

C-3. GSI Constraints Analysis Technical Memorandum

ALCOSAN Basin Facilities Planning Constraints Analysis Approach and Pilot Application in the Chartiers Creek Basin with Results for the Full Study Area

PREPARED FOR: ALCOSAN
COPY TO: Wade Trim
PREPARED BY: CH2M Hill Engineers, Inc. (now Jacobs)
DATE: April 26, 2018 (Chartiers Creek Pilot), July 2018 (Full Service Area)
PROJECT NUMBER: 698129.03.02.02

Contents

ALCOSAN Basin Facilities Planning Constraints Analysis Approach and Pilot Application in the Chartiers Creek Basin with Results for the Full Study Area.....	1
1.0 Introduction and Overview.....	1
2.0 Constraints Analysis Approach.....	2
2.1 Objective of Constraints Analysis.....	2
2.2 Geographic Scale of Evaluation.....	2
2.3 Methodology for Constraints Analysis.....	2
3.0 Summary.....	10

1.0 Introduction and Overview

ALCOSAN seeks to maximize the impact of green stormwater infrastructure (GSI) and source control (SC) measures to reduce the volume of overflows to receiving systems. CH2M has developed an approach for a GIS-based constraint scoring analysis which can provide ALCOSAN with a better understanding of the types and distribution of physical constraints, to be used in conjunction with results from the Opportunity Analysis and the Overflow Reduction Efficiency (ORE) modeling analysis to site GSI in areas that can provide the highest likelihood of success. This technical memorandum (TM) summarizes the Constraints Analysis and how it was applied in combined sewer areas of the Chartiers Creek Basin. Results from this analysis will provide ALCOSAN, municipalities, and GSI planners a geospatially informed estimate of areas where GSI potential may be limited and/or GSI costlier based on the likelihood of physical and environmental constraints. A scoring system was developed to weight each constraint, and an overlay process was performed to create the resultant datasets. In a parallel effort for the Regional Stormwater Plan, results from the GIS-based Opportunity Analysis can provide an additional overlay by which GSI projects can be located in minimally constrained/high opportunity areas to achieve the

maximum GSI benefit. The constraints analysis approach and results for the Chartiers Creek Basin are described in this TM. Results for the other basins and the full service area are included as appendices.

2.0 Constraints Analysis Approach

2.1 Objective of Constraints Analysis

The objective of the constraints analysis is to estimate the amount, spatial distribution, and magnitude of physical and environmental constraints, using a scoring system that scores each constraint feature (or layer) on a scale that is related to the suitability for GSI implementation. Through an overlay process, the data layers are combined and the constraint scores are summed. Areas with a high constraint score are considered to be less suitable for GSI development and low scoring areas (low constraints) are considered to be more suitable for GSI development. Some constraints are considered “absolute constraints” (described in section 2.3), representing conditions that typically preclude GSI development altogether. Other constraints, defined as “relative constraints” (also described in section 2.3), do not necessarily preclude GSI implementation but may impact the effectiveness, cost, and/or limit the types of GSI possible.

2.2 Geographic Scale of Evaluation

The Constraints Analysis was piloted for the Chartiers Creek Basin using data provided by Allegheny County GIS Department, ALCOSAN, and the Preliminary Planner. The area of focus (study area) within the Chartiers Creek Basin consists of the combined and draining to combined sewershed areas as classified in the GIS provided by ALCOSAN.

2.3 Methodology for Constraints Analysis

The Constraints Analysis was performed with ESRI ArcGIS 10.5.1 using out of the box desktop tools. Appendix A includes a detailed listing of the data used in the analysis, including the original file name, original data source provider, and data year. Constraints were organized according to whether they were an absolute constraint or a relative constraint and relative constraints were scored based on an overall scale of 0 to 5, with a higher number indicating a higher relative level of constraint.

Absolute constraints (Table 1) are defined as characteristics that would typically preclude GSI implementation; these features were not scored since they are considered an absolute constraint for this planning analysis. Relative constraints (Table 2) are defined as characteristics that do not necessarily preclude GSI but may impact it. Relative constraints were scored according to the relative degree of constraint for that feature based on discussions with ALCOSAN as well as professional experience and judgement. Relative constraints are made up of discrete features (data at a fixed location, e.g., streams) as well as continuous data features (data with transition from one value to another, e.g., slopes) that include a range of constraint scores. For this analysis, when an absolute constraint overlaps a relative constraint, the absolute constraint governs.

Building footprints with a 10-foot buffer were originally included as a relative constraint due to the limited options and associated costs for GSI in or on buildings but after further discussion they were removed from the relative constraint scoring and are instead treated as an overlay.

Table 1. Absolute Constraint Data Used for the Chartiers Creek Constraints Analysis

Absolute Constraints	Buffer Included	Notes
Wetlands	10 feet	Regulatory protection*
Streams	20 feet from line feature	Regulatory protection*
Floodway	None	Regulatory protection and preservation of GSI*
Very Shallow Bedrock (less than 1.1 feet)	None	Feasibility, difficulty of construction, performance*
Railroads	15 feet from line feature	No GSI on active railroads
Surface water (from Soil and Land Use)	None	Feasibility and possible regulatory protection
Very steep slopes (greater than 25%)	None	Construction difficult / regulatory protection*
Superfund or fuel/storage tank locations	None	Environmental issues / hotspots*

* The PA Stormwater BMP Manual includes infiltration guidelines related to wetlands and streams buffers, bedrock separation, steep slopes, and hotspots.

Table 2. Relative Constraint Data and Scoring Used for the Chartiers Creek Constraints Analysis

Relative Constraints	Constraint Score	Notes / Description of Constraint
Utilities (i.e., sewers) including 3-foot buffer	3.5	May limit infiltration and/or increase cost
Slopes (Moderate to Steep)	1 to 5	Lower efficiency and possible regulatory protection at higher slopes*
Hydrologic soil group (B/D, C, D, Urban)	0.5 to 2	May limit infiltration and/or reduce performance*
Shallow depth to bedrock/water table	0.5 to 5	May limit infiltration and/or increase cost*
FEMA 100-year floodplains	2.5	May reduce performance and/or increase cost*
Forest Cover	2.5	Preservation of forest encouraged; tree removal/replacement costs*
Brownfields / abandoned mines	3	Potential environmental/stability issues*
Streets	1.5	May have limited space, utility conflicts and/or increased costs
Cemeteries	3	Limited space/opportunity

* The PA Stormwater BMP Manual includes infiltration guidelines related to bedrock/water table separation, HSG D soils, compacted fill, limiting excavation, steep slopes, floodplains, hotspots, and preservation of forest

2.3.1 Data Development

A number of data development activities needed to occur prior to undertaking the analysis. In general, constraints were clipped to the study area and a buffer was applied (if needed) to create the constraint input feature used in the analysis. Some constraints required additional attribute editing, such as assigning or joining data from related or separate source data tables (e.g., hydrologic soils, shallow depth to bedrock, and shallow depth to water table). Utilities (i.e., sewers), that are represented in the GIS as a line feature, required attribute field calculations to convert to a polygon feature based on pipe size. Other constraints required conversion of point to polygon data via spatial selection and an intersection with parcels (e.g., brownfields, fuel/storage tank sites, and superfund sites). In one case, a superfund location was identified in a very large parcel (Schenley Park) and a 100-ft buffer was applied to this point to create the absolute constraint input. Roadways, originally created as a line feature that represents the edge of pavement, also had to be converted to a polygon feature.

Constraint data that had a range of values and contained both absolute and relative constraints, such as slopes, were separated into two data layers. For example, the absolute constraint of very steep slopes (over 25 percent) were extracted into a separate data layer from slopes under 25 percent (relative constraints). All constraints had an area attribute field added to be recalculated as needed. Once data development was complete, summary tables showing the area (acres) and percent coverage in the study area were created. Appendix B includes a summary of this output.

The final step in the data development task was to develop a common attributing system so that the resultant file could be summarized and depicted correctly. For each relative constraint input listed in Table 2, a new attribute was created to classify each feature as a constraint or non-constraint. For example, a new attribute field was created in the floodplain constraint layer, and each floodplain polygon was classified as "Yes" to denote the type of constraint for that polygon. A second attribute was added to each relative constraint for the Constraint Score (needed for summation step later in the analysis). For example, a new attribute "Floodplain_Score" was created and each floodplain polygon was edited to include the constraint score listed in Table 2. Any unnecessary attributes were deleted, such as individual feature class area fields and fields containing unhelpful or extraneous feature class identification information.

2.3.2 Absolute Constraints

The absolute constraint data layers listed in Table 1 were combined in GIS using the Union tool into one output polygon data layer. Unnecessary attribute fields were deleted during post-processing and review. Unlike the overlay of relative constraints which considers a summation of scores, a location with more than one absolute constraint is still simply absolutely constrained. Figure 1 depicts the extent of all absolute constraints in the Chartiers Creek study area. A total of 697 acres, or 16 percent of the study area contains absolute constraints that are typically not suitable for GSI development. Table 3 summarizes the area for each absolute constraint in the study area.

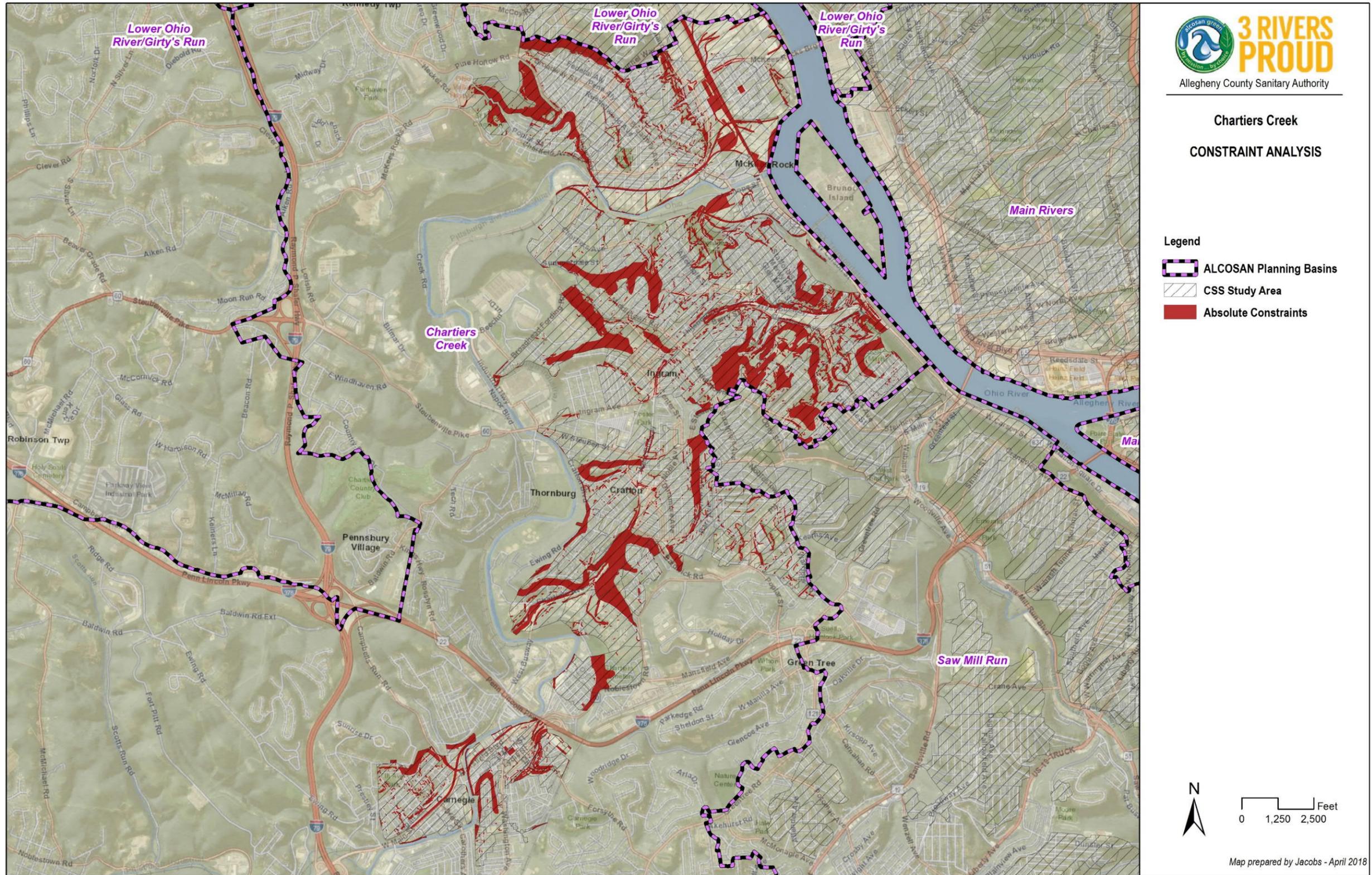


Figure 1. Absolute constraints in Chartiers Creek Study Area

Table 3. Summary of Absolute Constraints by Area and Percent Coverage in Chartiers Creek Study Area

Absolute Constraints	Area (acres)*	% of Study Area
Wetlands (10-foot buffer)	1	0.0%
Surface Water and Streams (20-foot buffer)	20	0.5%
Railroads (15-foot buffer)	58	1.4%
Water (from Soil and Land Use)	2	0.0%
Very steep slopes (25%+)	262	6.2%
Superfund or fuel/storage tank sites	25	0.6%
Very Shallow Bedrock (less than 1.1 feet)	424	10%
Floodway	8	0.2%
Total absolute constraints (accounting for overlap)	697	16%

* Although some of the constraints only have a small area in the Chartiers Creek study area, they were included for this analysis as they may be more significant in other basins.

2.3.3 Relative Constraints

The relative constraint input data layers were combined in GIS into one output feature class. Unnecessary attributes were deleted during post-processing and review. Table 4 summarizes the area for each relative constraint category in the study area. A field calculation was performed on a newly created attribute to total the score for all overlapping relative constraints polygons by summing all individual scores into a Total Score value. For example, a brownfield (with a relative constraint score of 3) located in an area with depth to bedrock between 1.1 and 2.6 feet (with a relative constraint score of 3) would have a Total Score of 6.

Table 4. Summary of Relative Constraints by Area and Percent Coverage in Chartiers Creek Study Area

Relative Constraints	Area (acres)*	% of Study Area
Utilities (i.e., sewers) including 3-foot buffer	149	3.5%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	141	3.3%
Forest Cover	523	12%
Parcels with Brownfields / Abandoned Mines	340	8.0%
Streets	531	12%
Cemeteries	86	2.0%

* See Appendix B, Table B-1 for breakdown by category.

The last step to develop the final relative constraints data layer was to remove any spatial overlap with absolute constraints features (since those take precedence) and to overlay the building footprints. Over 99% of the resultant area had total constraint scores ranging up to 14 (Appendix B, Table B-2). As shown in Table 5, these were categorized into areas with a relatively high level of relative constraints (total constraint score of 7 or higher), medium-high (scores 4.5 to 6.5), medium (score 2.5 to 4), and low (score 2 or less).

Figure 2 is an example showing the overlay of multiple relative constraints including their individual scores and the Total Score for that area. Figure 3 spatially depicts the results of the constraints analysis for the Chartiers study area and Figure 4 summarizes these results for the Chartiers Creek study area.

Table 5. Summary of Constraints Analysis in Chartiers Creek Study Area		
Constraints	Acres	% of Total
Low (constraint score 2 or less)	261	6.1%
Medium (constraint score 2.5 - 4)	918	22%
Medium-High (constraint score 4.5 - 6.5)	581	14%
High (constraint score 7 and above)	698	16%
Absolute (wetlands, very steep slopes, etc.)*	645	15%
Buildings with 10' buffer	1,146	27%
Total	4,248	100%

* For the purposes of this summary, 52 acres of buildings that overlap with absolute constraints are included in buildings category value of 1,146 acres rather than the absolute constraint category.

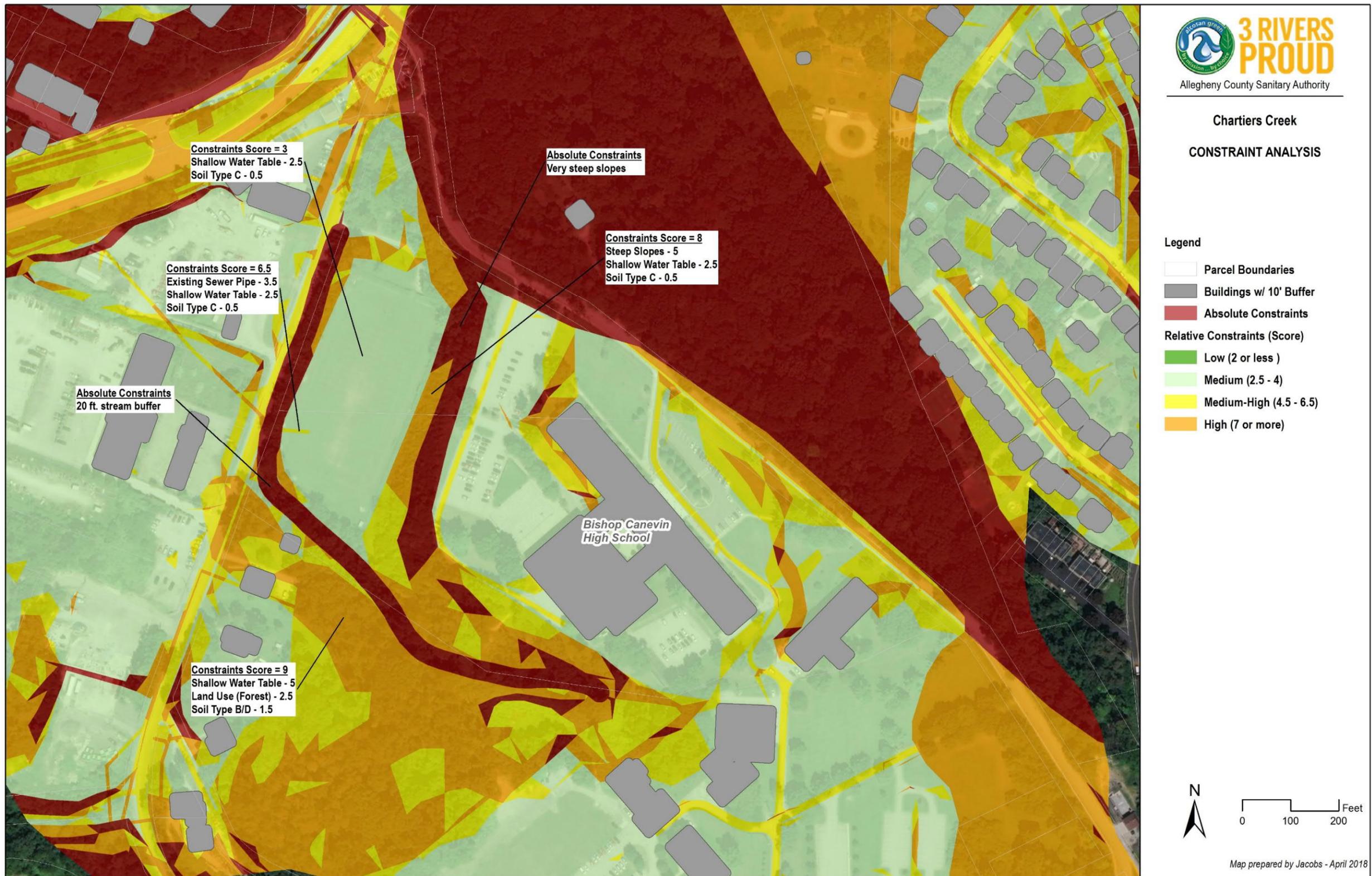


Figure 2. Example Showing the Overlay of Constraint Layers and the Resultant Scores

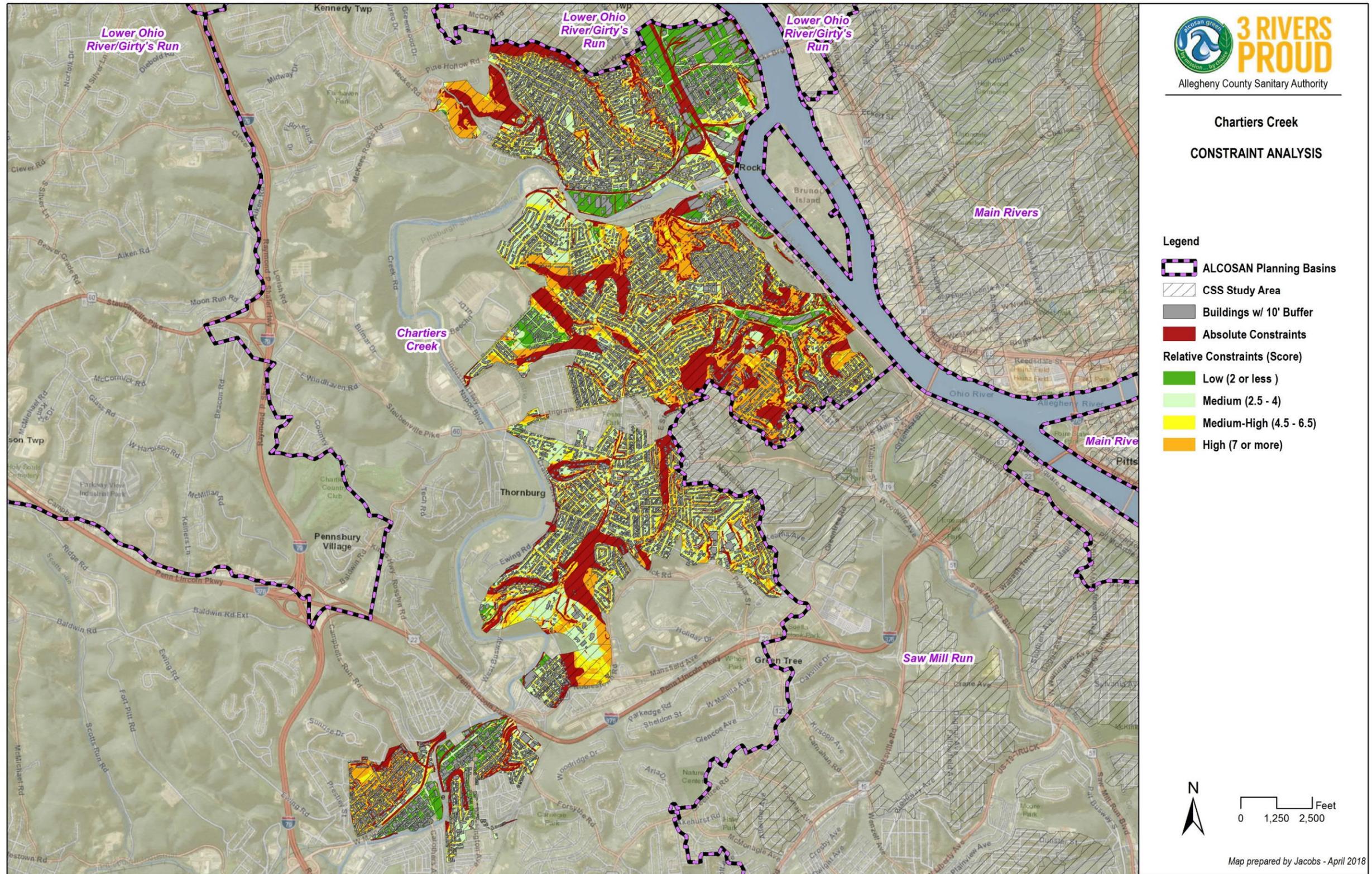


Figure 3. Results of Constraint Analysis in Chartiers Creek Study Area

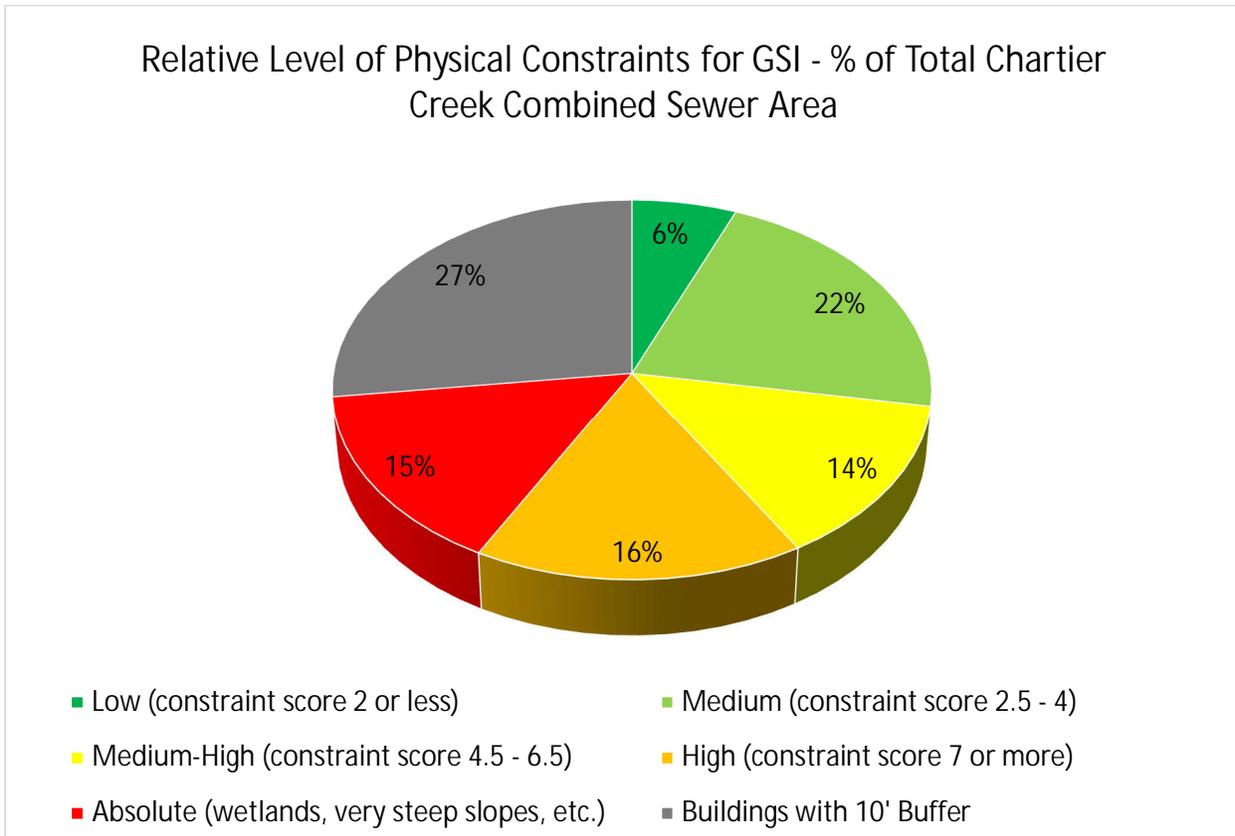


Figure 4. Summary of Constraints Analysis in Charters Creek Study Area

3.0 Summary

According to this analysis, approximately 15% of the Chartiers study area is not suitable for typical GSI development due to the prevalence of highly constraining features such as wetlands, very steep slopes, railroads, and other absolute constraints. In addition, buildings (with a 10-foot buffer) cover an additional 27% of the total study area. On the other hand, 28% of the Chartiers study area is categorized as having a low or medium level of constraints. This information will be used in conjunction with results from the overflow reduction efficiency (ORE) modeling analysis and the GIS-based Opportunity Analysis to develop potential GSI projects in minimally constrained/high opportunity areas to maximize the potential benefit and cost efficiency of GSI. The results of the Constraints Analysis will also be used to inform feasible implementation levels of GSI and costs of GSI implementation to evaluate potential changes to the Wet Weather Plan.

Following this same approach, the Constraint Analysis was applied to the other six planning basins. The GSI ORE geographic boundaries (combined sewer areas per the Regional Collection System Model), which were developed by CH2M, were used as the study area for the remaining six planning basins. Appendix C through Appendix H provide summary tables of the absolute and relative constraints inputs, the overall summary of the analysis results, and maps showing the results. Appendix I provides a breakdown of area by total constraint score for the full service area.

Appendix A

Table A-1. List of Data and Sources for Chartiers Creek Constraints Analysis

Constraint Type	Data Input Feature	Specific Data Sources (original file names)	Source	Year	Clipped Layer Name
Overlay	Buildings	Allegheny_County_Building_Footprint_Locations	Allegheny County	2017	ChartiersCSS_Building_Footprint_Locations_10ftBuffer
Relative	Streets	AlleghenyCounty_StreetEOP2016	Allegheny County	2016	ChartiersCSS_Streets
Relative	Cemeteries	Allegheny_County_Cemetery2002	Allegheny County	2002	ChartiersCSS_Cemetery2002
Absolute	Railroads	Allegheny_County_RRLines2006	Allegheny County	2006	ChartiersCSS_RRLines2006_Buffer15ft
Absolute (Slopes > 25%); all else relative	Slopes	Allegheny_County_Slopes201001	Allegheny County	2010	ChartiersCSS_Slopes_Code234; ChartiersCSS_Slopes_Code56Steep
Absolute (surface water); all else relative	Hydrologic soil groups			2003	ChartiersCSS_Soils
Relative	Depth to water table	Allegheny_wss_SSA_PA003_soildb_PA_2003_[2014-09-15]	Soil Survey Geographic (SSURGO) database for Allegheny County; U.S. Department of Agriculture, Natural Resources Conservation Service	2003	ChartiersCSS_WaterTable_AnnMin_Soils
Absolute (less than 1.1 feet); all else relative	Depth to bedrock			2003	REL_ChartiersCSS_BedrockDepth_Soils ABS_ChartiersCSS_Bedrock_Below_1_1
Absolute	National Wetland Inventory	Allegheny_County_NWI2000	U.S. Fish & Wildlife Service, via Allegheny County	2000	ChartiersCSS_NWI2000_10ftBuffer
Absolute	Streams / waterway / surface water	Allegheny_2010_LandUse; Allegheny_wss_SSA_PA003_soildb_PA_2003_[2014-09-15]	Allegheny County; Soil Survey Geographic (SSURGO) database for Allegheny County; U.S. Department of Agriculture, Natural Resources Conservation Service	2010; 2003	ChartiersCSS_Landuse_2010_WaterOnly ChartiersCSS_MajorRivers_20ftBuffer
Relative	FEMA 100-year floodplain	National Flood Hazard Layer - Allegheny County	Federal Emergency Management Agency (FEMA) via PASDA http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=2282	2016	ChartiersCSS_S_FLD_HAZ_AR
Absolute	FEMA Floodway			2016	ChartiersCSS_Floodway
Relative	Brownfields	Brownfields_acres_frs.gdb	Environmental Protection Agency via https://www.epa.gov/enviro/geospatial-data-download-service	2017	ChartiersCSS_Brownfield_Parcels
Relative	Abandoned Mines	ALCOSAN_Abandoned_Mine_Land_Inventory	Environmental Protection Agency via https://www.epa.gov/enviro/geospatial-data-download-service	2017	Chartiers_AbandonedMines_Parcels
Absolute	Superfund sites	LandRecyclingCleanupLocations2017_10.shp	PA Dept. of Environmental Protection via http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=279	2017	ChartiersCSS_LandRecyclingCleanupLocations2017_10
Absolute (parcels containing)	Fuel sites	StorageTankLocations2017_10.shp	PA Dept. of Environmental Protection via ftp://ftp.pasda.psu.edu/pub/pasda/dep/historic/StorageTankLocations/	2017	ChartiersCSS_StorageTank_Parcels
Relative	ALCOSAN sewer pipes	ACSA_StructuresInterceptors.gdb/Pipes	ALCOSAN	2017	ChartiersCSS_PipesAlcosan_10_3_2017_3ftBuffer
Relative	PWSA sewer main	PWSA_GIS.gdb/Sewer Main	ALCOSAN	2017	ChartiersCSS_PipesPWSASewerMain_3ftbuffer
Relative	Wooded areas / forest cover	Allegheny_County_Wooded_Area_Boundaries	Allegheny County	2011	ChartiersCSS_Wooded_Area_Boundaries

Appendix B

Table B-1. Summary of Relative Constraints by Area (ac) in the Chartiers Creek Study Area

Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	149	4%	3.5
Slopes			
5 to 9.99%	933	22%	1
10 to 14.99%	495	12%	3
15 to 24.99%	557	13%	5
Hydrologic Soil Group (HSG)			
B/D	14	0.3%	1.5
C	1,842	43%	0.5
C/D	113	3%	1.5
D	74	2%	2
Urban	840	20%	1
Depth to bedrock			
1.1 to 2.6 feet	1,673	39%	3
2.6 to 5.0 feet	57	1%	1
5.0 to 5.7 feet	5	0.1%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	10	0.2%	5
0.5 to 1.35 feet	68	2%	4
1.36 to 1.9 feet	120	3%	3
1.91 to 2.26 feet	1,339	32%	2.5
2.27 to 2.59 feet	106	2%	2
FEMA Floodplains 100-year – Zones A and AE	141	3%	2.5
Land use/land cover – forest cover	523	12%	2.5
Brownfield parcels	8	0.2%	3
Parcels with abandoned mines	332	8%	3
Streets/Roadway	531	12%	1.5
Cemeteries	86	2%	3
Total relative constraints (after Union tool) ²	3,552		
Total study area	4,248		

¹Combined Sewer and Draining to Combined Sewer subcatchments.

²Union tool calculates geometric intersection of polygons, total will be less than the sum of individual areas.

Table B-2. Breakdown of Area by Total Constraint Score in Chartiers

Total Constraint Score	Area (acres)	% of Total Study Area
0.5	1	0%
1	230	5%
1.5	1	0%
2	29	1%
2.5	49	1%
3	481	11%
3.5	55	1%
4	333	8%
4.5	180	4%
5	18	0%
5.5	88	2%
6	256	6%
6.5	38	1%
7	60	1%
7.5	44	1%
8	223	5%
8.5	47	1%
9	57	1%
9.5	26	1%
10	24	1%
10.5	31	1%
11	60	1%
11.5	18	0%
12	14	0%
12.5	11	0%
13	11	0%

Table B-2. Breakdown of Area by Total Constraint Score in Chartiers

Total Constraint Score	Area (acres)	% of Total Study Area
13.5	45	1%
14	6	0%
14.5	4	0%
15	12	0%
15.5	3	0%
16	1	0%
16.5	0	0%
17	1	0%
17.5	0	0%
18	1	0%
18.5	0	0%
19	0	0%
19.5	0	0%
20	0	0%
21.5	0	0%
Absolute Constraints	645	15%
Buildings with 10-foot Buffer	1,146	27%

Appendix C

Table C-1. Summary of Absolute Constraints by Area and Percent Coverage in the Lower Ohio Girty's Run Study Area

Absolute Constraints	Area (acres)*	% of Study Area
Wetlands (10-foot buffer)	0	0.0%
Surface Water and Streams (20-foot buffer)	17	0.9%
Railroads (15-foot buffer)	17	0.9%
Water (from Soil and Land Use)	0	0.0%
Very steep slopes (25%+)	175	9.1%
Parcels with Superfund or fuel/storage tank sites	15	0.8%
Very Shallow Bedrock (less than 1.1 feet)	87	4.5%
Floodway	18	1.0%
Total absolute constraints (accounting for overlap)	304	16%

Table C-2. Summary of Relative Constraints by Area and Percent Coverage in the Lower Ohio Girty's Run Study Area

Relative Constraints	Area (acres)*	Area (acres)*
Utilities (i.e., sewers) including 3-foot buffer	63	3.3%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	44	2.3%
Forest Cover	256	13%
Parcels with Brownfields / Abandoned Mines	1	0.0%
Streets	209	11%
Cemeteries	12	0.6%

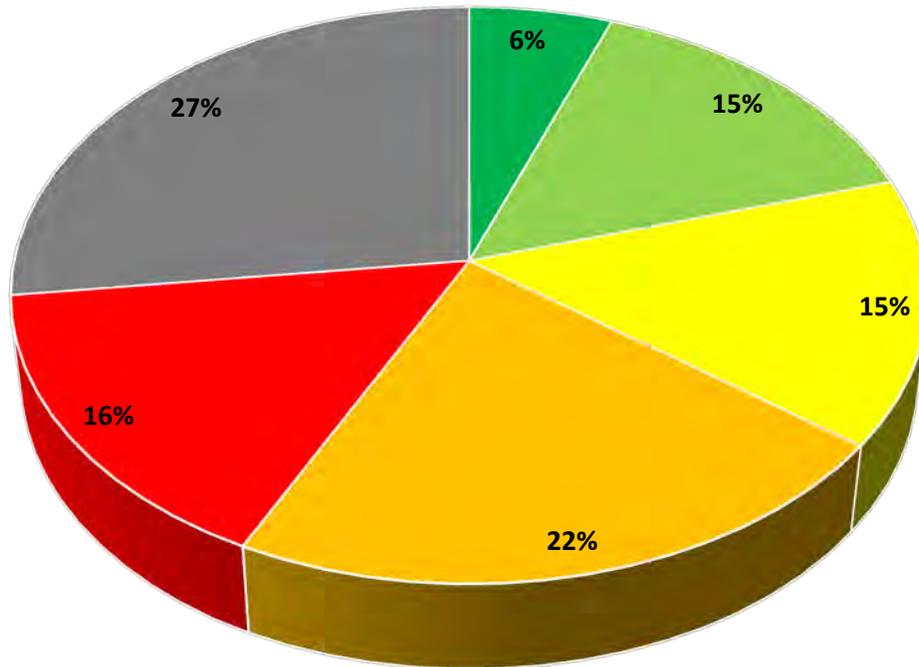
* See Appendix C-5, Table C-4 for breakdown by category.

Table C-3. Summary of Constraints Analysis in the Lower Ohio Girty's Run Study Area

Constraints	Acres	% of Total
Low (constraint score 2 or less)	109	5.7%
Medium (constraint score 2.5 - 4)	283	15%
Medium-High (constraint score 4.5 - 6.5)	288	15%
High (constraint score 7 and above)	424	22%
Absolute (wetlands, very steep slopes, etc.)*	304	16%
Buildings with 10' buffer	518	27%
Total	1,926	100%

* For the purposes of this summary, 33 acres of buildings that overlap with absolute constraints are included in buildings category value of 518 acres rather than the absolute constraint category.

Relative Level of Physical Constraints for GSI - % of Total Lower Ohio
Girty's Run Combined Sewer Area



- Low (constraint score 2 or less)
- Medium (constraint score 2.5 - 4)
- Medium-High (constraint score 4.5 - 6.5)
- High (constraint score 7 or more)
- Absolute (wetlands, very steep slopes, etc.)
- Buildings with 10' Buffer

Figure 1. Summary of Constraints Analysis in Lower Ohio Girty's Run Study Area

Table C-4. Summary of Relative Constraints by Area (ac) in the Lower Ohio Girty's Run Study Area

Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	63	3%	3.5
Slopes			
5 to 9.99%	419	22%	1
10 to 14.99%	265	14%	3
15 to 24.99%	314	16%	5
Hydrologic Soil Group (HSG)			
B/D	0	0.0%	1.5
C	1,152	60%	0.5
C/D	10	1%	1.5
D	19	1%	2
Urban	346	18%	1
Depth to bedrock			
1.1 to 2.6 feet	1,081	56%	3
2.6 to 5.0 feet	37	2%	1
5.0 to 5.7 feet	0	0.0%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	0	0.0%	5
0.5 to 1.35 feet	75	4%	4
1.36 to 1.9 feet	10	1%	3
1.91 to 2.26 feet	742	38%	2.5
2.27 to 2.59 feet	27	1%	2
FEMA Floodplains 100-year – Zones A and AE	44	2%	2.5
Land use/land cover – forest cover	256	13%	2.5
Brownfield parcels	1	0.0%	3
Parcels with abandoned mines	0	0.0%	3
Streets/Roadway	209	11%	1.5
Cemeteries	12	1%	3
Total relative constraints (after Union tool)²	1,926		
Total study area	1,926		

¹Combined subcatchments as included in the ALCOSAN model consistent with the ORE analysis

²Union tool calculates geometric intersection of polygons, total will be less than or equal to the sum of individual areas.

Lower Ohio River/Girty's Run

CONSTRAINT ANALYSIS

Legend

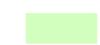
 ALCOSAN Planning Basins

 Buildings with 10' Buffer

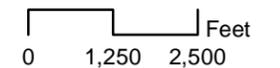
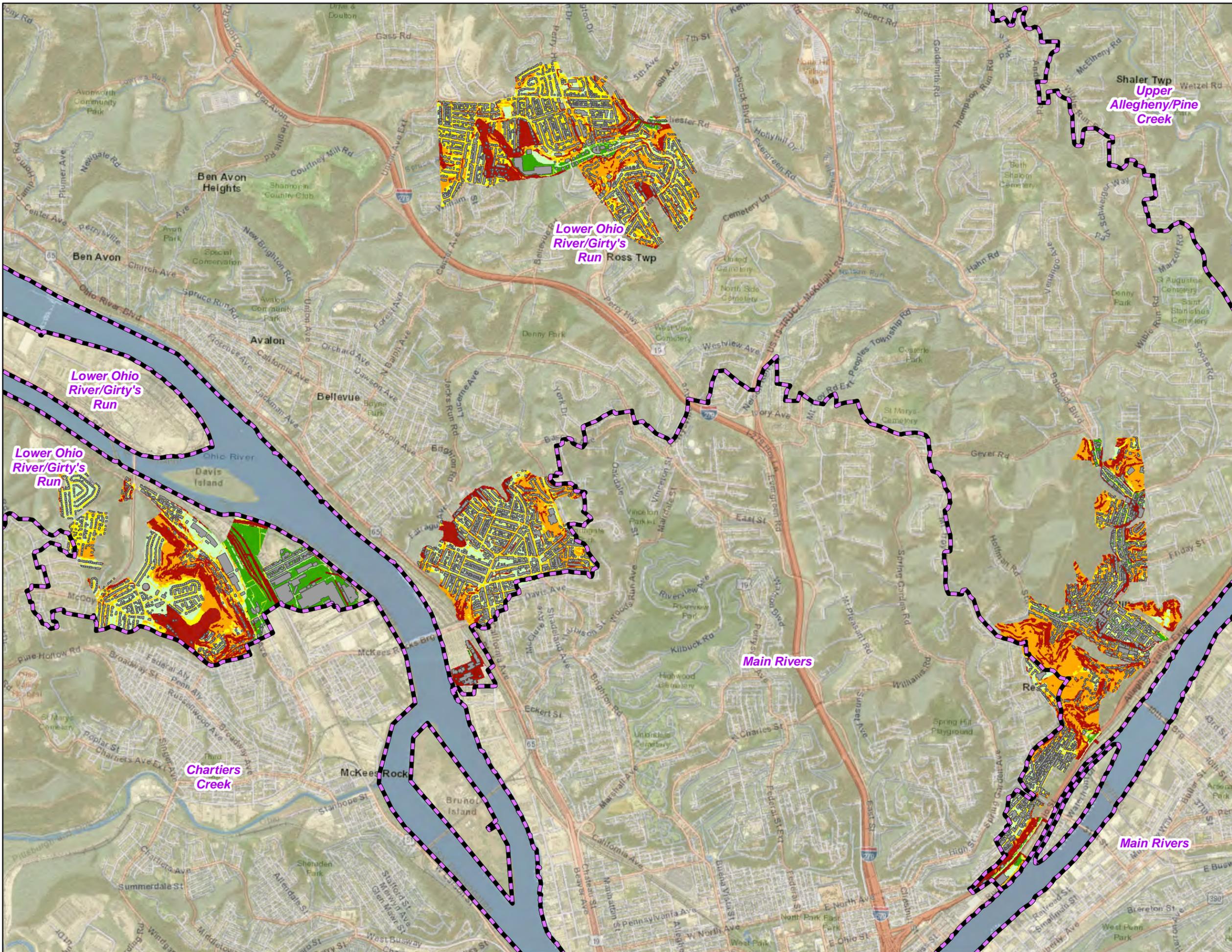
 Absolute Constraints

Relative Constraints (Score)

 Low (2 or less)

 Medium (2.5 - 4)

 Medium-High (4.5 - 6.5)

 High (7 or more)


Appendix D

Table D-1. Summary of Absolute Constraints by Area and Percent Coverage in the Main Rivers Creek Study Area

Absolute Constraints	Area (acres)	% of Study Area
Wetlands (10-foot buffer)	8	0.1%
Surface Water and Streams (20-foot buffer)	31	0.2%
Railroads (15-foot buffer)	161	1.1%
Water (from Soil and Land Use)	9	0.1%
Very steep slopes (25%+)	1,242	8.8%
Parcels with Superfund or fuel/storage tank sites	53	0.4%
Very Shallow Bedrock (less than 1.1 feet)	453	3.2%
Floodway	23	0.2%
Total absolute constraints (accounting for overlap)	1,856	13%

Table D-2. Summary of Relative Constraints by Area and Percent Coverage in the Main Rivers Creek Study Area

Relative Constraints	Area (acres)*	% of Study Area
Utilities (i.e., sewers) including 3-foot buffer	591	4.2%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	223	1.6%
Forest Cover	1,615	11%
Parcels with Brownfields / Abandoned Mines	2,116	15%
Streets	1,943	14%
Cemeteries	642	4.5%

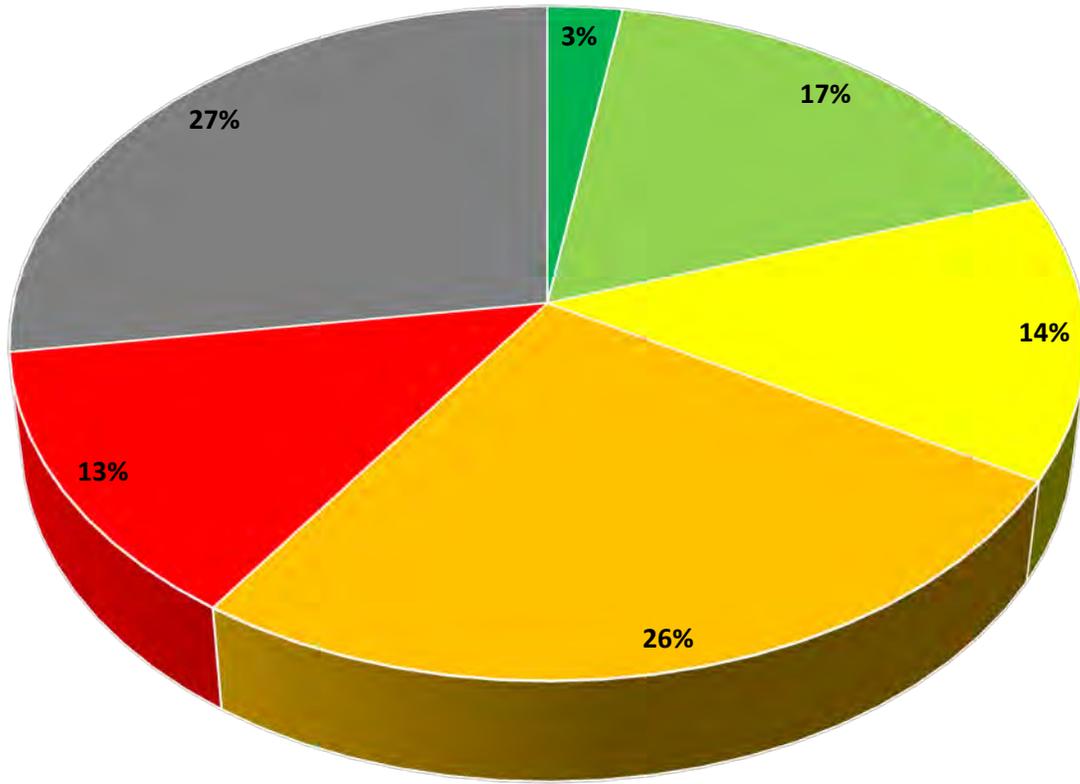
* See Appendix D-5, Table D-4 for breakdown by category.

Table D-3. Summary of Constraints Analysis in Main Rivers Creek Study Area

Constraints	Acres	% of Total
Low (constraint score 2 or less)	357	2.5%
Medium (constraint score 2.5 - 4)	2,428	17%
Medium-High (constraint score 4.5 - 6.5)	1,931	14%
High (constraint score 7 and above)	3,686	26%
Absolute (wetlands, very steep slopes, etc.)*	1,856	13%
Buildings with 10' buffer	3,855	27%
Total	14,111	100%

* For the purposes of this summary, 161 acres of buildings that overlap with absolute constraints are included in buildings category value of 3,855 acres rather than the absolute constraint category.

Relative Level of Physical Constraints for GSI - % of Total Main Rivers
Combined Sewer Area



- Low (constraint score 2 or less)
- Medium (constraint score 2.5 - 4)
- Medium-High (constraint score 4.5 - 6.5)
- High (constraint score 7 or more)
- Absolute (wetlands, very steep slopes, etc.)
- Buildings with 10' Buffer

Figure 1. Summary of Constraints Analysis in Main Rivers Study Area

Table D-4. Summary of Relative Constraints by Area (ac) in the Main Rivers Creek Study Area

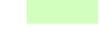
Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	591	4%	3.5
Slopes			
5 to 9.99%	2,746	19%	1
10 to 14.99%	1,524	11%	3
15 to 24.99%	1,885	13%	5
Hydrologic Soil Group (HSG)			
B/D	6	0.0%	1.5
C	7,631	54%	0.5
C/D	567	4%	1.5
D	61	0.4%	2
Urban	1,482	10%	1
Depth to bedrock			
1.1 to 2.6 feet	6,943	49%	3
2.6 to 5.0 feet	612	4%	1
5.0 to 5.7 feet	125	1%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	6	0.0%	5
0.5 to 1.35 feet	778	6%	4
1.36 to 1.9 feet	352	2%	3
1.91 to 2.26 feet	6,202	44%	2.5
2.27 to 2.59 feet	44	0.3%	2
FEMA Floodplains 100-year – Zones A and AE	223	2%	2.5
Land use/land cover – forest cover	1,615	11%	2.5
Brownfield parcels	311	2%	3
Parcels with abandoned mines	1,805	13%	3
Streets/Roadway	1,943	14%	1.5
Cemeteries	642	5%	3
Total relative constraints (after Union tool)²	14,111		
Total study area	14,116		

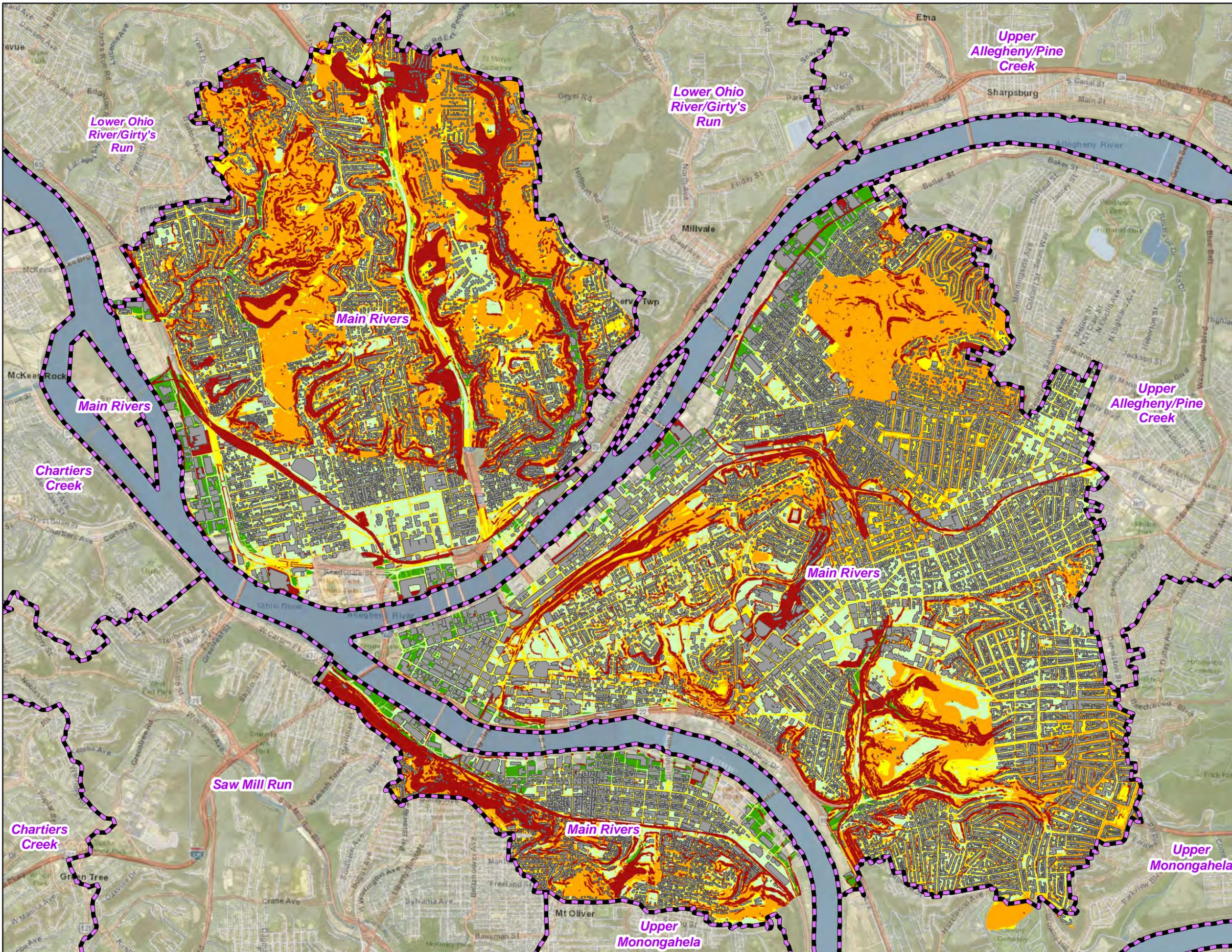
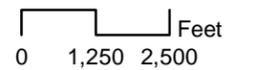
¹Combined subcatchments as included in the ALCOSAN model consistent with the ORE analysis

²Union tool calculates geometric intersection of polygons, total will be less than or equal to the sum of indiv

Main Rivers
CONSTRAINT ANALYSIS

Legend

-  ALCOSAN Planning Basins
-  Buildings with 10' Buffer
-  Absolute Constraints
- Relative Constraints (Score)
-  Low (2 or less)
-  Medium (2.5 - 4)
-  Medium-High (4.5 - 6.5)
-  High (7 or more)



Appendix E

Table E-1. Summary of Absolute Constraints by Area and Percent Coverage in the Saw Mill Run Study Area

Absolute Constraints	Area (acres)	% of Study Area
Wetlands (10-foot buffer)	0	0.0%
Surface Water and Streams (20-foot buffer)	19	0.4%
Railroads (15-foot buffer)	34	0.8%
Water (from Soil and Land Use)	0	0.0%
Very steep slopes (25%+)	363	8.5%
Parcels with Superfund or fuel/storage tank sites	1	0.0%
Very Shallow Bedrock (less than 1.1 feet)	529	12%
Floodway	2	0.1%
Total absolute constraints (accounting for overlap)	795	19%

Table E-2. Summary of Relative Constraints by Area and Percent Coverage in the Saw Mill Run Study Area

Relative Constraints	Area (acres)*	% of Study Area
Utilities (i.e., sewers) including 3-foot buffer	184	4.3%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	6	0.2%
Forest Cover	514	12%
Parcels with Brownfields / Abandoned Mines	499	12%
Streets	508	12%
Cemeteries	41	1.0%

* See Appendix E-5, Table E-1 for breakdown by category.

Table E-3. Summary of Constraints Analysis in the Saw Mill Run Study Area		
Constraints	Acres	% of Total
Low (constraint score 2 or less)	48	1.1%
Medium (constraint score 2.5 - 4)	240	5.7%
Medium-High (constraint score 4.5 - 6.5)	805	19%
High (constraint score 7 and above)	1,193	28%
Absolute (wetlands, very steep slopes, etc.)*	795	19%
Buildings with 10' buffer	1,172	28%
Total	4,254	100%

* For the purposes of this summary, 64 acres of buildings that overlap with absolute constraints are included in buildings category value of 1,172 acres rather than the absolute constraint category.

Relative Level of Physical Constraints for GSI - % of Total Saw Mill Run Combined Sewer Area

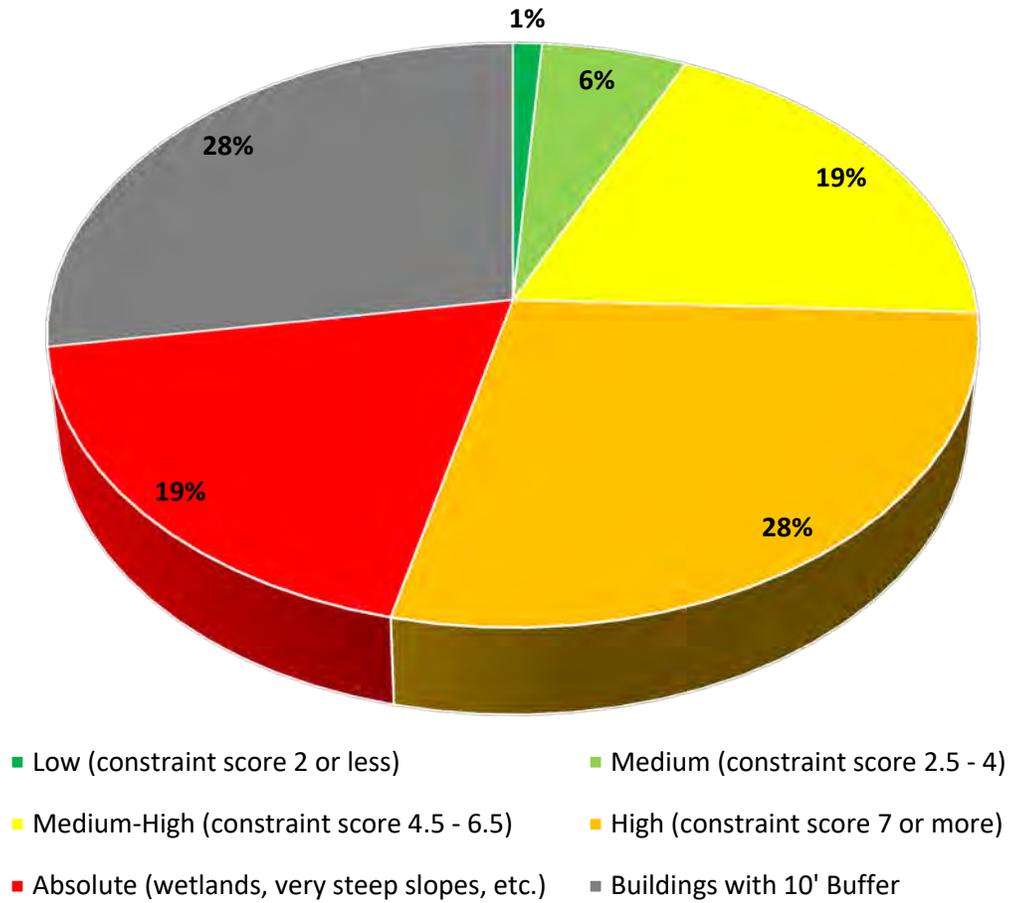


Figure 1. Summary of Constraints Analysis in Saw Mill Run Study Area

Table E-4. Summary of Relative Constraints by Area (ac) in the Saw Mill Run Study Area

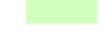
Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	184	4%	3.5
Slopes			
5 to 9.99%	1,298	31%	1
10 to 14.99%	754	18%	3
15 to 24.99%	691	16%	5
Hydrologic Soil Group (HSG)			
B/D	0	0.0%	1.5
C	689	16%	0.5
C/D	2,261	53%	1.5
D	101	2%	2
Urban	147	3%	1
Depth to bedrock			
1.1 to 2.6 feet	1,177	28%	3
2.6 to 5.0 feet	2,271	53%	1
5.0 to 5.7 feet	10	0.2%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	0	0.0%	5
0.5 to 1.35 feet	14	0.3%	4
1.36 to 1.9 feet	2,251	53%	3
1.91 to 2.26 feet	100	2%	2.5
2.27 to 2.59 feet	145	3%	2
FEMA Floodplains 100-year – Zones A and AE	6	0.2%	2.5
Land use/land cover – forest cover	514	12%	2.5
Brownfield parcels	0	0.0%	3
Parcels with abandoned mines	499	12%	3
Streets/Roadway	508	12%	1.5
Cemeteries	41	1%	3
Total relative constraints (after Union tool)²	4,254		
Total study area	4,254		

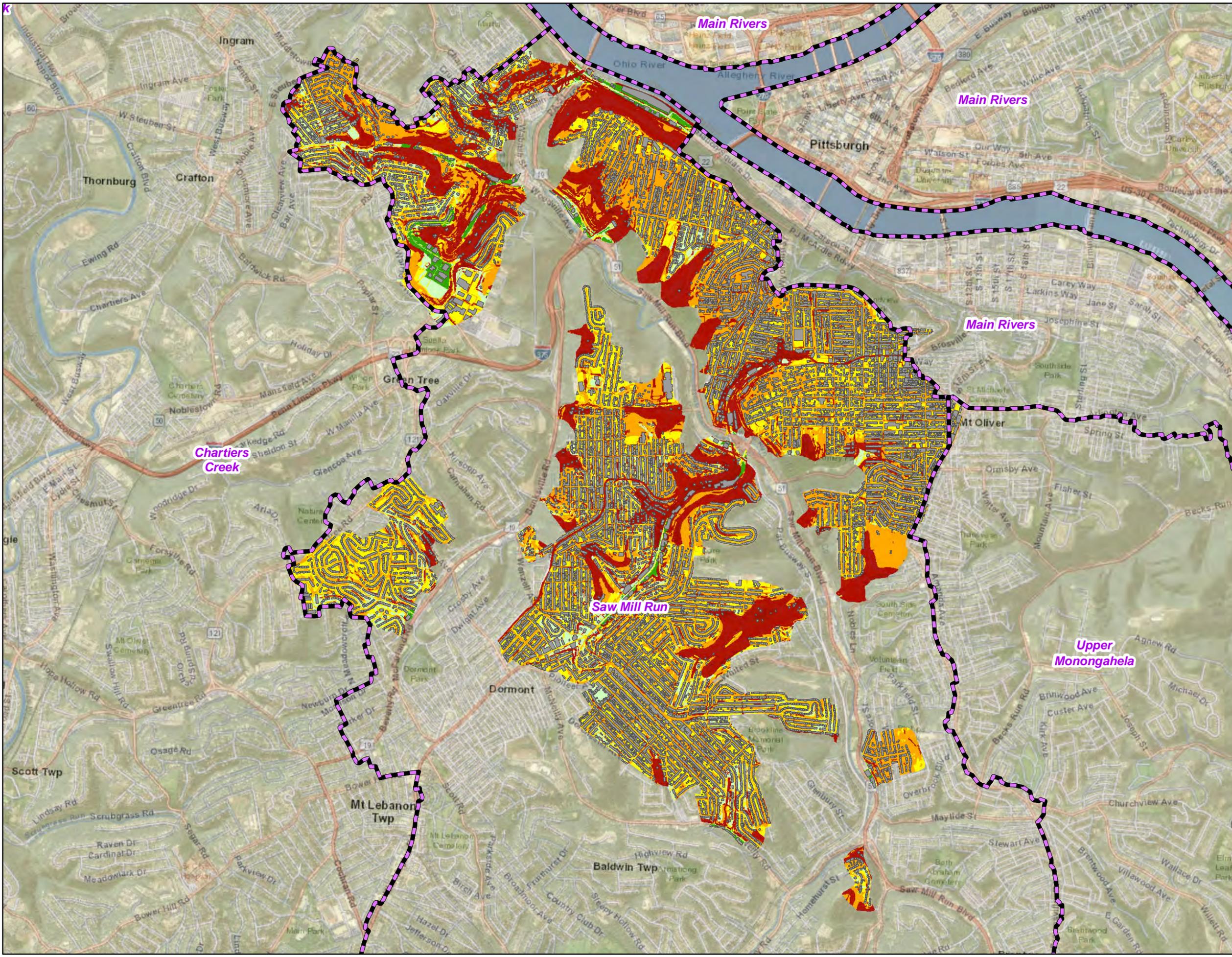
¹Combined subcatchments as included in the ALCOSAN model consistent with the ORE analysis

²Union tool calculates geometric intersection of polygons, total will be less than or equal to the sum of individual areas.

Saw Mill Run
CONSTRAINT ANALYSIS

Legend

-  ALCOSAN Planning Basins
-  Buildings with 10' Buffer
-  Absolute Constraints
- Relative Constraints (Score)
-  Low (2 or less)
-  Medium (2.5 - 4)
-  Medium-High (4.5 - 6.5)
-  High (7 or more)



Appendix F

Table F-1. Summary of Absolute Constraints by Area and Percent Coverage in the Turtle Creek Study Area

Absolute Constraints	Area (acres)	% of Study Area
Wetlands (10-foot buffer)	0	0.0%
Surface Water and Streams (20-foot buffer)	45	2.2%
Railroads (15-foot buffer)	28	1.4%
Water (from Soil and Land Use)	12	0.6%
Very steep slopes (25%+)	297	15%
Parcels with Superfund or fuel/storage tank sites	13	0.7%
Very Shallow Bedrock (less than 1.1 feet)	70	3.5%
Floodway	12	0.6%
Total absolute constraints (accounting for overlap)	416	21%

Table F-2. Summary of Relative Constraints by Area and Percent Coverage in the Turtle Creek Study Area

Relative Constraints	Area (acres)*	% of Study Area
Utilities (i.e., sewers) including 3-foot buffer	55	2.8%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	47	2.4%
Forest Cover	545	27%
Parcels with Brownfields / Abandoned Mines	220	11%
Streets	206	10%
Cemeteries	34	1.7%

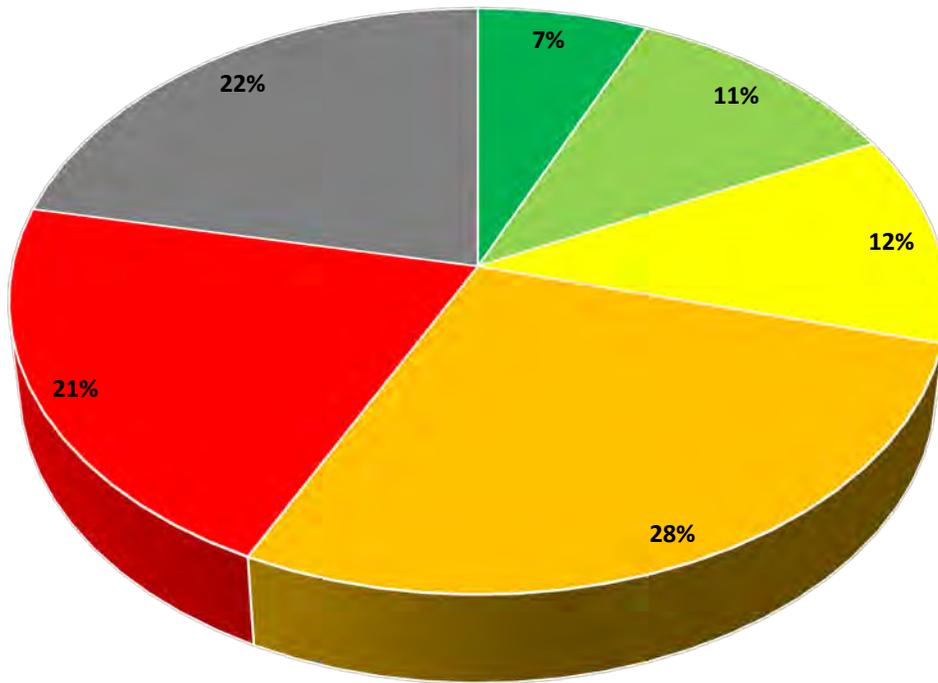
* See Appendix F-5, Table F-4 for breakdown by category.

Table F-3. Summary of Constraints Analysis in the Turtle Creek Study Area

Constraints	Acres	% of Total
Low (constraint score 2 or less)	130	6.6%
Medium (constraint score 2.5 - 4)	219	11%
Medium-High (constraint score 4.5 - 6.5)	229	12%
High (constraint score 7 and above)	557	28%
Absolute (wetlands, very steep slopes, etc.)*	416	21%
Buildings with 10' buffer	431	22%
Total	1,981	100%

* For the purposes of this summary, 20 acres of buildings that overlap with absolute constraints are included in buildings category value of 431 acres rather than the absolute constraint category.

Relative Level of Physical Constraints for GSI - % of Total Turtle Creek Combined Sewer Area



- Low (constraint score 2 or less)
- Medium (constraint score 2.5 - 4)
- Medium-High (constraint score 4.5 - 6.5)
- High (constraint score 7 or more)
- Absolute (wetlands, very steep slopes, etc.)
- Buildings with 10' Buffer

Figure 1. Summary of Constraints Analysis in Turtle Creek Study Area

Table F-4. Summary of Relative Constraints by Area (ac) in the Turtle Creek Study Area

Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	55	3%	3.5
Slopes			
5 to 9.99%	338	17%	1
10 to 14.99%	242	12%	3
15 to 24.99%	374	19%	5
Hydrologic Soil Group (HSG)			
B/D	0	0.0%	1.5
C	20	1%	0.5
C/D	55	3%	1.5
D	44	2%	2
Urban	418	21%	1
Depth to bedrock			
1.1 to 2.6 feet	1,168	59%	3
2.6 to 5.0 feet	156	8%	1
5.0 to 5.7 feet	10	0.5%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	0	0.0%	5
0.5 to 1.35 feet	34	2%	4
1.36 to 1.9 feet	24	1%	3
1.91 to 2.26 feet	575	29%	2.5
2.27 to 2.59 feet	85	4%	2
FEMA Floodplains 100-year – Zones A and AE	47	2%	2.5
Land use/land cover – forest cover	545	27%	2.5
Brownfield parcels	0	0.0%	3
Parcels with abandoned mines	220	11%	3
Streets/Roadway	206	10%	1.5
Cemeteries	34	2%	3
Total relative constraints (after Union tool)²	1,981		
Total study area	1,983		

¹Combined subcatchments as included in the ALCOSAN model consistent with the ORE analysis

²Union tool calculates geometric intersection of polygons, total will be less than or equal to the sum of individual areas.

Turtle Creek/Thompson Run

CONSTRAINT ANALYSIS

Legend

 ALCOSAN Planning Basins

 Buildings with 10' Buffer

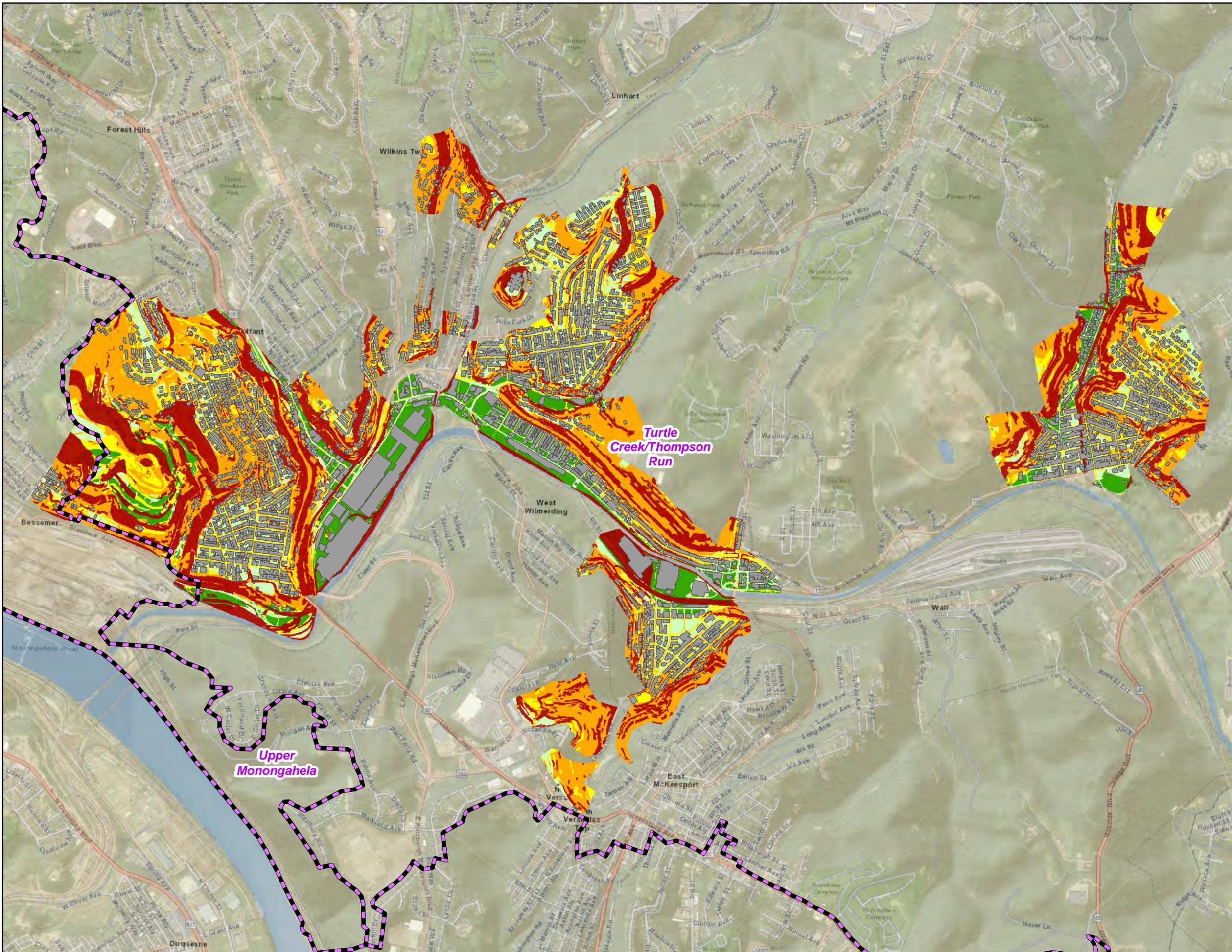
 Absolute Constraints

Relative Constraints (Score)

 Low (2 or less)

 Medium (2.5 - 4)

 Medium-High (4.5 - 6.5)

 High (7 or more)


Appendix G

Table G-1. Summary of Absolute Constraints by Area and Percent Coverage in the Upper Allegheny River Study Area

Absolute Constraints	Area (acres)*	% of Study Area
Wetlands (10-foot buffer)	4	0.1%
Surface Water and Streams (20-foot buffer)	28	0.5%
Railroads (15-foot buffer)	41	0.8%
Water (from Soil and Land Use)	5	0.1%
Very steep slopes (25%+)	360	7.1%
Parcels with Superfund or fuel/storage tank sites	52	1.0%
Very Shallow Bedrock (less than 1.1 feet)	45	0.9%
Floodway	27	0.5%
Total absolute constraints (accounting for overlap)	516	10%

Table G-2. Summary of Relative Constraints by Area and Percent Coverage in the Upper Allegheny River Study Area

Relative Constraints	Area (acres)*	% of Study Area
Utilities (i.e., sewers) including 3-foot buffer	196	3.9%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	149	2.9%
Forest Cover	692	14%
Parcels with Brownfields / Abandoned Mines	721	14%
Streets	641	13%
Cemeteries	80	1.6%

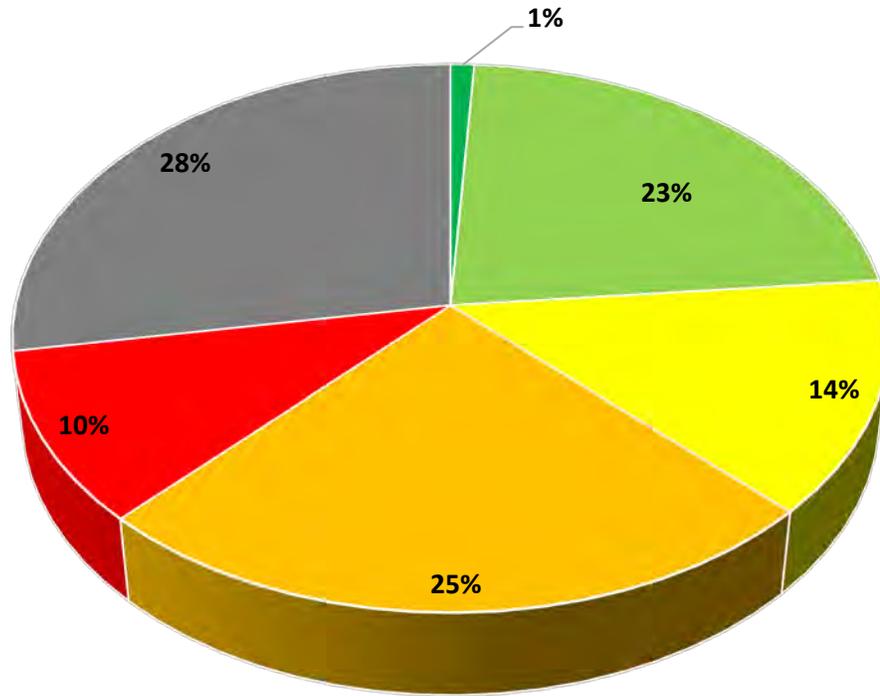
* See Appendix G-5, Table G-4 for breakdown by category.

Table G-3. Summary of Constraints Analysis in Upper Allegheny River Study Area

Constraints	Acres	% of Total
Low (constraint score 2 or less)	50	1.0%
Medium (constraint score 2.5 - 4)	1,146	23%
Medium-High (constraint score 4.5 - 6.5)	702	14%
High (constraint score 7 and above)	1,264	25%
Absolute (wetlands, very steep slopes, etc.)*	516	10%
Buildings with 10' buffer	1,406	28%
Total	5,082	100%

* For the purposes of this summary, 30 acres of buildings that overlap with absolute constraints are included in buildings category value of 1,406 acres rather than the absolute constraint category.

Relative Level of Physical Constraints for GSI - % of Total Upper Allegheny River Combined Sewer Area



- Low (constraint score 2 or less)
- Medium (constraint score 2.5 - 4)
- Medium-High (constraint score 4.5 - 6.5)
- High (constraint score 7 or more)
- Absolute (wetlands, very steep slopes, etc.)
- Buildings with 10' Buffer

Figure 1. Summary of Constraints Analysis in Upper Allegheny River Study Area

Table G-4. Summary of Relative Constraints by Area (ac) in the Upper Allegheny River Study Area

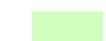
Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	196	4%	3.5
Slopes			
5 to 9.99%	913	18%	1
10 to 14.99%	561	11%	3
15 to 24.99%	596	12%	5
Hydrologic Soil Group (HSG)			
B/D	0	0.0%	1.5
C	2,948	58%	0.5
C/D	116	2%	1.5
D	17	0.3%	2
Urban	233	5%	1
Depth to bedrock			
1.1 to 2.6 feet	2,444	48%	3
2.6 to 5.0 feet	181	4%	1
5.0 to 5.7 feet	0	0.0%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	0	0.0%	5
0.5 to 1.35 feet	121	2%	4
1.36 to 1.9 feet	123	2%	3
1.91 to 2.26 feet	2,773	55%	2.5
2.27 to 2.59 feet	31	1%	2
FEMA Floodplains 100-year – Zones A and AE	149	3%	2.5
Land use/land cover – forest cover	692	14%	2.5
Brownfield parcels	5	0.1%	3
Parcels with abandoned mines	716	14%	3
Streets/Roadway	641	13%	1.5
Cemeteries	80	2%	3
Total relative constraints (after Union tool)²	5,082		
Total study area	5,083		

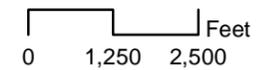
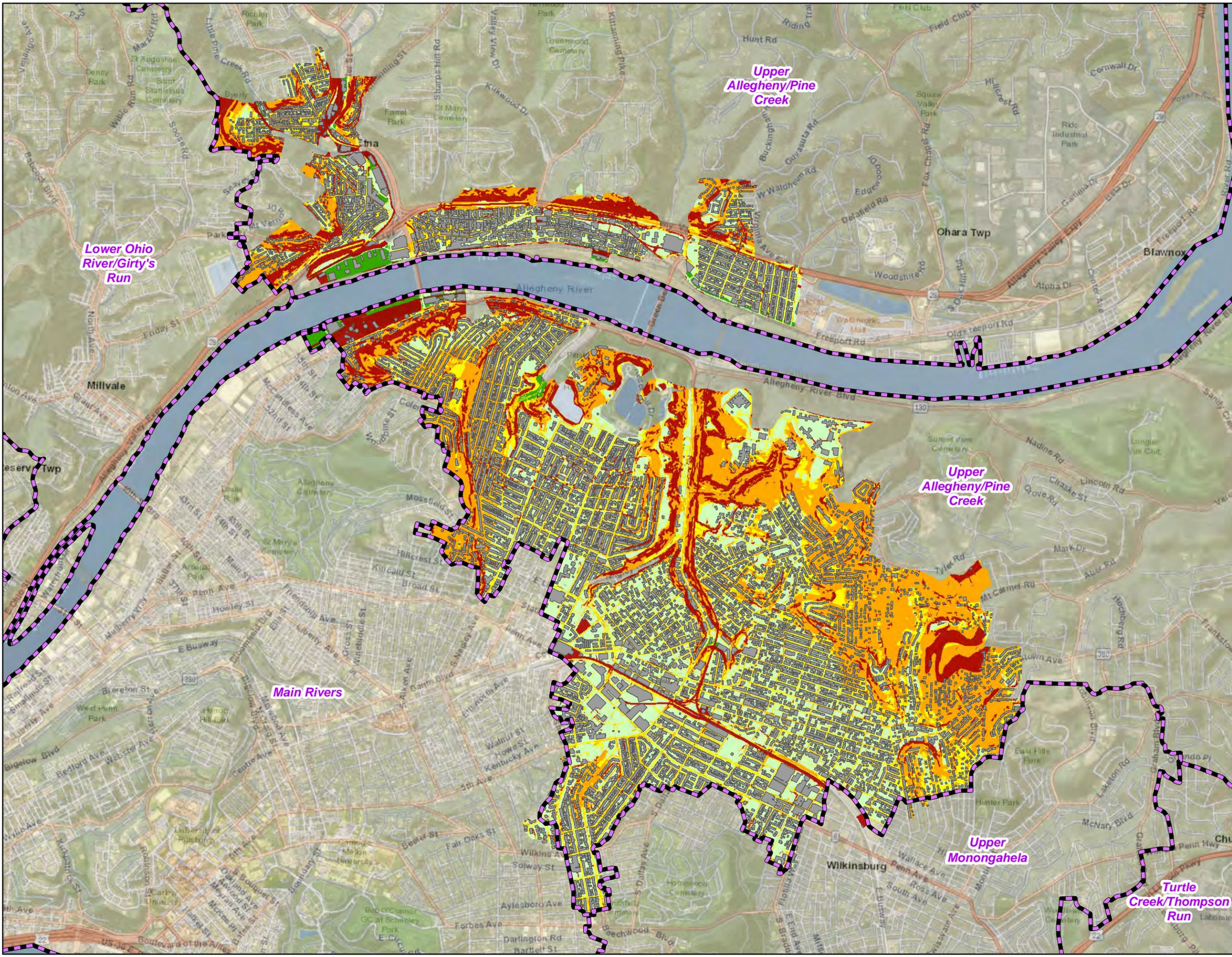
¹Combined subcatchments as included in the ALCOSAN model consistent with the ORE analysis

²Union tool calculates geometric intersection of polygons, total will be less than or equal to the sum of individual areas.

Upper Allegheny/Pine Creek CONSTRAINT ANALYSIS

Legend

-  ALCOSAN Planning Basins
-  Buildings with 10' Buffer
-  Absolute Constraints
- Relative Constraints (Score)
-  Low (2 or less)
-  Medium (2.5 - 4)
-  Medium-High (4.5 - 6.5)
-  High (7 or more)



Appendix H

Table H-1. Summary of Absolute Constraints by Area and Percent Coverage in the Upper Monongahela River Study Area

Absolute Constraints	Area (acres)	% of Study Area
Wetlands (10-foot buffer)	3	0.1%
Surface Water and Streams (20-foot buffer)	18	0.5%
Railroads (15-foot buffer)	77	2.0%
Water (from Soil and Land Use)	0	0.0%
Very steep slopes (25%+)	232	6.1%
Parcels with Superfund or fuel/storage tank sites	11	0.3%
Very Shallow Bedrock (less than 1.1 feet)	101	2.6%
Floodway	5	0.1%
Total absolute constraints (accounting for overlap)	420	11%

Table H-2. Summary of Relative Constraints by Area and Percent Coverage in the Upper Monongahela River Study Area

Relative Constraints	Area (acres)*	% of Study Area
Utilities (i.e., sewers) including 3-foot buffer	145	3.8%
Slopes (Moderate to Steep)	Varies by Slope Category*	
Hydrologic Soil Group (C, D, Urban)	Varies by Soil Category*	
Shallow Depth to Bedrock / Water Table	Varies by Depth Category*	
FEMA 100-year Floodplains	61	1.6%
Forest Cover	574	15%
Parcels with Brownfields / Abandoned Mines	579	15%
Streets	477	13%
Cemeteries	215	5.6%

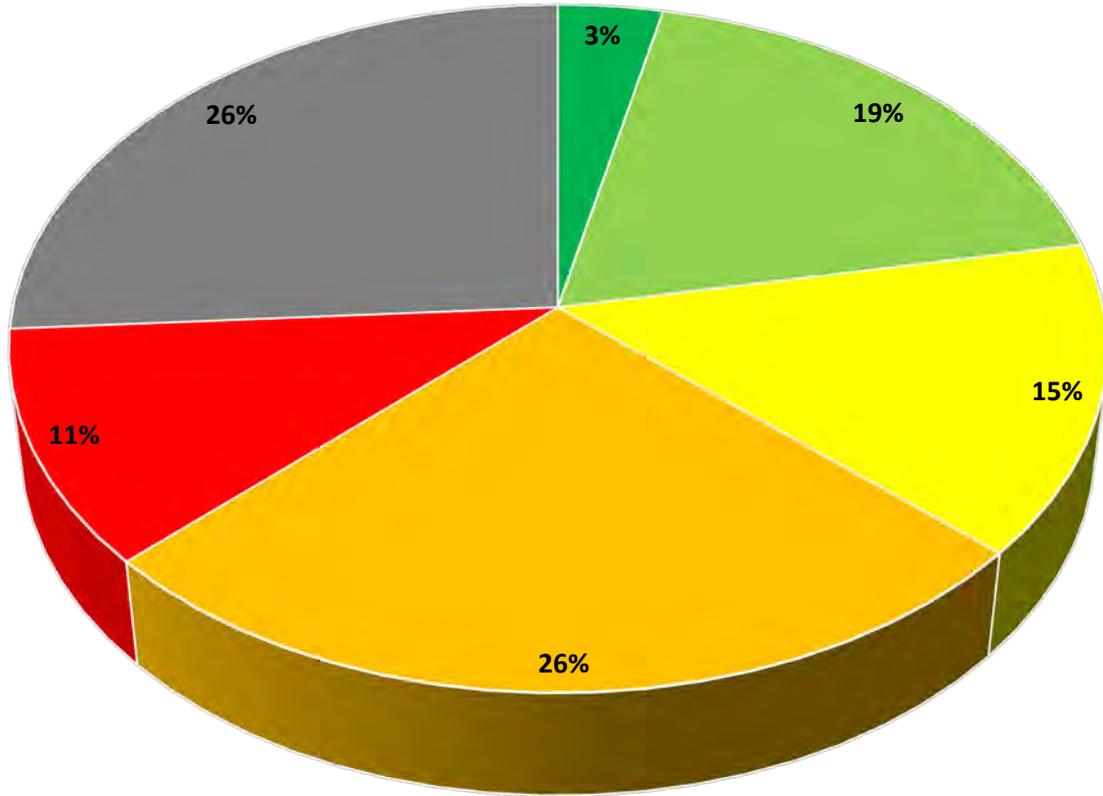
* See Appendix H-5, Table H-4 for breakdown by category.

Table H-3. Summary of Constraints Analysis in the Upper Monongahela River Study Area

Constraints	Acres	% of Total
Low (constraint score 2 or less)	131	3.5%
Medium (constraint score 2.5 - 4)	702	19%
Medium-High (constraint score 4.5 - 6.5)	555	15%
High (constraint score 7 and above)	997	26%
Absolute (wetlands, very steep slopes, etc.)*	420	11%
Buildings with 10' buffer	986	26%
Total	3,791	100%

* For the purposes of this summary, 25 acres of buildings that overlap with absolute constraints are included in buildings category value of 986 acres rather than the absolute constraint category.

Relative Level of Physical Constraints for GSI - % of Total Upper Monongahela River Combined Sewer Area



- Low (constraint score 2 or less)
- Medium (constraint score 2.5 - 4)
- Medium-High (constraint score 4.5 - 6.5)
- High (constraint score 7 or more)
- Absolute (wetlands, very steep slopes, etc.)
- Buildings with 10' Buffer

Figure 1. Summary of Constraints Analysis in Upper Monongahela River Study Area

Table H-4. Summary of Relative Constraints by Area (ac) in the Upper Monongahela River Study Area

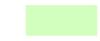
Relative Constraints	Area (ac)	% of Study Area ¹	Score
Sewer pipes with 3-foot buffer	145	4%	3.5
Slopes			
5 to 9.99%	825	22%	1
10 to 14.99%	463	12%	3
15 to 24.99%	524	14%	5
Hydrologic Soil Group (HSG)			
B/D	0	0.0%	1.5
C	1,399	37%	0.5
C/D	103	3%	1.5
D	49	1%	2
Urban	370	10%	1
Depth to bedrock			
1.1 to 2.6 feet	2,295	60%	3
2.6 to 5.0 feet	179	5%	1
5.0 to 5.7 feet	0	0.0%	0.5
Depth to water table annual minimum			
Less than 0.49 feet	0	0.0%	5
0.5 to 1.35 feet	71	2%	4
1.36 to 1.9 feet	93	2%	3
1.91 to 2.26 feet	1,206	32%	2.5
2.27 to 2.59 feet	151	4%	2
FEMA Floodplains 100-year – Zones A and AE	61	2%	2.5
Land use/land cover – forest cover	574	15%	2.5
Brownfield parcels	3	0.1%	3
Parcels with abandoned mines	576	15%	3
Streets/Roadway	477	13%	1.5
Cemeteries	215	6%	3
Total relative constraints (after Union tool)²	3,791		
Total study area	3,799		

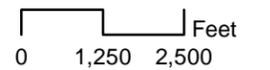
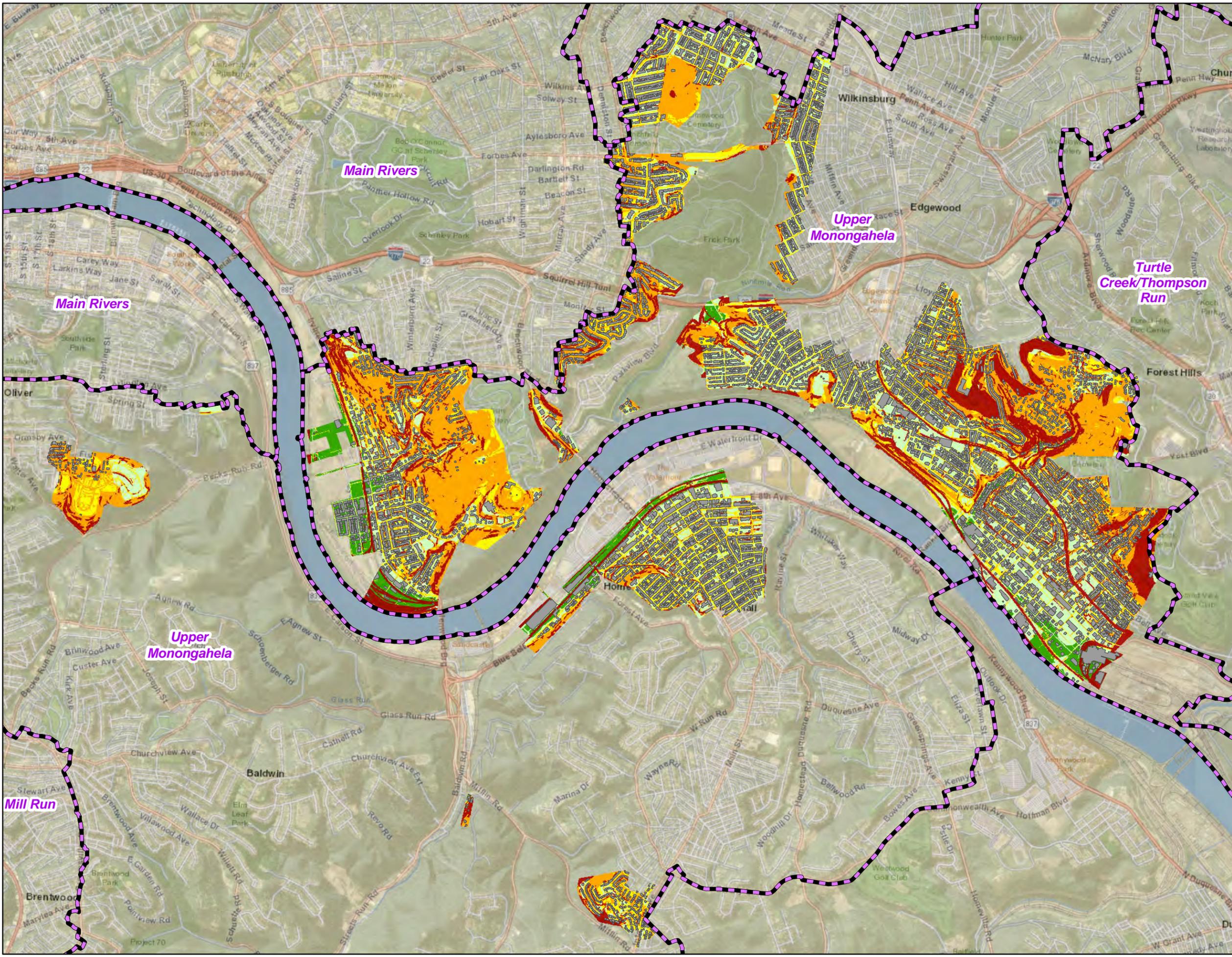
¹Combined subcatchments as included in the ALCOSAN model consistent with the ORE analysis

²Union tool calculates geometric intersection of polygons, total will be less than or equal to the sum of individual areas.

Upper Monongahela
CONSTRAINT ANALYSIS

Legend

-  ALCOSAN Planning Basins
-  Buildings with 10' Buffer
-  Absolute Constraints
- Relative Constraints (Score)
-  Low (2 or less)
-  Medium (2.5 - 4)
-  Medium-High (4.5 - 6.5)
-  High (7 or more)

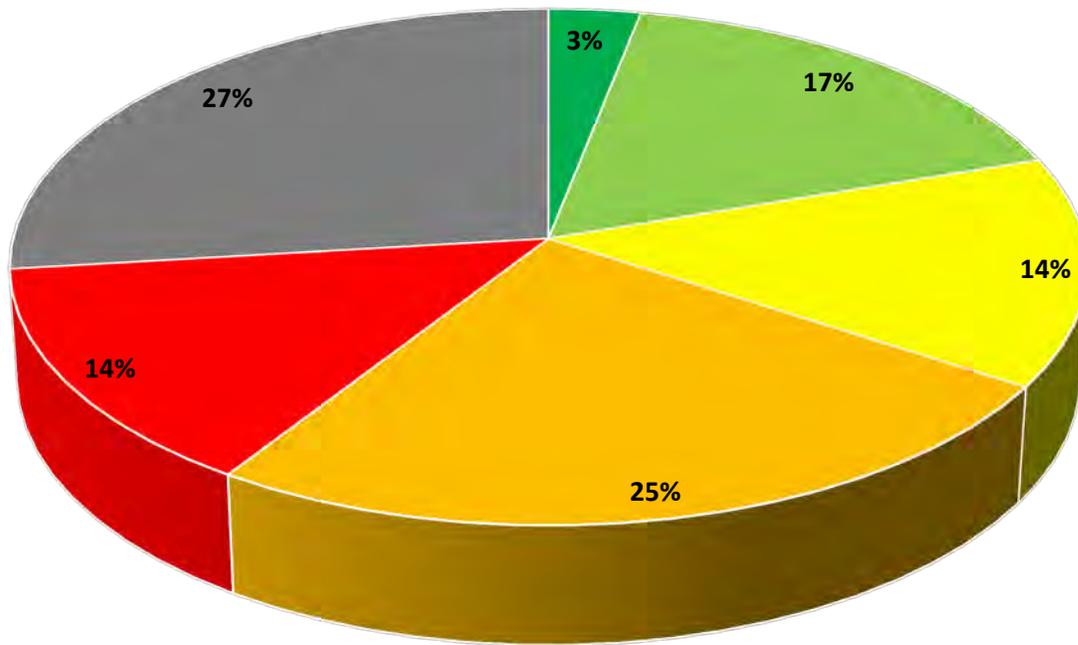


Appendix I

Table I-1: Summary of Area Breakdown by Total Constraint Score for Overall ALCOSAN Study Area

Total Constraint Score	Area (acres) per Basin							ALCOSAN Study Area Total	% Total Study Area
	Chartiers Creek	Lower Ohio Girty's Run	Main Rivers	Saw Mill Run	Turtle Creek	Upper Allegheny	Upper Monongahela		
0.5	1	0	0	13	12	0	0	25	0.1%
1	230	96	317	26	102	47	119	937	3%
1.5	1	0	0	2	5	0	0	8	0.0%
2	29	13	40	7	12	3	12	116	0.3%
2.5	49	18	151	11	31	7	20	286	1%
3	481	125	1439	92	80	807	414	3,439	10%
3.5	55	45	150	6	22	35	32	346	1%
4	333	96	687	132	85	296	236	1,865	5%
4.5	180	98	711	44	45	300	196	1,573	4%
5	18	27	74	15	20	17	17	187	1%
5.5	88	24	209	275	42	83	93	814	2%
6	256	98	796	139	98	249	204	1,839	5%
6.5	38	42	141	332	24	53	45	677	2%
7	60	26	321	150	37	135	79	808	2%
7.5	44	23	318	22	29	76	50	562	2%
8	223	83	583	215	76	220	169	1,570	4%
8.5	47	42	305	237	53	105	72	861	2%
9	57	35	363	44	40	132	92	763	2%
9.5	26	14	114	58	21	53	34	319	1%
10	24	5	66	55	27	20	25	222	1%
10.5	31	21	197	189	43	84	92	657	2%
11	60	51	427	37	48	138	87	848	2%
11.5	18	18	169	75	30	62	49	421	1%
12	14	2	50	19	13	21	24	144	0.4%
12.5	11	13	84	5	9	18	21	161	0.5%
13	11	4	68	11	4	15	17	129	0.4%
13.5	45	73	330	58	82	131	101	820	2%
14	6	1	27	7	9	15	14	78	0.2%
14.5	4	1	32	4	9	6	17	73	0.2%
15	12	6	64	3	2	12	2	100	0.3%
15.5	3	2	20	1	3	3	6	38	0.1%
16	1	1	17	0	2	2	3	26	0.1%
16.5	0	0	40	1	19	14	40	114	0.3%
17	1	0	17	1	1	2	1	23	0.1%
17.5	0	0	11	0	1	0	1	13	0.0%
18	1	1	21	0	0	0	0	23	0.1%
18.5	0	0	6	0	0	0	0	7	0.0%
19	0	0	1	0	0	0	0	1	0.0%
19.5	0	0	6	0	0	0	0	7	0.0%
20	0	0	21	0	0	0	0	22	0.1%
20.5	0	0	2	0	0	0	0	2	0.0%
21	0	0	0	0	0	0	0	0	0.0%
21.5	0	0	4	0	0	0	0	4	0.0%
22	0	0	0	0	0	0	0	0	0.0%
22.5	0	0	0	0	0	0	0	0	0.0%
23	0	0	0	0	0	0	0	0	0.0%
23.5	0	0	0	0	0	0	0	0	0.0%
24	0	0	0	0	0	0	0	0	0.0%
24.5	0	0	0	0	0	0	0	0	0.0%
25	0	0	0	0	0	0	0	0	0.0%
25.5	0	0	0	0	0	0	0	0	0.0%
26	0	0	0	0	0	0	0	0	0.0%
26.5	0	0	0	0	0	0	0	0	0.0%
Absolute Constraints	645	304	1,856	795	416	516	420	4,951	14%
Buildings with 10-foot Buffer	1,146	518	3,855	1,172	431	1,406	986	9,514	27%
Total Basin Study Area size	4,249	1,926	14,111	4,254	1,981	5,082	3,791	35,395	

Relative Level of Physical Constraints for GSI - % of Full Study Area



- Low (constraint score 2 or less)
- Medium (constraint score 2.5 - 4)
- Medium-High (constraint score 4.5 - 6.5)
- High (constraint score 7 or more)
- Absolute (wetlands, very steep slopes, etc.)
- Buildings with 10' Buffer

Figure I-1. Summary of Constraints Analysis in Full Study Area

Table I-2: Overall Constraint Score Summary for ALCOSAN Study Area

Constraint Score	Area (acres) per Basin							% Total Study Area
	Chartiers Creek	Lower Ohio Girty's Run	Main Rivers	Saw Mill Run	Turtle Creek	Upper Allegheny	Upper Monongahela	
Low (constraint score 2 or less)	6%	6%	3%	1%	7%	1%	3%	3%
Medium (constraint score 2.5 - 4)	22%	15%	17%	6%	11%	23%	19%	17%
Medium-High (constraint score 4.5 - 6.5)	14%	15%	14%	19%	12%	14%	15%	14%
High (constraint score 7 or more)	16%	22%	26%	28%	28%	25%	26%	25%
Absolute (wetlands, very steep slopes, etc.)	15%	16%	13%	19%	21%	10%	11%	14%
Buildings with 10' Buffer	27%	27%	27%	28%	22%	28%	26%	27%

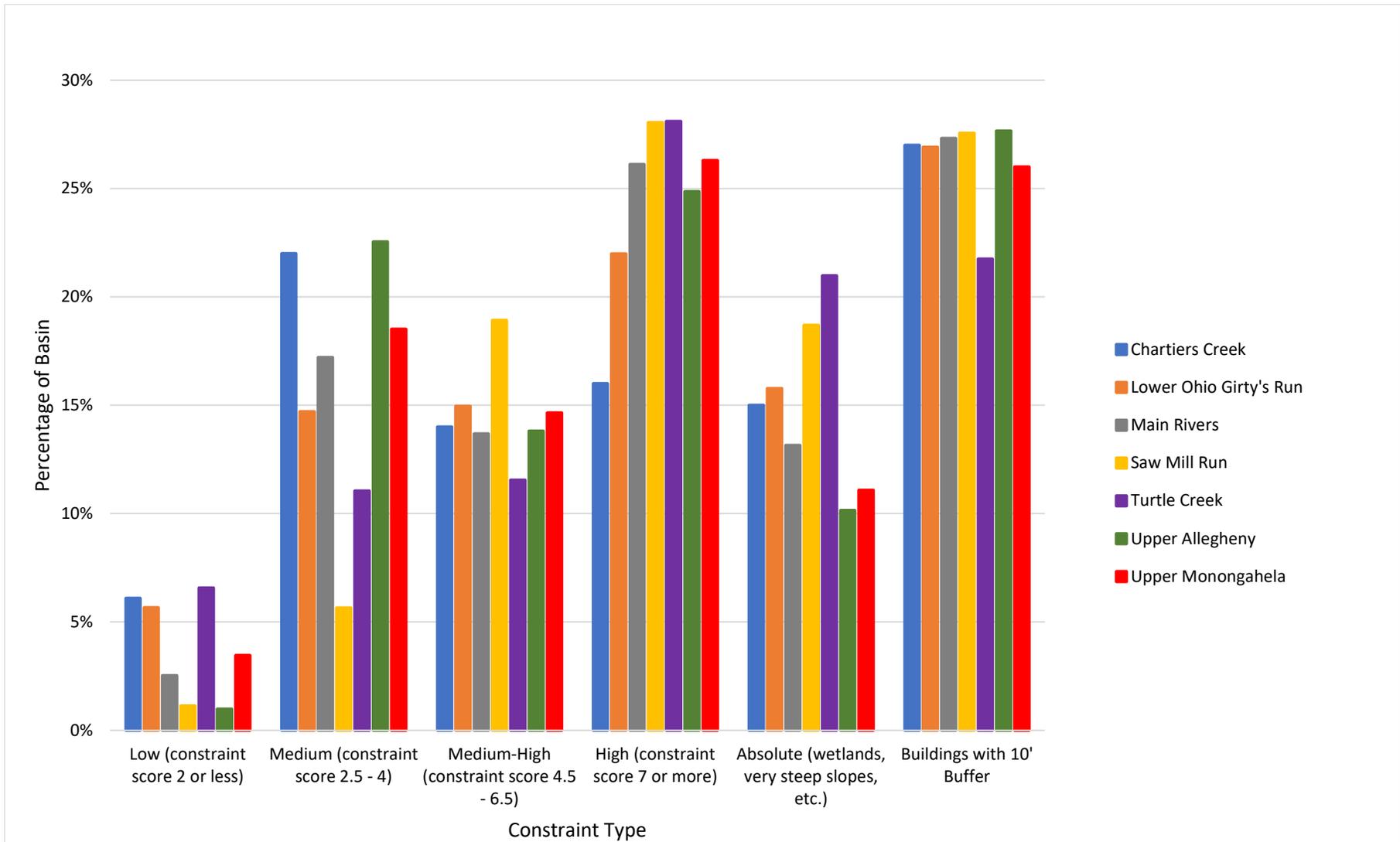


Figure I-2: Summary of Constraint Analysis per Basin for Total Study Area

Table I-3: Absolute Constraint Summary for ALCOSAN Study Area

Absolute Constraint Type	Area (acres) per Basin							% Total Study Area
	Chartiers Creek	Lower Ohio Girty's Run	Main Rivers	Saw Mill Run	Turtle Creek	Upper Allegheny	Upper Monongahela	
Wetlands (10-foot buffer)	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.03%
Surface Water and Streams (20-foot buffer)	0.5%	0.9%	0.2%	0.4%	2.2%	0.5%	0.5%	0.42%
Railroads (15-foot buffer)	1.4%	0.9%	1.1%	0.8%	1.4%	0.8%	2.0%	1.06%
Water (from Soil and Land Use)	0.0%	0.0%	0.1%	0.0%	0.6%	0.1%	0.0%	0.07%
Very steep slopes (25%+)	6.2%	9.1%	8.8%	8.5%	15.0%	7.1%	6.1%	7.27%
Parcels with Superfund or fuel/storage tank sites	0.6%	0.8%	0.4%	0.0%	0.7%	1.0%	0.3%	0.33%
Very Shallow Bedrock (less than 1.1 feet)	10.0%	4.5%	3.2%	12.4%	3.5%	0.9%	2.6%	4.70%
Floodway	0.2%	1.0%	0.2%	0.1%	0.6%	0.5%	0.1%	0.20%
Total Absolute (accounting for overlap)	16%	16%	13%	19%	21%	10%	11%	14%

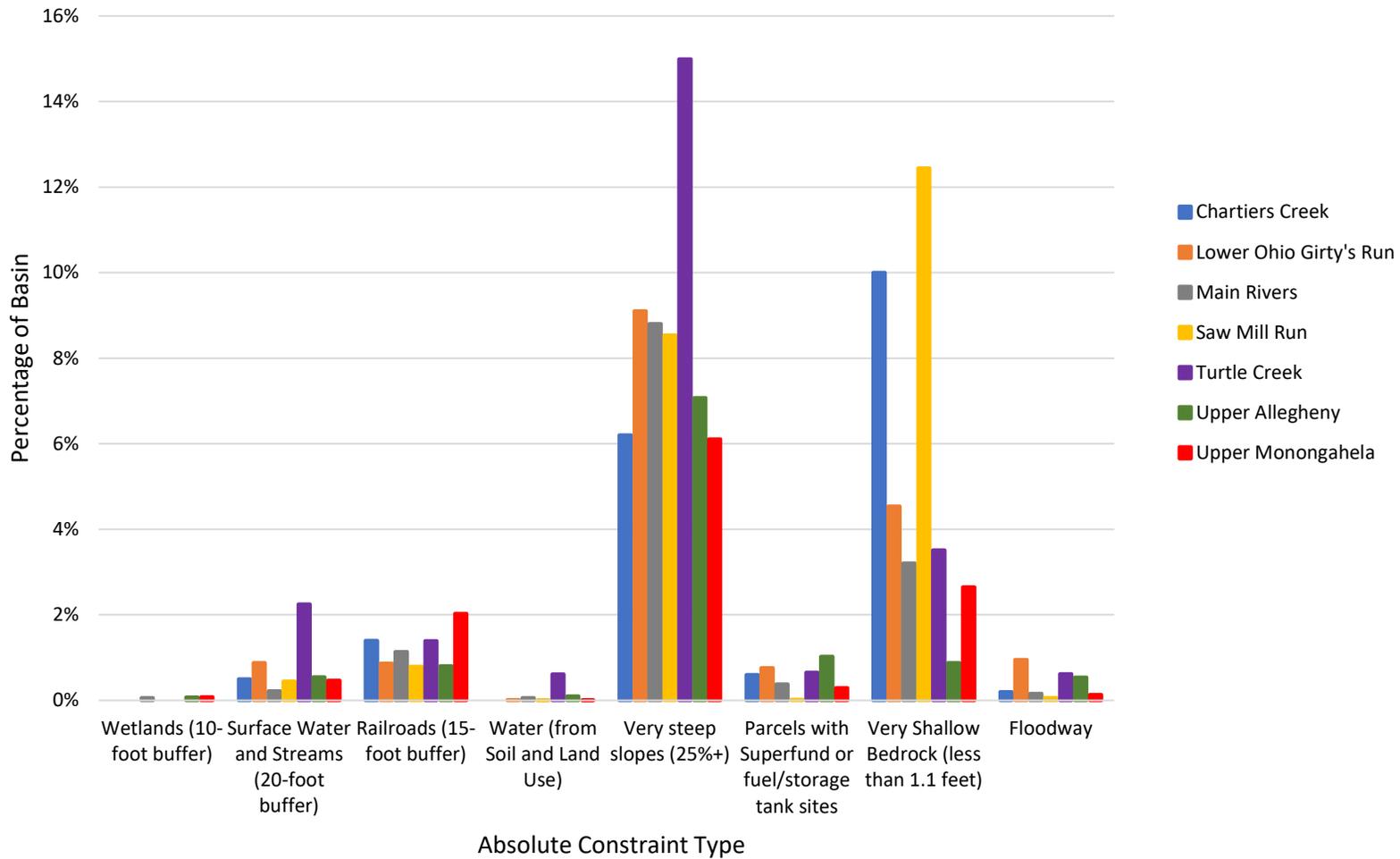


Figure I-3: Percentages of Absolute Constraint by Planning Area