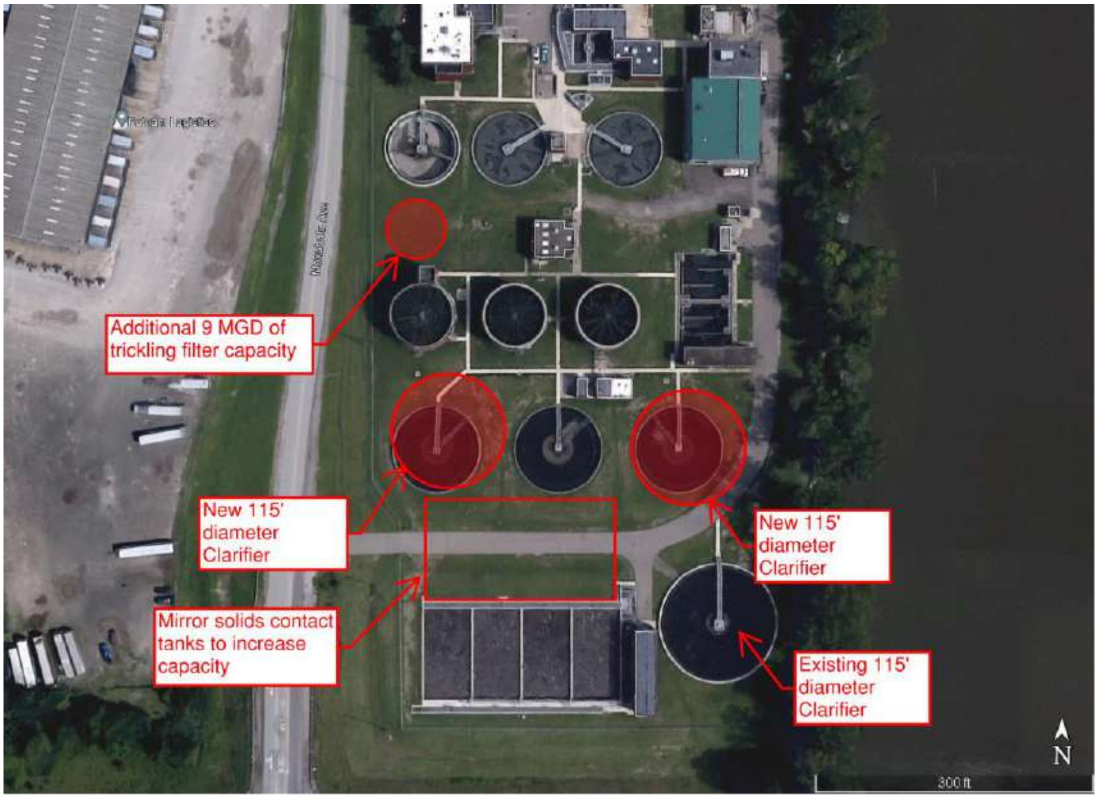

Figure 2: Alternative 1 (Secondary Treatment Upgrades) Conceptual Site Layout

2.1.6 Cost Considerations

A conservative planning level estimate for Alternative 1 is provided in **Table 2-1**. These values would vary depending on the treatment technologies and other details chosen during design. The numbers below are presented for planning purposes and are representative of costs for recently bid treatment works projects.

Table 2-1: Alternative 1 Opinion of Probable Cost Summary

Description	OPCC (2023 Dollars)
Secondary Pump Station Improvements	$1,000,000
Trickling Filter Improvements	$3,000,000
Secondary Clarifier Improvements	$3,554,000
Solids Contact Tank Expansion	$4,867,000
Site Piping and Valve Improvements	$1,000,000
Electrical, Instrumentation, and Controls	$2,014,000
Site Work	$100,000
Estimating Contingency (50%)	$7,768,000
Subtotal Direct Cost of Work:	**$23,303,000**
Contractor Overhead and Profit (20%):	$4,660,500
Subtotal Opinion of Probable Construction Cost:	**$27,963,000**
Engineering Design & Construction Administration (20%):	$5,593,000
Construction Phase Contingency (10%):	$2,797,000
Permitting, Legal and Miscellaneous:	$15,000
Secondary Treatment Expansion to 36.2 MGD Opinion of Probable Cost:	**$36,367,000**
LTCP WWTP Improvements Opinion of Probable Cost:	$17,647,000
Alternative 1 (Secondary Treatment Expansion to 36.2 MGD + LTCP WWTP Improvements) Opinion of Probable Cost:	**$54,014,000**

The estimated overall project cost for the secondary treatment expansion improvements is $36.4 million which includes construction costs, permitting and legal costs, engineering design and construction administration, and contingency for potential change orders during construction. If Alternative 1 would be implemented under the LTCP Update, these costs would be required in addition to the $17.65 million of WWTP improvements listed in **Table 1-1**, resulting in a total cost of $54.0 million for Alternative 1.

2.2 Alternative 2: Equalization Basin

Alternative 2 involves installing an equalization (EQ) basin to achieve elimination of the existing secondary bypass (Station 602). The proposed EQ basin would provide storage for primary treated flows exceeding 27.1 MGD and ultimately bleed these flows back into the plant's existing secondary treatment system when PHF recede to normal dry weather levels.

2.2.1 EQ Basin Conceptual Design

Hydraulic modeling results based on the LTCP Update Selected Alternative indicate a total storage volume of 3.15 million gallons would be required to store the flow exceedances beyond 27.1 MGD at the WWTP to achieve zero secondary bypasses during the typical year (2012). For planning purposes, a more conservatively sized

3.5-million-gallon EQ basin was evaluated for an approximate 10% safety factor. Flows greater than 27.1 MGD occur 22 times during the typical year with the longest event lasting 8 hours.

Ideally, the existing WWTP primary pumps would be used to fill the basin, negating the need for additional pumping capacity. Placing the basin between the primary clarifiers and the tertiary filters leaves a small area of approximately 130-ft x 64-ft for installation of a potential storage basin. Such a space would require a tank 50 feet below grade, resulting in increased construction costs associated with dewatering, rock excavation and soil stabilization of surrounding structures. Additionally, a 50-ft deep tank would result in O&M challenges related to post-event cleanup and odor control. The largest available area on the site is 98-ft x 198-ft near the existing solids contact tanks. Placing the EQ basin in this location would require a basin side water depth of approximately 21 feet. However, this would require the elimination of the driveway access and storage area and likely the replacement of primary pumps dedicated to the EQ basin. Again, shoring, potential rock excavation and stabilization of surrounding structures will increase the construction complexity and cost for such a project.

Figure 3 shows the approximate spacing available on the site for a potential EQ basin.

Figure 3: Alternative 2 Conceptual Site Layout

2.2.2 Cost Considerations

Recent EQ basin project cost estimates show that the average construction cost for a typical CSO storage basin is approximately $5 per gallon (2023 dollars). Based on this estimated construction cost, the total estimated project costs for a 3.5-million-gallon EQ basin was $28.8 million which includes construction costs, permitting engineering design and construction administration, and estimating contingency.

Table 2-2: Alternative 2 Opinion of Probable Cost Summary

Description	OPCC (2023 Dollars)
EQ Basin	$17,500,000
Subtotal Direct Cost of Work:	**$22,750,000**
Contractor Overhead and Profit (20%):	$4,661,000
Subtotal Direct Cost of Work:	**$27,411,000**
Engineering Design & Construction Administration (20%):	$4,433,000
Construction Phase Contingency (10%)	$2,217,000
Permitting, Legal and Miscellaneous:	$15,000
EQ Basin Opinion of Probable Cost:	**$28,824,000**
LTCP WWTP Improvements Opinion of Probable Cost:	$17,647,000
Alternative 2 (EQ Basin + LTCP WWTP Improvements) Opinion of Probable Cost:	**$46,471,000**

If Alternative 2 would be implemented under the LTCP Update, these costs would be required in addition to the $17.65 million of proposed LTCP Update WWTP improvements (listed in **Table 1-1**), resulting in a total cost of $46.54 million for Alternative 2.

2.3 *Alternative 3: Maintain Secondary Treatment Bypass with Chemically Enhanced Primary Treatment*

The option to maintain the existing 27.1 MGD secondary treatment design capacity and secondary treatment bypass with CEPT was evaluated as Alternative 3. Data collected by WWTP operations staff from 2020 through 2022 was used to measure existing performance of the plant and project future performance.

2.3.1 Existing Performance Evaluation

Data evaluated from 2020 through 2022 included concentrations of BOD, CBOD 5, suspended solids, and ammonia at multiple stages of the treatment process including, raw water at the plant intake, settled water following primary clarifiers, and plant effluent. To determine wet weather performance, data was filtered to include only days with influent plant flow greater than 15 MGD. The following tables provide a summary of these filtered data points.

Table 2-3: Wet Weather BOD/CBOD Recordings

	Influent Flow (MGD)	Raw BOD (mg/L)	Raw CBOD (mg/L)	Primary Settled BOD (mg/L)	Effluent BOD (mg/L)	Effluent CBOD (mg/L)
Max	26.5	270	270	151	16	12
Average	17.9	130.8	120.8	81.9	8.1	5.92
90^{th} Percentile	22.4	218	216.4	121.1	11.7	8

Table 2-4: Wet Weather Suspended Solids Recordings

	Influent Flow (MGD)	Raw TSS (mg/L)	Primary Settled TSS (mg/L)	Effluent TSS (mg/L)
Max	26.5	887	116	13
Average	17.9	159.2	68.26	7.0
90^{th} Percentile	22.4	294	86	10.2

Table 2-5: Wet Weather Ammonia Recordings

	Influent Flow (MGD)	Raw NH3 (mg/L)	Primary Settled NH3 (mg/L)	Effluent NH3 (mg/L)
Max	26.5	20.48	16	4
Average	17.9	8.8	9.8	0.8
90th Percentile	22.4	14.3	13.1	1.4

Data indicates average removal efficiencies through primary clarifiers of 37.4% and 57.1% for BOD and TSS respectively. Ammonia is not generally affected by primary clarifiers. This data indicates that the WWTP currently performs well under wet weather flows with effluent concentrations below the permit limits outlined in **Table 2-6** below.

Table 2-6: NPDES Permit Limit Summary

	Weekly Average	Monthly Average
CBOD	40 mg/L, 2730 kg/day	25 mg/L, 1710 kg/day
TSS	45 mg/L, 3070 kg/day	30 mg/L, 2050 kg/day
Ammonia	12.7 mg/L, 866 kg/day winter maximum. 8.85 mg/L, 603 kg/day summer maximum	

2.3.2 Projected Plant Performance at Future Wet Weather Flows

The plant performance data is used in the following sections to estimate effluent concentrations at future wet weather flows assuming 27.1 MGD receives full secondary treatment and 9.1 MGD bypasses secondary treatment downstream of the primary clarifiers. As flows approach 24.5 MGD, the WWTP can activate their CEPT system in order to improve removal efficiencies through the primary clarifiers. For the purposes of this evaluation, the following mass balance calculations assume average removal efficiencies are maintained through the use of the CEPT system. Typical removal efficiencies using a CEPT system are 45%-70% for BOD and 75% for TSS.

2.3.2.1 CBOD Mass Balance Evaluation

Expected CBOD concentrations during wet weather flows are shown in **Table 2-7**. These values are taken from data discussed in **Section 2.3.1**.

Table 2-7: Wet Weather CBOD Concentrations

Wet Weather CBOD Parameters	
Maximum Raw CBOD	270.0 mg/L
90th Percentile Raw CBOD	216.4 mg/L
Average CBOD Removed Through Primary Treatment	37.4%
Expected CBOD Following Primary Clarifiers Assuming Average Removal Efficiencies	135.50 mg/L
Maximum CBOD Following Secondary Treatment	12.0 mg/L
Average CBOD Following Secondary Treatment	5.92 mg/L
Wet Weather Flow Parameters	
Flow Through Primary Treatment	36.2 MGD
Flow Through Secondary Treatment	27.1 MGD
Flow Bypassing Secondary Treatment	9.1 MGD
Average Daily Design Flow from NPDES Permit	11.0 MGD

Applying these values for concentration of CBOD through the plant during wet weather, the expected CBOD concentrations leaving the plant while treating 36.2 MGD through primary treatment and 27.1 MGD through secondary treatment can be approximated. Model data for a typical year indicates that flows above 27.1 MGD occur for a maximum of eight hours between March 18th and 19th. Results of the mass balance calculations for this wet weather event are shown in **Table 2-8.**

Table 2-8: Wet Weather CBOD Mass Balance Results

Raw CBOD Concentration (90th Percentile Value from 2020-2022 Data)	216.4 mg/L
CBOD Concentration Following Primary Clarifiers Assuming Average Removal Efficiency of 37.4%	135.5 mg/L
CBOD Concentration Following Secondary Clarifiers (Maximum Value from 2020-2022 Data)	12.0 mg/L
Projected CBOD Effluent Concentration After Blending Primary and Secondary Streams	43.0 mg/L
Projected CBOD Effluent Loading During High Flow of 36.2 MGD (8 Hours)	1964.9 kg
Projected CBOD Effluent Loading Throughout the Remainder of the Wet Weather Event (16 of 24 Hours at 11.0 MGD)	332.9 kg
Projected CBOD Effluent Loading over 24 Hour Wet Weather Period	2297.8 kg/day
Projected Weekly Average Effluent Concentration for Wet Weather Week (March 15-21)*****	16.4 mg/L
Projected Monthly Average Effluent Concentration for Wet Weather Week (March 15-21)*****	13.1 mg/L
Daily Effluent Loading at Design Flow of 11 MGD with CBOD Concentration of 12.0 mg/L at Outfall	499.4 kg/day

Weekly Average Effluent Loading for Wet Weather Week (March 15-21)	756.3 kg/day
Monthly Average Loading for Wet Weather Month (March)	557.4 kg/day
CBOD Weekly Permit Limit	2,730.0 kg/day
CBOD Monthly Permit Limit	1,710.0 kg/day

***After wet weather flows, assumes 11 MGD Average Daily Design Flow with effluent concentration of 12.0 mg/L.**

The mass balance results indicate no permit violations during a typical year worst-case wet weather event.

2.3.2.2 TSS Mass Balance Evaluation

Expected TSS concentrations during wet weather flows are shown in **Table 2-9**. These values are taken from data discussed in **Section 2.3.1**.

Table 2-9: Wet Weather TSS Concentrations

Wet Weather TSS Parameters	
Maximum Raw TSS	887.0 mg/L
90th Percentile Raw TSS	294.0 mg/L
Average TSS Removed Through Primary Treatment	57.1%
Expected TSS Following Primary Clarifiers Assuming Average Removal Efficiencies	126.1 mg/L
Maximum TSS Following Secondary Treatment	13.0 mg/L
Average TSS Following Secondary Treatment	7.0 mg/L
Wet Weather Flow Parameters	
Flow Through Primary Treatment	36.2 MGD
Flow Through Secondary Treatment	27.1 MGD
Flow Bypassing Secondary Treatment	9.1 MGD
Average Daily Design Flow from NPDES Permit	11.0 MGD

These values were applied for concentration of TSS through the plant during wet weather and determine TSS concentrations leaving the plant while treating 36.2 MGD through primary treatment and 27.1 MGD through secondary treatment. Results of the mass balance calculations for this wet weather event are shown in **Table 2-10.**

Table 2-10: Wet Weather TSS Mass Balance Results

Raw TSS Concentration (90th Percentile Value from 2020-2022 Data)	294.0 mg/L
TSS Concentration Following Primary Clarifiers Assuming Average Removal Efficiency of 57.1%	126.1 mg/L
TSS Concentration Following Secondary Clarifiers (Maximum Value from 2020-2022 Data)	13.0 mg/L
Projected TSS Effluent Concentration After Blending Primary and Secondary Streams	41.4 mg/L

Projected TSS Effluent Loading During High Flow of 36.2 MGD (8 Hours)	1890.8 kg
Projected TSS Effluent Loading Throughout the Remainder of the Wet Weather Event (16 of 24 Hours at 11.0 MGD)	360.6 kg
Projected TSS Effluent Loading over 24 Hour wet Weather Period	2251.4 kg/day
Projected Weekly Average Effluent Concentration for Wet Weather Week (March 15-21)*	17.0 mg/L
Projected Monthly Average Effluent Concentration for Wet Weather Week (March 15-21)*	14.0 mg/L
Daily Effluent Loading at Design Flow of 11 MGD with TSS Concentration of 13.0 mg/L at Outfall	541.0 kg/day
Weekly Average Effluent Loading for Wet Weather Week (March 15-21)	785.3 kg/day
Monthly Average Loading for Wet Weather Month (March)	596.1 kg/day
TSS Weekly Permit Limit	3,070.0 kg/day
TSS Monthly Permit Limit	2,050.0 kg/day

***** After wet weather flows, assumes 11 MGD Average Daily Design Flow with effluent concentration of 13.0 mg/L.

The mass balance results indicate no permit violations during a typical year worst-case wet weather event.

2.3.2.3 Wet Weather Ammonia Concentrations and Loadings

Expected ammonia concentrations during wet weather flows are shown in **Table 2-11**. These values are taken from data discussed in **Section 2.3.1**.

Table 2-11: Wet Weather Ammonia Concentrations

Wet Weather Ammonia Parameters	
Maximum Raw Ammonia	20.48 mg/L
90th Percentile Raw Ammonia	14.3 mg/L
Average Ammonia Removed Through Primary Treatment	12.0%
Expected Ammonia Following Primary Clarifiers Assuming Average Removal Efficiencies	12.61 mg/L
Maximum Ammonia Following Secondary Treatment	3.99 mg/L
Average Ammonia Following Secondary Treatment	0.83 mg/L
Wet Weather Flow Parameters	
Flow Through Primary Treatment	36.2 MGD
Flow Through Secondary Treatment	27.1 MGD
Flow Bypassing Secondary Treatment	9.1 MGD
Average Daily Design Flow from NPDES Permit	11.0 MGD

These values were applied as parameters of a worst case scenario for concentration of ammonia through the plant during wet weather and determine ammonia concentrations leaving the plant while treating 36.2 MGD through primary treatment and 27.1 MGD through secondary treatment. Results of the mass balance calculations for this wet weather event are shown in **Table 2-12.**

Table 2-12: Wet Weather Ammonia Mass Balance Results

Raw Ammonia Concentration (90th Percentile Value from 2020-2022 Data)	14.3 mg/L
Ammonia Concentration Following Primary Clarifiers Assuming Average Removal Efficiency of 12.0%	12.61 mg/L
Ammonia Concentration Following Secondary Clarifiers	3.99 mg/L
Projected Ammonia Effluent Concentration After Blending Primary and Secondary Streams	6.2 mg/L
Projected Ammonia Effluent Loading During High Flow of 36.2 MGD (8 Hours)	281.2 kg
Projected Ammonia Effluent Loading Throughout the Remainder of the Wet Weather Event (16 of 24 Hours at 11.0 MGD)	110.8 kg
Projected Ammonia Effluent Loading over 24 Hour wet Weather Period	392.0 kg/day
Daily Effluent Loading at Design Flow of 11 MGD with Average Ammonia Concentration of 0.83 mg/L at Outfall	166.2 kg/day
Weekly Average Effluent Loading for Wet Weather Week (March 15-21)	198.5 kg/day
Monthly Average Loading for Wet Weather Month (March)	173.5 kg/day
Ammonia Daily Permit Limit (Summer)	603 kg/day

The mass balance results indicate no permit violations during a typical year worst-case wet weather.

2.3.3 Cost Considerations

Alternative 3 would involve implementing the proposed WWTP improvements listed in **Table 1-1**. The estimated cost for Alternative 3 is $17.65 million in 2023 dollars.

3 Cost-Benefit Analysis

Results from the data shown in **Section 2.3** indicate that the WWTP will not violate permit limits while continuing to bypass secondary treatment for flows greater than 27.1 MGD. AECOM further evaluated the costs related to removing the wet weather suspended solids in order to weigh the benefit of upgrading the secondary treatment to a capacity of 36.2 MGD. Using an average influent TSS concentration of 159 mg/L with a 75% capture rate through chemically enhanced primary treatment and an average effluent concentration of 7 mg/L, an estimate of the additional pounds of suspended solids removed for a typical year was determined. Results of the cost-benefit analysis are presented in **Table 3-1** and **Figure 4.**

Table 3-1: Cost per Pound of TSS Removed

	Opinion of Probable Cost ($ Mil), Rounded	Additional TSS Removed (lb)	Additional $/lb TSS Removed
Post-Proposed LTCP WWTP Improvements + Use Existing CEPT System (Alternative 3)	$17.7	17,700	$997
Additional Secondary Treatment Expansion to 36.2 MGD (Alternative 1)	$36.4	4,800	$7,576
Percent Increase (Alternative 1 from Alternative 3)		27%	660%
Post-Proposed LTCP WWTP Improvements + EQ Basin (Alternative 2)	$28.8	4,800	$6,000
Percent Increase (Alternative 2 from Alternative 3)		27%	502%

The table shows that the currently proposed treatment improvements will remove approximately 17,700 pounds of TSS at a cost of $1000 per pound removed. The benefit of full secondary treatment upgrades (Alternative 1) is a 27% increase in TSS removed. However the cost of that additional secondary treatment comes at a price that is 660% of the $/lb cost of the currently proposed improvements.

Selecting an EQ basin instead of full secondary treatment upgrades would decrease that cost, but it would still be 502% of the effective cost of the currently proposed treatment improvements.

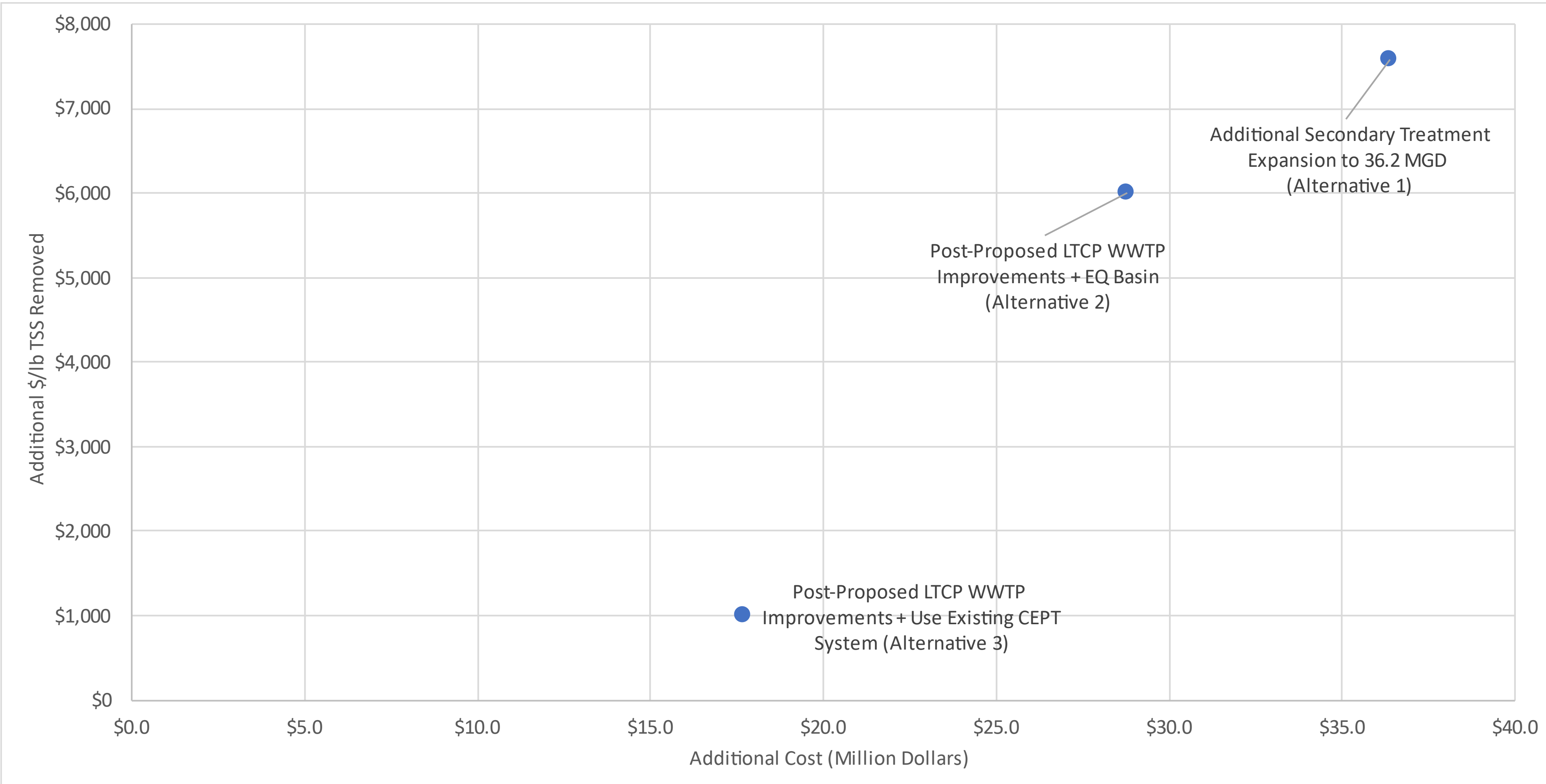

Figure 4: Alternatives Cost-Benefit Analysis

4 Conclusions and Recommendations

The two bypass elimination alternatives developed and evaluated in this study include expanding the secondary treatment capacity from 27.1 MGD to 36.2 MGD (Alternative 1) and constructing an EQ basin to store flows in excess of 27.1 MGD (Alternative 2). These alternatives are considered financially infeasible based on the following findings:

1. Secondary Treatment Upgrades (Alternative 1) would involve upgrades to all secondary treatment processes including significant modifications to existing structures that must be kept in service during construction.
2. Limited footprint is available at the existing site for construction of a proposed 3.5-million gallon EQ Basin (Alternative 2) due to conflicts with existing structures.
3. An analysis of data obtained by the City indicates that no permit violations are expected for a typical year at the current secondary treatment capacity of 27.1 MGD. Due to hydraulic limitations, data on flows greater than this is not available. However, utilizing the existing CEPT process at flows greater than 27.1 MGD will result in similar loadings downstream of the primary settling tanks where the existing secondary bypass is located. A marginal benefit of 27% additional TSS removal benefit may be seen, but at a 514-676% increase in incremental cost to the City.

From a financial feasibility standpoint, the high capital costs associated with these alternatives (estimated total project cost of $36.4 million for Alternative 1 and $28.8 million for Alternative 2) would increase the City's financial burden associated with the City's LTCP Update, which was already shown to be in the "high burden" category based on the expected project costs without the secondary bypass improvements. Refer to **Appendix H** of the LTCP Update for additional information on project costs and financial capability analysis.

Alternative 1 (expanding secondary treatment capacity) would increase the LTCP Update project costs (which were estimated at $46.54 million in 2023 dollars) by 78%. Alternative 2 (EQ Basin) would increase the LTCP Update project costs by 62%. As discussed in the City's FCA for the LTCP Update, additional rate increases related to the LTCP Update projects are considered unaffordable for most of the City's households, especially those living in lower income households. As a result, it is considered financially infeasible to increase the cost of the City's LTCP Update by 62-78% to eliminate the secondary bypass. Furthermore, evaluations presented in Alternative 3 indicate that adequate treatment will be maintained if the secondary bypass is kept in place and the chemically enhanced primary treatment (CEPT) system is used for flows above 24.5 MGD. Expanding secondary treatment to capture 36.2 MGD of flow will remove 27% more TSS at a 502-660% increase in incremental cost per pound of TSS removed.

Based on these findings, AECOM recommends maintaining the use of the WWTP secondary treatment bypass for flows in exceedance of 27.1 MGD. Flows greater than 24.5 MGD may be treated with the ferric chloride CEPT system to accommodate the higher surface overflow rates at the primary clarifiers. It is recommended that flows exceeding 27.1 MGD continue to bypass the secondary pump station and flow directly to the chlorine contact tank where it is combined with secondary treatment effluent for disinfection before discharge to the Muskingum River.

5 References

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