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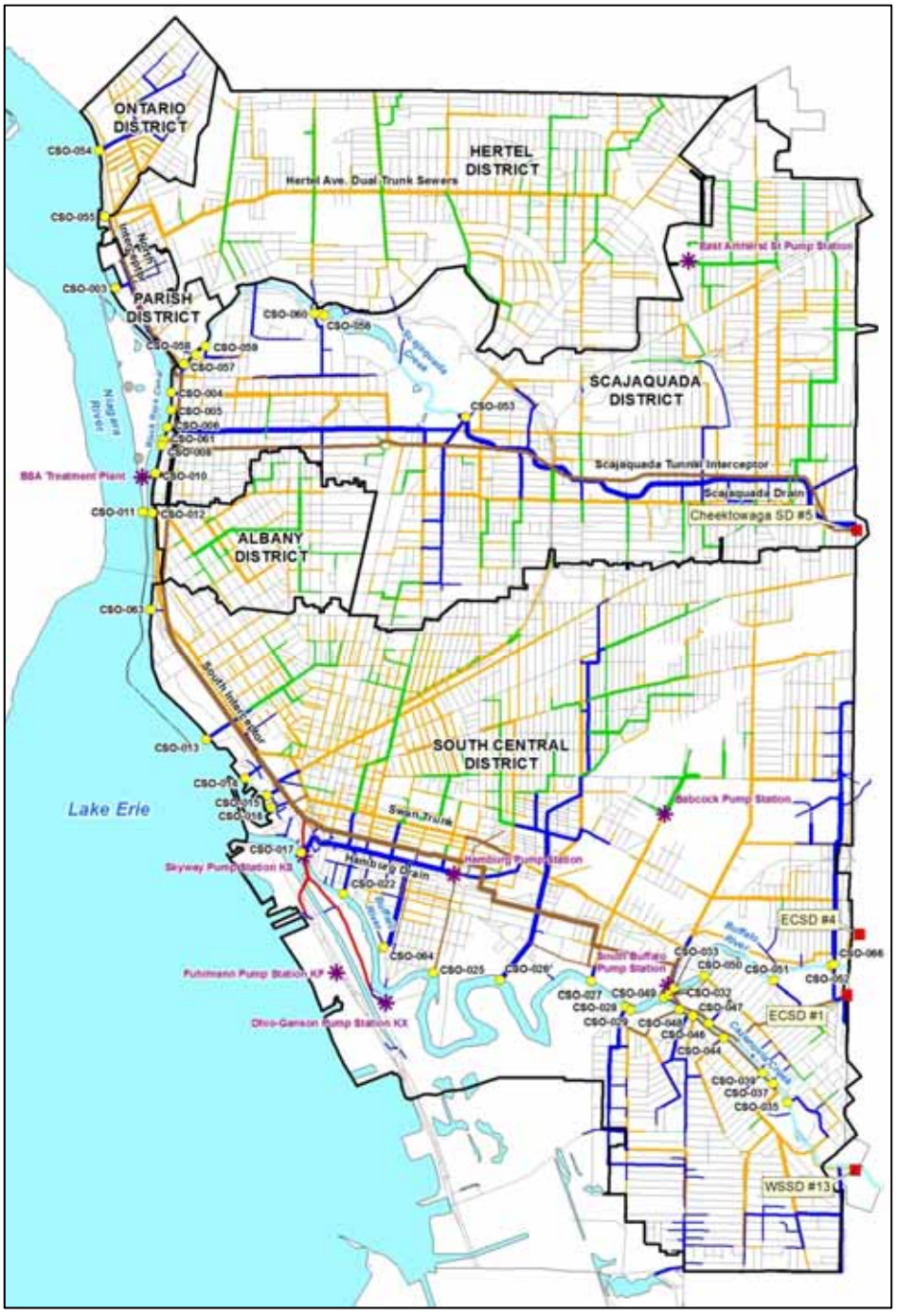
BUFFALO SEWER AUTHORITY

Long Term Control Plan - FINAL

January 2014



Executive Summary

Introduction

This document comprises the Buffalo Sewer Authority's (BSA's) Final Long-Term Control Plan (LTCP or the Plan) to address sewer overflows to area waterways, which occur during rain and/or snow melt events. It builds on an LTCP that was developed in 2004. Thanks to the relentless and impressive progress the BSA has made over the past several decades, the BSA is now in a position to propose and implement a plan to finally resolve its sewer overflow challenge. The recommended plan contains a careful balance of traditional "gray" infrastructure as well as innovative "green" solutions. The BSA believes the LTCP is the right approach for this community, and although it is financially burdensome, feels that it protects the environment and addresses water quality in receiving streams in the most affordable and cost-effective manner possible. The LTCP was developed in consultation with BSA's community stakeholder panel and has benefited from formal and informal stakeholder input over the past decade.

Including the wet weather treatment improvements at the BSA's Bird Island Wastewater Treatment Plant (WWTP), the Plan has an expected capital cost of approximately $380 million to implement over a 20 year period. This does not include the over $50 million the BSA has already invested in engineering and previously completed and ongoing construction projects (referred herein as "Phase I projects") or future operations and maintenance costs for the proposed facility improvements. The details of the development of the LTCP and the specific recommended plan are provided in the pages that follow. The BSA submitted this plan to the United States Environmental Protection Agency (USEPA) and the New York State Department of Environmental Conservation (NYSDEC), (collectively referred to as the Agencies or Regulatory Agencies) in April 2012, as ordered by the USEPA, and concurrently solicited public comments on the April 2012 submission. The BSA has revised this LTCP in response to final community input and comments issued by the Regulatory Agencies following the April 2012 submittal.

The BSA is a public benefit corporation of the State of New York (NYS), established by NYS in 1935 with exclusive jurisdiction, ownership, and possession of the sewage collection and treatment system that serves the City of Buffalo and, through inter-jurisdictional agreements, several communities adjacent to the City of Buffalo. The BSA is a legal entity separate from the City of Buffalo and NYS. The Buffalo Sewer Authority system consists of a secondary treatment plant located on Bird Island and a collection system of approximately 850 miles (790 miles of combined sewer and 60 miles of storm sewer) of sewer lines.

The service area of the BSA, within the City of Buffalo, is served primarily by a combined sewer system (CSS). The CSS was constructed with 65 permitted combined sewer overflow (CSOs) outfalls to relieve the CSS during wet weather events in order to protect downstream treatment facilities and prevent basement flooding. Over the years, the BSA has completed numerous CSS improvement projects resulting in the elimination of seven CSO outfalls. Currently, the system consists of 52 permitted CSO outfalls. The USEPA issued a national CSO Control Policy in 1994, requiring communities with CSSs to develop Long Term

Control Plans (LTCPs) that will provide for compliance with the requirements of the Clean Water Act, including attainment of current or revised (to reflect wet weather in-stream realities) water quality standards (WQS). This document is the BSA's LTCP.

Further, the BSA is required under the terms of its New York State issued State Pollutant Discharge Elimination System (SPDES) permit (Permit No. 002 8410) to implement Best Management Practices (BMPs) for CSOs. The BSA has successfully implemented the BMPs as required by its SPDES permit.

While this LTCP program focuses primarily on the collection system, the Bird Island WWTP is also an integral part of the CSS. Immediately after the establishment of the BSA in 1935, a primary wastewater treatment plant was constructed and began operation on July 1, 1938. The original WWTP was constructed to include bar screens, grit removal equipment, primary settling tanks (clarifiers) and disinfection facilities. Solids generated during the treatment process were disposed of in three multiple hearth incinerators. The Bird Island WWTP operated in this configuration until the mid-1970s, when in response to the federal Clean Water Act, the BSA upgraded the plant to meet new secondary treatment standards. Secondary treatment facilities were added at the plant between 1975 and 1979. Pursuant to this upgrade, aeration and secondary clarification equipment were added along with upgrades to the disinfection system. Completed and current upgrades to the facility will allow for improved treatment for up to 320 MGD of flow through the secondary treatment system and following completion of the upgrades recommended in the No Feasible Alternatives analysis up to 400 MGD through the secondary system. Flows in excess of the secondary treatment system capacity are treated through the original primary facilities or a combination of both primary and secondary. All treated flows are discharged to the Niagara River via two permitted outfalls. The WWTP is also equipped with a third emergency outfall which is used to protect the WWTP in the event of extreme wet weather or equipment malfunction to prevent the plant influent flow from exceeding the plant's treatment capacity. Recognizing the multiple modes of operation and in particular the partial treatment mode, a No Feasible Alternative (NFA) analysis was conducted as part of the LTCP development to confirm the WWTP wet weather capacity and evaluate feasible alternatives, if any, to reduce the volume of or provide additional treatment for the wet weather flows currently bypassing the secondary treatment and discharged directly following primary treatment and disinfection in the primary clarifiers.

LTCP Development Process

This report reviews the evaluations completed in the development of the previously submitted LTCP and documents the development of this LTCP for CSO abatement within the City of Buffalo.

The BSA originally submitted its LTCP for CSO abatement to the NYSDEC in July 2004 (2004 LTCP). The BSA received comments from the NYSDEC in 2006, and subsequently, the NYSDEC and the USEPA requested additional evaluations to address questions and comments derived from their regulatory review. The BSA began additional work in 2008 and completed the update of the 2004 LTCP in two phases:

- Additional evaluations, including water quality model development, collection system model refinement, and the associated data collection (rainfall, flow, water quality) to support these modeling tasks.

- Development and evaluation of CSO abatement alternatives and update of the 2004 LTCP documents as well as refinement of the previously prepared financial capability analysis.

The BSA retained Malcolm Pirnie, the Water Division of ARCADIS (Pirnie/ARCADIS), along with LimnoTech, GHD, and the State University of New York College at Buffalo, to address the USEPA's and NYSDEC's comments and to update the 2004 LTCP. The BSA also retained CRA Infrastructure and Engineering, Inc. (CRA) to update the Financial Capability Assessment. This document, referred to as the BSA's "LTCP", builds upon the 2004 LTCP and presents the additional evaluations performed and the BSA's revised preferred CSO abatement program.

Most, if not all, of the CSO communities in the country have had several rounds of LTCP development. This is due to a number of factors including, but not limited to:

- The community-specific nature of CSO control solutions.

- The massive scale of CSO control programs (usually the largest public works projects in community history)

- The incorporation by reference of the National CSO Policy into the Clean Water Act in 1999.

- Changing regulatory expectations.

- Funding constraints.

- Changes in technologies (such as a move away from sewer separation to evolving technologies including green solutions; the development of Real Time Control, etc).

- Smart growth considerations.

- A movement to watershed planning.

- Rapidly evolving urban stormwater control requirements.

- NPDES authorities' difficulty in developing wet weather water quality standards.

From 2008 through early 2012, the BSA and the Government Agencies had multiple meetings and discussions to discuss data collection, model development and results, and engineering analyses to support the development of a revised LTCP. On March 15, 2012, the USEPA unilaterally issued to the BSA an Administrative Order (AO) that required, in part, that the BSA submit an updated LTCP to the USEPA and NYSDEC no later than April 30, 2012. The AO is attached to this Executive Summary as Exhibit ES-1. The BSA subsequently sought clarification and revision of two key requirements and related issues imposed by the AO, in a letter dated March 28, 2012 to the USEPA (Exhibit ES-2). The USEPA responded in a letter dated March 29, 2012 (Exhibit ES-3). While the April 30th deadline required the BSA to expedite completion of updating the LTCP and submit it ahead of an opportunity for public notice, the BSA had no choice, but to make best efforts to comply with the USEPA's AO.

Following submission of the April 2012 LTCP, the Agencies provided comments in a letter dated December 6, 2012 (attached as Exhibit ES-4). The BSA and the Agencies subsequently discussed these comments through a series of meetings and correspondence. A major effort in addressing this set of comments was the development of an updated NFA analysis and a Green Infrastructure Master Plan. Based on the comments provided by the Agencies, the LTCP has been revised in general to incorporate the findings of both of these documents and address a number of other comments. This LTCP reflects the revisions developed by the BSA in response to those comments and concurred with by the Agencies in October 2013. Exhibit ES-5 includes a copy of the October 2013 correspondence.

In addition to developing this LTCP update, the BSA has continued to work diligently to reduce CSO overflow volumes and frequencies. Along the way, the BSA has invested tens of millions of dollars in capital improvements both at the WWTP and in the collection system, many of which pertain directly to this CSO Abatement program, not to mention the investment of over ten million dollars in the development and update of the LTCP documents. More recently, the BSA has had to be agile and adjust the LTCP development process to address numerous agency comments, many of which required not only changes in approach, but also, at times, significant technical re-analyses and rework. The BSA has made best efforts to accommodate and implement these Agency directives.

Development of Models to Predict Overflow Control Results and Benefits

Upon review of the 2004 LTCP, the NYSDEC and the USEPA asked the BSA to refine the BSA's sewer collection system model and to develop CSO receiving stream water quality models for waterways receiving CSO discharges. Additional flow/rainfall monitoring and receiving water quality sampling activities were necessary to support the requested modeling work. Of necessity, these additional requirements have extended the process and scope of gathering and evaluation of data for the updated LTCP. Collectively, this additional monitoring and modeling work was referred to as the "Phase II LTCP activities" and consisted of:

- Additional rainfall and in-system flow monitoring of the BSA's collection system to support the collection system model refinement.

- Additional receiving water quality sampling to support the water quality model development and calibration.

- More specific water quality models developed, calibrated, and validated for the Buffalo River, Scajaquada Creek, Niagara River, and Black Rock Canal receiving water bodies.

- Additional validation and refinement of the BSA collection system model.

Development and Evaluation of Alternatives

Using the collection system and water quality models, new CSO abatement alternatives were developed and evaluated for comparison to the updated Preferred Alternative from the 2004 LTCP. The first new alternative included innovative and/or emerging technologies such as real-time control (RTC), green infrastructure (GI) and a new relief line with an enhanced high rate treatment (EHRT) facility in the northern portion of Bird Island. Two additional system wide alternatives were developed based on requests from the USEPA and NYSDEC in the spring of 2011. The additional alternatives were system wide tunnels (to store wet weather flows underground until the storm passes and the flows can be pumped to the WWTP for treatment) and a combination of tunnels and a new relief line to an EHRT facility in the northern portion of Bird Island. These three new alternatives were then compared to the updated 2004 preferred system wide alternative to determine whether the 2004 LTCP could be improved upon.

The new alternatives are based on a Revised Foundation Plan. The Revised Foundation Plan represents an update of the original Foundation Plan implemented after the submittal of the 2004 LTCP. The objective of the Foundation Plan was to implement a set of controls that were likely to be part of the final LTCP so that progress could be made during the LTCP update development. However, the Revised Foundation Plan represents a shift in management philosophy by the BSA away from sewer separation as a primary control technology to a combination of low-cost system optimizations and cost-effective real time control (RTC) projects. While some sewer separation projects are carried forward in this Revised Foundation Plan, the extent of the areas to be separated has been reduced and replaced in favor of alternative technologies. Alternatives UA2 (Updated Alternative No. 2), UA3, and UA3A all build upon the Revised Foundation Plan. Alternative UA1 uses the original Foundation Plan as recommended in the 2004 LTCP as its starting point.

The Revised Foundation Plan comprises the following core components:

- Phase I Projects (recently completed or scheduled to be done by late 2014): Referred to as the “Phase I” projects, these are an initial series of projects identified during the development of the 2004 LTCP. Recognizing that these projects would likely be constructed regardless of the final LTCP program, the BSA, with the concurrence of the Regulatory Agencies, chose to undertake these projects. They include a mix of sewer separation, CSO regulator optimizations (for example, raising weirs and/or removing orifice plates), and supplemental sewer system capacity projects. As the implementation of these

projects evolved, several projects were modified to include real time control and green infrastructure elements. Most of these projects have been completed, with the remainder slated to be completed by the end of 2014.

- Other Projects (previously completed): These projects are primarily sewer separation projects carried over from the original Foundation Plan and completed prior to the Phase I projects.

- Real Time Control Program: 16 RTC projects (including the two included within the Phase I project list) that were selected after evaluations conducted as part of this LTCP effort.

- Additional Sewer Patrol Point (SPP) Optimizations: 20 additional optimization projects were identified as part of the alternatives evaluations conducted for this LTCP update. These modifications include optimizing weir elevations and orifice plate openings, increasing underflow pipe capacity, and flow redirection at a limited number of locations.

- Additional Storage Projects: Three projects to increase capture of CSO flows have been identified and are currently in various stages of design by BSA.

Summary descriptions of each system wide alternative evaluated are presented below.

- **Alternative UA1** consists of the updated 2004 preferred system wide alternative modified to provide better control of bacteria for the Buffalo River and Erie Basin receiving water bodies (RWBs). After review of the 2004 LTCP, the NYSDEC raised a concern that the 2004 LTCP Preferred Alternative did not provide for adequate bacteria control in the Class C receiving waters (this classification is made by the NYSDEC); therefore, each alternative was re-evaluated for the Buffalo River and Erie Basin. The updated 2004 LTCP preferred system wide alternative changes only the Buffalo River and Erie Basin alternatives, while keeping the alternatives in the other receiving water bodies the same. Note that unlike the other system wide alternatives evaluated in this LTCP, Alternative UA1 was built upon the original Foundation Plan. The original Foundation Plan consisted primarily of weir modifications and partial sewer separation projects. No RTC or GI projects were evaluated as part of this alternative. Alternative UA1 is intended to provide a benchmark system wide gray infrastructure alternative (with no emerging technologies or sustainability elements) against which all other alternatives will be evaluated.

- **Alternative UA2** consists of some elements of Alternative UA1 (updated 2004 preferred system wide alternative) plus a North interceptor relief sewer that will convey additional flows to the siphon across Black Rock Canal and into the headworks of the Bird Island WWTP. Additionally, under greater levels of control, a new pump station will be constructed to pump flows to a new EHRT facility located on the north side of the WWTP. Unlike Alternative UA1, however, Alternative UA2 builds upon the Revised Foundation Plan (which contains SPP optimizations and weir modifications as well as selected RTC

projects). In addition, Alternative UA2 uses the recommended GI results and applies a range of GI control of impervious surface from 10% to 20% with the initial target of controlling 1,620 acres system wide. Note that the initial GI acreage target was developed prior to the SPP level refinement completed during the development of the BSA's Green Infrastructure Master Plan and as such, represents the upper limit of GI control acreage under consideration by the BSA.

- **Alternative UA3** consists of the construction of deep-rock tunnels to provide storage for the majority of the BSA's CSOs. The mining of tunnels below grade is typically an effective method of providing off-line storage in congested urban areas. Seven remaining CSOs not controlled by the system wide tunnels (CSO 003, 051, 052, 055, 056, 060, and 066) would be controlled through satellite storage facilities. As specified by the Regulatory Agencies, Alternative UA3 is an 'all-gray' alternative and therefore, does not include green infrastructure as part of the alternative technologies.

- **Alternative UA3A** consists of the construction of deep-rock tunnels to provide storage for the majority of the BSA's CSOs, with the exception of the tunnel along Black Rock Canal. There, the leg of the North-South Tunnel that runs along the Black Rock Canal is replaced with a relief sewer that will convey additional flows to the siphon across the Canal and into the headworks of the Bird Island WWTP. In addition, under greater levels of control, a new pump station will be constructed to pump flows to a new EHRT facility located on the north side of the WWTP. As with Alternative UA3, any remaining CSOs not controlled by the tunnels/relief sewer would be handled through a combination of satellite storage facilities and the Revised Foundation Plan. As specified by the Agencies, Alternative UA3A is an 'all-gray' plan and does not include green infrastructure as part of the alternative technologies. This alternative maintains nearly all of the tunnels proposed in Alternative UA3, but incorporates alternative gray technologies for the Black Rock Canal CSOs to determine if they are more cost-effective.

Table ES-1 presents a summary of the overall framework for the additional alternatives evaluated as part of this LTCP. Alternative UA2 is the only alternative with the proposed GI program. As is noted later in this LTCP, the BSA proposes to implement components of this alternative as the BSA's Recommended Plan/LTCP with a 20-year implementation schedule.

Table ES-1: Predicted Components of Additional Alternatives for Evaluation in the LTCP

Alt.	Description	RTC	GI	Satellite Treatment	Satellite Storage	Tunnel	North Relief	Partial Sewer System Separation
UA1	Updated 2004 Preferred System wide Alternative with Original Foundation			X	X	X		X
UA2	RTC & GI & North Relief (1) + Revised Foundation + Selected Elements of UA1	X	X	X	X	X	X	
UA3	System wide Tunnel + Revised Foundation	X			X	X		
UA3A	System wide Tunnel + Revised Foundation + North Relief (1)	X		X	X	X	X	

Notes: (1) – For alternatives UA2 and UA3A, HRT will be required for higher levels of control but not universally.

Per the requirements of the AO, each alternative was evaluated for five different levels of control (LOCs) in terms of CSO activation frequency. Other regulatory metrics such as residual CSO volumes, system wide percent capture of wet weather flows, and remaining pollutant (bacteria) loadings were estimated as well for BSA's informational purposes. The costs and benefits (in the form of Water Quality Standards (WQS)) attainment and CSO frequency/volume reductions) for each alternative at each LOC were evaluated for each individual CSO receiving water body. The benefits of the alternatives were evaluated using 12-month continuous simulations with the 1993 modified typical precipitation year. As agreed upon with the USEPA, water quality benefits were evaluated only for select alternatives (UA1 and UA2) because the composition of technologies for UA3 and UA3A would yield very similar water quality results for the level of control being obtained by the UA1 and UA2 alternatives.

Compliance with WQS is the primary consideration for CSO LOCs, followed by affordability and cost-effectiveness. Thus, just because a particular LOC may appear to be cost-effective, it may be neither necessary (if WQS are met short of that level of CSO control) nor affordable. Moreover, it is important to note that the data inputs to these graphs are the best available information at this time, but are still only planning level estimates.

That said, the system wide cost-benefit curves for each alternative were compared for the different types of benefits. The cost curves for attainment of water quality standards, level of control (activations per year), residual CSO volume (million gallons), and percent capture were compared to assess the relative effectiveness of each alternative. Water quality attainment was evaluated on a receiving water body-specific basis rather than a system wide basis.

Figures ES-1, ES-2 and ES-3 present a comparison of the system wide cost curves comparing the costs for each system wide alternative versus the benefits gained by the alternatives. Figure ES-1 compares cost versus overflow frequency of activation, ES-2 compares cost versus remaining CSO volume and finally Figure ES-3 compares cost versus system wide percent capture.

As can be seen from all three figures, Alternative UA1 (Updated 2004 Preferred Alternative) presents the highest cost for all LOCs. This is due in part to the original Foundation Plan's reliance on a significant number of sewer separation projects. Also, there are two proposed storage tunnels (East-West for Scajaquada Creek and North-South for Black Rock Canal/Niagara River) included in this alternative.

Alternative UA2 has the lowest costs out of the three new alternatives evaluated in this LTCP and therefore, formed the basis of the Recommended Plan. While the majority of the evaluations were done on a cost-effectiveness basis, Alternative UA2 also represents a significant update of Alternative UA1 and incorporates emerging technologies such as RTC to better utilize the existing infrastructure, and also supports the USEPA's broader national sustainability objectives by including a substantial (but realistic and achievable) GI component.

Alternatives UA3 and UA3A are essentially bracketed by UA1 and UA2 and as shown provide greater cost effectiveness than UA1 for most levels of control but lesser cost effectiveness than UA2. Note that for the purposes of this update effort, the technologies evaluated for Alternatives UA1 remain unchanged from the 2004 LTCP, but were, however, evaluated using the 2012 models and the 1993 TY, and the costs were updated to 2012 dollars.

Figure ES-1: Present Worth Cost vs. Overflow Frequency
(2012 Dollars)

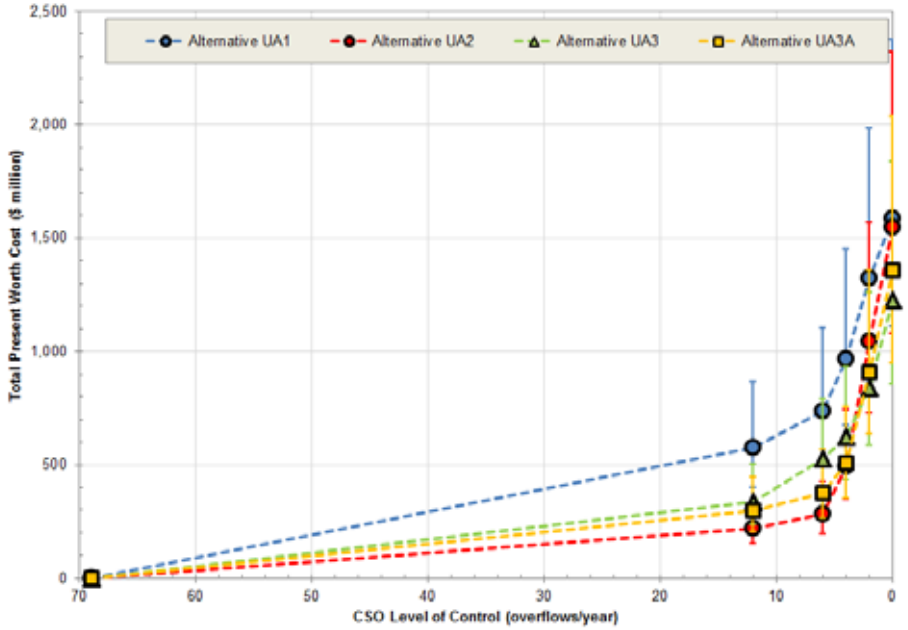
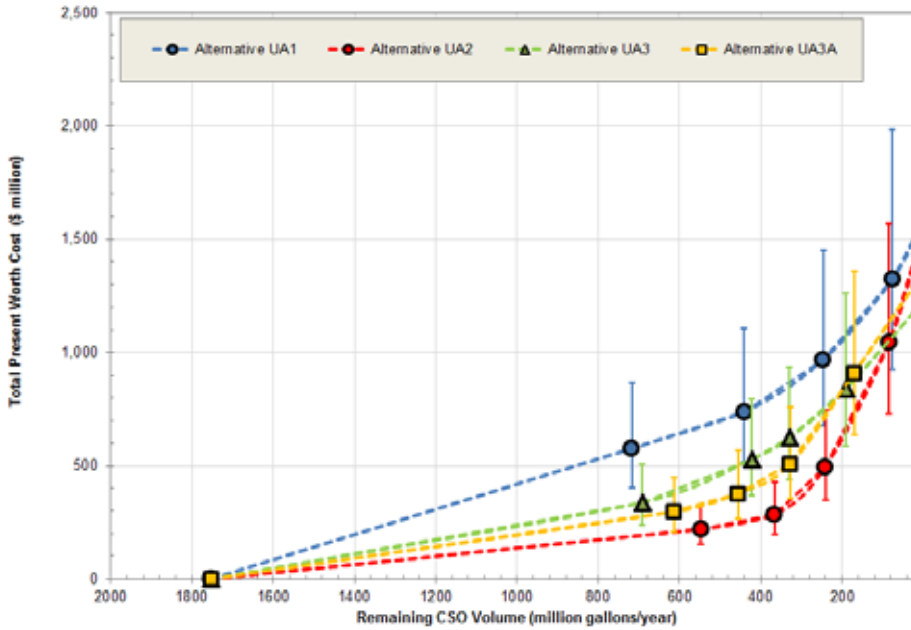
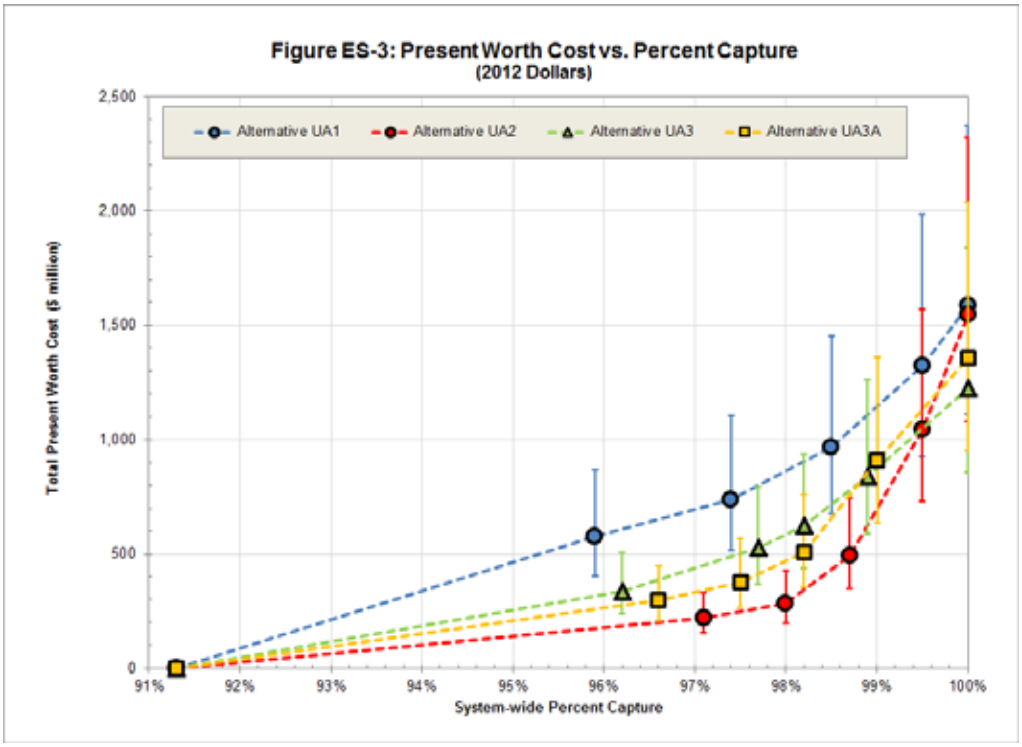


Figure ES-2: Present Worth Cost vs. Remaining Overflow Volume
(2012 Dollars)





Additional Evaluations

In response to Agencies' comments on the April 2012 LTCP, the BSA provided additional detail on their green infrastructure (GI) program by developing a Green Infrastructure Master Plan (GI Master Plan) as well as addressed treatment plant flow maximization processes by updating the No Feasible Alternatives (NFA) Analysis for the WWTP.

Generally speaking, the GI Master Plan includes further refinement of the GI impervious surface control targets presented in the April 2012 LTCP document to determine, on the SPP level, where the system would most benefit from GI technologies, as well as provides requested detail on the Phase 1 GI projects to be implemented over the first five-year period. A summary of the revised impervious acreage to be controlled by GI for each receiving water body, as well as the original acreage recommended to be managed by GI is presented in Table ES-2. Refining the impervious control acreage to the SPP level allowed for better identification of SPPs (and by extension CSO outfalls) that would benefit most from implementing GI technologies, and also for determining which SPPs would not benefit because they were already at or below the recommended RWB LOC or do not discharge directly to a RWB.

Table ES-2: Updated Impervious Area Target for Control by GI

Receiving Water	Original Area Managed (acres) by GI Based on CSO Level	Updated Area Managed (acres) by GI Based on SPP Level
Black Rock Canal	168	198
Buffalo River	418	319
Cazenovia Creek - B	3	3
Cazenovia Creek - C	60	58
Erie Basin	49	53
Niagara River	412	378
Scajaquada Creek	510	305
Total	**1,620**	**1,315**

As shown in Table ES-2, this refinement resulted in minimal to moderate changes in controlled acreage on a receiving water body basis. Recommended acreages increased in the Black Rock Canal and Erie Basin, and decreased in the Cazenovia Creek–C, Buffalo River, Niagara River, and Scajaquada Creek. Because the SPP-level GI allocation provides a more refined and cost-effective approach, the BSA will work towards a 1,315-acre total green infrastructure program effort. However, the BSA will utilize modeling and post-construction monitoring of the first three phases of GI projects to confirm that the 1,315 target acres will be sufficient to meet the level of control objectives. If needed, the acreage target for the fourth phase of GI projects will be adjusted to achieve the CSO outfall typical year frequency of activation requirements.

The Recommended Plan with the refined impervious surface control acreages was evaluated for each receiving water body in terms of targeted reduction in CSO activations and volumes. The projected activation frequencies in any given receiving water body remained the same or decreased for all but three CSOs. For the CSOs that showed an increase in activations, the resulting activations remained within the targeted typical year LOCs for each receiving water body. The total system wide CSO volume remaining increased slightly (approximately 4 percent); however, the projected increase in residual volume is within the uncertainty of the modeling tools and, accordingly, is insignificant, particularly in light of the conservative factors used elsewhere in the GI program and LTCP.

The GI Master Plan also identified the Phase 1 GI projects, which are summarized in Table ES-3. These GI projects rely upon demolition/vacant lot management, as well as runoff reduction from seven green streets projects to achieve the impervious surface management goal. While the BSA is accounting for Phase 1 GI

projects in all sub-catchments in the model, some of these projects may be located in a sub-catchment that is not targeted for impervious surface control. For the purpose of determining the GI implementation acreage towards target goals, the projects (primarily building demolitions) outside of the refined target areas were removed. Table ES-3 presents both the total impervious acreage controlled and the impervious acreage that would be applied to the proposed GI target acreage. The Phase 1 GI projects will control 448 acres of impervious area, of which 267 acres will be applied to the SPP-based GI acreage targets.

Table ES-3: BSA's Phase 1 Green Infrastructure Program Summary

Project Group	Sub Group	Impervious surface controlled (acres)	Impervious Acreage Applied to SPP-based Target CSO Control (acres)
Demolitions and Vacant Lot Management	2001 – 2013 Demolitions (excl. 2001-2009 demos in CSO 12)	354	210
	CSO 53 Pilot Project and 2014-2018 Demolitions	50	31
	Fillmore Ave green lots	0	0
	PUSH Blue Projects	1.0	1.0
Green Streets	Carlton Street porous asphalt	1.0	0
	Fillmore Ave porous parking lots	0.4	0.4
	Ohio Street	6.1	2.1
	Kenmore Ave(1)	4.1	4.1
	Kensington Ave(1)	5.5	2.5
	Allen Street(1)	2.5	2.5
	Niagara Street(1)	23	14.3
	TOTAL	448	267

Note: (1) Specific designs are not available for these projects at this time. The impervious acreage controlled was estimated based on the assumptions provided in Section 8 of the GI Master Plan.

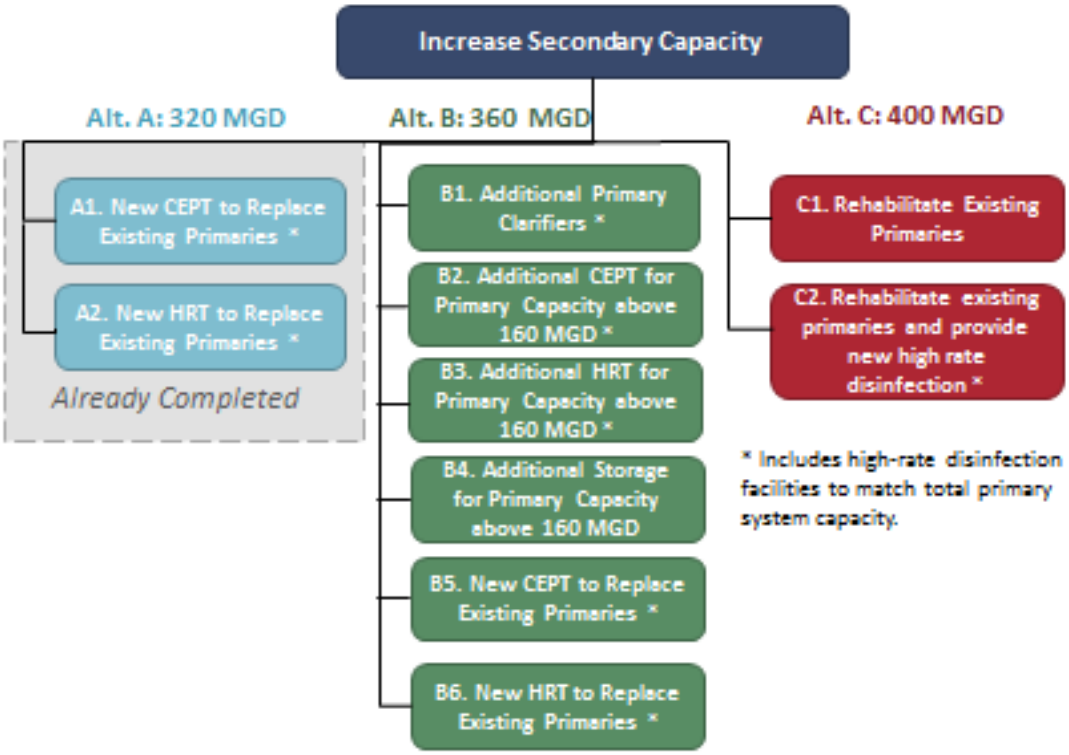
In response to public comment on the April 2012 submission, the BSA remains committed to evaluating opportunities to maximize the use of additional cost-effective green infrastructure approaches. The target acreage above is a minimum program commitment. Any additional green infrastructure acreage proposed in

conjunction with the optimization of gray projects would be in addition to the acreage above. This approach allows the BSA to adaptively manage the green infrastructure program to incorporate lessons learned in each five year program and take advantage of land use and infrastructure investments projected for each period to deliver the maximum public benefits at the lowest cost.

As briefly stated above, in order to address the Agencies' concerns regarding the secondary treatment plant bypasses and in particular the method by which the BSA disinfects these bypass flows, the BSA also updated the No Feasible Alternative (NFA) analysis initially prepared for the April 2012 document. While the NFA analysis in general concluded that the BSA has demonstrated, through operational modifications and capital improvements, that the plant is currently maximizing the treatment of wet weather flows conveyed to the plant through a combination of the three operating modes (normal, primary bypass and partial treatment), the BSA agreed to evaluate several alternatives to provide a higher level of treatment for wet weather flows reaching the WWTP that currently do not receive secondary treatment.

During completion of the NFA analysis, a number of alternatives were evaluated to provide treatment of plant influent flows of up to 560 MGD. Figure ES-4 below presents a summary of the evaluated alternatives.

Figure ES-4: Summary of Alternatives Evaluated in the No Feasible Alternative Analysis



The NFA considered three options for secondary system capacity: maintain the current secondary capacity of 320 MGD and replace the entire primary clarification system (240 MGD capacity), increase the secondary capacity to 360 MGD with several options for 200 MGD primary clarification capacity, and increase the secondary treatment capacity to 400 MGD. Each of these options was developed to address the Agencies' concerns relative to the effective capacity of the primary clarifiers and the method by which the BSA disinfects primary effluent when operating in the partial treatment mode.

Alternatives A1 and A2 considered a secondary treatment process hydraulic capacity of 320 MGD (current capacity), which would require providing 240 MGD of primary treatment capacity. Alternatives B1 through B6 considered increasing the secondary treatment sustained peak flow capacity up to 360 MGD with the remaining 200 MGD treated in the primary treatment process using various options as shown on Figure ES-4. In order to ensure a total flow through the secondary clarifiers of 360 MGD, for each Alternative B1 through B6, it was recommended to install additional orifices in the secondary clarifier influent channels in each clarifier. Finally, Alternatives C1 and C2 considered hydraulic and process improvements to the existing secondary treatment process to treat sustained peak flows up to 400 MGD in partial treatment mode, while addressing the Agencies' concerns relative to primary clarifier capacity and primary effluent disinfection. Each of these alternatives (C1 and C2) includes the construction of two additional secondary clarifiers, expansion of the existing secondary chlorine contact tank to accommodate an additional 40 MGD of flow at a minimum 15-minute contact time, and the addition of orifices in the secondary clarifier influent channels to increase the secondary treatment capacity to 400 MGD.

Following the completion of the NFA evaluations, Alternative C2 was recommended as the preferred WWTP alternative for implementation. In general, this alternative increases the capacity of the secondary treatment process to 400 MGD, addresses the concern relative to primary capacity and effluent disinfection and, more importantly, provides post-clarification disinfection of all primary effluent. Alternative C2 includes:

- Replacement of the sludge and scum collection systems in each of the four existing primary clarifiers.
- Replacement of the primary sludge pumps.
- Miscellaneous other repairs (including contract required to ensure that the primary clarifiers remain functional).
- Addition of a high rate disinfection system including a new chlorine contact tank and associated chemical storage and feed equipment to provide a minimum 5-minute detention time for high-rate disinfection for primary effluent flows up to 160 MGD.
- Improving hydraulics through the sixteen existing secondary clarifiers by providing additional orifices in the peripheral influent channel of each secondary clarifier.

- Construction of two new secondary clarifiers.

- Expanding the existing chlorine contact tank to disinfect a total secondary process effluent of 400 MGD, with a contact time of 15 minutes.

This alternative (C2) was recommended as the most technically and financially feasible alternative to be implemented for the following reasons:

- Maximizes secondary treatment of plant wet weather flows.

- Optimizes primary effluent disinfection.

- Offers the most appropriate life-cycle cost benefit.

- Involves relatively straightforward construction with minimal impact to other plant treatment processes during construction.

- Can be implemented within the limited available space on the WWTP property.

- Is similar to current treatment plant operations, providing a manageable learning curve for plant operations staff.

Recommended Plan

A careful analysis of detailed receiving stream water quality modeling results revealed that a uniform level of CSO control for all BSA receiving water bodies is neither cost effective nor necessary to meet the established WQS in each water body. This is a logical finding given the extremely varied nature of the CSO receiving waters. The modeling reveals that each receiving water body has a unique combination of the current WQS attainment status, impacts from CSOs versus background sources, and CSO control costs. Furthermore, the evaluation results show that the knee of the curve points for Alternative UA2 for each receiving water body already provides 100% attainment of the New York State (NYS) recreational (bacteria) WQS. Therefore, the BSA's recommended alternative was assembled with a primary focus on providing a cost-effective attainment of the current NYS bacteria WQS in each water body and the associated frequency of activation necessary to accomplish those WQS. This frequency of activation performance measure targets the USEPA CSO Control Policy presumption approach criterion of 4 to 6 overflow events per year. Following implementation of the Recommended Plan, all water bodies in the BSA system will meet the 4 to 6 events per typical year level of control, with the following clarifications:

- **Erie Basin -** The Erie Basin was identified as a sensitive area, and as such, has the highest selected cost-effective target LOC of 2 events per typical year. While water quality modeling reveals that the WQS are met under existing conditions in the Erie Basin, the BSA has elected to target the higher LOC as part of the Recommended Plan.

- **Buffalo River** - Based on the water quality modeling results, the Buffalo River would achieve 100% compliance with WQS at the lowest evaluated LOC of 12 events per typical year (provided that the USEPA and NYSDEC reasonably address upstream sources of pollutants by other parties); however, the BSA has targeted a higher level of control (6 events per year) based on the activation frequency versus project present worth costs knee of the curve for the Buffalo River.

- **Niagara River** - Water quality modeling results also reveal that the Niagara River already meets the current NYS bacteria WQS under the baseline conditions with 100% attainment. At the same time, the activation frequency versus project present worth costs knee of the curve for the Niagara River fell at approximately 8 to 10 events per year. Increased LOCs for the Niagara River provided marginal benefits in terms of CSO volume reduction and no additional benefits in terms of WQS attainment. However, through the LTCP program, the BSA will reduce overflow events in all Niagara River CSOs, with three of the four fully meeting the USEPA goal of 4 to 6 events per year. For the third CSO, 055, the BSA selected a cost-effective LOC of approximately 9 events during the typical year.

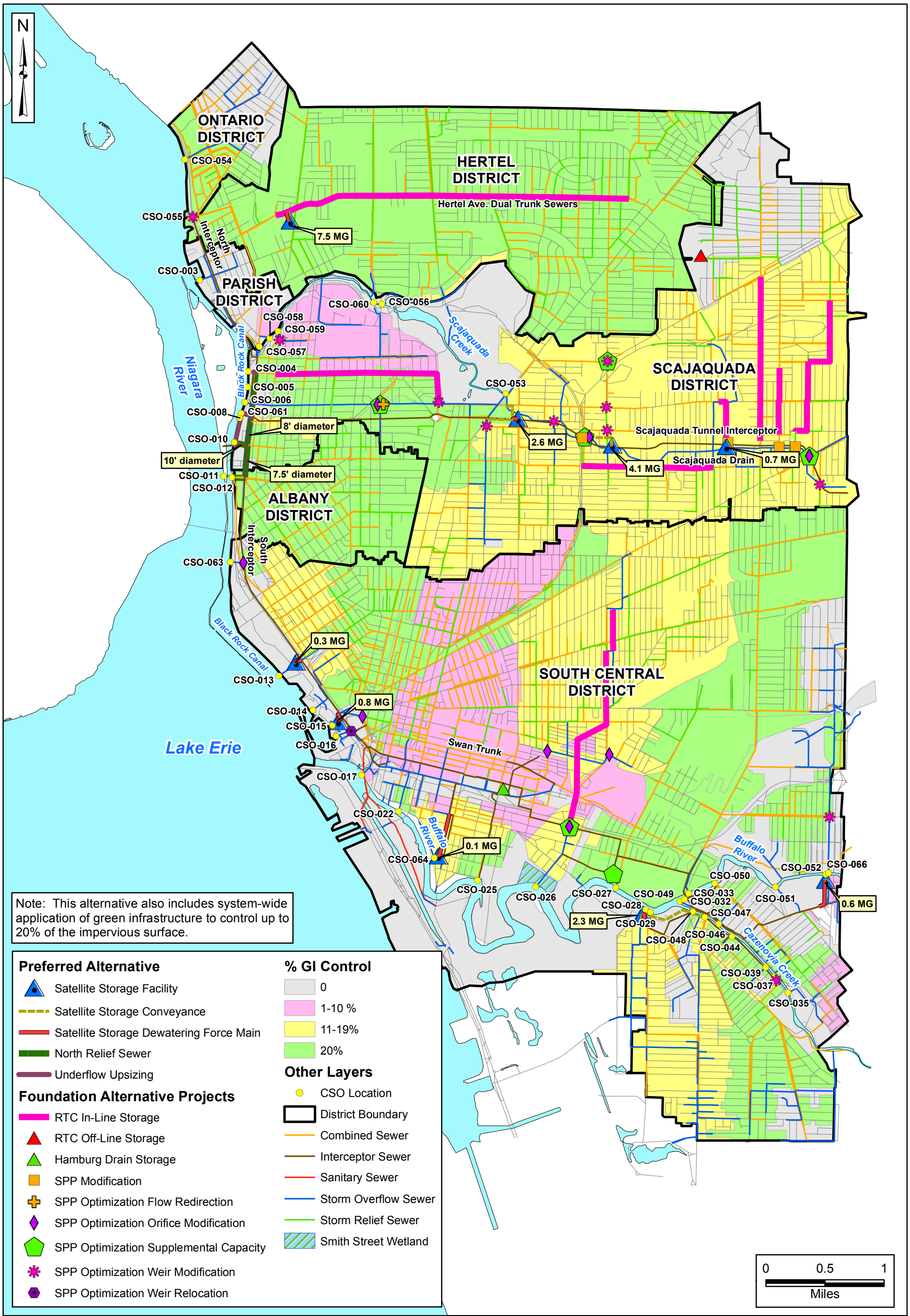
Table ES-4 below presents a more detailed listing of the projects that comprise the Recommended Plan. As shown, the list presents the projects proposed for each general type of project for each water body. Figure ES-5 presents a graphical representation of the components of the Recommended Plan.

Table ES-4: Summary of Recommended Plan Projects

Project Grouping	Specific Projects (Concept Level Approximate Sizing)
Revised Foundation Projects: Focus is on combination of low-cost system optimizations, pilot GI projects and cost-effective RTC projects	• Phase 1 Projects: Includes all Phase 1 projects described in Section 11.2. • Non-Phase 1 Projects: These projects are primarily sewer separation projects carried over from the original Foundation Plan and completed prior to the Phase 1 projects. These are also described in Section 11.2. • Real Time Control: 16 real-time control (RTC) projects that were selected after the evaluation described in Section 11.3 • Green Infrastructure Pilot Projects o CSO 060 – Combination of pervious pavements, rain gardens and downspout disconnections/rain barrel installations o Downspout disconnect/rain barrel pilot projects in the Old First Ward and Hamlin Park neighborhoods • Additional SPP Optimizations: 20 additional optimization projects were identified as part of the alternatives evaluations conducted for this LTCP update. These modifications include optimizing weir elevations and orifice plate openings, increasing underflow pipe capacity, and flow redirection at a limited number of locations. Details on these SPP optimization projects are presented in Section 11.4 • Additional Storage Projects: Three projects designed to increase capture of CSO flows

Project Grouping	Specific Projects (Concept Level Approximate Sizing)
	have been identified and are currently in various stages of design by BSA. o Hamburg Drain Storage - 5 MG offline storage facility o Smith Street Storage - 0.5 MG offline storage facility o CSO-016 Storage - 60,000 gallon inline storage
Gray Infrastructure Projects	• Black Rock Canal and Niagara River o Underflow pipe upsizing (to maximize flow to the existing interceptors) o New Northern Relief Sewer that runs parallel to the Black Rock Canal between CSO 004 and CSO 011/012 with an additional parallel relief sewer from CSO 004 to the existing siphon crossing at the WWTP influent. Northern Relief consists of the following components: ▪ 5,310 feet of 96-inch pipe ▪ 571 feet of 120-inch pipe o CSO 055 – 7.5 MG offline storage facility o CSO 013 – 0.3 MG offline storage facility • Scajaquada Creek o SPP 337: 0.7 MG offline storage facility o Jefferson Avenue & Florida Street: 2.6 MG offline storage facility o SPP 336 a & b: 4.2 MG offline storage facility • Buffalo River and Cazenovia Creek: o CSOs 028, 044 and 047: 2.3 MG offline storage facility o CSO 052: 0.6 MG offline storage facility o CSO 064: 0.1 MG offline storage facility • Erie Basin o CSO 014 and 015 – 0.8 MG offline storage facility
Green Infrastructure Projects	Green Infrastructure projects will include a mixture of the following techniques based upon the results of pilot studies undertaken during the early years of the LTCP implementation schedule and will be focused primarily on publically owned properties. • Vacant property demolitions • Modifications to vacant lots to store and infiltrate street runoff • Pervious pavements (public streets and parking lots) • Rain gardens • Downspout disconnections/rain barrels Green Infrastructure technology implementation will be based upon the control of up to 20% of the impervious surfaces (generally assumed to be publically owned) within selected sewer sheds as follows based on the SPP-level refinement outlined in the GI Master Plan: • Black Rock Canal – 198 acres • Buffalo River – 319 acres • Cazenovia Creek (Class B section) – 3 acres • Cazenovia Creek (Class C section) – 58 acres • Erie Basin – 53 acres • Niagara River – 378 acres • Scajaquada Creek – 305 acres Total controlled acreage – 1,315 acres

The planning level project costs were developed using a two-step approach for the Recommended Plan. The first step included assembling the costs for each alterative using the developed technology cost curves; this resulted in the cost performance curves. The opinion of probable project costs for the Recommended



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BUFFALO SEWER AUTHORITY
Long Term Control Plan Update

FIGURE ES-5

RECOMMENDED PLAN WITH APPROXIMATE GI 2 - 9 OF/yr

Plan under this methodology was estimated at approximately $273 million. A summary of probable capital costs using the cost curve methodology is presented in Table ES-5 below. Please note that while the refinement of the GI control acreage at the SPP level reduced the target control acreage to 1,315 acres, the GI cost was conservatively held at the initial $92.6 million estimate (based on $57,000/acre using the initial 1,620 acres impervious surface control) to reflect the BSA's commitment to increasing GI if necessary in the future and in response to the Agencies' view that GI costs were not conservative enough.

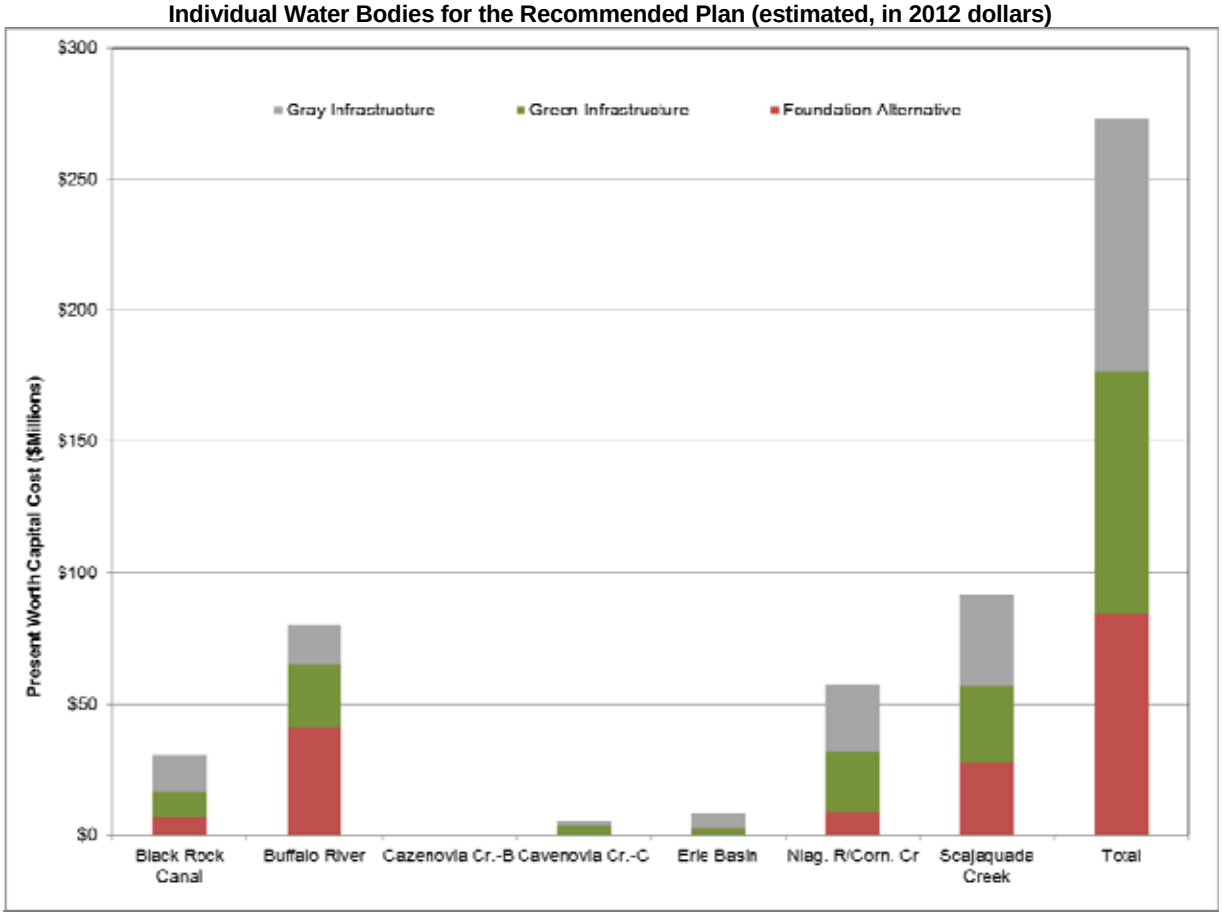
A cost breakdown (using present worth costs) by each receiving stream and general technology is shown on Figure ES-6. The estimated annual O&M cost associated with the Recommended Plan is approximately $350,000, resulting in a total 20-year Present Worth project cost (including O&M) of approximately $278 million.

Table ES-5: Summary of Recommended Plan Project Costs (estimated, in millions of dollars)
(Cost Curve Methodology, not including O&M, 2012 dollars)

Receiving Water Body	Green Infrastructure[1]	Gray Infrastructure	Foundation	Total Construction Cost
Black Rock Canal	$9.51	$14.41	$6.89	$30.80
Buffalo River	$23.83	$15.15	$41.13	$80.11
Cazenovia Cr.-B	$0.17	$0.00	$0.00	$0.17
Cazenovia Cr.-C	$3.42	$1.85	$0.02	$5.28
Erie Basin	$2.87	$5.43	$0.01	$8.30
Niagara River (includes CSO-055 (Cornelius Creek)	$23.50	$25.01	$8.70	$57.20
Scajaquada Creek	$29.32	$34.33	$27.75	$91.40
Total	**$92.61**	**$96.18**	**$84.49**	**$273.27**

NOTE: [1]GI cost based on initial target control of 1,620 acres as a conservative estimate.

Figure ES-6: Distribution of Gray, Green, and Foundation Alternative Present Worth Project Costs in the Individual Water Bodies for the Recommended Plan (estimated, in 2012 dollars)



NOTE: GI cost based on initial target control of 1,620 acres as a conservative estimate.

Next, a more detailed, yet still planning level, opinion of probable project costs was developed. This cost was developed using more specific information such as conceptual facility layouts, local knowledge of construction costs, costs for similar projects constructed elsewhere, etc. The probable project cost for the Recommended Plan under this methodology was estimated at $340 million, as shown in Table ES-6. In addition to the Recommended Plan cost, the costs for upgrades at the WWTP from the NFA Report (Alternative C2) have been added to reflect the overall expense for improvements across the BSA system ($380 million). For the purposes of this document, the O&M costs for all CSO-related construction projects are considered to be the same as presented above. However, the additional O&M cost for the NFA-related projects was estimated at $282,000 per year. It should be noted that while more detailed and refined, this cost estimate is still considered, at most, AACE Class 3 in that the costs are still based upon very limited design concepts. The refined system wide project cost estimate of $380 million was used as a conservative value cost for the affordability evaluations and initial project budgeting and scheduling.

Table ES-6: Summary of System Wide Estimated Project Costs

Receiving Water Body / Projects	Project Cost [1,2,3]
Black Rock Canal	
CSO 013 (300,000 gallons)	$3,000,000
North Relief Sewer	$36,000,000
CSO 008/010, 061, 004 Underflow Upsizing	$500,000
Erie Basin Marina	
CSO 014/015 (800,000 gallons)	$6,700,000
Cazenovia Creek – C	
CSO 028/044/047 (2,300,000 gallons)	$12,200,000
Buffalo River	
CSO 052 (600,000 gallons)	$3,900,000
CSO 064 (100,000 gallons)	$2,000,000
Scajaquada Creek	
Jefferson Avenue & Florida Street (SPP 170B) (2,600,000 gallons)	$9,500,000
SPP 336 a/b (SPP165A, SPP165B, SPP 336A, SPP336B) (4,200,000 gallons)	$11,500,000
SPP 337 (700,000 gallons)	$4,000,000
Niagara River (Cornelius Creek)	
CSO 055 (7,500,000 gallons)	$18,500,000
Subtotal	*$107,800,000*
Contingency (20%)	$21,500,000
Probable Construction Cost	*$129,300,000*
Administrative and Legal (5%)	$6,500,000
Engineering (20%)	$26,000,000
Total Recommended Plan Cost	**$161,800,000**
Revised Foundation Plan Cost (for projects not already completed, see Table 11-11)	*$85,000,000*
Green Infrastructure (system wide) [5]	*$92,600,000*
Revised Foundation Plan + Recommended Plan	**$339,400,000**
NFA Alternative C2 at WWTP	*$41,000,000*
System Wide Improvements	***$380,400,000***

NOTES:
[1] Year 2012 dollars.
[2] All Costs Rounded.
[3] Planning Level Estimate.
[4] Right-of-Way and/or land acquisition not included.
[5] GI cost based on initial target control of 1,620 acres.

Summary of Recommended Plan Benefits

The Recommended Plan offers significant benefits by focusing efforts and associated costs to tailor CSO improvements to achieve receiving water in stream improvements. The benefits of the Recommended Plan were evaluated for activation frequency for each receiving water body in terms of targeted CSO activation frequency LOC. Reduction in CSO volumes and the overall system wet weather percent capture have also been calculated and are included for informational purposes. The proposed performance measure at this time is the activation frequency criterion consistent with the presumption approach as provided in the CSO Control Policy. The Recommended Plan also meets the demonstration approach because each CSO receiving water will meet applicable water quality standards.

Table ES-7 presents a summary of the predicted frequencies, residual CSO volumes and percent capture for the Recommended Plan. Residual volumes and remaining overflows are presented for each receiving water body, while percent capture is presented on a system wide basis. As shown in Table ES-7, the Recommended Plan is predicted to achieve the 4 to 6 overflow events in a typical year at all but one of the Niagara River CSOs.

Table ES-7: Summary of Recommended Plan Benefits *

Receiving Water Body	CSO	Baseline Activations	Baseline CSO Volume (MG)	Projected Activations (LOC)	Residual CSO Volume (MG)	Remaining Fecal Coliform Annual Loadings (MPN)
Black Rock Canal	004	5	11.2	3	8.7	1.25E+14
	005	4	0.1	4	0.1	
	006	65	198.9	4	21.7	
	008	39	6.1	0	0.0	
	010	44	11.9	1	0.0	
	012	42	52.5	2	0.9	
	013	7	6.8	4	2.7	
	061	10	31.2	2	1.2	
	063	13	0.6	4	0.3	
	Total	**≤65**	**319.3**	**0 – 4**	**35.6**	
Buffalo River	017	49	71.3	4	34.8	6.26E+14
	022	49	29.8	5	2.0	
	025	11	1.4	6	1.2	
	026	63	124.2	3	29.6	
	027	36	31.7	6	39.1	
	028	69	45.5	6	22.7	

Receiving Water Body	CSO	Baseline Activations	Baseline CSO Volume (MG)	Projected Activations (LOC)	Residual CSO Volume (MG)	Remaining Fecal Coliform Annual Loadings (MPN)
	029	0	0.0	0	0.0	
	032	0	0.0	0	0.0	
	033	9	37.8	5	31.8	
	034	Closed	Closed	0	Closed	
	049	0	0.0	0	0.0	
	050	14	3.2	5	2.8	
	051	4	1.2	4	1.2	
	052	10	10.9	3	6.3	
	064	56	21.1	3	6.9	
	066	10	1.7	4	0.4	
	Total	**≤**69	**379.7**	**2 – 6**	**178.8**	
Cazenovia Cr.-B	035	0	0	0	0	0.00E+00
Cazenovia Cr.-C	037	13	23.3	6	11.9	5.38E+13
	039	0	0.0	0	0.0	
	044	7	2.3	2	0.7	
	046	1	1.3	0	1.3	
	047	44	8.7	3	1.5	
	048	0	0.0	0	0.0	
	Total	**≤**44	**35.6**	**0 – 6**	**15.4**	
Erie Basin	014	4	4.2	2	3.1	1.30E+13
	015	12	6.1	1	0.6	
	016	0	0.0	0	0.0	
	Total	**≤**12	**10.3**	**0 - 2**	**3.7**	
Niagara River (incl. CSO 055)	055	41	601.1	9	206.2	7.66E+14
	003	6	0.1	5	0.8	
	011	41	134.3	4	11.7	
	054	0	0.0	0	0.0	
	Total	**≤**41	**735.5**	**4 - 9**	**218.7**	
Scajaquada Creek	053	65	268.0	4	52.1	1.82E+14
	056	5	0.0	3	0.0	
	057	0	0.0	0	0.0	

Receiving Water Body	CSO	Baseline Activations	Baseline CSO Volume (MG)	Projected Activations (LOC)	Residual CSO Volume (MG)	Remaining Fecal Coliform Annual Loadings (MPN)
	058	0	0.0	0	0.0	
	059	0	0.0	0	0.0	
	060	5	0.7	0	0.0	
	Total	≤65	**268.7**	**0 - 4**	**52.1**	
Totals		**NA**	**1749.1**	**NA**	**504.3**	**1.77E+15**
Percent Capture		**NA**	**91.3%**	**NA**	**97.2%**	**NA**

NOTE: All model projections of frequency, volume and percent capture are based on selected 1993 typical year precipitation conditions and represent planning-level estimates that may vary within accepted industry standards.

The Recommended Plan was also evaluated for each receiving water body in terms of remaining pollutant loadings and water quality compliance (bacteria is the pollutant of concern). As agreed with the Regulatory Agencies at technical meetings conducted in 2011, for purposes of evaluating water quality compliance, a baseline scenario representing somewhat improved upstream water quality was chosen. This baseline scenario incorporates upstream water quality conditions set at 75% of the WQS. These modified upstream boundary conditions were identical for both the baseline scenario used in this report and for the Recommended Plan. Stormwater and upstream fecal coliform bacteria concentrations were set to 150 counts/100 mL, and BOD concentrations set to 75% of baseline in-stream conditions.

Attainment of the bacteria WQS for each water body under the Recommended Plan was calculated from model output and compared to the bacteria WQS attainment for the baseline condition. Table ES-8 presents a summary of annual percent attainment of bacteria WQS for all modeled water bodies under these two scenarios. Attainment was first calculated for each model segment and then spatially averaged across each water body.

Table ES-8: Water Quality Standards Attainment for Bacteria (Background Loadings set at 75% of WQS)

Scenario	Bacteria: Annual Percent Attainment (%) of WQS					
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal	Erie Basin	Niagara River (incl. CSO 055)
Baseline (Background 75% of WQS)	99	77	93	86	100	100
Recommended Plan	100	100	100	100	100	100

All water bodies demonstrated 100% attainment of the bacteria WQS under the Recommended Plan for the targeted levels of control presented previously (note that Black Rock Canal was rounded from 99.9% to 100%). The greatest improvement was seen for Lower Scajaquada Creek, where attainment increased from 77% in the baseline scenario to 100%. Additionally, bacteria WQS attainment increased from 86% to 100% in the Black Rock Canal, 93% to 100% for the Buffalo River, and from 99% to 100% for the Upper Scajaquada Creek. Bacteria WQS attainment in the Erie Basin and the Niagara River remained unchanged at 100% attainment for baseline conditions.

GI Sensitivity

The Recommended Plan has a significant GI component with most of the areas within the BSA CSS targeted for up to 20% of impervious area control by GI projects. Note that GI target percentages have been developed on a sewershed (area of collection system tributary to an individual CSO) basis. As such, the performance of the Recommended Plan is dependent on the future performance of the GI projects. While GI has evolved significantly over the last decade and is gaining strong public and regulatory support, many GI technologies are still evolving and their application and long-term performance can vary significantly among communities. Furthermore, GI performance in cold climates, such as the City of Buffalo, requires additional time and attention to assess and implement effectively. Finally, the ultimate effectiveness of a GI program in the longer term is heavily dependent upon community acceptance. These factors are why the BSA plans on conducting selected GI pilot projects to inform the proposed system wide GI implementation program.

Currently, the BSA is in the process of constructing a demonstration project in the CSO 060 project. This project includes a number of different GI techniques including pervious pavements, rain gardens and downspout disconnections and will begin to provide a database of local performance metrics. Additional GI pilot projects also are considered for the early years of the LTCP implementation. Further, the BSA is embarking on a broader downspout disconnect/rain barrel pilot program in two neighborhoods to assess the effectiveness of these measures at reducing CSOs and the public's willingness to participate in such a program.

In order to evaluate the sensitivity of the program to GI effectiveness, a model run was completed incorporating only the gray components of the recommended plan. This run was intended to determine how the system would react in the event that in the worst case, GI proved to be ineffective. The sensitivity evaluation results are presented in Table ES-9.

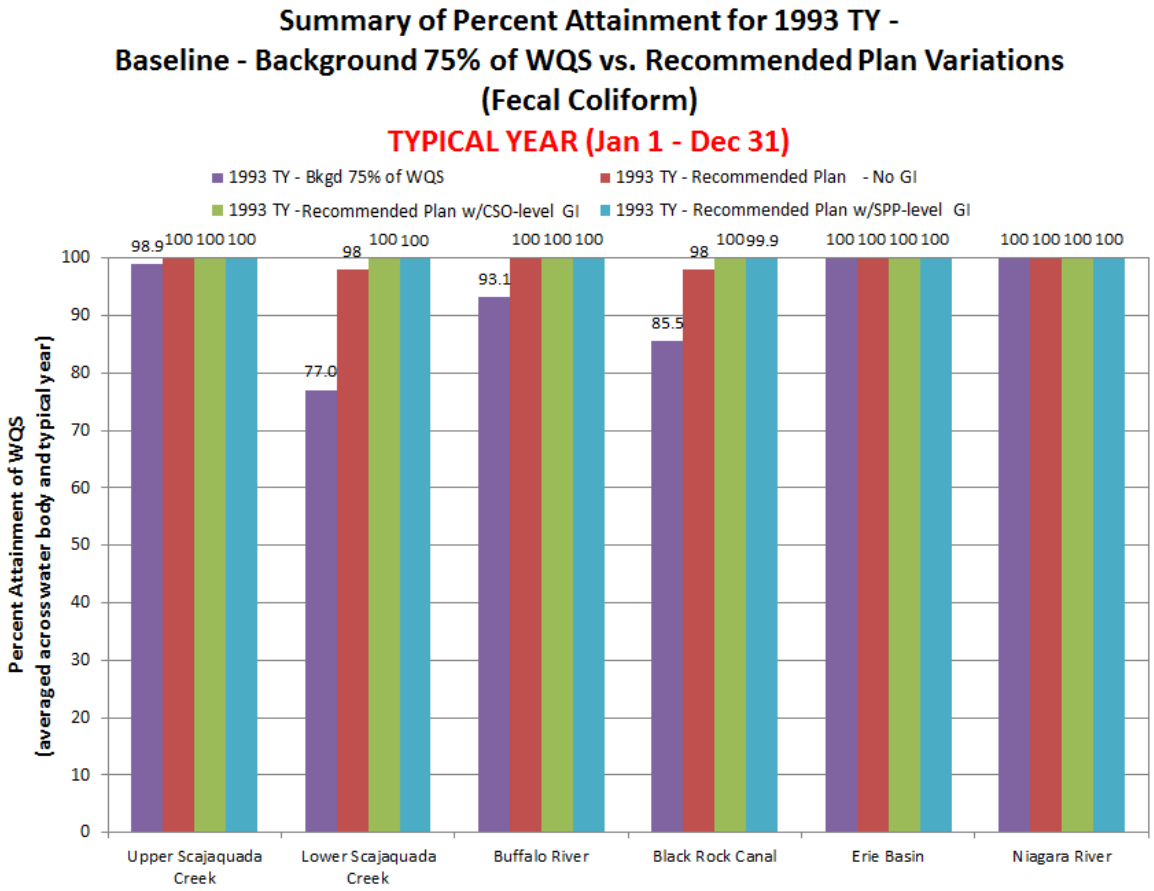
Table ES-9: Green Infrastructure Sensitivity Analysis Results

	Projected Activations (LOC)		Residual CSO Volume (MG)	
Receiving Water Body	**GI (SPP-level)**	**No GI**	**GI (SPP-level)**	**No GI**
Black Rock Canal	0 – 4	0 - 7	35.6	57.3
Buffalo River	2 – 6	3 - 10	178.8	233.9
Cazenovia Cr.-B	0	0	0.0	0.0
Cazenovia Cr.-C	0 - 6	0 - 8	15.4	20.6
Erie Basin	0 - 2	0 - 2	3.7	6.8
Niagara River (incl. CSO 055)	4 - 9	6 - 12	218.7	321.2
Scajaquada Creek	0 - 4	0 - 7	52.1	74.2
Totals	**NA**	**NA**	**504.3**	**713.9**
Percent Capture	**NA**	**NA**	**97.2%**	**96.5%**

The SPP-level GI scenario represents the impervious surface area control associated with the SPP-level refinement discussed above. As can be seen from Table ES-9, with no GI assumed, the effect on projected activations is relatively minor; however, the implementation of GI results in an annual CSO volume reduction of approximately 210 MG. This evaluation demonstrates that even if the GI program falls significantly short of the established goals, the resulting reduction in system performance will be negligible given the significant progress and high LOC achieved to date.

In addition to the hydraulic modeling comparison discussed above, the BSA also evaluated the water quality impact of no GI. Figure ES-7 shows a graphical comparison of the resulting water quality impacts.

Figure ES-7



NOTE: The 99.9 percent capture in Black Rock Canal for the "Recommended Plan w/SPP-level GI" scenario was rounded to 100 percent.

The water quality modeling results reveal that the Recommended Plan with no GI will result in 100% attainment of the current NYS bacteria WQS in all receiving water bodies, except for the Lower Scajaquada Creek and Black Rock Canal (both at approximately 98%). This suggests that much of the system will not be affected appreciably by reductions in GI.

That said, the GI controls are an important part of the Recommended Plan for reasons beyond water quality compliance. For example, the GI controls will provide multiple environmental and community benefits as compared to gray infrastructure designed solely to address bacteria loadings. GI controls will also serve to engage the public in tangible aspects of this important water quality program in a way that underground sewer pipes could never accomplish. Also, if GI is successful, there is the strong likelihood that GI can be

expanded beyond the levels proposed in the Recommended Plan. This will allow the BSA to resize/right-size future gray infrastructure and/or provide an even higher LOC. The more GI, the more sustainable the program will be over the long-term.

Implementation Schedule

The LTCP Recommended Plan will have a probable project cost of $380 million, and will be implemented over a 20-year period. Figure ES-8 presents the implementation of the BSA's Recommended Plan over the course of 20 years, resulting in a substantial reduction in annual CSO activation frequencies and volumes. Remaining Phase I and Revised Foundation Plan projects are scheduled to be implemented first, with the next priority given to Erie Basin Marina (sensitive area) and Black Rock Canal (water quality most affected by wet weather discharges). Storage and conveyance projects in the Scajaquada Creek, Buffalo River (with the exception of Smith Street project), and Niagara River sewersheds would primarily be implemented starting about halfway through the overall 20-year implementation, after evaluating the GI pilot project performance.

Most notably, the Recommended Plan has a significant (but reasonable and realistic) green component, with a plan to control a range of between 1,315 and 1,620 acres of impervious surface city-wide through the use of GI. These areas are distributed by receiving water body as previously shown in Table ES-2.

Because of the need for post-construction monitoring to evaluate the effectiveness of GI technologies, the minimum impervious surface control implementation is phased throughout the 20-years as follows:

- 267-acres controlled in Years 1-5 (20% of total GI, *i.e.*, 1,315-acres)
- 410-acres controlled in Years 6-10 (~30% of total GI)
- 375-acres controlled in Years 11-15 (~30% of total GI)
- 263-acres controlled in Years 16-19 (20% of total GI)

This scheduling allows for the upfront construction of gray infrastructure and technologies required to capture a significant amount of remaining wet weather flow in strategic areas and those that are relatively independent from the GI performance, while allowing the BSA adequate time to evaluate the effectiveness of the GI technologies implemented within the first five years. Consistent with the CSO Control Policy, the BSA will conduct post-construction monitoring (PCM) to verify the effectiveness of the CSO controls to meet the performance criteria specified in this LTCP. The PCM plan is due to the Agencies within one year from the approval of this LTCP. The performance feedback received from the GI projects during the post-construction monitoring, following the five-year initial period, is critical to the BSA's ability to right size the subsequent gray projects and more accurately determining the types of GI technologies to be used in

Figure ES-8: BSA CSO LTCP
Implementation Schedule - Recommended Plan

Project	Receiving Water	Description	Years 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
LTCP Regulatory Approval			▲																					
Phase 1 Projects	Varies	Bird/Lang RTC Projects (see Table 11-11)																						
		Construction																						
		Operations/Optimization (RTC)																						
Foundation Projects																								
CSO 016 Storage	Erie Basin	*Completed (In-Line Storage see Table 11-11)*																						
Foundation 1	Buffalo River	Smith St Storage																						
		(see Table 11-11)																						
Foundation 2	Varies	SPP Optimization (see Table 11-11)																						
		(20 projects)																						
		(conveyance facilities)																						
Foundation 3	Varies	Remaining RTC (see Table 11-11)																						
		(14 sites)																						
Foundation 4	Buffalo River	Hamburg Drain Optimizations																						
		(see Table 11-11)																						
	Buffalo River	Hamburg Drain Storage																						
		(see Table 11-11)																						
Green Projects																								
Green Pilot Projects	Varies	267-acres of GI control (See GI Master Plan)																						
		Construction																						
		PCM																						
Green 2	Varies	410-acres of GI control																						
Green 3	Varies	375-acres of GI control																						
Green 4	Varies	263-acres of GI control																						
WWTP																								
NFA Project	Niagara River	Alternative C2 from NFA																						
Gray Projects																								
014/015	Erie Basin	In-line storage and optimization																						
		(see Section 12.3)																						
013	Black Rock Canal	Satellite storage, conveyance, FM & PS																						
		(see Section 12.3)																						
North Relief	Black Rock Canal	Interceptor (see Section 12.3)																						
010, 008/010, 061, 004	Black Rock Canal	Underflow capacity upsizing																						
		(see Section 12.3)																						
SPP 337 (053)	Scajaquada Creek	Satellite storage, conveyance, FM & PS																						
		(see Section 12.3)																						
SPP 336 a + b (053)	Scajaquada Creek	Satellite storage, conveyance, FM & PS																						
		(see Section 12.3)																						
Jefferson & Florida (SPP 170B - CSO 053)	Scajaquada Creek	Satellite storage, convey & FM																						
		(see Section 12.3)																						
055	Niagara River	Satellite storage, conveyance, FM & PS																						
		(see Section 12.3)																						
028/044/047	Buffalo River/ Cazenovia Creek-C	Satellite storage, conveyance, FM & PS																						
		(storage at Tops from CSO 47 west)																						
		(see Section 12.3)																						
052	Buffalo River	Satellite storage, conveyance, FM & PS																						
		(see Section 12.3)																						
064	Buffalo River	Satellite storage, conveyance, FM & PS																						
		(see Section 12.3)																						
Submit PCM Plan				▲																				
Overall PCM																								

KEY
- Engineering
- Construction
- PCM/Optimization

NOTE: The BSA reserves the right to substitute projects within the same general timeframe as the projects listed in the schedule, either by implementing a project of equal cost value or one that achieves the same benefit as the original project.

subsequent implementation periods, as well as to make adjustments to the amount of GI to be constructed. Should the PCM results for the program suggest that the predicted level of activation performance criteria are not being met or are being out performed, the BSA will propose alternative projects (green or gray) to achieve the predicted outfall frequency of activation. Depending on the specific project area, this may include adjustments to impervious surface acreage controlled by GI, rightsizing an already proposed gray project or designing an entirely new project. The BSA will use the PCM data collected, as well as the models to fine-tune the program to meet the frequency of activation performance criteria. This fine-tuning process will determine whether the facilities need to be smaller or larger than what is estimated in this Recommended Plan.

Financial Impacts

To further address the USEPA's AO requirements, the BSA has evaluated financial affordability and rate impacts. The BSA updated and replaced the Financial Capability Assessment (FCA) originally submitted as part of the 2004 LTCP. The updated FCA was prepared by CRA in 2010 (revised in 2011), in accordance with the USEPA's *Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development, 1997* (Financial Capability Guidance). While BSA agrees with the conclusion that BSA ratepayers will be heavily burdened to implement the Recommended Plan, the BSA does not fully agree with the Financial Capability Guidance, as it does not present a complete and accurate picture of Buffalo's financial condition and capability. BSA believes that additional factors should be considered which would reveal that implementing the Recommended Plan will be an even heavier burden than demonstrated through the factors in USEPA's financial capability guidance.

Many local factors, trends, and financial conditions are neither contemplated nor considered within the Guidance's approach. Thus, the affordability of the LTCP relative to the BSA and its ratepayers cannot be determined solely on the results of the methodology prescribed by the Guidance. The Financial Capability Guidance itself acknowledges that local factors should be considered. Consequently, the BSA must reserve its rights to include such local factors and considerations, and or/seek schedule relief consideration relative to the LTCP implementation schedule.

Even using the Financial Capability Guidance results in a finding that the BSA's ratepayers will be heavily burdened to implement the LTCP. For the vast majority of other CSO communities in the heavy burden category, the USEPA has allowed 18 years or more to implement their LTCPs (see consent decrees for DC (20 years), Indianapolis (20 years), Cincinnati, ALCOSAN, Elkhart (20-plus years), Evansville (20-plus years), Kansas City, MO (25 years), Memphis, to name just a few recent communities). Therefore, the BSA believes that the Agency approved 20-year implementation schedule is not only appropriate, but in line with other approved programs.

Conclusions

The BSA believes that the Recommended Plan selected following the 2004 LTCP development process coupled with this update fully meets the requirements of the USEPA's CSO Policy, the BSA's SPDES Permit, and the terms and conditions of the USEPA's AO. More importantly, it will provide the greatest water quality and community benefits, and can be implemented within the approved 20 year implementation schedule.

The BSA's Recommended Plan was selected based on the following key factors:

- ***Satisfying the requirements of the USEPA CSO Control Policy***. A major tenet of satisfying the USEPA's CSO Control Policy is that the implemented LTCP should not preclude the attainment of WQS for CSO receiving water bodies. The Recommended Plan follows the frequency of activation option within the "presumption approach" provided in the CSO Policy. In addition, compliance with WQS (the "demonstration" approach under the CSO Control Policy) is achieved in all CSO receiving water bodies. Notably, despite the extreme economic challenges in the Buffalo region, the LOC provided by the Recommended Plan is fully consistent with (or exceeds) many other approved CSO LTCPs for communities around the country.

- ***Considering the City of Buffalo's financial condition***. Implementation of the Recommended Plan will result in a "high" burden to the BSA's residential and business customers using any financial measure – whether the USEPA's Financial Capability Guidance or a number of common criteria which are used to compare the financial health of communities. Notably, the State of New York has created and imposed the Buffalo Fiscal Stability Authority (BFSA) to oversee the budgetary expenditures and contractual obligations of the City of Buffalo and has jurisdiction over the BSA. These burdens necessitate the 20-year implementation schedule.

- ***Pollutant mass loading from upstream sources***. The pollutant mass loadings to the CSO receiving water bodies from upstream of the point where the loadings pass through the City of Buffalo were found to be significantly higher than the pollutant mass loadings contributed by the BSA's CSOs. The Recommended Plan calls for the BSA to continue its impressive CSO control efforts to date culminating in the target frequency of activation in the typical year in all receiving water bodies, as presented in detail in Section 12. The Plan assumes that modest improvements will be made by upstream sources (see Baseline Scenarios above) that will then allow applicable WQS to be met. To the extent the NYSDEC and the USEPA do not effectively address upstream sources (including through the imposition of a Total Maximum Daily Load for bacteria for impaired waters in and around the City), then a use attainability analysis (UAA) will be warranted as specified in the CSO Control Policy, before any further CSO controls are required. The CSO Control Policy mandates that the NYSDEC is responsible for coordinating the evaluation of wet weather WQS with the development of the CSO LTCP.

- ***Watershed Approach***: Even complete removal of the CSOs within the BSA's control, without the abatement of upstream pollutant loading, will not achieve attainment of WQS in a number of the water bodies evaluated as part of this LTCP. Moreover, requiring CSO control beyond the Recommended Plan is unfair to the BSA's ratepayers when modest reductions in upstream source loadings will allow WQS to be achieved.

- ***Implementation Schedule:*** The BSA's Recommended Plan is dependent on a 20-year implementation schedule that results in a substantial reduction in activation frequencies, as well as a reduction in annual CSO volume and an extremely high model predicted wet weather system wide percent capture rate of over 97 percent. This Recommended Plan also has a large GI component, with a commitment to control a minimum of approximately 1,315 acres city-wide through the use of GI. The 20-year schedule is essential to allow for the upfront construction of gray technologies required to capture a significant amount of wet weather flow in strategic areas, particularly those that are relatively independent from the GI performance, while also allowing the BSA adequate time to evaluate the effectiveness of a range of GI technologies to be implemented within the first five to seven years of the program. The scope and performance of the GI will be established through post-construction monitoring and will assist the BSA in rightsizing subsequent gray projects, more accurately determining the optimum GI technologies to be used in subsequent implementation periods, as well as to make adjustments to the amount of GI constructed.

- ***Public/Stakeholder Input –*** The CSO Policy recognizes that CSO control is a community-specific undertaking and the Recommended Plan reflects this reality having benefited from the BSA's implementation of the approved Public Participation Plan as part of the development of this Recommended Plan. In addition to formal stakeholder input and public meetings, the BSA's officials have worked tirelessly to obtain informal input and advice for a wide range of ratepayers, stakeholders, and public officials. The final 30-day public comment period and public meetings following the April 2012 LTCP submission found the public to be supportive of the Recommended Plan and suggest that the public is particularly pleased with the green infrastructure components of the plan. The BSA is greatly appreciative of and indebted to the many stakeholders and members of the public who have lent their time and talent to the development of this critical program for our community.

Finally, one must not understate the significance of the BSA embarking on a $380 million capital program in terms of community affordability, allocation of scarce public financial resources, disruption of multi-year capital improvement programs, and other impacts. The BSA calls on the Federal and State government to do their part by providing some grant (or grant-equivalent) funding toward the BSA's implementation of the Recommended Plan – an unfunded Federal and State mandate. This funding support can readily come from the State Revolving Fund program or federal grant funding. BSA is committed to seeking such funding to help minimize financial burdens on BSA's ratepayers.

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