PHASE 1 WATERSHED HYDROLOGY REPORT

2 May 2019

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1. INTRODUCTION

This Phase 1 Hydrology Study of the Nine Mile Run Watershed (NMRW) provides a hydrological characterization of the watershed and identifies potential stormwater reduction opportunities. The Nine Mile Run Watershed Association (NMRWA) performed this project in collaboration with CivicMapper.

For this project, NMRWA required the identification of eight (8) potential green stormwater infrastructure (GSI) locations within the Nine Mile Run Watershed, with two (2) of each in the four (4) watershed municipalities of Pittsburgh, Wilkinsburg, Edgewood, and Swissvale. Ultimately, twenty-seven (27) possible GSI sites were identified and analyzed.

This report describes the approach, methods, and results, of that process, as well as recommendations for future data development and analysis.

1.1. BACKGROUND: LESSONS FROM THE ROSEDALE RUNOFF REDUCTION PROJECT

The Rosedale Runoff Reduction project was used to inform the approach of this current project. Two reports were generated for the Rosedale Runoff Reduction project:

- the Phase 1 report that identified key contributing areas and quantified potential reduction opportunities in the Rosedale Street area;
- a Phase II report that further refined the Phase 1 results by incorporating updated SWMM models to identify the next round of GSI installations.

1.1.1 PHASE 1 REPORT (LANDBASE SYSTEMS)

The Phase 1 report prepared by Landbase Systems clearly quantified the volume of runoff within the Rosedale area and identified locations where GSI could be implemented to reduce runoff primarily based on subsurface pipe network models and surface drainage simulations. From this, three main sites were selected and various GSI options were proposed at each to compare total annual million gallons removed at each site. The methods used to determine site selection were not explicitly stated in the report. Due to the absence of this information, future iterations of the site selection following this methodology were not possible, hence the need to develop a Phase 1 study for the NMRW in this current project.

1.1.2 PHASE 2 REPORT (GHD)

The Phase II project report carried out by GHD summarizes the outcomes of existing SWMM hydrologic/hydraulic models and results of ArcHydro models to support a deeper analysis of the Rosedale watershed. Sites were identified for possible GSI implementation and quantitative statistics were provided that describe CSO reduction at each site.

While the methodology of this study was clearly spelled out in the report and served as a useful guide to the approach used in this current Phase 1 study, the tools, data, and models developed by GHD were not made available to NMRWA staff for use after the project. As with the original Phase 1 report, this absence limited the ability of NMRWA staff to revisit projects.

1.2. THE APPROACH FOR THIS PHASE 1 HYDROLOGY REPORT

In discussions with NMRWA staff and after reviewing previous study materials, CivicMapper recognized that:

- there is need for a robust, repeatable, data-driven methodology for the *strategic* identification of GSI sites;
- there is typically a need to revisit and re-evaluate GSI site identification as these projects are planned and other information comes to light; and
- the NMRWA has strong geographic information systems capabilities in-house.

To address these needs and realities, CivicMapper crafted an approach to this project that would:

- use available, open, high-quality off-the-shelf datasets;
- apply proven, scale-appropriate analytical tools for GSI site selection; and
- deliver tools and data to NMRWA in a web-based GIS environment that the staff are already accustomed to working in.

This approach is intended to maximize the value of NMRWA's existing data and technology investments while enabling NMRWA staff, who are experts on the watershed, to perform strategic planning for GSI that is backed by robust analytics. Furthermore, the approach is intended to provide the basis for future research, data development, visualization, and communication to stakeholders on GSI site selection and steps to implementation.

2. METHODOLOGY

To implement the approach described in section 1.2, CivicMapper designed a straightforward methodology:

1. Compile available data.
2. Refine existing data, and/or develop additional data as needed, to support identification and analysis of sites.
3. Identify potential sites.
4. Asses site performance.

The following sections describe how each of these steps was completed. Section 3 describes the results.

2.1. DATA COMPILATION

Part 1 of developing this Phase 1 Hydrology Report entailed compiling datasets needed to support basin characterization of the NMRW, GSI site identification, and GSI efficacy analysis.

2.1.1 DATASETS FOR BASIN CHARACTERIZATION

To support basin characterization of the NMRW, CivicMapper collected three key datasets:

- land cover data from the 2010 Allegheny County Urban Tree Canopy dataset
- digital elevation data from the 2015 Allegheny County QL2 LiDAR campaign
- sewer infrastructure data from the 3 Rivers Wet Weather Sewer Atlas

CivicMapper assessed the quality of these data and all three datasets were found to be of acceptable quality for use in Phase 1 of this project. CivicMapper provided a Data Quality Report that summarized these findings.

2.1.2 OTHER DATASETS

Other data compiled during Phase 1 were those that were already available at NMRWA from three main sources; past project reports, existing ArcGIS Online content, and existing models and GIS data outside of ArcGIS Online. This included:

- Allegheny County building footprints
- Allegheny County parcels
- Edge of pavement
- USDA NRCS Soils Survey
- LiDAR tiles (Allegheny County 2015 QL2)
- PWSA stormwater infrastructure

These datasets were selected to be used to assist with site selection, visualization, and analysis.

2.1.3 ORGANIZATION AND DELIVERY OF CONTENT

While compiling and evaluating the datasets described above, CivicMapper worked with NMRWA staff to correct and further develop data that would be used in Phase 1 and future project work. NMRWA staff also organized and inventoried existing ArcGIS Online content to make it more accessible and usable for this project.

All data described above has been made available to the NMRWA as static files and ArcGIS Online services.

2.2. DATA REFINEMENT AND DEVELOPMENT

Most off-the-shelf described in the previous section were useable as-is. To perform basin characterization and support identifying site locations, some available infrastructure data like stormwater catch basins and elevation data, were further refined and additional derivative data products were developed.

2.2.1 STORMWATER CATCH BASINS

It was identified early in the project that:

- The available stormwater catch basin geodata in the NMRW is somewhat aged.
- The 2017 imagery for the area was of high enough resolution to support improving the geographic precision of these data points.
- The catch basins are important for future modeling work, and improving it now would a worthwhile endeavor.

NMRWA staff edited approximately 10,000 culvert inlet location data within the NMRW to match their locations as identified in 2017 imagery. Note that these did not include stormwater catch basins within the City of Pittsburgh. This work was performed in ArcGIS Online on a culvert editor map, which included layers for documenting problem areas and culvert editing issues.

2.2.2 DIGITAL ELEVATION MODEL (DEM)

The 2015 QL2 LiDAR dataset from Allegheny County provided the basis for several datasets required for this project.

2.2.2.1 HYDROLOGICALLY-CORRECTED DIGITAL ELEVATION MODEL

A hydrologically corrected digital elevation model (DEM) was created by removing bridges and elevated roadways so that overland flow of water could be appropriately modeled with respect to the land surface. Break lines were added to allow for the future creation of a hydro-corrected DEM. This dataset can be used in future basin and site level analyses; in this study it was used for proper visualization of sub-basins when picking potential GSI sites.

2.2.2.2 REVISED HYDROLOGICAL BOUNDARY

A revised boundary was created from the DEM that more accurately describes the NMRW hydrological extents. It differs from the existing NMR organizational boundary outline—a likely result of having been developed from the high-resolution 2015 QL2 LiDAR. *Figure 1 – Basin Boundary and*

Basin Boundary and Hydrology

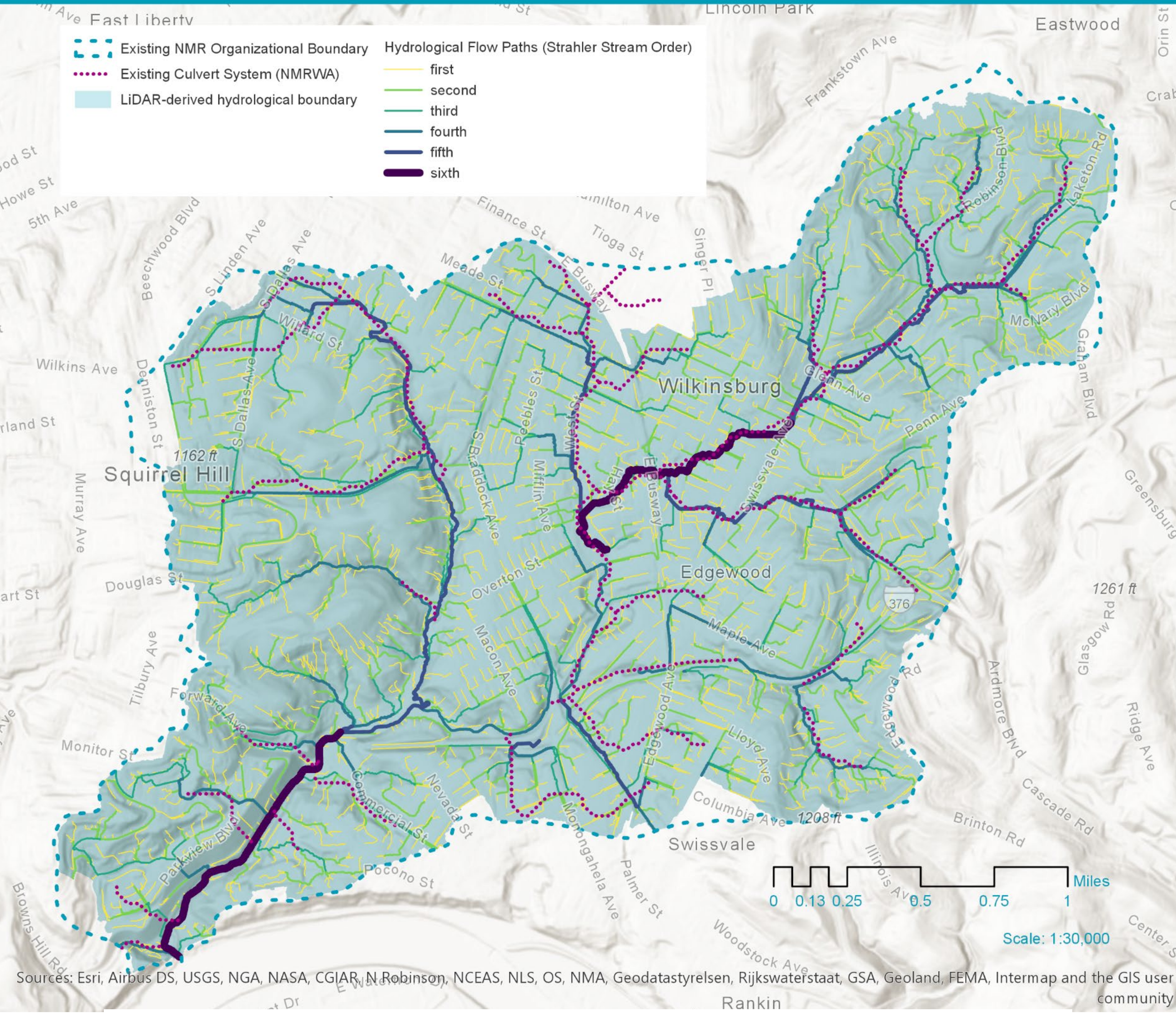


Figure 1 – Basin Boundary and Hydrology Map

Hydrology Map (page 6) shows the existing NMR organizational boundary and the revised hydrological boundary.

2.2.2.3 FLOW LINES

The DEM was used to generate hydrological flow paths, or flow lines, that show how water flows across the land surface in the NMRW. *Figure 1 – Basin Boundary and Hydrology Map* (page 6) shows flow lines, which illustrate how *surface* water flows from the headlands to lowlands, and then into the main branch of Nine Mile Run that flows into the Monongahela River. These flow lines are symbolized on the map by flow order, with order 1 originating in the watershed's headlands and order 6 representing the main branch of Nine Mile Run.

Importantly, note that this map was generated from a surface that includes sink features and culverts, where the stream passes into pipes and underground. These features are responsible for the visual disconnect of stream order in the visualization. Culverts are also shown on the map.

2.3. IDENTIFICATION OF POTENTIAL GSI SITES

Using data described in the previous sections, CivicMapper used a combination of qualitative and quantitative methods to choose a set of example GSI location sites. Example site selection was generally based upon the following criteria:

- The sites were adjacent to high flow accumulation points ("pour points").
- The locations were situated on a break in slope such that diverted water could accumulate into a GSI installation,
- The sites were not residential properties.
- The sites had spaces large enough for GSI installation, based on examples of previous work in the Rosedale Runoff Reduction project.
- The sites had nearby catch basins where overflow from GSI could be diverted.
- The sites were at locations where community visibility and opportunities for maintenance partnerships may be more likely.
- The contributing area (upstream) from the sites were not impacted by the disconnect brought about by sinks/culverts show in *Figure 1 – Basin Boundary and Hydrology Map* (page 6).

To identify these sites, CivicMapper visually examined the watershed from its headwaters to the main branch of Nine Mile Run to identify points where there was a confluence of flow accumulation. Adjacent parcels next to these high-flow pour points were then evaluated for locations where potential implementation of GSI may be of interest. Typically, non-residential parcels were favored over residential parcels due to their increased size and their opportunity for community engagement and partnership.

2.4. ANALYSIS OF POTENTIAL GSI SITES AND CATCHMENTS

Selected sites were then run through a set of automated analyses. These analyses provided two types of results:

- Metrics describing the performance of the potential GSI, provided by an open-source Peak Flow Calculator tool, and
- Characterization of the upstream catchment of the GSI, provided by cross tabulation with available datasets.

The details of these analyses are described in further detail below.

2.4.1 PEAK FLOW CALCULATIONS

A Peak Flow Calculator tool developed by CivicMapper (with early support from the Cornell Soil and Water Lab (http://soilandwater.bee.cornell.edu/)) was used to analyze the efficacy of each site.

The Peak Flow Calculator used by CivicMapper in this project determines the peak discharge runoff of given point's watershed using the USDA Soil Conservation Service (SCS) graphical curve number method described in Technical Release 55 (commonly referred to as the TR-55 model).

The calculator relies on the following inputs:

- input point location(s), representing locations at which peak flow is to be estimated (our example site),
- a raster indicating flow direction (derived from the DEM),
- a raster indicating slope (in percentages, derived from the DEM),
- a raster indicating *curve numbers*, which is derived from a crosswalk of NRCS soil hydrology data and 2010 Urban Tree Canopy landcover data following the method prescribed in USDA Technical Release 55,
- a precipitation frequency estimates table from NOAA, acquired from NOAA's Hydrometeorological Design Studies Center's Precipitation Frequency Data Server.

Using these inputs—which are all existing or easily derived off-the-shelf dataset—the calculator works as follows:

- Delineate an upstream catchment from the site (using a standard D8 watershed delineation method).
- Derive metrics of that catchment from supporting layers: slope, curve number (from land cover and soils), area, and maximum distance from the point to the top of the catchment (maximum flow length).
- Use those metrics to calculate *time of concentration*, which indicates how rapidly water flows through a watershed from top to bottom, based on soil, landcover, and topographic characteristics.
- Feed metrics calculated, along with precipitation frequency data from NOAA, into a set of equations implementing the *SCS graphic curve number method.*

This produces estimates of peak flow in cubic feet/second for a 24-hour storm duration at 5, 10, 25, 50, 100, 200, 500, and 1000-year events. The TR-55 model is designed around the underlying assumption that the rainfall modeled is of a 24-hour duration.

Note that prior to running the tool, all GSI sites were snapped to the nearest flow lines (shown on *Figure 1 – Basin Boundary and Hydrology Map* on page 6), which ensured that upstream delineations would provide analytically useable upstream catchment areas.

For more information on this tool and the calculation logic behind it, see:

- *Technical Release 55 on the USDA website at https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf for more information on the SCS Graphical Curve Number Method*
- *NOAA's Hydrometerological Design Studies Center's Precipitation Frequency Data Server at https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html*
- *The Peak Flow Calculator code repository and documentation on GitHub at https://github.com/civicmapper/peak-flow-calculator*

2.4.2 CATCHMENT CROSS-TABULATIONS

Using the catchments generated by the peak flow calculator, additional spatial cross tabulations with key datasets were generated. These datasets included:

- land cover (2010 Urban Tree Canopy)
- land use (Allegheny County parcel class)
- soil hydrology (NRCS)
- EPA SUSTAIN model results (3RWW), which indicates suitability for other GSI within the catchment

Note that the capability developed to perform these cross tabulations can be applied to any geodata that intersects with any such catchments.

3. RESULTS: EXAMPLE GSI OPPORTUNITY SITES

Using the methodology described in section 2, CivicMapper identified seventeen (27) GSI opportunity sites. The purpose of identifying these sites was two-fold:

- Identify and analyze candidate locations for GSI in the municipalities within the watershed.
- Demonstrate that potential for using largely off-the-shelf data and tools to support rapid identification, comparison, and prioritization of GSI locations.

These sites and their sub-basins within the NMR are show in *Figure 2 – GSI Opportunity Sites and Sub Basins* on page 11; A summary table of the sites, their locations, and their basin acreage is shown in *Table 1 – GSI Opportunity Sites and Sub Basins Summary By Municipality* on page 12.

3.1. SITE/SUB BASIN INFORMATION SHEET DEFINITIONS

Beginning on page 13 are information sheets for each of the identified sites.

Each site is described using following information:

- Municipality and a description of the location of the potential GSI site (i.e., the catchment outlet).
- Variables related to peak flow calculations for the catchment outlet, including:
    - **flow length**: the distance from catchment outlet to top of catchment
    - **time of concentration**: the time for water to flow from the top of the catchment to the outlet, based on landcover and soil types in the catchment
    - **peak flow** at the outlet (cubic feet / second) for a 24-hour storm at event frequencies of 1, 2, 5, 10, 25, 50, 100, 200, 500 and 1000 years.
- Area of the upstream catchment, in acres.
- Average slope of the upstream catchment, in percent.
- Proportional summaries of the intersection of the catchment area with
    - **land cover** (2010 Urban Tree Canopy)
    - **land use** (Allegheny County parcel class)
    - **soil hydrology** (NRCS)
    - **EPA SUSTAIN** model results (3RWW), which indicates suitability for other GSI within the catchment.

Sites and Sub-Basins

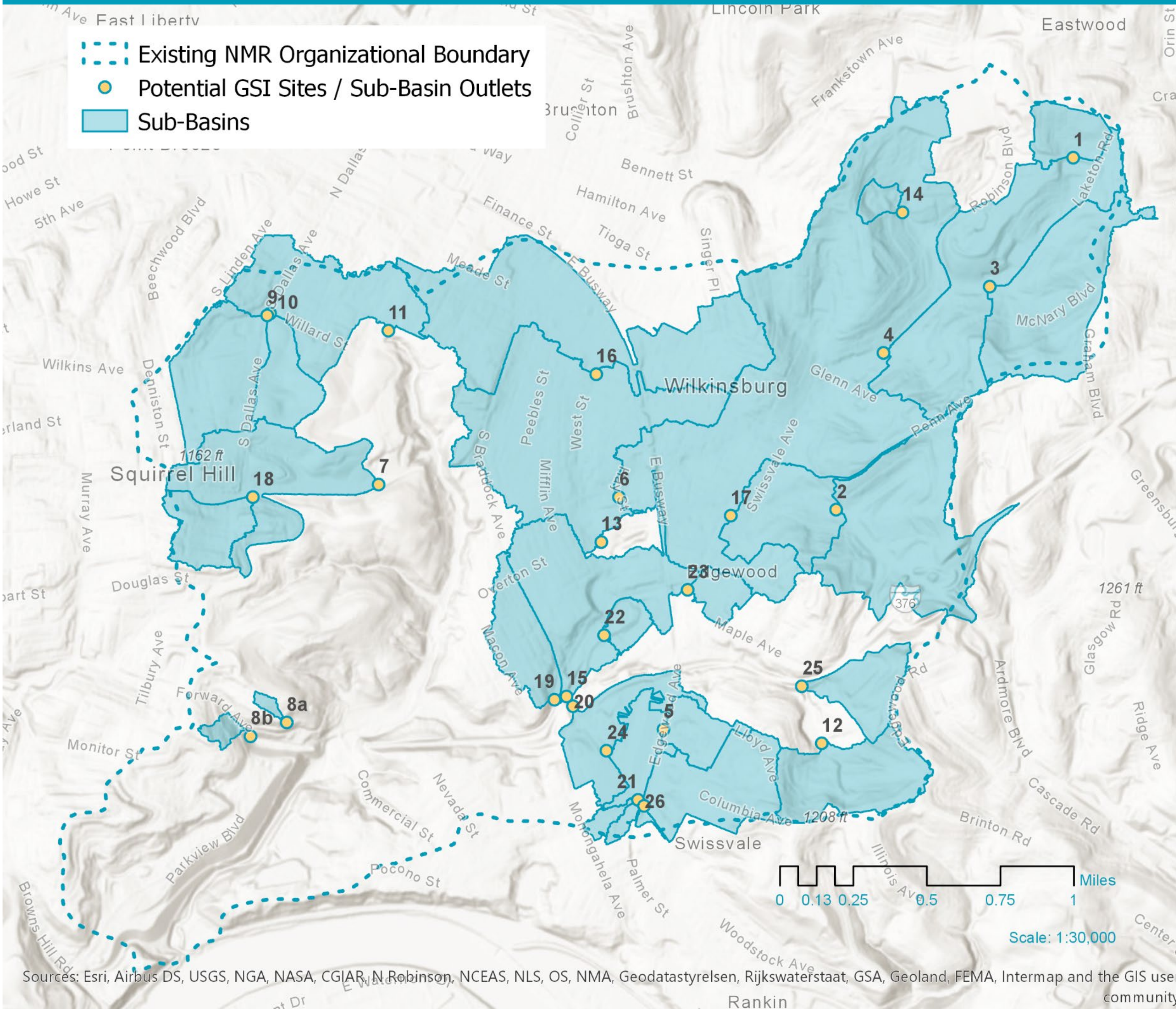


Figure 2 – GSI Opportunity Sites and Sub Basins

Table 1 – GSI Opportunity Sites and Sub Basins Summary by Municipality

Municipality	Site No	Site / Basin Outlet Location	Sub-Basin Acreage
Braddock Hills			216.81
	12	Ditch at McKelvey and Lorraine ROW	216.81
Edgewood			811.98
	15	376 W on-ramp loop	355.69
	20	ROW adjacent to 376 eastbound overpass	148.80
	22	South end of Koenig Field (Edgewood Boro)	38.94
	23	Western PA School for the Deaf	48.77
	24	Main entrance to Edgewood Towne Center	109.30
	25	Edgewood Boro maintenance area near Dickson Park	110.48
Edgewood/ Swissvale			72.16
	5	opposite LaCrosse St	72.16
Pittsburgh			1113.17
	7	Forbes Ave. adjacent to Community Garden area at Homewood Cemetery	306.74
	9	Small parklet at Wilkins and S. Dallas	226.14
	10	Homewood Cemetery near corner of Wilkins and S. Dallas	104.44
	11	Reynolds Street Circle	311.89
	14	East Hills Park	28.06
	18	Forbes Ave. American Legion Memorial Gardens	108.94
	8a	Walnut Towers, Forward Avenue, south facing slope behind building which drains Mt. Royal Rd.	8.38
	8b	Between inbound Sq. Hill Tunnel and Summerset Dr.	18.59
Swissvale			370.24
	19	ROW adjacent to CLASS building	133.02
	21	NW corner of Church St. and Braddock Ave.	17.61
	26	Swissvale Boro at Edgewood Ave and Tomlinson Way	219.61
Wilkinsburg			4326.99
	1	Douglass St. ROW adjacent to Hilltop Parklet	84.20
	2	Community Forge At Penn & Franklin	459.42
	3	Laketon Road at Turner Elementary School	358.18
	4	Montier Street/Park Ave	505.18
	6	Wilkinsburg Boro Hay Rec Area	1461.83
	13	Whitney Park	644.62
	16	Small parklet on West St.	614.86
	17	Pittsburgh Mercy Garden View Manor	198.70
Total Sub-Basin Acreage			6911.35

Site 1

28.07 acres Outlet: Wilkinsburg

Douglass St. ROW adjacent to Hilltop Parklet

Max. Flow Length	1,697 feet		Average Slope	17.4 %
Time of Concentration	0.08 hours		Average Curve Number	68.93

Estimated Peak Flows

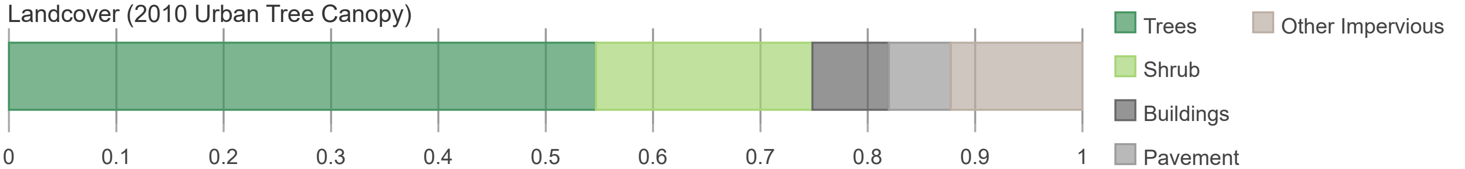
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	4.6	11	22.7	34.3	51.9	67	82.9	99.8	123.3	142
Normal	6.4	14.1	27.8	40.8	60.5	77.3	95.5	114.4	141.7	163.8
Upper	9.1	18.2	34	48.3	69.6	87.4	106.5	126.5	155.1	178.3

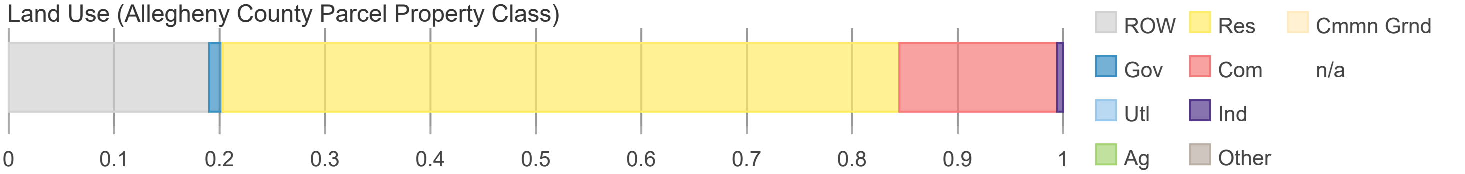
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

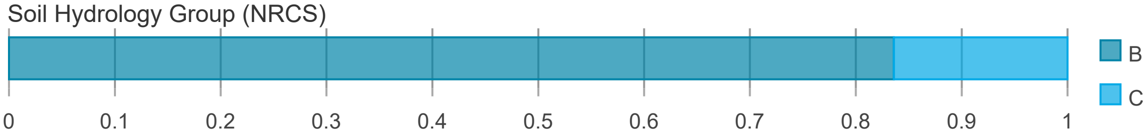
Landcover (2010 Urban Tree Canopy)



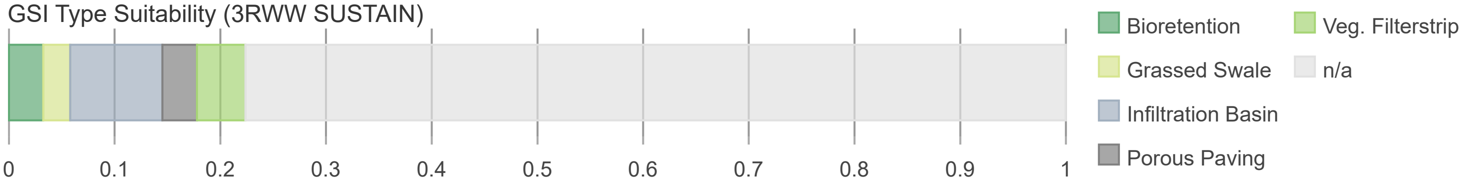
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



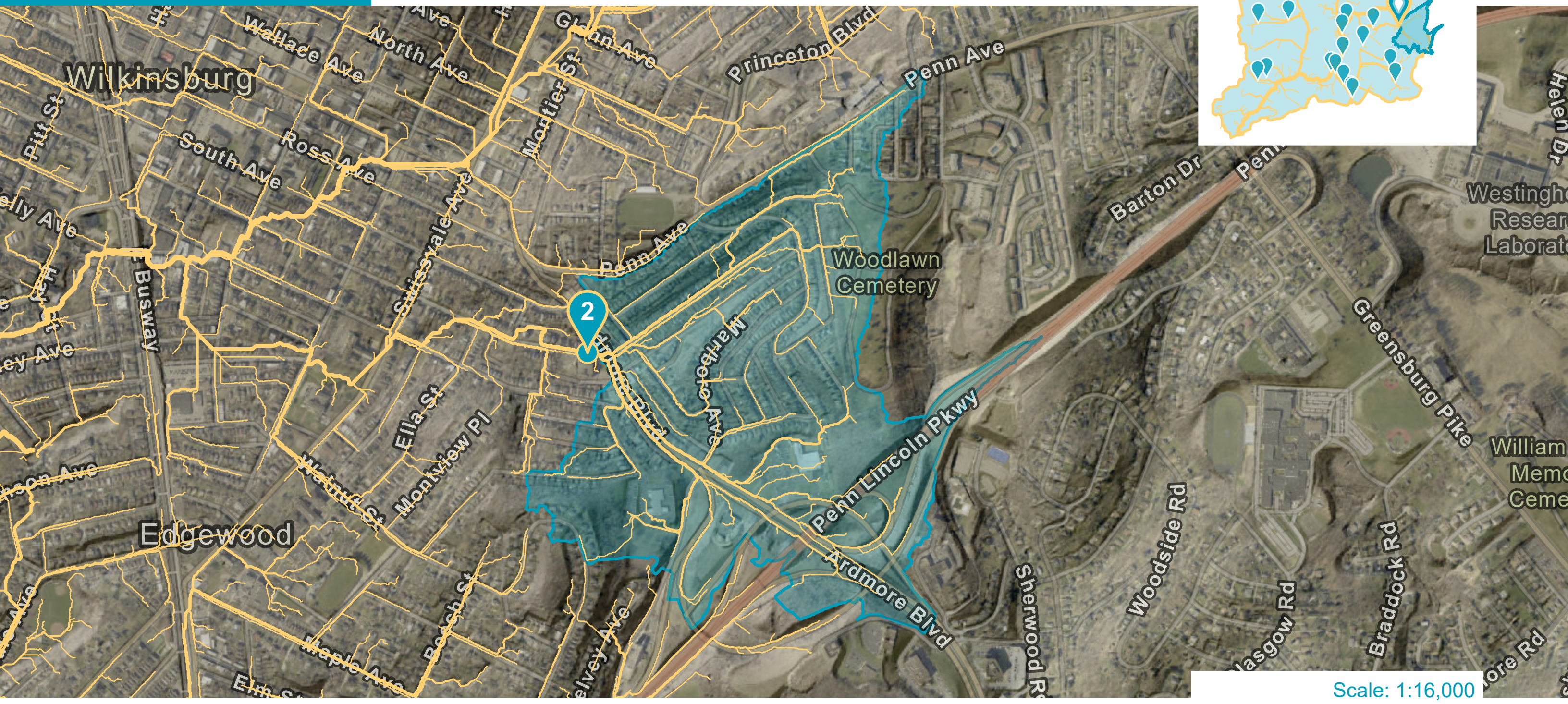
GSI Type Suitability (3RWW SUSTAIN)



Site 2

153.14 acres Outlet: Wilkinsburg

Community Forge At Penn & Franklin



Max. Flow Length 5,147 feet

Time of Concentration 0.17 hours

Average Slope 22.1 %

Average Curve Number 78.11

Estimated Peak Flows

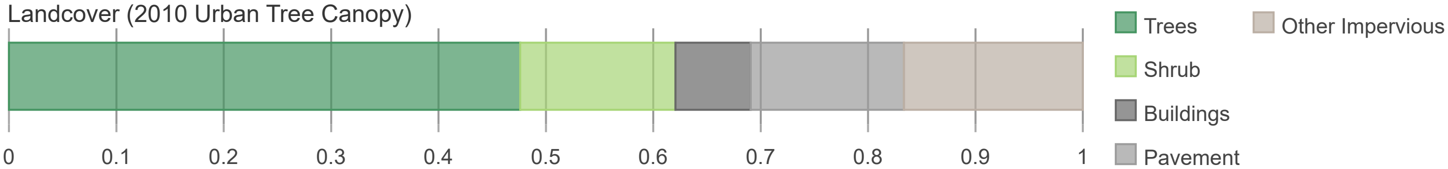
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	75.6	122.3	191.3	252.3	338.8	410.7	485.4	564	673.4	766.5
Normal	90.3	142.1	218.6	284.8	380.3	459.1	543.9	631.4	765.1	876.3
Upper	110	166.4	250.5	321.3	423.4	506.6	595	689.5	832.3	949.6

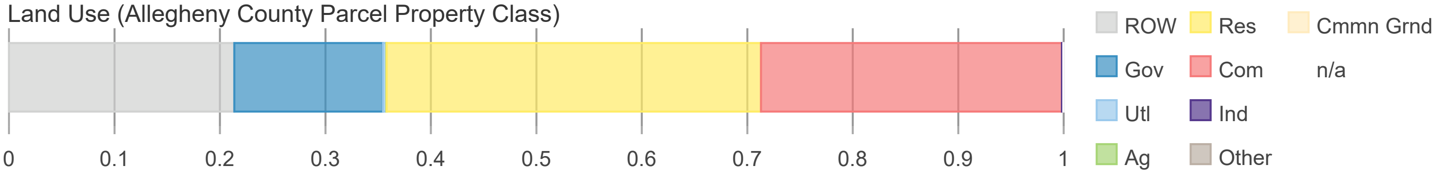
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

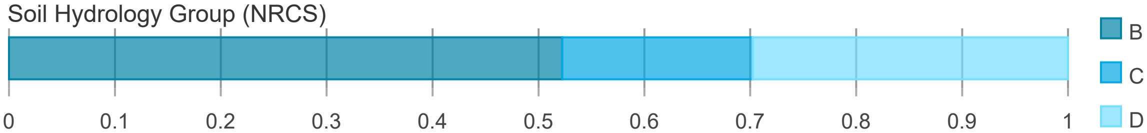
Landcover (2010 Urban Tree Canopy)



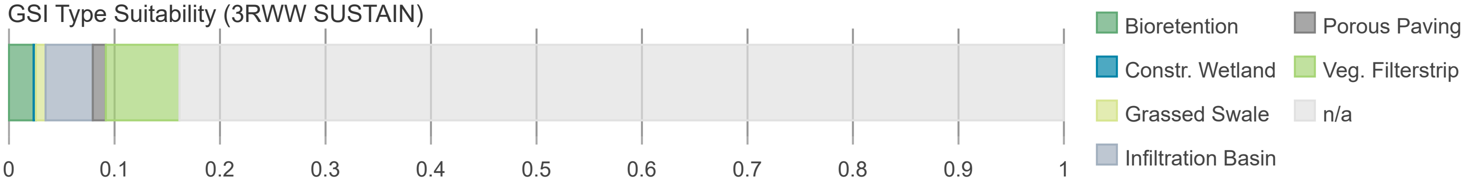
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

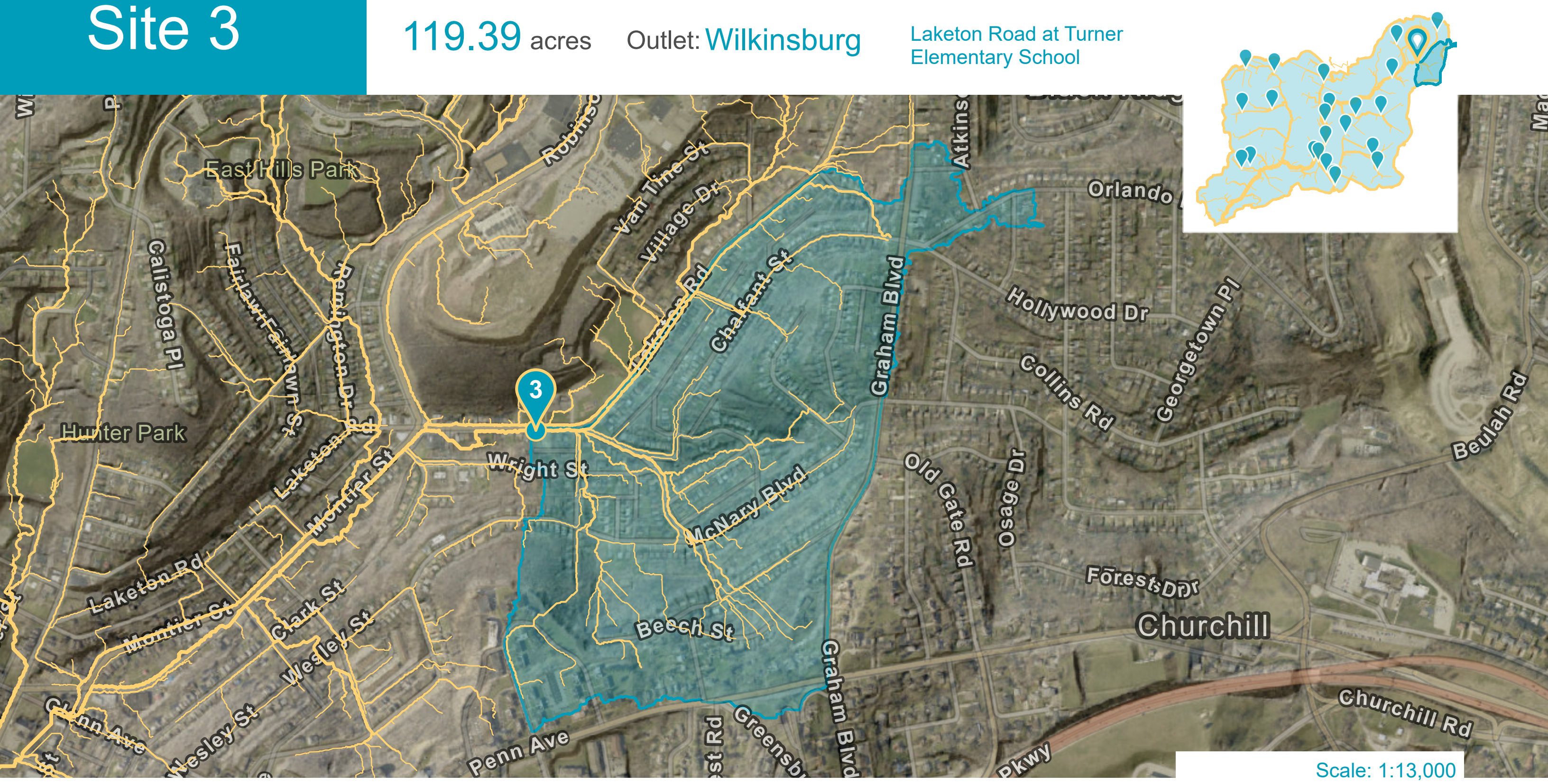


GSI Type Suitability (3RWW SUSTAIN)



Site 3

119.39 acres   Outlet: Wilkinsburg   Laketon Road at Turner Elementary School



Max. Flow Length **4,561** feet

Time of Concentration **0.16** hours

Average Slope **21** %

Average Curve Number **79.46**

Estimated Peak Flows

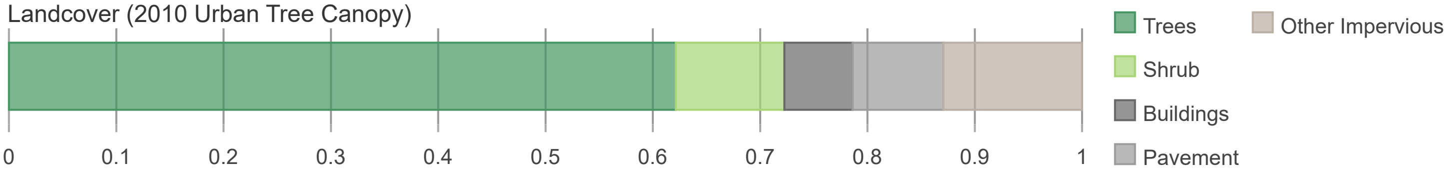
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	70.7	110	167	216.7	286.6	344.5	404.5	467.6	560	635.7
Normal	83.3	126.5	189.2	243	320	383.4	451.5	524.4	634.5	724.6
Upper	99.8	146.5	215.2	272.5	354.7	421.5	492.9	573.1	689	783.9

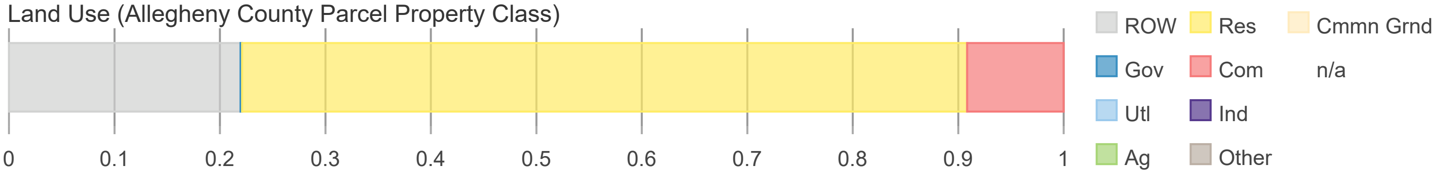
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

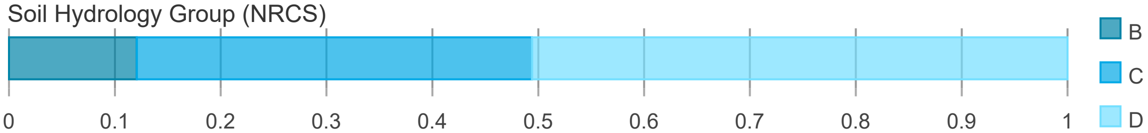
Landcover (2010 Urban Tree Canopy)



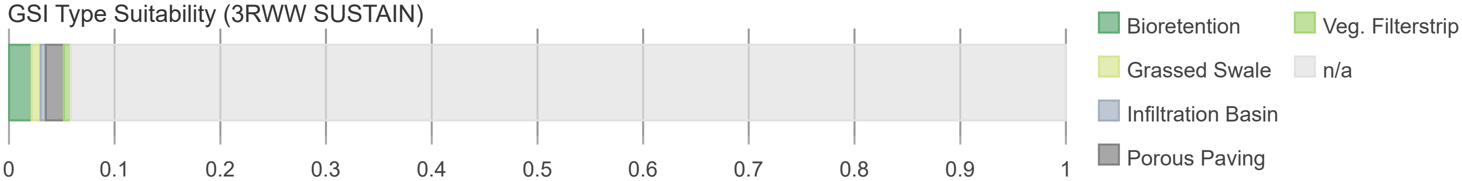
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

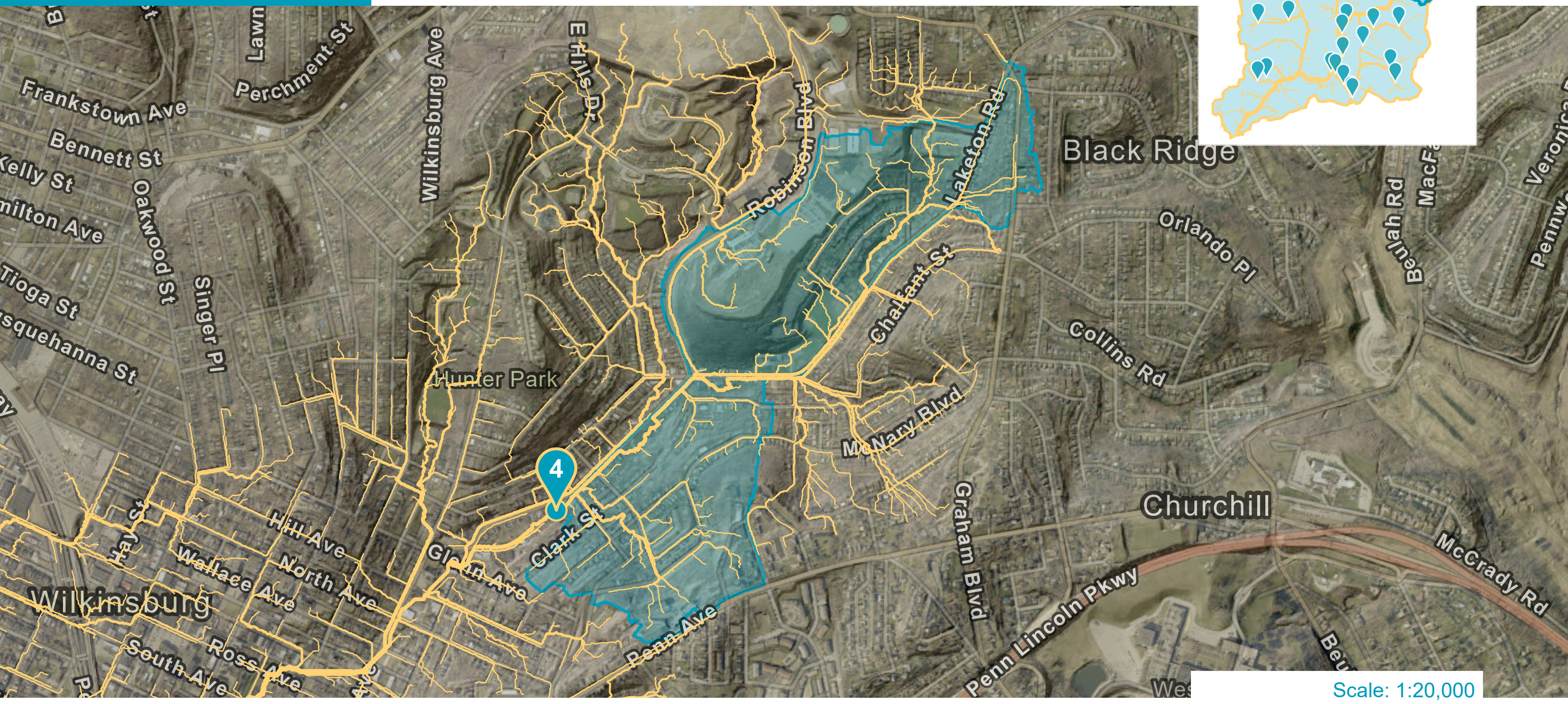


GSI Type Suitability (3RWW SUSTAIN)



Site 4

168.39 acres Outlet: Wilkinsburg Montier Street/Park Ave



Max. Flow Length	7,819	feet	Average Slope	20.1	%
Time of Concentration	0.24	hours	Average Curve Number	79.53	

Estimated Peak Flows

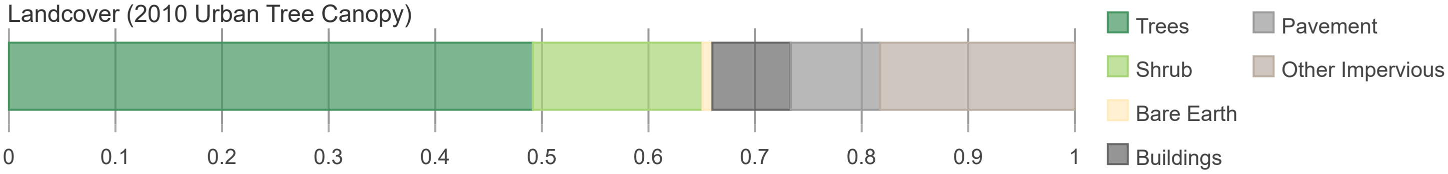
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	82.2	128.7	196.6	256.3	340.9	411.2	484.3	561.2	672.8	763.5
Normal	97	148.2	223.3	288.1	381.5	458.6	541.6	630	762.1	870.2
Upper	116.5	172.1	254.6	323.8	423.6	505	592.3	688.5	827.5	941.4

Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

Landcover (2010 Urban Tree Canopy)



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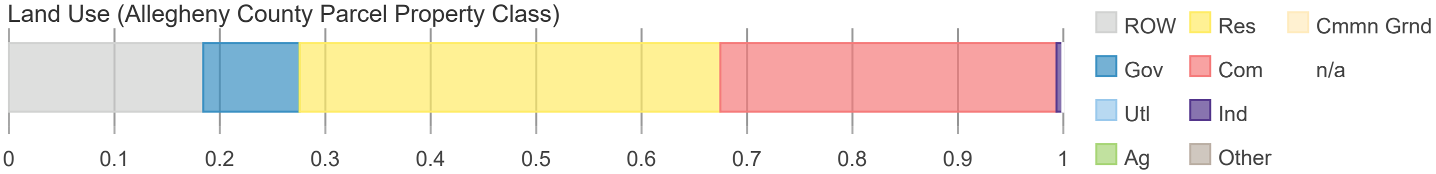

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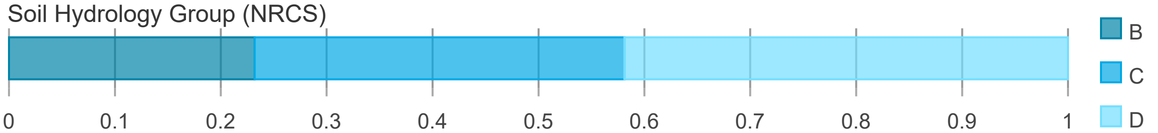
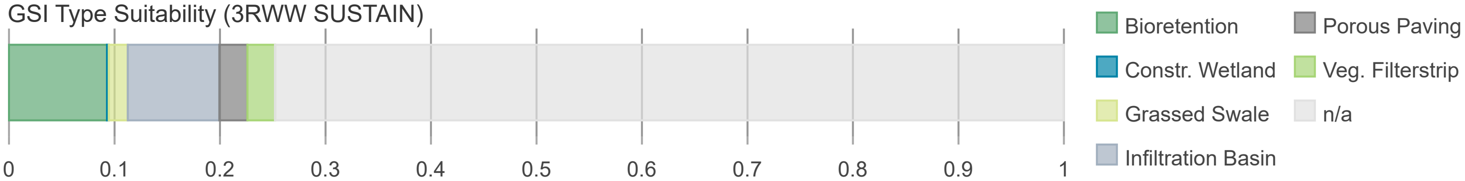
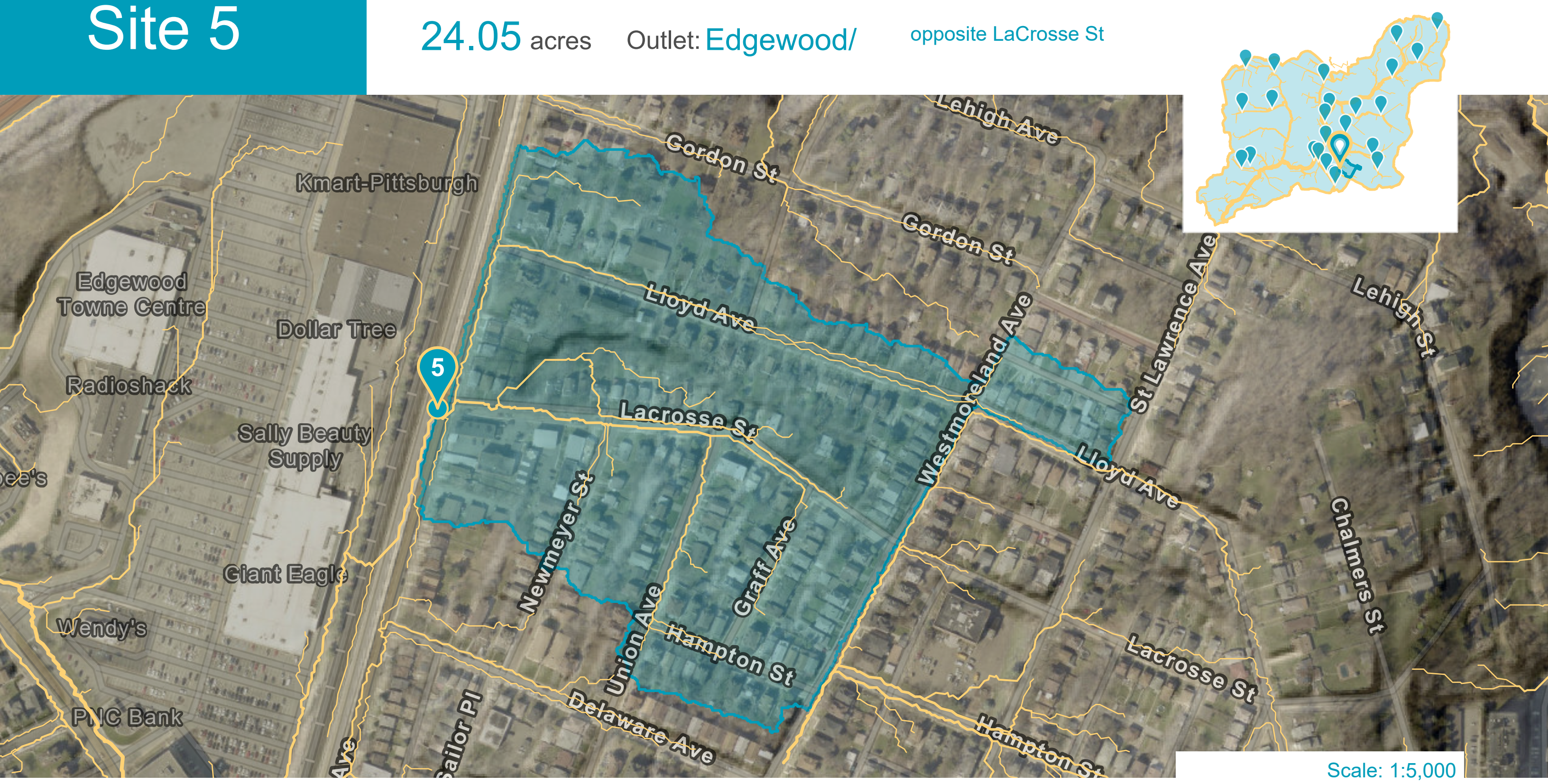


GSI Type Suitability (3RWW SUSTAIN)



Site 5

24.05 acres   Outlet: Edgewood/ opposite LaCrosse St



Max. Flow Length	2,213 feet	Average Slope	15.4 %
Time of Concentration	0.1 hours	Average Curve Number	79.74

Estimated Peak Flows

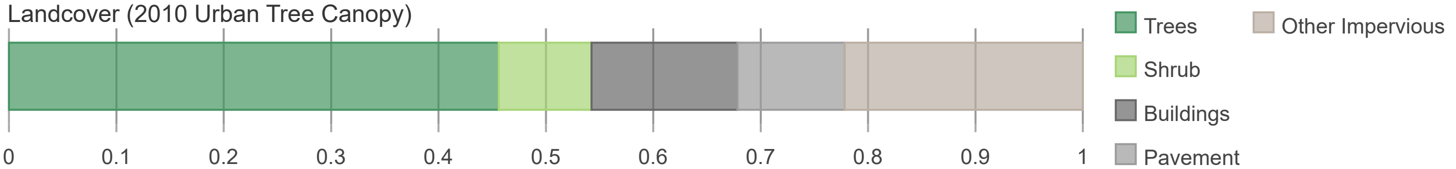
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	17.6	27	40.3	51.7	67.8	81	94.6	108.9	130.5	148
Normal	20.6	30.8	45.4	57.8	75.4	89.8	105.3	122.2	147.8	168.7
Upper	24.5	35.5	51.4	64.5	83.3	98.5	115	133.6	160.4	182.4

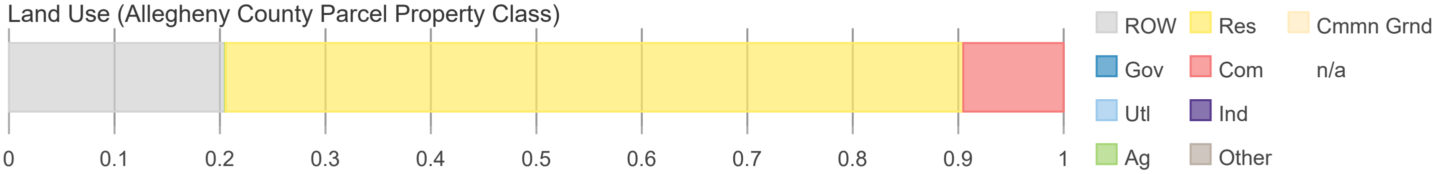
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

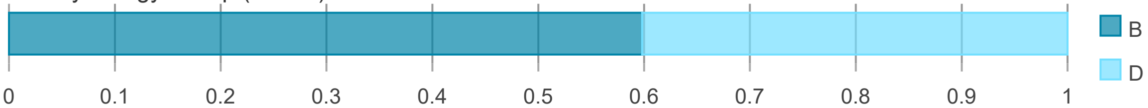
Landcover (2010 Urban Tree Canopy)



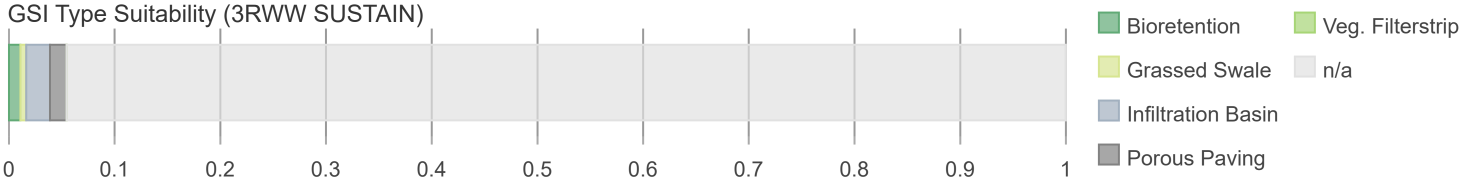
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

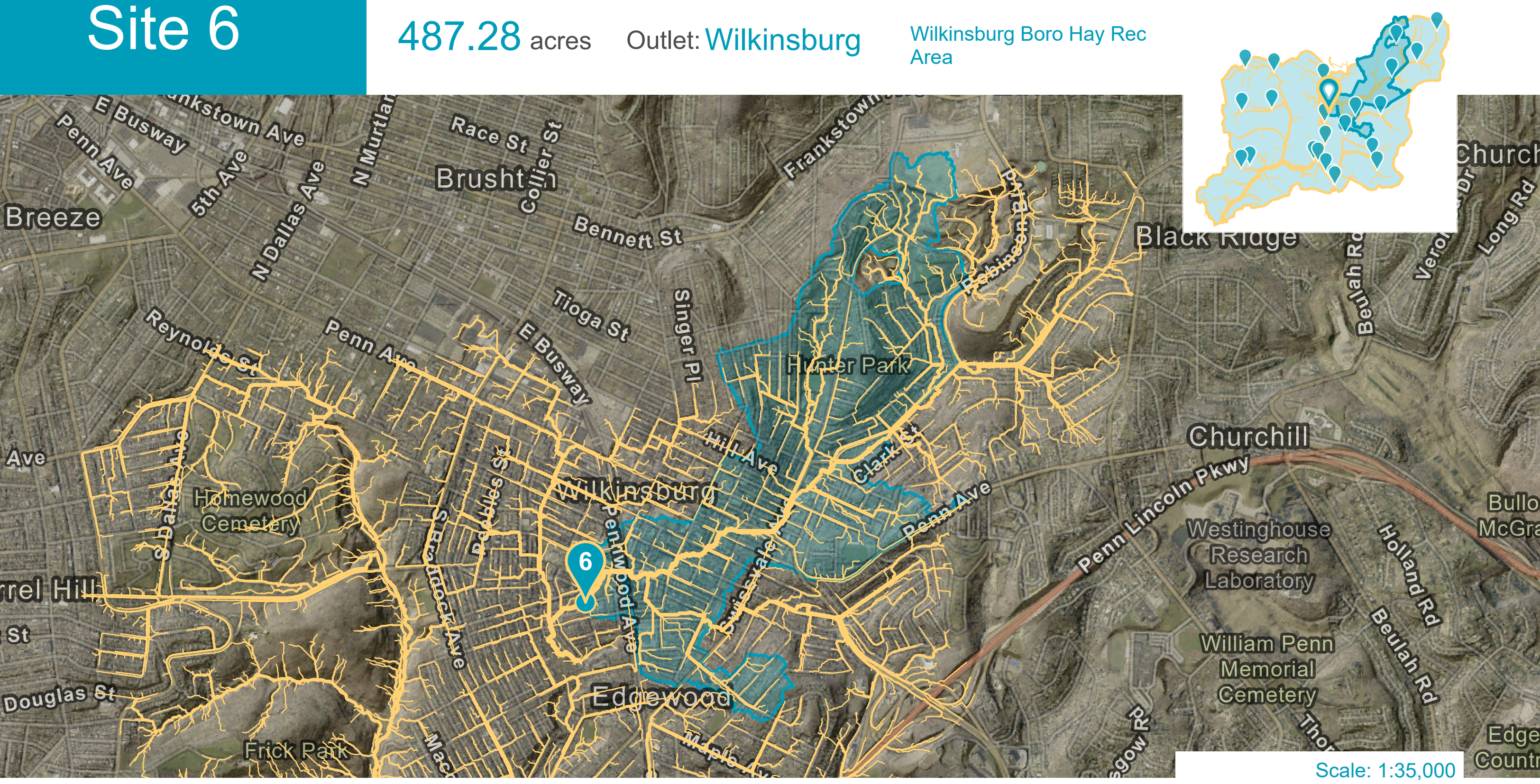


GSI Type Suitability (3RWW SUSTAIN)



Site 6

487.28 acres Outlet: Wilkinsburg Wilkinsburg Boro Hay Rec Area



Max. Flow Length **13,990** feet

Time of Concentration **0.41** hours

Average Slope **15.6** %

Average Curve Number **79.04**

Estimated Peak Flows

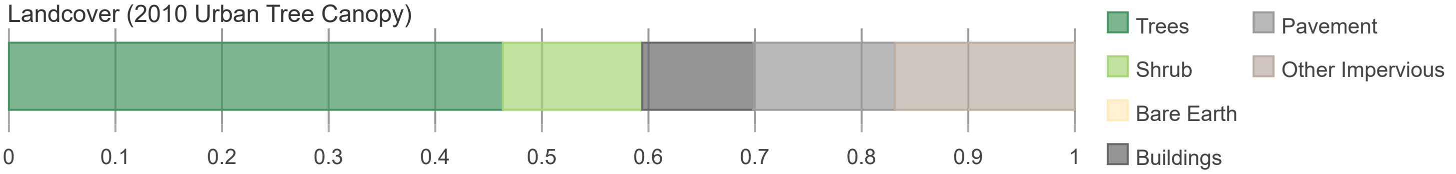
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	169.6	270.7	421.3	555.4	747	907.4	1075	1252.1	1502.6	1707
Normal	201.5	313.7	481	627	839.5	1016	1206.9	1406.2	1703.9	1947.5
Upper	244	366.7	551.3	708.1	935.9	1122.7	1322.3	1538	1851.2	2108.1

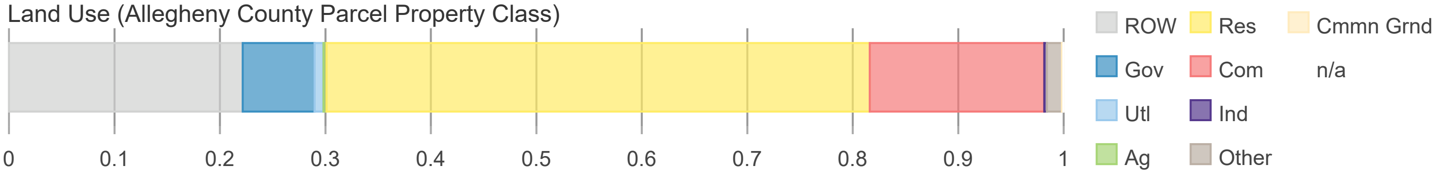
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

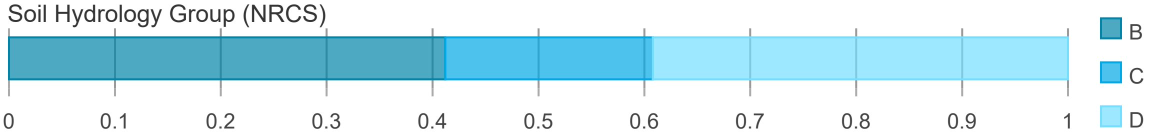
Landcover (2010 Urban Tree Canopy)



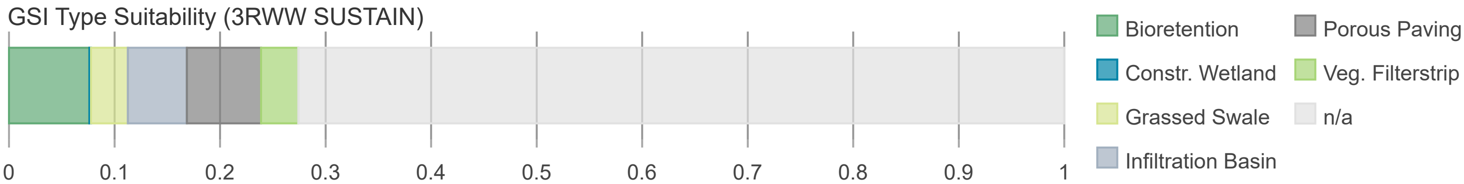
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



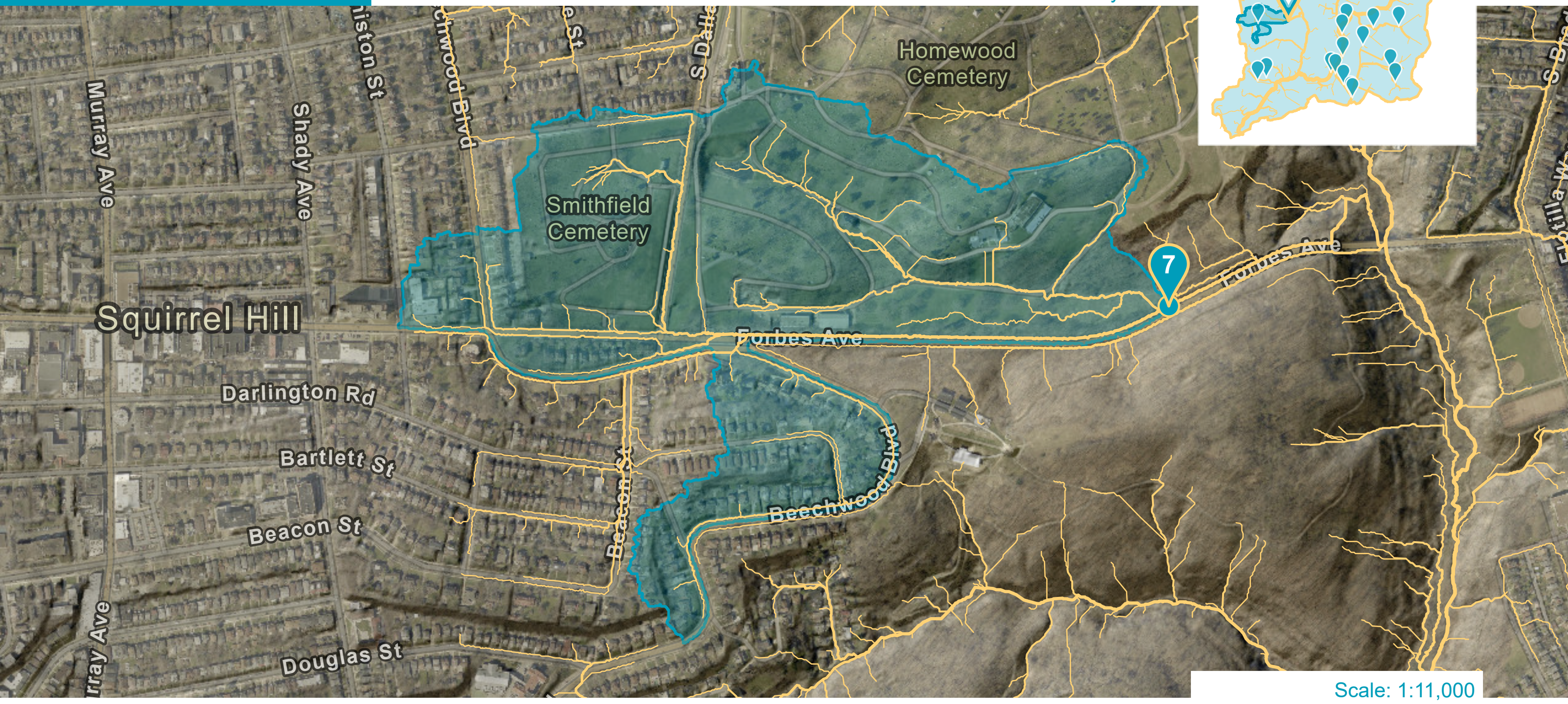
GSI Type Suitability (3RWW SUSTAIN)



Site 7

102.25 acres Outlet: Pittsburgh

Forbes Ave. adjacent to Community Garden area at Homewood Cemetery



Max. Flow Length 5,697 feet

Time of Concentration 0.21 hours

Average Slope 15 %

Average Curve Number 74.99

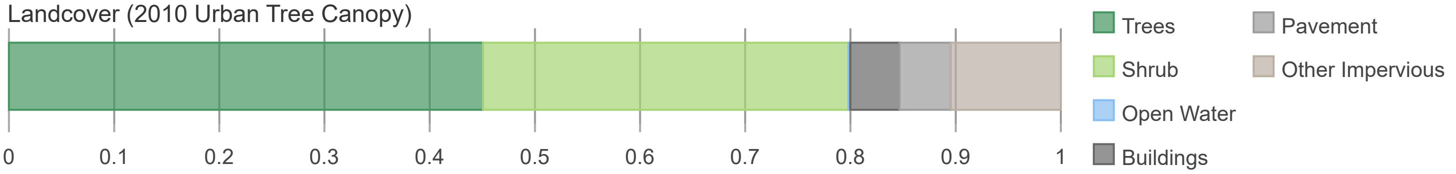
Estimated Peak Flows (cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	30.2	54.4	92.8	127.9	178.9	221.9	267	314.7	380.9	433.7
Normal	37.6	65.2	108.3	146.9	203.7	251.1	302.5	355.8	432.9	496.2
Upper	47.9	78.7	126.8	168.5	229.5	279.8	333.6	390	470.7	539.9

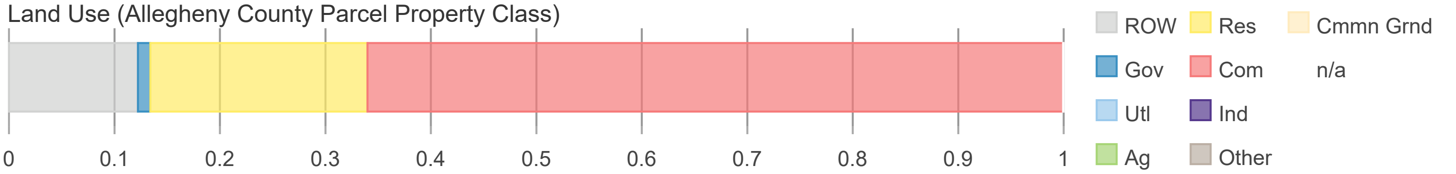
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

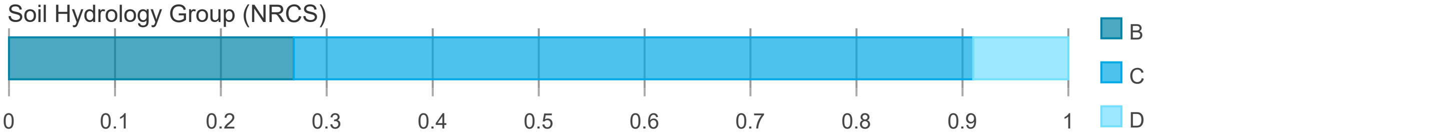
Landcover (2010 Urban Tree Canopy)



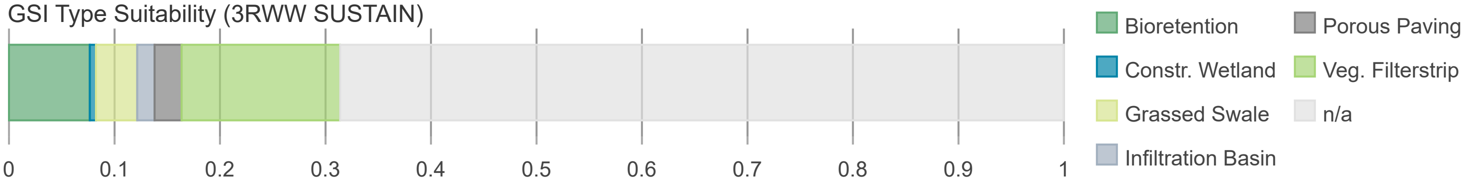
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



GSI Type Suitability (3RWW SUSTAIN)



Site 8a

2.79 acres Outlet: Pittsburgh

Walnut Towers, Forward Avenue, south facing slope behind building which drains

Max. Flow Length	1,022 feet	Average Slope	16.7 %
Time of Concentration	0.05 hours	Average Curve Number	75.08

Estimated Peak Flows

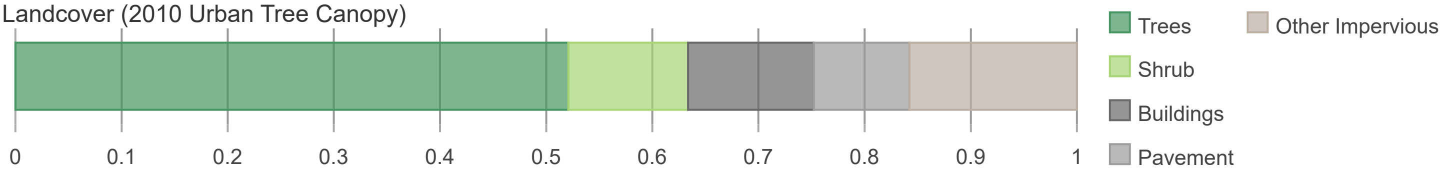
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	1.5	2.7	4.3	5.8	7.9	9.6	11.4	13.2	15.8	17.8
Normal	1.9	3.1	5	6.6	8.9	10.7	12.8	14.8	17.8	20.2
Upper	2.4	3.7	5.8	7.5	9.9	11.9	14	16.1	19.2	22

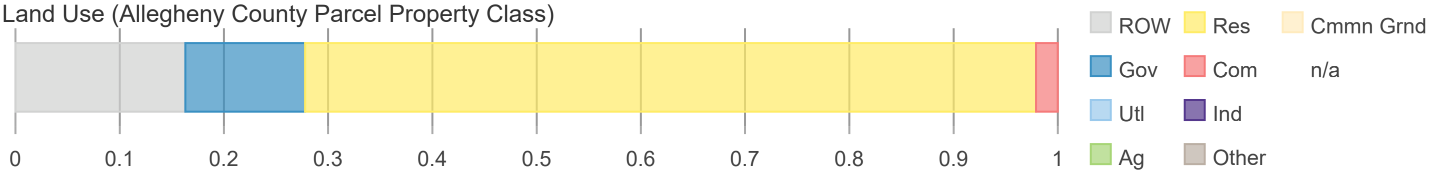
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

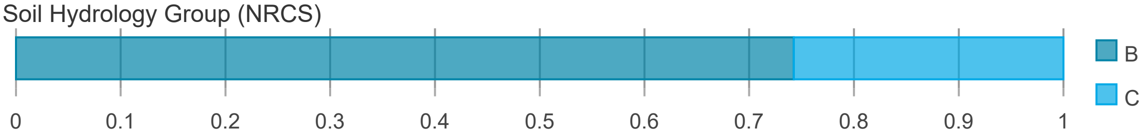
Landcover (2010 Urban Tree Canopy)



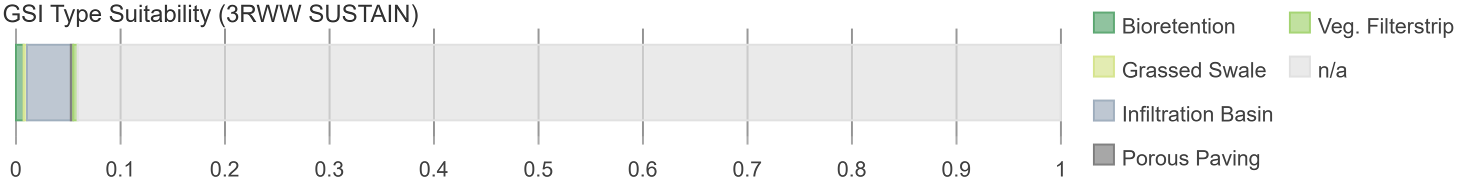
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



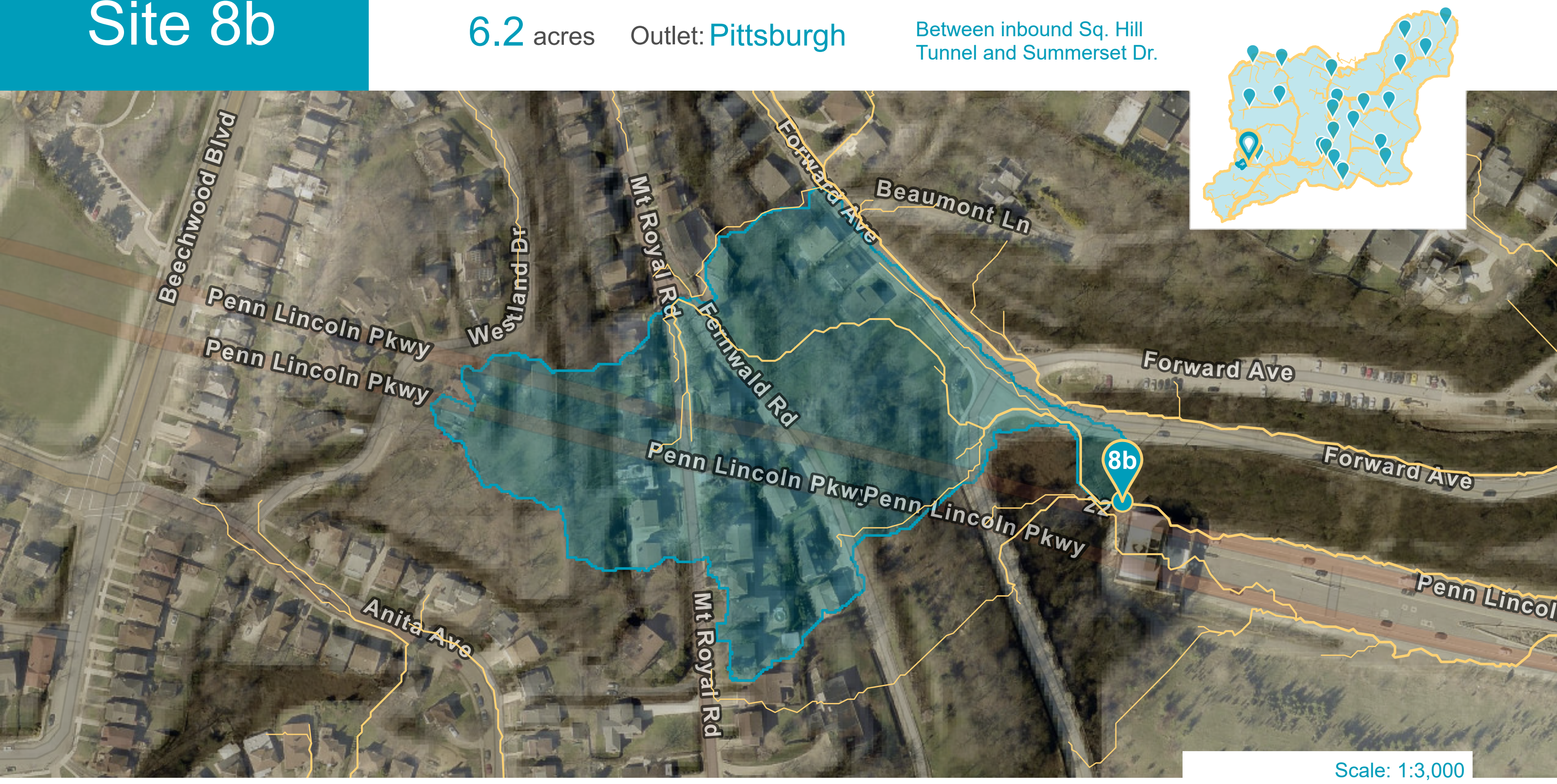
GSI Type Suitability (3RWW SUSTAIN)



Site 8b

6.2 acres Outlet: Pittsburgh

Between inbound Sq. Hill Tunnel and Summerset Dr.



Max. Flow Length 1,605 feet

Time of Concentration 0.06 hours

Average Slope 28.6 %

Average Curve Number 72.41

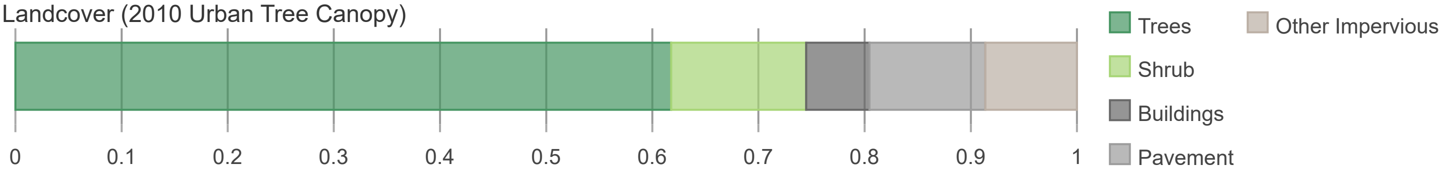
Estimated Peak Flows (cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	2.2	4.2	7.5	10.6	15	18.6	22.4	26.4	31.9	36.2
Normal	2.8	5.2	8.9	12.2	17.1	21.1	25.4	29.8	36.2	41.3
Upper	3.7	6.3	10.5	14.1	19.2	23.5	28	32.6	39.3	44.7

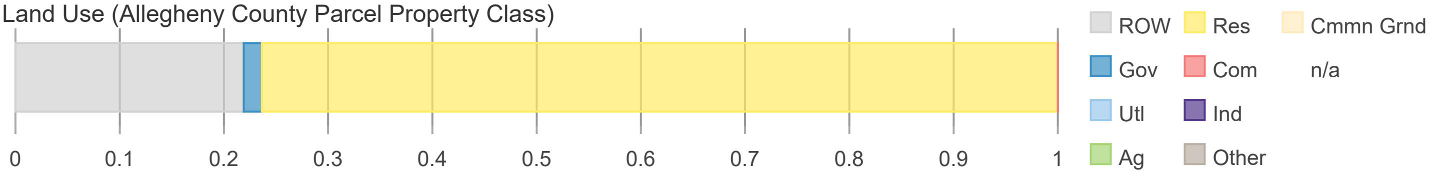
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

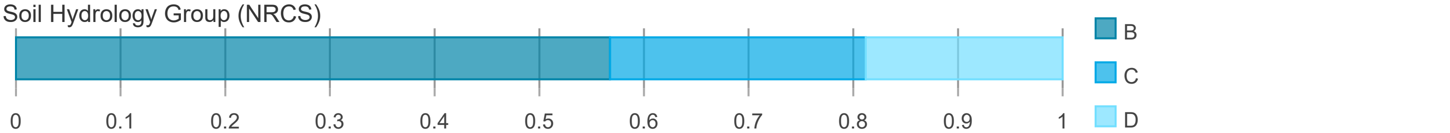
Landcover (2010 Urban Tree Canopy)



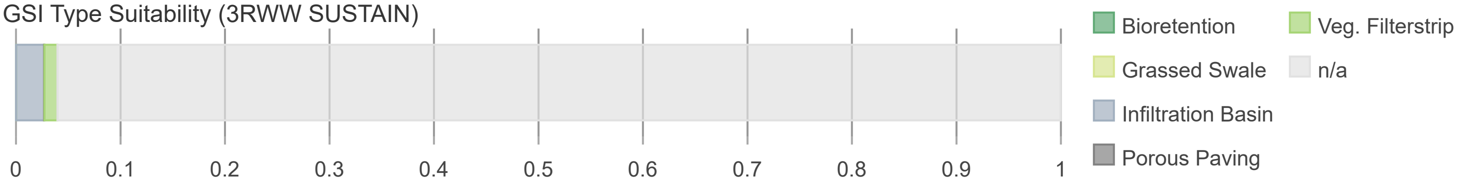
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

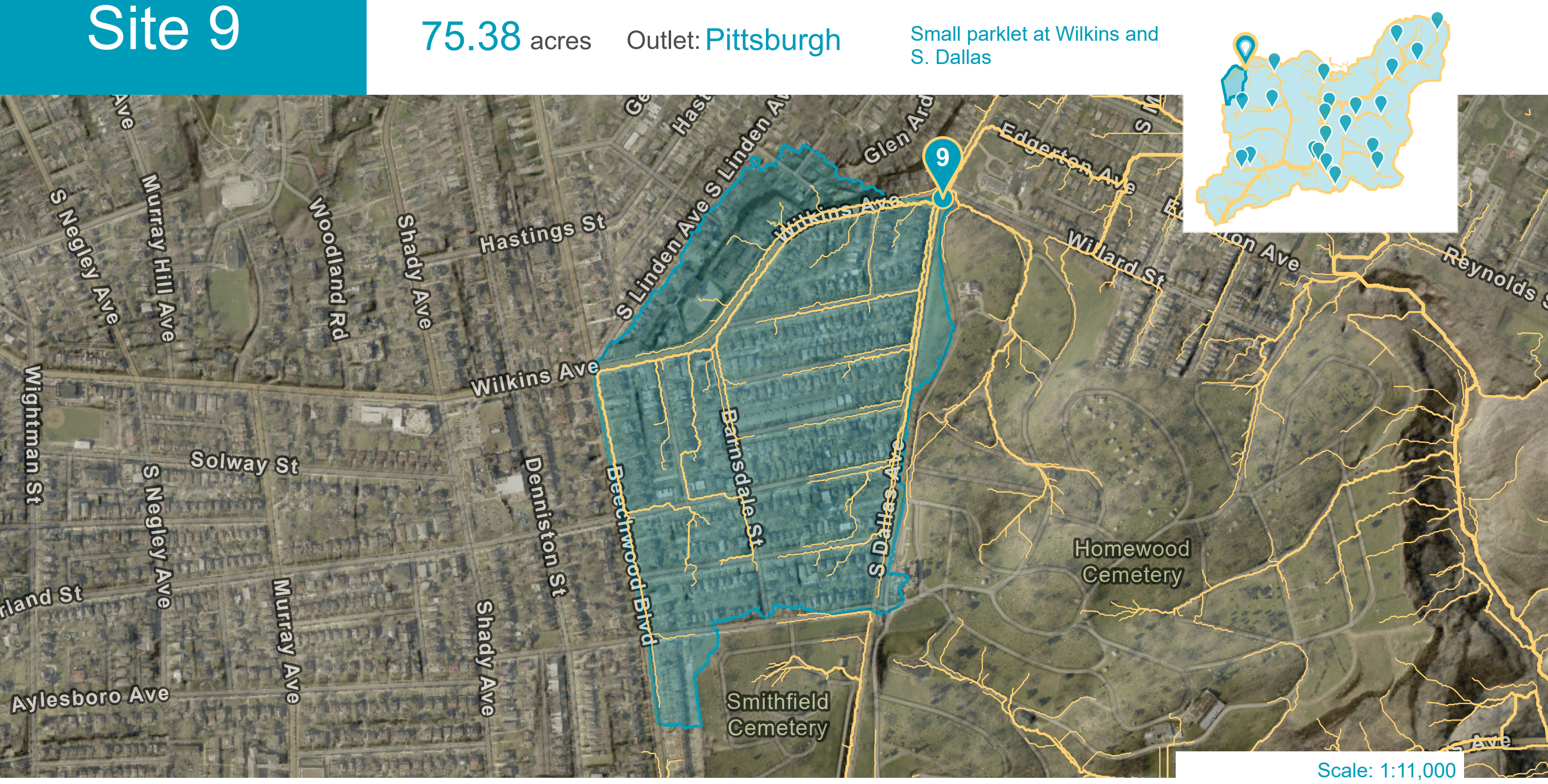


GSI Type Suitability (3RWW SUSTAIN)



Site 9

75.38 acres Outlet: Pittsburgh Small parklet at Wilkins and S. Dallas



Max. Flow Length	4,593 feet	Average Slope	11.6 %
Time of Concentration	0.2 hours	Average Curve Number	76.56

Estimated Peak Flows

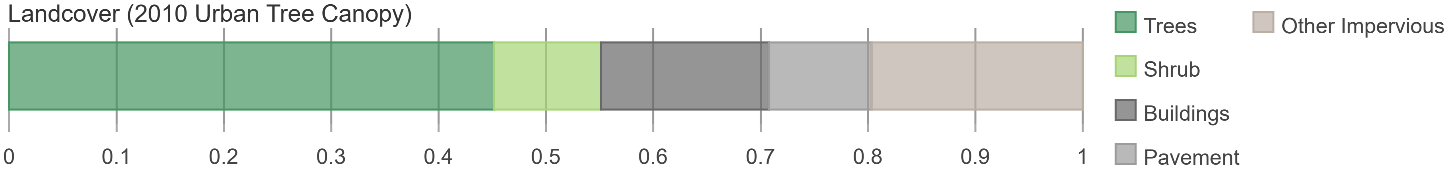
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	28.5	48.5	79.1	106.6	146	179.1	213.5	249.9	300.2	340.7
Normal	34.7	57.2	91.4	121.4	165.1	201.4	240.6	281.2	340	390.8
Upper	43.2	68	105.8	138	184.9	223.3	264.3	307.2	370.7	424.3

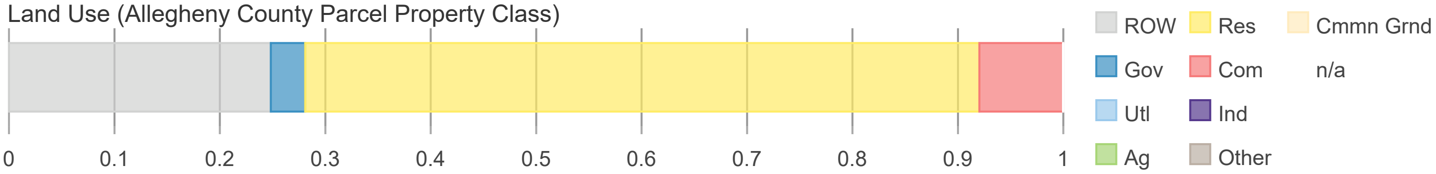
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

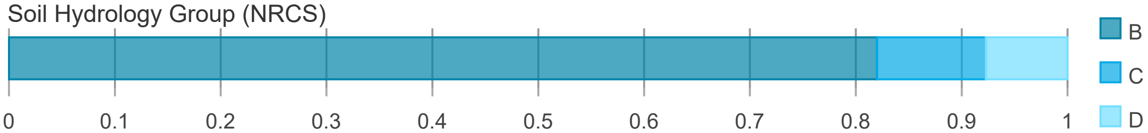
Landcover (2010 Urban Tree Canopy)



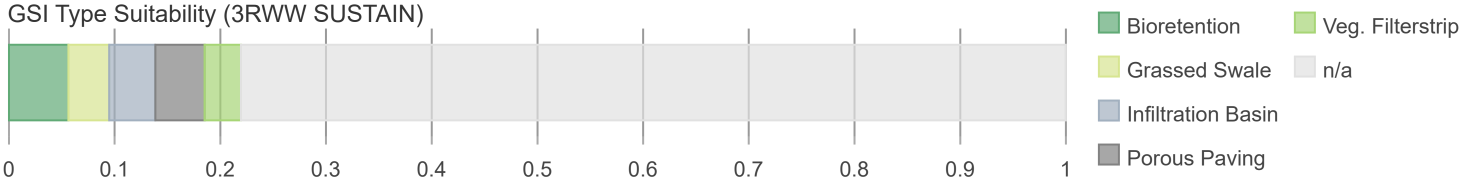
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



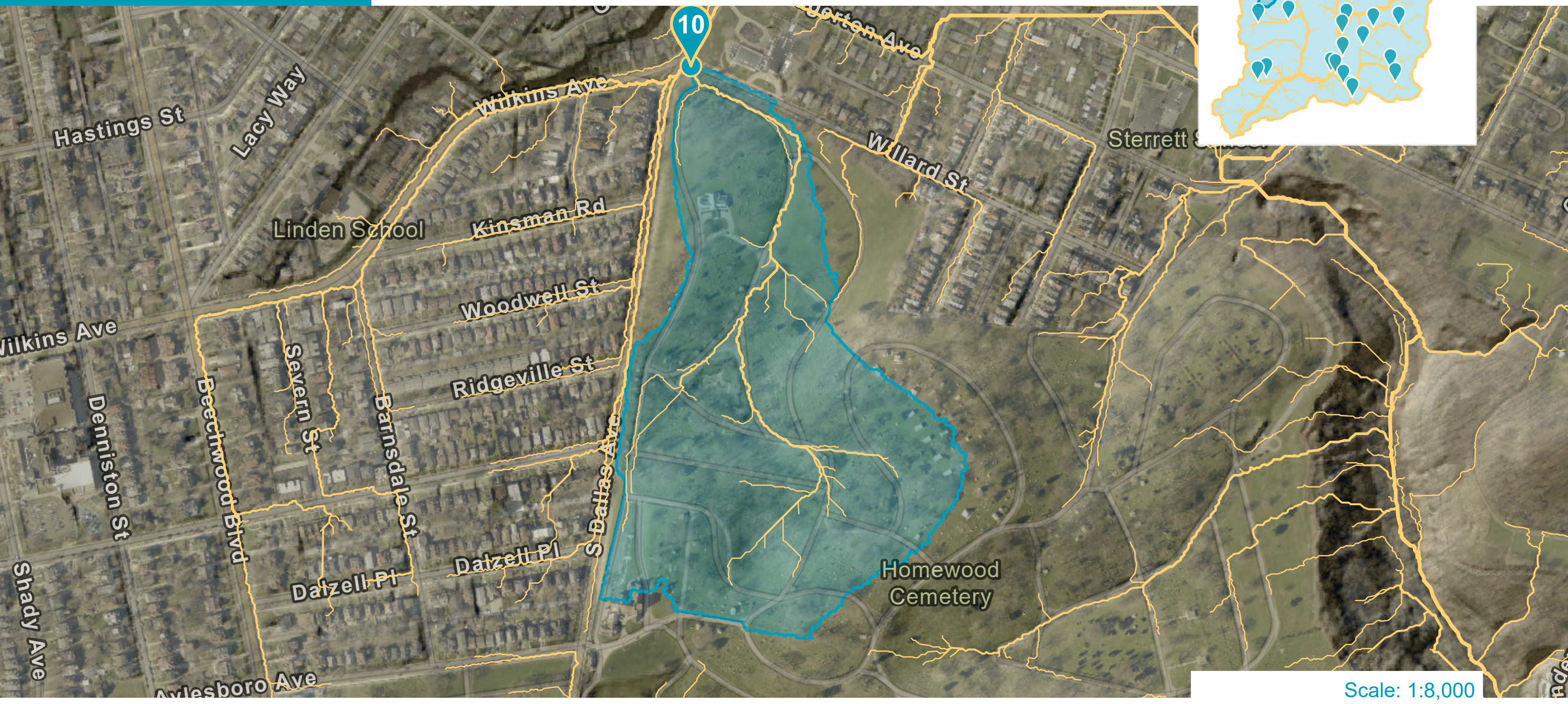
GSI Type Suitability (3RWW SUSTAIN)



Site 10

34.81 acres Outlet: Pittsburgh

Homewood Cemetery near corner of Wilkins and S. Dallas



Max. Flow Length 3,187 feet

Time of Concentration 0.15 hours

Average Slope 11.5 %

Average Curve Number 73.56

Estimated Peak Flows

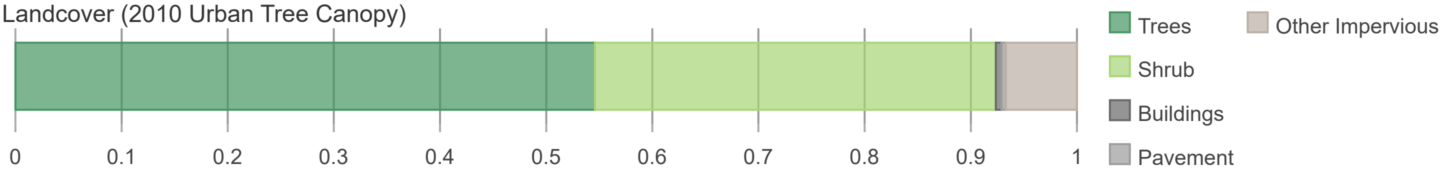
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	9.8	18.6	32.9	46.2	65.5	81.8	98.9	117	142	162
Normal	12.5	22.6	38.8	53.3	74.9	92.8	112.3	132.6	161.7	185.4
Upper	16.2	27.6	45.8	61.5	84.7	103.7	124.1	145.5	176.1	200.9

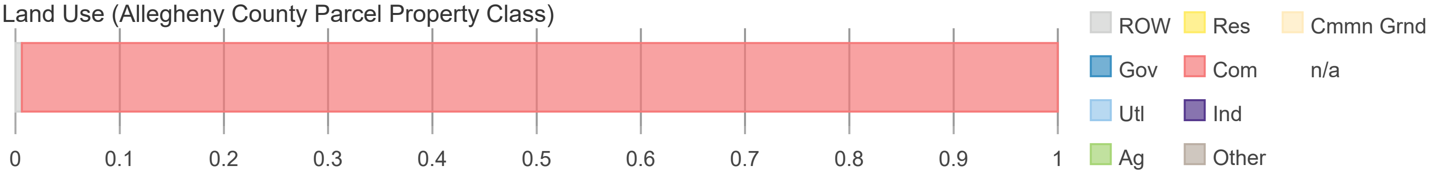
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

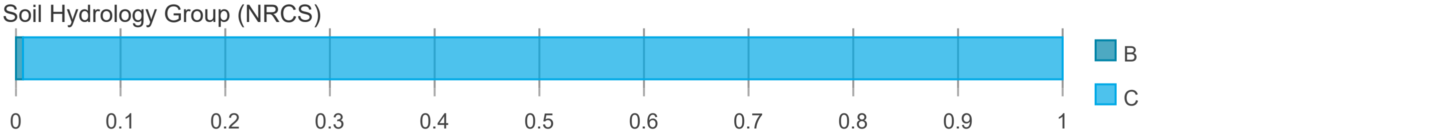
Landcover (2010 Urban Tree Canopy)



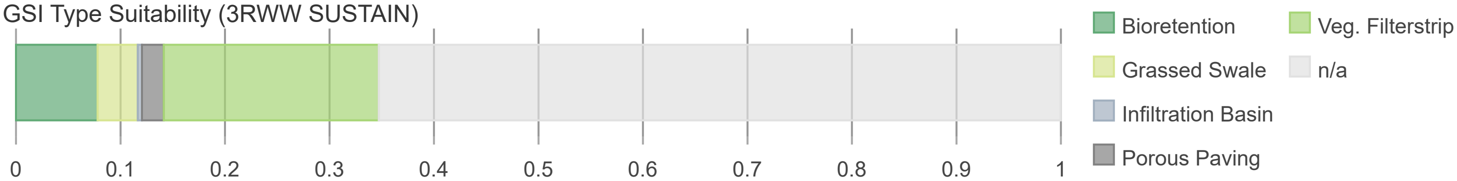
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



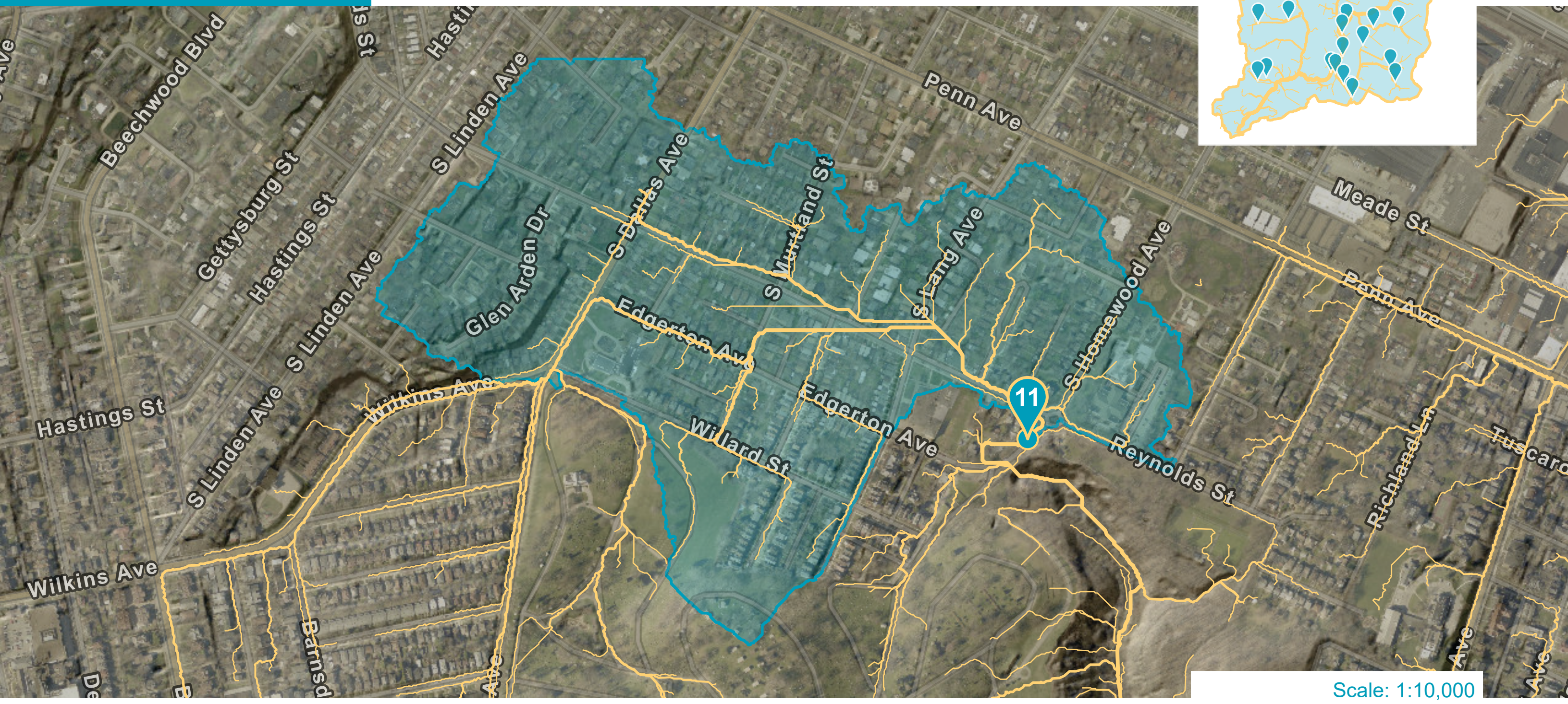
GSI Type Suitability (3RWW SUSTAIN)



Site 11

103.96 acres Outlet: Pittsburgh

Reynolds Street Circle



Max. Flow Length 4,400 feet

Time of Concentration 0.2 hours

Average Slope 9.8 %

Average Curve Number 74.59

Estimated Peak Flows

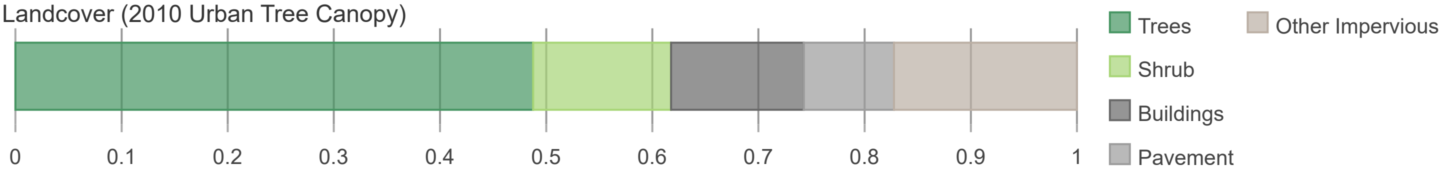
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	29.4	53.9	92.9	128.8	181	225.1	271.3	320.3	388.3	442.5
Normal	36.9	64.8	108.8	148.2	206.4	255	307.8	362.5	441.7	505.9
Upper	47.2	78.5	127.7	170.3	232.9	284.5	339.8	397.7	480.6	550.7

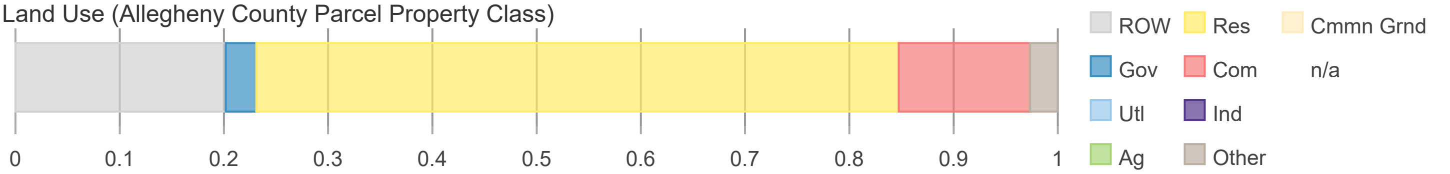
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

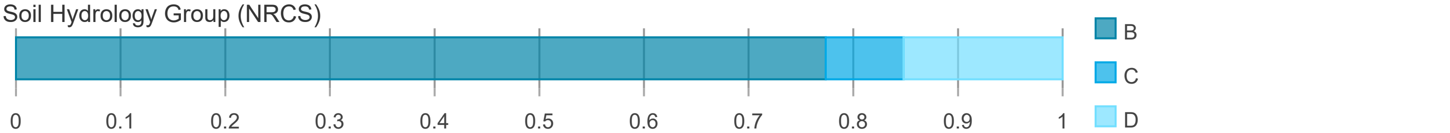
Landcover (2010 Urban Tree Canopy)



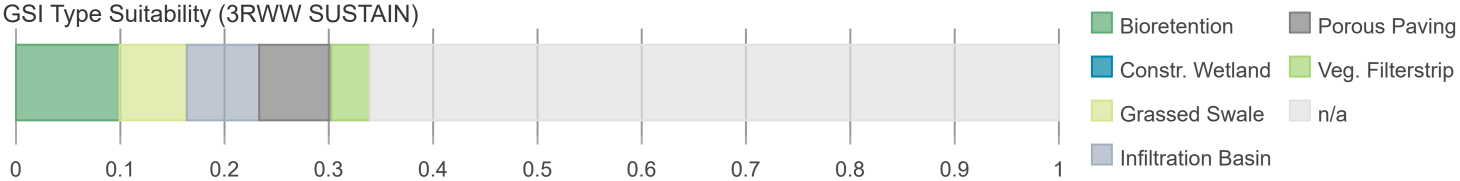
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

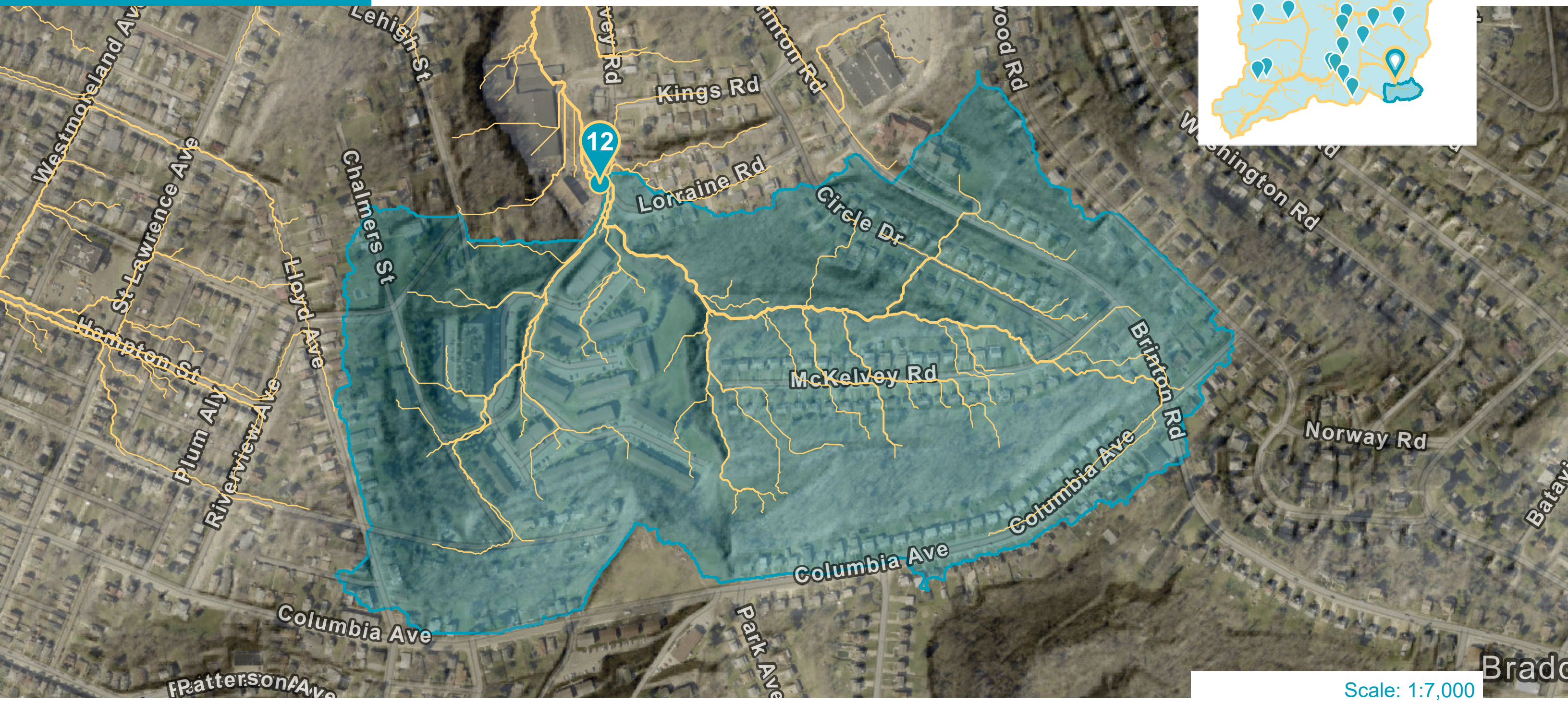


GSI Type Suitability (3RWW SUSTAIN)



Site 12

72.27 acres Outlet: Braddock Hills Ditch at McKelvey and Lorraine ROW



Max. Flow Length 3,647 feet
Time of Concentration 0.13 hours
Average Slope 21.7 %
Average Curve Number 76.97

Estimated Peak Flows

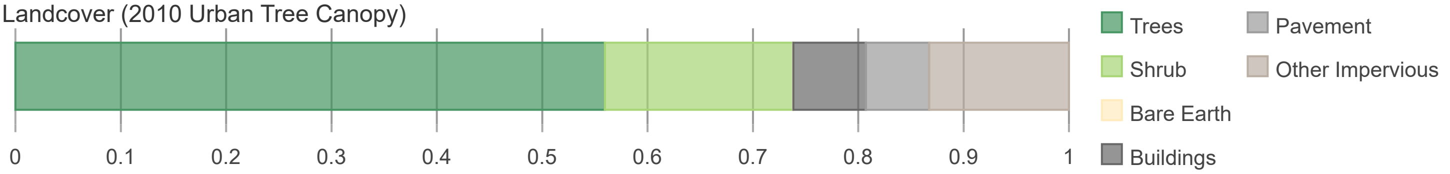
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	35	58.4	93.2	124.1	168	204.6	242.5	282.4	337.4	382.7
Normal	42.4	68.3	107	140.6	189.1	229.1	272.2	316.6	382	438.6
Upper	52.2	80.6	123.2	159.2	211	253.2	298.1	345	416.2	476

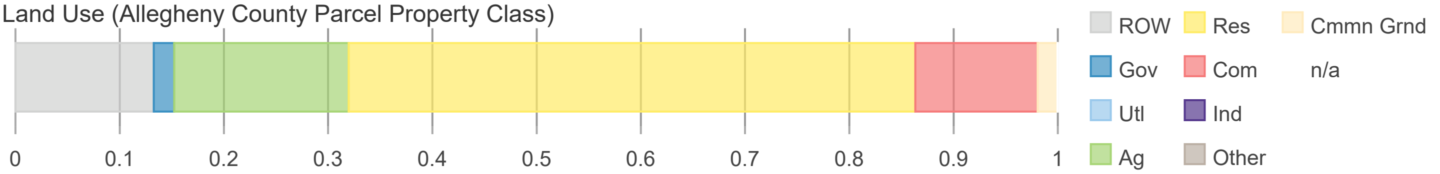
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

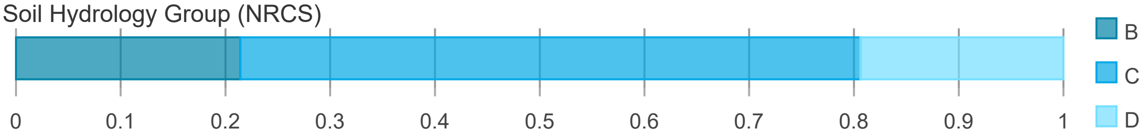
Landcover (2010 Urban Tree Canopy)



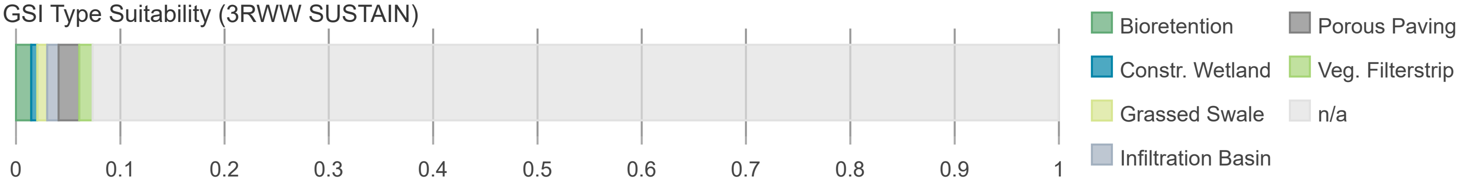
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

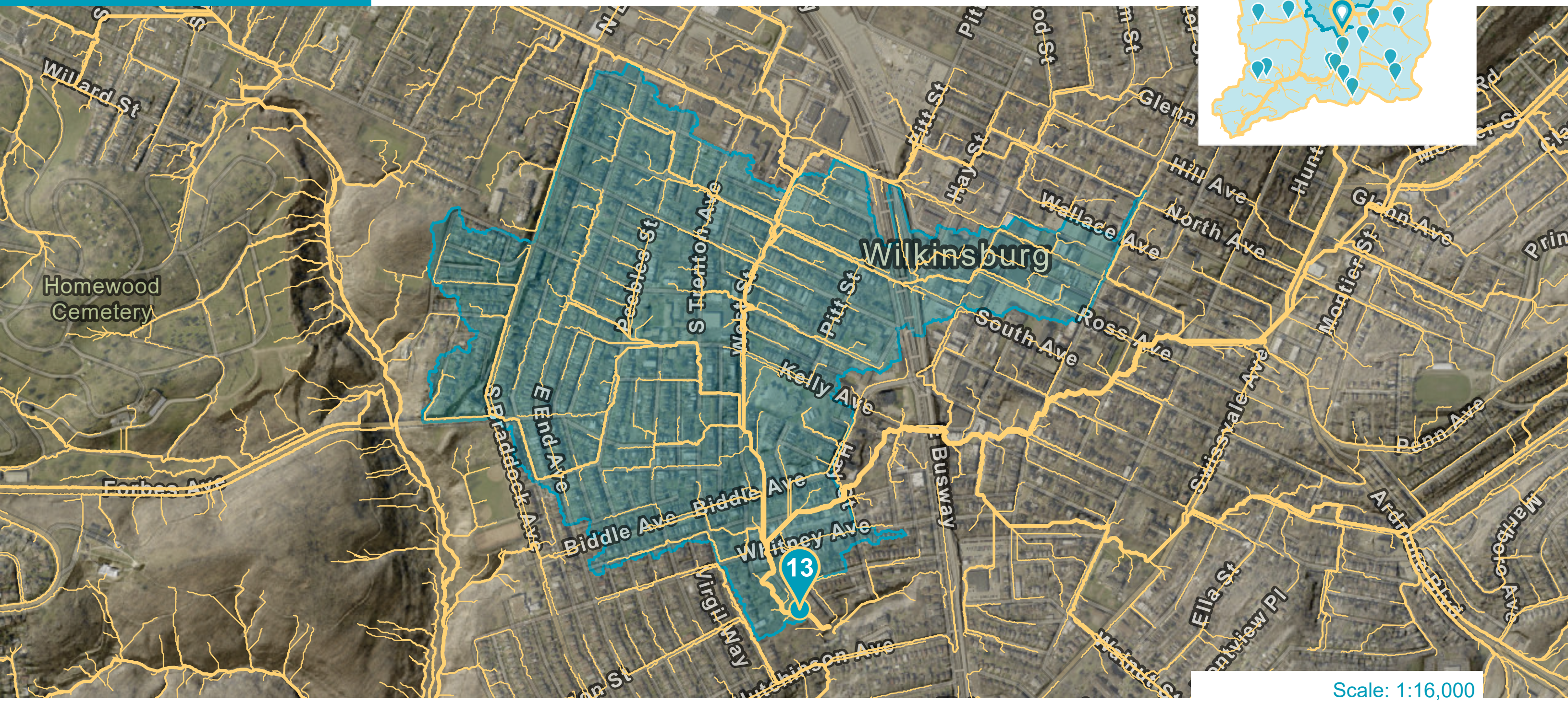


GSI Type Suitability (3RWW SUSTAIN)



Site 13

214.87 acres Outlet: Wilkinsburg Whitney Park



Max. Flow Length	7,983 feet	Average Slope	8.1 %
Time of Concentration	0.35 hours	Average Curve Number	86.29

Estimated Peak Flows

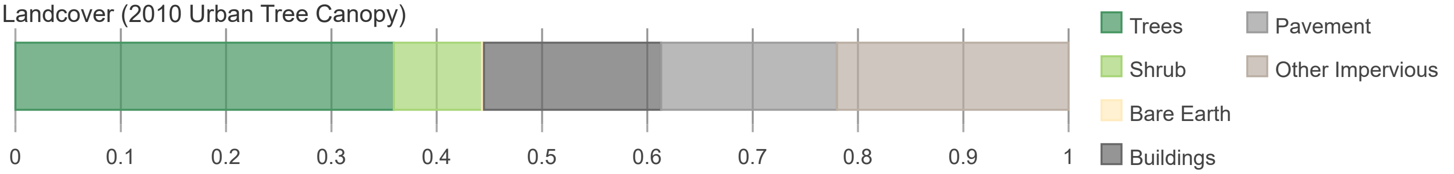
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	160.5	220.2	303	373.7	476.1	562	651.6	746.3	877.5	982.1
Normal	179.9	244.4	334.8	411.7	525.6	620.1	722.1	827.8	980.5	1104.3
Upper	204.9	273.6	371.6	455.2	577.2	677.1	783.8	895.6	1055.5	1185.4

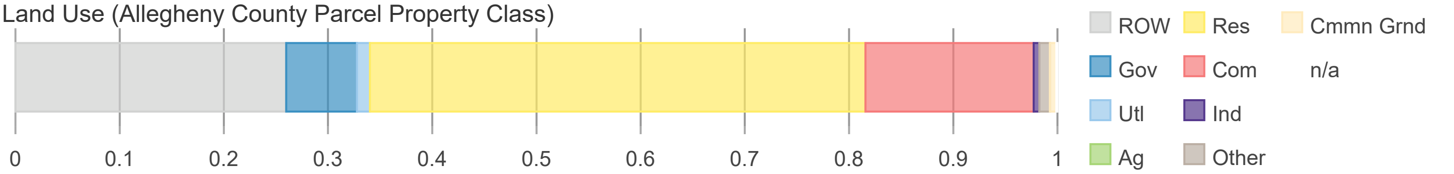
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

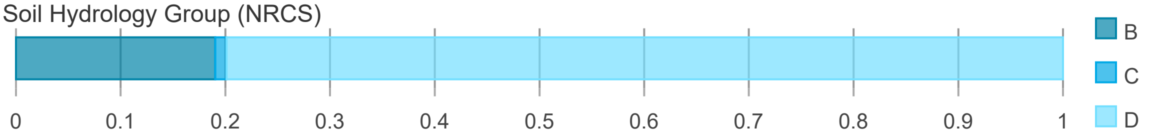
Landcover (2010 Urban Tree Canopy)



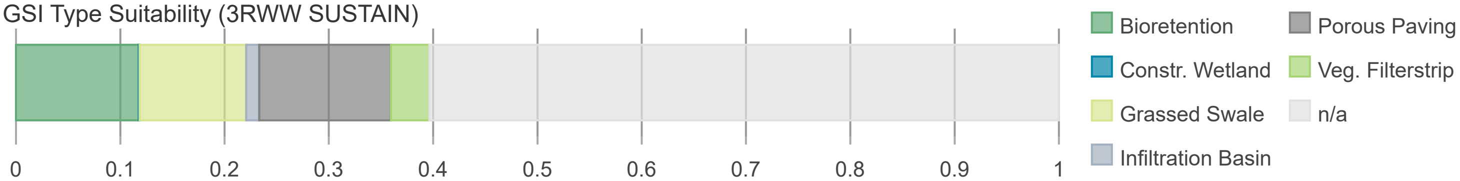
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



GSI Type Suitability (3RWW SUSTAIN)



Site 14

9.35 acres Outlet: Pittsburgh

East Hills Park

Max. Flow Length 1,925 feet

Time of Concentration 0.08 hours

Average Slope 20.5 %

Average Curve Number 76.27

Estimated Peak Flows

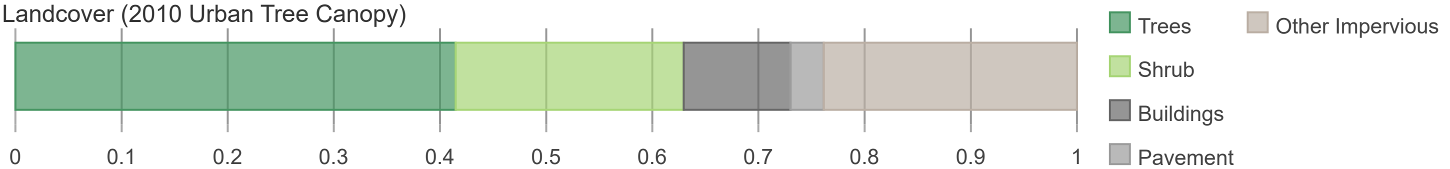
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	5.1	8.6	13.7	18.3	24.7	30	35.5	41.3	49.2	55.6
Normal	6.2	10	15.7	20.7	27.8	33.6	39.8	46.2	55.5	63.7
Upper	7.6	11.8	18.1	23.4	31	37.1	43.6	50.3	60.5	69.2

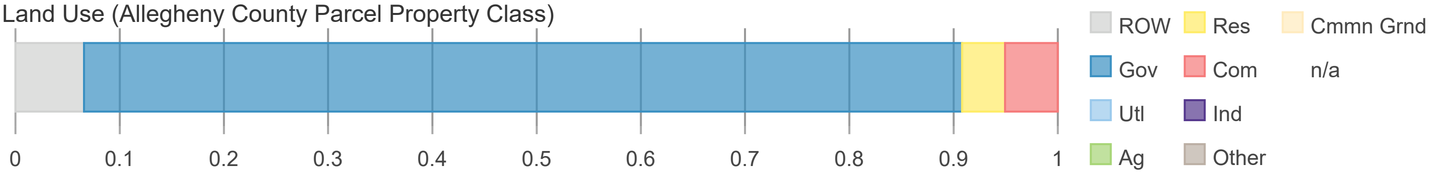
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

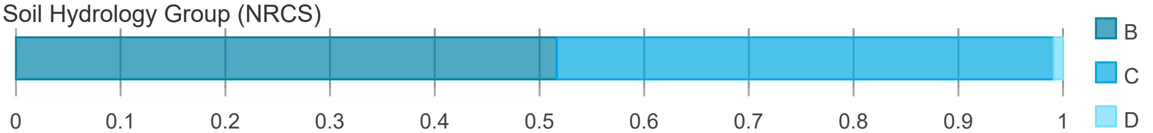
Landcover (2010 Urban Tree Canopy)



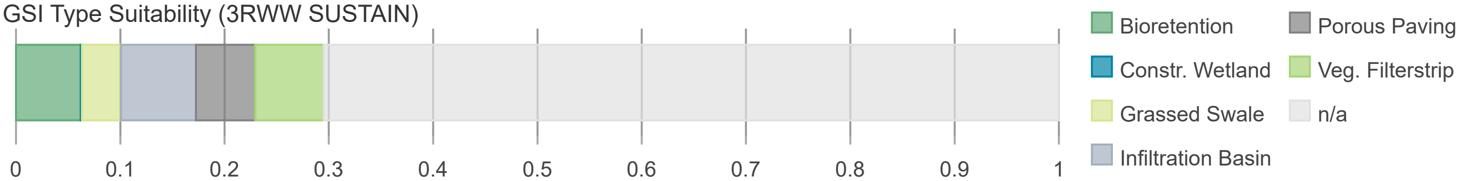
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

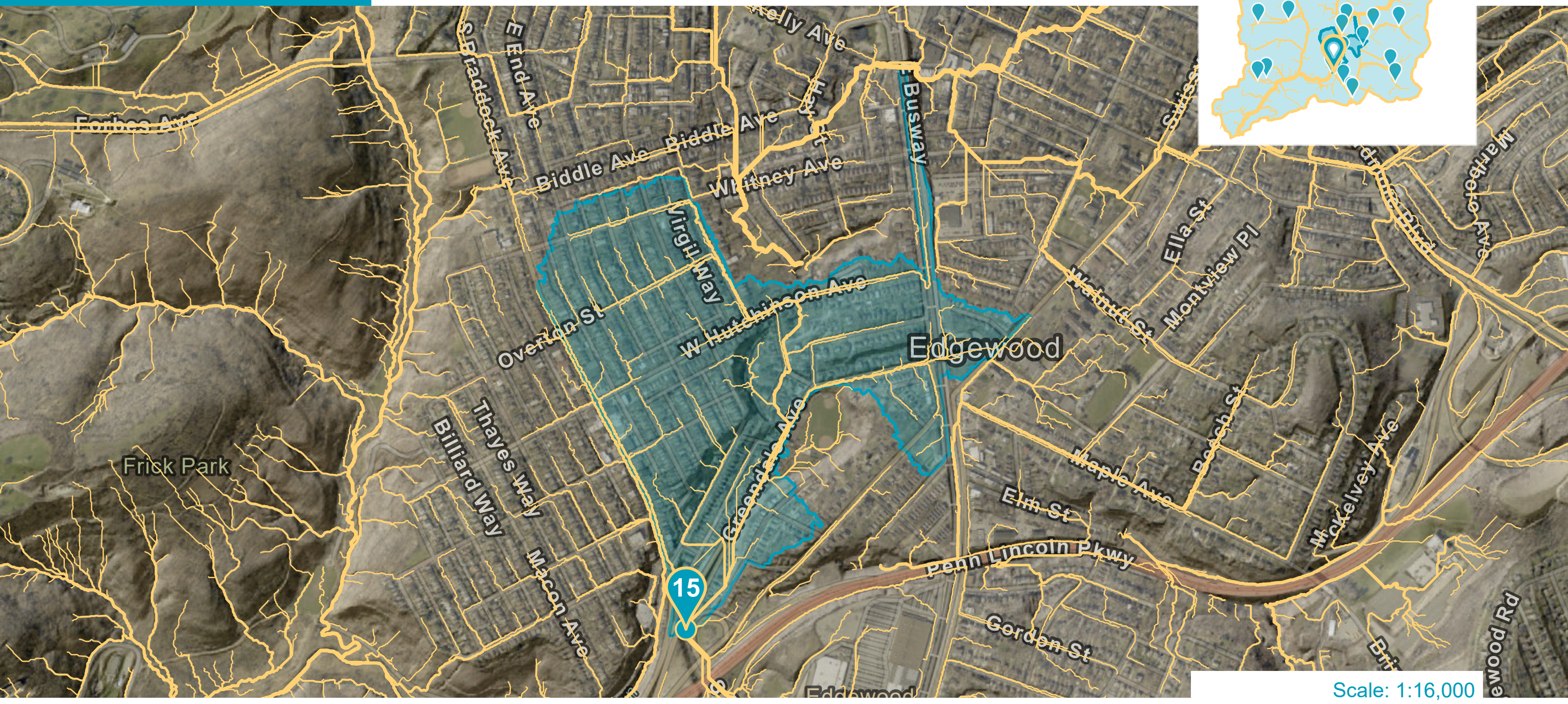


GSI Type Suitability (3RWW SUSTAIN)



Site 15

118.56 acres Outlet: Edgewood 376 W on-ramp loop



Max. Flow Length 5,933 feet

Time of Concentration 0.23 hours

Average Slope 12.9 %

Average Curve Number 79.22

Estimated Peak Flows

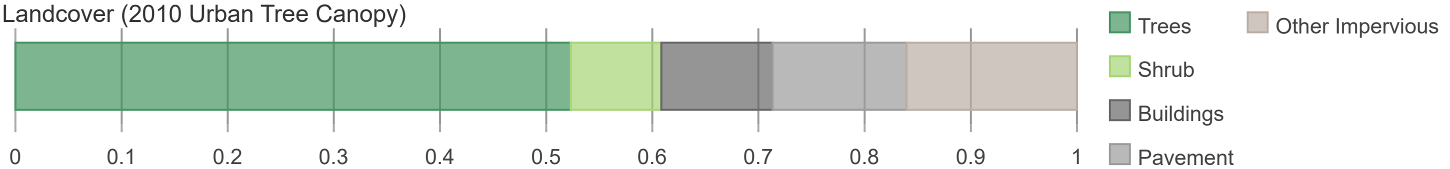
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	57	90	138.3	180.9	241.2	291.3	343.5	398.4	477.4	542.1
Normal	67.5	103.9	157.3	203.5	270.1	325.2	384.4	446.8	541.1	618.3
Upper	81.3	120.9	179.6	229	300.2	358.3	420.1	488.6	587.8	669.1

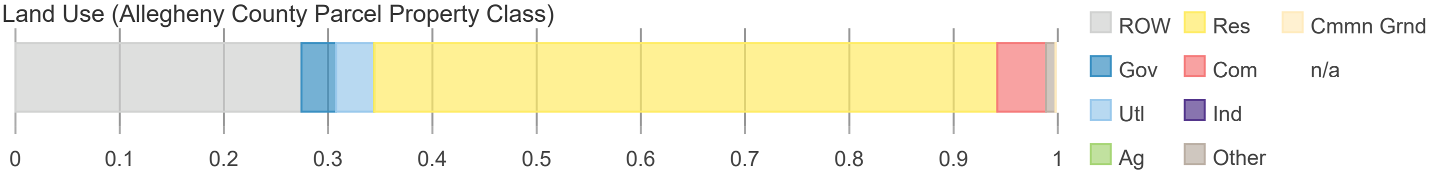
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

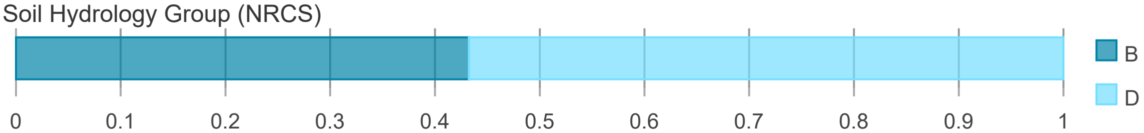
Landcover (2010 Urban Tree Canopy)



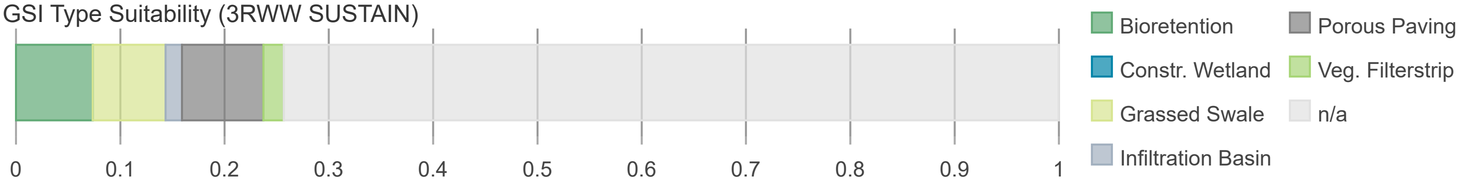
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



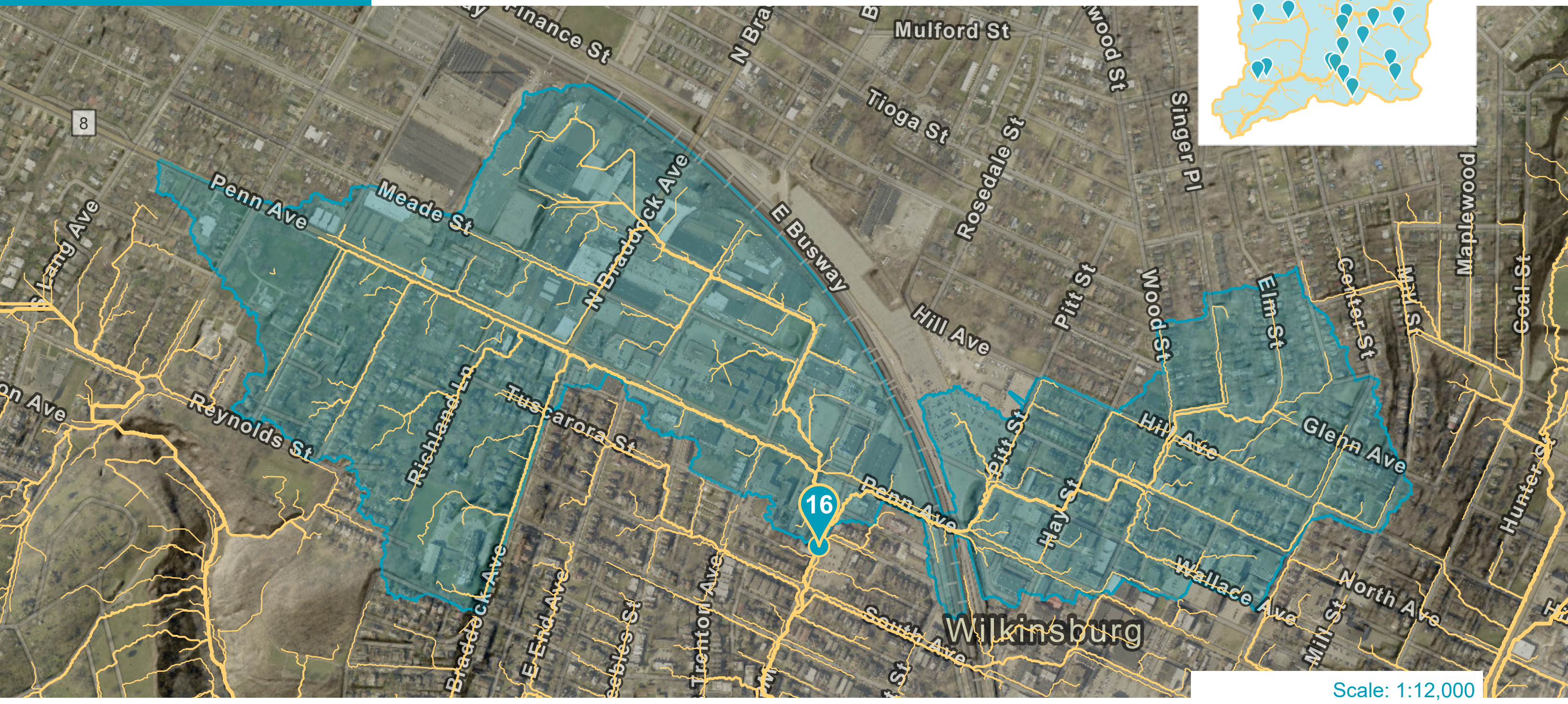
GSI Type Suitability (3RWW SUSTAIN)



Site 16

204.95 acres Outlet: Wilkinsburg

Small parklet on West St.



Max. Flow Length **5,904** feet

Time of Concentration **0.26** hours

Average Slope **9.4** %

Average Curve Number **86.09**

Estimated Peak Flows

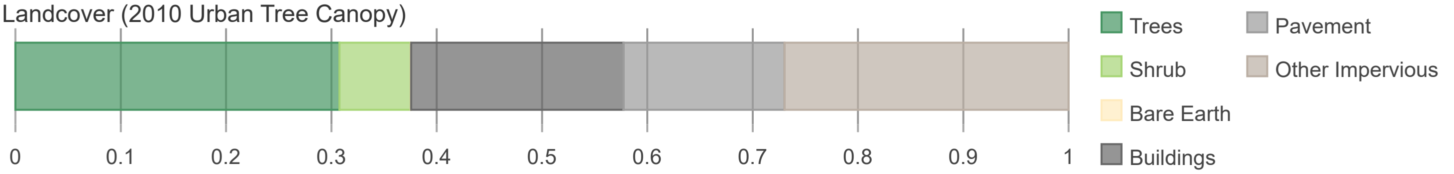
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	173.2	237.5	326.4	402.2	512.1	604.9	701.8	804.2	946.2	1059.4
Normal	194.2	263.5	360.5	442.6	565.6	667.7	778.1	892.4	1057.7	1191.7
Upper	221.1	294.8	399.9	489.6	621.4	729.4	844.8	965.8	1138.9	1279.5

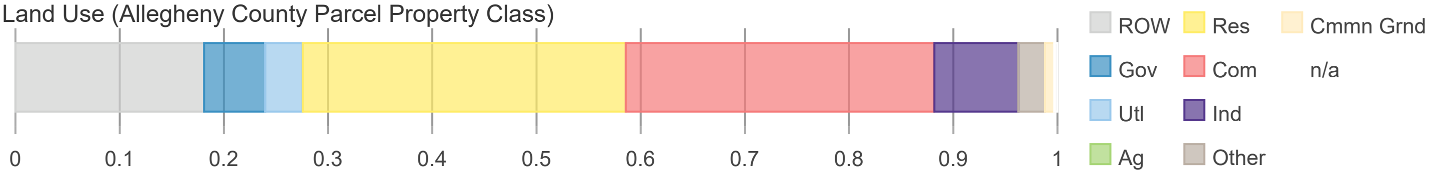
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

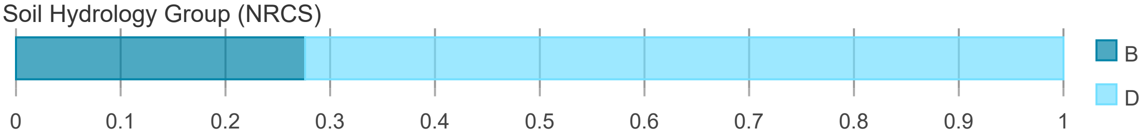
Landcover (2010 Urban Tree Canopy)



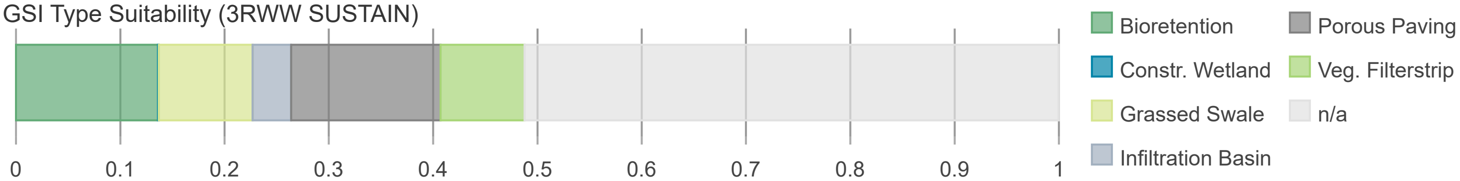
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



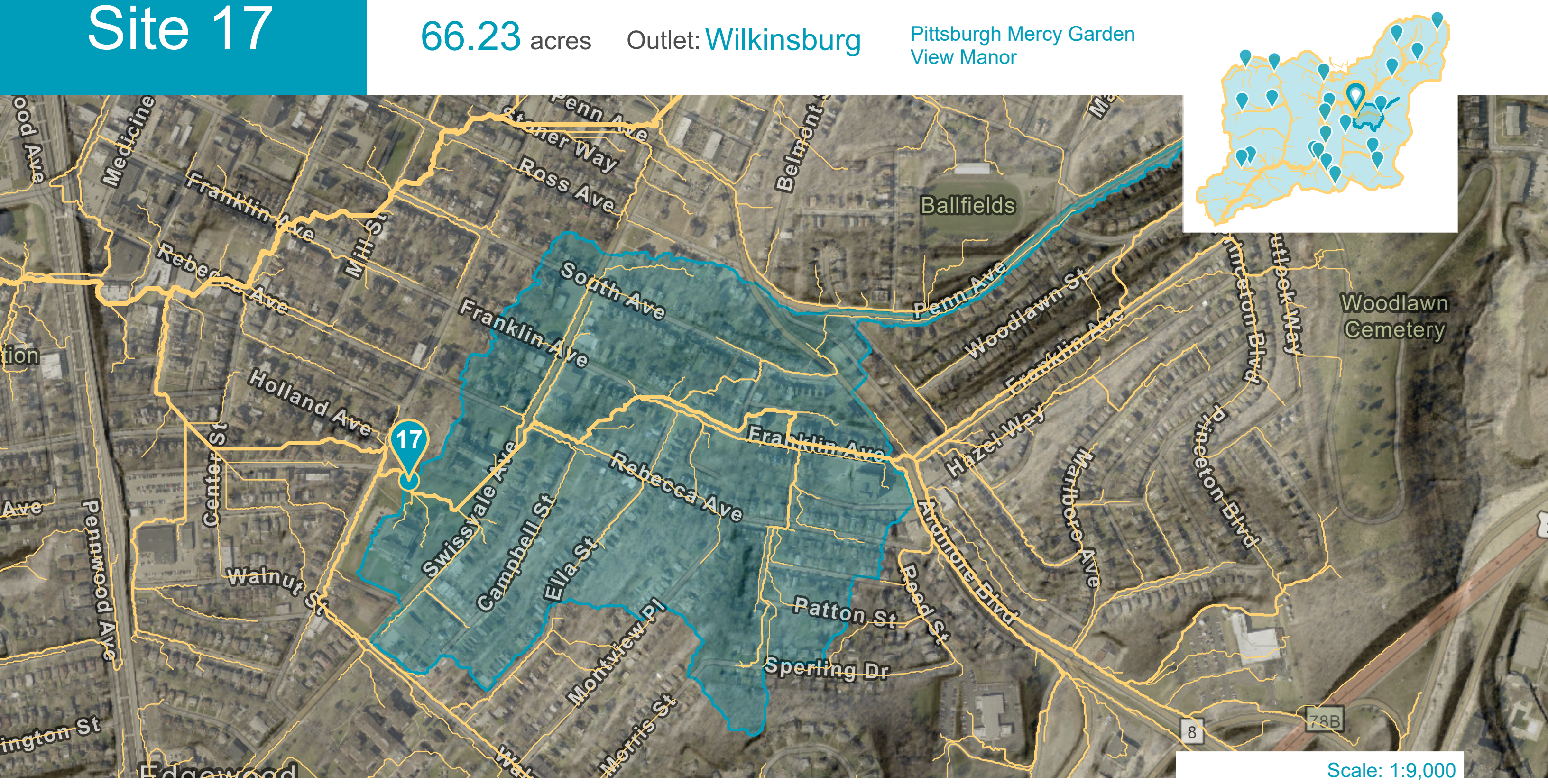
GSI Type Suitability (3RWW SUSTAIN)



Site 17

66.23 acres Outlet: Wilkinsburg

Pittsburgh Mercy Garden View Manor



Max. Flow Length	4,646 feet	Average Slope	15.5 %
Time of Concentration	0.18 hours	Average Curve Number	81.31

Estimated Peak Flows

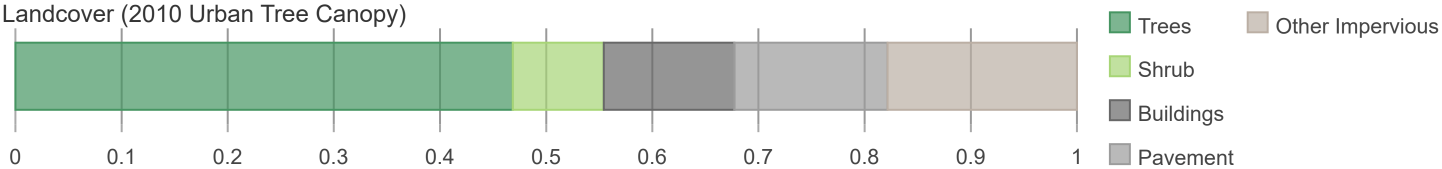
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	44.5	66.4	97.6	124.5	162.2	193.3	225.5	261.6	312.4	353.2
Normal	51.6	75.5	109.6	138.7	180.2	214.2	252.3	293.1	352.6	401.1
Upper	60.8	86.4	123.7	154.6	198.8	235.1	276.1	319.5	381.9	433

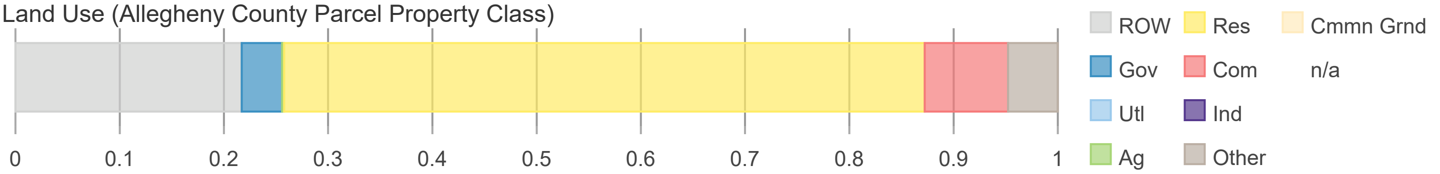
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

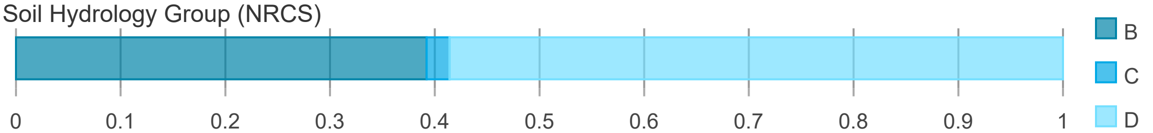
Landcover (2010 Urban Tree Canopy)



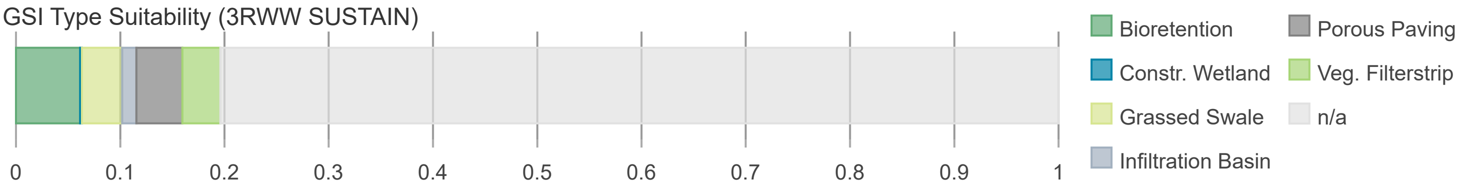
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



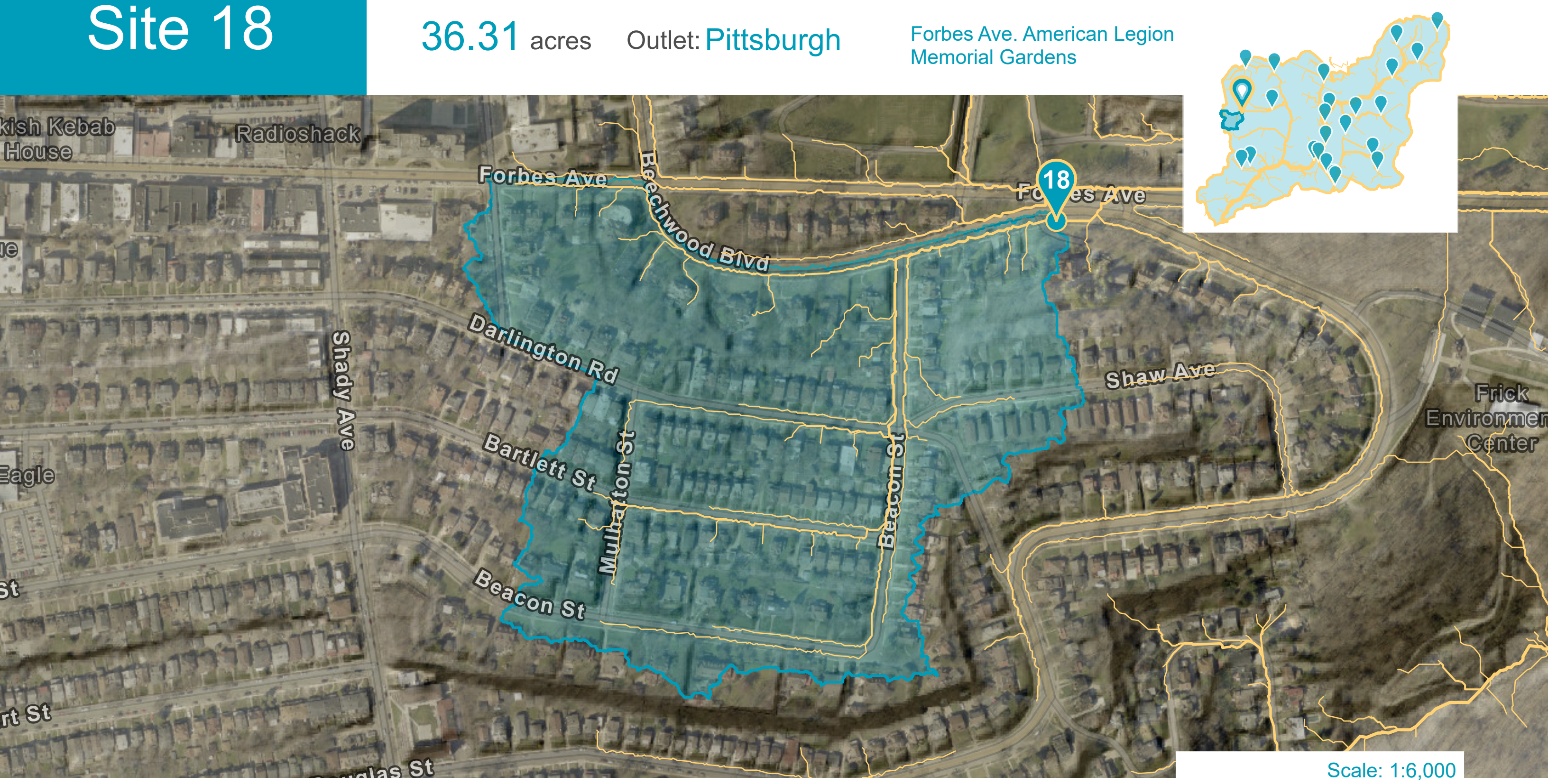
GSI Type Suitability (3RWW SUSTAIN)



Site 18

36.31 acres Outlet: Pittsburgh

Forbes Ave. American Legion Memorial Gardens



Scale: 1:6,000

Max. Flow Length 2,838 feet

Time of Concentration 0.12 hours

Average Slope 15.4 %

Average Curve Number 71.67

Estimated Peak Flows

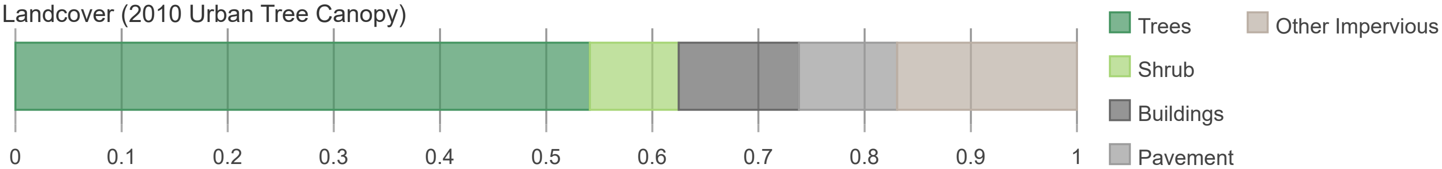
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	8.2	16.9	31.8	46	66.8	84.6	103.3	123.1	150.6	172.6
Normal	10.8	21	38	53.7	77.1	96.7	118.1	140.2	172.2	198.2
Upper	14.5	26.3	45.5	62.6	87.8	108.6	131	154.4	188	215.2

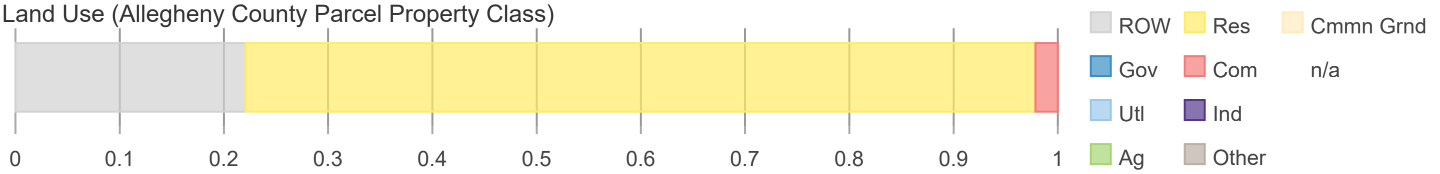
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

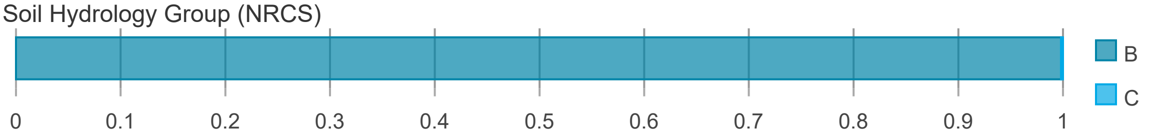
Landcover (2010 Urban Tree Canopy)



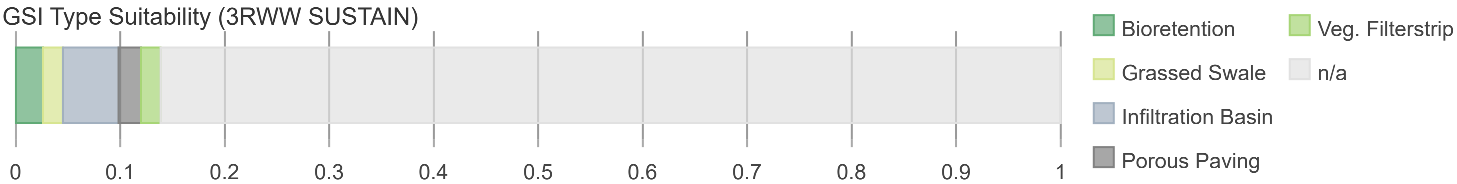
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



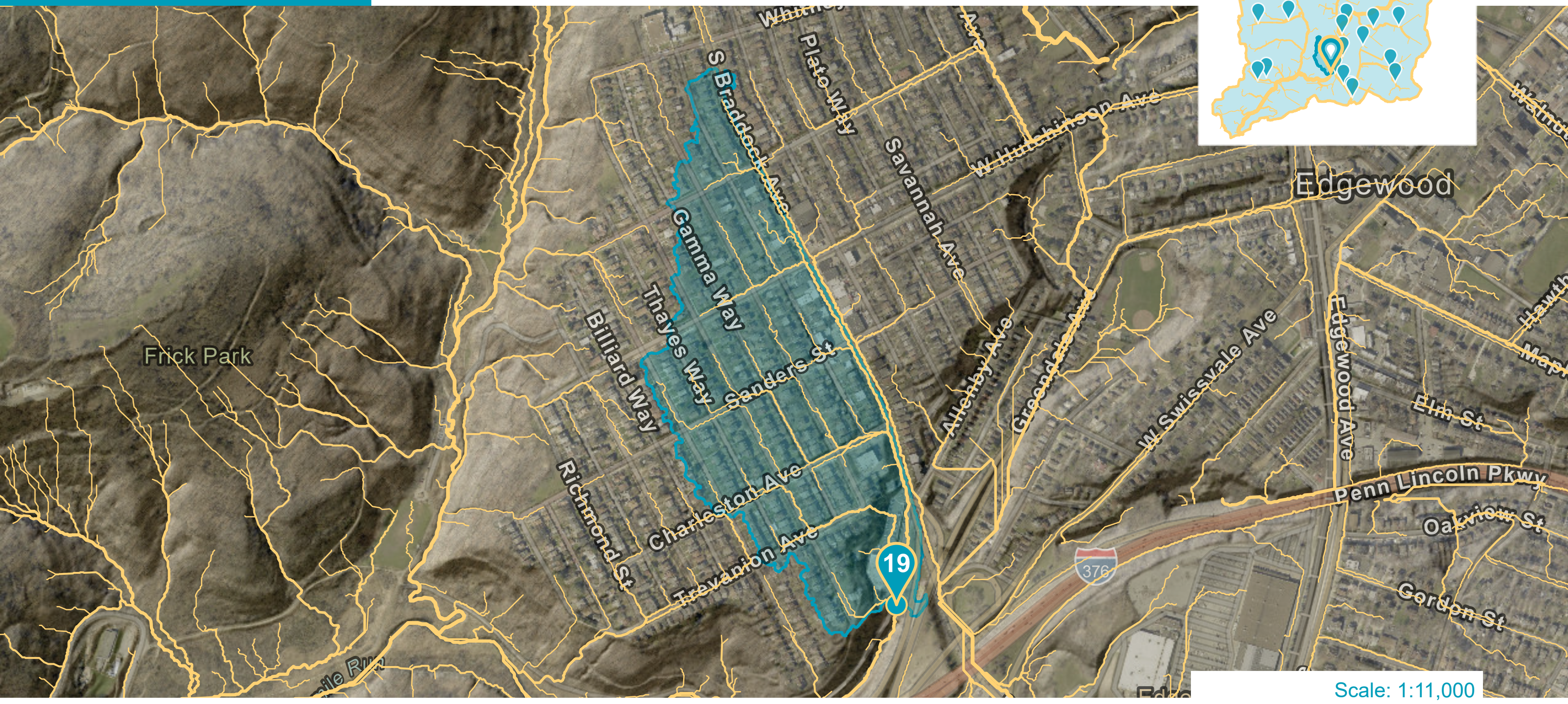
GSI Type Suitability (3RWW SUSTAIN)



Site 19

44.34 acres Outlet: Swissvale

ROW adjacent to CLASS building



Max. Flow Length	3,425 feet	Average Slope	10.7 %
Time of Concentration	0.16 hours	Average Curve Number	84.33

Estimated Peak Flows

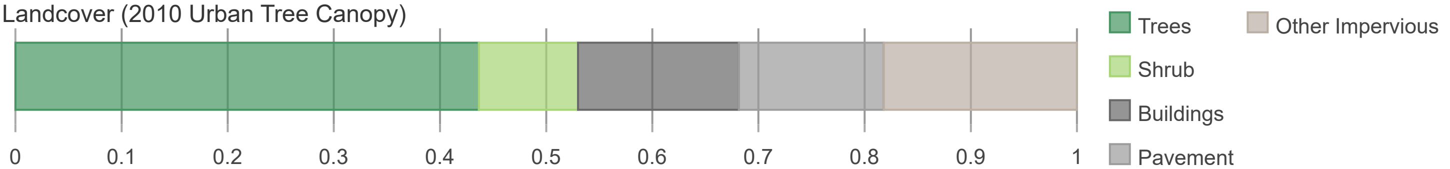
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	40.2	56.4	78.8	97.9	124.4	147.6	172.2	198.3	234.5	263.5
Normal	45.5	62.9	87.4	107.9	137.7	163.5	191.6	220.8	263.1	297.4
Upper	52.3	70.8	97.3	119	151.8	179.2	208.6	239.6	283.9	320

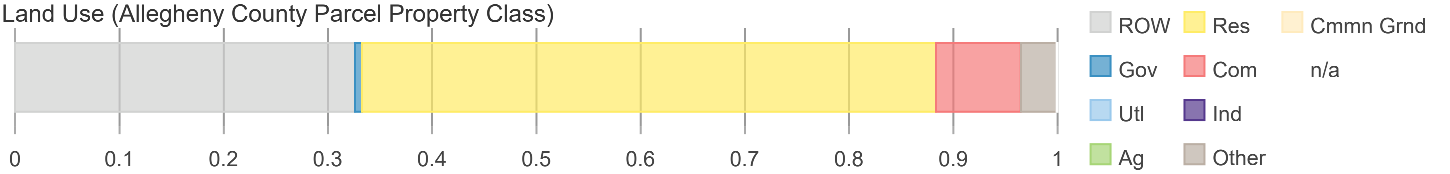
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

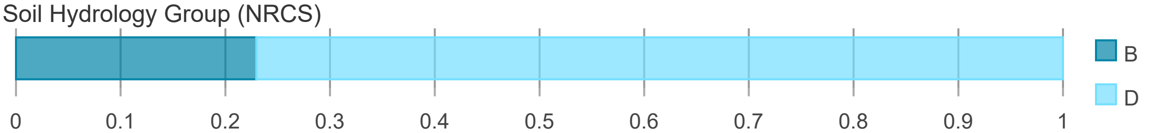
Landcover (2010 Urban Tree Canopy)



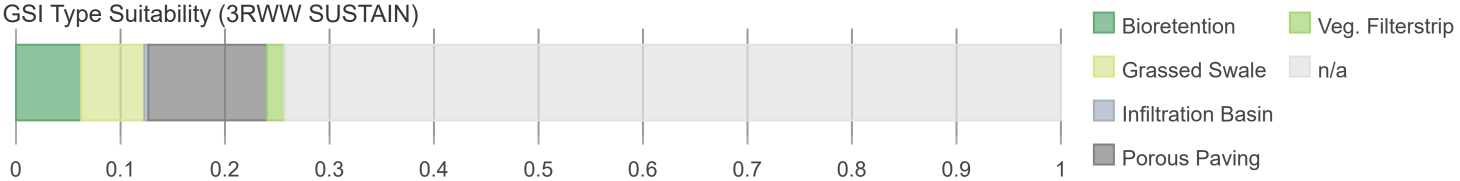
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)

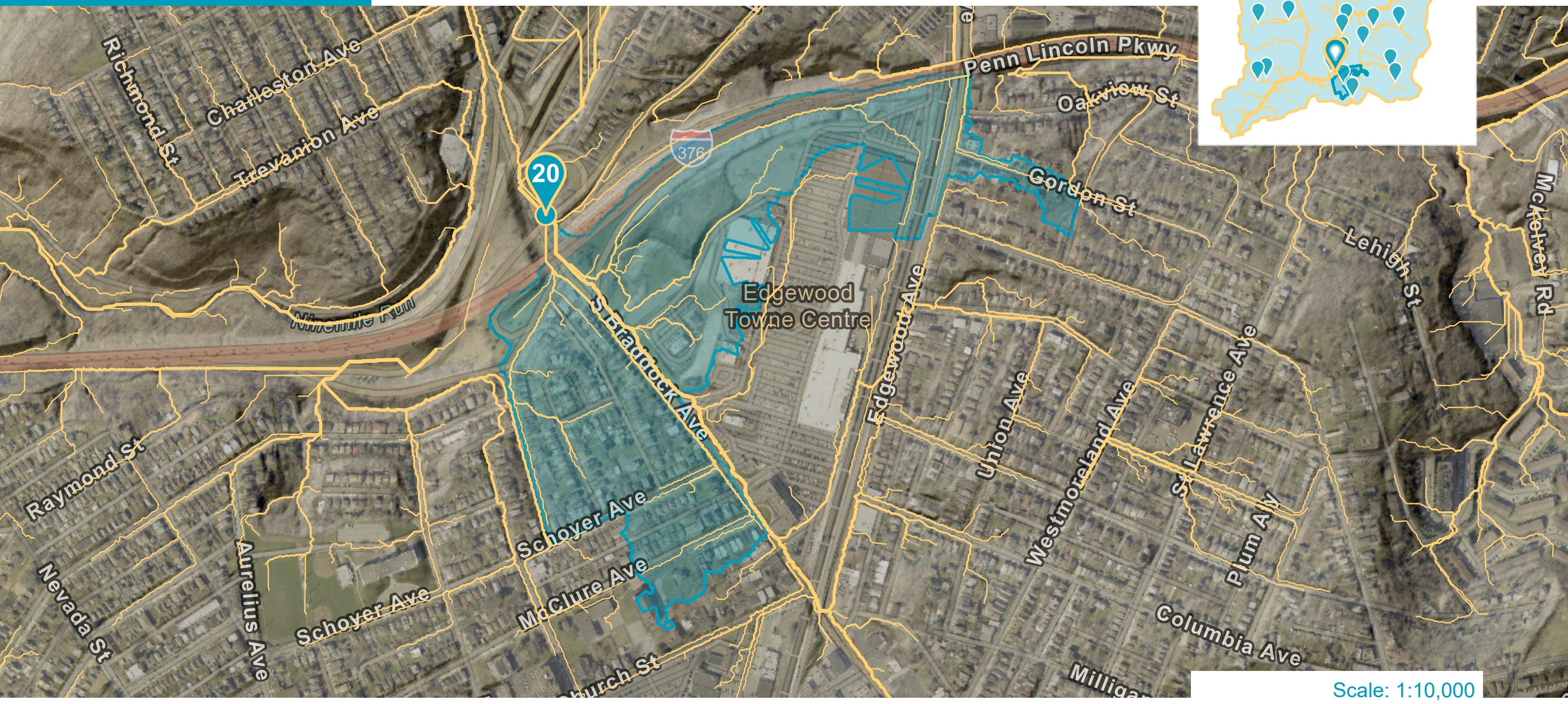


GSI Type Suitability (3RWW SUSTAIN)



Site 20

49.6 acres Outlet: Edgewood ROW adjacent to 376 eastbound overpass



Max. Flow Length **3,864** feet

Time of Concentration **0.16** hours

Average Slope **13.2** %

Average Curve Number **87.3**

Estimated Peak Flows

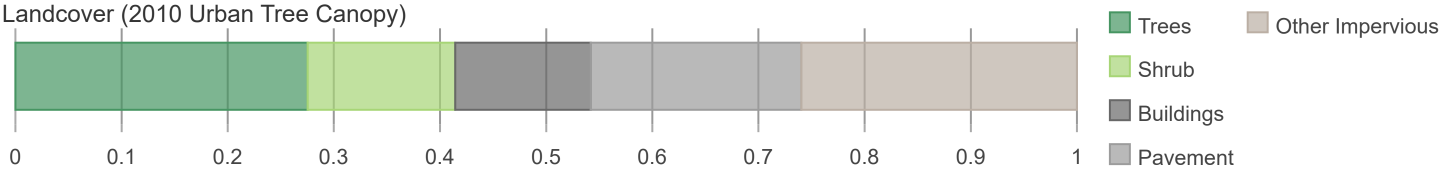
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	55.4	74.2	99.8	122.2	155	182.2	210.6	240.6	282	315
Normal	61.6	81.7	109.5	134.5	170.7	200.6	232.9	266.3	314.5	353.5
Upper	69.4	90.7	121.5	148.3	187.1	218.7	252.4	287.7	338.2	379.1

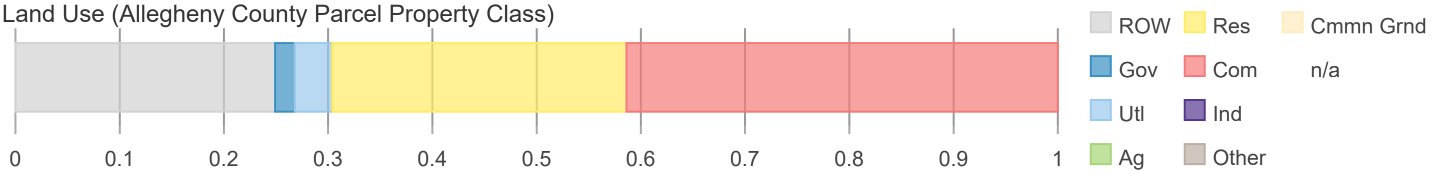
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

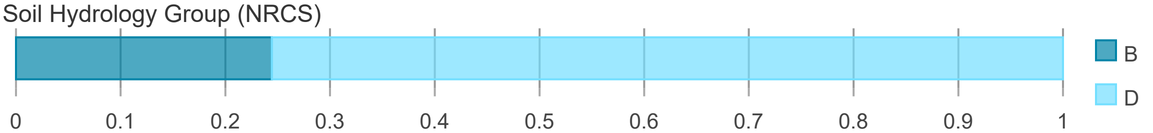
Landcover (2010 Urban Tree Canopy)



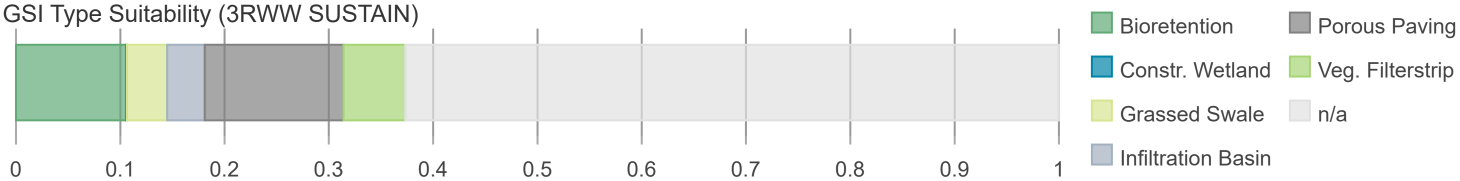
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



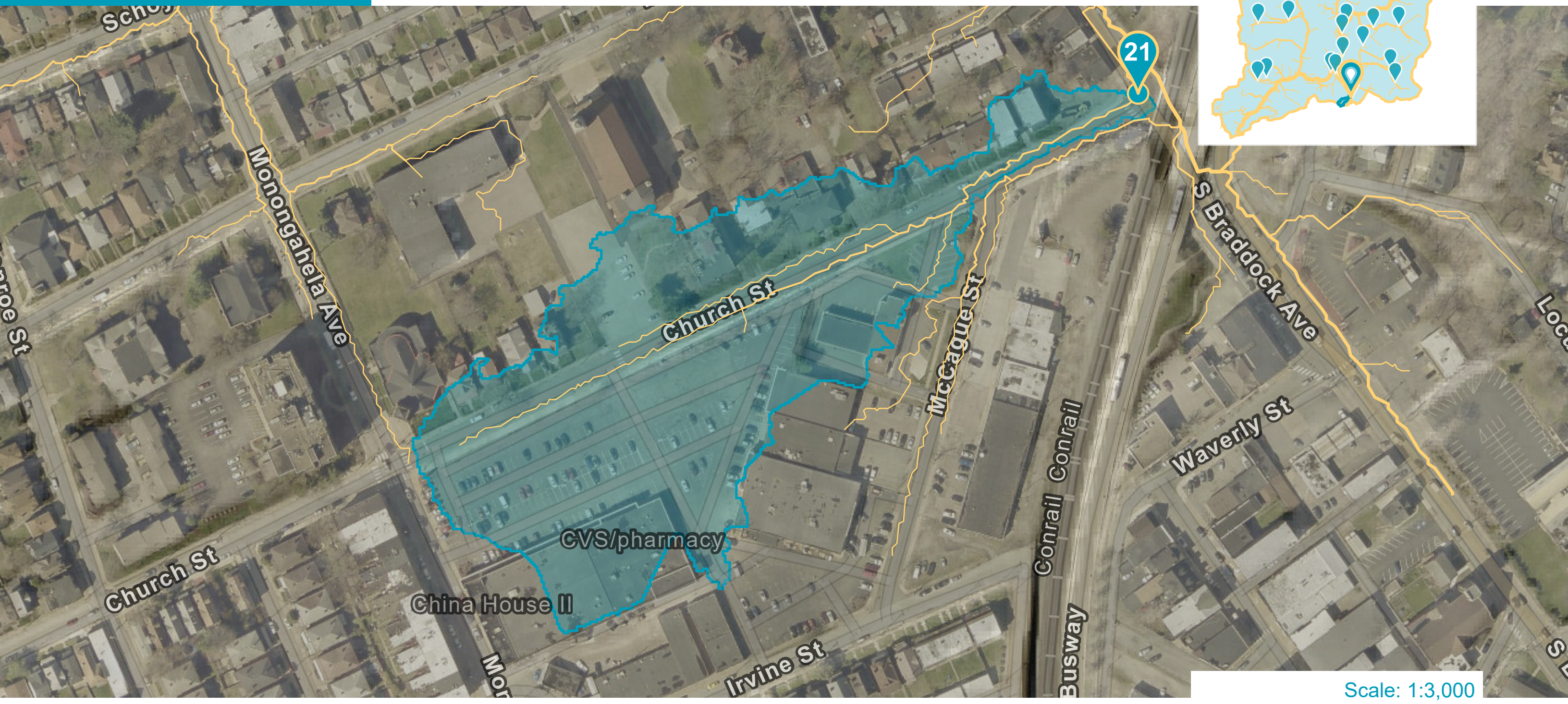
GSI Type Suitability (3RWW SUSTAIN)



Site 21

5.87 acres Outlet: Swissvale

NW corner of Church St. and Braddock Ave.



Max. Flow Length	1,585 feet	Average Slope	5.8 %
Time of Concentration	0.11 hours	Average Curve Number	94.04

Estimated Peak Flows

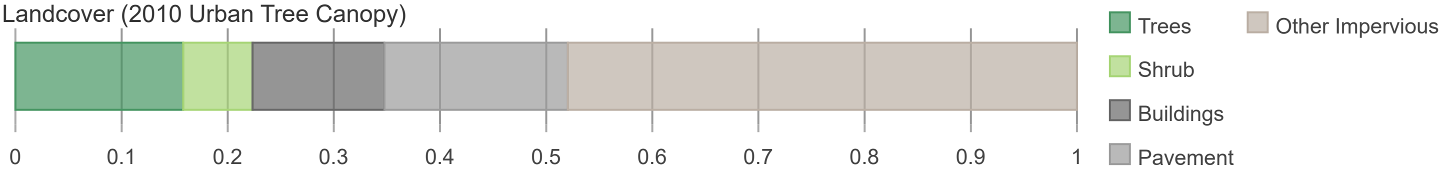
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	11.2	14.1	18.2	21.6	26.4	30.2	34.3	38.4	44.2	48.7
Normal	12.1	15.3	19.7	23.4	28.6	32.8	37.4	42	48.7	54
Upper	13.4	16.7	21.5	25.4	30.9	35.4	40.1	45	51.9	57.5

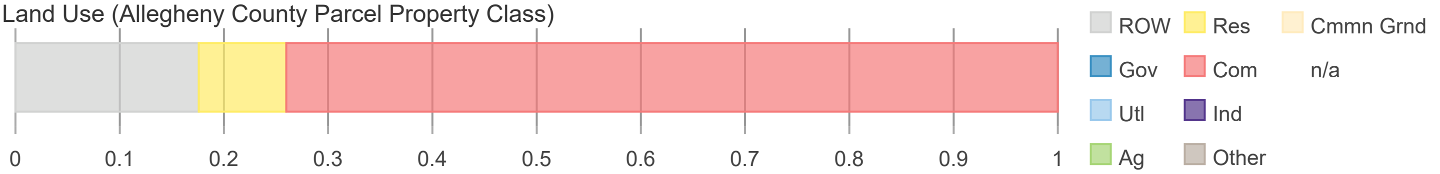
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

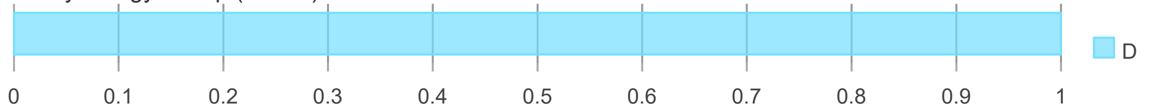
Landcover (2010 Urban Tree Canopy)



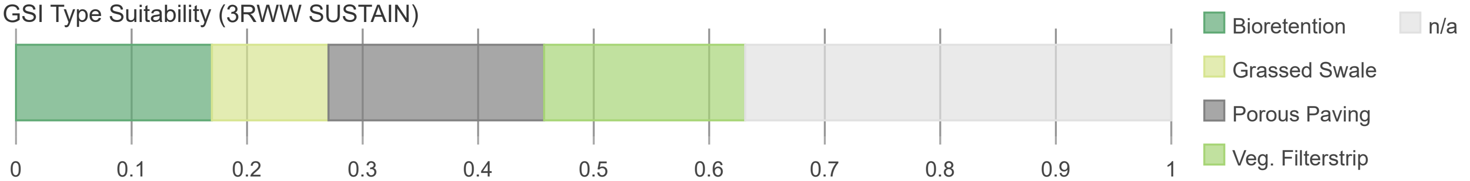
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



GSI Type Suitability (3RWW SUSTAIN)



Site 22

12.98 acres Outlet: Edgewood

South end of Koenig Field (Edgewood Boro)

Max. Flow Length 1,491 feet

Time of Concentration 0.07 hours

Average Slope 18.7 %

Average Curve Number 68.71

Estimated Peak Flows

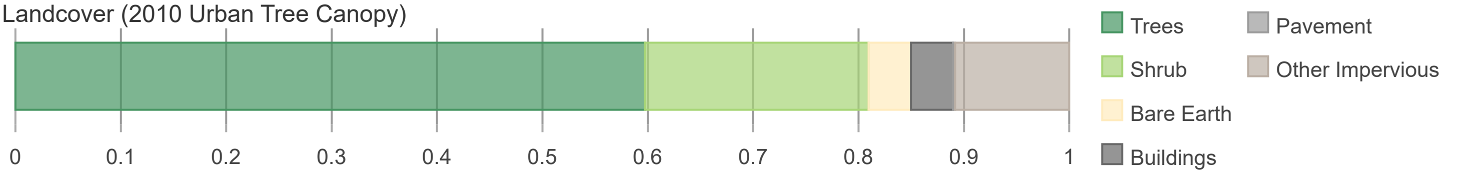
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	2.2	5.2	10.8	16.4	24.8	31.9	39.5	47.6	58.7	67.6
Normal	3	6.7	13.2	19.5	28.9	36.9	45.5	54.5	67.5	78
Upper	4.3	8.7	16.2	23	33.2	41.7	50.8	60.3	73.8	84.8

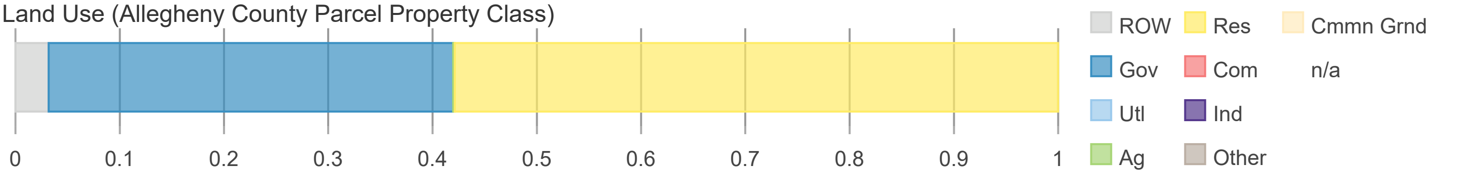
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

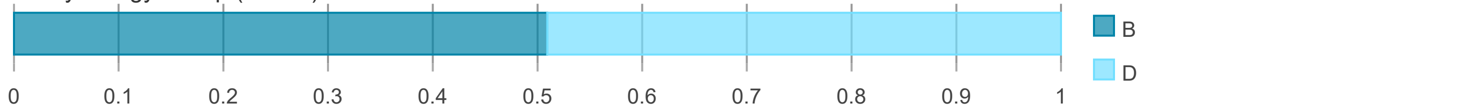
Landcover (2010 Urban Tree Canopy)



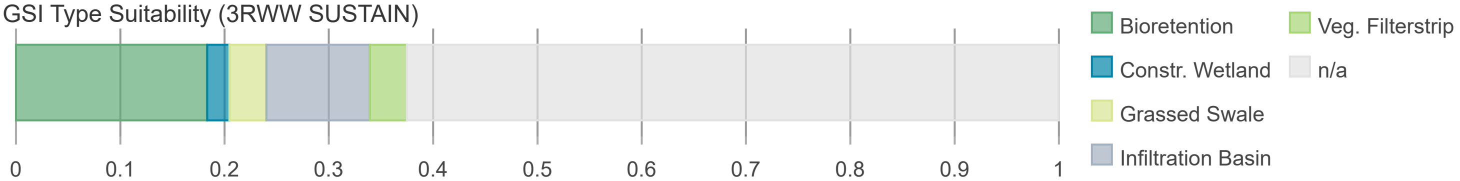
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



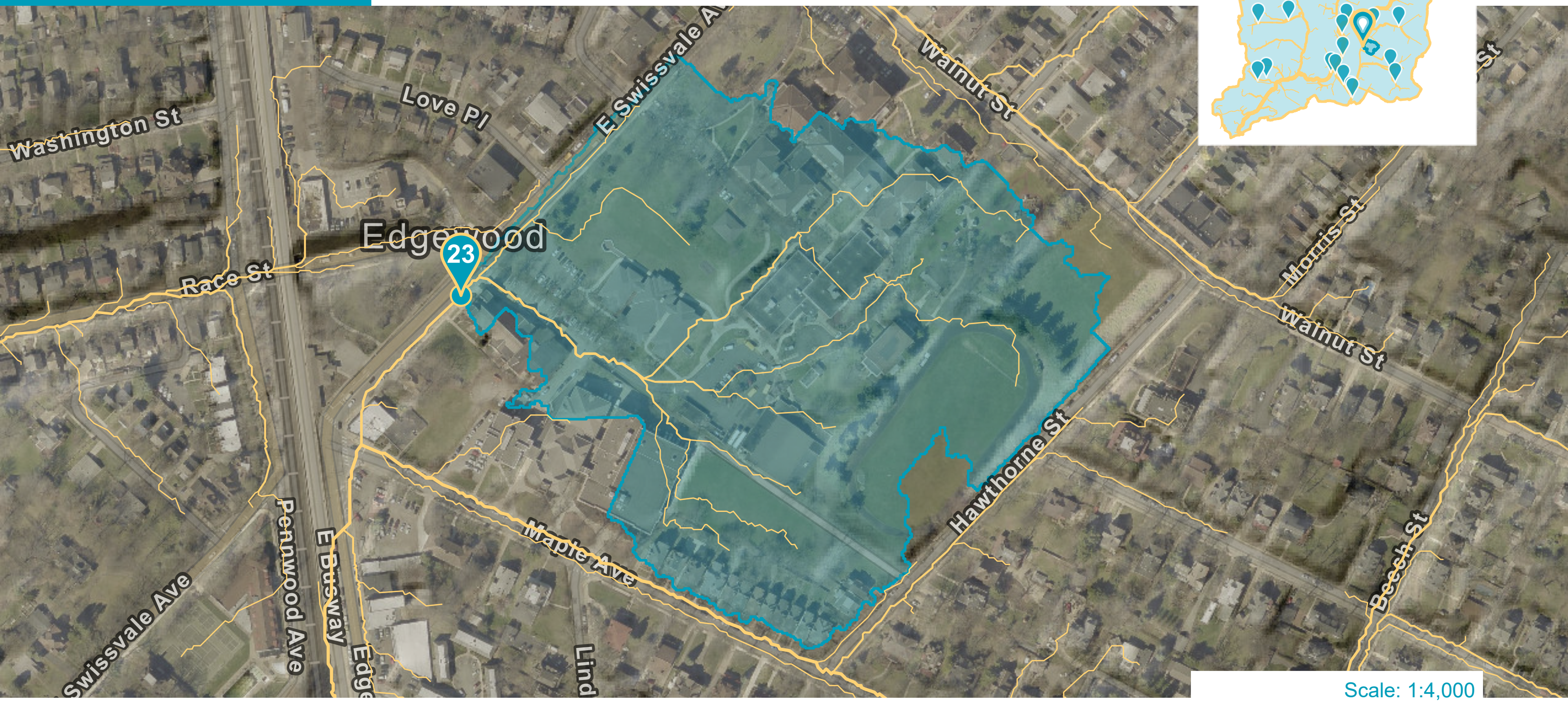
GSI Type Suitability (3RWW SUSTAIN)



Site 23

16.26 acres Outlet: Edgewood

Western PA School for the Deaf



Max. Flow Length	1,802 feet	Average Slope	10.2 %
Time of Concentration	0.1 hours	Average Curve Number	86.1

Estimated Peak Flows

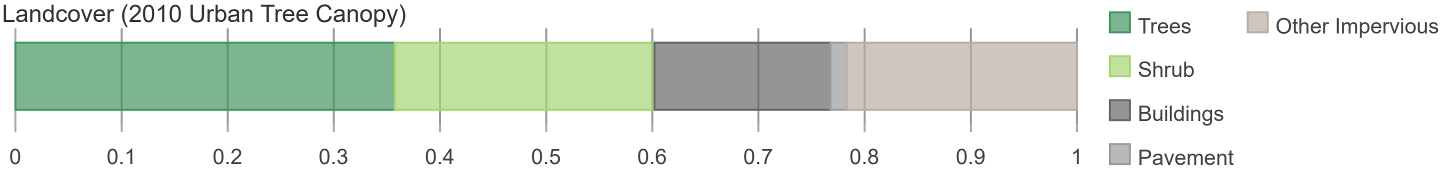
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	20	27	36.6	44.6	56.7	67	77.7	89	104.7	117.3
Normal	22.3	29.8	40.2	49	62.6	73.9	86.1	98.8	117.1	131.9
Upper	25.2	33.2	44.4	54.2	68.8	80.7	93.5	106.9	126	141.6

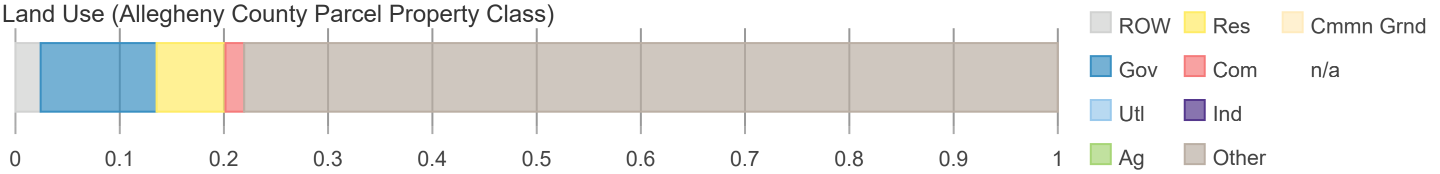
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

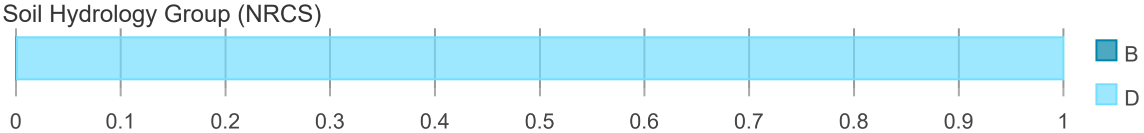
Landcover (2010 Urban Tree Canopy)



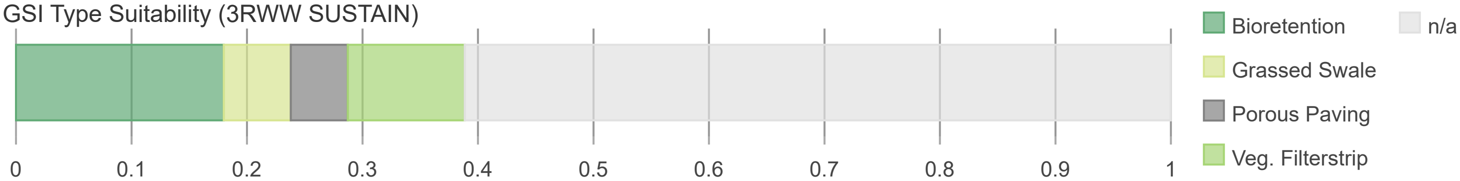
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



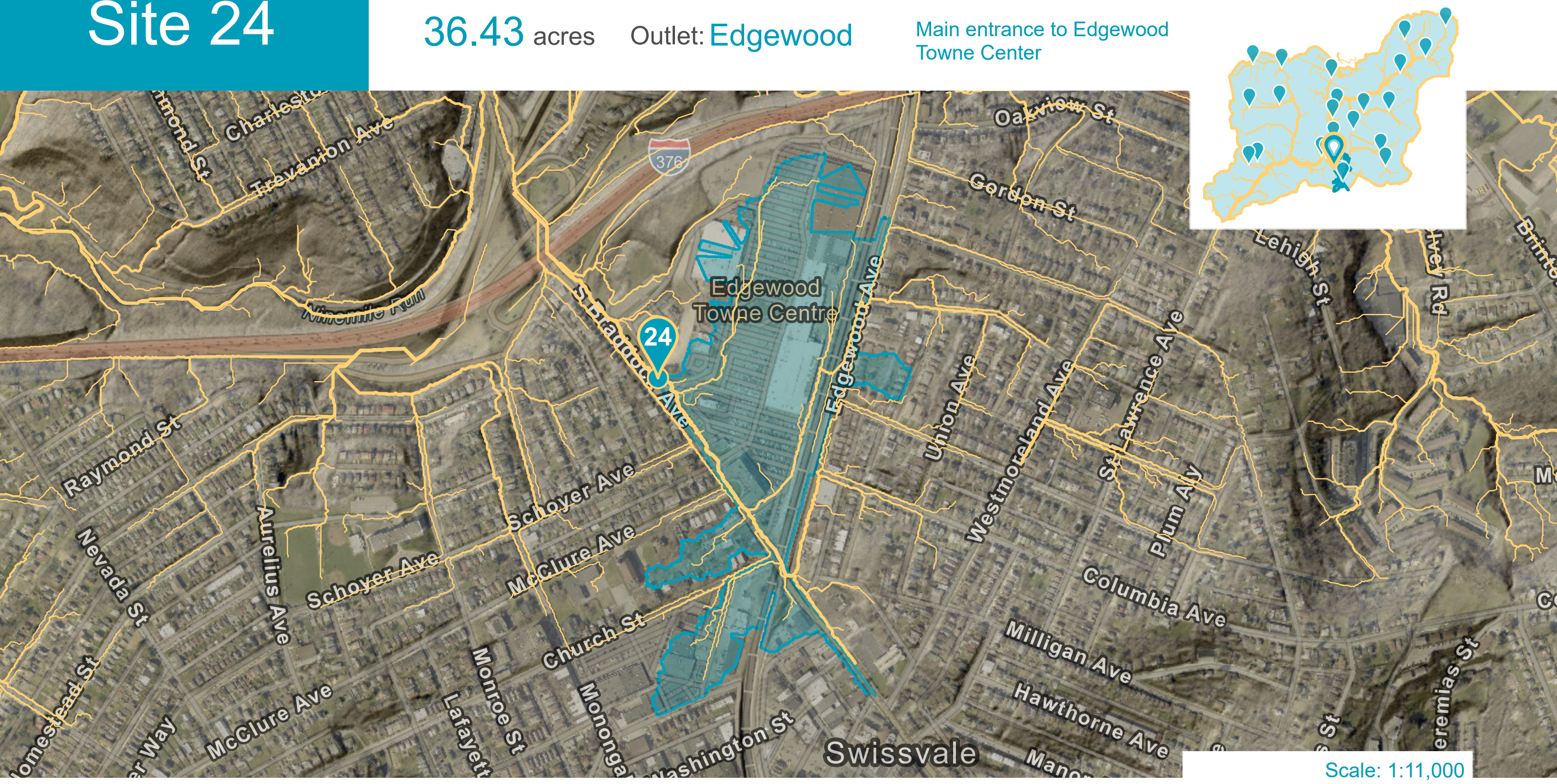
GSI Type Suitability (3RWW SUSTAIN)



Site 24

36.43 acres Outlet: Edgewood

Main entrance to Edgewood Towne Center



Max. Flow Length 2,974 feet

Time of Concentration 0.17 hours

Average Slope 7 %

Average Curve Number 95.42

Estimated Peak Flows

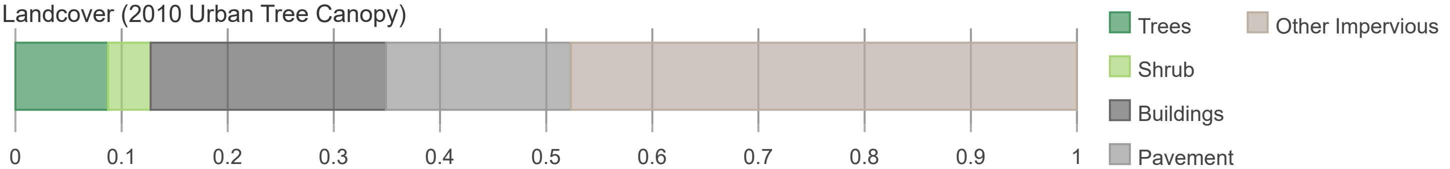
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	66.1	82.6	105	123.9	149.9	171.2	193.1	215.9	247.3	272.1
Normal	71.5	89.2	113.5	133.7	162.2	185.4	210.1	235.4	271.7	300.8
Upper	78.4	97.1	123.3	144.7	174.9	199.2	224.9	251.6	289.4	319.9

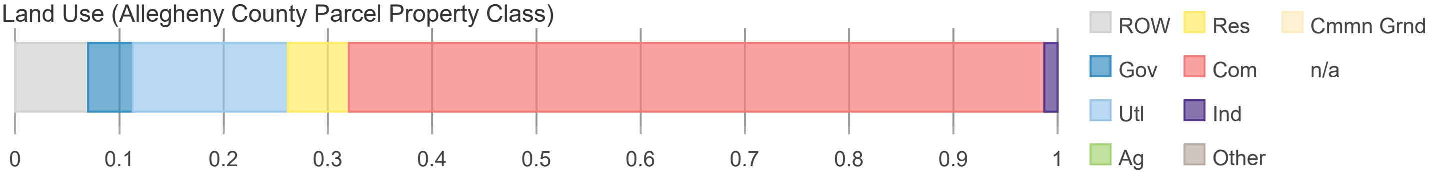
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

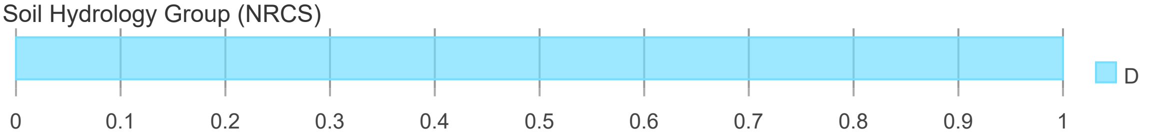
Landcover (2010 Urban Tree Canopy)



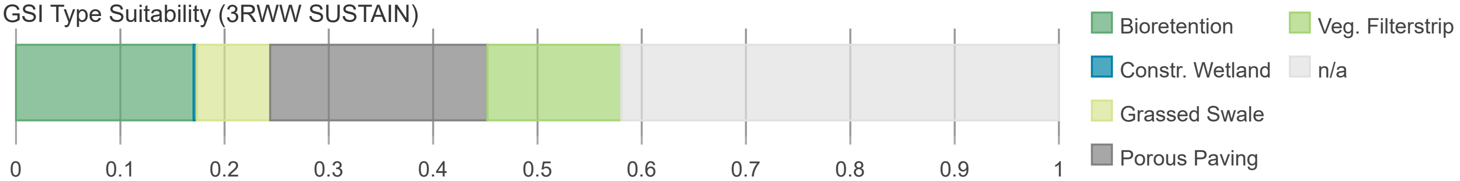
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



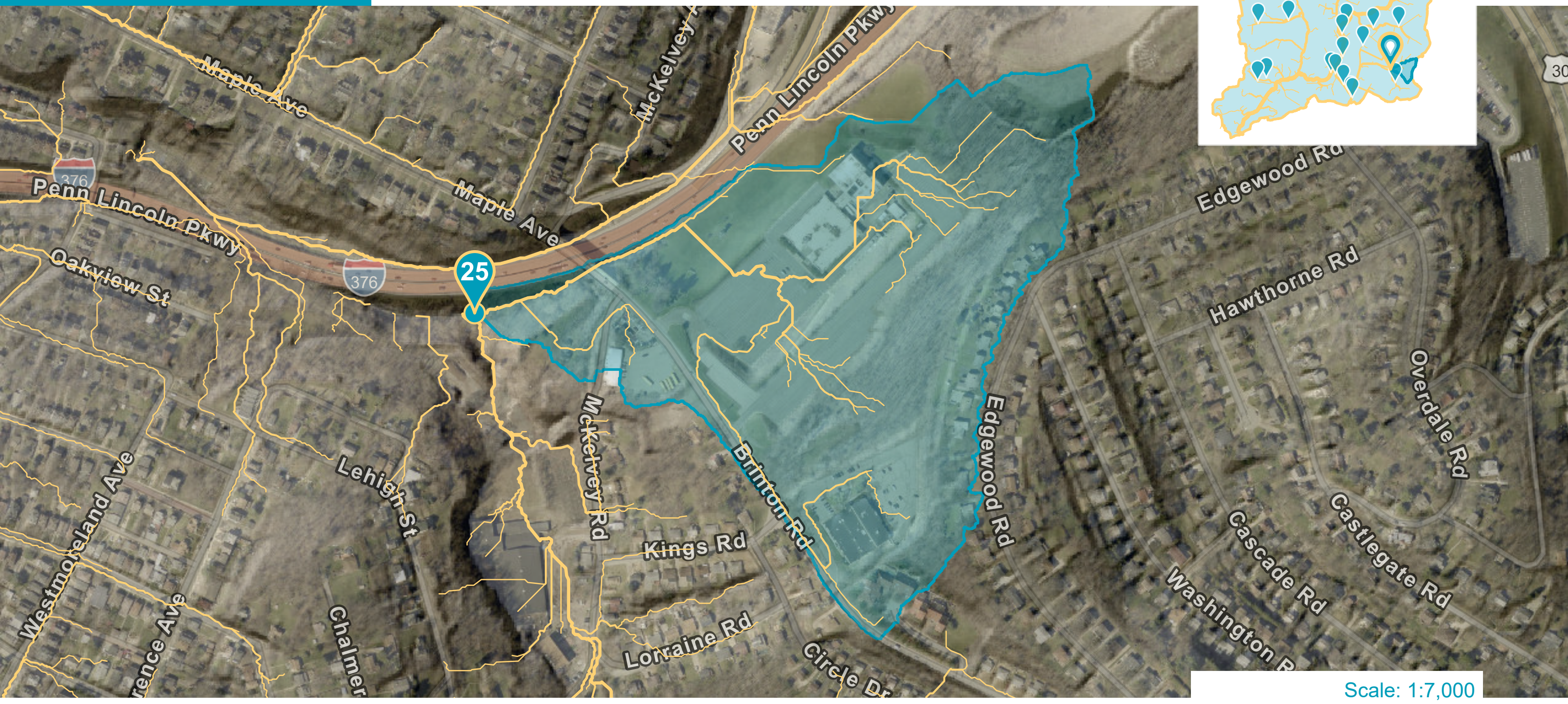
GSI Type Suitability (3RWW SUSTAIN)



Site 25

36.83 acres Outlet: Edgewood

Edgewood Boro maintenance area near Dickson Park



Max. Flow Length 3,791 feet

Time of Concentration 0.13 hours

Average Slope 21.4 %

Average Curve Number 79.38

Estimated Peak Flows

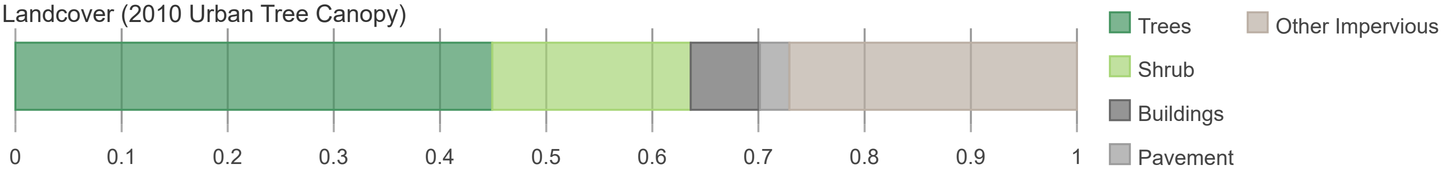
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	23.1	35.9	54.4	70.5	93.1	111.8	131.1	151.5	181.3	205.8
Normal	27.2	41.3	61.6	79	103.9	124.4	146.3	169.8	205.5	234.7
Upper	32.6	47.8	70	88.6	115.1	136.6	159.6	185.6	223.1	253.9

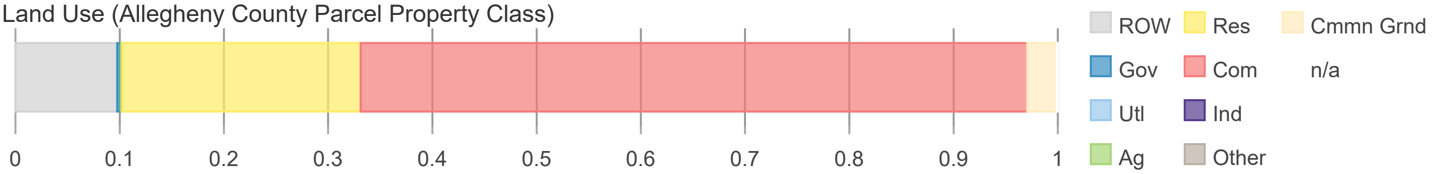
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

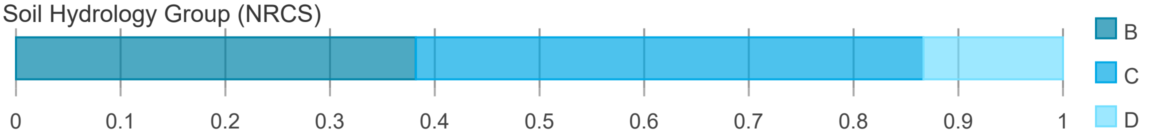
Landcover (2010 Urban Tree Canopy)



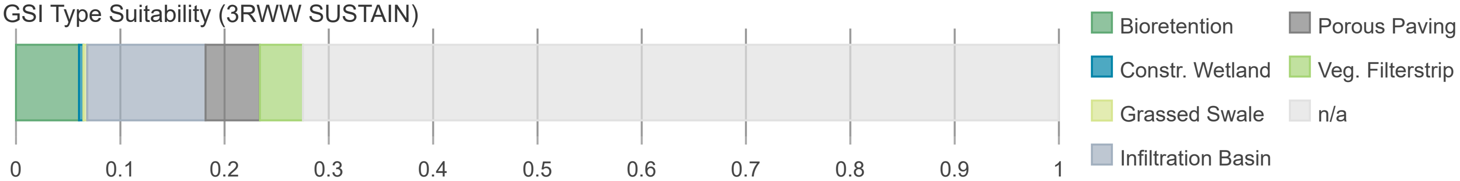
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



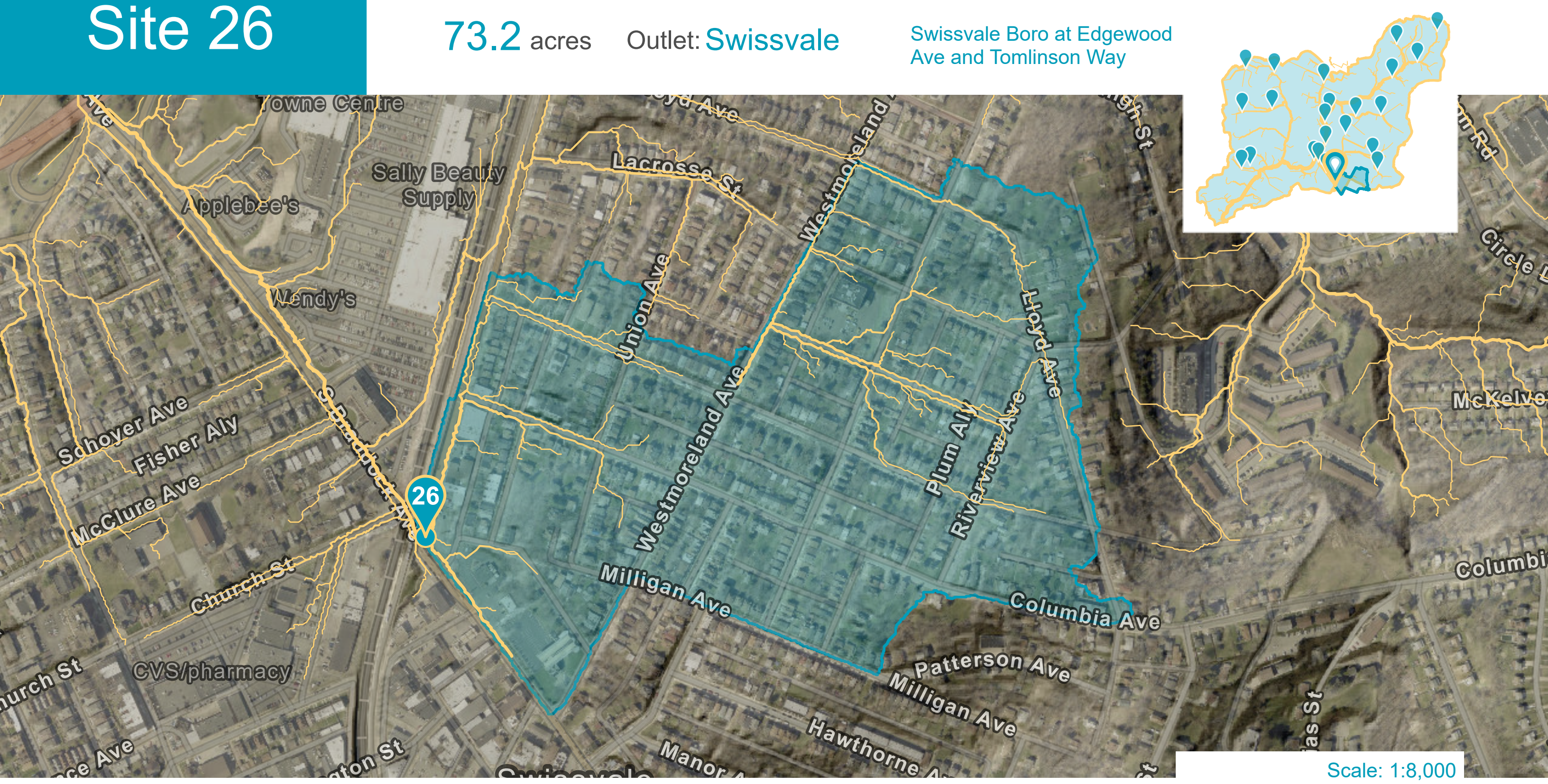
GSI Type Suitability (3RWW SUSTAIN)



Site 26

73.2 acres Outlet: Swissvale

Swissvale Boro at Edgewood Ave and Tomlinson Way



Max. Flow Length 5,168 feet

Time of Concentration 0.19 hours

Average Slope 17 %

Average Curve Number 80.64

Estimated Peak Flows

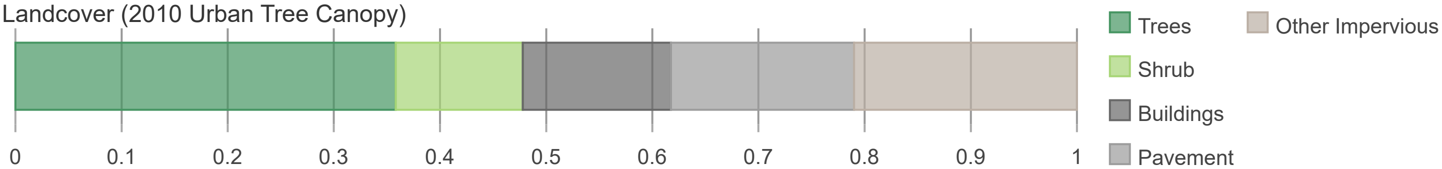
(cubic feet/second, for a 24-hour event duration, for NOAA lower, normal, and upper scenarios)

scenario	Y1	Y2	Y5	Y10	Y25	Y50	Y100	Y200	Y500	Y1000
Lower	45.2	68.5	101.9	131	171.8	205.6	240.5	278.5	333.2	377.3
Normal	52.7	78.2	115	146.3	191.3	228.2	268.5	312.4	376.6	429
Upper	62.4	90	130.1	163.6	211.5	250.4	294.1	340.9	408.3	463.5

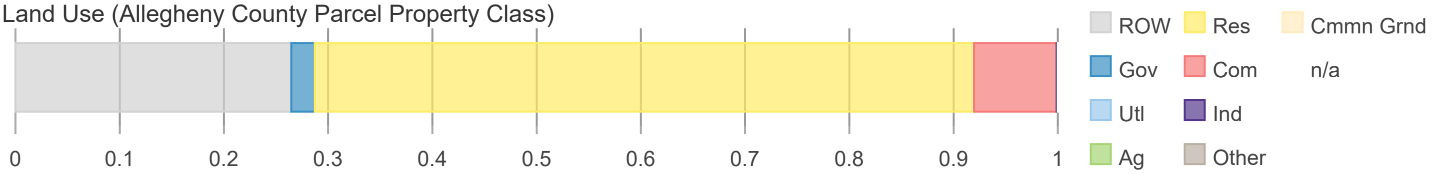
Catchment Summaries

Key geographic characteristics of this catchment, presented as a percent of catchment area

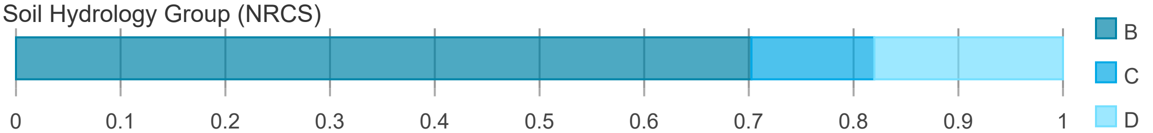
Landcover (2010 Urban Tree Canopy)



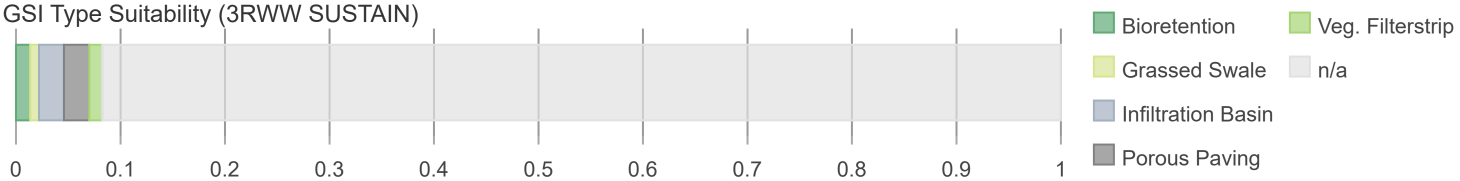
Land Use (Allegheny County Parcel Property Class)



Soil Hydrology Group (NRCS)



GSI Type Suitability (3RWW SUSTAIN)



4. RECOMMENDATIONS

4.1. ITERATIVE SITE SELECTION AND PRIORITIZATION

This report provides a large sample of well-supported locations for GSI, and a methodology (supported by a toolset delivered separately) for evaluating new sites. These provide the basis for further iteration on site selection using the data collected and developed for this project.

The catchment characterizations provided with each site, for example, provide additional indicators of where GSI is suitable. This directly supports the iterative narrowing down of sites to locations where feasibility is a factor not just of environmental characteristics, but political and social factors as well.

Additionally, the site reports here provide direct inputs to the EPA's National Stormwater Calculator, which can further help with site prioritization.

This iteration could possibly be enhanced with additional investment in data and tools as described in section 4.2.

4.2. FUTURE INVESTMENTS IN DATA AND TOOLS

4.2.1 DETAILED SOILS DATA

The USDA NRCS Soil Survey Geographic Database (SSURGO) is the most detailed county-level map publicly available of the watershed and is an important piece for evaluating GSI efficacy. It represents the best possible source of soil data available for this project. However, the detail and quality of the SSURGO data is widely variable: when the maps were created from soil samples, information was collected at scales varying from 1:12,000 to 1:63,360.

A future opportunity exists to compile soil data from soil boring and testing within the NMRW. While outside the scope of Phase 1, we recommend that soil boring data from engineering and construction projects in the NMRW be considered as a source for creating a more detailed and accurate soil map. These samples may provide additional resolution needed to improve the accuracy the current SSURGO thematic map with the NMRW.

4.2.2 LOCAL HISTORIC RAINFALL DATA

The rainfall quantities used to estimate peak flows in part 3, which are from NOAA NWS Hydrological Design Studies Center's Precipitation Frequency Data Server, are fairly coarse in geographic scope. 3 Rivers Wet Weather maintains a database of rain gauge and calibrated radar rainfall (virtual rain gauge) measurements data back to the year 2000. Approximately 12 of these virtual gauges provide coverage for the NMRW; their historic data, combined with 3RWW's storm event reports (prepared by Vieux Associates) could be used to generate depth duration and frequency estimates specifically for the NMRW.

4.2.3 HIGH-DEFINITION SURFACE MAPPING

There is an immediate opportunity to use high definition mapping ("HD mapping") data from autonomous vehicle systems to characterize right of way geometries such as:

- surface materials (i.e., brick, pavement, Belgian block)
- curb locations and heights
- road crowns
- catch basin/inlet locations and types
- sidewalk width and slopes
- edge of pavement
- building locations
- trees
- utilities

Detailed geometries for these types of features can support more detailed hydrological modeling. For example, having the location of curb cuts and the height of curbs above catch basins can potentially reveal patterns in flow for individual catch basins that are not otherwise evident when using existing sources.

4.2.4 CATCH BASIN EFFICACY ANALYSIS

Another HD mapping-related opportunity for future improvement is to incorporate catch basin efficacy into the peak flow model. With measurements of catch basin geometry, stormwater infrastructure capacity could be better modeled. This could involve work with HD mapping partners to acquire effective catch basin opening dimensions from repeated image capture of curbs.

4.2.5 LAND COVER UPDATE

Ideally, an up-to-date Allegheny County Land Cover dataset would be available to accurately classify land cover classes within the watershed. While we determined that the existing 2010 data set was sufficiently accurate for use in this project when compared to 2017 imagery, changes to land cover since 2017 have not yet been quantified.

4.2.6 DETAILED MODELING (E.G. SWMM, ARCHYDRO)

Even though CivicMapper did not implement a SWMM model in this phase of the project, the methodology, data sets, and calculations developed in this effort can readily serve as a basis for future SWMM modeling in future phases and are part of the deliverables for Phase 1 of this project.