Project Name: Developing PWSA's Strategic Plan for Stormwater

Project No.: 2020-025-OPS

Detailed Four Lenses Mapping and Methodology Memo

June 17, 2022

Purpose

The purpose of this analysis is to use the lenses of environmental justice, water quality, and flooding to determine priority areas for investment for PWSA.

A Note on the Planning Units

The spatial data used in this analysis has multiple geographic boundaries, including sewershed boundaries, MS4 subshed boundaries, census tracts, point data, and polyline data, as well as incorporates raster data. To handle the inconsistency across all geographic boundaries, and specifically to handle the gaps inherent to CSO sewershed coverage area, a set of Planning Units were created that correspond with local watershed boundaries of smaller creeks, major sewersheds, or direct drainage areas to the large rivers. These planning units are subdivisions of current hydrologic units established by the U.S. Geological Survey and align with the historic watersheds of several streams and runs that have been diverted underground.

Localized Flooding Lens

The localized flooding lens combines data sources obtained from PWSA, NOAA, PennDOT, Twitter, and First Street Foundation. This lens is not a flood risk assessment, rather it aggregates multiple data sources to determine where flooding related problems have occurred in the past and includes projected flood inundation during a 100 year storm during 2050 climate conditions. As with the previous two lenses, the scoring is assigned from 1 to 5, where 5 is highest combined observation of flooding related problems and projected flood inundation.

Methodology

The flood data was combined by determining how many occurrences of these data were within each planning unit, or how much of any of these data were within each planning unit. For the flood inundation data, the total inundation volume within each planning unit was calculated. For polyline layers such as the surcharging pipes data, the total linear feet of surcharging pipe within each planning unit were calculated. For point layers such as the capacity backups data, the number of backups within each planning unit were calculated. Finally, all the layers were reclassified and summed within each planning unit boundary, then reclassified in to the five groups.

The general workflow was as follows:

1. Summarize the volume/length/number of the input layer within the Planning Units boundaries.
2. Create a planning unit score for that layer on a scale of 1 to 5 using Jenks natural breaks of the layer's values.
3. Repeat for all input layers, creating a planning unit score for each layer.
4. Add all planning unit scores together, then regroup again into five groups on a scale of 1 to 5 using Jenks natural breaks.

Data Used:

- PWSA confirmed capacity related backups
- Modeled sewer pipes - surcharging under different storm intensities.
- NOAA flooding points
- PennDOT flood related road closures
- Flood incidents scraped from Twitter
- FloodFactor flood inundation, 2050 climate conditions, 1 in 100 year storm

Equity Lens

The equity lens uses the Environmental Justice Index created by the Allegheny County Health Department's Bureau of Assessment, Statistics & Epidemiology in 2019. The index aggregates the following eight indicators at the census level by ranking each raw metric in deciles on a scale of 1 to 10 and taking a simple mean of each indicator score. For indicators such as median household income, where higher value indicates lower need, the scores were assigned in descending order. For use in this analysis, the scores of 1 to 10 were then recategorized into five groups scored from 1 to 5.

Data Used:

- Median Household Income (MHINC)
- Diesel Particulate Matter (DPM)
- Particulate Matter ≤ 2.5 μm (PM2.5)
- Percent of the population identified as a racial minority
- Proximity to Greenspace
- Educational Attainment
- Miles of Railroad Track Coverage
- Housing Vacancy

Additionally, the team reviewed the EPA Environmental Justice Screening tool, as it is a nationally recognized resource for environmental justice mapping used across many states and jurisdictions. There is little variance between the priorities established by the Allegheny County environmental justice data and the EJ Screening tool data. The environmental justice indices included in the EJ Screening tool include:

- Particulate Matter 2.5
- Ozone
- 2017 Diesel Particulate Matter

- 2017 Air Toxics Cancer Risk
- 2017 Air Toxics Respiratory Health Index
- Traffic Proximity
- Lead Paint
- Superfund Proximity
- RMP Facility Proximity
- Hazardous Waste Proximity
- Underground Storage Tanks
- Wastewater Discharge

Opportunity Lens

The opportunity lens includes existing parks, greenways, and vacant lands that would provide opportunities for developing stormwater management projects. This lens was ultimately excluded from the final prioritization scoring, as the Strategic Plan team felt that the prioritization should ultimately be driven by need (i.e., the problem) rather than the ease of finding a cost-effective solution. However, this lens informed the selection of investment strategies and project types.

Water Quality Lens

The water quality lens integrates CSO outflow volumes and MS4 reduction requirements. A cumulative impact of each outfall is considered from 2022 until the projected completion of the Interim Measures Wet Weather Plan in 2037. The scoring methodology and the CSO volume analysis methodology are outlined below. As with the environmental justice lens, the scoring is from 1 to 5.

Overall Water Quality Scoring where 1 is lowest and 5 is highest:
1—3. Sewersheds that will eventually connect to the tunnel are grouped into three classes based on their cumulative outflow volumes projected over the next 15 years. Non-tunnel sewersheds that connect to sewer mains that will be transferred are included in these classes based on their cumulative outflow volume as well.

4. Non-tunnel sewersheds that are not in the PWSA confirmed transfer data layer ALCOSAN_Regionalization_Sewer_Mains were scored 4.

5. All MS-4 sheds were given the score of 5.

CSO Volumes Methodology

1. The timeline for the calculations is based on the implementation schedule in Section 11 – Interim Measures Wet Weather Plan of ALCOSAN Clean Water Plan.
2. The phase of the plan that each sewershed belongs to is determined by the sewersheds point of connection (POC), indicated by the first letter of the POC, such as A-42, which indicates that the POC flows in the Allegheny River and is associated with the Allegheny River Tunnel Segment. Sewershed points of connection are a field in the sewershed boundaries layer provided by PWSA.

   a. The POCs were also verified against the maps provided in the plan.
   b. Note, the plan is preliminary and subject to change according to ALCOSAN.
3. Determining the phase each sewershed belongs to establishes how long the shed's outfall will overflow at its current conditions flow rate before decreasing to its post-IWWP flow rate. The following calculation is used to determine cumulative volume using the two flow rates and the transition year determined by each sewersheds phase.
   a. Calculation for cumulative volume:
      (Current Flow Rate) * (Phase Year - 2022) +
      (Post-IWWP Flow Rate) * (2037 - Phase Year)
4. The cumulative outflow volumes were scored grouped into three groups and score 1 to 3, where 3 is the highest outflow volumes.

Data Used:

- ALCOSAN projected outfall volumes for current conditions and conditions after the Interim Wet Weather Plan interventions.
- Sewershed boundaries layer from PWSA.
- Outfall points layer from PWSA.
- PWSA confirmed sewer main transfer layer (ALCOSAN_Regionalization_Sewer_Mains)
- ALCOSAN Clean Water Plan

Aggregate of Environmental Justice, Water Quality, and Flooding Lenses

The preceding analysis led to three lenses that are then combined to create composite layers at both the Planning Unit and Sewershed geographic scale. These final composite layers can then be grouped again or ranked depending on the desired use of the final analysis.

Methodology

Each lens is considered equal in the aggregation steps. The three layers are converted from polygon layers, at geographic scales of census tract, sewershed/MS4 shed, and planning unit, to raster layers, which are then summed using raster algebra. The result is a raster layer with pixel values ranging from a minimum possible value of 1 to a maximum possible value of 15 (a score of 5 in each contributing lens). To overlay this composite back on to Planning Units or Sewersheds, zonal statistics are used to take the average pixel value found within each Planning Unit or Sewershed. The Planning Units and Sewersheds can then be ranked by these average values or grouped again into priority groups.

Detailed Four Lenses Mapping

The following maps show the detailed data that was aggregated to the planning unit boundaries, which are included in the Strategic Plan.

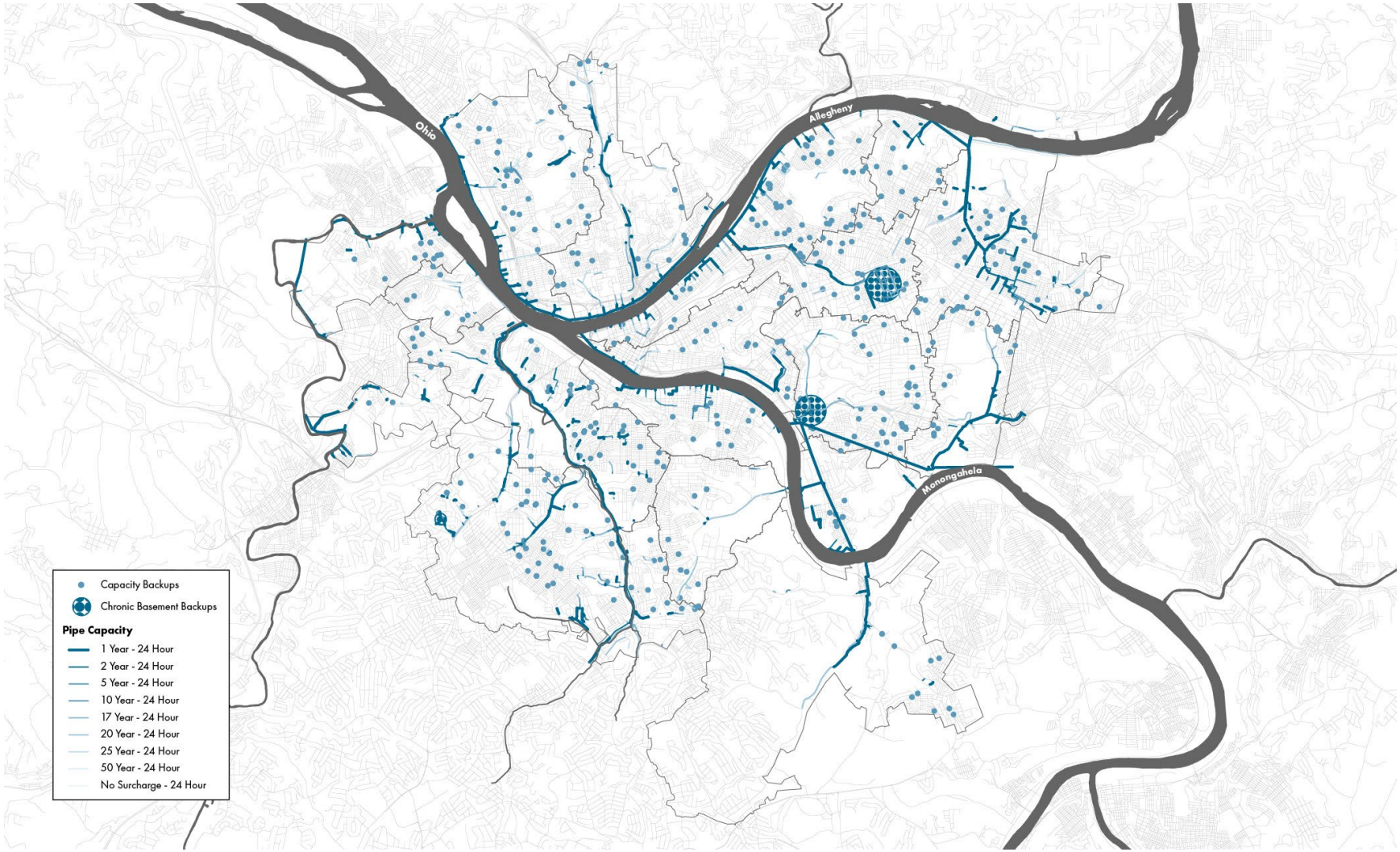

Figure 1: Localized Flooding Lens: Flooding Capacity

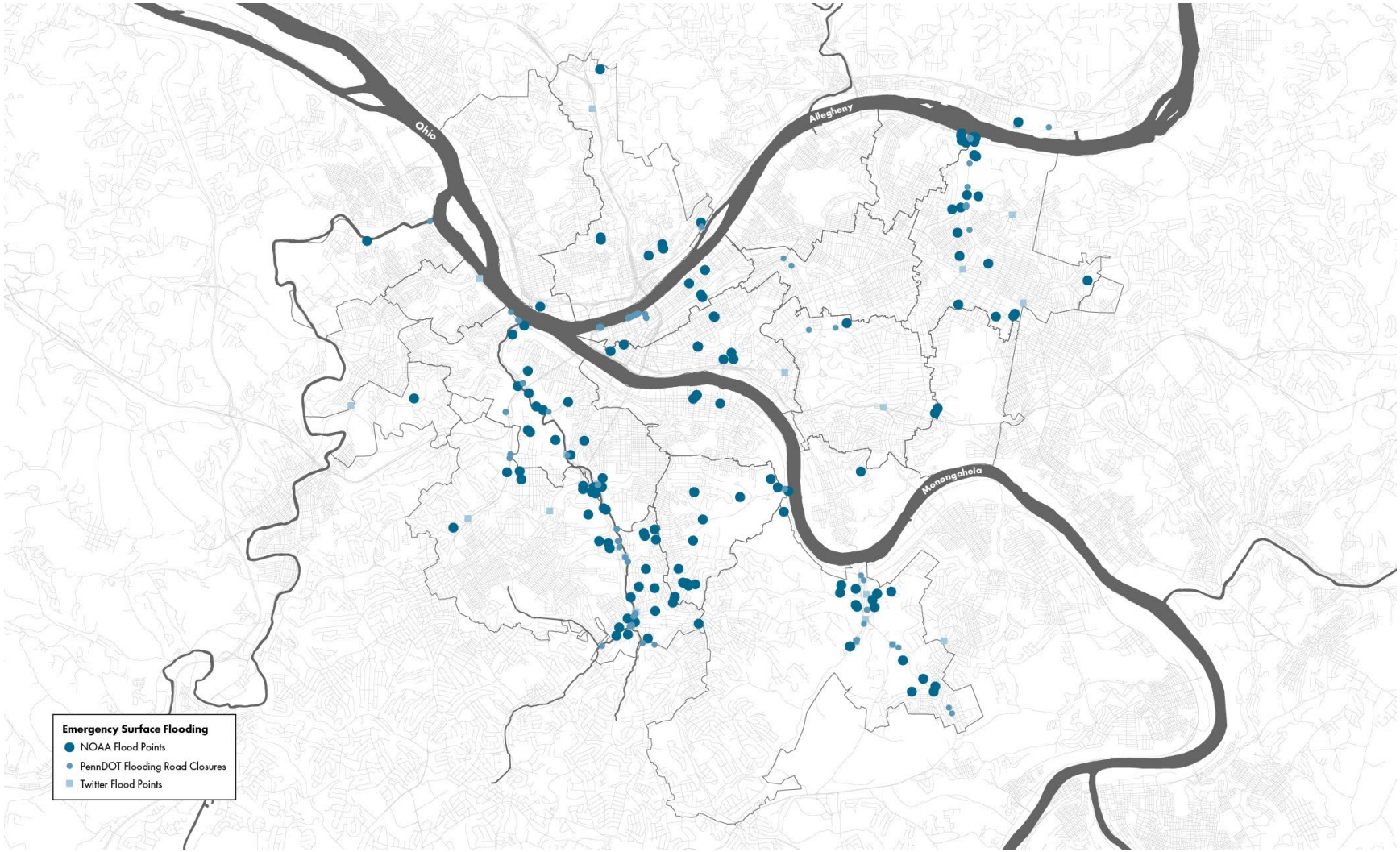

Figure 2: Localized Flooding Lens: Flooding Complaints

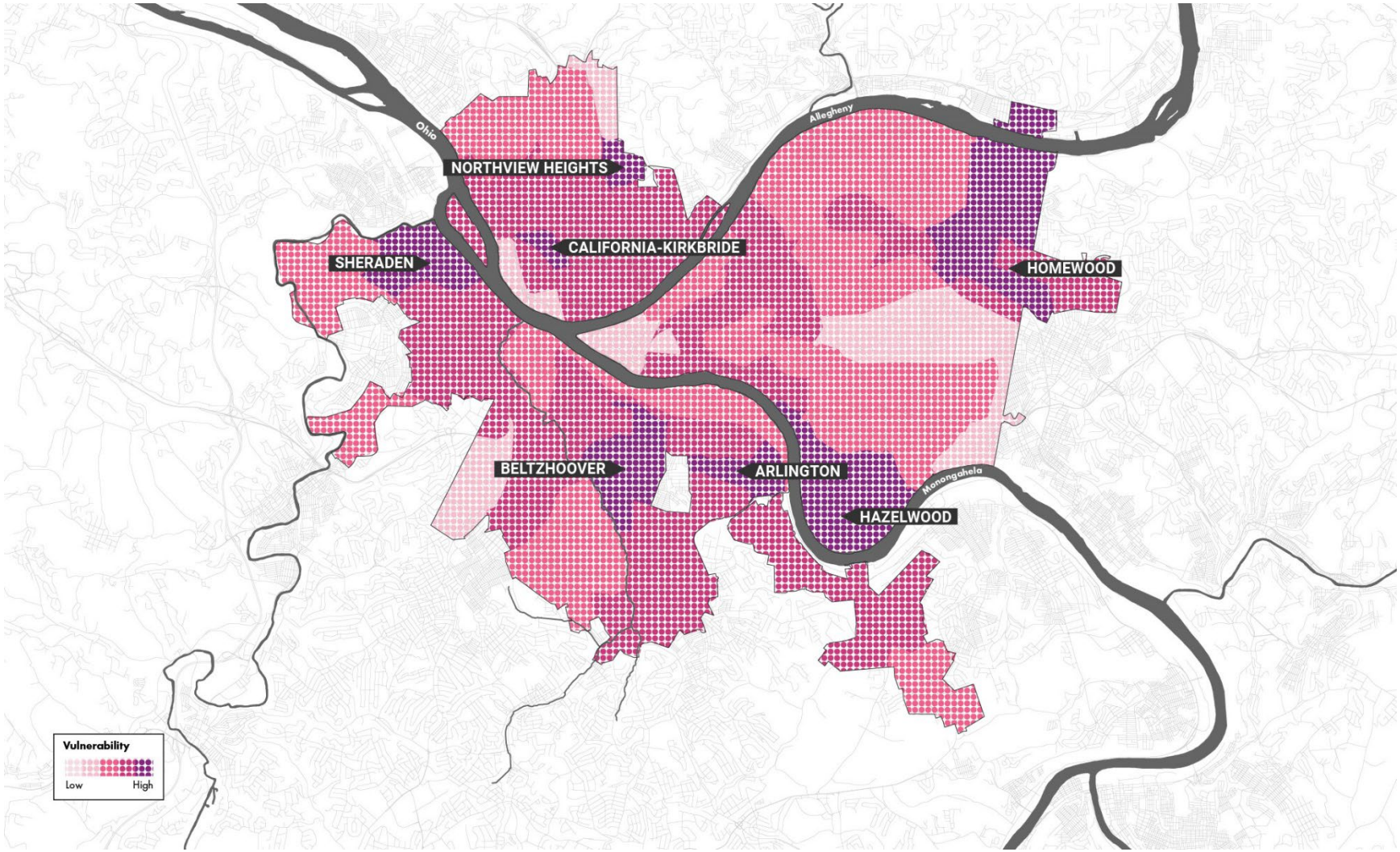

Figure 3: Equity Lens: Allegheny County Environmental Justice Index

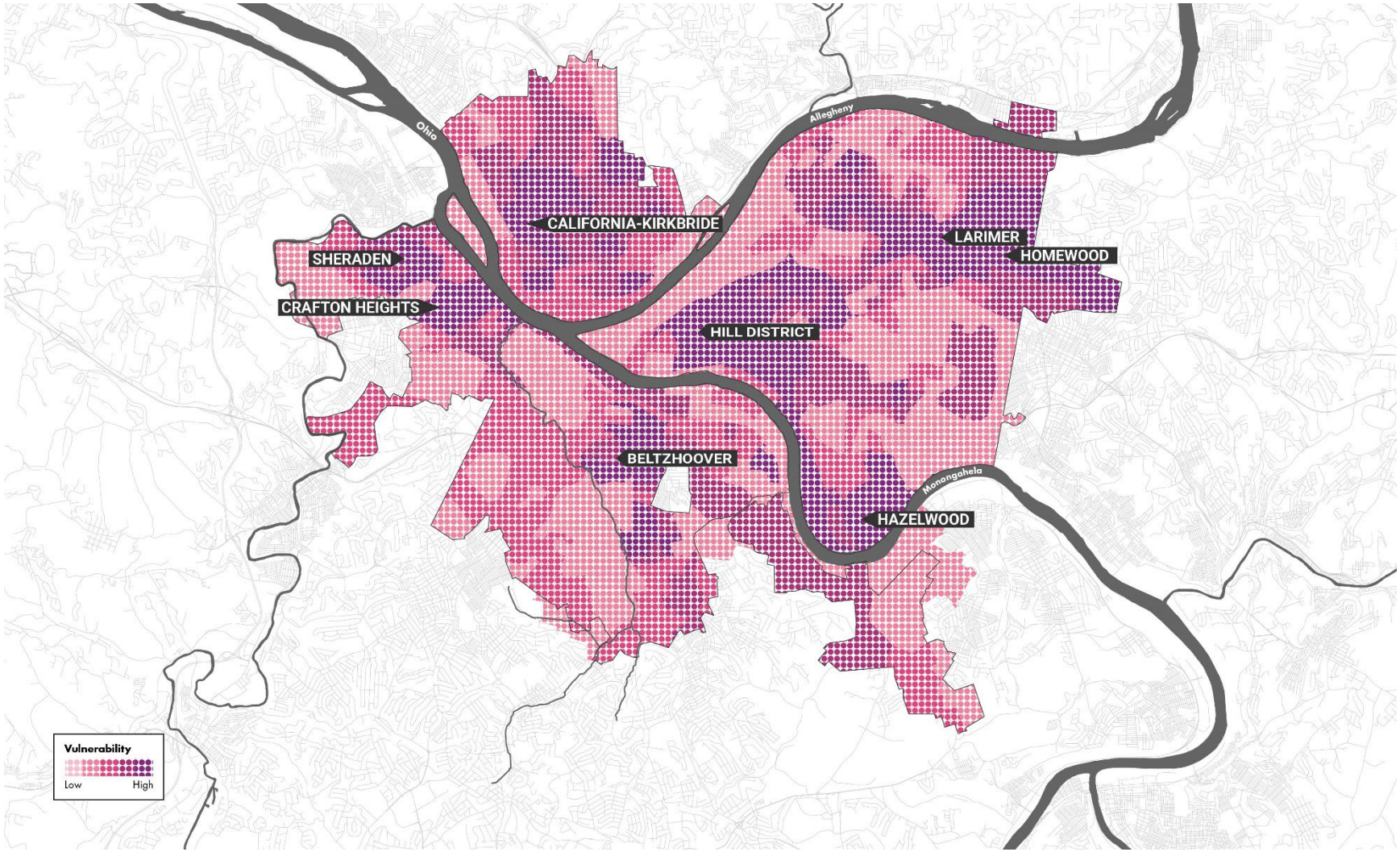

Figure 4: Equity Lens: EPA EJ Screen Environmental Justice Index

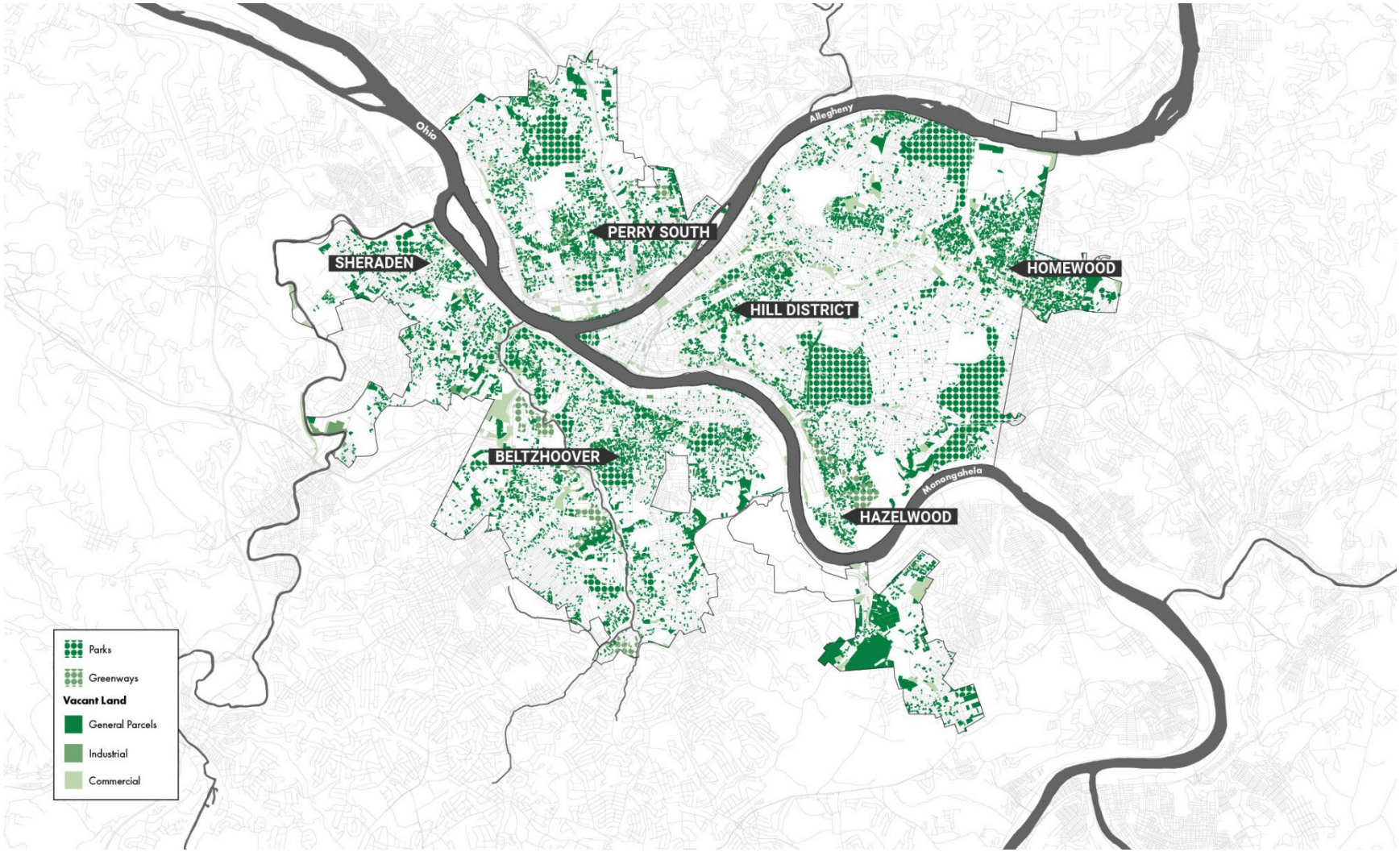

Figure 5: Opportunity Lens

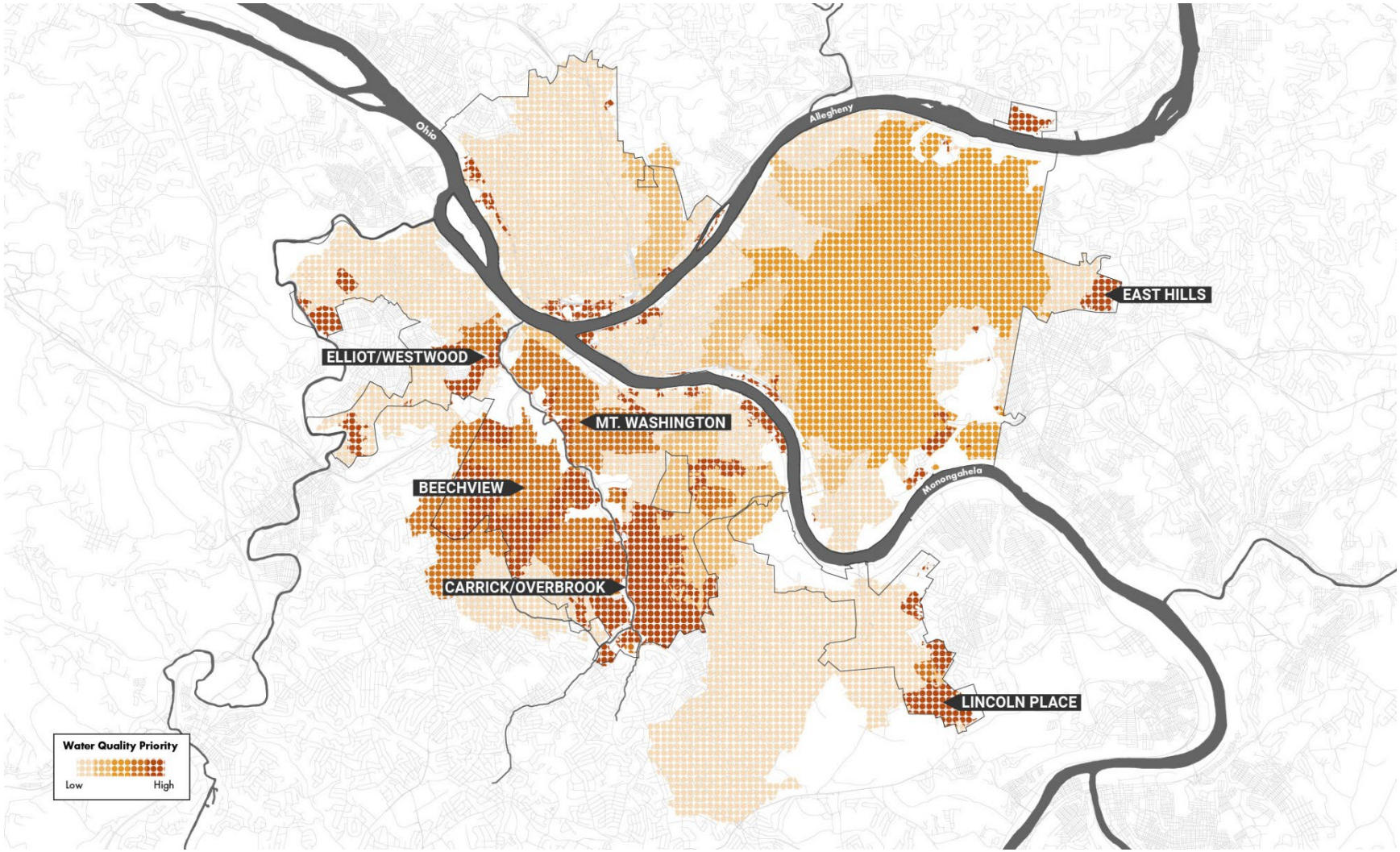

Figure 6: Water Quality Lens