CHAPTER 3: DEVELOPMENT AND EVALUATION OF ALTERNATIVES FOR SSO ELIMINATION

TABLE OF CONTENTS

SUPPORTING INFORMATION

Appendix 3.1.1 I/I Program Documentation
Appendix 3.1.2 Ground Truthing Documentation
Appendix 3.2.1 Re-evaluation of Preferred Projects Analysis
Appendix 3.3.1 Preferred Solution Cost Tables, Benefit-Cost Tables, Maps, Fact Sheets

CHAPTER 3: DEVELOPMENT AND EVALUATION OF ALTERNATIVES FOR SSO ELIMINATION

Once a clear understanding of the root problems of sanitary sewer overflows (SSOs) is obtained through the system characterization process, it is important to develop a comprehensive set of potential solutions that are effective and acceptable by the public.

Chapter 3 presents the methodologies used to evaluate the various SSO elimination solutions. The chapter defines and discusses strategies and technologies available to control and eliminate unauthorized discharges in the separate sanitary sewer system (SSS). The chapter also provides a summary of the evaluation for each SSO elimination alternative. The evaluation criterion includes feasibility screening, computer modeling, quality control, level of protection, cost estimates, and a benefit-cost analysis.

3.1 THE FINAL SSDP APPROACH

Overall, the Final Sanitary Sewer Discharge Plan (SSDP) approach to SSO elimination is to determine the solution that provides the greatest benefit-cost ratio for each watershed branch. Modeling teams used the Louisville and Jefferson County Metropolitan Sewer District (MSD) Project Cost Estimating Tool and the Benefit-Cost Value Model, both developed specifically for the Integrated Overflow Abatement Plan (IOAP). These tools were used to determine benefit scores, capital costs, long-term operation and maintenance (O&M) costs, and the benefit-cost ratio. The process is discussed in more detail in this section.

3.1.1 Solution Development Overview

The major steps in the solution development process are summarized below:

- Models were calibrated and validated (Volume 3, Chapter 2, Section 2.3).
- Where appropriate, rainfall dependent inflow and infiltration (RDI/I) and build-out was applied to the validated models (Volume 3, Chapter 2, Section 2.3.5.7).
- Where appropriate, capital projects were incorporated into the models (Volume 3, Chapter 2, Section 2.3.5.9).
- Input was gathered from public meetings, as well as guidance from the Wet Weather Team (WWT) Stakeholder Group and ground truthing exercises.
- Initial solutions were developed and presented at WWT Stakeholder Group meetings for review and comments.
- Solutions that addressed SSOs and reduced known surcharging under site-specific design conditions were developed using a diverse set of solution technologies.
- Benefits, capital costs, and benefit-cost ratios for each solution were developed at the baseline level of protection (1.82-inch cloudburst storm event).
- The solution with the best benefit-cost ratio was selected for development of the preferred level of protection (Volume 3, Chapter 4).

3.1.2 SSO Control Measures and Technologies

A wide range of technology approaches is available for the development of SSO abatement strategies and alternatives. These approaches are summarized in the following sub-sections.

3.1.2.1 Source Control through Infiltration and Inflow (I/I) Reduction

Source reduction focuses on preventing wet weather flows through various sources from reaching the sewer. Source reduction was considered for each branch solution. The method and degree of source reduction is described in Volume 3, Chapter 2, Section 2.3.5.7. MSD is embarking on programs to address countywide, private-side, and public-side source reduction. As it pertains to the Final SSDP, a 20-year program will be implemented to reduce flows in areas critical to Final SSDP success. The program is outlined in Appendix 3.1.1, I/I Program Documentation.

3.1.2.2 Basement Backups and Sewer Surcharging

Surcharge reduction focuses on the prevention of basement flooding during wet weather. Basement flooding protection was considered and analyzed for all branch solutions using the System Capacity Assurance Plan criterion discussed in Volume 3, Chapter 2, Section 2.5.1. The surcharge criterion was applied to all areas hydraulically connected to a documented or suspected SSO location (known as the “zone of influence”) and/or downstream of an SSDP solution. Solutions were then sized accordingly to reduce or eliminate surcharging to the Louisville Metro Sewer Capacity Assurance Plan (SCAP) criterion.

Other basement backup complaints or modeled surcharging not within the SSO zone of influence or downstream of an SSDP solution will be addressed by MSD’s Plumbing Modification Program, which is available to all MSD customers, as discussed in Volume 3, Chapter 1, Section 1.3.1.4. To-date, MSD has completed over 8,100 projects totaling approximately $16 million dollars under the Plumbing Modification Program. Refer to Appendix 1.3.1 for the Plumbing Modifications Program and Downspout Disconnection Program packet available to MSD customers.

3.1.2.3 Peak Flow Storage Alternatives

A storage solution is an alternative where flow is temporarily stored to eliminate SSOs. This includes inline storage (large diameter pipe(s) built into the sewer system) or offline storage (covered or open storage facilities). Storage alternatives may also include additional pumping capacity, conveyance to and from the storage location, controls, easements, land purchases, odor control, surface treatment, and long-term O&M. Storage solutions developed are then evaluated through a complete “fill-and-empty” cycle in the model, which also includes a secondary storm analysis (as described in Volume 3, Chapter 2, Section 2.3.4).

A significant cost factor in storage is whether the constructed storage facility is open or closed to the environment. Open facilities are generally less expensive, but they present potential problems such as odors and poor aesthetics. Covering the facility, generally by burying, can improve these conditions but significantly increases the cost of the facility.

For any facility, the siting location is critical. Thus, the ground truthing exercises were developed to assist with the siting process. Section 3.1.3.3 describes the ground truthing process in more detail.

3.1.2.4 Increased Conveyance Capacity

A conveyance solution increases the sewer capacity to eliminate SSOs. The solution may include: increases in pipe size, additional pumping capacity, parallel sewer conveyance, and elimination of bottlenecks. Pure conveyance solutions will usually result in increased flow downstream. In these cases, the increase in flow must be addressed by downstream branches in the system.

While siting is not as critical as storage alternatives, ground truthing is still required to properly cost the improvements for some conveyance solutions (see Section 3.1.3.3 for more detail on ground truthing).

3.1.2.5 Flow Diversion

A diversion solution is an alternative where flow is diverted to other systems or sewersheds to alleviate capacity at the solution location. Generally, a diversion solution will involve gravity solutions, although some pump station improvements may be included.

Diversion alternatives will undoubtedly impact other branches and potentially other watersheds. As a result, solutions will have to account for the additional flows to the impacted branches. Similar to conveyance alternatives, ground truthing is required to properly price diversion alternatives.

3.1.2.6 Water Quality Treatment Center (WQTC) Upgrades

In accordance with the Consent Decree, all WQTCs with the potential to receive additional flow as a result of SSO elimination were evaluated by developing a “Comprehensive Performance Evaluation” (CPE) in accordance with EPA guidance documents called out in the Consent Decree. The CPE process was originally developed to provide a systematic approach to improving the performance of WQTCs that were not in compliance with discharge standards. In this application it was necessary to conduct an evaluation based on the anticipated performance of the plants in treating the modeled peak wet weather flows. Initial evaluations considered the worst case scenario assuming SSO eliminations were accomplished by increasing conveyance capacity, essentially pushing the entire wet weather flow increase to the WQTC. Final evaluations were refined based on modeled wet weather hydrographs considering the actual SSO elimination projects selected in the Final SSDP.

The Consent Decree also required CPEs be conducted on the five plants in the Prospect area, and the Lake Forest WQTC. As a result of both sets of requirements, CPEs were developed for the following WQTCs in accordance with the Consent Decree:

- Berrytown WQTC
- Cedar Creek WQTC

- Chenoweth Hills WQTC
- Hite Creek WQTC
- Hunting Creek South WQTC
- Jeffersontown WQTC
- Ken Carla WQTC
- Lake Forest WQTC
- North Hunting Creek WQTC
- Starview WQTC
- Timberlake WQTC

A more complete description of the CPE process and the resultant Composite Correction Approach WQTC improvement recommendations is contained in Volume 1, Section 4.4. This section in Volume 1 also presents the evaluation of potential collection system modifications compared to WQTC expansions to address wet weather peaks.

CPEs were not developed for the Derek R. Guthrie WQTC (formerly known as the West County Wastewater Treatment Plant) or the Floyds Fork WQTC because both plants are scheduled to undergo significant expansions in the near future. The WQTC expansions will be sized to include any additional wet weather flow peaks anticipated as a result of SSO elimination. In lieu of CPEs, the preliminary design reports for those WQTC expansions are addressed in Volume 1. A CPE was not developed for the Morris Forman WQTC because it serves the combined sewer system and is specifically excluded from the CPE requirement in the Consent Decree.

3.1.3 Initial Solutions

MSD was committed to obtaining WWT Stakeholder Group input throughout the IOAP development. In particular, MSD solicited WWT Stakeholder Group input before modeled solution development began. To “kick off” the potential solution process, the initial solutions were developed for each modeled branch. The initial solution development phase involved desktop evaluation and simple sizing using existing condition model runs and MSD’s historical work order database.

Initial solutions were presented to the WWT Stakeholder Group in a series of meetings where the Group was engaged in discussions about the initial solutions and their comments or concerns were noted. This information was then considered and included in future modeled solution development. The following sections summarize the initial solution phase, from SSO characterization to the ground truthing process, and provide a general overview of the types and number of initial solutions that were a result of this particular stage of solution development.

3.1.3.1 SSO Characterization

Initially, there were 109 SSOs and more than 200 modeled overflow points (MOPs) used to determine the design of initial solution projects. Refer to Volume 3, Chapter 2, Section 2.4.2 for

a discussion of the MOP validation process. Many aspects of each area were reviewed before the initial solutions were developed; for example, the source or cause of the SSO(s) was investigated through a review of discharge work orders and, based on initial evaluation, the overflow volume for various levels of protection was reported.

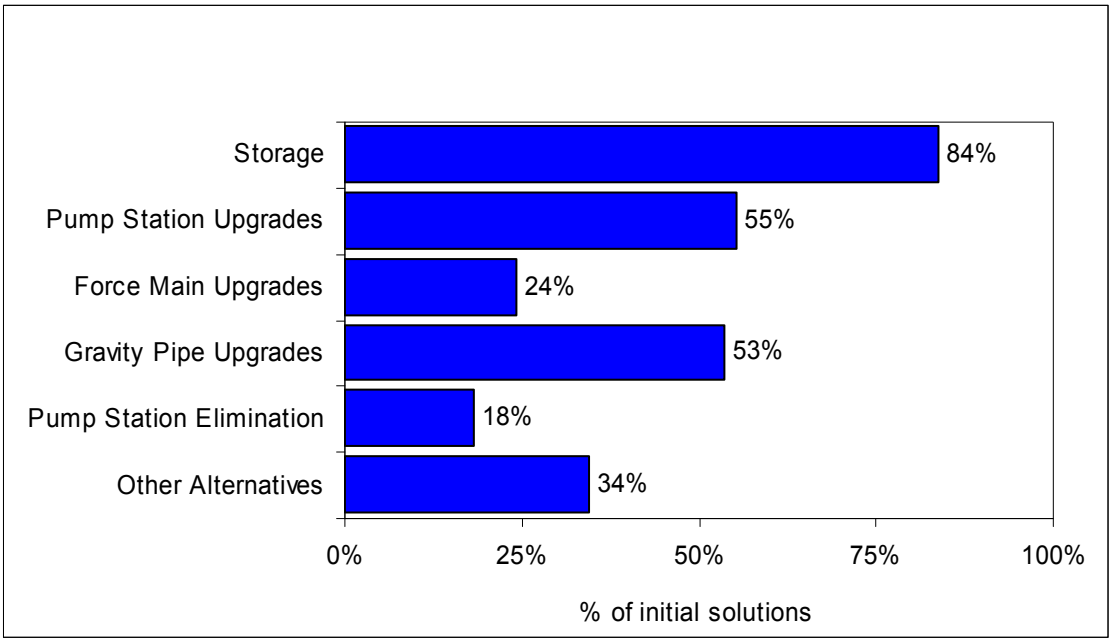
Site conditions for the entire area surrounding the SSOs and MOPs were also investigated and reported for each initial solution. Surrounding landuse, apparent utility conflicts, and other aspects that could affect a project were reviewed and documented.

Additionally, capital projects and proposed developments in the area were reviewed and summarized in each initial solution development phase. The initial solutions were developed after investigation of the cause of the SSO, surrounding area landuse, apparent utilities, proposed developments, capital projects, and modeling needs. The research was conducted with the objective of integrating the most important characterizations of each project location into the solution alternatives.

3.1.3.2 Initial Solution Alternatives

The initial solution alternatives that were considered included one or more of the available technologies as described in Section 3.1.2. Figure 3.1.2 summarizes the developed solutions. Some of the initial locations were identified as having more than one potential solution and the graph shows the percentage of initial solution options by solution type that may be able to eliminate the SSOs. The pump station elimination, sewer upgrades, force main upgrades, and pump station upgrades could be part of either a conveyance solution or a diversion solution.

FIGURE 3.1.2 SUMMARY OF INITIAL SOLUTION ALTERNATIVES



Storage Alternatives

More than eighty percent of the initial solution locations displayed potential for storage facilities and inline storage pipes. However, some locations were determined to be unsuitable for storage solutions due to maintenance access and land acquisition concerns.

Conveyance Alternatives

The conveyance alternatives included pump station, force main, and gravity pipe upgrades, pump station eliminations, and diversions. These alternatives were usually more complex requiring sewer pipe upgrades, newly constructed sewer pipe, and/or pump station upgrades. More than eighty percent of the initial solutions displayed potential for conveyance alternatives.

Other Alternatives

Other alternatives included capital project solutions, raising manholes and reducing I/I.

3.1.3.3 Ground Truthing

As mentioned earlier, siting is a critical component of project development. Thus, MSD developed a ground truthing process to consistently evaluate storage, conveyance, and diversion alternatives. Ground truthing collects critical information that could affect cost, such as soil conditions and easements, or, in some cases, prevent the site from being further considered, such as future planned development.

Each modeling team was responsible for ground truthing storage, conveyance, and diversion alternatives considered within the respective watersheds. In some cases, the solution involved alignments in existing rights-of-way or easements, such as pipe upsizing, and ground truthing was not necessary. The following list provides examples of features that were investigated during the ground truthing process:

- Rock depth
- 100-Year floodplain location
- Threatened/endangered species assessment
- Potential utility conflicts
- Required Permits, i.e. Kentucky Department of Environmental Protection (KDEP), U.S. Army Corp of Engineers (USACE), Etc.
- Green space initiatives
- National historic registry
- Development conflicts
- Significant topographical features, i.e. steep slope

Once ground truthing was completed, a recommendation was made labeling the site as either suitable or unsuitable for the particular solution type. Specific ground truthing and significant findings are briefly discussed for each individual watershed (see Section 3.3), and full ground truthing documents along with pictures of the sites are available for review in Appendix 3.1.2 Ground Truthing Documentation.

3.2 PROJECT SELECTION ANALYSIS

MSD used a standard benefit-cost ratio process to determine and select the most effective solution for each branch of SSOs for a baseline level of protection. In this case, the 1.82-inch cloudburst storm was utilized as the baseline level of protection. The same process was used to set optimal levels of protection for the selected solutions (described in Volume 3, Chapter 4).

Additionally, several projects were conceptually re-designed using a 2.25-inch cloudburst storm to evaluate if the initial level of control used as the baseline condition created any bias toward a particular technology in selecting a preferred solution from a group of initial competing technologies. The evaluation, detailed in Sections 3.3.5.2, 3.3.9.2, and 3.3.11.2, showed that the initial level of control used as the baseline condition appeared to have no impact on the technology selected. For a full explanation and results of the analysis refer to Appendix 3.2.1, Re-evaluation of Preferred Projects Analysis.

The MSD Project Cost Estimating Tool and the benefit-cost value model were utilized to develop Final SSDP solution costs and benefits, based on input from the WWT. These planning models are fully described in Volume 1, Section 2.5. The individual components are summarized in the following section.

3.2.1 Cost Analysis

A total project capital cost and present worth (including O&M) cost was computed for each solution alternative using the MSD Project Cost Estimating Tool, which uses cost curves based on common parameters obtained from model runs. This includes parameters such as pipe diameters, location (i.e. paved areas versus non-paved) and site conditions (i.e. site dewatering). It also includes costs for easements and land acquisitions, as well as O&M costs for pumping, cleaning and other recurring tasks.

It is important to understand that costs developed at this stage were planning level costs only and included planning level contingencies for the uncertainties at this level. Cost estimates that are more detailed were prepared for selected projects after the optimized solution evaluation stage and are discussed in Volume 3, Chapter 4.

3.2.2 Benefit Analysis

The MSD benefit-cost value model was used to consistently calculate benefits for the solution alternatives. Project-specific values, branching, and benefits based on SSO solutions and locations are discussed in this section.

3.2.2.1 Project-Specific Values

The WWT identified community values to be considered during SSO abatement planning. The community values identified were asset protection, customer satisfaction, eco-friendly solutions, economic vitality, environmental enhancement, environmental justice and equity, financial equity, financial stewardship, public health enhancement, public education, and regulatory performance. However, not all of these values were specifically analyzed as part of the benefit-cost analysis. Five project specific values were selected to provide a comprehensive and viable benefit-cost analysis.

Five Project-Specific Core Values

1. Regulatory Performance
2. Public Health Enhancement
3. Asset Protection
4. Environmental Enhancement
5. Eco-Friendly Solutions

To enhance the benefit-cost ratio process, the WWT assigned weighting factors on a zero to ten scale to each of the five values to reflect the degree of importance to the overall control plan impact to the community. The values and assigned weights that were used to score benefits were as follows:

- Public Health 10
- Regulatory Performance 8
- Environmental Enhancement 8
- Asset Protection 6
- Eco-Friendly Solution 6

One module for each of the five core values exists within the benefit-cost analysis tool in addition to a module that summarizes the resulting scores and costs for up to five alternatives per SSO or branch.

Regulatory Performance and Public Health were scored on a 25-point severity-frequency matrix according to SSO volume and frequency. The baseline characteristics of the SSO were initially scored, followed by scoring the remaining overflow/frequency resulting from the proposed solution. The difference in these values was the benefit score, with a higher score indicating a higher reduction in risk, or higher value of benefit. The Asset Protection value was also scored on a 25 point severity-frequency scale (level of protection versus damage impact) to account for reduction in basement flooding by a proposed SSO solution.

The Environmental Enhancement and Eco-Friendly Solution values were scored using several performance metrics that represent a variety of aspects related to the environment or ecosystems, Each of the aspects were scored on a 10-point negative-to-positive scale (-5 to +5). Environmental Enhancement primarily assesses aquatic impact, while Eco-Friendly Solutions assesses broader land/energy impacts of proposed SSO solution alternatives.

3.2.2.2 Benefits Based on SSO Locations and SSO Solutions

Two values, Regulatory Performance and Public Health Enhancement, are specific to the frequency and magnitude of each individual SSO location. Therefore, benefits are calculated separately for each SSO for both the existing conditions and proposed conditions, after the solution is in place.

The other three values, Eco-Friendly Solutions, Environmental Enhancement and Asset Protection, are specific to the type of solution. Therefore, benefits are calculated by solution and SSOs in the branch receive the same score for both the existing conditions and proposed conditions, after the solution is in place.

3.2.2.3 Branching or Clusters

As described above, benefits are calculated for each SSO individually at the Regulatory Performance and Public Health levels, and then aggregated for a "cluster" (branch) of SSOs to calculate Asset Protection, Environmental Enhancement, and Eco-Friendly Solutions scores.

Consequently, the net benefit is very much dependent on the number of SSOs in each cluster. Accordingly, net benefits cannot be compared directly from branch to branch. Likewise, benefit-cost ratios cannot be directly compared. Within a branch, however, net benefits can be directly compared and resulting benefit-cost ratios will identify the best solutions.

Table 3.2.1 shows an example of the calculations involved in determining a total benefit score for a cluster of SSOs.

TABLE 3.2.1

EXAMPLE BENEFIT CALCULATION

Example Benefit Calculation for One Branch					
SSO ID	**Regulatory Performance**	**Public Health**	**Asset Protection**	**Environmental Enhancement**	**Eco-Friendly Solutions**
MSD0023	12	7	4	4	1
MSD0010	5	2	4	4	1
MSD0007	5	2	4	4	1
26752	5	7	4	4	1
41416	5	5	4	4	1
24472	5	5	4	4	1
41374	0	0	4	4	1
MSD0024	0	2	4	4	1
24152-W	0	0	4	4	1
Sum	***37***	***30***	***36***	***36***	***9***
Weighting Factor	***8***	***10***	***6***	***8***	***6***
Weighted Benefit Score	***296***	***300***	***216***	***288***	***54***
Total Benefit Score	***1154***				

3.2.3 Benefit-Cost Ratio Analysis

The total weighted benefit-cost ratio can be automatically calculated for alternatives based on the total costs and the weighted benefit scores. Two weighted benefit-cost ratios are calculated; one using capital costs and the other using total present worth costs. Each branch solution has unique benefit-cost ratios for each level of protection. Once the ratios are calculated, the alternatives require further review relative to overall program values and objectives to determine which alternative best fits the overall needs of the community. In addition to the five core values, other values were considered including: Customer Satisfaction, Economic Vitality, Environmental Justice and Equity, Financial Equity, Financial Stewardship, and Public Education.

Benefit-cost Ratio Analysis examples are presented for each individual watershed solution in the following section.

3.3 EVALUATION OF SSO ABATEMENT ALTERNATIVES

The following sections summarize initial solutions considered for each modeled watershed, and the solution feasibility screening that included a thorough investigation of individual properties and sewer alignments in each branch (ground truthing). Additionally, modeled solution analyses including the benefit-cost procedure and the solution technology selected for each branch at the 1.82-inch cloudburst storm level are summarized for each modeled watershed. Appendix 3.1.2 contains the detailed ground truthing documents related to initial solutions. Appendix 3.3.1, Preferred Solution Cost Tables, Benefit-Cost Tables, Maps, Fact Sheets, contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

3.3.1 Cedar Creek Alternatives

Details on branching and SSO descriptions for Cedar Creek can be found in Volume 3, Chapter 2, Section 2.5.1. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.1.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction were applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated and, therefore, is not summarized below.

<u>Branch 70158</u>

This branch includes SSOs caused by a hydraulic bottleneck. The land surrounding the SSOs includes homes that are approximately 100 feet away from the SSO location, which was the former location of the Idlewood WQTC.

The conveyance alternative considered was to build a parallel relief line or increase the existing interceptor size. Initial assessment showed enough room for a construction easement. The first storage alternative considered was to construct a wet weather storage facility near the SSO location. Based on ground truthing, the open land originally considered for the storage facility near the SSO site has development planned. The best location for a storage facility would require additional conveyance downstream approximately 500 feet away. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing for inline storage found that 70 percent of the property is in the 100-year floodplain, and the utility conflicts would be minimal.

Branch 81316

This branch includes SSOs caused by insufficient capacity at the Fairmount Road Pump Station to handle upstream flows. The surrounding area is residential but consists of ample open space.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a wet weather storage facility onsite. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing for inline storage found that 80 percent of the property is in the 100-year floodplain and there is a potential utility conflict with an overhead electrical line.

Branch 67997

This branch includes SSOs caused by insufficient capacity of the interceptor to handle upstream flows during wet weather. The conveyance alternative considered was to increase the existing interceptor pipe size. No storage alternatives were considered for this branch due to lack of available open land. Ground truthing for pipe upgrades found that 90 percent of the property is in the 100-year floodplain and potential utility conflicts may occur with electrical and gas line crossings.

Branch MSD1025

This branch includes an SSO caused by insufficient capacity at the Bardstown Road Pump Station to handle upstream flows. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process discussed below.

Branch MSD1080

This branch includes an SSO caused by insufficient capacity at the Running Fox Pump Station to handle upstream flows. This SSO location was not reported as an SSO until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.1.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Cedar Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 70158

Based on the benefit-cost analysis, the chosen solution for Cedar Creek Branch 70158 is Inline Storage. Table 3.3.1 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.1

CEDAR CREEK BRANCH 70158 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_CC_CC_70158_M_09A_C	Inline Storage	Inline storage with 955 linear feet (LF) of (84" - 120") pipe to store wet weather peak flow, and upgrade 1,747 LF of (8" - 15") sewer to increase hydraulic capacity during wet weather peak flows.	24.66	31.36
S_CC_CC_70158_M_01_C	Pipe Upgrades	Upsize 8,218 LF of interceptor pipes.	5.76	7.26

Branch 81316

The chosen solution for Cedar Creek Branch 81316 (Fairmount Rd. PS) is Pump Station Upgrades. The Pump Station Upgrades solution is a capital project known as the Fairmount Rd. Pump Station Expansion Project (E00303) which is currently planned to install three new pumps at Fairmount Rd. Pump Station. The new pumps are sized to accommodate future development per the Cedar Creek Action Plan. Table 3.3.2 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.2

CEDAR CREEK BRANCH 81316 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_FF_CC_81316_M_03_C	PS Upgrades	Install (3) 130 HP, 1750 gpm pumps to increase capacity at the Fairmount Rd. Pump Station. (Cedar Creek Action Plan)	26.79	26.79
S_FF_CC_81316_M_09A_C	Inline Storage	Inline storage with 407 LF of 36" pipe to store wet weather peak flow.	21.29	27.00

Branch 67997

The chosen solution for Cedar Creek Branch 67997 is Pipe Upgrades. As discussed earlier, the only solution considered for this branch was the conveyance alternative. Table 3.3.3 summarizes the solution and the benefit-cost ratio associated with that solution.

TABLE 3.3.3

CEDAR CREEK BRANCH 67997 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_CC_CC_67997_M_01_C	Pipe Upgrades	Upsize 3,916 LF with (12" - 21") sewer pipe.	19.06	23.86

Branch MSD1025

Based on the benefit-cost analysis, the chosen solution for Cedar Creek Branch MSD1025 (Bardstown Rd. PS) is Pump Station Upgrades. Table 3.3.4 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.4

CEDAR CREEK BRANCH MSD1025 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_CC_CC_MSD1025_S_03_C	PS Upgrades	Increase capacity of the Bardstown Rd PS to handle peak flows of 0.39 mgd	34.40	29.42
S_CC_CC_MSD1025_S_09B_C	Offline Storage	Construct offline covered storage (0.063 MG) at manhole 88545 just upstream of the Bardstown Rd. PS.	28.19	28.52
S_CC_CC_MSD1025_S_09A_C	Inline Storage	Inline storage with 283 LF of 72" pipe to store wet weather peak flow.	12.88	16.50

Branch MSD1080

Based on the benefit-cost analysis, the chosen solution for Cedar Creek Branch MSD1080 (Running Fox PS) is Diversion. Table 3.3.5 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.5

CEDAR CREEK BRANCH MSD1080 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_CC_CC_MSD1080_S_01_C	Diversion	Construct 375 LF of 8" gravity sewer to eliminate Running Fox PS.	577.08	659.52
S_CC_CC_MSD1080_S_09A_C	Inline Storage	Inline storage with 400 LF of 60" pipe upstream of Running Fox PS to store wet weather peak flow.	86.72	108.82
S_CC_CC_MSD1080_S_09B_C	Offline Storage	Construct offline covered storage (.015 MG)	44.44	45.57
S_CC_CC_MSD1080_S_03_C	PS Upgrades	Increase the capacity of the Running Fox PS to handle peak flows of 0.4 mgd. Upsize 700 LF of force main to 6".	43.97	38.72

3.3.2 Floyds Fork Alternatives

Details on branching and SSO descriptions for Floyds Fork can be found in Volume 3, Chapter 2, Section 2.5.2. The initial solution development process summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.2.1 Initial Solutions and Feasibility Screening

Initial solutions were developed before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized below.

Branch 1

This branch includes SSOs due to insufficient conveyance capacity and surcharged pipe during wet-weather events. The surrounding area is residential but includes some small open space.

The conveyance alternative considered was to increase the existing interceptor pipe size upstream of the Pope Lick Pump Station. The diversion alternative considered conveying more flow to the Woodland Hills Pump Station, and then on to the Morris Forman WQTC. The first storage alternative considered was to construct a wet weather storage facility in the residential area. The second storage alternative considered was to construct large pipes in the vicinity of the SSOs to provide inline storage.

Branch 2

This branch includes an SSO believed to be caused by a blockage at the Eden Care Pump Station that was cleared on March 18, 2006. The pump station is located in a small residential area.

The conveyance alternative considered was to upgrade the pump station and force main. The first storage alternative considered was to construct a wet weather storage facility near the SSO location but available land near the pump station is limited. The best location for a storage facility would require additional conveyance upstream approximately 600 feet. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing for inline storage found that a small drainage ditch with riprap runs parallel to the gravity line and would most likely need to be replaced.

Branch 3

This branch includes SSOs caused by insufficient capacity at both Olde Copper Court and Ashburton Pump Stations to handle upstream flows. The surrounding area is residential with some small wooded areas near the pump stations.

The diversion alternative considered was to divert flow from the Ashburton Pump Station to an alternate gravity system. The first storage alternative considered was to construct a wet weather storage facility near the Olde Copper Court Pump Station. The second storage alternative considered was to construct large pipe in the vicinity of the Olde Copper Court Pump Station to provide inline storage. The third storage alternative considered was to construct large pipe in the woods behind residences near the Ashburton Pump Station to provide inline storage.

Ground truthing identified that a threatened/endangered species assessment is recommended because construction will take place near the wooded area. It also found potential conflicts of force main construction with two electrical lines and one gas main, and gravity sewer construction with an electrical line. Other conflicts with force main construction reveals that it runs along a very steep hill and is located very close to an existing home (would need to be constructed under existing driveway).

3.3.2.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Floyds Fork. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for Floyds Fork Branch 1 is Diversion. Table 3.3.6 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.6

FLOYDS FORK BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/Cost Ratio (Present Worth Costs)
S_FF_FF_NB01_S_01_C_A	Diversion	Replace the existing overflow and automated gate (to the Woodland Hills PS) with a double barrel overflow that consists of two-15 LF 12" diameter pipes. The upstream invert of the pipes needs to be 2" above the upstream invert of the exiting gravity pipe in manhole 82058. This new invert elevation will allow dry weather flow to gravity drain through the interceptor, but anything greater than dry weather flow will be diverted to the PS by an overflow pipe and reduce the surcharge further down the gravity line.	321.41	92.26
S_FF_FF_NB01_S_09A_C_A	Inline Storage	Inline storage with 400 LF and 110 LF of 48" pipes to store wet weather peak flow.	12.83	16.28
S_FF_FF_NB01_S_03_C_A	Pipe Upgrades	Upsize 1,650 LF of 15” sewer pipe with 18” sewer pipe.	10.84	13.60

Branch 2

The chosen solution for Floyds Fork Branch 2 (Eden Care PS) is Monitoring. The only overflow at this Pump Station occurred on March 18, 2006 and was believed to be caused by a blockage at the Eden Care Pump Station that was cleared on that date. Table 3.3.7 summarizes the solution chosen for Floyds Fork Branch 2.

TABLE 3.3.7

FLOYDS FORK BRANCH 2 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/Cost Ratio (Present Worth Costs)
S_FF_FF_NB02_S_13_C	Monitor	Monitor the Eden Care PS during rain events for the next three years according to SORP protocols.	--	--

Branch 3

Based on the benefit-cost analysis, the chosen solution for Floyds Fork Branch 3 (Ashburton PS / Olde Copper PS) is Pipe and Force Main Upgrades (A). Table 3.3.8 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.8

FLOYDS FORK BRANCH 3 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/Cost Ratio (Present Worth Costs)
S_FF_FF_NB03_M_01_C_A	Upgrade Force Main & Pipes (A)	Divert flow from Ashburton PS by upgrading 370 LF of force main from 2" to 3" and constructing 115 LF of 8" gravity sewer, also eliminates the SSO at Olde Copper Ct PS.	150.66	161.00
S_FF_FF_NB03_M_03_C_B	Force Main Upgrades	Upgrade 620 LF of force main from 2.5" to 4" at Olde Copper Ct PS and 700 LF of force main from 2" to 3" at Ashburton PS.	111.57	106.61
S_FF_FF_NB03_M_HB_C_C	Upgrade Force Main & Pipes (B)	Eliminate Olde Copper Ct PS, construct 370 LF of 8" gravity sewer to divert flow to another part of the system, upgrade 700 LF of force main from 2" to 3" for Ashburton PS.	86.27	91.31
S_FF_FF_NB03_M_HB_C_B	Inline Storage & Upgrade Force Main (A)	Inline storage with 320 LF of 42" pipe at Olde Copper Ct PS, upgrade 700 LF of force main from 2" to 3" at Ashburton PS.	52.51	59.44
S_FF_FF_NB03_M_HB_C_A	Inline Storage & Upgrade Force Main (B)	Inline storage with 150 LF of 60" pipe at Olde Copper Ct PS, upgrade 700 LF of force main from 2" to 3" at Ashburton PS.	51.19	58.40
S_FF_FF_NB03_M_03_C_A	PS & Force Main Upgrades (A)	Upgrade both pumps at Olde Copper Ct PS for a combined 60 gpm to 100 gpm; upgrade 700 LF of force main from 2" to 3" at the Ashburton PS.	47.82	42.51
S_FF_FF_NB03_M_03_C_C	PS & Force Main Upgrades (B)	Upsize existing wet well from 4' to 8' diameter and pumps at Olde Copper Ct PS for a combined 60 gpm to 90 gpm, upgrade 700 LF of force main from 2" to 3" at Ashburton PS.	27.03	27.73

3.3.3 Hite Creek Alternatives

Details on branching and SSO descriptions for Hite Creek can be found in Volume 3, Chapter 2, Section 2.5.3. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.3.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch MSD1082

This branch includes SSOs caused by insufficient capacity at the Meadow Stream Pump Station to handle upstream flows. The surrounding area is a mix of single-family residential, multi-family residential, and light industrial. There is ample open space in the area.

The conveyance alternative considered either upsizing the force main or adding a wet weather force main and pump. The first storage alternative considered was to construct a wet weather storage facility in an open area near the SSO locations. The second storage alternative considered was to construct a large pipe in the vicinity of the SSOs to provide inline storage. Ground truthing found that a portion of the pump station property is in the 100-year floodplain but construction would take place outside of the floodplain.

Branch MSD1085

This branch includes an SSO caused by insufficient capacity at the Kavanaugh Road Pump Station to handle upstream flows. The surrounding area is residential with available open space.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a wet weather storage facility on residential property. The best location for a storage facility would require additional conveyance downstream approximately 200 feet. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage. Ground truthing found a potential utility conflict with overhead electrical lines.

Branch MSD1086

This branch includes SSOs caused by insufficient capacity at the Floydsburg Road Pump Station to handle upstream flows. The surrounding area is industrial with some residential. There is some open space near the pump station and in a wooded area to the west.

The conveyance alternative considered upgrading the pump station. The storage alternative considered was to construct a wet weather storage facility on developed property. The best location for a storage facility would require additional conveyance downstream approximately 200 feet. Another alternative considered I/I reduction since the area is small (16 properties) and mostly industrial. Ground truthing at the pump station location found that the site is next to an electrical substation and several overhead and underground lines are onsite.

Branches MSD1085/MSD1086

An alternative that would eliminate SSOs at both Floydsburg Road and Kavanaugh Road Pump Stations was also considered. This alternative consisted of eliminating Floydsburg Road and Kavanaugh Road Pump Stations and constructing interceptors to run south to a new pump station site to serve the whole Crestwood area. A force main would be constructed parallel to the Floydsburg Road Interceptor.

3.3.3.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Hite Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch MSD1082

Based on the benefit-cost analysis, the chosen solution for Hite Creek Branch MSD1082 (Meadow Stream PS) is Inline Storage. Table 3.3.9 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.9

HITE CREEK BRANCH MSD1082 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HC_MSD1082_S_09A_C	Inline Storage	Inline storage with dual 238 LF, 120" parallel pipes to store wet weather peak flow.	10.77	13.77
S_HC_HC_MSD1082_S_09B_C	Offline Storage	Construct aboveground storage vault (0.2 MG).	8.67	8.85
S_HC_HC_MSD1082_S_03_C	PS & Force Main Upgrades	Increase the capacity of the Meadow Stream PS to handle peak flows of approximately 4.5 mgd, upgrade 15,395 LF to 18" force main.	3.14	2.77

Branch MSD1085

Based on the benefit-cost analysis, the chosen solution for Hite Creek Branch MSD1085 (Kavanaugh Rd. PS) is Pump Station and Force Main Upgrades. Table 3.3.10 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.10

HITE CREEK BRANCH MSD1085 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HC_MSD1085_S_03_C	PS & Force Main Upgrades	Increase the capacity of the Kavanaugh Rd. PS to handle peak flows of 0.674 mgd and upgrade 2,458 LF of force main.	19.46	19.77
S_HC_HC_MSD1085_S_09A_C	Inline Storage	Inline storage with dual 968 LF, 72" influent PS lines. Additional 2,243 LF of upsized sewer is required.	5.25	6.71

Branch MSD1086

The chosen solution for Hite Creek Branch MSD1086 (Floydsburg Rd. PS) is I/I Reduction. This solution was chosen as the recommended alternative since the contributing area is small and the pump station should have enough capacity based on design calculations. If I/I reduction is deemed unsuccessful in eliminating the SSO, then the next best alternative is Pump Station Upgrades. Table 3.3.11 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.11

HITE CREEK BRANCH MSD1086 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HC_MSD1086_M_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for Sanitary Sewer Evaluation Study (SSES) - no benefits calculated	
S_HC_HC_MSD1086_M_03_C	PS & Force Main Upgrades	Upgrade the capacity of the Floydsburg Rd. PS to handle peak flows of 0.30 mgd and upgrade 1,183 LF of force main.	19.78	19.80

Branches MSD1085/MSD1086

The Regional Pump Station alternative was not a favorable solution for Hite Creek Branches MSD1085 and MSD1086 based on the benefit-cost analysis; therefore, no further evaluation occurred for this solution. Table 3.3.12 summarizes the solution considered and the associated benefit-cost ratio.

TABLE 3.3.12

HITE CREEK REGIONAL PUMP STATION SOLUTION ALTERNATIVE

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HC_CrestwoodPS_M_13_C	New Regional PS	Eliminate Floydsburg Road PS and Kavanaugh Road PS, construct interceptors to a new regional PS to serve the entire Crestwood area, construct 6,135 LF of force main parallel to Floydsburg Road Interceptor. Additional 6,914 LF of new sewer construction required.	8.14	9.28

3.3.4 Jeffersontown Area Alternatives

Details on branching and SSO descriptions for Jeffersontown are in Volume 3, Chapter 2, Section 2.5.4. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.4.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity of the interceptor, siphon and Jeffersontown WQTC to handle wet weather flows. The surrounding area is a mix of commercial, industrial, residential, and athletic facilities.

Numerous storage, conveyance and diversion alternatives were considered. Most alternatives required the replacement of the interceptor from the Grassland area to the Jeffersontown WQTC. Another alternative considered a pump station or storage facility in the Grassland area.

Ground truthing revealed that 10 percent of the gravity interceptor line from the Grassland area to the Jeffersontown WQTC lies within the 100-year floodplain, has significant steep slopes, and an endangered/threatened species assessment is recommended due to the wooded area. The proposed storage site and the pump station at the Jeffersontown WQTC location lie within the 100-year floodplain and very near Chenoweth Run stream.

Branch 1A

Branch 1A includes the SSOs at the Chippewa and Chenoweth Run Pump Stations, which had previously been considered in the initial alternatives for Branch 4. Both SSOs are caused by insufficient capacity at the pump stations to handle upstream flows. The surrounding area is residential with lot sizes of approximately one acre or less. There is a large undeveloped area to the south of the Chenoweth Run Pump Station.

The conveyance alternative considered upgrading the pump station and the force main. The storage alternative considered was to construct a wet weather storage facility in the area to the south of the SSO locations.

Branch 2

This branch includes SSOs caused by insufficient capacity of the interceptor downstream of Charlane Parkway and Dell Road. The surrounding area is a mix of commercial, single-family, and multi-family residential.

The conveyance alternative considered upsizing the interceptor. The storage alternative considered was to construct a wet weather storage facility in a grassy area east of SSO ID 28391 between the railroad tracks and the sewer. Ground truthing found several utility crossings and a creek located north of the conveyance alternative.

Branch 3

This branch includes SSOs caused by insufficient capacity at the Raintree and Marian Court Pump Stations to handle upstream flows. The surrounding area is a mix of single-family and multi-family residential.

The conveyance alternative considered upgrading the pump stations. The storage alternative considered was to construct a wet weather storage facility at some undeveloped land to the northeast. An additional storage alternative could be under an existing commercial parking lot on Taylorsville Road. A diversion alternative included construction of new pipe to divert flows to an alternate system and eliminate the pump stations. Ground truthing found several utility crossings for the Marian Court Pump Station and Raintree Pump Station diversion alternative.

Branch 4

This branch includes an SSO caused by insufficient capacity at the Monticello Place Pump Station to handle upstream flows. As discussed in the Branch 1A description, several SSO locations initially evaluated in the Branch 4 network are now included in the Branch 1 solutions.

The Monticello Pump Station is the only SSO location that remains in Branch 4. The surrounding area is a mix of single-family and multi-family residential.

The conveyance alternative considered upgrading the pump station. The storage alternative considered was to construct a wet weather storage facility to the south of the pump station. A diversion alternative included construction of new pipe to divert flows to an alternate system and eliminate the pump station. Ground truthing for the diversion alternative found one underground utility crossing and a creek located near the site.

3.3.4.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Jeffersontown WQTC Branch Network. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 1 is Offline Storage and Pipe Upgrades as well as a new pump station to be constructed at the Jeffersontown WQTC site. This solution will eliminate the Jeffersontown WQTC. The alternative shown in the following table with the highest benefit-cost ratio initially assumed that the Jeffersontown WQTC would be available for upgrading. With the goal being to eliminate the Jeffersontown WQTC this alternative was not evaluated further. Table 3.3.13 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.13

JEFFERSONTOWN BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/ Cost Ratio (Present Worth Costs)
S_JT_JT_NB01_M_01_C_A	Offline Storage, Pipe Upgrades, WQTC Elimination	Upsize the interceptor (6,200 LF) from Grassland to the WQTC. Storage facility (5.7 MG) at the WQTC site and a new PS with capacity of 10 mgd. 32,100 LF of 24" force main constructed to convey flows to the Hikes Lane Interceptor.	4.93	5.23
S_JT_JT_NB01_M_01_C_B	WQTC & Pipe Upgrades	Upsize the interceptor (6,200 LF) from Grassland to the WQTC and increase the capacity of the WQTC to 20 mgd (full plant upgrade).	12.01	11.81
S_JT_JT_NB01_M_01_C_C	WQTC Upgrades, Storage & Pipe Upgrades	Upsize the interceptor (6,200 LF) from Grassland to the WQTC. Storage facility (2.3 MG) at the WQTC site and a new PS with capacity of 10 mgd. 32,100 LF of 24" force main constructed to convey flows to the Hikes Lane Interceptor. Convey Chenoweth Hills WQTC and the pumped zone of Jeffersontown (J'town) to the Billtown Road Interceptor for diversion to Cedar Creek WQTC. Plant upgrades required at Cedar Creek WQTC.	3.29	No Present Worth analysis performed
S_JT_JT_NB01_01_C_D	WQTC Upgrades, Storage, & Pipe Upgrades	Upsize the interceptor (6,200 LF) from Grassland to the WQTC. Storage facility (2.3 MG) at the WQTC site and a new PS with capacity of 10 mgd. 8,000 LF of 24" to 30" force main installed to the Chenoweth Run PS. All J'town flow (including Chenoweth Hills WQTC) is diverted to Cedar Creek WQTC. Plant upgrades required at Cedar Creek WQTC.	2.60	No Present Worth analysis performed

Branch 1A

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 1A is Pump Station and Force Main Upgrades and directs the flow from the Chenoweth Hills WQTC to the Chenoweth Run Pump Station. Each alternative in Branch 1A included the elimination of the Chenoweth Hills WQTC. Table 3.3.14 summarizes the solutions considered and the benefit-cost ratios associated with each solution; however, the costs for Branch 1A are incorporated into Branch 1.

TABLE 3.3.14

JEFFERSONTOWN BRANCH 1A SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/ Cost Ratio (Present Worth Costs)
S_JT_JT_NB01A_M_03_C	PS & Force Main Upgrades, WQTC Elimination	Upgrade Chenoweth Run PS to handle peak flow of 2.7 mgd and upsize 8,030 LF of force main to 12". Chenoweth Hills WQTC elimination. Upgrade Chippewa PS to handle peak flow of 0.15 mgd. Install 1,995 LF of new 15" sewer and replace 600 LF of 8" with 18" sewer pipe for Chenoweth Hills WQTC diversion.	22.47	20.05
S_JT_JT_NB01A_M_09_C	Offline Storage & Pipe Upgrades	Construct offline wet weather storage facility (0.8 MG) at Chenoweth Run PS and Chenoweth Hills WQTC diversion with Chippewa PS upgrades.	11.66	12.24

Branch 2

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 2 is Pipe Upgrades. Table 3.3.15 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.15

JEFFERSONTOWN BRANCH 2 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/ Cost Ratio (Present Worth Costs)
S_JT_JT_NB02_M_01_C	Pipe Upgrades	Upsize interceptor downstream of Charlane and Dell Road SSOs with 4,000 LF of (10"-21") sewer.	25.01	31.35
S_JT_JT_NB02_M_09_C	Offline Storage	Construct underground pumped offline storage facility (0.18 MG) near swimming pool site and storage facility (0.03 MG) at manhole 103647.	12.02	12.55

Branch 3

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 3 (Raintree PS / Marian Ct. PS) is Diversion and Pipe Upgrades. Table 3.3.16 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.16

JEFFERSONTOWN BRANCH 3 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/ Cost Ratio (Present Worth Costs)
S_JT_JT_NB03_M_01_C	Diversion & Pipe Upgrades	Eliminate Marian Ct. and Raintree PSs by installing 455 LF of 8" sewer from Marian Ct. PS and 400 LF of 8" sewer from Raintree PS to divert flows to the Southeast Diversion system, additional 2,675 LF of 15" sewer upgrades is required downstream of the PS diversions.	59.44	72.76
S_JT_JT_NB03_M_09_C	Offline Storage & Pipe Upgrades	Construct underground offline storage facility (0.007 MG) for Marian Ct PS, upgrade 928 LF of force main and pumps for Raintree PS to handle peak flow of 0.63 mgd, additional 2,530 LF of sewer upgrades downstream of the PS is required.	34.31	34.57
S_JT_JT_NB03_M_03_C	PS & Pipe Upgrades	Replace 878 LF of force main at Raintree PS, replace pumps at Marian Ct (to 0.3 mgd) PS and Raintree (to 0.6 mgd) PS, upsize 2,480 LF of gravity sewer downstream of the force main.	33.59	36.94

Branch 4

Based on the benefit-cost analysis, the chosen solution for Jeffersontown Branch 4 (Monticello PS) is Diversion. Table 3.3.17 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.17

JEFFERSONTOWN BRANCH 4 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Costs)	Benefit/Cost Ratio (Present Worth Costs)
S_JT_JT_NB04_M_01_C_C	Diversion	Eliminate Monticello PS by diverting to Derek R. Guthrie WQTC approximately 625 LF of 8" sewer.	39.43	48.90
S_JT_JT_NB04_M_03_C_C	PS Upgrades	Upgrade Monticello PS to handle peak flow of 0.75 mgd.	25.16	19.34
S_JT_JT_NB04_M_09_C_C	Offline Storage	Construct offline storage (0.053 MG) at Monticello PS.	8.83	8.59

3.3.5 Middle Fork Alternatives

Details on branching and SSO descriptions for Middle Fork can be found in Volume 3, Chapter 2, Section 2.5.5. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.5.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity in the collection system and the Upper Middle Fork Pump Station to handle upstream flows. The surrounding area is mostly commercial and residential with some industrial areas in the vicinity. This Branch has been evaluated with Southeastern Diversion branches to include the costs of the Buechel Basin for various comparative analyses. Initially, alternatives for this area were developed with the review of the Interim SSDP solutions, namely the Hikes Lane Interceptor and Northern Ditch Interceptor.

Ground truthing was performed at six locations in the area. Three of the locations had property in the 100-year floodplain, and three locations showed potential utility conflicts. Ground truthing identified two sites where a threatened/endangered species assessment was recommended. Four sites contained a protected waterway and another location was identified as a potential wetland (hydric soil was found). Several creeks were noted in the areas near the investigated sites.

Branch 4

This branch includes SSOs caused by insufficient capacity at Devondale, Goose Creek and Saurel Road Pump Stations to handle upstream flows. The surrounding area is primarily residential along with a large tract of farmland to the north, and a school to the east.

The conveyance alternative considered upgrading the Goose Creek, Devondale and Saurel Road Pump Stations and force mains. The storage alternative considered was to construct a wet weather storage facility on an undeveloped property adjacent to the pump station on the north and east. Additional storage sites are also available to the east on school property and to the west on undeveloped property.

Ground truthing was performed at four locations, and all had property in the 100-year floodplain. The Saurel Road force main location showed potential utility conflicts and the project could involve construction between existing homes within the easement.

Branch 6

This branch includes SSOs caused by insufficient capacity at Anchor Estates No. 1 and No. 2 Pump Stations, and Vannah Way Pump Station. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the Anchor Estates No. 1, No. 2, and Vannah Way Pump Stations and force mains. The storage alternative considered was to construct large pipe to provide inline storage at Anchor Estates No. 1 and No. 2 Pump Stations. The diversion alternative considered constructing gravity lines to alternate systems to eliminate each of the three pump stations.

Ground truthing was performed at three locations in the area, and a creek was identified at the southern end of the projects. Two locations had property in the 100-year floodplain, and one site had a threatened/endangered species assessment that was recommended. One site identified a protected waterway in the vicinity.

Branch 7

This branch includes an SSO caused by insufficient wet weather capacity in the collection system due to excessive I/I. This SSO location was not reported as an SSO until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.5.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Middle Fork. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for Middle Fork Branch 1 is Offline Storage and Pipe Upgrades (A). This branch is one of the three branches requested to be re-evaluated at the 2.25-inch cloudburst level to ensure the validity of the technology selection approach at the 1.82-inch cloudburst level. Table 3.3.18(A) summarizes the solutions considered for the 1.82-inch cloudburst storm and the benefit-cost ratios associated with each solution. Table 3.3.18(B) summarizes the solutions considered for the 2.25-inch cloudburst storm and the benefit-cost ratios associated with each solution.

TABLE 3.3.18(A)

MIDDLE FORK BRANCH 1 – 1.82-INCH SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MISF_MF_NB01_M_01_C_A1	Offline Storage & Pipe Upgrades (A)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and Upper Middle Fork Lift Station (UMFLS), construct 1.6 MG covered facility near Car Wash Site and 17.3 MG facility at Buechel Site. 11,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	1.14	1.26
S_MISF_MF_NB01_M_01_C_A2	Offline Storage & Pipe Upgrades (B)	Divert UMFLS to Hikes Lane Interceptor using capacity of existing pumps (no Middle Fork Interceptor required). Construct 17.3 MG storage facility at Buechel Site and 3.0 MG covered storage near Oxmoor Mall. 4,750 LF of additional gravity pipe improvements, 10,200 LF of force main.	1.06	1.15
S_MISF_MF_NB01_M_01_C_A3	Offline Storage & Pipe Upgrades (C)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and UMFLS, construct 3 MG covered facility at Cannons Lane site and 17.3 MG storage facility at Buechel site, 11,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	1.05	1.16
S_MISF_MF_NB01_M_01_C_B1	PS & Pipe Upgrades with Offline Storage	Divert all necessary flow through UMFLS to Hikes Lane Interceptor by upgrading pumps to convey peak discharge in diversion, construct 20.5 MG storage at Buechel Site, and construct 36" force main diversion to Hikes Lane Interceptor, 11,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138., 10,200 LF of force main.	0.84	0.93

TABLE 3.3.18(B)

MIDDLE FORK BRANCH 1 – 2.25-INCH SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MISF_MF_NB01_M_01_B_A1	Offline Storage & Pipe Upgrades (A)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and Upper Middle Fork Lift Station (UMFLS), construct 7.9 MG covered facility near Car Wash Site and 30.1 MG facility at Buechel Site. 16,900 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	0.96	1.07
S_MISF_MF_NB01_M_01_B_B1	PS & Pipe Upgrades with Offline Storage	Divert all necessary flow through UMFLS to Hikes Lane Interceptor by upgrading pumps to convey peak discharge in diversion, construct 57.2 MG storage at Buechel Site, and construct 36" force main diversion to Hikes Lane Interceptor, 16,900 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138., 10,200 LF of force main.	0.95	1.06
S_MISF_MF_NB01_M_01_B_A2	Offline Storage & Pipe Upgrades (B)	Divert UMFLS to Hikes Lane Interceptor using capacity of existing pumps (no Middle Fork Interceptor required). Construct 43.1 MG storage facility at Buechel Site and 8.5 MG covered storage near Oxmoor Mall. 5,900 LF of additional gravity pipe improvements, 10,200 LF of force main.	0.95	1.03
S_MISF_MF_NB01_M_01_B_A3	Offline Storage & Pipe Upgrades (C)	Construct 30" force main diversion to Hikes Lane Interceptor (10,200 LF), construct Middle Fork Relief Interceptor between Oxmoor Mall and UMFLS, construct 11.3 MG covered facility at Cannons Lane site and 34 MG storage facility at Buechel site, 25,800 LF total new gravity pipe including Relief Interceptor, storage piping, and relief at manhole 15138.	0.74	0.83

As indicated in the table, the Offline Storage and Pipe Upgrades (A) alternative had the best benefit-cost ratio, independent of level of control. It can be noted that the Pump Station and Pipe Upgrades with Offline Storage changed from the worst benefit-cost ratio at the 1.82-inch level to the second best benefit-cost ratio at the 2.25-inch level. The other 3 alternatives used underground, covered storage which increased in cost significantly at the higher storm level. The Pump Station and Pipe Upgrades with Offline Storage assumed an open, earthen facility which has a lower incremental cost to expand. A detailed evaluation of the odor generating

potential was not conducted for this technology screening step, but there is a high potential that depending on the final site selected for the storage facility, the larger facility needed to contain the 2.25-inch rain could exceed the criteria established for uncovered facilities, thus increasing the cost considerably for this alternative.

Branch 4

Based on the benefit-cost analysis, the chosen solution for Middle Fork Branch 4 (Devondale, Goose Creek, and Saurel Rd. PSs) is Storage and Force Main Upgrades. Table 3.3.19 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.19

MIDDLE FORK BRANCH 4 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MI_MF_NB04_M_03_B_A	Offline Storage, PS & Force Main Upgrades	Construct 0.5 MG covered storage facility near Devondale PS. Upsize 16" portion of force main at Goose Creek PS to 20" force main. Upgrade Goose Creek PS to 7.2 mgd. Replace Saurel Rd 4" force main with 6" force main. Upsize a total of 3,300 LF of force main.	10.78	11.00
S_MI_MF_NB04_M_09B_B	Inline and Offline Storage	Construct offline covered storage at Devondale PS (0.48 MG) and Goose Creek PS (0.19 MG). Inline storage with 72" pipe to store wet weather peak flow at Saurel Road PS.	9.04	9.17
S_MI_MF_NB04_M_03_B	Force Main & PS Upgrades	Upgrade the Devondale PS to handle peak flow of 1.5 mgd, upsize the force main to an 8" force main, and upsize downstream gravity pipes to 12" and 15" (5,710 LF). Upsize the 16" portion of Goose Creek force main to a 20" force main, and upgrade the PS to 7.2 mgd. Upsize 4" Saurel Rd force main to a 6" force main.	8.66	8.71

Branch 6

The chosen solution for Middle Fork Branch 6 (Anchor Estates No. 1 and 2 Pump Stations / Vannah Way Pump Station) is Diversion. This alternative was chosen because it eliminates three pump stations and has the potential for cost sharing with developers planning for new future connections in a currently un-sewered area. Table 3.3.20 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.20

MIDDLE FORK BRANCH 6 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MI_MF_NB06_M_01_C_A	Diversion	Construct 9,790 LF of 8" to 10" diversion gravity pipe to eliminate Anchor Estates No. 1 and No. 2 PSs, and Vannah Way PS. SSES upstream of Anchor Estates No. 2 PS.	20.86	25.39
S_MI_MF_NB06_M_01_C_C	Inline Storage & Diversion (A)	Construct 3,950 LF of 8" diversion gravity pipe to eliminate Vannah Way and Anchor Estates No. 1 PS, and construct 150 LF of 72" pipe at Anchor Estates No. 2 PS to provide inline storage	32.27	39.83
S_MI_MF_NB06_M_09_C	Inline Storage & Diversion (B)	Diversion pipe to eliminate Vannah Way PS, 150 LF of 72" pipe (at Anchor Estates No. 2 PS) and 300 LF of 72" pipe (at Anchor Estates No. 1 PS) to provide inline storage.	27.70	35.43
S_MI_MF_NB06_M_01_C_B	PS Upgrades & Diversion	Construct 3,950 LF of 8" diversion gravity pipes to eliminate Vannah Way and Anchor Estates No. 1 PSs, and Anchor Estates No. 2 PS upgrades with flow diverted to Vannah PS diversion.	20.10	23.05
S_MI_MF_NB06_M_03_C	PS Upgrades	Upgrade all PSs, upsize 2,300 LF of force main, upsize 2,300 LF of downstream collector sewers.	5.34	6.11

Branch 7

The chosen solution for Middle Fork Branch 7 is I/I Reduction. This solution was chosen as the recommended alternative based on modeling results. An overflow did not occur at this manhole in the existing conditions model at the 1.82-inch or 2.25-inch cloudburst storm indicating excessive I/I during heavy rainfall is likely the problem. Table 3.3.21 summarizes the solution considered.

TABLE 3.3.21

MIDDLE FORK BRANCH 7 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MI_MF_NB07_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	

3.3.6 Southeastern Diversion Alternatives

Details on branching and SSO descriptions for Southeastern Diversion can be found in Volume 3, Chapter 2, Section 2.5.6. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.6.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 3

This branch includes an SSO caused by insufficient capacity of the interceptor to handle upstream flows during wet weather. The surrounding area is a mix of single-family residential, multi-family residential, and light industrial.

The conveyance alternative considered was to upsize the interceptor. The first storage alternative considered was to construct a wet weather storage facility on land at the upper end of the industrial area or behind the school property. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Ground truthing at the storage location and along the Rustic Way corridor found hydric soil which may classify the area as a potential wetland site. Additionally, the locations were recommended for a threatened/endangered species assessment.

Branch 4

This branch includes an SSO caused by insufficient capacity of the system to handle upstream flows during wet weather. The surrounding area is single-family residential.

The conveyance alternative considered was to construct a relief sewer from the SSO at Alcona Lane to the new Hikes Lane Interceptor. The storage alternative considered was to construct a wet weather storage facility on the school property adjacent to the SSO location.

Ground truthing for the conveyance alternative found the alignment is 100 percent within the 100-year floodplain and a Louisville and Jefferson County Information Consortium (LOJIC) sensitive feature tool identified a protected waterway. A threatened/endangered species assessment was recommended because a portion of the construction would take place adjacent to a stream. Potential utility conflicts identified include water service replacements.

Branch 5

This branch includes an SSO caused by insufficient capacity of the interceptor to handle upstream flows during wet weather. The surrounding area is single-family residential.

The conveyance alternative considered was to upsize the interceptor behind homes on Sutherland Drive. The first storage alternative considered was to construct a wet weather storage facility on the school property to the south of the SSO locations. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Ground truthing for the conveyance alternative found the property is 45 percent within the 100-year floodplain and a LOJIC sensitive feature tool identified a protected waterway. The Beargrass Creek was identified at the south end of the project.

Branch 6

This branch includes an SSO caused by backwater in the Beargrass Interceptor due to obstructions in the sewer line. No initial solutions were developed for this location. This SSO is targeted for interceptor rehabilitation to remove obstructions in the downstream 42" interceptor.

3.3.6.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in the Southeastern Diversion area. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 3

The chosen solution for Southeastern Diversion Branch 3 is I/I Reduction. This solution was chosen as the recommended alternative since the contributing area is small and the interceptor should contain enough capacity based on design calculations. If infiltration reduction is deemed unsuccessful in eliminating the SSO, then the next best alternative is Pipe Upgrades. This solution is more desirable than the storage solution due to the proximity of the nearby school. Table 3.3.22 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.22

SOUTHEASTERN DIVERSION BRANCH 3 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_SD_MF_NB03_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_SD_MF_NB03_S_09B_C	Offline Storage	Construct offline covered (0.084 MG) storage in open field adjacent to SSO.	22.76	22.88
S_SD_MF_NB03_S_01_C	Pipe Upgrades	Construct 2,394 LF of 10" relief sewer that parallels the existing sewer along Rustic Way.	17.14	21.23
S_SD_MF_NB03_S_09A_C	Inline Storage	Construct 752 LF of 60" sewer from manhole 19320 to 47252 and 497 LF of 42" sewer from manhole 47252 to 27280 to provide inline storage.	10.62	13.48

Branch 4

The solution for the Southeastern Diversion Branch 4 is Pipe Upgrades. This solution involves a 30" gravity interceptor connecting to the Hikes Lane Interceptor where the Jeffersontown Branch 1 24" force main solution connects to the Hikes Lane Interceptor. The Southeastern Diversion Branch 4 solution was priced with a 30" gravity interceptor constructed to the Hikes Lane Interceptor minus the cost of the 24" Jeffersontown force main along the same route. Table 3.3.23 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.23

SOUTHEASTERN DIVERSION BRANCH 4 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_SD_MF_NB04_S_01_C_A	Pipe Upgrades	Construct 2,830 LF of 30" gravity interceptor connecting the Jeffersontown Branch 1 24" force main to the Hikes Lane Interceptor.	6.21	9.11
S_SD_MF_NB04_S_01_C_B	Pipe Upgrades	Construct 2,830 LF of 12" relief interceptor.	3.47	4.35
S_SD_MF_NB04_S_09B_C	Offline Storage	Construct a covered 0.12 MG offline storage facility in the school property adjacent to the SSO.	1.21	1.21

Branch 5

Based on the benefit-cost analysis, the chosen solution for Southeastern Diversion Branch 5 is Pipe Upgrades. Table 3.3.24 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.24

SOUTHEASTERN DIVERSION BRANCH 5 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_SD_MF_NB05_M_01_C	Pipe Upgrades	Upsize 1,760 LF of gravity pipe from 10" to 15" along rear yards.	20.54	25.22
S_SD_MF_NB05_M_09B_C	Offline Storage	Construct offline covered (0.089 MG) storage in an open field on school property.	18.10	18.10
S_SD_MF_NB05_M_09A_C	Inline Storage	Construct 620 LF of 60" sewer downstream of manhole ID 16649 to provide inline storage.	16.03	20.34

Branch 6

The chosen solution for Southeastern Diversion Branch 6 is Pipe Rehab. This is based on findings during the Interceptor Condition Assessment Phase 1. Table 3.3.25 summarizes the solution considered.

TABLE 3.3.25

SOUTHEASTERN DIVERSION BRANCH 6 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_SD_MF_NB06_S_13_C	Pipe Rehab	Heavily clean 2,000 LF of 42” interceptor	Cost only for Maintenance - no benefits calculated.	

3.3.7 Ohio River Force Main (ORFM) Alternatives

Details on branching and SSO descriptions for ORFM can be found in Volume 3, Chapter 2, Section 2.5.7. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.7.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline

conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and, therefore, is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity at pump stations in residential neighborhoods to handle upstream flows. Each pump station location was analyzed separately.

Many of the pump stations had available space for onsite storage alternatives. The conveyance alternatives considered would include pump station upgrades as well as pipe upgrades. The diversion alternatives involved elimination of pump stations by constructing new pipe to alternate systems.

Ground truthing was performed at six locations. Four of the locations include property in the 100-year floodplain. Two locations had a threatened/endangered species assessment recommended and two locations found potential utility conflicts with water lines. One location is located 70 percent in a golf course, and another location is located east of a creek. The Mockingbird Pump Station diversion location has potential steep slope and is in a Floodplain Management Ordinance review zone. The Mellwood Pump Station ground truthing noted a protected waterway. The Mellwood Pump Station force main project has numerous water lines to cross at Zorn Avenue.

Branch 2

This branch includes an SSO caused by a hydraulic bottleneck of two 8” pipes flowing into one 8” pipe. The surrounding area is single-family residential.

The conveyance alternative considered was to increase the existing pipe size downstream of the SSO. The storage alternative considered was to construct a wet weather storage facility behind residential lots due to lack of available land.

Branch 3

This branch includes an SSO caused by insufficient capacity at the Derington Court Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a wet weather storage facility in an area adjacent to the SSO. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage.

Ground truthing at the pump station property found that 10 percent of the property is in the 100-year floodplain and a sensitive feature was identified as a protected waterway southwest of the pump station. Ground truthing for offline storage found that 100 percent of the property is in the 100-year floodplain. A threatened/endangered species assessment was recommended.

Branch 4

This branch includes SSOs caused by insufficient capacity at pump stations in residential neighborhoods to handle upstream flows. Each pump station location was analyzed separately.

The conveyance alternatives considered would include pump station upgrades. The storage alternatives considered offline storage facilities in areas adjacent to the SSOs.

Ground truthing was performed at six locations. Five of the locations had properties in the 100-year floodplain. Two locations had a threatened/endangered species assessment recommended and many stream crossings were found in the area.

3.3.7.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in ORFM. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

Based on the benefit-cost analysis, the chosen solution for ORFM Branch 1 is Pump Station and Pipe Upgrades and Diversion. The Winton Avenue Pump Station and Mockingbird Valley Pump Station will be eliminated by the project. Table 3.3.26 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.26

ORFM BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_OR_MF_NB01_M_01_C	PS Upgrades, Pipe Upgrades & Diversion	Replace 1,760 LF of gravity sewer flowing into Mockingbird Valley PS, upgrade Mellwood Ave PS to handle peak flow of 2.5 mgd and flood-proof PS, upsize approximately 1,240 LF of 6" force main with 12" force main for Mellwood Ave PS, installation of 400 LF of 8" pipe for Winton PS diversion and 2,210 LF of 15" pipe for Mockingbird Valley PS diversion to alternate systems.	21.11	25.09
S_OR_MF_NB01_M_03_C	PS Upgrades & Pipe Upgrades	Replace 1,890 LF of gravity sewer flowing into Mockingbird Valley PS, upgrade pumps at Mockingbird Valley PS and Winton PS, total PS upgrade at Mellwood Ave PS, upsize 2,000 LF of force main for Mockingbird Valley PS, and upsize 1,240 LF of force main for Mellwood Ave PS.	19.55	22.90
S_OR_MF_NB01_M_09_C	Pipe Upgrades & Storage	Replace 200 LF of gravity sewer flowing into the storage area for Mockingbird Valley PS, divert Winton PS, construct 0.12 MG pumped storage facility at Mockingbird Valley PS, and construct 0.15 MG covered storage facility at Mellwood Ave PS.	14.27	15.38
S_OR_MF_NB01_M_01_C_A	Diversion, Pipe Upgrades & Storage	Replace 685 LF of 10" gravity sewer, construct 875 LF of 12" relief sewer, and 200 LF of 15" relief sewer for Mockingbird Valley PS. Additional upgrade of storage at Mellwood Ave PS to 1 MG (flood-proofed). Installation of 400 LF of 8" pipe for Winton PS diversion and 2,210 LF of 15" pipe for Mockingbird Valley PS diversion to alternate systems.	8.42	9.31

Branch 2

The chosen solution for ORFM Branch 2 is Condition Assessment. This solution was chosen because cleaning/flushing has occurred twice since March 2006 (the last documented overflow date) at this location and no additional overflows have been reported since that date. Table 3.3.27 the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.27

ORFM BRANCH 2 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_OR_MF_NB02_S_13_C	Condition Assessment	Perform periodic condition assessment (TVI and Wet Weather Monitoring) for three years to determine if SSO has been eliminated.	--	--
S_OR_MF_NB02_S_01_B	Pipe Upgrades	Construct 325 LF of 8" relief sewer.	85.67	102.80
S_OR_MF_NB02_S_09_B	Offline Storage	Construct offline covered pumped storage (0.048 MG) along the gravity sewer in the rear of homes on Leland Ave.	12.74	11.45

Branch 3

The chosen solution for ORFM Branch 3 (Derington Ct. PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area and difficult surrounding conditions (steep slopes and lack of available storage sites). If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best solution will be inline storage (based on Present Worth Benefit Cost ratio). Table 3.3.28 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.28

ORFM BRANCH 3 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_OR_MF_NB03_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_OR_MF_NB03_09_C_B	Offline Storage	Construct offline covered storage facility (0.016 MG) between the edge of pavement of Derington Court and the creek.	43.48	20.75
S_OR_MF_NB03_09_C_A	Inline Storage	Install 285 LF of 60" pipe parallel to the 8" gravity upstream of Derington Court PS to provide inline storage.	16.85	21.49
S_OR_MF_NB03_03_C	PS Upgrades	Upsize pumps at Derington Court PS, upsize 460 LF of force main from 4" to 6".	16.24	13.68

Branch 4

Based on the benefit-cost analysis, the chosen solution for ORFM Branch 4 is Pump Station and Pipe Upgrades and WQTC Elimination. This solution includes the elimination of five Prospect WQTCs. These solutions include the cost for a new Harrods Creek Pump Station but do not include the cost for additional treatment at Hite Creek WQTC. Table 3.3.29 summarizes the solutions considered and the benefit-cost ratios associated with each solution. A present worth analysis was not performed for these solutions.

TABLE 3.3.29

ORFM BRANCH 4 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_OR_MF_NB04_M_03_B_B	PS & Pipe Upgrades, WQTC Elimination	Upsize 8,300 LF of interceptor upstream of Muddy Fork PS. Upgrade pumps at Muddy Fork, Winding Falls/Phoenix Hill PS, and New Market PS. Upsize force main from Muddy Fork PS from 14" to a 24". Construct new 7.2 mgd Harrods Creek PS and 24,000 LF of 24" force main to pump flow to Hite Creek WQTC. The solution includes the elimination of the 5 Prospect WQTCs: Hunting Creek North, Hunting Creek South, Timberlake, Ken Carla, and Shadow Wood.	2.46	No Present Worth Analysis performed
S_OR_MF_NB04_M_01_B_B	Storage & PS Upgrades (A)	Construct covered storage facilities at Barbour Lane PS. Additional upsizing of interceptor upstream of Muddy Fork PS. Upgrade pumps at New Market PS.	1.94	No Present Worth Analysis performed
S_OR_MF_NB04_M_09_B_B2	PS & Force Main Upgrades	Construct additional 18” barrel for the ORFM from Muddy Fork PS to the outfall of the ORFM. This additional barrel would isolate Muddy Fork flow. Additional upsizing of interceptor required upstream of Muddy Fork PS. Upgrade pumps at Muddy Fork and New Market PSs. Upsize force main from Muddy Fork PS from 14" to an 18".	1.45	No Present Worth Analysis performed
S_OR_MF_NB04_M_09_B_B1	Storage & PS Upgrades (B)	Construct covered storage facilities at Muddy Fork PS and Winding Falls/Phoenix Hill PS. Additional upsizing of interceptor upstream of Muddy Fork PS. Upgrade pumps at New Market PS.	1.19	No Present Worth Analysis performed

3.3.8 CSO Area Alternatives

Details on branching and SSO descriptions for the CSO area can be found in Volume 3, Chapter 2, Section 2.5.8. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contain information on the ground truthing procedure.

3.3.8.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized.

Branch 30917

This branch includes SSOs caused by insufficient capacity in the collection system in the Camp Taylor neighborhood. The land surrounding the SSOs consists of single-family and multi-family residential.

The first conveyance alternative considered replacing the entire sewer system with approximately 47,000 LF of new sewer pipe. The second conveyance alternative considered building a relief sewer to convey excess wet weather flow from documented SSOs to the downstream interceptor. The storage alternative considered construction of offline storage facilities to store excess wet weather flow. Due to the age and condition of the system, a storage option alone was not viable. Another alternative considered performing an SSES to better define the problem and target the isolated problem area.

Branch 42007

This branch includes an SSO caused most likely by insufficient capacity at the Sonne Avenue Pump Station to handle excess wet weather flow and cross connections in the Sonne Avenue Pump Station area. The surrounding area is residential and industrial and is near electrical utilities.

The conveyance alternative considered upgrading the Sonne Avenue Pump Station to handle excess wet weather flow and convey flow to the downstream combined sewer system. The storage alternative considered construction of an offline storage facility at the adjacent property.

Ground truthing found a potential utility conflict at the pump station location with electrical and gas laterals nearby.

Branch 55665

This branch includes an SSO caused most likely by insufficient capacity at the Hazelwood Pump Station to handle excess wet weather flow. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since

it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.8.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in the CSO area. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 30917

Based on the benefit-cost analysis, the chosen solution for CSO Branch 30917 (Camp Taylor Neighborhood) is SSES, Rehabilitation, and Replacement. The chosen solution will include a full SSES to target sewers for replacement. Table 3.3.30 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.30

CSO BRANCH 30917 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_SF_MF_30917_M_09_C	SSES, Sewer Rehabilitation/ Replacement, Offline Storage	Replace and rehabilitate targeted sewer pipe after full SSES of the Camp Taylor area. Construct a pumped 0.02 MG covered storage facility to store excess wet weather flows, additional 3,395 LF of 8" pipe required to convey flow to the facility.	69.19	65.12
S_SF_MF_30917_M_12_A_A	System Replacement	Construct approximately 46,786 LF of new sanitary sewer pipe (8" - 15") to replace existing system.	7.18	9.05

Branch 42007

The chosen solution for CSO Branch 42007 (Sonne PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area and the fact that the area is located in the combined sewer system area and likely contains numerous cross connections. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage. Table 3.3.31 summarizes the solution and benefit-cost ratio associated with the solution.

TABLE 3.3.31

CSO BRANCH 42007 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_OR_MF_42007_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program)	Cost only for SSES - no benefits calculated.	
S_OR_MF_42007_S_09_C	Offline Storage	Construct offline covered pumped storage facility (0.18 MG) to store excess wet weather flows.	19.53	15.53
S_OR_MF_42007_S_03_C	PS Upgrades	Expand wet well from 6' to 12' diameter at the Sonne PS and upgrade PS to handle peak flow of 1.7 mgd.	9.26	10.12

Branch 55665

The chosen solution for CSO Branch 55665 (Hazelwood PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area and the fact that the area is located in the combined sewer system area and most likely contains numerous cross connections. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage and Pipe Upgrades. Table 3.3.32 summarizes the solution and the benefit-cost ratio associated with that solution.

TABLE 3.3.32

CSO BRANCH 55665 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MC_MF_55665_S_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_MC_MF_55665_S_13_C_B	Offline Storage & Pipe Upgrades	Construct offline covered storage facility (0.45 MG) to store excess wet weather flows and upsize 1,858 LF of 8" pipe to (12"-18")	10.98	11.60

3.3.9 Small WQTC Area Alternatives

Details on branching and SSO descriptions for the Small WQTC areas can be found in Volume 3, Chapter 2, Section 2.5.9. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.9.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline

conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized.

Berrytown Branch 1

This branch includes an SSO caused by insufficient capacity at the Lucas Lane Lift Station (LS) to handle upstream flows. With the exception of a few residences, the area surrounding the SSO is mostly open space and is adjacent to Goose Creek.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The storage alternative considered constructing large pipe in the vicinity of the SSOs to provide inline storage. The diversion alternative considered diverting flow to the Morris Forman WQTC through a force main. However, numerous utility lines would need to be avoided.

Ground truthing found a significant topographical feature identified as a drainage ditch that runs the length of the last two gravity sewer pipes upstream of the Lift Station. There are several trees growing above or very near the existing gravity sewer (sewer is currently scheduled to be replaced) potentially making replacement very difficult, and a resident's retaining wall is within ten feet of the proposed construction. The retaining wall would not impede construction of the proposed storage facility and the offline storage alternative would not require replacement of the entire sewer.

Chenoweth Hills Branch 1

This branch initially included an SSO located at the Chenoweth Hills WQTC caused by upstream flows greater than the WQTC capacity. The surrounding area is single-family residential. After initial solutions were investigated, it was found that the Chenoweth Hills WQTC location could be incorporated into the Jeffersontown Branch 1A solution. The SSO addressed by this branch is now the St. Rene Road Pump Station. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

Hunting Creek North Branch 1

This branch includes an SSO caused by insufficient capacity at the Riding Ridge Pump Station to handle upstream flows. The surrounding area is primarily residential with wooded and green space.

The conveyance alternative considered upgrading the wet well, pump station, and force main. Storage alternatives included constructing storage facilities in wooded areas near the SSO. Another storage alternative considered was to construct a large pipe in the vicinity of the SSO to provide inline storage. Ground truthing found an overhead electrical line runs near the pump station but is not in the potential area for a storage facility.

Hunting Creek North Branch 2

This branch includes an SSO caused by insufficient capacity at the Gunpowder Pump Station to handle upstream flows. The surrounding area is primarily residential.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The only storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage. Ground truthing at the Gunpowder Pump Station found water and gas mains and an underground electrical line that run parallel to the pump station, but the site was found to be suitable.

Hunting Creek North Branch 3

This branch includes an SSO caused by insufficient capacity at the Fox Harbor No. 1 and No. 2 Pump Stations to handle upstream flows. These SSO locations were not reported as SSOs until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

Hunting Creek South Branch 1

This branch includes an SSO caused by insufficient capacity at the Fairway View Pump Station to handle upstream flows. The surrounding area is mostly residential with some open area and a golf course.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The first storage alternative considered was to construct a wet weather storage facility in a small wooded area. The second storage alternative considered was to construct a large pipe in the vicinity of the SSO to provide inline storage. Ground truthing found the pipe upstream of the SSO intersects with three electrical lines and a gas main.

Hunting Creek South Branch 2

This branch includes an SSO caused by insufficient capacity at the Deep Creek Pump Station to handle upstream flows. The surrounding area is mostly residential with wooded areas in backyards.

The conveyance alternative considered upgrading the wet well and the pump station, and possibly the force main. The first storage alternative considered was to construct a wet weather storage facility in a small wooded area. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage. Another alternative considered building a storage facility at Deep Creek Trail Pump Station and reducing the pumping rate at Deep Creek Pump Station. Ground truthing identified electrical, water, and gas lines as potential utility conflicts.

Lake Forest Branch 1

This branch includes an SSO caused by insufficient capacity at the Lake Forest Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the wet well, pump station, and force main. The first storage alternative considered was to construct a wet weather storage facility; however, there are no locations available to build a storage facility near the pump station. There is an area near the Worthing Pump Station where volume could be stored to delay pumping to the Lake Forest Pump Station. The second storage alternative considered was to construct large pipe in the vicinity of the SSO to provide inline storage.

3.3.9.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Small WQTC areas. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Berrytown Branch 1

Based on the benefit-cost analysis, the chosen solution for Berrytown Branch 1 (Lucas Lane PS) is Inline Storage. The offline and inline storage solution ratios were almost identical, so other values were taken into account such as reduced maintenance costs due to self-flushing pipe (no need to clean). Table 3.3.33 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.33

BERRYTOWN BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_FF_BT_NB01_S_09A_C_A	Inline Storage	Replace 90 LF of 8” pipe upstream of the Lucas Lane PS with a 54” pipe and install an additional 90 LF of 54" pipe parallel to it to provide inline storage. Also, lower the invert of the influent 8” pipe to PS and replace that pipe with a 36" pipe	88.53	112.86
S_FF_BT_NB01_S_09B_C_B	Offline Storage	Construct covered storage facility (0.031 MG)	88.61	90.92
S_FF_BT_NB01_S_03_C_A	PS Upgrades	Upgrade Lucas Lane LS to handle peak flows of 0.23 mgd.	78.51	72.76

Chenoweth Hills Branch 1

Based on the benefit-cost analysis, the chosen solution for Chenoweth Hills Branch 1 (St. Rene Rd. PS) is Inline Storage. Table 3.3.34 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.34

CHENOWETH HILLS BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_FF_CH_NB01_S_09A_C_A	Inline Storage	Replace 42 LF of 8" pipe with 48" pipe just upstream of the St. Rene Rd. PS to provide inline storage.	163.34	212.00
S_FF_CH_NB01_S_01_C_B	Pipe Upgrades	Divert flow that currently flows to the St. Rene Road PS to a new gravity line that will connect to an existing 18" line that flows to the current location of the Chenoweth Run PS, however, eventually it will be taken offline by the Billtown Road Interceptor. Involves 1,291 LF of new gravity sewer.	72.17	88.66
S_FF_CH_NB01_S_01_C_A	Pipe Upgrades	Divert approximately 60% of the flow that currently flows to the St. Rene Road PS to a new gravity line that will take the flow to the Jeffersontown system. This portion of the Jeffersontown system will eventually be diverted to the Cedar Creek WQTC by the Billtown Road interceptor. Involves 605 LF of new gravity sewer.	44.35	56.16
S_FF_CH_NB01_S_03_C_A	PS Upgrades	Upgrade St. Rene Rd. PS to handle peak flows of 0.44 mgd.	42.87	36.13

Hunting Creek North Branch 1

Based on the benefit-cost analysis, the chosen solution for Hunting Creek North Branch 1 (Riding Ridge PS) is Pump Station Upgrades. Table 3.3.35 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.35

HUNTING CREEK NORTH BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HN_NB01_S_03_C_A	PS Upgrades	Upgrade Riding Ridge PS to handle peak flow of 0.075 mgd.	66.40	52.02
S_HC_HN_NB01_S_09A_C_A	Inline Storage	Upsize 131 LF of existing 8" sewer to 12", and lower its slope via a drop manhole at its upstream end.	29.65	37.96
S_HC_HN_NB01_S_03_C_B	Force Main Upgrades	Upsize 1,464 LF of force main at Riding Ridge PS from 2" to 2.5".	24.95	24.12

Hunting Creek North Branch 2

Based on the benefit-cost analysis, the chosen solution for Hunting Creek North Branch 2 (Gunpowder PS) is Inline Storage. This branch is one of the three branches requested to be re-evaluated at the 2.25-inch cloudburst level to ensure the validity of the technology selection approach at the 1.82-inch cloudburst level. Table 3.3.36(A) summarizes the solutions considered for the 1.82-inch cloudburst storm and the benefit-cost ratios associated with each solution. Table 3.3.36(B) summarizes the solutions considered for the 2.25-inch cloudburst storm and the benefit-cost ratios associated with each solution.

TABLE 3.3.36(A)

HUNTING CREEK NORTH BRANCH 2 - 1.82-INCH SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HN_NB02_S_09A_C_B	Inline Storage	Replace 120 LF of 8" with 60" sewer pipe to provide inline storage, 28 LF of additional pipe upgrades required.	61.73	78.71
S_HC_HN_NB02_S_09A_C_A	Inline Storage	Replace 252 LF of 8" with 48" sewer pipe to provide inline storage.	39.75	50.66
S_HC_HN_NB02_S_03_C_A	PS Upgrades	Upgrade both pumps to 155 gpm each, increase wet well to 8 ft diameter, and upsize 3,485 LF of force main to 6" at the Gunpowder PS	8.87	9.09

TABLE 3.3.36(B)

HUNTING CREEK NORTH BRANCH 2 - 2.25-INCH SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HN_NB02_S_09A_B_B	Inline Storage	Replace 120 LF of 8” (east of the lift station) with 60” sewer pipe as well as replace 148 LF of 8” sewer (west of the lift station) with 60” sewer pipe to provide in-line storage.	46.33	59.15
S_HC_HN_NB02_S_03_B_A	PS Upgrades	Upgrade both pumps to 220 gpm each, increase the wet well to 8 feet in diameter and upsize entire force main to 6” at the Gunpowder PS	11.29	11.62

As indicated Table 3.3.36(B), Inline Storage is the preferred alternative independent of level of control.

Hunting Creek North Branch 3

Based on the benefit-cost analysis, the chosen solution for Hunting Creek North Branch 3 (Fox Harbor No. 1 and No. 2 PSs) is Inline Storage. It was chosen based on the present worth benefit-cost ratio to avoid moving the problem downstream. Table 3.3.37 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.37

HUNTING CREEK NORTH BRANCH 3 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HN_NB03_M_09A_C_A	Inline Storage	Upsize 133 LF of 8" pipe upstream and east of the Fox Harbor No. 2 PS with 24" pipe. Upsize 110 LF of 8" pipe upstream of the Fox Harbor No. 1 PS with 18" pipe and lower the upstream invert of the pipe, new drop manhole required.	34.11	43.49
S_HC_HN_NB03_M_03_C_B	Inline Storage & Force Main Upgrades	Upgrade 810 LF of force main at Fox Harbor No. 2 PS to 6", upsize 110 LF of gravity sewer upstream of the Fox Harbor No. 1 PS from 8" to 18" to provide inline storage, lower upstream invert, new drop manhole required.	38.30	39.80

Hunting Creek South Branch 1

The chosen solution for Hunting Creek South Branch 1 (Fairway View PS) is Pump Station Upgrades. While Offline Storage had a higher benefit/cost ratio, pump replacement is a lower capital cost and can be accomplished easily with no underground construction that would disrupt the surrounding neighborhood. This is consistent with the community values of customer satisfaction and economic vitality. Table 3.3.38 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.38

HUNTING CREEK SOUTH BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_HC_HS_NB01_S_03_C_A	PS Upgrades	Upgrade the three pumps at Fairway View PS to 100, 100, and 120 gpm (previously 88 gpm each).	10.71	10.32
S_HC_HS_NB01_S_09A_C_B	Offline Storage	Construct offline covered storage facility (.0075 MG) upstream of Fairway View PS, upsize additional 175 LF of gravity sewer upstream of the PS.	29.69	33.55
S_HC_HS_NB01_S_13_C_A_	PS & Pipe Upgrades	Upgrade the three pumps to 92 gpm (previously 88 gpm each), upsize 152 LF of gravity sewer upstream of PS from 8" to 24", new pipe entrances at a lower elevation drilled into wet well for larger pipe diameters.	10.25	10.20

Hunting Creek South Branch 2

The chosen solution for Hunting Creek South Branch 2 (Deep Creek PS) is Diversion. During the solution optimization process (discussed in Volume 3, Chapter 4) it was discovered that this pump station could be eliminated with 130 linear feet of 8" pipe connecting to the new Harrods Creek Interceptor, analyzed in Branch 4 of the ORFM model. Therefore, the solutions initially analyzed for this branch are no longer warranted and the Deep Creek Pump Station will be addressed with ORFM Branch 4 solutions. Table 3.3.39 summarizes the solutions previously considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.39

HUNTING CREEK SOUTH BRANCH 2 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
See ORFM Branch 4	Diversion	Construct 130 LF of 8" gravity sewer connecting to the new Harrods Creek Interceptor in ORFM Branch 4 to eliminate Deep Creek PS	--	--
S_HC_HS_NB02_S_09A_C_A	Inline Storage	Replace two 8" gravity sewers immediately upstream of the Deep Creek PS with 150 LF of 42" and 170 LF of 30" sewer pipe respectively to provide inline storage.	64.09	80.83
S_HC_HS_NB02_S_13_C_A	PS Upgrades & Inline Storage	Install two new 138 gpm pumps at PS (previously 122 gpm). Replace 150 LF of 8" sewer directly upstream of the PS with 36" pipe to provide inline storage.	22.45	22.75
S_HC_HS_NB02_S_03_C_A	PS Upgrades	Upgrade the Deep Creek PS by installing a 7' diameter wet well and installing new 156 gpm pumps (previously 122 gpm).	7.89	8.79

Lake Forest Branch 1

The chosen solution for Lake Forest Branch 1 (Lake Forest PS) is Monitoring. The Lake Forest Pump Station was upgraded in June 2008. Two new 144 gpm pumps were installed. Table 3.3.40 summarizes the solution chosen for Lake Forest Branch 1.

TABLE 3.3.40

LAKE FOREST BRANCH 1 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_FF_LF_NB01_S_13_C_A	Monitor	Monitor the Lake Forest PS during rain events for the next three years according to SORP protocols.	--	--

3.3.10 Pond Creek Alternatives

Details on branching and SSO descriptions for Pond Creek can be found in Volume 3, Chapter 2, Section 2.5.10. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contains information on the ground truthing procedure.

3.3.10.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized below.

Branch 3

This branch includes SSOs caused by insufficient capacity at the Cooper Chapel Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station and collection system pipe. The storage alternative considered was to construct an off-site storage facility upstream of the pump station. The diversion alternative considered was to construct a sewer line to an alternate system to eliminate the pump station. Ground truthing at the storage location found that 30 percent of the property is in the 100-year floodplain, and a blue line stream runs through the middle of the open field. This site was not suitable for the project.

Branch 4

This branch includes SSOs caused by insufficient capacity at the Cinderella Pump Station to handle upstream flows and limited interceptor capacity downstream. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station and increasing the capacity of the interceptor. The storage alternative considered was to construct a larger wet well at the pump station or a storage facility at the pump station site.

Branch 5

This branch includes SSOs caused by insufficient capacity at the Lantana Drive Pump Station to handle upstream flows. The surrounding area is single-family residential.

The conveyance alternative considered upgrading the pump station. The first storage alternative considered was to construct a larger wet well at the pump station. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Branch 6

This branch includes SSOs caused by insufficient capacity at the Government Center Pump Station to handle upstream flows. The surrounding area is mostly single-family residential with some government-owned property.

The conveyance alternative considered upgrading the pump station. The storage alternative considered was to construct underground storage beneath the parking lot at the Government Center.

Branch 7

This branch includes SSOs caused by insufficient capacity at the Avanti Pump Station to handle upstream flows. The surrounding area is primarily residential with some commercial.

The conveyance alternative considered upgrading the pump station and increasing the capacity in the downstream collector sewer. The storage alternative considered was to construct offline storage near the pump station. The diversion alternative considered was to eliminate the pump station and divert all flow to the Cedar Creek WQTC.

Branch 8 / Branch 11

This branch includes SSOs caused by insufficient capacity at the Lea Ann Way Pump Station to handle upstream flows and limited collector sewer capacity upstream of the pump station. Initially, this branch included the SSO at the Edsel Pump Station which is now included in Branch 11. This SSO is most likely caused by excessive I/I in the upstream collection system. The surrounding area is primarily single-family residential.

The conveyance alternative considered was to upgrade the pump stations. The first storage alternative considered constructing larger wet wells at the pump stations. The second storage alternative considered was to construct large pipe in the vicinity of the SSOs to provide inline storage.

Ground truthing found 60 percent of one property near Edsel Pump Station (Branch 11) is in the 100-year floodplain and a creek runs through the center of the wooded area. A threatened/endangered species assessment was recommended for this location. The location was found unsuitable for the solution.

Branch 9

This branch includes SSOs caused by a hydraulic constriction at the I-65 crossing, limited collector sewer capacity, and insufficient capacity at the Caven Avenue Pump Station to handle upstream flows. The surrounding area is mostly single-family residential with some industrial and commercial properties.

The conveyance alternative considered was to upgrade the Caven Avenue Pump Station and upsize the interceptor under I-65 and down the Outer Loop. The storage alternative considered constructing offline storage facilities in open land near the SSO locations.

Ground truthing for one potential storage location found a potential utility conflict with an electrical line. Ground truthing at the Meijer site found 10 percent of the property is in the 100-year floodplain and creeks border the west and north sides of the wooded area. A threatened/endangered species assessment was recommended for this site. A retention basin is located just west of the property. Ground truthing at another site near a nursing home found five percent of the property is in the 100-year floodplain and a threatened/endangered species assessment was recommended for the wooded area. Fishpool Creek and utilities may create conflicts. The site was found unsuitable due to shallow rock and a force main and sewer line located on the property.

Branch 10

This branch includes an SSO caused by insufficient capacity at the Leven Pump Station to handle upstream flows. This SSO location was not reported as an SSO until mid-2008; therefore, no initial solutions were developed for the locations since they were not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.10.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Pond Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 3

The chosen solution for Pond Creek Branch 3 is Pipe Upgrades. The Charleswood Interceptor Capital Improvement Project specifically eliminates the Cooper Chapel Pump Station. This was the only solution considered at this phase because the project is currently under design. The solution listed in the table is an extension to the Capital Improvement Project due to downstream capacity problems caused by the additional flow. Table 3.3.41 summarizes the solution considered and the benefit-cost ratio associated with the solution.

TABLE 3.3.41

POND CREEK BRANCH 3 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC03_M_01_C	Pipe Upgrades	Upsize additional 1,846 LF of gravity sewer downstream of the Charleswood Interceptor connection to correct capacity problems.	50.30	62.84

Branch 4

The chosen solution for Pond Creek Branch 4 (Cinderella PS) is Diversion. While this does not appear to have the highest benefit/cost ratio, the cost estimates do not reflect the costs likely needed to keep the pump station in service. This pump station is nearly thirty years old and may require continual servicing and upgrades over time. When these costs are fully considered, it is likely that the diversion solution would have the highest benefit/cost ratio. Table 3.3.42 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.42

POND CREEK BRANCH 4 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC04_M_01_C	Diversion	Eliminate Cinderella PS by constructing 2,250 LF of 10" pipe. 208 LF of tunneling under I-265.	17.41	22.14
S_PO_WC_PC04_M_09B_C	Offline Storage	Construct offline covered storage facility at Cinderella PS (0.22 MG).	32.35	32.40
S_PO_WC_PC04_M_0103_C	PS Upgrades	Upgrade pumps at Cinderella PS to 1.5 mgd each (previously 0.5 mgd) and upsize 2,953 LF of force main from 6" to 15". Additional 2,918 LF of sewer improvements required downstream of new force main.	12.94	14.51

Branch 5

The chosen solution for Pond Creek Branch 5 (Lantana PS) is I/I Reduction. This solution was chosen as the recommended alternative due to the small contributing area. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage and Pipe Upgrades. Table 3.3.43 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.43

POND CREEK BRANCH 5 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC05_M_07_C	I/I Reduction	This location will be targeted for I/I source control (I/I Rehab and private property program.)	Cost only for SSES - no benefits calculated.	
S_PO_WC_PC05_M_0109B_C	Offline Storage & Pipe Upgrades	Construct offline covered storage facility at Lantana PS (0.08 MG). Additional 241 LF of sewer improvements (10" - 15") required upstream of PS.	71.21	72.58
S_PO_WC_PC05_M_0103_C	PS & Pipe Upgrades	Upgrade Lantana PS to handle peak flow of 1.45 mgd, upgrade or replace 1,345 LF of 8" force main, 3,770 LF of additional conveyance improvements (10" - 27") required upstream of the PS and downstream of force main.	12.53	14.48
S_PO_WC_PC05_M_09A_C	Inline Storage	Install 667 LF of 60" pipe upstream of Lantana PS to provide inline storage.	5.05	6.49

Branch 6

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 6 (Government Center PS) is Diversion. The cost estimates for Offline Storage and Pump Station Upgrades do not reflect the costs likely needed to keep the pump station in service. When these costs are fully considered, it is likely that these solutions would have even lower benefit/cost ratios. Table 3.3.44 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.44

POND CREEK BRANCH 6 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC06_M_01_C	Diversion	Eliminate Government Center PS by constructing 1,350 LF of 10" pipe.	35.50	44.91
S_PO_WC_PC06_M_0109B_C	Offline Storage & Pipe Upgrades	Construct offline covered storage facility at Government Center PS (0.31 MG). Additional 220 LF of sewer improvements (10" - 12") required upstream of PS.	21.29	22.17
S_PO_WC_PC06_M_0103_C	PS & Pipe Upgrades	Upgrade pumps at Government Center PS to 2.1 mgd each (previously 1 mgd) and upsize 3,107 LF of force main to 10". Additional 3,032 LF of sewer improvements (10" - 12") required downstream of new force main.	15.38	16.70

Branch 7

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 7 (Avanti PS) is Diversion. The cost estimates for Offline Storage and Pump Station Upgrades do not reflect the costs likely needed to keep the pump station in service. When these costs are fully considered, it is likely that these solutions would have even lower benefit/cost ratios. Table 3.3.45 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.45

POND CREEK BRANCH 7 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC07_M_01_C	Diversion	This alternative eliminates Avanti PS by constructing 150 LF of 8" pipe	900.43	1000.48
S_PO_WC_PC07_M_09B_C	Offline Storage	Construct offline covered storage facility at Avanti PS (0.023 MG).	256.76	263.10
S_PO_WC_PC07_M_0103_C	PS & Pipe Upgrades	Upgrade Avanti PS to handle peak flow of 1.8 mgd. Additional 1,886 LF of sewer improvements (10") required downstream of new force main.	16.80	19.52

Branch 8

The chosen solution for Pond Creek Branch 8 is Pipe Upgrades. This was the only solution considered because the pumps at the Lea Ann Way Pump Station are currently being replaced, which will increase the capacity of the pump station to 22 mgd and eliminate the SSO at the Pump Station. The first pump has been replaced and a developer is installing a fourth pump. The second and third pumps were replaced by MSD Operations in September 2008. The Pipe Upgrades solution addresses insufficient pipe capacity in the collection system upstream of the Lea Ann Way Pump Station. Table 3.3.46 summarizes the solution and the benefit-cost ratio associated with that solution.

TABLE 3.3.46

POND CREEK BRANCH 8 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC08_M_01_C	Pipe Upgrades	Upsize 3,255 LF of gravity sewer (12" - 18") upstream of Lea Ann Way PS.	39.74	49.01

Branch 9

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 9 is Offline Storage and Pipe Upgrades. The storage facility behind the Meijer on Preston Highway is necessary to alleviate future predicted overflows caused by upstream IOAP projects. Table 3.3.47 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.47

POND CREEK BRANCH 9 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC09_M_09B_C	Offline Storage & Pipe Upgrades	Construct offline covered storage facility at Caven Avenue PS (0.21 MG) and offline open storage facility behind the Meijer (1.42 MG) on Preston Hwy. Upsize 1,536 LF of sewer to 18" downstream of MH 70212.	6.61	7.08
S_PO_WC_PC09_M_0103_C	PS & Pipe Upgrades	Upsize Caven Avenue PS to handle peak flow of 3.9 mgd and upsize 1,715 LF of force main to 8". Additional 18,242 LF of sewer improvements (8" - 48") required in Okolona area.	3.28	4.06

Branch 10

Based on the benefit-cost analysis, the chosen solution for Pond Creek Branch 10 is Diversion. The cost estimates for Offline Storage, Inline Storage, and Pump Station Upgrades do not reflect the costs likely needed to keep the pump station in service. When these costs are fully considered, it is likely that these solutions would have even lower benefit/cost ratios. Table 3.3.48 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.48

POND CREEK BRANCH 10 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC10_M_01_C	Diversion	Eliminate Leven PS by constructing 890 LF of 10" pipe.	76.88	95.93
S_PO_WC_PC10_M_09B_C	Offline Storage	Construct offline covered storage facility at Leven PS (0.12 MG).	64.21	65.61
S_PO_WC_PC10_M_03_C	PS Upgrades	Upgrade Leven PS to handle peak flow of 3.42 mgd.	42.87	41.44
S_PO_WC_PC10_M_09A_C	Inline Storage	Install 1,084 LF of 48" pipe upstream of Leven PS to provide inline storage.	14.46	18.51

Branch 11

The chosen solution for Pond Creek Branch 11 is I/I Reduction. This solution was chosen as the recommended alternative based on modeling results. An overflow did not occur at this pump station in the existing conditions model at the 1.82-inch, 2.25-inch, or even 2.60-inch cloudburst storm indicating excessive I/I during heavy rain events is likely the problem rather than insufficient capacity at the pump station. If I/I reduction is deemed unsuccessful in eliminating the SSO, the next best alternative is Offline Storage. Table 3.3.49 summarizes the solutions considered and the benefit-cost ratios associated with each solution.

TABLE 3.3.49

POND CREEK BRANCH 11 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_PO_WC_PC11_M_07_C	I/I Reduction	This location is targeted for I/I source control (I/I rehab and private property program).	Cost only for SSES - no benefits calculated.	
S_PO_WC_PC11_M_0109B_C	Offline Storage	Construct offline covered storage facility at Edsel PS (0.09 MG). Additional 457 LF of sewer improvements (10" – 12") required upstream of PS.	58.87	62.63
S_PO_WC_PC11_M_0103_C	PS Upgrades	Upgrade Edsel PS to handle peak flow of 0.7 mgd and upsize 3,468 LF of force main to 10". Additional 925 LF of sewer improvements (10" – 12") required.	9.92	10.49
S_PO_WC_PC11_M_0109A_C	Inline Storage	Install 572 LF of 96" pipe upstream of Edsel PS to provide inline storage. Additional 423 LF of sewer improvements (10" - 12") required.	5.41	6.94

3.3.11 Mill Creek Alternatives

Details on branching and SSO descriptions for Mill Creek can be found in Volume 3, Chapter 2, Section 2.5.11. The initial solution development process is summarized in detail in Sections 3.1.3 and 3.1.3.3 contain information on the ground truthing procedure.

3.3.11.1 Initial Solutions and Feasibility Screening

Initial solutions were investigated before any baseline conditions (i.e. Capital Projects) or RDI/I reduction had been applied; therefore, some preliminary SSOs analyzed in the initial solutions were not considered in the project development phase due to the effects of the baseline conditions or RDI/I reduction. In these cases, the SSO was eliminated by one of the two and therefore is not summarized below.

Branch 1

This branch includes SSOs caused by insufficient capacity at Pioneer, Fern Lea, and Garrs Lane pump stations to handle upstream flow. The landuse in the area is a combination of park, residential, vacant lots, commercial, and industrial. Each pump station location was analyzed separately.

The conveyance alternatives considered pump station upgrades, pump station replacement, pipe upgrades, and pump station eliminations. The storage alternatives considered off-line storage facilities and expansion of pump station wet wells.

Ground truthing was performed at 22 locations in the Shively area. Twelve of the locations had 15 to 100 percent of the property in the 100-year floodplain. All twenty locations were found to

have potential utility conflicts including water lines, gas lines, storm drains, and electrical lines. The pipe upgrade solution could affect many residential properties and landscapes.

Branch 2

This branch includes an SSO caused most likely by surface flooding in the East Rockford Pump Station area during wet weather. This pump station was not reported as an SSO location until mid-2008; therefore, no initial solutions were developed for this location since it was not known at the time of initial solution development. Solutions, however, were developed later during the solution alternative analysis process.

3.3.11.2 Modeled Solutions - Benefit Cost Analysis

The following section summarizes the solution alternative analysis for each of the branches in Mill Creek. Based on ground truthing findings and judgments made during the modeling process, some initial solutions identified in the previous section may not have been evaluated. Section 3.2 provides detail on the solution alternative development and selection process. Appendix 3.3.1 contains the detailed cost sheets, benefit-cost analyses, solution maps, and fact sheets for all modeled solutions.

Branch 1

The Shively Interceptor Capital Improvement Project specifically eliminates five pump stations: Jacks Lane Pump Station, Pioneer Pump Station, Fern Lea Pump Station, Garrs Lane Pump Station, and City Park Pump Station, three of which are documented SSOs. This project is currently in the preliminary design stage. The solution listed below includes the benefit-cost ratio for the entire project. This branch is one of the three branches requested to be re-evaluated at the 2.25-inch cloudburst level to ensure the validity of the technology selection approach at the 1.82-inch cloudburst level. Table 3.3.50(A) summarizes the solutions considered for the 1.82-inch cloudburst storm and the benefit-cost ratios associated with each solution. Table 3.3.50(B) summarizes the solutions considered for the 2.25-inch cloudburst storm and the benefit-cost ratios associated with each solution.

TABLE 3.3.50(A)

MILL CREEK BRANCH 1 - 1.82-INCH SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MC_WC_NB01_M_01_C	Pipe Upgrades	Construct 18,830 LF of new gravity sewers (8" – 18") to eliminate the Jacks Lane, Pioneer, Garrs Lane, Fern Lea, and City Park PSs. This is the Shively Interceptor capital improvement project.	4.11	5.20
S_MC_WC_NB01_M_0109_C	Offline Storage & Pipe Upgrades	Construct new gravity sewers (2,821 LF). Construct seven small offline storage facilities (0.63 MG total) and 3,214 LF of force main.	1.44	1.70

TABLE 3.3.50(B)

MILL CREEK BRANCH 1 – 2.25-INCH SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description	Benefit/ Cost Ratio (Capital Cost)	Benefit/ Cost Ratio (Present Worth)
S_MC_WC_NB01_M_01_B	Pipe Upgrades	Construct 18,830 LF of new gravity sewers (10" – 21") to eliminate the Jacks Lane, Pioneer, Garrs Lane, Fern Lea, and City Park PSs.	5.27	6.68
S_MC_WC_NB01_M_0109_B	Offline Storage & Pipe Upgrades	Construct new gravity sewers (2,821 LF). Construct seven small offline storage facilities (0.74 MG total) and 3,214 LF of force main.	1.41	1.66

As indicated in Table 3.3.50(b), the pipe upgrades accomplished by expanding the Shively Interceptor Project has the highest benefit-cost ratio, independent of level of control. Costs are fairly similar for both technologies at each level of evaluation; however, the benefit scores are significantly lower for the Offline Storage solution due to storage facility construction in residential neighborhoods and lower impact in reducing overflow volumes during larger storm events.

Branch 2

The chosen solution for Mill Creek Branch 2 is Pump Station Replacement and Relocation. No modeling was used to identify this solution. It is the only solution considered for this branch because the problem is due to street surface flooding. Table 3.3.51 summarizes the solution.

TABLE 3.3.51

MILL CREEK BRANCH 2 SOLUTION ALTERNATIVES

Project ID	Solution Technology	Project Description
S_MC_WC_NB02_S_03_C	PS replacement and relocation	Relocate and replace East Rockford PS at 300 gpm. 150 LF of 4" force main will be replaced. Additional 150 LF of 10" gravity improvements required to relocate PS.