

City of St. Joseph, Missouri
Facilities Plan

Technical Memorandum No. TM-CSO-3c

**Future Phases of
CSO Long Term Control Plan**



By



Work Order No. 09-001
B&V Project 163509

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Future Phases of CSO Long Term Control Plan

1.0 Executive Summary

The purpose of this technical memorandum (TM) is to update the Long Term Control Plan (LTCP) combined sewer system (CSS) computer model with 2008 flow monitoring data and conduct computer modeling to refine the proposed LTCP projects for Phase IB, II, and III combined sewer overflow (CSO) control facilities. CSO flow equalization basin options recommended for the Patee and Missouri Avenue CSO outfalls are to be reviewed to determine if they would still be required to achieve the goal of capturing 85 percent of the wet weather flow volume. In addition, LTCP recommendations for flow control structure modifications (i.e., raising diversion weirs and adding motor-operated gates) are to be evaluated to determine the potential for obstructing combined sewer flow leaving the system. The CSS recommended improvements are also to be evaluated for Comprehensive Stormwater Management Plan event flows to confirm operation of the facilities during peak stormwater flooding events.

The United States Environmental Protection Agency (USEPA) presumptive approach policy of 85 percent capture of wet weather CSS flow volume was used as the basis for determining CSO control recommendations. In consultation with the Missouri Department of Natural Resources (MDNR) and the USEPA, it was determined that this approach is more appropriate than the CSO frequency goal for St. Joseph in order to accommodate phased implementation and financial capability.

To meet the presumptive approach requirements of the USEPA CSO control policy, the City of St. Joseph will be required to increase the volumetric combined sewage wet weather capture from 60 percent, achieved through Phase IA improvements, to 85 percent. Although the Phase IA improvements will provide a significant improvement over the existing conditions wet weather capture of 12.5 percent, additional improvement phases (i.e., future Phase IB, Phase II, and Phase III) will be required to meet USEPA presumptive approach requirements.

The Phase IB improvements from the 2008 CSO LTCP are being superseded by recommendations made herein. The ultimate objective of any CSO LTCP is to improve

water quality within the receiving stream. Therefore, upon completion of the Phase IA improvements, it is recommended that a two-year monitoring and evaluation study of Missouri River water quality be performed to demonstrate the effectiveness of the Phase IA improvements. This study phase, entitled Phase IB, will help establish the water quality benefits of the Phase IA improvements and will help to further refine the future Phase II and Phase III recommendations. Phase IB is part of an overall adaptive management approach for the City's CSO LTCP to ensure that funding continues to be optimized now and in the future for the improvement of Missouri River water quality.

The original Phase II improvements from the 2008 CSO LTCP consisted of a 23,000 foot long, 17 foot diameter tunnel (39.2 million gallons (MG) of storage) extending from the Blacksnake Diversion Structure to the Brown's Branch Diversion Structure. As part of the Facilities Plan work, documented herein, the LTCP results were updated. Based on the updates, it appears that the proposed 17 foot diameter deep tunnel facility increases the wet weather volumetric capture to 81 percent. The Phase III improvements from the 2008 CSO LTCP consisted of a 135 million gallons per day (mgd) high rate treatment (HRT) facility located in the vicinity of the existing Water Protection Facility (WPF). Updated modeling, performed as part of the Facilities Plan, indicates that a 135 mgd HRT facility in combination with a 23,000 foot long, 17 foot diameter tunnel could provide 88.5 percent wet weather capture, exceeding the 85 percent wet weather capture required by the USEPA CSO presumptive approach. Therefore, in order to evaluate future phase options, two alternatives were developed to achieve the 85 percent wet weather capture goal.

Since the 23,000 foot long, 17 foot diameter tunnel does not achieve an 85 percent wet weather capture by itself, additional high rate treatment will still be required if planned tunnel dimensions are not changed. If, however, the tunnel diameter is increased to 20 feet (54 MG of storage), an 85 percent wet weather volumetric reduction can be achieved without the need for additional high rate treatment. Alternative 1, as described herein, consists of a 23,000 foot long, 20 foot diameter tunnel (54 MG of storage) that achieves 85 percent wet weather capture (see Figures 1 and 2).

If the 23,000 foot long, 17 foot diameter tunnel is used, additional high rate treatment is required to achieve 85 percent wet weather capture. It was determined that an 80 mgd HRT facility (rather than 135 mgd as initially proposed in the 2008 LTCP) along with the 17 foot diameter deep tunnel would provide 85 percent capture. This scenario provides another option for the City to achieve 85 percent wet weather capture and is termed Alternative 2 in this evaluation (see Figures 3 and 4).

The project costs associated with future phases Alternative 1 and Alternative 2 are presented in Table ES-1.

Table ES-1		
Summary of Opinion of Probable Project Costs ¹		
Item	Alternative 1 20 ft Diameter Tunnel, \$	Alternative 2 17 ft Diameter Tunnel and Additional HRT, \$
Deep Tunnel, 23,000 lin ft	160,336,000	148,157,000
Deep Tunnel Pump Station, 61 mgd	28,281,000	---
Deep Tunnel Pump Station, 80 mgd	---	32,571,000
High Rate Treatment Facility, 80 mgd	---	20,984,000
UV Disinfection Facility, 80 mgd	---	7,000,000
Effluent Pump Station, 80 mgd	---	4,250,000
Yard Piping, 72 inch	324,000	3,240,000
Flood Protection (placeholder) ²	370,000	741,000
Site Remediation (placeholder) ²	2,222,000	4,444,000
<i>Subtotal</i>	<i>191,533,000</i>	<i>221,387,000</i>
Electrical, I&C, Sitework, Contractor General Requirements ³	15,447,000	36,744,000
<i>Subtotal</i>	<i>206,980,000</i>	<i>258,131,000</i>
Contingency ⁴	51,745,000	64,533,000
Land Acquisition (placeholder) ^{2, 5}	106,000	212,000
Opinion of Probable Construction Cost	258,831,000	322,876,000
Engineering, Legal, and Administration ⁶	51,766,000	64,575,000
Opinion of Total Project Cost	310,597,000	387,451,000
<ol style="list-style-type: none"> 1. All costs presented in May 2009 dollars (ENR BCI = 4773). 2. Site related costs are placeholders and must be revised following final siting of the facilities. Site related costs are provided for the site area required for the proposed facilities. 3. Electrical and instrumentation and controls (I&C) projected at 25% of the total of all equipment and structure costs but excludes the deep tunnel. Sitework projected at 10% of the total of equipment, structures, electrical, and I&C costs. Contractor general requirements projected at 12% of the total of equipment, structures, electrical, I&C, and sitework costs. 4. Project contingency is projected at 25% of the total of all equipment, structures, electrical, I&C, sitework, contractor general requirements, flood protection/fill, and site remediation costs. 5. Land acquisition cost is based on a projection provided by the City from a recent purchase of land directly south of the WPF. 		

Table ES-1		
Summary of Opinion of Probable Project Costs ¹		
Item	Alternative 1 20 ft Diameter Tunnel, \$	Alternative 2 17 ft Diameter Tunnel and Additional HRT, \$
6. Engineering, legal, and administration (ELA) costs are projected at 20% of the total of all equipment, structures, electrical, I&C, sitework, contractor general requirements, flood protection/fill, site remediation costs, contingency, and land acquisition.		

Upon review of Table ES-1, Alternative 1 – 20 foot Diameter Deep Storage Tunnel is more cost effective than Alternative 2 – 17 foot Diameter Deep Storage Tunnel and 80 mgd High Rate Treatment. Furthermore, based on review of similar CSO control programs, it is typically more cost effective to provide more deep tunnel storage and less peak flow treatment rather than providing less tunnel storage and greater peak flow treatment. The results of the analysis presented herein support this typical finding. Although there is some initial phased cost savings in the tunnel being downsized in Alternative 2, the initial cost savings is lost when the dedicated 80 mgd high rate treatment facility, 80 mgd ultraviolet (UV) disinfection facility, and 80 mgd effluent pump station are added to provide peak flow treatment.

Alternative 1 also makes use of facilities planned for construction during the Phase IA implementation period. The larger deep tunnel allows combined sewage to be stored and treated through the Phase IA HRT improvements after the wet weather event has passed. Since Alternative 2 provides less storage, treatment with an additional HRT facility must occur during the wet weather event as opposed to afterwards. The 80 mgd HRT would be a dedicated and separate facility from the 61 mgd HRT facilities proposed as part of Phase IA. Alternative 1 is also superior to Alternative 2 in that it allows operation of proposed Phase IA facilities to be maximized. Therefore, based on the results of updated modeling and evaluation, Alternative 1 is the recommended approach for the future LTCP CSO control phase. This recommendation could be modified or refined upon completion of the Phase IB monitoring and water quality study.

2.0 Purpose of Technical Memorandum

The purpose of this TM is to update the LTCP CSS computer model with 2008 flow monitoring data and conduct computer modeling to refine the proposed LTCP projects for Phase IB, II, and III CSO control facilities. CSO flow equalization basin options recommended for the Patee and Missouri Avenue CSO outfalls are to be reviewed to determine if they would still be required to achieve the goal of capturing 85 percent of the wet weather flow volume. In addition, LTCP recommendations for flow control structure modifications (i.e., raising diversion weirs and adding motor-operated gates) are to be evaluated to determine the potential for obstructing combined sewer flow leaving the system. The CSS recommended improvements are also to be evaluated for Comprehensive Stormwater Management Plan (Black & Veatch, 1998) event flows to confirm operation of the facilities during peak stormwater flooding events.

The USEPA presumptive approach policy of 85 percent capture of wet weather CSS flow volume was used as the basis for determining CSO control recommendations. In consultation with MDNR and USEPA, it was determined that this approach is more appropriate than the CSO frequency goal for St. Joseph in order to accommodate phased implementation and financial capability.

3.0 Introduction

A wet weather CSS volumetric percent capture goal of 60 percent was recommended for Phase IA in TM-CSO-3a – Phase IA CSO Control Recommended Improvements Model. Additional LTCP phases are necessary to achieve the 85 percent capture requirement. As stated in the 2008 LTCP, the original Phase II improvements consisted of a deep tunnel for CSS storage and Phase III consisted of additional high rate treatment capacity. These proposed facilities were modeled and updated based on the new 2008 flow data as part of the Facilities Plan. Appendix A includes the detailed flow and volume combined sewage calculations. The goal of the refined future LTCP phases, as documented herein, is to ultimately increase the volumetric capture of combined sewage from 60 percent to 85 percent as required by USEPA CSO control presumptive approach policy.

4.0 Phase IA Improvements

The Phase IA improvements were selected to provide the most effective initial CSO control with the least amount of capital expense. As described in TM-CSO-3a, the Phase IA improvements will consist of constructing the Blacksnake and Whitehead stormwater separation conduits, increasing the conveyance capacity of the Whitehead Pump Station to 80 mgd, increasing the treatment capacity of the existing WPF headworks to 88 mgd, providing 61 mgd HRT and disinfection facilities, and completing partial sewer separation in the Roy's Branch basin (currently underway). The Phase IA improvements will reduce the annual CSO volume by 2.4 billion gallons from 4.1 billion gallons to 1.7 billion gallons and increase the percent capture of combined sewage from 12.5 percent to 60 percent.

5.0 CSO LTCP Future Phases

5.1 Updated Phase IB Improvements

The 2008 LTCP originally proposed a 1 MG flow equalization basin in the vicinity of the Patee Diversion Structure and a 5 MG flow equalization basin in the vicinity of the Missouri Avenue Diversion Structure as part of the Phase IA and IB recommendations, respectively. Based on updated flowmetering and CSS modeling, these recommendations are being revised. Updated flowmetering and CSS model calibration indicates the previously proposed flow equalization basins provide significantly less reduction in CSO frequency and volumetric percent capture than was determined during development of the LTCP. Updated flow monitoring showed that smaller wet weather events produced more runoff than the LTCP flow monitoring data had indicated. The updated flow monitoring information was presented to MDNR and USEPA staff on April 8, 2009. As a result of the updated data and modeling, the flow equalization basins were found to provide a minimal annual reduction in CSO volume (7 MG at Patee and 33 MG at Missouri Avenue during a typical year) at a significant cost with covered basins. In addition, the LTCP recommendations are now focused on CSO percent capture instead of frequency, so it is not necessary or cost effective to provide

flow equalization basins for Phase I control. Therefore, it is recommended that neither of these flow equalization basins be carried forward as part of the revised CSO LTCP improvements presented herein.

The ultimate objective of any CSO LTCP is to improve water quality within the receiving stream. Therefore, upon completion of the Phase IA improvements, it is recommended that a two-year monitoring and evaluation study of Missouri River water quality be performed to demonstrate the effectiveness of Phase IA. This study phase, entitled Phase IB, will help establish the water quality benefits of the Phase IA improvements and will help to further refine the future Phase II and Phase III recommendations. Phase IB is part of an overall adaptive management approach for the City's CSO LTCP to ensure that funding continues to be optimized now and in the future for the improvement of Missouri River water quality.

5.2 Revised Phase II and Phase III Improvements

Updated 2008 flowmeter data and CSS modeling were used to reevaluate the LTCP Phase II and Phase III improvements to determine what changes, if any, are needed to achieve a volumetric wet weather capture of 85 percent. Initially, the LTCP Phase II and Phase III facilities were reevaluated to determine anticipated wet weather percent capture with no change in facility size or capacity. A deep storage tunnel that extends from the Blacksnake Diversion Structure to the Brown's Branch Diversion Structure was modeled for Phase II. The modeled tunnel is 17 feet in diameter and approximately 23,000 feet in length, which equates to a storage volume of 39.2 MG. The purpose of the tunnel is to provide storage of combined sewage until the WPF has capacity available to treat the stored combined sewage.

It was assumed that deep tunnel drop shafts would be located downstream of the existing interceptor diversion structures for CSS modeling. Effectively, the tunnel acts as a manifold for each of the City's trunk sewers and allows CSOs from them to be diverted and captured. The modeling did not evaluate the hydraulic characteristics of each diversion structure or drop shaft. Specific diversion structure and drop shaft hydraulic characteristics will be determined during design. Using this model, eight design storms

(see TM-CSO-2 – CSS Model Calibration and Existing Conditions for a description of the eight design storms) that comprise the typical year were simulated. The CSO volumes for the updated LTCP Phase II modeling are shown in Table 1.

Table 1				
Updated LTCP Phase II – 17 foot Diameter Storage Tunnel				
Overflow Volumes and Wet Weather Volumetric Percent Capture				
Design Event	Existing Combined Sewage Volume, MG	Existing CSO Volume, MG	Phase IA CSO Volume, MG	Updated LTCP Phase II CSO Volume, MG
> A	426.93	296.52	51.24	0.00
A-B	601.92	462.15	121.23	0.00
B-C	401.07	345.09	116.19	0.00
C-D	839.49	749.37	288.84	63.57
D-E	490.31	444.99	183.98	88.88
E-F	324.63	299.21	128.97	81.46
F-G	413.23	383.64	177.63	129.32
G-H	565.43	530.71	280.07	228.80
H	656.03	619.57	347.41	294.19
Total	4,719.04	4,131.25	1,695.56	886.21
Percent Capture		12.5%	64.1%	81.2%

The CSS model simulation with the 17 foot diameter, 23,000 foot tunnel shows that the percent capture of the typical year combined sewage would be increased from over 60 percent to 81 percent, which is a significant increase, however it is still less than the CSO policy guidance of 85 percent volumetric capture. Therefore, if a 17 foot diameter, 23,000 foot tunnel is used; additional high rate treatment will be required to achieve 85 percent wet weather capture. As part of the 2008 LTCP Phase III improvements, a 135 mgd HRT facility was proposed. Wet weather percent capture from the LTCP Phase III modeling should be determined before modifications are made to the Phase II and Phase III recommendations.

The updated LTCP Phase III modeling consisted of the Phase IA improvements, the Phase II deep tunnel (17 foot diameter, 23,000 feet long), and a 135 mgd HRT facility that begins operation after the deep tunnel storage is filled to capacity. Table 2 presents the updated LTCP Phase III wet weather percent capture results of this simulation.

Table 2		
Updated LTCP Phase III – 135 mgd High Rate Treatment Facility Overflow Volumes and Wet Weather Volumetric Percent Capture		
Design Event	Existing Combined Sewage Volume, MG	Phase III CSO Volume, MG
> A	426.93	0.00
A-B	601.92	0.00
B-C	401.07	0.00
C-D	839.49	10.86
D-E	490.31	35.82
E-F	324.63	42.67
F-G	413.23	81.24
G-H	565.43	160.46
H	656.03	211.57
Total	4719.04	542.61
Percent Capture		89%

The results of this simulation indicate that 89 percent of the estimated existing CSS volume could be captured and treated. The goal of the CSO LTCP is to achieve 85 percent volumetric capture and, as indicated, the 2008 LTCP proposed 135 mgd HRT facility would provide a greater level of CSO control than is required. Therefore, improvement alternatives and corresponding modeling were conducted to determine if a smaller HRT or a larger tunnel without HRT would be best to provide 85 percent volumetric control. The revised improvements alternatives to achieve 85 percent wet weather capture are presented in the following sections.

5.3 Alternative 1 – 20 foot Diameter Deep Storage Tunnel

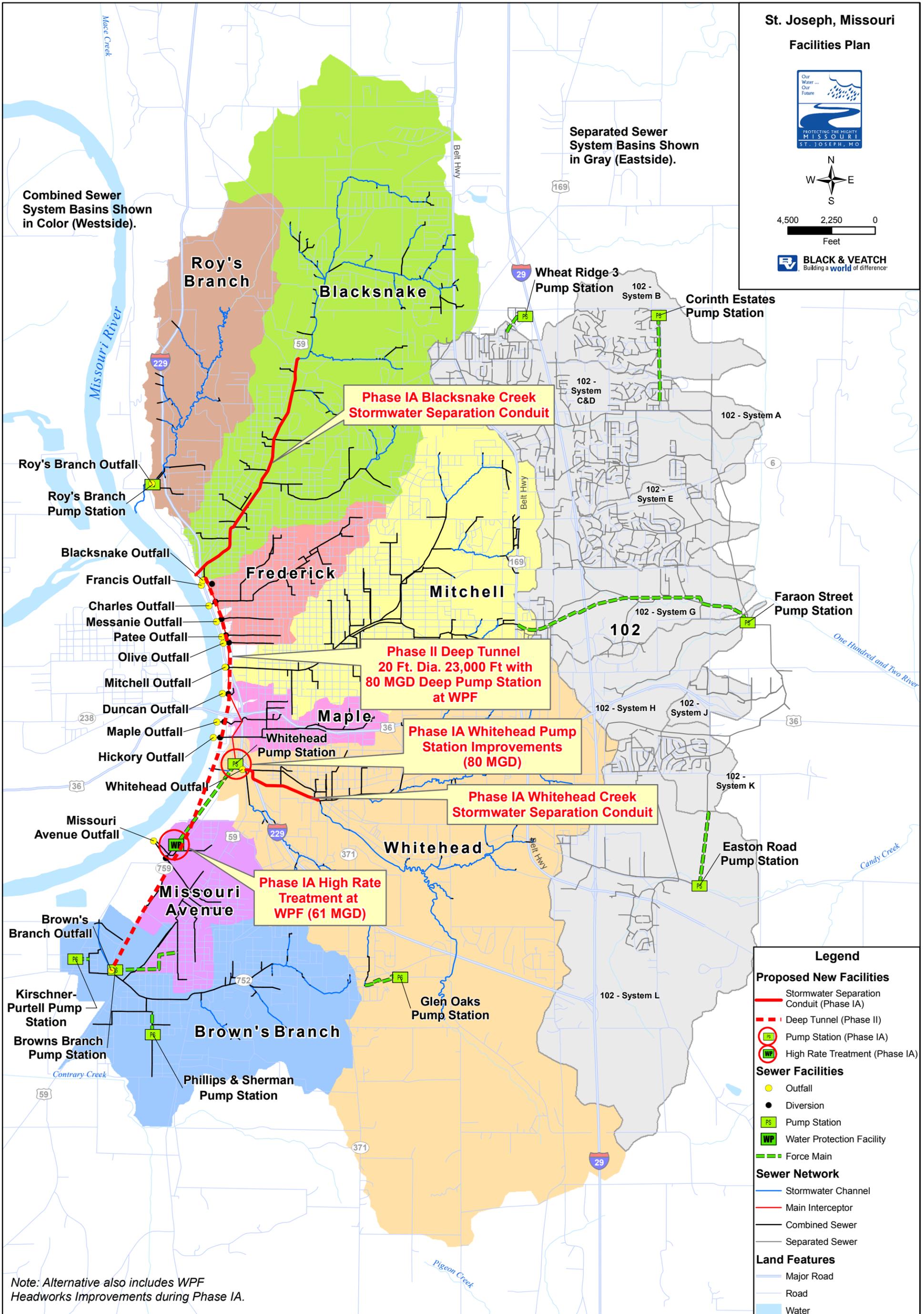
Additional CSS model simulations were conducted to determine what diameter tunnel would provide 85 percent volumetric control without adding Phase III high rate treatment. Model simulations were conducted assuming that the Phase IA improvements are in operation. After several iterations, a 20 foot diameter, 23,000 foot long tunnel model simulation was conducted. This tunnel has a storage capacity of approximately 54 MG. Table 3 presents the wet weather percent capture results of this simulation.

Table 3		
Alternative 1 – 20 foot Diameter Deep Storage Tunnel		
Overflow Volumes and Wet Weather Volumetric Percent Capture		
Design Event	Existing Combined Sewage Volume, MG	Phase II CSO Volume Using 20 ft Diameter Deep Tunnel, MG
> A	426.93	0.00
A-B	601.92	0.00
B-C	401.07	0.00
C-D	839.49	10.53
D-E	490.31	52.53
E-F	324.63	63.48
F-G	413.23	113.19
G-H	565.43	205.33
H	656.03	262.22
Total	4719.04	707.28
Percent Capture		85% ¹
1. The wet weather percent capture assumes that the Phase IA improvements have been implemented.		

Based on these CSS modeling results, the Phase IA improvements and the addition of a 20 foot diameter, 23,000 foot long tunnel could provide 85 percent volumetric capture and achieve the USEPA CSO presumptive control guidelines. The conceptual plan view for the deep tunnel in Alternative 1 is shown in Figure 1. The site layout of the deep tunnel pump station as well as the screening and grit shafts are presented in Figure 2. The deep tunnel pump station is sized to pump a peak flow of 61 mgd. This flow will be delivered to the 61 mgd HRT facility proposed as part of the Phase IA improvements. The opinion of probable project costs and approach for implementing Alternative 1 are presented in Section 7.0.

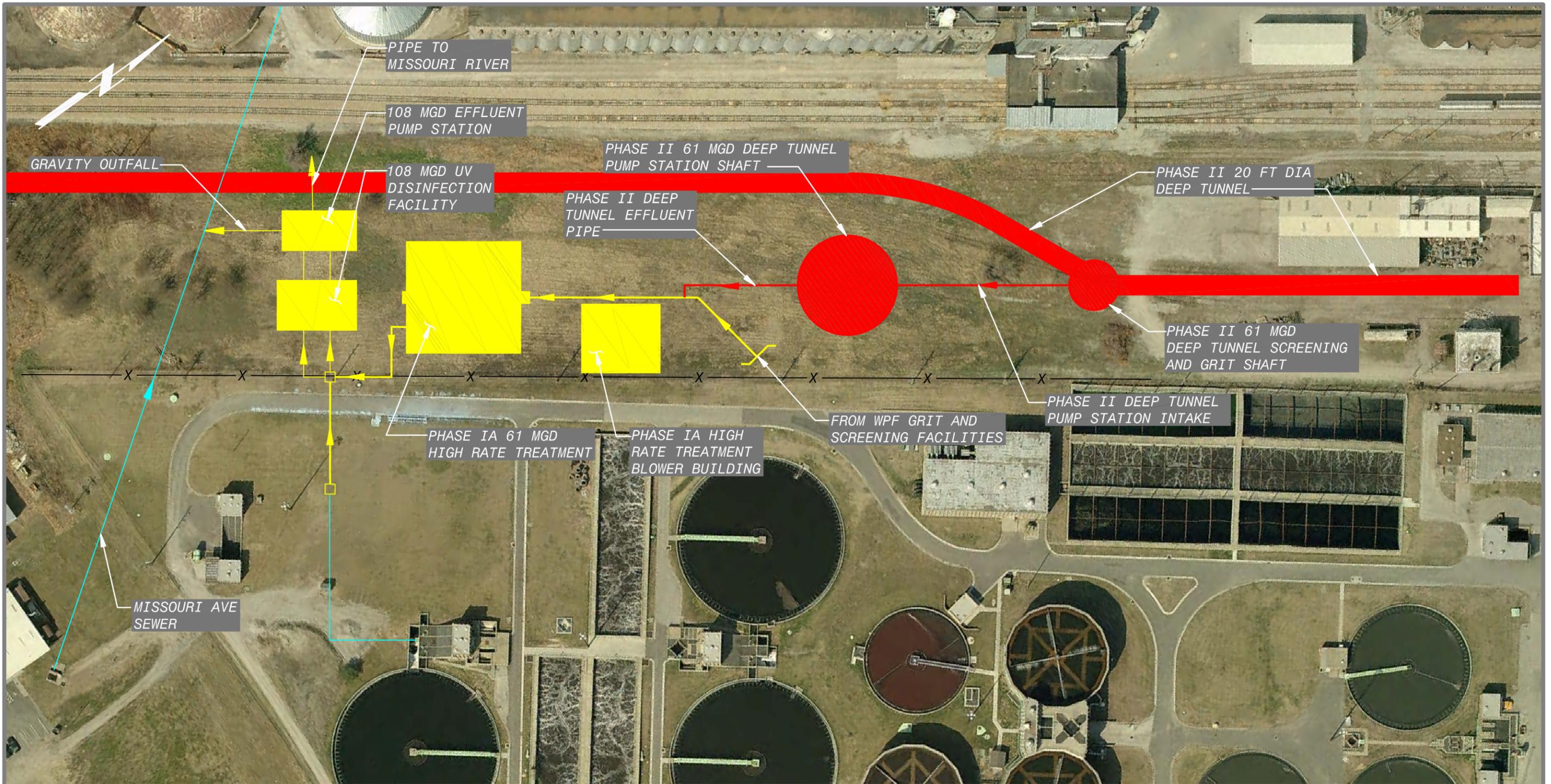
5.4 Alternative 2 – 17 Foot Diameter Deep Storage Tunnel and Additional High Rate Treatment

Additional CSS model simulations were conducted to determine what additional high rate treatment would be needed with a 17 foot diameter tunnel to provide 85 percent volumetric control. Based upon the updated simulations, it appears that 80 mgd of additional HRT, in combination with a 17 foot diameter, 23,000 foot long tunnel and the



Alternative 1 - Phase IA Improvements and Phase II - 20 Foot Diameter Deep Tunnel

Figure 1



BFIGBORD
BFIGBORD
CYGNET ID: 163509-2000-GENUP-C-N0001BGPR



LEGEND

- UV, EFFLUENT PUMP STATION AND PHASE IA FACILITIES
- FUTURE PHASE FACILITIES



ST. JOSEPH, MISSOURI
FACILITIES PLAN
PN 163509
ALTERNATIVE 1
SCREENING SHAFT AND
DEEP TUNNEL PUMP STATION LAYOUT

FIGURE 2

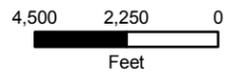
Phase IA facilities, could provide the required 85 percent wet weather capture. Table 4 shows the wet weather percent capture results of this simulation.

Table 4 Alternative 2 – 17 foot Diameter Deep Storage Tunnel with Additional 80 mgd High Rate Treatment Overflow Volumes and Wet Weather Volumetric Percent Capture		
Design Event	Existing Combined Sewage Volume, MG	Phase II & III CSO Volume, MG
> A	426.93	0.00
A-B	601.92	0.00
B-C	401.07	0.00
C-D	839.49	18.87
D-E	490.31	47.25
E-F	324.63	52.80
F-G	413.23	95.57
G-H	565.43	191.95
H	656.03	257.38
Total	4,719.04	663.81
Percent Capture		85%¹
1. The wet weather percent capture assumes that the Phase IA improvements have been implemented.		

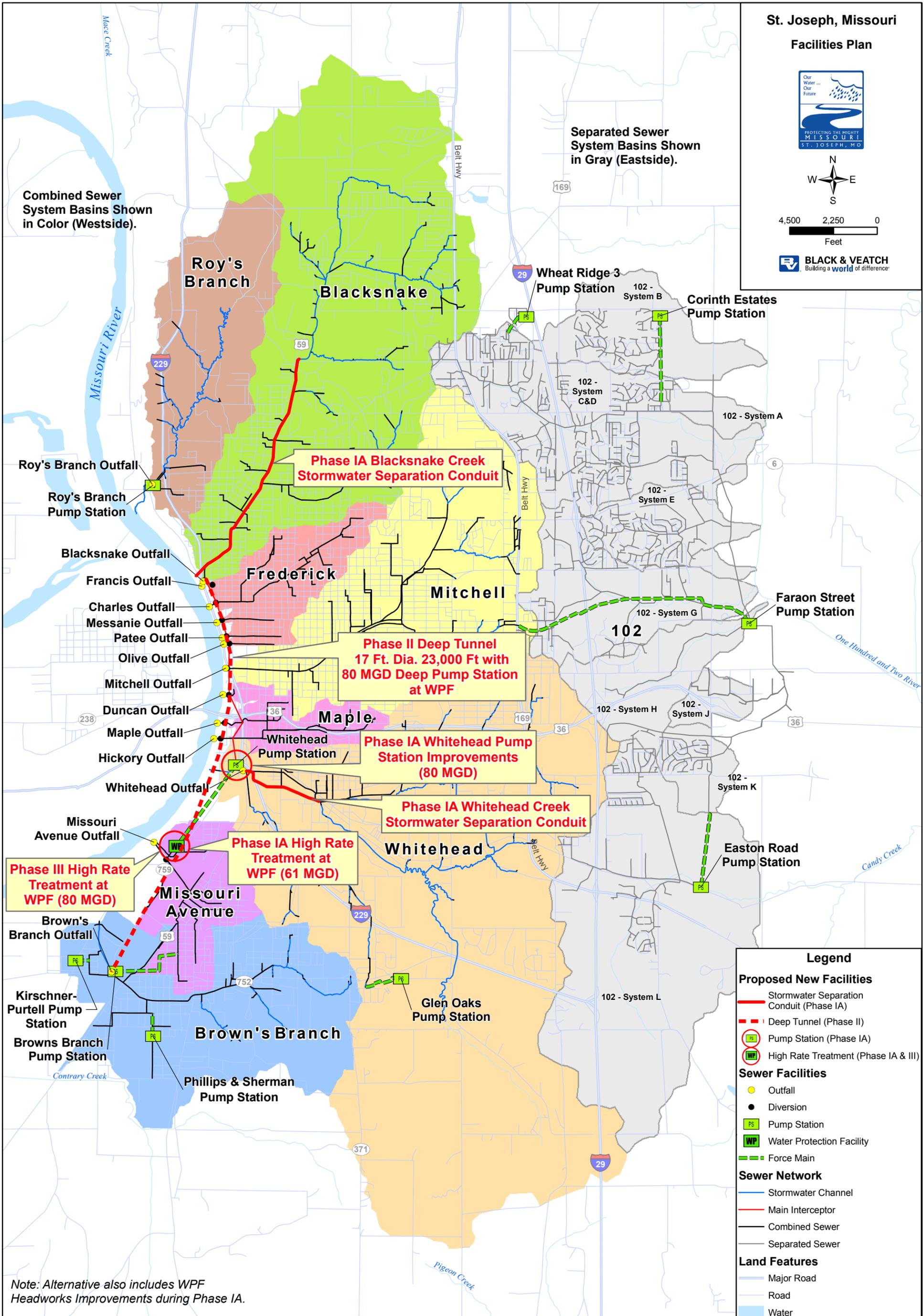
Based on these CSS modeling results, the Phase IA improvements, a 17 foot diameter tunnel, and an additional 80 mgd HRT could provide 85 percent volumetric capture and achieve the USEPA CSO presumptive control guidelines. A conceptual plan view indicating the location of the deep tunnel and additional HRT facilities for Alternative 2 is shown in Figure 3. The site layout of the deep tunnel pump station as well as the screening and grit shafts are presented in Figure 4. The deep tunnel pump station is sized to pump a peak flow of 80 mgd. This flow will be delivered to a new 80 mgd HRT facility proposed as part this alternative. The opinion of probable project costs and approach for implementing Alternative 2 are presented in Section 7.0.

St. Joseph, Missouri

Facilities Plan



BLACK & VEATCH
Building a world of difference



Legend

Proposed New Facilities

- Stormwater Separation Conduit (Phase IA)
- Deep Tunnel (Phase II)
- Pump Station (Phase IA)
- High Rate Treatment (Phase IA & III)

Sewer Facilities

- Outfall
- Diversion
- Pump Station
- Water Protection Facility
- Force Main

Sewer Network

- Stormwater Channel
- Main Interceptor
- Combined Sewer
- Separated Sewer

Land Features

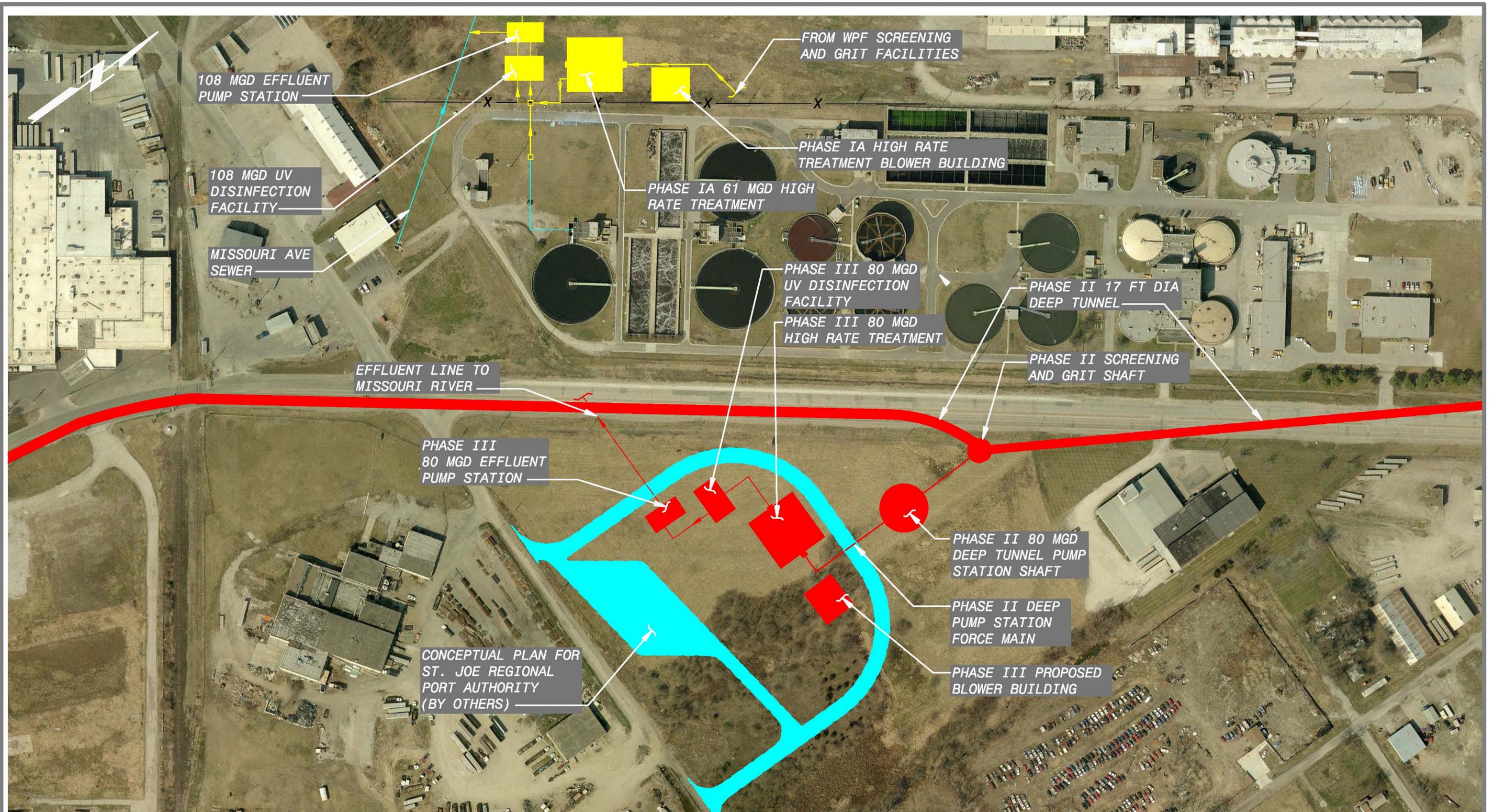
- Major Road
- Road
- Water

Note: Alternative also includes WPF Headworks Improvements during Phase IA.

Alternative 2 - Phase IA Improvements, Phase II - 17 Foot Diameter Deep Tunnel, and Phase III - 80 MGD HRT

Figure 3

BFIBORD
FBFIGBORD
CYGNET ID: 163509-2000-WWTUP-C-N0001C44S



SCALE IN FEET

LEGEND

-  UV, EFFLUENT PUMP STATION AND PHASE IA FACILITIES
-  FUTURE PHASE FACILITIES



**ST. JOSEPH, MISSOURI
FACILITIES PLAN**
PN 163509
ALTERNATIVE 2
SCREENING SHAFT, DEEP TUNNEL
PUMP STATION, AND 80 MGD HRT LAYOUT

FIGURE 4

6.0 Evaluation of Combined Sewer System with CSO Control Improvements During Stormwater Flooding Events

As part of the 2008 LTCP recommendations, some diversion structure weirs were proposed to be raised and some diversion structures were proposed to have motor-operated gates. However, based upon updated flow monitoring and modeling and the stated objective of achieving 85 percent wet weather capture in lieu of a frequency goal, these improvements are no longer necessary. As stated in the 2008 LTCP, these weir and gate improvements were intended to achieve the wet weather overflow frequency goal of 12 overflows per year for Phase I. Therefore, since the proposed Phase IA facilities will achieve a wet weather percent capture goal of at least 60 percent, these improvements are no longer recommended. Furthermore, modifications that raise the weir heights in the diversion structures could cause the following problems in the combined sewer system during extreme wet weather events such as the 25 year Comprehensive Stormwater Management Plan flooding event:

- Increased hydraulic gradeline profiles in the main trunk sewers potentially causing basement backups.
- Possible motor operated gate failure during a wet weather event resulting in increased upstream flooding.

Since these weir and gate improvements are not recommended as part of the Facilities Plan and updated CSO improvements documented herein, the need to simulate the impacts of raising weirs and adding motor operated gates in the diversion structures is not necessary and was not performed. Upon completion of the CSO LTCP implementation, the combined sewer system will still have the same system conveyance limitations as was identified in the City's Comprehensive Stormwater Management Plan. However, the CSO control improvements will not negatively impact the storm drainage system and flood control.

7.0 CSO LTCP Future Phases Costs and Implementation

A conceptual cost opinion methodology was employed to develop project capital costs for the proposed CSO LTCP future phase improvements. All project costs are given in May 2009 dollars (Engineering News Record (ENR) Building Cost Index (BCI) equal to 4773). Where applicable, detailed cost opinions developed for other facilities proposed as part of the Facilities Plan (such as UV disinfection facilities) were used as the basis to develop the cost opinion for the future phase CSO facilities.

7.1 Alternative 1 Project Cost – 20 foot Diameter Deep Storage Tunnel

Alternative 1 consists of a 20 foot diameter, 23,000 foot long, deep tunnel with a storage capacity of 54 MG. This tunnel, in combination with the Phase IA improvements, will allow the City to achieve 85 percent wet weather capture. Furthermore, this alternative assumes that the Phase IA facilities including 61 mgd high rate treatment, 61 mgd UV disinfection, and 61 mgd effluent pumping will provide the facilities to treat, disinfect, and convey the treated flows captured by the deep tunnel. The opinion of probable project cost for Alternative 1 is summarized in Table 5.

Table 5	
Summary of Opinion of Probable Project Costs for Alternative 1 – 20 foot Diameter Deep Storage Tunnel ¹	
Item	Improvement Costs, \$
Deep Tunnel, 20 ft diameter, 23,000 lin ft	160,336,000
Deep Tunnel Pump Station, 61 mgd	28,281,000
Yard Piping, 72 inch	324,000
Flood Protection (placeholder) ²	370,000
Site Remediation (placeholder) ²	2,222,000
<i>Subtotal</i>	<i>191,533,000</i>
Electrical, I&C, Sitework, Contractor General Requirements ³	15,447,000
<i>Subtotal</i>	<i>206,980,000</i>
Contingency ⁴	51,745,000
Land Acquisition (placeholder) ^{2, 5}	106,000
Opinion of Probable Construction Cost	258,831,000
Engineering, Legal, and Administration ⁶	51,766,000
Opinion of Total Project Cost	310,597,000

Table 5	
Summary of Opinion of Probable Project Costs for Alternative 1 – 20 foot Diameter Deep Storage Tunnel ¹	
Item	Improvement Costs, \$
1. All costs presented in May 2009 dollars (ENR BCI = 4773). 2. Site related costs are placeholders and must be revised following final siting of the facilities. Site related costs are provided for the site area required for the proposed facilities. 3. Electrical and instrumentation and controls (I&C) projected at 25% of the total of all equipment and structure costs but excludes the deep tunnel. Sitework projected at 10% of the total of equipment, structures, electrical, and, I&C costs. Contractor general requirements projected at 12% of the total of equipment, structures, electrical, I&C, and sitework costs. 4. Project contingency is projected at 25% of the total of all equipment, structures, electrical, I&C, sitework, contractor general requirements, flood protection/fill, and site remediation costs. 5. Land acquisition cost is based on a projection provided by the City from a recent purchase of land directly south of the WPF. 6. Engineering, legal, and administration (ELA) costs are projected at 20% of the total of all equipment, structures, electrical, I&C, sitework, contractor general requirements, flood protection/fill, site remediation costs, contingency, and land acquisition.	

7.2 Alternative 2 Project Cost – 17 Foot Diameter Deep Storage Tunnel and Additional High Rate Treatment

Alternative 2 consists of a 17 foot diameter, 23,000 foot long deep tunnel (storage capacity of 39.2 MG) and dedicated 80 mgd high rate treatment, UV disinfection, and effluent pumping facilities to treat, disinfect, and convey the treated flows captured by the deep tunnel to the Missouri River. This tunnel and dedicated HRT treatment train, in combination with the Phase IA improvements, would allow the City to achieve 85 percent wet weather capture. The 80 mgd HRT facilities provide dedicated treatment for the deep tunnel and are in addition to the 61 mgd high rate treatment, 61 mgd UV disinfection, and 61 mgd effluent pumping proposed as part of the Phase IA improvements. The opinion of probable project cost for Alternative 2 is summarized in Table 6.

Table 6	
Summary of Opinion of Probable Project Costs for Alternative 2 – 17 foot Diameter Deep Storage Tunnel with 80 mgd HRT ¹	
Item	Improvement Costs, \$
Deep Tunnel, 17 ft Diameter, 23,000 lin ft	148,157,000
Deep Tunnel Pump Station, 80 mgd	32,571,000
High Rate Treatment Facility, 80 mgd	20,984,000
UV Disinfection Facility, 80 mgd	7,000,000
Effluent Pump Station, 80 mgd	4,250,000
Yard Piping, 72 inch	3,240,000
Flood Protection (placeholder) ²	741,000
Site Remediation (placeholder) ²	4,444,000
<i>Subtotal</i>	<i>221,387,000</i>
Electrical, I&C, Sitework, Contractor General Requirements ³	36,744,000
<i>Subtotal</i>	<i>258,131,000</i>
Contingency ⁴	64,533,000
Land Acquisition (placeholder) ^{2,5}	212,000
Opinion of Probable Construction Cost	322,876,000
Engineering, Legal, and Administration ⁶	64,575,000
Opinion of Total Project Cost	387,451,000
<ol style="list-style-type: none"> 1. All costs presented in May 2009 dollars (ENR BCI = 4773). 2. Site related costs are placeholders and must be revised following final siting of the facilities. Site related costs are provided for the site area required for the proposed facilities. 3. Electrical and instrumentation and controls (I&C) projected at 25% of the total of all equipment and structure costs but excludes the deep tunnel. Sitework projected at 10% of the total of equipment, structures, electrical, and I&C costs. Contractor general requirements projected at 12% of the total of equipment, structures, electrical, I&C, and sitework costs. 4. Project contingency is projected at 25% of the total of all equipment, structures, electrical, I&C, sitework, contractor general requirements, flood protection/fill, and site remediation costs. 5. Land acquisition cost is based on a projection provided by the City from a recent purchase of land directly south of the WPF. 6. Engineering, legal, and administration (ELA) costs are projected at 20% of the total of all equipment, structures, electrical, I&C, sitework, contractor general requirements, flood protection/fill, site remediation costs, contingency, and land acquisition. 	

7.3 Implementation and Phasing

Upon review of Table 5 and Table 6, Alternative 1 – 20 foot Diameter Deep Storage Tunnel is more cost effective than Alternative 2 – 17 foot Diameter Deep Storage Tunnel and 80 mgd High Rate Treatment. Furthermore, based on review of similar CSO

control programs, it is typically more cost effective to provide more deep tunnel storage and less peak flow treatment rather than providing less storage and greater peak flow treatment. The results of the analysis presented herein support this typical finding. Although there is some initial phased cost savings in the tunnel being downsized in Alternative 2, the initial cost savings is lost when the dedicated 80 mgd high rate treatment facility, 80 mgd UV disinfection facility, and 80 mgd effluent pump station are added to provide peak flow treatment.

Alternative 1 also makes use of facilities planned for construction during the Phase IA implementation period. The larger deep tunnel allows combined sewage to be stored and treated through the Phase IA HRT improvements after the wet weather event has passed. Since Alternative 2 provides less storage, treatment with an additional HRT facility must occur during the wet weather event as opposed to afterwards. The 80 mgd HRT would be a dedicated and separate facility from the 61 mgd HRT facilities proposed as part of Phase IA. Alternative 1 is also superior to Alternative 2 in that it allows operation of proposed Phase IA facilities to be maximized.

In terms of implementation, since the tunnel length is not significantly long, it does not appear cost effective to construct the tunnel in phases for St. Joseph. The cost for tunnel mobilization for each phase would be \$5 to \$10 million and segmenting the deep tunnel into two phased tunnel projects would delay collecting CSO from all of the outfalls. In addition, tying a new tunnel segment into an existing and active deep tunnel would be more challenging construction. Therefore, it is recommended that Alternative 1 be implemented within one single phase (Phase II). Conversely, Alternative 2 has a deep tunnel storage component as well as surface HRT, disinfection, and effluent pumping. Therefore, Alternative 2 could be built in two phases which may be advantageous to the City. Table 7 summarizes the anticipated implementation phasing and costs for the two potential alternatives.

Table 7			
CSO LTCP Phase Project Costs by Alternative			
Alternative	Phase II, \$	Phase III, \$	Total, \$
Alternative 1 – 20 ft Diameter Deep Tunnel	310,597,000	0	310,597,000
Alternative 2 – 17 ft Diameter Deep Tunnel and 80 mgd HRT	301,490,000	85,961,000	387,451,000

As shown in Table 7, the cost difference between the larger diameter tunnel in Alternative 1 and the smaller diameter tunnel in Alternative 2 is less than \$10 million dollars. Therefore, it does not appear prudent for the City to pursue Alternative 2 to reduce the Phase II costs. Furthermore, the cost sensitivity analysis indicated that if the tunnel were reduced in diameter to a size smaller than 17 feet, the Phase II cost reduction would be more than offset by the Phase III costs and overall LTCP costs would be equal or higher. It is recommended that Alternative 1 – 20 foot Diameter Deep Storage Tunnel be selected as the preferred approach for the future LTCP CSO control phase. This recommendation could be modified or refined upon completion of the Phase IB monitoring and water quality study.

8.0 Conclusions and Recommendations

Upon completion of the Phase IA improvements, it is recommended that the City conduct a two year system monitoring and evaluation study to determine the effectiveness of the Phase IA improvements in improving water quality in the Missouri River. This water quality study, entitled Phase IB, will help refine and update the proposed future CSO phases proposed herein as part of an overall adaptive management approach for the City’s CSO LTCP. This study will ensure that City funding will continue to be optimized now and into the future for the improvement of Missouri River water quality. The flow equalization basin facilities at Patee and Missouri Avenue that were recommended in the 2008 LTCP are not required to achieve a wet weather capture of 85 percent and are therefore eliminated from the recommendations presented herein.

For the Phase II and Phase III recommendations, two alternatives were investigated that achieve 85 percent wet weather capture. Alternative 1 consists of a 20 foot diameter, 23,000 foot long, deep storage tunnel with a capacity of 54 MG that captures combined sewage and allows it to be treated after the wet weather event subsides through the 61 mgd HRT, 61 mgd disinfection, and 61 mgd effluent pump station facilities proposed as part of the Phase IA improvements. Alternative 2 consists of a 17 foot diameter, 23,000 foot long, deep storage tunnel with a capacity of 39.2 MG that captures combined sewage and conveys it to a dedicated 80 mgd HRT, 80 mgd disinfection, and 80 mgd effluent pump station. Alternative 2 would require that the 80 mgd HRT be active during a wet weather event as opposed to afterwards. Based on a review of the associated costs and phasing, Alternative 1 appears to be the superior alternative for future CSO control phasing and is therefore recommended. Therefore, Phase II of the CSO control program will include a deep storage tunnel with a total project cost of \$310,597,000. An adaptive management approach should be used for the CSO control program, and this recommendation could be modified or refined upon completion of the Phase IB monitoring and water quality study.

9.0 References

1. Black & Veatch Corporation, TM-CSO-3a – Phase IA CSO Control Recommended Improvements Model, 2009.
2. Black & Veatch Corporation, TM-CSO-2 – CSS Model Calibration and Existing Conditions, 2009.
3. Black & Veatch Corporation, Comprehensive Stormwater Management Plan, 1998.

Appendix A

Detailed Flow and Volume Combined Sewage Calculations

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Basin Summary

Basin:
Diversion Structure No.:
Design Condition/Alt.:
Average Dry Weather Flow (ADWF), mgd:

St. Joseph CSO
All
Phase 2
17.417

Rainfall Characteristics						Summary Data during Precipitation Events			
Design Storm ID	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Design Storm Summary		Estimated Annual Totals	
						Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)	Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.00		
A	0.29	0.20	6.00	36	18	12.15	0.00	255.15	0.00
B	0.51	0.26	8.75	18	6	28.21	0.00	363.24	0.00
C	0.86	0.58	12.25	12	6	50.43	0.00	235.92	0.00
D	1.41	0.75	16.75	6	2	113.86	21.19	492.87	63.57
E	1.82	0.87	19.75	4	1	172.72	67.69	286.58	88.88
F	2.00	0.95	21.00	3	1	204.50	95.22	188.61	81.46
G	2.37	1.06	23.75	2	1	287.23	163.41	245.87	129.32
H	2.88	1.25	26.75	1	1	422.88	294.19	355.06	228.80
Totals					78			2846.17	886.21
Long-Term Mean Annual Rainfall (inches)					36.5				
Long-Term Median Annual Rainfall (inches)					35.0				
Total Rainfall Depth Represented Above (inches)					37.04				
Estimated Total Annual Inflow to Diversion Structures (mg)						8823.73			
Estimated Annual Volume Retained in System (mg)						7937.52			
ESTIMATED BASIN-WIDE ANNUAL CAPTURE DURING PRECIPITATION EVENTS*						81.22%			

* - This calculation is based on the estimated Existing total volume to Diversion Structures, which is 4719.04 MG.

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Roys_Branch

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BSS-30**
 Discharges to Outfall No.: **BSS-RIVER**
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.00	0.00
A	0.29	0.20	6.00	36	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	0.51	0.26	8.75	18	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	0.86	0.58	12.25	12	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	1.41	0.75	16.75	6	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	1.82	0.87	19.75	4	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	2.00	0.95	21.00	3	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G	2.37	1.06	23.75	2	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H	2.88	1.25	26.75	1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				78									0.00	0.00
											Estimated Annual Time During Runoff Events (hours)	0		
											Estimated Annual Time Between Runoff Events	8,760		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	0		
											Estimated Total Annual Inflow to Diversion Structure (mg)	0.00		
											Estimated Annual Volume Retained in System (mg)	0.00		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Blacksnake

Basin:
Diversion Structure No.:
Discharges to Outfall No.:
Design Condition/Alt.:
Average Dry Weather Flow (mgd):

St. Joseph CSO
BSS-30
BSS-RIVER
Phase 2

Or to:

At:

4.6 (ADWF)

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.92	41.16	0.00
A	0.29	0.20	6.00	36	18	5.83	1.96	18.57	0.00	0.00	0.00	7.82	52.83	0.00
B	0.51	0.26	8.75	18	6	9.80	3.91	32.76	0.00	0.00	0.00	9.80	28.08	0.00
C	0.86	0.58	12.25	12	6	9.80	5.45	59.53	0.00	0.00	0.00	13.61	55.53	0.00
D	1.41	0.75	16.75	6	2	17.42	13.06	97.59	0.00	0.00	0.00	18.92	33.75	0.00
E	1.82	0.87	19.75	4	1	20.42	20.69	119.24	0.00	0.00	0.00	21.13	23.63	0.01
F	2.00	0.95	21.00	3	1	21.83	26.56	196.29	0.01	3.81	0.17	23.21	34.24	1.78
G	2.37	1.06	23.75	2	1	24.58	41.92	407.13	3.55	255.82	1.25	26.08	55.23	10.87
H	2.88	1.25	26.75	1	1	27.58	68.53	901.04	18.19	753.68	1.67	27.58	68.53	18.19
				78									392.97	30.85
Estimated Annual Time During Runoff Events (hours)												539		
Estimated Annual Time Between Runoff Events												8,221		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												1575.599028		
Estimated Total Annual Inflow to Diversion Structure (mg)												1968.57		
Estimated Annual Volume Retained in System (mg)												1937.72		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Francis

Basin: **St. Joseph CSO**
 Diversion Structure No.: **16-37**
 Discharges to Outfall No.: **16-River1**
 Design Condition/Alt.: **Phase 2**

Or to: _____ At: _____

Average Dry Weather Flow (mgd):

0.0 (ADWF)

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.17	0.21	0.00
A	0.29	0.20	6.00	36	18	4.33	0.01	0.28	0.00	0.00	0.00	5.58	0.36	0.00
B	0.51	0.26	8.75	18	6	6.83	0.03	0.52	0.00	0.00	0.00	8.71	0.27	0.00
C	0.86	0.58	12.25	12	6	10.58	0.06	1.16	0.00	0.00	0.00	12.96	0.54	0.00
D	1.41	0.75	16.75	6	2	15.33	0.12	1.67	0.00	0.00	0.00	16.83	0.28	0.00
E	1.82	0.87	19.75	4	1	18.33	0.16	1.95	0.00	0.00	0.00	19.00	0.17	0.00
F	2.00	0.95	21.00	3	1	19.67	0.17	2.17	0.00	0.00	0.00	21.04	0.19	0.00
G	2.37	1.06	23.75	2	1	22.42	0.21	2.43	0.00	0.00	0.00	23.88	0.24	0.00
H	2.88	1.25	26.75	1	1	25.33	0.26	2.89	0.00	0.00	0.00	25.33	0.26	0.00
				78									2.51	0.00
Estimated Annual Time During Runoff Events (hours)												444		
Estimated Annual Time Between Runoff Events												8,316		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												0		
Estimated Total Annual Inflow to Diversion Structure (mg)												2.51		
Estimated Annual Volume Retained in System (mg)												2.51		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **SBS-33**
 Discharges to Outfall No.: **SBS-RIVER** Or to:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **1.2 (ADWF)**

At:

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	14.07	0.00
A	0.29	0.20	6.00	36	18	4.50	0.67	11.79	0.00	0.00	0.00	5.75	19.98	0.00
B	0.51	0.26	8.75	18	6	7.00	1.55	20.86	0.00	0.00	0.00	8.75	12.39	0.00
C	0.86	0.58	12.25	12	6	10.50	2.58	42.46	0.00	0.00	0.00	13.00	25.35	0.00
D	1.41	0.75	16.75	6	2	15.50	5.87	66.53	0.00	0.00	0.00	17.00	14.49	0.00
E	1.82	0.87	19.75	4	1	18.50	8.62	79.73	0.00	0.00	0.00	19.17	9.32	0.00
F	2.00	0.95	21.00	3	1	19.83	10.02	106.90	0.00	0.00	0.00	21.21	11.71	0.11
G	2.37	1.06	23.75	2	1	22.58	13.40	134.32	0.22	19.78	0.58	24.04	15.58	3.10
H	2.88	1.25	26.75	1	1	25.50	17.75	198.53	5.97	207.89	1.25	25.50	17.75	5.97
				78								140.64	170.64	9.18
											Estimated Annual Time During Runoff Events (hours)	452		
											Estimated Annual Time Between Runoff Events	8,308		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	415.3791667		
											Estimated Total Annual Inflow to Diversion Structure (mg)	556.01		
											Estimated Annual Volume Retained in System (mg)	546.84		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Messanie

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-75**
 Discharges to Outfall No.: **9-RIVER** Or to: _____ At: _____
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.50	4.20	0.00
A	0.29	0.20	6.00	36	18	5.00	0.20	3.66	0.00	0.00	0.00	6.46	5.85	0.00
B	0.51	0.26	8.75	18	6	7.92	0.45	6.49	0.00	0.00	0.00	9.79	3.84	0.00
C	0.86	0.58	12.25	12	6	11.67	0.83	14.34	0.00	0.00	0.00	14.08	7.38	1.53
D	1.41	0.75	16.75	6	2	16.50	1.63	21.01	0.51	35.34	1.08	18.04	3.83	4.85
E	1.82	0.87	19.75	4	1	19.58	2.20	25.58	4.34	110.00	3.50	20.25	2.34	5.64
F	2.00	0.95	21.00	3	1	20.92	2.47	29.39	6.94	120.66	4.58	22.29	2.77	9.24
G	2.37	1.06	23.75	2	1	23.67	3.06	33.37	11.53	129.78	7.25	25.13	3.44	14.66
H	2.88	1.25	26.75	1	1	26.58	3.82	44.82	17.79	145.73	10.50	26.58	3.82	17.79
				78								37.46	53.71	
											Estimated Annual Time During Runoff Events (hours)	495		
											Estimated Annual Time Between Runoff Events	8,265		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	41,325,833		
											Estimated Total Annual Inflow to Diversion Structure (mg)	78.79		
											Estimated Annual Volume Retained in System (mg)	25.08		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Patee

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-76**
 Discharges to Outfall No.: **9-R2** Or to: At:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	2.52	0.00
A	0.29	0.20	6.00	36	18	4.50	0.12	2.38	0.00	0.00	0.00	5.75	3.60	0.00
B	0.51	0.26	8.75	18	6	7.00	0.28	4.33	0.00	0.00	0.00	8.83	2.43	0.00
C	0.86	0.58	12.25	12	6	10.67	0.53	9.57	0.00	0.00	0.00	13.13	4.80	30.78
D	1.41	0.75	16.75	6	2	15.58	1.07	13.94	10.26	65.65	16.17	17.21	2.57	28.49
E	1.82	0.87	19.75	4	1	18.83	1.50	16.38	18.23	85.18	18.50	19.50	1.62	19.90
F	2.00	0.95	21.00	3	1	20.17	1.73	19.35	21.57	92.58	19.25	21.50	1.98	24.63
G	2.37	1.06	23.75	2	1	22.83	2.23	22.75	27.68	106.47	18.08	24.08	2.49	32.02
H	2.88	1.25	26.75	1	1	25.33	2.75	30.40	36.36	121.30	16.92	25.33	2.75	36.36
				78									24.76	172.18
											Estimated Annual Time During Runoff Events (hours)	455		
											Estimated Annual Time Between Runoff Events	8,305		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	27,684,222		
											Estimated Total Annual Inflow to Diversion Structure (mg)	52.44		
											Estimated Annual Volume Retained in System (mg)	-119.74		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Olive

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-76**
 Discharges to Outfall No.: **9-R2** Or to: At:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.67	1.26	0.00
A	0.29	0.20	6.00	36	18	5.33	0.06	1.10	0.00	0.00	0.00	6.63	1.71	0.00
B	0.51	0.26	8.75	18	6	7.92	0.13	2.00	0.00	0.00	0.00	9.79	1.17	0.00
C	0.86	0.58	12.25	12	6	11.67	0.26	3.99	0.00	0.00	0.00	14.08	2.28	0.00
D	1.41	0.75	16.75	6	2	16.50	0.50	6.60	0.00	0.00	0.00	18.00	1.18	0.00
E	1.82	0.87	19.75	4	1	19.50	0.68	8.03	0.00	0.00	0.00	20.17	0.73	0.00
F	2.00	0.95	21.00	3	1	20.83	0.77	9.29	0.00	0.00	0.00	22.21	0.86	0.00
G	2.37	1.06	23.75	2	1	23.58	0.95	10.58	0.00	0.00	0.00	25.04	1.07	0.17
H	2.88	1.25	26.75	1	1	26.50	1.18	12.95	0.33	19.24	0.83	26.50	1.18	0.33
				78								11.43	1.18	0.50
											Estimated Annual Time During Runoff Events (hours)	504		
											Estimated Annual Time Between Runoff Events	8,256		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	7,911,600,694		
											Estimated Total Annual Inflow to Diversion Structure (mg)	19.34		
											Estimated Annual Volume Retained in System (mg)	18.85		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Mitchell

Basin: **St. Joseph CSO**
 Diversion Structure No.: **N7**
 Discharges to Outfall No.: **BDCS-RIVER** Or to:
 Design Condition/Alt.: **Phase 2** At:
 Average Dry Weather Flow (mgd): **4.7 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.54	61.95	0.00
A	0.29	0.20	6.00	36	18	5.08	2.95	44.50	0.00	0.00	0.00	6.21	88.56	0.00
B	0.51	0.26	8.75	18	6	7.33	6.89	88.02	0.00	0.00	0.00	9.13	59.61	0.00
C	0.86	0.58	12.25	12	6	10.92	12.98	161.03	0.00	0.00	0.00	13.42	121.80	22.86
D	1.41	0.75	16.75	6	2	15.92	27.62	276.57	7.62	139.79	7.67	17.42	69.70	33.63
E	1.82	0.87	19.75	4	1	18.92	42.08	342.53	26.01	358.21	10.17	19.58	45.85	31.43
F	2.00	0.95	21.00	3	1	20.25	49.62	432.32	36.85	470.50	11.25	21.67	58.61	49.72
G	2.37	1.06	23.75	2	1	23.08	67.59	580.38	62.59	737.46	12.92	24.58	79.71	83.96
H	2.88	1.25	26.75	1	1	26.08	91.83	908.50	105.32	1083.71	14.75	26.08	91.83	105.32
				78									677.62	326.92
											Estimated Annual Time During Runoff Events (hours)	481		
											Estimated Annual Time Between Runoff Events	8,280		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	1621.402083		
											Estimated Total Annual Inflow to Diversion Structure (mg)	2299.02		
											Estimated Annual Volume Retained in System (mg)	1972.10		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Duncan

Basin: **St. Joseph CSO**
 Diversion Structure No.: **83-18**
 Discharges to Outfall No.: **83-RIVER** Or to: At:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.00	0.84	0.00
A	0.29	0.20	6.00	36	18	4.00	0.04	1.58	0.00	0.00	0.00	5.17	1.71	0.00
B	0.51	0.26	8.75	18	6	6.33	0.15	2.89	0.00	0.00	0.00	8.08	1.44	0.00
C	0.86	0.58	12.25	12	6	9.83	0.33	6.52	0.00	0.00	0.00	12.25	2.94	0.00
D	1.41	0.75	16.75	6	2	14.67	0.65	9.36	0.00	0.00	0.00	16.21	1.54	0.12
E	1.82	0.87	19.75	4	1	17.75	0.89	10.97	0.12	7.57	1.00	18.42	0.95	0.22
F	2.00	0.95	21.00	3	1	19.08	1.00	12.46	0.31	11.18	1.33	20.54	1.12	0.57
G	2.37	1.06	23.75	2	1	22.00	1.23	14.15	0.82	17.95	2.25	23.46	1.39	1.12
H	2.88	1.25	26.75	1	1	24.92	1.55	17.45	1.42	20.25	3.08	24.92	1.55	1.42
				78									13.47	3.44
Estimated Annual Time During Runoff Events (hours)											419			
Estimated Annual Time Between Runoff Events											8,341			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											1.390208333			
Estimated Total Annual Inflow to Diversion Structure (mg)											14.86			
Estimated Annual Volume Retained in System (mg)											11.42			

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Maple

Basin: **St. Joseph CSO**
 Diversion Structure No.: **84-8**
 Discharges to Outfall No.: **84-RIVER** Or to:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

At:

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.42	9.03	0.00
A	0.29	0.20	6.00	36	18	4.83	0.43	8.02	0.00	0.00	0.00	6.04	12.78	0.00
B	0.51	0.26	8.75	18	6	7.25	0.99	14.56	0.00	0.00	0.00	9.13	8.40	0.00
C	0.86	0.58	12.25	12	6	11.00	1.81	30.71	0.00	0.00	0.00	13.50	16.32	0.30
D	1.41	0.75	16.75	6	2	16.00	3.63	47.07	0.10	7.64	0.83	17.50	8.68	2.39
E	1.82	0.87	19.75	4	1	19.00	5.05	55.40	2.29	83.38	2.25	19.67	5.40	3.11
F	2.00	0.95	21.00	3	1	20.33	5.75	64.27	3.92	103.45	3.08	21.71	6.52	6.40
G	2.37	1.06	23.75	2	1	23.08	7.28	74.97	8.88	179.73	4.83	24.54	8.30	12.33
H	2.88	1.25	26.75	1	1	26.00	9.31	99.34	15.78	221.92	8.92	26.00	9.31	15.78
				78									84.73	40.31
											Estimated Annual Time During Runoff Events (hours)	473		
											Estimated Annual Time Between Runoff Events	8,287		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	89,776,736,11		
											Estimated Total Annual Inflow to Diversion Structure (mg)	174,51		
											Estimated Annual Volume Retained in System (mg)	134,20		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Hickory

Basin: **St. Joseph CSO**
 Diversion Structure No.: **33-1**
 Discharges to Outfall No.: **33-RIVER** Or to:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

At:

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.08	3.78	0.00
A	0.29	0.20	6.00	36	18	4.17	0.18	4.14	0.00	0.00	0.00	5.38	5.94	0.00
B	0.51	0.26	8.75	18	6	6.58	0.48	7.43	0.00	0.00	0.00	8.38	4.02	0.00
C	0.86	0.58	12.25	12	6	10.17	0.86	15.54	0.00	0.00	0.00	12.67	8.34	0.96
D	1.41	0.75	16.75	6	2	15.17	1.92	23.98	0.32	15.72	1.67	16.67	4.67	3.40
E	1.82	0.87	19.75	4	1	18.17	2.75	28.30	3.08	96.83	5.67	18.83	2.96	4.00
F	2.00	0.95	21.00	3	1	19.50	3.16	33.81	4.92	114.99	6.50	20.96	3.64	7.56
G	2.37	1.06	23.75	2	1	22.42	4.12	40.40	10.19	181.65	8.17	23.88	4.73	14.25
H	2.88	1.25	26.75	1	1	25.33	5.34	56.47	18.31	255.00	11.58	25.33	5.34	18.31
				78									43.42	48.48
											Estimated Annual Time During Runoff Events (hours)	433		
											Estimated Annual Time Between Runoff Events	8,327		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	93,680,625		
											Estimated Total Annual Inflow to Diversion Structure (mg)	137.10		
											Estimated Annual Volume Retained in System (mg)	88.62		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
Whitehead

Basin: **St. Joseph CSO**
 Diversion Structure No.: **WMS-19**
 Discharges to Outfall No.: **WMS-RIVER** Or to: At:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **2.8 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.79	69.72	0.00
A	0.29	0.20	6.00	36	18	5.58	3.32	36.49	0.00	0.00	0.00	6.75	106.11	0.00
B	0.51	0.26	8.75	18	6	7.92	8.47	86.54	0.00	0.00	0.00	9.71	74.40	0.00
C	0.86	0.58	12.25	12	6	11.50	16.33	146.07	0.00	0.00	0.00	14.00	151.17	0.00
D	1.41	0.75	16.75	6	2	16.50	34.06	258.97	0.00	0.00	0.00	18.00	84.33	0.22
E	1.82	0.87	19.75	4	1	19.50	50.27	341.84	0.22	28.70	0.75	20.17	54.40	0.42
F	2.00	0.95	21.00	3	1	20.83	58.52	424.55	0.61	41.75	1.17	22.25	71.57	1.88
G	2.37	1.06	23.75	2	1	23.67	84.61	558.92	3.15	156.36	2.00	25.25	111.95	9.47
H	2.88	1.25	26.75	1	1	26.83	139.28	2192.82	15.78	1086.91	2.75	26.83	139.28	15.78
					78								862.92	27.76
Estimated Annual Time During Runoff Events (hours)												512		
Estimated Annual Time Between Runoff Events												8,249		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												962,325		
Estimated Total Annual Inflow to Diversion Structure (mg)												1825.24		
Estimated Annual Volume Retained in System (mg)												1797.48		

Combined Sewer System
Phase 2 Improvements with 17-ft diameter Deep Tunnel
MOAV

Basin: **St. Joseph CSO**
 Diversion Structure No.:
 Discharges to Outfall No.: Or to: At:
 Design Condition/Alt.: **Phase 2**
 Average Dry Weather Flow (mgd): **2.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	3.46	33.18	0.00
A	0.29	0.20	6.00	36	18	6.92	1.58	22.22	0.00	0.00	0.00	7.92	45.54	0.00
B	0.51	0.26	8.75	18	6	8.92	3.48	41.34	0.00	0.00	0.00	11.00	28.56	0.00
C	0.86	0.58	12.25	12	6	13.08	6.04	81.44	0.00	0.00	0.00	15.63	54.60	7.14
D	1.41	0.75	16.75	6	2	18.17	12.16	126.39	2.38	96.23	5.58	19.71	28.73	15.52
E	1.82	0.87	19.75	4	1	21.25	16.57	149.04	13.14	345.49	8.75	22.08	17.54	16.58
F	2.00	0.95	21.00	3	1	22.92	18.51	170.59	20.01	456.97	10.58	24.13	20.91	27.20
G	2.37	1.06	23.75	2	1	25.33	23.31	196.20	34.38	501.13	12.33	26.50	26.05	45.76
H	2.88	1.25	26.75	1	1	27.67	28.79	238.81	57.13	551.27	14.25	27.67	28.79	57.13
					78								283.90	169.32
Estimated Annual Time During Runoff Events (hours)												587		
Estimated Annual Time Between Runoff Events												8,173		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												715,111,972		
Estimated Total Annual Inflow to Diversion Structure (mg)												999.01		
Estimated Annual Volume Retained in System (mg)												829.70		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BNB-24**
 Discharges to Outfall No.: **BNB-28** Or to: **[REDACTED]** At: **[REDACTED]**
 Design Condition/Alt.: **Phase 2**
Average Dry Weather Flow (mgd): 1.3 (ADWF)

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	3.71	13.23	0.00
A	0.29	0.20	6.00	36	18	7.42	0.63	4.08	0.00	0.00	0.00	9.58	18.27	0.00
B	0.51	0.26	8.75	18	6	11.75	1.40	11.21	0.00	0.00	0.00	12.83	11.31	0.00
C	0.86	0.58	12.25	12	6	13.92	2.37	20.79	0.00	0.00	0.00	16.42	41.82	0.00
D	1.41	0.75	16.75	6	2	18.92	11.57	84.88	0.00	0.00	0.00	20.46	32.83	0.26
E	1.82	0.87	19.75	4	1	22.00	21.26	155.62	0.26	73.41	0.17	22.67	23.74	0.17
F	2.00	0.95	21.00	3	1	23.33	26.22	213.08	0.08	14.51	0.25	24.71	31.77	0.25
G	2.37	1.06	23.75	2	1	26.08	37.32	326.33	0.42	90.80	0.50	26.75	44.91	1.12
H	2.88	1.25	26.75	1	1	27.42	52.49	508.88	1.81	81.03	1.33	27.42	52.49	1.81
				78								270.37		3.61
											Estimated Annual Time During Runoff Events (hours)	646		
											Estimated Annual Time Between Runoff Events (hours)	8,114		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	425.9740625		
											Estimated Total Annual Inflow to Diversion Structure (mg)	696.34		
											Estimated Annual Volume Retained in System (mg)	692.73		

Combined Sewer System
20-ft diameter tunnel for 85% Volumetric Capture
Basin Summary

Basin:
Diversion Structure No.:
Design Condition/Alt.:
Average Dry Weather Flow (ADWF), mgd:

St. Joseph CSO
All
20-ft dia. Tunnel
17.417

Rainfall Characteristics						Summary Data during Precipitation Events			
Design Storm ID	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Design Storm Summary		Estimated Annual Totals	
						Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)	Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.00		
A	0.29	0.20	6.00	36	18	12.15	0.00	255.15	0.00
B	0.51	0.26	8.75	18	6	28.21	0.00	363.24	0.00
C	0.86	0.58	12.25	12	6	50.43	0.00	235.92	0.00
D	1.41	0.75	16.75	6	2	113.90	3.51	492.99	10.53
E	1.82	0.87	19.75	4	1	172.71	49.02	286.61	52.53
F	2.00	0.95	21.00	3	1	204.56	77.94	188.64	63.48
G	2.37	1.06	23.75	2	1	288.01	148.44	246.29	113.19
H	2.88	1.25	26.75	1	1	410.65	262.22	349.33	205.33
Totals					78			2828.81	707.28
Long-Term Mean Annual Rainfall (inches)					36.5				
Long-Term Median Annual Rainfall (inches)					35.0				
Total Rainfall Depth Represented Above (inches)					37.04				
Estimated Total Annual Inflow to Diversion Structures (mg)						8805.92			
Estimated Annual Volume Retained in System (mg)						8098.64			
ESTIMATED BASIN-WIDE ANNUAL CAPTURE DURING PRECIPITATION EVENTS						85.0%			

* - This calculation is based on the estimated Existing total volume to Diversion Structures, which is 4719.04 MG.

Combined Sewer System
 20-ft diameter tunnel for 85% Volumetric Capture
 Roys Branch

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BSS-30**
 Discharges to Outfall No.: **20-ft dia. Tunnel**
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.00	0.00
A	0.29	0.20	6.00	36	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	0.51	0.26	8.75	18	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	0.86	0.58	12.25	12	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	1.41	0.75	16.75	6	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	1.82	0.87	19.75	4	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	2.00	0.95	21.00	3	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G	2.37	1.06	23.75	2	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H	2.88	1.25	26.75	1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				78									0.00	0.00
Estimated Annual Time During Runoff Events (hours)											0			
Estimated Annual Time Between Runoff Events											8,760			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											0			
Estimated Total Annual Inflow to Diversion Structure (mg)												0.00		
Estimated Annual Volume Retained in System (mg)												0.00		

Combined Sewer System
 20-ft diameter tunnel for 85% Volumetric Capture
 Blacksnake

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BSS-30**
 Discharges to Outfall No.: **20-ft dia. Tunnel**
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **4.6 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.92	41.16	0.00
A	0.29	0.20	6.00	36	18	5.83	1.96	18.57	0.00	0.00	0.00	7.82	52.83	0.00
B	0.51	0.26	8.75	18	6	9.80	3.91	32.76	0.00	0.00	0.00	9.80	28.08	0.00
C	0.86	0.58	12.25	12	6	9.80	5.45	59.53	0.00	0.00	0.00	13.61	55.53	0.00
D	1.41	0.75	16.75	6	2	17.42	13.06	97.59	0.00	0.00	0.00	18.96	33.77	0.00
E	1.82	0.87	19.75	4	1	20.50	20.71	119.24	0.00	0.00	0.00	21.17	23.64	0.00
F	2.00	0.95	21.00	3	1	21.83	26.56	196.30	0.00	0.93	0.08	23.25	34.25	0.73
G	2.37	1.06	23.75	2	1	24.67	41.94	407.15	1.45	126.33	0.92	26.13	55.24	8.00
H	2.88	1.25	26.75	1	1	27.58	68.53	901.06	14.55	524.65	1.50	27.58	68.53	14.55
				78									393.02	23.28
Estimated Annual Time During Runoff Events (hours)												540		
Estimated Annual Time Between Runoff Events												8,220		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												1575.559097		
Estimated Total Annual Inflow to Diversion Structure (mg)												1968.58		
Estimated Annual Volume Retained in System (mg)												1945.30		

Combined Sewer System
 20-ft diameter tunnel for 85% Volumetric Capture
 Francis

Basin: **St. Joseph CSO**
 Diversion Structure No.: **16-37**
 Discharges to Outfall No.: **20-ft dia. Tunnel**
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.17	0.21	0.00
A	0.29	0.20	6.00	36	18	4.33	0.01	0.28	0.00	0.00	0.00	5.58	0.36	0.00
B	0.51	0.26	8.75	18	6	6.83	0.03	0.52	0.00	0.00	0.00	8.71	0.27	0.00
C	0.86	0.58	12.25	12	6	10.58	0.06	1.16	0.00	0.00	0.00	12.96	0.54	0.00
D	1.41	0.75	16.75	6	2	15.33	0.12	1.67	0.00	0.00	0.00	16.83	0.28	0.00
E	1.82	0.87	19.75	4	1	18.33	0.16	1.95	0.00	0.00	0.00	19.00	0.17	0.00
F	2.00	0.95	21.00	3	1	19.67	0.17	2.17	0.00	0.00	0.00	21.04	0.19	0.00
G	2.37	1.06	23.75	2	1	22.42	0.21	2.43	0.00	0.00	0.00	23.88	0.24	0.00
H	2.88	1.25	26.75	1	1	25.33	0.26	2.89	0.00	0.00	0.00	25.33	0.26	0.00
				78									2.51	0.00
Estimated Annual Time During Runoff Events (hours)												444		
Estimated Annual Time Between Runoff Events												8,316		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												0		
Estimated Total Annual Inflow to Diversion Structure (mg)												2.51		
Estimated Annual Volume Retained in System (mg)												2.51		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **SBS-33**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **1.2 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	14.07	0.00
A	0.29	0.20	6.00	36	18	4.50	0.67	11.79	0.00	0.00	0.00	5.75	19.98	0.00
B	0.51	0.26	8.75	18	6	7.00	1.55	20.86	0.00	0.00	0.00	8.75	12.39	0.00
C	0.86	0.58	12.25	12	6	10.50	2.58	42.46	0.00	0.00	0.00	13.00	25.35	0.00
D	1.41	0.75	16.75	6	2	15.50	5.87	66.53	0.00	0.00	0.00	17.00	14.49	0.00
E	1.82	0.87	19.75	4	1	18.50	8.62	79.73	0.00	0.00	0.00	19.17	9.32	0.00
F	2.00	0.95	21.00	3	1	19.83	10.02	106.90	0.00	0.00	0.00	21.21	11.71	0.06
G	2.37	1.06	23.75	2	1	22.58	13.40	134.32	0.11	25.02	0.33	24.04	15.56	2.62
H	2.88	1.25	26.75	1	1	25.50	17.72	198.37	5.12	217.02	1.08	25.50	17.72	5.12
				78								140.59	140.59	7.79
											Estimated Annual Time During Runoff Events (hours)	452		
											Estimated Annual Time Between Runoff Events	8,308		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	415.3791667		
											Estimated Total Annual Inflow to Diversion Structure (mg)	555.97		
											Estimated Annual Volume Retained in System (mg)	548.18		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-75**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.50	4.20	0.00
A	0.29	0.20	6.00	36	18	5.00	0.20	3.66	0.00	0.00	0.00	6.46	5.85	0.00
B	0.51	0.26	8.75	18	6	7.92	0.45	6.49	0.00	0.00	0.00	9.79	3.84	0.00
C	0.86	0.58	12.25	12	6	11.67	0.83	14.34	0.00	0.00	0.00	14.08	7.38	0.00
D	1.41	0.75	16.75	6	2	16.50	1.63	21.01	0.00	0.00	0.00	18.04	3.83	2.50
E	1.82	0.87	19.75	4	1	19.58	2.20	25.58	2.50	94.25	3.00	20.25	2.34	3.86
F	2.00	0.95	21.00	3	1	20.92	2.47	29.39	5.22	120.66	4.25	22.29	2.77	7.98
G	2.37	1.06	23.75	2	1	23.67	3.06	33.37	10.73	130.04	7.17	25.13	3.43	13.51
H	2.88	1.25	26.75	1	1	26.58	3.80	42.19	16.28	147.43	9.92	26.58	3.80	16.28
				78								37.43	78.76	44.12
											Estimated Annual Time During Runoff Events (hours)	495		
											Estimated Annual Time Between Runoff Events	8,265		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	41,325,833		
											Estimated Total Annual Inflow to Diversion Structure (mg)	78.76		
											Estimated Annual Volume Retained in System (mg)	34.64		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-76**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	2.52	0.00
A	0.29	0.20	6.00	36	18	4.50	0.12	2.38	0.00	0.00	0.00	5.75	3.60	0.00
B	0.51	0.26	8.75	18	6	7.00	0.28	4.33	0.00	0.00	0.00	8.83	2.43	0.00
C	0.86	0.58	12.25	12	6	10.67	0.53	9.57	0.00	0.00	0.00	13.21	4.80	8.94
D	1.41	0.75	16.75	6	2	15.75	1.07	13.94	2.98	24.65	13.00	17.25	2.56	19.56
E	1.82	0.87	19.75	4	1	18.75	1.49	16.38	16.58	80.93	19.08	19.46	1.61	18.45
F	2.00	0.95	21.00	3	1	20.17	1.72	19.35	20.32	91.23	18.92	21.50	1.98	23.72
G	2.37	1.06	23.75	2	1	22.83	2.23	22.75	27.11	106.55	17.92	24.25	2.54	31.03
H	2.88	1.25	26.75	1	1	25.67	2.84	29.66	34.94	123.01	16.75	25.67	2.84	34.94
				78									24.87	136.63
											Estimated Annual Time During Runoff Events (hours)	456		
											Estimated Annual Time Between Runoff Events	8,304		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	27,681,250		
											Estimated Total Annual Inflow to Diversion Structure (mg)		52.55	
											Estimated Annual Volume Retained in System (mg)		-84.08	

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-76**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.67	1.26	0.00
A	0.29	0.20	6.00	36	18	5.33	0.06	1.10	0.00	0.00	0.00	6.63	1.71	0.00
B	0.51	0.26	8.75	18	6	7.92	0.13	2.00	0.00	0.00	0.00	9.75	1.17	0.00
C	0.86	0.58	12.25	12	6	11.58	0.26	3.99	0.00	0.00	0.00	14.04	2.28	0.00
D	1.41	0.75	16.75	6	2	16.50	0.50	6.60	0.00	0.00	0.00	18.00	1.18	0.00
E	1.82	0.87	19.75	4	1	19.50	0.68	8.03	0.00	0.00	0.00	20.17	0.73	0.00
F	2.00	0.95	21.00	3	1	20.83	0.77	9.29	0.00	0.00	0.00	22.21	0.86	0.00
G	2.37	1.06	23.75	2	1	23.58	0.95	10.58	0.00	0.00	0.00	25.04	1.07	0.19
H	2.88	1.25	26.75	1	1	26.50	1.19	12.94	0.37	25.51	0.75	26.50	1.19	0.37
				78								11.45	11.45	0.56
											Estimated Annual Time During Runoff Events (hours)	504		
											Estimated Annual Time Between Runoff Events	8,256		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	7,912,079,861		
											Estimated Total Annual Inflow to Diversion Structure (mg)	19.36		
											Estimated Annual Volume Retained in System (mg)	18.80		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **N7**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **4.7 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.54	61.95	0.00
A	0.29	0.20	6.00	36	18	5.08	2.95	44.50	0.00	0.00	0.00	6.21	88.56	0.00
B	0.51	0.26	8.75	18	6	7.33	6.89	88.02	0.00	0.00	0.00	9.13	59.61	0.00
C	0.86	0.58	12.25	12	6	10.92	12.98	161.03	0.00	0.00	0.00	13.42	121.83	1.59
D	1.41	0.75	16.75	6	2	15.92	27.63	276.59	0.53	7.02	3.25	17.42	69.71	20.39
E	1.82	0.87	19.75	4	1	18.92	42.08	342.53	19.86	302.95	9.67	19.58	45.85	25.47
F	2.00	0.95	21.00	3	1	20.25	49.62	432.33	31.07	425.31	10.92	21.67	58.61	44.57
G	2.37	1.06	23.75	2	1	23.08	67.59	583.19	58.06	721.05	12.75	24.58	79.73	78.15
H	2.88	1.25	26.75	1	1	26.08	91.87	907.56	98.23	1132.45	14.50	26.08	91.87	98.23
				78									677.72	268.39
Estimated Annual Time During Runoff Events (hours)												481		
Estimated Annual Time Between Runoff Events												8,280		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												1621.402083		
Estimated Total Annual Inflow to Diversion Structure (mg)												2299.12		
Estimated Annual Volume Retained in System (mg)												2030.73		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **83-18**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

At:

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.00	0.84	0.00
A	0.29	0.20	6.00	36	18	4.00	0.04	1.58	0.00	0.00	0.00	5.17	1.71	0.00
B	0.51	0.26	8.75	18	6	6.33	0.15	2.89	0.00	0.00	0.00	8.08	1.44	0.00
C	0.86	0.58	12.25	12	6	9.83	0.33	6.52	0.00	0.00	0.00	12.25	2.94	0.00
D	1.41	0.75	16.75	6	2	14.67	0.65	9.36	0.00	0.00	0.00	16.21	1.54	0.02
E	1.82	0.87	19.75	4	1	17.75	0.89	10.97	0.02	3.41	0.50	18.42	0.95	0.11
F	2.00	0.95	21.00	3	1	19.08	1.00	12.46	0.19	9.56	1.08	20.54	1.12	0.45
G	2.37	1.06	23.75	2	1	22.00	1.23	14.15	0.71	16.96	2.08	23.46	1.39	1.00
H	2.88	1.25	26.75	1	1	24.92	1.55	17.20	1.28	20.64	2.75	24.92	1.55	1.28
				78									13.47	2.85
											Estimated Annual Time During Runoff Events (hours)	419		
											Estimated Annual Time Between Runoff Events	8,341		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	1.390208333		
											Estimated Total Annual Inflow to Diversion Structure (mg)	14.86		
											Estimated Annual Volume Retained in System (mg)	12.01		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **84-8**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.42	9.03	0.00
A	0.29	0.20	6.00	36	18	4.83	0.43	8.02	0.00	0.00	0.00	6.04	12.78	0.00
B	0.51	0.26	8.75	18	6	7.25	0.99	14.56	0.00	0.00	0.00	9.13	8.40	0.00
C	0.86	0.58	12.25	12	6	11.00	1.81	30.71	0.00	0.00	0.00	13.50	16.32	0.00
D	1.41	0.75	16.75	6	2	16.00	3.63	47.07	0.00	0.00	0.00	17.50	8.68	0.98
E	1.82	0.87	19.75	4	1	19.00	5.05	55.40	0.98	52.06	1.75	19.67	5.40	1.94
F	2.00	0.95	21.00	3	1	20.33	5.75	64.27	2.89	90.70	2.67	21.71	6.52	5.32
G	2.37	1.06	23.75	2	1	23.08	7.28	74.97	7.75	166.21	4.67	24.54	8.30	11.00
H	2.88	1.25	26.75	1	1	26.00	9.31	99.69	14.24	226.94	8.42	26.00	9.31	14.24
				78									84.73	33.47
											Estimated Annual Time During Runoff Events (hours)	473		
											Estimated Annual Time Between Runoff Events	8,287		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	89,776,736,11		
											Estimated Total Annual Inflow to Diversion Structure (mg)	174,51		
											Estimated Annual Volume Retained in System (mg)	141,04		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **33-1**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to:
 Design Condition/Alt.: **20-ft dia. Tunnel**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.08	3.78	0.00
A	0.29	0.20	6.00	36	18	4.17	0.18	4.14	0.00	0.00	0.00	5.38	5.94	0.00
B	0.51	0.26	8.75	18	6	6.58	0.48	7.43	0.00	0.00	0.00	8.38	4.02	0.00
C	0.86	0.58	12.25	12	6	10.17	0.86	15.54	0.00	0.00	0.00	12.67	8.34	0.00
D	1.41	0.75	16.75	6	2	15.17	1.92	23.98	0.00	0.00	0.00	16.67	4.67	1.52
E	1.82	0.87	19.75	4	1	18.17	2.75	28.30	1.52	56.29	5.17	18.83	2.96	2.64
F	2.00	0.95	21.00	3	1	19.50	3.16	33.81	3.75	100.03	6.17	20.96	3.64	6.38
G	2.37	1.06	23.75	2	1	22.42	4.12	40.40	9.00	168.06	7.92	23.88	4.73	12.61
H	2.88	1.25	26.75	1	1	25.33	5.34	56.01	16.22	232.68	10.92	25.33	5.34	16.22
				78								43.42	5.34	39.36
											Estimated Annual Time During Runoff Events (hours)	433		
											Estimated Annual Time Between Runoff Events	8,327		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	93.680625		
											Estimated Total Annual Inflow to Diversion Structure (mg)	137.10		
											Estimated Annual Volume Retained in System (mg)	97.74		

Combined Sewer System
20-ft diameter tunnel for 85% Volumetric Capture
Whitehead

Basin: **St. Joseph CSO**
 Diversion Structure No.: **WMS-19**
 Discharges to Outfall No.: **20-ft dia. Tunn** Or to: **20-ft dia. Tunn** At: **20-ft dia. Tunn**
 Design Condition/Alt.: **2.8 (ADWF)**
 Average Dry Weather Flow (mgd): **2.8 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.79	69.72	0.00
A	0.29	0.20	6.00	36	18	5.58	3.32	36.49	0.00	0.00	0.00	6.75	106.11	0.00
B	0.51	0.26	8.75	18	6	7.92	8.47	86.54	0.00	0.00	0.00	9.71	74.40	0.00
C	0.86	0.58	12.25	12	6	11.50	16.33	146.07	0.00	0.00	0.00	14.00	151.17	0.00
D	1.41	0.75	16.75	6	2	16.50	34.06	258.97	0.00	0.00	0.00	18.00	84.34	0.00
E	1.82	0.87	19.75	4	1	19.50	50.28	341.84	0.00	0.75	0.25	20.17	54.40	0.11
F	2.00	0.95	21.00	3	1	20.83	58.51	424.55	0.22	19.03	0.83	23.25	71.97	1.24
G	2.37	1.06	23.75	2	1	25.67	85.42	563.51	2.26	123.76	1.75	26.21	106.26	6.04
H	2.88	1.25	26.75	1	1	26.75	127.10	989.31	9.81	329.29	2.50	26.75	127.10	9.81
					78								845.46	17.20
Estimated Annual Time During Runoff Events (hours)												513		
Estimated Annual Time Between Runoff Events												8,247		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												962,106.25		
Estimated Total Annual Inflow to Diversion Structure (mg)												1807.57		
Estimated Annual Volume Retained in System (mg)												1790.37		

Combined Sewer System
 20-ft diameter tunnel for 85% Volumetric Capture
 MOAV

Basin: **St. Joseph CSO**
 Diversion Structure No.: **20-ft dia. Tunn** Or to: **20-ft dia. Tunn** At: **20-ft dia. Tunn**
 Discharges to Outfall No.: **20-ft dia. Tunn**
 Design Condition/Alt.: **2.1 (ADWF)**
 Average Dry Weather Flow (mgd): **2.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	3.46	33.18	0.00
A	0.29	0.20	6.00	36	18	6.92	1.58	22.22	0.00	0.00	0.00	7.92	45.54	0.00
B	0.51	0.26	8.75	18	6	8.92	3.48	41.34	0.00	0.00	0.00	11.13	28.56	0.00
C	0.86	0.58	12.25	12	6	13.33	6.04	81.44	0.00	0.00	0.00	15.83	54.66	0.00
D	1.41	0.75	16.75	6	2	18.33	12.18	126.39	0.00	0.12	1.17	19.79	28.74	7.56
E	1.82	0.87	19.75	4	1	21.25	16.56	149.04	7.56	147.64	8.25	21.92	17.58	10.90
F	2.00	0.95	21.00	3	1	22.58	18.59	170.59	14.23	267.47	10.25	24.00	20.92	22.61
G	2.37	1.06	23.75	2	1	25.42	23.25	196.20	30.99	538.39	12.25	26.54	25.98	40.40
H	2.88	1.25	26.75	1	1	27.67	28.70	249.93	49.80	564.32	14.08	27.67	28.70	49.80
					78								283.85	131.26
Estimated Annual Time During Runoff Events (hours)											589			
Estimated Annual Time Between Runoff Events											8,171			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											714,944,270.8			
Estimated Total Annual Inflow to Diversion Structure (mg)											998.79			
Estimated Annual Volume Retained in System (mg)											867.53			

Combined Sewer System
 Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
 Basin Summary

Basin:
 Diversion Structure No.:
 Design Condition/Alt.:
 Average Dry Weather Flow (ADWF), mgd:

St. Joseph CSO
 All
 Phase 3 135 MGD
 17.417

Rainfall Characteristics						Summary Data during Precipitation Events			
Design Storm ID	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Design Storm Summary		Estimated Annual Totals	
						Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)	Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.00	255.15	0.00
A	0.29	0.20	6.00	36	18	12.15	0.00	363.24	0.00
B	0.51	0.26	8.75	18	6	28.21	0.00	235.92	0.00
C	0.86	0.58	12.25	12	6	50.43	0.00	493.05	10.86
D	1.41	0.75	16.75	6	2	113.92	3.62	286.69	35.82
E	1.82	0.87	19.75	4	1	172.77	32.20	188.61	42.67
F	2.00	0.95	21.00	3	1	204.44	53.13	246.18	81.24
G	2.37	1.06	23.75	2	1	287.92	109.34	349.55	160.46
H	2.88	1.25	26.75	1	1	411.17	211.57	411.17	211.57
Totals					78			2829.55	542.61
Long-Term Mean Annual Rainfall (inches)					36.5				
Long-Term Median Annual Rainfall (inches)					35.0				
Total Rainfall Depth Represented Above (inches)					37.04				
Estimated Total Annual Inflow to Diversion Structures (mg)						8806.76			
Estimated Annual Volume Retained in System (mg)						8264.16			
ESTIMATED BASIN-WIDE ANNUAL CAPTURE DURING PRECIPITATION EVENTS*						88.5%			

* - This calculation is based on the estimated Existing total volume to Diversion Structures, which is 4719.04 MG.

Combined Sewer System
 Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
 Roys_Branch

Basin:
 Diversion Structure No.:
 Discharges to Outfall No.:
 Design Condition/Alt.:

St. Joseph CSO
 BSS-30
 BSS-RIVER
 Phase 3 135 MGD

Or to:

At:

Average Dry Weather Flow (mgd):

0.0 (ADWF)

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.00	0.00
A	0.29	0.20	6.00	36	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	0.51	0.26	8.75	18	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	0.86	0.58	12.25	12	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	1.41	0.75	16.75	6	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	1.82	0.87	19.75	4	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	2.00	0.95	21.00	3	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G	2.37	1.06	23.75	2	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H	2.88	1.25	26.75	1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				78									0.00	0.00
Estimated Annual Time During Runoff Events (hours)											0			
Estimated Annual Time Between Runoff Events											8,760			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											0			
Estimated Total Annual Inflow to Diversion Structure (mg)												0.00		
Estimated Annual Volume Retained in System (mg)												0.00		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Blacksnake

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BSS-30**
 Discharges to Outfall No.: **BSS-RIVER**
 Design Condition/Alt.: **Phase 3 135 MGD**

Or to: _____ At: _____

Average Dry Weather Flow (mgd):

4.6 (ADWF)

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.92	41.16	0.00
A	0.29	0.20	6.00	36	18	5.83	1.96	18.57	0.00	0.00	0.00	7.82	52.83	0.00
B	0.51	0.26	8.75	18	6	9.80	3.91	32.76	0.00	0.00	0.00	9.80	28.08	0.00
C	0.86	0.58	12.25	12	6	9.80	5.45	59.53	0.00	0.00	0.00	13.61	55.53	0.00
D	1.41	0.75	16.75	6	2	17.42	13.06	97.59	0.00	0.00	0.00	18.92	33.76	0.00
E	1.82	0.87	19.75	4	1	20.42	20.70	119.24	0.00	0.00	0.00	21.13	23.64	0.00
F	2.00	0.95	21.00	3	1	21.83	26.57	196.28	0.00	1.25	0.17	23.21	34.25	1.01
G	2.37	1.06	23.75	2	1	24.58	41.93	407.13	2.01	101.98	1.00	26.08	55.23	9.57
H	2.88	1.25	26.75	1	1	27.58	68.53	901.05	17.13	728.65	1.58	27.58	68.53	17.13
				78									393.01	27.71
Estimated Annual Time During Runoff Events (hours)											539			
Estimated Annual Time Between Runoff Events											8,221			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											1575.599028			
Estimated Total Annual Inflow to Diversion Structure (mg)											1968.60			
Estimated Annual Volume Retained in System (mg)											1940.90			

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Francis

Basin: **St. Joseph CSO**
Diversion Structure No.: **16-37**
Discharges to Outfall No.: **16-River1**
Design Condition/Alt.: **Phase 3 135 MGD**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.17	0.21	0.00
A	0.29	0.20	6.00	36	18	4.33	0.01	0.28	0.00	0.00	0.00	5.58	0.36	0.00
B	0.51	0.26	8.75	18	6	6.83	0.03	0.52	0.00	0.00	0.00	8.71	0.27	0.00
C	0.86	0.58	12.25	12	6	10.58	0.06	1.16	0.00	0.00	0.00	12.96	0.54	0.00
D	1.41	0.75	16.75	6	2	15.33	0.12	1.67	0.00	0.00	0.00	16.83	0.28	0.00
E	1.82	0.87	19.75	4	1	18.33	0.16	1.95	0.00	0.00	0.00	19.00	0.17	0.00
F	2.00	0.95	21.00	3	1	19.67	0.17	2.17	0.00	0.00	0.00	21.04	0.19	0.00
G	2.37	1.06	23.75	2	1	22.42	0.21	2.43	0.00	0.00	0.00	23.88	0.24	0.00
H	2.88	1.25	26.75	1	1	25.33	0.26	2.89	0.00	0.00	0.00	25.33	0.26	0.00
				78									2.51	0.00
Estimated Annual Time During Runoff Events (hours)												444		
Estimated Annual Time Between Runoff Events												8,316		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												0		
Estimated Total Annual Inflow to Diversion Structure (mg)												2.51		
Estimated Annual Volume Retained in System (mg)												2.51		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Charles

Basin: St. Joseph CSO
Diversion Structure No.: SBS-33
Discharges to Outfall No.: SBS-RIVER
Design Condition/Alt.: Phase 3 135 MGD
Average Dry Weather Flow (mgd): 1.2 (ADWF)

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	14.07	0.00
A	0.29	0.20	6.00	36	18	4.50	0.67	11.79	0.00	0.00	0.00	5.75	19.98	0.00
B	0.51	0.26	8.75	18	6	7.00	1.55	20.86	0.00	0.00	0.00	8.75	12.39	0.00
C	0.86	0.58	12.25	12	6	10.50	2.58	42.46	0.00	0.00	0.00	13.00	25.35	0.00
D	1.41	0.75	16.75	6	2	15.50	5.87	66.53	0.00	0.00	0.00	17.00	14.49	0.00
E	1.82	0.87	19.75	4	1	18.50	8.62	79.73	0.00	0.00	0.00	19.17	9.33	0.00
F	2.00	0.95	21.00	3	1	19.83	10.03	106.90	0.00	0.00	0.00	21.21	11.71	0.06
G	2.37	1.06	23.75	2	1	22.58	13.39	134.32	0.11	13.15	0.42	24.04	15.56	2.77
H	2.88	1.25	26.75	1	1	25.50	17.72	198.53	5.42	187.27	1.17	25.50	17.72	5.42
				78									140.59	8.24
											Estimated Annual Time During Runoff Events (hours)	452		
											Estimated Annual Time Between Runoff Events	8,308		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	415.3791667		
											Estimated Total Annual Inflow to Diversion Structure (mg)	555.97		
											Estimated Annual Volume Retained in System (mg)	547.73		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Messanie

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-75**
 Discharges to Outfall No.: **9-RIVER**
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.50	4.20	0.00
A	0.29	0.20	6.00	36	18	5.00	0.20	3.66	0.00	0.00	0.00	6.46	5.85	0.00
B	0.51	0.26	8.75	18	6	7.92	0.45	6.49	0.00	0.00	0.00	9.79	3.84	0.00
C	0.86	0.58	12.25	12	6	11.67	0.83	14.34	0.00	0.00	0.00	14.08	7.38	0.18
D	1.41	0.75	16.75	6	2	16.50	1.63	21.01	0.06	7.65	0.42	18.04	3.83	3.17
E	1.82	0.87	19.75	4	1	19.58	2.20	25.58	3.11	103.12	1.67	20.25	2.34	4.27
F	2.00	0.95	21.00	3	1	20.92	2.47	29.39	5.42	120.46	2.17	22.29	2.77	7.47
G	2.37	1.06	23.75	2	1	23.67	3.06	33.37	9.51	129.07	3.08	25.13	3.44	11.56
H	2.88	1.25	26.75	1	1	26.58	3.81	43.13	13.61	144.87	5.08	26.58	3.81	13.61
				78								37.45	37.45	40.25
											Estimated Annual Time During Runoff Events (hours)	495		
											Estimated Annual Time Between Runoff Events	8,265		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	41,325,833		
											Estimated Total Annual Inflow to Diversion Structure (mg)	78.77		
											Estimated Annual Volume Retained in System (mg)	38.52		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment Patee

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-76**
 Discharges to Outfall No.: **9-R2**
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	2.52	0.00
A	0.29	0.20	6.00	36	18	4.50	0.12	2.38	0.00	0.00	0.00	5.75	3.60	0.00
B	0.51	0.26	8.75	18	6	7.00	0.28	4.33	0.00	0.00	0.00	8.83	2.43	0.00
C	0.86	0.58	12.25	12	6	10.67	0.53	9.57	0.00	0.00	0.00	13.21	4.77	4.47
D	1.41	0.75	16.75	6	2	15.75	1.06	13.94	1.49	57.26	1.00	17.29	2.56	7.00
E	1.82	0.87	19.75	4	1	18.83	1.50	16.38	5.51	83.25	2.67	19.50	1.60	6.62
F	2.00	0.95	21.00	3	1	20.17	1.70	19.35	7.73	91.50	3.75	21.54	1.96	10.22
G	2.37	1.06	23.75	2	1	22.92	2.21	22.75	12.70	105.10	5.42	24.33	2.45	16.93
H	2.88	1.25	26.75	1	1	25.75	2.69	30.24	21.16	120.45	8.75	25.75	2.69	21.16
				78								24.58	2.69	66.40
											Estimated Annual Time During Runoff Events (hours)	456		
											Estimated Annual Time Between Runoff Events	8,304		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	27,680,138.89		
											Estimated Total Annual Inflow to Diversion Structure (mg)	52.26		
											Estimated Annual Volume Retained in System (mg)	-14.14		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Mitchell

Basin: **St. Joseph CSO**
 Diversion Structure No.: **N7**
 Discharges to Outfall No.: **BDCS-RIVER** Or to:
 Design Condition/Alt.: **Phase 3 135 MGD** At:
 Average Dry Weather Flow (mgd): **4.7 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.54	61.95	0.00
A	0.29	0.20	6.00	36	18	5.08	2.95	44.50	0.00	0.00	0.00	6.21	88.56	0.00
B	0.51	0.26	8.75	18	6	7.33	6.89	88.02	0.00	0.00	0.00	9.13	59.61	0.00
C	0.86	0.58	12.25	12	6	10.92	12.98	161.03	0.00	0.00	0.00	13.42	121.83	4.74
D	1.41	0.75	16.75	6	2	15.92	27.63	276.57	1.58	93.21	0.83	17.42	69.73	14.39
E	1.82	0.87	19.75	4	1	18.92	42.10	342.53	12.81	329.58	2.33	19.58	45.87	16.64
F	2.00	0.95	21.00	3	1	20.25	49.63	432.32	20.47	433.45	3.33	21.67	58.61	31.08
G	2.37	1.06	23.75	2	1	23.08	67.59	580.37	41.68	707.38	4.92	24.58	79.74	57.75
H	2.88	1.25	26.75	1	1	26.08	91.89	908.67	73.82	1056.66	8.58	26.08	91.89	73.82
				78								677.79	198.42	
											Estimated Annual Time During Runoff Events (hours)	481		
											Estimated Annual Time Between Runoff Events	8,280		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	1621.402083		
											Estimated Total Annual Inflow to Diversion Structure (mg)	2299.19		
											Estimated Annual Volume Retained in System (mg)	2100.77		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Duncan

Basin: **St. Joseph CSO**
 Diversion Structure No.: **83-18**
 Discharges to Outfall No.: **83-RIVER** Or to: _____ At: _____
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.00	0.84	0.00
A	0.29	0.20	6.00	36	18	4.00	0.04	1.58	0.00	0.00	0.00	5.17	1.71	0.00
B	0.51	0.26	8.75	18	6	6.33	0.15	2.89	0.00	0.00	0.00	8.08	1.44	0.00
C	0.86	0.58	12.25	12	6	9.83	0.33	6.52	0.00	0.00	0.00	12.25	2.94	0.00
D	1.41	0.75	16.75	6	2	14.67	0.65	9.36	0.00	0.00	0.00	16.21	1.54	0.06
E	1.82	0.87	19.75	4	1	17.75	0.89	10.97	0.06	6.06	0.67	18.42	0.95	0.14
F	2.00	0.95	21.00	3	1	19.08	1.00	12.46	0.21	9.41	1.08	20.54	1.12	0.46
G	2.37	1.06	23.75	2	1	22.00	1.23	14.15	0.70	17.27	2.00	23.46	1.39	0.95
H	2.88	1.25	26.75	1	1	24.92	1.55	17.45	1.20	20.02	2.58	24.92	1.55	1.20
				78									13.47	2.80
											Estimated Annual Time During Runoff Events (hours)	419		
											Estimated Annual Time Between Runoff Events	8,341		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	1.390208333		
											Estimated Total Annual Inflow to Diversion Structure (mg)		14.86	
											Estimated Annual Volume Retained in System (mg)		12.06	

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Maple

Basin: **St. Joseph CSO**
 Diversion Structure No.: **84-8**
 Discharges to Outfall No.: **84-RIVER** Or to: _____ At: _____
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.42	9.03	0.00
A	0.29	0.20	6.00	36	18	4.83	0.43	8.02	0.00	0.00	0.00	6.04	12.78	0.00
B	0.51	0.26	8.75	18	6	7.25	0.99	14.56	0.00	0.00	0.00	9.13	8.40	0.00
C	0.86	0.58	12.25	12	6	11.00	1.81	30.71	0.00	0.00	0.00	13.50	16.32	0.06
D	1.41	0.75	16.75	6	2	16.00	3.63	47.07	0.02	5.40	0.25	17.50	8.68	1.49
E	1.82	0.87	19.75	4	1	19.00	5.05	55.40	1.47	72.75	1.50	19.67	5.40	2.16
F	2.00	0.95	21.00	3	1	20.33	5.75	64.27	2.85	86.84	2.00	21.71	6.52	5.14
G	2.37	1.06	23.75	2	1	23.08	7.28	74.97	7.43	172.61	2.75	24.54	8.30	10.28
H	2.88	1.25	26.75	1	1	26.00	9.31	99.29	13.13	217.45	3.58	26.00	9.31	13.13
				78								84.73	32.26	
											Estimated Annual Time During Runoff Events (hours)	473		
											Estimated Annual Time Between Runoff Events	8,287		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	89,776,736,11		
											Estimated Total Annual Inflow to Diversion Structure (mg)	174,51		
											Estimated Annual Volume Retained in System (mg)	142,25		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Hickory

Basin: **St. Joseph CSO**
 Diversion Structure No.: **33-1**
 Discharges to Outfall No.: **33-RIVER**
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.08	3.78	0.00
A	0.29	0.20	6.00	36	18	4.17	0.18	4.14	0.00	0.00	0.00	5.38	5.94	0.00
B	0.51	0.26	8.75	18	6	6.58	0.48	7.43	0.00	0.00	0.00	8.38	4.02	0.00
C	0.86	0.58	12.25	12	6	10.17	0.86	15.54	0.00	0.00	0.00	12.67	8.34	0.27
D	1.41	0.75	16.75	6	2	15.17	1.92	23.98	0.09	15.39	0.50	16.67	4.67	2.06
E	1.82	0.87	19.75	4	1	18.17	2.75	28.30	1.97	82.65	1.75	18.83	2.96	2.70
F	2.00	0.95	21.00	3	1	19.50	3.16	33.81	3.43	100.93	2.25	20.96	3.64	5.78
G	2.37	1.06	23.75	2	1	22.42	4.12	40.40	8.12	173.63	3.50	23.88	4.73	11.13
H	2.88	1.25	26.75	1	1	25.33	5.34	56.62	14.14	221.42	5.42	25.33	5.34	14.14
				78								43.42	43.42	36.08
											Estimated Annual Time During Runoff Events (hours)	433		
											Estimated Annual Time Between Runoff Events	8,327		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	93.680625		
											Estimated Total Annual Inflow to Diversion Structure (mg)	137.10		
											Estimated Annual Volume Retained in System (mg)	101.02		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
Whitehead

Basin: **St. Joseph CSO**
 Diversion Structure No.: **WMS-19**
 Discharges to Outfall No.: **WMS-RIVER** Or to: At:
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **2.8 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.79	69.72	0.00
A	0.29	0.20	6.00	36	18	5.58	3.32	36.49	0.00	0.00	0.00	6.75	106.11	0.00
B	0.51	0.26	8.75	18	6	7.92	8.47	86.54	0.00	0.00	0.00	9.71	74.40	0.00
C	0.86	0.58	12.25	12	6	11.50	16.33	146.07	0.00	0.00	0.00	14.00	151.20	0.00
D	1.41	0.75	16.75	6	2	16.50	34.07	258.97	0.00	0.00	0.00	18.00	84.35	0.07
E	1.82	0.87	19.75	4	1	19.50	50.28	341.84	0.07	13.73	0.58	20.17	54.40	0.16
F	2.00	0.95	21.00	3	1	20.83	58.52	424.55	0.25	30.36	1.00	23.21	71.92	1.27
G	2.37	1.06	23.75	2	1	25.58	85.31	561.77	2.28	132.26	1.67	26.25	106.55	6.06
H	2.88	1.25	26.75	1	1	26.92	127.78	992.22	9.83	278.90	2.33	26.92	127.78	9.83
					78								846.42	17.38
Estimated Annual Time During Runoff Events (hours)												514		
Estimated Annual Time Between Runoff Events												8,246		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												962,086,805.6		
Estimated Total Annual Inflow to Diversion Structure (mg)												1808.51		
Estimated Annual Volume Retained in System (mg)												1791.13		

Combined Sewer System
Phase 3 Improvements with 17-ft diameter Deep Tunnel and 135 MGD High Rate Treatment
MOAV

Basin: **St. Joseph CSO**
 Diversion Structure No.: **[REDACTED]**
 Discharges to Outfall No.: **[REDACTED]** Or to: **[REDACTED]** At: **[REDACTED]**
 Design Condition/Alt.: **Phase 3 135 MGD**
 Average Dry Weather Flow (mgd): **2.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	3.46	33.18	0.00
A	0.29	0.20	6.00	36	18	6.92	1.58	22.22	0.00	0.00	0.00	7.92	45.54	0.00
B	0.51	0.26	8.75	18	6	8.92	3.48	41.34	0.00	0.00	0.00	11.00	28.56	0.00
C	0.86	0.58	12.25	12	6	13.08	6.04	81.44	0.00	0.00	0.00	15.83	54.72	1.14
D	1.41	0.75	16.75	6	2	18.58	12.20	126.39	0.38	26.38	0.75	19.88	28.77	7.42
E	1.82	0.87	19.75	4	1	21.17	16.57	149.04	7.04	341.49	2.08	21.88	17.51	9.85
F	2.00	0.95	21.00	3	1	22.58	18.44	170.59	12.65	434.39	2.67	23.96	20.88	18.53
G	2.37	1.06	23.75	2	1	25.33	23.32	196.20	24.41	485.53	4.58	26.50	25.98	32.41
H	2.88	1.25	26.75	1	1	27.67	28.63	238.79	40.41	538.72	8.42	27.67	28.63	40.41
					78								283.76	109.76
Estimated Annual Time During Runoff Events (hours)												589		
Estimated Annual Time Between Runoff Events												8,172		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												715,00625		
Estimated Total Annual Inflow to Diversion Structure (mg)												998.77		
Estimated Annual Volume Retained in System (mg)												889.01		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BNB-24**
 Discharges to Outfall No.: **BNB-28**
 Design Condition/Alt.: **Phase 3 135 MGD**
Average Dry Weather Flow (mgd): 1.3 (ADWF)

Or to: [redacted] At: [redacted]

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	3.71	13.23	0.00
A	0.29	0.20	6.00	36	18	7.42	0.63	4.08	0.00	0.00	0.00	9.58	18.27	0.00
B	0.51	0.26	8.75	18	6	11.75	1.40	11.21	0.00	0.00	0.00	12.83	11.31	0.00
C	0.86	0.58	12.25	12	6	13.92	2.37	20.79	0.00	0.00	0.00	16.42	41.85	0.00
D	1.41	0.75	16.75	6	2	18.92	11.58	84.88	0.00	0.00	0.00	20.46	32.85	0.16
E	1.82	0.87	19.75	4	1	22.00	21.27	153.64	0.16	45.08	0.17	22.67	23.75	0.14
F	2.00	0.95	21.00	3	1	23.33	26.23	209.88	0.12	30.56	0.25	24.71	31.78	0.26
G	2.37	1.06	23.75	2	1	26.08	37.32	326.33	0.39	89.38	0.42	26.75	44.90	0.93
H	2.88	1.25	26.75	1	1	27.42	52.48	508.95	1.46	68.56	1.08	27.42	52.48	1.46
				78									270.42	2.94
											Estimated Annual Time During Runoff Events (hours)	646		
											Estimated Annual Time Between Runoff Events (hours)	8,114		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	425.9740625		
											Estimated Total Annual Inflow to Diversion Structure (mg)	696.39		
											Estimated Annual Volume Retained in System (mg)	693.45		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Basin Summary

Basin:
Diversion Structure No.:
Design Condition/Alt.:
Average Dry Weather Flow (ADWF), mgd:

St. Joseph CSO
All
Phase 3 80 MGD
17.417

Rainfall Characteristics						Summary Data during Precipitation Events			
Design Storm ID	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Design Storm Summary		Estimated Annual Totals	
						Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)	Total Volume to Diversion Structures (mg)	Total Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.00		
A	0.29	0.20	6.00	36	18	12.15	0.00	255.15	0.00
B	0.51	0.26	8.75	18	6	28.23	0.00	363.42	0.00
C	0.86	0.58	12.25	12	6	50.42	0.00	235.95	0.00
D	1.41	0.75	16.75	6	2	113.87	6.29	492.87	18.87
E	1.82	0.87	19.75	4	1	172.71	40.96	286.58	47.25
F	2.00	0.95	21.00	3	1	204.38	64.63	188.55	52.80
G	2.37	1.06	23.75	2	1	287.75	126.51	246.07	95.57
H	2.88	1.25	26.75	1	1	430.22	257.38	358.99	191.95
Totals					78			2857.79	663.81
					Long-Term Mean Annual Rainfall (inches)	36.5			
					Long-Term Median Annual Rainfall (inches)	35.0			
					Total Rainfall Depth Represented Above (inches)	37.04			
						Estimated Total Annual Inflow to Diversion Structures (mg)		8834.83	
						Estimated Annual Volume Retained in System (mg)		8171.02	
						ESTIMATED BASIN-WIDE ANNUAL CAPTURE DURING PRECIPITATION EVENTS*		85.9%	

* - This calculation is based on the estimated Existing total volume to Diversion Structures, which is 4719.04 MG.

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Roys Branch

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BSS-30**
 Discharges to Outfall No.: **BSS-RIVER**
 Design Condition/Alt.: **Phase 3 80 MGD**

Or to: At:

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.00	0.00
A	0.29	0.20	6.00	36	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	0.51	0.26	8.75	18	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	0.86	0.58	12.25	12	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	1.41	0.75	16.75	6	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	1.82	0.87	19.75	4	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	2.00	0.95	21.00	3	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G	2.37	1.06	23.75	2	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H	2.88	1.25	26.75	1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				78									0.00	0.00
Estimated Annual Time During Runoff Events (hours)											0			
Estimated Annual Time Between Runoff Events											8,760			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											0			
Estimated Total Annual Inflow to Diversion Structure (mg)												0.00		
Estimated Annual Volume Retained in System (mg)												0.00		

Basin: **St. Joseph CSO**
 Diversion Structure No.: **BSS-30**
 Discharges to Outfall No.: **BSS-RIVER**
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **4.6 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.92	41.16	0.00
A	0.29	0.20	6.00	36	18	5.83	1.96	18.57	0.00	0.00	0.00	7.82	52.83	0.00
B	0.51	0.26	8.75	18	6	9.80	3.91	32.76	0.00	0.00	0.00	9.80	28.08	0.00
C	0.86	0.58	12.25	12	6	9.80	5.45	59.53	0.00	0.00	0.00	13.61	55.53	0.00
D	1.41	0.75	16.75	6	2	17.42	13.06	97.59	0.00	0.00	0.00	18.92	33.75	0.00
E	1.82	0.87	19.75	4	1	20.42	20.69	119.24	0.00	0.00	0.00	21.13	23.62	0.00
F	2.00	0.95	21.00	3	1	21.83	26.55	196.29	0.00	0.81	0.08	23.25	34.25	1.08
G	2.37	1.06	23.75	2	1	24.67	41.95	407.14	2.16	110.76	1.00	26.13	55.20	10.09
H	2.88	1.25	26.75	1	1	27.58	68.45	901.05	18.02	867.55	1.75	27.58	68.45	18.02
				78									392.87	29.19
Estimated Annual Time During Runoff Events (hours)												540		
Estimated Annual Time Between Runoff Events												8,220		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												1575.583056		
Estimated Total Annual Inflow to Diversion Structure (mg)												1968.45		
Estimated Annual Volume Retained in System (mg)												1939.26		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Francis

Basin: **St. Joseph CSO**
 Diversion Structure No.: **16-37**
 Discharges to Outfall No.: **16-River1**
 Design Condition/Alt.: **Phase 3 80 MGD**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.17	0.21	0.00
A	0.29	0.20	6.00	36	18	4.33	0.01	0.28	0.00	0.00	0.00	5.58	0.36	0.00
B	0.51	0.26	8.75	18	6	6.83	0.03	0.52	0.00	0.00	0.00	8.71	0.27	0.00
C	0.86	0.58	12.25	12	6	10.58	0.06	1.16	0.00	0.00	0.00	12.96	0.54	0.00
D	1.41	0.75	16.75	6	2	15.33	0.12	1.67	0.00	0.00	0.00	16.83	0.28	0.00
E	1.82	0.87	19.75	4	1	18.33	0.16	1.95	0.00	0.00	0.00	19.00	0.17	0.00
F	2.00	0.95	21.00	3	1	19.67	0.17	2.17	0.00	0.00	0.00	21.04	0.19	0.00
G	2.37	1.06	23.75	2	1	22.42	0.21	2.43	0.00	0.00	0.00	23.88	0.24	0.00
H	2.88	1.25	26.75	1	1	25.33	0.26	2.89	0.00	0.00	0.00	25.33	0.26	0.00
				78									2.51	0.00
Estimated Annual Time During Runoff Events (hours)											444			
Estimated Annual Time Between Runoff Events											8,316			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											0			
Estimated Total Annual Inflow to Diversion Structure (mg)												2.51		
Estimated Annual Volume Retained in System (mg)												2.51		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Charles

Basin: **St. Joseph CSO**
 Diversion Structure No.: **SBS-33**
 Discharges to Outfall No.: **SBS-RIVER** Or to: **_____**
 Design Condition/Alt.: **Phase 3 80 MGD** At: **_____**
 Average Dry Weather Flow (mgd): **1.2 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.25	14.07	0.00
A	0.29	0.20	6.00	36	18	4.50	0.67	11.79	0.00	0.00	0.00	5.75	19.98	0.00
B	0.51	0.26	8.75	18	6	7.00	1.55	20.86	0.00	0.00	0.00	8.75	12.39	0.00
C	0.86	0.58	12.25	12	6	10.50	2.58	42.46	0.00	0.00	0.00	13.00	25.35	0.00
D	1.41	0.75	16.75	6	2	15.50	5.87	66.53	0.00	0.00	0.00	17.00	14.49	0.00
E	1.82	0.87	19.75	4	1	18.50	8.62	79.73	0.00	0.00	0.00	19.17	9.32	0.00
F	2.00	0.95	21.00	3	1	19.83	10.02	106.67	0.00	0.00	0.00	21.21	11.72	0.07
G	2.37	1.06	23.75	2	1	22.58	13.41	134.21	0.13	14.23	0.42	24.04	15.57	3.32
H	2.88	1.25	26.75	1	1	25.50	17.73	198.53	6.50	454.96	1.17	25.50	17.73	6.50
				78									140.62	9.88
											Estimated Annual Time During Runoff Events (hours)	452		
											Estimated Annual Time Between Runoff Events	8,308		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	415.3791667		
											Estimated Total Annual Inflow to Diversion Structure (mg)	555.99		
											Estimated Annual Volume Retained in System (mg)	546.11		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Messanic

Basin: **St. Joseph CSO**
 Diversion Structure No.: **9-75**
 Discharges to Outfall No.: **9-RIVER**
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **0.1 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.50	4.20	0.00
A	0.29	0.20	6.00	36	18	5.00	0.20	3.66	0.00	0.00	0.00	6.46	5.85	0.00
B	0.51	0.26	8.75	18	6	7.92	0.45	6.49	0.00	0.00	0.00	9.79	3.84	0.00
C	0.86	0.58	12.25	12	6	11.67	0.83	14.34	0.00	0.00	0.00	14.08	7.38	0.45
D	1.41	0.75	16.75	6	2	16.50	1.63	21.01	0.15	15.27	0.58	18.04	3.83	3.62
E	1.82	0.87	19.75	4	1	19.58	2.20	25.58	3.47	103.77	1.83	20.25	2.34	4.74
F	2.00	0.95	21.00	3	1	20.92	2.47	29.39	6.00	120.65	2.50	22.29	2.77	8.11
G	2.37	1.06	23.75	2	1	23.67	3.06	33.36	10.21	129.27	4.25	25.13	3.42	13.09
H	2.88	1.25	26.75	1	1	26.58	3.78	41.20	15.96	150.57	6.67	26.58	3.78	15.96
				78								37.40	45.96	
											Estimated Annual Time During Runoff Events (hours)	495		
											Estimated Annual Time Between Runoff Events	8,265		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	41.32583333		
											Estimated Total Annual Inflow to Diversion Structure (mg)	78.73		
											Estimated Annual Volume Retained in System (mg)	32.77		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Mitchell

Basin: **St. Joseph CSO**
 Diversion Structure No.: **N7**
 Discharges to Outfall No.: **BDCS-RIVER** Or to:
 Design Condition/Alt.: **Phase 3 80 MGD** At:
 Average Dry Weather Flow (mgd): **4.7 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.54	61.95	0.00
A	0.29	0.20	6.00	36	18	5.08	2.95	44.50	0.00	0.00	0.00	6.21	88.56	0.00
B	0.51	0.26	8.75	18	6	7.33	6.89	88.02	0.00	0.00	0.00	9.13	59.61	0.00
C	0.86	0.58	12.25	12	6	10.92	12.98	161.03	0.00	0.00	0.00	13.42	121.83	7.44
D	1.41	0.75	16.75	6	2	15.92	27.63	276.56	2.48	113.16	1.42	17.42	69.71	18.01
E	1.82	0.87	19.75	4	1	18.92	42.08	342.53	15.53	336.27	5.50	19.58	45.85	20.16
F	2.00	0.95	21.00	3	1	20.25	49.62	432.32	24.79	444.85	6.33	21.67	58.61	36.47
G	2.37	1.06	23.75	2	1	23.08	67.59	580.05	48.15	722.31	7.50	24.58	79.73	68.66
H	2.88	1.25	26.75	1	1	26.08	91.87	908.71	89.17	1060.52	11.17	26.08	91.87	89.17
				78									677.72	239.91
											Estimated Annual Time During Runoff Events (hours)	481		
											Estimated Annual Time Between Runoff Events	8,280		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	1621.402083		
											Estimated Total Annual Inflow to Diversion Structure (mg)	2299.12		
											Estimated Annual Volume Retained in System (mg)	2059.21		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Duncan

Basin: **St. Joseph CSO**
 Diversion Structure No.: **83-18**
 Discharges to Outfall No.: **83-RIVER** Or to:
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **0.0 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.00	0.84	0.00
A	0.29	0.20	6.00	36	18	4.00	0.04	1.58	0.00	0.00	0.00	5.17	1.71	0.00
B	0.51	0.26	8.75	18	6	6.33	0.15	2.89	0.00	0.00	0.00	8.08	1.44	0.00
C	0.86	0.58	12.25	12	6	9.83	0.33	6.52	0.00	0.00	0.00	12.25	2.91	0.00
D	1.41	0.75	16.75	6	2	14.67	0.64	9.36	0.00	0.00	0.00	16.21	1.53	0.08
E	1.82	0.87	19.75	4	1	17.75	0.89	10.97	0.08	5.93	0.75	18.42	0.95	0.17
F	2.00	0.95	21.00	3	1	19.08	1.00	12.46	0.26	10.85	1.33	20.54	1.12	0.51
G	2.37	1.06	23.75	2	1	22.00	1.23	14.15	0.75	17.45	2.08	23.46	1.39	1.07
H	2.88	1.25	26.75	1	1	24.92	1.55	17.44	1.39	20.07	3.08	24.92	1.55	1.39
				78									13.43	3.22
											Estimated Annual Time During Runoff Events (hours)	419		
											Estimated Annual Time Between Runoff Events	8,341		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	1.390208333		
											Estimated Total Annual Inflow to Diversion Structure (mg)	14.82		
											Estimated Annual Volume Retained in System (mg)	11.61		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Maple

Basin: **St. Joseph CSO**
 Diversion Structure No.: **84-8**
 Discharges to Outfall No.: **84-RIVER** Or to: _____ At: _____
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.42	9.03	0.00
A	0.29	0.20	6.00	36	18	4.83	0.43	8.02	0.00	0.00	0.00	6.04	12.78	0.00
B	0.51	0.26	8.75	18	6	7.25	0.99	14.56	0.00	0.00	0.00	9.13	8.40	0.00
C	0.86	0.58	12.25	12	6	11.00	1.81	30.71	0.00	0.00	0.00	13.50	16.32	0.06
D	1.41	0.75	16.75	6	2	16.00	3.63	47.07	0.02	2.75	0.42	17.50	8.68	1.75
E	1.82	0.87	19.75	4	1	19.00	5.05	55.40	1.73	69.86	1.75	19.67	5.40	2.55
F	2.00	0.95	21.00	3	1	20.33	5.75	64.27	3.37	101.62	2.25	21.71	6.52	5.71
G	2.37	1.06	23.75	2	1	23.08	7.29	74.91	8.04	172.26	3.33	24.54	8.30	11.72
H	2.88	1.25	26.75	1	1	26.00	9.31	99.30	15.40	218.37	5.67	26.00	9.31	15.40
				78									84.74	37.19
											Estimated Annual Time During Runoff Events (hours)	473		
											Estimated Annual Time Between Runoff Events	8,287		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	89,776,736,11		
											Estimated Total Annual Inflow to Diversion Structure (mg)	174.52		
											Estimated Annual Volume Retained in System (mg)	137.33		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Hickory

Basin: **St. Joseph CSO**
 Diversion Structure No.: **33-1**
 Discharges to Outfall No.: **33-RIVER**
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **0.3 (ADWF)**

Or to: _____ At: _____

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	2.08	3.78	0.00
A	0.29	0.20	6.00	36	18	4.17	0.18	4.14	0.00	0.00	0.00	5.38	5.94	0.00
B	0.51	0.26	8.75	18	6	6.58	0.48	7.43	0.00	0.00	0.00	8.38	4.02	0.00
C	0.86	0.58	12.25	12	6	10.17	0.86	15.54	0.00	0.00	0.00	12.67	8.34	0.36
D	1.41	0.75	16.75	6	2	15.17	1.92	23.98	0.12	9.64	0.75	16.67	4.67	2.39
E	1.82	0.87	19.75	4	1	18.17	2.75	28.30	2.27	83.37	2.17	18.83	2.96	3.16
F	2.00	0.95	21.00	3	1	19.50	3.16	33.81	4.05	107.89	2.83	20.96	3.64	6.47
G	2.37	1.06	23.75	2	1	22.42	4.12	40.36	8.88	174.23	4.67	23.88	4.73	12.94
H	2.88	1.25	26.75	1	1	25.33	5.33	55.87	17.00	222.58	8.92	25.33	5.33	17.00
				78								43.40	42.32	
											Estimated Annual Time During Runoff Events (hours)	433		
											Estimated Annual Time Between Runoff Events	8,327		
											Estimated Annual Inflow at ADWF Between Runoff Events (mg)	93.680625		
											Estimated Total Annual Inflow to Diversion Structure (mg)	137.08		
											Estimated Annual Volume Retained in System (mg)	94.77		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
Whitehead

Basin: **St. Joseph CSO**
 Diversion Structure No.: **WMS-19**
 Discharges to Outfall No.: **WMS-RIVER** Or to: At:
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **2.8 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00			
A	0.29	0.20	6.00	36	18	5.58	3.32	36.49	0.00	0.00	0.00	2.79	69.72	0.00
B	0.51	0.26	8.75	18	6	8.00	8.48	82.33	0.00	0.00	0.00	6.79	106.20	0.00
C	0.86	0.58	12.25	12	6	11.58	16.32	144.33	0.00	0.00	0.00	9.79	74.40	0.00
D	1.41	0.75	16.75	6	6	16.58	34.07	256.33	0.00	0.00	0.00	14.08	151.17	0.00
E	1.82	0.87	19.75	4	2	19.58	50.29	337.13	0.11	19.30	0.67	18.08	84.36	0.11
F	2.00	0.95	21.00	3	1	20.92	58.51	403.30	0.32	25.99	1.00	20.25	54.40	0.22
G	2.37	1.06	23.75	2	1	25.92	85.08	549.26	2.62	136.80	1.83	23.42	71.80	1.47
H	2.88	1.25	26.75	1	1	26.92	146.89	2620.33	14.46	712.34	2.67	26.42	115.99	8.54
					78							26.92	146.89	14.46
													874.92	24.80
Estimated Annual Time During Runoff Events (hours)											516			
Estimated Annual Time Between Runoff Events											8,244			
Estimated Annual Inflow at ADWF Between Runoff Events (mg)											961,809,722			
Estimated Total Annual Inflow to Diversion Structure (mg)												1836.73		
Estimated Annual Volume Retained in System (mg)												1811.93		

Combined Sewer System
Phase 3 Improvements using an 80 MGD High Rate Treatment Facility
MOAV

Basin: **St. Joseph CSO**
 Diversion Structure No.: **[REDACTED]**
 Discharges to Outfall No.: **[REDACTED]** Or to: **[REDACTED]** At: **[REDACTED]**
 Design Condition/Alt.: **Phase 3 80 MGD**
 Average Dry Weather Flow (mgd): **2.1 (ADWF)**

Design Storm ID	Rainfall Characteristics					Total Design Storm Flow to Diversion Structure			Overflow Characteristics			Design Year Summary for All Events in Range		
	Storm Depth (inches)	Peak Hour Intensity (in/hr)	Storm Duration (hours)	Times Equalled or Exceeded in Design Year	No. of Events in Range During Design Year	Runoff Event Time Base (hours)	Total Volume to Diversion Structure (mg)	Peak Rate of Flow to Diversion Str. (mgd)	Overflow Volume (mg)	Peak Overflow Rate (mgd)	Duration of Overflow (hours)	Mean Runoff Event Duration (hours)	Total Volume to Diversion Structure (mg)	Overflow Volume (mg)
None	0.00	0.00	0.00	78	42	0.00	0.000	0.00	0.00	0.000	0.00	3.46	33.18	0.00
A	0.29	0.20	6.00	36	18	6.92	1.58	22.22	0.00	0.00	0.00	8.00	45.63	0.00
B	0.51	0.26	8.75	18	6	9.08	3.49	41.25	0.00	0.00	0.00	10.96	28.59	0.00
C	0.86	0.58	12.25	12	6	12.83	6.04	81.88	0.00	0.00	0.00	15.42	54.54	3.33
D	1.41	0.75	16.75	6	2	18.00	12.14	126.39	1.11	78.70	1.17	19.75	28.63	9.89
E	1.82	0.87	19.75	4	1	21.50	16.49	149.04	8.78	385.55	3.58	21.96	17.48	11.20
F	2.00	0.95	21.00	3	1	22.42	18.46	170.59	13.61	448.42	5.92	23.96	20.88	20.69
G	2.37	1.06	23.75	2	1	25.50	23.30	196.08	27.77	504.73	7.33	26.50	25.95	38.78
H	2.88	1.25	26.75	1	1	27.50	28.60	240.17	49.78	541.25	10.58	27.50	28.60	49.78
					78								283.48	133.66
Estimated Annual Time During Runoff Events (hours)												587		
Estimated Annual Time Between Runoff Events												8,173		
Estimated Annual Inflow at ADWF Between Runoff Events (mg)												715,144,7917		
Estimated Total Annual Inflow to Diversion Structure (mg)												998.62		
Estimated Annual Volume Retained in System (mg)												864.96		

