

1. UP-FRONT PLANNING AND SEQUENCING

This section describes the planning and sequencing process followed to identify and select the priority sewersheds and associated areas for the City-Wide Green Infrastructure (GI) Assessment.

1.1 Review Background Information

The project team collected and reviewed numerous local and regional data sets, including:

- GIS information, including the existing sewer system, sewersheds, land uses, populations, topography, and Light Detection and Ranging (LIDAR) elevation survey data, planimetrics, demographics, stream inlet locations, catch basin inlet data, historical stream mapping, and planned and ongoing new and redevelopment sites.
- Historical hazard and public safety information for flooding locations.
- Previous reports including: Pittsburgh Water and Sewer Authority (PWSA)'s Wet Weather Feasibility Study (WWFS) report dated July 2013; Allegheny County Sanitary Authority (ALCOSAN)'s Wet Weather Plan (WWP) dated January 2013; PWSA's Feasibility Study Draft Report dated October 2008; ALCOSAN Starting at the Source Report dated August 2015; and, previous stream inflow studies.
- Urban planning activities across the City and connected municipalities, including planned projects from the Urban Redevelopment Authority (URA), City Planning, Pittsburgh Parks Conservancy, and other local neighborhoods.
- Seven basins' collection system hydrologic and hydraulic (H&H) models provided by ALCOSAN.

The collected information was compiled into geographic information system (GIS) shapefiles, where possible, and all of the data was used to inform the GI evaluation described in this report.

PWSA would like to acknowledge and thank the City Office of Emergency Management (OEMHS), URA, City Planning, PWSA GIS, 3 Rivers Wet Weather (3RWW), and ALCOSAN for their willingness to share information to support this assessment.

1.2 Identification of High Priority Areas for GI and Urban Planning Projects

The team evaluated candidate locations and opportunities for inclusion in the GI Assessment, and considered the following factors:

- One of the key focuses of the GI Assessment was to determine how GI could benefit combined sewer overflow (CSO) reduction. In reviewing the combined sewersheds and combined sewer outfalls that were considered priorities in

past projects, a key resource was the ALCOSAN WWP report. This report described the proposed Recommended Plan for regional CSO reduction, and this Plan included a proposed regional tunnel with approximately 30 combined sewer outfalls connected to the proposed tunnel via conveyance conduits and drop shafts. ALCOSAN stated in their WWP (Section 10.4) that these combined sewer outfalls were selected to address the largest overflows by volume and also to provide an enhanced level of control to combined sewer overflows that are directly impacting sensitive areas.

In addition, there are multiple combined sewer regulators and outfalls that are in relative proximity to the combined sewer outfalls to be connected to the proposed tunnel, and they were identified in this study because they may potentially experience some degree of reduction because of the hydraulic improvements associated with the regional tunnel, or because of proposed regulator modifications that may direct more flow into the existing interceptors. There were 62 of these combined sewersheds identified.

Table 1-1 lists the 29 combined sewersheds tributary to the proposed tunnel, and 62 combined sewersheds, all of which were considered for inclusion in this GI Assessment study. For initial consideration, these 91 combined sewersheds were prioritized by annual CSO volume, defined as the annual volume of combined sewer overflow that is discharged in a typical year to the rivers through a combined sewer outfall, and is shown in Table 1-1.

- Top ten hazard and public safety mitigation areas across the City. The City provided a top ten list of the public safety hazard locations. Meetings were held with the City OEMHS to gather details and background information on each location. A detailed description of each location is provided in Section 4 of this report.
- Urban planning/redevelopment sites currently being considered by other stakeholders. Numerous meetings were held with the URA and other city planning stakeholder groups to learn about and identify ongoing or planned new and redevelopment within the City.
- Direct stream inflow locations to the combined sewer system:
 - Woods Run (8 locations)
 - Panther Hollow Stream and Lake
 - Spring Garden
 - Corks Run (2 locations)

A detailed description of the stream inflow analysis is included in Section 5 of this report.

Figure 1-1 illustrates the locations of the above identified candidate opportunities.

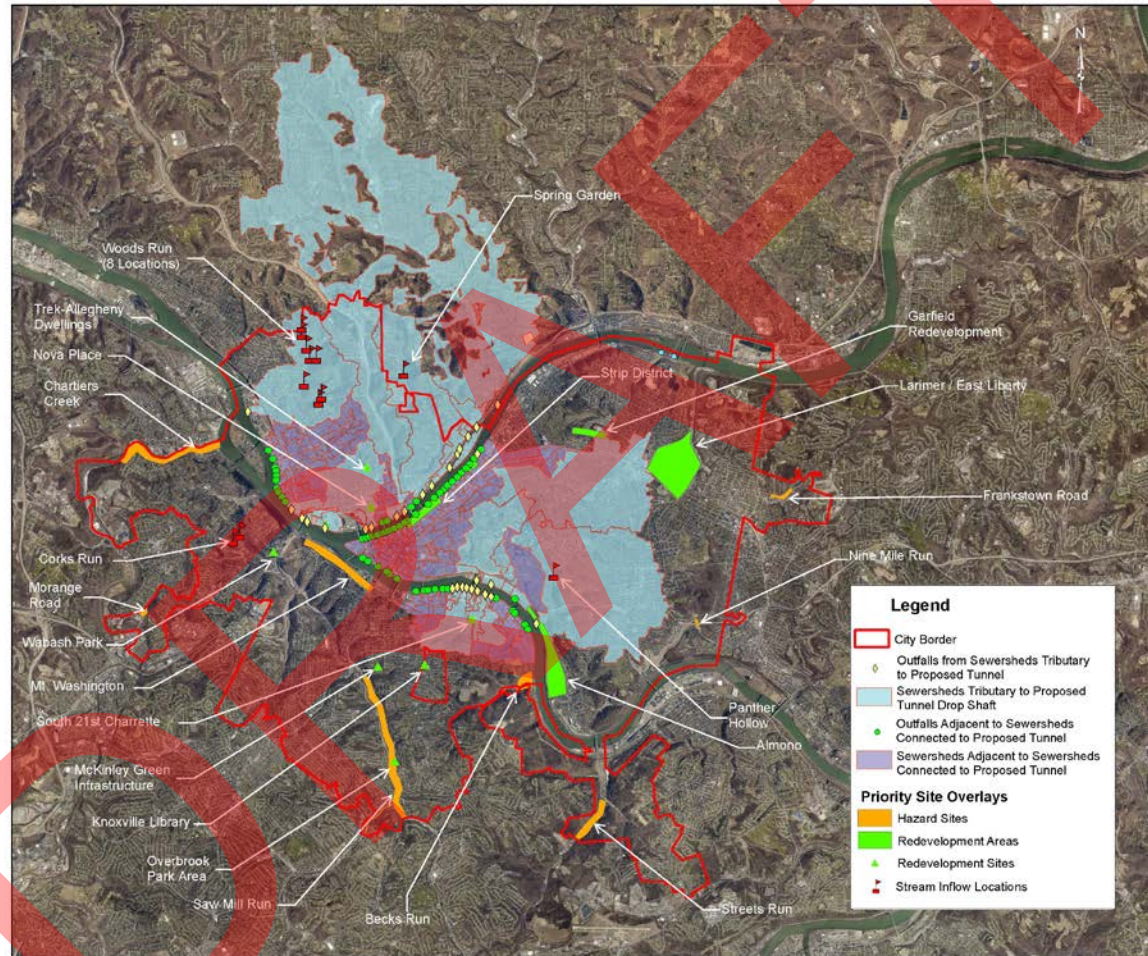


Figure 1-1: Identification of Candidate Areas for GI and Urban Planning Projects

**TABLE 1-1
SUMMARY OF 91 COMBINED SEWERSHEDS EVALUATED FOR INCLUSION IN THE
GI ASSESSMENT**

Count	Outfall	Annual Overflow Volume (MG), Typical Year, from ALCOSAN WWP ¹	Basin
Sewersheds Tributary to Proposed Tunnel Drop Shafts			
1	A-22-OF	593	Main Rivers
2	M-29-OF	400	Main Rivers
3	A-60-OF	198	Main Rivers
4	M-19-OF	150	Main Rivers
5	A-67-OF	128	Lower Ohio/Girty's Run
6	M-16-OF	102	Main Rivers
7	O-27-OF	96.6	Main Rivers
8	A-58-OF	82.0	Main Rivers
9	A-48-OF	47.9	Main Rivers
10	A-66-OF ²	34.4	Lower Ohio/Girty's Run
11	A-65-OF	19.8	Lower Ohio/Girty's Run
12	M-19B-OF	17.1	Main Rivers
13	O-41-OF	13.6	Main Rivers
14	M-21-OF	10.9	Main Rivers
15	A-62-OF	8.20	Lower Ohio/Girty's Run
16	O-39-OF	6.71	Main Rivers
17	M-22-OF	6.31	Main Rivers
18	A-61-OF	5.32	Main Rivers
19	M-15-OF	4.04	Main Rivers
20	A-64-OF	3.86	Lower Ohio/Girty's Run
21	M-20-OF	1.29	Main Rivers
22	A-56-OF	1.03	Main Rivers
23	A-47-OF	0.74	Main Rivers
24	M-15Z-OF	0.608	Main Rivers
25	M-18-OF	0.598	Main Rivers
26	O-43-OF	0.389	Main Rivers
27	M-17-OF	0.375	Main Rivers
28	A-63-OF ³	0.158	Lower Ohio/Girty's Run
29	O-40-OF	0.127	Main Rivers
Total Overflow Volume from Sewersheds Tributary to Proposed Tunnel Drop Shafts		1,933	

**TABLE 1-1
SUMMARY OF 91 COMBINED SEWERSHEDS EVALUATED FOR INCLUSION IN THE
GI ASSESSMENT**

Count	Outfall	Annual Overflow Volume (MG), Typical Year, from ALCOSAN WWP ¹	Basin
Sewersheds Adjacent to Sewersheds to be Connected to Proposed Tunnel			
1	M-19A-OF	84.5	Main Rivers
2	A-23-OF	56.0	Main Rivers
3	O-34-OF	38.1	Main Rivers
4	M-10-OF	29.2	Main Rivers
5	A-20-OF	23.1	Main Rivers
6	A-18-OF	20.0	Main Rivers
7	O-33-OF	19.3	Main Rivers
8	M-27-OF	19.2	Main Rivers
9	M-05-OF	19.0	Main Rivers
10	A-21-OF	18.5	Main Rivers
11	A-19X-OF	18.2	Main Rivers
12	A-14-OF	18.1	Main Rivers
13	M-26-OF	13.0	Main Rivers
14	A-51-OF	12.8	Main Rivers
15	O-32-OF	10.7	Main Rivers
16	O-38-OF	9.61	Main Rivers
17	M-03-OF	9.45	Main Rivers
18	A-50-OF	8.79	Main Rivers
19	A-12-OF	7.61	Main Rivers
20	A-17-OF	7.18	Main Rivers
21	M-12-OF	7.06	Main Rivers
22	A-19Z-OF	6.26	Main Rivers
23	A-19Y-OF	5.68	Main Rivers
24	A-16-OF	5.16	Main Rivers
25	O-36-OF	4.57	Main Rivers
26	A-59-OF	4.41	Main Rivers
27	A-09-OF	2.61	Main Rivers
28	A-15-OF	2.57	Main Rivers
29	M-14-OF	2.50	Main Rivers
30	A-04-OF	2.39	Main Rivers
31	M-13-OF	2.37	Main Rivers
32	A-01-OF	1.89	Main Rivers
33	A-10-OF	1.57	Main Rivers
34	A-07-OF	1.31	Main Rivers

**TABLE 1-1
SUMMARY OF 91 COMBINED SEWERSHEDS EVALUATED FOR INCLUSION IN THE
GI ASSESSMENT**

Count	Outfall	Annual Overflow Volume (MG), Typical Year, from ALCOSAN WWP ¹	Basin
35	A-18X-OF	1.27	Main Rivers
36	M-11-OF	1.20	Main Rivers
37	A-59Z-OF	0.921	Main Rivers
38	M-01-OF	0.866	Main Rivers
39	O-37-OF	0.641	Main Rivers
40	M-24-OF	0.516	Main Rivers
41	A-49-OF	0.488	Main Rivers
42	A-05-OF	0.455	Main Rivers
43	A-13-OF	0.450	Main Rivers
44	O-35-OF	0.394	Main Rivers
45	A-11-OF	0.370	Main Rivers
46	M-04-OF	0.270	Main Rivers
47	A-18Z-OF	0.222	Main Rivers
48	M-23-OF	0.212	Main Rivers
49	O-31-OF	0.196	Main Rivers
50	M-02-OF	0.187	Main Rivers
51	A-18Y-OF	0.157	Main Rivers
52	M-12Z-OF	0.154	Main Rivers
53	A-08-OF	0.140	Main Rivers
54	A-14Z-OF	0.0762	Main Rivers
55	A-06-OF	0.0517	Main Rivers
56	O-29-OF	0.0455	Main Rivers
57	A-03-OF	0.0257	Main Rivers
58	A-02-OF	0.0224	Main Rivers
59	M-28-OF	0.00361	Main Rivers
60	A-20Z-OF	0	Main Rivers
61	M-04Z-OF	0	Main Rivers
62	O-30-OF	0	Main Rivers
Total Overflow Volume from Sewersheds Adjacent to Sewersheds Tributary to Proposed Tunnel		502	

¹ From ALCOSAN WWP, January 2013.

² The SWMM Model of Lower Ohio-Girty's Run Basin received from ALCOSAN in 2015 included A-66, so the City-Wide analysis included this sewershed. In 2016, PWSA received ALCOSAN information that the A-66 point of connection (POC) has been closed and the regulator has been sealed. Sanitary flows are directed to adjoining POCs.

³ The SWMM Model of Lower Ohio-Girty's Run Basin received from ALCOSAN in 2015 included A-63, so the City-Wide analysis included this sewershed. It was found that this sewershed does not require GI to meet 85% combined sewage capture. In June 2016, PWSA received information from ALCOSAN that PennDOT's work on State Route 28 may have resulted in A-63 abandonment. ALCOSAN is working to confirm this with testing.

1.3 Final Selection of High Priority Sewersheds for Analysis

A workshop was held with PWSA staff to review the candidate opportunities for GI and urban planning discussed in Section 1.2. Each sewershed, new development and redevelopment location, flood hazard location, and direct stream inflow location was reviewed and discussed. The outcomes from the workshop identified the following areas of the City to focus on during the City-Wide GI Assessment:

- 30 combined sewersheds, which are listed in Table 1-2. Of the 29 sewersheds that are tributary to the proposed tunnel, shown in Table 1-1, 26 are in the list of selected high priority sewersheds. In addition, A-41, A-42, A-51, and M-19A were included in the selected high priority sewersheds. The 30 high priority sewersheds were selected to align with potential CSO reduction, flood hazards, and direct stream inflow locations across the City. These 30 high priority sewersheds account for just over 3 billion gallons (BG) of CSO discharge in a typical year (representing about one-third of the CSO discharge from the entire ALCOSAN service area).

Most combined sewage in the 30 high priority sewersheds are generated within the City. Three of the sewersheds (A-42, A-60, and O-27) have contributing flows from other municipalities, but these flows are primarily sanitary flows.

- Of the 30 high priority sewersheds, six were selected for strategic urban planning opportunities. They were primarily selected to align with new and redevelopment initiatives in sewersheds estimated to have larger CSO volumes. These six sewersheds are:
 - M-29 sewershed, including Junction Hollow and Panther Hollow stream and Lake, with connection to the Monongahela River at Almono.
 - M-16 sewershed, including the South 21st Street Corridor and Southside Park and East Carson Street.
 - A-42 sewershed, including Negley Run and the, Washington Boulevard corridor, Larimer, and Homewood.
 - A-41 sewershed, including Heth's Run.
 - M-19 sewershed, including the Hill District & Uptown areas.
 - O-27 sewershed, including Woods Run.
- The top 10 largest direct stream inflows to the combined sewer system. A review of the associated dry and wet weather flows indicated that the locations below were the top 10 stream inflow contributors to the combined sewer system. Of the stream inflows considered, Corks Run has the lowest estimated volume of stream inflow, so it was not selected for this GI Assessment project. The ten stream inflow sites selected are:
 - Eight stream inflow points in the Woods Run watershed (8 locations)
 - Panther Hollow Stream and Lake
 - Spring Garden

- Top 10 City hazard locations, as identified by the City’s Office of Emergency Management:
 - Calera Street – Streets Run
 - Morange Road – Chartiers Creek
 - Frankstown Avenue – Homewood
 - Commercial Street - Nine Mile Run
 - Susquehanna Street to East Carson Street - Becks Run
 - Library Road - Saw Mill Run
 - Saw Mill Run Boulevard
 - Route 28 and 31st Street Bridge
 - Mount Washington
 - Rear of Eggers Street

**TABLE 1-2
SUMMARY OF 30 SELECTED HIGH PRIORITY COMBINED SEWERSHEDS**

Count	Outfall	Wet Weather Combined Sewer Volume (MG)	Annual Overflow Volume (MG), Typical Year, from PWSA System Wide Model Run ¹
1	A-22-OF	1,594.8	580.5
2	A-41-OF	664.5	338.6
3	A-42-OF	2,175.9	783.0
4	A-58-OF	1,007.8	174.2
5	A-60-OF	801.5	209.8
6	A-61-OF	14.1	5.1
7	A-62-OF	8.3	8.4
8	A-65-OF	11.8	20.9
9	M-15-OF	7.9	4.6
10	M-16-OF	249.0	102.9
11	M-19-OF	265.9	146.0
12	M-19A-OF	318.2	83.5
13	M-19B-OF	75.5	17.0
14	M-21-OF	62.6	11.1
15	M-29-OF	1,426.3	402.0
16	O-39-OF	29.3	7.5
17	O-41-OF	33.3	14.5
18	O-40-OF	3.2	0.20
19	A-63-OF ²	2.9	0.18
20	M-20-OF	13.4	1.7
21	M-18-OF	8.9	0.72
22	A-64-OF	30.3	4.0

**TABLE 1-2
SUMMARY OF 30 SELECTED HIGH PRIORITY COMBINED SEWERSHEDS**

Count	Outfall	Wet Weather Combined Sewer Volume (MG)	Annual Overflow Volume (MG), Typical Year, from PWSA System Wide Model Run ¹
23	M-17-OF	8.8	0.54
24	M-15Z-OF	10.4	0.61
25	A-47-OF	32.7	0.93
26	M-22-OF	72.0	6.5
27	A-51-OF	119.8	13.1
28	O-43-OF	35.3	0.16
29	A-48-OF	546.0	49.1
30	O-27-OF	696.9	79.6
	Total Volume	10,327	3,067

¹ Overflow volumes shown are from model runs conducted by PWSA with the system wide model developed from the seven models provided by ALCOSAN (Section 2 provides more discussion). There are slight differences between the overflow volumes for a particular sewershed in Table 1-1 and Table 1-2 due to the different model runs and software versions. These slight differences are acceptable in the modeling industry. Section 2 discusses additional information about modeling software and simulation methods.

² The SWMM Model of Lower Ohio-Girty's Run Basin received from ALCOSAN in 2015 included A-63, so the City-Wide analysis and evaluation included this sewershed. It was found that this sewershed does not require GI to meet 85% combined sewage capture. In June 2016, PWSA received information from ALCOSAN that PennDOT's work on State Route 28 may have resulted in A-63 abandonment. ALCOSAN is working to confirm this with testing.

Figure 1-2 displays the selected areas across the City that were evaluated as part of the City-Wide GI Assessment. Figure 1-3 provides greater detail about the locations of the 30 priority sewersheds.

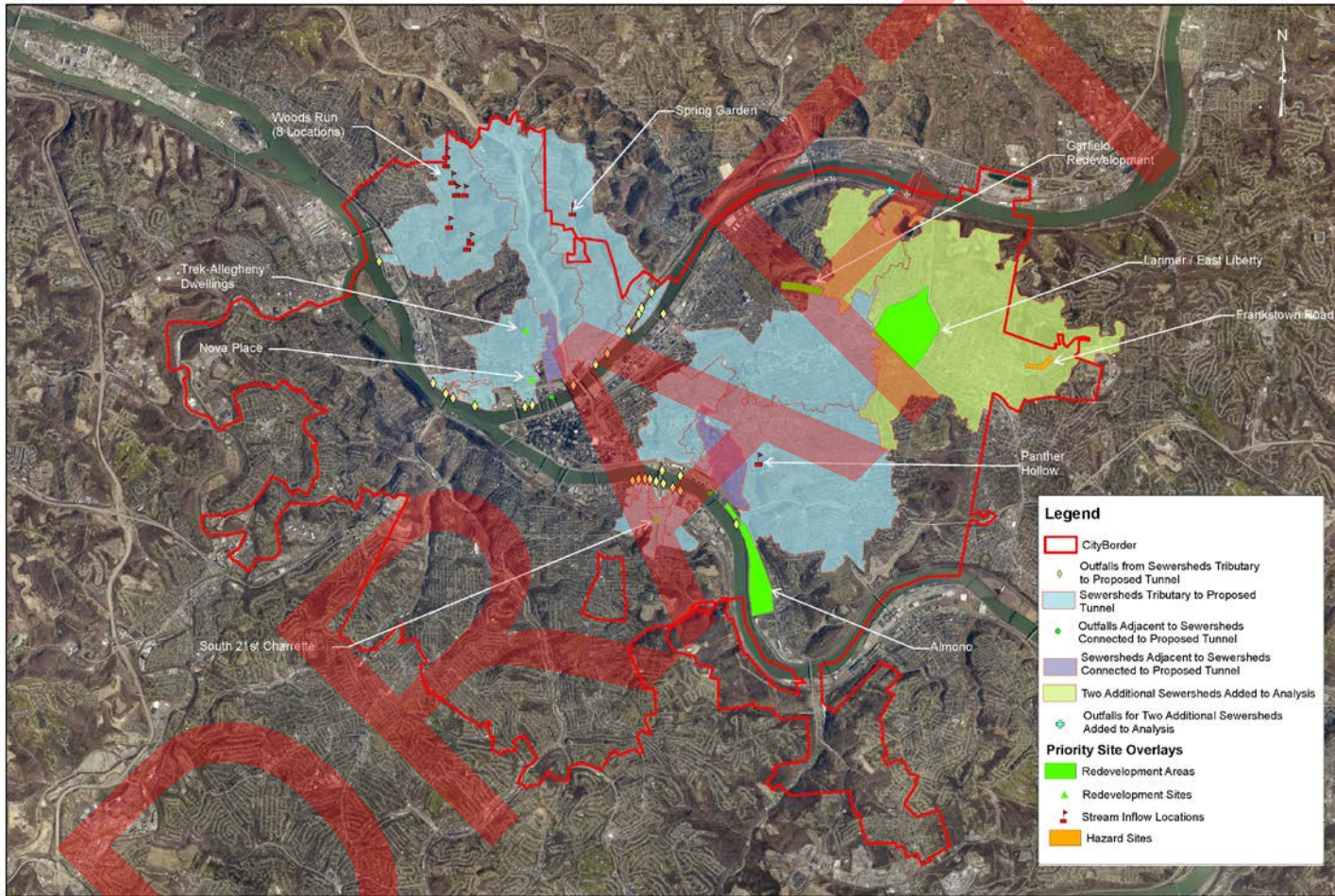


Figure 1-2: 30 Selected High Priority Combined Sewersheds for Analysis

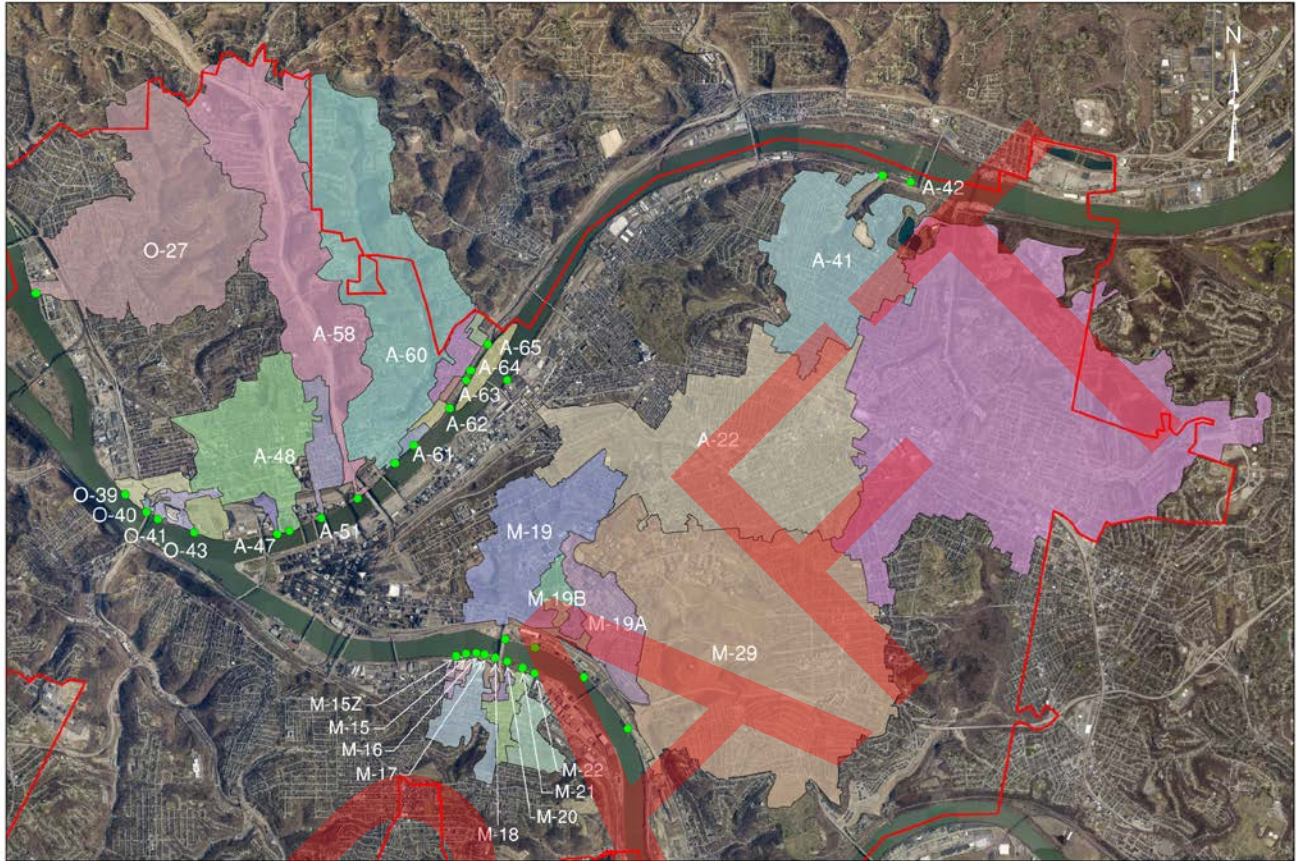


Figure 1-3: 30 Priority Sewersheds

With the high priority sewersheds and other focus areas identified for the GI Assessment, the associated H&H models and target areas for impervious area stormwater management were then reviewed and identified. Section 2 describes the method that was used to develop target GI management goals for the 30 high priority sewersheds. Sections 2 and 3 describe the H&H modeling process that was followed. Sections 4 and 5 of this report describe the detailed investigations and analysis performed for the flood hazard (Section 4) and the direct stream inflow locations (Section 5).

Section 6 introduces the strategic urban planning and GI opportunities as envisioned for six redevelopment initiatives within high priority sewersheds, and Section 7 presents the costing protocols, including the consideration of field investigations, constructability, and operation and maintenance cost development.

Section 8 presents results of the triple bottom line analysis conducted to look to additional environmental, social, and economic benefits.

The report concludes with a summary of the GI Program benefits in Section 9.