INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
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Michael R. Pence
Governor

Thomas W. Easterly
Commissioner

October 9, 2014

VIA ELECTRONIC MAIL

The Honorable Duke Bennett, Mayor
City of Terre Haute
17 Harding Avenue
Terre Haute, Indiana 47807

Dear Mayor Bennett:

Re: Long Term Control Plan Amendment Review
City of Terre Haute
NPDES Permit No. IN0025607
State Judicial Order No. 84D02-0809-CC-11402
Vigo County

The Indiana Department of Environmental Management (IDEM) Office of Water Quality (OWQ) has conducted a substantive review of the City of Terre Haute's Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) Amendment originally submitted January 22, 2014, with the final revision submitted September 18, 2014. The original LTCP was approved on August 10, 2011.

The LTCP Amendment proposes the following changes from the originally approved LTCP:

- The International Paper (IP) lagoons were originally intended to be utilized for CSO storage. Due to existing conditions of the lagoons, the IP site will now be used as the location for a high rate treatment facility with UV disinfection. The high rate treatment facility will be constructed in two phases, a 16.25 MGD unit in Phase I and a second unit of identical capacity in Phase II. The total capacity of the high rate treatment facility will be 32.5 MGD.

- The sewer consolidation of CSOs 009/010 was originally intended to be constructed along First Street. Due to recent developments by Indiana State University, an alternate connection route was identified and will now be constructed along Fourth Street.

- The scheduled construction of the floatable/in-line storage control structure for CSOs 004/011 is indeterminate at this time due to contamination at the construction site. The LTCP implementation schedule will be updated once the site is cleared for construction activities to occur.

The proposed LTCP Amendment does not change the level of control or overall schedule length approved in the original LTCP. Based on the information provided, IDEM has determined that the plan is acceptable and approves the City of Terre Haute's LTCP Amendment. In accordance with the 'Compliance and Implementation of the Approved Long Term Control Plan' section of State Judicial Agreement (SJA) Number 84D02-0809-CC-11402, an amendment to the SJA is not necessary. The revised LTCP shall supersede the schedule contained in the previously approved LTCP, and the City shall implement the revised LTCP in accordance with the schedule in the approved LTCP Amendment.

Please contact Kara Wendholt at 317-233-5961 or by e-mail at kwendhol@idem.in.gov if you have any questions regarding this letter.

Sincerely,

Paul Higginbotham, Chief
Permits Branch
Office of Water Quality

cc: Mark Stanifer, OWQ Inspections
Mark Thompson, Wastewater Utility Director
Chuck Ennis, P.E., City Engineer
Eric Smith, P.E., HWC Engineering
Jeremy Burch, P.E., HWC Engineering

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Executive Summary

Introduction

The City of Terre Haute has developed a Combined Sewer Overflow Long-Term Control Plan (CSO LTCP), which describes the measures they will take to reduce the combined sewer overflows and improve water quality in the Wabash River in the City of Terre Haute. The LTCP will be reviewed by the Indiana Department of Environmental Management (IDEM) and once approved will be incorporated into a new National Pollution Discharge Elimination System (NPDES) permit.

Currently *ten* combined sewer overflows are active in the Terre Haute area and 100% of those outfalls discharge into the Wabash River. Flow, water quality and rainfall data was collected and both the combined sewer system and the Wabash River in the CSO areas was modeled to assist in the planning process. No areas were qualified as "sensitive areas" but the outfalls around Fairbanks Park were to be given priority. A CSO LTCP is recommended to reduce the number of CSO events per year (average year) from 37 to 7 times per year, which will reduce the number of hours when bacteria loadings from the CSO's exceed recommended levels in the river by 75%, from 174 hours to 45 hours at the wastewater treatment plant.

Many regulatory requirements were considered in the City of Terre Haute's LTCP. Both Federal and State CSO policies are divided into two phases. Phase I (CSO Operational Plan) was submitted to IDEM and approved by IDEM in 2006. Phase II represents the submittal of this document. All of the regulatory requirements are intended to reduce the in-stream impact from CSO discharges during wet conditions and ultimately make the Wabash River more "fishable and swimmable" (CWA, 1972).

The City of Terre Haute's LTCP was developed with IDEM's assistance. Several key issues specific to Terre Haute were evaluated as described in Section 1.3. The project team consisted of two separate groups. The first group included engineering and financial consultants; the second group was a technical review committee which included members of the City Engineering and WWTP Staff.

The groups worked together to establish project goals specific to the City of Terre Haute. The work was carried out over two year period and a plan was completed and submitted to IDEM by the deadline. All of the key decision-making involved input from members of the team. Revisions to the plan based on the results of "basis of design" studies for Phase I projects were completed and submitted to IDEM in December 2013. These revisions are incorporated within this document.

Existing Conditions

The City of Terre Haute's combined sewer system has approximately 5,100 acres that discharge through 10 combined sewer overflow points along the Wabash River. The most upstream combined sewer overflow (CSO) discharge point is at River Mile 215 and the wastewater treatment plant discharge is at River Mile 210. Figure ES-1 shows the location of the CSOs and the boundary of the combined sewer area.

The interceptor sewer collects the dry weather flow and a portion of the wet weather flows from each CSO and conveys it to the 48 MGD main lift station. The main lift station (which has an emergency overflow at 002) pumps the flow to the wastewater treatment plant that has an existing primary treatment and disinfection peak flow capacity of 48 MGD and a secondary treatment peak flow capacity of 36 MGD, although only a flow of 31 MGD can be currently sustained through the plant due to a series of hydraulic bottlenecks that limit the process performance at high flows. These bottlenecks limit the ability to transmit greater flow volumes from the combined sewer area and results in more combined sewer overflows of greater duration and flow volume. Improvements to the plant to increase capacities are discussed in Section 6 and are scheduled for completion in early 2015.

In an average year, a continuous simulation of the collection system model simulates that 284 million gallons of combined sewage is discharged from these CSOs. Terre Haute is fortunate in that the receiving stream has a large average flow rate relative to the volume of CSO overflow, which can provide significant assimilative capacity. Despite this fact, simulations indicate that in an average year, the Wabash River exceeds the water quality standards for *E. coli* approximately 30% of the time during the recreation season (April-October) when bacteria loads from all pollutant sources are considered and less than 5% of the time if non-CSO sources effects are eliminated.

Terre Haute has an important public park, Fairbanks Park, located in the center of the city that has a boat launch. There are 4 CSOs that discharge in the park. Special attention was given to these particular CSOs (005, 006, 007 and 008).

Consideration of Sensitive Areas

Both IDEM and EPA guidelines require determination of any "sensitive areas" within the CSO outfall areas and farther downstream. Any areas deemed sensitive would be given the highest priority for CSO reduction, elimination or control.

The sensitive areas were evaluated based on several criteria including: Habitats for Threatened or Endangered Wildlife, Primary Contact Recreational Areas, Drinking Water Sources and Outstanding State Resource Waters or Outstanding Natural Resource Waters. None of the areas within the CSO outfalls or downstream were found to be "sensitive" areas. The Citizens Action Committee did prioritize the areas around Fairbanks Park for the LTCP.

Evaluation of Alternatives (2011)

A variety of CSO capture alternatives were considered in the LTCP submitted to IDEM in 2011, including:

- No Action
- System-wide Separation
- Storage (inline, tanks, earthen, tunnel)
- Conveyance (open cut gravity sewer, tunnel)
- High Rate Treatment

One additional alternative evaluated was a CSO tunnel (approximately 40 feet deep) connecting all of the CSO outfalls to a new main lift station and utilization of the IP site (approximately 30 MG) for storage. The other final alternatives for parts of the system included construction of a large diameter open cut gravity interceptor from Fairbanks Park (consolidating and closing all of the outfalls within the park) and using the IP site for storage of CSO flows. One of the comprehensive alternatives included consolidation of the northern two CSO outfalls and storage and a new main lift station to replace the City's existing aging lift station (which would eliminate outfall 002). This alternative also suggested the use of green infrastructure within the basins 009 and 010 to capture flow before entering the combined system.

These technologies were screened and then evaluated with consideration for initial costs, annual operation and maintenance costs, ease of implementation, environmental impacts, primary and secondary impacts and local affordability. Two factors weighed into consideration for three final alternatives that were evaluated in greater detail. The first factor was the purchase of the International Paper site by the City of Terre Haute and which includes several large earthen ponds located adjacent to the City's main combined sewer pumping station in 2010. The second factor was the City's decision to significantly increase the peak, sustained wet weather treatment capacity at the WWTF from 30 to 36 MGD up to 48 MGD. These two developments were used in consideration of the final alternatives set aside for detailed evaluation.

The alternatives were evaluated independently and combined in various manners to develop three comprehensive alternative plans for the system as described in detail in Sections 6 and 7.

Re-Evaluation of Alternatives (2014)

The City began implementation of its Phase I projects recommended in the approved LTCP in August 2012. The three major projects included in the Phase I recommended plan (excluding smaller common alternative projects) included:

Project 1-1: Floatable Control and In-Line Storage Structure at CSO 004/011 (Hulman/Idaho Street Combined Sewers)

Project 1-2: Floatable Control Structure at CSO 009/010 (Chestnut/Spruce Street Combined Sewers)

Project 1-3: Rehabilitation of Lagoons at Former IP Site for CSO Storage and Additional Main Lift Station Force Main

Prior to design, the City contracted with consultants to develop a basis of design (BOD) report for each project. Each BOD report evaluated the suitability of different technologies through preliminary engineering design and offered more specific design recommendations for each project.

In the BOD report for Project 1-3, the consultant identified three major issues with the recommended alternative of using the former IP site for CSO storage, all of which increased costs from estimates included in the previously approved plan. The three major issues, among others, are described as follows:

1) The existing soil conditions were discovered to be worse than originally thought after the removal of all sludge;
2) The hydrostatic pressure from the Wabash River during a 100-year flood event coupled with soil conditions dictates a far more robust (e.g. concrete) liner system; and

3) The existing lagoon berm elevations were discovered to be approximately 2-feet lower than the established 100-year Flood Elevations. (The previous Agreed Order compliance by the former owner indicated the berms were elevated to the 100-year flood level.)

For these reasons, it was recommended a concrete lined basin be considered in lieu of the previously approved HDPE-lined alternative. It was further recommended that supplemental mixing/aeration be provided as well as a means to clean the basin following draining. These additional requirements increased the cost of the originally recommended storage alternative by approximately $10.9 million.

The consultant then developed additional high rate treatment alternatives to be used either in lieu of the storage option at the former IP site, or in conjuction with storage at the former IP site. In the Project 1-3 BOD, construction costs of the new high rate treatment alternative were compared to the revised construction costs of the IP lagoon storage alternative, resulting in a 40% construction cost savings. However, when the construction costs for the new high rate treatment facility were incorporated into the new recommended plan, it resulted in a 3% overall increase in the total project cost over the initial estimate.

Section 10, including the final LTCP recommended plan, are revised to reflect the alternative re-evaluation and adjustments to the scope cost and schedule of the recommended plan.

Public Participation

Public Participation is an IDEM requirement for completing the City of Terre Haute CSO LTCP. The public was involved in many ways including both City government officials and private citizens. Several City government divisions including the City Council, the Board of Public Works and Safety, the Terre Haute Sanitary District Board of Commissioners and the Terre Haute Wastewater Treatment Plant were brought into the LTCP. The 2014 revisions to the LTCP were presented to the public at a Terre Haute Sanitary District board meeting. Meeting minutes issued by the Sanitary District Board are included in Appendix 6-6.

Perhaps the most important public participation came from the Citizen's Advisory Committee (CAC). A series of meetings were held with the CAC over a 10 year period to explain the process of determining alternatives for control and to garner input throughout the project.

Public Education was handled through various means. The CAC helped to educate the public at its meetings and through various meetings its members attended. A brochure outlining Terre Haute's plans was distributed and several newspaper articles were published in the local newspaper. Warning signs were installed at all of the outfall structures to provide information about potential health risks associated with structure overflows. A website was created to educate the public on the issues that CSOs cause and what the City is doing to rectify the problems associated with them.

A community notification program will be required by IDEM. This typically involves additional signage in prominent areas of the Wabash River and also notification if an overflow event is occurring or will occur within 24 hours. All notifications would be documented and submitted to IDEM.

The current volume of CSO discharges impairs the water quality in the Wabash River during CSO events and for several days afterwards. The recommended plan for the LTCP can be developed and implemented in phases and each phase will act to reduce the CSO volumes discharged to the Wabash River to some degree. The results of each phase will be monitored and those results will be used in the design and implementation of the future phases.

Financial Capability Assessment and Implementation Schedule

Funding of a LTCP is perhaps the greatest challenge in developing the plan. The goal in funding is to determine the level of control that the community can provide without causing undue hardship on the City or on the individual households within the community. The guidelines consider the ability to contribute financially of both residents, and the City, to help determine the schedule implementation length for the plan. The recommended plan is not the most or least expensive of the three final alternatives considered for implementation.

Recommended Plan (2011)

After reviewing the environmental performance, cost-effectiveness and affordability, operability, reliability, and constructability, a recommended plan was developed that reduces CSO volume discharging to the river by 72%, results in 96% capture of wet weather flow, eliminates the CSOs in Fairbanks Park and results in no more than seven overflows in a typical year at the remaining CSOs. The recommended plan will utilize a combination of greater wet weather treatment capacity at the City's wastewater treatment facility, a large CSO storage facility at the former International Paper (IP) Brownfield site, a new main pump station to replace the existing facility constructed in 1965, a new large diameter CSO gravity sewer interceptor along the Wabash River between Fairbanks Park and the new main lift station and either "gray" or "green" CSO storage facilities at the north end of the CSO system. Eight of the ten existing CSO outfalls will be closed off completely. The recommended plan is shown in Figure ES-2. The estimated cost of the recommended plan is $120 million and the recommended implementation schedule for the plan is 25 years.

Revised Recommended Plan (2014)

In lieu of the previously recommended plan's intention to utilize an existing lagoon at the former IP Brownfieldsite for CSO storage, it is now recommended the City construct a high-rate clarification with UV disinfection satellite treatment facility at this site and the lagoons will be used for recreation and stormwater detention only. All other aspects of the previously recommended plan, with the exception of minor revisions to the consolidation of CSO 009 into 010, are to remain the same. The revised estimated cost of the new recommended plan is $124 million and the recommended implementation schedule remains 25 years.

Compliance Monitoring Plan

A post-construction monitoring program will be implemented upon approval of the LTCP and submitted to IDEM prior to implementation of the LTCP. The program will measure reduction of combined sewer overflows and improvements to river quality. The City will conduct periodic reviews, not less than every five years after approval of the LTCP, to determine if the CSO control goals are being met. CSO control will be modified to meet the goals.

1 Section One – Purpose and Intent of CSO LTCP

1.1 Project Overview

1.1.1 Background Information

The City of Terre Haute has completed this Combined Sewer Overflow Long-Term Control Plan (CSO LTCP) document in accordance with previous and updated regulatory requirements described in Section 1.2. The CSO LTCP describes the control measures that would reduce the frequency and volume of combined sewer overflows and improve water quality all of which were evaluated and selected by the City of Terre Haute during the LTCP development.

This CSO LTCP is subject to review by the Indiana Department of Environmental Management (IDEM) and the United States Environmental Protection Agency (USEPA). The recommended improvements and implementation schedule will eventually be incorporated into a new National Pollutant Discharge Elimination System (NPDES) permit that will be issued to the City after the approval of the plan by IDEM. This section provides information about the regulatory requirements that the City and its technical team considered during the planning effort and which must be satisfied as well as the project approach utilized in the development of the CSO LTCP.

1.2 Regulatory Requirements

1.2.1 Water Quality Standards

The Indiana Water Pollution Control Board has established water quality standards for Indiana waterways. These standards, which have been approved by the federal government, serve as the legal basis for permit requirements under the 1972 Federal Clean Water Act (CWA). Water quality standards include "uses" designated by the state for each water body. Uses for a water body might include recreation, public water supply, industrial use, and irrigation. Water quality standards include pollution criteria to protect those uses and other policies designed to protect water quality. All Indiana waters are designated for aquatic life and full body contact recreation (often referred to as "fishable and swimmable").

To meet the full body recreation standard, the maximum concentration of bacteria allowed in Indiana waters is 235 colonies E coli/100 ml. of water. There is an allowance for up to 10% of samples to exceed this standard as described in 327 IAC 2-1-6(d). This standard will likely be exceeded with any CSO discharge or with storm water runoff in urban and suburban areas. The State also has a 30-day geometric mean criterion of 125 cfu/100 ml but because CSO discharges are intermittent, this standard is not as restrictive as the "single sample maximum" criterion of 235 cfu/100 ml. The State has numeric criteria for other parameters and these were used with existing data to determine the pollutants of concern in the City's CSOs (see Section 2).

1.2.2 NPDES Permit Requirements

The U.S. Environmental Protection Agency (EPA) issued a National Combined Sewer Overflow Control Strategy in 1989 (EPA, 1989). This Strategy reaffirmed that CSOs are point source discharges subject to National Pollutant Discharge Elimination System (NPDES) permit requirements. This Strategy was expanded and updated, resulting in the National CSO Control Policy published in 1994 (EPA, 1994). The Indiana Department of Environmental Management (IDEM) adopted the State's Combined Sewer Overflow Strategy in 1996, based on the National CSO Strategy and Policy (IDEM, 1996). These three documents comprise the backbone for the site-specific NPDES permit requirements for Combined Sewer Systems (CSS) in the State of Indiana.

The Federal and State CSO policies are divided into two phases. Phase I focuses on implementation of technology-based requirements referred to as the Nine Minimum Controls (NMCs). The NMCs were developed to provide low-cost measures that could be implemented to reduce the magnitude, frequency and duration of CSOs. The City of Terre Haute satisfied this requirement with the development and submission of the CSO Operational Plan to IDEM. This document was last updated in 2006. Section 11 of this report will explain the necessary changes to the CSO Operational Plan as a result of the acceptance and implementation of this CSO LTCP.

Phase II of the federal and state CSO policies focus on meeting water quality based standards if the Phase I actions were found to be inadequate. The CSO control policies emphasize four key principles to ensure that CSO controls are cost-effective and meet the requirements of the CWA described as follows:

- Provide clear levels of control that would meet appropriate health and environmental objectives.

- Provide sufficient flexibility to municipalities, especially those that are financially disadvantaged, to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements.

- Allow a phased approach for implementation of CSO controls considering a community's financial capability.

- Review and revise, as appropriate, water quality standards and their implementation procedures when developing long-term CSO control plans to reflect the site-specific wet weather impacts of CSOs.

1.2.3 City of Terre Haute NPDES Permit

CSOs are point source discharges and are subject to NPDES permit requirements. They are not subject to "limits based" parameters or secondary treatment requirements that are applicable to POTWs (EPA). The City of Terre Haute was issued its Phase II requirements in its NPDES permit in March of 1999. "Attachment A" of this permit outlines the Phase II requirements. The current NPDES permit is provided in Appendix 1-1. By permit requirements, Terre Haute was required to prepare a Stream Reach Characterization and Evaluation Report (SRCER) and a Long-Term Control Plan (LTCP).

The SRCER is intended to establish a "baseline" condition of the water quality of the receiving streams after implementation of the NMCs, prior to the implementation of any long-term control measures. Within the SRCER, it is to be determined if the currently permitted CSOs impact the receiving stream segments in Terre Haute. The City submitted its SRCER to IDEM in October of 2000.

The LTCP is to include the following minimum elements as defined by EPA's CSO Control Policy:

1. Characterization, Monitoring, and Modeling of the CSS;
2. Consideration of Sensitive Areas;
3. Evaluation of Alternatives;
4. Cost/Performance Considerations;

5. Revising the CSO Operational Plan;
6. Maximizing Treatment at the WWTP;
7. Use Attainability Analysis (if applicable)
8. Development of an Implementation Schedule;
9. Development of a Post Construction Compliance Monitoring Program; and
10. Public Participation.

These elements can be modified to meet Terre Haute's unique conditions. The permit requires that the City meet with IDEM early and frequently through the study to coordinate the development of the LTCP. At these meetings, IDEM and the City should agree on the data, information, and analysis needed to support the development of the LTCP. The City met with IDEM early in the LTCP development to discuss the project approach and then later in the project at milestone stages to discuss project status and findings. The permit also requires the LTCP to assess the City's financial capability to implement CSO controls to meet water quality standards.

Lastly, the permit requires the LTCP to include monitoring and modeling activities to characterize the impact of CSOs on each stream, and targets environmentally sensitive areas. The plan incorporates community input in identifying priority areas and selecting the long-term CSO controls.

Terre Haute's original and revised LTCP incorporates all of the above requirements.

1.2.4 Senate Bill 431 and LTCP Guidance

Senate Enrolled Act 431 (SEA 431), signed by Governor Frank O'Bannon in March of 2000, established the circumstances under which a long-term control plan meets the state's water quality goals for wet weather overflows. As codified in IC 13-18-3-2.3, the law requires that a long-term control plan fulfills the water quality goals of the state if:

- The plan provides for the implementation of cost-effective control alternatives that will attain water quality standards or maximize the extent to which water quality standards will be attained if they are not otherwise attainable;

- The plan provides, at a minimum, for the capture for treatment of the sewer system's "first flush," which carries solids that have settled in pipes between wet weather events or that have washed off of streets and parking lots at the beginning of a storm;
- The plan is reviewed periodically; and
- Additional, cost-effective controls are implemented as necessary, pursuant to the reviewed and updated plan.

SEA 431 required IDEM to provide guidance to explain the requirements of the use attainability analysis and the LTCP. IDEM released this guidance in September of 2001. SEA 431, EPA and IDEM policies and guidance require an evaluation of a reasonable range of control alternatives for various levels of controls (design storms). Cost-effectiveness are to be used as a guide for consideration of the controls. Sensitive areas and financial capability are also to be included in the evaluation of alternatives.

The appropriate level of CSO control must be defined based on water quality data, system performance modeling, and economic factors. These factors may support the revision of existing water quality standards.

SEA 431 requires municipalities to maximize treatment of wet weather flows at the treatment plant as part of the LTCP. Maximizing the use of existing wastewater treatment facilities to treat wet weather flow is a cost-effective way to reduce the magnitude, frequency, and duration of CSOs, which flow untreated into receiving waters. The municipality must submit documentation in the LTCP demonstrating a diligent effort to evaluate alternatives for increasing flow to the POTW.

1.2.5 Updated IDEM Policy Requirements (Current Standards - 2006)

Current IDEM and EPA policy requirements include some previous regulatory requirements along with newer directives as summarized below. A range of alternatives should be developed including "No Action", complete elimination of all CSO impacts and a range of alternatives at varying numbers of overflow events per year. The alternatives are developed for a "typical year" of rainfall for the City of Terre Haute.

IDEM has approved the "typical year" of rainfall. They have also approved the design storm of 1.56 inches of rain in 17 hours. This is the equivalent of an event which would result in on average, 4 overflows per year per outfall.

Alternatives eliminating all overflows are deemed unaffordable considering other wastewater utility needs. However, several options and alternatives were evaluated and will be explained further in this document.

If total elimination of CSO impacts is considered to cause widespread economic and social hardship, the community must determine the point at which implementation of CSO controls would no longer cause widespread impacts (See Section 8). If water quality standards are not able to be met, the community can apply for relief of standards through the Use Attainability Analysis as described in the following section (See Section 9).

1.2.6 Use Attainability Analysis

A Use Attainability Analysis (UAA) is a structured scientific assessment of the factors affecting the attainment of uses that are specified in Section 101(a)(2) of the Clean Water Act. IDEM recognizes that in many instances, a community will not be able to afford the total elimination of all impacts from CSOs. They recommend that if a community cannot afford to eliminate all of its CSOs, or demonstrate CSO control at regulatory accepted level, then that community should conduct a UAA. This UAA should demonstrate that attaining the use is not feasible due to one or more of the following six factors listed in 40 C.F.R. § 131.10 (g):

(1) Naturally occurring pollutant concentrations prevent the attainment of the use

(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met

(3) Human caused conditions or sources of pollution prevention cannot be remedied or would cause more environmental damage to correct than to leave in place

(4) Dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in attainment of the use

(5) Physical conditions related to the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses

(6) Controls more stringent than those required by sections 301 (b) and 306 of the Act would result in substantial and widespread economic and social impact.

1.3 Project Approach

In accordance with the NPDES Permit, Attachment A, Terre Haute met with IDEM in May 2001, early in the development of the original LTCP with IDEM, to present the project approach. IDEM was given the Project Plan and Sampling and Flow Monitoring Work Plan documents at the meeting.

The initial approach used to evaluate CSO long-term control alternatives is described as follows:

- Select a design storm at the anticipated knee-of-the-curve for the evaluation of alternatives. Storm E (0.818 inches) was selected as the design storm. (The percent capture for Storm E level of control was approximately 83%.)
- Identify feasible CSO control technologies that are specific to Terre Haute.
- Develop three integrated CSO control alternatives to capture and treat a Storm E level of control. Each alternative included feasible CSO control technologies specific to each CSO, and other technologies identified by the City and the Citizen Advisory Committee (CAC) that would satisfy infrastructure needs and would reduce CSO impacts on the Wabash River.
- Develop the three integrated alternatives for Storms D, F, and G level of control. The cost and performance for Storm D, E, F and G were estimated to develop the cost/performance knee-of-the-curve.
- Develop options that are common to each alternative, which addressed CAC's comments on priority areas. The options reduce CSO discharges at priority sites, but do not reduce the total overflow volume to the river.
- Estimate the cost performance for complete sewer separation.

Due to the fact that IDEM never reviewed or approved the originally submitted plan, the City of Terre Haute decided to amend their project approach based on revised IDEM and EPA policy. Accordingly, the City and its consultants revised the plan to include measures to satisfy the updated IDEM policy requirements. The final revised project approach used to evaluate CSO long-term control alternatives is described as follows:

- Identify feasible CSO control technologies.
- Based on new collection system flow and rainfall data monitoring, calibrate and develop a SWMM model for evaluation of CSO system reaction to storm events and control alternatives
- Develop integrated CSO control alternatives to capture and treat typical year rainfall at various levels of control. Each alternative included feasible CSO control technologies specific to each CSO or combinations of CSOs, and other technologies identified by the City and the Citizen Advisory Committee (CAC) that would reduce CSO impacts on the Wabash River.
- Estimate the cost for each feasible CSO alternative and also for complete sewer separation.
- Evaluate each CSO alternative's performance using a "typical year" rainfall approach and calculate the associated costs.
- Perform an economic affordability evaluation and determine if a Use Attainability Analysis (UAA) will be performed

1.3.1 Project Team

The Terre Haute CSO LTCP team consisted of two groups:

- Consultants
- Technical Review Team

The primary project engineering consultant was Hannum, Wagle & Cline Engineering. The river modeling work was completed by Limno-Tech, Incorporated of Ann Arbor, Michigan, and the financial capabilities analysis and user rate work was performed by H.J. Umbaugh & Associates. Fred Andes of Barnes and Thornburg served as special legal counsel and advisor to the team.

The second group was the technical review team, which consisted of members of the City Wastewater Treatment Plant Staff, the City Engineering Staff and the Consultants.

A third group involved in the project was the Citizens Advisory Committee appointed by Mayor Duke Bennett. This group met five times during the CSO LTCP process and provided public review during the development of a recommended plan.

A the fourth part of the team included the City government groups (City Council, Board of Works and Sanitary District) that approved the recommended plan or will be responsible for adopting measures necessary for LTCP implementation.

The Citizens Advisory Committee and City Government Groups are described in more detail in Section 5 – "Public Participation".

1.3.2 Project Goals

As the CSO LTCP process evolved, goals varied and were subsequently modified. The following general goals were originally established for the City of Terre Haute at the onset of the original plan:

1. Meet the IDEM requirements of the LTCP guidance and Senate Bill 431 and CSO related NPDES permit requirements.
2. Develop and select an alternative that meets the "first flush" capture criteria and the knee of the curve.
3. Add in options that eliminate overflows in the priority areas by re-routing the overflows downstream of the park.
4. Upgrade combined sewer overflow related transport and treatment facilities that are in significant need of upgrade regardless of which alternative and/or option is selected.
5. Select a plan that can be implemented in phases over a reasonable period of time.
6. Minimize the impact of implementing the selected plan on the sewer rates for the Terre Haute citizens, commercial and industrial community.

After the initial review of the plan by IDEM and the updated plan requirements for design storms were implemented, the following goals supplemented the original goals:

1. Meet the IDEM requirements of the LTCP guidance, Senate Bill 431, updated IDEM policy requirements and CSO related NPDES permit requirements and revise the plan as required by IDEM'S review and/or comments of the initial plan
2. Explore additional options that eliminate overflows in the priority areas at the first flush design event by selecting alternatives which address effects of overflows on these areas.
3. Select a plan that can be implemented in phases over a reasonable period of time.

4. Minimize the impact of implementing the selected plan on the sewer rates for the Terre Haute community taking into account CSO control and other utility needs.

1.3.3 Project Work Plan

Based on the project goals, the original project work plan consisted of the following activities, shown in their order of sequence:

- Collect data on the physical characteristics of the CSO system, Wabash River and the Wastewater Treatment Plant (WWTP).
- Capture water quality and quantity data by use of flow meters, rain gauges and a field sampling/testing data.
- Develop design storms based upon historical storm events.
- Model the CSO system and WWTP performance at the various design storm events and calibrate the model based on actual field data.
- Using the calibrated sewer system model, develop anticipated overflow volumes and durations for the design storm events. In the case of Terre Haute, the uncaptured overflow volume at the knee of the curve was approximately four million gallons, a small volume when compared to other CSO communities of similar size.
- Develop alternatives (three minimum) that utilize acceptable technologies to capture and treat combined sewer overflows to a design storm.
- Develop options to supplement the CSO control alternatives that re-locate the overflows of two, three or all four of the active CSO's in the Fairbanks Park area to a point downstream of this priority area.
- Develop and calibrate the river model to estimate the reduction in water quality impacts that will occur as a result of implementing CSO improvements at the various design storms.
- Develop a capital cost and operation, maintenance and replacement (O, M & R) costs for the alternatives at the various design storms.

- Utilizing the river model data and cost estimates develop a curve that indicates water quality improvements as they relate to capital and O, M & R cost improvements. Select the "knee" of this curve and determine if this point meets the IDEM CSO volume reduction guidelines.
- Determine if the total estimated project costs and O,M & R costs on a Present Worth Basis at the knee of the curve exceed or fall below the 2% equivalent affordable cost described in IDEM's guidance.
- Determine the reasonable CSO project implementation timeline based upon the estimated City financial capability index, IDEM standards and project team input.
- Develop a schedule that divides the recommended improvements into phases over the implementation timeline.
- Determine anticipated sewer rate increases for the typical homeowner in Terre Haute utilizing various financing options. As with the phasing of the Capital Cost Improvements and O, M & R increases, develop a plan to phase in the needed sewer rate increases over the implementation period.

The original work plan was implemented over an 11-month period while the study was being completed. Numerous meetings, conference calls, updating reports and draft review documents were developed and distributed among this Technical Review Group, Citizens Advisory Committee and City Government Groups by the Consultant Team throughout the process. All key decisions involved input from all parties of the team.

Over the past several years (primarily after 2006), the City of Terre Haute has completed additional research and modeling in order to revise and improve the original CSO LTCP. Additional system characterization data has been collected, hydraulic and water quality models were enhanced, a detailed evaluation of the initial alternatives was conducted resulting in the formulation of new alternatives for consideration, and consideration was given to changes in Indiana Water Quality Standards. After the initial review by IDEM, the work plan was modified to include the following:

- By means of new flow monitoring and a Storm Water Management Model (SWMM), develop anticipated overflow volumes and durations for the design storm events and calibrate the SWMM model based upon real time monitored data

- Conduct SWMM Model and River Model evaluation of screened alternatives at various levels of control
- Develop alternatives that utilize acceptable technologies to capture and eventually treat the typical year storm volumes.
- Develop capital and annual operating, maintenance, and replacement costs for the alternatives at the typical year rainfall.
- Determine if the total estimated project costs exceed the affordability limits.
- Determine, based on affordability, whether a UAA will be necessary, and if so, complete the UAA concurrent with the LTCP.
- Determine the reasonable CSO project implementation timeline based upon the calculated City financial capability index, IDEM standards and project team input.

2 Section Two – Current Conditions

2.1 Introduction

Understanding the current baseline condition of the collection system and local waterways provides a basis for understanding sources of pollution and for comparing the benefits of potential CSO controls. This section describes the current capacity and condition of the existing wastewater collection system, including the combined sewer system (CSS), and the wastewater treatment plant (WWTP). This chapter also discusses the current water quality in the Wabash River and the impacts of the City's CSOs on the river based on available data collected since 1991. These data indicate that *E. coli* is the only pollutant of concern.

The City submitted a Stream Reach Characterization and Evaluation Report (SRCER) in 1999 as part of the development of its first Long Term Control Plan (LTCP) that described current river quality conditions. This section summarizes the SRCER's conclusions and updates the information presented in the SRCER by extending the data analyses through 2009 and includes activities that have been conducted since the first SRCER was submitted. For example, the City conducted flow monitoring in the combined collection system in 2005 to better characterize the system and to have a robust dataset for calibrating and validating the CSS model (discussed in Section 3). The City also conducted an extensive Wet Weather Sampling Program in 2007 to characterize water quality in the Wabash River during periods when their CSOs are actively discharging to use in calibrating and validating their detailed river model (presented in Section 4). These datasets serve as a baseline for comparing the benefits of potential CSO controls.

The following sections describe the current conditions of major elements of the combined sewer system in and around the City of Terre Haute.

2.2 Wabash River Watershed

Thirty miles after its starting point in Grand Lake, Ohio, the Wabash River enters Indiana, where it drains two-thirds of Indiana's 92 counties. It flows over 475 miles before it enters the Ohio River below Mount Vernon, Indiana and is the longest free-flowing river east of the Mississippi River (Figure 2.2-1). The total Wabash River watershed is 32,959 square miles with numerous streams and creeks flowing into the river. Much of Indiana's farmland drains into the Wabash River (www.indianaoutfitters.com).

Throughout the Wabash River Watershed, the major land uses are agriculture and urbanization (commercial, industrial, and residential land areas). Several cities have grown along the banks of the Wabash River, including Vincennes, Terre Haute, Lafayette, and Logansport. Major tributaries to the Wabash River include major population centers of Kokomo (Wildcat Creek), and Marion (Mississinewa River) as well as Indianapolis, Anderson, and Muncie (White River). The total population for the Wabash River Watershed is approximately 1,250,000 (U.S. Census Bureau, 2010). This total does not include the population along the White River, which drains into the Wabash River in the lower portion of its watershed.

Most of the Wabash River basin lies in the geologic area known as the Tipton Till Plain. This area, characterized by flat to gently rolling surfaces, till (a mixture of sand, silt, clay, and boulders), and covered bedrock, comprises the landscape for a large portion of the Upper Wabash River watershed. A small portion of the Upper Wabash River watershed lies in the Northern Moraine and Lake Region, which is mainly hilly with many lakes and large depressions formed from glacial retreat (Indiana Geology Today website). The Middle and Lower Wabash River watersheds are located in the areas known as the Wabash Lowland, the Mitchell Plain, and the Crawford Upland. The Wabash Lowland consists of relatively nonresistant siltstone and shale of the Pennsylvanian age, which occurred approximately 310 million years ago. The Mitchell Plain geological division is distinguished by its sinkholes and underlain cave systems developed in the Mississippian age limestone bedrock, which occurred approximately 345 million years ago. Alternating layers of limestone, shale, and sandstone of late Mississippian age and some sandstone of the Pennsylvanian age forms the Crawford Upland. The geology of both the Pennsylvanian age and Mississippian age are part of the Paleozoic Era. (Smith, 2001.)

Figure 2.2-1. Wabash River Watershed.

The river has historically had a robust and diverse aquatic life. During a 2001 fish survey of the Wabash River conducted by the Indiana Department of Natural Resources Fish and Wildlife Service, 82 species and two hybrids of fish were collected from 15 different families. The most dominant species present, as reported by the Indiana Department of Natural Resources (IDNR), were common carp, channel catfish, flathead catfish, freshwater drum, golden redhorse, gizzard shad, shortnose gar, quillback, blue sucker, and river carpsucker (http://www.state.in.us/isdh/dataandstats/fish/fish_99/watershed.htm).

More recently, Asian carp have been found in the Wabash River (IDNR 2010b). Asian carp (comprising the species of bighead, black, grass and silver carps) are found across much of the Mississippi River Basin (Kolar et al. 2005, Figures 2.2-2A and 2.2-2B). Asian carp were first detected in Indiana in 1996 in the southwest corner of the state (IDNR 2010a). Subsequent surveys from Indiana Department of Natural Resources (IDNR) have found bighead carp and silver carp to be in low abundances across the Wabash River system, but the recent surveys suggest an upstream expansion to Huntington, Salamonie, and Mississenewa lakes in the upper portion of the Wabash River watershed. As recently as 2008, IDNR surveyed over 105-miles of the Wabash River, and found that Asian carp abundances appeared low at that time (IDNR 2010b). Anecdotal evidence suggests that Asian carp are quite abundant in the Wabash River, however, scientific quantification of local abundance is lacking for locations like Terre Haute, Indiana so their local influence is uncertain at this time.

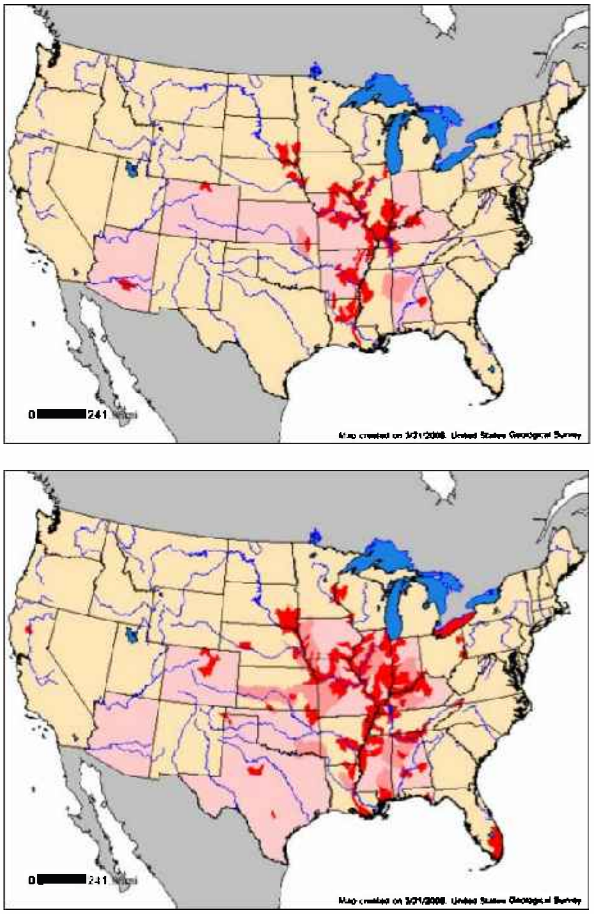


Figure 2.2-2A (top). Silver carp distribution in 2006 (from USFWS 2006). Figure 2.2-2B (bottom). Bighead carp distribution in 2006 (USFWS 2006).

Detailed risk assessments for Asian carp are being completed across their potential range in North America (USFWS 2006). Known risks include rapid range expansion and population increases, resulting in decreases in abundances of native aquatic fauna (USFWS 2006). Research summaries on specific Asian carp affects, such as that of Kolar et al. (2005) suggest that the primary negative ecosystem effects that Bighead and Silver carps have on ecosystems into which they invade is trophic alteration. Kolar et al. (2005) also documents lesser but important adverse changes to habitats, water quality, individual species and disease transmission within invaded and introduced systems.

Within Indiana, Dr. Reuben Goforth (Purdue University) has expressed a concern over Asian carp impacts on native fishes in the Wabash River stating their numbers appear to be increasing but additional surveys are still needed to verify the rate (Goforth 2010a). Dr. Goforth stated that these invasives are removing the plankton that serves as the food base for this ecosystem and for species like gizzard shad and skipjack herring (Goforth 2010b). Shad and herring serve as the main foods for large predators like catfish, bass and walleye, and although it is hard to tell if their presence has had a negative effect on the system as of yet, the trajectory could mean a significant impact on the overall fish community (Goforth 2010b). Again, local information on abundances and impacts for areas like Terre Haute are lacking but their presence in the Wabash suggests that adverse effects on the aquatic community are likely.

2.2.1 Terre Haute River Basin

The City of Terre Haute, Indiana is located approximately 220 miles upstream of the Wabash River's confluence with the Ohio River in the center of Vigo County in west-central Indiana (Figure 2.2-1). The upstream portion of the watershed draining to the Terre Haute reach is approximately 12,263 square miles. The City itself is approximately 31 square miles in size and serves a population of approximately 57,259, based on a 2006 estimate from the U.S. Census Bureau. Population has been declining slightly based on the change in population from 2000, when it was 59, 614 (U.S. Census Bureau, 2010). The City has 10 CSO outfalls and a 48 million gallons per day (MGD) WWTP that discharge to the main stem of the Wabash River (Figure 2.2-3).

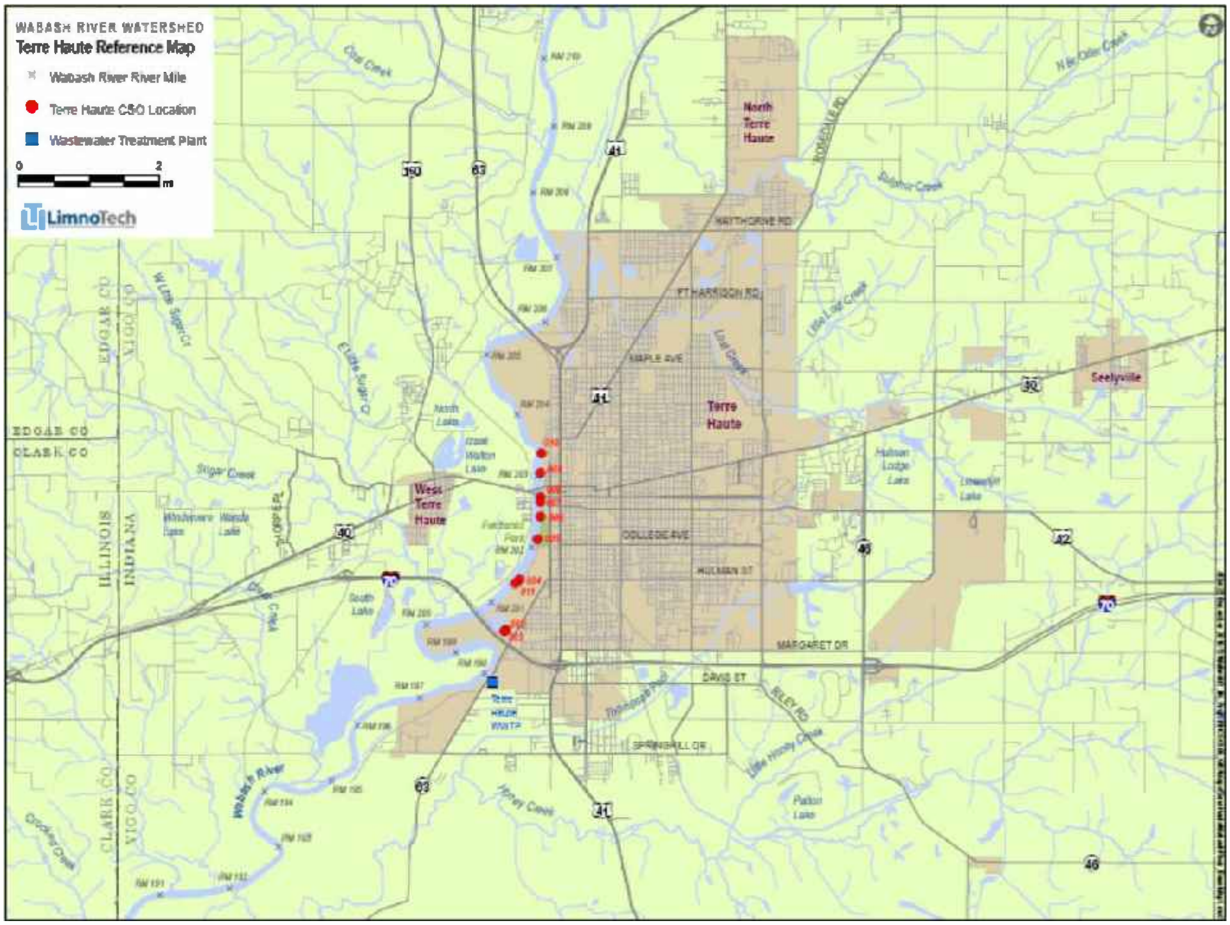


Figure 2.2-3. Wabash River Watershed Features Near the City of Terre Haute

The dominant land use in the Terre Haute metro area is industrial but the watershed upstream is largely agricultural and forested (NLCD, 2001). Several CSO communities are located upstream, including the larger communities of Lafayette, West Lafayette, and Kokomo. All of these Cities are implementing Long Term Control Plans to address their combined overflows.

The City of Terre Haute is home to Indiana State University, whose campus is contained completely within the combined sewer service area, and the Rose Hulman Institute of Technology (located east of the City limits). Outside of these campus areas, land use is largely commercial and industrial in the historical downtown area and becomes increasingly residential away from downtown (Figure 2.2-3). The City has numerous parks and recreation areas and of particular note is Fairbanks Park, a large park located along the Wabash River near downtown (see Figure 2.2-3 and 2.2-4).

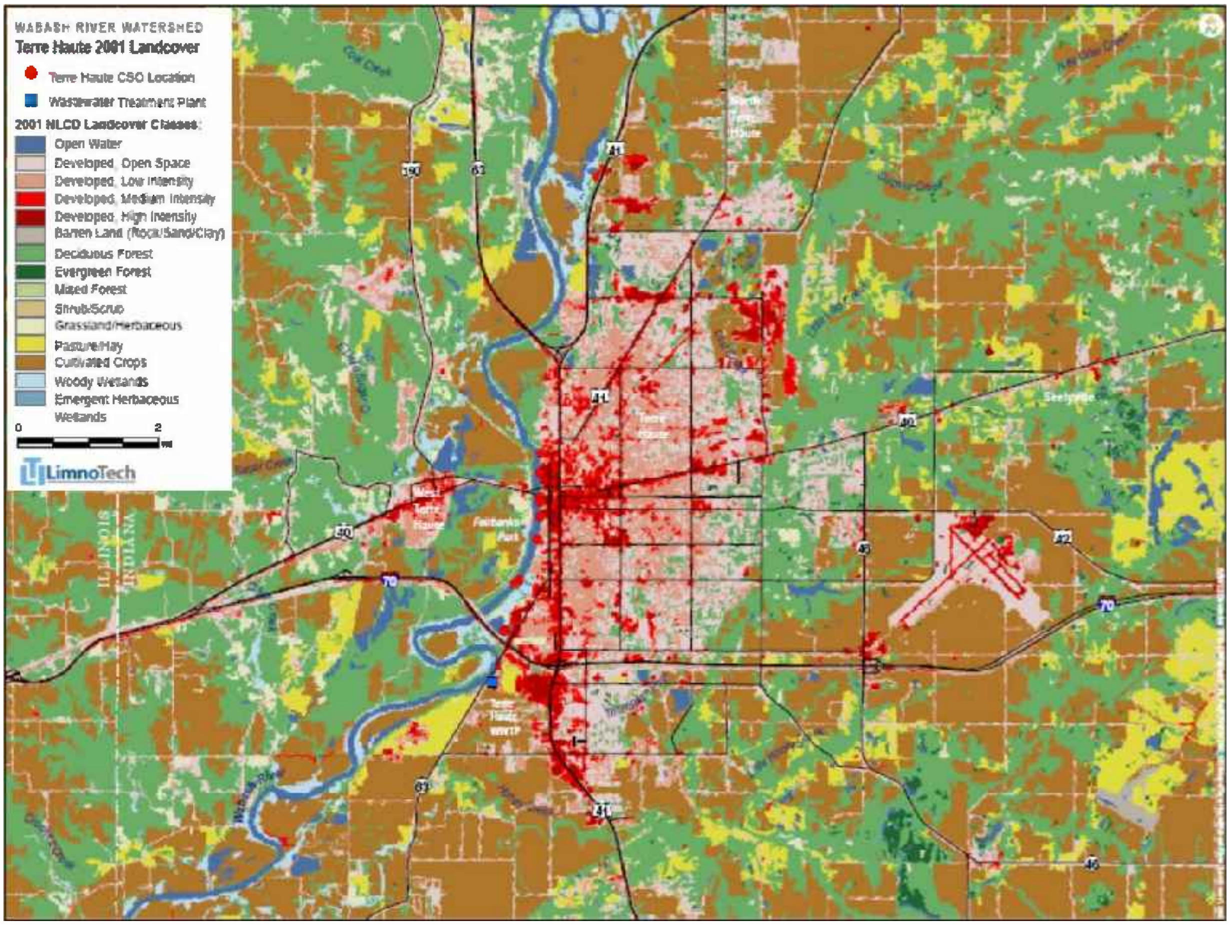


Figure 2.2-4. Land Cover in the Wabash River Watershed Near the City of Terre Haute.

The U.S. Geological Survey (USGS) has maintained a gage in the Wabash River in Terre Haute since 1927. Water Resources Data from the U.S. Geological Survey (USGS) indicate that the mean annual flow in the Wabash River at their gage in Terre Haute is 11,410 cubic feet per second (cfs) and the median flow (50th percentile) is 6,620 cfs, based on daily records from 1928-2009.

There are several small tributaries to the Wabash River that flow through or near Terre Haute. They are Sugar Creek, Otter Creek, Honey Creek, and Lost Creek (Figure 2.2-3). Storm water discharges in Terre Haute flow into these tributaries and consequently can affect the water quality of the Wabash River. The City does not have any CSO discharges to the tributaries.

The water quality of the Wabash River in Terre Haute is impacted by CSOs, urban storm water and agricultural runoff and upstream pollution sources. IDEM's 2008 303(d) List of Impaired Water

Bodies has the Wabash River listed as impaired by E. coli and nutrients as well as fish consumption advisories for PCB and Mercury contamination (IDEM, 2008). The nearby tributaries of Sulphur Creek and Sugar Creek are also on the 2008 303(d) list. Sulphur Creek is also listed for mercury and PCB fish consumption advisories and E. coli as well as pH, total dissolved solids and sulphate while Sugar Creek is listed for impaired biotic communities. None of these tributaries receive discharges from the City's CSOs.

2.3 CSS Description

2.3.1 Combined Sewer System Description

The City's Sanitary District includes significant rural and urban areas outside of the City so the City's waste water treatment plant (WWTP) not only treats wastewater for Terre Haute but also for the Town of Seelyville, which is located to the east of Terre Haute and has a population of 1,117 (U.S. Census Bureau, 2009 Population Estimates) and significant nearby unincorporated developed and undeveloped areas. In 1965, the City constructed the main interceptor, main lift station and primary wastewater treatment plant to convey dry weather and a portion of wet weather wastewater flows to the WWTP. Both combined and separated sewers convey wastewater to the main interceptor sewer, which flows to the WWTP.

The combined sewer area is centrally located in the older, central and northern sections of the City and covers approximately 5,100 acres. Many of the combined sewer trunk lines (of brick construction), which discharged directly into the Wabash River prior to the construction of the main interceptor, were installed in the late 1800's and early 1900's. Ten CSO outfalls are located in the combined sewer area and one outfall is located at the WWTP.

2.3.2 Combined Sewer Service Areas

Figure 2.3-1 shows the boundaries of each of the seven CSO service areas, some of which contain more than one outfall. The areas and corresponding outfalls are designated from north to south, as the Spruce, Chestnut, Ohio, Walnut, Oak and Crawford, Hulman and Idaho, and Turner basins. The service areas receive sanitary flow from both combined and separated sewers. Table 2.2-1 shows the combined and separated areas in each service area. The following sections describe each of the individual CSO basins.

Table 2.2-1
City of Terre Haute CSO Service Areas

CSO Service Area	CSO Service Area Names	Combined Area (acres)	Separated Area (acres)	Total (acres)
010	Spruce St.	1,262.6	5,877.0	7,139.6
009	Chestnut St.	321.9	7.3	329.2
008	Ohio St.	87.0	7.6	94.6
007	Walnut St.	1,079.5	2,890.0	3,969.5
005/006	Oak/Crawford St.	271.1	36.0	307.1
004/011	Hulman/Idaho St.	1,502.6	1,079.0	2,581.6
003	Turner St.	613.8	2,086.0	2,699.8
TOTAL		5,138.4	11,982.9	17,121.3

2.3.2.1 Spruce Street

The Spruce Street service area (CSO-010) is the most northern service area in Terre Haute's combined sewer area and is served by the 108-inch Spruce Street trunk sewer. It has approximately 1,260 acres of combined sewers. The land use in the area consists mostly of residential with some commercial areas including the expanding Union Hospital campus and a small portion of Indiana State University. The trunk line, which extends northeast on Lafayette Avenue, receives sanitary flows from the separated area to the north of the basin. Flows are conveyed through the trunk sewer to a 36-inch throttle pipe diversion structure that diverts dry weather flows to the interceptor sewer. The throttle pipe defines the beginning of the main interceptor sewer.

2.3.2.2 Chestnut Street

The Chestnut Street service area (CSO-009) is located directly south of the Spruce Street service area and is served by a 66-inch trunk sewer that flows from the old Canal Sewer. It has approximately 320 acres of combined sewers and the land use in the area consists mostly of Indiana State University.

2.3.2.3 Ohio Street

The Ohio Street service area (CSO-008) is located between the Chestnut Street and Walnut Street service areas and is served by the 42-inch Ohio Street trunk sewer. This area serves most of the downtown area therefore; the land use is mostly commercial with some industry and a small portion of the Indiana State University campus area. The outfall for this basin lies in Fairbanks Park.

2.3.2.4 Walnut Street

The Walnut Street service area (CSO-007) is located immediately south of the Ohio Street service area. It has approximately 1,080 acres of combined sewers. The land use is mostly residential with some commercial areas. The separated area to the east of this service area includes the Town of Seelyville. Areas east of this basin (including the Seelyville interceptor) have recently been separated and diverted to the south side lift station via the Thompson Ditch interceptor. The Walnut Street CSO outfall structure is located in Fairbanks Park.

2.3.2.5 Oak and Crawford Streets

The Oak (CSO-006) and Crawford Streets (CSO-005) service area is located south of the Walnut Street service area. The combined basin area has approximately 270 acres of combined sewers. The area serves mostly residential and commercial areas. Although each area has a trunk sewer that conveys combined sewage to the interceptor sewer, there is a cross connection between the two sewers on Second Street from Oak Street to Crawford Street. Therefore, the Crawford Street trunk sewer is a relief sewer for the Oak Street trunk sewer. The outfalls for these service areas are located in Fairbanks Park.

2.3.2.6 Hulman and Idaho Streets

The Hulman Street (CSO-004) and Idaho Street (CSO-011) service area is the largest area in the City with a total combined area of approximately 1,500 acres. The basin is served by the 114-inch Hulman Street trunk sewer and the 96-inch Idaho Street trunk sewer. The land use is mostly residential with some commercial and industrial areas. The Idaho Street trunk sewer is referred to as the Central Relief Sewer because the two trunk lines contain several cross connections. The two trunk lines also collect sanitary flow from the separated area to the east of 25th Street and conveys it to the main interceptor sewer. The outfalls are interconnected just upstream of each diversion structure.

2.3.2.7 Turner Street

The Turner Street service area (CSO-003) is the southernmost combined sewer service area and is served by 84-inch trunk sewer. It has approximately 610 acres of combined sewers. The land use is mostly residential with some commercial along the Margaret Avenue corridor. The trunk sewer picks up sanitary flows from the separated areas to the east and south of the CSO basin and then conveys all flow to the main lift station. The overflow outlets to a ditch just southeast of the main lift station, which extends south and west around an existing basin.

2.3.2.8 Main Lift Station

The Main Lift Station overflow (CSO-002) is an interceptor relief overflow that is activated when the capacity of the main lift station is exceeded and the interceptor sewer is surcharged. There is a gate at the main lift station wet well that can be opened prior to the Lift Station being flooded out. Currently there are automatic controls on this gate that the City personnel can override to maximize the flow to the treatment plant.

2.3.3 Trunk Sewer & Interceptor Network

The City of Terre Haute has nine major trunk sewers that flow to the west towards the Wabash River, as described in the previous section. The main interceptor sewer along the river intercepts all of the flows from the trunk sewers and conveys flow to the main lift station. The trunk sewer diameters range from 42-inches to 132-inches. Figure 2.3-2A through 2.3-2C shows the major trunk sewers and the interceptor sewer. The figure shows diameters and capacities of the sewers from the collection system model runs during wet weather conditions.

The concrete main interceptor sewer runs along the east bank of the Wabash River to intercept wastewater flows from the trunk sewers that originally flowed directly into the river. The interceptor sewer conveys this flow to the 48 MGD Main Lift Station where it is then pumped to the Wastewater Treatment Plant.

The concrete interceptor sewer starts at the north end of the combined sewer area at Spruce Street. The 36-inch throttle pipe from the Spruce Street diversion structure begins the interceptor sewer. The interceptor sewer consists of several large diameter sewers to convey the wastewater to the main lift station. It begins as a 36-inch pipe and then immediately increases to 48-inch just south of Spruce Street. It then increases to a 54-inch sewer just south of Ohio Street and increases again to a

60-inch sewer at Oak Street. Lastly, it increases to a 66-inch sewer at Idaho Street and proceeds to the main lift station. The interceptor is constructed in a 100 foot easement and contains sections with little or no cover.

Wastewater from each of Terre Haute's combined sewer service areas discharge to a diversion structure. During dry weather, all of the flow is diverted through the throttle pipes into the main interceptor sewer for conveyance to the wastewater treatment facility. During large storms, excessive flows enter the diversion structure, overtop the elevation of a weir and overflow into the Wabash River through the outfall pipe. The CSS has nine diversion structures and ten outfalls. The diversion structures vary in design. The diversion structures at Hulman and Idaho Streets are located at the interceptor whereas the other seven diversion structures divert dry weather flow through a throttle pipe to the interceptor. A flap gate is located on each outfall pipe, except the outfall at the main lift station and the WWTP, to prevent river water from entering the system. Table 2.2-2 describes each CSO diversion structure. Drawings and photographs of each diversion structure are shown in Terre Haute's *Combined Sewer Operational Plan* (2006). Currently, City personnel inspect the outfalls during and after every rain event in accordance with their Operational Plan.

Table 2.2-2
CSO Diversion Structure Descriptions

CSO Diversion Structure	CSO Diversion Structure Location	CSO Diversion Structure Description	Outfall Pipe Size [(1)]	Throttle Pipe Size	Influent Pipe Invert Elevation (ft.)	Height of Weir (ft.)	Outfall Pipe Submerged
010	Spruce St.	108" trunk sewer from Spruce St. enters weir chamber and is diverted into a 36" throttle pipe which is the start of the interceptor	108"	36"	468.92	3.88	no
009	Chestnut St.	66" trunk sewer conveys flows from the Canal Sewer and flow that is diverted over the weir at Lafayette St. and Spruce St. into a weir chamber that is located near Third St. The flow is diverted into a 30" throttle pipe into the 48" interceptor	96"	30"	469.11	2.54	partially
008	Ohio St.	42" trunk sewer from Ohio St. enters weir chamber and is diverted into an 8" throttle pipe and then into a 15" throttle pipe to the 54" interceptor	42"	8" - 15"	468.25	3.18	partially
007	Walnut St.	96" trunk sewer from Walnut St. enters weir chamber and is diverted into an 18" throttle pipe to the 54" interceptor	96"	18"	463.92	4.25	no
006	Oak St.	54" trunk sewer form Oak St. enters weir chamber and is diverted into an 8" throttle pipe to the 60" interceptor. Some flow from Oak St. flows to the Crawford St. outfall from a cross connection on Second St.	54"	8"	469.5	1.5	yes
005	Crawford St.	63" trunk sewer from Crawford St. enters weir chamber and is diverted into a 12" throttle pipe to the 60" interceptor	66"	12"	471.08	2.81	yes

004	Hulman St.	114" trunk line on Hulman St. coveys flow from Hulman St. and flow relieved from Idaho St. through the 84" cross connection at Prairieton Rd. Flow enters the diversion structure and is diverted to the 60" interceptor through a 56" X 64" orifice	96"	orifice opening 56" X 64"	459.18	2.61	no
011	Idaho St.	96" trunk line on Idaho St. enters the diversion structure and is diverted to the 66" interceptor through a 65" X 72" orifice	96"	orifice opening 65" X 72"	458.75	3.92	no
003	Turner St.	84" trunk sewer from Turner St. enters weir chamber and is diverted into a 20" throttle pipe to the 66" interceptor which flows into the Main Lift Station which is then pumped to the WWTP	84"	20"	459.47	4.25	no
002	Main Lift Station	The flow enters the wet well of the main lift station and when the capacity of the lift station is reached, the flow goes over a weir and out the outfall.	48"	N/A	N/A	Elevation = 461.0	no

2.3.4 Wastewater Treatment Plant Facilities

The wastewater treatment plant in Terre Haute, located along the Wabash River, east of SR 63 and south of Interstate 70 was originally constructed and put into operation in 1963 as a primary treatment facility. New facilities at that time included: pretreatment and primary treatment facilities, chlorination and digestion facilities, the administration/control building and the main lift station. In 1971, it was expanded to include secondary treatment. Additional sludge handling and dewatering/storage facilities and fine-bubble diffusers were added in 1989. The two flow equalization basins were added in 1990 and the main lift station was upgraded with new screening in 1997. A summary of the process capacities described in the following sections are included in Table 2.3-3. The schematic of the existing processes is shown in Figure 2.3-3.

The existing NPDES permit (Permit No. IN 0025607) indicates that the WWTP is rated for a design average daily flow of 24 MGD. A copy of the current NPDES permit is included in

Appendix 1-1. The effluent discharge limits contained in the permit are shown in Table 2.3-4. The mass loading limits presented are based on a peak wet weather flow of 48 MGD. A summary of the current plant flow loadings is included in Table 2.3-5.

Table 2.3-3
Wastewater Treatment Facility Capacities

Facility	No. of Units	Unit Size	Design Peak Capacity (MGD)	Actual Peak Capacity (MGD)
Main Lift Station	4	4 @ 11,100 GPM	56	48
		(1 is a standby)		
Preliminary Treatment				
- Aerated Grit Tanks	2	40'x16'-2"x14'-4"SWD	48	48
- Comminutors	3	36"	48	48(1)
- Pre-Aeration Tanks	4	68'x16'x12'-8"SWD	48	48
Primary Treatment				
- Primary Clarifier	12	139'x16'x10'-1"SWD	48	48(2)
Secondary Treatment				
- Aeration Tanks	4	3 passes each @	36	31(3)
		108'-8"x30'x15'-1"SWD		
- Secondary Clarifiers	4	100' Diam. 12'SWD	36	31(3)
- Chlorine Contact Tank	1	66,840 cu. Ft. volume	48	48
- Dechlorination Tank	1	3,570 cu. Ft. volume	48	48
Equalization Tanks	2	5.2 Mgal Volume		

(1) One channel does not receive grinding to maintain this peak capacity
(2) Based on NPDE permit and 1,800 gpd/sf
(3) Based on previous operational experience

Table 2.3-4
Terre Haute WWTP - NPDES Discharge Limits

Parameter	Quantity or Loading				Quality or Concentration		
	Monthly Average	Weekly Average	Units		Monthly Average	Weekly Average	Units
BOD$_5$	10014	16022	lbs/day		25	40	mg/L
TSS	12017	18025	lbs/day		30	45	mg/L
Interim NH$_3$-N							
Summer	2003	3004	lbs/day		5	7.5	mg/L
Winter	6008	9013	lbs/day		15	22.5	mg/L
Final NH$_3$-N							
Summer	1843	2764	lbs/day		4.6	6.9	mg/L
Winter	2604	3925	lbs/day		6.5	9.8	mg/L

Parameter	Quality or Concentration			
	Daily Minimum	Daily Maximum	Monthly Average	Units
pH	6	9	---	s.u.
Total Residual Chlorine Final Effluent	---	0.04	0.02	mg/L
E. Coli	---	235	125	colonies/100 ml

Table 2.3-5
WWTF Influent and Effluent Loadings
June 2008 through June 2010

Month	Avg. Flow MGD	Max. Day MGD	Raw BOD mg/l	Raw TSS mg/l	Raw NH4 mg/l	Final BOD mg/l	Final TSS mg/l	Final NH4 mg/l
June '08	19.2833	42	75	122	10.03	9.7	33.9	0.5357
July	15.2387	20.6	98	114	13.28	5.9	16.7	0.2929
August	9.7129	13	139	127	18.66	5.4	5.9	0.259
September	10.9467	19.6	141	131	19.09	Missing Data		
October	8.73548	14.4	157	135	22.62	4.8	9.8	0.502
November	8.22	12.7	165	136	24.18	4.6	7.9	0.8693
December	10.8194	21.4	155	144	21.21	8.6	28.4	0.6235
January '09	9.16129	11.1	177	144	23.61	4.9	14.3	0.8465
February	11.3036	28.9	171	170	18.78	20.6	68.9	1.445
March	8.97419	15.4	165	154	21.09	9.3	23.1	0.3648
April	13.45	22.5	151	131	17.53	14.6	26.9	0.7887
May	13.0065	20.1	113	132	15.68	8.6	17.4	0.5513
June	13.4333	19.1	124	130	16.79	5.2	11.7	0.2997
July	13.9613	19.5	126	147	17.32	3.2	6.7	0.2687
August	10.3387	16.9	143	130	19	3.7	7.4	0.241
September	10.45	15.1	168	147	24.31	4.7	11.9	0.51
October	11.4484	20.6	162	160	21.45	4.3	8.8	0.2894
November	9.34333	15.2	184	150	25.25	3.6	10.6	0.272
December	12.8548	20.5	180	136	23.42	7.8	16	0.4748

Month	Avg. Flow MGD	Max. Day MGD	Raw BOD mg/l	Raw TSS mg/l	Raw NH4 mg/l	Final BOD mg/l	Final TSS mg/l	Final NH4 mg/l
January '10	15.8161	28.4	179	163	24.2	4.5	14.7	0.1535
February	17.9393	23.3	181	145	24.43	6.8	24.5	0.2054
March	10.8484	26.9	184	176	22.84	10.4	24.8	0.4694
April	10.937	17.7	174	183	22.28	8.4	22.1	0.3693
May	11.142	16.1	165	161	20.34	4.6	9.5	0.1352
June	13.02	20.3	117	147	14.36	4.4	9.1	0.3583

	Avg. Flow MGD	Max. Day MGD	Raw BOD mg/l	Raw TSS mg/l	Raw NH4 mg/l	Final BOD mg/l	Final TSS mg/l	Final NH4 mg/l
Combined Average	12.01539	20.052	151.76	144.6	20.07	7.025	17.9583	0.463558

2.3.4.1 Main Lift Station

The Main Lift Station consists of two buildings connected at an upper level. The first building houses the influent screening facilities. The original bar screens were designed to handle 60 Million Gallons Per Day (MGD). The improvement project of 1997 replaced the mechanically operated screens with similar type equipment and rated capacity. The second building houses the four raw sewage pumps and controls. The station was originally designed to pump 40 MGD with three vertical shaft pumps operating. In 1997, the pumps were changed to dry-pit submersibles and designed to pump 48 MGD to the wastewater treatment plant with three pumps operating. The force main to the plant is 48-inches. At the average daily flow of 12 MGD, the velocity in the force main is approximately 1.5 feet per second (fps). To prevent solids from settling out in the pipe, a velocity of 2-3 fps is required. The buildup of solids in the pipe can and has caused problems at the headworks of the plant when a surge of flow from a rain storm flushes the solids through the pipes. The buildup of the solids in the grit chamber lowers the holding capacity and sends more solids to the primary clarifiers to be removed when pumping sludge.

The wastewater treatment plant also receives wastewater from the following lift stations:

- Southside Lift Station (which has a self cleaning bar screen),
- Honey Creek Mall Lift Station, and
- Penitentiary Lift Station.

The current average dry weather flow from these three lift stations is estimated to be 1.5 MGD, with a peak of 5.0 MGD. Unlike the main lift station, these lift stations serve areas with separate sanitary sewers. There are sub-basins within those separate sewer areas however that have peak flows due primarily to inflow/infiltration during rain events that act similar to combined sewers. All flow from the four lift stations discharge into the preliminary treatment facility.

2.3.4.2 Preliminary Treatment

The original preliminary treatment processes, sometimes referred to as the headworks, was constructed in 1963. It consists of 2 aerated grit tanks, 3 comminutors/grinders in channels downstream of the grit tanks and 4 pre-aeration tanks. The facilities were originally designed with a treatment capacity rating of 48 MGD. The grit was removed from the aerated grit tank with a clamshell bucket which is now inoperable. The only improvement project to these facilities over the years replaced two comminutors with channel type grinders. Previous studies have indicated that the capacity for the preliminary treatment is limited to 40 MGD because of hydraulic problems with the comminutors/grinders (Terre Haute CSO Operational Plan - 2006). It has been estimated that present facilities only remove a small portion of the grit. The remaining grit passing through these facilities acts to degrade downstream equipment, create odors and make sludge handling more difficult.

These preliminary treatment facilities were part of the original construction and were up to date for the 1960's. The operational and maintenance difficulties and age of the units have made the preliminary treatment an inefficient process that affects the overall performance of the entire treatment facility. The upgrade of these facilities would significantly reduce problems in this area as well as the treatment performance and cost of the entire wastewater treatment plant.

2.3.4.3 Primary Treatment

The primary clarifiers were part of the original 1963 construction. They were designed to treat wastewater flow of 48 MGD. There are four clarifier tanks with three channels per tank. The clarifiers' longitudinal collectors act to move sludge to one end and cross collectors move sludge at the end of the channels to a common hopper for wasting. The effluent channel from the primary clarifiers was altered with a side channel weir in 1990 to discharge to the flow equalization (EQ) basins during high flow periods. This discharge to the EQ basins presently occurs at 24 MGD. The south end of the effluent channel has a sluice gate which is opened manually to act as a bypass when the EQ tanks are full and the flow rate exceeds the secondary treatment capacity.

2.3.4.4 Administration and Control Building

The existing administration and control building was constructed in 1963. It is a two level brick building located near the entrance gate. The building contains various process equipment and control components, insufficient storage areas and personnel lockers in addition to the management and staff offices. It is undersized for current and future needs and approaching 40 years in age. The current location on the site is in a position relatively distant from most plant operational and maintenance activities. There is not sufficient parking. A properly programmed and designed facility to meet all the current and projected staff needs is desirable. It has served its useful life.

2.3.4.5 Secondary Treatment

The secondary treatment plant consists of aeration tanks and secondary clarifiers that were built in 1971. It is rated for 24 MGD. The four aeration tanks are comprised of three passes each and can be operated in step feed mode. There are four 100' diameter circular secondary clarifiers with 12' side water depth. The plant staff has operated these clarifiers up to the equivalent of 36 MGD during field testing and believes a higher rate is possible if flow splitting and piping improvements are constructed. Flow distribution between the aeration tanks and the clarifiers is not balanced. Better flow splitting facilities would help to balance out flows to all tanks and thereby increase performance and efficiency.

The discharge from the clarifiers is disinfected by utilizing gas chlorination and dechlorination with sulphur dioxide. The wastewater is only disinfected during the recreation season (April-October) in accordance with the NPDES Permit. The disinfection system is sized for 48 MGD.

2.3.4.6 Biosolids

The original plant was constructed with anaerobic digesters and storage of liquid digested biosolids in lagoons. In 1989, new belt presses and dewatered biosolids storage facilities were constructed to allow disposal of liquid and/or dewatered biosolids. Recently, the anaerobic digesters were converted to aerobic units. Most biosolids processes and equipment with the exception of the digesters are in a deteriorated condition.

2.3.4.7 Flow Equalization Basins

The two earthen, lined flow equalization basins were constructed in 1990 and have a total volume of 5.2 Million gallons. The equalization basins receive primary effluent on flows greater than 24 MGD. Once the basins are full, approximately 24 MGD of flow continues to be sent to secondary treatment and the balance is bypassed from the primary effluent channel to the chlorine contact tank. When raw sewage flows subside, sewage from the basins can be pumped back into pre-aeration tanks. The bypass weir in the primary clarifier effluent channel could be adjusted or replaced to increase the amount of flow sent to secondary treatment before discharge occurs to the basins.

2.3.4.8 WWTF Expansion – Phase I

Given the age and condition of the existing treatment facility, a preliminary engineering report (PER) was completed for the entire facility in 2008/09 during the latter stages of the CSO LTCP process. The PER recommended significant upgrades for the facility to address antiquated equipment and processes, operational issues, hydraulic/organic capacity and to have the ability to meet future regulatory requirements. The improvements recommended were estimated at $130 million and were proposed to be completed in 3 phases over 5 – 6 years.

Phase I of the improvements to the treatment facility consist of a new Headworks facility which initiated construction in late 2010. As a result, this new facility shall be considered part of the existing facility with respect to the CSO LTCP, and the Phase II and III work considered as future improvements and will be discussed later in the report. A summary of the new headworks facility is as follows:

The new headworks facility will be constructed east of the existing aerobic digesters. New influent piping will convey all influent flows from the existing preliminary treatment structure to the new facility site. Three 24 MGD fine screens will be followed by two 30 MGD Pista grit removal systems. The third fine screen will be redundant and a by-pass channel will be provided between the two grit removal tanks to meet firm peak wet weather capacity. The entire preliminary treatment facility will be enclosed with ozone odor control equipment. Influent flow metering and sampling facilities will be installed upstream of the influent screening. A flow division structure will initially be installed downstream of the headworks structure to split flow to the primary tanks. The new headworks facility will have a capacity of 48 MGD.

2.3.4.9 Summary

In general, while the wastewater treatment plant has adequate capacity for the present dry weather flows, there are many areas that are significantly depreciated, inefficient and are beyond the useful life cycle. The recommended and planned improvements proposed as phases II and III of the overall facility rehabilitation will be discussed later in the report.

2.3.5 Implementation of Nine Minimum Controls

Various options were investigated to determine the options applicable to implementation of the Nine Minimum Controls in Terre Haute's combined sewer system. Each of these options is summarized in Table 2.2-5 below.

Table 2.2-5
Options for Implementation of Nine Minimum Controls

Control	Pros	Cons	Implemented by City
Netting Devices	Lower capital cost than other floatable control equipment, easy to operate and maintain, and detains high percentage of floatable material until net becomes full.	Cost of replacing and maintaining the nets, frequent maintenance/disposal costs, poor performance for high flows, maintenance difficult for CSO's in remote locations.	No
Manually Cleaned Bar Screens	Easy to install and less costly than other mechanical type screening equipment and easier to retrofit into existing structures	Frequency of cleaning required to prevent clogging and typical bar spacing greater than most mechanical systems allows smaller floatable materials to pass through.	Yes
Mechanically Cleaned Weir-Mounted Screens	Controls floatable material directly at the weir in the diversion structures with a higher percentage of capture.	Maintenance and cleaning can be difficult due to the design of the diversion structure containing the weir	No
Overflow Screen with Automatic Backwash	High capture of floatable material, and ease of maintenance as screen floatable material backwashed to interceptor	Cost of installation and operation and difficult to install or retrofit in existing overflows without construction of new overflow diversion structure	No
Baffles Mounted in Regulator	Low cost method of decreasing velocity of CSO flows to encourage capture of floatables in the existing interceptors	Additional headloss in the combined sewer can affect upstream flow levels and effectiveness of floatable control/capture is limited the amount of material captured and directed into the interceptor	Yes
Street Sweeping	Typically already a maintenance task completed by Cities and thus low cost of implementation. Captures most floatable material on streets which are swept	Cost of maintenance, only removes larger floatable materials and grit which accumulates on the streets, and frequency of sweeping and ability to sweep all areas in a CSO basin have a direct affect on effectiveness	Yes
Catch Basin Cleansing	No capital costs required and floatable material and other accumulated solids which affect combined sewer flows are removed prior to entry into the sewer system.	Cost of maintenance, and removal of material from catch basins can increase the flow of stormwater into the combined sewer system thus increasing the potential for CSO's and consequently floatable material.	Yes

Control	Pros	Cons	Implemented by City
Public Education	Low cost option which encourages the public to prevent CSO's and introduction of floatable materials at the source	Not often effective or measurable in regards to CSO and floatable material control	Yes
Maximization of flow through the plant	Typically low capital cost to utilize existing systems to convey maximum amount of flow to WWTF which in turn should limit the amount of floatables entering receiving waters by reduction of CSO's in the system.	Can affect WWTF operations by exceeding process capacities which can affect discharge quality and allow floatables to be discharged at the WWTF. Also, may require costly plant expansion to be effective in treating additional CSO flows.	Yes
Public Notification Program	Low cost action which encourages the public to be proactive in measures which will limit floatable materials from entering the CSO system	Effectiveness is dependent upon the public's willingness to take measures suggested in the program to limit floatable materials from entering CSO system	Yes

The City is currently implementing all of the Nine Minimum Controls except for Floatable controls which are addressed in the LTCP.

2.4 Receiving Stream Water Quality

In 1999, the City of Terre Haute submitted its Stream Reach Characterization and Evaluation Report (SRCER) to characterize conditions within the CSO receiving stream, the Wabash River. The City conducted a river sampling program to measure *E. coli*, Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), and various metals in summer 1999. Although many of the bacteria data had results of "not in range" or "too numerous to count", qualitatively, the data were sufficient to identify *E. coli* as the only pollutant of concern in the river in the 1999 SRCER. This section summarizes the SRCER's conclusions and updates the information presented in the SRCER by extending the data analyses to 2009.

2.4.1 Receiving Stream Water Quality Data Sources

2.4.1.1 Historical Water Quality Data

Several Agencies have monitored water quality in the Wabash River, most notably the Indiana Department of Environmental Management (IDEM), but also U.S. EPA, ORSANCO and USGS. Monitoring the Wabash River near the City of Terre Haute is difficult because there are no safe bridges to sample from and sampling by boat is both expensive and time-consuming. Many of the agencies have focused their water quality surveying on sections of the Wabash River outside of the Terre Haute area.

IDEM monitored water quality, including *E. coli*, for several years in the 1990s and again in 2009 in the Terre Haute area. They also collected many more samples in the 1990s and 2000s at a location approximately 25 miles downstream of the City. The data from this location were compiled but were not used in any analyses because this location's distance from the City likely does not capture impacts on the river in the City.

The City, as noted above, has also conducted sampling in the Wabash River to supplement the paucity of data collected by other agencies in the local area. As part of the original CSO LTCP development, the City conducted another river sampling program from September 2001 through November 2001 to measure *E. coli* and dissolved oxygen (D.O.) primarily to inform the calibration of the river model used for the 2002 LTCP. Unlike the 1999 Sampling Program, nearly all of the *E. coli* data were quantified within the counting range of the analysis. Once the City embarked on the update to the LTCP in 2007, a more extensive Wet Weather Sampling Program was designed and conducted in Fall 2007, as described in the next section.

2.4.1.2 City of Terre Haute Wet Weather Sampling Program

The updated Wet Weather Sampling Program was conducted by LimnoTech in Fall 2007 for the City of Terre Haute and consisted of collecting water samples from the Wabash River, selected combined sewer overflows, and tributaries that receive storm water for *E. coli* analysis (Figure 2.4-1). This is the most detailed water quality sampling conducted in this portion of the Wabash River. Six rounds of river sampling and two rounds of source sampling were conducted over a 72-hour period during three discrete storm events with varying characteristics (City of Terre Haute Sampling Plan, July 2007). The results from the wet weather sampling were used to characterize impacts of the City's CSOs on river quality by monitoring the amount of *E. coli* found in the river over the course of the storm event.

LimnoTech mobilized on four separate occasions between August and October, 2007, and gathered data for three wet-weather events and one dry period. Temporal, spatial and statistical analyses were used to assess the river data by event, location and hour of sampling. Major findings from the river sampling program include:

- The City's CSOs impact water quality in the Wabash River but impacts tend to last less than a day;
- Local precipitation conditions do not significantly alter in-stream pollutant loads originating upstream of the City;
- Upstream sources do not impact the City until one or two days after the local storm event; and,
- The magnitude of the impact from the City's CSOs on the river water quality is positively correlated with the magnitude of the rainfall.

The goal of the source sampling program was to identify representative concentrations for estimating *E. coli* loadings from the City's CSOs and storm water. Major findings from the source sampling program include:

- No first flush effect was evident in the source sampling data;
- The data from CSO-009 was significantly different from the data from the other CSOs;
- An event mean (representative) concentration of 210,000 cfu/100 ml was determined from the data for CSO-009 while an event mean concentration of 675,000 cfu/100 ml was determined from the data for the remaining CSOs (CSO-007, CSO-006, and CSO-004);
- An event mean concentration of 5,000 cfu/100 ml was determined from the storm water data; and,
- The data from the CSO and storm water sites are consistent with values in the literature and at other Indiana CSO communities.

More detail on the storm event characteristics and associated data are described in Appendix 2-1.

2.4.2 Effects of CSOs on Water Quality

The analyses presented in this section include analysis of water quality parameters relevant to the designated uses of the Wabash River: recreation use and supporting aquatic life. Specifically, *E. coli* data were used to assess impacts to recreation use. Aquatic life use was assessed by evaluating available dissolved oxygen, metals and total suspended solids data.

Chemical data, which are snapshots of in-stream conditions in space and time, can be segregated into "wet" and "dry" categories so that distinctions in water quality attributed to wet weather sources, such as CSOs, can be identified, if such distinctions exist. For this analysis, data were characterized as "wet" if the monitoring was conducted on or the day after a local rainfall event of at least 0.10 inches. Otherwise the data were characterized as "dry". It should be noted that these characterizations were based on local conditions only. Given the large size of the upstream watershed (Figure 2.2-1), it is possible that upstream wet weather source loads may reach the Terre Haute area during local dry weather conditions. Nevertheless, the local condition is used as the basis for segregating the data because the purpose of this analysis is to discern water quality impacts, if any, from the City's CSOs, which are dependent on local rainfall.

2.4.2.1 E. coli

The State of Indiana has designated all surface waters to support full-body contact recreation at all times, during both dry and wet weather. As noted in Chapter 1, Indiana's recreation standards require that no sample in a 30-day period can exceed an *E. coli* bacteria criterion of 235 Coliform forming units (cfu) per 100 ml sample from April through October. If at least five samples are taken over a period of 30 days, a geometric mean of the samples cannot exceed a value of 125 *E. coli* colonies per 100 ml. *E. coli* is an organism found in the intestines of many warm-blooded animals and is used as an indicator of untreated human sewage.

This section analyzes bacteriological conditions in the Wabash River during both dry and wet weather, based upon data collected by IDEM and the City between 1991 and 2009 (including 2007 Wet Weather Sampling Program). The data indicate that the Wabash River occasionally exceeds the State's water quality standards and these exceedances occur more frequently during wet weather, suggesting that CSOs and other wet weather sources are contributing *E. coli* loads to the river.

Figure 2.4-2 presents a box-and-whisker analysis of *E. coli* levels during wet and dry conditions in the Wabash River. Data were aggregated into categories corresponding to the location relative to the City. Samples collected between river miles 220 and 216.85, which are upstream of the City's CSO area, were grouped together into the "Upstream" category. Samples collected between river miles 216.75 and 211.85 correspond to the portion of the river adjacent to the downtown CSO area and are categorized as "City". Samples collected below river mile 211.85 and river mile 207 were categorized as "Downstream". In this figure, the "box" corresponds to the 25th and 75th percentile concentrations. The line in the middle of the figure corresponds to the median concentration. The "whiskers" correspond to the 5th and 95th concentrations measured since 1990. Indiana's single sample maximum water quality standard criterion (235 cfu/100 ml) is also shown as a red line on the figure.

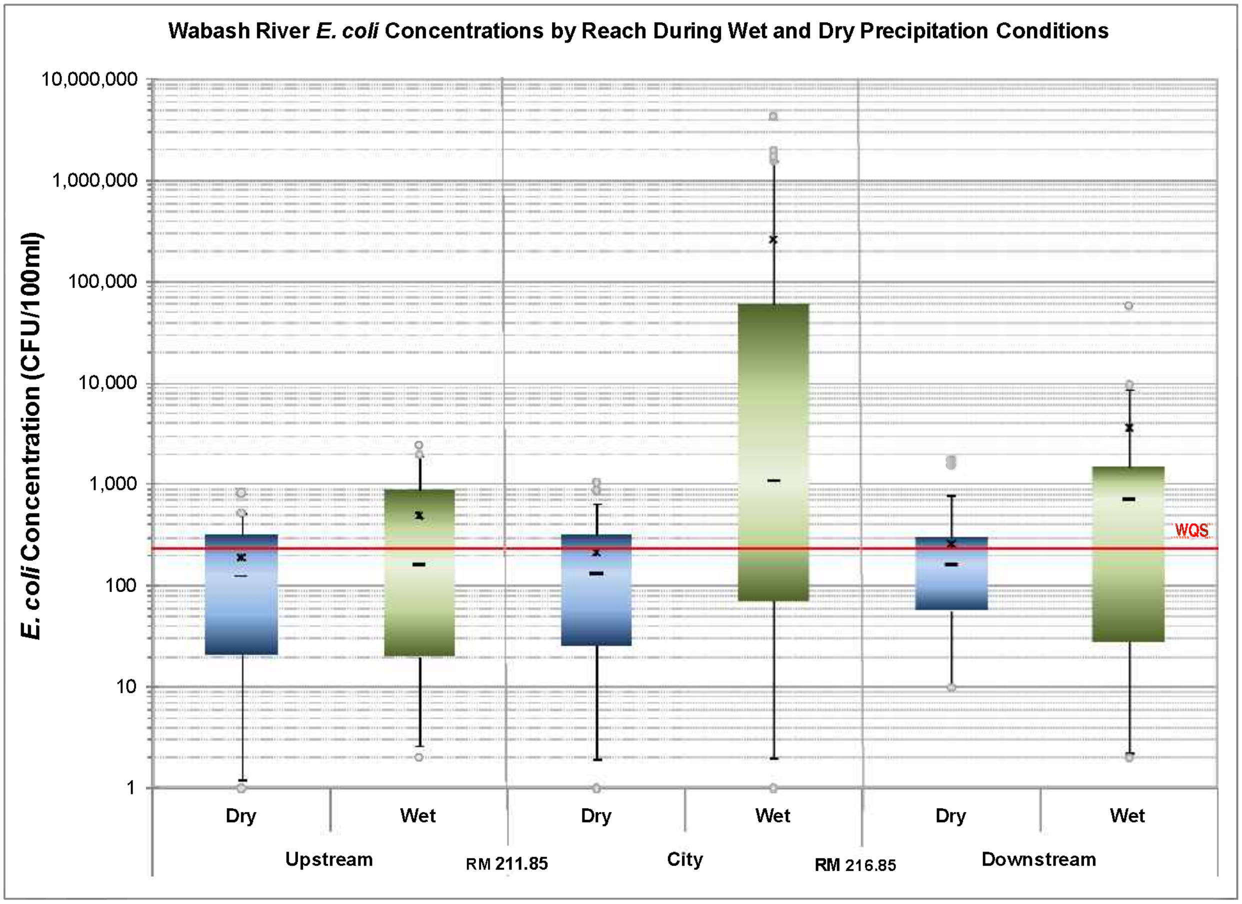


Figure 2.4-2. Box-and-whisker plot of wet and dry E. coli data in the Wabash River.

A comparison of the "boxes" (concentrations between the 25th and 75th percentiles) in these figures illustrate that wet weather concentrations tend to be higher than dry weather concentrations at all locations. This suggests that wet weather sources of bacteria are important. Further, the wet weather concentrations in the City tend to be higher than upstream wet weather concentrations. This suggests that local CSOs are important factors in local water quality. However, as the top of the "boxes" and the upper "whiskers" indicate, concentrations during both dry and wet weather exceed the single sample maximum water quality standard. This suggests that dry weather and/or upstream sources can be significant in the watershed. To date, dry weather sources have not been identified, although commonly discussed sources include failing septic systems, wildlife, agriculture (livestock with stream access), and storm sewer cross connections. Based on the watershed characteristics (land cover, census data), all of these sources are likely to be potential sources contributing to the occasional high dry weather observations.

The Wabash River meets *E. coli* water quality standards (single sample maximum) approximately 60% of the time as it enters the Terre Haute area. Compliance is approximately 55% of the time within the City and 45% downstream of the City. Compliance tends to be worse during wet weather than dry weather in and downstream of the City. Table 2.4-1 presents a tabular comparison of water quality standard compliance during wet and dry periods (single sample maximum criterion of 235 cfu/100 ml). Because there were no 30-day periods with at least five samples, compliance with the State's 30-day geometric mean criterion (125 cfu/100 ml) could not be analyzed. The trend in compliance also indicates that wet weather sources in the City, such as CSOs, are factors affecting compliance with the State's *E. coli* water quality standards.

Table 2.4-1
Frequency of E. coli Single Sample Maximum Water Quality Standard Compliance During Wet and Dry Periods

Reach	River Mile Extent	Number of Observations		Percent of Observations < 235 cfu/100 ml	
		Dry	Wet	Dry	Wet
Upstream	220.00 - 216.85	18	23	61%	61%
City	216.85 - 211.85	40	83	68%	35%
Downstream	211.85 - 207.00	38	25	63%	32%

2.4.2.2 Dissolved Oxygen

Dissolved oxygen (DO) concentration provides a reasonable indicator of impacts to aquatic life due to oxygen-depleting pollutants. Monitoring data for DO are available for the Wabash River from the early 1990s through 2009. The State of Indiana has developed numeric criteria for dissolved oxygen in their water quality standards to protect aquatic life (IWPCB, 2010). These criteria are a daily average concentration of 5.0 mg/L (to protect chronic exposure to oxygen-demanding pollutants) and a minimum concentration of 4.0 mg/L (to protect acute exposure).

Figure 2.4-3 presents a box-and-whisker analysis of dissolved oxygen levels during wet and dry conditions in the Wabash River. Data were aggregated into categories corresponding to the location relative to the City. Samples collected between river miles 220 and 216.85, which is upstream of the City's CSO area, were grouped together into the "Upstream" category. Samples collected between river miles 216.75 and 211.85 correspond to the portion of the river adjacent to the downtown area and are categorized as "City". Samples collected below river mile 211.85 and river mile 207 were categorized as "Downstream". In this figure, the "box" corresponds to the 25th and 75th percentile concentrations. The line in the middle of the figure corresponds to the median concentration. The "whiskers" correspond to the 5th and 95th concentrations measured since 1990. Indiana's acute water quality standard criterion (4 mg/L) is also shown as a red line on the figure.

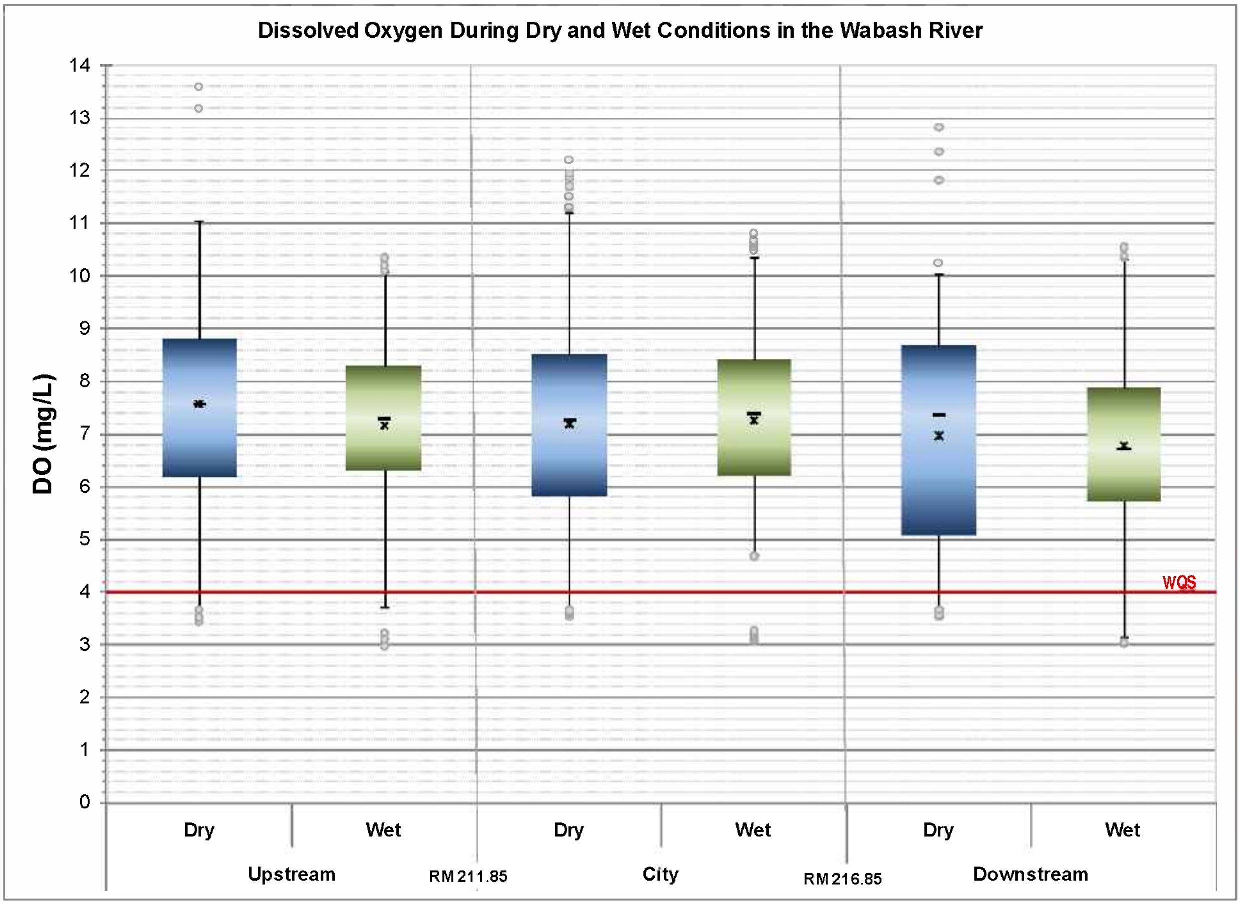


Figure 2.4-3. Box-and-whisker plot of wet and dry dissolved oxygen data in the Wabash River.

A comparison of the "boxes" (concentrations between the 25th and 75th percentiles) in these figures illustrate that dry and wet weather concentrations are not similar in all reaches. This suggests that wet weather sources of oxygen-depleting materials are not significant. Further, the wet weather concentrations in and downstream of the City are similar to upstream wet weather concentrations, suggesting that local CSOs are not important factors affecting dissolved oxygen. However, as the bottom of the "boxes" and the lower "whiskers" indicate, concentrations during both dry and wet weather exceed the acute minimum water quality standard criterion (4 mg/L). This suggests that other sources are significant but these have not been identified.

The Wabash River meets dissolved oxygen water quality standards (acute criterion of 4 mg/L) approximately 90% of the time as it enters the Terre Haute area. Compliance is also approximately 90% of the time within the City and 85% downstream of the City. Compliance tends to be worse during dry weather than wet weather in all reaches. Table 2.4-2 presents a tabular comparison of water quality standard compliance during wet and dry periods (both acute and chronic criteria).

Table 2.4-2
Frequency of Dissolved Oxygen Water Quality Standard Compliance During Wet and Dry Periods

Reach	River Mile Extent	Number of Observations		Compliance with Chronic Criterion (>5 mg/L)		Compliance with Acute Criterion (>4 mg/L)	
		Dry	Wet	Dry	Wet	Dry	Wet
Upstream	220.00 - 216.85	53	47	83%	91%	85%	94%
City	216.85 - 211.85	108	136	83%	90%	84%	96%
Downstream	211.85 - 207.00	76	59	76%	90%	79%	90%

2.4.2.3 Metals

Limited data are available for pollutants with potentially toxic effects on aquatic life, such as metals. Table 2.4-3 shows the results of metals data in the three reaches (Upstream, City and Downstream) of the local Wabash River area (insufficient data were available to evaluate the data on the basis of "wet" vs. "dry"). In general, heavy metals are not prevalent in the water column of the river, as shown by the high percent of non-detected results in this table. Copper and nickel are most frequently detected, although their frequency of detection is not significantly higher in the City compared to upstream locations, suggesting that the sources of these metals are distributed throughout the watershed. There were no exceedances of the acute or chronic criteria for any of the metals. Given the low levels of metals, it is unlikely that any are impairing water quality since the overwhelming majority are below detection limit. This conclusion is reinforced by the fact that the state has not listed this reach of the Wabash River as impaired by metals in their 305(b) reports (see Section 2.2.1.1).

Table 2.4-3
Summary of Heavy Metals Data by Reach Measured in the Wabash River Near the City of Terre Haute

	Number of Observations			Percent of Non-Detects		
Metal	Upstream	City	Downstream	Upstream	City	Downstream
Arsenic	6	3	6	100%	100%	100%
Cadmium	6	3	6	100%	100%	100%
Chromium	6	3	6	67%	67%	67%
Copper	6	3	6	33%	33%	50%
Nickel	6	3	6	0%	33%	0%
Lead	6	3	6	67%	67%	67%
Selenium	6	3	6	100%	100%	100%
Zinc	6	3	6	67%	67%	67%

2.4.2.4 Total Suspended Solids

Suspended solids in a water body can depress dissolved oxygen levels, block sunlight needed by aquatic plants and smother organisms that live in the stream bed. Sediment layers that build up in a water body can change its natural flow. After wet weather events, streams and rivers can carry significant quantities of suspended solid matter that have entered the waterway from both urban and rural runoff. Indiana does not have any numeric criteria for total suspended solids.

Figure 2.4-4 presents a box-and-whisker analysis of total suspended solids (TSS) levels during wet and dry conditions in the Wabash River. Data were aggregated into categories corresponding to the location relative to the City. Samples collected between river miles 220 and 216.85, which is upstream of the City's CSO area, were grouped together into the "Upstream" category. Samples collected between river miles 216.75 and 211.85 correspond to the portion of the river adjacent to the downtown area and are categorized as "City". Samples collected below river mile 211.85 and river mile 207 were categorized as "Downstream". In this figure, the "box" corresponds to the 25th and 75th percentile concentrations. The line in the middle of the figure corresponds to the median concentration. The "whiskers" correspond to the 5th and 95th concentrations measured since 1990.

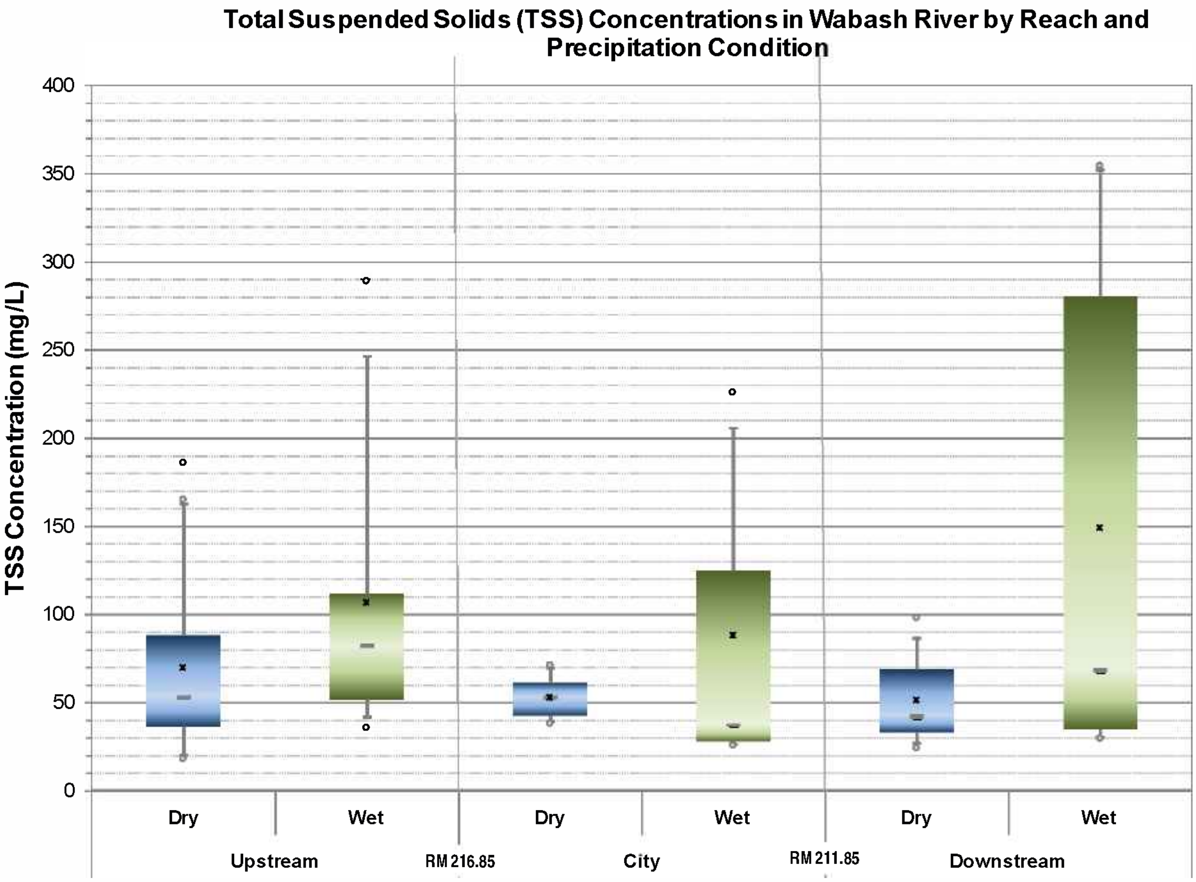


Figure 2.4-4. Box-and-whisker plot of wet and dry total suspended solids (TSS) data in the Wabash River.

Results of the box-and-whisker plot show that wet weather concentrations tend to be higher than dry weather concentrations, indicating that wet weather sources and resuspension of in-stream sediment are potentially important. The plot also shows that wet weather concentrations tend to increase as one moves downstream, though the reason for this is not clear. It is likely that other, non-CSO sources are contributing solids to the river during wet weather. However, the TSS data are somewhat limited (e.g. there were only 12 observations in the City reach) so the spatial differences may be due to the limited data rather than the result of pollutant loads.

2.4.2.5 Conclusions

Data collected by the City of Terre Haute and IDEM indicate that the Wabash River near Terre Haute is impacted by elevated bacteria concentrations. While the City's CSOs have been identified as a source of bacteria, analyses of the available data show that state water quality standards are exceeded in both dry and wet weather and that exceedances are observed in portions of the watershed that do not receive any CSO discharges. These results suggest that there are multiple sources loading bacteria to the rivers. CSO discharges in wet weather appear to have no impact on either the dissolved oxygen or total suspended solids parameters of the receiving streams. In addition, the streams do not appear to be under any conditions of stress due to biodegradable organics or heavy metals.

The data analyses presented in this section that include data collected since the first SRCER and LTCP were submitted provide additional confirmation that *E. coli* is the only pollutant of concern with respect to CSO discharges and that it is the appropriate water quality parameter to evaluate the benefits of CSO control.

2.5 Sensitive Areas

2.5.1 Consideration of Sensitive Areas

USEPA and Indiana CSO Control Strategies require that communities identify any "sensitive areas" along the CSO stream segments, or further downstream. Any area meeting one or more of the "sensitive" criteria must be given the highest priority for CSO discharge elimination, reduction or control. The USEPA CSO Policy lists the following criteria: :

- Habitat for threatened or endangered species,
- Primary Contact Recreational Areas such as swimming and water skiing areas,
- Drinking Water Source Waters, and
- Outstanding State Resource Waters or Outstanding Natural Resource Waters.

The City conducted a sensitive area analysis as one of their first steps in the development of the 2002 LTCP. This section presents the findings from that investigation.

Several agencies were contacted to determine if "sensitive areas" exist in the Terre Haute area. Responses were received from United States Department of the Interior Fish and Wildlife Service, and the Indiana Department of Natural Resources. The "Outstanding Rivers List for Indiana" as compiled by the Natural Resources Commission was also reviewed.

2.5.1.1 Habitat for Threatened or Endangered Species

Based on the letters received from the contacted agencies, the Wabash River has suitable habitat for the federally endangered Indiana bat, the ring pink mussel, the tubercled-blossom pearlymussel, the white-warty back pearlymussel and the bald eagle. After receipt of the agency letters, the city's consultant contacted the agency experts.

- Brant Fisher of IDNR confirmed on January 2, 2002 that the endangered mussels listed have not been found in Indiana for many years and are considered expatriated. Mussel surveys that have been completed for IDNR have confirmed this finding.
- Forest Clark with U.S. Fish & Wildlife discussed the endangered species on January 7, 2002. His past survey information indicated that there are no federally endangered mussels found alive in the Wabash River stream section. He also indicated that a bald eagle's nest has been observed in northwestern Vigo County (though not on the banks of the river itself).

2.5.1.2 Primary Contact Recreational Areas

The Wabash River can frequently have a velocity greater than 2.5 feet per second which is considered dangerous. The City and its Parks Department have posted "NO SWIMMING" signs at several locations. Boat access to the river is available at Fairbanks Park, which has a public boat ramp.

A stream survey was conducted by boat during the Fall of 2001 for visual confirmation that primary contact recreational activities were occurring in the Wabash River. No contact activities were noted. The stream banks are generally very steep and overgrown, which makes access difficult. It was noted that several areas had narrow footpaths to the riverbank, which appeared to allow access for fishing. Stair steps down to the river edge also exist in several locations. All of the steps are for wastewater staff to access and maintain the CSO's except for one across the river from CSO-007. These conditions have been witnessed by numerous individuals involved with the creation of the plan. In summary, no primary contact recreational activities were observed.

2.5.1.3 Drinking Water Source Waters

The Wabash River is not the source of any water supplies in the area. The City of Terre Haute is served by Indiana-American Water Company, which utilizes a well field north of the northern most CSO. The interceptor for the northern most CSO in Terre Haute is partially in the 5 year Time of Travel (TOT) boundary for the city wells. This is depicted on Figure 2.4-1. The city will study the interceptor for exfiltration in the future. The Town of West Terre Haute and Marion Heights Conservancy District own and operate well fields within one mile of the Wabash River.

2.5.1.4 Outstanding State Resource Waters

The Wabash River is not an Outstanding State Resource Water (327 IAC 2-1-2).

2.5.2 Sensitive Area Assessment

As a part of the planning process to create the 2002 LTCP, information regarding sensitive areas was presented to the Citizen Advisory Committee. Several items were noted during the discussions:

- The Wabash River is dangerous because of the rapid currents, channels in the river bottom and difficult access.
- There are only a few areas that are known to be frequented for fishing and camping (these are noted in Figure 2.4-1).
- Convenient access to the river's edge is only possible at Fairbanks Park because of the boat dock.

2.5.3 Identification of Areas to be Further considered

Although no sensitive areas were identified, the City and Citizens Advisory Committee considered whether some areas of the City should be prioritized with respect to CSO control. The consensus of the Citizen Advisory Committee and City staff was that Fairbanks Park, a prominent City park on the banks of the Wabash that has several CSO outfalls within its area, should be given priority for protection by reducing or eliminating the CSOs discharging to the river from the outfalls located in the park.

2.6 Historical Rainfall Analysis

This subsection discusses the analysis of the 50 years of rainfall data used to develop the typical design storms used for the collection system computer model.

2.6.1 Fifty-Year Data Analysis

Historical hourly precipitation records were obtained from the National Climatic Data Center. Rainfall data for Terre Haute was only available from 1948 to 1954. This seven-year period was compared to the same seven-year period of rainfall data from Indianapolis and was found to have similar rainfall patterns. Therefore, 51 years (1948 – 1998) of rainfall data from Indianapolis was used for Terre Haute's historical rainfall analysis.

The 51 years of hourly precipitation data was imported in XP-SWMM for preliminary analysis. During the analysis, the criterion of a dry period of six hours between storms was used. XP-SWMM's output file included rainfall statistics by year, which included duration, intensity, volume and the number of months of data per year. XP-SWMM's output file also included rainfall statistics by month and ranked return periods for duration, intensity and volume.

2.6.2 Design Storms

The rainfall data from the original XP-SWMM output file was sorted by depth of rain to determine rainfall ranges for the design storms as shown in Table 2.6-1. The 50% Huff Curve Ordinates table for Indianapolis (Burke, p. 2-5) was used to develop the hourly distribution of rainfall for each rainfall range. The rainfall hyetograph (bar graph of rainfall amount versus time) for each rainfall range is shown on Figure 2.6-1. The data for the rainfall hyetographs for each design storm, shown in Table 2.6.2, was used to define the duration, the average total rainfall, the maximum one-hour intensity, and the number of hours into the storm the peak occurred. These storm parameters are shown in Table 2.6-1. The typical storm hyetographs were used as input to the XP-SWMM model to estimate the overflow volume for each CSO structure for each design storm. In addition to using the Huff Curve analysis, a rainfall frequency curve was created from the 51 years of historical rainfall data. From this curve the percentage of occurrence for each storm was determined and is shown in Table 2.6-1. The approximate return periods for each storm were determined from *Rainfall Frequency Atlas of the Midwest* (1992) and are also shown in Table 2.6-1.

Table 2.6-1
Characteristics of Selected Storms

Range	Duration of Storm (Hour)	Average Total Rainfall for Storm (T.R.) (inch)	Maximum One-Hour Intensity (M.I.) (inch/hour)	Number of Hours Into Storm Peak Occurs	M.I./T.R.	T.R./ Duration (inch/hour)	Rainfall Range (inches)	Occurrence %	Approximate Return Period (2)
A	2	0.023	0.016		0.696	0.011	0.010 - 0.050	31.62%	---
B	7	0.242	0.121	3	0.500	0.033	0.051 - 0.150	19.48%	---
C	8	0.367	0.18	3	0.490	0.046	0.150 - 0.370	18.94%	---
D	9	0.486	0.22	3	0.453	0.051	0.371 - 0.650	13.94%	15 days
E	12	0.818	0.332	4	0.406	0.068	0.651 - 1.000	7.65%	30 days
F	15	1.212	0.451	9	0.372	0.083	1.001 - 1.500	4.68%	60 days
G	19	2.043	0.676	11	0.331	0.107	1.501 - 3.399	3.42%	1 year
H	23	3.888	1.146	14	0.295	0.168	3.400 - 5.290	0.25%	6 years
I (3)	21	5.32	1.24	12	0.233	0.253	5.300 & Larger	0.02%	80 years

Table 2.6-2
Rainfall Hyetograph Data

Hours	Rain, inches							
	Storm B	Storm C	Storm D	Storm E	Storm F	Storm G	Storm H	Storm I
1	0.020	0.020	0.023	0.020	0.020	0.026	0.066	0.230
2	0.040	0.050	0.064	0.061	0.040	0.026	0.066	0.000
3	0.121	0.180	0.220	0.081	0.020	0.076	0.066	0.000
4	0.030	0.060	0.064	0.332	0.020	0.026	0.066	0.000
5	0.020	0.030	0.064	0.100	0.040	0.026	0.066	0.000
6	0.010	0.020	0.013	0.081	0.040	0.076	0.066	0.010
7	0.001	0.005	0.033	0.041	0.080	0.026	0.066	0.080
8		0.002	0.003	0.041	0.120	0.076	0.066	0.190
9			0.004	0.020	0.451	0.076	0.066	0.150
10				0.020	0.140	0.176	0.166	0.090
11				0.001	0.100	0.676	0.216	0.050
12				0.020	0.060	0.226	0.266	0.090
13					0.040	0.176	0.266	0.760
14					0.020	0.126	1.146	1.240
15					0.020	0.076	0.316	0.620
16						0.076	0.266	0.620
17						0.026	0.216	0.100
18						0.026	0.116	0.240
19						0.026	0.116	0.400
20							0.066	0.370
21							0.016	0.080
22							0.066	
23							0.066	
24								
Total Rainfall	0.242	0.367	0.486	0.818	1.211	2.044	3.898	5.320
Max. Intensity	0.121	0.180	0.220	0.332	0.451	0.676	1.146	1.240

In addition, a Design Storm event resulting in 4 overflows per year was developed and accepted by IDEM for use in preliminary sizing of alternatives.

2.6.3 Typical Year Rainfall

The City of Terre Haute proposed to use a continuous modeling approach for the alternative evaluations using rainfall data from 1978 for sizing controls, then evaluating the performance of the alternatives using 1978 rainfall and stream flow conditions.

The documentation of the selection of the typical year period of 1978 is detailed in Appendix 2-2, "Typical" Period Analysis for the City of Terre Haute."

2.7 Summary

Current conditions in the City of Terre Haute and the Wabash River can be summarized in the following bullets:

1. The City has *10* CSOs discharging to the Wabash River. No CSOs discharge to local tributaries.
2. Although the City's collection system and WWTP reflect the age of this historic river community, the City has been investing in upgrades to their system, including implementation of NMCs to limit CSO overflows.
3. The Wabash River is a very large watershed. Over 12,000 sq mi. have drained to the Wabash River by the time it passes through the City of Terre Haute. Upstream sources can affect water quality in the vicinity of the City
4. The City has invested significant resources in understanding the effects of their CSOs on in-stream water quality and has determined (in combination with IDEM data) that *E. coli* is the only pollutant of concern from the City's CSOs. CSOs do not impact DO, TSS, or metals.
5. The Citizens Advisory Committee has identified Fairbanks Park, which has four CSOs located in it, as an area for reducing or eliminating CSO discharges.
6. The year 1978 has a typical year of rainfall and was used to evaluate benefits of control alternatives (presented in Section 6). Design storms were developed from rainfall data in Indianapolis and were used to size the CSO controls evaluated in the control alternatives.

3 Section Three – Collection System Model Development

3.1 Combined Sewer System Model Development and Calibration

3.1.1 Introduction

This subsection discusses the development of the calibrated combined sewer system (CSS) computer model. The model simulates runoff from the CSO service areas and then routes the flow through the major trunk sewers, CSO diversion structures and the interceptor to the WWTP. The collection system hydraulic model was originally calibrated in 2001 for use in the 2002 Terre Haute Long Term Control Plan. Since that time, the City has made changes in the collection system that warranted model recalibration. The model software originally selected for the collection system was Version 8.0 of EPA's Storm Water Management Model (SWMM) from XP-Software. *The CSO Control Program Model Calibration and Verification Report* can be found in Appendix 3-1. That report, which was approved by IDEM in December 2006, explains the recalibration process for the collection system hydraulic model. The current model software used for the collection system is SWMM2000 Version 8.52 of EPA's Storm Water Management Model (SWMM) from XP-Software, which is an updated version of the previous modeling program. This version of the model is commonly referred to as XP-SWMM and this notation will be used throughout the rest of the report when referring to the model. This subsection also presents the estimated CSO and storm water discharge volumes to the Wabash River in response to actual storms and various size typical storms. The estimated CSO and storm water discharge volumes during the actual storms were used to calibrate and verify the Wabash River computer model.

This subsection presents the following information:

- Description of Terre Haute's XP-SWMM combined sewer system computer model.
- Estimated CSO service areas dry weather flow rates.
- Development of a calibrated XP-SWMM Runoff Block Model to estimate the runoff volumes from the combined sewer areas.
- Development of a calibrated XP-SWMM Extran Block Model to estimate wet weather flow rates through the major trunk sewers and the interceptor.
- Estimate of the CSO volumes and durations to the river.

- Estimate of the storm water volumes to the river.

3.1.2 Combined Sewer System Model

The XP-SWMM model provides the following capabilities for the City:

- Developed from EPA SWMM software for technical and regulatory credibility of results.
- A user-friendly graphical interface for cost-effective use and updating
- A physical based model with formulations explicitly linked to actual conditions in the field as input by the user.
- Can be used to simulate the hydraulic conditions of the modeled trunk sewers, interceptors, gravity sewers, force mains, pump stations, and treatment plants during dry and wet weather.
- Can be used to evaluate CSO control alternatives and interceptor capacities.
- As the CSO control plan is implemented and as the City develops, the XP-SWMM model can be progressively updated.
- Can estimate flows from separate sewered areas.

XP-SWMM is one of the most comprehensive model packages available for assessing CSS. XP-SWMM computations are based on the well-documented and widely accepted USEPA SWMM model. It may be used to simulate continuous (multi-year) or single storm events. It can estimate runoff flow from several subcatchment basins and route the flow through the sewer system to treatment facilities or to the receiving waters.

XP-SWMM has three main simulation blocks; RUNOFF block, TRANSPORT block and EXTRAN block. The RUNOFF block simulates runoff in response to rainfall. Most model parameters that are adjusted during calibration are in the RUNOFF block. The TRANSPORT and EXTRAN blocks simulate conveyance of combined runoff and sanitary flow through conduits and flow diversion structures. The EXTRAN block is capable of simulating surcharged conditions and outfall tail water effects. The TRANSPORT block is incapable of directly simulating these conditions. The EXTRAN block was used to model Terre Haute's trunk sewers to the CSO diversion structures and the interceptor system.

3.1.3 Simulation of Overland Flow

Overland flow or runoff from combined sewer areas is simulated in the XP-SWMM RUNOFF Block. The RUNOFF Block represents a combined sewer area as an aggregate of idealized rectangular subcatchments. It accepts rainfall hyetographs and makes a step-by-step accounting of the rainfall over pervious and impervious areas to synthesize sewer inlet hydrographs for input to the EXTRAN Block. The synthesized runoff hydrographs are based on the surface condition in the combined sewer service areas and is independent of the sewer collection system model.

3.1.4 Simulation of Flow through Trunk Sewers to CSO Diversion Structures

Terre Haute trunk sewers were simulated using the EXTRAN Block. The RUNOFF Block is capable of simulating a complete network of interconnected trunk sewers in either single event or continuous (cumulative) mode. The RUNOFF Block routes the flow as follows:

- It assumes the sewer system is a series of cascading reservoirs ignoring tailwater effects and control points.
- In the event of a surcharge, the RUNOFF Block indicates what section of the trunk sewer system is surcharged and the full flow capacity of the conduit is used during flow routing. Flow in excess of the full flow capacity of the conduit is stored in the upstream manhole until the trunk sewer can handle the flow.

Because of the above limitations of the RUNOFF Block, CSO service area trunk sewers for the Terre Haute model are simulated in the EXTRAN Block. The EXTRAN Block offers the following advantages:

- Simulates surcharged pipe conditions allowing higher than full pipe flow capacity to be conveyed.
- Simulates tailwater effects and control points to estimate the hydraulic grade lines in any sewer segment and at any time during the simulation.

CSO trunk sewers were simulated to mimic the response of the sewer collection system during high rainfall events. The CSO tailwater effects and surcharged conditions can propagate to the upper reach of the trunk sewer during such conditions.

3.1.5 Simulation of Flow Through Interceptor System

The EXTRAN Block determines the combined amount of storm water runoff and dry weather flow that goes through the throttle pipe to the interceptor and through the overflow pipe to the river. The EXTRAN Block uses the synthesized runoff hydrographs as input and simultaneously solves all hydraulic conditions as flow is routed through the conduits and CSO diversion structures.

The EXTRAN Block has the added capability of simulating dry weather flow, pump stations, detention basins and flow diversion structures. The table below summarizes the different types of flow diversion structures used in the model.

TYPE	DESCRIPTION
Orifice	The Orifice can be either a bottom or side discharge orifice (similar to a throttle pipe). Flow in excess of the orifice capacity is routed to the overflow pipe.
Pumps	Used for modeling lift stations.
Weir	The weir can either be a transverse (perpendicular to flow) or side (parallel to flow). Flow diversion occurs when the hydraulic grade line exceeds the weir invert elevation.

3.1.6 Runoff Block Input Data

Basic input to the RUNOFF Block are rainfall data and the watershed parameters. The watershed parameters pertains to the combined sewer service areas only and are as follows:

- Rainfall Data
- Subcatchment areas
- Percent imperviousness
- Subcatchment widths
- Overland slope
- Depression storage
- Overland flow Manning's roughness coefficient
- Soil infiltration parameters

The rainfall data and watershed parameters are described in the following subsections.

3.1.7 Rainfall Data

Rainfall data represents the average precipitation that falls on an area within a defined time interval. Rainfall data can be entered in the model as total rainfall or rainfall intensity occurring within a time interval. The rainfall time interval can be as small as every minute or as large as every hour. Generally, the model results satisfactorily match flow monitor data when the rainfall time interval does not exceed 15 minutes.

3.1.8 Subcatchment Areas

Subcatchment areas represent the surface area that contributes overland wet weather flow to the combined sewers. The subcatchment areas are shown on Figure 3.1-1. The CSO service areas include combined and separate sewered areas. Large CSO service areas were sub-divided into more than one subcatchment to develop a more accurate runoff model. Service Area 008 is a single subcatchment area. Service Areas 010, 009, 007, 005/006, 004/011 and 003 were subdivided into subcatchments, as shown on Figure 3.1-1. (*CSO 002, Main Lift Station is assumed to be impacted by all other basins.)* Table 3.1-1 shows the subcatchment area land use breakdown. Subcatchment boundaries were determined from the sewer system maps, topographical maps and land use. AutoCAD computer software was used to estimate the acreage within a subcatchment boundary. The model represents a subcatchment as a rectangular area with the overland slope perpendicular to the subcatchment width. The point where the runoff enters the sewer is called the point of concentration. Table 3.1-1 shows the area and point of concentration of each subcatchment. The land use for each subcatchment area was determined using aerial photography maps of the City. The different land use areas consisted of single-family residential (houses), multi-family residential (apartment complexes), commercial, industrial and open spaces. The land use of the Indiana State University area contains several buildings, parking lots and some open space and was determined that it closely represented a commercial area. Therefore, during analysis, the university area was added to the commercial area for the subcatchment that the university was located in. The land use acreage is used to estimate the subcatchment's percent imperviousness. Figures 3.1-2A through 3.1-2E show the collection system as laid out for use in the XP-SWMM model.

Table 3.1-1
Subcatchment Area Land Use

CSO Sub-basin	Sub-catchment	Runoff Model Point of Concentration	Total Area (Acres)	Land Use (Acres)						Flow Length (ft)	Elevation Difference (ft)		Rain Gauge
				Single-Family	Multi-Family	Commercial	University	Industrial	Open Space		High	Low	
003	003-1	003-209TN	97.44	70.36	0.00	3.95		4.50	18.63	3800	495	485	5
	003-2	003-204TN	105.04	36.47	0.00	41.50		14.85	12.22	3300	489	478	5
	003-3	003-217TN	86.17	30.05	2.24	36.42		8.02	9.44	2800	492	484	5
	003-4	003-226N	131.17	23.81	14.10	0.00		50.15	43.11	2200	493	487	5
	003-5	003-225TN	194.01	144.02	2.91	15.85		3.67	27.56	4400	491	485	5
004/011	004/011-1	004-292TN	124.33	43.67	0.00	21.75		46.77	12.14	3400	513	486	5
	004/011-2	004-290TN	121.99	110.74	0.00	11.25		0.00	0.00	5700	503	488	3
	004/011-3	011-121N	133.62	81.42	0.00	31.40		16.34	4.46	3600	492	487	4
	004/011-4	004-295TN	152.56	76.28	0.00	0.00		43.70	32.58	4800	491	488	4
	004/011-5	011-083N	129.92	94.01	0.00	0.00		32.76	3.15	5200	502	487	3
	004/011-6	004/011-6N	96.31	34.91	12.18	3.85		24.07	21.30	2900	488	486	4
	004/011-7	004-298TN	77.52	45.06	0.00	4.18		0.00	28.28	2600	488	487	4
	004/011-8	004-140TN	166.07	122.96	0.00	0.00		0.00	43.11	4800	507	487	4
	004/011-9	011-150N	41.92	32.76	0.00	3.99		0.00	5.17	1600	502	497	4
	004/011-10	004-342N	67.82	48.67	0.00	0.00		5.17	13.98	2100	501	489	4
	004/011-11	011-183TN	69.65	69.65	0.00	0.00		0.00	0.00	2400	493	489	4
	004/011-12	011-174TN	73.51	73.51	0.00	0.00		0.00	0.00	4400	500	488	4
	004/011-13	004-245TN	71.87	27.43	0.00	14.42		10.15	19.87	3000	491	488	3
	004/011-14	004-255TN	49.24	33.16	0.00	10.46		0.00	5.62	2000	492	488	3
	004/011-15	004-257N	126.22	112.09	0.00	6.82		0.00	7.31	4000	500	489	4
005/006	005/006-1	005/006-1N	56.43	0.00	30.65	0.00		10.02	15.76	3200	511	467	3
	005/006-2	5/6-210N	28.76	7.44	4.07	17.25		0.00	0.00	3500	513	494	3
	005/006-3	5/6-200N	83.16	78.70	2.34	0.00		0.00	2.12	3400	512	502	3

CSO Sub-basin	Sub-catchment	Runoff Model Point of Concentration	Total Area (Acres)	Land Use (Acres)						Flow Length (ft)	Elevation Difference (ft)		Rain Gauge
				Single-Family	Multi-Family	Commercial	University	Industrial	Open Space		High	Low	
	005/006-4	5/6-100N	102.73	47.15	0.00	29.02		21.52	5.04	2600	512	480	3
007	007-1	007-160N	117.21	0.00	0.00	112.59		0.00	4.62	5100	507	492	3
	007-2	007-120N	137.91	91.62	0.00	42.71		0.00	3.58	3300	495	490	3
	007-3	004-102TN	160.30	118.28	0.00	34.06		0.00	7.96	4400	493	488	3
	007-4	004-061N	200.32	113.82	0.00	49.38		16.87	20.25	3100	502	486	2
	007-5	007-5N	211.66	151.07	0.00	35.60		0.00	24.99	4100	511	487	4
	007-6	004-338TN	185.00	113.89	0.00	12.55		0.00	58.56	3600	503	496	4
	007-7	007-152N	67.06	0.00	0.00	0.00		44.08	22.98	2400	497	485	3
008	008-1	008-100N	86.97	0.00	0.00	40.20	15.10	22.87	8.80	2300	507	489	3
009	009-1	009-325TN	104.83	0.00	0.00	0.00	57.20	32.82	14.81	2800	502	488	3
	009-2	009-312TN	108.40	16.57	0.00	0.00	72.20	0.00	19.63	3000	504	489	3
	009-3	009-092N	108.70	28.76	8.18	43.69		9.37	18.70	2400	494	486	3
010	010-1	010-1N	80.15	17.36	0.00	3.84	11.79	22.20	24.96	3200	502	495	3
	010-2	010-302TN	149.91	74.21	0.00	18.67		6.48	50.55	4000	503	485	3
	010-3	010-236TN	108.38	76.84	0.00	22.02		0.00	9.52	4000	492	486	3
	010-4	010-319TN	68.60	40.09	0.00	17.11		0.00	11.40	4400	502	491	3
	010-5	010-129N	55.83	39.92	0.00	13.09		0.00	2.82	4100	499	487	2
	010-6	010-318TN	110.74	75.03	0.00	33.08		0.00	2.63	3600	495	486	2
	010-7	010-171TN	129.04	81.12	2.64	11.93		14.87	18.48	4200	493	189	2
	010-8	010-270TN	87.32	56.02	0.00	0.00		19.07	12.23	3100	493	488	2
	010-9	010-266N	52.40	39.09	0.00	2.97		0.00	10.34	2800	494	488	2
	010-10	010-018N	109.63	57.48	0.00	0.00		29.72	22.43	3600	503	489	2
	010-11	010-021N	55.55	53.64	0.00	1.91		0.00	0.00	2500	503	496	2
	010-12	010-151TN	60.36	60.36	0.00	0.00		0.00	0.00	2800	495	489	2
	010-13	010-042TN	95.55	71.01	0.00	6.35		0.00	18.19	4200	497	488	2

CSO Sub-basin	Sub-catchment	Runoff Model Point of Concentration	Total Area (Acres)	Land Use (Acres)						Flow Length (ft)	Elevation Difference (ft)		Rain Gauge
				Single-Family	Multi-Family	Commercial	University	Industrial	Open Space		High	Low	
	010-14	010-045N	99.09	90.22	0.00	0.00		0.00	8.87	2800	498	488	2

3.1.9 Percent Impervious

Percent imperviousness is the ratio of hydraulically connected impervious areas (parking lots, streets, etc.) to the total subcatchment area. Hydraulically connected means that the travel path of overland flow is continuous over impervious areas until the point of concentration is reached. Rooftops are considered impervious areas if the rain leaders are directly connected to the combined sewer system.

Values used for percent imperviousness for different land uses are as shown in Table 3.1-2.

Table 3.1-2
Assumed Values of Percent Imperviousness

Land Use	Percent Imperviousness
Single Family Residential	20-33
Multi-Family Residential	57
Commercial	68
Industrial	25-96

A study was conducted by the City to investigate the percentage of rain leaders connected to the combined sewer system. These percentages are shown in Table 3.1-3. The percent imperviousness for each single-family residential land use in each CSO sub-basin varied due to the difference in the percentage of rain leaders connected to the combined sewer system. Therefore the percent imperviousness values for the single-family residential areas range from 20% to 33%. The percent imperviousness for each industrial land use area was calculated individually because each area was significantly different. Therefore, the percent imperviousness values for the industrial areas range from 25% to 96%. The percent imperviousness for each subcatchment is shown in Table 3.1-4.

Table 3.1-3
Rain Leader Estimate

Basin	Percent Not Connected to Sewer	Percent Connected to Sewer
003	85	15
004/011	65	35
005/006	50	50
007	65	35
008	10	90
009	40	60
010	80	20

**002 (Main Lift Station is within Basin 003 and impacted by all basins)*

Table 3.1-4
Percent Imperviousness

CSO Sub-basin	Sub-catchment Number	Total Sub-catchment Area (Acres)	Single Family Land Use			Multi-Family Land Use			Commercial Land Use			Industrial Land Use						Open Area (Acres)	Total Impervious Area (Acres)	% Impervious	Total Pervious Area (Acres)
			Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	Roofs (Acres)	Streets (Acres)	Impervious (Acres)	% Impervious	Pervious (Acres)				
003	003-1	97.44	70.36	20%	56.57	0.00	57%	0.00	3.95	68%	1.26	4.50	0.44	2.03	2.47	55%	2.03	18.63	18.95	19%	78.49
	003-2	105.04	36.47	20%	29.32	0.00	57%	0.00	41.50	68%	13.28	14.85	3.36	8.07	11.43	77%	3.42	12.22	46.80	45%	58.24
	003-3	86.17	30.05	20%	24.16	2.24	57%	0.96	36.42	68%	11.65	8.02	2.27	3.13	5.4	67%	2.62	9.44	37.33	43%	48.84
	003-4	131.17	23.81	20%	19.14	14.10	57%	6.06	0.00	68%	0.00	50.15	9.85	21.67	31.52	63%	18.63	43.11	44.22	34%	86.95
	003-5	194.01	144.02	20%	115.79	2.91	57%	1.25	15.85	68%	5.07	3.67	0.61	2.6	3.21	87%	0.46	27.56	43.87	23%	150.14
004/011	004/011-1	124.33	43.67	23%	33.49	0.00	57%	0.00	21.75	68%	6.96	46.77	5.65	15.12	20.77	44%	26.00	12.14	45.74	37%	78.59
	004/011-2	121.99	110.74	23%	84.94	0.00	57%	0.00	11.25	68%	3.60	0.00			0.00		0.00	0.00	33.45	27%	88.54
	004/011-3	133.62	81.42	23%	62.45	0.00	57%	0.00	31.40	68%	10.05	16.34	7.22	1.26	8.48	52%	7.86	4.46	48.80	37%	84.82
	004/011-4	152.56	76.28	23%	58.51	0.00	57%	0.00	0.00	68%	0.00	43.70	6.42	4.48	10.9	25%	32.80	32.58	28.67	19%	123.89
	004/011-5	129.92	94.01	23%	72.11	0.00	57%	0.00	0.00	68%	0.00	32.76	5.35	7.03	12.38	38%	20.38	3.15	34.28	26%	95.64
	004/011-6	96.31	34.91	23%	26.78	12.18	57%	5.24	3.85	68%	1.23	24.07	6.52	2.92	9.44	39%	14.63	21.30	27.13	28%	69.18
	004/011-7	77.52	45.06	23%	34.56	0.00	57%	0.00	4.18	68%	1.34	0.00			0.00		0.00	28.28	13.34	17%	64.18
	004/011-8	166.07	122.96	23%	94.31	0.00	57%	0.00	0.00	68%	0.00	0.00			0.00		0.00	43.11	28.65	17%	137.42
	004/011-9	41.92	32.76	23%	25.13	0.00	57%	0.00	3.99	68%	1.28	0.00			0.00		0.00	5.17	10.35	25%	31.57
	004/011-10	67.82	48.67	23%	37.33	0.00	57%	0.00	0.00	68%	0.00	5.17	0.59	1.14	1.73	33%	3.44	13.98	13.07	19%	54.75
	004/011-11	69.65	69.65	23%	53.42	0.00	57%	0.00	0.00	68%	0.00	0.00			0.00		0.00	0.00	16.23	23%	53.42
	004/011-12	73.51	73.51	23%	56.38	0.00	57%	0.00	0.00	68%	0.00	0.00			0.00		0.00	0.00	17.13	23%	56.38
	004/011-13	71.87	27.43	23%	21.04	0.00	57%	0.00	14.42	68%	4.61	10.15	2.44	3.02	5.46	54%	4.69	19.87	21.66	30%	50.21
	004/011-14	49.24	33.16	23%	25.43	0.00	57%	0.00	10.46	68%	3.35	0.00			0.00		0.00	5.62	14.84	30%	34.40
	004/011-15	126.22	112.09	23%	85.97	0.00	57%	0.00	6.82	68%	2.18	0.00			0.00		0.00	7.31	30.75	24%	95.47
005/006	005/006-1	56.43	0.00	26%	0.00	30.65	57%	13.18	0.00	68%	0.00	10.02	2.53	7.1	9.63	96%	0.39	15.76	27.10	48%	29.33
	005/006-2	28.76	7.44	26%	5.51	4.07	57%	1.75	17.25	68%	5.52	0.00			0.00		0.00	0.00	15.98	56%	12.78

CSO Sub-basin	Sub-catchment Number	Total Sub-catchment Area (Acres)	Single Family Land Use			Multi-Family Land Use			Commercial Land Use			Industrial Land Use						Open Area (Acres)	Total Impervious Area (Acres)	% Impervious	Total Pervious Area (Acres)
			Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	Roofs (Acres)	Streets (Acres)	Impervious (Acres)	% Impervious	Pervious (Acres)				
	005/006-3	83.16	78.70	26%	58.24	2.34	57%	1.01	0.00	68%	0.00	0.00			0.00		0.00	2.12	21.80	26%	61.36
	005/006-4	102.73	47.15	26%	34.89	0.00	57%	0.00	29.02	68%	9.29	21.52	5.34	13.64	18.98	88%	2.54	5.04	50.97	50%	51.76
007	007-1	117.21	0.00	23%	0.00	0.00	57%	0.00	112.59	68%	36.03	0.00			0.00		0.00	4.62	76.56	65%	40.65
	007-2	137.91	91.62	23%	70.27	0.00	57%	0.00	42.71	68%	13.67	0.00			0.00		0.00	3.58	50.39	37%	87.52
	007-3	160.30	118.28	23%	90.72	0.00	57%	0.00	34.06	68%	10.90	0.00			0.00		0.00	7.96	50.72	32%	109.58
	007-4	200.32	113.82	23%	87.30	0.00	57%	0.00	49.38	68%	15.80	16.87	4.04	7.11	11.15	66%	5.72	20.25	71.25	36%	129.07
	007-5	211.66	151.07	23%	115.87	0.00	57%	0.00	35.60	68%	11.39	0.00			0.00		0.00	24.99	59.41	28%	152.25
	007-6	185.00	113.89	23%	87.35	0.00	57%	0.00	12.55	68%	4.02	0.00			0.00		0.00	58.56	35.07	19%	149.93
	007-7	67.06	0.00	23%	0.00	0.00	57%	0.00	0.00	68%	0.00	44.08	8.15	12.15	20.3	46%	23.78	22.98	20.30	30%	46.76
008	008-1	86.97	0.00	33%	0.00	0.00	57%	0.00	55.30	73%	14.93	22.87	2.18	13.86	16.04	70%	6.83	8.80	56.41	65%	30.56
009	009-1	104.83	0.00	28%	0.00	0.00	57%	0.00	57.20	86%	8.01	32.82	20.26	6.96	27.22	83%	5.60	14.81	76.41	73%	28.42
	009-2	108.40	16.57	28%	11.96	0.00	57%	0.00	72.20	87%	9.39	0.00			0.00		0.00	19.63	67.42	62%	40.98
	009-3	108.70	28.76	28%	20.76	8.18	57%	3.52	43.69	68%	13.98	9.37	1.58	1.67	3.25	35%	6.12	18.70	45.62	42%	63.08
010	010-1	80.15	17.36	24%	13.16	0.00	57%	0.00	15.63	92%	1.25	22.20	4.6	4.15	4.15	19%	18.05	24.96	27.33	34%	52.82
	010-2	149.91	74.21	24%	56.25	0.00	57%	0.00	18.67	68%	5.97	6.48	1.11	2.07	2.07	32%	4.41	50.55	33.83	23%	116.08
	010-3	108.38	76.84	24%	58.24	0.00	57%	0.00	22.02	68%	7.05	0.00			0.00		0.00	9.52	33.57	31%	74.81
	010-4	68.60	40.09	24%	30.39	0.00	57%	0.00	17.11	68%	5.48	0.00			0.00		0.00	11.40	21.34	31%	47.26
	010-5	55.83	39.92	24%	30.26	0.00	57%	0.00	13.09	68%	4.19	0.00			0.00		0.00	2.82	18.56	33%	37.27
	010-6	110.74	75.03	24%	56.87	0.00	57%	0.00	33.08	68%	10.59	0.00			0.00		0.00	2.63	40.65	37%	70.09
	010-7	129.04	81.12	24%	61.49	2.64	57%	1.14	11.93	68%	3.82	14.87	3.88	6.31	10.19	69%	4.68	18.48	39.44	31%	89.60
	010-8	87.32	56.02	24%	42.46	0.00	57%	0.00	0.00	68%	0.00	19.07	2.8	9.63	12.43	65%	6.64	12.23	25.99	30%	61.33
	010-9	52.40	39.09	24%	29.63	0.00	57%	0.00	2.97	68%	0.95	0.00			0.00		0.00	10.34	11.48	22%	40.92
	010-10	109.63	57.48	24%	43.57	0.00	57%	0.00	0.00	68%	0.00	29.72	3.82	14.11	17.93	60%	11.79	22.43	31.84	29%	77.79
	010-11	55.55	53.64	24%	40.66	0.00	57%	0.00	1.91	68%	0.61	0.00			0.00		0.00	0.00	14.28	26%	41.27
	010-12	60.36	60.36	24%	45.75	0.00	57%	0.00	0.00	68%	0.00	0.00			0.00		0.00	0.00	14.61	24%	45.75

CSO Sub-basin	Sub-catchment Number	Total Sub-catchment Area (Acres)	Single Family Land Use			Multi-Family Land Use			Commercial Land Use			Industrial Land Use						Open Area (Acres)	Total Impervious Area (Acres)	% Impervious	Total Pervious Area (Acres)
			Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	% Impervious	Pervious (Acres)	Total (Acres)	Roofs (Acres)	Streets (Acres)	Impervious (Acres)	% Impervious	Pervious (Acres)				
	010-13	95.55	71.01	24%	53.83	0.00	57%	0.00	6.35	68%	2.03	0.00			0.00		0.00	18.19	21.50	23%	74.05
	010-14	99.09	90.22	24%	68.39	0.00	57%	0.00	0.00	68%	0.00	0.00			0.00		0.00	8.87	21.83	22%	77.26

3.1.9.1 Subcatchment Widths

Subcatchment width determines the shape of the runoff hydrograph. Higher peak flow rates and more immediate response to a storm event can be achieved when the subcatchment width is increased for the same area. For model calibration this parameter is adjusted to match the model's peak runoff rate to the flow monitor's peak runoff rate without significant change in the model's runoff volume. The widths for each subcatchment are shown in Table 3.1-4.

3.1.9.2 Overland Slope

Overland slope affects the travel time of overland flow, peak runoff rate and runoff volume. Steeper slope decreases the travel time, increases the peak runoff rate and increases the runoff volume. Average overland slope was estimated by overlaying the subcatchment area boundary over current USGS contour maps. The overland slope for each subcatchment is shown in Table 3.1-4.

3.1.9.3 Depression Storage

Depression storage relates to both pervious and impervious areas and is defined as the amount of incidental surface depressions that must be filled before runoff begins. For pervious areas, the following values were used prior to calibration (Greeley and Hansen Engineers, 1994):

Land Use	Pervious Depression Storage
Residential/Commercial	0.20
Industrial/Open Grass Area	0.15

Impervious depression storage is a function of the average subcatchment slope and was estimated from the following equation (Kidd, 1978 referenced in Huber and Dickinson, 1988):

$$\text{Depression storage (in)} = 0.0303 \text{ x } (\text{average slope } (\%))^{-0.49}$$

The values for the pervious and impervious depression storage for each subcatchment are shown in Table 3.1-5.

Table 3.1-5
Model Input Data

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Green Ampt Parameters			Rain Gauge
							Impervious	Pervious	Impervious	Pervious	Permeability (in/hr)	Initial Moisture Deficit (in/in)	Capillary Suction (in)	
003	003-1	003-209TN	97.44	19%	1117	0.009	0.305	0.188	0.014	0.20	0.630	0.140	4.330	5
	003-2	003-204TN	105.04	45%	1387	0.008	0.324	0.187	0.014	0.20	1.247	0.140	4.330	5
	003-3	003-217TN	86.17	43%	1341	0.006	0.373	0.190	0.014	0.20	1.726	0.140	4.330	5
	003-4	003-226N	131.17	34%	2597	0.002	0.593	0.164	0.014	0.19	0.630	0.140	4.330	5
	003-5	003-225TN	194.01	23%	1921	0.003	0.512	0.192	0.014	0.20	2.000	0.140	4.330	5
004/011	004/011-1	004-292TN	124.33	37%	1593	0.017	0.223	0.176	0.014	0.18	2.000	0.140	4.330	5
	004/011-2	004-290TN	121.99	27%	932	0.016	0.229	0.200	0.014	0.20	2.000	0.140	4.330	3
	004/011-3	011-121N	133.62	37%	1617	0.003	0.514	0.192	0.014	0.20	2.000	0.140	4.330	4
	004/011-4	004-295TN	152.56	19%	1384	0.002	0.612	0.175	0.014	0.19	2.000	0.140	4.330	4
	004/011-5	011-083N	129.92	26%	1088	0.014	0.247	0.186	0.014	0.19	1.863	0.149	4.554	3
	004/011-6	004/011-6N	96.31	28%	1447	0.001	0.763	0.176	0.014	0.19	2.430	0.137	4.138	4
	004/011-7	004-298TN	77.52	17%	1299	0.001	1.016	0.182	0.014	0.20	2.147	0.143	4.346	4
	004/011-8	004-140TN	166.07	17%	1507	0.013	0.252	0.187	0.014	0.20	3.075	0.133	3.850	4
	004/011-9	011-150N	41.92	25%	1141	0.004	0.434	0.194	0.014	0.20	2.000	0.140	4.330	4
	004/011-10	004-342N	67.82	19%	1407	0.009	0.313	0.186	0.014	0.20	4.013	0.134	3.594	4
	004/011-11	011-183TN	69.65	23%	1264	0.003	0.509	0.200	0.014	0.20	2.000	0.140	4.330	4
	004/011-12	011-174TN	73.51	23%	728	0.016	0.226	0.200	0.014	0.20	2.860	0.134	3.946	4
	004/011-13	004-245TN	71.87	30%	1044	0.003	0.533	0.179	0.014	0.20	0.630	0.230	6.570	3
	004/011-14	004-255TN	49.24	30%	1072	0.004	0.469	0.194	0.014	0.20	3.010	0.160	4.416	3
	004/011-15	004-257N	126.22	24%	1375	0.008	0.323	0.197	0.014	0.20	2.000	0.140	4.330	4
005/006	005/006-1	005/006-1N	56.43	48%	768	0.057	0.123	0.177	0.014	0.20	2.000	0.140	4.330	3

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Green Ampt Parameters			Rain Gauge
							Impervious	Pervious	Impervious	Pervious	Permeability (in/hr)	Initial Moisture Deficit (in/in)	Capillary Suction (in)	
	005/006-2	5/6-210N	28.76	56%	358	0.053	0.128	0.200	0.014	0.20	2.000	0.140	4.330	3
	005/006-3	5/6-200N	83.16	26%	1065	0.009	0.298	0.199	0.014	0.20	2.000	0.140	4.330	3
	005/006-4	5/6-100N	102.73	50%	1721	0.019	0.214	0.187	0.014	0.20	2.000	0.140	4.330	3
007	007-1	007-160N	117.21	65%	1001	0.015	0.237	0.198	0.014	0.20	1.795	0.154	4.666	3
	007-2	007-120N	137.91	37%	1820	0.003	0.545	0.199	0.014	0.20	1.197	0.217	5.847	3
	007-3	004-102TN	160.30	32%	1587	0.003	0.510	0.198	0.014	0.20	0.904	0.206	4.894	3
	007-4	004-061N	200.32	36%	2815	0.006	0.382	0.191	0.014	0.20	0.904	0.206	4.894	2
	007-5	007-5N	211.66	28%	2249	0.011	0.280	0.194	0.014	0.20	1.863	0.148	4.247	4
	007-6	004-338TN	185.00	19%	2239	0.003	0.511	0.184	0.014	0.20	1.521	0.171	4.961	4
	007-7	007-152N	67.06	30%	1217	0.01	0.291	0.150	0.014	0.17	0.767	0.221	6.346	3
008	008-1	008-100N	86.97	65%	1647	0.011	0.277	0.147	0.014	0.19	2.000	0.140	4.330	3
009	009-1	009-325TN	104.83	73%	1631	0.009	0.312	0.068	0.014	0.19	2.000	0.140	4.330	3
	009-2	009-312TN	108.40	62%	1574	0.01	0.296	0.058	0.014	0.20	2.000	0.140	4.330	3
	009-3	009-092N	108.70	42%	1973	0.004	0.450	0.187	0.014	0.20	1.863	0.149	4.554	3
010	010-1	010-1N	80.15	34%	1091	0.006	0.360	0.141	0.014	0.19	2.000	0.140	4.330	3
	010-2	010-302TN	149.91	23%	1633	0.011	0.276	0.181	0.014	0.20	2.000	0.140	4.330	3
	010-3	010-236TN	108.38	31%	1180	0.005	0.403	0.196	0.014	0.20	2.000	0.140	4.330	3
	010-4	010-319TN	68.60	31%	679	0.016	0.228	0.192	0.014	0.20	3.505	0.130	3.658	3
	010-5	010-129N	55.83	33%	593	0.02	0.205	0.197	0.014	0.20	2.000	0.140	4.330	2
	010-6	010-318TN	110.74	37%	1340	0.007	0.352	0.199	0.014	0.20	2.000	0.140	4.330	2
	010-7	010-171TN	129.04	31%	1338	0.003	0.523	0.187	0.014	0.20	1.726	0.158	4.686	2
	010-8	010-270TN	87.32	30%	1227	0.004	0.449	0.182	0.014	0.19	2.000	0.140	4.330	2
	010-9	010-266N	52.40	22%	815	0.007	0.336	0.190	0.014	0.20	2.000	0.140	4.330	2
	010-10	010-018N	109.63	29%	1327	0.011	0.282	0.176	0.014	0.19	1.932	0.145	4.442	2

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Green Ampt Parameters			Rain Gauge
							Impervious	Pervious	Impervious	Pervious	Permeability (in/hr)	Initial Moisture Deficit (in/in)	Capillary Suction (in)	
	010-11	010-021N	55.55	26%	968	0.007	0.339	0.200	0.014	0.20	0.973	0.205	5.396	2
	010-12	010-151TN	60.36	24%	939	0.006	0.360	0.200	0.014	0.20	1.247	0.188	5.255	2
	010-13	010-042TN	95.55	23%	991	0.009	0.303	0.190	0.014	0.20	0.767	0.218	5.732	2
	010-14	010-045N	99.09	22%	1542	0.006	0.358	0.196	0.014	0.20	0.630	0.225	5.496	2

3.1.9.4 Mannings' Roughness Coefficient

The following Manning's roughness coefficients were used for pervious overland flow (Crawford and Linsley, 1966 and Engman, 1936, referenced in Huber and Dickinson, 1988):

Land Use	**Manning Coefficient**
Residential/Commercial	0.20
Industrial	0.15

The Manning's roughness coefficient used for impervious overland flow was 0.015.

3.1.9.5 Soil Infiltration

Infiltration parameters influence the runoff hydrograph from the combined sewer system subcatchments by absorbing rainfall into the soil. The infiltration capacity of the soil is exceeded when the soil becomes saturated during continuous simulation and heavy precipitation. When soil saturation is reached, most of the subsequent rainfall becomes runoff making the pervious areas behave as impervious areas.

The Green-Ampt infiltration equation was used to represent the soil infiltration parameters. The percentage of the different soil types for each subcatchment was determined from the *Soil Survey of Vigo County, Indiana* obtained from the United States Department of Agriculture (USDA, 1974). For each type of soil, the values of the saturated hydraulic conductivity (permeability, in./hr.) and the available water capacity (initial moisture deficit, in./in.) were found in the *Soil Survey of Vigo County, Indiana.* The values of the average capillary suction (inch) were found using the *Handbook of Hydrology* (D.R. Maidment, 1993). Once all the soil infiltration parameters were determined for each soil, a value for each parameter was calculated for each subcatchment and then entered into the model. The values for each parameter are shown in Table 3.1-6.

Table 3.1-6
Green-Ampt Parameters

	Soil Type											
Soil Characteristics	AdB	Cr	EiA	EiB	Ma[3]	Pt	Rg	Rn	Tp	WrA	WrB2	Ws
Permeability (in/hr) [1]	6.3 - 20.0	.63 - 2.0	2.0 - 6.3	2.0 - 6.3	.63 - 2.0	.63 - 2.0	.63 - 2.0	.63 - 2.0	.63 - 2.0	.63 - 2.0	.63 - 2.0	.63 - 2.0
Selected Permeability (in/hr)	6.3	0.63	2	2	2	0.63	0.63	0.63	0.6	0.6	0.63	0.63
Available Water Capacity (in/in)	.10 - .12	.22 - .24	.13 - .15	.13 - .15	.13 - .16	.22 - .24	.20 - .23	.20 - .23	.13 - .15	.13 - .15	.13 - .15	.22 - .24
Average AWC	0.11	0.23	0.14	0.14	0.14	0.23	0.215	0.215	0.14	0.14	0.14	0.23
Soil Classification [1]	Loamy Sand	Silt Loam	Sandy Loam	Sandy Loam	Sandy Loam	Silt Loam	Loam	Loam	Silt Loam	Sandy Loam	Sandy Loam	Silt Loam
Suct (in) [2]	2.41	6.57	4.33	4.33	4.33	6.57	3.50	3.50	6.57	4.33	4.33	6.57

													Computed Parameters		
Subcatchment	Percent Soil Type												Permeability	Initial Moisture	Capilary
Number	AdB	Cr	EiA	EiB	Ma[3]	Pt	Rg	Rn	Tp	WrA	WrB2	Ws	(in/hr)	Deficit (in/in)	Suction (in)
003-1										65%	35%		0.630	0.140	4.330
003-2			45%							55%			1.247	0.140	4.330
003-3			80%							20%			1.726	0.140	4.330
003-4					8%					88%	4%		0.630	0.140	4.330
003-5			100%										2.000	0.140	4.330
004/011-1			90%	10%									2.000	0.140	4.330
004/011-2			45%	55%									2.000	0.140	4.330
004/011-3			96%	4%									2.000	0.140	4.330
004/011-4			97%	3%									2.000	0.140	4.330
004/011-5			85%	5%		10%							1.863	0.149	4.554
004/011-6	10%		90%										2.430	0.137	4.138
004/011-7	5%		90%			5%							2.147	0.143	4.346

004/011-8	25%		60%	15%									3.075	0.133	3.850
004/011-9			45%	55%									2.000	0.140	4.330
004/011-10	50%		40%			10%							4.013	0.134	3.594
004/011-11			100%										2.000	0.140	4.330
004/011-12	20%		80%										2.860	0.134	3.946
004/011-13						100%							0.630	0.230	6.570
004/011-14	34%		33%			33%							3.010	0.160	4.416
004/011-15			92%	8%									2.000	0.140	4.330
005/006-1			35%	65%									2.000	0.140	4.330
005/006-2			50%	50%									2.000	0.140	4.330
005/006-3			75%	25%									2.000	0.140	4.330
005/006-4			85%	15%									2.000	0.140	4.330
007-1			80%	5%		15%							1.795	0.154	4.666
007-2	10%					80%	10%						1.197	0.217	5.847
007-3			10%	10%		40%	40%						0.904	0.206	4.894
007-4			10%	10%		40%	40%						0.904	0.206	4.894
007-5			70%	20%			10%						1.863	0.148	4.247
007-6		20%	55%	10%				5%	10%				1.521	0.171	4.961
007-7			10%			90%							0.767	0.221	6.346
008-1			100%										2.000	0.140	4.330
009-1			100%										2.000	0.140	4.330
009-2			100%										2.000	0.140	4.330
009-3			90%			10%							1.863	0.149	4.554
010-1			100%										2.000	0.140	4.330
010-2			100%										2.000	0.140	4.330
010-3			100%										2.000	0.140	4.330
010-4	35%		65%										3.505	0.130	3.658
010-5			100%										2.000	0.140	4.330
010-6			100%										2.000	0.140	4.330
010-7			80%			17%	3%						1.726	0.158	4.680

010-8			100%										2.000	0.140	4.330
010-9			100%										2.000	0.140	4.330
010-10			95%			5%							1.932	0.145	4.442
010-11				25%		40%		20%				15%	0.973	0.205	5.396
010-12			45%			45%	10%						1.247	0.188	5.255
010-13			10%			70%	20%						0.757	0.218	5.732
010-14						65%		35%					0.630	0.225	5.496

3.1.10 Dry Weather Flow

Dry weather flow to the CSO diversion structure is the sum of sanitary flow and infiltration. Dry weather flow is estimated based on land use and flow monitoring information. Dry weather flow to a CSO diversion structure was estimated as follows:

- Identify the major dry weather flow contributors based on water consumption data.
- Identify the land use and area of each major dry weather flow contributor.
- Estimate the area of residential, multi-family, commercial, industrial and open area land uses for each CSO service area.
- Estimate the dry weather flow for each land use and major contributor.
- Compare estimated dry weather flows to flow monitoring data and adjust dry weather flows as necessary.

Table 3.1-7 shows the estimated dry weather flow for each CSO service area subcatchment. Dry weather flow is broken down by land use and infiltration. The dry weather flow was used as input for each service area subcatchment's point of concentration in the EXTRAN model.

Table 3.1-7
Dry Weather Flow Estimation

CSO Sub-basin	Sub-catchment	Runoff Model Point of Conc.	Total Area (Acres)	Land Use (Acres)						Dry Weather (gpd)				
				Single-Family	Multi-Family	Commercial	University	Industrial	Open Space	Infiltration	Residential	Commercial	Point (mgd)	Point (cfs)
003	003-1	003-209TN	97.44	70.36	0.00	3.95	0.00	4.50	18.63	10,213	26,049	1,971	0.038	0.059
	003-2	003-204TN	105.04	36.47	0.00	41.50	0.00	14.85	12.22	12,029	13,502	20,710	0.046	0.072
	003-3	003-217TN	86.17	30.05	2.24	36.42	0.00	8.02	9.44	9,944	11,955	18,175	0.040	0.062
	003-4	003-226N	131.17	23.81	14.10	0.00	0.00	50.15	43.11	11,412	14,035	0	0.025	0.039
	003-5	003-225TN	194.01	144.02	2.91	15.85	0.00	3.67	27.56	21,571	54,398	7,910	0.084	0.130
003	003-6	003-400N*	2086.82	250.00	125.00	250.00	0.00		1461.00	81,101	138,837	124,762	0.345	0.533
004/011	004/011-1	004-292TN	124.33	43.67	0.00	21.75	0.00	46.77	12.14	14,539	16,168	10,854	0.042	0.064
	004/011-2	004-290TN	121.99	110.74	0.00	11.25	0.00	0.00	0.00	15,809	40,999	5,614	0.062	0.097
	004/011-3	011-121N	133.62	81.42	0.00	31.40	0.00	16.34	4.46	16,738	30,144	15,670	0.063	0.097
	004/011-4	004-295TN	164.52	76.28	0.00	0.00	0.00	43.70	32.58	17,098	28,241	0	0.045	0.070
	004/011-5	011-083N	129.92	94.01	0.00	0.00	0.00	32.76	3.15	16,428	34,805	0	0.051	0.079
	004/011-6	004/011-6N	96.31	34.91	12.18	3.85	0.00	24.07	21.30	9,721	17,434	1,921	0.029	0.045
	004/011-7	004-298TN	77.52	45.06	0.00	4.18	0.00	0.00	28.28	6,381	16,683	2,086	0.025	0.039
	004/011-8	004-140TN	166.07	122.96	0.00	0.00	0.00	0.00	43.11	15,935	45,524	0	0.061	0.095
	004/011-9	011-150N	41.92	32.76	0.00	3.99	0.00	0.00	5.17	4,762	12,129	1,991	0.019	0.029
	004/011-10	004-342N	67.82	48.67	0.00	0.00	0.00	5.17	13.98	6,977	18,019	0	0.025	0.039
	004/011-11	011-183TN	69.65	69.65	0.00	0.00	0.00	0.00	0.00	9,026	25,787	0	0.035	0.054
	004/011-12	011-174TN	73.51	73.51	0.00	0.00	0.00	0.00	0.00	9,526	27,216	0	0.037	0.057
	004/011-13	004-245TN	71.87	27.43	0.00	14.42	0.00	10.15	19.87	6,739	10,155	7,196	0.024	0.037
	004/011-14	004-255TN	49.24	33.16	0.00	10.46	0.00	0.00	5.62	5,653	12,277	5,220	0.023	0.036
	004/011-15	004-257N	126.22	112.09	0.00	6.82	0.00	0.00	7.31	15,410	41,499	3,404	0.060	0.093
Sep-4/11	004/011-16	011-190TN	1079.00	100.00	600.00	79.00	0.00	0.00	300.00	100,952	259,162	39,425	0.400	0.618
Sep-4/11	004/011-17	011-190TN	400.00	30.00	198.00	30.00	0.00	0.00	142.00	33,435	84,413	14,971	0.133	0.206
005/006	005/006-1	005/006-1N	56.43	0.00	30.65	0.00	0.00	10.02	15.76	5,270	11,348	0	0.017	0.026

CSO Sub-basin	Sub-catchment	Runoff Model Point of Conc.	Total Area (Acres)	Land Use (Acres)						Dry Weather (gpd)				
				Single-Family	Multi-Family	Commercial	University	Industrial	Open Space	Infiltration	Residential	Commercial	Point (mgd)	Point (cfs)
	005/006-2	5/6-210N	28.76	7.44	4.07	17.25	0.00	0.00	0.00	3,727	4,261	8,609	0.017	0.026
	005/006-3	5/6-200N	83.16	78.70	2.34	0.00	0.00	0.00	2.12	10,502	30,004	0	0.041	0.063
	005/006-4	5/6-100N	102.73	47.15	0.00	29.02	0.00	21.52	5.04	12,660	17,456	14,482	0.045	0.069
Sep-5/6	005/006-5	3071N	36.22	0.00	0.00	0.00	0.00	10.00	26.00	1,324	0	0	0.001	0.002
007	007-1	007-160N	117.21	0.00	0.00	112.59	0.00	0.00	4.62	14,591	0	56,188	0.071	0.110
	007-2	007-120N	137.91	91.62	0.00	42.71	0.00	0.00	3.58	17,408	33,921	21,314	0.073	0.112
	007-3	004-102TN	160.30	118.28	0.00	34.06	0.00	0.00	7.96	19,742	43,791	16,998	0.081	0.125
	007-4	004-061N	200.32	113.82	0.00	49.38	0.00	16.87	20.25	23,336	42,140	24,643	0.090	0.139
	007-5	007-5N	211.66	151.07	0.00	35.60	0.00	0.00	24.99	24,191	55,931	17,766	0.098	0.151
	007-6	004-338TN	185.00	113.89	750.00	12.55	0.00	0.00	58.56	16,386	42,166	6,263	0.065	0.100
	007-7	007-152N	67.06	0.00	0.00	0.00	0.00	44.08	22.98	5,712	0	0	0.006	0.009
Sep-7	007-8	004-332TN*	2890.00	275.00	0.00	50.00	0.00	0.00	1815.00	139,311	379,487	24,952	0.544	0.841
008	008-1	008-100N	86.97	0.00	0.00	40.20	15.10	22.87	8.80	10,130	0	27,597	0.038	0.058
Sep-8	008-2	301TN	7.61	0.00	0.00	0.00	0.00	4.11	3.50	533	0	0	0.001	0.001
009	009-1	009-325TN	104.83	0.00	8.18	0.00	57.20	32.82	14.81	11,666	0	28,546	0.040	0.062
	009-2	009-312TN	108.40	16.57	0.00	0.00	72.20	0.00	19.63	11,504	6,135	36,031	0.054	0.083
	009-3	009-092N	108.70	28.76	0.00	43.69	0.00	9.37	18.70	11,663	13,676	21,803	0.047	0.073
Sep-9	009-4	1201N	7.27	0.00	0.00	0.00	0.00	5.27	2.00	683	0	0	0.001	0.001
010	010-1	010-1N	80.15	17.36	0.00	3.84	11.79	22.20	24.96	7,152	6,427	7,800	0.021	0.033
	010-2	010-302TN	149.91	74.21	0.00	18.67	0.00	6.48	50.55	12,876	27,475	9,317	0.050	0.077
	010-3	010-236TN	108.38	76.84	0.00	22.02	0.00	0.00	9.52	12,811	28,449	10,989	0.052	0.081
	010-4	010-319TN	68.60	40.09	2.64	17.11	0.00	0.00	11.40	7,413	14,843	8,539	0.031	0.048
	010-5	010-129N	55.83	39.92	0.00	13.09	0.00	0.00	2.82	6,870	14,780	6,533	0.028	0.044
	010-6	010-318TN	110.74	75.03	0.00	33.08	0.00	0.00	2.63	14,010	27,778	16,509	0.058	0.090
	010-7	010-171TN	126.40	81.12	0.00	11.93	0.00	14.87	18.48	13,986	31,011	5,954	0.051	0.079
	010-8	010-270TN	87.32	56.02	0.00	0.00	0.00	19.07	12.23	9,731	20,740	0	0.030	0.047
	010-9	010-266N	52.40	39.09	0.00	2.97	0.00	0.00	10.34	5,451	14,472	1,482	0.021	0.033

				Land Use (Acres)						Dry Weather (gpd)				
CSO Sub-basin	Sub-catchment	Runoff Model Point of Conc.	Total Area (Acres)	Single-Family	Multi-Family	Commercial	University	Industrial	Open Space	Infiltration	Residential	Commercial	Point (mgd)	Point (cfs)
	010-10	010-018N	109.63	57.48	0.00	0.00	0.00	29.72	22.43	11,300	21,281	0	0.033	0.050
	010-11	010-021N	55.55	53.64	0.00	1.91	0.00	0.00	0.00	7,199	19,859	953	0.028	0.043
	010-12	010-151TN	60.36	60.36	0	0.00	0.00	0.00	0.00	7,822	22,347	0	0.030	0.047
	010-13	010-042TN	95.55	71.01	0	6.35	0.00	0.00	18.19	10,025	26,290	3,169	0.039	0.061
	010-14	010-045N	99.09	90.22	0	0.00	0.00	0.00	8.87	11,692	33,402	0	0.045	0.070
Sep-10	010-15	010-033TN*	2902	855.00	500	150	0.00	0.00	1397	195,035	501,663	74,857	0.772	1.194
Sep-10	010-16	010-033TN*	2975	1800.00	0	650	0.00	0.00	525	317,499	666,416	324,381	1.308	2.024
WWTP			6932	1500.00	750	586	0.00	0.00	4097	367,392	833,020	292,442	0.149	2.310
Total			24464	7721	3002	2549	156	459	10496.65	1,810,000	3,970,000	1,350,000	7.130	11.033

3.1.11 Trunk Sewer and Main Interceptor Data for Model

The nine major trunk sewers were simulated in the EXTRAN model. Pipe lengths, sizes and slopes were determined from sewer system maps provided by the City. If the City record maps did not show the slope of the trunk sewer, the minimum of ground slope or the minimum pipe slope to obtain 2 feet per second full pipe flow velocity was used as input to the EXTRAN model.

3.1.12 Other Model Data

The City provided manhole numbers for each modeled manhole. For modeling purposes, the letter N was added to the end of each manhole number to designate a node in the model. The conduit downstream of the manhole has the same name as the manhole, but with the letter L added to the end of it to designate it as a link (pipe) in the model. The example below illustrates the model node and link names with the first three numbers corresponding to the CSO service area:

Manhole - 004-097TN

Downstream Conduit - 004-097TL

CSO structures were labeled as CSO0XX where XX is the CSO service area number. CSO overflow links and nodes were labeled as CSO0XXOF___ where the last character identifies the element as a pipe or manhole, L or N respectively.

3.1.12.1Computational Time Step

The RUNOFF Block utilizes the following time steps:

Wet time step - 60 seconds,

Wet/Dry time step - 60 seconds, and

Dry time step - 86,400 seconds.

The EXTRAN Block utilizes a time step of 60 seconds.

3.2 CS Model Calibration and Verification

3.2.1 Objectives

This section describes the XP-SWMM model calibration and verification. The objective of the calibration and verification process is to obtain a calibrated and verified model that is acceptable to the regulatory agencies for CSO Control Alternatives Evaluation. The previously submitted "CSO Program Model Calibration and Verification" report was reviewed by IDEM and approved for use in further alternative analysis December 2006.

3.2.2 Model Development

3.2.2.1 Model Input Data

The model data needed for calibration is comprised of two types of data: Rainfall data and flow monitoring data. This section describes the data used in the calibration and verification of the model.

3.2.2.2 Flow Monitoring Program

Seventeen area-velocity flow meters were placed within the collection system to measure flow for a six month period. Meters gathered data in the collection system from May 18, 2005 to November 22, 2005. The data were collected in 5-minute increments.

Flow meters were installed in three types of locations to assist in calibration: upstream in the system, downstream in the system and on interceptors. Table 3.2-1 shows the location of the flow meters installed in the system.

Table 3.2.1
Flow Monitoring Locations

Meter	Location	Installation Date
FM01	Intersection of 3rd Ave. and 7th St.	18-May-05
FM02	Intersection of 8th and Elm St.	18-May-05
FM03	Intersection of Spruce and Water St.	23-May-05
FM04	Intersection of Mulberry St. and Water St.	23-May-05
FM05	Just southwest of Lafayette and 4th St.	18-May-05
FM06	Intersection of 5th and Spruce St. At ISU	18-May-05
FM07	Intersection of Ohio and 15th. Line flowing from east to west	4-May-05
FM08	Intersection of Ohio and 15th. Line flowing from north to south	4-May-05

Meter	Location	Installation Date
FM09	On Walnut St. between 1st and 2nd St.	18-May-05
FM10	In the parking lot of Fairbanks Park	23-May-05
FM11	The Idaho line. Located in the Junkyard	23-May-05
FM12	At the intersection of Praireton and Hulman St.	23-May-05
FM13	Intersection of 18th and Franklin St.	18-May-05
FM14	Intersection of 15th and Park	18-May-05
FM15	Intersection of 14th and Park	18-May-05
FM16	On side of drive of the Main Lift Station	23-May-05
FM18	Intersection of Turner and Dillman St.	23-May-05

Upstream Meters

Flow meters that were installed significantly upstream of the interceptor and upstream of major inputs and diversion structures are referred to as "upstream meters". The upstream meters provide redundancy and a quality control check to the downstream meters. The upstream meters typically yield higher quality flow data because they are in more ideal flow metering conditions that the downstream meters (i.e. not adjacent to weirs that cause turbulent hydraulic conditions).

Downstream Meters

Flow meters that were installed downstream of all major inputs and close to the CSO diversion structures that split flow to the interceptor and to an outfall are referred to as "downstream meters". The downstream meters measure the total runoff from an entire CSO area.

The hydraulic conditions close to weirs is variable and can cause uncertainty in downstream flow monitoring data. Upstream meters were used as a tool in downstream meter calibration.

Interceptors

Flow meters were installed on the interceptor to measure the flow split between the outfall and the throttle pipe to the interceptor.

3.2.2.3 Rainfall Data

The City of Terre Haute has four main rain gauges in the collection system that it uses to record rainfall. The gauges are tipping bucket type gauges that tip after collecting 0.01 inches of rain.

During the flow monitoring period, an additional three rain gauges were installed. Table 3.2-2 lists the rainfall events during the 2005 flow monitoring period.

Table 3.2-2
2005 Monitored Rainfall Events

Date	Average Rainfall (inches)	Rainfall Range for Rain Gauges[3] (inches)	Duration (hours)	Maximum Intensity (in/hr)	No. of Dry Days Prior to Storm
5/19/2005	0.56	0.35 - 0.86	1.2	0.85	3
6/12/2005[1]	1.70	1.51 - 1.80	10.2	0.61	1
7/11/2005	0.55	0.44 - 0.74	8.8	0.35	24
7/21/2005[2]	1.79	1.74 - 1.87	4.3	1.04	2
7/26/2005	0.50	0.45 - 0.56	3.6	0.38	4
8/12/2005	1.09	0.81 - 1.48	7.8	0.84	15
8/13/2005	0.56	0.46 - 0.73	3.3	0.59	0
8/19/2005	0.98	0.39 - 1.43	4.0	0.77	4
8/30/2005	0.42	0.31 - 0.51	11.7	0.13	2
9/19/2005	0.87	0.68 - 1.18	9.5	0.30	2
9/25/2005	1.77	1.55 - 2.05	18.1	0.52	4
9/25/2005[1]	0.57	0.52 - 0.59	3.5	0.40	2

[1] Model Calibration storms

[2] Model Verification storm

[3] Rain guages from 4 City rain gauges and 3 ADS rain gauges

Each subcatchment was assigned a rain gauge for model calibration based on the Thiessen Polygon method.

3.2.2.4 Model Update

The XP-SWMM model was originally calibrated in 2002. The XP-SWMM model was updated in 2005. The following updates were made:

- City staff raised weirs. The weir heights were updated in the model based on measurements conducted by the City.
- 1st Street cross connections and Oak and Crawford cross connections were updated based on field investigations conducted by the City.

- CSO 002 was closed by the City and the change was reflected in the model.
- Subcatchment 003-5 was removed from the model. Initial model runs indicated that less combined sewer area contributed to combined sewer in which the flow meter was located. The area was further evaluated and it was determined that subcatchment 003-5 is likely served by separate sewers. Therefore, the subcatchment was removed and the flow meter calibrated well.

3.2.3 Calibration and Verification Objectives

The main objective of the model calibration was to obtain a good visual comparison of model and metered hydrographs, in terms of peak flow, total volume, peak flow rate of occurrence and shape of the hydrograph for a range of storm sizes. The goal of model calibration is for model results to meet or exceed the measured flow data to be conservative. The calibration process incorporates EPA's suggestions for model calibration along with the City's knowledge of the performance of its collection system in wet weather.

3.2.3.1 Dry Weather Calibration

Dry weather flow to the CSO diversion structure is the sum of sanitary flow and infiltration. Dry weather flow was estimated based on land use and flow monitoring information. The dry weather calibration consisted of comparing the dry weather model results to the actual flow monitoring data collected. A diurnal curve was created to simulate varied flow patterns over the course of a day by evaluating a period of one month.

The dry weather inputs were adjusted until the model results approximated the metered flows. The dry weather inputs are as shown in Table 3.2-3.

Table 3.2-3
Dry Weather Flow Inputs

Subcatchment Number	Flow Rate	Flow	Units
003-204TN	0.072	0.072	CFS
003-209TN	0.059	0.059	CFS
003-210TN	0.0243	0.0376	MGD
003-217TN	0.062	0.062	CFS

Subcatchment Number	Flow Rate	Flow	Units
003-225TN	0.13	0.13	CFS
003-226N	0.039	0.039	CFS
004-061N	0.2	0.2	CFS
004-102TN	0.2	0.2	CFS
004-110N	0.0035	0.0054	MGD
004-140TN	0.095	0.095	CFS
004-245TN	0.037	0.037	CFS
004-225TN	0.036	0.036	CFS
004-257N	0.093	0.093	CFS
004-288TN	0.105	0.1625	MGD
004-290TN	0.097	0.097	CFS
004-292TN	0.064	0.064	CFS
004-295TN	0.07	0.07	CFS
004-298TN	0.039	0.039	CFS
004-332TN	1.1	1.702	MGD
004-342N	0.039	0.039	CFS
301IN	0.001	0.001	CFS
009-092N	0.3	0.3	CFS
009-312TN	0.15	0.15	CFS
010-014TN	0.1	0.1547	MGD
010-018N	0.05	0.05	CFS
010-020N	0.035	0.0542	MGD
010-021N	0.043	0.043	CFS
010-033TN	1.5	2.3208	MGD
010-042TN	0.061	0.061	CFS
010-045N	0.07	0.07	CFS
010-129N	0.044	0.044	CFS
010-151TN	0.047	0.047	CFS
010-236TN	0.081	0.081	CFS
010-266N	0.033	0.033	CFS
010-270TN	0.047	0.047	CFS
010-302TN	1	1	CFS
010-303TN	0.09	0.1393	MGD
010-318TN	0.09	0.09	CFS
010-319TN	0.048	0.048	CFS
011-083N	0.079	0.079	CFS
011-121N	0.097	0.097	CFS
011-174TN	0.057	0.057	CFS

Subcatchment Number	Flow Rate	Flow	Units
011-183TN	0.054	0.054	CFS
011-190TN	0.824	0.824	CFS
011-198TN	0.0635	0.0982	MGD
010-171TN	0.079	0.079	CFS
004/011-6N	0.045	0.045	CFS
011-150N	0.029	0.029	CFS
010-1N	0.033	0.033	CFS
009-325TN	0.062	0.062	CFS
008-100N	0.058	0.058	CFS
007-160N	0.11	0.11	CFS
007-120N	0.112	0.112	CFS
007-5N	0.151	0.151	CFS
004-338TN	0.1	0.1	CFS
5/6-200N	0.063	0.063	CFS
5/6-210N	0.026	0.026	CFS
005/006-1N	0.026	0.026	CFS
5/6-100N	0.069	0.069	CFS
120IN	0.001	0.001	CFS
307IN	0.002	0.002	CFS
360IN	0.001	0.0015	MGD
010-330TN	0.034	0.0526	MGD
003-400N	0.745	1.1527	MGD
007-150N	0.017	0.0263	MGD
007-200N	0.012	0.0186	MGD
007-152N	0.009	0.009	CFS

3.2.3.2 Wet Weather Calibration and Verification Summary

The wet weather calibration consisted of running the model with rainfall data collected from selected storms and then comparing the calculated results to the actual flow monitoring data collected. The model parameters were adjusted and the process repeated until the calculated results approximated the actual flow monitor measurements. Goals for the model calibration included:

- To match model runoff volumes (volume under curve) to actual runoff volumes (calculated with flow meter data) within approximately +/- 20%

- To match model runoff peak flow rates to actual flow monitor runoff peak flow rates within approximately +/- 20%

- To match model peak flow rate time of occurrence to actual flow monitored peak flow rate time of occurrence within approximately +/- one hour

The model calibration effort consisted of calibrating runoff from CSO Service Areas 010. 009, 007, 004, 011 and 003. The areas comprise approximately 93% of the total combined sewer area.

The model calibration began with the most upstream flow meter. Once an upstream meter was calibrated, those parameters were not adjusted to calibrate downstream meters. Each CSO service area was calibrated independently. Figure 3.1-1 also shows a schematic of flow meter and rain gauge locations used in data collection for the model calibration.

The runoff from the six CSO service areas was calibrated with two storms and then the model was verified independently with one storm.

3.3 CS Model Calibration

The June 12, 2005 and September 28, 2005 storms were used to calibrate the model. Storm event data is shown in Table 3.2-2. The June 12th storm had an average total rainfall of 1.70 inches. The September 28th storm had an average total rainfall of 0.57 inches. The goal was to calibrate the model with two storm events with even rainfall distribution and with various total rainfalls, intensities and durations. The chosen storm events met this goal. Even rainfall distribution increases the likelihood that the rain gauge data represents the actual rainfall that occurred in the entire flow metered basin.

The rainfall from the June 12th and September 28th storm events were entered in to the XP-SWMM model. Modifications were made to percent imperviousness, subcatchment width and depression storage to obtain the desired calibration curves. The model results were compared to the actual flow monitoring data collected. The model parameters were adjusted and the process repeated until the calibrated results approximated the actual flow monitor measurements.

Table 3.3-1 shows the initial RUNOFF parameters prior to calibration and Table 3.3-2 shows the final RUNOFF parameters after calibration. An effort was made to balance the modeled response between storm events while striving to predict the meter response on the average.

Table 3.3-1
Initial Model Data

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Rain Gauge[1]
							Impervious	Pervious	Impervious	Pervious	
003	003-1	003-209TN	97	19%	1,117	0.003	0.058	0.188	0.014	0.2	ADS1
	003-2	003-204TN	105	45%	1,387	0.003	0.052	0.187	0.014	0.2	ADS1
	003-3	003-217TN	86	43%	1,341	0.003	0.056	0.19	0.014	0.2	ADS1
	003-4	003-226N	131	34%	2,597	0.003	0.057	0.164	0.014	0.19	ADS1
	003-5	003-225TN	194	23%	1,921	0.001	0.08	192	0.014	0.2	ADS1
004/011	004/011-1	004-292TN	124	37%	1,593	0.008	0.034	176	0.014	0.18	ADS3
	004/011-2	004-290TN	122	27%	932	0.003	0.058	0.2	0.014	0.2	ADS3
	004/011-3	011-121N	134	37%	1,617	0.001	0.08	0.192	0.014	0.2	ADS3
	004/011-4	004-295TN	153	19%	1,384	0.001	0.118	0.175	0.014	0.19	ADS3
	004/011-5	011-083N	130	26%	1,088	0.003	0.056	0.186	0.014	0.19	ADS3
	004/011-6	004/011-6N	96	28%	1,447	0.001	0.112	0.176	0.014	0.19	ADS3
	004/011-7	004-298TN	78	17%	1,299	0.0004	0.15	0.182	0.014	0.2	ADS3
	004/011-8	004-140TN	166	17%	1,507	0.004	0.047	0.187	0.014	0.2	ADS3
	004/011-9	011-150N	42	25%	1,141	0.003	0.054	0.194	0.014	0.2	ADS3
	004/011-10	004-342N	68	19%	1,407	0.006	0.04	0.186	0.014	0.2	ADS3
	004/011-11	011-183TN	70	23%	1,264	0.002	0.073	0.2	0.014	0.2	ADS3
	004/011-12	011-174TN	74	23%	728	0.003	0.057	0.2	0.014	0.2	ADS3
	004/011-13	004-245TN	72	30%	1,044	0.001	0.094	0.179	0.014	0.2	ADS3
	004/011-14	004-255TN	49	30%	1,072	0.002	0.067	0.194	0.014	0.2	ADS3
	004/011-15	004-257N	126	24%	1,375	0.003	0.057	0.197	0.014	0.2	ADS3
005/006	005/006-1	005/006-1N	56	48%	768	0.014	0.026	0.177	0.014	0.2	ADS3
	005/006-2	5/6-210N	29	56%	358	0.005	0.041	0.2	0.014	0.2	ADS3
	005/006-3	5/6-200N	83	26%	1,065	0.003	0.055	0.199	0.014	0.2	ADS3
	005/006-4	5/6-100N	103	50%	1,721	0.012	0.027	0.187	0.014	0.2	ADS3
007	007-1	007-160N	117	65%	1,001	0.003	0.055	0.198	0.014	0.2	ADS3

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Rain Gauge[1]
							Impervious	Pervious	Impervious	Pervious	
	007-2	007-120N	138	37%	1,820	0.002	0.076	0.199	0.014	0.2	ADS3
	007-3	004-102TN	160	32%	1,587	0.001	0.088	0.198	0.014	0.2	ADS3
	007-4	004-061N	200	36%	2,815	0.005	0.042	0.191	0.014	0.2	City6
	007-5	007-5N	212	28%	2,249	0.006	0.039	0.194	0.014	0.2	City7
	007-6	004-338TN	185	19%	2,239	0.002	0.068	0.184	0.014	0.2	City7
	007-7	007-152N	67	30%	1,217	0.005	0.043	0.15	0.014	0.17	ADS3
008	008-1	008-100N	87	65%	1,647	0.008	0.034	0.147	0.014	0.19	City4
009	009-1	009-325TN	105	73%	1,631	0.005	0.043	0.068	0.014	0.19	City4
	009-2	009-312TN	108	62%	1,574	0.005	0.043	0.058	0.014	0.2	City4
	009-3	009-092N	109	42%	1,973	0.003	0.052	0.187	0.014	0.2	ADS2
010	010-1	010-1N	80	34%	1,091	0.002	0.064	0.141	0.014	0.19	City4
	010-2	010-302TN	150	23%	1,633	0.005	0.045	0.181	0.014	0.2	City4
	010-3	010-236TN	108	31%	1,180	0.002	0.077	0.196	0.014	0.2	ADS2
	010-4	010-319TN	69	31%	679	0.003	0.06	0.192	0.014	0.2	ADS2
	010-5	010-129N	56	33%	593	0.003	0.055	0.197	0.014	0.2	ADS2
	010-6	010-318TN	111	37%	1,340	0.003	0.06	0.199	0.014	0.2	ADS2
	010-7	010-171TN	129	31%	1,338	0.001	0.096	0.187	0.014	0.2	ADS2
	010-8	010-270TN	87	30%	1,227	0.002	0.074	0.182	0.014	0.19	ADS2
	010-9	010-266N	52	22%	815	0.002	0.064	0.19	0.014	0.2	ADS2
	010-10	010-018N	110	29%	1,327	0.004	0.048	0.176	0.014	0.19	ADS2
	010-11	010-021N	56	26%	968	0.003	0.057	0.2	0.014	0.2	City6
	010-12	010-151TN	60	24%	939	0.002	0.064	0.2	0.014	0.2	ADS2
	010-13	010-042TN	96	23%	991	0.002	0.064	0.19	0.014	0.2	City6
	010-14	010-045N	99	22%	1,542	0.004	0.05	0.196	0.014	0.2	City6

[1] Rain Guage assignments based on Thisessen Polygon Method. ADS refers to ADS rain gauge. City refers to city rain gauge.

Table 3.3-2
Final Model Data

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Rain Gauge^1
							Impervious	Pervious	Impervious	Pervious	
003	003-1	003-209TN	97	10%	559	0.003	0.116	0.188	0.014	0.2	ADS1
	003-2	003-204TN	105	23%	694	0.003	0.104	0.187	0.014	0.2	ADS1
	003-3	003-217TN	86	22%	671	0.003	0.112	0.19	0.014	0.2	ADS1
	003-4	003-226N	131	17%	1,299	0.003	0.114	0.164	0.014	0.19	ADS1
004/011	004/011-1	004-292TN	124	51%	2,390	0.008	0.034	176	0.014	0.18	ADS3
	004/011-2	004-290TN	122	26%	5,592	0.003	0.116	0.2	0.014	0.2	ADS3
	004/011-3	011-121N	134	51%	2,426	0.001	0.08	0.192	0.014	0.2	ADS3
	004/011-4	004-295TN	153	26%	2,076	0.001	0.118	0.175	0.014	0.19	ADS3
	004/011-5	011-083N	130	25%	6,528	0.003	0.112	0.186	0.014	0.19	ADS3
	004/011-6	004/011-6N	96	39%	2,171	0.001	0.112	0.176	0.014	0.19	ADS3
	004/011-7	004-298TN	78	17%	7,794	0.0004	0.3	0.182	0.014	0.2	ADS3
	004/011-8	004-140TN	166	17%	9,042	0.004	0.094	0.187	0.014	0.2	ADS3
	004/011-9	011-150N	42	50%	2,567	0.003	0.068	0.194	0.014	0.2	ADS3
	004/011-10	004-342N	68	19%	8,442	0.006	0.08	0.186	0.014	0.2	ADS3
	004/011-11	011-183TN	70	26%	948	0.002	0.091	0.2	0.014	0.2	ADS3
	004/011-12	011-174TN	74	26%	546	0.003	0.071	0.2	0.014	0.2	ADS3
	004/011-13	004-245TN	72	29%	6,264	0.001	0.188	0.179	0.014	0.2	ADS3
	004/011-14	004-255TN	49	29%	6,432	0.002	0.134	0.194	0.014	0.2	ADS3
	004/011-15	004-257N	126	23%	8,250	0.003	0.114	0.197	0.014	0.2	ADS3
005/006	005/006-1	005/006-1N	56	48%	768	0.014	0.026	0.177	0.014	0.2	ADS3
	005/006-2	5/6-210N	29	56%	358	0.005	0.041	0.2	0.014	0.2	ADS3
	005/006-3	5/6-200N	83	26%	1,065	0.003	0.055	0.199	0.014	0.2	ADS3
	005/006-4	5/6-100N	103	32%	5,163	0.012	0.027	0.187	0.014	0.2	ADS3
007	007-1	007-160N	117	42%	4,004	0.003	0.11	0.198	0.014	0.2	ADS3

CSO Service Area	Subcatchment Number	Runoff Model Point of Concentration	Combined Area (Acres)	Percent Impervious	Subcatchment Width (ft)	Overland Slope (%)	Depression Storage (in)		Overland Mannings "n"		Rain Gauge[1]
							Impervious	Pervious	Impervious	Pervious	
	007-2	007-120N	138	24%	7,280	0.002	0.152	0.199	0.014	0.2	ADS3
	007-3	004-102TN	160	28%	3,333	0.001	0.11	0.198	0.014	0.2	ADS3
	007-4	004-061N	200	32%	5,912	0.005	0.053	0.191	0.014	0.2	City6
	007-5	007-5N	212	40%	1,687	0.006	0.098	0.194	0.014	0.2	City7
	007-6	004-338TN	185	27%	1,679	0.002	0.068	0.184	0.014	0.2	City7
	007-7	007-152N	67	19%	4,868	0.005	0.086	0.15	0.014	0.17	ADS3
008	008-1	008-100N	87	65%	1,647	0.008	0.034	0.147	0.014	0.19	City4
009	009-1	009-325TN	105	61%	6,524	0.005	0.043	0.068	0.014	0.19	City4
	009-2	009-312TN	108	51%	7,870	0.005	0.086	0.058	0.014	0.2	City4
	009-3	009-092N	109	35%	9,865	0.003	0.104	0.187	0.014	0.2	ADS2
010	010-1	010-1N	80	30%	2,455	0.002	0.064	0.141	0.014	0.19	City4
	010-2	010-302TN	150	20%	3,674	0.005	0.045	0.181	0.014	0.2	City4
	010-3	010-236TN	108	26%	1,770	0.002	0.13	0.196	0.014	0.2	ADS2
	010-4	010-319TN	69	28%	2,037	0.003	0.225	0.192	0.014	0.2	ADS2
	010-5	010-129N	56	30%	1,779	0.003	0.206	0.197	0.014	0.2	ADS2
	010-6	010-318TN	111	34%	4,020	0.003	0.225	0.199	0.014	0.2	ADS2
	010-7	010-171TN	129	26%	1,967	0.001	0.162	0.187	0.014	0.2	ADS2
	010-8	010-270TN	87	25%	1,841	0.002	0.125	0.182	0.014	0.19	ADS2
	010-9	010-266N	52	19%	1,223	0.002	0.108	0.19	0.014	0.2	ADS2
	010-10	010-018N	110	25%	1,991	0.004	0.081	0.176	0.014	0.19	ADS2
	010-11	010-021N	56	22%	1,452	0.003	0.096	0.2	0.014	0.2	City6
	010-12	010-151TN	60	20%	1,409	0.002	0.108	0.2	0.014	0.2	ADS2
	010-13	010-042TN	96	19%	1,487	0.002	0.108	0.19	0.014	0.2	City6
	010-14	010-045N	99	19%	2,313	0.004	0.084	0.196	0.014	0.2	City6

[1] Rain Guage assignments based on Thisessen Polygon Method. ADS refers to ADS rain gauge. City refers to city rain gauge.

3.4 CS Model Verification

According to EPA Guidance on Modeling and Modeling (1999), "validation is the process of testing the calibrated model using one or more independent data set(s) of rainfall data."

After calibration, the next step consisted of using the July 21, 2005 storm as shown in Table 3.2-2, to verify the model. The July 21st storm had an average total rainfall of 1.77 inches and was chosen because of even distribution of rainfall.

The model results were compared to actual flow monitoring data collected. The validation effort resulted in a satisfactory verification. The validation proved the model calibration to be suitable for alternative evaluation.

Detailed information regarding the calibration and verification of the collection system model is provided in the "CSO Program Model Calibration and Verification Report, December 2006" that was previously submitted to IDEM and approved for alternative analysis. The complete report can be found in Appendix 3-1 of this document.

4 Section Four – Receiving Stream Model Development

4.1 Introduction

This section presents an overview of the development, calibration and application of a river model of the Wabash River to simulate water quality in the river from upstream of the City of Terre Haute to approximately 11.5 miles downstream of the City's waste water treatment plant (Figure 4.1-1). The development, calibration and application were described previously (LimnoTech 2008b) and this memorandum has been included in this LTCP as Appendix 4-1. The water quality model provides a causal linkage between the discharge of CSO pollutants and impacts on river water quality. It provides a more complete assessment of water quality conditions than data alone by filling gaps between sampling locations and collection times and for simulating conditions under a "typical" or average year. The calibrated model also provides the capability to forecast relative improvements in water quality conditions resulting from various CSO controls (described in Section 7).

The model domain for the Wabash River extends from Vigo County at RM 217.5 downstream to RM 200.0, downstream of the City's WWTP and all of the City's CSOs. A schematic of the model is shown in Figure 4.1-1. The extent of the model domain of the Wabash River was chosen for several reasons:

- The upstream boundary of the model is upstream of the City's CSOs and will provide insight to the loads not originating from Terre Haute;
- The model domain includes Sugar Creek, a tributary to the Wabash River, which may identify another potential source of *E. coli*; and
- The model extends over fourteen miles beyond the last CSO outfall and 11.5 miles beyond the City's WWTP (at RM 211.50), which allows an assessment of the impact of the City's sources on water quality downstream of the City.

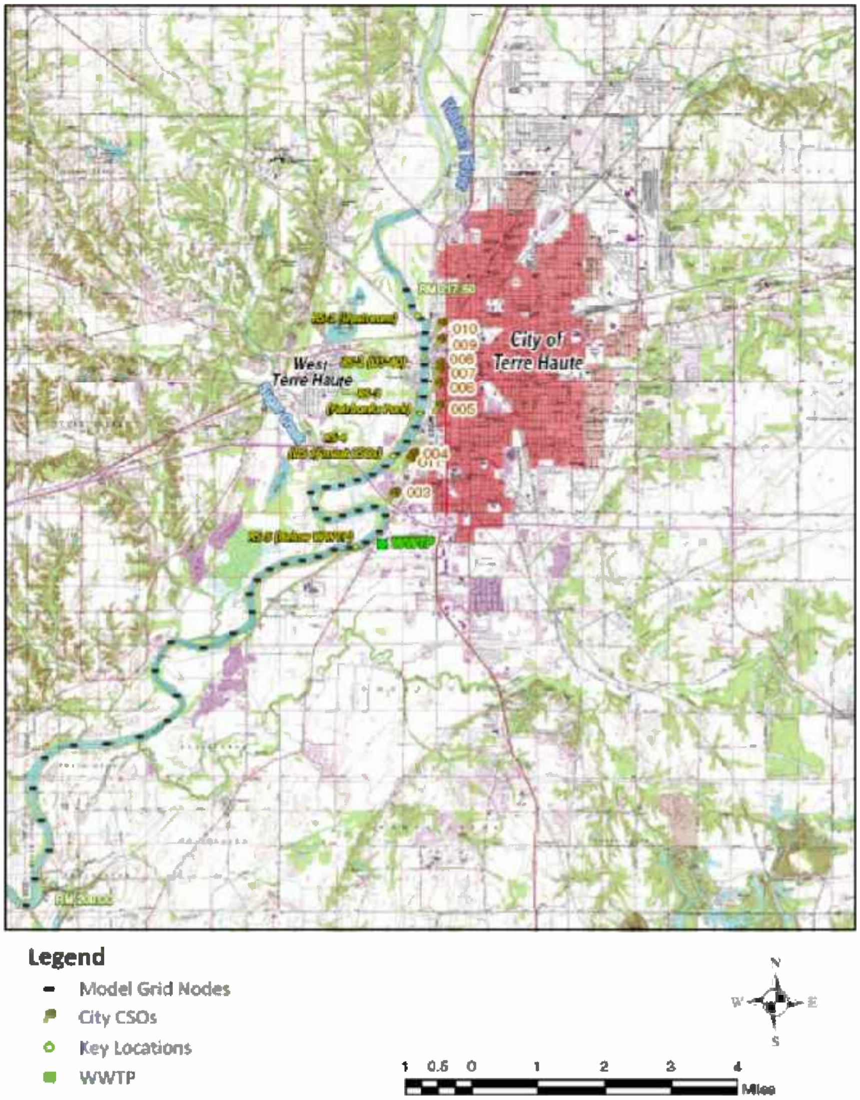


Figure 4.1-1. River Model Extent and CSO Load Inputs.

The United States Geological Survey's (USGS) Branched Lagrangian Transport Model was selected as the model to simulate water quality in the Wabash River near Terre Haute. The river model uses a moving frame of reference (Lagrangian) approach to dynamically calculate *E. coli* concentrations in the river in response to a host of time variable discharges including Terre Haute CSO, stormwater and wastewater treatment plant discharges. The model calculates the influences on each "parcel" of water as it moves through the river system, including bacteria added from the various discharges and bacterial die-off and settling. The Langrangian results are then automatically translated into time variable concentration results for each fixed location in the river. This approach provides a complex dynamic simulation of *E. coli* concentrations in the river based on a multitude of simpler calculations applied to each water parcel in the river. Other sources, including upstream (nonpoint, CSO and urban stormwater), dry weather (failing septic, straight pipe) and tributaries were also included and tracked in the model as separate state variables.

4.2 River Model Calibration and Validation

The model was calibrated to data from three wet weather events sampled by the City in 2007. The monitoring program and data are described in Section 2.4.1.2 and in the previously provided memorandum included as Appendix 2-1 (LimnoTech 2008a). The model calibration and validation was based on comparisons of model predicted concentrations to corresponding in-stream observations at each sampling location using temporal profiles, statistical analyses and sensitivities to critical model inputs (such as the *E. coli* loss rate). The calibration and validation was presented previously (LimnoTech 2008b) and this memorandum is provided in Appendix 4-1.

The calibration and validation of the river model indicates that it is capable of reproducing the timing and magnitude of most of the observed data. The model performs well for a variety of conditions, from dry weather to storms ranging from 0.2 inches up to 2.2 inches. It is suitable for evaluating in-stream impacts from Terre Haute's CSOs and watershed sources under a range of environmental conditions and control scenarios, and therefore should be sufficient for evaluating different CSO control alternatives.

4.3 Application to Characterize Baseline Conditions

The CSO Policy and subsequent EPA guidance recognizes that the annual performance of CSO controls will vary based on rainfall conditions. Long-term hourly rainfall and daily stream flow data were examined on an annual and summer (recreation season, April-October) basis, and compared to historical averages to identify 1978 as a "typical" period of rainfall and stream flow, as described in Section 2.6.3 and described in LimnoTech 2007 (Appendix 2-2). This section provides the results of the application of the river model for the selected "typical" or average year environmental conditions. This work was presented previously (LimnoTech 2008c) and is provided in Appendix 4-2. The City used the results of this scenario as a baseline to compare the effectiveness of CSO control alternatives on improving water quality in the Wabash River, as described in Section 6.

The calibrated BLTM river model was applied for the baseline simulation. External forcing (e.g. flows, bacteria loads, climate) inputs were adjusted to reflect 1978 conditions for this simulation. The calibrated collection system model was applied in a continuous simulation configuration to generate hourly estimates of CSO overflow activations, volumes and durations for input in the river model. Table 4.3-1 summarizes the overflow characteristics for each of the City's CSOs for a "typical" year. Upstream and CSO sources are the predominant sources of *E. coli* in the Wabash River (Figure 4.3-1).

Table 4.3-1
Overflow Characteristics by CSO for a Typical Year

		Total Overflow Volume (MG):	Total Hours of Overflow:	Total Number of Events:
CSO 010	Spruce	76.1	93	21
CSO 009	Chestnut	76.3	339	30
CSO 008	Ohio	12.6	131	32
CSO 007	Walnut	116.7	145	27
CSO 006	Oak	7.8	74	21
CSO 005	Crawford	15.4	145	29
CSO 004	Hulman	229.3	222	33
CSO 011	Idaho	137.1	165	29
CSO 003	Turner	18.6	90	21
Totals		690.0	362	33

CSO 002 (Main Lift Station) is an emergency overflow only with no overflows predicted in the typical year.

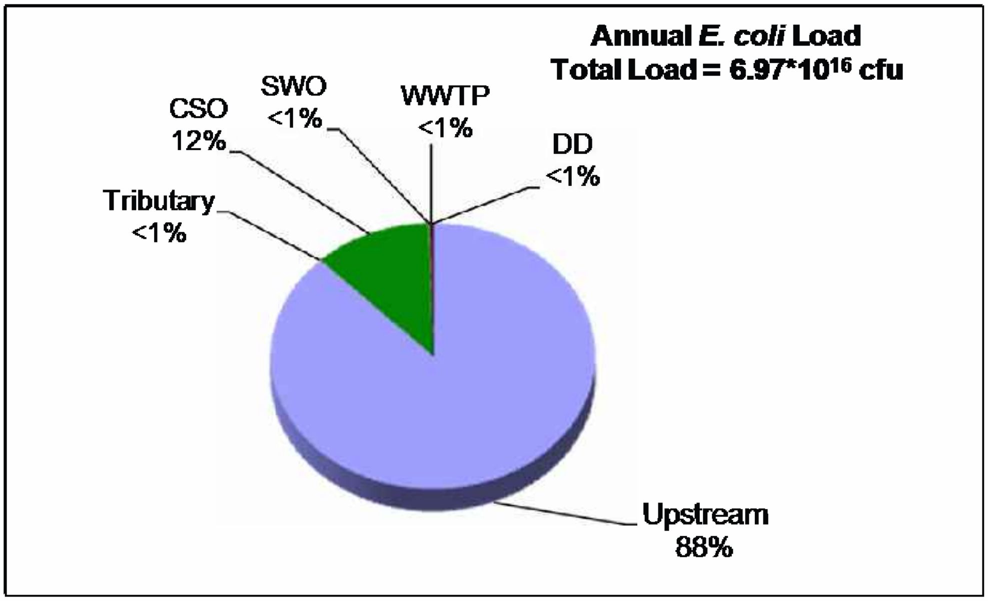
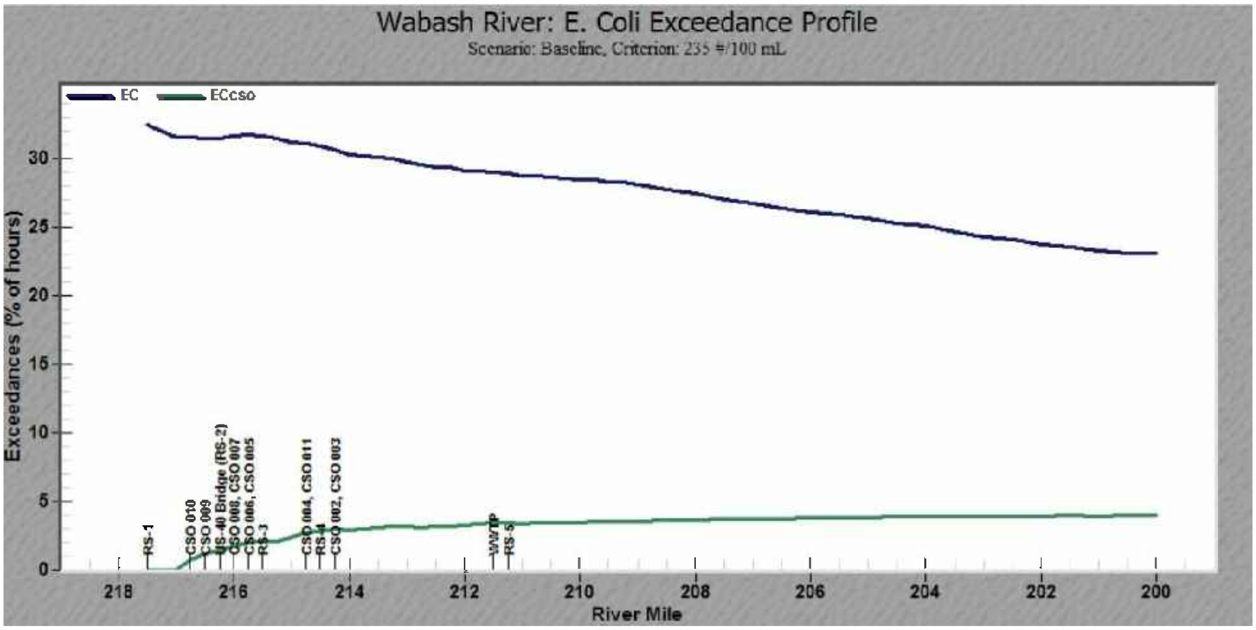


Figure 4.3-1. Annual *E. coli* Loads to the Wabash River by Source Type for a Typical Year

The model was applied with a 15-minute computation time step and hourly output frequency. The model output at each model grid node was evaluated and compared to State water quality standards for *E. coli*. Indiana water quality standards include numeric criteria for single sample and 30-day geometric mean concentrations from April through October, inclusive, to protect recreational uses. Both criteria are important when evaluating total *E. coli* results. The river exceeds the State's single sample maximum criterion approximately 30% of the time during the recreation season, as illustrated by the dark blue line in Figure 4.3-2. Terre Haute's CSOs alone cause exceedances of the single sample maximum criterion less than 5% of the time during the recreation season as illustrated by the green line in Figure 4.3-2. Compliance with the 30-day geometric mean criterion was evaluated for total *E. coli* (e.g. the sum of all source contributions). The evaluation was done using a rolling 30-day period. The river complies with this criterion approximately half of the time.



4.3-2. Downstream Profile of Exceedances of Indiana's Single Sample Maximum *E. coli* Criterion (235 cfu/100 mL).

Fairbanks Park was identified as a key location for CSO controls by the Citizens Advisory Committee. Results are shown in Table 4.3-2 at this key location as well as the locations used as sampling stations during the City's Wet Weather Sampling Program, and include a summary of all hourly outputs during the specified period that exceeded the specified criteria. Approximately one-third of the hours during the recreation season exceed the criterion, due largely to upstream source loads.

Table 4.3-2
Hours Exceeding Indiana's *E. coli* Single Sample Water Quality Standard Criterion During the Recreation Season (5,136 hours)[1]

		All Sources		Terre Haute CSOs Alone	
Location	e	hours	% hours	hours	% hours
Upstream of City CSOs	50	1621	31.6%	0	0.0%
US-40 Bridge	6.30	615	31.4%	72	4%
Fairbanks Park	5.50	1627	31.7%	04	2.0%
Downstream of CSOs 004 and 011	4.70	1588	30.9%	43	2.8%
Downstream of WWTP	21.20	1484	28.9%	174	3.4%

Notes:

[1] Defined for Recreation Season only (April-October); Single Sample Maximum Criterion = 235 cfu/100 mL

When considering the in-stream impact from the City's CSOs, the single sample maximum criterion is more restrictive than the 30-day criterion. This is because the City's CSOs are intermittent discharges and do not affect very many days within any given 30-day period. The concentration of *E. coli* in the CSO overflow is several orders of magnitude higher than the Standard's single sample maximum criterion of 235 cfu/100 ml so the resulting in-stream concentration that includes a bacteria loads from the City's CSOs is likely to exceed 235 cfu/100 ml. Therefore, the City evaluated the in-stream water quality benefits of the CSO control alternatives using the State's single sample maximum criterion.

4.3.1 River Sensitivity to Sources of E. coli

The magnitude and relative contribution of upstream and City CSO sources of E. coli, as shown in Figure 4.3-1, to compliance with the State's water quality standards were evaluated by conducting sensitivity simulations with the river model. Figure 4.3-3 shows the change in compliance with the State's single sample maximum E. coli criterion (235 cfu/100 ml) if the City's CSOs were completely eliminated. As this figure illustrates, the river will still exceed the State's criterion at least 20% of the hours in the recreation season (1,027 hours). This suggests that upstream and other sources deliver sufficient load of bacteria to the portion of the river by Terre Haute so that compliance with the State's standards would not be achieved even if the City's CSOs were completely eliminated.

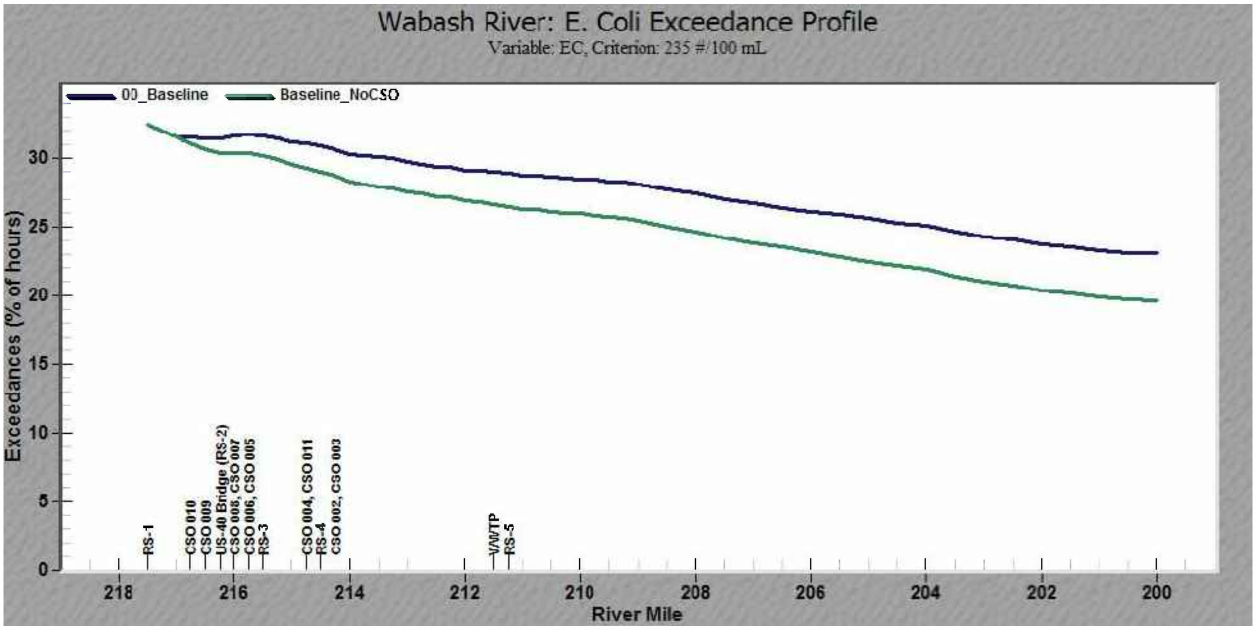


Figure 4.3-3. Downstream Profile of Exceedances of Indiana's Single Sample Maximum *E. coli* Criterion (235 cfu/100 mL) with and without the City's CSOs.

5 Section Five – Public Participation

5.1 Introduction

The involvement of the public is vital to the success of any long term planning process for any public works projects. The creation of the City of Terre Haute CSO Long-term Control Plan through its CAC and its consultant has emphasized this involvement through both the original planning process and the LTCP updates/revisions. In addition, establishing and maintaining public involvement is a requirement of the IDEM guidance in completing the document. The City of Terre Haute has taken this requirement of public involvement seriously as this section will describe.

5.2 Stakeholder Identification

Because CSO control is specific to each particular community, strong stakeholder support is essential to promoting the plan to ratepayers, agencies, and third party interest groups. Early awareness of stakeholder views and inputs can help ensure that the alternative selected responds to the beneficiary community, and can also help identify potential environmental and social impacts that might otherwise be overlooked. The mayor and administration has changed twice since the original CSO LTCP was written. As a consequence of the local elections in November 2007, a new mayor and city administration took office. Mayor-elect Duke Bennett reviewed the membership of the Citizen's Advisory Committee (CAC). He elected to reappoint most members and add some new members. These educated stakeholders helped to provide input during the planning process which culminated with the final alternative selection.

5.3 Public Participation Process

At the outset of the LTCP process, it was made clear that public involvement and notification were essential to a successful implementation of the final plan. In order to accomplish this involvement, several steps were taken. In August 2001, then Mayor Judith Anderson issued a press release informing the public that the LTCP was under way and she was seeking volunteers to assist in the decision making process by serving on a Citizen's Advisory Committee. She issued a second press release in September 2001 after the original CAC members were appointed and notified the public of their meetings. After the first press release, the mayor made available an information brochure titled "Terre Haute's Plan to

Fight Combined Sewer Overflows". The brochure was written at a layman's level to facilitate understanding of the project and its requirements by the general public.

The staff from the WWTP also attended civic organization meetings to educate the public on combined sewer overflows and the City's options for improving water quality. Presentations were made to the Environmental Committee of the Terre Haute Chamber of Commerce, the Kiwanis Club, the Breakfast Optimists Club, and the Noon Optimists Club.

After the decision was made to revise and update the original LTCP and seek other alternatives to meet changing regulatory requirements in 2006-2007, the CAC was required to become involved in the process again, however, due to the elapsed time since the original group's meetings, there were some necessary changes to the committee members. This re-shaped CAC was convened in meetings beginning in 2008 after the CSO technical team had completed some key steps including:

- New flow monitoring in the CSO system to calibrate and develop a new SWMM model
- Development of new CSO control technologies and alternatives based on new CSO overflow data and typical year design storms.
- Evaluation of the affect current regulatory requirements would have on the necessary changes and revisions to the LTCP

As discussed in detail later in this section, the CAC was presented information to refresh and/or educate members on the City's CSO system and LTCP requirements. Eventually, the meetings with the CAC presented information regarding developed alternatives along with cost/performance data necessary for their input regarding a selected plan.

During the period of alternative development with the CAC, the City entered into negotiations to purchase the former wastewater treatment facility site of the International Paper property adjacent to the City's Main lift station and outfall 003. The cost benefit and volume of storage the existing 70 million gallon lagoons offered for CSO storage made this facility an attractive addition to most alternatives developed in the LTCP. Based on concerns use of this facility for storage of combined sewage would have on future use of and development of the Riverfront area, the Riverscape group questioned the inclusion of these storage basins in the plan. Accordingly, additional meetings were held to inform/update members of the Riverscape group whose mission is to develop the areas along the Wabash River in accordance with a plan developed by their group and its consultant. The technical team met with Riverscape members, the Terre Haute Chamber of Commerce and others to explain the significant benefit the lagoons had on all alternatives based on their size and location, and how the use of the lagoons could be mitigated to prevent odors and generally not detract from future potential development.

Local newspaper and television coverage has been provided numerous times throughout the process to educate the public. Some of the related articles are included in Appendix 5-1.

5.3.1 City Involvement

The City of Terre Haute wastewater system is under the direction or control of several governmental units. Each unit's role in developing and implementing the LTCP is also discussed in this section.

The City Council consists of nine members which are elected officials. The Council approves the city budgets and rate adjustments, appropriates money to various departments and enacts, repeals or amends local laws and ordinances. In regard to the wastewater system and the LTCP, their most significant input will be consideration of any user rate adjustments necessary to support revenue bond financing.

The Board of Public Works and Safety consists of five members, which are appointed officials. The Board is responsible for awarding contracts relative to the various city departments, and will select professionals, contractors and other groups needed to implement a public works project such as those required to implement the recommendations of the LTCP.

The Terre Haute Sanitary District Board of Sanitary Commissioners consists of three to five appointed members including the City Engineer. The primary responsibility of the district is to develop and plan sanitary and storm sewer interceptors, relief sewers and extensions to serve the district. Revenues to support bonds for the work are funded through tax levies. Assuming new interceptor or relief sewers are constructed as a result of the LTCP, the district would be involved in improving and overseeing the project.

The Terre Haute Wastewater Treatment Plant (WWTP) is run completely by City staff. The management team and staff have been actively involved in the LTCP process and the resulting recommendations as the amount of CSO flows handled by the existing or expanded WWTP have a direct impact on CSO LTCP alternatives.

5.3.2 Mayor's Appointment of Citizen's Advisory Committee (CAC) (2 Phases)

As mentioned previously, the development of the LTCP has continued through several administrations. In September of 2001, then Mayor Judith Anderson appointed the original 15 member Citizen's Advisory Committee. The committee was formed to provide guidance to the city and the consulting engineers as the CSO system models and study information were prepared. They acted as a liaison between the general public and the city officials. The original committee members were:

Bob Houghtalen	Rose-Hulman Institute of Technology
Joyce Cadwallader	St. Mary of the Woods
Dave Danneer	Vigo County School Corp.
Bill Cultice	Citizen
Mike Johnson	Advanced Waste Management
Bob Hellman	Attorney
George Azar	City Council
Chris Pfaff	Indiana Department of Commerce
Tim Porter	Vigo County Area Planning
Chuck Adamson	Indiana American Water
Timothy Hennessy	WTWO
Charles Botts	Tri-Manufacturing
Janice Webster	Ivy Tech
Jeff Duell	GE Engine Services/Tri-Remanufacturing
Jack Roetker	Vigo County Department of Health

The city conducted five public meetings via the original Citizen Advisory Committee between September 2001 and April 2002. Those meetings were held not only to gain direction, but to also disseminate information to the public through the committee. The meetings allowed open public forum during the entire planning process which allowed the plan to be formulated in a manner that is environmentally and economically responsible for Terre Haute and its citizens. The meetings conducted with the CAC were intensive. They typically lasted for 2 to 3 hours and had significant feedback and committee interaction. The various news media representatives were normally in attendance.

The first meeting was held September 27, 2001. The focus of that meeting was to explain:

- The history of the sewer system in Terre Haute,
- What a combined sewer is,
- The reason a LTCP is required,
- Their role in the LTCP process,
- The work plan on describing the river sampling and monitoring plan, and
- Discussion that input on public access to the river was needed at the next meeting in order to determine priority areas.

The second meeting was conducted on November 29, 2001. The discussion items during the meeting were as follows:

- Reminder on the purpose of the committee and their role,
- Update status of the sampling and modeling work,
- Review agency responses on sensitive areas and river assessment
- Forum on public access and uses observed along the river,
- Presentation on types of CSO control technologies, and
- Discussion that the next meeting would request their input on alternatives.

The committee concluded and verified that there are no sensitive areas. However, the committee felt that the Fairbanks Park area should be considered a priority area. Therefore, the alternatives to be developed should consider how to eliminate or reduce discharges in and upstream of the park. It was also concluded that the area from Fairbanks Park and north could be the only possible area of residential access. South of the park was considered to be industrial/commercial. The committee concluded that there is no swimming or full body contact recreation in the Wabash River in Terre Haute.

The third meeting was held on January 31, 2002. The meeting provided significant detail on the work completed. The discussion items were as follows:

- Explanation of the system characterization results of the collection system model and the typical storms used in the evaluation,
- Presentation on the volume of overflow from the CSOs predicted by the collection system model,
- Presentation on detailed CSO control alternatives that included specific project components along with pros and cons,
- Options to eliminate, or relocate discharges in the priority area which will be beyond the knee of the curve costs,
- Other projects and goals that should be incorporated into the plan, and
- Discussion regarding the next meeting which will review cost estimates and select the preferred alternative.

Citizen Advisory Committee Meeting No. 4 was held on March 18, 2002. The meeting discussed the following topics:

- The results of the river modeling for the control alternatives, which included, days of the exceedance of water quality standards and CSO impacts on the river,
- Review of the work items associated with the alternatives and options,
- Discussion of the costs estimates for the alternatives and options along with the cost effectiveness evaluation by the Present Worth Analysis.
- The possibility of using existing industrial treatment facilities that are underutilized along 1st St. and the vicinity of potential storage tanks. The owner of the property was present and also offered input,
- Presentation of the resulting "Knee of the Curve" analysis which showed the In-line storage alternative (No. 1) to primarily be the lowest cost alternative,
- The minimum project cost based on the LTCP guidance economic affordability limit,
- Terre Haute's Socio-Economic indicator and the resulting implementation period required,
- Possible phasing options, and

- Discussion of the next meeting which would have potential rate impacts

The final CAC meeting of the original members was held April 16, 2002. It was held to finalize the committee's input of the plan. The specific discussion items included:

- Review of proposal from Wabash Environmental Technology,
- Review of the work items selected in the plan,
- Finalized project costs for the recommended plan,
- An implementation schedule for the plan, and
- The resulting impact on the user rates.

In 2008, after several meetings had been held with IDEM concerning the review of the initial LTCP submittal, enactment of the revised regulatory requirements, and development of a plan to revise/update the LTCP, the City re-engaged the CAC, with some revisions to the member list due to the time which had elapsed since the original planning. Also, since the submission of the original LTCP, new flow monitoring had been completed, a new SWMM model developed and calibrated, rehabilitation of large diameter combined sewers had been completed to allow for in-line storage of CSO flows and new CSO control technologies had been developed. The new CAC committee members consisted of the following:

Mike Robinson	Rose Hulman Institute of Technology
Joyce Cadwallader	St. Mary of the Woods
Franklin Fennell	Vigo Co School Corp
Bill Culltice	Citizen
Mike Johnson	Advanced Waste Management
Darrick Scott	County Council
Todd Nation	City Council
Bryan Duncan	ISU
Jeremy Weir	Vigo County Area Planning Commissioner
Chuck Adamson	IN-American Water Co
Timothy Hennessy	WTWO
Janice Webster	Ivy Tech
Jeff Duell	GE Engine Services/Tri-Remanuf
Steve Thompson	Department of Health Administrator

Joe Weber	Maple System
Jeff Perry	Riverfront Committee

This revised committee met 4 times during the course of developing and revising the LTCP. The group met on May 20, 2008 and February 15, June 23 and November 1 in 2010. The meetings discussed plan requirements and purpose of the CAC, updated regulatory requirements, updated SWMM model results, new alternatives development and analysis, and the proposed plan along with total cost considerations. After each meeting was held, the most current power point presentation was made available to the public on the Terre Haute Clean Water website. Handouts of the presentations given at these meetings are included in Appendix 5-2.

The first meeting of the revised CAC was held on May 20, 2008 and was largely informational. The meeting included the following topics:

- Introduction of the CAC to the City of Terre Haute Combined Sewer System (for the benefit of new members),
- History of the Sewer System in Terre Haute,
- "Early Action Items" that were completed after development of the original LTCP,
- Required updates to the Long Term Control Plan,
    - New IDEM requirements
    - Potential further "Early Action Items"
- State Judicial Agreement Requirements relative to the new plan and schedule.

The second meeting of the CAC was held on February 15, 2010 and discussed the following:

- Review of the existing CSO system,
- Presentation of activities completed since last CAC meeting including:
    - River Model Wet Weather Results Approved by IDEM,
    - Development of seven system-wide control plan alternatives,
    - Initial screening of control plan alternatives to three or four final alternatives,
    - IDEM Approval of Alternative Screening/Methodology,

  - Geotechnical testing of soil profiles along the river,
  - SWMM model analysis of developed and screened alternatives,
  - International Paper property acquisition investigation.

The third meeting of the CAC was held on June 23, 2010. The topics discussed included:

- Upcoming Long Term Control Plan Updates,
- Existing Pollutant Sources in the Wabash River (e. Coli),
- Range of Screened Alternatives and request for input,
- Estimated Sewer Rate Impacts of the screened alternatives and request for input,
- Upcoming activities required.

The fourth and final CAC meeting during the LTCP planning stages was held on November 1, 2010. The following topics were discussed:

- Review CSO LTCP requirements and past meeting information,
- Present Evaluation Data for final three alternatives including:
  - Overflow Frequency and Volume,
  - River impacts,
  - Costs and User Rate Impacts,
- Discussion of CAC's input on final alternative selection,
- Review process for finalization of the LTCP for submittal to IDEM.

This final meeting allowed the CAC members to provide recommendations to the Sanitary District Board before a final alternative was selected by the sanitary district. While the CAC considered and favored the environmental benefit Alternative 7B offered at 0 overflows, they understood the financial impact given the overall needs of the utility was too significant and thus a lower level of control was necessary to consider. The group did continue to support consideration of Fairbanks Park as a priority area and to take into account future expansion plans for ISU with regard to CSO's

009 and 010. The CAC members were invited to attend the Sanitary District meeting on November 3, 2010 to provide input.

The Citizen's Advisory Committee was asked to continue to meet as the project is implemented. This will allow the city to obtain input from the public as the work begins to impact their daily lives. Such input could prompt the implementation schedule to be adjusted as permitted by IDEM.

5.4 Public Meetings and Public Education

In addition to the meetings conducted prior to the City's initial LTCP submittal to IDEM, the City and its consultants discussed the Long Term Control Plan progress at the Sanitary District meetings held bi-monthly. The consultants provided updates to the Board on a regular basis between 2003 and 2010 as to the progress of ongoing tasks.

City staff members, including Mayor Bennett, also attended civic organizational meetings over several months to educate the public about the CSO project. The discussion included the history of CSOs, what is required of the City of Terre Haute and other Indiana communities regarding CSO control, and the plan of attack to complete the LTCP.

In addition, the Technical Team met with the Riverscape organization to provide information regarding the City's plans for land use along the river and a member of the group was added to the CAC for the final 3 meetings. The Riverscape group expressed concerns of odor resulting from the use of the International Paper ponds for CSO storage. The final selected alternative includes mitigation of potential odor sources at the storage ponds and significant discussion occurred between the technical team and the Riverscape group regarding the use of the site.

A final public meeting was held on January 24, 2011 to present the plan and the final selected alternative to the public. The presentation to the public is included in Appendix 5-2.

5.5 Community Notification Program

As a part of this LTCP, a proposed notification program was established. The IDEM guidance requires that a program be implemented that will provide warning when an overflow events is occurring or when there is likelihood that one will occur within twenty-four hours. The City has previously completed finalized this procedure and submitted it to IDEM. The procedure is generally summarized in the remaining sections of this chapter.

5.5.1 Signage

All the CSO outfall structures now have public warning signs. Signs have been posted along the Wabash River. All signs follow the requirements of the IDEM guidance and contain language stating that the waters could be polluted after rainfall and snow melts. The signs also state "No swimming or wading is allowed."

5.5.2 Notification

The City developed a finalized plan for public notification. The plan involves sending an invitation in March of each year to property owners along the river plus downstream, and to the media outlets (Newspaper, Television, and Radio) as required by the guidance. It asks each party if they wish to receive the notification of: 1) Occurring combined sewer overflow events, or 2) That there is a likelihood of one to occur within twenty four hours. If they request such notification, then they are included on a list to notify along with Fairbanks Park. A copy of the public notification procedure (including the public notice, the notification list and a list of affected persons) is included in Appendix 5-3.

The notifications must be documented and recorded for submission to IDEM. Such documentation will further the efforts of notifying and educating the public about their combined sewer overflow status.

5.6 Print and Electronic Media Coverage

As mentioned previously, information about CSOs is available on the Terre Haute Clean Water website, www.terrehautecleanwater.com. The purpose of the website is to educate the public about CSOs in general as well as provide a history of the CSOs in the Midwest and specifically Terre Haute. The website also provides information about what the City is currently doing about them as well as future plans for the reduction of CSO events. All brochures used for public education and awareness are available on this website. The presentations made to the Citizens Advisory Committees and other local groups have also been posted on this website. Once approved by IDEM, the entire CSO LTCP will also be available on the website.

6 Section Six – Development of CSO Control Alternatives

6.1 Introduction

It is required that the CSO Long Term Control Plan (LTCP) contains an evaluation of a reasonable range of control alternatives. This section describes the process that the City of Terre Haute team used to develop and evaluate CSO control alternatives. The selection process included considerations of the water quality benefits and equivalent affordable cost standards of various alternatives developed to meet the goals of the CSO Long Term Control Plan (LTCP). The focus of the evaluation was the reduction of overflow frequencies and volumes of discharge which in turn would reduce stream bacteria, solids and floatables entering the river.

6.2 Goals of the CSO Control Plan

The CAC and technical committee identified the following goals:

1. Comply with IDEM requirements
2. Reduce in-stream bacteria from CSOs
3. Eliminate / reduce CSOs 005, 006, 007 and 008 in Fairbanks Park
    - This is considered a priority area given the potential access to the river by park users
4. Wastewater Treatment Plant (WWTP) Improvements
    - Provide new preliminary treatment facility
    - Upgrade sustained wet weather peak treatment capacity to 48 MGD in all sections of the plant
    - Replace and upgrade old equipment
    - Eliminate peak flow bottlenecks at the Plant
5. Maximize flow to the WWTP
6. Generally site new CSO control facilities to allow for ISU campus expansion near the river

7. Control and eliminate floatables from CSOs in accordance with NPDES permit requirements
8. Provide Protection Within Wellhead Protection Zone (This was accomplished as an "early action" project through rehabilitation of large diameter pipe within the wellhead protection area).
9. Reasonable sewer rate increase based on total project cost with consideration given to phasing the proposed work
10. Effective Odor Control at WWTP

6.3 Evaluation Factors

The LTCP utilized several factors to screen and evaluate alternatives for CSO Control including cost-effectiveness, regulatory compliance, technical feasibility, and community input.

For the CSO LTCP, the City of Terre Haute developed a range of alternatives based on the typical year rainfall of 1978 approved by IDEM. Alternatives were evaluated ranging from "No Action" to complete closure of all CSO. Costs of each alternative were determined and corresponding affordability was calculated for each alternative. If the alternative to close all outfalls is deemed unaffordable then the City would perform a UAA to seek a Wet Weather Limited Use subcategory for the CSO-receiving waters, which would temporarily suspend the Recreational Use designation.

The CSO Policy requires that the CSO control program that is selected be sufficient to meet water quality standards and other CWA requirements. A post-construction water quality assessment program of monitoring or modeling is necessary to demonstrate compliance with water quality standards, regardless of which approach is taken.

The following evaluation criteria were utilized by the Technical Team to evaluate the CSO control technologies and alternatives under either approach for the selected plan of the LTCP.

6.3.1 Cost Effectiveness

The cost effectiveness of each control alternative will be determined by comparing the reduction on CSO overflows to the cost of the alternative. Alternatives for the different design storms system-wide overflow frequencies will be investigated and the alternative that can achieve the desired goals at the lowest cost will be considered to be most cost effective.

6.3.2 Regulatory Compliance

The Terre Haute CSO LTCP technical team developed and evaluated alternatives in accordance with EPA and IDEM CSO control policies. The selected alternative will comply with appropriate regulatory requirements or amended standards as designated through a UAA.

6.3.3 Non-Monetary Factors

The non-monetary factors included environmental issues/impacts, technical issues, implementation issues, priority areas, and public acceptance. These factors while not deciding factors in the CSO control selection process are considered in the overall evaluation of alternatives.

Environmental Issues/Impacts

Alternatives evaluated take into account environmental issues/impacts, which include wetlands, floodplains, geotechnical and groundwater sources, threatened and endangered species, water quality impacts from construction, and future operational odors from the facilities.

Technical Issues

The evaluation of CSO control alternatives included the following technical issues:

- Construction feasibility – how complex it is to construct the facilities included in each of the alternatives.
- Operability/reliability – the level of complexity of the technologies involved and the impact this would have on the City's ability to operate the systems, and the number of remote facilities that will affect the reliability of the alternative and operational capacity of the utility.
- Expandability – alternatives should have the ability to expand in the future if regulatory requirements dictate.

Implementation Issues

The evaluation of alternatives included implementation considerations, which included the ability to phase the implementation of various elements of an alternative. These factors included land availability, complex construction and interrelation of elements (i.e., building conveyance to a new treatment facility prior to completing the treatment facility.) Ultimately, the ability to construct a comprehensive alternative in multiple phases will allow the utility to defer costs and rate impacts upon the users over a longer period of time while still making progress toward improvement of water quality.

Public Acceptance

The control alternatives were evaluated on the ability to receive public acceptance. Public acceptance is relative to the level of disruption a CSO project would have on local businesses and neighborhoods during construction and during the operation of the facility. Consideration of future community planning and development in proposed project areas was also considered particularly in the Wabash River area as recent planning efforts have been completed for future development and utilization of that area.

6.3.4 Community and Technical Committee Input

As part of the public participation program, the Mayor of the City of Terre Haute appointed a Citizen Advisory Committee (CAC). During the nearly 12 year development of the LTCP, the CAC consisted of two separately appointed groups (with some common members). The CAC was an integral part of the CSO control alternative development and evaluation process during both the original CSO LTCP development stage as well as the revision process/final LTCP development. The input and comments of the CAC during both periods were considered in the completion of the LTCP.

In addition to the CAC, a technical committee team was also established. The technical committee included wastewater treatment plant staff, the City Engineer and staff, and the team of environmental, engineering, financial and legal consultants, led by Hannum Wagle and Cline Engineering. The technical team developed and evaluated alternatives for presentation to the CAC. At the first CAC meeting (during both initial and final phases), a description of the system and regulatory requirements was presented to "educate" the group, and individual CSO control technologies were introduced to the committee and screened based on CAC input. The technical team then integrated the feasible technologies into comprehensive system-wide CSO control alternatives. The integrated comprehensive alternatives were then presented to the CAC. The advantages and disadvantages of each alternative, along with non-monetary benefits, were presented. After receiving feedback from the CAC, the integrated alternatives were further refined. The alternatives were then modeled and costs and performance were estimated at different levels of

CSO control. The final alternatives, along with the present worth costs, were then presented to the CAC for final input and development of the recommended plan.

6.4 Initial Screening of CSO Control Technologies

A wide range of CSO control technologies applicable to Terre Haute's combined sewer system were initially considered by the technical team. The technologies were grouped into the following general categories:

- Collection System Control
- Storage Technologies
- Treatment Technologies

6.4.1 Collection System Control

The objective of using collection system technologies as a control alternative is to reduce the amount of combined sewage into the collection system below the WWTP capacity during wet weather. Collection system controls fall into the following categories:

1. Inflow/Infiltration Reduction
2. Real Time Control
3. Sewer Separation
4. Outfall Consolidation/Relocation

6.4.1.1 Inflow/Infiltration Reduction

Inflow/Infiltration reduction involves the elimination of storm water connections to the combined sewer system. Generally this involves the disconnection of rain leaders from the combined sewer system and the resulting storm runoff is diverted elsewhere. Depending on the neighborhood, the leaders may be run to a dry well, vegetation bed, a lawn, a storm sewer or the street. For most residences in the combined sewer area, the most feasible rain leader disconnection scheme is diversion to the lawn or dry wells. The diversion to the street contributes to nuisance street flooding and only briefly delays the water from entering the combined sewer system through combined sewer connected catch basins.

There are newer "green technology" opportunities for inflow/infiltration reduction which will be discussed in greater detail later in this section.

6.4.1.2 Real Time Control

Real-time control (RTC) is a sophisticated in-line storage method that uses sewer depth and rainfall monitors to control the amount of wastewater being stored, transported, and directed throughout the existing combined sewer system. This method of CSO flow control can be highly automated and can increase efficiency and holding capacity within the existing sewer system by creating real-time response to rain as it falls over the city. Dams or gates allow sewage to flow from one trunk sewer into another during intense rainfall and runoff, and can hold flow back when rain subsides and capacity is needed in another part of the city.

Monitors necessary to control the storage of flow in existing sewers require a power source and telecommunication lines to communicate with a central computer system. The computer system processes the monitoring data every few seconds or minutes, using data to make control decisions at the CSO, such as whether to inflate or deflate in-line dams, or raise/lower flow control weirs. These instantaneous decisions cannot always rely upon depth data alone but must also incorporate rainfall data.

Releasing in-system storage volumes by deflating a dam or lowering a weir is not instantaneous. Therefore, incorporating rainfall data into the decision process is necessary to give the system enough time to react to an approaching storm that has intensities or duration that will breach the storage limit, thus preparing the in-system storage release process before basement or surface flooding occurs. Rain gauges must be spaced to accurately monitor the average storm size of four to five miles. A real-time control system of this type maximizes the full storage capability of the existing collection system while avoiding upstream basement flooding and spills to the environment, thereby minimizing public health concerns and CSO impacts on the receiving water. The size of the Terre Haute system's main combined trunk sewers allows this option to receive serious consideration.

Static flow control devices, such as vortex valves are generally used for flow control in conjunction with other devices that provide the storage, such as inflatable dams, weir structures or concrete storage tanks. The inherent storage capacity of the existing City of Terre Haute sewer collection system allows for a 77% capture. The actual capture rate that might be attained through RTC could be significantly higher if flows are transferred between trunk sewers or if the RTC devices were installed in small diameter sewers also.

However, while RTC does potentially increase storage at a relatively low cost, the risk of flooding basements with raw sewage increase as additional RTC devices are installed in the collection system and as storage is attempted in smaller sewers. While RTC reduces capital costs of CSO controls, operation and maintenance costs can be more expensive over the long-term. Furthermore, proper operation and maintenance of an RTC system is exceptionally critical to protecting citizens from basement flooding. Also, flooded buildings pose a significantly higher likelihood of unintentional human contact and resulting health effects than combined sewer overflow into the streams.

RTC could be used in selective areas of the system and as part of a larger more complex plan and thus, provide the basis for system-wide control and minimization of structural capital improvements that could result in a more cost-effective solution for CSO control. All components of CSO control, including flow, level and rain gauge data, in-line storage, off-line storage, maximization of flow to existing treatment, and additional high-rate treatment could all become an integral part of the RTC System.

6.4.1.3 Sewer Separation

Sewer separation is the conversion of a combined sewer system, or sub-system into a system of separate sanitary sewers and storm sewers. This alternative prevents sanitary wastewater from being discharged to receiving waters. However, when combined sewers are separated, storm sewer discharges will greatly increase and contribute additional pollutant load to the receiving waters since storm water will no longer be captured and treated in the combined sewer system. New stringent storm water regulations may at some point in the future require some type of pollutant control on the storm water system. In addition, this alternative involves substantial citywide excavation, thus exacerbating street disruption problems. Varying degrees of sewer separation could be achieved with rain leader (gutters and downspouts) disconnection, partial separation, and complete separation.

With partial separation, combined sewers are separated in the streets only, or other public right of way. This is accomplished by constructing either a new sanitary wastewater system or a new storm water system.

In addition to separation of sewers in the streets, storm water runoff from each private residence or building such as from rooftops and parking lots is also separated. See Figures 6.3-1A and 6.3-1B for a schematic of how sewer separation can be achieved. For other cities, separation has proved most feasible for CSO areas of 200 acres or less. Terre Haute has approximately 5,000 acres of combined sewers, therefore, this is likely not a feasible option as a stand-alone CSO control alternative except, possibly, in small, discrete areas of the City or portions of CSO basins, and as a part of a more comprehensive CSO LTCP.

6.4.1.4 Outfall Consolidation/Relocation

Outfall consolidation allows nearby outfalls to be joined together, eliminating the number of outfall points. The elimination of outfalls reduces the monitoring requirement and localizes end-of-pipe treatment technologies, like floatable controls. Outfall consolidation, as well as outfall relocation, can be used to direct CSO flows, via larger conveyance relief sewers, away from specific areas. This method may be used to address sensitive and priority areas. As with Fairbanks Park, a priority area with several outfalls within the park, outfalls could be consolidated or relocated to improve the aesthetics and the river water quality at the park. The close proximity of several outfalls in the system allows outfall consolidation and elimination in the Terre Haute system.

6.4.2 Storage Technologies

The objective of using storage technologies as a control alternative is to capture combined sewage in excess of the WWTP capacity during wet weather for controlled release into the collection system for conveyance to the WWTP after storm events. Storage options fall into the following categories:

1. Storm water storage ahead of combined system;
2. In-line Storage - Storage of CSO flows within the sewer system;
3. Off-line storage of CSO flows.

6.4.2.1 Storm Water Storage ahead of Combined System

There are two ways to provide storage of runoff prior to entering the combined system and mixing with the sanitary flow. One method is to require industries or other large property developments to build detention basins and release the storm water after storm events. Terre Haute has a small industry base that is connected to the combined sewer system. However, storm water contributions to the combined sewers from industries are not significant. The other opportunities within this option are to detain, with wet or dry detention basin, runoff from residential or commercial property within the combined sewer service area. Terre Haute's combined sewer service area is fully developed, which would make locating necessary basins very difficult.

The other methods of providing storage of CSO flows are to collect combined sewage prior to the outfall. This can be accomplished with in-line storage, off-line storage tanks, or a combination of the two technologies. The storage volumes required in Terre Haute are large, particularly at higher levels of control. As a result, storage can best be achieved in a cost effective manner by utilization of large earthen basins – which the International Paper lagoons (described later in this section) located adjacent to the Wabash River and the city's main lift station offer. Some flows could be feasibly stored by utilizing storage tanks, while tunnels require large volumes of storage to be cost effective and thus, should also be further considered. The following is a detailed description of feasible storage options for the City.

6.4.2.2 In-line Storage

In-line storage optimizes the use of the existing storage capacity of the combined sewer collection system to reduce overflow volumes. It often proves to be less expensive than other alternatives since there are significantly lower construction costs involved due to the use of existing infrastructure. It also proves to be the most attractive alternative since existing facilities are most efficiently utilized without the disruptions of major construction.

This technology cannot typically be used alone to achieve complete control of substantial wet-weather events. In-line storage can only be used if sufficient capacity is available within the collection system and to a lesser degree at the treatment plant. By utilizing this alternative, there is increased risk of basement or street flooding, increased opportunity for sediment deposition, and higher costs associated with maintenance of regulators, inflatable dams, level control weirs and other features to ensure proper functioning. Some examples of controls are: regulators, vortex valves, inflatable dams, motor- or hydraulically-operated sluice gates or weirs, raising static regulators, and system-wide real-time control.

Each trunk sewer of the Terre Haute collection system was investigated for available storage capacity during the initial LTCP development and reconfirmed during the final plan development. The areas best suited for in-line storage are the large, flat combined sewers associated with the large CSO outfalls such as Hulman/Idaho, Ohio and Walnut Street combined sewers. An example of an end of pipe inflatable dam is shown in Figure 6.3-2.

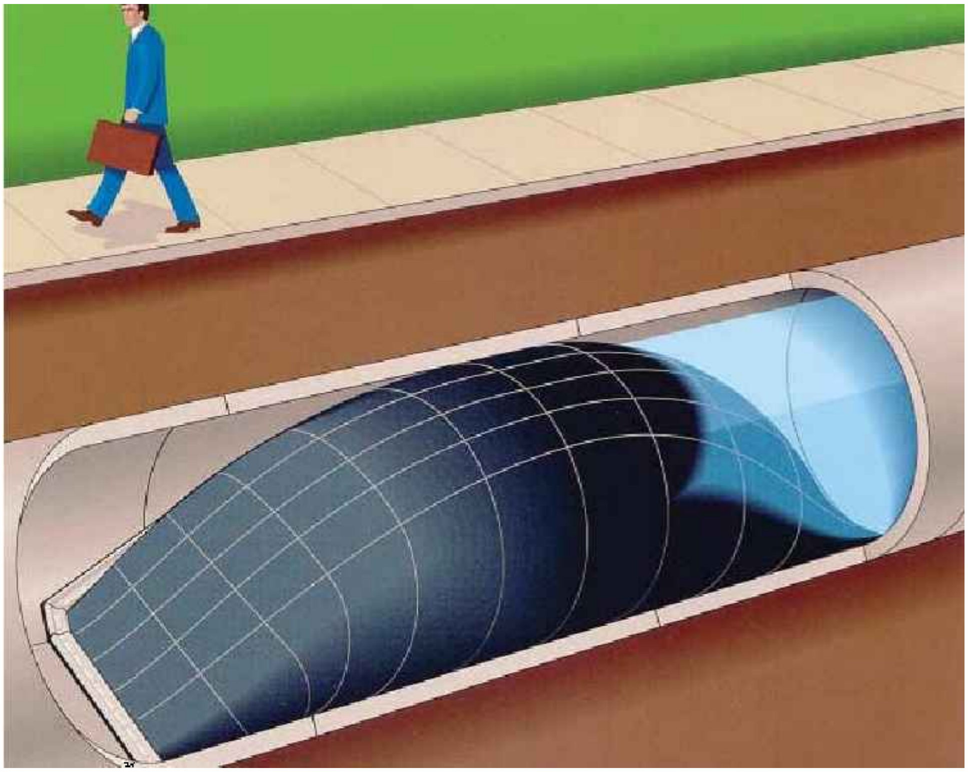


Figure 6.3-2 Inflatable Dam

In-line storage will only extend to a location upstream (the storage limit) where the water elevation in the combined trunk sewer equals the elevation of the outfall pipe or regulator downstream. If an attempt is made to store wastewater above this storage limit, it is likely to overflow into the manholes and basements.

One storage technology that has been evaluated as a control alternative is inflatable dams. Inflatable dams are rubber fabric devices which can be inflated during wet weather conditions to hold wastewater within the sewer and prevent combined sewage from entering the receiving stream. These dams, which are normally in the deflated (closed) position, can be designed to activate (inflate) automatically from a master control center in response to upstream water levels or surface rainfall data. If monitors indicate that the in-line storage volume may exceed the storage limit, then the dam structure is automatically deflated, and a CSO occurs. In the event of an exhaust valve malfunction or other system breakdown (i.e. electrical power failure), the dam contains a safety valve that would deflate the dam and prevent backups into basements and streets.

The air supply to inflate the dam, which is either produced by a compressor or supplied from a storage tank, is located on site in an equipment vault. This on-site equipment vault also contains a manual control to deflate the dam in case of equipment failure.

Since the dams are generally made from a heavy fabric or rubber, they should not require a substantial amount of in-pipe maintenance; however, some maintenance will be required for the instrumentation inside the equipment vault. Also, these dams must include pressure relief valves, mechanical deflation controls and backup manual deflation valves to ensure that basement or street flooding does not occur during a power failure. Finally, installation of the dams does not require major reconstruction of the existing system, therefore limiting the amount of time and manpower needed.

Although the fabric and rubber material used in these structures is durable, sharp objects can penetrate it. In addition, since inflatable dams are installed directly inside the combined sewer outfall pipe, they must be able to accommodate the various pipe shapes in the City's system. Currently an inflatable dam cannot accommodate two pipe shapes: rectangular pipe outfalls with a rise greater than the span and semicircular pipe outfalls that are not rounded at the base.

Another option for in-line storage which would operate similar to inflatable dams would be an operable weir structure. This type of control would include a large concrete structure located near the outfall of a CSO and would contain an adjustable weir/gate which could rise and block flow in the combined sewer based on system conditions. The Hulman, Walnut and Ohio combined sewers were identified as potential locations for this type of control technology. The control or operation of the weir/gate would be very similar to the inflatable dam with similar system monitoring and safety systems to prevent system overflows or basement backups.

6.4.2.3 Off-line Storage

Another CSO control alternative that has been evaluated for a storage option is using off-line structures such as earthen basins or closed concrete tanks. The type of storage structure requires very different operations and design considerations.

Closed concrete tanks typically include odor control systems, washdown/solids removal systems, and access for cleaning and maintenance. Closed concrete tanks have been constructed below grade such that the surface at grade can be used for parks, playgrounds, parking or other light uses. Closed concrete tanks are potentially viable alternatives for Terre Haute's combined sewer system. A typical layout is shown on Figure 6.3-3. Depending upon the elevation of the CSO and surrounding ground, the tanks could be below grade with gravity influent and pumped effluent, or above grade with pumped influent and gravity effluent to the CSO, main interceptor or new relief sewer.

Earthen basins often provide a more cost effective method for CSO flow storage; however, their construction near urbanized areas has often been a problem from a public perception perspective. As a result, earthen basins were initially not considered for off-line CSO flow storage in the original LTCP. However, during the development of the final LTCP, an existing paper manufacturing facility located along the Wabash River and directly north of I-70 and the City's Main Lift Station (along with the Turner (CSO 003) Outfall) became decommissioned and the land and an existing lagoon-type wastewater treatment facility available for purchase. The facility's treatment system consisted of a 5-cell lagoon system which has a capacity to hold and store up to 60 MG of combined wastewater by utilizing the two larger basins as shown in Figure 6.3-4. Given the ideal location of this facility and the fact that the facilities for storage exist, the technical team concurred that the City should consider this off-line storage option in some or all potential comprehensive control alternatives for the system. The ponds to be utilized would require a new liner system with piping and control structures be installed along with wash-down facilities.

An existing wastewater treatment facility, Wabash Environmental Technologies (WET), exists just north of the Hulman (004) outfall. The facility has storage tanks available on site which could be used for CSO storage in lieu of or in combination with new off-line storage tanks. However, given the daily treatment and storage capacity of the facility of 1.9 MGD, and given the rate of CSO flows at this location (assuming only the Hulman/Idaho systems, and not upstream flows) and the subsequent volume of storage required, this facility would not be adequate nor economical for use as a CSO off-line storage facility. The existing tanks would fill up in less than 20 minutes at the start of a CSO event that last several hours.

6.4.3 Treatment and Floatables Controls Technologies

There are two types of treatment technologies for CSO flows: treatment at the CSO outfall and treatment expansion of the existing treatment plant. Given its condition and capacity, expansion of the existing treatment plant is considered common to any CSO plan developed and will be discussed in detail elsewhere in the report. Terre Haute CSO outfalls are all located near the riverbanks and in the floodplain of the Wabash River, thus locating and constructing a treatment facility near any of the outfalls would prove difficult. There are two types of CSO outfall treatment facilities: high-rate treatment and floatables control.

Providing high rate treatment facilities at each of the outfalls would be expensive because the peak wet weather flow rate in the collection system would have to be pumped up to each treatment unit. Also, disinfection chemicals would have to be handled at each treatment unit. Additionally, and perhaps most importantly, the remoteness of some of the outfalls would make operation of a "satellite" treatment facility difficult, and the construction of this type of facility(s) would require additional NPDES permits for the City. Providing a high rate treatment facility at the IP site could be an alternative to providing high rate treatment facilities at each outfall. This facility could utilize the main lift station to pump flows up to the treatment unit. Also, similar to a new facility at each outfall, use of this facility would require an additional NPDES permit to be held by the City. High rate treatment is discussed in more detail in Section 6.4.3.4.

Conversely, floatable controls provide screening and removal of floatables from combined sewer overflows only and are actually an NPDES permit requirement for existing outfalls. As a result, a form of floatable controls will be provided at each outfall which will remain as a result of the CSO LTCP selected plan implementation. In 2005, after submission of the original LTCP, a study was completed by Malcolm Pirnie for the selection of and installation of floatables control on the Terre Haute CSO's. The study was conducted prior to the consideration of consolidation or elimination of any of the outfalls as a result of the selected plan of the final LTCP. The following sections describe various technologies considered available and feasible for the Terre Haute outfalls for floatables control as detailed in the Malcolm Pirnie study.

6.4.3.1 Screens

Screening devices can be used to prevent floatables from being discharged from CSOs to receiving water bodies during wet weather after floatables have entered the combined sewer system. Screening of CSOs can potentially be challenging because the quantities and loading rates of floatables and solids vary widely during CSO events, from first flush at the initiation of the event to more dilute conditions towards the end of the event. If a period of drought is followed by a significant storm event, the quantity of floatables and solids discharged from CSOs will likely be high. However, if two storm events occur on consecutive days, the quantity of floatables and solids discharges from the CSOs from the second day's storm would be reduced. Selected screening systems for CSO control must be designed with sufficient flexibility to adapt to the fluctuations in floatables and solids loading conditions. Screening systems for floatables control in combined systems are typically installed in regulator chambers to prevent solids from being discharged from CSO outfalls. Screening devices that were included in the technology screening process for Terre Haute's System include:

- Static bar screens
- Vertical mechanical screens
- Horizontal mechanical bar screens

Static Bar Screens

Static bar screens are one of the least expensive forms of screening technologies available. The static bar screen consists of sturdy bars, aligned in parallel to one another and typically spaced 0.5 to 1.0 inches apart. The screens are fixed in place, trapping solids and floatable material. Static bar screens are manual, stand-alone systems without any mechanical moving parts or any automated cleaning mechanisms, thus requiring intensive operation labor. The advantages of static bar screens include:

- Capital installation costs are low.
- Since there are no moving parts, no mechanical repairs are needed.

- The disadvantages of static bar screens include:
- Periodic manual raking and removal of solids and floatables from the screen is required. Maintenance crews are generally required to visit each screen during and after each storm event to ensure that screens do not become clogged and restrict flows.
- Manual raking and removal of screenings during overflow events is impossible.
- Regular visitation of bar screens increases the frequency of confined space entry by maintenance personnel.
- Static bar screens typically require significant space for installation when high flows are expected.
- Static bar screens have the potential to clog with solids and floatables, which could cause flow restrictions and surcharges in upstream trunk sewers, which could lead to basement backups and street flooding around catch basins.

For the CSO outfalls that discharge infrequently and low volumes, static screens can be used. Some commercially available static screens are equipped with flushing water devices that can be activated after overflow events. For high volume discharges, clogging is certain without the addition of an automatic cleaning device and operators will have to be present at each location during or immediately after each storm event to ensure that the screens will not become clogged.

Vertical Mechanical Screens

Vertical mechanical bar screens are typically equipped with a vertical, inclined, static bar screen rack which remains submerged below the water surface, and a mechanical rake arm which remains above the water surface. When the bar rack requires cleaning, the mechanism periodically drives the rake arm vertically down below the water surface and on to the bar rack and then rakes the bars clean. The rake arm continues to rake upward on the screen to a discharge chute, where the solids and floatables are dumped into a storage container. Mechanical screens with perforated plate belts are also available. The perforated plate screen belt moves vertically upward continuous or intermittent. The perforated plate is typically cleaned with brushes and water sprays at the discharge chute. The advantages of vertical mechanical screens include:

- Having been used in wastewater treatment for decades, the technology is well known, understood, and reliable.
- The cleaning mechanisms prevent the screen from clogging and may be programmed to activate when high water levels are detected in a chamber.
- Addition of water is possible to flush solids and floatables back to the interceptor.
- Mechanical screens are effective for removal of solids and floatables of 114 inches and greater in size.
- The disadvantages of vertical mechanical screens include:
- The mechanical and electrical components have more O&M requirements than other non-mechanical screening options.
- High height clearances are involved, which may present a problem at some overflow locations.
- Additional concrete or other structures may be required to house the screening facilities.

<u>Horizontal Mechanical Bar Screens</u>

Horizontal mechanical bar screens are a relatively new technology being utilized in the United States to screen solids and floatables, though the screens are already being utilized in Europe for CSO control. The screens are rigid, weir-mounted, and constructed of narrow, corrosion resistant stainless steel bars with evenly spaced openings. The screening bars are designed in continuous runs with no intermediate supports to collect solids. The screen is activated automatically by a level sensor as storm water rises sufficiently to overflow the weir of the screen. When the screen requires cleaning, a hydraulically-driven rake assembly travels horizontally back and forth across the screen, combing away solids trapped on the screen. The combing tines carry the solids to one end of the screen for disposal back into the wastewater channel. The advantages of horizontal mechanical bar screens include:

- The rake arm assembly prevents the bar screen from clogging and may be programmed to activate when high water levels are detected in the chamber.

- Bar screens consist of thick, heavy-duty bars, which are more structurally sturdy during high storm flows than other wire mesh-type screens.
- Solids and floatables are "pushed back" into the wastewater channel to be handled at the treatment plant. Therefore, there are minimal maintenance personnel costs for screenings pickup and transportation.
- Horizontal mechanical bar screens are effective for removal of solids and floatables of 1/6 inches and greater in size.
- The disadvantages of horizontal mechanical bar screens include:
- The technology is relatively new.
- The mechanical and electrical components have more O&M requirements than other non-mechanical screening systems.

Vortex-Type Separators

A vortex separator is a cylindrical unit, which uses the hydrodynamics of swirling or vortex velocities to concentrate and remove solids and grit. The unit has no moving parts. Storm flows enter the unit tangent to the cylindrical chamber to create a swirling vortex that imparts velocities beneficial to separating solids out of liquids. Vortex separation occurs when the circulating suspended solids are drawn to the center of the swirl and are directed down toward the center of the unit where the solids concentrate. This mixture of concentrated solids and wastewater is then removed from the bottom of the unit by a "foul" sewer pipe, which directs the foul sewer flow back to the interceptor continuing flow to the treatment plant. The clarified effluent exits the top of the unit and is discharged to the receiving outfall through an outfall pipe from the vortex separator unit.

Currently, there are various model types of vortex separators in use; despite variations among the different types, the principles of operation of most models are essentially the same. The advantages of vortex separators include:

- Vortex separators are a viable CSO control technology that has been installed in several locations in the U.S., Britain, Germany, Japan, and other countries.

- Depending on the type of vortex separator, it is possible to pump the floatables and solids collected by the vortex separator into the interceptor with a cleanout pump, thus eliminating the need for mechanical cleaning.
- Smaller manufactured vortex units are commercially available.

The disadvantages of vortex separators include:

- Vortex separator units for large urbanized areas may require a large footprint area for installation. In general, the spatial requirements are higher than those required for screening or netting technologies.
- More extensive construction is needed for vortex separator systems. Typical vortex separator units would approach an average depth of 30 ft, which is more than three times the depth required for concrete chambers for screening or netting technologies.
- Depending on the type of vortex separator, removal of solids from the vortex units would require mechanical cleaning, which would incur additional O&M costs. A vortex separator system with a cleanout pump included in the design would also incur additional O&M costs associated with pump operation and maintenance.

6.4.3.2 Netting Systems

Two types of netting systems were identified in development of the system-wide alternatives:

- End-of-pipe
- In-line

End-of-Pipe Netting System

End-of-pipe netting systems are designed to "catch" floatable materials shortly after being discharged by CSOs. Most applications consist of simple construction materials and components, such as nylon netting and support platform and framing. The end of the outfall pipe is channeled into the mesh bags, which are each sized to capture a given volume of floatable material. The mouth of the mesh bags is fabricated with wooden frames, which slide into channels to connect to the rectangular frames.

When the mesh bags are full, they are removed and hauled away. The bags are usually disposed of with the solids and floatables. The waste materials are usually landfilled and new clean nets are replaced on the system.

The advantages of this system include:

- Capital costs are lower than other mechanical screens.
- Few mechanical components and mechanical repair costs are lower when compared to other screening alternatives.
- Construction of an on-land concrete chamber to hold screening equipment is not required.
- The system can be constructed without interfering with current operation of existing CSOs.
- End-of-pipe netting is effective for removal of solids and floatables of 0.5 inches and greater in size.
- The mesh bags provide more screening surface area per unit flow area than any other screening alternative.
- The system may be easily expanded with additional mesh bags for only minimal design and construction effort relative to other alternatives where expansion may not be economically feasible.
- The disadvantages of this system include:
- Full mesh bags are manually removed. Operation personnel labor costs will increase due to required localized screenings pickup, transportation, and disposal, and to install new nets.
- A mobile hoisting crane will be required to retrieve and remove the full mesh bags.
- Access to the nets may be difficult in some areas when major storm events cause high water elevations.

In-Line Netting System

In addition to the end-of-pipe netting system, in-line netting can be installed where end-of-pipe installations are not technically feasible. This system operates on the same principle as the end-of-pipe nets but consists of a concrete chamber to hold the mesh bag netting, net support guides, and access hatches, and a mesh bag net insert.

This system allows for the netting, floatables, and solids to be removed from the chamber by hoisting the nets out of the chamber with a crane, which may then be loaded on a truck for disposal. In addition to the advantages mentioned for the end-of-pipe netting system, advantages for this alternative include:

- Personnel and equipment will be more accessible for removal and disposal of the nets than the end-of-pipe netting alternative.
- Disadvantages of the in-line netting system include:
- Operation personnel labor costs will increase because screenings pickup, transportation, and disposal will be required with this alternative for the manual disposal of the solids and floatables captured in the netting and to install new nets.
- A mobile hoisting crane will be required to retrieve and remove the full nets.

Due to the disadvantages detailed in this section, netting systems were eliminated from consideration for further evaluation.

6.4.3.3 Floatables Source Control

Floatables source controls are methods of reducing floatables and solids at their source. Floatables source control methods include:

- Catch basin cleaning – This measure typically involves cleaning of catch basins by maintenance crews using a vacuum truck.
- Catch basin modifications – Catch basins are modified to capture floatables prior to discharging to the combined trunk sewers. These measures include baffles installed in catch basins, screen blankets installed at inlet gratings, or mesh bags inserted in catch basins.

- Street cleaning – This measure involves cleaning of street litter by mechanical or manual street cleaning. The USEPA recommends that street cleahing should be done as often as once or twice per week and before each storm. However, street sweeping performed at that high of a frequency may not be feasible due to O&M costs incurred and logistical difficulties in large urban areas.

- Trash receptacles – This measure involves the provision of standard trash receptacles throughout major public areas within the system.

- Public education programs – This measure involves the implementation of programs to educate the public on initiatives such as litter control (with information regarding associated fines and penalties), illegal disposal, and the link between litter and CSO impacts. Public notification typically includes postings in public places, radio and television advertisements, and letter notification to residents and commercial entities.

The primary advantage of the use of source controls is low capital cost. The primary disadvantages include increased O&M costs required for cleaning streets, inlets, and potential for street and yard flooding. Due to the nature of these kinds of controls, numerical estimation of their effectiveness on the river water aesthetics is not feasible. Also, these source control methods are typically considered to be insufficient for total floatables control. Source controls were not considered as an effective floatable control method.

The actual method proposed for floatables control for the CSO's to remain in the developed comprehensive system-wide alternatives will be discussed with each respective alternative evaluated.

6.4.3.4 Remote Treatment

High Rate Clarification

High rate clarification treatment can provide secondary-level treatment to wastewater. Typically, clarification is accomplished by providing quiescent conditions in a tank or basin so that the suspended solids in the wastewater can bind together, thus creating heavier floc, which slowly settle to the bottom while the cleaner water overflows at the top. To provide non-turbulent conditions, long detention times and low overflow rates are required, which necessitates large volume/large surface area tanks or basins.

In high rate clarification, a coagulant is added to the wastewater so that solids bind together more readily and a polymer and ballast, such as sand, is added to increase the weight of the floc so it settles out more quickly. This type of system allows for high overflow rates and short detention times, each of which reduces the size or footprint of the facility. The ballast is removed from the settled sludge and recycled for use in the system. The settled sludge is conveyed in a waste stream to the wastewater treatment facility. Overflows can also be disinfected before entering the receiving stream. The advantages of high rate clarification include:

- High rate clarification facilities have been installed for CSO LTCPs in Indiana and other states, as well as in other countries, and have proved to be effective
- High rate clarification facilities have a relatively small footprint compared to storage facilities
- Facilities emit practically no odors from combined sewage
- Facilities can be obscured in a building that is blended in with the surroundings
- Facility controls can be integrated into a SCADA system to allow for remote monitoring and control

Disadvantages with this alternative include:

- High rate clarification facilities consists of mechanical equipment that will require typical operation (power, chemicals and labor) and maintenance (numerous pumps and motors)
- High rate clarification facilities have a relatively large footprint compared with other screening and netting technologies
- High rate clarification is considered satellite treatment. As such, IDEM will require the City's NPDES permit to be modified to recognize and establish water quality limits for the HRC effluent. The City will have to perform ongoing monitoring and testing of its effluent water to ensure compliance.

6.4.4 Summary of Screening Process of CSO Control Technologies

On September 12, 2008 the Technical Team conducted a planning meeting to evaluate and screen the various CSO control technologies developed for Terre Haute, and based on this screening, develop comprehensive system wide control alternatives based on the use of screened technologies in the various areas of the system.

The first step in the CSO technology screening process was to assess each of the major and minor technologies and their environmental impact (high or low). Table 6.4-1 displays the results of this assessment on the various technologies.

After assessing each of the technologies, a matrix was developed in which the decision to eliminate or consider each of the various technologies was made. Table 6.4-2 displays this decision matrix and it should be noted the some of the technologies were noted to be common to any and all alternatives.

Table 6.4-1
Initial CSO Technology Screening

TECHNOLOGIES	ENVIRONMENTAL IMPACTS AND IMPROVEMENTS							IMPLEMENTATION & OPERATION FACTORS
	Flow Reduction	BOD Reduction	DO Enhancement	Settleableu Solids Removal	Bacteria Reduction	Floatables Reduction	Other	
MAJOR								
I. STORAGE TECHNOLOGIES								
A. In-line Storage – Trunk Sewer	High	High	High	High	High	High		
B. Tunnels	High	High	High	High	High	High		
C. Vertical Shaft	High	High	High	High	High	High		
D. Earthen Lined Storage Basins	High	Low	Low	Low	Low	High		
E. Off-line Covered Storage Tanks	High	High	High	High	High	High		
F. Off-line Open Storage Tanks	High	High	High	High	High	High		
II. TREATMENT TECHNOLOGIES								
A. Maximize Capacity at WWTP Plant	High	High	High	High	High	High		
B. Treatment Tanks	High	High	High	High	High	High		
C. Enhanced Treatment Tanks	High	High	High	High	High	High		
D. High Rate Clarification	High	High	High	High	High	High		
MINOR								
III. COLLECTION SYSTEM CONTROLS (O & M)								
A. Infiltration/Inflow Reduction (Private/Public)	High	Low	Low	Low	Low	Low		
B. Sewer System Cleaning	Low	High	Low	High	Low	High		
C. House Lateral Repairs	High	Low	Low	Low	Low	None		
D. CSO Diversion Structure Improvement Program	Low	Low	Low	Low	Low	Low		
E. Real Time Control / w/Inline Storage	High	High	High	High	High	Low		
F. Illicit Disconnect Program	Low	Low	Low	Low	Low	Low		
IV. SOURCE CONTROL TECHNOLOGIES								
A. Sewer Separation								
- Partial – New Storm Sewers	High	High	High	High	High	High		
- Total – Sanitary Sewers	High	High	High	High	High	High		

TECHNOLOGIES	ENVIRONMENTAL IMPACTS AND IMPROVEMENTS							IMPLEMENTATION & OPERATION FACTORS
	Flow Reduction	BOD Reduction	DO Enhancement	Settleableu Solids Removal	Bacteria Reduction	Floatables Reduction	Other	
B. Storage Ponds - Stormwater	High	Low	Low	High	Low	High		
C. Street Storage (Catch Basin Inlet Control)	High	Low	Low	Low	Low	High		
D. Leaching Catch Basins (Dry Well)	Low	Low	Low	Low	Low	Low		
E. Porous Pavement	Low	Low	Low	Low	Low	Low		
F. Swales & Filter Strips	Low	Low	Low	Low	Low	High		
G. Rain Gardens	Low	Low	Low	Low	Low	High		

Table 6.4-2
Consideration of Technologies

TECHNOLOGIES	Eliminate	Consider	Common to All	REASONS/NOTES
MAJOR				
I. STORAGE TECHNOLOGIES				
A. In-line Storage – Trunk Sewer		✓		
B. Tunnels		✓		
C. Vertical Shaft		✓		
D. Earthen Lined Storage Basins	✓			
E. Off-line Covered Storage Tanks		✓		
F. Off-line Open Storage Tanks		✓		
II. TREATMENT TECHNOLOGIES				
A. Maximize Capacity at WWTP Plant		✓		
B. Treatment Tanks		✓		
C. Enhanced Treatment Tanks		✓		
D. High Rate Clarification		✓		
MINOR				
III. COLLECTION SYSTEM CONTROLS (O & M)				
A. Infiltration/Inflow Reduction (Private/Public)			✓	
B. Sewer System Cleaning			✓	
C. House Lateral Repairs			✓	
D. CSO Diversion Structure Improvement Program			✓	
E. Real Time Control / w/Inline Storage			✓	
F. Illicit Disconnect Program			✓	
IV. SOURCE CONTROL TECHNOLOGIES				
A. Sewer Separation				
- Partial – New Storm Sewers		✓		
- Total – Sanitary Sewers		✓		
B. Storage Ponds - Stormwater	✓			
C. Street Storage (Catch Basin Inlet Control)	✓			
D. Leaching Catch Basins (Dry Well)		✓		
E. Porous Pavement		✓		
F. Swales & Filter Strips		✓		
G. Rain Gardens		✓		

*Minutes and summaries from the technology screening process are included in Appendix 6-1.

**Documentation regarding the decision to evaluate High Rate Clarification as an alternative is included in Appendix 6-5

6.5 Development of Control Alternatives

6.5.1 In-Depth Evaluation of Control Alternatives

Based on the screened CSO control technologies, the technical team began to develop comprehensive alternatives for CSO control for the entire system. The alternatives could then be input into the SWMM model to determine infrastructure sizing required for various levels of control, after which cost estimates for each alternative were developed for evaluation. The various components of each comprehensive system alternative were developed utilizing the following general schemes.

6.5.1.1 Main Lift Station and WWTP Upgrade

The existing main lift station is nearly 45 years old and is in a deteriorated condition which requires significant pump maintenance and rehab annually. Similarly, most components of the wastewater treatment facility were constructed over 40 years ago and flow is limited to 45 – 48 MGD in the primary treatment processes (with the actual sustained capacity being closer to 30 MGD) and 24 MGD capacity in the secondary processes. It is assumed for all comprehensive system alternatives that the plant will be upgraded to rehabilitate or replace all major components and increase the capacity of the entire facility to 48 MGD. Likewise, it is also assumed that the main lift station will be replaced in most alternatives (please note that one alternatives as described later is proposed which will not replace the main lift station.) *If the main lift station is replaced and treatment facility upgrades are constructed as planned, CSO 002 an emergency overflow at the existing main lift station can be eliminated.*

6.5.1.2 In-Line Storage Alternatives

As discussed elsewhere in this report, several of the existing large diameter combined sewers in the system offer favorable conditions for in-line storage of combined wastewater flows. The Walnut, Hulman, and Ohio sewers in particular are of brick construction and are over-sized with diameters as high as 84" to 120". Accordingly, all comprehensive alternatives for the system will assume common in-line storage concepts which will be utilized in the SWMM model analysis of each of the alternatives. The inline storage will be accomplished by installing weir/back-up structures at the Hulman/Idaho combined outfall and at the 15th/Ohio Street area.

Additional in-line storage opportunities can be developed utilizing relief sewers which will store and ultimately convey combined wastewater flows from one outfall or area to another.

Lastly, large diameter tunnels can be constructed which will operate similar to CSO relief sewers, however, their storage capacities and operation and maintenance differ significantly.

The comprehensive alternatives developed and discussed in Section 6.5.2 utilize a variety of combinations of these in-line storage opportunities.

6.5.1.3 Off-Line Storage Alternatives

Off line storage of combined sewage flows is attained through transferring flows from the combined sewer to a facility which is separated from the combined system. Combined wastewater flows can either be conveyed by gravity to the storage facility and pumped out, or pumped into the facility for gravity conveyance back to the CSO outfall or main interceptor depending upon flow conditions. Two options are essentially available for off-line storage in the Terre Haute system as described by the following two sections.

International Paper Lagoons

During the LTCP revision process, an industrial site directly north of and adjacent to the city's main lift station and Turner outfall ceased operation and the property became available. The site contained a five cell lagoon based wastewater treatment facility (with an existing NPDES permit) along the Wabash River with ultimate capacity to store in excess of 70 MG of combined wastewater. The main issues with the lagoons were sludge removal and disposal, and transfer of the facility from private to municipal use.

Given the location of this facility and the fact that the property could be acquired by the City with the lagoons/basins in-place, it was the recommendation of the tech team to utilize this option for off-line storage of combined sewage flows in some or all comprehensive alternatives.

Storage Tanks

The other viable option for off-line storage which was selected by the Tech Team for evaluation in some alternatives was the use of storage tanks. Given the location of the need for these tanks, most would need to be below grade concrete tanks with mixing/cleaning systems. During the alternative screening process, the use of vertical caissons for storage was also considered however, due to the volume of storage needed and elevation constraints, these type of structures were not considered in the final comprehensive alternative development.

6.5.1.4 Treatment Alternatives

Satellite treatment can be provided at CSO outfalls by removing solids and disinfecting the overflows in. manner which would eliminate CSO's at that location to a specific level of control. A number of treatment technologies are currently available, including vortex separators and high rate clarification facilities. Though not included in the in-depth evaluation of alternatives in the approved LTCP of 2011, additional information gathered during the design of Phase I projects has led the City to evaluate a treatment alternative to be used in lieu of the originally approved storage alternative at the IP site. The City's design consultant provided the City and Program Manager with a Basis of Design for the high rate clarification treatment option at that location in lieu of storage within that comprehensive alternative.

6.5.2 Description of Comprehensive Alternatives Developed

In order to develop the comprehensive system-wide alternatives, the Terre Haute CSO system was divided into four distinct areas: Spruce/Chestnut Outfalls Area (CSO's 009/010), Fairbanks Park Area (CSO's 005, 006, 007 and 008), Hulman/Idaho Outfalls Area (CSO's 004/011) and the Turner Outfall/Main Lift Station Area (CSO's 003/002). Next, the above described CSO control schemes were applied to the specific areas based on applicability and comprehensive CSO control alternative plans were developed for the entire system. During the September 12, 2008 Technical Team meeting, seven alternatives were developed for the system and are described in the following sub-sections.

The infrastructure sizing references are based upon an initial overflow volume predicted for the 4 overflow storm event.

Alternative 1- North Storage/International Paper Storage Option I

- Consolidation of Spruce and Chestnut outfalls via relief sewer from Spruce to Chestnut, closure of Spruce and new storage tank (10 MG).
- Relief Sewer (48" – (2) 144") for conveyance from Fairbanks Park south to International Paper lagoons, closure of outfalls 004, 005, 006, 007, 008 and 009.

- International Paper lagoon modifications, influent and effluent conveyance for lagoons and Turner Outfall conveyance. *Outfall 002 to remain open*.

Alternative 2 – North Storage/International Paper Storage Option II

- Consolidation of Outfalls 007, 008, 009 and 010 via relief sewer (96" to 120") from Walnut Street north to Chestnut, closure of outfalls 007, 008 and 009, and new storage tank (10.8 MG) at outfall 010.
- Relief sewer (60" – (2) 132") for conveyance for Oak Street south to International Paper Lagoons, closure of outfalls 006, 005, and 004.
- International Paper lagoon modifications and Turner Outfall conveyance. *Outfall 002 to remain open*.

Alternative 3 – Conveyance and Storage Option

- Consolidation of Spruce and Chestnut outfalls via relief sewer from Spruce to Chestnut, new Storage tank (10 MG) at Chestnut and closure of outfall 010.
- Relief sewer (48" – 144") for storage and conveyance from Ohio Street to Hulman Street with closure of outfalls 005, 006, and 008 in Fairbanks Park with 007 remaining open for storm water discharge only.
- Hulman Street Storage Tank (7 MG), outfall 011 remains open.
- Turner Street Storage Tank (3.2 MG), outfalls 003 *and 002* remain open.

Alternative 4 – Storage Tanks Option

- North conveyance via relief sewer from Spruce to Chestnut
- North Storage tank (10 MG) at Chestnut, closure of outfalls 009 and 010
- Park conveyance and storage via relief sewer (48" – 144") from Ohio Street to storage tank (2 MG) at south end of the park. Closure of outfalls 005, 006 and 008 with 007 remaining open for storm water only.
- New outfall 005A at new storage tank at south end of Fairbanks Park
- Hulman Street Storage tank (5 MG)

- Turner Storage Tank (3.2 MG), *outfalls 003 and 002 remain open*.

Alternative 5 – North Tunnel

- 17' diameter tunnel from Spruce Street south to Crawford Street, closure of outfalls 006, 007, 008, 009 and 010.
- North Tunnel flow storage evacuation lift station with outlet south of Fairbanks Park
- Idaho Storage Tank (5 MG) with Outfall 011 remaining open.
- Turner Storage Tank (3.2 MG) with Outfall 003 *and 002* remaining open.

Alternative 6 – Tunnel to Idaho Street

- 17' diameter tunnel from Spruce Street (010) to Idaho Street (004), closure of outfalls 004, 005, 006, 008, 009 and 010.
- Idaho Tunnel flow storage Evacuation Lift station
- Idaho Storage Tank (5 MG)
- Turner Storage Tank (3.2 MG), outfall *003 and 002* to remain open.

Alternative 7 – Tunnel to Main Lift Station

- 17' diameter tunnel for conveyance and storage from Spruce Street south to the Main Lift Station, closure of all outfalls but Turner (003) *and Main Lift Station (002)*.
- Tunnel flow storage evacuation lift station

6.5.3 Common Alternative Elements

Concurrent to development of the comprehensive alternatives for the system, several common elements were developed which would enhance the effectiveness of any of the CSO control alternatives. The following common alternative elements were combined with each of the comprehensive alternatives.

6.5.3.1 Floatable Controls at CSO's to remain

In all of the comprehensive alternatives developed for the combined sewer system, at least one and in most cases a few outfalls will remain. In accordance with the City's NPDES permit, floatables control shall be placed on each outfall which will remain in service. As described previously in this section, several types of floatables control methods were considered for the Terre Haute CSO's. However, given the location of the outfalls which will likely remain and the volume of flows which the facilities could be required to handle, the technology selected for each outfall will consist of mechanical screening only (either vertical or horizontal). The quantity of floatables control facilities and the associated costs will be included in each of the comprehensive system alternatives.

6.5.3.2 Back-Up Weir Structure at Hulman/Idaho and Floatables Control

All of the SWMM model analysis for the combined sewer system and each alternative for CSO control will assume that a backup weir structure will be constructed at the Hulman Street outfall. This backup weir structure will allow the Hulman and Idaho Street combined sewers to be used to store combined sewer flows until they can be released into other new or existing infrastructure, or released to outfall depending upon the storm conditions. The new structure will also contain floatables control via mechanical screen for the alternatives which require this outfall to remain open.

6.5.3.3 Interim Plant Upgrades – Piping/Hydraulics and Chlorine Contact Tank Upgrades

When the original seven comprehensive alternatives were developed, the new treatment plant upgrades and expansion were not finalized and approved for construction. As a result, the alternatives assumed that piping and hydraulic capacity of the primary treatment processes and the chlorine contact tank would be upgraded to a 48 MGD capacity to allow for primary settling and disinfection of peak wet weather flows. Now, the treatment plant improvements and expansion are approved and a peak capacity of 48 MGD throughout the treatment facility will be the basis of design for all CSO alternatives. Essentially, the Phases II and III of the treatment plant improvements project (see section 6.5.3.8 below) will be the initial phases of the CSO LTCP selected plan as described later in the report and the interim piping and disinfection process improvements will not be required as a common alternative element.

6.5.3.4 Rehabilitation of North Hulman Street Sewer and Weir at 15th and Ohio

In addition to the in-line storage proposed for the Hulman/Idaho combined sewers, in-line storage is proposed in an upstream section of the system. The SWMM model analysis of all alternatives will assume a weir is placed at the intersection of 15th and Ohio Streets to allow for re-routing of combined flows south of the CSO's in the priority area of Fairbanks Park. Also, in order to accommodate this section of in-line storage and flow re-routing, in the system, the existing combined sewers in these areas will require rehabilitation similar to the method used on other large diameter sewers as discussed in the following section.

6.5.3.5 Large Diameter Pipe Rehabilitation

In order to utilize some of the larger combined sewers in the system and to address poor conditions of some of the pipes which will be required to continue to operate in the system, inspection and rehabilitation of several of the systems larger outfalls was necessary. Accordingly, rehabilitation based on inspection of sections of the Spruce, Ohio, Walnut and Hulman Street sewers was completed in 2006/2007. As a result, while this rehabilitation is a common element to all comprehensive alternatives, the costs associated with this work are not included in the costs of any of the LTCP alternatives since this work has been previously completed utilizing proceeds from a revenue bond issued by the City in 2005.

6.5.3.6 New Headworks Facility at Wastewater Treatment Facility

Phase I of the City's wastewater treatment plant improvement/expansion project consists of the construction of a new headworks facility. In the original LTCP development and through the early portions of the final plan development, it was assumed that improvements to the primary treatment and disinfection sections of the treatment facility would require improvements to maximize flow to the plant up to 48 MGD. However, now that the treatment plant project has been approved and is in progress, this requirement as a common alternative element is no longer required. The new headworks facility began in January 2011 and was completed in May 2012. While the costs of this work are not included in the costs of the comprehensive system alternatives, the cost of this WWTF Phase I project (and phases II and III) is included along with CSO LTCP costs in the financial analysis of the wastewater utility included in section 8 of the LTCP.

6.5.3.7 Separation of East area of basin 003 and west end of 009

Given the size of the Terre Haute system, complete separation of the combined sewer system was not a viable option. However, two areas of two of the basins, the east area of the Turner Street basin, and the western area of the Chestnut street basin do offer opportunity to separate combined sewers economically.

The area of the Turner Street basin is along Margaret Avenue, a major transportation route in the City which will be improved in the next several years with combined sewer separation possible through the construction of new storm sewers.

The western section of the Chestnut Street basin can be feasibly separated since it is outside of the main campus area of Indiana State University.

All of the comprehensive alternatives and SWMM model analyses will assume separation of these areas at some point in the LTCP implementation. Additionally, other areas of the Chestnut Street basin could realize a reduction in CSO flows through the implementation of "green technologies" as discussed later in this section.

6.5.3.8 Wastewater Treatment Plant Improvements Phases II and III

As stated previously, the new Headworks proposed for the wastewater treatment facility is Phase I of the overall facility improvements and is scheduled to begin construction in January 2011. The remainder of the improvements to the facility, Phases II and III, are scheduled to be designed and constructed between 2011 and 2016 and will generally replace antiquated equipment, structures and processes, and increase the overall capacity of all sections of the plant to 48 MGD. The various components of the treatment facility improvements project are described in the following sections based on information contained in the Wastewater Treatment Facility's Preliminary Engineering Report completed by HNTB.

Demolition of Grit Tank and Pre-Aeration Tank

The existing grit chambers and pre-aeration tanks will be excavated and demolished after the new headworks is operational.

Anoxic Tank Conversion

The primary tanks will be converted to four (4) anoxic tanks — concrete will be repaired, weirs replaced, primary sedimentation equipment removed and mixers installed. The walls of the tanks will be raised to hydraulically accommodate 48 MGD peak wet weather flow plus combined return activated sludge (RAS) and internal recycle flows for a total of 144 MGD through secondary treatment.

Internal Recycle Division Structure

Due to the high flow planned through the anoxic tanks, a new flow division structure downstream of the headworks is required. An internal recycle flow division structure will be built to accept the internal recycle flow from the aeration tank effluent (72-96 MGD), the RAS flow (24 MGD) from the secondary clarifiers and the influent flow (design 24 MGD, peak wet weather 48 MGD) and split the flow between the four (4) anoxic tanks.

Proposed Aeration Tanks

Twelve (12) new aeration tanks, an influent division structure, effluent division structure and piping are required to meet the higher flow demands. This structure will be built perpendicular and to the east of the existing aeration tanks. New aeration equipment will be provided including air piping, headers, valves and diffusers, and flow control weirs.

Proposed Blower Building

A new blower building will be built to the south of the new aeration tanks to house six (6) 6000 scfm blowers to aerate all the aeration tanks plus two (2) 1000 scfm blowers to aerate the channels.

Existing Aeration Tank Upgrades

The existing aeration tanks will have upgrades which include concrete replacement of the top two (2) feet of all walls, increased wall height of two (2) feet, additional flow control weirs and replacement of the air piping, valves and diffusers. New influent and effluent flow splitting structures will be provided.

Existing Secondary Clarifier Upgrades

The existing rim flow secondary clarifiers will need equipment replacement as well as minor concrete repairs. Influent and effluent piping will be replaced as needed.

Proposed Secondary Clarifier Tanks and RAS Pump Building

Two new secondary clarifiers will be constructed along with a new RAS pumping building, secondary effluent control box and piping.

Conversion to Ultraviolet Disinfection

The existing chlorine disinfection system will be converted to UV disinfection by modifying the chlorine contact tank and installing UV disinfection equipment. In addition, the existing Parshall Flume will be replaced with a magnetic flow meter and the effluent weir will be lowered by one (1) foot to provide protection to UV equipment up to the 100-year flood level.

Proposed Sludge Process Building

The gravity belt thickeners and belt filter press dewatering systems will be removed and replaced with rotary drum thickeners and centrifuges respectively. Four rotary drum thickeners (including one backup) and three centrifuges (including one backup) will be located in one building south of the dewatered sludge storage pad. The building will also include a 500,000-gallon waste activated sludge (WAS) receiving well, a thickened WAS receiving well and pumps.

The remaining sludge pad, approximately 166 ft by 60 ft, will run west to east and provide approximately 1330 cy of storage for the dewatered sludge from the centrifuges in the new sludge handling facility.

Proposed Liquid Storage Tanks and Odor Control/Pump Building

Four (4) 2.5 million gallon (MG) storage tanks will store either thickened WAS, aerobic sludge or both. The tanks will have wet scrubbers for odor control and jet mixing for aeration. The storage tanks are sized for 90 days of storage and will be located in the southeast corner of the WWTP where the existing lagoons are located.

Administration Building

A new administration building, which will also house a new laboratory and SCADA control center, will be located south of the southernmost entrance to the WWTP.

Plant Water System

The existing process of chlorine disinfection of the final effluent at the Terre Haute WWTP will be replaced by ultraviolet (UV) disinfection. Because the secondary effluent is the source of non-potable water for the existing non-potable water system at the WWTP, a reconfiguration of the non-potable water system is required. The new headworks will require plant water for proper operation.

Plant Side Stream Lift Station

To accommodate upgrades to the WWTP including proposed sludge processes, a new lift station will be built to receive recycle water waste streams from throughout the WWTP and pump the streams back to the proposed headworks facility.

Proposed Internal Anoxic Recycle Pump Station

A pump station from the effluent division structure is necessary to pump the internal recycle flow to the internal recycle flow division structure upstream of the anoxic tanks.

Proposed Scum Handling Pit

The current collection of scum at the primary and secondary clarifiers and disposal to the landfill will need to be reconfigured with proposed changes to both processes. The collected scum from various processes will be concentrated in a scum pit, pumped to a truck, and then transported to a landfill for final disposal.

Flow Equalization Basins and Odor Control System

The existing basins have liners that have pulled loose from the anchoring system and need replacement. Odor control provisions using chemical addition and a new water monitor system will also be provided.

Electrical and Instrumentation and Control (IOC)

The electrical and I&C upgrades will be incorporated into the upgrades listed above and include replacing electrical equipment as needed, adding standby power for critical unit processes, and a new Supervisory Control and Data Acquisition (SCADA) system to provide supervisory control and monitoring from strategic remote locations.

6.5.3.9 Combined Sewer Inspection and Cleaning

The City plans to implement a program to inspect and clean the combined sewers in the collection system. Most of the large diameter combined sewers in the system except for those rehabilitated in 2006/2007 have not been inspected or cleaned in several years. The "early action" project completed on several of the large combined sewers suitable for in-line storage consisted of inspecting the following sewers: Ohio, Walnut, Hulman and Spruce/Chestnut. Based on the results of this inspection report, sections of these sewers were cleaned and rehabilitated utilizing a spray-on applied grout, reinforced where necessary. Details of the project and its limits are included in Appendix 6-2.

The program proposed for sewers not included in the "early action" project will involve hiring specialists to assess the conditions of the sewers to evaluate if the sewers are in need of repair. After the inspection is complete the City will then implement a cleaning schedule of the sewers. Either the City will purchase cleaning equipment and clean the sewers or hire a cleaning service to clean the sewers.

6.5.3.10 Wellhead Protection Zone

During one of the original plan development CAC meetings, the issue of exfiltration of combined sewage in some of the older sewers was brought to the attention of the group. The CAC expressed their concern of exfiltration of combined sewers in the Wellhead Protection Zone of the City's drinking water supply. A portion of the one-year time of travel wellhead protection zone boundary extends into the northern boundary of the combined sewer collection system. Therefore, costs for lining the sewers in that area with cured-in-place pipe were included in the original LTCP. However, as part of some early action CSO work for which the City issued revenue bonds, this area of the combined system and other area proposed for in-line storage of CSO flows was rehabilitation utilizing a spray-on grout system. This $6 million project was completed in 2006/2007.

6.6 Evaluation of Comprehensive System-Wide Alternatives

After the development of the seven comprehensive system alternatives, evaluation of the alternatives was completed prior to detailed analysis of the final 2 or 3 options. The following two subsections described the screening process completed by the technical team for the alternatives prior to the detailed evaluation of alternatives including SWMM model analysis for various storm events and river quality impacts described in later sections of this report. The results of this process are shown in Appendix 6-3, "Long Term Control Plan Alternative Screening".

6.6.1 Initial Screening (Screen from 1-7 to 1, 5A, 5B and 7)

6.6.1.1 Cost Model

Costs were developed for each of the seven alternatives that had been previously determined by the Technical Team and approved by IDEM for further evaluation. The alternatives were developed to store or treat flows for the design storm resulting in four overflows per year for the system. The seven alternatives were:

- Alternative 1 – North Storage/International paper Storage Option I
- Alternative 2 – North Storage/International Paper Storage Option II
- Alternative 3 – Conveyance and Storage Option
- Alternative 4 – Storage Tanks Option
- Alternative 5 – North Tunnel
- Alternative 6 – Tunnel to Idaho Street
- Alternative 7 – Tunnel to Main Lift Station

The costs for each of the seven options are shown in Table 6.6-1

Table 6.6-1
Preliminary Opinion of Construction Cost Summary – Initial Alternatives Sized for 4 Overflows per Year

Alternative	Description	Capital Cost
1	North Storage/International Paper Storage Option I	$125,000,000
2	North Storage/International Paper Storage Option II	$120,000,000
3	Conveyance and Storage Option	$179,000,000
4	Storage Tank Option	$171,000,000
5	North Tunnel	$130,000,000
6	Tunnel to Idaho	$149,000,000
7	Tunnel to Main Lift Station	$120,000,000

*Note – Costs indicated are for construction only and do not include common items nor non-construction costs.
Costs were developed using bid tabulations from several communities for similar projects. Bid tabulations are generally the best indication of costs. Material and equipment and labor costs were determined from supplier estimates.

Table 6.6-2
Preliminary Opinion of Operations and Maintenance Costs Summary – Initial Alternatives Sized for 4 Overflows per Year

Alternative	Description	O&M Cost
1	North Storage/International Paper Storage Option I	$1,250,000
2	North Storage/International Paper Storage Option II	$1,230,000
3	Conveyance and Storage Option	$2,020,000
4	Storage Tank Option	$2,010,000
5	North Tunnel	$1,180,000
6	Tunnel to Idaho	$1,280,000
7	Tunnel to Main Lift Station	$650,000

The Operations and Maintenance costs for each alternative were developed by using a percentage based on the type of project was to be constructed. The percentages used are 0.5% for primarily pipeline projects and 1.65% for projects that include a combination of pipeline, structures and lift stations as seen in Table6.5-2.

6.6.1.2 Screening Criteria

The Technical Team concluded that eight different criteria would be used for further screening of the alternatives.

- Capital Cost
- Adaptability to Future Regulatory Regulations
- Inconvenience During Construction
- O&M Staff Requirements/Reliability
- O&M Costs
- Potential for Regulatory Support
- Smoothness of Rate Impact (Phasing)
- Uncertainty/Risk

Each criterion was weighted by the Technical Team. The goal was to determine the relative importance of each criterion. A score of 0 to 25 was given to each criterion. A score of 25 would represent the most important criteria and 0 would represent the least important. The weighting of the given criteria is given in Table 6.6-3.

Table [redacted]
Evaluation Criteria Weighting

Criterion	Weight (0 to 25)
Capital Cost	25
Adaptability to Future Regulatory Regulations	10
Inconvenience During Construction	20
Operations and Maintenance Staff Requirements/Reliability	15
Operations and Maintenance Costs	15
Potential for Regulatory Support	20
Smoothness of Rate Impact (Phasing)	15
Uncertainty/Risk	15

After the criteria were weighted, each alternative was ranked according to each scoring criterion by the Technical Team. Each criterion was given a score of 0 to 5. A score of 5 points meant that the alternative met the criterion completely. A score of 0 points meant that the alternative did not meet the criterion. The scoring was then multiplied by the weighting of each criterion to determine a total score and overall ranking. A total score was determined for each alternative by adding all of the weighted scores. Table [redacted] shows the weighted scores of each criterion as well as the overall score of each alternative.

Table [redacted]
Terre Haute CSO LTCP Alternative Screening
Alternative Scoring/Ranking

Alternative	Description	Capital Cost	Weight	Score	Adaptability to Future Regulations	Weight	Score	Inconvenience During Construction	Weight	Score	O&M Staff Requirements/ Reliability	Weight	Score	O&M Costs	Weight	Score	Potential for Regulatory Support	Weight	Score	Smoothness of Rate Impact (Phasing)	Weight	Score	Uncertainty/Risk	Weight	Score	Total Score
1	North/IP Storage I	5	25	125	4	10	40	1	20	20	5	15	75	3	15	45	3	20	60	3	15	45	3	15	45	455
2	North/IP Storage II	5	25	125	4	10	40	1	20	20	5	15	75	3	15	45	3	20	60	3	15	45	3	15	45	455
3	Conveyance and Storage	1	25	25	1	10	10	1	20	20	1	15	15	1	15	15	1	20	20	4	15	60	2	15	30	195
4	Storage Tanks	2	25	50	1	10	10	1	20	20	1	15	15	1	15	15	1	20	20	4	15	60	2	15	30	220
5	North Tunnel	4	25	100	3	10	30	4	20	80	3	15	45	3	15	45	3	20	60	2	15	30	1	15	15	405
6	Tunnel to Idaho	3	25	75	2	10	20	5	20	100	3	15	45	3	15	45	3	20	60	2	15	30	1	15	15	390
7	Tunnel to Main Lift	5	25	125	4	10	40	5	20	100	3	15	45	5	15	75	5	20	100	1	15	15	1	15	15	515

As seen in Table [redacted], the highest ranking alternative is Alternative 7 – Tunnel to Main Lift Station. The second highest ranking alternatives were Alternatives 1 and 2 – both of which make use of the existing ponds at the International Paper site. Alternative 2 was eliminated because it conveys additional flow to the north. The north area is already heavily impacted by high CSO volumes and the goal is to take flow away from the northern outfalls. A third alternative was deemed necessary because at the time of screening, some uncertainty existed in terms of property acquisition of the International Paper site. In the event that the property could not be acquired, a third alternative that did not involve the IP property was chosen. Alternative 5 was selected to be evaluated as a third alternative.

In addition, Alternative 5 was broken into Alternative 5A and Alternative 5B. Alternative 5B included the use of the International Paper ponds. The use of the ponds in this alternative could result in a decrease in overall capital cost, but again, at the time of screening, the uncertainty of the property acquisition did not allow for its use as a primary alternative.

Accordingly, the four screened alternatives and their descriptions are as follows:

- Alternative 1 – North Storage/International Paper Storage Option I
  - Storage facility on the north side of Terre Haute to handle flows at the Chestnut (010) and Spruce (009) outfalls.
    - Closure of the Spruce outfall with all of the flows routed to the Chestnut outfall.
    - A floatable control facility constructed at Chestnut.
  - The International Paper Lagoons would be utilized for flows from Ohio (008) to Turner (003).
    - Conveyance piping from the Ohio Outfall constructed south to a new pump station at Hulman Street.
    - The Conveyance piping sized for ultimate conveyance of all flows within the park allowing all of the outfalls with Fairbanks Park to be closed.
    - A pump station constructed at Hulman Street to convey flows via force main from the park as well as flows from the Hulman and Idaho conveyance to the existing lagoons at the International Paper site.

    - Closure of the Hulman outfall as (004) would be closed and Idaho will remain open for storm events greater than the 4 overflow per year design storm and installation of floatable controls.
    - Conveyance of the Turner outfall (003) to the International Paper lagoons. Turner *and 002* will remain open for storm events greater than the 4 overflow per year design storm and floatable controls will be installed *on 003*.
    - Utilization of the International Paper Lagoons for storage of CSO overflows until the existing wastewater treatment facility can provide treatment.

- Alternative 5A – North Tunnel with Storage Tanks
  - Construction of a tunnel from the Spruce outfall (010) to the Crawford Outfall (005).
    - The tunnel sized for conveyance and storage.
    - Closure of Outfalls 010 (Crawford), 009 (Spruce), 008 (Ohio), 007 (Walnut), and 006 (Oak) with all flow for storm events larger than the 4 overflow per year design storm conveyed to the Crawford (005) outfall.
    - Floatable Controls will be installed on the Crawford (005) outfall.
  - Storage facility (5 MG) at Hulman Street to store all volumes up to the 4 overflow per year design storm.
    - Closure of the Hulman outfall (004) and floatable controls installed on the Idaho (010) outfall.
  - Storage Facility (3.2 MG) at the Turner Outfall (003) to store volumes up to the 4 overflow per year design storm.
    - Floatable Controls installed on the Turner outfall.
    - *Outfall 002 to remain open.*
- Alternative 5B – North Tunnel with International Paper Storage
  - Construction of a tunnel from the Spruce outfall (010) to the Crawford Outfall (005).
    - The tunnel sized for conveyance and storage.
    - Closure of outfalls 010 (Chestnut), 009 (Spruce), 008 (Ohio), 007 (Walnut), and 006 (Oak) with all flow for storm events larger than the 4 overflow per year design storm conveyed to the Crawford (005) outfall.
    - Floatable Controls installed on the Crawford (005) outfall.

  - Utilization of the International Paper Lagoons for flows from Hulman (004) to Turner (003).
    - The Hulman (004) and Idaho (010) flows conveyed to the International Paper Lagoons for storage.
    - A pump station constructed at Hulman Street to convey flows via force main from the Hulman and Idaho conveyance to the existing lagoons at the International Paper site.
    - Closure of the Hulman outfall (004) and Idaho will remain open for storm events greater than the 4 overflow per year design storm and floatable controls will be installed.
    - The Turner outfall (003) conveyed to the International paper lagoons. Turner to remain open for storm events greater than the 4 overflow per year design storm and floatable controls installed. *Outfall 002 to remain open*.
    - Utilization of the International Paper Lagoons for storage of CSO overflows until the existing wastewater treatment facility can provide treatment.

- Alternative 7 – Tunnel to Main Lift Station
  - Construction of a tunnel for conveyance and storage of all flows from Chestnut (010) to Turner (003).
  - Closure of all outfalls in the system. No floatable controls required.
  - Construction of a pump station at the south end of the tunnel in order to evacuate the tunnel and convey the flows to the existing wastewater treatment facility. *New pump station would allow closure of 002*.

6.6.1.3 **Common Alternatives**

Based on each alternative, the common elements that have been previously proposed may be modified. For example, no floatable requirements will be necessary for Alternative 7 – Tunnel to Main Lift Station since all of the existing outfalls would be closed and floatable control would be unnecessary. Floatable controls are included in the Common Alternatives, but would not be required for Alternative 7. The Common Alternatives described previously will be included as appropriate for each respective alternative in Section 7 for the final alternatives evaluation..

Based on this screening process, the City of Terre Haute Long Term Control Plan Technical Team narrowed down the comprehensive alternatives previously defined and approved by the Indiana Department of Environmental Management (IDEM). The process resulted in four alternatives that would be evaluated in detail at different overflow event design storms. A graphic representation of each of these screened alternatives is included in Appendix 6-3 and in Figures [redacted] through [redacted]. The four alternatives screened for detailed evaluation from the original seven are as follows:

- Alternative 1 – North Storage/International Paper Storage Option I
- Alternative 5A – North Tunnel with Storage Tanks
- Alternative 5B – North Tunnel with International Paper Storage
- Alternative 7 – Tunnel to Main Lift Station

6.6.2 Final Screening and Evaluation (Screen from 1, 5A, 5B and 7 to 7, 11, [redacted] and Hybrid)

After the technical team screened the original seven alternatives to four for detailed evaluation, a few key events prompted further analysis and alternative development including the following:

- Acquisition of the International Paper Property – The City acquired the property and thus given its location and size, it was logical to include its use in all alternatives included in the final detailed evaluation.

- Approval of Wastewater Treatment Facility Upgrade and Expansion – The City approved a plan for upgrading and expanding the wastewater treatment plant in 2009 and actual user rate increases for the approximate $120 million phased project were initiated in 2010. The cost burden of this project created a greater emphasis on cost considerations for the CSO LTCP. Additionally, the opportunities the facility upgrade offered to the CSO control alternatives necessitated some re-evaluation.

- Indiana State University Master Plan – During this period, Indiana State University finalized a master plan of its current campus which included proposed development near the Chestnut/Spruce outfalls. The plan required some additional analysis and re-consideration of options for this area within the alternatives.

- Wabash River Riverscape Planning Efforts – A community group and its consultant completed a plan for future development along the Wabash River in order to enhance its value to the community. This plan required some additional consideration within the alternatives, particularly in the Fairbanks Park and Main Lift Station areas – including the newly acquired International Paper lagoons site.
- Consultant's Basis of Design (BOD) Report for International Paper storage – During this period, the City's Design Consultant Engineers finalized a Basis of Design Report analyzing the proposed project at the IP site. The report evaluates the feasibility of using the IP lagoons, as well as alternatives to the off-line storage at the site.

In consideration of these key elements, several months of re-analysis of the alternatives were conducted and new alternatives which were simply variations of the screened four alternatives were developed. Alternative 11 was developed as a variation of Alternative 1, and the "Hybrid" alternative was developed as a lower cost alternative to Alternative 11 utilizing similar technology schemes as 11, without the replacement of the Main Lift Station. Alternative 7 remained viable utilizing the International Paper lagoons and extending the tunnel from Spruce to the Main Lift station site near Turner's outfall and the lagoons. 5A was dropped from consideration due to its lack of utilization of the newly acquired lagoons, and 5B was eliminated due to the increasing costs of the necessary storage tanks when compared to alternatives 11 and the "hybrid". Alternative 11B was developed after approval of the LTCP based on information in Consultant's BOD report, which includes the use of high rate treatment facility with UV disinfection at the IP site. Other alternatives were ultimately developed including 8A/8B, 9A/9B and 10 each of which was a variation of Alternatives 1, 5 or 7; however, these options were screened out by the technical team in lieu of the final 4 alternatives described in detail in section 6.8.

6.7 Green Infrastructure Opportunities

USEPA has expressed support for CSO communities to utilize green infrastructure in their CSO control solutions (USEPA 2007, USEPA 2010). The City of Terre Haute identified green infrastructure as a potential means of reducing volume or the size of gray infrastructure in the collection system in the CSO basins upstream of Fairbanks Park (e.g. CSO-009 and CSO-010) because extending traditional gray technologies to these basins is cost-prohibitive. The City conducted a detailed analysis green infrastructure retrofit potential in CSO basin 009 drainage area. The goal of this evaluation was to identify potential green infrastructure retrofits in Terre Haute's CSO-009 drainage area, estimate the cost of those retrofits and assess their benefit in terms of storm water volume capture. The detailed report is presented in Appendix 6-4.

Based on this evaluation, it was found that there are widespread opportunities for green infrastructure implementation in the CSO 009 drainage area (Figure 6.7-1). These opportunities are more prominent in part of the drainage area occupied by the Indiana State University (ISU) campus, as compared to other areas occupied mainly by single family residences. On the ISU campus, the large impervious areas created by large buildings, surface parking lots, and streets present a variety of green infrastructure retrofit opportunities. Controlling stormwater runoff from these impervious areas can potentially have significant impact on reducing wet weather flows from the drainage area. In addition, large athletic fields, in combination with permeable soils, present a unique opportunity for construction of infiltration beds that can provide large stormwater storage volume without compromising the primary use of the fields.

Basins 009 and 010 were looked at for possible green technologies because each basin has large, single owners for portions of the basins (Indiana State University and Union Hospital) and very large flows come from these basins. CSO controls are also more difficult in these basins due to the distance from the existing wastewater treatment facility.

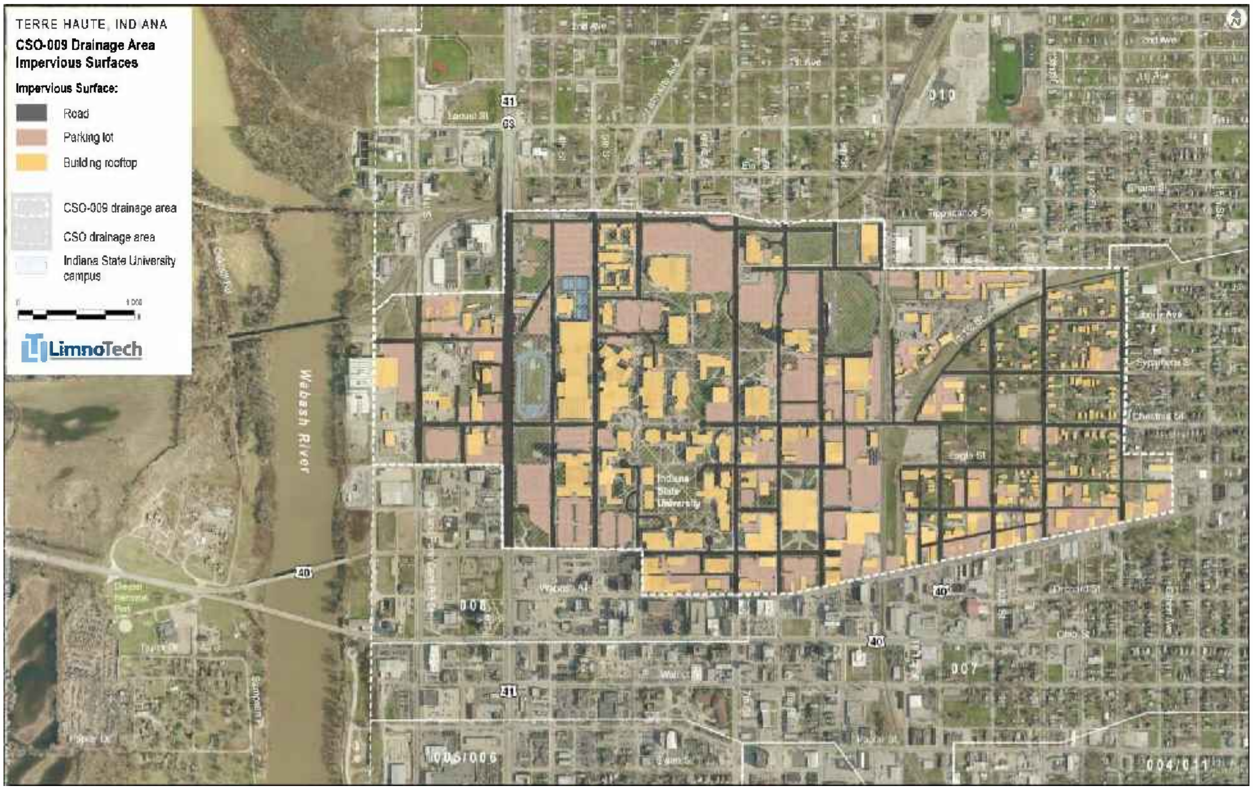


Figure 6.7-1. Impervious Surface (Green Infrastructure Opportunities) in CSO-009 Drainage Area.

Conceptual designs that illustrate several green infrastructure retrofit opportunity types were developed as part of this evaluation. Extrapolating the storage volume and cost estimates for these conceptual designs to the overall campus area provides estimates of the total potential cost and benefit of green infrastructure in the CSO 009 drainage area. The total estimated storage volume that could potentially be provided by green infrastructure retrofits on the campus alone, assuming 100% buildout, is 6.2 million gallons, which is more than sufficient to store all runoff from the 1.0" rainfall event. The total estimated cost for complete green infrastructure buildout is $16.1 million, which yields an estimated unit storage cost of $2.60/gallon.

While it is unlikely that 100% implementation of green infrastructure retrofits can be achieved on the ISU campus, these estimates clearly show that significant stormwater storage potential exists for even partial implementation. This storage potential can be further enhanced by extending green infrastructure retrofits in other parts of the CSO 009 drainage area, including the predominantly residential area to the east, as well as to the area in the CSO 010 basin. Based on this analysis, it appears possible that green infrastructure implementation can provide equivalent storage to offset the need for millions of gallons in storage tank volume to control overflows from CSO basins 009 and 010.

Implementation of green infrastructure at the levels needed to affect storage tank volume will require the City to partner with other public and private entities within CSO basins 009 and 010. The City intends to explore the feasibility of utilizing green infrastructure controls in these basins during the implementation of the preferred alternative.

The plan will be implemented as shown with green technologies, but if the green technologies are unsuccessful, the City is committed to building traditional grey infrastructure.

6.8 Conclusion

Several factors were taken into consideration when developing and evaluating the CSO control alternatives, such as:

- Cost Effectiveness
- Non-Monetary Factors
- Goals of the CSO Control Plan

Based on these factors, the technical team selected the following four alternatives for detailed analysis. The detailed analysis of these four alternatives will include SWMM model analysis and several storm events for varying overflow frequencies which will in turn predict infrastructure sizing required. Detailed costs for each overflow scenario of each of the three alternatives will be developed as well as water quality impacts. Discussion of this detailed analysis is included in Section 7 which will demonstrate the rationale for identification of the final selected plan.

6.8.1 Alternatives Screened for Detailed Evaluation

6.8.1.1 Alternative 7B

Alternative 7B is a variation of one of the original 7 comprehensive alternatives developed for the system which consists of a large diameter tunnel constructed from the Spruce Street outfall south to the main lift station. This variation of Alternative 7 utilizes the International Paper lagoons for storage of CSO flows in addition to the storage offered in the tunnel. This combination of storage will allow the tunnel to be smaller in size under all levels of control. A new main lift station which will replace the existing facility will evacuate flows from the tunnel and allow flows to be pumped to the treatment plant and the storage lagoons. This option can close all outfalls dependent upon the level of control the design is based upon. The detailed analysis of the SWMM model for various levels of control will predict the size of the tunnel required and be the basis for cost estimates presented in Section 7 for this alternative. (Figure 6.8-1)

6.8.1.2 Alternative 11

Alternative 11 selected for detailed evaluation is a variation of the screened original alternative #1 with the major difference being that the conveyance relief sewer included in alternative 1 in Fairbanks Park is extended south to the main lift station and International Paper lagoons. This alternative includes consolidation of Spruce and Chestnut outfalls, closure of the Spruce outfall, and a storage tank at the Chestnut outfall. The new relief sewer will allow closure of outfalls 005,006,007 and 008 in the park, and Turner (003) which will outlet to the new main lift station. The new main lift station will convey flows to either the lagoons or the treatment facility. *(002 will also be eliminated.)* The new piping installed at the lagoons will allow flows to be drained back to the new main lift station for transfer to the treatment facility as wet weather flows subside. The detailed analysis for this alternative in the SWMM model will predict sizes for the conveyance/relief sewers, pumping facilities and storage structure under the various levels of control, for which costs will be presented in Section 7. (Figure 6.8-2)

6.8.1.3 Alternative "Hybrid"

The "hybrid" alternative was developed as a "lower cost" alternative developed for evaluation and is based upon the same technologies and principles of Alternative 11. The main difference between the "hybrid" and Alternative 11 is that the hybrid does NOT replace the main lift station, *thus 002 would remain open*. Instead, a CSO pumping station is proposed at the end of the relief sewer from the park area which contains large low head, high flow pumps which will lift conveyed CSO flows into the storage lagoons. The lagoons will outlet to the existing main lift station when flows subside. The detailed analysis for this alternative in the SWMM model will predict sizes for the conveyance/relief sewers, pumping facilities and storage structure under the various levels of control, for which costs will be presented in Section 7. (Figure 6.8-3)

6.8.1.4 Alternative 11B

Alternative 11B is a variation of Alternative 11 with the major difference being that the International Paper lagoons will not be utilized for off-line storage. This alternative will use the International Paper site as the location for secondary treatment, consisting of a High Rate Clarification (HRC) system with UV disinfection and direct discharge to the river. As with Alternative 11, outfalls 004, 005, 006, 007, 008, 009, Turner (003), and 002 will all be closed. The detailed analysis for this alternative was conducted by the City's Design Consultant for this site in 2012/2013 and is included in the basis of design report, some of which is included in Appendix 6-5. Costs are presented in Section 7. (Figure 6.8.4)

7 Section Seven – Cost Performance Considerations

7.1 Introduction

The National CSO Control Policy requires CSO communities to consider a reasonable range of CSO control alternatives. For example, the plan should evaluate control alternatives that would capture 75-100 percent of wet-weather sewer flows during a typical year or reduce the frequency of sewer overflows to zero to twelve events in a typical year. Continuous simulation, such as modeling a typical year, is generally acknowledged as a superior approach for modeling wet weather controls and water quality effects (EPA, 1999). For these reasons, a continuous simulation approach was used to evaluate the effectiveness of the final control alternatives identified for the Terre Haute combined sewer collection system. This approach was conducted by applying the City's calibrated collection system and river models for 1978 environmental conditions, which was identified as a typical year of rainfall and river conditions (see Section 2.6.3).

As a result of the analysis of the options described in Section 6, the City, U.S. EPA and IDEM agreed that Alternative 7B (tunnel) and 11 (parallel interceptor and local storage) should be carried forward as final alternatives for a detailed analysis. A third alternative, which is a lower-cost hybrid of Alternative 11 was also developed and carried forward through a detailed analysis. This detailed analysis included cost/performance evaluations and non-monetary analysis at seven levels of control: 1-month (12 overflows/year), 6-weeks (9 overflows/year), 2-month (6 overflows/year), 3-month (4 overflows/year), 6-month (2 overflows/year), 9-month (1 overflow/year) and 1-year (0 overflows/year) storms. Alternative 11 was also analyzed at a storm size corresponding 7 overflows/year. Sewer separation was also evaluated as an alternative. In addition to the capital costs of each option, the annual operation and maintenance costs for each option are also presented so that their impact on the overall implementation can be considered.

The cost/performance analysis included simulating each level of control of each final alternative to predict the water quality improvements in the Wabash River if that alternative was implemented. The water quality benefit results were combined with the associated cost to construct a "knee-of-the curve" graph to identify the most cost-effective level of control for each final alternative. The non-monetary analysis included an assessment of environmental issues, technical issues, implementation issues, and public acceptance.

The detailed analysis is described in this section. More emphasis has been given to the cost-performance analysis than the non-monetary analysis because the cost of each of the final alternatives is unaffordable, even at low levels (e.g. 12 overflows/year) of control.

7.2 Cost Performance Curve Analysis

The final developed alternatives were evaluated using the models to determine performance of each alternative over a typical year (1978). Hourly CSO overflows predicted by the collection system model were input into the river model to simulate resulting water quality improvements relative to the baseline (current) conditions (presented in Section 4.3). The water quality benefit results for each alternative were combined with the associated cost to construct a "knee-of-the curve" graph to identify the most cost-effective level of control. This section presents the development of the cost of each alternative, end-of-pipe and in-stream results from the collection system and river model applications over the typical year, respectively, and the cost-performance analysis for each alternative.

7.2.1 Unit Cost Development

Unit construction cost opinions were developed for the infrastructure components of the various CSO control alternatives. These opinions were based on actual construction costs for similar facilities. The costs were adjusted to current price levels using if necessary based upon the age of the reference material.

The following subsections describe the process utilized for development of unit costs for CSO conveyance systems, CSO storage facilities and other construction items within the alternatives and operation, maintenance, and replacement unit costs for the new systems included in each alternative in order to develop present worth costs for each alternative.

7.2.1.1 Conveyance Unit Costs

Pipeline and tunnel unit costs used to develop conveyance cost opinions were obtained by determining unit quantities for proposed tunnels and sewers at various sizes and depths of installation. Pipeline unit costs were developed from actual bid tabulations and results from various projects including but not limited to the following:

- Past Terre Haute Sanitary District Projects
- City of Indianapolis

- City of Des Moines, Iowa
- Stratford County, Virginia
- King County, Washington
- Other Indiana communities Long Term Control Plans including the Cities of Lafeyette and Fort Wayne.

The quantities and unit costs were reviewed against the proposed work of the Terre Haute alternatives and adjustments were made based upon depth of cut, diameter, quantity and size of structures/manholes, etc. Several local contractors also reviewed the proposed sewer locations and costs for further evaluation. Unit cost reference information is included in Appendix 7-1.

7.2.1.2 CSO Storage Facilities

The CSO storage facilities included in the unit construction cost opinions are designed as below grade covered concrete storage tanks with flushing/cleaning systems and in some cases also include floatables control, weir/gate structures, connecting sewer reinforcement and combined sewer consolidation/separation. Covered storage tank costs are based on actual construction costs for underground cast-in-place storage tanks. Each tank includes provisions for cleaning/flushing as well as pumping systems to evacuate the tank. Excavation, sheeting, backfilling, dewatering, concrete and piling quantities are included in the estimation for each tank or structure. The unit costs for floatables control and weir/gate structures include equipment costs from manufacturers and estimated installation costs. The sewer reinforcement and sewer separation costs are based on actual construction project costs within the State of Indiana.

The costs for storage structures were confirmed and verified for accuracy against other similarly constructed facilities in Michigan and Indiana. Based upon similar facilities design, cost estimates were adjusted utilizing a cost per gallon of storage. Research of other facilities and estimations for labor, material and equipment for storage tanks of various sizes yielded an approximate cost of $5/gallon of CSO flow storage for the various structures included in the alternatives.

7.2.1.3 Operation, Maintenance and Replacement Costs

Annual operating and maintenance costs for power and labor for cleaning and inspection of the CSO control alternative technologies were developed for each alternative. Labor costs were developed from costs provided by the City based on the time and personnel required and actual operation and maintenance costs of similar facilities from other Indiana communities. Table 7.2-1 provides a summary of the annual costs for each alternative and detail on the calculations is included in Appendix 7-2. During cost analysis of operation, maintenance and replacement, a present worth analysis was completed for 25 years. The present worth analysis included an equal series present worth calculated from year 1 to year 25 to estimate the present worth cost needed to operate and maintain the facilities after construction is completed. Table 7.2-2 presents a summary of the capital costs (updated during Phase I design) and Table 7.2-3 shows the present worth value for each alternative.

Table 7.2-1
Annual Operations and Maintenance Costs for each Alternative[1]

	0 Overflows	1 Overflow	2 Overflows	4 Overflows	6 Overflows	7 Overflows	9 Overflows	12 Overflows
Alternative 7B	[illegible]	-	-	-	[illegible]	-	[illegible]	[illegible]
Alternative 11	[illegible]	$1,257,300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Alternative 11B	-	-	-	-	-	[illegible]	-	-
Hybrid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]

[1] Costs have been updated and revised from 2011 estimates

Table 7.2-2
Total Project Costs for Each Alternative[1,3]

	0 Overflows	1 Overflow	2 Overflows	4 Overflows	6 Overflows	7 Overflows	9 Overflows	12 Overflows
Alternative 7B	$178,377,600	-	-	-	$180,181,700	-	$159,646,700	$145,552,200
Alternative 11	$525,956,300	$316,065,600	$276,316,100	$208,829,000	$150,465,400	$130,261,000	$128,941,800	$114,465,500
Alternative 11B	-	-	-	-	-	$123,678,400	-	-
Hybrid[2]	$522,925,300	$354,306,500	$326,534,000	$161,221,500	$132,787,800	-	$109,593,300	$87,772,100

[1] Costs include Construction, Contingency and Non-Construction

[2] The Hybrid Alternative does not include a new main lift station

[3] Costs have been updated and revised from 2011 estimates

Table 7.2-3
Present Worth of Total Project Costs for Each Alternative[1]

	0 Overflows	1 Overflow	2 Overflows	4 Overflows	6 Overflows	7 Overflows	9 Overflows	12 Overflows
Alternative 7B	$194,577,600	-	-	-	$197,398,500	-	$175,822,600	$161,013,100
Alternative 11	$560,092,100	$339,557,400	$297,791,800	$226,882,800	$165,330,700	$144,094,800	$142,636,100	$127,424,700
Alternative 11B	-	-	-	-	-	$136,404,200	-	-
Hybrid	$607,528,300	$410,689,300	$378,268,800	$185,290,100	$152,098,500	-	$125,259,400	[illegible]

[1] All present worth values provided herein are based on updated costs included in revised Tables 7.2-1 and 7.2-2

Replacement costs were also included as an annual expense for short-lived assets such as equipment placed into service which will require replacement prior to the 25 year completion of the CSO LTCP implementation. The replacement costs are based upon the cost of the items and are spread out evenly during the estimated life of each respective item which requires replacement.

7.2.2 Cost for Each Control Alternative

Based upon the infrastructure sizing predicted by the SWMM model for each level of control, various cost estimates were developed using the process and rationale discussed in 7.2.1. Cost estimates for Alternative 11 and the "Hybrid" alternative were developed for the following levels of control: 0, 1, 2, 4, 6, 9 and 12 overflows per year. Costs for Alternative 7B which includes a CSO tunnel were developed for 0, 6 and 12 overflows per year scenarios only. Costs were developed by the City's design consultant costs for Alternative 11B (the amended selected plan), which includes new High Rate Clarification system, for 7 overflows per year scenario only. Tables 7.2-4A – 7.2-7A provide detailed breakdown of the capital costs for each level of CSO flow control for each of the alternatives.

A summary of the costs for each alternative at the various levels of control is included in Tables 7.2-2 and 7.2-3.

Table 7.2-4A
Alternative 7B – 12 Overflows

New Main Lift and Tunnel Option w/IP Storage

Item	Description	Total
I.	Main Lift Tunnel	$55,589,100.00
II.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
III.	Sitework and Piping[1]	$2,115,800.00
IV.	Lagoon Modifications[2]	$17,173,000.00
V.	Common Alternatives	$14,500,000.00
	Subtotal	$110,058,300.00
	Construction Contingencies (15%)	$16,508,800.00
	Non-Construction Costs (15%)	$18,985,100.00
	Main Lift Tunnel Option Total[3]	$145,552,200.00

Costs have decreased from the 2011 estimate of $2,176,100

Costs have increased from the 2011 estimate of $6,168,800

Costs have increased from the 2011 estimate of $131,078,800

I. Main Lift Tunnel (Spruce to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	TBM Mobilization	LS	1	$6,000,000.00	$6,000,000.00
2	Launching/Receiving Shaft	EA	3	$300,000.00	$900,000.00
3	84" Open Cut Tunnel	LF	14,500	$2,500.00	$36,250,000.00
4	84" Gravity Sewer - 003 to New Main Lift Station	LF	1,500	$850.00	$1,275,000.00
5	Diversion Structures/Outfalls & Piping Reconst.	EA	7	$750,000.00	$5,250,000.00
6	Ventilation Duct and Fan	EA	2	$500,000.00	$1,000,000.00
7	Odor Control Facilities	EA	2	$700,000.00	$1,400,000.00
8	Excess Excavation Spoil Disposal	CY	20,700	$10.00	$207,000.00
9	Maintenance of Traffic	LS	1	$250,000.00	$250,000.00
10	Geotechnical Controls	LS	1	$110,000.00	$110,000.00
11	Erosion Control	LS	1	$100,000.00	$100,000.00
12	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
13	General Conditions (NTE 5%)	LS			$2,647,100.00
	Main Lift Tunnel Subtotal				$55,589,100.00

II. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Tunnel Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	Main Lift Tunnel Lift Station Subtotal				$20,680,400.00

III. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
4	Manhole Structures	EA	4	$20,000.00	$80,000.00
~~5~~	~~18" Lagoon Drain Piping~~[1]	~~LF~~	~~300~~	~~$75.00~~	~~$22,500.00~~
~~6~~	~~Lagoon Drain Flow Control~~[1]	~~LS~~	~~1~~	~~$10,000.00~~	~~$10,000.00~~
~~7~~	~~18" Force Main to Lagoon~~[1]	~~LF~~	~~500~~	~~$75.00~~	~~$37,500.00~~
8	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
9	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
10	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
11	Erosion Control	LS	1	$50,000.00	$50,000.00
12	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
13	General Conditions (NTE 5%)[2]	LS			$100,800.00
	Site Work and Piping Subtotal[3]				$2,115,800.00

[1] Line items were included in 2011 estimate but have been removed since they are included in the revised Lagoon Modifications cost estimate.

[2] Costs have decreased from the 2011 estimate of $104,300

[3] Costs have decreased from the 2011 estimate of $2,189,300

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Floatables Controls at CSO 011/004	EA	1	$2,000,000.00	$2,000,000.00
3	Floatables Controls at CSO 009	EA	1	$2,000,000.00	$2,000,000.00
4	Floatables Controls at CSO 010	EA	1	$2,000,000.00	$2,000,000.00
5	Floatables Controls at CSO 003	EA	1	$2,000,000.00	$2,000,000.00
6	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
7	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
8	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
	Common Alternatives Subtotal				$14,500,000.00

Table 7.2-4B
Alternative 7B – 9 Overflows

New Main Lift and Tunnel Option w/IP Storage

Item	Description	Total
I.	Main Lift Tunnel	$66,246,600.00
II.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
III.	Sitework and Piping[1]	$2,115,800.00
IV.	Lagoon Modifications[2]	$17,173,000.00
V.	Common Alternatives	$14,500,000.00
	Subtotal	$120,715,800.00
	Construction Contingencies (15%)	$18,107,400.00
	Non-Construction Costs (15%)	$20,823,500.00
	Main Lift Tunnel Option Total[3]	$159,646,700.00

Costs have decreased from the 2011 estimate of $2,176,100

Costs have increased from the 2011 estimate of $6,168,800

Costs have increased from the 2011 estimate of $145,173,400

I. Main Lift Tunnel (Spruce to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	TBM Mobilization	LS	1	$6,000,000.00	$6,000,000.00
2	Launching/Receiving Shaft	EA	3	$300,000.00	$900,000.00
3	Tunnel - 16' Diameter	LF	14,500	$3,200.00	$46,400,000.00
4	84" Gravity Sewer - 003 to New Main Lift Station	LF	1,500	$850.00	$1,275,000.00
5	Diversion Structures/Outfalls & Piping Reconst.	EA	7	$750,000.00	$5,250,000.00
6	Ventilation Duct and Fan	EA	2	$500,000.00	$1,000,000.00
7	Odor Control Facilities	EA	2	$700,000.00	$1,400,000.00
8	Excess Excavation Spoil Disposal	CY	20,700	$10.00	$207,000.00
9	Maintenance of Traffic	LS	1	$250,000.00	$250,000.00
10	Geotechnical Controls	LS	1	$110,000.00	$110,000.00
11	Erosion Control	LS	1	$100,000.00	$100,000.00
12	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
13	General Conditions (NTE 5%)	LS			$3,154,600.00
	Main Lift Tunnel Subtotal				$66,246,600.00

II. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Tunnel Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	Main Lift Tunnel Lift Station Subtotal				$20,680,400.00

III. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
4	Manhole Structures	EA	4	$20,000.00	$80,000.00
~~5~~	~~18" Lagoon Drain Piping~~[1]	~~LF~~	~~300~~	~~$75.00~~	~~$22,500.00~~
~~6~~	~~Lagoon Drain Flow Control~~[1]	~~LS~~	~~1~~	~~$10,000.00~~	~~$10,000.00~~
~~7~~	~~18" Force Main to Lagoon~~[1]	~~LF~~	~~500~~	~~$75.00~~	~~$37,500.00~~
8	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
9	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
10	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
11	Erosion Control	LS	1	$50,000.00	$50,000.00
12	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
13	General Conditions (NTE 5%)[2]	LS			$100,800.00
	Site Work and Piping Subtotal[3]				$2,115,800.00

Line items were included in 2011 estimate but have been removed since they are included in the revised Lagoon Modifications cost estimate.

Costs have decreased from the 2011 estimate of $104,300

Costs have decreased from the 2011 estimate of $2,189,300

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Floatables Controls at CSO 011/004	EA	1	$2,000,000.00	$2,000,000.00
3	Floatables Controls at CSO 009	EA	1	$2,000,000.00	$2,000,000.00
4	Floatables Controls at CSO 010	EA	1	$2,000,000.00	$2,000,000.00
5	Floatables Controls at CSO 003	EA	1	$2,000,000.00	$2,000,000.00
6	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
7	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
8	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
	Common Alternatives Subtotal				$14,500,000.00

Table 7.2-4C
Alternative 7B – 6 Overflows

New Main Lift and Tunnel Option w/IP Storage

Item	Description	Total
I.	Main Lift Tunnel	$81,774,000.00
II.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
III.	Sitework and Piping[1]	$2,115,800.00
IV.	Lagoon Modifications[2]	$17,173,000.00
V.	Common Alternatives	$14,500,000.00
	Subtotal	$136,243,200.00
	Construction Contingencies (15%)	$20,436,500.00
	Non-Construction Costs (15%)	$23,502,000.00
	Main Lift Tunnel Option Total[3]	$180,181,700.00

Costs have decreased from the 2011 estimate of $2,176,100

Costs have increased from the 2011 estimate of $6,168,800

Costs have increased from the 2011 estimate of $165,708,300

I. Main Lift Tunnel (Spruce to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	TBM Mobilization	LS	1	$11,500,000.00	$11,500,000.00
2	Launching/Receiving Shaft	EA	3	$450,000.00	$1,350,000.00
3	Tunnel - 16' Diameter	LF	14,500	$3,750.00	$54,375,000.00
4	84" Gravity Sewer - 003 to New Main Lift Station	LF	1,500	$850.00	$1,275,000.00
5	Diversion Structures/Outfalls & Piping Reconst.	EA	7	$750,000.00	$5,250,000.00
6	Ventilation Duct and Fan	EA	2	$500,000.00	$1,000,000.00
7	Odor Control Facilities	EA	2	$700,000.00	$1,400,000.00
8	Excess Excavation Spoil Disposal	CY	107,000	$10.00	$1,070,000.00
9	Maintenance of Traffic	LS	1	$250,000.00	$250,000.00
10	Geotechnical Controls	LS	1	$110,000.00	$110,000.00
11	Erosion Control	LS	1	$100,000.00	$100,000.00
12	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
13	General Conditions (NTE 5%)	LS			$3,894,000.00
	Main Lift Tunnel Subtotal				$81,774,000.00

II. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Tunnel Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	Main Lift Tunnel Lift Station Subtotal				$20,680,400.00

III. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
4	Manhole Structures	EA	4	$20,000.00	$80,000.00
~~5~~	~~18" Lagoon Drain Piping~~[1]	~~LF~~	~~300~~	~~$75.00~~	~~$22,500.00~~
~~6~~	~~Lagoon Drain Flow Control~~[1]	~~LS~~	~~1~~	~~$10,000.00~~	~~$10,000.00~~
~~7~~	~~18" Force Main to Lagoon~~[1]	~~LF~~	~~500~~	~~$75.00~~	~~$37,500.00~~
8	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
9	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
10	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
11	Erosion Control	LS	1	$50,000.00	$50,000.00
12	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
13	General Conditions (NTE 5%)[2]	LS			$100,800.00
	Site Work and Piping Subtotal[3]				$2,115,800.00

Line items were included in 2011 estimate but have been removed since they are included in the revised Lagoon Modifications cost estimate.

Costs have decreased from the 2011 estimate of $104,300

Costs have decreased from the 2011 estimate of $2,189,300

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

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[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Floatables Controls at CSO 011/004	EA	1	$2,000,000.00	$2,000,000.00
3	Floatables Controls at CSO 009	EA	1	$2,000,000.00	$2,000,000.00
4	Floatables Controls at CSO 010	EA	1	$2,000,000.00	$2,000,000.00
5	Floatables Controls at CSO 003	EA	1	$2,000,000.00	$2,000,000.00
6	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
7	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
8	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
	Common Alternatives Subtotal				$14,500,000.00

Table 7.2-4D
Alternative 7B – 0 Overflows

New Main Lift and Tunnel Option w/IP Storage

Item	Description	Total
I.	Main Lift Tunnel	$86,409,800.00
II.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
III.	Sitework and Piping[1]	$2,115,800.00
IV.	Lagoon Modifications[2]	$17,173,000.00
V.	Common Alternatives	$8,500,000.00
	Subtotal	$134,879,000.00
	Construction Contingencies (15%)	$20,231,900.00
	Non-Construction Costs (15%)	$23,266,700.00
	Main Lift Tunnel Option Total[3]	$178,377,600.00

[1] Costs have decreased from the 2011 estimate of $2,176,100

[2] Costs have increased from the 2011 estimate of $6,168,800

[3] Costs have increased from the 2011 estimate of $163,904,200

I. Main Lift Tunnel (Spruce to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	TBM Mobilization	LS	1	$12,000,000.00	$12,000,000.00
2	Launching/Receiving Shaft	EA	3	$500,000.00	$1,500,000.00
3	Tunnel - 17' Diameter	LF	14,500	$4,000.00	$58,000,000.00
4	84" Gravity Sewer - 003 to New Main Lift Station	LF	1,500	$850.00	$1,275,000.00
5	Diversion Structures/Outfalls & Piping Reconst.	EA	7	$750,000.00	$5,250,000.00
6	Ventilation Duct and Fan	EA	2	$500,000.00	$1,000,000.00
7	Odor Control Facilities	EA	2	$700,000.00	$1,400,000.00
8	Excess Excavation Spoil Disposal	CY	121,000	$10.00	$1,210,000.00
9	Maintenance of Traffic	LS	1	$250,000.00	$250,000.00
10	Geotechnical Controls	LS	1	$110,000.00	$110,000.00
11	Erosion Control	LS	1	$100,000.00	$100,000.00
12	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
13	General Conditions (NTE 5%)	LS			$4,114,800.00
	Main Lift Tunnel Subtotal				$86,409,800.00

II. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Tunnel Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	Main Lift Tunnel Lift Station Subtotal				$20,680,400.00

III. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
4	Manhole Structures	EA	4	$20,000.00	$80,000.00
~~5~~	~~18" Lagoon Drain Piping~~[1]	~~LF~~	~~300~~	~~$75.00~~	~~$22,500.00~~
~~6~~	~~Lagoon Drain Flow Control~~[1]	~~LS~~	~~1~~	~~$10,000.00~~	~~$10,000.00~~
~~7~~	~~18" Force Main to Lagoon~~[1]	~~LF~~	~~500~~	~~$75.00~~	~~$37,500.00~~
8	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
9	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
10	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
11	Erosion Control	LS	1	$50,000.00	$50,000.00
12	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
13	General Conditions (NTE 5%)[2]	LS			$100,800.00
	Site Work and Piping Subtotal[3]				$2,115,800.00

[1] Line items were included in 2011 estimate but have been removed since they are included in the revised Lagoon Modifications cost estimate.

[2] Costs have decreased from the 2011 estimate of $104,300

[3] Costs have decreased from the 2011 estimate of $2,189,300

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

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[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	CSO 003 Closure	LS	1	$250,000.00	$250,000.00
3	CSO 004 Closure	LS	1	$250,000.00	$250,000.00
4	CSO 005 Closure	LS	1	$250,000.00	$250,000.00
5	CSO 006 Closure	LS	1	$250,000.00	$250,000.00
6	CSO 007 Closure	LS	1	$250,000.00	$250,000.00
7	CSO 008 Closure	LS	1	$250,000.00	$250,000.00
8	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
9	CSO 010 Closure	LS	1	$250,000.00	$250,000.00
10	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
11	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
12	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
	Common Alternatives Subtotal				$8,500,000.00

Table 7.2-5A
Alternative 11 – 12 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$17,952,000.00
II.	Parallel Interceptor	$18,398,600.00
III.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
IV.	Sitework and Piping	$3,848,300.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$8,500,000.00
	Subtotal	$86,552,300.00
	Construction Contingencies (15%)	$12,982,900.00
	Non-Construction Costs (15%)	$14,930,300.00
	Parallel Interceptor Option Total	**$114,465,500.00**

Costs have decreased from the 2011 estimate of $21,102,300

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $104,245,300

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)[1]	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)[1]	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH[1]	EA	1	$25,000.00	$25,000.00
[illegible]	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	1.5 MG of Storage at 010	Gal	1,500,000	$5.00	$7,500,000.00
17	Storage Structure Evacuation Piping	LS	1	$50,000.00	$50,000.00
18	HAC Surface, 1.5"	Ton	[illegible]	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	[illegible]	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	[illegible]	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$855,000.00
	North Conveyance/Storage Subtotal[2]				$17,952,000.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $21,102,300

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	96" Gravity Sewer (31-35' dp.)	LF	750	$1,500.00	$1,125,000.00
2	96" Gravity Sewer (26-30' dp.)	LF	850	$1,250.00	$1,062,500.00
3	96" Gravity Sewer (21-25' dp.)	LF	500	$1,000.00	$500,000.00
4	96" Gravity Sewer (11-15' dp.)	LF	600	$900.00	$540,000.00
5	96" Gravity Sewer (16-20' dp.)	LF	350	$850.00	$297,500.00
6	96" Gravity Sewer (11-15' dp.)	LF	4,000	$800.00	$3,200,000.00
7	144" Gravity Sewer (0-10' dp.)	LF	2,950	$2,000.00	$5,900,000.00
8	Std. MH, 7' Diameter	EA	17	$50,000.00	$850,000.00
9	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$876,100.00
	Parallel Interceptor Subtotal				$18,398,600.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	New Main Lift Station Subtotal				$20,680,400.00

IV. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	96" Gravity Sewer (003 to New Main Lift)	LF	1,500	$1,100.00	$1,650,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	Erosion Control	LS	1	$50,000.00	$50,000.00
10	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
11	General Conditions (NTE 5%)	LS			$183,300.00
	Site Work and Piping Subtotal				$3,848,300.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase 1. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$8,500,000.00

Table 7.2-5B
Alternative 11 – 9 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$20,104,400.00
II.	Parallel Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
IV.	Sitework and Piping	$5,580,800.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$8,500,000.00
	Subtotal	$97,498,500.00
	Construction Contingencies (15%)	$14,624,800.00
	Non-Construction Costs (15%)	$16,818,500.00
	Parallel Interceptor Option Total	$128,941,800.00

Costs have decreased from the 2011 estimate of $23,254,800

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $118,721,700

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)[1]	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)[1]	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals[1]	EA	5	$10,000.00	$50,000.00
9	Std. MH[1]	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	1.9 MG of Storage at 010	Gal	1,900,000	$5.00	$9,500,000.00
17	Storage Structure Evacuation Piping	LS	1	$100,000.00	$100,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$957,400.00
	North Conveyance/Storage Subtotal[2]				$20,104,400.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $23,254,800

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	New Main Lift Station Subtotal				$20,680,400.00

IV. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	Erosion Control	LS	1	$50,000.00	$50,000.00
10	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
11	General Conditions (NTE 5%)	LS			$265,800.00
	Site Work and Piping Subtotal				$5,580,800.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at CSO 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$8,500,000.00

Table 7.2-5C
Alternative 11 – 7 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$20,629,400.00
II.	Parallel Main Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$21,152,900.00
IV.	Sitework and Piping	$5,580,800.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$8,500,000.00
	Subtotal	$98,496,000.00
	Construction Contingencies (15%)	$14,774,400.00
	Non-Construction Costs (15%)	$16,990,600.00
	Parallel Interceptor Option Total[3]	$130,261,000.00

Costs have decreased from the 2011 estimate of $23,779,800

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $120,040,900

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$1,300,000.00
5	72" Gravity Sewer (21-25' dp.)[1]	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)[1]	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	2.0 MG of Storage at 010	Gal	2,000,000	$5.00	$10,00,000.00
17	Storage Structure Evacuation Piping	LS	1	$100,000.00	$100,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$982,400.00
	North Conveyance/Storage Subtotal[2]				$20,629,400.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $23,779,800

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$13,200,000.00	$13,200,000.00
2	Tunnel Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$1,007,300.00
	New Main Station Subtotal				$21,152,900.00

IV. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	Erosion Control	LS	1	$50,000.00	$50,000.00
10	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
11	General Conditions (NTE 5%)	LS			$265,800.00
	Site Work and Piping Subtotal				$5,580,800.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at CSO 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$8,500,000.00

Table 7.2-5D
Alternative 11 – 6 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$35,854,400.00
II.	Parallel Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$21,205,400.00
IV.	Sitework and Piping	$5,580,800.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$8,500,000.00
	Subtotal	$113,773,500.00
	Construction Contingencies (15%)	$17,066,000.00
	Non-Construction Costs (15%)	$19,625,900.00
	Parallel Interceptor Option Total[3]	**$150,465,400.00**

Costs have decreased from the 2011 estimate of $39,004,800

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $140,245,500

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)	LF	20	$1,500.00	30,000.00
6	66" Gravity Sewer (21-25' dp.)	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	4.9 MG of Storage at 010	Gal	4,900,000	$5.00	$24,500,000.00
17	Storage Structure Evacuation Piping	LS	1	$100,000.00	$100,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	[illegible]	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$1,707,400.00
	North Conveyance/Storage Subtotal[2]				$35,854,400.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase 1. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $39,004,800.

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$13,250,000.00	$13,250,000.00
2	Tunnel Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$1,009,800.00
	New Main Lift Station Subtotal				$21,205,400.00

IV. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	Erosion Control	LS	1	$50,000.00	$50,000.00
10	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
11	General Conditions (NTE 5%)	LS			$265,800.00
	Site Work and Piping Subtotal				$5,580,800.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at CSO 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$8,500,000.00

Table 7.2-5E
Alternative 11 – 4 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$53,730,600.00
II.	Parallel Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
IV.	Sitework and Piping	$30,360,800.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$10,500,000.00
	Subtotal	$157,904,700.00
	Construction Contingencies (15%)	$23,685,700.00
	Non-Construction Costs (15%)	$27.238,600.00
	Parallel Interceptor Option Total	$208,829,000.00

Costs have decreased from the 2011 estimate of $56,881,000

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $198,608,900

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	8.3 MG of Storage at 010	Gal	8,300,000	$5.00	$41,500,000.00
17	Storage Structure Evacuation Piping	LS	1	$125,000.00	$125,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$2,558,600.00
	North Conveyance/Storage Subtotal[2]				$53,730,600.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase 1. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $56,881,000.00

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Tunnel Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	New Main Station Subtotal				$20,680,400.00

IV. Site Work and Piping (for New Main Lift, Turner Storage & Hulman Storage)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	0.8 MG of Storage at 003	GAL	800,000	$5.00	$4,000,000.00
10	3.9 MG of Storage at 011	GAL	3,900,000	$5.00	$19,500,000.00
11	Storage Evacuation Piping	LS	1	$100,000.00	$100,000.00
12	Erosion Control	LS	1	$50,000.00	$50,000.00
13	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
14	General Conditions (NTE 5%)	LS			$1,445,800.00
	Site Work and Piping Subtotal				$30,360,800.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
6	Floatables Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$10,500,000.00

Table 7.2-5F
Alternative 11 – 2 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$72,158,100.00
II.	Parallel Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
IV.	Sitework and Piping	$62,963,300.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$10,500,000.00
	Subtotal	$208,934,700.00
	Construction Contingencies (15%)	$31,340,200.00
	Non-Construction Costs (15%)	$36,041,200.00
	Parallel Interceptor Option Total[3]	$276,316,100.00

Costs have decreased from the 2011 estimate of $75,308,500

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $266,096,100

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)[1]	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)[1]	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH[1]	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	11.8 MG of Storage at 010	Gal	11,800,000	$5.00	$59,000,000.00
17	Storage Structure Evacuation Piping	LS	1	$175,000.00	$175,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$3,436,000.00
	North Conveyance/Storage Subtotal[2]				$72,158,100.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $73,308,500.00

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Twin 144" Gravity Sewers (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	New Main Lift Station Subtotal				$20,680,400.00

IV. Site Work and Piping (for New Main Lift, Turner Storage & Hulman Storage)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewers	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	0.8 MG of Storage at 003	GAL	800,000	$5.00	$4,000,000.00
10	10.1 MG of Storage at 011	GAL	10,100,000	$5.00	$50,500,000.00
11	Storage Evacuation Piping	LS	1	$150,000.00	$150,000.00
12	Erosion Control	LS	1	$50,000.00	$50,000.00
13	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
14	General Conditions (NTE 5%)	LS			$2,998,300.00
	Site Work and Piping Subtotal				$62,963,300.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
6	Floatables Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$10,500,000.00

Table 7.2-5G
Alternative 11 – 1 Overflow

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$80,584,400.00
II.	Parallel Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
IV.	Sitework and Piping	$84,593,300.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$10,500,000.00
	Subtotal	$238,991,000.00
	Construction Contingencies (15%)	$35,848,700.00
	Non-Construction Costs (15%)	$41,225,900.00
	Parallel Interceptor Option Total[3]	$316,065,600.00

Costs have decreased from the 2011 estimate of $83,734,800

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $305,845,600

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)[1]	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)[1]	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH[1]	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	13.4 MG of Storage at 010	Gal	13,400,000	$5.00	$67,000,000.00
17	Storage Structure Evacuation Piping	LS	1	$200,000.00	$200,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$3,837,400.00
	North Conveyance/Storage Subtotal[2]				$80,584,400.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $83,734,800.00

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	New Main Station Subtotal				$20,680,400.00

IV. Site Work and Piping (for New Main Lift, Turner Storage & Hulman Storage)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	1.3 MG of Storage at 003	GAL	1,300,000	$5.00	$6,500,000.00
10	13.7 MG of Storage at 011	GAL	13,700,000	$5.00	$68,500,000.00
11	Storage Evacuation Piping	LS	1	$250,000.00	$250,000.00
12	Erosion Control	LS	1	$50,000.00	$50,000.00
13	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
14	General Conditions (NTE 5%)	LS			$4,028,300.00
	Site Work and Piping Subtotal				$84,593,300.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
6	Floatables Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$10,500,000.00

Table 7.2-5H
Alternative 11 – 0 Overflows

Parallel Interceptor, Lagoon and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$138,439,400.00
II.	Parallel Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$20,680,400.00
IV.	Sitework and Piping	$185,445,800.00
V.	Lagoon Modifications	$17,173,000.00
VI.	Common Alternatives	$10,500,000.00
	Subtotal	$397,698,500.00
	Construction Contingencies (15%)	$59,654,800.00
	Non-Construction Costs (15%)	$68,603,000.00
	Parallel Interceptor Option Total[3]	$525,956,300.00

Costs have decreased from the 2011 estimate of $141,589,800

Costs have increased from the 2011 estimate of $6,294,800

Costs have increased from the 2011 estimate of $515,736,200

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)[1]	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)[1]	LF	400	$800.00	$320,000.00
7	~~Bore and Jack – 96" Gravity Sewer~~[1]	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH[1]	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer[1]	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	24.4 MG of Storage at 010	Gal	24,400,000	$5.00	$122,000,000.00
17	Storage Structure Evacuation Piping	LS	1	$300,000.00	$300,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00

20	HAC Base, 4"[1]	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"[1]	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement[1]	LF	800	$20.00	$16,000.00
23	Concrete Sidewalk Replacement[1]	LF	150	$45.00	$6,750.00
24	Remove Existing 82" Sewer[1]	LF	100	$200.00	$20,000.00
25	Remove Existing 15" Sewer[1]	LF	250	$50.00	$12,500.00
26	Remove Manhole[1]	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer[1]	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping[1]	LS	1	$100,000.00	$100,000.00
29	Granular Backfill[1]	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)[1]	LS			$6,592,400.00
	North Conveyance/Storage Subtotal[2]				$138,439,400.00

[1] The scope of work for the North Conveyance/Storage has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New and existing line items have been adjusted to indicate such changes.

[2] Costs have decreased from the 2011 estimate of $141,589,800.00

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$12,750,000.00	$12,750,000.00
2	Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$984,800.00
	New Main Lift Station Subtotal				$20,680,400.00

IV. Site Work and Piping (for New Main Lift, Turner Storage & Hulman Storage)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	4.9 MG of Storage at 003	GAL	4,900,000	$5.00	$24,500,000.00
10	29.3 MG of Storage at 011	GAL	29,300,000	$5.00	$146,500,000.00
11	Storage Evacuation Piping	LS	1	$300,000.00	$300,000.00
12	Erosion Control	LS	1	$50,000.00	$50,000.00
13	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
14	General Conditions (NTE 5%)	LS			$8,830,800.00
	Site Work and Piping Subtotal				$185,445,800.00

V. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	36" Force Main from Main Lift Station to Storage Tank	LS	1	$1,362,000.00	$1,362,000.00
3	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
4	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
5	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
6	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
7	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
8	General Conditions (NTE 5%)	LS	1	$818,000.00	$818,000.00
	Lagoon Modifications Subtotal				$17,173,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
6	Floatables Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$10,500,000.00

Table 7.2-6A
Alternative Hybrid – 12 Overflows

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	Description	Total
I.	Parallel Main Interceptor	$14,797,100.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$29,000,000.00
	Subtotal	$66,349,000.00
	Construction Contingencies (15%)	$9,964,200.00
	Non-Construction Costs (15%)	$11,458,900.00
	Hybrid Parallel Interceptor Option Total[2]	$87,772,100.00

[1] Costs have increased from the 2011 estimate of $4,856,300

[2] Costs have increased from the 2011 estimate of $73,629,200

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	60" Gravity Sewer (31-35' dp.)	LF	750	$1,800.00	$1,350,000.00
2	60" Gravity Sewer (26-30' dp.)	LF	850	$1,300.00	$1,105,000.00
3	60" Gravity Sewer (21-25' dp.)	LF	500	$800.00	$400,000.00
4	60" Gravity Sewer (16-20' dp.)	LF	350	$500.00	$175,000.00
5	60" Gravity Sewer (11-15' dp.)	LF	4,600	$450.00	$2,070,000.00
6	60" Gravity Sewer (0-10' dp.)	LF	2,950	$400.00	$1,180,000.00
7	Std. MH, 8' Diameter	EA	17	$45,000.00	$765,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$704,600.00
	Parallel Main Interceptor Subtotal				$14,797,100.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Interceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	1.3 MG of Storage at 010	GAL	1,300,000	$5.00	$6,500,000.00
7	1.3 MG of Storage at 009	GAL	1,300,000	$5.00	$6,500,000.00
8	Floatable Controls at CSO 003	LS	1	$2,000,000.00	$2,000,000.00
9	Floatables Controls at CSO 009	LS	1	$2,000,000.00	$2,000,000.00
10	Floatables Controls at CSO 010	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at CSO 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$29,000,000.00

Table 7.2-6B
Alternative Hybrid – 9 Overflows

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	Description	Total
I.	Parallel Main Interceptor	$14,797,100.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$45,500,000.00
	Subtotal	$82, 849,000.00
	Construction Contingencies (15%)	$12,439,200.00
	Non-Construction Costs (15%)	$14,305,100.00
	Hybrid Parallel Interceptor Option Total[2]	$109,593,300.00

[1] Costs have increased from the 2011 estimate of $4,856,300

[2] Costs have increased from the 2011 estimate of $83,000,400

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	60" Gravity Sewer (31-35' dp.)	LF	750	$1,800.00	$1,350,000.00
2	60" Gravity Sewer (26-30' dp.)	LF	850	$1,300.00	$1,105,000.00
3	60" Gravity Sewer (21-25' dp.)	LF	500	$800.00	$400,000.00
4	60" Gravity Sewer (16-20' dp.)	LF	350	$500.00	$175,000.00
5	60" Gravity Sewer (11-15' dp.)	LF	4,600	$450.00	$2,070,000.00
6	60" Gravity Sewer (0-10' dp.)	LF	2,950	$400.00	$1,180,000.00
7	Std. MH, 8' Diameter	EA	17	$45,000.00	$765,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$704,600.00
	Parallel Main Interceptor Subtotal				$14,797,100.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Interceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	1.0 MG of Storage at 010	GAL	1,000,000	$5.00	$5,000,000.00
7	4.9 MG of Storage at 009	GAL	4,900,000	$5.00	$24,500,000.00
8	Floatable Controls at CSO 003	LS	1	$2,000,000.00	$2,000,000.00
9	Floatables Controls at CSO 009	LS	1	$2,000,000.00	$2,000,000.00
10	Floatables Controls at CSO 010	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at CSO 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$45,500,000.00

Table 7.2-6C
Alternative Hybrid – 6 Overflows

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	Description	Total
I.	Parallel Main Interceptor	$16,335,400.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$61,500,000.00
	Subtotal	$100,387,300.00
	Construction Contingencies (15%)	$15,070,000.00
	Non-Construction Costs (15%)	$17,330,500.00
	Hybrid Parallel Interceptor Option Total[2]	$132,787,800.00

Costs have increased from the 2011 estimate of $4,856,300

Costs have increased from the 2011 estimate of $118,644,900

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	72" Gravity Sewer (31-35' dp.)	LF	750	$2,000.00	$1,500,000.00
2	72" Gravity Sewer (26-30' dp.)	LF	850	$1,500.00	$1,275,000.00
3	72" Gravity Sewer (21-25' dp.)	LF	500	$1,000.00	$500,000.00
4	72" Gravity Sewer (16-20' dp.)	LF	350	$600.00	$210,000.00
5	72" Gravity Sewer (11-15' dp.)	LF	4,600	$550.00	$2,530,000.00
6	72" Gravity Sewer (0-10' dp.)	LF	2,950	$500.00	$1,475,000.00
7	Std. MH, 10' Diameter	EA	17	$60,000.00	$1,020,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$777,900.00
	Parallel Main Interceptor Subtotal				$16,335,400.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Intereceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	1.0 MG of Storage at 010	GAL	1,000,000	$5.00	$5,000,000.00
7	8.1 MG of Storage at 011	GAL	8,100,000	$5.00	$40,500,000.00
8	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
9	Floatable Controls at 009	LS	1	$2,000,000.00	$2,000,000.00
10	Floatables Controls at 010	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$61,500,000.00

Table 7.2-6D
Alternative Hybrid – 4 Overflows

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	Description	Total
I.	Parallel Main Interceptor	$16,335,400.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$83,000,000.00
	Subtotal	$121,887,300.00
	Construction Contingencies (15%)	$18,295,000.00
	Non-Construction Costs (15%)	$21,039,200.00
	Hybrid Parallel Interceptor Option Total[2]	$161,221,500.00

[1] Costs have increased from the 2011 estimate of $4,856,300

[2] Costs have increased from the 2011 estimate of $147,078,700

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	72" Gravity Sewer (31-35' dp.)	LF	750	$2,000.00	$1,500,000.00
2	72" Gravity Sewer (26-30' dp.)	LF	850	$1,500.00	$1,275,000.00
3	72" Gravity Sewer (21-25' dp.)	LF	500	$1,000.00	$500,000.00
4	72" Gravity Sewer (16-20' dp.)	LF	350	$600.00	$210,000.00
5	72" Gravity Sewer (11-15' dp.)	LF	4,600	$550.00	$2,530,000.00
6	72" Gravity Sewer (0-10' dp.)	LF	2,950	$500.00	$1,475,000.00
7	Std. MH, 10' Diameter	EA	17	$60,000.00	$1,020,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$777,900.00
	Parallel Main Interceptor Subtotal				$16,335,400.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Intereceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	2.4 MG of Storage at 010	GAL	2,400,000	$5.00	$12,000,000.00
7	11 MG of Storage at 009	GAL	11,000,000	$5.00	$55,000,000.00
8	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
9	Floatable Controls at 009	LS	1	$2,000,000.00	$2,000,000.00
10	Floatables Controls at 010	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$83,000,000.00

Table 7.2-6E
Alternative Hybrid – 2 Overflows

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	Description	Total
I.	Parallel Main Interceptor	$16,335,400.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$208,000,000.00
	Subtotal	$246,887,300.00
	Construction Contingencies (15%)	$37,045,000.00
	Non-Construction Costs (15%)	$42,601,700.00
	Hybrid Parallel Interceptor Option Total[2]	$326,534,000.00

[1] Costs have increased from the 2011 estimate of $4,856,300

[2] Costs have increased from the 2011 estimate of $312,391,200

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	72" Gravity Sewer (31-35' dp.)	LF	750	$2,000.00	$1,500,000.00
2	72" Gravity Sewer (26-30' dp.)	LF	850	$1,500.00	$1,275,000.00
3	72" Gravity Sewer (21-25' dp.)	LF	500	$1,000.00	$500,000.00
4	72" Gravity Sewer (16-20' dp.)	LF	350	$600.00	$210,000.00
5	72" Gravity Sewer (11-15' dp.)	LF	4,600	$550.00	$2,530,000.00
6	72" Gravity Sewer (0-10' dp.)	LF	2,950	$500.00	$1,475,000.00
7	Std. MH, 10' Diameter	EA	17	$60,000.00	$1,020,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$777,900.00
	Parallel Main Interceptor Subtotal				$16,335,400.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Intereceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	13 MG of Storage at 003	GAL	13,000,000	$5.00	$65,000,000.00
7	16.9 MG of Storage at 009	GAL	16,900,000	$5.00	$84,500,000.00
8	3.3 MG of Storage at 010	GAL	3,300,000	$5.00	$16,500,000.00
9	5.2 MG of Storage at 011	GAL	5,200,000	$5.00	$26,000,000.00
10	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at 009	LS	1	$2,000,000.00	$2,000,000.00
12	Floatables Controls at 010	LS	1	$2,000,000.00	$2,000,000.00
13	Floatable Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$208,000,000.00

Table 7.2-6F
Alternative Hybrid – 1 Overflow

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	**Description**	**Total**
I.	Parallel Main Interceptor	$16,335,400.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$229,000,000.00
	Subtotal	$267,887,300.00
	Construction Contingencies (15%)	$40,195,000.00
	Non-Construction Costs (15%)	$46,224,200.00
	Hybrid Parallel Interceptor Option Total[2]	$354,306,500.00

Costs have increased from the 2011 estimate of $4,856,300

Costs have increased from the 2011 estimate of $340,163,700

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1	72" Gravity Sewer (31-35' dp.)	LF	750	$2,000.00	$1,500,000.00
2	72" Gravity Sewer (26-30' dp.)	LF	850	$1,500.00	$1,275,000.00
3	72" Gravity Sewer (21-25' dp.)	LF	500	$1,000.00	$500,000.00
4	72" Gravity Sewer (16-20' dp.)	LF	350	$600.00	$210,000.00
5	72" Gravity Sewer (11-15' dp.)	LF	4,600	$550.00	$2,530,000.00
6	72" Gravity Sewer (0-10' dp.)	LF	2,950	$500.00	$1,475,000.00
7	Std. MH, 10' Diameter	EA	17	$60,000.00	$1,020,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$777,900.00
	Parallel Main Interceptor Subtotal				$16,335,400.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Intereceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	13 MG of Storage at 003	GAL	13,000,000	$5.00	$65,000,000.00
7	16.9 MG of Storage at 009	GAL	16,900,000	$5.00	$84,500,000.00
8	6.5 MG of Storage at 010	GAL	6,500,000	$5.00	$32,500,000.00
9	6.2 MG of Storage at 011	GAL	6,200,000	$5.00	$31,000,000.00
10	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at 009	LS	1	$2,000,000.00	$2,000,000.00
12	Floatables Controls at 010	LS	1	$2,000,000.00	$2,000,000.00
13	Floatable Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$229,000,000.00

Table 7.2-6G
Alternative Hybrid – 0 Overflows

Parallel Main Interceptor, Lagoon Improvements with Lift Option

Item	Description	Total
I.	Parallel Main Interceptor	$16,335,400.00
II.	Lagoon Lift Station	$4,488,800.00
III.	Turner Diversion	$2,532,100.00
IV.	Lagoon Modifications[1]	$15,531,000.00
V.	Common Alternatives	$356,500,000.00
	Subtotal	$395,387,300.00
	Construction Contingencies (15%)	$59,320,000.00
	Non-Construction Costs (15%)	$68,218,000.00
	Hybrid Parallel Interceptor Option Total[2]	$522,925,300.00

[1] Costs have increased from the 2011 estimate of $4,856,300

[2] Costs have increased from the 2011 estimate of $508,782,400

I. Parallel Main Interceptor (Ohio to Lagoon Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	72" Gravity Sewer (31-35' dp.)	LF	750	$2,000.00	$1,500,000.00
2	72" Gravity Sewer (26-30' dp.)	LF	850	$1,500.00	$1,275,000.00
3	72" Gravity Sewer (21-25' dp.)	LF	500	$1,000.00	$500,000.00
4	72" Gravity Sewer (16-20' dp.)	LF	350	$600.00	$210,000.00
5	72" Gravity Sewer (11-15' dp.)	LF	4,600	$550.00	$2,530,000.00
6	72" Gravity Sewer (0-10' dp.)	LF	2,950	$500.00	$1,475,000.00
7	Std. MH, 10' Diameter	EA	17	$60,000.00	$1,020,000.00
8	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
9	Crawford Evacuation Lift Station	LS	1	$3,000,000.00	$3,000,000.00
10	24" Force Main	LF	500	$150.00	$75,000.00
11	Pavement Replacement	LF	500	$200.00	$100,000.00
12	Fence Replacement	LF	1,500	$15.00	$22,500.00
13	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
14	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
15	Erosion Control	LS	1	$250,000.00	$250,000.00
16	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
17	General Conditions (NTE 5%)	LS			$777,900.00
	Parallel Main Interceptor Subtotal				$16,335,400.00

II. New Lagoon Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Influent Screening Channel and Lagoon Channel	LS	1	$750,000.00	$750,000.00
2	Self-Cleaning Bar Screens, 2 EA @ 12 MGD	LS	1	$450,000.00	$450,000.00
3	Screw Pumps, 3 EA @ 8 MGD	LS	1	$1,200,000.00	$1,200,000.00
4	Channel Grinders, 3 EA @ 8 MGD	LS	1	$200,000.00	$200,000.00
5	Excavation/Dewatering	LS	1	$210,000.00	$210,000.00
6	Equipment Installation	LS	1	$930,000.00	$930,000.00
7	Site Piping/Frames/Grates	LS	1	$200,000.00	$200,000.00
8	Electrical	LS	1	$185,000.00	$185,000.00
9	Site Improvements/Erosion Control	LS	1	$100,000.00	$100,000.00
10	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
11	General Conditions (NTE 5%)	LS			$213,800.00
	Lagoon Lift Station Subtotal				$4,488,800.00

III. Turner Diversion

Item	Description	Unit	Quantity	Unit Cost	Total
1	36" Gravity Sewer	LF	550	$250.00	$137,500.00
2	96" Gravity Sewer (003 to Intereceptor)	LF	1,500	$1,100.00	$1,650,000.00
3	Turner Diversion	LS	1	$500,000.00	$500,000.00
4	Dewatering	LF	550	$80.00	$44,000.00
5	By-Pass Pumping	LS	1	$30,000.00	$30,000.00
6	Erosion Control	LS	1	$25,000.00	$25,000.00
7	Construction Layout/Engineering	LS	1	$25,000.00	$25,000.00
8	General Conditions (NTE 5%)	LS			$120,600.00
	Turner Diversion Subtotal				$2,532,100.00

IV. Lagoon Modifications[1]

Item	Description	Unit	Quantity	Unit Cost	Total
1	Site Work	LS	1	$201,000.00	$201,000.00
2	27 MG Unaerated, Open Top Concrete Storage Tank w/ Flushing Buckets	LS	1	$13,220,000.00	$13,220,000.00
3	24"/30" Drain Pipe and Flow Control Box	LS	1	$370,000.00	$370,000.00
4	42"/48" Overflow Pipe and Collection Box	LS	1	$852,000.00	$852,000.00
5	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
6	Instrumentation and Control for Overall Site	LS	1	$100,000.00	$100,000.00
7	General Conditions (NTE 5%)	LS	1	$739,000.00	$739,000.00
	Lagoon Modifications Subtotal				$15,531,000.00

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[1] The scope of work for Lagoon Modifications has changed significantly from the 2011 report based on additional "basis of design" studies completed in Phase I. New line items with associated estimated costs are provided.

V. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	15th and Ohio Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
4	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
5	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
6	18.9 MG of Storage at 003	GAL	18,900,000	$5.00	$94,500,000.00
7	22.8 MG of Storage at 009	GAL	22,800,000	$5.00	$114,000,000.00
8	10.1 MG of Storage at 010	GAL	10,100,000	$5.00	$50,500,000.00
9	16.3 MG of Storage at 011	GAL	16,300,000	$5.00	$81,500,000.00
10	Floatables Controls at 003	LS	1	$2,000,000.00	$2,000,000.00
11	Floatable Controls at 009	LS	1	$2,000,000.00	$2,000,000.00
12	Floatables Controls at 010	LS	1	$2,000,000.00	$2,000,000.00
13	Floatable Controls at 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$356,500,000.00

Table 7.2-7A
Alternative 11b – 7 Overflows

Parallel Interceptor, High Rate Clarification and Main Lift Option

Item	Description	Total
I.	North Conveyance/Storage	$20,629,400.00
II.	Parallel Main Interceptor	$25,459,900.00
III.	Main Lift Station Structure, Mechanical, Electrical	$21,152,900.00
IV.	Sitework and Piping	$5,580,800.00
V.	High Rate Clarification	$12,167,000.00
VI.	Common Alternatives	$8,500,000.00
	Subtotal	$93,490,000.00
	Construction Contingencies (15%)	$14,041,100.00
	Non-Construction Costs (15%)	$16,147,300.00
	Parallel Interceptor Option Total	$123,678,400.00

I. North Conveyance/Storage (Chestnut to Spruce)

Item	Description	Unit	Quantity	Unit Cost	Total
1	Clearing of Right of Way	LS	1	$100,000.00	$100,000.00
2	Common Excavation	LF	11,000	$25.00	$275,000.00
3	Building Demolition	LS	1	$75,000.00	$75,000.00
4	96" Gravity Sewer (21-25' dp.)	LF	300	$1,000.00	$300,000.00
5	72" Gravity Sewer (21-25' dp.)	LF	20	$1,500.00	$30,000.00
6	66" Gravity Sewer (21-25' dp.)	LF	400	$800.00	$320,000.00
7	~~Bore and Jack - 96" Gravity Sewer~~	~~LF~~	~~250~~	~~$4,500.00~~	~~$1,125,000.00~~
8	Reconnect Existing Laterals	EA	5	$10,000.00	$50,000.00
9	Std. MH	EA	1	$25,000.00	$25,000.00
10	Std MH, Set Over Existing Sewer	EA	2	$25,000.00	$50,000.00
11	Diversion Structures & Piping Construction	EA	2	$500,000.00	$1,000,000.00
12	CSO 009 Closure	LS	1	$250,000.00	$250,000.00
13	Spruce Diversion and Floatables Structure	LS	1	$2,000,000.00	$2,000,000.00
14	Spruce Evacuation Lift Station/Control Bldg	LS	1	$4,000,000.00	$4,000,000.00
15	36" Force Main	LF	150	$200.00	$30,000.00
16	2.0 MG of Storage at 010	Gal	2,000,000	$5.00	$10,000,000.00
17	Storage Structure Evacuation Piping	LS	1	$100,000.00	$100,000.00
18	HAC Surface, 1.5"	Ton	225	$90.00	$20,250.00
19	HAC Intermediate, 2"	Ton	300	$80.00	$24,000.00
20	HAC Base, 4"	Ton	600	$80.00	$48,000.00
21	Compacted Aggregate Base, #53, 6"	Ton	600	$20.00	$12,000.00
22	Concrete Curb Replacement	LF	800	$20.00	$16,000.00

23	Concrete Sidewalk Replacement	LF	150	$45.00	$6,750.00
24	Remove Existing 82” Sewer	LF	100	$200.00	$20,000.00
25	Remove Existing 15” Sewer	LF	250	$50.00	$12,500.00
26	Remove Manhole	EA	2	$5,000.00	$10,000.00
27	Plug Existing Sewer	EA	3	$7,500.00	$22,500.00
28	Temporary Bypass Pumping	LS	1	$100,000.00	$100,000.00
29	Granular Backfill	CY	15,000	$20.00	$300,000.00
30	Civil/Architectural Site Improvements	LS	1	$100,000.00	$100,000.00
31	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
32	Erosion Control	LS	1	$50,000.00	$50,000.00
33	Landscape Restoration	LS	1	$50,000.00	$50,000.00
34	Construction Layout/Staking	LS	1	$100,000.00	$100,000.00
35	General Conditions (NTE 5%)	LS			$982,400.00
	North Conveyance/Storage Subtotal				$20,629,400.00

II. Parallel Interceptor (Ohio to Main Lift)

Item	Description	Unit	Quantity	Unit Cost	Total
1	144" Gravity Sewer (008 to New Main LS)	LF	10,000	$2,000.00	$20,000,000.00
2	Sewer Access Structure	EA	4	$50,000.00	$200,000.00
3	Diversion Structures/Outfalls & Piping Const.	EA	4	$750,000.00	$3,000,000.00
4	24" Force Main	LF	500	$150.00	$75,000.00
5	Pavement Replacement	LF	500	$200.00	$100,000.00
6	Fence Replacement	LF	1,500	$15.00	$22,500.00
7	Existing Storm Repair/Crossing/Replacement	LS	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LS	1	$150,000.00	$150,000.00
9	Erosion Control	LS	1	$250,000.00	$250,000.00
10	Construction Layout/Staking	LS	1	$200,000.00	$200,000.00
11	General Conditions (NTE 5%)	LS			$1,212,400.00
	Parallel Interceptor Subtotal				$25,459,900.00

III. New Main Lift Station

Item	Description	Unit	Quantity	Unit Cost	Total
1	Lift Station, Control, Admin and Lab Building	LS	1	$13,200,000.00	$13,200,000.00
2	Tunnel Outlet Structure	LS	1	$1,200,000.00	$1,200,000.00
3	Grit Removal Facility	LF	1	$4,900,600.00	$4,900,600.00
4	Splitter Structures	LS	1	$150,000.00	$150,000.00
5	Mechanical/Electrical/Controls	LS	1	$470,000.00	$470,000.00
6	Civil/Architectural Site Improvements	LS	1	$125,000.00	$125,000.00
7	Erosion Control	LS	1	$50,000.00	$50,000.00
8	Construction Layout/Engineering	LS	1	$50,000.00	$50,000.00
9	General Conditions (NTE 5%)	LS			$1,007,300.00
	New Main Station Subtotal				$21,152,900.00

IV. Site Work and Piping (for New Main Lift and Turner Closure)

Item	Description	Unit	Quantity	Unit Cost	Total
1	66" Gravity Sewer	LF	200	$400.00	$80,000.00
2	84" Gravity Sewer	LF	1,200	$850.00	$1,020,000.00
3	Twin 96" Gravity Sewers (003 to New Main LS)	LF	1,500	$2,200.00	$3,300,000.00
4	120" Gravity Sewer	LF	100	$1,500.00	$150,000.00
5	Manhole Structures	EA	4	$20,000.00	$80,000.00
6	48" Force Main/Connect to Existing FM	LF	1,300	$350.00	$455,000.00
7	Demolition of Existing Main Lift	LS	1	$100,000.00	$100,000.00
8	By-Pass Pumping	LS	1	$50,000.00	$50,000.00
9	Erosion Control	LS	1	$50,000.00	$50,000.00
10	Construction Layout/Engineering	LS	1	$30,000.00	$30,000.00
11	General Conditions (NTE 5%)	LS			$265,800.00
	Site Work and Piping Subtotal				$5,580,800.00

V. High Rate Clarification[1]

Item	Description	Unit	Quantity	Unit Cost	Total
Phase I					
1	Site Work	LS	1	$801,000.00	$801,000.00
2	24" Force Main from Main Lift Station to HRC Facility	LS	1	$530,000.00	$530,000.00
3	16.25 MGD HRC & UV Disinfection Facility	LS	1	$5,518,000.00	$5,518,000.00
4	15"/48" Drain Pipe and Outfall Structures	LS	1	$317,000.00	$317,000.00
5	Electrical Work for Overall Site	LS	1	$400,000.00	$400,000.00
6	Instrumentation and Control for Overall Site	LS	1	$125,000.00	$125,000.00
7	General Conditions (NTE 4%)[2]	LS	1	$308,000.00	$308,000.00
	Phase I Subtotal				$7,999,000.00
Phase II					
1	Site Work	LS	1	$77,000.00	$77,000.00
2	Additional 16.25 MGD HRC Facility	LS	1	$3,606,000.00	$3,606,000.00
3	Electrical Work for Overall Site	LS	1	$250,000.00	$250,000.00
4	Instrumentation and Control for Overall Site	LS	1	$75,000.00	$75,000.00
5	General Conditions (NTE 4%)[2]	LS	1	$160,000.00	$160,000.00
	Phase II Subtotal				$4,168,000.00
	High Rate Clarification Subtotal				$12,167,000.00

[1] At the request of the City, the HRC facility is projected to be constructed in 2 phases, with a 16.25 MGD HRC train and UV Disinfection facility constructed in Phase I and an additional 16.25 MGD HRC train constructed in Phase II.

[2] The General Conditions have been revised from the original 5% (as indicated the 2011 estimate) to 4% to match the cost estimate as provided in the Basis of Design.

VI. Common Alternatives

Item	Description	Unit	Quantity	Unit Cost	Total
1	Back-up Structure for Hulman/Idaho Storage	LS	1	$1,700,000.00	$1,700,000.00
2	Walnut Diversion Structure	LS	1	$1,500,000.00	$1,500,000.00
3	Large Dia Pipe Rehab - North Hulman w/Weir	LS	1	$2,000,000.00	$2,000,000.00
4	Large Dia Pipe Rehab - North Walnut	LS	1	$1,300,000.00	$1,300,000.00
5	Floatables Controls at CSO 011	LS	1	$2,000,000.00	$2,000,000.00
	Common Alternatives Subtotal				$8,500,000.00

7.2.3 Collection System Model Results

The collection system model was applied for the typical year (1978) at several levels of control for each of the final four alternatives. Although the controls in each alternative were sized initially using the rainfall from the appropriate design storm, the sizing was adjusted as needed to ensure that the number of overflows in the typical year met the intended number of activations for that level of control. End-of-pipe performance for individual CSOs was evaluated by tallying number of activations (Table 7.2-8), total annual volume (Table 7.2-9) and hours of overflow (Table 7.2-10). Note that the CSOs in the priority area of Fairbanks Park (CSO-008, CSO -007, CSO-006 and CSO-005) have been eliminated in each of the final alternatives. The reduction in volume from CSO-004 and CSO-011 allowed their volume to be combined into a single discharge location at CSO-011 in all of the alternatives so CSO-004 is also indicated as "eliminated" in all of these tables. A similar strategy was used with CSO-009 and CSO-010 in Alternatives 11 and 11b, as indicated in the tables.

Table 7.2-8
Total Number of Overflows in a Typical Year for Each Level of Control of Final Alternatives

Alternative	CSO Name/ Number Level of Control (OF/yr)	Spruce 010	Chestnut 009	Ohio 008	Walnut 007	Oak 006	Crawford 005	Hulman 004	Idaho 011	Turner 003	Max
Baseline	N/A	24	33	37	30	24	31	36	32	24	37
Hybrid	1	1	1	Eliminated					1	1	1
Hybrid	2	2	2						2	1	2
Hybrid	4	3	4						4	3	4
Hybrid	6	6	5						6	5	6
Hybrid	9	9	7						7	6	9
Hybrid	12	11	9						7	7	11
7B	6	3	5	Eliminated					8	6	8
7B	9	7	7						9	8	9
7B	12	7	10						12	11	12
11	1	1	Eliminated						1	1	1
11	2	2							2	2	2
11	4	4							4	4	4
11	6	5							6	Elimin-ated	6
11	7	7							7		7
11	9	9							8		9
11	12	10							8		10
11B	7	7	Eliminated						7	Elimin ated	7

**Note: CSO 002 at the main lift station is an emergency overflow only with no overflows predicted in the typical year. CSO 002 is eliminated in all scenarios of Alternative 7B, 11 and 11B.*

Table 7.2-9
Total Annual Volume (Million Gallons) in a Typical Year for Each Level of Control of Final Alternatives

	CSO Name/ Number	Spruce	Chestnut	Ohio	Walnut	Oak	Crawford	Hulman	Idaho	Turner	
Alternative	Level of Control (OF/yr)	010	009	008	007	006	005	004	011	003	Total
Baseline	N/A	76.1	76.3	12.6	116.7	7.8	15.4	229.3	137.1	18.6	690
Hybrid	1	2.8	4.9	Eliminated					7.9	4.5	20
Hybrid	2	7.4	5.5						11.7	4.6	29
Hybrid	4	11.4	14.2						19.2	15.9	61
Hybrid	6	17.6	20.7						37.9	63.7	140
Hybrid	9	63.4	8.9						47.8	50.6	171
Hybrid	12	74.6	14.9						52.5	61.7	204
7B	6	0.7	3.7	Eliminated					39.8	14.1	58
7B	9	13.3	17.1						107.9	41.3	179
7B	12	18.7	27.7						86.1	23.9	156
11	1	1.9	Eliminated						1.3	0.5	4
11	2	12.8							8.9	3.8	26
11	4	24.0							17.4	7.3	49
11	6	35.1							70.1	Elimin-ated	105
11	7	71.6							82.2		154
11	9	75.8							110.3		186
11	12	83.9							110.0		194
11B	[illegible]	[illegible]	Eliminated						[illegible]	[illegible]	[illegible]

**Note:* *CSO 002 at the main lift station is an emergency overflow only with no overflows predicted in the typical year. CSO 002 is eliminated in all scenarios of Alternative 7B, 11 and 11B.*

Table 7.2-10
Total Hours of Overflow in a Typical Year for Each Level of Control of Final Alternatives

	CSO Name/ Number	Spruce	Chestnut	Ohio	Walnut	Oak	Crawford	Hulman	Idaho	Turner	
Alternative	Level of Control (OF/yr)	010	009	008	007	006	005	004	011	003	Total
Baseline	N/A	89	224	122	128	73	109	219	164	82	224
Hybrid	1	4	14	Eliminated					8	8	14
Hybrid	2	9	21						11	8	21
Hybrid	4	12	48						22	24	48
Hybrid	6	19	58						25	38	58
Hybrid	9	48	64						30	41	64
Hybrid	12	54	83						32	47	83
7B	6	8	39	Eliminated					31	26	39
7B	9	22	42						54	47	54
7B	12	29	87						62	48	87
11	1	7	Eliminated						8	5	8
11	2	11							12	10	12
11	4	25							25	21	25
11	6	27							31	Elimin-ated	31
11	7	43							40		43
11	9	49							50		50
11	12	54							51		54
[redacted]	[redacted]	[redacted]	[redacted]						[redacted]	[redacted]	[redacted]

**Note: CSO 002 at the main lift station is an emergency overflow only with no overflows predicted in the typical year. CSO 002 is eliminated in all scenarios of Alternative 7B, 11 and 11B.*

Figure 7.2-1 shows the total overflow volume for the final alternatives at each level of control. The total volume of overflow remaining for each level of control varies by alternative but even at 12 overflows per year, the City is reducing the overflow volume by 72% (690 MG currently down to 194 MG. At seven overflows per year for Alternative 11 [redacted], the volume remaining corresponds to a nearly 80% reduction in overflow volume from current conditions.

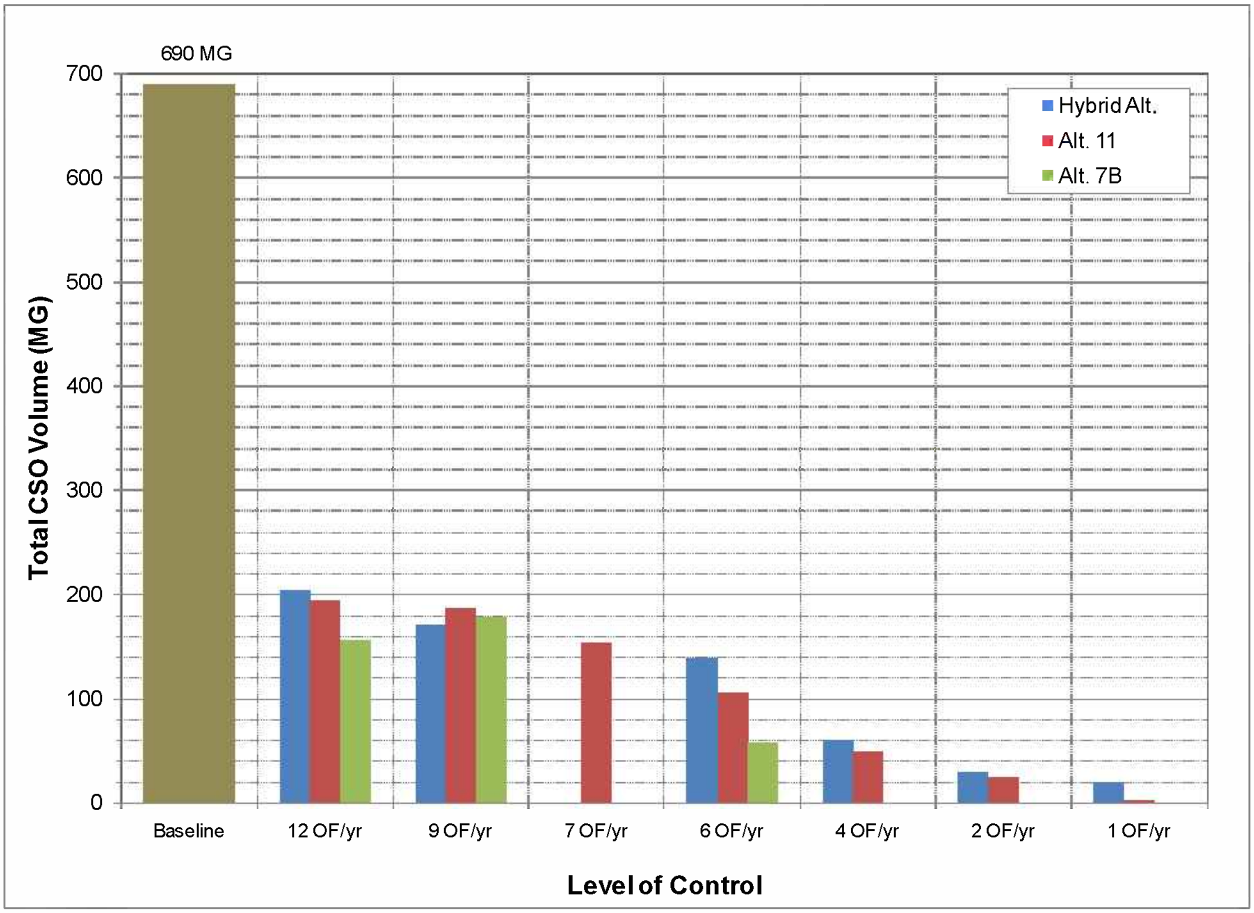


Figure 7.2-1. Total Annual CSO Volume in a Typical Year by Level of Control.

*Alternative 11B, with a level of control of 7 OF/yr, will yield the same total annual CSO Volume as Alternative 11 with a level of control

These collection system model results were then used to calculate the percent capture for the various levels of control. The percent capture is defined as the volume of combined sewage treated during wet weather on a system wide annual average basis divided by the total volume of the combined sewage collected in the combined sewer system during wet weather on a system wide annual average basis.

$$\text{\% Capture} = \frac{\text{Total System Volume} - \text{CSO Volume}}{\text{Total System Volume}}$$

7.2.4 River Model Results

The final CSO control alternatives, which included sewer separation, were developed (described in Chapter 6) and their performance was evaluated by applying the collection system model in continuous mode for a "typical" year of rainfall (identified as 1978). The collection system model results were used as input to the river model to evaluate the effectiveness of the alternative in improving water quality relative to current (baseline) conditions. For the sewer separation scenario, the hourly CSO volumes from the baseline simulation were input to the river model with a typical stormwater event mean concentration of 5,000 cfu/100 ml applied to them and resulting impacts were evaluated by tracking these loads in the model using the CSO state variable. The river model results were compared to water quality standards to characterize the performance of each alternative. Cost-performance curves were constructed to identify an appropriate level of control.

In-stream benefits of the final alternatives are presented in terms of reduction in CSO volume (see previous section) and exceedance of Indiana's 235 cfu/100 ml single sample maximum criterion. The river model results for each CSO control alternative were compared to Indiana water quality standards using the same methodology that was applied for the baseline simulation presented in Section 4.2. Simulated in-stream concentrations due to all sources and to the City of Terre Haute's CSOs alone were evaluated for the recreation season (April-October) when the State's E. coli water quality standards are applicable. For comparison to Indiana's single sample maximum criterion (235 cfu/100 ml), the hourly model results at each key location that exceeded the criterion were tallied as a total count of hours and as a percentage of available hours.

As noted in Section 4, although the State has a 30-day geometric mean criterion (125 cfu/100 ml), compliance with this standard was not evaluated because upstream loads are the primary factor affecting compliance with this standard and when these sources are included in the evaluation, they obscure the improved benefit of increasing CSO control. The effect of the CSO alternatives on water quality are best expressed in terms of total hours of exceedance of the water quality standard or percent of time, and by excluding other sources in comparing the relative benefit to river water quality. (Note that upstream and other sources are expected to cause exceedances, as described in Section 4.2.1).

The results and information described in the previous section were used to develop a recommended plan, which is described in Section 10.

7.2.5 Comparison to Single Sample Maximum Criterion

River model results indicate that the Hybrid and 11 alternatives provide similar water quality benefits for E. coli at the same level of control. At a control level of 12 overflows per year, the City's CSOs would cause approximately 55 hours of exceedance of the State's single sample maximum criterion (235 cfu/100 ml) at the WWTP or approximately 1% of the hours in the recreation season. Increasing the level of control to 4 overflows per year would reduce the number of hours of exceedance to approximately 25 hours or less than 0.5% of the hours in the recreation season. The tunnel alternative provided similar hours of exceedance as the other two alternatives for the same level of control (Figure 7.2-2). Note that in this figure, current conditions correspond to the dark blue line, alternative 7b (tunnel) at 12 OF/yr corresponds to the green line, alternative 11 (parallel interceptor and local storage) corresponds to the yellow line and the hybrid alternative corresponds to the light blue line.

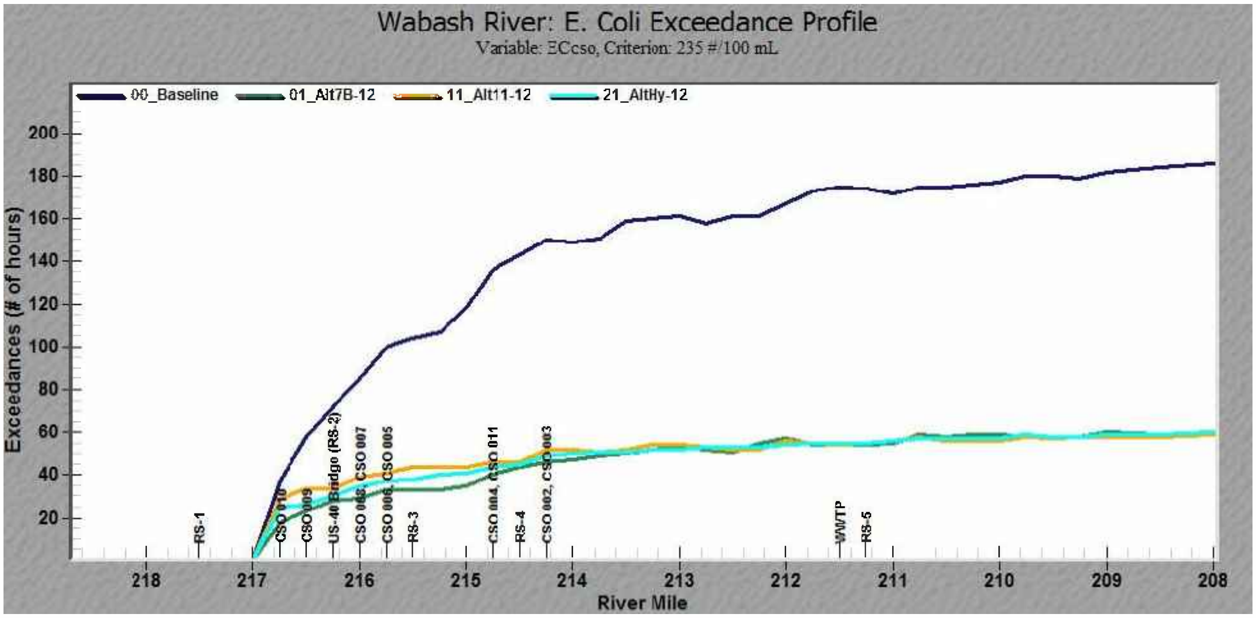


Figure 7.2-2. Comparison of Compliance with Indiana's Single Sample Maximum E. coli Criterion for Each Final Alternative Sized at 12 Overflows/Year.

Table 7.2-11 presents a summary, in hours of exceedance, of each control alternative to the single sample maximum criterion for the recreation season at the key locations within or downstream of the City's CSO outfalls.

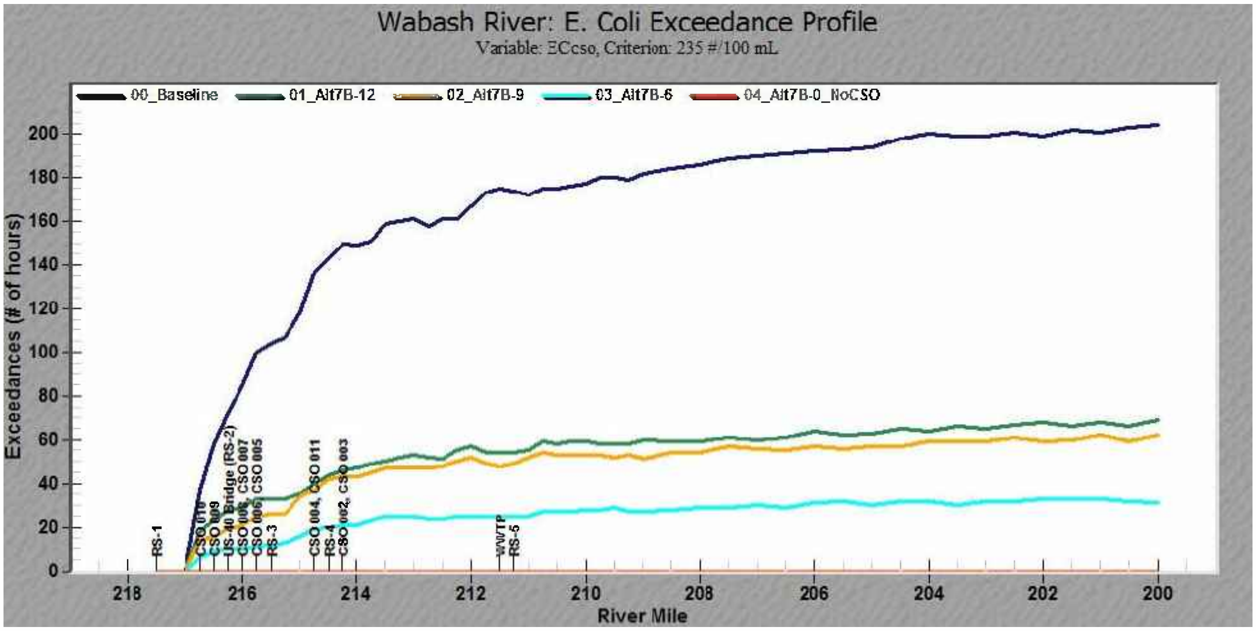
Table 7.2-11
Total Hours of Exceedances of Indiana's Single Sample Maximum E. coli Criterion in the Recreation Season of the Typical Year for Each Level of Control of Final Alternatives

Location	River Mile	Baseline	Sewer Separation	Alt 11							
				12 OF/yr	9 OF/yr	7 OF/yr	6 OF/yr	4 OF/yr	2 OF/yr	1 OF/yr	0 OF/yr
Upstream of City's CSOs	217.5	0	0	0	0	0	0	0	0	0	0
US-40 Bridge	216.3	72	2	34	32	32	17	13	9	3	0
Fairbanks Park	215.5	104	4	44	40	36	21	17	10	4	0
Downstream of Downtown CSOs	214.5	143	19	46	43	39	24	19	13	6	0
Downstream of WWTP	211.3	174	6	55	51	45	31	24	16	6	0

Location	River Mile	Baseline	Sewer Separation	Alt Hybrid							
				12 OF/yr	9 OF/yr	7 OF/yr	6 OF/yr	4 OF/yr	2 OF/yr	1 OF/yr	0 OF/yr
Upstream of City's CSOs	217.5	0	0	0	0	Not evaluated	0	0	0	0	0
US-40 Bridge	216.3	72	2	30	32		23	17	12	7	0
Fairbanks Park	215.5	104	4	38	39		26	17	14	7	0
Downstream of Downtown CSOs	214.5	143	19	45	45		29	22	16	10	0
Downstream of WWTP	211.3	174	6	55	52		38	27	18	11	0

Location	River Mile	Baseline	Sewer Separation	Alt 7B							
				12 OF/yr	9 OF/yr	7 OF/yr	6 OF/yr	4 OF/yr	2 OF/yr	1 OF/yr	0 OF/yr
Upstream of City's CSOs	217.5	0	0	0	0	Not evaluated	0	Not evaluated	Not evaluated	Not evaluated	0
US-40 Bridge	216.3	72	2	28	19		10				0
Fairbanks Park	215.5	104	4	33	26		12				0
Downstream of Downtown CSOs	214.5	143	19	44	42		20				0
Downstream of WWTP	211.3	174	6	54	49		25				0

For each alternative, the incremental in-stream benefit due to increasing the level of control is shown in Figures 7.2-3, 7.2-4, and 7.2-5 for Alternative 7b, Alternative 11 and the Hybrid Alternative, respectively. Results in these figures are expressed as a count of the available hours (e.g. 5,136 hours) in the recreation season that the State's standard is exceeded.

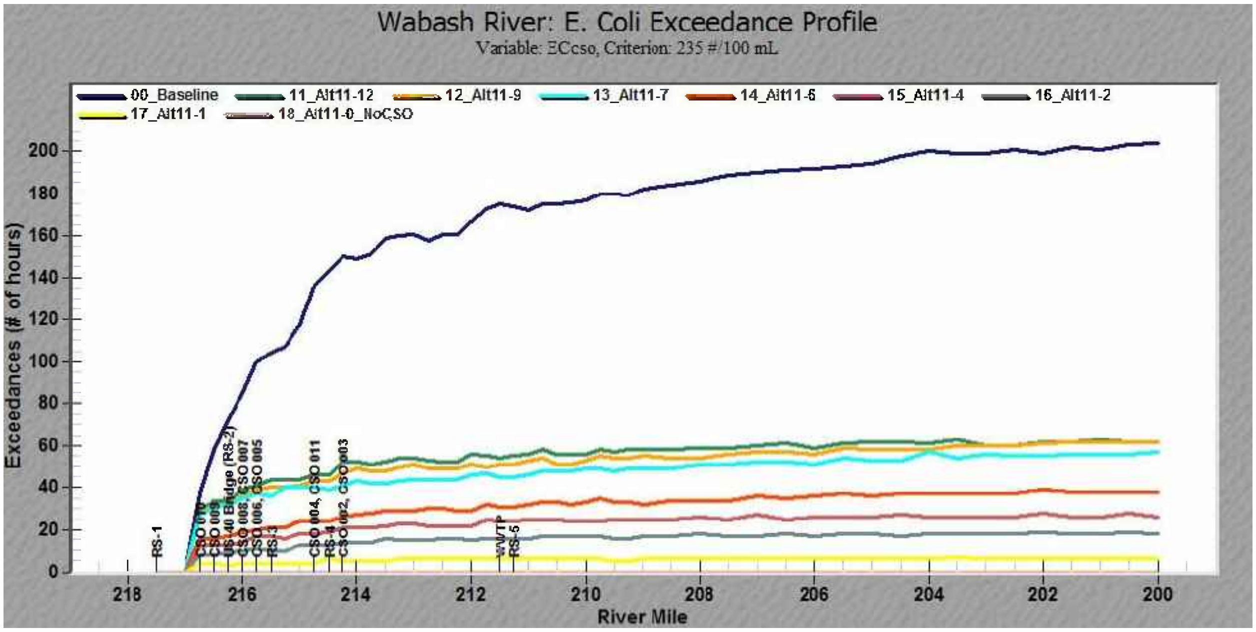


Note: In this figure, the following scenarios are included as follows:

- Dark blue line = current conditions/baseline
- Green line = Alternative 7b at 12 OF/yr
- Gold line = Alternative 7b at 9 OF/yr
- Light blue line = Alternative 7b at 6 OF/yr
- Red line = Alternative 7b at 0 OF/yr (all locations have 0 hours of exceedance)

Results are presented for the exceedances based on CSO loads alone.

Figure 7.2-3. Comparison of Compliance with Indiana's Single Sample Maximum E. coli Criterion for Different Levels of Control for Alternative 7b.

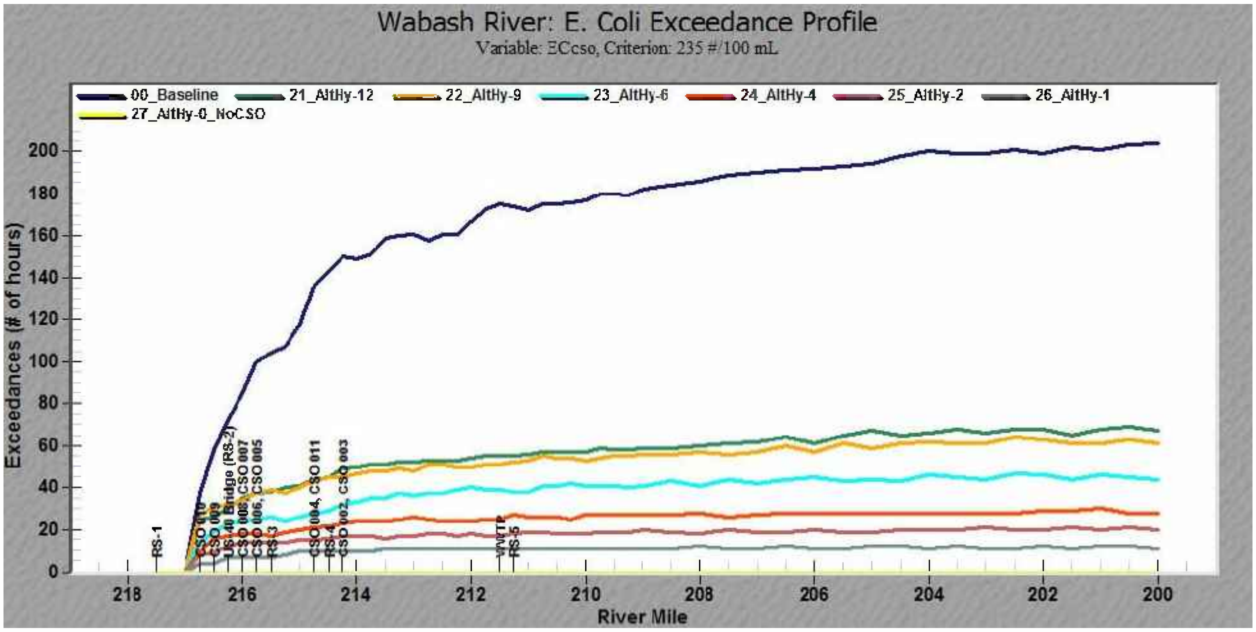


Note: In this figure, the following scenarios are included as follows:

- Dark blue line = current conditions/baseline
- Green line = Alternative 11 at 12 OF/yr
- Gold line = Alternative 11 at 9 OF/yr
- Light blue line = Alternative 11 at 7 OF/yr
- Red line = Alternative 11 at 6 OF/yr
- Brick line = Alternative 11 at 4 OF/yr
- Gray line = Alternative 11 at 2 OF/yr
- Yellow line = Alternative 11 at 1 OF/yr
- Brown line = Alternative 11 at 0 OF/yr (all locations have 0 hours of exceedance)

Results are presented for the exceedances based on CSO loads alone.

Figure 7.2-4. Comparison of Compliance with Indiana's Single Sample Maximum E. coli Criterion for Different Levels of Control for Alternative 11.



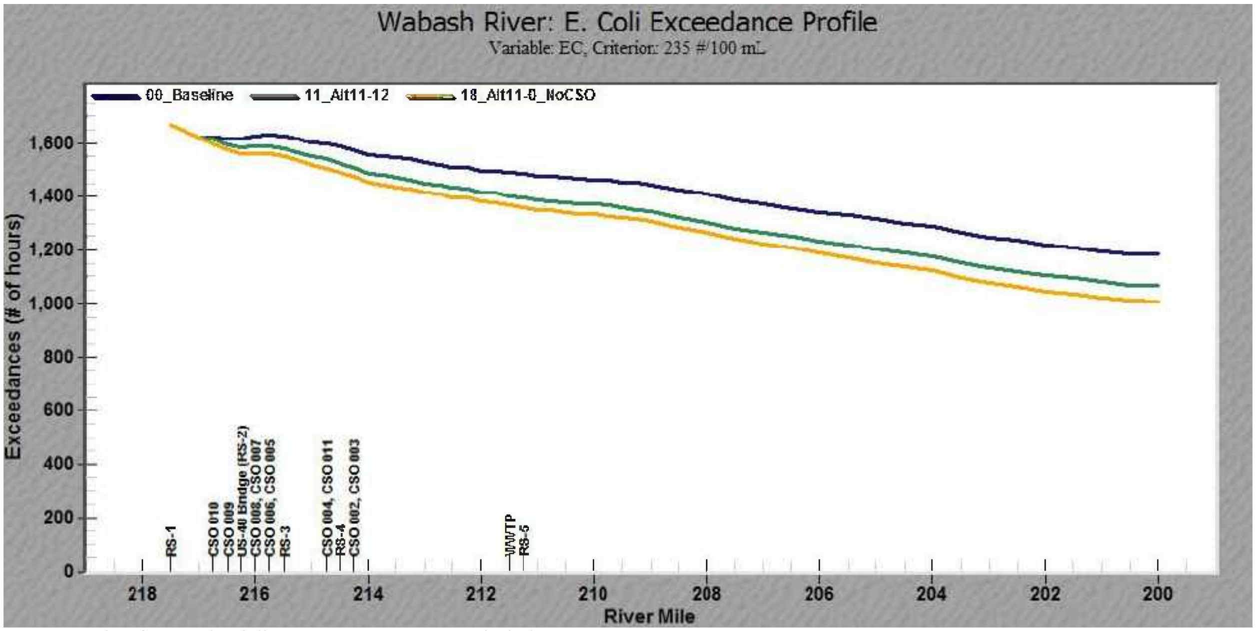
Note: In this figure, the following scenarios are included as follows:

- Dark blue line = current conditions/baseline
- Green line = Hybrid Alternative at 12 OF/yr
- Gold line = Hybrid Alternative at 9 OF/yr
- Light blue line = Hybrid Alternative at 6 OF/yr
- Red line = Hybrid Alternative at 4 OF/yr
- Brick line = Hybrid Alternative at 2 OF/yr
- Gray line = Hybrid Alternative at 1 OF/yr
- Yellow line = Hybrid Alternative at 0 OF/yr (all locations have 0 hours of exceedance)

Results are presented for the exceedances based on CSO loads alone.

Figure 7.2-5. Comparison of Compliance with Indiana's Single Sample Maximum E. coli Criterion for Different Levels of Control for Hybrid Alternative.

Within the City limits, the maximum benefit of Alternative 11 is an additional 60-100 hours of compliance from the approximately 1,600 hours of exceedance simulated during baseline conditions (Figure 7.2-6). Downstream of the City, at the wastewater treatment plant, the benefit is approximately 90-120 additional hours of compliance. This suggests that even if CSOs were completely eliminated, water quality standards will still not be met unless reduction in loads from other sources can be achieved. Section 4.2.1 presented a detailed analysis of the additional benefit of complete CSO elimination (which is unaffordable). As Figure 7.2-6 illustrates, the magnitude of other source loads diminish the relative benefit of CSO control, as the results show limited reduction in exceedances. Note also that increasing the level of CSO control does not show an appreciable reduction in exceedances.



Note: In this figure, the following scenarios are included as follows:

- Dark blue line = current conditions/baseline
- Green line = Alternative 11 at 12 OF/yr
- Gold line = Alternative 11 at 0 OF/yr

Results are presented for the exceedances based on loads from all sources.

Figure 7.2-6. Comparison of Compliance with Indiana's Single Sample Maximum E. coli Criterion for Different Levels of Control for Alternative 11 Considering All Bacteria Sources.

7.2.6 Cost Performance Curve

The performance of each control alternative was evaluated by relating the water quality benefit at two key locations within the remaining CSO area to the cost for each level of control. Costs for each alternative and the river model results were presented previously in Section 7. Figure 7.2-7 and Figure 7.2-8 show the cost versus performance at Fairbanks Park (RM 215.5) and near the City's WWTP (downstream of all CSOs at RM 211.25), respectively.

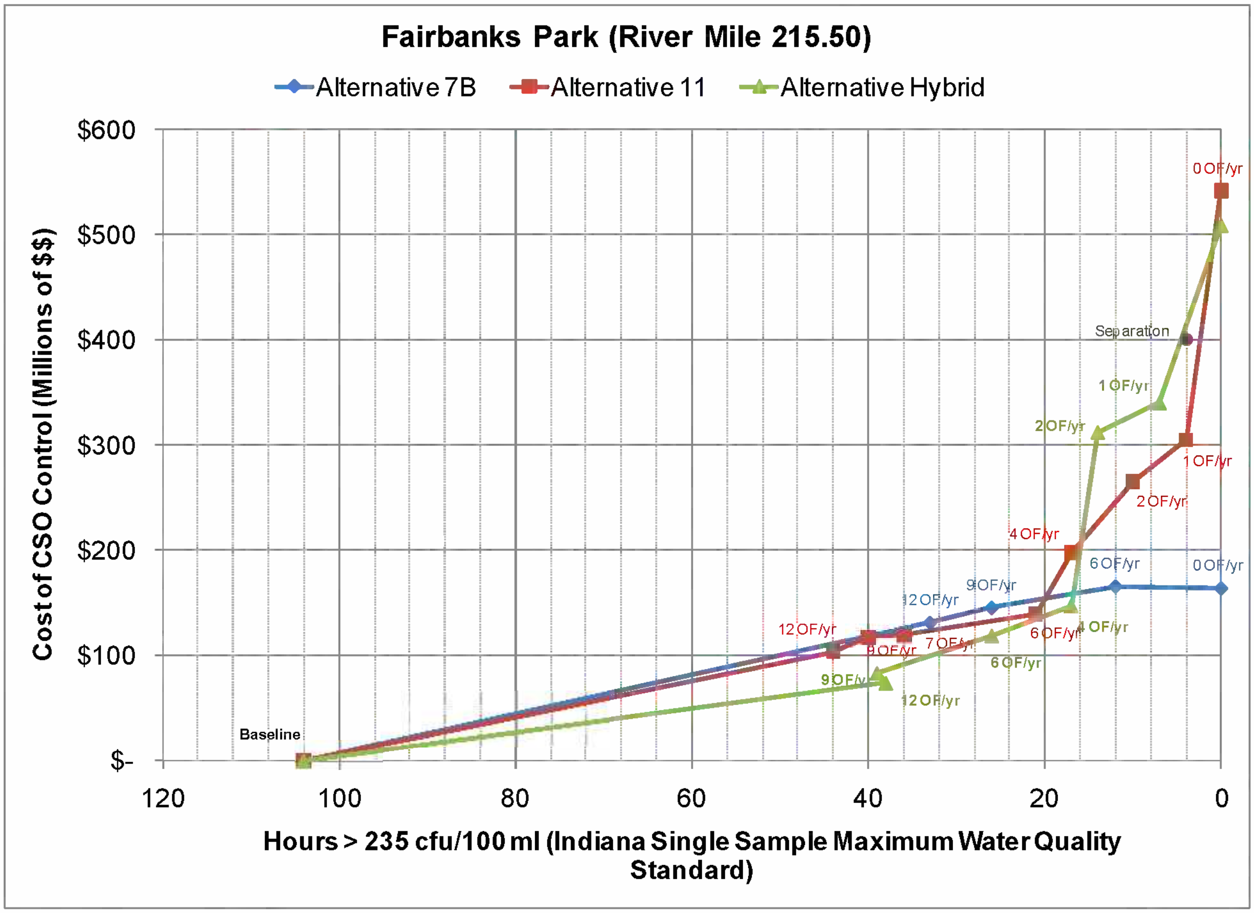


Figure 7.2-7. Cost-Performance Analysis of CSO Control Alternatives Based on Water Quality Benefit at Fairbanks Park.

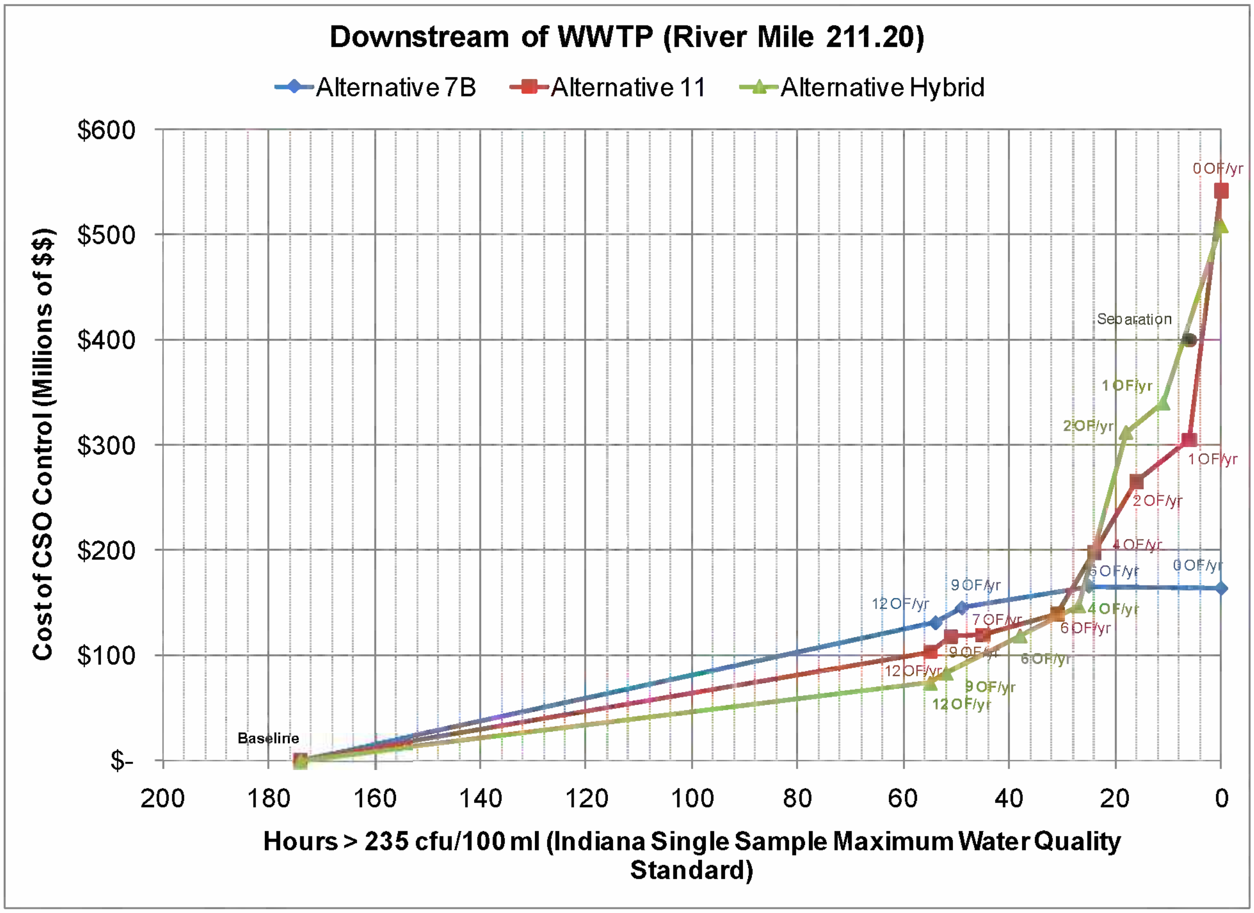


Figure 7.2-8. Cost-Performance Analysis of CSO Control Alternatives Based on Water Quality Benefit Near the Waste Water Treatment Plant.

The cost-performance graphs were used to identify the most cost-effective level of control, which is approximately 4 overflows/year for Alternative 11 and the Hybrid Alternative. The tunnel alternative (7B) did not have a classic knee because the technologies included in each level of control changed at the 0 OF/yr level of control (for example, floatables and solids controls were not included in the 0 OF/yr scenario but were included in the other levels of control), so the total cost of control at 6 and 0 OF/yr was comparable. The "Total Present Worth" was used as the cost basis for the graphs. These costs were summarized in Table 7.2-3. The recreation season model results of hours where the simulated river concentration due to Terre Haute's CSOs is greater than Indiana's single sample maximum criterion (235 cfu/100 ml) was used as the performance or benefit basis for the graphs.

The shape of the cost-performance curves are similar for the alternatives 11 and its hybrid, with both showing a "knee" between 6 and 4 overflows per year. Costs for equivalent levels of control are similar. Also of note is that there is very little difference in the shape of the cost-performance curves between key locations.

As will be explained in Section 8, based on affordability, the recommended alternative is not at the knee of the curve. Although the knee is the location of the most cost-effective solution, it is higher than the calculated affordability of the community and is therefore, not the recommended alternative.

7.2.7 Priority Area Assessment

Care was taken during the development of the final CSO control alternatives to reduce or eliminate the CSO volume discharging to the river at or upstream of Fairbanks Park, which had been identified as an area of priority by the Citizens Advisory Committee. In each of the final alternatives, the City eliminated the CSOs in the park itself. Volume from the two most northern or upstream CSOs (CSO-010 and CSO-009) was minimized to the extent practical and feasible in each alternative. As a result, the CSO volume discharged in and upstream of Fairbanks Park was reduced from 304 MG currently to less than 75 MG for all of the final alternatives sized at 9 or fewer overflows per year. This corresponds to a 75% reduction in CSO volume at the park. Compliance with State water quality standards at the park due to the City's CSOs alone improves approximately threefold, with exceedances dropping from 104 hours currently to approximately 35 hours (based on 7 overflows/year or fewer).

An assessment of the river model results at Fairbanks Park (RM 215.50) for the storm events remaining after implementation of the LTCP indicates that the water quality at this location returns to acceptable bacteria levels (e.g. < 235 cfu/100 ml) within 16 hours after a rain event starts, as shown in Figure 7.2-9. As this figure illustrates, there is often a several hour lag between when the rain starts and when the CSOs start discharging. Once the CSOs start overflowing to the river, bacteria concentrations exceed the water quality standard within the first hour of overflow. Bacteria concentrations return to levels below the water quality standard 6-12 hours after the CSOs start overflowing, depending on the storm event.

This suggests that CSO discharges remaining after the preferred CSO control alternative is implemented will affect Fairbank Parks approximately one day after each event. If the level of control in the final alternative is 7 overflows, then Fairbanks Park will have unacceptable E. coli levels due to the CSOs for 7 days of the year (note however, that some of the remaining events will occur outside of the recreation season and so the in-stream water quality standard criteria are not applicable).

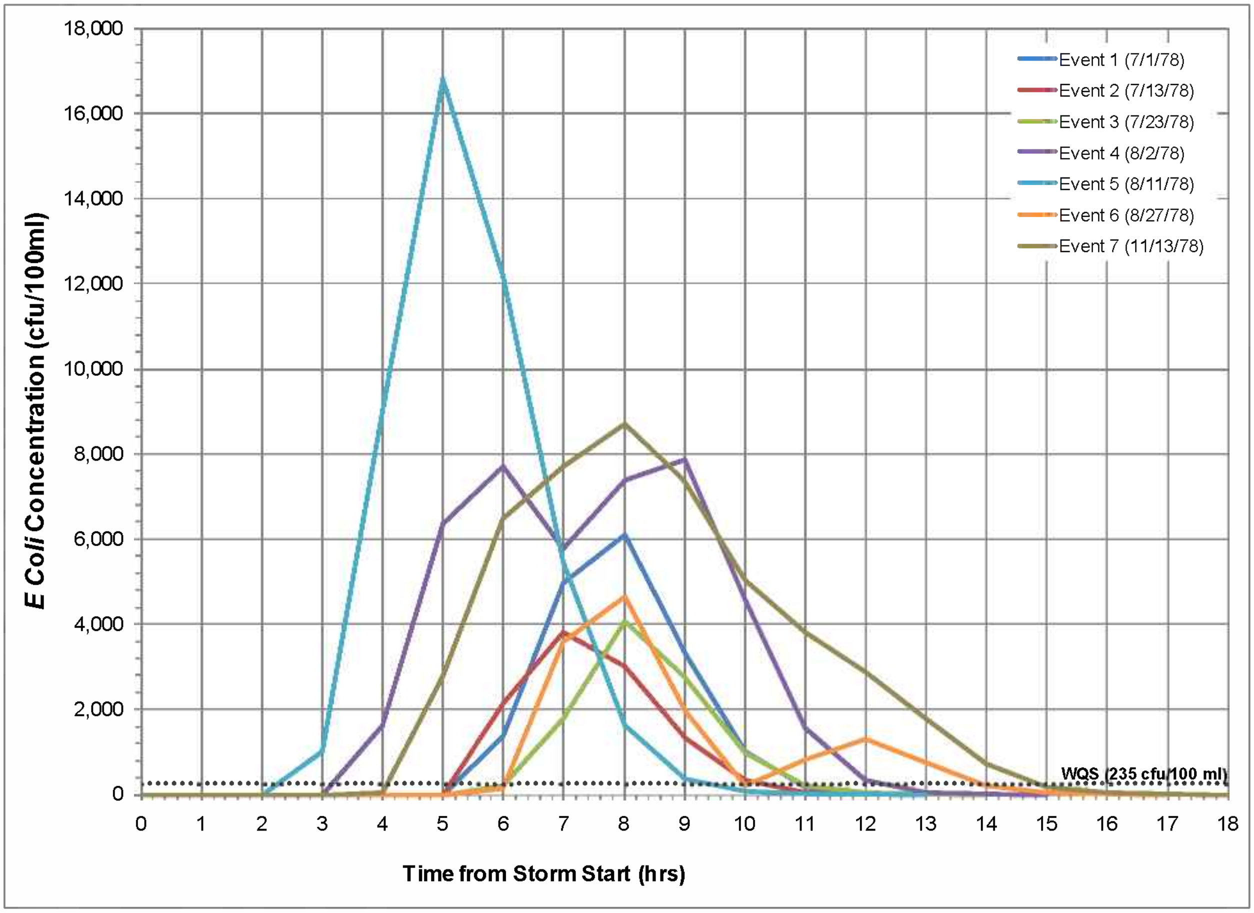


Figure 7.2-9. E. coli Concentration Profile at Fairbanks Park During Events Remaining After Implementation of the Long Term Control Plan.

7.3 Summary of Alternative Development

Based upon the cost/performance criteria described in the previous Section, the following three alternatives were evaluated at various levels of control. The following descriptions provide the details of the three final alternatives and the corresponding benefits with respect to cost/performance as well as other factors discussed in more detail in this section.

Alternative 7B

Alternative 7B can eliminates all or most CSO's depending upon the level of control selected. Under the zero overflow scenario, an emergency overflow at the International Paper storage lagoons could be open in the unlikely case that an overflow event occurs during a period when the lagoons are full and the WWTF is operating at peak capacity. Under the lesser levels of control, the alternative 7B eliminates all overflows except 003, 004, 009 and 010. The proposed tunnel ranges in size from 7 feet diameter up to 17 feet diameter and extends from the Spruce outfall south to a new tunnel evacuation lift station located adjacent to the storage lagoons. Details of this option are shown on Figure 6.8-1.

The most significant benefits to this option are that it will eliminate all CSO structures in the park under all levels of control and other CSO's based on tunnel size/level of control, has the lowest capital cost for the best water quality benefit over the long term and eliminates most "at-grade" construction disturbance. Conversely, this option requires a shorter implementation schedule for construction and rate increases due to the type of construction, cannot be feasibly phased over 20 years, and it cannot allow for cost effective implementation of "green" technologies.

Alternative 11

Alternative 11 consolidates CSO's 009/010 into one outfall with a storage tank, eliminates all CSO's in the park via conveyance of flows to CSO 011 or the International Paper lagoons depending upon the level of control, and replaces the existing main lift station with a new facility which conveys flows into the storage lagoons and to the WWTF. The various levels of control affect the size of and need for storage tanks at 010 (Spruce), 004 (Hulman), and 003 (Turner), and the size of relief sewer from Ohio to the Main Lift Station. Details of this option are shown on Figure 6.8-2.

The most significant benefits to this option are that it can be phased over 20 years (both project construction and rate implementation), can be reasonably expanded to gain more CSO control, allows ISU development along the Riverfront by consolidating 009/010, provides for a new main lift station designed to allow for future tunnel connection (if necessary), has lower operational costs than the "Hybrid" alternative, and has lower capital costs than Alternative 7B at most levels of CSO control.

Hybrid Alternative

The "Hybrid" Alternative utilizes very similar technologies and infrastructure as Alternative 11 with a few differences including both CSO 009 and 010 remain open and a storage facility is constructed at each outfall and the main lift station is not replaced – instead, a new CSO pumping station is constructed to simply convey flows from the relief sewer into the lagoons only. Similar to Alternative 11, the various levels of control affect the size of storage tanks at 009 (Chestnut), 010 (Spruce), 004 (Hulman) and 003 (Turner) as well as the size of the relief sewer extending from Ohio to the Main Lift Station/International Paper lagoon site. Details of this option are shown on Figure 6.8-3.

The most significant benefits to this option as compared to the other two under all levels of control are as follows: lowest capital cost, lowest rate impact, and it can be phased over 20 years (both project construction and rate implementation). Negatively, this alternative has the highest operating costs due primarily to CSO's which remain in service and large storage tanks included in most levels of control, it limits the development potential for ISU along the Riverfront, requires the continued use of a 45 year old main lift station, and offers very limited capacity for expansion for additional future CSO control.

The costs for each level of control within each alternative are represented on Figures 7.2-7 and 7.2-8 as part of the knee-of-the-curve and in Table 7.2-3 referenced previously.

Several factors were taken into consideration when developing and evaluating the final screened CSO control alternatives, such as:

- Cost Effectiveness
- Non-Monetary Factors
- Goals of the CSO Control Plan

The following subsections describe how each of these factors was considered during the evaluation process which ultimately led to the final selected plan discussed in Section 10.

7.4.1 Cost Effectiveness

The cost effectiveness is determined with the cost performance curves shown in Figures 7.2-7 and 7.2-8. The process used for the CSO control alternatives developed demonstrates the improvements to water quality in the Wabash River and shows how much it costs for each increment of water quality improvement. As indicated in the cost performance curve the costs to improve the water quality beyond the "knee" for each alternative begin to increase significantly.

7.4.2 Non-Monetary Factors

The non-monetary factors include environmental issues/impacts, technical issues, implementation issues, and public acceptance.

When the alternatives were evaluated, environmental issues and impacts were taken into consideration. The parallel interceptor that is considered in several alternatives was preliminarily designed on First Street rather than along the river to avoid construction in a floodplain.

During the evaluation of alternatives, construction feasibility, implementation issues such as operability and reliability, and expandability were taken into consideration with the help of the City staff, CAC and the technical committee. The concepts of each alternative were kept as simple as possible with the public in mind and since each alternative was developed in a limited number of remote locations, the technologies should not be complex to construct or operate. To accommodate future changes in CSO control policies, it will be beneficial if the selected control facilities are expandable. Two of the three alternatives are expandable, however, the tunnel alternative 7B cannot be feasibly expanded. The covered concrete storage tank alternatives can also be expanded with the addition of more tank volume in most locations. However, if expansion is likely the associated facilities should be designed initially to facilitate the expansion. Expansion of the storage tank and storage tunnel alternatives may be limited by the capacity of the interceptor downstream of CSO 009. If flows in the collection system remain high due to continuing precipitation, it may not be possible to increase the capacity of the return pumping stations, or it may be necessary to increase the period of return pumping to more than 24 hours.

The control alternatives are to be evaluated on the ability to receive public acceptance. Public acceptance is relative to the level of disruption a CSO project would have on local businesses and neighborhoods during construction and during the operation of the facility. One concern that was addressed was the disruption of too many streets at once. Additionally, the use of the international paper lagoon was a concern to the Riverfront Group particularly with regard to odor. Thus, all alternatives included mitigation measures in the modifications of the lagoons for CSO storage.

During implementation of the selected plan, phasing of the control technologies in the alternative can be achieved as described in Section 10.4.

7.4.3 Meeting the Goals of the CSO Control Plan

The following goals were established during the CAC and technical committee meetings and used to develop the CSO control alternatives during the evaluation process. The summary below indicates how these goals were addressed with respect to the three final screened alternatives:

1. Comply with IDEM requirements

   IDEM's Combined Sewer Overflow Long Term Control Plan Use Attainability Analysis Guidance was used during the development of the alternatives. It is presumed that the level of control selected will meet with approval by IDEM in accordance with an approved UAA which will change the designated use of the river during and 4 days after overflow events to the limited CSO use category. IDEM has been heavily involved in the Terre Haute LTCP planning process with multiple meetings and partial plan elements submittals to ensure that the Terre Haute plan complies with IDEM requirements.

2. Reduce in-stream bacteria from CSOs

   All alternatives reduce in-stream bacteria from CSOs by reducing the volume and duration of CSO entering the river.

3. Eliminate / reduce CSOs 005, 006, 007 and 008 in Fairbanks Park

   Priority area options were specifically developed in each alternative including those screened out to eliminate or reduce CSOs 005, 006, 007 and 008, which are in the priority area, Fairbanks Park.

4. WWTP Improvements

   During the LTCP development process, a plan to improve and increase the capacity of the WWTP was approved by the City. The improvements proposed have been incorporated into the design of CSO control elements and the financial analysis of the LTCP implementation. The WWTP improvements are being constructed in three phases between 2011 and 2016 and will be considered the initial phases of the CSO LTCP as discussed in Section 10.

5. Maximize Flow to the WWTP

   Given the expansion of the existing treatment facility, maximization of wet weather flows to and through the plant will be implemented once the improvements are complete. The SWMM model and subsequent CSO control infrastructure have been sized based upon the proposed flow capacities of the expanded plant.

6. Control and eliminate floatables from CSOs in accordance with NPDES permit requirements

   Floatables controls have been incorporated in each alternative for every outfall which would be proposed to remain. The outfalls to remain vary within each of the three screened alternatives and with the level of control within the alternatives.

7. Provide Protection Within Wellhead Protection Zone

   After concern was addressed at a CAC meeting during the original LTCP development in 2001 regarding exfiltration of the combined sewers in the wellhead protection zone, lining of the combined sewers in the protection zone was a priority. The rehabilitation of several large diameter combined sewers was completed as an "early action" type project and funded with a Sanitary District bond issue in 2006-2007 since any CSO LTCP recommendation would include the use of some in-line storage of CSO flows in some of the existing oversized sewers. During this project, additional rehabilitation measures including thicker grout in the lower half of the pipeline were incorporated in combined sewers in the wellhead protection area.

8. Reasonable Rate Increase based on total project cost with consideration given to phasing the proposed work

   During the development of the LTCP, reasonable rate impacts were considered, particularly after the approval of the WWTP project which has an estimated cost of approximately $120 million. The final three alternatives were evaluated and cost estimates developed for various levels of control to allow for cost considerations in the UAA. Additionally, the alternatives were evaluated with respect to their ability to allow phasing of construction and subsequent rate impacts.

9. Review of Odor Control at WWTP

   Odor control is a major element of the improvement's project at the WWTP and will be incorporated into the construction of each phase of the project.

7.5 Preferred Alternative (2011)

Based upon the information presented in this section, the technical team completed an evaluation of the final three screened alternatives at several levels of CSO control each. This process produced a recommended final selected plan which would include Alternative 11 sized at the level of control which would produce on average 7 overflows per year. The selection of this alternative, and particularly this level of control, was based upon several factors all of which were discussed within this section including the following:

- Cost/Rate Impact vs. Performance – Alternative 11 at 7 overflows per year allowed for a lower capital cost option and subsequent rate impact than Alternative 7B which was important given the additional burden imposed on user rates by the City's Wastewater Treatment Facility project. (The capital cost for this option was higher than the "hybrid", however, Alternative 11 replaces the main lift station which was a priority to the technical team *which allows 002 to be eliminated*.) The option allows a level of control below 10, and a small incremental increase in cost allows an increased level of control from 9 to 7 overflows. As shown on the cost/performance curve, the incremental costs increase significantly for this option for higher levels of control.

- Ability to Phase Project –The infrastructure included in Alternative 11 allows for easy phasing of the project's construction which allows for a phased financing/rate impact. Additionally, the phasing allows for the utilization of "green" technologies which can reduce the size of infrastructure of subsequent phases based on CSO control performance.

- Regulatory Acceptance –Given the meetings the City and technical team has had with IDEM throughout the planning process and the UAA document presented in Section 9, it is presumed that the alternative selected will meet with regulatory acceptance from IDEM and EPA.

- Consideration of Public Concerns – This alternative, as do all of the final screened alternatives, utilizes the International Paper lagoons for CSO flow storage. However, while incorporating these basins, which allows for significant flow storage at a very low cost, provisions for mitigating the basins operational affect on the surrounding properties' development have been incorporated. Additionally, this alternative consolidates outfalls 009 and 010 with 009 being eliminated and a small storage tank constructed below grade at 010. Thus, impact to expansion/development plans proposed by ISU can be mitigated.

7.6 Preferred Alternative (2014)

Based on additional information provided in a Basis of Design Report prepared by the City's Design Consultant in 2012/2013 (which is included in Appendix 6-5), the preferred alternative is Alternative 11B. Alternative 11B is a variation of Alternative 11, with the major difference being that the International Paper lagoons will not be utilized for off-line storage. Rather, a High Rate Clarification (HRC) system with UV disinfection is to be installed at the IP site to provide primary treatment and disinfection to all flows greater than the capacity of the City's Main Lift Station. The treated water will directly discharge to the river.

Alternative 11B will provide the same level of control as the previously preferred Alternative 11 (7 overflows per year in a typical year); however, it will do so with a lower capital cost than the revised Alternative 11 cost. Additionally, it will allow the City to utilize the IP site in the Riverscape long-term plan

Section 10 will present the selected plan in greater detail along with the proposed schedule including cost/construction phasing proposed review and approval.

8 Section Eight – Affordability and Financial Capability Assessment

8.1 Introduction

One of the greatest challenges in funding a LTCP is to fund the program in such a way to not cause undue hardship on the citizens and industry in the area. There are numerous requirements for the LTCP set by the EPA and IDEM that can make this type of project the most expensive public works project that any community can undertake. Currently, there is no LTCP-specific grant availability. Although some loan money is available from State Revolving Funds (SRF), these funds cannot be guaranteed. Therefore, individual communities are responsible for providing funding for these projects for themselves. To assist in this process, the planning team utilized the services of the city's financial advisor, H.J. Umbaugh and Associates.

IDEM and the EPA have set forth specific guidelines for determining affordability of a LTCP. The goal of these guidelines is to determine what measures can be taken by a community without causing undue hardship, currently or in the future, for the community or the residents.

The affordability analysis focuses on many financial and socio-economic issues including:

- Median household income
- Total annual wastewater and CSO costs as a percent of the median household income
- Fixed service costs in addition to wastewater and CSO costs that affect affordability
- Sewer utility rate as a percent of the median household income
- Overall net debt of the Sanitary District as a percent of full market property value
- The Sanitary District's current bond rating and term of current bonded indebtedness
- The Sanitary District's ability to assume more debt
- Property tax revenues as a percent of full market property value
- Property tax collection rate
- Sanitary District unemployment rate

- Availability of grants and loans

8.2 Determining What Residents Can Afford

IDEM recommends an approach similar to the EPA CSO LTCP Implementation Schedule to conduct the affordability analysis and develop the implementation schedule. IDEM provides a two-phase approach to determining the financial capability of a community. The first phase considers the impact of wastewater and CSO controls on individual households in the community and results in a Wastewater Cost Per Household Indicator (The WW_{CPHI}). The second phase examines the debt, socioeconomic and financial conditions of the community itself and determines the Socio-Economic Indicator. This indicator demonstrates the widespread nature of the economic and social impact of the LTCP. These two indicators are then entered into a Financial Capability Matrix to determine the overall financial burden placed on the community and individual households to implement the CSO control program.

8.2.1 Phase 1: Calculation of the Wastewater Cost Per Household Indicator

IDEM specifies that the initial step in the analysis involves determining a benchmark that relates the LTCP costs and current wastewater treatment (WWT) costs to the CSO municipality's representative Median Household Income (MHI) on an annualized basis. This benchmark is called the Wastewater Cost per Household Indicator, or WW_{CPHI}. It is defined as follows:

$$\textbf{The } \mathbf{WW_{CPHI}} = \frac{\text{Annualized LTCP and Existing Wastewater Costs Per Household}}{\text{Annualized Median Household Income}} \text{ X } 100$$

The WW_{CPHI} is analyzed to determine the impact on individual households in the service area as shown in Table 8.2-1.

Table 8.2-1
Financial Impact Based on WWCPHI

Financial Impact	WW_{CPHI} (CPH as % MHI)
Low	Less than 1% of MHI
Medium	1.0% - 2.0% of MHI
High	Greater than 2% of MHI

IDEM specifies that for a "Medium" result, more detail is necessary to complete the affordability assessment and that additional socio-economic factors will be considered. If the WWCPHI is greater than 2% of MHI, the socio-economic impacts will be considered widespread.

For the Terre Haute Sanitary District, the WWCPH1 equation was solved for a WWCPH1 of 2.0%, which resulted in a residential rate of $63.50. The current operation and maintenance expenses, current debt, projected WWT operation and maintenance costs and projected WWT debt service were subtracted from this figure. This results in a total monthly availability of $14.86 per month for the CSO project. This amount was annualized and multiplied by the number of residential households to determine an annual amount available for CSO projects from residents. That amount was then divided by the residential share of costs to determine an annual amount available for CSO projects from all customers. Operation and Maintenance costs were then removed and a total Capital Improvement Project (CIP) dollar amount was established for both a traditional bond at 5.5%, 20 years and an SRF loan at 4.5%, 20 years (Table 8.2-2).

Table 8.2-2
2% Equivalent Affordable Capital Costs

	Traditional Bond (5.5%, 20 years)	SRF Loan (4.5%, 20 years)
Median Household Income ("MHI")	$38,100	$38,100
Municipal Affordability Screener ("MAS")	2%	2%
MAS Applied to MHI	$762.00	$762.00
Monthly Equivalent Residential MAS Rate	$63.50	$63.50
Less:		
Amount allocated to current operation and maintenance expenses	$13.27	$13.27
Amount allocated to current debt service	$15.23	$15.23
Amount allocated to projected WWT operation and maintenance expenses	$6.82	$6.82
Amount allocated to projected WWT debt service	$13.32	$13.32
Sub-Total	$48.64	$48.64
Amount available for CSO project	$14.86	$14.86
Annual dollar amount available for CSO project costs from residents	$5,046,500	$5,046,500
Annual dollar amount available for CSO project costs from all customers	$10,299,000	$10,299,000
Reduce by allocation to operation and maintenance costs	$3,373,800	$3,373,800
Total CIP dollar amount available for CSO project cost	$82,755,000	$90,080,000

The WWCPHI, or the Municipal Affordability Screener (MAS), enabled the service area to determine the level at which total CIP dollars would trigger the 2% Wastewater Cost Per Household Indicator. For the service area of the Terre Haute Sanitary District, the 2% threshold would be reached at $82,755,000 for a traditional 20-year bond at 5.5% and $90,080,000 for SRF funding for 20 years at 4.5% (Table 8.2-2).

Based on the analysis in Table 8.2-2, it became clear that the recommended CIP would exceed the 2% threshold, which means that the financial impact will be considered "high". This is demonstrated in Table 8.2-3, which calculates the WW CPHI based on the recommended CIP. With total estimated CSO CIP costs of $120,040,900, the monthly WW CPHI was $69.58 assuming traditional bonding and $67.99 for SRF funding, both of which exceed the $63.50 established at the 2.0% threshold (Table 8.2-3).

Table 8.2-3
Cost per Household Based on the Recommended Project

Current WWT Costs:	Traditional Bonding	SRF Program	Line Number from EPA CPH Worksheet
Annual operations and maintenance - Sanitary District	$1,092,400	$1,092,400	
Annual operations and maintenance - Wastewater Utility	$7,992,300	$7,992,300	
Sub-Total	$9,084,700	$9,084,700	100
Annual special taxing district debt service - Sanitary District	$7,721,600	$7,721,600	
Annual revenue bond debt service	$2,044,200	$2,044,200	
Sub-Total	$9,765,800	$9,765,800	101
Total Current WWT Costs:	$18,850,500	$18,850,500	102
Projected WWT and CSO Costs (Current Dollars): (1)			
Estimated annual operations and maintenance (excluding depreciation)	$9,195,500	$8,909,700	103
Annual debt service (principal and interest)	$19,274,700	$18,458,100	104
Total Projected WWT and CSO Costs:	$28,470,200	$27,367,800	105
Total Current and Projected WWT and CSO Annual Costs	$47,320,700	$46,218,300	106
Residential share of WWT and CSO annual costs	$23,627,900	$23,087,700	107
Total number of households in service area	28,300	28,300	108
Annual WWT and CSO cost per household	$834.91	$815.82	109
EPA method estimated combined monthly WWT and CSO cost per household indicator	$69.58	$67.99	
Assumptions:			
Interest rate	5.50%	4.50%	
Payback period (years)	20	20	
Total estimated CSO CIP costs	$120,040,900	$120,040,900	

(1) Includes Phases II and III of the WWTF upgrades.

The following sections show how the figures needed to determine the capital costs available based on a 2.0 WWCPHI were determined. The city's financial advisors, *H.J.* Umbaugh and Associates, provided these calculations.

8.2.1.1 Median Household Income

The first step in determining the Wastewater Cost Per Household Indicator is to develop the Annualized Median Household Income (MHI) for the service area. EPA Guidance documents suggest two methods for calculating the MHI: averaging and weighting.

The averaging method uses the most recent MHI available from the U.S. Census Bureau. The Consumer Price Index (CPI) adjustment factor is applied to each year since the last census data to establish a MHI in today's dollars. MHI figures for the City of Terre Haute and Vigo County were adjusted based on the CPI adjustment figures to determine the MHI of each sector.

The weighting method establishes a weighted MHI for the Terre Haute Sanitary District based on the share of total households that are customers within the City of Terre Haute and the rest of Vigo County.

For the service area encompassing the Terre Haute Sanitary District, the Adjusted Median Household Income was calculated to be $38,100 (Table 8.2-4).

Table 8.2-4
Median Household Income and Residential Indicator

	City of Terre Haute	Vigo County
Median Household Income (MHI)		
2000 Census (1999 data)	$28,018	$33,184
Adjustment factor:		
CPI Nov. '10/Jan. '00 (218.803/168.8)	1.30	1.30
MHI adjusted to November, 2010	$36,423	$43,139
Number of residential households	21,225	7,075
Sub-Totals	$773,078,175	$305,208,425
Combined Total		$1,078,286,600
Total number of residential households		28,300
Weighted average MHI for District		$38,100

	Traditional Bond (5.5%, 20 years)	SRF Loan (4.5%, 20 years)
Annual WWT and CSO control cost per household (CPH)	$834.91	$815.82
Adjusted MHI	$38,100	$38,100
Annual Wastewater and CSO control cost per household as a percent of adjusted median household income (CPH as % MHI)	2.19%	2.14%

8.2.1.2 Cost Per Household

EPA guidance is followed to determine the Cost Per Household (CPH) by adding current WWT and projected WWT and CSO control costs. Next, the residential share of total WWT and CSO costs is calculated. Finally, the CPH is found by dividing the residential share of the WWT and CSO costs by the number of households in the service area.

Current WWT Costs: The EPA defines current WWT costs as current annual wastewater operating and maintenance expenses (excluding depreciation) plus current annual debt service (principal + interest). This procedure fairly represents cash expenses for current WWT operations. Expenses for funded depreciation, capital replacement funds or other types of capital reserve funds are not included in current WWT costs because they represent a type of savings account rather than an actual operation and maintenance expense.

Projected Additional WWT and CSO costs: Projected costs for various levels of CSO control were developed in Section 7.2, of this report. For purposes of calculating the cost per household, we have used the recommended alternative, with an estimated CIP of $120,040,900. In addition, there are current plans for wastewater treatment facility upgrades that are being included in the projected costs as well.

The Terre Haute Sanitary District would like to use SRF funds to finance CSO controls at a lower interest rate of 4.5%. Availability of SRF funds is not guaranteed though so projected capital improvement availability was also determined using the community's current bond interest rate of 5.5%.

Residential Share of Total WWT and CSO costs: The EPA guidance suggests computing the residential share of total cost by multiplying the percent of total wastewater flow including infiltration and inflow attributable to residential users by the total costs.

$$\text{Residential Share of Costs} = \quad \text{Total Costs x} \; \frac{\text{Residential Water Flow}}{\text{Total Wastewater Flow}}$$

The flow breakdown of residential and commercial wastewater usage is given in Table 8.2-5. It was determined that 49% of the usage is based on residential usage.

Table 8.2-5
Water Usage

	Consumption (100 Cubic Feet)		Number of Users	
Residential	1,800,258	49%	28,300	98%
Other	1,895,004	51%	711	2%
Total Flow	3,695,262	100%	29,011	100%

Note: If the flow of tax-exempt users is excluded, then the residential consumption percentage for the Sanitary District is 54%.

Total Annual WWT and CSO Cost Per Household (CPH): The CPH is calculated by dividing the residential share of WWT and CSO annual costs by the number of households served by the system.

$$\text{Annual Cost per Household} = \frac{\text{Residential Share of Cost}}{\text{Number of Households Served}}$$

For the Terre Haute Sanitary District service area, the CPH household was found to be $834.91 using traditional bonding and $812.82 using SRF funding. The monthly CPH was then calculated by dividing that by 12 months, which resulted in $69.58 and 67.99 respectively. Table 8.2-2 shows the traditional EPA method for determining the CPH.

8.2.2 Phase 2: Socio-Economic Indicators Matrix (SEIM)

The second phase of financial capability assessment involves determining the Socio-Economic Indicator for the Terre Haute Sanitary District. The indicators for the Terre Haute Sanitary District are summarized in the Socio-Economic Indicators Matrix (Table 8.2-8).

For each given indicator, the Terre Haute Sanitary District was evaluated and given a score of three (strong), two (mid-range) or one (weak) according to the following IDEM standards:

- Bond Rating: The bond rating is identified for the CSO municipality's utility, which may be based on ratepayers, property taxpayers or a combination of these bases.

Weak:	BB-D (S&P) or Ba-C (Moody's)
Mid-Range:	BBB (S&P) or Baa (Moody's)
Strong:	AAA-A (S&P) or Aaa-A (Moody's)

• Overall Net Debt as a Percent of Full Market Property Value: Overall net debt is debt repaid by property taxes in the permittee's service area. It excludes debt which is repaid by special user fees. It includes the debt issued directly by the local jurisdiction and debt of overlapping entities, such as school districts.

Weak:	Above 5%
Mid-Range:	2%-5%
Strong:	Below 2%

- Average Unemployment Rate:
  - Weak: More than one percentage point above the National Average
  - Mid-Range: + or – one percentage point of National Average
  - Strong: More than one percentage point below the National Average
- Median Household Income: All incomes within the municipality's service area should be represented. The MHI for the service area is compared to the National MHI.
  - Weak: More than 25% below National MHI
  - Mid-Range: + or – 25% of the National MHI
  - Strong: More than 25% above National MHI
- Property Tax Collection Rate:
  - Weak: Below 94%
  - Mid-Range: 94% - 98%
  - Strong: Above 98%
- Property Tax Revenue as a Percent of Full Market Property Value
  - Weak: Above 4%
  - Mid-Range: 2% - 4%
  - Strong: Below 2%

The Socio-Economic Indicator was then found by calculating an average of those six indicators to determine the level of financial burden on the Terre Haute Sanitary District as a whole. The six individual indicators for the Terre Haute Sanitary District are summarized in the following sections.

8.2.2.1 Bond Rating

According to Moody's Investor Service, Inc., the Sanitary District has a current bond rating of Aa2. The rating on the Sanitary District Bonds of 2006, which were insured, was an Aaa, with an underlying rating of A 1. Each of these bond ratings are considered Strong.

8.2.2.2 Overall Net Debt as a Percent of Full Market Property Value

Overall net debt is debt that is repaid by property taxes in the service area. Table 8.2-6 shows the District's property tax supported debt, including underlying debt, as a percentage of full market property value in the Terre Haute Sanitary District. This indicator provides a measure of the debt burden on residents within the permittee's service area and measures the ability of local governmental jurisdictions to issue additional debt. Terre Haute Sanitary District receives a Mid-Range rating for this indicator since the calculated percentage is 2.97%.

Table 8.2-6
Overall Net Debt as a Percentage of Market Value of Real Property for Terre Haute Sanitary District

Current overall net debt Property tax supported debt including underlying debt	$73,735,810
Full market property value	$2,481,925,867
Overall net debt as a percent of full market value	2.97%

8.2.2.3 Unemployment Rate

The Indiana Business Research Center provided the unemployment rate of 10.4% for Vigo County. It was then compared to the national unemployment rate of 9.3% for the same time period. Vigo County was given a Weak rating because its unemployment rate was more than one percentage point above the national rate.

8.2.2.4 Median Household Income

Median Household Income (MHI) is defined as the median amount of total income dollars received per household during a calendar year in a given area. It serves as an indicator of a community's overall earning capacity.

Median Household Income for the service area was determined during Phase 1 (Table 8.2-4). The service area MHI is then compared to the adjusted national MHI. The service area was given a rating of Weak since its MHI is more than 25% below the national adjusted MHI.

8.2.2.5 Property Tax Revenues as a Percent of Full Market Property Value

This indicator can be referred to as the "property tax burden" since it indicates the funding capacity available to support debt based on the wealth of the community. The percentage of revenue generated as compared to full market value of property in the Terre Haute Sanitary District is 3.15% as shown in Table 8.2-7. This percentage gives the Terre Haute Sanitary District a Mid-Range score for this indicator.

Table 8.2-7
Property Tax Revenue as a Percent of Full Market Property Value

Property tax revenues in Terre Haute Sanitary District for collection year 2010	$78,068,495
Full market property value	$2,481,925,867
Property tax revenue as a percent of full market property value	3.15%

8.2.2.6 Property Tax Collection Rate

The property tax collection indicator shows the efficiency of the tax collection system and the acceptability of tax levels to the residents. The property rate collection rate for the Terre Haute Sanitary District as reported by Vigo County for the year 2009 was 94.47% giving the District a Mid-Range rating for this indicator.

8.2.2.7 Analyzing Permittees Socio-Economic Indicators

The second phase indicators are compared to national benchmarks to form an overall assessment of the service area's financial capability and its affect on implementation schedules in the long-term CSO control plan. Table 8.2-8 summarizes the indicators and averages them to determine the overall Socio-Economic Indicator.

Table 8.2-8
Socio-Economic Indicators Matrix

Indicator	Actual Value	Rating	Score
Bond rating	Aa2	Strong	3
Overall net debt as a percent of full market property value	2.97%	Mid-Range	2
Unemployment rate	10.40%	Weak	1
Median household income	$38,100	Weak	1
Property tax revenue as a percent of full market property values	3.15%	Mid-Range	2
Property tax revenue collection rate	95.47%	Mid-Range	2
Net Financial Capability Indicator		Mid-Range	1.83

8.2.3 Financial Capability Assessment Summary

The results of the Residential Indicator and the Socio-Economic Indicators analyses are combined in the Financial Capability Matrix to evaluate the level of financial burden the CSO controls may impose on the Terre Haute Sanitary District service area.

Table 8.2-9
Financial Capability Matrix

		Residential Indicator (Cost Per Household as % of MHI)		
		Low (Below 1.0%)	Mid-Range (Between 1.0% and 2.0%)	High (Above 2.0%)
Permittees Socio-Economic Indicators Score	Weak (Below 1.5)	Medium Burden	High Burden	High Burden
	Mid-Range (Between 1.5 and 2.5)	Low Burden	Medium Burden	High Burden
	Strong (Above 2.5)	Low Burden	Low Burden	Medium Burden

The Wastewater Cost Per Household Indicator of 2.14 to 2.19 and the Socio-Economic Indicator of 1.83 determine the Terre Haute Sanitary District service area to show a High Burden to enact

CSO controls (Table 8.2-9). This result 1S used to develop an implementation schedule as outlined in the EPA CSO guidelines.

8.3 Financial Consideration on the Development of the CSOLTCP Implementation Schedule

Chapter 10 of this CSOLTCP outlines the detailed aspects of the recommended plan as well as the presentation of the implementation and phasing schedule for this plan.

There are many factors that enter into the determination of how long of a period of time should be allocated for the improvements recommended for combined sewer overflow reduction in Terre Haute to be completed. These factors include:

8.3.1 Environmental

The longer a plan takes to implement the longer a higher level of annual overflows will occur.

8.3.2 New Technology Considerations

If newer CSO reduction technologies are to be considered, there must be adequate to pilot test and fully monitor the results of those reduction technologies before any large scale implementation. This is certainly the case in CSO basins 009 and 010 where the recommended plan includes consideration of green infrastructure reduction facilities.

8.3.3 Other Major Sewer and Wastewater Treatment Facility Planned Improvements

The Terre Haute Sanitary District and City Board of Works have many other aspects of the sewer utility to design, build and fund over the next 20 years which will have scheduling and financial impact on any planned and programmed improvements in the combined sewer overflow long term control plan. Some are interconnected, such as the upgrading of the Cities wastewater treatment facilities sustained peak flow improvements and the recommended improvements for the CSOLTCP.

8.3.4 Available Low Interest Loan or Grant Funding

As section 8.2.1 indicated, financing at traditional bonding resulted in a slightly higher future residential sewer rate impact than utilizing the SRF program for financing. Should even more federal funding be provided in the future to Indiana communities in the form of grants for forgivable loans, the sewer rate impact could be lowered and the remaining phases to be financed be advanced in the implementation timeframe.

8.3.5 Public Acceptance and Affordability

The financial impact of the recommended plan on the sewer customers of Terre Haute is considered "High". This should allow for a lengthy period of implementation in order to spread the resulting sewer rate increases over as long of a time as possible to allow for greater public acceptance of the more incremental increases to their monthly sewer rates.

8.3.6 Recommended Length of the Implementation Schedule for the Terre Haute CSOLTCP

Based upon all of the reasons noted in this chapter, the length of the implementation schedule period for the recommended plan will be *20* years. Chapter 10 includes more details on the scheduling and phasing of the recommended plan.

During the 20-year time period, the City will continue its efforts to reduce wet-weather flow through green infrastructure projects. If those projects will result in attainment of the target level of control within the 20-year time period, then no further time will be needed or requested. If, though, it appears that the target level of control cannot be achieved without additional or larger "gray" infrastructure, particularly storage tanks near 009/010, then the City may request additional time beyond the 20-year timeframe. If so, IDEM will seriously consider that request, and if IDEM determines that the additional time is needed, then the parties would amend the State Judicial Agreement, the LTCP and the permit to specify additional time.

9 Section Nine – Use Attainability Analysis

10 Section Ten – Recommended Plan

10.1 Introduction and Recommended Plan History

A previous CSO Long Term Control planning effort from 1999 to 2002 resulted in a Recommended Plan that generally involved utilizing a combination of in-line storage and consolidating CSO's, thereby re-directing or eliminating 5 of the *10* existing CSO outfalls, including all four existing outfalls in the priority area of Fairbanks Park. However, this recommended plan would only result in a capture of approximately 83% of typical yearly total CSO volume and would leave the *five* remaining CSO's (*002*, 003, 004, 009 and 010) with almost no reduction in the number of CSO events in the design year. The estimated cost of the recommended plan in that version of the Terre Haute CSOLTCP was approximately $48 million as developed utilizing the "Knee of the Curve" methodology utilized and accepted by USEPA and IDEM at that time.

Since that plan submittal, the USEPA and IDEM changed the methodology and approach to determine how much CSO capture would be considered responsible, affordable and reasonable that significantly increased the requirement for a much greater level of CSO capture than previously considered. While other sections of this long term control plan describe the new regulatory approaches in great detail – the end result was that the updated long term control plan had to include a solution that removed a much more significant amount of CSO volumes than what was previously considered, at a much greater cost and local financial impact. A new planning effort to address the Terre Haute CSO's was initiated in 2008 and completed in 2011.

The 2011 LTCP called for a number of new CSO control projects to be implemented in four phases. These projects and implementation phases are more fully described in Section 10.3.2. Engineering design work on the first phase of projects was initiated in early 2012.

There have been unknown/unforeseen conditions in three of the five CSO control projects scheduled for the first phase that have resulted in reconsidering major aspects of those projects. The three projects are floatable controls at CSO 004/011 (Hulman/Idaho Street), the route of the consolidation of CSO 009 (Spruce Street) into CSO 010 (Chestnut) and the proposed CSO capture and storage facility near the existing main lift station on the former International Paper site. These three conditions have resulted in significant changes or delays to those three projects that are more fully described in the revised Section 10.2.

10.2 Recommended Plan Description

The fully implemented recommended plan will reduce the total number of active CSO's from *10* to 2, which would include the complete elimination of CSO's *002*, 003, 005, 006, 007 and 008, the consolidation of CSO's 004/011 and CSO's 009/010. New floatable controls will be installed at the two consolidated CSO's to remain active (004/011 and 009/010).

The recommended plan will also include a new large diameter gravity interceptor running parallel along the river to the existing CSO relief sewer that will connect *the* Fairbanks Park (priority) area CSO's (005, 006, 007 and 008) to the consolidated 004/011, then from there to a new main pumping station to be built near the existing station. A new main pumping station is needed for the following reasons: The existing station does not have the peak pumping capacity to handle the maximum expected CSO volumes, it is not deep enough to completely eliminate CSO 003 and it is 45 years old and has reached the end of it useful life.

The CSO LTCP recommended that a portion of the paper mill wastewater treatment ponds on the former International Paper site be converted into CSO storage facilities. This would have provided storage of up to 32 MG of captured CSO volume at the existing main lift station that would then allow for the stored water to be bled back to the City WWTF as treatment capacity allowed. This planning concept was based upon limited information provided by IP concerning the condition of their treatment pond berms and facilities.

After the ponds were emptied of the existing sludge and when the preliminary "Basis of Design" analysis started on these ponds in 2012, a geotechnical firm was retained to evaluate the stability of the pond berms and basin bottom under varying conditions. A new site survey was completed on the tops of the berms at the same time. This preliminary design work resulted in the following conclusions:

1. That the top of the berms were generally high enough to withstand a 25 year flood event in the Wabash River (not a 100 year event as the City had anticipated). As a part of the

planned CSO storage process, the top of the berms would need to exceed the 100 year event with three feet of freeboard added.

2. That a potential scenario of the river at its 100 year flood level and the storage pond being empty would result in failure of the pond bottom. The hydraulic pressure under that scenario would overcome any stability of the pond base soils and the pond would fill up several feet and remain at that level while the river stays up. Therefore, the new liner would need to be made of concrete in lieu of geomembrane/clay and extend above the hydraulic gradient of this scenario. A copy of the appropriate sections of this geotech report is included at the end of this chapter.

3. Based upon the design consultants opinion, the quality of the berms original construction is suspect. This was actually verified when the western most section of the existing berms were washed out by recent river flooding. Much of the berm construction (at least in that area) included buried fill (construction debris) and organic material. This led to a conclusion that the existing treatment pond berm construction quality (and structural integrity) over-all was poor and would need to be significantly upgraded if the ponds were to be utilized as CSO storage facilities.

As a result of this new information the design consultant prepared new options to be considered that would result in the same volume of CSO (32 MG in one day) being either stored in a better consieved storage facility and then transported and treated at the City WWTF or installation of a new high rate treatment process to be located near the IP ponds with a new treated effluent outfall to the Wabash River in that area.

The results of that study are in the appendix of this updated chapter. The study concluded that construction of a high rate treatment facility with an ultimate capacity of 32.5 MGD would be the most cost effective solution. In order to fit within the Terre Haute Sanitary District CSO Phase I Budget, this modular type facility would be constructed in two phases, a 16.25 MGD unit in Phase One of the LTCP and a second unit of identical capacity to be built adjacent to the first in Phase Two of the LTCP. Figure 10.2-1 depicts the location of these proposed units. A modification to the existing City NPDES permit to add this proposed facility would be requested once the construction permit for the first phase of the treatment unit is approved.

A final consideration for the change from an open air CSO storage facility to a high-rate treatment system was the acceptance of the option by the City leadership and local Riverscape group, and efforts will be made to landscape the new facilities in a "park type" setting in this area as part of the over-all River Front Development project and as local funding allows.

During Phase One, a second forcemain from the existing main lift station will be installed to connect that pump station to the new CSO high rate treatment facilities to be utilized on an interim basis until the new main lift station is constructed and put into service. Additionally, the new station will eliminate CSO 002 which is currently an emergency overflow.

In their review of the recommended plan, officials at IDEM requested that information be included in the final CSOLTCP regarding what changes could be incrementally made in future years to increase the level of CSO volume capture and treatment to 6 overflows per year in lieu of the 7overflows per year level outlined in the recommended plan for Alternative 11.

As stated earlier, implementation of Alternative 11 would result in the 10 existing CSO overflow points reduced to 2 remaining CSO outfalls. The overflow points at 004 and 011 would be combined into one outfall, as well as those at 009 and 010. Regarding the combined 004/011 outfall, a review of the model results and the proposed gravity interceptor capacity calculations found that a level of control that can actually be achieved by implementing the controls noted in the selected plan is 6 overflows per year and not 7. The diameter of the proposed gravity interceptor between and connecting CSO 008 and the new main lift station downstream would have been 8 feet (CSO008 to 004) and 10 feet (CSO 004 to the new main lift station) at the 9 overflow per year level of control. The pipe diameter would have increased to just over 11 feet in diameter at 7 overflows per year and 12 feet in diameter at 6 overflows per year. Since gravity sewer pipe that size comes in one foot diameter increments, it was decided to utilize 12' diameter pipe for the selected plan and then make the new main lift station pumps just incrementally larger and there was already additional CSO storage capacity available at the former International Paper Storage Pond site. The estimated costs for the recommended plan assumed utilization of the larger facilities. Therefore, all controls south of CSO's 009 and 010 were sized to achieve a level of 6 overflows per year at the estimated project costs for the recommended plan.

Another element of the recommended plan is to facilitate CSO capture at CSO's 009/010 by constructing new storage facilities. These two CSO's have relatively large drainage basins and are located the furthest away from the Main Lift Station of all the CSO's. Connecting these CSO's to the others via a new gravity interceptor is not economically feasible, short of constructing a tunnel interceptor system connecting all the CSO's (which was evaluated). Therefore, additional CSO capture for these basins must be done by storage. Two storage options generally exist in the area where CSO's 009/010 are consolidated including a storage tank near the old outfall, and storage measures on private and public right of way primarily cateragorized as "Green Infrastructure" or a combination of both. These two options are described in the following paragraphs. The first storage option considered in the final plan would be to construct a large underground tank on city owned property between CSO 009 and CSO 010. There are items to be mitigated with this conventional ("Gray") storage option. Immediately to the north of that site is the Indiana-American Water Company wellfield and water treatment plant, so care must be taken to minimize any potential impacts on the area groundwater with any CSO storage facilities there. Secondly, Indiana State University has plans to completely redevelop the riverfront between these CSO's and Highway *41*, and their plans could include a new football stadium on the riverfront and immediately downstream of the consolidated CSO's, very near the proposed storage site.

The initial routing of the consolidation sewer of CSO 009 into CSO 010 was originally intended to be along First Street from Chestnut Street north to Spruce Street. The 2012 Indiana State University updated Riverfront Development plans precluded that particular 009 into 010 route from being feasible. As a result, a more detailed investigation of the existing combined sewer system in that area revealed a second potential route upstream of First Street just to the east of Third Street where the two basins are in close proximity. The new connection route has been surveyed and studied in the XP-SWMM CSO model and will result in a shorter and less costly consolidation. Essentially a new sewer will ne constructed from a new diversion structure which will divert flow from the Chestnut Street system to the Spruce Street system. Sections of the Chestnut Street system downstream of the new diversion structure will be converted to sanitary flow only with outlet to the new main interceptor. The existing CSO 009 diversion structure will be demolished and the existing outfall will be utilized for storm water flows only.

Recently, officials at Indiana State University have agreed that the new route is acceptable with respect to their future redevelopment and expansion plans and can be constructed within the City right-of-way and easements granted by the University.

Figure 10.2-1 depicts the present CSO 009 into CSO 010 consolidation sewer locations.

To achieve a level of control of 7 overflows per year, the storage facility near the present outfall 010 would need to have a storage capacity of 2.0 million gallons (MG). To achieve a level of control of 6 overflows per year, the storage volume requirements at this site would increase to 4.9MG. The additional capital costs required to build the larger storage facilities needed to meet the 6 overflow level was estimated to be approximately fifteen million dollars. Note, however, that the size of the proposed CSO interceptor connecting CSO 009 to 010 would not have to be increased in diameter to go thru 7 to 6 overflows/year. This is due to the fact that basin 009 is quite a bit smaller than basin 010 and that there is an interconnection point in the existing combined sewer system that allows for high level flows to pass from basin 009 to 010 anyway.

The other option explored for CSO storage at 009/010 is to construct storage facilities on public and private property upstream within the basins that would reduce or slow down stormwater flow into the combined system. These "Green" infrastructure technologies have great potential in the CSO 009 and CSO 010 basins, as two entities dominate the property ownership there - Indiana State University (basin 009) and the Union Hospital *Campus* (basin 010). A study was completed outlining the potential for green infrastructure utilization at the Indiana State Campus area with very encouraging results. A copy of this study is included in Appendix 6-4 of this long-term control plan.

Whether the storage facilities be green or gray, the recommended plan includes enough storage to be constructed at 009/010 to be able to reduce the number of CSO events there to approximately 7 per year. Given that the concept of utilizing green technologies on public and private properties for CSO reduction is relatively new and lacks a long history of capture results and maintenance needs, the recommended plan will include a series of pilot green storage project implemented early enough in the implementation schedule to monitor the results and refine future design, with the very last aspect of the plan to be implemented being the installation of new gray storage facilities at the outfall location. If green technologies can effectively allow the City to reach its target CSO capture without gray construction at a reasonable capital and annual operating cost, then no storage construction will be needed along the river where the previously noted concerns would require mitigation. Alternativly, partial success or Green Infrastructure could reduce the size of the storage tank necessary to achieve a level of CSO control of at least 7 and potentially 6 overflows per year.

The projects constructed on the front end of implementation, focused in the areas south of 009/010, are already sized for 6 overflows per year. Therefore, money saved due to success of the green projects, through reduction of the size of the north-end storage tank, would not make any difference in the City meeting that goal. Moreover, once those projects are built, it would not be possible to change the sizes of those pieces of equipment. The City would expect to utilize any savings to explore other options for reducing wet-weather flows, but cannot predict at this point what those options might be, or what costs would result.

As the City proceeds with its green planning efforts, it plans to provide to IDEM any information that the agency reasonably requests concerning those projects. We will use the items that have been provided by EPA (listed below) as a guide to the additional information that will need to be generated and submitted – subject, of course, to any changes in regulations or policies concerning green infrastructure that occur while those projects are being planned.

- Modeling. A Hydrology and Hydraulic Model can be used to simulate the effects of the green infrastructure measures (working in combination with the existing and any future gray infrastructure elements) and provide information on the number of activations and the volume of overflows in a typical year. The effects of the green infrastructure can be incorporated into the Hydrology inputs for each catchment. The goal would be that the green infrastructure measures, in combination with the gray infrastructure components, would provide an equivalent level of CSO control as what would be expected for a more conventional gray infrastructure set of controls.

- Descriptions and Technical Details for Green Infrastructure Sites/Projects. Under the LTCP the City would need to develop a detailed description of the green infrastructure site(s)/project(s) to be implemented, including locations, technologies to be employed (wetlands, infiltration practices, etc.), capacity, costs, and schedule. Note not all site/project details would necessarily need to be decided upon at the onset of the program.
- Pilot Testing. A series of pilot tests on constructed green infrastructure controls of all types of capacities, on both public and private properties should be planned, designed and constructed in phases two and three of the Implementation Plan. It is hopeful that the financing of these pilot tests could be shared between public, private and institutional sources.
- Monitoring and Performance Verification. The City would need to include plans/provisions to monitor the green infrastructure practices (or a sampleset of the practices) and the sewersheds where the green infrastructure is implemented to evaluate if the green practices are successfully storing (and for certain practices infiltrating) runoff and if CSO control goals for the sewershed are being achieved. Performance can be tuned up using adaptive management or corrective action steps if CSO control goals are not being met.
- Preservation of Green Infrastructure Sites/Projects. The City will need to provide some form of assurances that the green infrastructure control measures will be held/preserved for the long term, with no substantive changes that could reduce performance. It must also be clear that there will be sufficient access and control so that maintenance activities can be carried out. If the site/practice will not be owned by the City, an easement or some other type of agreement may be needed.
- Maintenance. For green infrastructure practices the City would need to determine and document what maintenance is needed and on what schedule, and roles for performing the maintenance would need to be clearly defined. For example, if a practice is on the Indiana State campus, would the City perform maintenance or would the University. If it would be the University IDEM would be looking for some sort of maintenance agreement.
- Stakeholder Outreach and Public Participation. For green infrastructure sites and practices, particularly outside the campus or area where "Green" infrastructure has been

implemented, it is usually important to perform some education and outreach so neighbors understand and buy into what will be implemented.

- Tracking and Reporting. As LTCP implementation proceeds the City would need to track its implementation, operation, and maintenance of the green infrastructure measures, and report on activities and accomplishments as part of regular reporting.

Given the previously mentioned IDEM review request that potential additional controls be considered for implementation of an ultimate level of control of 6 overflows per year be analyzed in the future, it is recommended that the City of Terre Haute authorize a detailed study of the implementation of a fairly significant amount of green infrastructure CSO reduction control strategies in basins 009 and 010 starting in the second phase of the recommended implementation plan.

The recommended plan also includes some components of the previously submitted CSOLTCP - that being utilization of in-line storage in the 004 (Hulman) and 008 (Walnut) large diameter combined sewers by construction of weirs/dams and reinforcing these older sewers with trenchless sewer rehabilitation.

The initial implementation schedule for the City's LTCP is 20 years. During that time period, the City will continue its efforts to reduce wet-weather flow through green infrastructure projects. If those projects will result in attainment of the target level of control within the 20-year time period, then no further time will be needed or requested. If, though, it appears that the target level of control cannot be achieved without additional or larger "gray" infrastructure, particularly storage tanks near 009/010, then the City may request additional time beyond the 20-year timeframe. If so, IDEM will seriously consider that request, and if IDEM determines that the additional time is needed, then the parties would amend the State Judicial Agreement, the LTCP and the permit to specify additional time.

The total cost of the updated recommended plan is estimated to be $124 million. The plan can be implemented over several phases as described in *the following* section 10.3.

10.3 Phases of the Selected Plan

10.3.1 General Phasing Considerations

There are several items to be considered when developing a recommended phasing plan and implementation plan as part of this CSOLTCP for Terre Haute. The length of the implementation period is a major consideration that must take into account other, on-going wet-weather related water pollution control projects the city is implementing. The financial impacts and particularly the level of burden that is placed on the residential customers there during the implementation period is a strong consideration in determining the length of the financial implementation time frame. The phasing plan should also take NPDES permit compliance, priority areas and construction component sequencing (downstream to upstream). Finally, there must be sufficient time between the initiation of each phase to adequately monitor and evaluate the previous phase's impact on local water quality of the Wabash River.

For example, a key recommendation of the selected plan is to provide CSO storage at the combined 009 and 010 outfalls – which are the furthest CSO's from the main lift station/WWTP and have relatively large drainage basins. These basins include: two property owners, The Indiana State University and the Union Regional Hospital Center, that control large amounts of property ownership and use. These areas offer significant opportunities for use of green storage technologies out in the collection system in lieu of the end-of-pipe storage tank options also considered for these particular CSO's. However, as of this writing, there simply is not enough real data available as to the effectiveness of CSO capture, or initial capital cost, or annual operating costs of green vs. gray storage facilities. The recommended plan includes initiating design and implementation of green technologies on the early phases (phases two and three) so that adequate flow and qualitative data can be captured after their construction, which should be well before the final capture and storage solution (phase 5) can be planned, designed and built at 009/010.

The City of Terre Haute has recently implemented a series of upgrades at their WWTP that will have a significant impact of that facilities ability to treat captured and stored combined sewer overflow volumes on a sustained basis. This plant will allow for the constant treatment of up to 42 MGD of combined sewage transport from the mail lift station over a period of days, whereas the current facility can only treat this level of flow over a series of hours. This $130 million dollar project will be implemented over two phases. Construction work on the first phase of this project was completed in May 2012 and the second and final phase is scheduled for completion in 2015. This large project implementation must be factored into the CSOLTCP implementation schedule for both technical and financial reasons.

The Terre Haute Sanitary District utilizes a portion of the property tax revenue locally to fund other sewer system improvement projects, such as upgrades/maintenance to existing collection system facilities and pumping stations as well as constructing new sewer interceptors to facilitate regionalization of growth. There are two such maintenance related projects included in the CSOLTCP recommendations – rehabilitation of portions of the very old and large diameter Hulman Street and Walnut Street interceptors. The THSD will see a large amount of existing property related debt go away in 2015 and can better afford to finance these rehabilitation projects at that time. This must also be taken into account when developing the phasing and implementation schedule.

The final consideration to be taken into account when developing the recommended plan's implementation schedule is the burden to local residents, businesses, institutions and industry. As seen in section eight "Affordability and Financial Capability Assessment", Terre Haute falls within the "high burden" impact, which should allow for a longer implementation period to be allowed.

When all of these factors were taken into account, the City elected to develop a *20* year implementation period which included the WWTP improvements project, as well as adequate time for future between phase monitoring and re-assessment. Based upon the previously discussed considerations, the recommended implementation plan will be broken into a total of five phases. The following tables and graphics (Tables 10.3-1 and 10.3-2 and Figure 10.3-1) illustrate this implementation schedule, and the elements of each phase are described in greater detail in this chapter.

10.3.2 Description of Phases

The following two tables and graphic describe and depict the recommended implementation schedule phasing of both the proposed Terre Haute wastewater treatment facility improvements as well as the CSO capture and transport facilities recommended in this long term control plan.

Table 10.3-1
Implementation Schedule
Description of Phases

Item	Description	Project Start Construction Date
WWTF Improvements - Phase One	Construction of new Headworks	11/2010
WWTF Improvements - Phase II/III	Increase sustained flow capacity through entire plant from approximately less than 40MGD to 48MGD, add nutrient removal capability to plant, improve other aspects of plant facilities Upgrade disinfection facilities and biosolids processing and storage facilities	11/2012
CSO LTCP Phase 1	Project 1-1: 009/010 Floatables Control Project 1-2: 004/011 Floatables Control Project 1-3: Phase I of High Rate Treatment (HRT) Facility (16.5 MGD) at the Main Lift Station and IP Lagoon rehabilitation, add 2nd FM at existing main lift station to HRT Project 1-4: Consolidate 009/010 Project 1-5: Sewer Rehabilitation	08/2013 TBD 11/2014 05/2014 11/2014
CSO LTCP Phase 2	Construct new main lift station and Phase II of HRT (16.5 MGD), initial phase of green infrastructure implementation in Basins 009/010	02/2017
CSO LTCP Phase 3	Construct CSO Interceptor from 004 to new min lift station, final phase of green infrastructure implementation in Basins 009/010	07/2020
CSO LTCP Phase 4	Construct CSO Interceptor from 008 to 004 Monitor success of Green Infrastructure in Basins 009/010	02/2025
CSO LTCP Phase 5	Construct Storage Facility at 010*	06/2028

**If the green infrastructure projects implemented in Phase 2 and 3 and monitored in Phase 4 result in the attainment of the target level of control at the combined 009/010 outfall, then Phase 5 will not be needed.*

If, though, it appears that the target level of control cannot be achieved without additional green or new "gray" infrastructure, (storage tanks near 009/010), then the City will request additional time beyond the 20-year timeframe in order to plan, design and construct the additional facilities. We understand that IDEM would seriously consider that request, and if IDEM determines that the additional time is needed, then the parties would amend the State Judicial Agreement to specify additional time. Language to this effect has been added to Sections 8 and 10 of the LTCP, and we understand that it will also be added to the City's NPDES permit when the LTCP is approved and incorporated into the permit by IDEM.

Note that this condition also applies to the proposed implementation schedule shown on Table. 10.3-2

[1] Actual schedule for bidding and construction of Project 1-2 is indeterminate due to current EPA managed cleanup of site due to contaminated soil from illegal dumping. Schedule will be updated once site is cleared for construction activities to occur.

[2] Revised from previously updated schedule included in letter to IDEM dated August, 26 2013.

Table 10.3-2
Implementation Schedule
(20 Years)

Item	Milestone Date
• Complete & Submit CSOLTCP	04/2011
• WWTF Improvements – Complete Phase I Construction	04/2012
• WWTF Improvements – Complete Phase II Design Finalize Financing, Procure Bids	09/2012
~~• CSOLTCP – Complete Phase I P.E.R.~~ ~~Initiate Design of Phase I~~	~~10/2012~~
~~• CSOLTCP – Complete Phase I Design~~ ~~Finalize Financing, Procure Bids~~	~~06/2013~~
• CSOLTCP – Initiate Basis of Design Reports Projects 1-1, 1-2 and 1-3	10/2012
• CSOLTCP – Complete Phase I Design – Project 1-1 (Spruce/Chestnut Floatables Control Structure	06/2013
• CSOLTCP Receive Bids for Project 1-1	07/2013
• CSOLTCP Begin Design Phase I Common Elements (Projects 1-4 and 1-5)	08/2013
• CSOLTCP Begin Construction Project 1-1	08/2013
• CSOLTCP Permit Application Submission Projects 1-2 and 1-3	12/2013
• CSOLTCP Complete Design Phase I Common Elements (Projects 1-4)	03/2014
• CSO LTCP Complete Design Phase I Common Elements (Project 1-5)	08/2014
• CSOLTCP Complete Design Project 1-3 (Main Lift Station Site High Rate Treatment)	03/2014
• CSOLTCP Receive Bids Phase I Common Elements Project 1-4	05/2014

Project 1-5	09/2014
• CSOLTCP Receive Bids Project 1-3	10/2014
• CSO LTCP Receive Bids Project 1-2	TBD[1]
• CSO LTCP Begin Construction Phase I Common Elements	
Project 1-4	05/2014
Project 1-5	11/2014
• CSO LTCP Begin Construction Project 1-3	11/2014
• CSO LTCP Begin Construction Project 1-2	TBD[1]
• WWTF Improvements – Complete Construction of Phase II	10/2015
• CSO LTCP Complete Construction Project 1-2	TBD[1]
~~• CSOLTCP – Complete Construction of Phase I~~	~~03/2015~~
• CSO LTCP – Complete Construction Project 1-1 and 1-4	09/2014
• CSO LTCP – Complete Construction Project 1-5	07/2015
• CSO LTCP – Complete Construction of Phase I – Project 1-3	03/2016
• CSOLTCP – Initiate Monitoring of Phase I and P.E.R. of Phase II	11/2015
• Review and Re-evaluate CSOLTCP	09/2016
• CSOLTCP – Complete Phase I Monitoring and Phase II P.E.R Initiate Phase II Design	09/2016
• CSOLTCP – Complete Phase II Design Finalize Financing, Procure Bids	12/2016
• CSOLTCP – Complete Construction of Phase II	08/2018
• CSOLTCP – Initiate Monitoring of Phase II and P.E.R. of Phase III	09/2018
• CSOLTCP – Complete Phase II Monitoring and Phase III P.E.R. Initiate Phase III Design	06/2019
• Review and Re-evaluate CSOLTCP	06/2019
• CSOLTCP – Complete Phase III Design Finalize Financing, Procure Bids	06/2020
• CSOLTCP – Compete Phase III Construction	06/2022
• CSOLTCP – Initiate Monitoring of Phase III and P.E.R. of Phase IV	07/2022
• CSOLTCP – Complete Phase III Monitoring and Phase IV P.E.R. Initiate Design of Phase IV	06/2023
• Review and Re-evaluate CSOLTCP	12/2023
• CSOLTCP – Complete Phase IV Design Finalize Financing, Procure Bids	12/2024
• CSOLTCP – Complete Phase IV Construction	12/2026
• CSOLTCP – Initiate Monitoring of Phase IV and Phase V P.E.R.	01/2026
• CSOLTCP – Complete Phase IV Monitoring and Phase V P.E.R Initiate Design of Phase V	01/2027
• Review and Re-evaluate CSOLTCP	06/2027
• CSOLTCP – Complete Phase V Design Finalize Financing, Procure Bids	04/2028

CSOLTCP – Complete Phase V Construction	04/2030
CSOLTCP – Initiate Monitoring of Phase V	05/2030
CSOLTCP – Complete Monitoring of Phase V	05/2031
Review and Re-evaluate CSOLTCP	12/2031

[1] Actual schedule for bidding and construction of Project 1-2 is indeterminate due to current EPA managed cleanup of site due to contaminated soil from illegal dumping. Schedule will be updated once site is cleared for construction activities to occur and IDEM will be notified of the anticipated construction start date.

10.4 Post Construction Monitoring Program

As noted in the detailed list of activities in the implementation schedule shown in Table 10.3-2, there will be periods of post-construction monitoring between each phase of the implementation schedule. A post-construction monitoring program will be submitted to IDEM prior to implementation of the LTCP. The program will include the following elements:

- A method for reporting on the volume, duration and frequency of any remaining overflows on an annual basis. This could be accomplished through continuous flow monitoring of outfalls, updating and application of the collection system model, or a combination of both. Rainfall data will be gathered from the City's network of rain gauges.
- A system to measure the degree to which any CSO storage facilities are filled.
- A receiving water program to evaluate E. coli conditions in the river. The program could be structured similarly to that employed to obtain information for the LTCP and may include additional instream sampling, application of the receiving water model or a combination of both.

This information will be used to evaluate the performance of CSO controls. The evaluations will help determine the need for future modifications to the LTCP or improvements to the controls.

In accordance with SEA 431, the City will conduct a periodic review not less than every 5 years after the approval of the LTCP as shown on the implementation schedule. The City will:

- Submit a document to IDEM demonstrating that the LTCP has been reviewed.
- Update the LTCP as necessary to document the results of post-construction monitoring of installed CSO abatement projects
- Submit any amendments to the LTCP to IDEM for review
- Implement control alternatives determined to be cost-effective

Any recommended future changes regarding the post-construction monitoring program that was previously developed for an earlier phase could be later modified as part of the 5 year CSO LTCP review and re-evaluation process.

11 Section Eleven – Revisions to CSOOP Plan

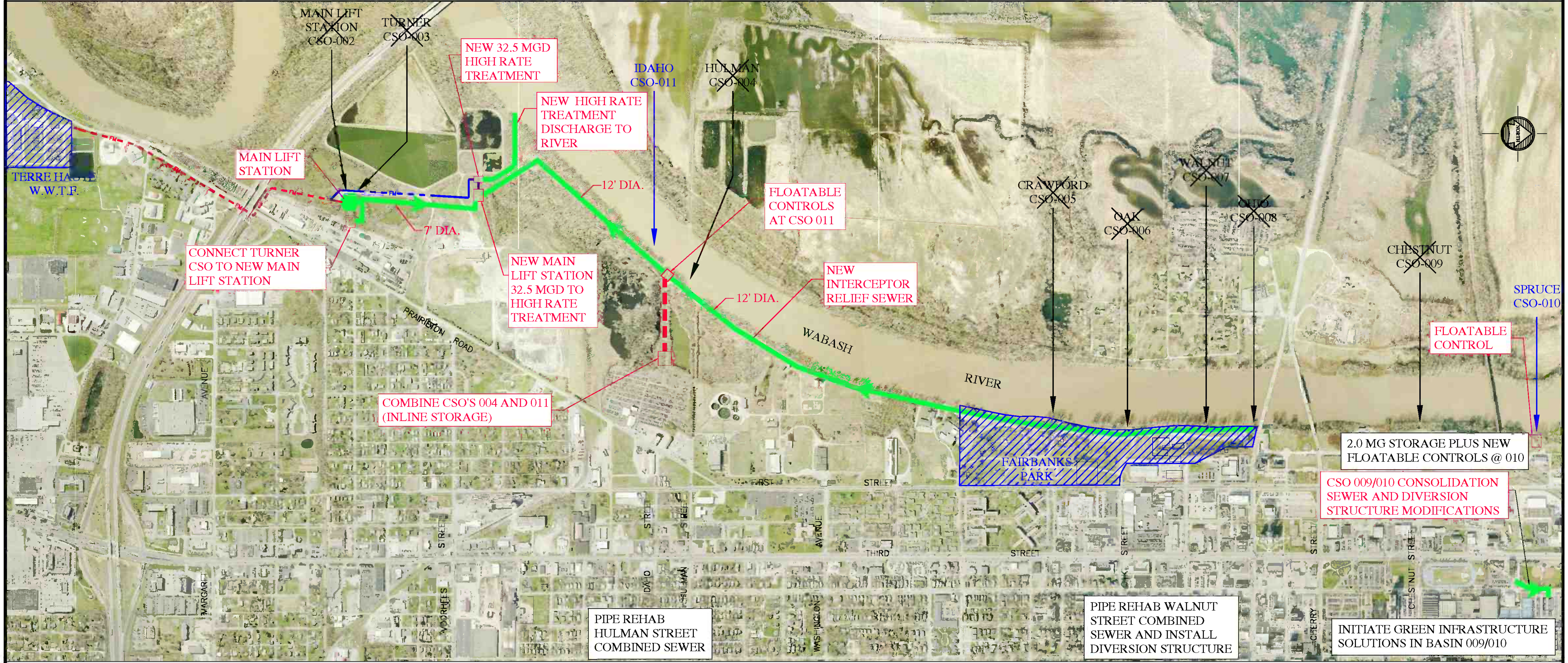
As a part of the Long Term Control Plan planning and development, the technical team evaluated the existing CSO Operational Plan that was submitted and approved in 2006. There will be changes required to the CSO Operational Plan based on the LTCP. Once the LTCP is approved, the required changes will be incorporated into the CSO operational plan.

11.1 Revisions Required

There are currently several areas of the CSO Operational Plan that require updates based on the LTCP. These sections will be updated once an approved LTCP is received by the City. The sections requiring updating include the following:

- CSO Control Efforts
- Operation and Maintenance Practices
- Collection System Storage
- Flow Maximization to the WWTF
- Floatables Controls
- Post Construction Monitoring Program

Terre Haute CSO LTCP



LEGEND

🟩	RELIEF SEWER AND FLOW
⬢	EXISTING MAIN LIFT STATION
12"Ø	RELIEF SEWER SIZE
☐	NEW PUMP STATION OR STRUCTURE
- - FM - -	NEW FORCE MAIN
▬ ▬ ▬	EXISTING COMBINED SEWER OUTFALL
OHIO CSO-008	EXISTING CSO TO BE ELIMINATED
OHIO CSO-008	EXISTING CSO TO REMAIN (SOME REMAIN OPEN AT LESSER LEVELS OF CONTROL)

TERRE HAUTE A LEVEL ABOVE

HWC ENGINEERING

Figure ES-2
Recommended Plan
REVISED - SEPTEMBER 2014

Terre Haute CSO LTCP

LEGEND

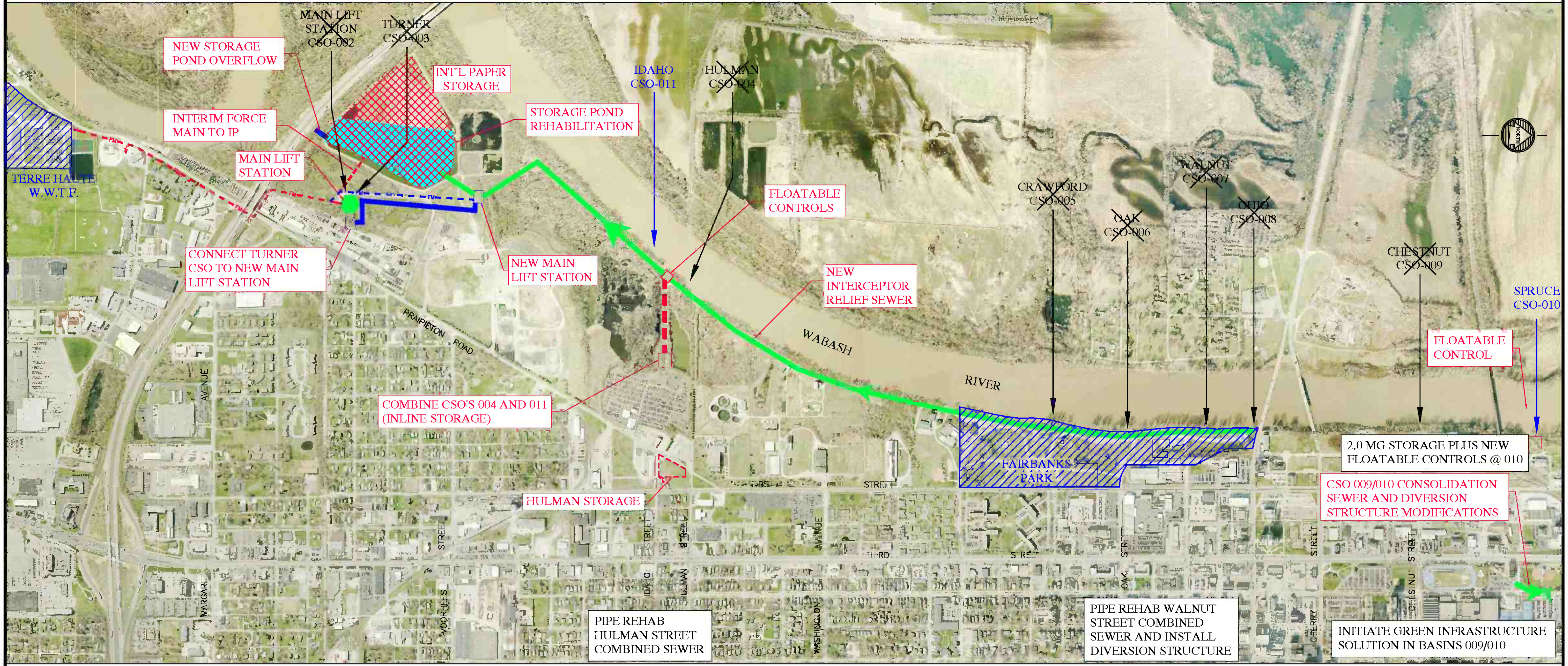
←	RELIEF SEWER AND FLOW	CSO-009A ┬	NEW CSO FROM CONSOLIDATION
⬢	MAIN LIFT STATION	~~OHIO CSO-008~~	EXISTING CSO TO BE ELIMINATED
■	STORAGE TANK (INCLUDES SIZE AND VOLUME)	OHIO CSO-008	EXISTING CSO TO REMAIN (SOME REMAIN OPEN AT LESSER LEVELS OF CONTROL)
UC	ULTIMATE CONVEYANCE	▬ ▬ T ▬	CSO TUNNEL
12"Ø	RELIEF SEWER SIZE		
- - - FM - - -	NEW FORCE MAIN		

TERRE HAUTE A LEVEL ABOVE

HWC ENGINEERING

Figure 6.8-1
ALTNERATIVE 7B
REVISED - SEPTEMBER 2014

Terre Haute CSO LTCP



LEGEND

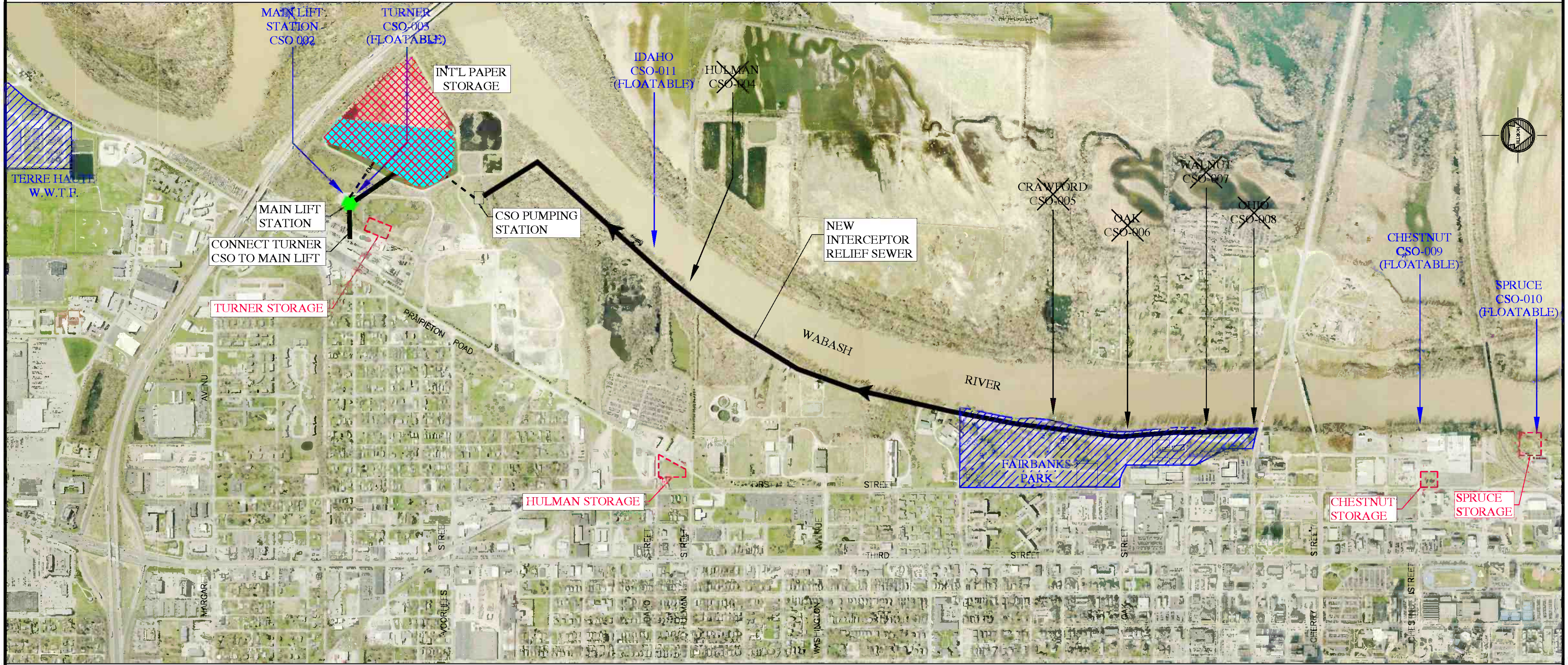
🟩	RELIEF SEWER AND FLOW	~~OHIO CSO-008~~	EXISTING CSO TO BE ELIMINATED
●	EXISTING MAIN LIFT STATION	OHIO CSO-008	EXISTING CSO TO REMAIN (SOME REMAIN OPEN AT LESSER LEVELS OF CONTROL)
12"Ø	RELIEF SEWER SIZE		
☐	NEW PUMP STATION OR STRUCTURE		
- - FM - -	NEW FORCE MAIN		
▬ ▬ ▬	EXISTING COMBINED SEWER OUTFALL		

TERRE HAUTE
A LEVEL ABOVE

HWC
ENGINEERING

Figure 6.8-2
ALTERNATIVE 11
REVISED - SEPTEMBER 2014

Terre Haute CSO LTCP



LEGEND

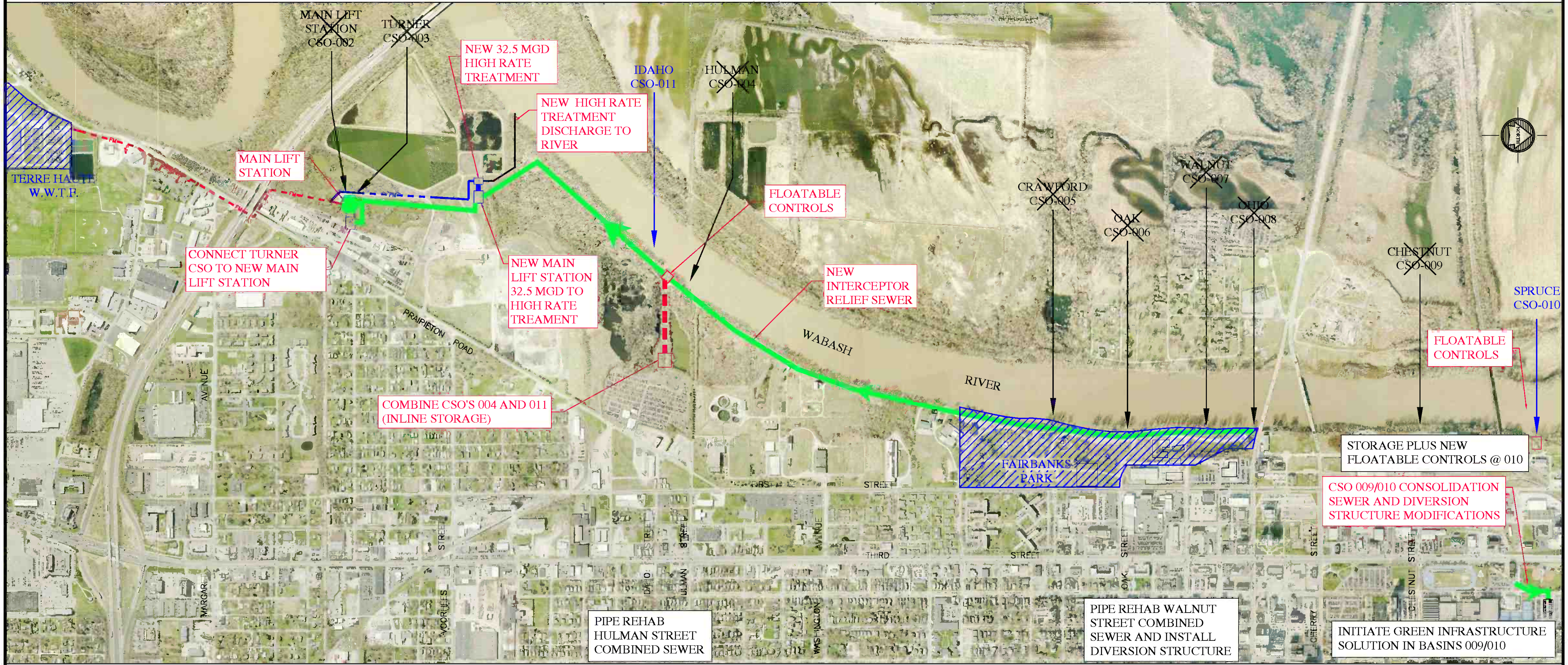
◀━━	RELIEF SEWER AND FLOW
●	EXISTING MAIN LIFT STATION
12"Ø	RELIEF SEWER SIZE
☐	NEW POWER STATION OR STRUCTURE
- - -FM- - -	NEW FORCE MAIN
~~OHIO CSO-008~~	EXISTING CSO TO BE ELIMINATED
OHIO CSO-008	EXISTING CSO TO REMAIN (SOME REMAIN OPEN AT LESSER LEVELS OF CONTROL)

TERRE HAUTE A LEVEL ABOVE

HWC ENGINEERING

Figure 6.8-3
ALTNERATIVE - HYBRID
REVISED - SEPTEMBER 2014

Terre Haute CSO LTCP



LEGEND

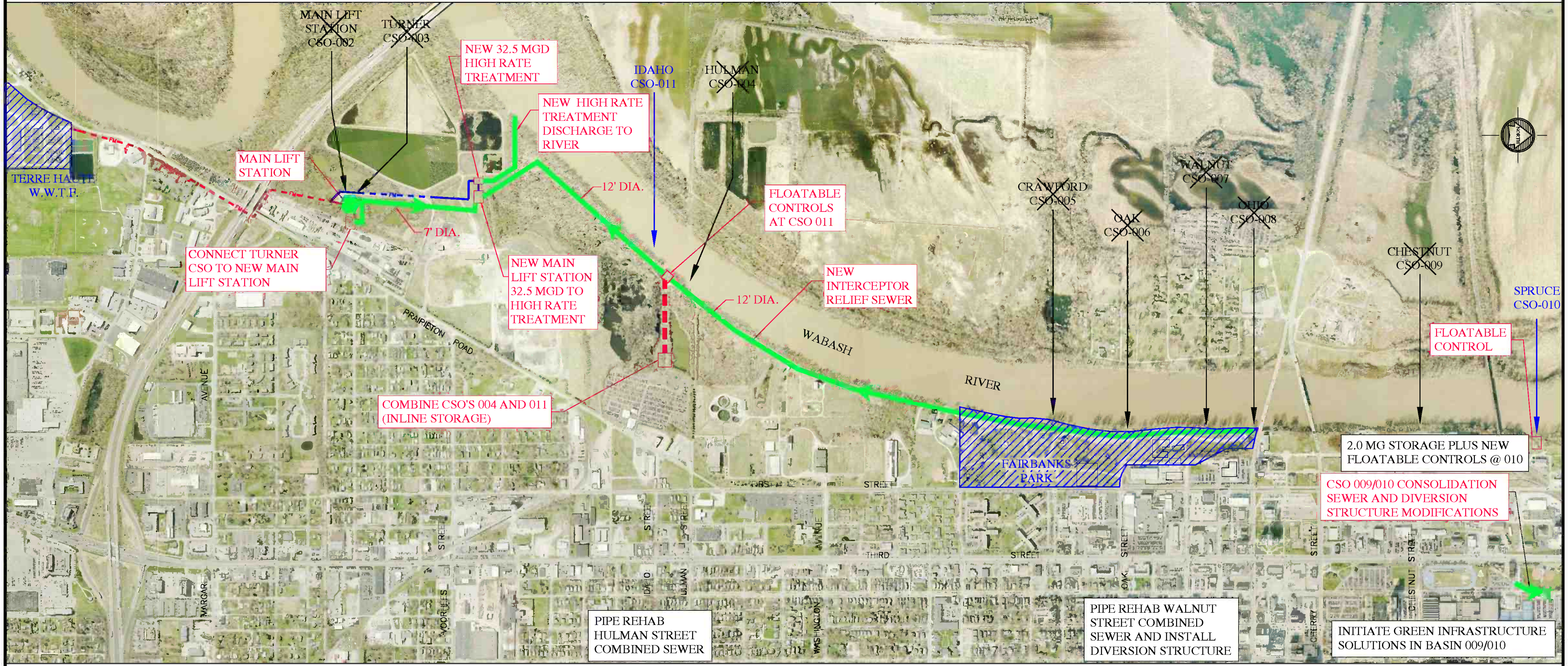
🟩	RELIEF SEWER AND FLOW	~~OHIO CSO-008~~	EXISTING CSO TO BE ELIMINATED
⬢	EXISTING MAIN LIFT STATION	OHIO CSO-008	EXISTING CSO TO REMAIN (SOME REMAIN OPEN AT LESSER LEVELS OF CONTROL)
12"Ø	RELIEF SEWER SIZE		
☐	NEW PUMP STATION OR STRUCTURE		
- - FM - -	NEW FORCE MAIN		
▬ ▬ ▬	EXISTING COMBINED SEWER OUTFALL		

TERRE HAUTE A LEVEL ABOVE

HWC ENGINEERING

Figure 6.8-4
Alternative 11b
REVISED - SEPTEMBER 2014

Terre Haute CSO LTCP



LEGEND

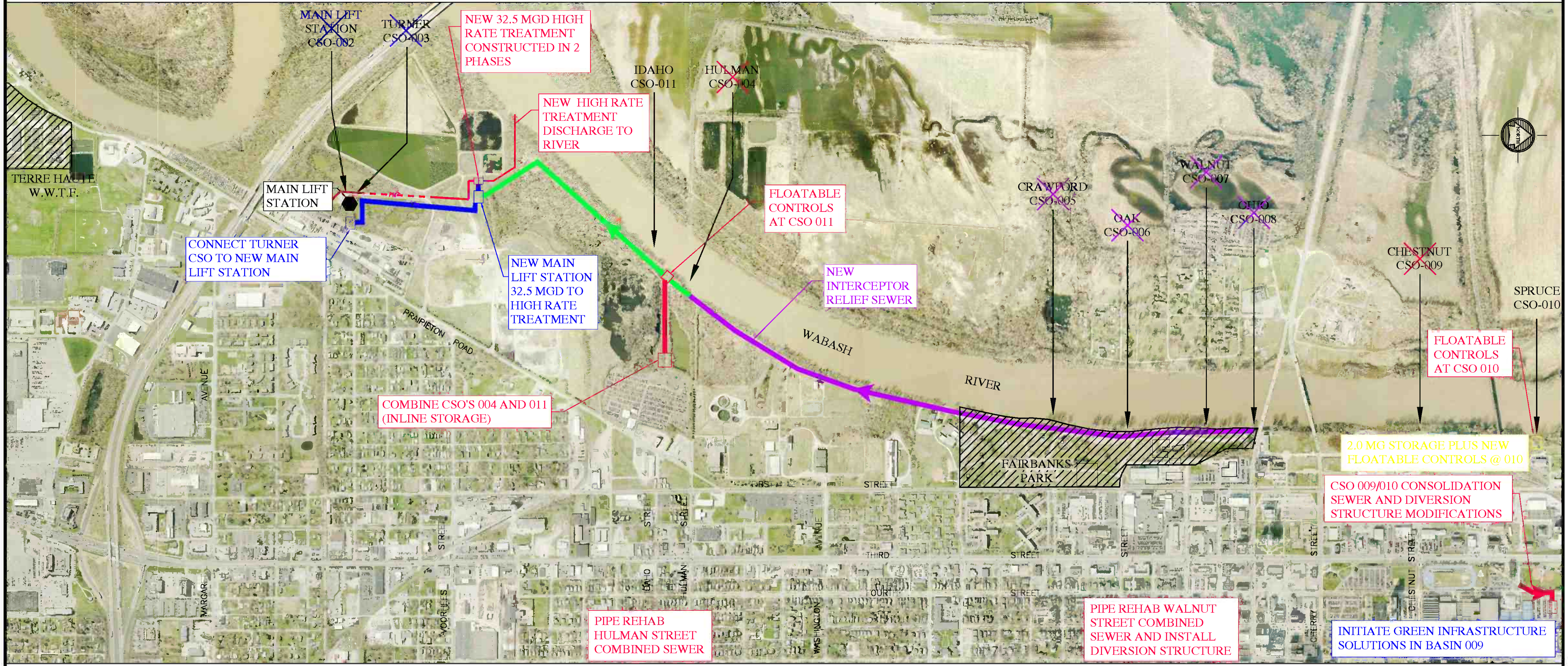
🟩 ←	RELIEF SEWER AND FLOW
⬢	EXISTING MAIN LIFT STATION
12"Ø	RELIEF SEWER SIZE
☐	NEW PUMP STATION OR STRUCTURE
- - FM - -	NEW FORCE MAIN
▬ ▬ ▬	EXISTING COMBINED SEWER OUTFALL
~~OHIO CSO-008~~	EXISTING CSO TO BE ELIMINATED
OHIO CSO-008	EXISTING CSO TO REMAIN (SOME REMAIN OPEN AT LESSER LEVELS OF CONTROL)

TERRE HAUTE A LEVEL ABOVE

HWC ENGINEERING

Figure 10.2-1
Recommended Plan
REVISED - SEPTEMBER 2014

Terre Haute CSO LTCP



LEGEND

←	RELIEF SEWER
⬢	MAIN LIFT STATION
12"Ø	RELIEF SEWER SIZE
☐	NEW PUMP STATION OR STRUCTURE
- - -FM- - -	NEW FORCE MAIN
~~OHIO CSO-008~~	EXISTING CSO TO BE ELIMINATED
OHIO CSO-008	EXISTING CSO TO REMAIN
🟥	PHASE 1
🟦	PHASE 2
🟩	PHASE 3
🟪	PHASE 4
🟨	PHASE 5

TERRE HAUTE A LEVEL ABOVE

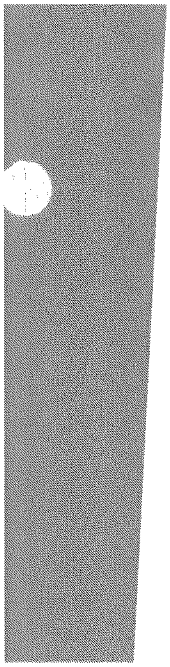
HWC ENGINEERING

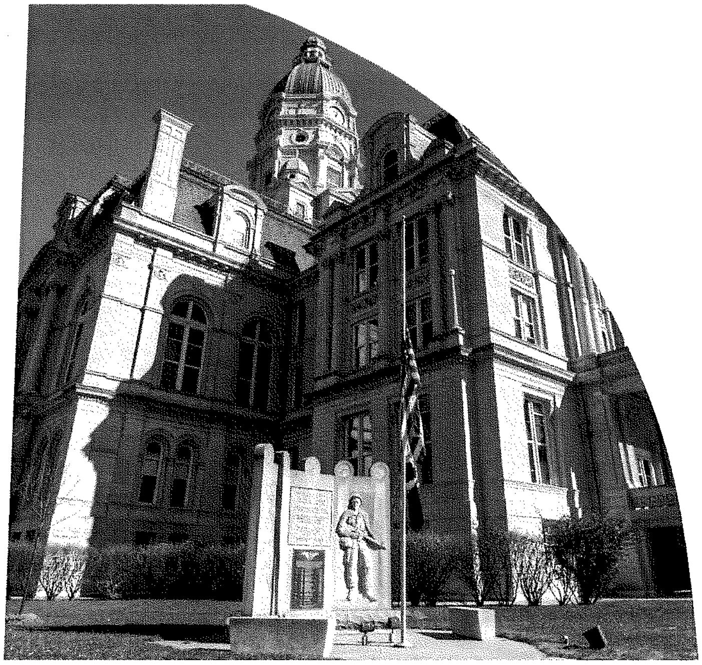
Figure 10.3-1
PHASING OF
RECOMMENDED PLAN

REVISED - SEPTEMBER 2014

Appendix 6-5

Project 1-3 Basis of Design





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City of Terre Haute

CSO Phase 1 Design, Project 1-3 / CSO Project at Main Lift Station

Basis of Design Report

Volume I of II
January 2013

A Wealth of Resources to Master a Common Goal

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Executive Summary

Purpose

This Basis of Design (BOD) Report does not support the implementation of Phase 1, Project 1-3 Combined Sewer Overflow (CSO) Storage Lagoons as outlined in the City of Terre Haute's (City's) Long Term Control Plan (LTCP). Phase 1, Project 1-3, as defined in the City's LTCP, consists of improvement to the existing International Paper (IP) Southeastern Lagoon to provide 27 million gallons (mg) of storage. The improvements are identified to commence construction in August 2013 at an estimated construction cost of $6,294,800 per the LTCP; $6,700,000 per revised costs provided by the City's Program Manager HWC Engineering on October 11, 2012.

This BOD Report identifies an anticipated construction cost of $18,645,000 for a 27 mg Wastewater Storage Facility. This BOD Report also identified permitting issues, primarily associated with construction in a flood plain, that all but guarantee a six (6) to nine (9) month permitting process which would extend the design to October 2013; two (2) months past the identified date for construction to commence.

Two (2) alternative design concepts have been developed within this BOD Report; a primary treatment alternative and a secondary treatment alternative. The secondary treatment alternative consists of a High Rate Clarification (HRC) system with U.V. disinfection and direct discharge to the river. This alternative could be readily incorporated into the City's LTCP, in lieu of the identified storage, at a 40% construction cost savings (when compared to storage); i.e. $11,114,000. The August 2013 start construction date can be achieved and the potential need for future costs associated with additional storage at the IP site could be eliminated.

The primary treatment device consists of a solids vortex separator facility known as "Storm King" with chemical disinfection. This alternate also can be readily incorporated into the City's LTCP, at a 63% construction costs savings (when compared to storage); i.e. $6,865,000. The August 2013 start construction date can also be achieved. However, this alternative presents a risk for future costs associated with additional storage – either at the IP site or upstream within the collection system.

Unlike secondary treatment with U.V. disinfection, a primary treatment alternative with chemical disinfection currently requires storage and biological treatment of the "first-flush". The "first-flush" as defined in IDEM NRPD Water-016 is currently defined as the 1 year, 1 hour storm event.

However, in the case of the City of Terre Haute's project, "First-Flush" is not the 1-year, 1-hour flow. Further, the primary pollutant of concern as related to the water quality of the Wabash River with respect to loading from the City's CSOs is bacteriological. Primary Treatment with chemical disinfection insures the bacteriological issues would be addressed.

Since the City's LTCP is assembled and approved based off achieving the maximum protection possible for the water quality of the Wabash River within the community's financial capacity to afford, two (2) potential approaches exist that could allow the Primary Treatment Project with Chemical Disinfection to be utilized in lieu of the proposed storage alternative:

A. **Primary Treatment with Chemical Disinfection Alternative No. 1**

1. Install the primary treatment unit with chemical disinfection in lieu of any current or future storage at the IP site, at an identified maximum capacity of 32.5 mgd.
2. Identify the costs associated with the two (2) alternative solutions both exceed that budgeted for these Phase 1 Improvements.
3. Identify the primary treatment with chemical disinfection alternatives will achieve the water quality goals for the protection of the Wabash River (i.e. eliminating bacterial contributions from CSOs) and the overall objectives of the LTCP.
4. Request approval to substitute this primary treatment with chemical disinfection alternative for the originally identified storage with "bleed-back" to the WWTP alternative.

B. **Primary Treatment with Chemical Disinfection Alternative No. 2**

1. Same as Alternative No. 1.
2. If IDEM will not alleviate the requirement to contain and biologically treat the "first-flush" identify the need for additionally flow monitoring, flow modeling, and CSO sampling as Phases 2, 3, and 4, are implemented (i.e. thru 2025).
3. Determine what, if any, additional storage would be required and incorporated as part of the Phase 5 improvements (i.e. in 2028).

It is evident that the "first-flush" at the IP site is not the 1 year, 1 hour storm event. Flow rate at this location is linked to the main lift stations pumping capacity. Flow in excess of this pumping capacity will either be attenuated in the upstream sewer system or will be alleviated in upstream overflow(s). Therefore, determination of the "first-flush" is best left to 2025 once all additional improvements are performed and updated post construction flow monitoring and modeling are performed.

This conversation / negotiation with IDEM regarding Primary Treatment with Disinfection, as it relates to the City's LTCP, is strongly encouraged. Not only would it result in a signification cost savings to the Phase 1 Project, but it also has the potential to provide a viable and cost savings alternative to the potential Phase 5 Storage Facility at CSO 010.

Regardless, it has been identified that a treatment alternative versus storage facilities at the IP site should be implemented. Not only do they provide cost savings, but they are also better supportive of construction permitting activities, LTCP compliance, operation, general aesthetics/synergies with the IP restoration and synergies with future LTCP requirements.

The cost effectiveness analysis of alternative along with the other critical decision making criteria comparisons are presented below in **Tables ES-1 through ES-9**.

Table ES-1
Cost Effectiveness Analysis of Alternatives

Item/Alternative	Factor	Storage Alternative	Primary Treatment with Storage Alternative	Primary Treatment Alternative	Secondary Treatment Alternative
		CSO Storage Tank Unaerated, Open Top	**Vortex Treatment, Disinfection and Tank Storage**	**Vortex Treatment, Disinfection and No Storage**	**Sand Ballasted Floc, Surface Discharge**
Total Estimate of Probable Construction Cost		$ 18,645,000	$ 23,916,000	$ 6,865,000	$ 11,114,000
Project Related Costs (25%)	0.25	$ 4,661,000	$ 5,979,000	$ 1,716,000	$ 2,779,000
Total Estimated Initial Capital Cost		**$ 23,306,000**	**$ 29,895,000**	**$ 8,581,000**	**$ 13,893,000**
Annual Estimated O&M&R Cost		$ 79,100	$ 215,700	$ 168,100	$ 253,200
Present Worth of Annual Estimated O&M&R Cost	16.8349	$ 1,332,000	$ 3,631,000	$ 2,830,000	$ 4,263,000
Total Estimated Present Worth		**$ 24,638,000**	**$ 33,526,000**	**$ 11,411,000**	**$ 18,156,000**
Equivalent Annual Cost	0.05940	$ 1,463,000	$ 1,991,000	$ 678,000	$ 1,078,000
Percent More of Least Cost Alternative		**116%**	**194%**	**Least Cost**	**59%**

Table ES-2
Cost Effectiveness Analysis of Alternatives

Item / Alternative	Storage Alternative	Primary Treatment with Storage Alternative	Primary Treatment Alternative	Secondary Treatment Alternative
	CSO Storage Tank Unaerated, Open Top	**Vortex Treatment, Disinfection and Tank Storage**	**Vortex Treatment, Disinfection and No Storage**	**Sand Ballasted Floc, Surface Discharge**
Total Estimate of Probable Construction Cost	$ 18,645,000	$ 23,916,000	$ 6,865,000	$ 11,114,000
LTCP Project 1-3 Anticipated Construction Cost	$6,294,800	$6,294,800	$6,294,800	$6,294,800
Developed Alternative Cost Increase / Decrease (%) from LTCP Anticipated Construction Cost	196%	280%	9%	77%
Developed Alternative Cost Outcome	More Negative	Most Negative	Neutral	Negative

Table ES-3
Developed Alternatives Construction Permitting Requirements

Item / Alternative	Construction Permits / Coordination Required*						Summary Discussion on Permitting Time Requirements and Associated Risk	Developed Alternative Construction Permitting Ranking
	IDEM Construction Permit	IDEM 401 WQC	IDNRFWS/USFWS	IDEM Rule 5 Erosion Control	IDNR Construction in a Floodway	USACE Section 404 Wetlands/Dredge and Fill		
Storage Alternative CSO Storage Tank Unaerated, Open Top	X	X	X	X	X	X	IDNR Berm Elevation Requirements/Floodway Modeling (6-9 months) Acquisition of Waivers for IDEM Setback Requirements for 1,320 feet radius(6 months) USACE Section 404/ Wetlands Major Disturbance (6-9 months) IDNRFWS/USFWS Major Disturbance and Restrictions (2-3 months) IDEM Rule 5 Erosion Control Major Disturbance (3 months)	Negative
Primary Treatment with Storage Alternative Vortex Treatment, Disinfection and Tank Storage	X	X		X	X	X	Same as above although IDEM Setback Restrictions are 500 feet radius rather than 1,320 radius for CSO storage tank; thus, much fewer properties will be included in waiver acquisition process.	Negative

Table ES-3
Developed Alternatives Construction Permitting Requirements

Item / Alternative	Construction Permits / Coordination Required*						Summary Discussion on Permitting Time Requirements and Associated Risk	Developed Alternative Construction Permitting Ranking
	IDEM Construction Permit	IDEM 401 WQC	IDNRFWS/USFWS	IDEM Rule 5 Erosion Control	IDNR Construction in a Floodway	USACE Section 404 Wetlands/Dredge and Fill		
Primary Treatment Alternative								
Vortex Treatment, Disinfection and No Storage	X	X		X			IDEM Construction Permit Deliberation on LTCP Objectives (3-4 months) Minimal disturbance which reduces complexity of IDNR FWS/USFWS, IDEM 401 & Erosion Control, and USACE review processes. IDNR construction in a floodway permitting process significantly reduced since project will not significantly impact floodway when compared to previous two alternatives.	Neutral
Secondary Treatment Alternative								
Sand Ballasted Floc, Surface Discharge	X	X	X	X			Same as above with significantly reduced IDEM Construction Permit deliberation due to previous permits issued for CSO LTCP application. Minor site disturbance expedites remaining permit review/coordination as described in previous alternative.	Positive

Table ES-4
Developed Alternatives LTCP Compliance Requirements

Item / Alternative	**Compliance Activity**			**Summary Discussion on Anticipated Activities Associated with Insuring LTCP Compliance Requirements and Associated Risk**	**Developed Alternative LTCP Compliance Ranking**
	Approved Level of Control Evaluation	**IDEM Coordination/ Negotiation**	**LTCP Schedule Amendment Required**		
Storage Alternative CSO Storage Tank Unaerated, Open Top		X	X	Schedule will be affected due to multiple regulatory agency construction permitting requirements for storage	Neutral
Primary Treatment with Storage Alternative Vortex Treatment, Disinfection and Tank Storage		X	X	Schedule will be affected due to multiple regulatory agency construction permitting requirements for storage.	Neutral
Primary Treatment Alternative Vortex Treatment, Disinfection and No Storage	X	X	X	Selection of this alternative would require significant coordination with IDEM to ensure that the water quality goals (i.e. reduction in CSO bacterial loading to the Wabash River) and adequate treatment of first flush of pollutants in a cost affordable manner. In addition, post construction monitoring phases and possible reorganization of construction phases will likely be necessary requiring amendment of LTCP and Agreed Judgment.	Negative
Secondary Treatment Alternative Sand Ballasted Floc, Surface Discharge				Precedence with regard to IDEM approval and previous installations would streamline process. No first flush evaluation as described above required. Construction Permitting delays associated with storage do not exist with this alternative (i.e. no impedance of floodway or major disturbance). Expedited permitting anticipated.	Positive

Table ES-5
Developed Alternatives Operation Considerations

Item / Alternative	Operation Considerations		Developed Alternative Operations Ranking
	Pros	Cons	
Storage Alternative			
CSO Storage Tank Unaerated, Open Top	• More Readily Cleaned with Tipping Buckets than the other Storage Alternatives (i.e. CSO Lagoon wash down requirements are far more labor intensive)	Reference **Appendix A** – White Paper for a summary of issues related to CSO Storage several communities Commonwealth works with across the State of Indiana experience. A succinct synopsis is presented below: • Back to back storms / antecedent conditions will result in the tankage holding CSO in excess of 48-hours. Though these will be situations that exceed the design storm requirements, and regulatory discretion can be applied to insure the City is not penalized by IDEM, the actual on-site conditions will none-the-less result in wastewater turning septic and corresponding odor issues from the pond until it can be drained. • Flow to the CSO Storage may not exceed the design storm flow rate (32.5 MGD) but could exceed the design storm volume (27.6 Mgal). Since rate to the CSO management facility is limited by the existing and ultimately new Main Lift Stations Pumping Capacity, a Storage Alternative will not lower level of protection than a Treatment Alternative (i.e. overflows will occur that could otherwise be prevented) • Any Storage Facility will have a larger footprint than a treatment facility. Naturally resulting in increased efforts associated with general upkeep. • Any Storage Facility receiving CSO flow will have latent materials within it (i.e. cigarettes, paper towels, sanitary napkins, tampons, etc.) that will require attention to insure they are thoroughly cleaned. • Floatables within a filling Storage unit resulting in foaming, sludge,	Neutral to Positive

Table ES-5
Developed Alternatives Operation Considerations

Item / Alternative	Operation Considerations		Developed Alternative Operations Ranking
	Pros	Cons	
		scum, and algae are likely and would be an unsightly by-product of the selected technology that the operator would need to expend additional efforts to address, or, accept the related perception during these occurrences. • Access to the Storage Units represents Confined Space Entry. Limited access is anticipated, however, when needed, it will present an additional level of effort not associated with a Treatment Alternative • Potential future need for site disruption to construct additional storage.	
Primary Treatment with Storage Alternative	• Issues noted associated with solids are minimized through primary clarification of tank contents. • Odor contributors eliminated through the primary treatment device prior to storage – minimizing the potential for septic conditions and corresponding odors when waters stand for extended period of times in storage. • Flow to the CSO Storage may not exceed the design storm flow rate (32.5 MGD) but could exceed the design storm volume (27.6 Mgal). However, by incorporating primary treatment, an higher level of treatment than storage alone is achieved - (i.e. overflows that would otherwise occur with storage alone can be routed through the primary treatment with disinfection and then out to the river.) • Future need to disrupt the site for construction of additional storage is eliminated. • No moving parts requirement for maintenance and upkeep	• Any Storage Facility will have a larger footprint than a treatment facility alone. Naturally resulting in increased efforts associated with general upkeep. • Screenings removed within Primary Treatment Device will require removal and disposal – after the storm event. • Light facilities management is required to insure proper stock of chlorine and hypochlorite.	Positive
Vortex Treatment, Disinfection and Tank Storage			

Table ES-5
Developed Alternatives Operation Considerations

Item / Alternative	Operation Considerations		Developed Alternative Operations Ranking
	Pros	Cons	
	on primary treatment unit.		
Primary Treatment Alternative Vortex Treatment, Disinfection and No Storage	• Future need to disrupt the site for construction of additional storage is eliminated. • No moving parts requirement for maintenance and upkeep on primary treatment unit. • CSO Management is maximized through flow (dictated by ability to receive from Main Lift Station) versus Volume (which can be limiting. • No odors • Cleaning requirements are • minimized with the smaller unit footprint – versus those noted associated with a storage alternative	• Screenings removed within Primary Treatment Device will require removal and disposal – after the storm event • Light facilities management is required to insure proper stock of chlorine and hypochlorite. • Least operator attention needed of all alternatives.	Positive
Secondary Treatment Alternative Sand Ballasted Floc, Surface Discharge	• Potential corresponding capacity benefits can be achieved at the WWTP • Future need to disrupt the site for construction of additional storage is eliminated. • CSO Management is maximized through flow (dictated by ability to receive from Main Lift Station) versus Volume (which can be limiting. • No odors • Cleaning requirements are minimized with the smaller unit footprint – versus those noted associated with a storage alternative	• Facility consists of mechanical equipment that will require typical operation and maintenance (chemical and polymer pumps and feed systems, sludge pumps, UV Disinfection System – Bulbs, etc. This alternative will require more maintenance of equipment than other alternatives.	Neutral (due to having more actively engaged operation needs – though they could be accomplished through SCADA monitoring and control at the WWTP)

Table ES-6
Developed Alternatives Aesthetic Considerations

Item / Alternative	Discussion	Developed Alternative Aesthetic Ranking
Storage Alternative	• Large open tank with CSO sewage is not supportive of a park-like setting or a desirable appearance in and around the storage basin.	Negative
CSO Storage Tank Unaerated, Open Top		
Primary Treatment with Storage Alternative	• Large open tank of primary treated and disinfected CSO is more supportive of appearance considerations. This would be similar to the facilities addressing snow melt in the western US. When full, contents would always appear clean and no risk of odor exists. Cleaning of tank in between will be far more effective with storage of primary treated and disinfected CSO versus raw CSO. • Integration with IP restoration will severely limit any recreational opportunities associated with storage facility. • Tank extends above grade and may provide site restoration impediments.	Negative, but less negative
Vortex Treatment, Disinfection and Tank Storage		
Primary Treatment Alternative	• Small Footprint. Installation can be obscured in a building that is blended with its surroundings. • CSO treatment offers opportune disconnect with City's wishes to restore IP site to natural setting.	Positive
Vortex Treatment, Disinfection and No Storage		
Secondary Treatment Alternative	• Small Footprint. Installation can be obscured in a building that is blended with its surroundings. • CSO treatment offers opportune disconnect with City's wishes to restore IP site to natural setting.	Positive
Sand Ballasted Floc, Surface Discharge		

Table ES-7
Developed Alternatives Synergies with Future Require LTCP Projects

Item / Alternative	Discussion	Developed Alternative Synergies with Future Required LTCP Projects Ranking
Storage Alternative	Additional Storage may be required in the future depending on the performance of future LTCP phases.	Negative
CSO Storage Tank Unaerated, Open Top		
Primary Treatment with Storage Alternative	First Flush containment is insured. Additional flows beyond that required stored can be treated through Primary Means with Direct Discharge to the River. Minimal IDEM coordination/negotiation is anticipated.	Positive
Vortex Treatment, Disinfection and Tank Storage		
Primary Treatment Alternative	This alternative implemented without the immediate implementation of CSO storage is dependent upon successful negotiations with IDEM on an LTCP/Agreed Judgment Amendment. This uncertainty and potential for future required storage of first flush results in neutral (but not negative) rating. If approved without need for future storage, this would be a very positive outcome. (Phase 5 Project implications)	Neutral
Vortex Treatment, Disinfection and No Storage		
Secondary Treatment Alternative	Precedence has been established based on previous experience incorporating technology into LTCPs. In conjunction with the proposed lift station expansion in CSO LTCP Phase 2, this alternative would preclude the necessity for future CSO storage or treatment.	Positive
Sand Ballasted Floc, Surface Discharge		

Table ES-8
Developed Alternatives Summary Comparison Matrix

Item / Alternative	Cost Effectiveness Analysis of Alternatives	Developed Alternative Construction Permitting Ranking	Developed Alternative LTCP Compliance Ranking	Developed Alternative Operations Ranking	Developed Alternative Aesthetic Ranking	Developed Alternative Synergies with Future Required LTCP Projects Ranking	Overall Rating
Storage Alternative CSO Storage Tank Unaerated, Open Top	Negative	Negative	Neutral	Negative	Negative	Negative	Negative
Primary Treatment with Storage Alternative Vortex Treatment, Disinfection and Tank Storage	Negative	Negative	Neutral	Neutral to Positive	Negative, but less negative	Positive	Neutral
Primary Treatment Alternative Vortex Treatment, Disinfection and No Storage	Neutral	Neutral	Negative	Positive	Positive	Neutral	Neutral to Positive
Secondary Treatment Alternative Sand Ballasted Floc, Surface Discharge	Negative	Positive	Positive	Neutral	Positive	Positive	Positive

Table ES-9
Developed Alternatives Comparison Matrix

Item / Alternative	Cost Effectiveness Analysis of Alternatives	Developed Alternative Construction Permitting Ranking	Developed Alternative LTCP Compliance Ranking	Developed Alternative Operations Ranking	Developed Alternative Aesthetic Ranking	Developed Alternative Synergies with Future Required LTCP Projects Ranking	Overall Rating
Storage Alternative CSO Storage Tank Unaerated, Open Top	Negative (Total Estimated Probable Construction Cost - $23,306,000)	Negative (Primarily due to disturbance and Setback Requirements)	Neutral (Likely schedule amendment due to multiple permit acquisition)	Negative (Comprehensive cleaning required and odor risk)	Negative (not conducive to IP site restoration)	Negative (Additional Storage may be required in the future depending on the performance of future LTCP phases.)	Negative
Primary Treatment with Storage Alternative Vortex Treatment, Disinfection and Tank Storage	Negative (Total Estimated Probable Construction Cost - $23,916,000)	Negative- (Primarily due to disturbance)	Neutral (Likely schedule amendment due to multiple permit acquisition)	Neutral to Positive (No moving parts. Disinfection must be stocked before storm event and screenings must be removed)	Negative, but less negative (Far more congruent with IP site restoration but limits recreational attributes of proposed water feature)	Positive (First flush containment is insured. Minimal IDEM coordination anticipated)	Neutral
Primary Treatment Alternative Vortex Treatment, Disinfection and No Storage	Neutral (Total Estimated Probable Construction Cost - $8,581,000)	Neutral (Minimal disturbance but with LTCP uncertainties)	Negative (Alternative would require reopening of LTCP for schedule modification and phasing modifications)	Positive (Disinfection must be stocked before storm event and screenings must be removed)	Positive (Small footprint. CSO treatment offers opportune disconnect with City's wishes to restore IP site to natural setting)	Neutral (First flush containment is insured. Major IDEM coordination anticipated)	Neutral to Positive
Secondary Treatment Alternative Sand Ballasted Floc, Surface Discharge	Negative (Total Estimated Probable Construction Cost - $13,893,000)	Positive (Minimal disturbance and precedence with regard to effluent quality)	Positive (No LTCP modification necessary with approved wet weather treatment technology)	Neutral (mechanical equipment that will require typical operation and maintenance)	Positive (Small footprint. CSO treatment offers opportune disconnect with City's wishes to restore IP site to natural setting)	Positive (No issues due to precedence established on previous wet weather treatment facilities.	Positive

Appendix 6-6

2014 LTCP Revision Public Meeting Minutes

Minutes of a Regular Meeting of the Board of Sanitary Commissioners Terre Haute, IN July 15, 2014

A Regular Meeting of the Board of Sanitary Commissioners of the City of Terre Haute, Indiana was held in the Mayor's Conference Room on the third floor, City Hall, 17 Harding Avenue, Terre Haute, Indiana, on the 15th day of July 2014, at 10:00 a.m. Those present were Jim Winning, Tim Adams, and Chuck Ennis for the Board of Sanitary Commissioners. Terry Modesitt was also present. Brad Bush was absent.

Also present were Sally Roetker, Pat Martin, and Jennifer Bolen of the Engineering Department; Kevin Hurst of HNTB; Eric Smith and Troy Swan of HWC.

The meeting was called to order by President Jim Winning. There were no public comments.

APPROVE MINUTES

The minutes from the July 1st meeting were presented to the Board.

On motion of Tim Adams, seconded by Chuck Ennis, and unanimously approved, it was resolved that the minutes from the July 1st meeting be approved.

APPROVE CLAIMS

There were no claims.

CHANGE ORDER #5 FOR THE WASTEWATER TREATMENT PLANT PHASE II PROJECT

Kevin Hurst of HNTB presented the Board with Change Order #5 for this project.

It was moved by Larry Auler, seconded by Tim Adams, and unanimously approved, it was resolved that Change Order #5 for the Wastewater Treatment Plant Phase II Project be approved.

LTCP REVISIONS - HIGH RATE TREATEMENT FACILITY

Eric Smith of HWC presented the Board with a revision for the LTCP. It is no longer feasible to use the lagoons as planned. A high rate treatment facility will be used instead. See attached document. This will be more cost effective. Chuck Ennis also informed the Board that IDEM will be conducting an audit of our LTCP. They will be here on August 28th to complete the audit. Chuck also informed the Board that the consultant for the re-lining project is getting ready to bid the project.

OTHER

Sugar Creek Scarp - Pat Martin updated the Board on the progress at the Sugar Creep Scrap site. Lead was found throughout the site and arsenic was found in two squares. They should be finishing up the last week of July. After they are finished, the remaining waste will be cleared by the Sanitary District. Chuck Ennis said that we will put this out of bid in a couple of weeks. Contractor will need to remove the remaining trash and then put a soil cover in place. The EPA is investigating where contamination came from.

ADJOURNMENT

The meeting was adjourned at 10:37.

The next regular meeting of the Sanitary Board will be held on August 5, 2014 at 10:00 a.m. in the Mayor's Conference Room, 3rd Floor, City Hall, 17 Harding Avenue, Terre Haute, Indiana.

APPROVED on the 5th day of August, 2014.

Jim Winning, President

Tim Adams, Vice President

Brad Bush, Secretary

Larry Auler, Member

Chuck Ennis, Member

IDEM
OFFICE OF
WATER QUALITY
2014 MAY -1 P 2:16

April 25, 2014

Ms. Kara Wendholt
Indiana Department of Environmental Management
Office of Water Quality
Mail Code 65-42
100 N Senate Ave Room IGCN 1255
Indianapolis, IN 46204

**CITY OF
TERRE HAUTE
MAYOR'S OFFICE**

**City Hall
17 Harding Avenue
Terre Haute, IN 47807**

**Phone: 812.244.2303
Fax: 812.244.2305**

www.terrehaute.IN.gov

**DUKE A BENNETT
Mayor**

Re: City of Terre Haute
CSO Long Term Control Plan – Response to LTCP Amendment Review

Dear Ms. Wendholt:

We have received and reviewed your comments to our LTCP Amendment in a letter dated March 10, 2014 and offer the following responses. For ease of review, IDEM comments are listed with our responses in bold and italics.

Table of Contents

1) Several page numbers are inaccurate throughout the Table of Contents. Please correct the page numbering.

The page numbering has been corrected in the Table of Contents. The revised table of contents is included with this submittal.

Executive Summary

1) Introduction (Page E-1) – In the second paragraph of this section, it appears the level of control is being changed from seven (7) overflow events per typical year to six (6) overflow events per typical year. Please mention the change in the level of control with this LTCP Amendment and ensure all references to the level of control are updated.

Upon further review, the level of control will remain at seven (7) overflow events per typical year even with amendments to the LTCP. There is an indication in the data that a level of control of six (6) overflow events per typical year could potentially be realized at the Spruce Street Outfall (010), which would reduce the number of overflow events per typical year upstream of the Fairbanks Park priority area to six (6). This could be achieved through flow control in Basins 009/010 and reduction of wet weather flows via green infrastructure improvements in Basins 009/010, both of which are included in the recommended plan as an interim step to get to seven (7) overflows to reduce or eliminate storage at that location. Additionally, the relief sewer is sized larger than that required for seven (7) overflows due to nominal pipe diameters. However, more significant modifications would be required at CSOs 004/-11 and 003 to achieve a six (6) overflow per typical year level of control now. Accordingly, the level of control will officially remain at seven (7) overflow events per typical year for the City's overall system.

2) Introduction (Page E-1) – In the second paragraph of this section, the level of control is changing from seven (7) to six (6) overflow events per typical year, but the numbers of hours when bacteria

loadings from the CSOs exceed recommended levels in the river by 75% has not changed. Please update the number of hours CSOs will exceed recommended levels.

The level of control will remain at seven (7) overflow events per typical year, so no change in the number of hours CSOs will exceed recommended levels is required.

3) Public Participation (Page E-5) – If public meetings were held to notify the public and/or interested parties of the changes to the City's LTCP, please include that information in this section.

Public meetings were not held to notify the public and/or interested parties of the changes to the City's LTCP. A CAC meeting is being proposed for later this year. Please advise if additional public notification is required.

4) Revised Recommended Plan (2013) (Page E-7) – The revised estimated cost of the new recommended plan is listed at $124 million. On Page ES-1 of the Project 1-3 Basis of Design listed in Appendix 6-5, it states the high rate treatment facility is a 40% construction cost savings when compared to the storage lagoons alternative at the IP site. Please discuss why the overall costs increased when the high rate treatment facility is 40% less expensive than the storage lagoons at the IP site.

Due to the additional information gathered concerning the IP lagoons during the basis of design phase, which are discussed on Pages E-4 through E-5, construction costs for the original recommended plan (Alternative 11) had to be revised and increased drastically from initial estimates included in the LTCP. In the Project 1-3 Basis of Design, construction costs of the new high rate treatment facility were compared to the revised construction costs of the IP lagoon storage (Alternative 11), resulting in a 40% construction cost savings. However, when the construction costs for the new high rate treatment facility were incorporated into the new recommended plan (Alternative 11b), it resulted in a 3% overall increase in the total project cost over the initial estimate.

Section 6 – Development of CSO Control Alternatives

1) Section 6.4.3.4 (Page 6-22) – The last bulleted item under Disadvantages mentions the requirement for a separate NPDES permit for the effluent discharge from the high rate treatment facility. A separate NPDES permit would not be issued for the high rate treatment facility; however, the existing NPDES permit would need to be modified to recognize and establish limits for the high rate treatment facility.

Per this comment, the report has been revised accordingly to reflect additional NPDES permit requirements but not an additional permit.

2) Section 6.8.1.4 (Page 6-52) – It states that outfalls 004, 005, 006, 007, 008, 009 and Turner (003) will be closed. Maps in Figures ES-2, 6.7-4 and 10.2-1 show Turner will remain open. Why do the maps show CSO 003 to remain open? If CSO 003 is to remain open, why can it not be closed? Also, there is no mention in this section that CSO 002 will be closed, but the maps indicate CSO 002 will be eliminated. Please clarify the fate of CSOs 003 and 002.

Both CSO 003 and 002 will be closed as part of Phase II of the recommended plan. Text in Section 6.8.1.4 and all figures referenced have been revised to reflect this.

Section 7 – Cost Performance Considerations

1) Section 7.2.3 (Page 7-76) – The first sentence of this section mentions 'the final three alternatives'. With the addition of Alternate 11b, it should now read 'the final four alternatives'.

   The report has been revised as suggested.

2) Section 7.2.3 (Pages 7-77 through 7-79) – Tables 7.2-8, 7.2-9 and 7.2-10 do not contain information for the newly considered alternative. Please update the tables to contain information for Alternative 11b. Also, please update Page EX-1 with the correct number of total hours of overflow in a typical year for six (6) overflow events per year.

   Tables 7.2-8, 7.2-9 and 7.2-10 have been revised to contain information for Alternative 11b. However, since the level of control will remain at seven (7) overflow events per year, Page EX-1 will not be revised as suggested.

3) Section 7.5 (Page 7-97) – The preferred alternative is still listed as Alternative 11 with a level of control of seven (7) overflow events per typical year. Alternative 11b is the new selected alternative with a level of control of six (6) overflow events per typical year. Please correct this information with the section and throughout the document where necessary.

   Alternative 11b will provide a level of control of seven (7) overflow events per typical year. This is the same as the previously preferred alternative. However, a new Section 7.6 has been added to the report to state that Alternative 11b is the new selected alternative.

Section 10 – Recommended Plan

1) Section 10.1 (Page 10-1) – The last paragraph on the page mentions there have been unknown/unforeseen conditions in two of the five CSO control projects for Phase I. Per discussions and a letter from the City dated August 26, 2013, there were unknown/unforeseen conditions in three of the five CSO control projects within Phase I of the LTCP (Phase 1-2 – Hulman/Idaho Street (CSO 004/011) Project, Phase 1-3 – High Rate Treatment Facility, and Phase 1-4 – CSO 009/010 Sewer Consolidation Project).

   The report has been revised as suggested.

2) Section 10.2 (Page 10-2) – Will a screen be necessary upstream of the high rate treatment facility for floatables control?

   No, a screen will not be necessary upstream of the high rate treatment facility for floatables control. The high rate treatment facility will receive flows from the main lift station, which has mechanical screens ahead of the pumps, so screening is already provided to flows conveyed to the high rate treatment facility.

3) Section 10.2 (Page 10-2) – The first paragraph of this section states 'There would be a relocation of CSO 003 to involve only a high level overflow of the converted IP storage ponds, with the current CSO 003 being completely eliminated'. The maps provided in Figures ES-2, 6.7-4 and 10.2-1 show CSO 003 to remain open. Conversely, Figure 10.3-1 shows CSO 003 to be eliminated. Please clarify the fate of CSO 003 and correct in all appropriate locations within the document.

   CSO 003 will be closed as indicated in the text. All appropriate figures have been revised accordingly.

4) Section 10.2 (Page 10-3) – Number 2 of the site survey conclusions references a geotech report. Will this be included with the full submittal of the Phase 1-3 Basis of Design report? If not, please include the geotech report referenced.

   The geotech report is included with the full Project 1-3 Basis of Design report. See later comment for download instructions.

5) Section 10.2 (Page 10-4) – Figure 10-2013-2 is referenced. Is the figure titled correctly within the text?

   The figure was not titled correctly within the text. The figure referenced should be Figure 10.2-1. The report has been revised accordingly.

6) Section 10.2 (Page 10-6) – Figure 10-2013-1 is referenced. Is the figure titled correctly within the text?

   The figure was not titled correctly within the text. The figure referenced should be Figure 10.2-1. The report has been revised accordingly. Furthermore, the text has been revised so that the previous CSO 009 to CSO 010 consolidation sewer location is no longer included.

7) Section 10.3.2 (Page 10-12) – Table 10.3-1 does not appear to match the Implementation Schedule Description of Phases submitted to IDEM in a letter from the City dated August 26, 2013. Please update Table 10.3-1 to match the table submitted in 2013.

   Table 10.3-1 has been corrected to match the Implementation Schedule Description of Phases per the August 26, 2013 letter cited.

8) Section 10.3.2 (Page 10-12) – Please incorporate the five projects of Phase I into the Description of Phases in Table 10.3-1 (like detailed in the letter to IDEM dated August 26, 2013, from the City).

   The five projects of Phase I have been incorporated into the Description of Phases in Table 10.3-1 as suggested.

9) Section 10.3.2 (Page 10-13) – Table 10.3-2 does not appear to match the Implementation Schedule submitted to IDEM in a letter from the City dated August 26, 2013. Please update Table 10.3-2 to match the schedule submitted in 2013.

Table 10.3-2 has been corrected to match the Implementation Schedule per the August 26, 2013 letter cited.

Figures

1) The maps in Figures ES-2 (Recommended Plan), Figure 6.7-4 (Alternative 11b), Figure 10.2-1 (Recommended Plan) and 10.3-1 (Phasing of Recommended Plan) are all slightly different. Which map contains the accurate depiction of the recommended plan? Please update the maps that are inaccurate.

   Each figure cited above has been corrected as necessary to ensure they depict an identical recommended plan.

   While not noted in comments, Figures 6.7-1 through 6.7-4 are referred to as Figures 6.8-1 through 6.8-4, respectively, in the text. In keeping with the standard figure notation within the text, each figure title has been revised accordingly.

2) A revised map of Alternative 11 in Figure 6.7-2 was submitted. The map for Alternative 11 does not reference the storage lagoons at the IP site which is a project in Alternative 11, but rather shows the new high rate treatment facility which is a project in Alternative 11b. It appears in the LTCP Amendment that Alternative 11 has not changed. Why was a revised map of Alternative 11 submitted?

   Figure 6.7-2 (now titled 6.8-2) has been revised so that it shows only those project elements included in Alternative 11.

Appendix 6-5

1) Only a portion of the Project 1-3 Basis of Design was submitted in Appendix 6-5. Please submit the full Project 1-3 Basis of Design Report.

   The full Project 1-3 Basis of Design Report will be available for download through HWC Engineering's FTP site. Please contact Jeremy Burch (jburch@hwcengineering.com) for download instructions.

2) Since the City used two separate consultants, did the consultants share the same hydraulic model for design? Had the model been substantially changed since it was approved?

   The two consultants did share the same hydraulic model for the development of the Project 1-3 Basis of Design and the model had not been substantially changed since it was approved. HWC, as the program manager, provided the model information to all of the design consultants.

If you have any questions or additional concerns, please contact either myself at 812-232-6564 or our LTCP Program Management Consultant, Eric Smith at 812-234-2551, ext. 410.

Sincerely,

Honorable Mayor Duke Bennett

City of Terre Haute

Attachment

cc: Chuck Ennis, P.E., City Engineer
Mark Thompson, Wastewater Utility Director
Eric Smith, P.E., HWC Engineering

IDEM
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
We Protect Hoosiers and Our Environment.

Michael R. Pence
Governor

Thomas W. Easterly
Commissioner

100 North Senate Avenue
Indianapolis, Indiana 46204
(317) 232-8603
Toll Free (800) 451-6027
www.idem.IN.gov

March 10, 2014

VIA ELECTRONIC MAIL

The Honorable Duke Bennett, Mayor
City of Terre Haute
17 Harding Avenue
Terre Haute, Indiana 47803

Dear Mr. Bennett:

Re: Long Term Control Plan
Amendment Review
City of Terre Haute
NPDES Permit No. IN0025607
Vigo County

The Indiana Department of Environmental Management (IDEM) Office of Water Quality (OWQ) has conducted a substantive review of the City of Terre Haute's Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) Amendment document initially received on January 22, 2014, with a version highlighting changes from the originally approved LTCP received February 21, 2014. The review is to determine whether the LTCP Amendment meets the requirements of Federal and State law. This letter is intended to outline the alternative proposed in your LTCP Amendment (as understood by IDEM), outline the issues regarding the LTCP Amendment which must be resolved before approval may occur, and continue discussions between IDEM and the City to resolve remaining issues. The issues are outlined below following a brief summary of the proposed LTCP Amendment alternative.

Proposed Alternative

The City of Terre Haute's LTCP, once implemented, is expected to result in six (6) overflow events per typical year. This is a more stringent level of control from the original LTCP that was approved on August 10, 2011. The LTCP will be implemented over a 20-year period at a cost of approximately $124 million.

The LTCP Amendment contains the following changes from the originally approved LTCP:

- The International Paper (IP) lagoons were originally intended to be utilized for CSO storage. Due to existing conditions of the lagoons, the IP site will now be used as the location for a high rate treatment facility with UV disinfection. The high rate treatment facility will be constructed in two phases, a 16.25 MGD unit in Phase I and a second unit of identical capacity in Phase II. The total capacity of the high rate treatment facility will be 32.5 MGD.

- The sewer consolidation of CSOs 009/010 was originally intended to be constructed along First Street. Due to recent developments, an alternate connection route was identified and will now be constructed along Fourth Street.

- The scheduled construction of the floatable/in-line storage control structure for CSOs 004/011 is indeterminate at this time due to contamination at the construction site. The LTCP implementation schedule will be updated once the site is cleared for construction activities to occur.

IDEM staff has compiled a series of comments and questions that must be addressed prior to further action on your LTCP Amendment. Our staff looks forward to assisting the City of Terre Haute in addressing these issues. Additional questions may arise after further review of the information presented. The issues that need to be resolved are broken down to correlate with the Sections listed in the LTCP Amendment.

Table of Contents

1) Several page numbers are inaccurate throughout the Table of Contents. Please correct the page numbering.

Executive Summary

1) Introduction (Page E-1) – In the second paragraph of this section, it appears the level of control is being changed from seven (7) overflow events per typical year to six (6) overflow events per typical year. Please mention the change in the level of control with this LTCP Amendment and ensure all references to the level of control are updated.
2) Introduction (Page E-1) – In the second paragraph of this section, the level of control is changing from seven (7) to six (6) overflow events per typical year, but the number of hours when bacteria loadings from the CSOs exceed recommended levels in the river by 75% has not changed. Please update the number of hours CSOs will exceed recommended levels.
3) Public Participation (Page E-5) – If public meetings were held to notify the public and/or interested parties of the changes to the City's LTCP, please include that information in this section.
4) Revised Recommended Plan (2013) (Page E-7) – The revised estimated cost of the new recommended plan is listed at $124 million. On Page ES-1 of the Project 1-3 Basis of Design listed in Appendix 6-5, it states the high rate treatment facility is a 40% construction cost savings when compared to the storage lagoons alternative at the IP site. Please discuss why the overall costs increased when the high rate treatment facility is 40% less expensive than the storage lagoons at the IP site.

Section 6 – Development of CSO Control Alternatives

1) Section 6.4.3.4 (Page 6-22) – The last bulleted item under Disadvantages mentions the requirement for a separate NPDES permit for the effluent discharge from the high rate treatment facility. A separate NPDES permit would not be issued for the high rate treatment facility; however, the existing NPDES permit would need to be modified to recognize and establish limits for the high rate treatment facility.

2) Section 6.8.1.4 (Page 6-52) – It states that outfalls 004, 005, 006, 007, 008, 009, and Turner (003) will be closed. Maps in Figures ES-2, 6.7-4, and10.2-1 show Turner (003) will remain open. Why do the maps show CSO 003 to remain open? If CSO 003 is to remain open, why can it not be closed? Also, there is no mention in this section that CSO 002 will be closed, but the maps indicate CSO 002 will be eliminated. Please clarify the fate of CSOs 003 and 002.

Section 7 – Cost Performance Considerations

1) Section 7.2.3 (Page 7-76) – The first sentence of this section mentions 'the final three alternatives'. With the addition of Alternative 11b, it should now read 'the final four alternatives'.
2) Section 7.2.3 (Pages 7-77 through 7-79) – Tables 7.2-8, 7.2-9, and 7.2-10 do not contain information for the newly considered alternative. Please update the tables to contain information for Alternative 11b. Also, please update Page EX-1 with the correct number of total hours of overflow in a typical year for six (6) overflow events per year.
3) Section 7.5 (Page 7-97) – The preferred alternative is still listed as Alternative 11 with a level of control of seven (7) overflow events per typical year. Alternative 11b is the new selected alternative with a level of control of six (6) overflow events per typical year. Please correct this information within the section and throughout the document where necessary.

Section 10 – Recommended Plan

1) Section 10.1 (Page 10-1) – The last paragraph on the page mentions there have been unknown/unforeseen conditions in two of the five CSO control projects for Phase I. Per discussions and a letter from the City dated August 26, 2013, there were unknown/unforeseen conditions in three of the five CSO control projects within Phase I of the LTCP (Phase 1-2 – Hulman/Idaho Street (CSO 004/011) Project, Phase 1-3 – High Rate Treatment Facility, and Phase 1-4 – CSO 009/010 Sewer Consolidation Project).
2) Section 10.2 (Page 10-2) – Will a screen be necessary upstream of the high rate treatment facility for floatables control?
3) Section 10.2 (Page 10-2) – The first paragraph of this section states 'There would be a relocation of CSO 003 to involve only a high level overflow of the converted IP storage ponds, with the current CSO 003 being completely eliminated'. The maps provided in Figures ES-2, 6.7-4, and 10.2-1 show CSO 003 to remain open. Conversely, Figure 10.3-1 shows CSO 003 to be eliminated. Please clarify the fate of CSO 003 and correct in all appropriate locations within the document.
4) Section 10.2 (Page 10-3) – Number 2 of the site survey conclusions references a geotech report. Will this be included with the full submittal of the Phase 1-3 Basis of Design report? If not, please include the geotech report referenced.
5) Section 10.2 (Page 10-4) – Figure 10-2013-2 is referenced. Is the figure titled correctly within the text?
6) Section 10.2 (Page 10-6) – Figure 10-2013-1 is referenced. Is the figure titled correctly within the text?
7) Section 10.3.2 (Page 10-12) – Table 10.3-1 does not appear to match the Implementation Schedule Description of Phases submitted to IDEM in a letter from the City dated August 26, 2013. Please update Table 10.3-1 to match the table submitted in 2013.

8) Section 10.3.2 (Page 10-12) – Please incorporate the five projects of Phase I into the Description of Phases in Table 10.3-1 (like detailed in the letter to IDEM dated August 26, 2013, from the City).
9) Section 10.3.2 (Page 10-13) – Table 10.3-2 does not appear to match the Implementation Schedule submitted to IDEM in a letter from the City dated August 26, 2013. Please update Table 10.3-2 to match the schedule submitted in 2013.

Figures

1) The maps in Figures ES-2 (Recommended Plan), Figure 6.7-4 (Alternative 11b), Figure 10.2-1 (Recommended Plan), and 10.3-1 (Phasing of Recommended Plan) are all slightly different. Which map contains the accurate depiction of the recommended plan? Please update the maps that are inaccurate.
2) A revised map of Alternative 11 in Figure 6.7-2 was submitted. The map for Alternative 11 does not reference the storage lagoons at the IP site which is a project in Alternative 11, but rather shows the new high rate treatment facility which is a project in Alternative 11b. It appears in the LTCP Amendment that Alternative 11 has not changed. Why was a revised map of Alternative 11 submitted?

Appendix 6-5

1) Only a portion of the Project 1-3 Basis of Design was submitted in Appendix 6-5. Please submit the full Project 1-3 Basis of Design report.
2) Since the City used two separate consultants, did the consultants share the same hydraulic model for design? Had the model been substantially changed since it was approved?

IDEM is encouraged that the approach being proposed within the City's LTCP Amendment may be acceptable and would like to work with you to rapidly address the issues within this letter. Please respond to these comments within 45 days from the date of this letter. Please contact Kara Wendholt at 317-233-5961or by email at kwendhol@idem.in.gov if you have questions regarding this letter.

Sincerely,

Paul Higginbotham, Chief
Permits Branch
Office of Water Quality

cc: Mark Thompson, Wastewater Utility Director
Chuck Ennis, P.E., City Engineer
Eric Smith, P.E., HWC Engineering
Jeremy Burch, P.E., HWC Engineering

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January 20, 2014

Ms. Kara Wendholt
Indiana Department of Environmental Management
Office of Water Quality
Mail Code 65-42
100 North Senate Avenue Room NPDES Permit #2
Indianapolis, IN 46204

Re: City of Terre Haute
CSO Long Term Control Plan Revisions

Dear Ms. Wendholt:

As we discussed in our meeting with IDEM representatives on May 25, 2013, some issues have developed during the implementation of the City of Terre Haute's CSO LTCP Phase I which affect the recommended plan. While we have submitted updated schedules which reflect the modifications to the Phase I work, it was requested that due to the significance of the modifications to the plan, specifically the use of the former International Paper lagoons for CSO storage, that a revised LTCP report be submitted to IDEM which includes the rationale for the requested changes.

To summarize our discussions with respect to the need for scope adjustments for the selected plan, the following describes the issues which necessitated these changes during the Phase I projects.

- Project 1-3 – CSO Flow Storage – International Paper Lagoons – Each project recommended in the Phase I of the LTCP was required to be re-evaluated by a consultant in a "basis of design" study phase during which more detailed analysis would be completed to develop a more defined scope of work for the project. During the study phase for this project, the consultant did additional testing and analyses necessary to evaluate the recommended plan for this site. Due to several factors including but not limited to the following:
    - Soil Conditions ;
    - Berm Condition/Elevations;
    - Cost ;
    - Additional Time for Regulatory Approvals;
    - "First Flush" Sizing Requirements for Primary Treatment with chlorination/de-chlorination (StormKing);

  The consultant evaluated other alternatives for this site, including the option included in the revised selected plan of a 32.5 MGD High Rate Treatment facility with effluent discharge to the Wabash River.

- Project 1-4 CSO 009/010 Consolidation Sewer (a common project element in the LTCP) – The original sewer proposed to consolidate these two outfalls and close CSO 009 was to be constructed along or in First Street between Chestnut and Spruce Streets. Due to recent developments along First Street by Indiana State University, the planned route was less desirable and other options were explored in the system's model. An alternate route was identified which reduced the amount of sewer required significantly and would be constructed in Fourth Street, a less traveled street, thus making construction more feasible.

Accordingly, please find attached a revised copy of the approved LTCP with the proposed changes to Phase I and other aspects of the plan. The major scope revisions to the selected plan include a revision to the location of the connection of CSO's 009 and 010, and the conversion from CSO storage via the existing lagoons to a phased high rate treatment system. The revised sections of the LTCP provide the information documenting these revisions and other minor changes based on information obtained during Phase I for your review and approval. As you review the revised plan, please consider the following changes in the respective sections of the report:

1. Executive Summary – Revised language to reflect the changes in the selected plan affected by the scope changes.
2. Section 6 – Addition of the alternative of High Rate Treatment at the Storage Lagoon site and other modifications to reflect inclusion of the scope modification to the alternative evaluation section.
3. Section 7 – Revisions to the capital and annual costs of all alternatives evaluated as a result of the scope changes to the selected plan, and the cost modifications based on re-evaluation of various components of the alternatives during the "Basis of Design" development of Phase I.
4. Section 10 – Revised language regarding the selected plan revision, scope changes to Phase I and II (and affects upon future phases), and updated schedules previously submitted separately to IDEM and approved.
5. Appendix 6-5 – This appendix has been added to include information from the Consultant's Basis of Design report documenting the recommended revisions at the International Paper Lagoon site.

If you have any questions or additional concerns, please contact either me at 812-234-2551 ext. 410.

Sincerely,

Eric M Smith

Eric M. Smith, P.E., Program Manager
HWC Engineering

ESM:leb/O:\PROJECTS\Terre Haute\2003-121 CSO Program Management\LTCP-December 2013-Revisions\ltr.wendholt.idem.LTCPrev.1-9-14.ems-leb.docx

Attachments

cc: Chuck Ennis, P.E., City Engineer
Mark Thompson, Wastewater Utility Director

IDEM
OFFICE OF
WATER QUALITY

2013 OCT -1 A 8: 02

August 26, 2013

CITY OF
TERRE HAUTE
MAYOR'S OFFICE

City Hall
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Terre Haute, IN 47807

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DUKE A BENNETT
Mayor

Ms. Kara Wendholt
Indiana Department of Environmental Management
Office of Water Quality
Mail Code 65-42
100 N Senate Ave Room IGCN 1255
Indianapolis, IN 46204

Re: City of Terre Haute
CSO Long Term Control Plan – Schedule Update Notification

Dear Ms. Wendholt:

As we discussed in our meeting with IDEM representatives on May 25, 2013, several issues have occurred recently with regard to multiple sites included in the Phase I projects of the City's Long Term Control Plan (LTCP) which necessitate schedule adjustments and milestone complete date modifications. Accordingly, this notification is being submitted regarding the completion of the various Phase I projects for the LTCP and the corresponding scope revisions we have discussed previously.

For reference, there are 5 separate and distinct projects in Phase I of the City's LTCP and discussed within this letter and the corresponding revised schedule, identified as follows:

1. Project 1-1 – Spruce/Chestnut Street (CSO 009/010) Floatable Control Structure
2. Project 1-2 – Hulman/Idaho Street (CSO 004/011) Floatable/In-line Storage Control Structure
3. Project 1-3 – Main Lift Station Site High Rate Treatment Facility (CSO Lagoon Storage Facility in LTCP – See below for discussion of Scope change)
4. Project 1-4 – CSO 009/010 Consolidation Sewer (Connecting Chestnut Combined Sewer to Spruce Street and allow for closure of CSO 009)
5. Project 1-5 - Sewer Rehabilitation

To summarize our discussions with respect to the need for scope and/or schedule adjustments for these various projects, the following describes the issues which are affecting the Phase I projects.

- Project 1-2 – Hulman/Idaho Floatables Control/Flow Control Structure – The proposed site of this project located west of First Street/Prairieton Road, and along the Idaho Combined sewer was being cleared for the future construction in early 2013 when potential contamination from prior dumping of industrial materials and waste was discovered. Additional testing conducted by and in conjunction with IDEM and EPA investigations indicated materials on and just below the surface which would require removal and disposal before any construction of CSO LTCP improvements on the site. EPA is managing the testing and cleanup – which does not qualify as a "superfund" site - and the City with agency assistance will attempt to recover costs of cleanup from the previous property owners. Given the uncertain schedule for cleanup, revised completion dates for starting and completing construction are indeterminate at this time. As directed in our meeting, we have provided milestone completion dates for other tasks related to this project including design and permit applications with the understanding that new completion dates for construction will be proposed once the cleanup of the site is finished.

- Project 1-3 – CSO Flow Storage – International Paper Lagoons – Each project recommended in the LTCP was required to be re-evaluated by a consultant in a "basis of design" study phase during which more detailed analysis would be completed to develop a more defined scope of work for the project. During the study phase for this project, the consultant did additional testing and analyses necessary to evaluate the recommended plan for this site. Due to several factors including but not limited to the following, the consultant evaluated other alternatives for this site:

    - Soil Conditions – After completion of the LTCP, all sludge was removed from the lagoons. Testing of the in-situ soils revealed that the lagoons could not meet permeability requirements and lining the lagoon would be required. Additionally, due to the 100 year flood elevation, the potential for excessive groundwater pressure eliminated the option of geo-membrane type liners.
    - Berm Condition/Elevations – The existing berms were raised by the former owner in compliance with an Agreed Order, however the elevation is below the 100 year flood elevation based on field surveys conducted. Additionally, soil testing and observations of the profile of the berm made possible due to failure of the berm in recent flooding events indicate that the berms are not suitable to protect stored CSO flows from high river levels without significant improvements.
    - Cost – Given the additional needs of the site in order to allow the lagoon facility to be utilized for CSO flow storage, the cost for this site as included in the LTCP increased significantly in the basis of design phase such that storage was not cost effective when compared to other alternatives including various forms of high rate treatment. As a result, these options were further evaluated in the study phase and ultimately were more cost effective than the LTCP recommended plan of CSO storage at the site..
    - Additional Time for Regulatory Approvals - Given the results of detailed field surveys, it was determined that additional time would have been required for regulatory approvals which would have prevented the current implementation schedule from being met.
    - "First Flush" Sizing Requirements for Primary Treatment with chlorination/dechlorination (StormKing) – The first alternative considered in lieu of CSO flow storage was a "StormKing" primary treatment unit with chemical disinfection. While this option provided a viable alternative to storage, its design requirement of the first flush for sizing proved problematic given the variation and size of the flows predicted in the system's model.

As a result of these factors, the City accepted the recommendation of the consultant to implement a high rate treatment (HRT) facility at this site in lieu of the CSO storage. Additionally, the HRT selected would be a sand ballasted type clarification unit with chemical coagulation addition and ultra-violet disinfection which was preferred by the operations staff. Given the incremental increase in cost of this alternative as compared to the original Phase I budget for which bonds have been procured for, the HRT will be constructed in two phases of 16.5 MGD each, with the second phase being constructed concurrently with the new main lift station in Phase II of the LTCP.

- Project 1-4 CSO 009/010 Consolidation Sewer (a common project element in the LTCP) – The original sewer proposed to consolidate these two outfalls and close CSO 009 was to be constructed along or in First Street. Due to recent developments along First Street by Indiana State University, the planned route was less desirable and other options were explored in the system's model. An alternate route was identified which reduced the amount of sewer required significantly and would be constructed in Fourth Street, a less traveled street, thus making construction more feasible. While saving Phase I project costs, this option will require easements and property acquisition from Indiana State, and should be constructed during a period when students are not in school, all of which affects the schedule for this item which was included with all other Phase I work originally.

Given these necessary changes, as discussed in our meeting, some milestone dates for design and construction of Phase I projects required modification. It is estimated that all remaining Phase I activities will be completed in accordance with the new or revised dates included in the attached Table 10.3-2. As a result, we hereby request approval to amend the completion dates of the highlighted Phase I project items accordingly. It should be noted that the revisions to the schedule proposed do not affect the level of CSO control (except the HRT will be constructed in two phases), nor will the final completion date for all Phase I or subsequent Phases be affected. Since the construction of the Floatable Control/Flow Control Structure at Idaho Street is indeterminate with respect to the schedule of the EPA cleanup, milestone dates have been included for design and permitting so that the project is essentially ready for construction pending the cleanup.

The scope revisions which include a revision to the location of the connection of CSO's 009 and 010, and the conversion from CSO storage via the existing lagoons to a phased high rate treatment system will be submitted with a revised LTCP per your direction.

If you have any questions or additional concerns, please contact either myself at 812-232-6564 or our LTCP Program Management Consultant, Eric Smith at 812-234-2551.

Sincerely,

Duke A Bennett

Honorable Mayor Duke Bennett
City of Terre Haute

Attachment

cc: Chuck Ennis, P.E., City Engineer
Mark Thompson, Wastewater Utility Director
Eric Smith, P.E., HWC Engineering

Table 10.3-1
Implementation Schedule
Description of Phases

Item	**Description**	**Project Start Construction Date**
WWTF Improvements - Phase One	Construction of new Headworks	11/2010
WWTF Improvements - Phase II/III	Increase sustained flow capacity through entire plant from approximately less than 40MGD to 48MGD, add nutrient removal capability to plant, improve other aspects of plant facilities Upgrade disinfection facilities and biosolids processing and storage facilities	*11/2012*
CSO LTCP Phase 1	Phase I of High Rate Treatment (HRT) Facility (16.5 MGD) at the Main Lift Station and IP Lagoon rehabilitation, add 2nd FM at existing main lift station to HRT, combine CSO's 004 and 011 with new floatable controls there. Combine CSO's 009 and 010 with new floatable controls there plus other common alternatives.	*08/2013*
CSO LTCP Phase 2	Construct new main lift station and Phase II of HRT (16.5 MGD), initial phase of green infrastructure *implementation in Basins 009/010*	*02/2017*
CSO LTCP Phase 3	Construct CSO Interceptor from 004 to new main lift station, final phase of green infrastructure *implementation in Basins 009/010*	*07/2020*
CSO LTCP Phase 4	Construct CSO Interceptor from 008 to 004 *Monitor success of Green Infrastructure in Basins 009/010*	*02/2025*
CSO LTCP Phase 5	Construct Storage Facility at 010*	*06/2028*

**If the green infrastructure projects implemented in Phase 2 and 3 and monitored in Phase 4 result in the attainment of the target level of control at the combined 009/010 outfall, then Phase 5 will not be needed.*

If, though, it appears that the target level of control cannot be achieved without additional green or new "gray" infrastructure, (storage tanks near 009/010), then the City will request additional time beyond the 20-year timeframe in order to plan, design and construct the additional facilities. We understand that IDEM would seriously consider that request, and if IDEM determines that the additional time is needed, then the parties would amend the State Judicial Agreement to specify additional time. Language to this effect has been added to Sections 8 and 10 of the LTCP, and we understand that it will also be added to the City's NPDES permit when the LTCP is approved and incorporated into the permit by IDEM.

Note that this condition also applies to the proposed implementation schedule shown on Table. 10.3-2

Table 10.3-2
Implementation Schedule
(20 Years)

Item	Original Milestone Date	Revised Milestone Date
Complete & Submit CSOLTCP	04/2011	
WWTF Improvements – Complete Phase I Construction	04/2012	
WWTF Improvements – Complete Phase II Design Finalize Financing, Procure Bids	09/2012	
~~CSOLTCP – Complete Phase I P.E.R.~~ ~~Initiate Design of Phase I~~	~~10/2012~~	
~~CSOLTCP – Complete Phase I Design~~ ~~Finalize Financing, Procure Bids~~	~~06/2013~~	
CSOLTCP – Initiate Basis of Design Reports Projects 1-1, 1-2 and 1-3		10/2012
CSOLTCP – Complete Phase I Design – Project 1-1 (Spruce/Chestnut Floatables Control Structure		06/2013
CSOLTCP Receive Bids for Project 1-1		07/2013
CSOLTCP Begin Design Phase I Common Elements (Project 1-4 and 1-5)		08/2013
CSOLTCP Begin Construction Project 1-1		08/2013
CSOLTCP Permit Application Submission Projects 1-2 and 1-3		12/2013
CSOLTCP Complete Design Phase I (Project 1-4 and 1-5)		03/2014
CSOLTCP Complete Design Project 1-3 (Main Lift Station Site High Rate Treatment)		03/2014
CSOLTCP Receive Bids Project 1-3 and Phase I Common Elements Projects (Project 1-4 and 1-5)		04/2014
CSOLTCP Receive Bids Project 1-2		TBD[1]
CSOLTCP Begin Construction Project 1-3, and Phase I Common Elements (Project 1-4 and 1-5)		05/2014
CSOLTCP Begin Construction Project 1-2		TBD[1]
WWTF Improvements – Complete Construction of Phase II	10/2015	
CSOLTCP Complete Construction Project 1-2		TBD[1]
~~CSOLTCP – Complete Construction of Phase I~~	~~03/2015~~	
CSOLTCP – Complete Construction of Phase I – Project 1-1, and Phase I Common Elements Projects (Project 1-4 and 1-5)		09/2015
CSOLTCP – Complete Construction of Phase I – Project 1-3		09/2015
CSOLTCP – Initiate Monitoring of Phase I and P.E.R. of Phase II	11/2015	
Review and Re-evaluate CSOLTCP	12/2015	
CSOLTCP – Complete Phase I Monitoring and Phase II P.E.R Initiate Phase II Design	04/2016	
CSOLTCP – Complete Phase II Design Finalize Financing, Procure Bids	12/2016	
CSOLTCP – Complete Construction of Phase II	08/2018	
CSOLTCP – Initiate Monitoring of Phase II and P.E.R. of Phase III	09/2018	

Item	Original Milestone Date	Revised Milestone Date
CSOLTCP – Complete Phase II Monitoring and Phase III P.E.R. Initiate Phase III Design	*06/2019*	
Review and Re-evaluate CSOLTCP	*06/2019*	
CSOLTCP – Complete Phase III Design Finalize Financing, Procure Bids	*06/2020*	
CSOLTCP – Compete Phase III Construction	*06/2022*	
CSOLTCP – Initiate Monitoring of Phase III and P.E.R. of Phase IV	*07/2022*	
CSOLTCP – Complete Phase III Monitoring and Phase IV P.E.R. Initiate Design of Phase IV	*06/2023*	
Review and Re-evaluate CSOLTCP	*12/2023*	
CSOLTCP – Complete Phase IV Design Finalize Financing, Procure Bids	*12/2024*	
CSOLTCP – Complete Phase IV Construction	*12/2026*	
CSOLTCP – Initiate Monitoring of Phase IV and Phase V P.E.R.	*01/2026*	
CSOLTCP – Complete Phase IV Monitoring and Phase V P.E.R Initiate Design of Phase V	*01/2027*	
Review and Re-evaluate CSOLTCP	*06/2027*	
CSOLTCP – Complete Phase V Design Finalize Financing, Procure Bids	*04/2028*	
CSOLTCP – Complete Phase V Construction	*04/2030*	
CSOLTCP – Initiate Monitoring of Phase V	*05/2030*	
CSOLTCP – Complete Monitoring of Phase V	*05/2031*	
Review and Re-evaluate CSOLTCP	*12/2031*	

[1] Actual schedule for bidding and construction of Project 1-2 is indeterminate due to current EPA managed cleanup of site due to contaminated soil from illegal dumping. Schedule will be updated once site is cleared for construction activities to occur.

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April 26, 2013

Ms. Kara Wendholt
Indiana Department of Environmental Management
Office of Water Quality
Mail Code 65-42
100 North Senate Avenue Room NPDES Permit #2
Indianapolis, IN 46204

Re: City of Terre Haute
CSO Long Term Control Plan - Phase I Scope and Schedule Revisions

Dear Ms. Wendholt:

The City of Terre Haute is currently working on several projects included in Phase I of its CSO Long Term Control Plan (LTCP) proceeding toward the next milestone schedule item of starting construction by August 2013. The design of the major Phase I projects was initiated in October 2012, as required by the schedule, however, some issues have developed or been discovered during the detailed design phase which will impact the schedule of the projects. Also, we have identified some recommended revisions to the Phase I projects which are more feasible from a cost or implementation perspective than the scope of work included in the LTCP.

Accordingly, the City and HWC, as CSO LTCP Program Manager, are hereby requesting a meeting to discuss the potential changes to the Phase I scope and schedule and particularly explain the recommended revisions as follows:

1. Floatables Control/In-line Storage Structure at CSO 004/011 – Schedule Adjustment – The City initiated some clearing and construction preparation for this site in advance of the project which identified some potential environmental concerns due to previous material disposal on the site which was recently acquired by the City. Both IDEM Office of Land and EPA are involved in the testing and potential remediation of the site which will likely affect the construction start date of the project, currently planned and required to be August 2013. Additionally, recent flooding has slowed the testing and cleanup of the site, further hindering the schedule.
2. Consolidation of CSO 009 into 010/Closure of CSO 009 – Scope of Work Revision – Prior to the design phase of the Phase I projects, an alternative route for the sewer proposed to consolidate the two outfalls and close CSO 009. The previous route included in the LTCP connected the two CSO's along First Street. The revised route, developed while evaluating potential sewer relocations near the outfalls due to ISU developments in the area, is located farther east, along 4th Street, and at a location in which the two systems are much closer in proximity. We have developed SWMM model data which supports this relocation for your review.
3. IP Lagoon rehabilitation for CSO Storage – Scope and Schedule Revision – During the Basis of Design study phase conducted by the project consultant at the beginning of the design phase, several issues were discovered which were not known at the time of the LTCP development, including soil conditions of the lagoons, 100 year flood protection of the existing lagoon berms and other site conditions. As a result, the cost of the alternative included in the LTCP increased significantly and other alternatives were evaluated ultimately resulting in a revised recommendation which included a secondary high rate treatment facility at this site. Essentially, flows which would have been conveyed to the lagoons for storage will now ultimately be conveyed to the new system for clarification and disinfection. The high rate treatment will be constructed in two phases, with the second phase being constructed in the LTCP

Phase II with the new main lift station. We have also developed SWMM model data which supports this modification and the consultant could attend the meeting to further describe the planned system. This change will ultimately affect the schedule of this project, although not significantly and this would be discussed as well.

We could present more details regarding these requested changes and the impact each would have on the overall LTCP schedule and implementation during the meeting. Please consider and offer potential dates for this meeting and we will develop the required information for review by you and your staff. We would anticipate attendance by one of the City's project consultants for at least part of the meeting to discuss the revisions to the former IP lagoon site.

We appreciate your consideration of our request and look forward to meeting with you and your staff to demonstrate both the benefit and need for the revisions to the Phase I work.

Sincerely,

Eric M. Smith, P.E.
Director Water Resources/Associate Partner

cc: Chuck Ennis, P.E., City Engineer
Mark Thompson, Director Terre Haute Wastewater Utility
Mike Cline, P.E., HWC Engineering