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City-Wide Green Infrastructure Assessment Public Summary

BACKGROUND & SCOPE

The Allegheny County Region experiences degraded water quality from frequent overflows of sewage and stormwater from the Allegheny County Sanitary Authority (ALCOSAN) service area piped collection systems. These overflows occur during storm events from more than 100 system wide outfalls. Correction of these federal water quality violations have been mandated by both the Pennsylvania Department of Environmental Protection (DEP) and the United States Environmental Protection Agency (EPA). Regional solutions have been proposed, with which the Pittsburgh Water and Sewer Authority (PWSA) and the City of Pittsburgh are required to participate.

In response, PWSA has been developing its “Green First” approach to stormwater management. By managing the stormwater flows during the storm, PWSA’s combined sewer overflows would be reduced. The PWSA would be able to delay stormwater conveyance to the ALCOSAN system until after rain induced peak flows are abated. PWSA plans to prioritize source reduction and the implementation of Enhanced Green Best Management Practices (EGBMPs) in lieu of large scale traditional conveyance and storage structural alternatives.

PWSA’s “Green First” approach offers the following benefits to Combined Sewer Systems (CSS):

- Cost-effectively reduces combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) during storm events;
- Reduces basement backups, localized surface flooding, and direct stream inflows to the sewer system;
- Improves water quality and restores local habitats; and,
- Enhances urban settings and accrues social, economic, and environmental benefits to the entire Pittsburgh community.

The City-Wide “Green First” assessment was developed to analyze the benefits of distributed EGBMPs if implemented in targeted areas in the CSS. The impact of source reduction to the hydraulically-connected municipalities was also assessed. The City-Wide “Green First” approach is designed to guide and inform the City’s capital

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improvement projects, regulatory compliance, stormwater management, and urban planning decisions.

The program included the following tasks:

1. Analyzing high priority sewersheds to determine the most efficient locations for source reduction and EGBMP implementation in terms of cost per annual volume of CSO reduced;
2. Conducting outreach initiatives to collaborate among the Mayor's office, various City departments, municipal representatives, regional organizations, multi-municipal organizations, and other stakeholders to coordinate the "Green First" assessments;
3. Evaluating the feasibility and cost-effectiveness of separating and daylighting streams that currently flow into the CSS;
4. Identifying and quantifying the multiple community benefits of EGBMP implementation and stream daylighting; and,
5. Coordinating with the City's ongoing redevelopment, bylaw and ordinance modification/development, and resilience initiatives.

PROJECT APPROACH

Priority sewersheds were determined by collecting and analyzing data on:

1. The current sewer system and sewershed characteristics;
2. Stream inlet locations;
3. Catch basin inlet locations;
4. Sites of planned and ongoing new and redevelopment;
5. Historical hazard and public safety information on flooding locations;
6. Historical wet weather and stream reports;
7. Urban planning activities throughout the City and neighboring municipalities; and,
8. Hydrologic and hydraulic (H&H) models of seven sewage collection system basins provided by ALCOSAN.

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The team selected candidate locations and opportunities for the EGBMP assessment, by considering the following factors:

- Volumes of potential annual CSO reduction;
- Application to CSS outfalls that ALCOSAN's Recommended Plan outlined in its 2013 Wet Weather Plan Report intended to directly discharge to their conveyance, storage and treatment system;
- Key known flooding hazard and public safety mitigation areas in the City;
- Locations of known urban planning and redevelopment sites;
- Direct stream discharge locations into the CSS; and,
- Potential for overall water quality improvement.

Upon review and discussion of the candidate opportunities, the following areas of the City were identified for the City-Wide "Green First" Assessment:

- Thirty high priority sewersheds – shown in Figure 1 - were selected to optimize the CSO volume reduction, and offer relief for historic flood hazard areas. These 30 high priority sewersheds contribute to just over 3 billion gallons (BG) of CSO discharge in a typical year, representing approximately one-third of the CSO discharge from the entire ALCOSAN service area. Most combined sewage in the 30 high priority sewersheds is generated within the City. Three of the sewersheds (A-42, A-60, and O-27) have contributing flows from other municipalities;
- The 10 largest direct stream inflow contributors to the CSS (and therefore primary CSO's); and,
- The top 10 City hazard locations as identified by the City's Office of Emergency Management

To integrate the results of the priority sewersheds and enhanced Green Infrastructure (GI) analyses with the City's planning and urban development opportunities, PWSA coordinated with several City agencies, and considered existing community-driven redevelopment plans, stakeholder development plans, and City department progress reports on initiatives being pursued. Six priority sewersheds were selected where GI

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would best complement the strategic urban development plans, existing characteristics, and high yield areas:

1. Four Mile Run (M-29 sewershed)
2. Washington Blvd. and Negley Run (A-42 sewershed)
3. South Side (M-16 sewershed)
4. Woods Run (O-27 sewershed)
5. Heth's Run (A-41 sewershed)
6. Hill District/Uptown (M-19 sewershed)

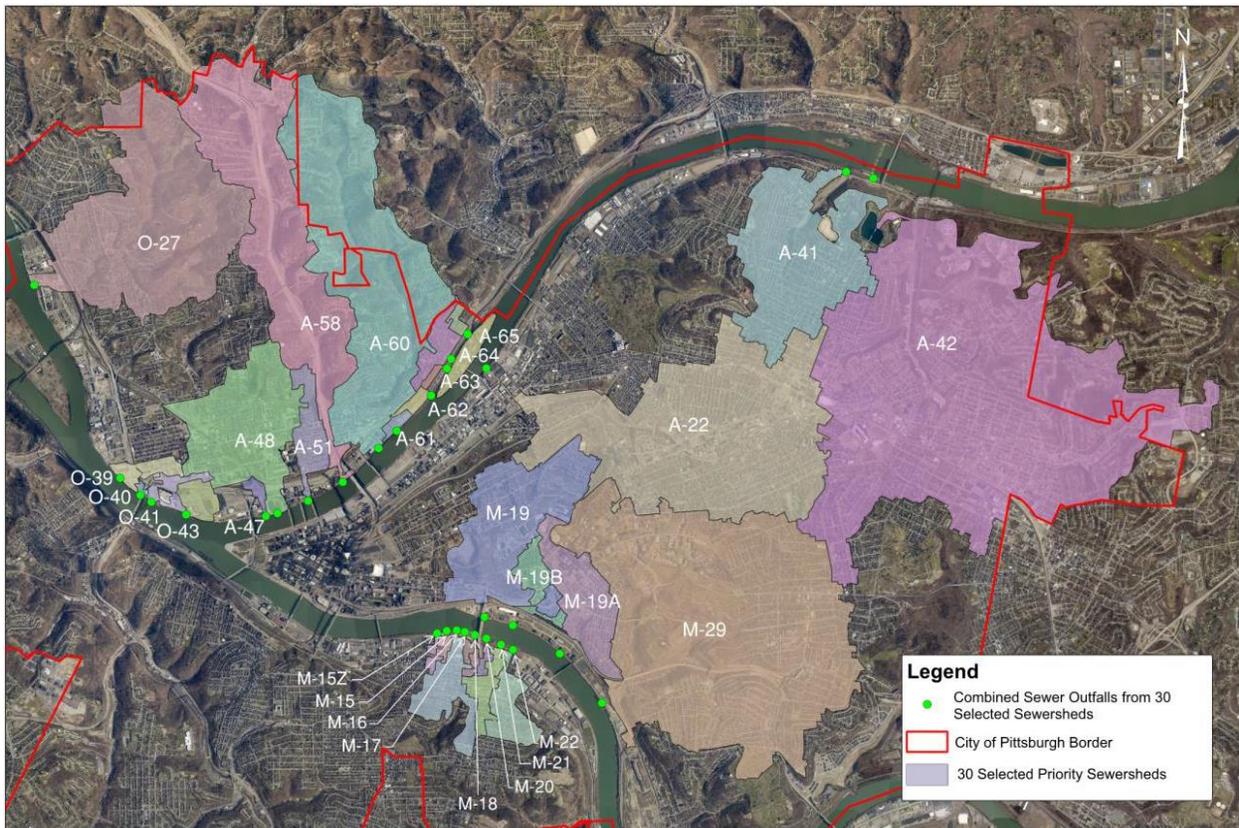


Figure 1: City-Wide 30 Priority Sewersheds (alphanumeric numbers refer to CSO designations)

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The team established a set of guiding principles to assist in the selection of the source control and EGBMP locations within the respective sewersheds:

- Cost-effective public realm investment;
- Re-establish riverfront connections;
- City design approach: “complete streets design”;
- Foster healthy, walkable communities concepts;
- Creation of resilient infrastructure; and,
- Align with the City’s people, planet, place, and performance (P4) metrics.

These principles were applied to develop stormwater management plans for each of the selected six sewersheds to demonstrate the long-term benefits that can be established for each neighborhood - with opportunities inside the City and throughout the County.

“Green First” Stormwater Management Goals and Modeling Results

To estimate stormwater control targets for the 30 priority combined sewersheds, the baseline CSO performance and the influence of other sewer system components, such as ALCOSAN’s Woods Run Wastewater Treatment Plant (WWTP), and the existing conveyance tunnels and interceptors was evaluated. PWSA compiled ALCOSAN’s seven separate basin-level sewage flow models into a single comprehensive, interconnected, system-wide model of the combined and separated sewage through the regional conveyance system.

For this project, 85 percent capture of the stormwater flows was the selected EPA CSO Control Policy objective. The 85 percent combined sewage capture target is not meant to presume a final level of control for the region’s CSOs, but simply to define a target that has been a compliance goal or requirement enforced in other cities similar to Pittsburgh. This approach allows the flexibility needed to optimize future stormwater management investment levels in conjunction with necessary gray infrastructure, to comply with the ultimate CSO compliance target that is ultimately agreed upon with state and federal regulators.

Alternative regional conveyance, storage and treatment system configuration scenarios were simulated to determine which existing and potential future infrastructure can

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influence the amount of “City-Wide” stormwater to be managed to achieve the 85 percent capture goal. The “typical year” for four system configurations is based on 2003 precipitation data. Integrated modeling results for the 30 priority sewersheds, including individual simulation of three proposed ALCOSAN conveyance and treatment system configurations (not including existing conditions) was simulated in concert with City implemented EGBMPs. These studies indicate that the City’s implementation of EGBMPs would significantly reduce CSO overflows and improve regional water quality. The analytical results are shown on Table 1 herein.

The modeling results also show that other system wide conveyance and system hydraulic adjustments could possibly further improve the CSO amount captured. In addition, CSO abatement would be increased by implementing the Green First strategy in other City sewage collection basins. Additional studies will be performed to estimate the value of the Green First strategy if implemented throughout the City.

FLOOD HAZARD MITIGATION

PWSA coordinated with the City of Pittsburgh Office of Emergency Management and Homeland Security to obtain the Hazard Vulnerability Assessment report from 2013. From this report, PWSA identified the top 10 most hazardous locations in the City. The hazards included landslide-prone areas on steep slopes, recurring stream flooding from large rain events, and recurring street flooding from sewer surcharges during large rain events. Of the ten locations, four flooding-related hazard locations were analyzed for this study:

1. Morange Road - located in the Chartiers Creek Basin in the C-25 sewershed
2. Frankstown Avenue - located in the Upper Allegheny Basin in the A-42 sewershed
3. Streets Run - located in the Monongahela Basin in the M-42 sewershed
4. Nine Mile Run - located in the Monongahela Basin in the M-47 sewershed

EGBMPs and source reduction implementation were analyzed for its effectiveness in flood mitigation for these locations. Estimates were developed assuming EGBMPs would be designed to protect property against a less frequent storm event than for CSO compliance. The event condition analyzed was an August 31, 2014 event with a peak rainfall intensity of 1.05-inches in 15 minutes, and a rainfall volume of 2.25-inches in 10 hours. Regardless of the type of overflow reduction solution selected, additional studies

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are required to address flooding and asset management of the existing sewer system, and demonstration projects are recommended to confirm the stormwater control and flood reduction benefits.

STREAM INFLOW IMPROVEMENTS

Removing direct stream inflows (DSI) from the collection system can restore significant wastewater conveyance and treatment capacity, thereby reducing CSOs. An analysis of the 10 largest DSIs was conducted, and alternatives were developed for detaining and/or removing the DSI (stream base flow and stormwater runoff during wet weather conditions) from the sewer system to estimate the most cost effective option for CSO reduction. Recommended solutions for each of the locations are as follows:

Woods Run – Detention with slow release of flows into the CSS using EGBMPs to address the eight inflow locations.

Spring Garden – Detention with slow release into a shallow storm sewer that ultimately discharges to the Allegheny River.

Panther Hollow – Detention with daylighted surface channel and discharge into the Monongahela River.

Further study and coordination with other projects in the areas adjacent to these DSI opportunities are needed to confirm estimated capital costs.

SUMMARY

Achievement of the “Green First” City-Wide program goals depends upon the amount of stormwater controlled throughout the City. Moreover, the EGBMP investment to achieve an 85 percent combined sewage capture target is highly influenced by the capacity and operation of the ALCOSAN wastewater system operations. Under existing ALCOSAN operating conditions, 13 to 17 of the 30 sewersheds analyzed already meet the 85 percent combined sewage capture goal, and only offer marginal CSO reduction benefits from EGBMP implementation. However, benefits of reduced basement backups and reduced localized surface flooding can be achieved anywhere SWBMP’s are implemented. The estimated costs and system flow reduction quantities for the

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developed “Green First” approach are summarized in the following tables (See attachment).

The estimated CSO compliance benefits and program costs are presented in Tables 1 and 2 attached. The analyses were founded upon, and developed to integrate with, ALCOSAN’s CSO compliance facility plans. EGBMP performance demonstration will be needed to confirm PWSA’s estimated benefits and costs of the “Green First” strategy.

PWSA also identified a range of non-water quality benefits by using EGBMPs. These include: air quality, city aesthetics, reduced flood hazard, reduced localized sewer system backups, as well as economic benefits of increased property values and long term job opportunities.

NEXT STEPS

As part of City-Wide phase 1, PWSA has analyzed 30 high priority sewersheds for SWBMP prioritization, flood hazard mitigation, and direct stream inflow opportunities. In 2017, PWSA plans to model and assess the remaining 61 combined sewersheds in the City. PWSA will establish implementation plans for the priority sewersheds to achieve the goal of managing 1,835 acres of impervious surface using EGBMPs by 2032. To comply with a USEPA consent decree, PWSA’s initial investment is estimated to be \$100 Million over the next five years. This investment will confirm the design, probable performance, and costs of City-Wide implementation of the EGBMP.

Validating the “Green First” approach will require coordination with various city agencies and other community partners. Working across city agencies will assist PWSA in the development of the necessary standardized documentation including EGBMP design standards, ordinance and code modifications, maintenance protocol, workforce development, and community engagement plans. PWSA will continue to develop a stormwater division within the Authority to efficiently and effectively implement the “Green First” approach.

PWSA is now collaborating with ALCOSAN, the federal and state regulators, and the City to formalize the integrated program for regional CSO compliance while addressing the City’s flood management needs.

TABLE 1 CAPITAL COSTS AND OVERFLOW REDUCTIONS FOR THE 30 PRIORITY SEWERSHED “GREEN FIRST” APPROACH				
System	Plant Capacity (MGD)	480 MGD WWTP Expansion	600 MGD WWTP Expansion & System Improvements	Lowered HGL Operation During Wet Weather
	Sediment Removed From in Existing Tunnel?	No	Yes	Yes
	19 of 30 CSO Regulators Modified to Allow More Flow to Tunnel?	No	Yes	Yes
City- Wide	GI Impervious Area Managed (acres)	1,835	1,835	1,286
	Flood Hazard Reduction and Overflow Reduction Costs Included?	Only Frankstown Road and Morange Road Included		
	Stream Removal/Detention Costs Included?	Panther Hollow, Woods Run, and Spring Garden Included		
	Surface Flooding and Basement Sewage Backup Reduction Costs Included?	In sewersheds where SWBMP's are located, it was assumed that they would be designed for a flooding level related to rainfall intensity of 1.05 inches in 15 minutes.		
System Improvements	WWTP Upgrade Capital Cost (\$ M) ¹	\$334	\$378	\$378
	Existing Tunnel Cleaning and Modernization (\$ M) ²	\$0	\$200	\$200
	New Wet Weather Pump Station Cost to Allow Lower HGL Operation (\$ M) ³	\$0	\$0	\$150
	High Rate Treatment at WWTP to Treat Flows Above 600 MGD (\$ M) ²	\$0	\$0	\$70-\$100
GI + Stream Removal	Stormwater BMPs Construction (\$ M) ⁴	\$690 – 920	\$690 – 920	\$490 – 660
	Stream Removal/Detention (\$ M)	\$46 – 62	\$46 – 62	\$46 – 62
	Total Capital Cost (\$ M)	\$1,070 – 1,310	\$1,310 – 1,560	\$1,340 – 1,550
	Total System Wide Overflow Reduction (BG), Typical Year	4.09	5.00	5.20

**TABLE 2
TOTAL COSTS (INCLUDING O&M) FOR THE 30 PRIORITY SEWERSHED
“GREEN FIRST” APPROACH
30 PRIORITY SEWERSHEDS RESULTS**

	480 MGD WWTP Expansion	600 MGD WWTP Expansion & System Improvements	Lowered HGL Operation During Wet Weather Conditions
GI Impervious Area Managed (acres)	1,835	1,835	1,286
Total Capital Cost (\$ Million)	\$1,070 – \$1,310	\$1,310 – \$1,560	\$1,340 – \$1,550
Total System Wide Overflow Reduction (billion gallons), Typical Year	4.09	5.00	5.20
Total Capital Cost Per Overflow Gallon Reduced	\$0.26 – \$0.32	\$0.26 – \$0.31	\$0.26 – \$0.30
Annual O&M Cost for SWBMPs (at build-out) (\$ Million per year)	\$8.1	\$8.1	\$5.7
50-Year Net Present Value (Annual O&M+ GI Replacement at Year 25) (\$ Million)	\$288	\$288	\$202
Total Net Present Value Cost (\$ Million)	\$1,358 – \$1,598	\$1,598 – \$1,848	\$1,542 – \$1,752