City of Madison, Wisconsin

# Central Isthmus Watershed Study - Existing Condition and Mitigation Alternatives Model Report







Tetra Tech Project Number 200-166078-20001
October 2025

TETRA TECH

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October 2025

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## ACKNOWLEDGMENTS

Tetra Tech appreciates the valuable contribution of the following people to the success of this project.

City of Madison

- Jojo O'Brien, Project Manager
- Caroline Burger, Project Coordinator
- Richie Breidenbach, Engineer
- Hannah Mohelnitzky; Public Information Officer
- Janet Schmidt, Principal Engineer
- Greg Fries, Assistant City Engineer

## EXECUTIVE SUMMARY

### Background

Recognizing the changing rain patterns, and the likelihood of more frequent future large rain events, the City of Madison (City) is conducting a multi-faceted approach to address stormwater flooding. As one component of that approach, the City is developing comprehensive stormwater management studies for each watershed within the City. The studies are conducted in two phases. Throughout both phases, the City incorporates multiple opportunities for public involvement and interaction.

Phase 1 includes the development of a hydrologic/hydraulic stormwater runoff model representing the physical and drainage properties of the watershed under existing conditions. The model is used to identify the areas of the watershed most likely to flood under various rain conditions.

Phase 2 uses the model to evaluate alternative methods and infrastructure improvements to eliminate or reduce flooding impacts from large rain events.

The improvements documented in this report are not meant to be full design-level efforts; they are conceptual solutions that help the City's Engineering Division understand the magnitude of solutions needed in each area to meet the targets. As projects are looked at further, and if they move to the point where they are contemplated for programming, then projects will then go into a more detailed design phase.

This document reports the methods, procedures, and results of the Central Isthmus Watershed Study. The project area covers approximately 107 acres (0.17 square miles) in downtown Madison. Figure ES-1 shows the extent of the project area.

### City's Flood Mitigation Targets

The analyses use the City's flood mitigation targets, which may change in the future as more information becomes available. The flood mitigation targets include:

- No storm sewer surcharging onto the street for up to the 10 percent Annual Exceedance Probability (AEP) design storm.
- The centerline of the street to remain passable during a 4 percent AEP design storm with no more than 0.2 feet of water at the centerline.
- No home or business will be flooded during the 1 percent AEP design storm, which includes model-projected flooding of 6 inches or more within a 5-foot buffer of buildings.
- Enclosed depressions to be served to the 1 percent AEP design storm.
- Greenway crossings at streets to be served to the 1 percent AEP design storm.
- Safely convey stormwater during the 0.2 percent AEP design storm.
- Provide flooding solutions that do not negatively impact downstream properties.

### Existing Conditions Results

The existing conditions analysis found the following when compared to the City's flood mitigation targets:

- Of the 3.1 miles of storm sewer evaluated during the study, approximately 0.3 miles (10 percent) were projected to surcharge to grade during the 10 percent AEP design storm, thus not meeting the target. Projected surcharging is solely based on pipe capacity because inlet capacity was not evaluated.
- Of the 5.0 miles of streets evaluated in the study, approximately 0.3 miles (6 percent) were projected to have more than 0.2 feet of water at the centerline during the 4 percent AEP design storm, thus not meeting the target.
- Of the 252 buildings in the watershed, eleven, or 4 percent, are projected to be at risk of flooding during the 1 percent AEP design storm, thus not meeting the target. An additional 40 structures have less than 6 inches of projected water depth within the 5-foot buffer.
- There are no enclosed depressions or greenway crossings in the watershed.
- The 0.2 percent AEP design storm was not explicitly evaluated for impact on private property or safety during this study. However, overland flow is limited to streets and the defined channel along the WSOR tracks, and therefore, no specific areas of unsafe conveyance beyond the other Level of Service (LoS) Targets are identified.

Figure ES-1 shows surface flooding locations during the 4 percent AEP design storm and how the performance of the stormwater conveyance system compares to the City's flood mitigation targets.

**Recommended Solutions**

Following the existing conditions analysis, an extensive process was conducted to brainstorm, evaluate, and identify solutions to meet the City's flood mitigation targets. Fifteen mitigation solutions were developed and using different combinations of the solutions, three alternatives were evaluated. Design and construction cost opinions were not included in the project scope. Figures depicting each solution are provided later in the report.

- **Mitigation Solution A:** Replace 580 feet of existing 24-inch sewer on S. Broom Street between W. Doty and W. Wilson Streets with a 29-inch by 45-inch elliptical sewer.
- **Mitigation Solution B:** Install 560 feet of new 36-inch sewer on W. Wilson Street between S. Henry and S. Broom Streets.
- **Mitigation Solution C:** Replace 60 feet of existing 18-inch sewer on W. Wilson Street near the intersection with S. Broom Street with a 36-inch sewer to match the recommended upstream sewer from Mitigation Solution B.
- **Mitigation Solution D:** Redirect the existing 12- and 21-inch sewers from the existing S. Hamilton Street sewer to the recommended W. Wilson Street sewer (Mitigation Solution B).
- **Mitigation Solution E:** Redirect the existing 24-inch sewers from the existing S. Hamilton Street sewer to the recommended W. Wilson Street sewer (Mitigation Solution B).
- **Mitigation Solution F:** Replace 180 feet of existing 15-inch sewer on S. Pinckney Street near the intersection with E. Doty Street with an 18-inch sewer.
- **Mitigation Solution G:** Replace 120 feet of existing 15-inch sewer on S. Pinkney Street between E. Doty and E. Wilson Streets with a 21-inch sewer.

- **Mitigation Solution H:** Replace 40 feet of existing 15-inch sewer on S. Pinckney Street upstream of the intersection with E. Wilson Street with a 24-inch sewer.
- **Mitigation Solution I:** Replace 70 feet of existing 12-inch sewer on S. Pinckney Street downstream of the intersection with E. Wilson Street with an 18-inch sewer.
- **Mitigation Solution J:** Replace 76 feet of existing variable sized (15-21 inch) sewer on S. Hamilton Street upstream of the intersection with W. Wilson and S. Henry Streets with a 24-inch sewer.
- **Mitigation Solution K:** Replace 277 feet of existing 21-inch and 395 feet of existing 24-inch pipes on S. Hamilton Street downstream of the Wilson Street intersection with a 36-inch sewer. (This solution is not part of Alternative 3, the recommended alternative)
- **Mitigation Solution L:** Replace 120 feet of existing 12-inch sewer on E. Wilson Street near the intersection with King and S. Butler Streets with a 15-inch sewer.
- **Mitigation Solution M:** Replace 70 feet of existing 12-inch sewer on W. Doty Street near the intersection with S. Hamilton Street with an 18-inch sewer.
- **Mitigation Solution N:** Redirect the existing 12- and 15-inch sewers at the intersection of S. Hamilton, W. Wilson, and S. Henry streets from the existing S. Hamilton sewer to the recommended W. Wilson Street sewer (Mitigation Solution B).
- **Mitigation Solution O:** Replace 560 feet of existing 29-inch by 45-inch elliptical sewer along S. Broom Street from W. Wilson Street to the outfall with a 43-inch by 68-inch elliptical sewer.

**Recommended Solutions Results**

As the recommended solutions were being evaluated, they were compared to the flood mitigation targets. The analysis found that all flood mitigation targets were met with the recommended solution, including the following specific elements:

- All sewers are projected to meet the surcharge target during the 10 percent AEP design storm.
- All streets are projected to meet the drivability target during the 4 percent AEP design storm.
- No buildings are projected to flood during the 1 percent AEP design storm.
- The 0.2 percent AEP design storm was not explicitly evaluated for impact on private property or safety during this study, however, a significant reduction in flooding was achieved.

Figure ES-2 shows the recommended solution, Alternative 3, and the proposed mitigation solutions. Figure ES-3 depicts the flood control summary within the watershed with the recommended solutions implemented. It shows surface flooding locations during the 4 percent AEP design storm and how the performance of the improved stormwater conveyance system compares to the City's flood mitigation targets with the selected solutions in place. Additional schematics depicting mitigation solutions can be found in Appendix E.

Figure ES-1: Existing Conditions - Flood Mitigation Goals

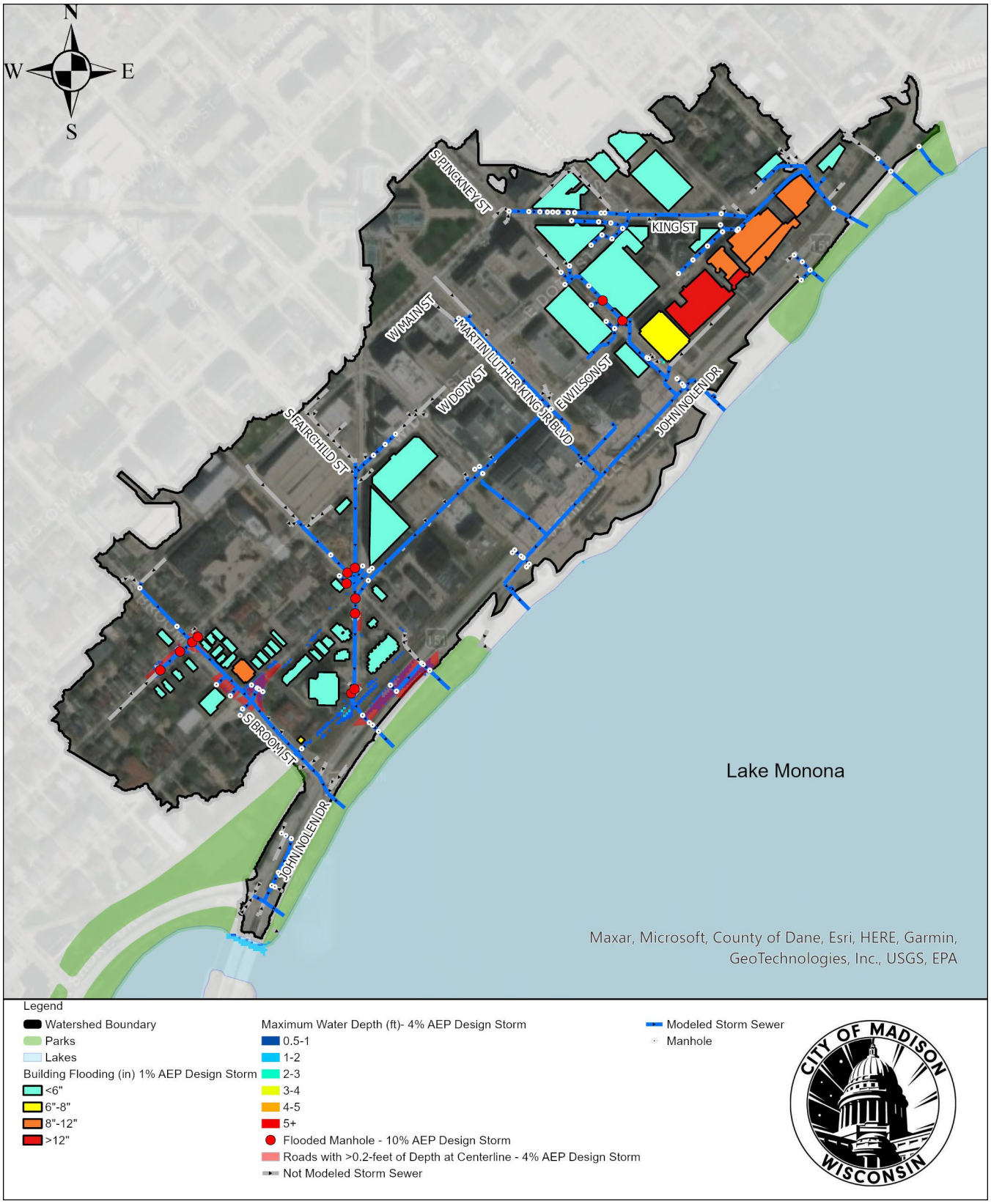


Figure ES-2: Alternative 3 – Schematic (Chosen Alternative)



Figure ES-3: Alternative 3 - Flood Mitigation Goals



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Appendix B: Hydrologic and Hydraulic Input Parameters
Appendix C: Flood Maps
Appendix D: Mitigation Alternatives
Appendix E: East Isthmus Yahara Watershed Study Calibration

## ACRONYMS

| Term | Definition |
|---|---|
| 1D | one dimensional |
| 2D | two dimensional |
| AEP | Annual Exceedance Probability |
| ASCII | American Standard Code for Information Interchange |
| CRS | Coordinate Reference System |
| DCIA | Directly Connected Impervious Area |
| DNR | Department of Natural Resources |
| GIS | Geographic Information System |
| HARN | High Accuracy Reference Network |
| HEC-SSP | Hydrologic Engineering Center Statistical Software Package |
| HGL | Hydraulic Grade Line |
| HSG | Hydrologic Soil Group |
| LoS | Level of Service |
| MSE | Midwest South East |
| NAD | North American Datum |
| NOAA | National Oceanic and Atmospheric Administration |
| NRCS | Natural Resources Conservation Service |
| OHWM | Ordinary High-Water Mark |
| PFC | Peak Flow Control |
| ROW | Right-of-Way |
| SLU | Standard Land Use |
| SWMM | Storm Water Management Model |
| USACE | United States Army Corps of Engineers |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| VC | Volume Control |
| WinSLAMM | Windows Source Loading and Management Model |
| WSOR | Wisconsin and Southern Railroad |

# 1.0 INTRODUCTION

## 1.1 PROJECT BACKGROUND AND PURPOSE

Over the last several years, the City of Madison has been evaluating its storm sewer system to understand potential flooding risks caused by large rainfalls and developing alternatives to mitigate the risk. The studies are being conducted by watershed. The focus of this evaluation is the Central Isthmus watershed, which was completed concurrently with the larger, adjacent East Isthmus and Yahara River Isthmus (East Isthmus) watershed. Figure 1-1 shows the extent of the Central Isthmus watershed. The East Isthmus watershed study is documented in a separate report.

## 1.2 RAINFALL EVENT NOMENCLATURE

The watershed study includes evaluating potential flood risks for multiple statistical rainfalls ranging from the 50 percent annual exceedance probability (AEP) to the 0.2 percent (AEP). Statistical rainfalls are based on both the magnitude and duration of the event. Statistical rainfalls have a defined nomenclature, but the same event can be described in multiple ways.

For example, a 1 percent AEP rainfall is also called the 100-year storm because, on average, the recurrence or return interval between a rainfall of that size is 100 years. However, encountering a 100-year storm in one year does not decrease the chance of a second 100-year storm occurring in that same year or any following year. In other words, there is a 1 in 100 or 1 percent chance that a storm will reach this intensity in any given year. Likewise, a 50-year rainfall event has a 1 in 50 or 2 percent chance of occurring in a year.

Table 1-1 Rainfall Event Nomenclature

| Annual Exceedance Probability (AEP) | Recurrence Interval or Return Period (year) | Probability of Occurrence in any Given Year |
|---|---|---|
| 50% | 2 | 1 in 2 |
| 20% | 5 | 1 in 5 |
| 10% | 10 | 1 in 10 |
| 4% | 25 | 1 in 25 |
| 2% | 50 | 1 in 50 |
| 1% | 100 | 1 in 100 |
| 0.5% | 200 | 1 in 200 |
| 0.2% | 500 | 1 in 500 |

## 1.3 SCOPE OF STUDY

The project's scope of study included the tasks listed below:

1. Review and Update Collection System Data. This task reviewed the city's GIS data to identify missing or potentially erroneous data and updated as necessary based on available drawings and field investigation. Record drawings were provided by the city. In cases where record documents could not verify data, assumptions were made (see Section 4.4.2 for more detail).
2. Develop Existing Conditions Model. Model development included calculating model inputs and building the model in XPSWMM™. Hydrologic inputs were based on the adjacent East Isthmus watershed since watershed specific model calibration was not performed in the Central Isthmus.
3. Execute the Existing Conditions Model. The model was then solved for a range of design storm events (0.2- to 50% AEP) for existing conditions to predict the collection system's performance. Predicted flood inundation maps were shared with the public and stakeholders during the public information meeting to obtain feedback on system performance and areas of flooding.
4. Evaluate Flood Mitigation Measures. Mitigation alternatives were developed for locations of concern, which included areas of flooding observed by City staff and the existing condition model results. Mitigation alternatives followed the City's flood mitigation targets and a hydraulic justification for each proposed measure. The recommended solutions were shared with the public and stakeholders during the public information meeting.

The Central Isthmus Watershed Study was completed on a compressed timeline in comparison to other watershed studies so that recommended solutions from the study could be built with a reconstruction project at Wilson and Broom Streets. Completing the study on a compressed timeline was feasible because of the small size of the watershed, limited known flooding issues, and the fact that the watershed is fully urbanized, so the primary solutions involved increasing pipe sizes. The main differences between the Central Isthmus Watershed Study and other studies are:

1. The City hosted one public information meeting instead of the typical three. The public information meeting presented the existing conditions and proposed solutions and discussed how the solutions would be incorporated into upcoming projects.
2. No flow monitoring was conducted, so a watershed-specific calibration did not occur. Calibration parameters from the neighboring watershed, the East Isthmus watershed, were applied to the Central Isthmus watershed.

Figure 1-1: Central Isthmus Watershed Location Map



## 1.4 HISTORIC FLOODING IN WATERSHED

Historic flooding has occurred predominantly in the lower elevations of the watershed, particularly along S. Broom and S. Hamilton Streets, which are shown on Figure 1-3. Historically three areas have been reported as significant areas of concern for flooding. These include:

1. The parking lot and first floor elevations of the Nolen Shore Condominiums (shown in Figure 1-2), at the dead end of S. Hamilton Street, adjacent to the Wisconsin and Southern Railroad (WSOR) train tracks and John Nolen Drive, are lower than the street and sidewalk. During heavy rainfall, stormwater from the intersection of S. Hamilton, S. Henry, and W. Wilson streets can flow south along S. Hamilton Street into the Nolen Shore Condominium parking lot and first floor of the building.

Figure 1-2: Nolen Shore Condominiums




2. A low point on S. Hamilton Street between W. Wilson Street and the dead end, adjacent to the Nolen Shore Condominiums.
3. The intersection of S. Broom and W. Wilson streets is a local low point. Stormwater runoff from the intersection of S. Broom and W. Doty Streets, as well as the intersection of S. Hamilton, S. Henry, and W. Wilson Streets, flows overland towards this location due to limited sewer and inlet capacity.

Figure 1-3: Reported Flood Locations



## 1.5 SUMMARY OF PAST STUDIES

There are no past studies of the Central Isthmus watershed.

## 1.6 COORDINATE SYSTEM AND VERTICAL DATUM

The hydraulic model and mapping data shown in this report use the North American Datum (NAD) 1983 HARN Wisconsin CRS Dane (US Feet) coordinate system. Elevations utilize the North American Vertical Datum of 1988 (NAVD88). Some record documents reference elevations in the City of Madison Datum, which is 845.60 feet below NAVD88 (City of Madison Datum = NAVD88 – 845.60 feet).

## 1.7 FLOOD MITIGATION LEVEL OF SERVICE TARGETS

The City has the following flood mitigation Level of Service (LoS) targets. These targets may change in the future as more information becomes available. Table 1-2 lists the flood mitigation LoS targets.

Table 1-2 Flood Mitigation LoS Targets

| LoS Target | Focus | Description | AEP |
|---|---|---|---|
| 1 | Collection System | No storm sewer surcharging of the collection system onto the street | 10% |
| 2 | Passable Streets | Street to remain passable to automobiles with no more than 0.2 feet of water at the centerline. | 4% |
| 3 | Building Flooding | No home or business will be flooded and enclosed depressions and greenway crossings at streets will be served. | 1% |
| 4 | Safe Conveyance | Safely convey stormwater runoff. | 0.2% |
| 5 | Downstream Impacts | Provide flooding solutions that do not negatively impact downstream properties | All |

# 2.0 WATER RESOURCES INVENTORY

## 2.1 STUDY SETTING

The Central Isthmus watershed is approximately 107 acres and is fully urbanized. The watershed is approximately 80 percent impervious. The watershed borders the East Isthmus watershed to the northeast, Lake Monona to the southeast, and the Near West watershed on the other sides. Stormwater conveyed by the public drainage system discharges into Lake Monona. The extent of the watershed relative to Lake Monona and the East Isthmus watershed is depicted in Figure 1-1.

Prominent geographic features within the watershed include:

- Lake Monona, discussed further in Section 2.3.1.
- John Nolen Drive (US-151), which is a 6-lane road parallel to the Wisconsin and Southern Railroad (WSOR) tracks and Lake Monona shoreline. The major outfalls in the watershed cross the road and WSOR rights-of-way (ROW), presenting constructability constraints for conveyance improvements.

Infrastructure mentioned by city staff that is susceptible to flooding within the watershed:

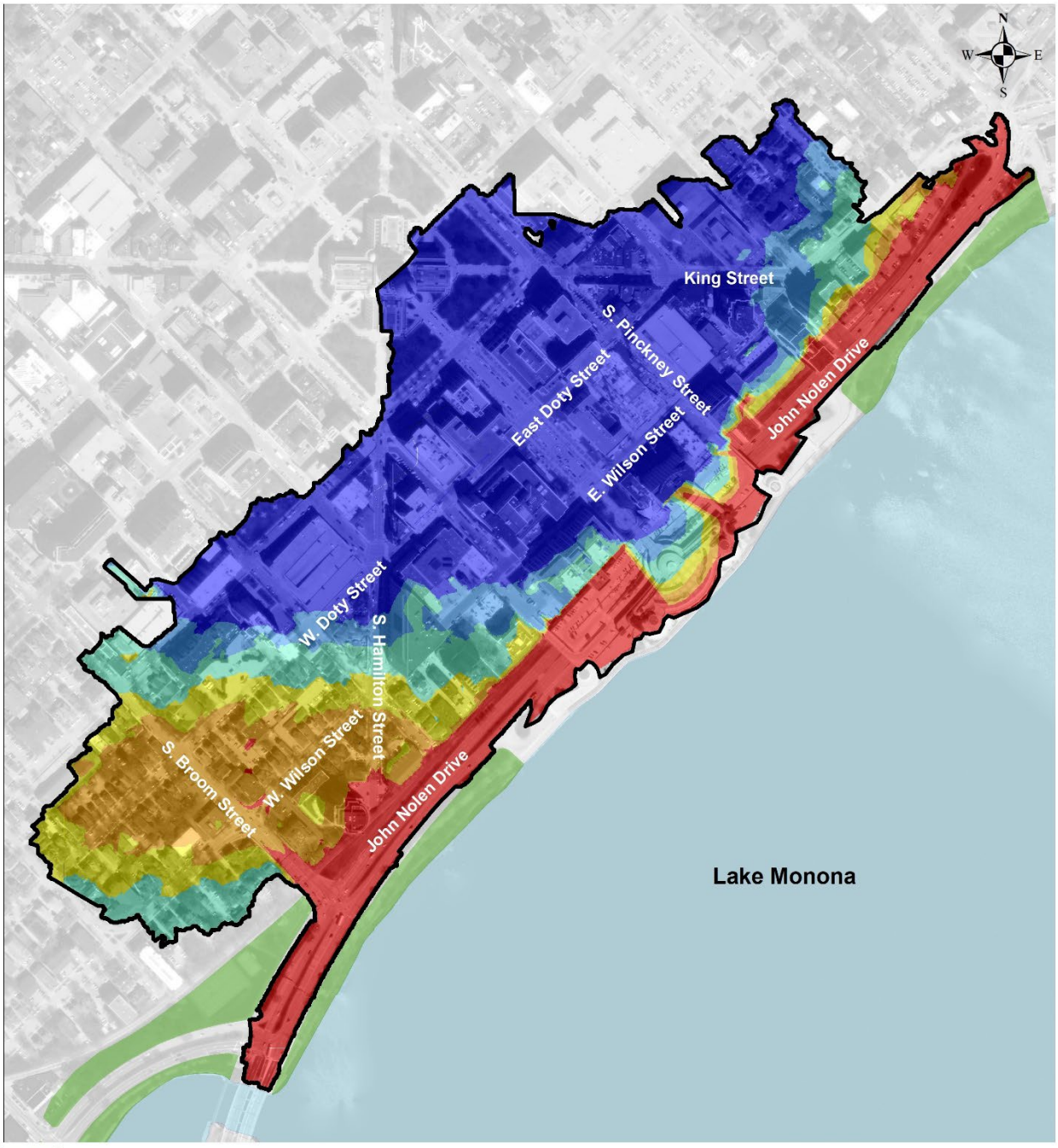
- Nolen Shore Condominiums at the dead end of S. Hamilton Street near John Nolen Drive.
- Municipal Buildings on E. Wilson Street northeast of the intersection with S. Pinckney Street.

## 2.2 TOPOGRAPHY

The City's 2016 Lidar data is the source of ground elevations used in the study. The terrain on the south quadrant of the intersection of E. Doty and S. Pinckney Streets was manually adjusted to match the adjacent elevations because of a hole in the data caused by building construction. Most of the area that was adjusted is now within a building footprint and was treated the same in the 2D portion of the model as other buildings.

Elevations in the watershed range from 849 feet to 924 feet, with a consistent downward slope from northwest to southeast toward Lake Monona, as shown in Figure 2-1. Over the span of approximately 1,000 linear feet on S. Hamilton Street from E. Doty Street to the dead end, the elevation drops over 55 feet, which characterizes the steep grades present in the watershed.

Figure 2-1: Central Isthmus Watershed Topography



## 2.3 DRAINAGE SYSTEMS

The Central Isthmus watershed is fully urbanized. As such, the drainage system predominately consists of a constructed urban stormwater conveyance system with curb and gutter and storm sewers. An open channel drainage ditch runs parallel to the WSOR tracks and adjacent to John Nolen Drive. The drainage ditch is relevant to the flooding issues at the south end of Hamilton Street.

### 2.3.1 Natural System

The only natural drainage features within the Central Isthmus watershed is Lake Monona, which is the receiving waterbody for all drainage in the Central Isthmus watershed.

Lake Monona water surface levels have been tracked and documented by USGS since 1915. High water recurrence intervals are estimated from the 1990 to 2020 subset of the USGS gauging station 05429000 data. Earlier water surface elevations are not included because of changes in lake level management methods and watershed urbanization that have occurred. The lake level return intervals were calculated using the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center's Statistical Software Package (HEC-SSP). Table 2-1 lists the regulatory and flood water surface elevations for Lake Monona.

Table 2-1: Lake Monona Water Surface Elevations

| | Water Surface Elevation (feet) |
|---|---|
| Target Winter Minimum[†] | 842.0 |
| Target Summer Maximum[†] | 845.0 |
| Ordinary High Water Mark[†] | 845.62 |
| 1% AEP (100-year) Flood | 847.49 |
| Record High Lake Level (2018) | 848.31 |

[†] *Dane County Lake Level Management Guide for the Yahara Chain of Lakes*, page 5, Table 1. Elevations converted from NGVD29 to NAVD88.

### 2.3.2 Constructed System

Stormwater is conveyed entirely through 10 storm sewer outfalls discharging into Lake Monona, all of which are either fully or partially submerged below the lake's ordinary high-water mark (OHWM). Five of the outfalls have an upstream storm sewer system that provides drainage solely for John Nolen Drive. The other five outfalls serve the remainder of the watershed. Table 2-2 summarizes the storm sewer outfalls. The tributary drainage areas for each outfall are depicted in Figure 2-2**.**

Table 2-2: Storm Sewer Outfalls

| Location | Shape | Size (inches) | Invert Elevation (feet) | Drainage Area (acres) |
|---|---|---|---|---|
| N. Shore Drive | Circular | 24 | 844.35 | 2.1 |
| S. Broom Street | Elliptical | 29 x 45 | 844.35 | 26.4 |

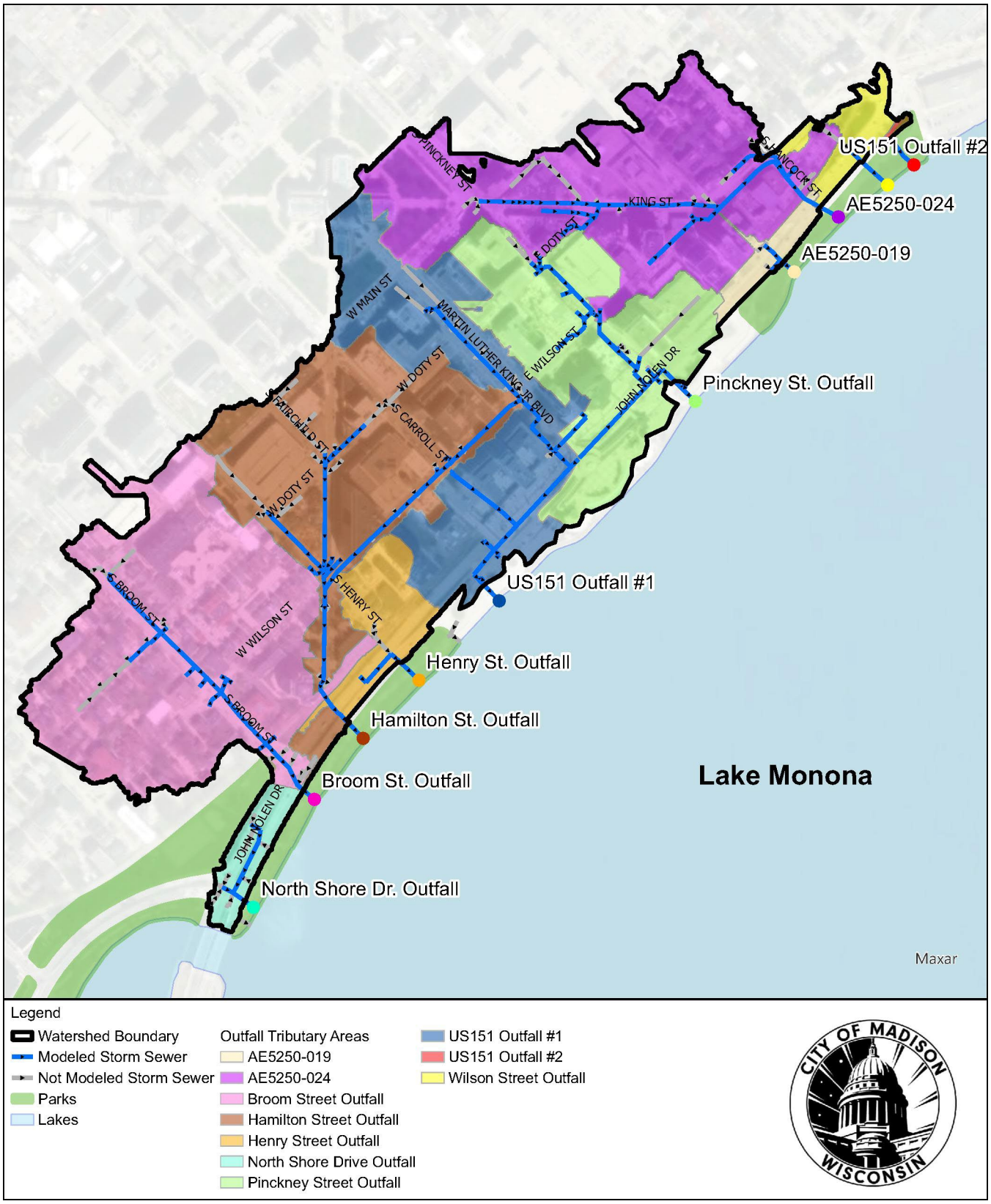
| Location | Shape | Size (inches) | Invert Elevation (feet) | Drainage Area (acres) |
|---|---|---|---|---|
| S. Hamilton Street | Circular | 21 | 843.60 | 19.1 |
| S. Henry Street | Circular | 21 | 844.35 | 3.8 |
| Between S. Henry and S. Pinckney Streets | Box | 36 x 72 | 843.24 | 15.2 |
| S. Pinckney Street | Elliptical | 29 x 45 | 843.12 | 14.5 |
| S. Butler Street | Circular | 24 | 844.10 | 1.4 |
| S. Hancock Street | Circular | 36 | 843.85 | 21.9 |
| S. Franklin Street | Circular | 30 | 843.00 | 2.0 |
| S. Blair Street | Circular | 18 | 843.00 | 0.1 |

Except for an approximately 200-foot-long ditch running parallel to the WSOR tracks from S. Hamilton to S. Broom Streets, the system contains only storm sewers ranging in size from 6 inches in diameter to 36- x 72-inch elliptical sewers. The existing storm sewer network has approximately 4.3 miles of storm sewer, of which approximately 3.1 miles are evaluated in the hydraulic model. Table 2-3 summarizes the length of sewer evaluated in the hydraulic model by size and shape. Figure 2-2 shows modeled and non-modeled sewers.

Table 2-3: Storm Sewer Summary

| Size (inches) | Shape | Length Evaluated in Model (feet) | Length not Evaluated in Model (feet) | Total Length (feet) |
|---|---|---|---|---|
| 8 | Circular | 119 | 213 | 332 |
| 10 | Circular | 61 | 60 | 121 |
| 12 | Circular | 1,743 | 4,467 | 6,210 |
| 15 | Circular | 1,638 | 1,624 | 3,262 |
| 18 | Circular | 4,396 | 0 | 4,396 |
| 20 | Circular | 104 | 0 | 104 |
| 21 | Circular | 1,726 | 0 | 1,726 |
| 24 | Circular | 2,753 | 0 | 2,753 |
| 27 | Circular | 396 | 0 | 396 |
| 30 | Circular | 778 | 0 | 778 |
| 36 | Circular | 557 | 0 | 557 |
| 14 x 23 | Box | 163 | 0 | 163 |
| 36 x 72 | Box | 416 | 0 | 416 |
| 19 x 30 | Elliptical | 250 | 0 | 250 |
| 24 x 38 | Elliptical | 20 | 0 | 20 |
| 29 x 45 | Elliptical | 942 | 0 | 942 |
| 34 x 53 | Elliptical | 15 | 0 | 15 |
| 38 x 60 | Elliptical | 407 | 0 | 407 |

Figure 2-2: Constructed Drainage System Map



## 2.4 RUNOFF CONDITIONS

Stormwater runoff generated from the land surface varies with the magnitude of impervious area, soil type, and topography.

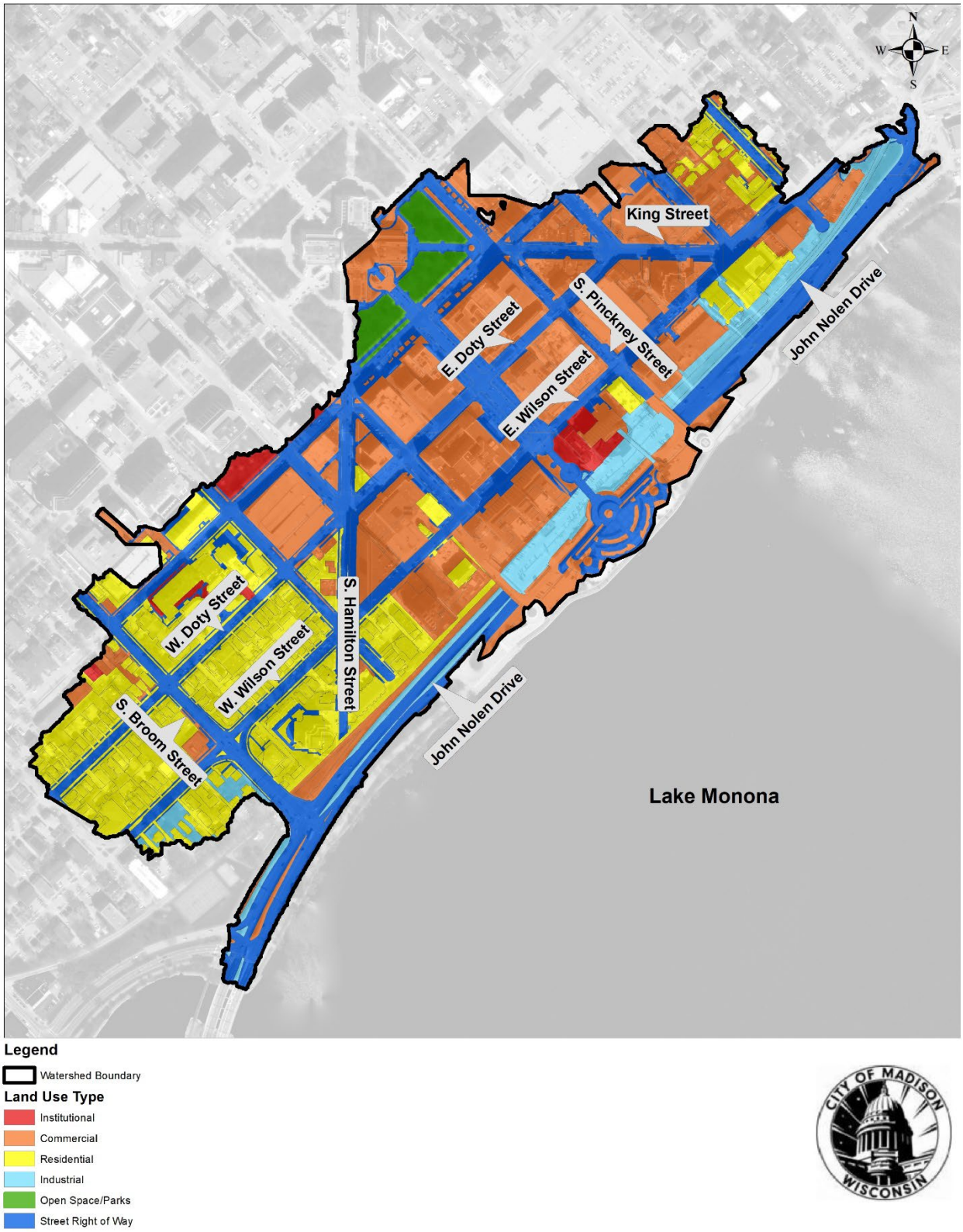
### 2.4.1 Land Use

The Central Isthmus watershed is a highly developed urban area. Land use data provided by the City, categorizes areas into 19 different land uses. This information was simplified into six general land use types. Table 2-4 summarizes the land use within the watershed. Figure 2-3 shows land use within the watershed. Appendix B includes additional detail on the land use categories.

Table 2-4: Existing Land Use

| Land Use Type | Area (acres) | Percent (%) |
|---|---|---|
| Residential | 24.1 | 23 |
| Institutional | 1.8 | 2 |
| Commercial | 36.4 | 34 |
| Industrial | 6.8 | 6 |
| Open Space/Parks | 2.1 | 2 |
| Street Right of Way | 35.6 | 33 |
| **Total** | **106.8** | **100** |

Figure 2-3: Watershed Land Use Types



### 2.4.2 Impervious Area

The City of Madison's 2020 Impervious Cover layer was used to define pervious and impervious areas. The watershed is approximately 80 percent impervious, including streets, parking lots, and building roofs. Table 2-5 summarizes the watershed imperviousness.

Table 2-5: Watershed Surface Type

| Surface Type | Area (acres) |
|---|---|
| Pervious | 21.3 |
| Impervious | 85.5 |
| **Total** | **106.8** |

### 2.4.3 Soil Type

Hydrologic Soil Group (HSG) classifications from the Natural Resources Conservation Service (NRCS) Soil Survey for Dane County are used in the model to estimate infiltration parameters for pervious surfaces. The Central Isthmus watershed has HSG soil types B, C and D and are summarized in Table 2-6.

Table 2-6: Summary of Hydraulic Soil Groups for Pervious Surfaces

| HSG | Pervious Area (acres) | Percent of Pervious Area (%) |
|---|---|---|
| A | 0.0 | 0.0 |
| B | 10.5 | 49.1 |
| C | 3.5 | 16.2 |
| D | 7.4 | 34.7 |
| **Total** | **21.4** | **100** |

Note: Table excludes impervious areas.

# 3.0 GUIDANCE AND DATA SOURCES

## 3.1 MODELING GUIDANCE DOCUMENT

The hydraulic model and flood mitigation solutions were developed following the City's Modeling Guidance for Round 3 Study Consultants dated July 14, 2020. The Modeling Guidance defines acceptable modeling methods and input parameters. The Modeling Guidance is provided in Appendix A.

## 3.2 DATA SOURCES

The data sources used for this watershed study include:

- GIS datasets from the City including reported flood locations, land use, impervious area, building footprints, public and private storm sewer infrastructure, city limits, greenways, ponds, lakes, rivers, parks, and roads.
- The City's GTWeb viewer, which contains infrastructure mapping.
- Construction plans for Monona Terrace and John Nolen Drive.
- Field surveys for unknown inverts at critical drainage structures within the watershed. Areas surveyed for this project included the W. Wilson and S. Broom Street area and all outfalls.
- City's 2016 LiDAR data. Section 2.2 summarizes the manual edit to the terrain file at the south quadrant of the intersection of E. Doty and S. Pinckney Streets.
- NRCS Soil Survey for Dane County.

Table 3-1 summarizes the digital source files that were used. Changes to the source data after the date shown in the table are not incorporated into the watershed study.

Table 3-1: Digital Source Files

| Data Type | Source Data Set | File Name | File Date |
|---|---|---|---|
| Land Use | 2020 Impervious Cover | Task5_CityLanduseData.gdb (Task5_WinSLAMM_Central feature class) | 10/22/2021 |
| Building Footprints *(for Level of Service Target #3 Analysis)* | 2020 Impervious Cover | Building_Flooding.shp | 10/22/2021 |
| Storm Sewer | City of Madison Public and Private Pipes and Structures Database | Stm_Cntrl_10182021.gdb<br>StmPvt_10222021.gdb | 10/18/2021<br>10/22/2021 |
| Lakes and Rivers | City Database | Lakes_and_Rivers.shp | 2/20/2020 |

| Data Type | Source Data Set | File Name | File Date |
|---|---|---|---|
| Greenways and Ponds | City Database | Greenways_and_Ponds.shp | 2/20/2020 |
| Parks | City Database | Parks.shp | 2/20/2020 |
| Elevation | 2016 Lidar data (3.125- by 3.125-foot grid) | aoi_asc.asc (merger of Lidar tiles) | 6/1/2020 |
| Soils | NRCS | NRCS_HSG_Madison_02-03-2021 | 2/3/2021 |
| Reported Flood Locations | City Database | FloodReports_ForConsultants.gdb | 8/20/2020 |

# 4.0 MODEL DEVELOPMENT

## 4.1 MODELING SOFTWARE

XPSWMM™ version 2020.1 by Innovyze® was used to simulate the watershed hydrology and hydraulics. The model includes one-dimensional (1D) sewer flow and two-dimensional (2D) overland flow.

## 4.2 RAINFALL FILES

The hydraulic model includes several 24-hour design rainfall events to evaluate the flood risk in accordance with the City's flood mitigation targets. All design storms evaluated as a part of this study have 24 hour durations.

### 4.2.1 Measured Rain Events

Rainfall monitoring was not completed as part of this study.

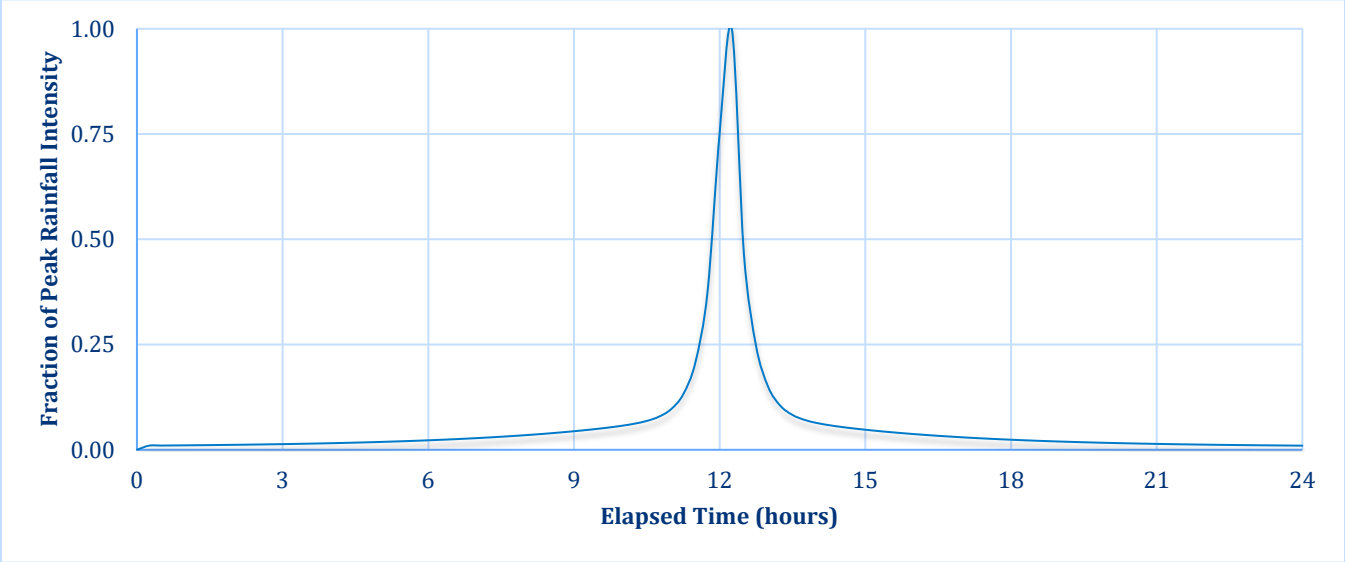
### 4.2.2 Design Rain Events

All the design rainfall events use the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall depths listed in the City's Modeling Guidance with the MSE 4 24-hour rainfall distribution in 15-minute increments. The MSE rainfall distribution is a nested distribution in which the rainfall intensity for each smaller increment of time is nested within each other (e.g., the 1 percent AEP, 15-minute rainfall is nested within the 1 percent AEP, 30-minute rainfall, which is nested within the 1 percent AEP, 60-minute rainfall, etc.). Table 4-1 lists the modeled design storms, their 24-hour rainfall depth, and their peak rainfall intensity. Figure 4-1 shows the unit design storm hyetograph applied to the design rainfall depths.

Table 4-1: Design Storm Rainfall Depths

| AEP | Rainfall Depth (inches) | Peak 15-minute Rainfall Intensity (in/hr) |
|---|---|---|
| 50% | 2.8 | 1.9 |
| 20% | 3.5 | 2.4 |
| 10% | 4.1 | 2.8 |
| 4% | 5.0 | 3.4 |
| 2% | 5.7 | 3.9 |
| 1% | 6.6 | 4.5 |
| 0.2% | 8.8 | 6.0 |

Figure 4-1: Design Storm Hyetograph




## 4.3 HYDROLOGIC MODEL DEVELOPMENT

Hydrology is the relationship between rainfall and runoff. The basis for the hydrologic method and the acceptable range of model inputs is defined in the City's Modeling Guidance.

### 4.3.1 SWMM Runoff Description

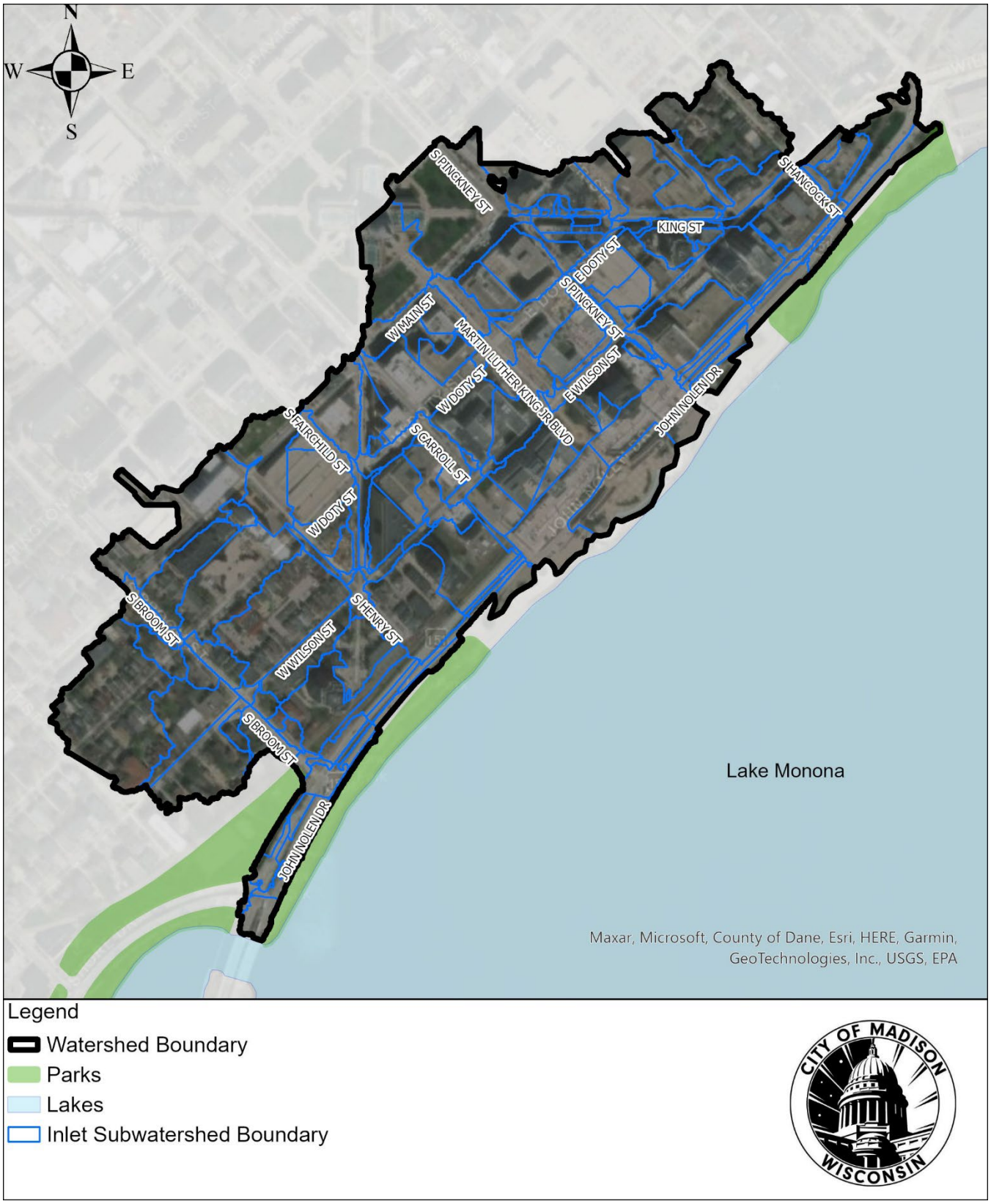
Hydrologic calculations for each subcatchment in the model were executed in the hydraulic model using the Storm Water Management Model (SWMM) runoff non-linear reservoir method. The non-linear reservoir method uses drainage area size, width, slope, imperviousness, and soil infiltration parameters to calculate runoff for a rain event. Runoff is loaded to nodes in the 1D portion of the hydraulic model.

### 4.3.2 Subwatershed Input Data

A drainage area was defined for every inlet in the Central Isthmus watershed using the City's Lidar data and an automated delineation process in GIS. The automated drainage area delineations were reviewed and modified as needed. After the initial delineation, drainage areas tributary to private or non-modeled inlets were merged with the closest downstream modeled inlet area. The Central Isthmus hydraulic model includes 153 subwatersheds shown in Figure 4-2. Two small areas within the northwest portion of the watershed are tributary to private inlets that discharge to sewers outside the watershed. For that reason, those areas are excluded from the Central Isthmus subwatersheds.

The subwatershed hydrologic model inputs were derived from the 2020 Impervious Cover Layer. The parameters used in hydrologic model calculations are described below. Appendix B lists the modeled inputs for each subwatershed.

Figure 4-2: Delineated Inlet Subwatersheds



#### 4.3.2.1 Area

The subwatershed delineation yielded the spatial polygons shown in Figure 4-2. The subwatersheds range in size from 0.1 to 4.9 acres, with a median area of 0.5 acres.

#### 4.3.2.2 Impervious Area

Impervious area was calculated using the land cover data in theTask5_WinSLAMM data in the Task5_CityLanduse geodatabase. The layer included the type of impervious surface (roof, road ROW, landscaped area, etc), whether the area was connected/disconnected, and the type of soil. For each subwatershed, which were divided into three subcatchments based on surface type and runoff routing, including:

- Directly connected impervious area (DCIA). Impervious area that drains directly to a storm sewer, typically street areas but also roof areas or parking lots plumbed to the public storm sewer.
- Indirectly connected impervious area (non-DCIA). Impervious area that drains over a pervious surface prior to entering a storm sewer.
- Pervious area. Areas that allow infiltration, such as lawn area.

Table 4-2 summarizes DCIA and non-DCIA areas within the watershed.

Table 4-2: Directly and Indirectly Connected Impervious Area Summary

| Impervious Area Type | Impervious Area (acres) | Portion of Impervious Area (%) |
|---|---|---|
| DCIA | 49.0 | 57.4 |
| non-DCIA | 36.4 | 42.6 |
| **Total** | **85.4** | **100.0** |

#### 4.3.2.3 Width

The subcatchment width defines the general shape of a subwatershed and the maximum distance runoff travels to reach the subwatershed outlet and primarily impacts peak flow rate predicted by the model. Each of the three subcatchments (DCIA, non-DCIA, and pervious areas) that comprise the subwatershed area have the same width. Widths would typically be developed through model calibration, but calibration was not performed in the Central Isthmus because there was no flow monitoring data collected to which to calibrate.

The widths in the Central Isthmus model were derived by dividing the DCIA by the flow length, which was calculated using the Flow Length function in GIS. Outlier widths that deviated significantly were adjusted, if necessary, based on a manual review of the subcatchment. Some outliers were retained because they reflected drainage from surfaces other than streets (e.g. large roofs or parking areas). The average subcatchment width in the model is 20 feet, which is approximately the average subcatchment width for the post-calibration East Isthmus watershed model. Therefore, the subwatershed widths used in the Central Isthmus model are considered to be consistent with the neighboring East Isthmus area.

#### 4.3.2.4 Slope

The subwatershed slope defines how quickly runoff reaches the subwatershed outlet. Like the width, the slope primarily impacts peak flow rate, but is more well defined than the width. A slope for each subwatershed, uniformly assigned to all three subcatchments, was calculated by dividing the difference between the high and low elevation points along the longest flow path within the subwatershed by the flow path length.

#### 4.3.2.5 Antecedent Moisture Conditions

Antecedent moisture conditions define the initial saturation levels of the soil at the beginning of a storm event. In conditions where the soil is saturated at the beginning of an event, maximum infiltration rates and depression storage are reduced. Conversely, in dry conditions the maximum infiltration rate and depression storage are higher than normal. For the purposes of this study, typical antecedent moisture conditions are assumed and are represented by the parameters in Table 4-3.

#### 4.3.2.6 Infiltration

The pervious subcatchment of each subwatershed was assigned infiltration characteristics based upon an area weighted composite HSG soil type for the subwatershed. The City's Modeling Guidance requires the Horton infiltration method to be used. The composite infiltration parameters were added to the model in 10 percent increments (e.g., 10 percent HSG B and 90 percent HSG C or 30 percent HSG C and 70 percent HSG D, etc.). Table 4-3 shows the base Horton infiltration parameters used to develop the area-weighted composite parameters. Appendix B summarizes the composite soil group parameters in the Modeled Horton Infiltration Data Table.

Table 4-3: Horton Infiltration Parameters

| HSG Group | Maximum Infiltration Rate (in/hr) | Minimum Infiltration Rate (in/hr) | Decay Rate (1/hr) | Dry Days |
|---|---|---|---|---|
| A | 4.0 | 1.0 | 4.0 | 3.1 |
| B | 2.0 | 0.5 | 4.0 | 4.4 |
| C | 1.0 | 0.2 | 4.0 | 7.0 |
| D | 0.5 | 0.1 | 4.0 | 9.9 |
| Water | 0.0 | 0.0 | 0.0 | 0.0 |

#### 4.3.2.7 Depression Storage

Surface depressions can store runoff and are accounted for in the hydraulic model in the depression storage input. The amount of runoff volume is reduced by the amount of depression storage. For design rainfall events, typical depression storage inputs generally do not impact the peak runoff rate. The City's Modeling Guidance requires each subcatchment to have a depression storage of 0.05 inches for impervious areas and 0.15 inches for pervious areas, and 25 percent of the subcatchment area to have zero depression storage.

#### 4.3.2.8 Internally Drained Areas

An internally drained area is an area without a drainage outlet. There are no internally drained areas in the Central Isthmus watershed.

#### 4.3.2.9 Runoff Routing

Runoff from DCIA and pervious subcatchments are loaded directly to a node in the 1D model network. Runoff from the non-DCIA subcatchment is routed to the pervious area subcatchment, before being loaded to the 1D network, allowing for infiltration of disconnected impervious area runoff (see Section 4.3.2.2).

### 4.3.3 Evaporation

Evaporation is assumed to be zero for the design rainfall events.

## 4.4 1D HYDRAULIC MODEL DEVELOPMENT

The 1D portion of the hydraulic model includes storm sewers, manholes, inlets, and outfalls. There are no 1D channels in the hydraulic model. The hydraulic model only includes storm sewers 18 inches in diameter or greater, plus smaller pipes that are necessary for model connectivity. The 1D hydraulic input parameters used in the hydraulic model are summarized in Tables 1 and 2 in Appendix B. Figure 2-2 shows the model network.

### 4.4.1 Open Channel Conveyance System

No open channel conveyance systems were modeled in 1D as part of this study.

### 4.4.2 Closed Conduit Conveyance System

The City provided GIS storm sewer data that included alignment, invert elevations, shape, pipe size and material, as well as node data that included inlet and manhole locations. Record drawings were used to fill in missing data not found in the GIS data. If the required data was not found in either data source, the following assumptions were made to fill in the gaps:

- Missing invert elevations were interpolated between the nearest known upstream and downstream invert elevations, assuming a constant slope between the known points.
- The nearest known upstream pipe size was used when pipe sizes were missing.

Entrance and exit losses represent energy losses at manholes and inlets caused by the contraction and expansion of flow. In the model, the entrance and exit losses are added to storm sewers based on the manhole or inlet configuration. Table 4-4 summarizes the entrance and exit losses from the City's Modeling Guidance. Pipes discharging to outfalls at Lake Monona were assigned an exit loss of 1.0 to represent the expansion of flow into a still body of water.

Table 4-4: Entrance and Exit Losses

| Configuration | Entrance Loss in Effluent Sewer | Exit Loss in Influent Sewer |
|---|---|---|
| Straight-through manhole | 0.05 | 0.05 |
| 45-degree bend manhole | 0.25 | 0.25 |
| 90-degree bend manhole | 0.5 | 0.5 |
| Tee manhole | 0.5 | 0.5 |
| Cross manhole | 0.5 | 0.5 |
| Blind Tap | 0.5 | 0.5 |

### 4.4.3 Inlet Capacity Analysis

Storm sewer systems include inlets, primarily along street curbs, that allow runoff from the ground surface into the storm sewer. Inlet capacity defines the maximum rate of runoff that can be conveyed into the storm sewer. In most storm sewer systems, the inlet capacity is designed to have the same level of service as the storm sewer, but that is not always the case. The number of inlets, their location, and debris on the inlet can impact observed flooding because when there is insufficient inlet capacity, runoff will collect on the street and either bypass the inlet (if on a slope) and continue as overland flow or pond if the inlet is at a low point.

Following the Modeling Guidance, inlet capacity was not evaluated as part of this study. It is possible that portions of the existing network are limited by inlet capacity and not conveyance capacity, hence are not captured by the model. Therefore, it is possible that flooding predicted by the model (or lack thereof) would underestimate actual flooding. Furthermore, mitigation improvements that increase conveyance capacity may need to be paired with inlet capacity improvements.

### 4.4.4 Detention Pond Analysis

There are no detention ponds in the Central Isthmus watershed.

### 4.4.5 Outfall Boundary Conditions

All sewers within the watershed drain to Lake Monona. Lake Monona's OHWM was applied to all outfalls in the model for all design storms.

This boundary condition was established with a sensitivity analysis whereby the 1 percent AEP design storm rainfall was simulated using three lake elevations: 845.62 feet (OHWM), 847.5 feet (100-year lake level), and 848.5 feet (0.2 feet above the record high). The model results showed that sewers located downstream of John Nolen Drive had significantly more flooding with higher lake levels, but the higher lake levels had a minimal impact on street inundation or building flooding because no streets or buildings are situated between John Nolen Drive and Lake Monona. Differences in the predicted flooding upstream of John Nolen Drive were negligible because the ground elevation increases significantly away from the shoreline.

Furthermore, using the lower lake level also allowed the pipe conveyance restrictions to be more readily distinguished from flooding caused solely by the lake level.

## 4.5 2D HYDRAULIC MODEL DEVELOPMENT

The 2D portion of the hydraulic model is used to represent overland flow, both along the streets and through other man-made or natural conveyance routes. The entire watershed is included in the 2D portion of the model. The 2D model utilizes topographic data and 2D land use characteristics to simulate the overland flow.

### 4.5.1 Topographic Data

All areas of the watershed are included in the 2D portion of the model by referencing an ASCII grid file containing the 2016 Lidar data within the 2D Job Control settings. Referencing the topography file externally instead of creating a digital terrain model within the hydraulic model allows for faster run times. The Lidar data has a 3.125- by 3.125-foot grid.

### 4.5.2 2D Grid

The 2D grid is used to complete the 2D calculations and display the flooding results. XPSWMM uses square grid cells, but the grid can be rotated to align with overland channels, predominantly streets in this watershed. Water that enters the grid moves between grid cells based on the elevations assigned to the grid cell. A 10- by 10-foot grid was used, which allows for multiple grid cells to span the ROW, providing more precise overland flow calculations and creating more detailed flooding results along streets and near buildings.

### 4.5.3 2D Roughness Values

Land use was georeferenced into the model and defined throughout the 2D grid as one of four 2D land use classifications from the City's SLU dataset: roadway, non-roadway impervious, pervious silty soil (HSG Type C), and pervious clay soil (HSG Type D). There are no pervious sandy soils (HSG Type A/B) within the watershed. Each land use was assigned a roughness coefficient representing the effectiveness of overland flow. The lower the roughness coefficient the more effective overland flow conveyance. Table 4-5 shows the 2D land use roughness coefficients used in the model.

Table 4-5: 2D Land Use Roughness Coefficients

| 2D Land Use | Manning's Roughness Coefficient |
|---|---|
| Roadway | 0.016 |
| Non-roadway Impervious | 0.100 |
| Buildings | Inactive/No Overland Conveyance |
| Pervious Silty Soil | 0.240 |
| Pervious Clay Soil | 0.240 |

### 4.5.4 2D Infiltration

The 2D infiltration feature was not used in the model because this effectively doubles the infiltration of pervious areas when using the traditional subcatchment hydrology (see Section 4.3).

### 4.5.5 Inactive Areas

Inactive areas are portions of the hydraulic model that cannot convey flow. Physical barriers, such as buildings or walls, are common inactive areas. Stormwater flowing along the 2D surface redirects around inactive areas. Building footprints from the 2020 Impervious Cover Layer were added to the model as inactive areas.

### 4.5.6 1D/2D Interface

All runoff is loaded to the 1D portion of the model, but water can be exchanged between the 1D and 2D portions of the model in both directions at 1D model nodes and at 1D/2D interface lines (there are no 1D/2D interface lines in this model). At 1D model nodes, water in the 1D system spills onto the 2D grid when the 1D hydraulic grade line (HGL) exceeds the spill crest of a structure, assuming the structure is not sealed. Water can flow back from the 2D grid to the 1D system when there is inundation within a grid cell containing an inlet and capacity within the storm sewer to convey additional flow.

### 4.5.7 Boundary Conditions

A ridge between John Nolen Drive and Lake Monona typically prevents overland flow from the Central Isthmus watershed to Lake Monona but for cases where water overtops that ridge, a 2D boundary was included to allow flow out of the model and into Lake Monona. Section 4.4.5 describes the 1D boundary condition at Lake Monona.

### 4.5.8 Special Conditions

No special conditions were considered as part of the Central Isthmus watershed evaluation.

# 5.0 MODEL CALIBRATION

Calibration is the process by which model inputs are adjusted such that model results reasonably match the measured data. A calibrated model has less uncertainty than an un-calibrated model. No flow or rainfall monitoring was completed in the Central Isthmus watershed because of the compressed timeline of the study, and no calibration specific to the watershed was performed. The hydrologic components, while derived using slightly different methods, were compared and adjusted based on the calibration done for the neighboring East Isthmus Yahara watershed. The East Isthmus Yahara watershed was calibrated to the following events (all rainfalls are reported using the rain gauge at McPike Park, which was the closest rain gauge in the East Isthmus watershed to the Central Isthmus watershed):

- 1.13-inch total rainfall with 0.74-inch peak hour rainfall on May 3, 2021
- 1.83-inch total rainfall with 1.09-inch peak hour rainfall on June 18, 2021
- 1.46-inch total rainfall with 1.41-inch peak hour rainfall on August 7, 2021

Additional information about the calibration done for the East Isthmus Yahara watershed is included in Appendix E.

As specified in the City's Modeling Guidance, subcatchment width is the primary hydrologic input that is adjusted to calibrate the modeled peak flow rates. Subcatchment widths were not specifically calibrated, but Section 4.3.2.3 describes how the widths were derived.

Although Central Isthmus Watershed model specific calibration was not performed, the results of the model were reviewed with City staff to ensure that the results approximated past flood event observations. The model predicts flooding in all the areas where flooding has been observed.

# 6.0 RESULTS EVALUATION

The hydraulic model was used to predict areas of storm sewer surcharging and surface flooding during each of the design storms.

## 6.1 EVALUATION APPROACH

The model results were evaluated against the City's flood mitigation targets to identify flood-prone areas.

Existing condition flood maps were created for each of the design storms referenced in Table 4-1. Results were exported as ASCII raster files with cell sizes equal to the modeled grid cell size of 10 feet.

## 6.2 SUMMARY OF HISTORICAL FLOODING COMPARISON

The model predicted flooding in the historical flood locations identified in Section 1.4. The cause of flooding in these areas was insufficient pipe capacity causing the HGL to rise above grade. Table 6-1 summarizes model predicted flood depths for design storms associated with LoS Targets at the three historical flood locations.

Table 6-1: Model Predicted Existing Condition Results for Historical Flood Locations

| Design Storm | Point 1 (350 S. Hamilton Street) Flood Depth (feet) | Point 2 (325 S. Hamilton Street) Flood Depth (feet) | Point 3 (W. Wilson and S. Broom Streets) Flood Depth (feet) |
|---|---|---|---|
| 10 percent AEP | 0.1 | 0.3 | 0.4 |
| 4 percent AEP | 0.4 | 0.4 | 0.9 |
| 1 percent AEP | 0.4 | 0.5 | 1.3 |
| 0.2 percent AEP | 0.5 | 0.6 | 1.6 |

## 6.3 SURCHARGING TO GRADE (LEVEL OF SERVICE TARGET #1)

Level of Service Target #1 requires the storm sewer to convey the 10 percent AEP design storm without surcharging to grade.

The model predicts storm sewer surcharging to grade to occur at thirteen manholes and inlets at the following locations, which also are shown in Figure 6-1:

- E. Doty Street, at and west of S. Broom Street
- S. Hamilton Street, at and south of W. Wilson Street
- S. Pickney Street between E. Doty and E. Wilson Streets

Approximately 0.2 miles of the 3.1 miles of storm sewer evaluated surcharged to grade during the 10 percent AEP design storm. This equates to 6 percent of storm sewers not meeting LoS Target #1. Only the sewers

immediately downstream of the manholes predicted to surcharge to grade were considered in the length of sewer not meeting LoS Target #1, although sewers further downstream may contribute to the high HGL.

Figure 6-1: Projected Existing Condition Surcharging to Grade during 10 percent AEP Design Storm



## 6.4 STREET CENTERLINE FLOODING (LEVEL OF SERVICE TARGET #2)

Level of Service Target #2 requires all streets be drivable during the 4 percent AEP design storm. The City defines a non-drivable street as one with more than 0.2 feet of water depth at the street centerline.

The model predicts more than 0.2 feet of flooding at the street centerline at the following locations, which are also shown in Figure 6-2.

- John Nolen Drive near S. Hamilton Street (extended).
- S. Hamilton Street south of the intersection with W. Wilson Street.
- Intersection of W. Wilson and S. Broom Streets.
- Intersection of W. Doty and S. Broom Streets.

Approximately 0.3 miles of the 5.0 miles of streets evaluated in the study have more than 0.2 feet of water at the centerline during the 4 percent AEP design storm. This equates to 6 percent of streets not meeting LoS Target #2. The length of street with centerline flooding exceeding 0.2 feet is approximate based on visual review of the model results because the 2D grid cells do not always align with the street centerline.

Figure 6-2: Projected Existing Condition Non-Drivable Streets during 4 percent AEP Design Storm



## 6.5 BUILDING FLOODING (LEVEL OF SERVICE TARGET #3)

Level of Service Target #3 requires that no buildings are flooded during the 1 percent AEP design storm. There are no enclosed depressions or greenway crossings in the watershed, so those parts of LoS Target #3 are not considered.

Building flooding was estimated by utilizing a spatial join between exported flood rasters and the building footprint feature class. Due to the inherent uncertainty in the models and the desire to take a conservative approach, a building is assumed to be flooded if the model shows more than 6 inches of flooding within a 5-foot buffer of the building footprint.

Eleven buildings are projected to be flooded during the 1 percent AEP design storm, including:

- Building 11, located at 215 S Hamilton St.
- Building 17, located at 114 W Wilson St.
- Building 31, located at 101 E Wilson St.
- Building 34, located at 117 E Wilson St.
- Building 44, located at 323 E Wilson St.
- Building 56, located at 231 S. Broom St.
- Building 78, located at 350 W Wilson St.
- Building 92, located at 137 E Wilson St.
- Building 93, located at 151 E Wilson St.
- Building 103, located at 137 E Wilson St.
- Building 104, located at 149 E Wilson St.

Figure 6-3 shows the buildings that are projected to flood during the 1 percent AEP design storm. A list of buildings that are projected to be flooded is in Table 4 and Figure 1 of Appendix D, respectively.

A building at 321 S. Broom Street (Building 56) that was projected to be within the 5-foot flooding buffer was excluded from the list of buildings at risk for flooding. The building is adjacent to the side slope of the WSOR ditch that runs from S. Hamilton Street to S. Broom Street but is approximately 3.5 feet higher in elevation than 1 percent AEP water surface elevation. The relatively steep side slopes of the ditch and 10-foot grid cell size make it appear in the hydraulic model that the building is closer to flooding than it is.

An additional 40 buildings are not considered to be at-risk of flooding based on the City's LoS Target #3 but are within a 5-foot buffer of flooding less than 6 inches. These buildings are primarily located immediately adjacent to the sidewalk where less than 6 inches of flooding would be contained below the top of curb and not flood the building.

Figure 6-3: Projected Existing Condition Building Flooding during 1 percent AEP Design Storm



## 6.6 SAFELY CONVEY STORMWATER (LEVEL OF SERVICE TARGET #4)

Level of Service Target #4 requires safe conveyance of stormwater during the 0.2 percent AEP design storm. In the Central Isthmus, overland flow is limited to streets and the defined channel along the WSOR tracks, and therefore, no specific areas of unsafe conveyance beyond the other LoS Targets are identified within the model. Figure 6-4 shows the projected flood extents during the 0.2 percent AEP design storm.

## 6.7 AVOID EXACERBATING DOWNSTREAM FLOODING (LEVEL OF SERVICE TARGET #5)

Level of Service Target #5 requires mitigation solutions to not negatively impact downstream properties.

Figure 6-4: Projected Existing Condition Flooding During 0.2 percent AEP Design Storm



## 6.8 POINT FLOODING DEPTH AND DURATION

The City identified 15 indicator points near areas of past flooding within the watershed. The indicator points were defined to characterize the projected flooding during the design storms. Figure 6-5 shows the indicator points, and Table 6-2 shows the inundation peak depth and duration of flooding at the indicator points for the four design storms corresponding to level of service targets (10-, 4-, 1-, and 0.2 percent AEP)

The indicator points show a short duration of flooding (generally less than two hours), which correlates well with the steep terrain and relatively small drainage areas. The short duration of flooding also indicates that mitigation solutions to improve capacity, rather than storage, would be more effective at meeting level of service targets.

Figure 6-5: Point Flooding Timeseries Location Map



Table 6-2: Point Inundation Maximum Depth-Duration Timeseries Data

| | Point # | Ground Surface Elevation (feet) | 10 percent AEP (LoS #1) | 4 percent AEP (LoS #2) | 1 percent AEP (LoS #3) | 0.2 percent AEP (LoS #4) |
|---|---|---|---|---|---|---|
| Peak Flood Depth (feet) | 1 | 850.48 | 0.0 | 0.0 | 0.2 | 0.4 |
| | 2 | 858.99 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 875.83 | 0.0 | 0.1 | 0.2 | 0.4 |
| | 4 | 887.60 | 0.1 | 0.1 | 0.2 | 0.3 |
| | 5 | 897.22 | 0.2 | 0.4 | 0.5 | 0.7 |
| | 6 | 909.98 | 0.0 | 0 | 0.4 | 0.5 |
| | 7 | 860.74 | 0.2 | 0.4 | 0.6 | 0.7 |
| | 8 | 855.28 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 9 | 849.65 | 1.0 | 1.0 | 1.1 | 1.2 |
| | 10 | 851.21 | 0.4 | 0.4 | 0.5 | 0.5 |
| | 11 | 856.11 | 0.2 | 0.4 | 0.6 | 0.7 |
| | 12 | 855.17 | 0.1 | 0.7 | 1.0 | 1.4 |
| | 13 | 852.13 | 0.0 | 0.1 | 0.4 | 0.7 |
| | 14 | 856.32 | 0.3 | 0.5 | 0.8 | 1.0 |
| | 15 | 856.38 | 0.3 | 0.5 | 0.7 | 0.9 |
| Flood Duration (hours) | 1 | 850.48 | 0.0 | 0.0 | 0.6 | 0.9 |
| | 2 | 858.99 | 0.0 | 0.3 | 0.7 | 0.9 |
| | 3 | 875.83 | 0.5 | 0.8 | 1.2 | 1.4 |
| | 4 | 887.60 | 0.6 | 1.0 | 1.3 | 1.5 |
| | 5 | 897.22 | 0.4 | 0.7 | 1.0 | 1.2 |
| | 6 | 909.98 | 0.0 | 0 | 0.6 | 1.1 |
| | 7 | 860.74 | 0.4 | 0.7 | 1.1 | 1.3 |
| | 8 | 855.28 | 0.0 | 0.0 | 0.4 | 0.6 |
| | 9 | 849.65 | 2.5 | 2.8 | 3.0 | 3.1 |
| | 10 | 851.21 | 0.7 | 0.9 | 1.2 | 1.5 |
| | 11 | 856.11 | 0.6 | 0.8 | 1.2 | 1.3 |
| | 12 | 855.17 | 0.7 | 1.5 | 1.6 | 2.0 |
| | 13 | 852.13 | 0.0 | 0.8 | 0.7 | 1.1 |
| | 14 | 856.32 | 0.8 | 1.2 | 1.6 | 2.0 |
| | 15 | 856.38 | 1.1 | 1.4 | 1.9 | 2.3 |

## 6.9 LIMITATIONS

The hydraulic model was built in accordance with the City's Modeling Guidance to maintain the standard used by the City to understand flood risks and prioritize alternatives. Even so, models have limitations, and their output has some uncertainty so models should be understood to be approximations of actual flooding that could occur. Approximations in input data, simplifications of methods to calculate flow rate and HGL, exclusion of inlet capacity, and no model calibration are examples of potential sources of uncertainty.

### 6.9.1 Hydrologic Uncertainty

Actual conditions that differ from the inputs in the model can lead to higher or lower flooding than predicted by the model. Furthermore, although the model was reviewed against known areas of flooding, this model was not calibrated and may not represent flooding conditions as accurately or precisely as a calibrated model. Other hydrologic factors that could impact the flood results are weather and/or soil conditions that are higher or lower than average values used in the model. Future changes to land use, especially redevelopment that includes stormwater control on private property, could reduce flooding relative to the model prediction.

### 6.9.2 Inlet Capacity

Inlet capacity was not considered as part of this study. As such, the inlets were assumed to have no constraint on the modeled 1D inflows and inlet capacity must be analyzed independently during design to ensure inlet capacity at least matches, if not exceeds, pipe capacity. It is possible that inlet capacity limitations in the watershed lead to flooding not predicted by the model.

### 6.9.3 Building First Floor Elevations

Building first floor elevations were assumed to match the fronting ground surface elevation because first floor elevations were not available. Buildings with a first-floor elevation or other point of entry that does not match the model assumption may or may not flood as predicted by the model.

## 6.10 HYDRAULIC PERFORMANCE SUMMARY

Table 6-3 summarizes the storm sewer surcharging (LoS Target #1), street centerline flooding (LoS Target #2) and building flooding (LoS Target #3) for all design storms.

Table 6-3: Hydraulic Performance Summary

| Design Storm | Length of Storm Sewer Surcharged to Grade (feet) | Length of Street Centerline with >0.2 of Flooding (feet) | Buildings At Risk for Flooding (Flooding Depth > 6 inches) | Buildings adjacent to Flooding Depth < 6 inches |
|---|---|---|---|---|
| 50 percent AEP | 50 | 10 | 0 | 0 |
| 20 percent AEP | 770 | 340 | 0 | 2 |
| 10 percent AEP | **920 (LoS Target #1)** | 660 | 0 | 10 |
| 4 percent AEP | 1,740 | 1,100 | 3 | 33 |
| 2 percent AEP | 2,480 | **1,410 (LoS Target #2)** | 7 | 45 |
| 1 percent AEP | 28,50 | 2,370 | **11 (LoS Target #3)** | 40 |
| 0.2 percent AEP | 3,570 | 4,570 | 34 | 82 |
| **Total in Watershed** | **16,480**[†] | **26,000** | **252** | **252** |

[†] Total sewer length represents modeled pipes only.

### 6.10.1 Sewers

The City's LoS Target #1 is to eliminate storm sewer surcharging to grade during the 10 percent AEP design storm. Approximately 0.2 miles of 3.1 miles of modeled sewer are projected to surcharge to grade at 13 of the 227 modeled structures in the watershed during the 10 percent AEP design storm. This equates to 6 percent of sewers not meeting the LoS Target #1.

### 6.10.2 Streets

The City's LoS target is to maintain drivability during the 4 percent AEP design storm. Drivability is defined as having no more than 0.2 feet of flooding at the center of the street. Approximately 0.3 miles of the 5.0 miles of streets within the watershed have a projected centerline water depth exceeding 0.2 feet. This equates to 6 percent of streets not meeting LoS Target #2.

### 6.10.3 Buildings

The City's LoS target is to prevent building flooding during the 1 percent AEP design storm. Of the 252 buildings within the watershed, the model predicts eleven do not meet LoS Target #3. An additional 40 buildings are projected to have flooding within a 5-foot buffer, but less than 6 inches of depth, and therefore, do not meet the flooding criteria for LoS Target #3 and are not included in the count. The excluded buildings are primarily located immediately adjacent to the sidewalk where less than 6 inches of flooding would be contained below the top of curb and not flood the building.

# 7.0 PUBLIC ENGAGEMENT

As part of the Central Isthmus watershed study, the City conducted a virtual public information meeting. No focus groups were conducted.

## 7.1 PUBLIC INFORMATION MEETING

The public information meeting was conducted on September 1, 2022. Study background was presented including historical precipitation, design storms, urban flood dynamics, and an overview of the flood mitigation targets. The existing conditions flood mapping was presented and verified by residents. Additionally, the design approach and recommended mitigation solutions were shared. Implementation schedules were discussed in relation to upcoming budgeted street reconstruction projects.

Additional public information is provided on the City's project website: www.cityofmadison.com/engineering/projects/central-isthmus-watershed-study.

# 8.0 SOLUTIONS DEVELOPMENT

Flood mitigation solutions were developed to address areas where LoS targets were not met. Flood mitigation measures are classified by the City as either Volume Control (VC) or Peak Flood Control (PFC). No volume control solutions were considered because of the density of the development in this area, the lack of open area large enough upstream of areas of concern for surface detention, and underground detention is limited by utilities, steep terrain, and cost. Since only PFC solutions were considered, they will be referred to as mitigation solutions. A specific group of mitigation solutions will be referred to as a mitigation alternative.

## 8.1 ALTERNATIVES DEVELOPMENT APPROACH

Three alternatives to mitigate flooding were developed using the City's LoS targets (refer to Section 1.7) and input from City staff throughout the duration of the project. Each mitigation alternative was developed into a hydraulic model with the same hydrologic inputs as the existing model.

The alternatives development approach began by identifying locations that were projected to not meet the City's first four LoS targets (see Section 6.0) while ensuring that mitigation solutions would not exacerbate downstream flooding (LoS Target #5). Once the areas were defined, the following general steps were taken:

- Where storm sewer surcharging was projected to reach the ground surface, the downstream capacity was increased, or flows redirected to other sewers until nominal capacities exceeded the design flow rate (LoS #1 Collection System).
- Upon compiling a set of mitigation solutions that the met collection system LoS target (LoS #1), the models were run for the 4 percent AEP design storm to check on meeting the street flooding limits (LoS #2). All three alternatives that met the collection system target (LoS #1) also satisfied the street flooding target (LoS #2) without additional modifications.
- One (1) percent AEP design storm simulations were run to evaluate compliance of not flooding buildings (LoS #3). Some sewers sized for LoS Targets #1 and #2 were not adequate for meeting LoS Target #3, and sewer sizes were increased accordingly. Mitigation solutions that were expanded after meeting the street flooding target (LoS #2) to avoid flooding buildings (LoS #3) are listed as having a design recurrence interval of 100 years in the mitigation summaries in Tables 1-3 of Appendix D.
- The 0.2 percent AEP design storm was simulated to ensure that no additional improvements were necessary to safely convey stormwater (LoS Target #4). Since LoS Target #4 was met in the existing condition and conveyance capacity was increased downstream of areas that did not meet the other LoS targets, it was confirmed to have been met in each of the mitigation alternatives.
- Lastly, the PFC Solutions model results were compared to the existing conditions results to verify that no locations experienced an increase in flooding due to mitigation solutions (LoS Target #5).

## 8.2 MITIGATION ALTERNATIVES SUMMARY

The three mitigation alternatives are comprised of a set of mitigation solutions that address flooding concerns in individual areas. The primary difference between the alternatives is the capacity and location of the sewers that cross the WSOR tracks and John Nolen Drive.

- Alternative 1 does not include improvements across the railroad and John Nolen Drive.
- Alternatives 2 and 3 include larger sewers crossing the railroad and John Nolen Drive at S. Hamilton Street and S. Broom Street, respectively.

Alternatives 2 and 3 are more effective at achieving LoS targets than Alternative 1 because of the additional capacity provided at the downstream end of the collection system. Alternative 1 avoids the more difficult sewer construction under the WSOR tracks and John Nolen Drive. The hydraulic benefits of Alternatives 2 and 3 should be considered in conjunction with the constructability benefits of Alternative 1.

Alternatives 1 and 3 also include a new storm sewer along W. Wilson Street between S. Henry and S. Broom Streets to divert flow away from the S. Hamilton Street outfall, which is under capacity in the existing conditions. The remaining mitigation solutions overlapped in all three alternatives.

Schematics depicting proposed sewers and summary tables showing capacities and design flow rates for all three alternatives are in Appendix D. Mitigation solutions were assigned a reference letter that corresponds with the mitigation schematic maps and summary table in Appendix D.

### 8.2.1 Common Mitigation Solutions

The following mitigation solutions are included in all three alternatives (see Appendix D – Mitigation Schematics for location of mitigation solution designation):

- **Mitigation Solution A** – The 10 percent AEP model predicted flooding at the intersection of S. Broom Street and W. Doty Street because of insufficient downstream capacity in the S. Broom Street sewer. By upsizing the existing 24-inch sewer to match the downstream 29- by 45-inch elliptical sewer, and evenly distributing the slope between the four pipe segments, the sewer capacity was increased to meet 10 percent AEP design flows (LoS Target #1). Mitigation Solution A is to replace 580 feet of existing 24-inch sewer on S. Broom Street between W. Doty and W. Wilson Streets with 29-inch by 45-inch elliptical sewer.
- **Mitigation Solutions F, G, H and I** – The model predicts flooding at manholes on S. Pinckney Street between E. Doty and E. Wilson Streets during the 1 percent AEP storm. Due to the slope of E. Wilson Street towards the intersection with King Street, the resulting overland flow along the southeastern curb line is projected to flood several buildings along E. Wilson Street. The sewers on S. Pinckney Street were upsized to meet the 1 percent AEP design flows and is projected to mitigate building flooding (LoS Target #3) using the existing invert elevations and alignment. These mitigation solutions include:
    - Replacing 180 feet of existing 15-inch sewer on S. Pinckney Street near the intersection with E. Doty Street with 18-inch sewer.

  - Replacing 120 feet of existing 15-inch sewer on S. Pinkney Street between E. Doty and E. Wilson Streets with 21-inch sewer.
  - Replacing 40 feet of existing 15-inch sewer on S. Pinckney Street upstream of the intersection with E. Wilson Street with 24-inch sewer.
  - Replacing 70 feet of existing 12-inch sewer on S. Pinckney Street downstream of the intersection with E. Wilson Street with 18-inch sewer.

- **Mitigation Solution J** –The sewer immediately downstream of IN5051-057 is undersized causing flooding at IN5051-057 during the 10 percent AEP design storm. Replace 21 feet of 15-inch sewer on S. Hamilton Street upstream of the intersection with W. Wilson and S. Henry Streets with 24-inch sewer. The next two downstream pipes will also need to be upsized. Replace 30 feet of 18-inch sewer and 25 feet if 21-inch sewer with 24-inch pipe.
- **Mitigation Solution L** – Two 12-inch sewers upstream of structure AS5250-005 on E. Wilson Street merge into a single 12-inch sewer, causing downstream capacity constraints that leads to significant flooding in the 1 percent AEP design storm. The model predicts that the overland flow would flood buildings on the southeast side of E. Wilson Street between S. Butler and S. Hancock Streets given their low elevation relative to the adjacent street. Upsizing two downstream sewer segments from 12 inches to 15 inches in diameter increases the capacity and is projected to mitigate building flooding during the 1 percent AEP design storm (LoS Target #3).
- **Mitigation Solution M** – Sewer MI5151-054_IN5151-053 is 12 inches in diameter but the upstream and downstream sewers are 18 inches in diameter. Manhole MI_151-054 surcharges to the ground surface in the existing condition 1 percent AEP design storm, inundating the intersection of S. Hamilton and W. Wilson Streets and contributing to building flooding at the intersection of W. Wilson and S. Broom Streets via overland flow. Replace 70 feet of existing 12-inch sewer on W. Doty Street near the intersection with S. Hamilton Street with 18-inch sewer.

### 8.2.2 Alternative 1 – Retain Existing Sewers under WSOR and John Nolen Drive

Alternative 1 includes mitigation solutions upstream of the WSOR right-of-way but retains the existing sewers under the WSOR tracks and John Nolen Drive, which is beneficial from a constructability perspective. This alternative meets LoS Targets #1, #2, and #4. One building at 350 W Wilson St. is projected to be at risk for flooding during the 1 percent AEP design storm, so Alternative 1 does not meet LoS #3. Since no outfall improvements are associated with this alternative, flow was redirected from sewers with limited capacity to sewers with excess capacity. As such, additional mitigation solutions to resolve the building flooding would exacerbate downstream flooding relative to the existing condition, hence failing to meet LoS Target #5.

Individual components of Alternative 1 include:

- All common mitigation solutions listed in Section 8.2.1.
- The existing condition 10 percent AEP model predicts flooding at the dead end of S. Hamilton Street because of insufficient downstream capacity while the S. Broom Street outfall pipe has excess

capacity. To improve the hydraulic performance without increasing the capacity of individual sewers near the outfalls, flow was redirected from the sewer on S. Hamilton Street with limited capacity to the sewer on S. Broom Street with excess capacity via a new 560 foot, 36-in sewer on W. Wilson Street **(Mitigation Solution B)**.

- An existing 18-inch pipe on W. Wilson Street, just northeast of the intersection with S. Broom Street, conveys the flow of two catch basins. To accommodate the additional flow from the 36-inch W. Wilson Street diversion sewer, replace 60 feet of existing 18-inch sewer on W. Wilson Street near the intersection with S. Broom Street with a 36-inch sewer. **(Mitigation Solution C)**.
- An existing 24-inch pipe in W. Wilson Street northeast of the S. Hamilton Street intersection, as well as 12-inch and 21-inch pipes in N. Henry Street, were redirected from the S. Hamilton Street sewer to the proposed sewer on W. Wilson Street **(Mitigation Solution D and E)**.

### 8.2.3 Alternative 2 – Increased Sewer Capacity along S. Hamilton Street

Alternative 2 includes mitigation solutions centered around increasing the capacity of the S. Hamilton Street sewer from the intersection with N. Henry and W. Wilson Streets to the outfall. This mitigation solution would require replacing or paralleling the sewer beneath the WSOR tracks and John Nolen Drive, presenting potential constructability complications.

Individual components of Alternative 2 include:

- All common mitigation solutions listed in Section 8.2.1.
- The existing model predicted flooding on the S. Hamilton Street sewer between the intersection with W. Wilson and N. Henry Streets to the dead end, in both the 10 percent AEP and 1 percent AEP design storms. Due to the road slope towards the dead end, stormwater accumulates near the dead end and causes building flooding. By upsizing the S. Hamilton Street sewer from 21-inch and 24-inch sewers to 672 feet of 36-inch sewer, LoS Targets #1 and #3 are met. Furthermore, this negates the need to redirect flow to a new sewer on W. Wilson Street, as in Alternatives 1 and 3. Due to the steep street grade, additional inlets are likely to be required as well to mitigate flooding **(Mitigation Solution K)**.

### 8.2.4 Alternative 3 – Increased Sewer Capacity along S. Broom Street

Alternative 3 increases the capacity of the S. Broom Street sewer from the intersection with W. Wilson Street to the outfall and includes the same proposed sewer on W. Wilson Street described in Alternative 1**.** Due to the increased S. Broom Street outfall capacity, additional flow would be able to be redirected from the S. Hamilton Street outfall.

Individual components of Alternative 3 include:

- All common mitigation solutions listed in Section 8.2.1 (from Section 8.2.1).
- **Mitigation Solution B**. Same justification as in Alternative 1.
- **Mitigation Solution C**. Same justification as in Alternative 1.
- **Mitigation Solutions D and E**. Same justification as in Alternative 1.

- Without capacity constraints on the S. Broom Street sewer downstream of the proposed W. Wilson Street sewer, additional flow can be rerouted from S. Hamilton Street **(Mitigation Solution N).**
- In Alternative 1, flooding on S. Broom Street between the intersections with W. Doty Street and W. Wilson Street, caused buildings to flood at the local low point near the intersection of S. Broom and W. Wilson Streets. By upsizing 560 feet of pipe downstream of the W. Wilson Street diversion sewer connection point from a 29-inch by 45-inch horizontal ellipse to a 43-inch by 68-inch horizontal ellipse, the system has enough drainage capacity to prevent building flooding in the area **(Mitigation Solution O)**.
- In Alternative 3, to mitigate excessive stormwater from the intersection of Hamilton, Wilson, and Henry Street, from flowing down the Hamilton Street cul-de-sac, a raised multi-path crossing is included with this solution. The City plans construct a counterflow multi-use path at this intersection. A raised crossing which would have both stormwater and safety benefits.

# 9.0 SELECTED ALTERNATIVE

Results from each of the three mitigation alternatives were evaluated using the flood mitigation LoS targets with additional consideration for historical flood locations and buildings with lesser projected flooding. The selected alternative is based upon hydraulic performance only, but non-hydraulic constraints are considered in Section 9.2. Costs are prepared by City staff.

## 9.1 HYDRAULIC COMPARISON

Since all three alternatives were projected to eliminate flooding during the 10 percent AEP design storm (LoS Target #1) and street centerline flooding exceeding 0.2 feet during the 4 percent AEP design storm (LoS Target #2), these were not included mitigation results comparison. Table 9-1 compares the number of model-predicted buildings flooded during the 1 percent AEP design storm (LoS Target #3) and projected flood depths at reported flood locations for both the 1- and 0.2 percent AEP design storms. Alternatives 2 and 3 yield comparable results for all locations apart from reported flood location #3, located at the intersection of W. Wilson Street and S. Broom Street. Without upsizing the S. Broom Street sewer downstream of W. Wilson Street, the lesser conveyance capacity causes more flooding of the intersection.

Table 9-1: Mitigation Results Comparison

| | Buildings At Risk for Flooding LoS Target #3 | Buildings adjacent to Flooding Depth < 6 inches | Reported Flood Location Projected 1 percent AEP Depth (feet) | | | Reported Flood Location Projected 0.2 percent AEP Depth (feet) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Location 1 | Location 2 | Location 3 | Location 1 | Location 2 | Location 3 |
| Existing | 11 | 40 | 0.39 | 0.51 | 1.30 | 0.47 | 0.64 | 1.57 |
| Alt. 1 | 1 | 18 | 0 | 0.17 | 1.15 | 0.13 | 0.34 | 1.66 |
| Alt. 2 | 0 | 7 | 0 | 0 | 0.49 | 0.07 | 0.31 | 1.12 |
| Alt. 3 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0.58 |

## 9.2 OTHER CONSIDERATIONS

The primary non-hydraulic consideration are sewer constructability constraints underneath the WSOR track and John Nolen Drive.

Alternative 1, which does not include any work under the railroad or John Nolen Drive, includes the fewest potential constructability constraints, but also provides the least effective mitigation of flooding. While both Alternative 2 and Alternative 3 include sewer construction under the railroad and John Nolen Drive, the City staff have expressed interest in potentially incorporating a larger S. Broom Street sewer into already planned roadway construction. Since the S. Hamilton Street outfall downstream of the dead end is not within a roadway ROW, incorporating Alternative 2 sewer reconstruction into a future road project is not possible.

## 9.3 SELECTION SUMMARY

Alternative 3 is recommended. Alternative 3 provides better hydraulic performance compared to Alternative 1 and similar hydraulic results compared to Alternative 2, as well as better constructability considerations, especially if the work can be constructed in conjunction with the planned road construction on S. Broom Street. Schematics and tabular summaries of Alternative 3, and other alternatives, can be reviewed in Appendix D.

## 9.4 AREAS IN WHICH LOS TARGETS ARE NOT MET

For the selected alternative, all LoS targets are met.

## 9.5 CITY-WIDE PRIORITY

The City is conducting similar watershed studies for all the watersheds in the City. All watersheds are expected to have numerous recommendations resulting from the studies. The City is developing a process to rank and prioritize the order in which the solutions might be implemented if and when funding and public support are obtained. Information on this process will be shared by the City when it is available.

# 10.0 ADDITIONAL FIGURES

Figure 10-1: Impervious Areas - Connected vs Disconnected



Figure 10-2: Surface Roughness Values



# APPENDIX A: HYDRAULIC MODELING GUIDANCE

# MODELING GUIDANCE

Version 2020_07_14 (DRAFT)

Round 3 Study Consultants

The City recognizes that an important aspect of modeling is professional judgement; and it will be up to the Consultant to appropriately define parameters, variables, and methodology. However, it is in the City's best interest to have relative uniformity amongst City models. This guidance document was developed to provide uniformity. Where inputs and assumptions differ from those outlined in this document, the Consultant will be expected to justify and document the differences and reasons for the differences.

The purpose of the watershed modeling is to construct planning-level models of the watershed to identify locations with significant conveyance system deficiencies. The identified solutions will be conceptual solutions, not design-level solutions. Characterization of localized street flooding is not a focus.

**City of Madison Flooding Level of Service Goals**

1. 10-year design storm event:
    a. No surcharging onto the street for up to the 10-year design storm; water shall be contained within the pipes and structures.
    b. There are locations within the City where low points exist that pond water; these low points are excluded from this goal and will be addressed as streets are redesigned.
    c. For locations limited by known inlet capacity, allow no more than 0.5 feet of water above storm sewer inlet rim.
2. 25-year design storm event:
    a. Centerline of street to remain passable during 25-year design storm with no more than 0.2 feet of water at the centerline.
    b. Note that the Watershed Study modeling approach will not explicitly account for cross flow conditions where more gutter flow on one side of the street can overtop the crown.
3. 100-year design storm event:
    a. No home or business will be flooded during the 100-year design storm.
    b. Enclosed depressions to be served to the 100-year design storm (which can include safe overland flow within street, easements, greenways or other public lands).
    c. Greenway crossings at streets to be served to the 100-year design storm.
4. 500-year design storm event:
    a. Safely convey stormwater; i.e. limited impact on private property
5. Provide flooding solutions that do not negatively impact downstream properties.

Due to the inherent variability and complexity of stormwater conveyance systems, it is understand it may not be practical to meet the above level of service goals in all areas of the City.

**Guidance for Solutions**

1. For the purpose of the watershed studies "deficiencies" in the system shall be defined as existing infrastructure, drainage capacity, or system limitations that fail to meet the goals stated in 1-5 above.
2. Watershed deficiencies will be reviewed, and solutions will be provided up to, the 100-yr design storm.
3. In areas where flooding occurs in events exceeding the 100-year storm, those areas will not be prioritized for engineering solutions, but will be identified in existing conditions model for 500-year event storms.
4. Proposed solutions will be identified for only the publicly owned drainage system.
5. Drainage issues that are private (water from the public infrastructure such as streets, greenways, ponds and/or easements is not the cause of the drainage issue) will not require modeling solutions but should be noted, where possible, in the existing conditions analysis so staff may

work with property owners if necessary. (See Also Hydraulics section of Modeling Guidance for discussion on private system existing conditions modeling.)

**Emergency Vehicle Allowable Flood Depths (email from Fleet on 5/12/2020)**

1. SUVs – up to 6-inches
2. Large Trucks – up to 3-feet
3. Ambulances, vans, and pick-up trucks – between 6-inches and 3-feet

**MODELING PARAMETERS:**

Initial model parameters are the following items:

1. Include storm sewers and culvert segments for the trunk line drainage system and major conveyance to that system. Additional conveyance components may be included if felt necessary by the modeler to understand the conveyance system drainage.
2. Inlet capacity will not be included in the model. It is assumed that sufficient inlets are present accommodate stormwater. In areas where there is known chronic flooding that has been reported to Engineering, additional detail may be requested.
3. Incorporate significant existing storm water management facilities (public and private) into the model.
4. Subdivide provided outfall basins into smaller watersheds as needed in order to properly execute the model.
5. Coordinate System and Vertical Datum
    a. Horizontal Coordinate System: Wisconsin County Coordinate System – Dane Zone NAD83 (HARN).
    b. Vertical Datum: NAVD88 (pre 2007 adjustment) ft (City of Madison Datum + 845.6)
    c. Various data sources have different horizontal and vertical datums, check datum for each data source prior to use.
6. Monitoring Data Time Zone: Different sources of monitoring data use different time zones. Also, some adjust for daylight savings time whereas others do not. When using the monitoring data, check both the time zone and if the data is adjusted for daylight savings time.
7. Monitoring Data Review: Familiarize yourself with the location of the monitoring gage at each site. Also, visit the monitoring site following a rain event to review the site conditions for things that would impact the measurements. For example, is there debris clogging anything?
8. Naming convention
    a. Names are limited to 20 characters where possible. Both PC-SWMM and XP-SWMM can take lengthy names but both indicate shorter is better for avoiding truncating names.
    b. Subcatchments:
        i. Begin with Subcatchments naming convention provided by the City in the Outfall Basin feature class.
            1. Add a three-digit designator to the end of the name, beginning with 000
            2. As subcatchments are subdivided, increase the added designator by 1.
            3. Example: ME04-A-0014-H *(Provided by City)* → ME04-A-0014-H-MAD-C-000 *(For the original basin)* → ME04-A-0014-H-001 *(For first subdivision)*
        ii. Final outfall basin feature class file, including supporting files used to compute runoff timing and volume parameters shall be part of the deliverables provided to the City of Madison.
    c. Structures and Junctions:
        i. Node (Junction/Storage/Outfall) names for existing structures shall retain the asset identification provided by the City.
        ii. Proposed Structure names are to be determined by the Consultant but shall be given a “logical” name that reflects general location, function, or other.
        iii. For junctions that need to be added that are storm sewer tees as constructed, use the downstream manhole / structure with “_01” added in increasing order moving from downstream to upstream. For example, the first junction added for a tee upstream of MI3350-001 would be MI3350-001_01

d. Pipes:
    i. Conduit names for existing pipes shall retain the asset identification provided by the City, except that:
        1. The first two letters (i.e AE, IN, etc) can be removed
        2. Leads with an asset ID that takes up all 20 characters can be shortened to the corresponding assigned ID. For example, IN3350-032_AS3350-007_3350-001 can be changed to 3350-032_3350-001_001
    ii. Proposed Pipe names are to be determined by the Consultant but shall be named in a manner similar to the City pipe naming convention, which includes the upstream and downstream structure names.
e. Channel/Street Flow Segments:
    i. Conduit names for drainage-ways shall be named in a manner that identifies the greenway segment it represents by Greenway Node Number and the distance from the upstream end. Example: GR7541-062_125 would represent a channel segment that begins 125 feet into the North Door Creek Greenway – Sprecher Road Section.
    ii. Conduit names for streets shall be named with "Rd_"[US_Node_Name]_[DS_Node_Name] and remove the first two letters in the node name similar to how pipes are named.
f. Natural Channels:
    i. Natural channel transects shall be named with the same ID as the conduit name.
    ii. Street models as natural channels shall be named in a manner that is easily identifiable for the street or street type it represents.
    iii. A shapefile shall be created documenting where natural channel transects are cut.
g. Other SWMM Features (Weirs, orifices, etc)
    i. Other SWMM features shall have readily identifiable names corresponding to the type of feature they are trying to model. For example, an orifice for a detention pond should have an ID that is "<Detention Pond ID>_ORIF_01", keeping within a 20 character limit.
h. Ponds
    i. Use the pond name identifier from GT-Viewer combined with a common name. For example, the ponds at Odana Hills Golf Course would be "PD3461-001_OdanaHills"
    ii. Use abbreviation of name if unofficial full name creates a model name longer than 20 characters.
i. Non-City owned infrastructure
    i. Consultant may choose name if consistent naming convention is not created by entity that owns infrastructure
    ii. If Consultant chooses name, all infrastructure owned by another entity shall start with the same few characters. For example, DOT infrastructure could all start with "DOT-" or Fitchburg owned infrastructure could start with "Fit-"

9. Rainfall
    a. MSE4 24-hour Distribution and NOAA Atlas 14 Depths

| Recurrence Interval (years) | Rainfall Depth (inches) |
|---|---|
| 2 | 2.8 |
| 5 | 3.5 |
| 10 | 4.1 |
| 25 | 5.0 |
| 50 | 5.7 |
| 100 | 6.6 |
| 500 | 8.8 |

    b. Long-Duration Storm – Two 24-hour, 100-year MSE4 storm events with the time between

peak rainfalls shorted from 24 hours to 12 hours.

10. Hydrology (SWMM Method with Horton Infiltration) (References: A, B, C, J)
    - Parameters listed are default parameters and may need to be adjusted based on calibration data.

    a. Subcatchment Detail for Street Drainage
        i. Contributing area to the existing storm sewer system that is to be modeled (Determined on a watershed by watershed basis)

    b. SWMM Routing Parameters (if calibration is not available to adjust parameters)
        i. Percent Impervious - Follow Step 1 (pages 1-3) of the "HowTo_CalculateCN" document.
        ii. DCIA – Reference WinSLAMM Standard Land Use DCIA Spreadsheet
        iii. Width – Estimated based on subcatchment shape. Estimation methodology shall be documented.
        A single width shall be calculated for the entire subcatchment and used for all three sub-areas.
        It is expected Width is one of the first calibration parameters for peak flow.
        iv. Slope – Computed manually or estimated based on LiDAR. Computation or estimation methodology shall be documented.
        v. In XP-SWMM, each subcatchment is to be split into area of (1) DCIA, (2) non-DCIA, and (3) pervious area. Within the model, the non-DCIA shall be routed to the pervious area.
        vi. In PC-SWMM, indicate the percent being routed to pervious in the subcatchment attribute.

    c. Horton Infiltration
        i. For typical urban pervious area (Based on range of values for different soil types, moisture conditions, and vegetation conditions found in Reference A):

| HSG Group[a] | Max Infil. Rate (in/hr) | Min Infil. Rate (in/hr) | Decay Rate (1/hr) | Dry Days[b] | Maximum Infiltration Volume (in) |
|---|---|---|---|---|---|
| A | 4.0 | 1.0 | 4.0 | 3.1 | |
| B | 2.0 | 0.5 | 4.0 | 4.4 | sandy |
| C | 1.0 | 0.2 | 4.0 | 7.0 | silty |
| D | 0.5 | 0.1 | 4.0 | 9.9 | clayey |
| Water | 0 | 0 | 0 | 0 | |

        [a]For HSG listed as A/D, B/D, C/D, the default approach will be to assume the HSG associated with the lower infiltration rate (HSG D).
        [b]Use equation 4-12, pg 99, SWMM Reference Manual Volume 1 – Hydrology (Revised), January 2016
        ii. Impervious Manning's n – 0.016
        iii. Pervious Manning's n – 0.20
        iv. Depression Storage for Impervious – 0.05 inches
        v. Depression Storage for Pervious – 0.15 inches
        vi. Zero Depression Storage – 25 percent
        vii. Factors for adjusting
            1. Forest – Multiply max and min infiltration rates by 2.
            2. Farmland (row crops) – Multiply max and min infiltration rates by 1.2.
            3. Farmland (close crops) - Multiply max and min infiltration rates by 1.8.
            4. Other land uses – discuss with City staff
        viii. Area-weight the Horton Infiltration parameters for each subcatchment based on the area of each soil type within a subcatchment. Remove impervious area from area-weighting.
        ix. It is understood the NRCS/SCS updates the soil mapping at various times. The project teams will identify a date the soils data will be downloaded and that will be the data used for the duration of the project.

d. Evaporation: Turn off evaporation from calibration and design storm event runs.

11. 1D Hydraulics (References: A, B, D, E, F, G)
    - Dynamic mode with constant / variable timestep sufficient to model system accurately.
    - Conduit lengthening shall not be used unless prior approval from City on reason.
    - Parameters are default parameters and may need to be adjusted based on calibration data.
    - This list is not intended to be exhaustive.

    a. System to be Modeled
        i. Public
            1. Standard: Trunk line and major conveyance components to trunk line.
            2. Process for Exceptions: Provide justification for conveyance components not included.
            3. Use engineering judgement for inclusion of additional detail beyond this standard.
        ii. Private
            1. Standard: Not included
            2. Process for requiring inclusion of private pipes:
                a. Stormwater management detention facilities providing significant detention
                b. When necessary to understand the functioning of the public system. For example, the West Towne Mall parking lot drainage system.
        iii. Greenways and major surface drainages
        iv. Significant stormwater detention facilities (public and private).
            1. Private systems may be simplified if serving a single site.
            2. Provide justification for detention facilities not included.

    b. Loss Coefficients (see drawing at end of document)
        i. Entry
            1. Culverts – Select Inlet Type based on the Help File or HEC-RAS Hydraulic Reference Manual
            2. Storm Sewer (internal at MHs) = 0.05
            3. Storm Drainage Structures (MH) at 45 degree bend = 0.25
            4. Storm Drainage Structures (MH) at 90 degree bend = 0.5
            5. For culverts and entrances to storm sewer from an open channel or pond, both the energy loss coefficient and the inlet control (culvert code) shall be used.
        ii. Exit
            1. Culverts –
                a. Exit closed conduit to open channel = 0.5
                b. Exit closed conduit to lake or pond = 1.0
            2. Storm Sewer (internal at MHs) = 0.05
            3. Storm Drainage Structures (MH) at 45 degree bend = 0.25
            4. Storm Drainage Structures (MH) at 90 degree bend = 0.5

    c. Coefficient of Discharge
        i. Weirs
            1. Sharp Crested – 3.0
            2. Roadway embankment – 2.6
            3. Flatter overflow – Use engineering judgment
        ii. Orifices
            1. 0.6

    d. Manning's n
        i. Pipes
            1. Concrete Pipe: 0.013
            2. Other n values shall be chosen within generally acceptable ranges.
        ii. Channels
            1. Use Chow's Open Channel Hydraulics, Reference E

iii. Bank Flow, including developed urban areas
1. Use Chow's Open Channel Hydraulics, Reference E

e. Transect Placement and Modifiers
i. Splitting long open channels
1. Changes in cross section
2. Significant changes in slope and roughness
3. Overflow points
ii. Segment Lengths
iii. Channel Geometry
iv. Provide shapefile where natural channel transects are selected along with XS Identifier

f. Tailwater Conditions:
i. Lake Mendota: one foot over Summer Maximum – 851.10
ii. Lake Monona: TBD
iii. Lake Wingra (100-year WSE): 848.0
iv. Yahara River between Lakes Mendota and Monona: TBD

g. Inlet Clogging Factors
i. Continuous Slopes
1. Street slope < 1% - 25% Clogging
2. Street slope >= 1% - No Clogging
ii. Sags – 50% Clogging

12. 2D Data (References: A, G, H, I)
a. Surface Roughness – The average Manning's n may vary by land cover / land use. Referencing TR-55, the following roughness can be used for sheet flow conditions. Choose based on professional judgement and document in the report.
i. Impervious areas - 0.1
ii. Turf grass areas - 0.24
iii. Wooded – 0.4
iv. Prairie – 0.15
v. Other – reference TR-55

b. Channel Roughness: Where the 2D surface experiences channel flow, rather than sheet flow, utilize the Manning's n values for open channels

c. There is not currently a city-wide impervious area layer. The consultant may choose to delineate the impervious area for the watershed.
Or, the existing data may be utilized. The following assumptions can be made using the existing land use data:
i. For non-residential parcels, impervious and pervious area is available, therefore, that shall be used.
ii. A percent impervious is available for residential parcels. Calculate a composite roughness using the percent impervious area. Remove roofs from the composite roughness calculation – reference the Dane County land use for residential roofs. (roofs will be entered as blocked obstructions)
iii. Average the roughness within the ROW based impervious and pervious area.

d. Blocked Obstructions – enter roofs as Inactive Areas in XP-SWMM and Obstructions in PC-SWMM
i. Non-residential – use City impervious area data for roofs
ii. Residential – use Dane County roof layer

e. Grid cell/mesh size: Use size that balances model run time and sufficient 2D overland flow detail.

f. Grid/mesh orientation: Where possible, align grid/mesh with major channel flow direction. If not practical, then use orientation that minimizes run time.

13. Non-Modeling Data
a. When utilizing XP-SWMM, provide attributed describing the source of data in the representative GIS feature classes

b. When utilizing PC-SWMM, also add attributes to the entities describing their data sources.

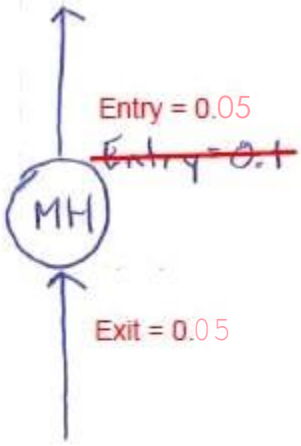
14. Solutions
    a. Analysis – what are the underlying causes of flooding in:
        i. Areas reported in the "Flood Download" from City staff
        ii. Other flooded areas in the modeling not identified in the "Flood Download"
            1. If more than 10 total areas, work with City staff to prioritize locations to evaluate
        iii. City to identify suggested solutions and provide to Consultant for consideration
        iv. Consultant to identify solutions independently and take lead on overall solutions for watershed
    b. Prioritize Solutions
        i. Property Damage
        ii. Major arterials where emergency vehicles cannot get through
        iii. More criteria - TBD
    c. Displaying solutions/Order of solutions
        i. Show each solution independently and then combined
        ii. Order
            1. Property/pipe owned by Stormwater Utility
            2. Pipe size needed to solve remainder of issues
            3. Other public properties
                a. Janet will provide areas where there are non-starters in Parks
            4. Private properties
    d. Overlay TIP map with inundation mapping to understand where immediate future project opportunities are
    e. Freeboard – City does not have a minimum freeboard requirement
    f. Properties adjacent to greenway and new greenway crossings – Current ordinance states property low building opening must be 4' above invert of downstream greenway street structure crossing. Therefore, may need to make structures wider, instead of deeper, to not flood upstream properties

**REFERENCES**

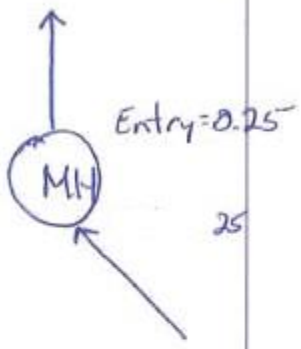

A. Model Help Files and User Forums
B. Storm Water Management Model version 5.1 User's Manual. (Available at: https://www.epa.gov/water-research/storm-water-management-model-swmm-version-51-users-manual)
C. SWMM reference manual volume I – hydrology (Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NYRA.txt)
D. SWMM reference manual volume volume II – hydraulics (Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100S9AS.PDF?Dockey=P100S9AS.PDF)
E. Chow, Open Channel Hydraulics, 1959
F. HEC-RAS Hydraulic Reference Manual. (Available at: https://www.hec.usace.army.mil/software/hec-ras/documentation/HEC-RAS%205.0%20Reference%20Manual.pdf)
G. ASCE Two-Dimensional Modeling Using HEC-RAS, Lecture 8 – Troubleshooting and Reviewing, Page 31; 2017.
H. Australian Rainfall & Runoff Revision Projects, Project 15: Two Dimensional Modeling in Urban and Rural Floodplains, November 2012.
I. FLO-2D Reference Manual, FLO-2D Software, 2012.
J. ASCE Manual of Engineering Practice No 28.

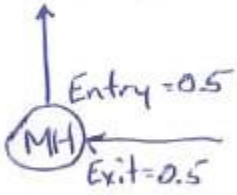
References/Notes

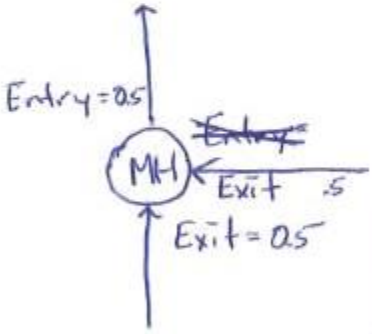
## Straight-Through Manhole



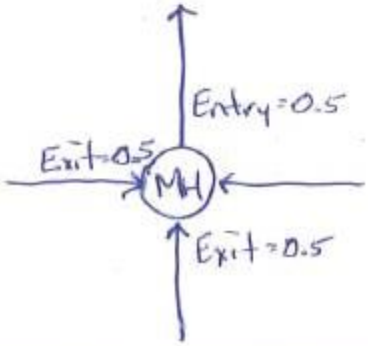

## 45° Bend Manhole

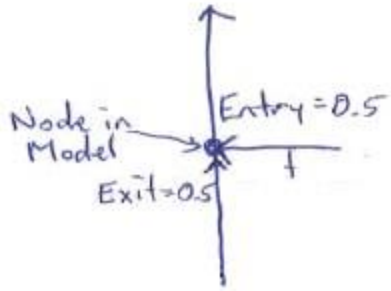



## TEE (No Manhole)



# APPENDIX B: HYDROLOGIC AND HYDRAULIC INPUT PARAMETERS

## Table 1. Link XP-Table Input Data

| Name | Upstream Node Name | Downstream Node Name | Upstream Invert Elevation ft | Downstream Invert Elevation ft | Diameter (Height) ft | Bottom Width ft | Special Conduit Shape | Length ft | Shape | Roughness | Entrance Loss | Exit Loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IN5052-081_AS5052-080 | IN5052-081 | AS5052-080 | 848.66 | 846.28 | 1.25 | 1.25 | | 23 | Circular | 0.013 | 0.05 | 0.5 |
| AS5249-051_AS5249-053 | AS5249-051 | AS5249-053 | 858.53 | 848.39 | 1.67 | 1.667 | | 104 | Circular | 0.013 | 0.25 | 0.5 |
| AS5249-053_IN5249-086 | AS5249-053 | IN5249-086 | 848.39 | 844.85 | 3 | 3 | | 108 | Circular | 0.013 | 0.5 | 0.05 |
| AS5249-056_AS5249-053 | AS5249-056 | AS5249-053 | 859.24 | 848.39 | 2.25 | 2.25 | | 95 | Circular | 0.013 | 0.5 | 0.5 |
| AS5249-057_AS5249-056 | AS5249-057 | AS5249-056 | 868.6 | 859.24 | 2.25 | 2.25 | | 270 | Circular | 0.013 | 0.25 | 0.25 |
| AS5249-058_AS5249-057 | AS5249-058 | AS5249-057 | 869.44 | 868.6 | 2.5 | 2.5 | Horizontal Ellipse | 19 | Special | 0.013 | 0.05 | 0.25 |
| AS5249-066_AS5249-053 | AS5249-066 | AS5249-053 | 849.1 | 848.39 | 1.75 | 1.75 | | 66 | Circular | 0.013 | 0.05 | 0.5 |
| IN5249-071_IN5249-072 | IN5249-071 | IN5249-072 | 846.15 | 844.86 | 2.5 | 2.5 | Horizontal Ellipse | 70 | Special | 0.013 | 0.05 | 0.05 |
| IN5249-072_LKMON | IN5249-072 | WilsonStOutfall | 844.86 | 843 | 2.5 | 2.5 | | 134 | Circular | 0.013 | 0.05 | 1 |
| IN5249-073_LKMON | IN5249-073 | US151Outfall2 | 844.86 | 843 | 1.5 | 1.5 | | 135 | Circular | 0.013 | 0.05 | 1 |
| AS5249-083_CB5249-088 | AS5249-083 | CB5249-088 | 879.8 | 874.06 | 2 | 2 | | 104 | Circular | 0.013 | 0.05 | 0.05 |
| AS5149-047_AS5149-095 | AS5149-047 | AS5149-095 | 893.6 | 889 | 1.75 | 1.75 | | 80 | Circular | 0.013 | 0.5 | 0.05 |
| AS5149-048_AS5249-083 | AS5149-048 | AS5249-083 | 885.69 | 879.8 | 2 | 2 | | 131 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-050_IN5149-103 | IN5149-050 | IN5149-103 | 909.5 | 907.35 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5249-086_AE5250-024 | IN5249-086 | AE5250-024 | 844.85 | 843.85 | 3 | 3 | | 158 | Circular | 0.013 | 0.05 | 1 |
| CB5249-088_AS5249-090 | CB5249-088 | AS5249-090 | 874.06 | 873.58 | 2 | 2 | | 12 | Circular | 0.013 | 0.05 | 0.05 |
| AS5249-090_AS5249-058 | AS5249-090 | AS5249-058 | 873.58 | 869.44 | 2.5 | 2.5 | Horizontal Ellipse | 70 | Special | 0.013 | 0.05 | 0.05 |
| AS5053-032_AE5053-053 | AS5053-032 | NorthShoreDrOutfall | 844.81 | 844.35 | 2 | 2 | | 91 | Circular | 0.013 | 0.5 | 1 |
| AS5051-014_TP5051-016 | AS5051-014 | TP5051-016 | 897.77 | 893.74 | 1.5 | 1.5 | | 53 | Circular | 0.013 | 0.25 | 0.05 |
| AS5051-028_CB5051-063 | AS5051-028 | CB5051-063 | 860.1 | 858.89 | 1.5 | 1.5 | | 19 | Circular | 0.013 | 0.05 | 0.25 |
| AS5052-037_AS5052-109 | AS5052-037 | AS5052-109 | 846.83 | 846.15 | 1.75 | 1.75 | | 16 | Circular | 0.013 | 0.05 | 0.25 |
| AS5150-024_AS5150-025 | AS5150-024 | AS5150-025 | 849.56 | 848.04 | 1.5 | 1.5 | | 27 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-025_AS5151-001 | AS5150-025 | AS5151-001 | 848.04 | 846.84 | 1.5 | 1.5 | | 138 | Circular | 0.013 | 0.5 | 0.05 |
| AS5150-028_AS5150-027 | AS5150-028 | AS5150-027 | 847.49 | 846.5 | 1.5 | 1.5 | | 52 | Circular | 0.013 | 0.25 | 0.5 |
| IN5150-030_IN5250-003 | IN5150-030 | IN5250-003 | 886.6 | 882.4 | 1 | 1 | | 77 | Circular | 0.013 | 0.05 | 0.05 |
| IN5150-044_AS5150-136 | IN5150-044 | AS5150-136 | 905.12 | 902.52 | 1 | 1 | | 72 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-027_AS5150-049 | AS5150-049 | AS5150-027 | 879.7 | 846.5 | 2 | 2 | | 90 | Circular | 0.013 | 0.5 | 0.5 |
| AS5150-052_AS5150-049-01 | AS5150-052 | AS5150-049-01 | 884.4 | 880.58 | 1.75 | 1.75 | | 125 | Circular | 0.013 | 0.25 | 0.5 |
| AS5150-052_AS5150-049 | AS5150-052 | AS5150-049 | 884.4 | 879.7 | 1 | 1 | | 125 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-057_AS5150-122 | AS5150-057 | AS5150-122 | 894.36 | 894.02 | 1 | 1 | | 34 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-072_AS5150-136 | IN5150-072 | AS5150-136 | 905.85 | 902.52 | 1 | 1 | | 50 | Circular | 0.013 | 0.05 | 0.5 |
| IN5250-003_IN5250-004 | IN5250-003 | IN5250-004 | 882.4 | 879.9 | 1 | 1 | | 83 | Circular | 0.013 | 0.05 | 0.05 |
| IN5250-004_IN5250-029 | IN5250-004 | IN5250-029 | 879.9 | 876.15 | 1 | 1 | | 83 | Circular | 0.013 | 0.05 | 0.05 |
| AS5151-001_AS5151-004 | AS5151-001 | AS5151-004 | 846.84 | 846.16 | 2.5 | 2.5 | | 50 | Circular | 0.013 | 0.05 | 0.5 |
| AS5151-004_MI5151-006 | AS5151-004 | AS5151-038 | 846.16 | 846.17 | 4.417 | 4.417 | Horizontal Ellipse | 15 | Special | 0.013 | 0.5 | 0.05 |
| AS5151-008_AS5151-009 | AS5151-008 | AS5151-009 | 847.59 | 845.22 | 1.75 | 1.75 | | 45 | Circular | 0.013 | 0.05 | 0.05 |
| AS5151-009_AS5151-034 | AS5151-009 | AS5151-034 | 845.22 | 844.98 | 1.75 | 1.75 | | 80 | Circular | 0.013 | 0.05 | 0.5 |
| IN5151-013_AS5051-055 | IN5151-013 | AS5051-055 | 858.35 | 854.6 | 1.25 | 1.25 | | 76 | Circular | 0.013 | 0.05 | 0.25 |
| AS5151-019_AS5151-008 | AS5151-019 | AS5151-008 | 881.6 | 847.59 | 1.25 | 1.25 | | 230 | Circular | 0.013 | 0.5 | 0.05 |
| AS5151-020_AS5151-019 | AS5151-020 | AS5151-019 | 881.72 | 881.6 | 1.25 | 1.25 | | 20 | Circular | 0.013 | 0.05 | 0.5 |
| AS5052-044_MI5052-045 | AS5052-044 | MI5052-045 | 852.34 | 852.3 | 2 | 2 | | 13 | Circular | 0.013 | 0.5 | 0.05 |
| IN5052-046_AS5052-044 | IN5052-046 | AS5052-044 | 852.81 | 852.26 | 2.5 | 2.5 | Horizontal Ellipse | 62 | Special | 0.013 | 0.5 | 0.5 |

| Name | Upstream Node Name | Downstream Node Name | Upstream Invert Elevation ft | Downstream Invert Elevation ft | Diameter (Height) ft | Bottom Width ft | Special Conduit Shape | Length ft | Shape | Roughness | Entrance Loss | Exit Loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5052-047_IN5052-046 | AS5052-047 | IN5052-046 | 852.87 | 852.81 | 2.5 | 2.5 | Horizontal Ellipse | 4 | Special | 0.013 | 0.5 | 0.5 |
| IN5052-049_AS5052-047 | IN5052-049 | AS5052-047 | 853.51 | 852.87 | 1.917 | 1.917 | Horizontal Ellipse | 111 | Special | 0.013 | 0.05 | 0.5 |
| IN5051-034_AS5052-044 | IN5051-034 | AS5052-044 | 853.1 | 852.34 | 1.917 | 1.917 | Horizontal Ellipse | 29 | Special | 0.013 | 0.05 | 0.5 |
| AS5051-038_IN5051-048 | AS5051-038 | IN5051-048 | 873.1 | 865.97 | 1.5 | 1.5 | | 144 | Circular | 0.013 | 0.05 | 0.05 |
| AS5051-039_AS5051-038 | AS5051-039 | AS5051-038 | 875.85 | 873.1 | 1.5 | 1.5 | | 47 | Circular | 0.013 | 0.05 | 0.05 |
| IN5051-048_IN5051-049 | IN5051-048 | IN5051-049 | 865.97 | 860.6 | 1.5 | 1.5 | | 97 | Circular | 0.013 | 0.05 | 0.05 |
| IN5051-049_AS5051-050 | IN5051-049 | AS5051-050 | 860.6 | 859.8 | 1.25 | 1.25 | | 38 | Circular | 0.013 | 0.05 | 0.5 |
| AS5051-050_AS5051-055 | AS5051-050 | AS5051-055 | 859.8 | 854.6 | 1.75 | 1.75 | | 25 | Circular | 0.013 | 0.25 | 0.05 |
| IN5051-052_IN5051-083 | IN5051-052 | IN5051-083 | 861.66 | 860.09 | 1 | 1 | | 42 | Circular | 0.013 | 0.05 | 0.25 |
| AS5053-049_AS5053-032 | AS5053-049 | AS5053-032 | 845.54 | 844.81 | 1.5 | 1.5 | | 47 | Circular | 0.013 | 0.05 | 0.5 |
| IN5053-054_AS5053-032 | IN5053-054 | AS5053-032 | 845.17 | 844.81 | 1.75 | 1.75 | | 72 | Circular | 0.013 | 0.5 | 0.5 |
| IN5053-056_IN5053-054 | IN5053-056 | IN5053-054 | 845.33 | 845.17 | 1.5 | 1.5 | | 60 | Circular | 0.013 | 0.05 | 0.5 |
| IN5053-057_IN5053-054 | IN5053-057 | IN5053-054 | 845.87 | 845.17 | 1.5 | 1.5 | | 15 | Circular | 0.013 | 0.05 | 0.5 |
| AS5052-061_IN5053-056 | AS5052-061 | IN5053-056 | 845.61 | 845.33 | 1.5 | 1.5 | | 100 | Circular | 0.013 | 0.05 | 0.05 |
| IN5052-062_AS5052-061 | IN5052-062 | AS5052-061 | 845.84 | 845.61 | 1.5 | 1.5 | | 47 | Circular | 0.013 | 0.5 | 0.05 |
| IN5052-063_IN5052-1111 | IN5052-063 | IN5052-111 | 846.07 | 845.97 | 1.5 | 1.5 | | 45 | Circular | 0.013 | 0.05 | 0.05 |
| IN5152-009_IN5152-010 | IN5152-009 | IN5152-010 | 844.51 | 844.3 | 1.75 | 1.75 | | 35 | Circular | 0.013 | 0.05 | 0.05 |
| IN5152-010_AS5152-014 | IN5152-010 | AS5152-014 | 844.3 | 844.27 | 1.75 | 1.75 | | 5 | Circular | 0.013 | 0.05 | 0.05 |
| IN5152-011_IN5152-012 | IN5152-011 | IN5152-012 | 844.22 | 844.05 | 1.75 | 1.75 | | 35 | Circular | 0.013 | 0.05 | 0.05 |
| IN5152-012_AE5152-013 | IN5152-012 | HamiltonStOutfall | 844.05 | 843.6 | 1.75 | 1.75 | | 90 | Circular | 0.013 | 0.05 | 1 |
| AS5152-014_IN5152-011 | AS5152-014 | IN5152-011 | 844.27 | 844.22 | 1.75 | 1.75 | | 10 | Circular | 0.013 | 0.05 | 0.05 |
| IN5152-015_IN5152-016 | IN5152-015 | IN5152-016 | 846.35 | 846.17 | 1.5 | 1.5 | | 36 | Circular | 0.013 | 0.05 | 0.5 |
| IN5152-016_IN5152-018 | IN5152-016 | IN5152-018 | 846.17 | 845.14 | 1.5 | 1.5 | | 156 | Circular | 0.013 | 0.5 | 0.5 |
| IN5152-018_IN5152-019 | IN5152-018 | IN5152-019 | 845.14 | 845.1 | 1.75 | 1.75 | | 7 | Circular | 0.013 | 0.5 | 0.05 |
| IN5152-019_IN5152-020 | IN5152-019 | IN5152-020 | 845.1 | 844.91 | 1.75 | 1.75 | | 37 | Circular | 0.013 | 0.05 | 0.05 |
| IN5152-020_AE5152-021 | IN5152-020 | HenryStOutfall | 844.91 | 844.35 | 1.75 | 1.75 | | 112 | Circular | 0.013 | 0.05 | 1 |
| AS5151-025_TP5151-042 | AS5151-025 | TP5151-042 | 844.15 | 844.05 | 3 | 6 | | 32 | Rectangular | 0.013 | 0.5 | 0.5 |
| IN5151-026_IN5151-030 | IN5151-026 | IN5151-030 | 845.22 | 844.88 | 1.5 | 1.5 | | 15 | Circular | 0.013 | 0.05 | 0.5 |
| IN5151-027_IN5151-031 | IN5151-027 | IN5151-031 | 844.55 | 844.75 | 1.5 | 1.5 | | 15 | Circular | 0.013 | 0.05 | 0.5 |
| IN5151-028_AS5151-032 | IN5151-028 | AS5151-032 | 844.6 | 844.55 | 1.75 | 1.75 | | 7 | Circular | 0.013 | 0.05 | 0.5 |
| IN5151-029_IN5151-028 | IN5151-029 | IN5151-028 | 844.64 | 844.6 | 1.75 | 1.75 | | 5 | Circular | 0.013 | 0.05 | 0.05 |
| IN5151-030_IN5151-029 | IN5151-030 | IN5151-029 | 844.88 | 844.64 | 1.75 | 1.75 | | 40 | Circular | 0.013 | 0.5 | 0.05 |
| IN5151-031_AS5151-032 | IN5151-031 | AS5151-032 | 844.75 | 844.55 | 1.75 | 1.75 | | 32 | Circular | 0.013 | 0.5 | 0.5 |
| AS5151-032_AS5151-025 | AS5151-032 | AS5151-025 | 844.55 | 844.15 | 3 | 6 | | 133 | Rectangular | 0.013 | 0.5 | 0.5 |
| AS5151-034_AS5151-032 | AS5151-034 | AS5151-032 | 844.95 | 844.55 | 3 | 6 | | 135 | Rectangular | 0.013 | 0.5 | 0.5 |
| AS5151-035_AS5151-034 | AS5151-035 | AS5151-034 | 844.98 | 844.95 | 5 | 5 | Horizontal Ellipse | 10 | Special | 0.013 | 0.05 | 0.5 |
| AS5151-037_AS5151-035 | AS5151-037 | AS5151-035 | 845.93 | 844.98 | 5 | 5 | Horizontal Ellipse | 317 | Special | 0.013 | 0.5 | 0.05 |
| AS5151-038_AS5151-037 | AS5151-038 | AS5151-037 | 846.17 | 845.93 | 5 | 5 | Horizontal Ellipse | 80 | Special | 0.013 | 0.05 | 0.5 |
| IN5250-009_AS5250-026 | IN5250-009 | AS5250-026 | 844.35 | 843.97 | 3.75 | 3.75 | Horizontal Ellipse | 108 | Special | 0.013 | 0.05 | 0.5 |
| AS5250-010_IN5250-009 | AS5250-010 | IN5250-009 | 844.51 | 844.35 | 3.75 | 3.75 | Horizontal Ellipse | 108 | Special | 0.013 | 0.5 | 0.05 |
| AS5250-011_AS5250-010 | AS5250-011 | AS5250-010 | 844.74 | 844.51 | 3.75 | 3.75 | Horizontal Ellipse | 46 | Special | 0.013 | 0.5 | 0.5 |
| AS5150-076_AS5250-011 | AS5150-076 | AS5250-011 | 844.97 | 844.74 | 3.75 | 3.75 | Horizontal Ellipse | 47 | Special | 0.013 | 0.05 | 0.5 |
| IN5250-012_AS5250-011 | IN5250-012 | AS5250-011 | 845.07 | 844.74 | 1.5 | 1.5 | | 33 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-077_AS5150-076 | AS5150-077 | AS5150-076 | 845.14 | 844.97 | 2 | 2 | | 54 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-079_AS5150-076 | AS5150-079 | AS5150-076 | 845.34 | 844.97 | 2.5 | 2.5 | | 74 | Circular | 0.013 | 0.5 | 0.5 |
| IN5250-013_AS5250-011 | IN5250-013 | AS5250-011 | 844.81 | 844.74 | 1.75 | 1.75 | | 7 | Circular | 0.013 | 0.05 | 0.5 |

| Name | Upstream Node Name | Downstream Node Name | Upstream Invert Elevation ft | Downstream Invert Elevation ft | Diameter (Height) ft | Bottom Width ft | Special Conduit Shape | Length ft | Shape | Roughness | Entrance Loss | Exit Loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IN5250-014_IN5250-013 | IN5250-014 | IN5250-013 | 845.13 | 844.81 | 1.5 | 1.5 | | 6 | Circular | 0.013 | 0.05 | 0.05 |
| IN5150-080_IN5250-014 | IN5150-080 | IN5250-014 | 845.62 | 845.13 | 1.5 | 1.5 | | 40 | Circular | 0.013 | 0.05 | 0.05 |
| IN5250-017_IN5250-018 | IN5250-017 | IN5250-018 | 845.77 | 844.83 | 1.5 | 1.5 | | 55 | Circular | 0.013 | 0.05 | 0.5 |
| IN5250-018_AE5250-019 | IN5250-018 | AE5250-019 | 844.83 | 844.1 | 2 | 2 | | 73 | Circular | 0.013 | 0.5 | 1 |
| IN5250-020_IN5250-018 | IN5250-020 | IN5250-018 | 845.44 | 844.83 | 1.75 | 1.75 | | 44 | Circular | 0.013 | 0.05 | 0.5 |
| IN5250-021_IN5250-020 | IN5250-021 | IN5250-020 | 845.78 | 845.44 | 1.75 | 1.75 | | 43 | Circular | 0.013 | 0.05 | 0.05 |
| AS5052-073_AE5052-075 | AS5052-073 | BroomStOutfall | 845.12 | 844.35 | 3.75 | 3.75 | Horizontal Ellipse | 91 | Special | 0.013 | 0.25 | 1 |
| AS5052-074_AS5052-073 | AS5052-074 | AS5052-073 | 845.66 | 845.12 | 3.75 | 3.75 | Horizontal Ellipse | 82 | Special | 0.013 | 0.25 | 0.25 |
| AS5052-078_AS5052-074 | AS5052-078 | AS5052-074 | 845.93 | 845.68 | 3.75 | 3.75 | Horizontal Ellipse | 62 | Special | 0.013 | 0.05 | 0.25 |
| AS5052-080_AS5052-078 | AS5052-080 | AS5052-078 | 846.28 | 845.93 | 3.75 | 3.75 | Horizontal Ellipse | 70 | Special | 0.013 | 0.5 | 0.05 |
| IN5052-082_AS5052-080 | IN5052-082 | AS5052-080 | 848.51 | 846.28 | 1.5 | 1.5 | | 35 | Circular | 0.013 | 0.05 | 0.5 |
| AS5052-083_AS5052-080 | AS5052-083 | AS5052-080 | 847.42 | 846.28 | 3.75 | 3.75 | Horizontal Ellipse | 100 | Special | 0.013 | 0.05 | 0.5 |
| AS5052-085_AS5052-083 | AS5052-085 | AS5052-083 | 848.23 | 847.4 | 3.75 | 3.75 | Horizontal Ellipse | 77 | Special | 0.013 | 0.05 | 0.05 |
| AS5052-087_AS5052-085 | AS5052-087 | AS5052-085 | 849.47 | 848.25 | 3.75 | 3.75 | Horizontal Ellipse | 77 | Special | 0.013 | 0.5 | 0.05 |
| IN5052-088_AS5052-087 | IN5052-088 | AS5052-087 | 852.04 | 850.37 | 1.25 | 1.25 | | 50 | Circular | 0.013 | 0.25 | 0.5 |
| IN5052-089_IN5052-088 | IN5052-089 | IN5052-088 | 852.2 | 852.06 | 1 | 1 | | 27 | Circular | 0.013 | 0.05 | 0.25 |
| IN5052-090_AS5052-087 | IN5052-090 | AS5052-087 | 851.58 | 849.51 | 1.5 | 1.5 | | 60 | Circular | 0.013 | 0.5 | 0.5 |
| IN5052-091_IN5052-090 | IN5052-091 | IN5052-090 | 851.64 | 851.64 | 1.25 | 1.25 | | 7 | Circular | 0.013 | 0.05 | 0.5 |
| IN5052-092_IN5052-091 | IN5052-092 | IN5052-091 | 852.11 | 851.66 | 1.25 | 1.25 | | 19 | Circular | 0.013 | 0.05 | 0.05 |
| IN5052-093_IN5052-090 | IN5052-093 | IN5052-090 | 852.01 | 851.62 | 1.25 | 1.25 | | 26 | Circular | 0.013 | 0.05 | 0.5 |
| AS5052-094_AS5052-087 | AS5052-094 | AS5052-087 | 850.77 | 849.59 | 2 | 2 | | 84 | Circular | 0.013 | 0.5 | 0.5 |
| IN5052-096_AS5052-094 | IN5052-096 | AS5052-094 | 852.2 | 850.55 | 1.25 | 1.25 | | 45 | Circular | 0.013 | 0.05 | 0.5 |
| 5052-097_5052-094_001 | IN5052-097 | AS5052-094-01 | 852.7 | 850.55 | 1 | 1 | | 55 | Circular | 0.013 | 0.05 | 0.5 |
| AS5051-053_AS5051-054 | AS5051-053 | AS5051-054 | 888.94 | 878.42 | 1.25 | 1.25 | | 115 | Circular | 0.013 | 0.05 | 0.05 |
| AS5051-054_IN5051-057 | AS5051-054 | IN5051-057 | 878.22 | 863.22 | 1.25 | 1.25 | | 206 | Circular | 0.013 | 0.05 | 0.05 |
| AS5051-055_AS5051-056 | AS5051-055 | AS5051-056 | 854.6 | 853.1 | 2 | 2 | | 46 | Circular | 0.013 | 0.05 | 0.25 |
| AS5052-106_AS5052-037 | AS5052-106 | AS5052-037 | 847.01 | 846.83 | 2.25 | 2.25 | | 31 | Circular | 0.013 | 0.05 | 0.05 |
| AS5052-107_AS5052-106 | AS5052-107 | AS5052-106 | 850.82 | 847.01 | 2 | 2 | | 160 | Circular | 0.013 | 0.05 | 0.25 |
| AS5051-056_AS5051-069 | AS5051-056 | AS5051-069 | 853.1 | 851.87 | 2 | 2 | | 66 | Circular | 0.013 | 0.25 | 0.05 |
| SS5151-041_TP5151-043 | SS5151-041 | TP5151-043 | 843.85 | 843.76 | 3 | 3 | | 10 | Circular | 0.013 | 0.5 | 0.5 |
| SS5250-025_AS5250-027 | SS5250-025 | AS5250-027 | 844.1 | 843.75 | 3 | 3 | | 10 | Circular | 0.013 | 0.5 | 0.5 |
| AS5250-026_AS5250-027 | AS5250-026 | AS5250-027 | 844.11 | 845.3 | 3.75 | 3.75 | Horizontal Ellipse | 8 | Special | 0.013 | 0.5 | 0.5 |
| AS5250-026_SS5250-025 | AS5250-026 | SS5250-025 | 844.36 | 844.1 | 3 | 3 | | 10 | Circular | 0.013 | 0.5 | 0.5 |
| AS5250-027_LKMON | AS5250-027 | PinckneyStOutfall | 843.75 | 843.12 | 3.75 | 3.75 | Horizontal Ellipse | 66 | Special | 0.013 | 0.5 | 1 |
| AS5052-109_IN5152-009 | AS5052-109 | IN5152-009 | 846.15 | 844.51 | 1.75 | 1.75 | | 86 | Circular | 0.013 | 0.25 | 0.05 |
| IN5051-057_MI5051-002 | IN5051-057 | MI5051-002 | 863.22 | 860.75 | 1.25 | 1.25 | | 206 | Circular | 0.013 | 0.05 | 0.05 |
| CB5051-063_IN5051-064 | CB5051-063 | IN5051-064 | 858.89 | 854.25 | 1.5 | 1.5 | | 218 | Circular | 0.013 | 0.25 | 0.05 |
| IN5051-064_AS5052-044 | IN5051-064 | AS5052-044 | 854.25 | 852.34 | 1.75 | 1.75 | | 89 | Circular | 0.013 | 0.05 | 0.5 |
| AS5051-068_AS5052-107 | AS5051-068 | AS5052-107 | 851.7 | 850.82 | 2 | 2 | | 110 | Circular | 0.013 | 0.05 | 0.05 |
| AS5051-069_AS5051-068 | AS5051-069 | AS5051-068 | 851.87 | 851.7 | 2 | 2 | | 28 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-091_AS5150-087 | AS5150-091 | AS5150-087 | 897.48 | 894.62 | 2.5 | 2.5 | | 38 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-094_AS5150-091 | AS5150-094 | AS5150-091 | 904.44 | 897.48 | 2.5 | 2.5 | | 173 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-099_AS5150-094 | AS5150-099 | AS5150-094 | 907.48 | 904.44 | 2.5 | 2.5 | | 157 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-103_AS5150-099 | AS5150-103 | AS5150-099 | 909.28 | 907.48 | 2.5 | 2.5 | | 104 | Circular | 0.013 | 0.5 | 0.05 |
| IN5150-106_AS5150-103 | IN5150-106 | AS5150-103 | 910.7 | 909.28 | 2 | 2 | | 33 | Circular | 0.013 | 0.25 | 0.5 |
| AS5051-076_AS5051-014 | AS5051-076 | AS5051-014 | 898.79 | 897.77 | 1.25 | 1.25 | | 45 | Circular | 0.013 | 0.05 | 0.05 |

| Name | Upstream Node Name | Downstream Node Name | Upstream Invert Elevation ft | Downstream Invert Elevation ft | Diameter (Height) ft | Bottom Width ft | Special Conduit Shape | Length ft | Shape | Roughness | Entrance Loss | Exit Loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5151-050_AS5051-014 | AS5151-050 | AS5051-014 | 897.74 | 897.77 | 1.5 | 1.5 | | 28 | Circular | 0.013 | 0.25 | 0.25 |
| AS5151-052_AS5151-050_1 | AS5151-052 | AS5151-050 | 898.53 | 897.74 | 1 | 1 | | 35 | Circular | 0.013 | 0.25 | 0.25 |
| IN5151-053_AS5151-052 | IN5151-053 | AS5151-052 | 899.33 | 898.53 | 1.5 | 1.5 | | 41 | Circular | 0.013 | 0.05 | 0.25 |
| AS5151-056_AS5151-079 | AS5151-056 | AS5151-079 | 885.07 | 883.88 | 1.5 | 1.5 | | 28 | Circular | 0.013 | 0.05 | 0.25 |
| IN5149-091_IN5149-049 | IN5149-091 | IN5149-049 | 898.29 | 897.56 | 1.5 | 1.5 | | 15 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-049_AS5149-047 | IN5149-049 | AS5149-047 | 897.56 | 893.6 | 1.5 | 1.5 | | 101 | Circular | 0.013 | 0.5 | 0.5 |
| IN5149-098_IN5149-091 | IN5149-098 | IN5149-091 | 901.9 | 898.29 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-099_IN5149-098 | IN5149-099 | IN5149-098 | 903 | 901.9 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-100_IN5149-099 | IN5149-100 | IN5149-099 | 904.44 | 903 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-101_IN5149-100 | IN5149-101 | IN5149-100 | 905.34 | 904.44 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-102_IN5149-101 | IN5149-102 | IN5149-101 | 906.29 | 905.34 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-103_IN5149-102 | IN5149-103 | IN5149-102 | 907.35 | 906.29 | 1.5 | 1.5 | | 295 | Circular | 0.013 | 0.05 | 0.05 |
| IN5149-051_IN5149-050 | IN5149-051 | IN5149-050 | 912.75 | 909.5 | 1.5 | 1.5 | | 82 | Circular | 0.013 | 0.05 | 0.05 |
| IN5150-110_MI5150-112 | IN5150-110 | MI5150-112 | 900.74 | 898.94 | 1 | 1 | | 35 | Circular | 0.013 | 0.05 | 0.05 |
| IN5150-111_AS5150-113 | IN5150-111 | AS5150-113 | 898.94 | 896.2 | 1 | 1 | | 63 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-114_AS5150-113_2 | IN5150-114 | AS5150-113 | 896.2 | 896.2 | 0.67 | 0.667 | | 15 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-115_IN5150-114 | IN5150-115 | IN5150-114 | 896.51 | 896.2 | 1.25 | 1.25 | | 61 | Circular | 0.013 | 0.5 | 0.05 |
| IN5150-116_IN5150-115 | IN5150-116 | IN5150-115 | 897.2 | 896.51 | 1 | 1 | | 44 | Circular | 0.013 | 0.5 | 0.5 |
| IN5150-117_IN5150-116 | IN5150-117 | IN5150-116 | 899.9 | 897.2 | 0.83 | 0.833 | | 61 | Circular | 0.013 | 0.05 | 0.5 |
| IN5052-1111_IN5052-062 | IN5052-111 | IN5052-062 | 845.97 | 845.84 | 1.5 | 1.5 | | 45 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-046_IN5150-110 | IN5150-046 | IN5150-110 | 904.2 | 900.2 | 1 | 1 | | 111 | Circular | 0.013 | 0.05 | 0.05 |
| IN5150-124_IN5150-125 | IN5150-124 | IN5150-125 | 887.8 | 883.75 | 1.5 | 1.5 | | 7 | Circular | 0.013 | 0.05 | 0.5 |
| 5150-125_5150-049_001 | IN5150-125 | AS5150-049-01 | 883.75 | 880.58 | 1.5 | 1.5 | | 5 | Circular | 0.013 | 0.5 | 0.5 |
| IN5250-006_AS5250-005 | IN5250-006 | AS5250-005 | 879 | 875.66 | 1 | 1 | | 40 | Circular | 0.013 | 0.25 | 0.25 |
| IN5250-028_AS5249-057 | IN5250-028 | AS5249-057 | 871.68 | 868.6 | 1 | 1 | | 65 | Circular | 0.013 | 0.05 | 0.05 |
| IN5250-029_AS5250-005 | IN5250-029 | AS5250-005 | 876.15 | 875.66 | 1 | 1 | | 15 | Circular | 0.013 | 0.05 | 0.25 |
| IN5151-062_MI5151-054 | IN5151-062 | MI5151-054 | 900.73 | 900.67 | 1.5 | 1.5 | | 28 | Circular | 0.013 | 0.05 | 0.05 |
| IN5151-063_IN5151-062 | IN5151-063 | IN5151-062 | 901.88 | 900.73 | 1.5 | 1.5 | | 62 | Circular | 0.013 | 0.05 | 0.05 |
| IN5150-133_AS5150-023 | IN5150-133 | AS5150-023 | 893 | 892.52 | 2.5 | 2.5 | | 19 | Circular | 0.013 | 0.5 | 0.05 |
| IN5150-133_AS5150-135 | IN5150-133 | AS5150-135 | 893 | 895.69 | 2 | 2 | | 54 | Circular | 0.013 | 0.05 | 0.5 |
| AS5149-095_AS5149-048 | AS5149-095 | AS5149-048 | 889 | 885.69 | 1.75 | 1.75 | | 58 | Circular | 0.013 | 0.05 | 0.05 |
| AS5249-092_AS5249-050 | AS5249-092 | AS5249-051 | 862.57 | 858.53 | 0.67 | 0.667 | | 104 | Circular | 0.013 | 0.25 | 0.25 |
| AS5249-093_AS5249-092 | AS5249-093 | AS5249-092 | 866.19 | 862.57 | 1.5 | 1.5 | | 56 | Circular | 0.013 | 0.05 | 0.25 |
| AS5249-094_AS5249-093 | AS5249-094 | AS5249-093 | 866.24 | 866.19 | 1.5 | 1.5 | | 40 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-113_AS5149-047 | AS5150-113 | AS5149-047 | 896.2 | 893.6 | 1.25 | 1.25 | | 50 | Circular | 0.013 | 0.5 | 0.5 |
| AS5150-122_AS5150-052 | AS5150-122 | AS5150-052 | 894.02 | 884.4 | 1 | 1 | | 67 | Circular | 0.013 | 0.5 | 0.25 |
| AS5250-005_IN5250-028 | AS5250-005 | IN5250-028 | 875.66 | 871.68 | 1 | 1 | | 55 | Circular | 0.013 | 0.25 | 0.25 |
| AS5150-128_IN5150-106 | AS5150-128 | IN5150-106 | 910.76 | 910.7 | 2 | 2 | | 20 | Circular | 0.013 | 0.05 | 0.25 |
| AS5150-129_AS5150-103 | AS5150-129 | AS5150-103 | 910.49 | 909.28 | 2.5 | 2.5 | Horizontal Ellipse | 25 | Special | 0.013 | 0.05 | 0.5 |
| AS5150-087_IN5150-133 | AS5150-087 | IN5150-133 | 894.62 | 893 | 2.5 | 2.5 | | 29 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-023_AS5150-134 | AS5150-023 | AS5150-134 | 892.52 | 891.97 | 3 | 3 | | 87 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-134_AS5151-064 | AS5150-134 | AS5151-064 | 891.97 | 891 | 3 | 3 | | 53 | Circular | 0.013 | 0.5 | 0.5 |
| AS5151-064_AS5151-065 | AS5151-064 | AS5151-065 | 891 | 885.4 | 3 | 3 | | 99 | Circular | 0.013 | 0.5 | 0.25 |
| AS5151-065_ND5151-066 | AS5151-065 | ND5151-066 | 885.4 | 885.3 | 3 | 3 | | 12 | Circular | 0.013 | 0.25 | 0.25 |
| ND5151-066_AS5151-004 | ND5151-066 | AS5151-004 | 885.3 | 846.16 | 2 | 2 | | 25 | Circular | 0.013 | 0.25 | 0.5 |
| MI5051-002_AS5051-050 | MI5051-002 | AS5051-050 | 860.65 | 859.8 | 1.5 | 1.5 | | 30 | Circular | 0.013 | 0.05 | 0.25 |

| Name | Upstream Node Name | Downstream Node Name | Upstream Invert Elevation ft | Downstream Invert Elevation ft | Diameter (Height) ft | Bottom Width ft | Special Conduit Shape | Length ft | Shape | Roughness | Entrance Loss | Exit Loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP5051-016_AS5051-053 | TP5051-016 | AS5051-053 | 893.74 | 888.99 | 1.25 | 1.25 | | 46 | Circular | 0.013 | 0.05 | 0.05 |
| MI5052-045_AS5052-094-01 | MI5052-045 | AS5052-094-01 | 852.3 | 851.55 | 2 | 2 | | 247 | Circular | 0.013 | 0.05 | 0.5 |
| PL5151-039_AS5151-037 | PL5151-039 | AS5151-037 | 846.15 | 845.93 | 1.5 | 1.5 | | 44 | Circular | 0.013 | 0.05 | 0.5 |
| PL5151-040_AS5150-077 | PL5151-040 | AS5150-077 | 846.19 | 845.14 | 1.75 | 1.75 | | 350 | Circular | 0.013 | 0.05 | 0.05 |
| TP5151-042_TP5151-043 | TP5151-042 | TP5151-043 | 845.08 | 843.76 | 3 | 6 | | 8 | Rectangular | 0.013 | 0.5 | 0.5 |
| TP5151-042_SS5151-041 | TP5151-042 | SS5151-041 | 845.08 | 843.85 | 3 | 3 | | 10 | Circular | 0.013 | 0.5 | 0.5 |
| TP5151-043_LKMON | TP5151-043 | US151Outfall | 843.76 | 843.24 | 3 | 6 | | 108 | Rectangular | 0.013 | 0.5 | 1 |
| MI5151-054_IN5151-053 | MI5151-054 | IN5151-053 | 899.88 | 899.33 | 1 | 1 | | 65 | Circular | 0.013 | 0.05 | 0.05 |
| IN5151-067_IN5151-013 | IN5151-067 | IN5151-013 | 858.45 | 858.35 | 1.25 | 1.25 | | 17 | Circular | 0.013 | 0.05 | 0.05 |
| IN5051-083_AS5051-050 | IN5051-083 | AS5051-050 | 859.93 | 859.69 | 1 | 1 | | 35 | Circular | 0.013 | 0.25 | 0.5 |
| IN5151-068_MI5151-069 | IN5151-068 | MI5151-069 | 863.23 | 862.88 | 1 | 1 | | 15 | Circular | 0.013 | 0.05 | 0.25 |
| MI5151-069_AS5051-050 | MI5151-069 | AS5051-050 | 862.88 | 859.8 | 1 | 1 | | 60 | Circular | 0.013 | 0.25 | 0.25 |
| IN5151-070_AS5051-056 | IN5151-070 | AS5051-056 | 855.2 | 852.3 | 2 | 2 | | 89 | Circular | 0.013 | 0.05 | 0.25 |
| AS5151-071_IN5151-070 | AS5151-071 | IN5151-070 | 863.14 | 855.26 | 2 | 2 | | 194 | Circular | 0.013 | 0.05 | 0.05 |
| AS5151-073_AS5151-071 | AS5151-073 | AS5151-071 | 870.56 | 863.17 | 2 | 2 | | 145 | Circular | 0.013 | 0.05 | 0.05 |
| AS5151-076_AS5151-073 | AS5151-076 | AS5151-073 | 874.69 | 870.63 | 2 | 2 | | 110 | Circular | 0.013 | 0.05 | 0.05 |
| AS5151-079_AS5151-076 | AS5151-079 | AS5151-076 | 878.81 | 874.69 | 2 | 2 | | 120 | Circular | 0.013 | 0.25 | 0.05 |
| AS5151-080_AS5151-079 | AS5151-080 | AS5151-079 | 883.41 | 878.86 | 2 | 2 | | 74 | Circular | 0.013 | 0.5 | 0.25 |
| IN5151-081_AS5151-080 | IN5151-081 | AS5151-080 | 885.19 | 884.65 | 1 | 1 | | 10 | Circular | 0.013 | 0.5 | 0.5 |
| IN5151-082_AS5151-080 | IN5151-082 | AS5151-080 | 883.83 | 883.58 | 1 | 1 | | 24 | Circular | 0.013 | 0.5 | 0.5 |
| IN5151-083_IN5151-082 | IN5151-083 | IN5151-082 | 886.68 | 883.86 | 1 | 1 | | 22 | Circular | 0.013 | 0.5 | 0.5 |
| AS5151-084_AS5151-080 | AS5151-084 | AS5151-080 | 885.93 | 883.43 | 2 | 2 | | 70 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-135_AS5151-084 | AS5150-135 | AS5151-084 | 895.61 | 886.09 | 2 | 2 | | 263 | Circular | 0.013 | 0.05 | 0.05 |
| AS5150-136_AS5150-138 | AS5150-136 | AS5150-138 | 902.52 | 901.95 | 1.25 | 1.25 | | 27 | Circular | 0.013 | 0.5 | 0.25 |
| IN5150-137_AS5150-136 | IN5150-137 | AS5150-136 | 904.03 | 902.77 | 1 | 1 | | 27 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-138_IN5150-139 | AS5150-138 | IN5150-139 | 901.95 | 899.96 | 1.25 | 1.25 | | 70 | Circular | 0.013 | 0.25 | 0.05 |
| IN5150-139_IN5150-140 | IN5150-139 | IN5150-140 | 899.96 | 897.75 | 1.25 | 1.25 | | 84 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-140_IN5150-142 | IN5150-140 | IN5150-142 | 897.75 | 894.78 | 1.25 | 1.25 | | 115 | Circular | 0.013 | 0.5 | 0.5 |
| IN5150-141_IN5150-140 | IN5150-141 | IN5150-140 | 898.51 | 898 | 1 | 1 | | 54 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-142_AS5150-143 | IN5150-142 | AS5150-143 | 894.78 | 894.49 | 1.25 | 1.25 | | 16 | Circular | 0.013 | 0.5 | 0.05 |
| AS5150-143_AS5150-122 | AS5150-143 | AS5150-122 | 894.24 | 894.02 | 1.5 | 1.5 | | 24 | Circular | 0.013 | 0.05 | 0.5 |
| IN5150-144_IN5150-142 | IN5150-144 | IN5150-142 | 894.99 | 894.49 | 1.25 | 1.25 | | 46 | Circular | 0.013 | 0.5 | 0.5 |
| IN5150-145_IN5150-144 | IN5150-145 | IN5150-144 | 895.67 | 895.24 | 1 | 1 | | 46 | Circular | 0.013 | 0.05 | 0.5 |
| AS5150-146_IN5150-144 | AS5150-146 | IN5150-144 | 895.3 | 895.24 | 1 | 1 | | 36 | Circular | 0.013 | 0.25 | 0.5 |
| AS5150-147_AS5150-146 | AS5150-147 | AS5150-146 | 895.39 | 895.3 | 1 | 1 | | 72 | Circular | 0.013 | 0.25 | 0.25 |
| AS5150-148_AS5150-147 | AS5150-148 | AS5150-147 | 895.65 | 895.45 | 1 | 1 | | 83 | Circular | 0.013 | 0.05 | 0.25 |
| AS5052-094-01_AS5052-094 | AS5052-094-01 | AS5052-094 | 851.55 | 850.78 | 2 | 2 | | 247 | Circular | 0.013 | 0.5 | 0.5 |
| AS5150-049-01_AS5150-049 | AS5150-049-01 | AS5150-049 | 880.58 | 879.7 | 1.75 | 1.75 | | 125 | Circular | 0.013 | 0.5 | 0.05 |
| MI5150-112_IN5150-111 | MI5150-112 | IN5150-111 | 898.94 | 898.94 | 1 | 1 | | 16 | Circular | 0.013 | 0.05 | 0.05 |
| IN5052-081-01_IN5052-081 | IN5052-081-01 | IN5052-081 | 849.17 | 848.66 | 1.17 | 1.917 | | 23 | Rectangular | 0.013 | 0.05 | 0.05 |

## Table 2. Node XP-Table Input Data

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| AS5249-051 | 1 | AS5249-051 | 858.53 | 863.87 | 1.176 | 0.038 | 100 | 15.401 | Type 1, Free Outfall | 0 |
| AS5249-051 | 2 | | | | 1.041 | 0.038 | 100 | 15.401 | | |
| AS5249-051 | 3 | | | | 0.82 | 0.038 | 0 | 15.401 | | |
| AS5249-053 | 1 | AS5249-053 | 848.39 | 854.77 | 0.121 | 0.044 | 100 | 13.699 | Type 1, Free Outfall | 0 |
| AS5249-053 | 2 | | | | 0.04 | 0.044 | 100 | 13.699 | | |
| AS5249-053 | 3 | | | | 0.06 | 0.044 | 0 | 13.699 | | |
| AS5249-056 | 1 | AS5249-056 | 859.24 | 863.97 | 0.405 | 0.029 | 100 | 33.591 | Type 1, Free Outfall | 0 |
| AS5249-056 | 2 | | | | 0.031 | 0.029 | 100 | 33.591 | | |
| AS5249-056 | 3 | | | | 0.033 | 0.029 | 0 | 33.591 | | |
| AS5249-057 | | AS5249-057 | 868.6 | 874.04 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5249-058 | 1 | AS5249-058 | 869.44 | 875.34 | 0.352 | 0.047 | 100 | 39.008 | Type 1, Free Outfall | 0 |
| AS5249-058 | 2 | | | | 0.098 | 0.047 | 100 | 39.008 | | |
| AS5249-058 | 3 | | | | 0.068 | 0.047 | 0 | 39.008 | | |
| AS5249-066 | 1 | AS5249-066 | 849.1 | 854.67 | 0.009 | 0.004 | 100 | 10 | Type 1, Free Outfall | 0 |
| AS5249-066 | 2 | | | | 0.4 | 0.004 | 100 | 10 | | |
| AS5249-066 | 3 | | | | 0.135 | 0.004 | 0 | 10 | | |
| IN5249-071 | 1 | IN5249-071 | 846.15 | 850.29 | 0.866 | 0.011 | 100 | 37.515 | Type 1, Free Outfall | 0 |
| IN5249-071 | 2 | | | | 0.177 | 0.011 | 100 | 37.515 | | |
| IN5249-071 | 3 | | | | 0.539 | 0.011 | 0 | 37.515 | | |
| IN5249-072 | 1 | IN5249-072 | 844.86 | 850.35 | 0.42 | 0.006 | 100 | 45.074 | Type 1, Free Outfall | 0 |
| IN5249-072 | 3 | | | | 0.162 | 0.006 | 0 | 45.074 | | |
| IN5249-073 | | IN5249-073 | 844.85 | 850.88 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5249-083 | 1 | AS5249-083 | 879.8 | 885.22 | 0.412 | 0.019 | 100 | 24.956 | Type 1, Free Outfall | 0 |
| AS5249-083 | 2 | | | | 0.986 | 0.019 | 100 | 24.956 | | |
| AS5249-083 | 3 | | | | 0.234 | 0.019 | 0 | 24.956 | | |
| AS5149-047 | 1 | AS5149-047 | 893.6 | 899.17 | 0.33 | 0.022 | 100 | 36.743 | Type 1, Free Outfall | 0 |
| AS5149-047 | 2 | | | | 0.207 | 0.022 | 100 | 36.743 | | |
| AS5149-047 | 3 | | | | 0.022 | 0.022 | 0 | 36.743 | | |
| AS5149-048 | | AS5149-048 | 885.69 | 892.21 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5149-050 | 1 | IN5149-050 | 909.5 | 913.54 | 0.059 | 0.023 | 100 | 22.049 | Type 1, Free Outfall | 0 |
| IN5149-050 | 2 | | | | 0.005 | 0.023 | 100 | 22.049 | | |
| IN5149-050 | 3 | | | | 0.004 | 0.023 | 0 | 22.049 | | |
| IN5249-086 | 1 | IN5249-086 | 844.85 | 851.5 | 0.482 | 0 | 100 | 38.91 | Type 1, Free Outfall | 0 |
| IN5249-086 | 2 | | | | 0.786 | 0 | 100 | 38.91 | | |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5249-086 | 3 | | | | 0.183 | 0 | 0 | 38.91 | | |
| CB5249-088 | 1 | CB5249-088 | 870.05 | 878.5 | 0.019 | 0.033 | 100 | 20.939 | Type 1, Free Outfall | 0 |
| CB5249-088 | 3 | | | | 0.002 | 0.033 | 0 | 20.939 | | |
| AS5249-090 | 1 | AS5249-090 | 873.58 | 878.23 | 0.496 | 0.023 | 100 | 33.113 | Type 1, Free Outfall | 0 |
| AS5249-090 | 2 | | | | 0.309 | 0.023 | 100 | 33.113 | | |
| AS5249-090 | 3 | | | | 0.111 | 0.023 | 0 | 33.113 | | |
| AS5053-032 | 1 | AS5053-032 | 844.81 | 851.48 | 0.397 | 0.006 | 100 | 27.461 | Type 1, Free Outfall | 0 |
| AS5053-032 | 2 | | | | 0.002 | 0.006 | 100 | 27.461 | | |
| AS5053-032 | 3 | | | | 0.047 | 0.006 | 0 | 27.461 | | |
| AS5051-014 | 1 | AS5051-014 | 897.77 | 902.11 | 0.495 | 0.038 | 100 | 48.906 | Type 1, Free Outfall | 0 |
| AS5051-014 | 2 | | | | 0.003 | 0.038 | 100 | 48.906 | | |
| AS5051-028 | 1 | AS5051-028 | 860.1 | 866.44 | 0.045 | 0.008 | 100 | 10 | Type 1, Free Outfall | 0 |
| AS5051-028 | 2 | | | | 0.161 | 0.008 | 100 | 10 | | |
| AS5051-028 | 3 | | | | 0.042 | 0.008 | 0 | 10 | | |
| AS5052-037 | 1 | AS5052-037 | 846.83 | 851.69 | 0.635 | 0.024 | 100 | 41.005 | Type 1, Free Outfall | 0 |
| AS5052-037 | 2 | | | | 0.269 | 0.024 | 100 | 41.005 | | |
| AS5052-037 | 3 | | | | 0.195 | 0.024 | 0 | 41.005 | | |
| AS5150-024 | 1 | AS5150-024 | 849.56 | 883.57 | 0.09 | 0.083 | 100 | 19.809 | Type 1, Free Outfall | 0 |
| AS5150-024 | 2 | | | | 0.089 | 0.083 | 100 | 19.809 | | |
| AS5150-025 | | AS5150-025 | 848.04 | 887.69 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-027 | | AS5150-027 | 846.5 | 869.88 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-028 | 1 | AS5150-028 | 847.49 | 872.25 | 0.084 | 0.022 | 100 | 10 | Type 1, Free Outfall | 0 |
| AS5150-028 | 2 | | | | 1.44 | 0.022 | 100 | 10 | | |
| AS5150-028 | 3 | | | | 0.253 | 0.022 | 0 | 10 | | |
| IN5150-030 | 1 | IN5150-030 | 886.6 | 889.3 | 0.214 | 0.01 | 100 | 11.81 | Type 1, Free Outfall | 0 |
| IN5150-030 | 2 | | | | 0.393 | 0.01 | 100 | 11.81 | | |
| IN5150-030 | 3 | | | | 0.085 | 0.01 | 0 | 11.81 | | |
| IN5150-044 | 1 | IN5150-044 | 905.12 | 907.4 | 0.263 | 0.025 | 100 | 12.894 | Type 1, Free Outfall | 0 |
| IN5150-044 | 2 | | | | 0.155 | 0.025 | 100 | 12.894 | | |
| IN5150-044 | 3 | | | | 0.028 | 0.025 | 0 | 12.894 | | |
| AS5150-049 | 1 | AS5150-049 | 879.7 | 888.09 | 0.044 | 0.004 | 100 | 25.644 | Type 1, Free Outfall | 0 |
| AS5150-052 | 1 | AS5150-052 | 884.4 | 897.06 | 0.708 | 0.011 | 100 | 34.133 | Type 1, Free Outfall | 0 |
| AS5150-052 | 2 | | | | 0.618 | 0.011 | 100 | 34.133 | | |
| AS5150-052 | 3 | | | | 0.197 | 0.011 | 0 | 34.133 | | |
| AS5150-057 | 1 | AS5150-057 | 889.6 | 897.32 | 0.074 | 0.022 | 100 | 10 | Type 1, Free Outfall | 0 |
| AS5150-057 | 2 | | | | 0.042 | 0.022 | 100 | 10 | | |
| AS5150-057 | 3 | | | | 0.002 | 0.022 | 0 | 10 | | |
| IN5150-072 | 1 | IN5150-072 | 905.85 | 907.7 | 0.197 | 0.025 | 100 | 12.048 | Type 1, Free Outfall | 0 |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5150-072 | 2 | | | | 1.182 | 0.025 | 100 | 12.048 | | |
| IN5150-072 | 3 | | | | 0.014 | 0.025 | 0 | 12.048 | | |
| IN5250-003 | 1 | IN5250-003 | 882.4 | 886.64 | 0.065 | 0.041 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5250-003 | 2 | | | | 0.575 | 0.041 | 100 | 10 | | |
| IN5250-003 | 3 | | | | 0.005 | 0.041 | 0 | 10 | | |
| IN5250-004 | | IN5250-004 | 879.9 | 883.5 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-001 | | AS5151-001 | 846.84 | 884.6 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-004 | | AS5151-004 | 846.16 | 868.11 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-008 | | AS5151-008 | 847.59 | 851.75 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-009 | | AS5151-009 | 845.22 | 850.87 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5151-013 | 1 | IN5151-013 | 858.35 | 865.48 | 0.072 | 0.065 | 100 | 13.871 | Type 1, Free Outfall | 0 |
| IN5151-013 | 2 | | | | 0.004 | 0.065 | 100 | 13.871 | | |
| AS5151-019 | 1 | AS5151-019 | 881.6 | 887.92 | 0.338 | 0.038 | 100 | 41.194 | Type 1, Free Outfall | 0 |
| AS5151-019 | 2 | | | | 0.302 | 0.038 | 100 | 41.194 | | |
| AS5151-019 | 3 | | | | 0.07 | 0.038 | 0 | 41.194 | | |
| AS5151-020 | | AS5151-020 | 881.72 | 888.5 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5052-044 | | AS5052-044 | 852 | 856.4 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5052-046 | 1 | IN5052-046 | 852.81 | 856.62 | 0.159 | 0.011 | 100 | 20.679 | Type 1, Free Outfall | 0 |
| IN5052-046 | 2 | | | | 0.226 | 0.011 | 100 | 20.679 | | |
| IN5052-046 | 3 | | | | 0.17 | 0.011 | 0 | 20.679 | | |
| AS5052-047 | 1 | AS5052-047 | 852.87 | 856.38 | 0.322 | 0.029 | 100 | 42.391 | Type 1, Free Outfall | 0 |
| AS5052-047 | 2 | | | | 0.183 | 0.029 | 100 | 42.391 | | |
| AS5052-047 | 3 | | | | 0.097 | 0.029 | 0 | 42.391 | | |
| IN5052-049 | 1 | IN5052-049 | 853.51 | 856.4 | 1.279 | 0.016 | 100 | 21.756 | Type 1, Free Outfall | 0 |
| IN5052-049 | 2 | | | | 2.147 | 0.016 | 100 | 21.756 | | |
| IN5052-049 | 3 | | | | 1.46 | 0.016 | 0 | 21.756 | | |
| IN5051-034 | 1 | IN5051-034 | 853.1 | 856.57 | 1.01 | 0.046 | 100 | 34.38 | Type 1, Free Outfall | 0 |
| IN5051-034 | 2 | | | | 1.161 | 0.046 | 100 | 34.38 | | |
| IN5051-034 | 3 | | | | 0.649 | 0.046 | 0 | 34.38 | | |
| AS5051-038 | 1 | AS5051-038 | 873.1 | 879.52 | 1.017 | 0.065 | 100 | 32.207 | Type 1, Free Outfall | 0 |
| AS5051-038 | 2 | | | | 0.419 | 0.065 | 100 | 32.207 | | |
| AS5051-038 | 3 | | | | 0.057 | 0.065 | 0 | 32.207 | | |
| AS5051-039 | 1 | AS5051-039 | 875.85 | 883.62 | 1.352 | 0.05 | 100 | 37.172 | Type 1, Free Outfall | 0 |
| AS5051-039 | 2 | | | | 0.002 | 0.05 | 100 | 37.172 | | |
| AS5051-039 | 3 | | | | 0.73 | 0.05 | 0 | 37.172 | | |
| IN5051-048 | 1 | IN5051-048 | 865.97 | 869.72 | 0.204 | 0.1 | 100 | 41.564 | Type 1, Free Outfall | 0 |
| IN5051-048 | 2 | | | | 0.127 | 0.1 | 100 | 41.564 | | |
| IN5051-048 | 3 | | | | 0.24 | 0.1 | 0 | 41.564 | | |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5051-049 | 1 | IN5051-049 | 860.6 | 864.47 | 0.094 | 0.09 | 100 | 20.05 | Type 1, Free Outfall | 0 |
| IN5051-049 | 2 | | | | 0.098 | 0.09 | 100 | 20.05 | | |
| IN5051-049 | 3 | | | | 0.108 | 0.09 | 0 | 20.05 | | |
| AS5051-050 | | AS5051-050 | 859 | 863.82 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5051-052 | 1 | IN5051-052 | 861.66 | 864.72 | 0.115 | 0.052 | 100 | 16.275 | Type 1, Free Outfall | 0 |
| IN5051-052 | 2 | | | | 0.015 | 0.052 | 100 | 16.275 | | |
| IN5051-052 | 3 | | | | 0.056 | 0.052 | 0 | 16.275 | | |
| AS5053-049 | 1 | AS5053-049 | 845.54 | 852.85 | 0.081 | 0.013 | 100 | 14.314 | Type 1, Free Outfall | 0 |
| AS5053-049 | 3 | | | | 0.026 | 0.013 | 0 | 14.314 | | |
| IN5053-054 | 3 | IN5053-054 | 845.17 | 851.1 | 0.005 | 0.011 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5053-056 | 1 | IN5053-056 | 845.33 | 851.65 | 0.035 | 0 | 100 | 20.899 | Type 1, Free Outfall | 0 |
| IN5053-056 | 3 | | | | 0.017 | 0 | 0 | 20.899 | | |
| IN5053-057 | 1 | IN5053-057 | 845.87 | 851.62 | 0.183 | 0 | 100 | 36.075 | Type 1, Free Outfall | 0 |
| IN5053-057 | 3 | | | | 0.036 | 0 | 0 | 36.075 | | |
| AS5052-061 | 1 | AS5052-061 | 845.61 | 851.29 | 0.442 | 0.002 | 100 | 28.814 | Type 1, Free Outfall | 0 |
| AS5052-061 | 3 | | | | 0.108 | 0.002 | 0 | 28.814 | | |
| IN5052-062 | 1 | IN5052-062 | 845.84 | 851.11 | 0.157 | 0.004 | 100 | 34.118 | Type 1, Free Outfall | 0 |
| IN5052-062 | 3 | | | | 0.019 | 0.004 | 0 | 34.118 | | |
| IN5052-063 | 1 | IN5052-063 | 846.07 | 850.67 | 0.022 | 0.013 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5052-063 | 2 | | | | 0.077 | 0.013 | 100 | 10 | | |
| IN5052-063 | 3 | | | | 0.119 | 0.013 | 0 | 10 | | |
| IN5152-009 | 1 | IN5152-009 | 844.51 | 850.33 | 0.208 | 0.006 | 100 | 31.129 | Type 1, Free Outfall | 0 |
| IN5152-009 | 2 | | | | 0.104 | 0.006 | 100 | 31.129 | | |
| IN5152-009 | 3 | | | | 0.027 | 0.006 | 0 | 31.129 | | |
| IN5152-010 | 1 | IN5152-010 | 844.3 | 851.13 | 0.067 | 0 | 100 | 12.139 | Type 1, Free Outfall | 0 |
| IN5152-010 | 3 | | | | 0.044 | 0 | 0 | 12.139 | | |
| IN5152-011 | 1 | IN5152-011 | 844.22 | 851.72 | 0.127 | 0 | 100 | 23.013 | Type 1, Free Outfall | 0 |
| IN5152-011 | 3 | | | | 0.029 | 0 | 0 | 23.013 | | |
| IN5152-012 | 1 | IN5152-012 | 844.05 | 851.96 | 0.108 | 0.005 | 100 | 13.892 | Type 1, Free Outfall | 0 |
| IN5152-012 | 3 | | | | 0.007 | 0.005 | 0 | 13.892 | | |
| AS5152-014 | | AS5152-014 | 844.27 | 851.08 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5152-015 | 1 | IN5152-015 | 846.35 | 849.65 | 0.104 | 0.004 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5152-015 | 2 | | | | 0.165 | 0.004 | 100 | 10 | | |
| IN5152-015 | 3 | | | | 0.195 | 0.004 | 0 | 10 | | |
| IN5152-016 | 1 | IN5152-016 | 846.17 | 850.3 | 0.172 | 0.009 | 100 | 46.334 | Type 1, Free Outfall | 0 |
| IN5152-016 | 3 | | | | 0.022 | 0.009 | 0 | 46.334 | | |
| IN5152-018 | 1 | IN5152-018 | 845.14 | 851.04 | 1.091 | 0.039 | 100 | 34.253 | Type 1, Free Outfall | 0 |
| IN5152-018 | 2 | | | | 0.992 | 0.039 | 100 | 34.253 | | |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5152-018 | 3 | | | | 0.541 | 0.039 | 0 | 34.253 | | |
| IN5152-019 | 1 | IN5152-019 | 845.1 | 850.34 | 0.17 | 0.006 | 100 | 31.213 | Type 1, Free Outfall | 0 |
| IN5152-019 | 3 | | | | 0.075 | 0.006 | 0 | 31.213 | | |
| IN5152-020 | 1 | IN5152-020 | 844.91 | 850.34 | 0.274 | 0.005 | 100 | 47.202 | Type 1, Free Outfall | 0 |
| IN5152-020 | 3 | | | | 0.028 | 0.005 | 0 | 47.202 | | |
| AS5151-025 | | AS5151-025 | 844.15 | 850.11 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5151-026 | 1 | IN5151-026 | 845.22 | 849.18 | 0.332 | 0.051 | 100 | 21.313 | Type 1, Free Outfall | 0 |
| IN5151-026 | 2 | | | | 1.038 | 0.051 | 100 | 21.313 | | |
| IN5151-026 | 3 | | | | 0.5 | 0.051 | 0 | 21.313 | | |
| IN5151-027 | 1 | IN5151-027 | 844.55 | 849.63 | 0.3 | 0.001 | 100 | 58.509 | Type 1, Free Outfall | 0 |
| IN5151-027 | 3 | | | | 0.063 | 0.001 | 0 | 58.509 | | |
| IN5151-028 | 1 | IN5151-028 | 844.6 | 849.38 | 0.099 | 0.006 | 100 | 11.712 | Type 1, Free Outfall | 0 |
| IN5151-028 | 3 | | | | 0.068 | 0.006 | 0 | 11.712 | | |
| IN5151-029 | 1 | IN5151-029 | 844.64 | 849.38 | 0.102 | 0.003 | 100 | 12.266 | Type 1, Free Outfall | 0 |
| IN5151-029 | 3 | | | | 0.031 | 0.003 | 0 | 12.266 | | |
| IN5151-030 | 1 | IN5151-030 | 844.88 | 849.1 | 0.035 | 0.263 | 100 | 11.662 | Type 1, Free Outfall | 0 |
| IN5151-030 | 2 | | | | 0.067 | 0.263 | 100 | 11.662 | | |
| IN5151-030 | 3 | | | | 0.05 | 0.263 | 0 | 11.662 | | |
| IN5151-031 | 1 | IN5151-031 | 844.75 | 849.1 | 0.005 | 0.02 | 100 | 17.142 | Type 1, Free Outfall | 0 |
| AS5151-032 | | AS5151-032 | 844.55 | 849.63 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-034 | 1 | AS5151-034 | 844.95 | 850.01 | 2.197 | 0.001 | 100 | 115.843 | Type 1, Free Outfall | 0 |
| AS5151-034 | 3 | | | | 0.105 | 0.001 | 0 | 115.843 | | |
| AS5151-035 | | AS5151-035 | 844.98 | 850.04 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-037 | | AS5151-037 | 845.93 | 873.19 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-038 | | AS5151-038 | 846.17 | 851.2 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5250-009 | | IN5250-009 | 843.5 | 849.76 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5250-010 | 1 | AS5250-010 | 844.51 | 849.78 | 0.218 | 0.015 | 100 | 33.211 | Type 1, Free Outfall | 0 |
| AS5250-010 | 3 | | | | 0.095 | 0.015 | 0 | 33.211 | | |
| AS5250-011 | | AS5250-011 | 844.74 | 849.63 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-076 | | AS5150-076 | 844.97 | 849.74 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5250-012 | 1 | IN5250-012 | 845.07 | 849.1 | 0.265 | 0.003 | 100 | 26.792 | Type 1, Free Outfall | 0 |
| IN5250-012 | 3 | | | | 0.009 | 0.003 | 0 | 26.792 | | |
| AS5150-077 | 1 | AS5150-077 | 845.14 | 849.9 | 1.763 | 0.028 | 100 | 120.06 | Type 1, Free Outfall | 0 |
| AS5150-077 | 2 | | | | 0.112 | 0.028 | 100 | 120.06 | | |
| AS5150-077 | 3 | | | | 0.046 | 0.028 | 0 | 120.06 | | |
| AS5150-079 | | AS5150-079 | 845.34 | 873.07 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5250-013 | 1 | IN5250-013 | 844.81 | 849.38 | 0.168 | 0.01 | 100 | 33.273 | Type 1, Free Outfall | 0 |
| IN5250-014 | 1 | IN5250-014 | 845.13 | 849.38 | 0.194 | 0.005 | 100 | 19.867 | Type 1, Free Outfall | 0 |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5150-080 | 1 | IN5150-080 | 845.62 | 849.1 | 0.197 | 0.005 | 100 | 11.269 | Type 1, Free Outfall | 0 |
| IN5150-080 | 2 | | | | 0.001 | 0.005 | 100 | 11.269 | | |
| IN5150-080 | 3 | | | | 0.087 | 0.005 | 0 | 11.269 | | |
| IN5250-017 | 1 | IN5250-017 | 845.77 | 850.36 | 0.485 | 0.004 | 100 | 29.278 | Type 1, Free Outfall | 0 |
| IN5250-017 | 3 | | | | 0.005 | 0.004 | 0 | 29.278 | | |
| IN5250-018 | 1 | IN5250-018 | 844.83 | 850.58 | 0.288 | 0.003 | 100 | 42.526 | Type 1, Free Outfall | 0 |
| IN5250-018 | 3 | | | | 0.019 | 0.003 | 0 | 42.526 | | |
| AE5250-019 | | AE5250-019 | 844.1 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| IN5250-020 | 1 | IN5250-020 | 845.44 | 850.73 | 0.238 | 0.005 | 100 | 37.954 | Type 1, Free Outfall | 0 |
| IN5250-021 | 1 | IN5250-021 | 845.78 | 850.13 | 0.283 | 0.003 | 100 | 12.042 | Type 1, Free Outfall | 0 |
| IN5250-021 | 2 | | | | 0.047 | 0.003 | 100 | 12.042 | | |
| IN5250-021 | 3 | | | | 0.071 | 0.003 | 0 | 12.042 | | |
| AE5250-024 | | AE5250-024 | 843.85 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| AS5052-073 | 1 | AS5052-073 | 845.12 | 853.03 | 0.384 | 0.003 | 100 | 21.71 | Type 1, Free Outfall | 0 |
| AS5052-073 | 2 | | | | 0.004 | 0.003 | 100 | 21.71 | | |
| AS5052-073 | 3 | | | | 0.015 | 0.003 | 0 | 21.71 | | |
| AS5052-074 | 1 | AS5052-074 | 845.59 | 851.96 | 0.059 | 0.006 | 100 | 23.693 | Type 1, Free Outfall | 0 |
| AS5052-078 | 1 | AS5052-078 | 845.93 | 852.21 | 0.139 | 0.005 | 100 | 37.228 | Type 1, Free Outfall | 0 |
| AS5052-078 | 3 | | | | 0.012 | 0.005 | 0 | 37.228 | | |
| AS5052-080 | | AS5052-080 | 846.28 | 852.44 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5052-081 | 1 | IN5052-081 | 848.66 | 852.66 | 0.112 | 0.03 | 100 | 25.424 | Type 1, Free Outfall | 0 |
| IN5052-081 | 2 | | | | 0.052 | 0.03 | 100 | 25.424 | | |
| IN5052-081 | 3 | | | | 0.032 | 0.03 | 0 | 25.424 | | |
| IN5052-082 | 1 | IN5052-082 | 848.08 | 852.31 | 0.317 | 0.015 | 100 | 23.077 | Type 1, Free Outfall | 0 |
| IN5052-082 | 2 | | | | 0.134 | 0.015 | 100 | 23.077 | | |
| IN5052-082 | 3 | | | | 0.182 | 0.015 | 0 | 23.077 | | |
| AS5052-083 | 1 | AS5052-083 | 847 | 854.8 | 0.046 | 0.041 | 100 | 16.969 | Type 1, Free Outfall | 0 |
| AS5052-083 | 2 | | | | 0.043 | 0.041 | 100 | 16.969 | | |
| AS5052-083 | 3 | | | | 0.017 | 0.041 | 0 | 16.969 | | |
| AS5052-085 | | AS5052-085 | 848 | 855.75 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5052-087 | 1 | AS5052-087 | 849 | 855.87 | 0.113 | 0.002 | 100 | 24.207 | Type 1, Free Outfall | 0 |
| AS5052-087 | 2 | | | | 0.003 | 0.002 | 100 | 24.207 | | |
| AS5052-087 | 3 | | | | 0.091 | 0.002 | 0 | 24.207 | | |
| IN5052-088 | 1 | IN5052-088 | 851.26 | 856.1 | 0.642 | 0.018 | 100 | 42.15 | Type 1, Free Outfall | 0 |
| IN5052-088 | 2 | | | | 0.529 | 0.018 | 100 | 42.15 | | |
| IN5052-088 | 3 | | | | 0.752 | 0.018 | 0 | 42.15 | | |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5052-089 | 1 | IN5052-089 | 851.71 | 856.53 | 0.061 | 0.047 | 100 | 10.464 | Type 1, Free Outfall | 0 |
| IN5052-089 | 2 | | | | 0.068 | 0.047 | 100 | 10.464 | | |
| IN5052-089 | 3 | | | | 0.116 | 0.047 | 0 | 10.464 | | |
| IN5052-090 | 1 | IN5052-090 | 851.09 | 855.74 | 0.1 | 0.024 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5052-090 | 2 | | | | 0.002 | 0.024 | 100 | 10 | | |
| IN5052-090 | 3 | | | | 0.015 | 0.024 | 0 | 10 | | |
| IN5052-091 | 1 | IN5052-091 | 851.45 | 855.81 | 0.01 | 0.083 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5052-092 | 1 | IN5052-092 | 851.77 | 855.31 | 0.548 | 0.007 | 100 | 40.539 | Type 1, Free Outfall | 0 |
| IN5052-092 | 2 | | | | 0.278 | 0.007 | 100 | 40.539 | | |
| IN5052-092 | 3 | | | | 0.347 | 0.007 | 0 | 40.539 | | |
| IN5052-093 | 1 | IN5052-093 | 851.67 | 855.17 | 1.238 | 0.019 | 100 | 57.84 | Type 1, Free Outfall | 0 |
| IN5052-093 | 2 | | | | 1.294 | 0.019 | 100 | 57.84 | | |
| IN5052-093 | 3 | | | | 0.806 | 0.019 | 0 | 57.84 | | |
| AS5052-094 | 1 | AS5052-094 | 850.55 | 855.53 | 0.262 | 0.004 | 100 | 34.76 | Type 1, Free Outfall | 0 |
| AS5052-094 | 2 | | | | 0.187 | 0.004 | 100 | 34.76 | | |
| AS5052-094 | 3 | | | | 0.129 | 0.004 | 0 | 34.76 | | |
| IN5052-096 | 1 | IN5052-096 | 851.96 | 855.72 | 0.53 | 0.022 | 100 | 40.487 | Type 1, Free Outfall | 0 |
| IN5052-096 | 2 | | | | 0.534 | 0.022 | 100 | 40.487 | | |
| IN5052-096 | 3 | | | | 0.576 | 0.022 | 0 | 40.487 | | |
| IN5052-097 | 1 | IN5052-097 | 852.21 | 856.18 | 0.254 | 0.003 | 100 | 45.136 | Type 1, Free Outfall | 0 |
| IN5052-097 | 2 | | | | 0.043 | 0.003 | 100 | 45.136 | | |
| IN5052-097 | 3 | | | | 0.06 | 0.003 | 0 | 45.136 | | |
| AS5051-053 | | AS5051-053 | 888.94 | 894.79 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5051-054 | | AS5051-054 | 878.22 | 883.57 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5051-055 | | AS5051-055 | 854.6 | 862.5 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5052-106 | | AS5052-106 | 847.01 | 852 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5052-107 | | AS5052-107 | 850.82 | 856 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5051-056 | | AS5051-056 | 852 | 860.84 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| SS5151-041 | | SS5151-041 | 843.85 | 850.16 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| SS5250-025 | | SS5250-025 | 844.1 | 849.86 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5250-026 | | AS5250-026 | 843.5 | 849.76 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5250-027 | | AS5250-027 | 843.75 | 849.85 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5052-109 | 1 | AS5052-109 | 846.15 | 851.8 | 0.007 | 0.012 | 100 | 10 | Type 1, Free Outfall | 0 |
| AS5052-109 | 3 | | | | 0.005 | 0.012 | 0 | 10 | | |
| IN5051-057 | 1 | IN5051-057 | 863.22 | 866.77 | 0.155 | 0.095 | 100 | 21.283 | Type 1, Free Outfall | 0 |
| IN5051-057 | 2 | | | | 0.007 | 0.095 | 100 | 21.283 | | |
| IN5051-057 | 3 | | | | 0.087 | 0.095 | 0 | 21.283 | | |
| CB5051-063 | 1 | CB5051-063 | 856 | 865.64 | 1.707 | 0.027 | 100 | 20.895 | Type 1, Free Outfall | 0 |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| CB5051-063 | 2 | | | | 0.706 | 0.027 | 100 | 20.895 | | |
| CB5051-063 | 3 | | | | 0.49 | 0.027 | 0 | 20.895 | | |
| IN5051-064 | 1 | IN5051-064 | 854.25 | 857.6 | 0.287 | 0.089 | 100 | 40.921 | Type 1, Free Outfall | 0 |
| IN5051-064 | 2 | | | | 0.769 | 0.089 | 100 | 40.921 | | |
| IN5051-064 | 3 | | | | 0.375 | 0.089 | 0 | 40.921 | | |
| AS5051-068 | 1 | AS5051-068 | 851.7 | 858.18 | 0.28 | 0.023 | 100 | 22.761 | Type 1, Free Outfall | 0 |
| AS5051-068 | 3 | | | | 0.026 | 0.023 | 0 | 22.761 | | |
| AS5051-069 | | AS5051-069 | 851.87 | 858.81 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-091 | 1 | AS5150-091 | 897.48 | 903.97 | 0.667 | 0.031 | 100 | 35.807 | Type 1, Free Outfall | 0 |
| AS5150-091 | 2 | | | | 0.002 | 0.031 | 100 | 35.807 | | |
| AS5150-091 | 3 | | | | 0.222 | 0.031 | 0 | 35.807 | | |
| AS5150-094 | 1 | AS5150-094 | 904.44 | 910.45 | 0.503 | 0.016 | 100 | 41.301 | Type 1, Free Outfall | 0 |
| AS5150-094 | 2 | | | | 0.007 | 0.016 | 100 | 41.301 | | |
| AS5150-094 | 3 | | | | 0.02 | 0.016 | 0 | 41.301 | | |
| AS5150-099 | 1 | AS5150-099 | 907.48 | 912.88 | 0.565 | 0.008 | 100 | 46.486 | Type 1, Free Outfall | 0 |
| AS5150-099 | 2 | | | | 0.089 | 0.008 | 100 | 46.486 | | |
| AS5150-099 | 3 | | | | 0.001 | 0.008 | 0 | 46.486 | | |
| AS5150-103 | | AS5150-103 | 909.28 | 916.03 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5150-106 | 1 | IN5150-106 | 910.7 | 915.72 | 0.299 | 0.014 | 100 | 31.208 | Type 1, Free Outfall | 0 |
| IN5150-106 | 2 | | | | 0.227 | 0.014 | 100 | 31.208 | | |
| IN5150-106 | 3 | | | | 0.003 | 0.014 | 0 | 31.208 | | |
| AS5051-076 | 1 | AS5051-076 | 898.79 | 904.21 | 0.766 | 0.033 | 100 | 21.829 | Type 1, Free Outfall | 0 |
| AS5051-076 | 2 | | | | 0.59 | 0.033 | 100 | 21.829 | | |
| AS5051-076 | 3 | | | | 0.01 | 0.033 | 0 | 21.829 | | |
| AS5151-050 | | AS5151-050 | 897.74 | 903 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-052 | 1 | AS5151-052 | 898.53 | 903.53 | 0.336 | 0.051 | 100 | 43.101 | Type 1, Free Outfall | 0 |
| AS5151-052 | 2 | | | | 0.264 | 0.051 | 100 | 43.101 | | |
| IN5151-053 | 1 | IN5151-053 | 899.33 | 904.38 | 0.028 | 0.06 | 100 | 15.944 | Type 1, Free Outfall | 0 |
| IN5151-053 | 2 | | | | 0.053 | 0.06 | 100 | 15.944 | | |
| AS5151-056 | 1 | AS5151-056 | 883.88 | 887.6 | 0.603 | 0.054 | 100 | 35.545 | Type 1, Free Outfall | 0 |
| AS5151-056 | 2 | | | | 0.159 | 0.054 | 100 | 35.545 | | |
| AS5151-056 | 3 | | | | 0.035 | 0.054 | 0 | 35.545 | | |
| IN5149-091 | 1 | IN5149-091 | 898.29 | 903.57 | 0.066 | 0.026 | 100 | 22.043 | Type 1, Free Outfall | 0 |
| IN5149-091 | 2 | | | | 0.001 | 0.026 | 100 | 22.043 | | |
| IN5149-049 | 1 | IN5149-049 | 897.56 | 903.06 | 0.628 | 0.023 | 100 | 24.441 | Type 1, Free Outfall | 0 |
| IN5149-049 | 2 | | | | 0.741 | 0.023 | 100 | 24.441 | | |
| IN5149-049 | 3 | | | | 0.061 | 0.023 | 0 | 24.441 | | |
| IN5149-098 | 1 | IN5149-098 | 901.9 | 906.96 | 0.018 | 0.049 | 100 | 10 | Type 1, Free Outfall | 0 |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5149-098 | 2 | | | | 0.04 | 0.049 | 100 | 10 | | |
| IN5149-099 | 1 | IN5149-099 | 903 | 907.89 | 0.027 | 0.044 | 100 | 11.796 | Type 1, Free Outfall | 0 |
| IN5149-099 | 2 | | | | 0.012 | 0.044 | 100 | 11.796 | | |
| IN5149-100 | 1 | IN5149-100 | 904.44 | 909.14 | 0.016 | 0.066 | 100 | 11.77 | Type 1, Free Outfall | 0 |
| IN5149-100 | 2 | | | | 0.014 | 0.066 | 100 | 11.77 | | |
| IN5149-101 | 1 | IN5149-101 | 905.34 | 909.9 | 0.182 | 0.033 | 100 | 23.323 | Type 1, Free Outfall | 0 |
| IN5149-101 | 2 | | | | 0.16 | 0.033 | 100 | 23.323 | | |
| IN5149-101 | 3 | | | | 0.002 | 0.033 | 0 | 23.323 | | |
| IN5149-102 | 1 | IN5149-102 | 906.29 | 910.79 | 0.02 | 0.027 | 100 | 19.914 | Type 1, Free Outfall | 0 |
| IN5149-103 | 1 | IN5149-103 | 907.35 | 911.89 | 0.032 | 0.035 | 100 | 26.408 | Type 1, Free Outfall | 0 |
| IN5149-103 | 2 | | | | 0.007 | 0.035 | 100 | 26.408 | | |
| IN5149-051 | 1 | IN5149-051 | 912.75 | 916.58 | 2.058 | 0.01 | 100 | 28.381 | Type 1, Free Outfall | 0 |
| IN5149-051 | 2 | | | | 0.488 | 0.01 | 100 | 28.381 | | |
| IN5149-051 | 3 | | | | 1.803 | 0.01 | 0 | 28.381 | | |
| IN5150-110 | 1 | IN5150-110 | 900 | 903.85 | 0.095 | 0.021 | 100 | 16.191 | Type 1, Free Outfall | 0 |
| IN5150-110 | 2 | | | | 0.008 | 0.021 | 100 | 16.191 | | |
| IN5150-111 | 1 | IN5150-111 | 898.94 | 902.54 | 0.047 | 0.033 | 100 | 12.357 | Type 1, Free Outfall | 0 |
| IN5150-111 | 2 | | | | 0.056 | 0.033 | 100 | 12.357 | | |
| IN5150-114 | 1 | IN5150-114 | 896.2 | 900.92 | 0.052 | 0.021 | 100 | 18.442 | Type 1, Free Outfall | 0 |
| IN5150-114 | 2 | | | | 0.001 | 0.021 | 100 | 18.442 | | |
| IN5150-115 | 1 | IN5150-115 | 896.51 | 903.04 | 0.16 | 0.018 | 100 | 27.484 | Type 1, Free Outfall | 0 |
| IN5150-115 | 2 | | | | 0.008 | 0.018 | 100 | 27.484 | | |
| IN5150-116 | | IN5150-116 | 897.2 | 903.67 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5150-117 | 1 | IN5150-117 | 899.9 | 905.1 | 0.049 | 0.033 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5150-117 | 2 | | | | 0.211 | 0.033 | 100 | 10 | | |
| IN5150-117 | 3 | | | | 0.002 | 0.033 | 0 | 10 | | |
| IN5052-111 | 1 | IN5052-111 | 845 | 850.44 | 0.245 | 0.012 | 100 | 30.358 | Type 1, Free Outfall | 0 |
| IN5052-111 | 2 | | | | 0.024 | 0.012 | 100 | 30.358 | | |
| IN5052-111 | 3 | | | | 0.079 | 0.012 | 0 | 30.358 | | |
| IN5150-046 | 1 | IN5150-046 | 904.2 | 917.38 | 0.025 | 0.033 | 100 | 6.56 | Type 1, Free Outfall | 0 |
| IN5150-046 | 2 | | | | 0.03 | 0.033 | 100 | 6.56 | | |
| IN5150-124 | 1 | IN5150-124 | 887.8 | 891 | 0.135 | 0.059 | 100 | 22.194 | Type 1, Free Outfall | 0 |
| IN5150-124 | 2 | | | | 0.037 | 0.059 | 100 | 22.194 | | |
| IN5150-124 | 3 | | | | 0.032 | 0.059 | 0 | 22.194 | | |
| IN5150-125 | 1 | IN5150-125 | 883.75 | 890.31 | 0.026 | 0.006 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5150-125 | 3 | | | | 0.001 | 0.006 | 0 | 10 | | |
| IN5250-006 | 1 | IN5250-006 | 878.99 | 880.16 | 0.193 | 0.037 | 100 | 21.14 | Type 1, Free Outfall | 0 |
| IN5250-006 | 2 | | | | 0.042 | 0.037 | 100 | 21.14 | | |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5250-028 | 1 | IN5250-028 | 871.68 | 876.49 | 0.576 | 0.013 | 100 | 27.605 | Type 1, Free Outfall | 0 |
| IN5250-028 | 2 | | | | 1.059 | 0.013 | 100 | 27.605 | | |
| IN5250-028 | 3 | | | | 0.541 | 0.013 | 0 | 27.605 | | |
| IN5250-029 | 1 | IN5250-029 | 876.15 | 879.61 | 0.109 | 0.033 | 100 | 18.669 | Type 1, Free Outfall | 0 |
| IN5250-029 | 2 | | | | 0.111 | 0.033 | 100 | 18.669 | | |
| IN5151-062 | 1 | IN5151-062 | 900.73 | 905.44 | 0.014 | 0.01 | 100 | 14.072 | Type 1, Free Outfall | 0 |
| IN5151-062 | 2 | | | | 0.015 | 0.01 | 100 | 14.072 | | |
| IN5151-063 | 1 | IN5151-063 | 901.88 | 905.69 | 0.977 | 0.021 | 100 | 24.338 | Type 1, Free Outfall | 0 |
| IN5151-063 | 2 | | | | 1.02 | 0.021 | 100 | 24.338 | | |
| IN5151-063 | 3 | | | | 0.031 | 0.021 | 0 | 24.338 | | |
| IN5150-133 | 1 | IN5150-133 | 893 | 901.64 | 0.138 | 0.001 | 100 | 38.215 | Type 1, Free Outfall | 0 |
| IN5150-133 | 3 | | | | 0.01 | 0.001 | 0 | 38.215 | | |
| AS5149-095 | 1 | AS5149-095 | 889 | 895.12 | 0.102 | 0.037 | 100 | 25.167 | Type 1, Free Outfall | 0 |
| AS5149-095 | 2 | | | | 0.037 | 0.037 | 100 | 25.167 | | |
| AS5249-092 | | AS5249-092 | 862.57 | 866.82 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5249-093 | | AS5249-093 | 866.19 | 868.72 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5249-094 | 1 | AS5249-094 | 866.24 | 870.14 | 0.457 | 0.026 | 100 | 41.377 | Type 1, Free Outfall | 0 |
| AS5249-094 | 2 | | | | 0.333 | 0.026 | 100 | 41.377 | | |
| AS5249-094 | 3 | | | | 0.051 | 0.026 | 0 | 41.377 | | |
| AS5150-113 | | AS5150-113 | 896.2 | 899.74 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-122 | | AS5150-122 | 894.02 | 897.78 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5250-005 | | AS5250-005 | 875.66 | 879.36 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-128 | 1 | AS5150-128 | 910.76 | 916.83 | 0.675 | 0.007 | 100 | 65.014 | Type 1, Free Outfall | 0 |
| AS5150-128 | 2 | | | | 0.909 | 0.007 | 100 | 65.014 | | |
| AS5150-128 | 3 | | | | 0.071 | 0.007 | 0 | 65.014 | | |
| AS5150-129 | 1 | AS5150-129 | 910.49 | 916.24 | 0.619 | 0.012 | 100 | 15.442 | Type 1, Free Outfall | 0 |
| AS5150-129 | 2 | | | | 1.284 | 0.012 | 100 | 15.442 | | |
| AS5150-129 | 3 | | | | 0.869 | 0.012 | 0 | 15.442 | | |
| AS5150-087 | | AS5150-087 | 894.62 | 902.09 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-023 | 1 | AS5150-023 | 892.52 | 901.77 | 0.539 | 0.038 | 100 | 65.638 | Type 1, Free Outfall | 0 |
| AS5150-023 | 2 | | | | 0.481 | 0.038 | 100 | 65.638 | | |
| AS5150-023 | 3 | | | | 0.111 | 0.038 | 0 | 65.638 | | |
| AS5150-134 | 1 | AS5150-134 | 891.97 | 901.4 | 0.254 | 0.003 | 100 | 51.997 | Type 1, Free Outfall | 0 |
| AS5150-134 | 2 | | | | 0.094 | 0.003 | 100 | 51.997 | | |
| AS5150-134 | 3 | | | | 0.326 | 0.003 | 0 | 51.997 | | |
| AS5151-064 | | AS5151-064 | 891 | 897 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-065 | 1 | AS5151-065 | 885.4 | 889.6 | 0.182 | 0.038 | 100 | 22.143 | Type 1, Free Outfall | 0 |
| AS5151-065 | 2 | | | | 0.162 | 0.038 | 100 | 22.143 | | |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| AS5151-065 | 3 | | | | 0.038 | 0.038 | 0 | 22.143 | | |
| ND5151-066 | | ND5151-066 | 885.3 | 888.5 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| MI5051-002 | | MI5051-002 | 860.65 | 865.15 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| TP5051-016 | 1 | TP5051-016 | 893.74 | 898.74 | 0.399 | 0.023 | 100 | 37.949 | Type 1, Free Outfall | 0 |
| TP5051-016 | 2 | | | | 0.05 | 0.023 | 100 | 37.949 | | |
| TP5051-016 | 3 | | | | 0.001 | 0.023 | 0 | 37.949 | | |
| MI5052-045 | | MI5052-045 | 852 | 856.07 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| PL5151-039 | | PL5151-039 | 846.15 | 874.31 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| PL5151-040 | 2 | PL5151-040 | 846.19 | 874.3 | 0.127 | 0.008 | 100 | 0 | Type 1, Free Outfall | 0 |
| PL5151-040 | 3 | | | | 1.987 | 0.008 | 0 | 0 | | |
| TP5151-042 | | TP5151-042 | 844 | 850.08 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| TP5151-043 | | TP5151-043 | 843.76 | 850.26 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| MI5151-054 | | MI5151-054 | 899.88 | 904.64 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5151-067 | 1 | IN5151-067 | 858 | 865.73 | 0.48 | 0.056 | 100 | 30.611 | Type 1, Free Outfall | 0 |
| IN5151-067 | 2 | | | | 1.131 | 0.056 | 100 | 30.611 | | |
| IN5151-067 | 3 | | | | 0.06 | 0.056 | 0 | 30.611 | | |
| IN5051-083 | 1 | IN5051-083 | 859.93 | 862.92 | 0.053 | 0.023 | 100 | 29.1 | Type 1, Free Outfall | 0 |
| IN5051-083 | 3 | | | | 0.005 | 0.023 | 0 | 29.1 | | |
| IN5151-068 | 1 | IN5151-068 | 863.23 | 867.23 | 0.366 | 0.068 | 100 | 34.917 | Type 1, Free Outfall | 0 |
| IN5151-068 | 2 | | | | 0.008 | 0.068 | 100 | 34.917 | | |
| MI5151-069 | | MI5151-069 | 862.88 | 865.46 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5151-070 | 1 | IN5151-070 | 855.2 | 870.73 | 0.191 | 0.035 | 100 | 38.02 | Type 1, Free Outfall | 0 |
| IN5151-070 | 3 | | | | 0.027 | 0.035 | 0 | 38.02 | | |
| AS5151-071 | 1 | AS5151-071 | 863.14 | 870.73 | 0.139 | 0.045 | 100 | 46.539 | Type 1, Free Outfall | 0 |
| AS5151-071 | 2 | | | | 0.013 | 0.045 | 100 | 46.539 | | |
| AS5151-071 | 3 | | | | 0.01 | 0.045 | 0 | 46.539 | | |
| AS5151-073 | 1 | AS5151-073 | 870.56 | 877.18 | 0.39 | 0.026 | 100 | 24.194 | Type 1, Free Outfall | 0 |
| AS5151-073 | 2 | | | | 0.554 | 0.026 | 100 | 24.194 | | |
| AS5151-073 | 3 | | | | 0.011 | 0.026 | 0 | 24.194 | | |
| AS5151-076 | 1 | AS5151-076 | 874.69 | 882.07 | 0.188 | 0.029 | 100 | 38.122 | Type 1, Free Outfall | 0 |
| AS5151-076 | 2 | | | | 0.002 | 0.029 | 100 | 38.122 | | |
| AS5151-076 | 3 | | | | 0.012 | 0.029 | 0 | 38.122 | | |
| AS5151-079 | | AS5151-079 | 878.81 | 886.15 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5151-080 | | AS5151-080 | 883.41 | 889.03 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5151-081 | 1 | IN5151-081 | 885.19 | 889 | 0.071 | 0.03 | 100 | 22.853 | Type 1, Free Outfall | 0 |
| IN5151-081 | 2 | | | | 0.001 | 0.03 | 100 | 22.853 | | |
| IN5151-081 | 3 | | | | 0.019 | 0.03 | 0 | 22.853 | | |
| IN5151-082 | 1 | IN5151-082 | 883.83 | 890.16 | 0.083 | 0.052 | 100 | 10 | Type 1, Free Outfall | 0 |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| IN5151-082 | 2 | | | | 1.199 | 0.052 | 100 | 10 | | |
| IN5151-082 | 3 | | | | 0.012 | 0.052 | 0 | 10 | | |
| IN5151-083 | 1 | IN5151-083 | 886.68 | 889.84 | 0.046 | 0.047 | 100 | 17.542 | Type 1, Free Outfall | 0 |
| IN5151-083 | 2 | | | | 0.017 | 0.047 | 100 | 17.542 | | |
| AS5151-084 | 1 | AS5151-084 | 885.93 | 891.77 | 0.626 | 0.05 | 100 | 47.203 | Type 1, Free Outfall | 0 |
| AS5151-084 | 2 | | | | 0.323 | 0.05 | 100 | 47.203 | | |
| AS5151-084 | 3 | | | | 0.133 | 0.05 | 0 | 47.203 | | |
| AS5150-135 | | AS5150-135 | 895.61 | 900.82 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-136 | | AS5150-136 | 902.52 | 906.72 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5150-137 | 1 | IN5150-137 | 904.03 | 907.51 | 0.433 | 0.015 | 100 | 53.991 | Type 1, Free Outfall | 0 |
| IN5150-137 | 2 | | | | 0.593 | 0.015 | 100 | 53.991 | | |
| IN5150-137 | 3 | | | | 0.162 | 0.015 | 0 | 53.991 | | |
| AS5150-138 | | AS5150-138 | 901.95 | 906.57 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5150-139 | 1 | IN5150-139 | 899.96 | 904.99 | 0.06 | 0.023 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5150-139 | 2 | | | | 0.638 | 0.023 | 100 | 10 | | |
| IN5150-139 | 3 | | | | 0.01 | 0.023 | 0 | 10 | | |
| IN5150-140 | 1 | IN5150-140 | 897.75 | 902.01 | 0.056 | 0.026 | 100 | 10 | Type 1, Free Outfall | 0 |
| IN5150-140 | 2 | | | | 0.447 | 0.026 | 100 | 10 | | |
| IN5150-140 | 3 | | | | 0.013 | 0.026 | 0 | 10 | | |
| IN5150-141 | 1 | IN5150-141 | 898.51 | 903.03 | 0.123 | 0.021 | 100 | 10.791 | Type 1, Free Outfall | 0 |
| IN5150-141 | 2 | | | | 0.085 | 0.021 | 100 | 10.791 | | |
| IN5150-141 | 3 | | | | 0.049 | 0.021 | 0 | 10.791 | | |
| IN5150-142 | 1 | IN5150-142 | 894 | 898.68 | 0.118 | 0.025 | 100 | 33.759 | Type 1, Free Outfall | 0 |
| IN5150-142 | 2 | | | | 0.014 | 0.025 | 100 | 33.759 | | |
| IN5150-142 | 3 | | | | 0.007 | 0.025 | 0 | 33.759 | | |
| AS5150-143 | | AS5150-143 | 894.24 | 897.96 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5150-144 | 1 | IN5150-144 | 894.99 | 898.87 | 0.205 | 0.013 | 100 | 29.267 | Type 1, Free Outfall | 0 |
| IN5150-144 | 2 | | | | 0.035 | 0.013 | 100 | 29.267 | | |
| IN5150-144 | 3 | | | | 0.031 | 0.013 | 0 | 29.267 | | |
| IN5150-145 | 1 | IN5150-145 | 895.67 | 900.19 | 0.011 | 0.014 | 100 | 5.887 | Type 1, Free Outfall | 0 |
| IN5150-145 | 2 | | | | 0.035 | 0.014 | 100 | 5.887 | | |
| AS5150-146 | | AS5150-146 | 895.3 | 899.19 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-147 | | AS5150-147 | 895 | 900.99 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-148 | 1 | AS5150-148 | 895.65 | 902.15 | 0.104 | 0.017 | 100 | 14.623 | Type 1, Free Outfall | 0 |
| AS5150-148 | 2 | | | | 0.783 | 0.017 | 100 | 14.623 | | |
| AS5150-148 | 3 | | | | 0.127 | 0.017 | 0 | 14.623 | | |
| NorthShoreDrOutfall | | NorthShoreDrOutfall | 844.35 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |

| Name | Subcatchment | Node Name | Invert Elevation ft | Ground Elevation (Spill Crest) ft | Area acres | Slope ft/ft | Impervious Percentage % | Width ft | Type of Outlet Control | Outlet Control Backwater ft |
|---|---|---|---|---|---|---|---|---|---|---|
| BroomStOutfall | | BroomStOutfall | 844.35 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| HamiltonStOutfall | | HamiltonStOutfall | 843.6 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| HenryStOutfall | | HenryStOutfall | 844.35 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| WilsonStOutfall | | WilsonStOutfall | 842.99 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| US151Outfall2 | | US151Outfall2 | 842.99 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| US151Outfall | | US151Outfall | 843.23 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| PinckneyStOutfall | | PinckneyStOutfall | 843.11 | 848.51 | 0 | 0 | 0 | 0 | Type2, Fixed Backwater | 845.62 |
| AS5052-094-01 | | AS5052-094-01 | 850.5 | 855.19 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| AS5150-049-01 | | AS5150-049-01 | 879.5 | 889.65 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| MI5150-112 | | MI5150-112 | 898.94 | 902.79 | 0 | 0 | 0 | 0 | Type 1, Free Outfall | 0 |
| IN5052-081-01 | 1 | IN5052-081-01 | 848.66 | 852.66 | 0.293 | 0.008 | 100 | 15.957 | Type 1, Free Outfall | 0 |
| IN5052-081-01 | 2 | | | | 0.657 | 0.008 | 100 | 15.957 | | |
| IN5052-081-01 | 3 | | | | 0.912 | 0.008 | 0 | 15.957 | | |

## Table 3. Subcatchment XP-Table Input Data

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5249-051 | 1 | 1.176 | 100 | 0.038 | 15.401 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-051 | 2 | 1.041 | 100 | 0.038 | 15.401 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-051 | 3 | 0.82 | 0 | 0.038 | 15.401 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5249-053 | 1 | 0.121 | 100 | 0.044 | 13.699 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-053 | 2 | 0.04 | 100 | 0.044 | 13.699 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-053 | 3 | 0.06 | 0 | 0.044 | 13.699 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5249-056 | 1 | 0.405 | 100 | 0.029 | 33.591 | 10C90D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-056 | 2 | 0.031 | 100 | 0.029 | 33.591 | 10C90D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-056 | 3 | 0.033 | 0 | 0.029 | 33.591 | 10C90D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5249-057 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-058 | 1 | 0.352 | 100 | 0.047 | 39.008 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-058 | 2 | 0.098 | 100 | 0.047 | 39.008 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-058 | 3 | 0.068 | 0 | 0.047 | 39.008 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5249-066 | 1 | 0.009 | 100 | 0.004 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-066 | 2 | 0.4 | 100 | 0.004 | 10 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-066 | 3 | 0.135 | 0 | 0.004 | 10 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5249-071 | 1 | 0.866 | 100 | 0.011 | 37.515 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5249-071 | 2 | 0.177 | 100 | 0.011 | 37.515 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5249-071 | 3 | 0.539 | 0 | 0.011 | 37.515 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5249-072 | 1 | 0.42 | 100 | 0.006 | 45.074 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5249-072 | 3 | 0.162 | 0 | 0.006 | 45.074 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5249-073 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-083 | 1 | 0.412 | 100 | 0.019 | 24.956 | 10C90D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-083 | 2 | 0.986 | 100 | 0.019 | 24.956 | 10C90D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-083 | 3 | 0.234 | 0 | 0.019 | 24.956 | 10C90D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5149-047 | 1 | 0.33 | 100 | 0.022 | 36.743 | 10B90C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5149-047 | 2 | 0.207 | 100 | 0.022 | 36.743 | 10B90C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5149-047 | 3 | 0.022 | 0 | 0.022 | 36.743 | 10B90C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5149-048 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-050 | 1 | 0.059 | 100 | 0.023 | 22.049 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-050 | 2 | 0.005 | 100 | 0.023 | 22.049 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-050 | 3 | 0.004 | 0 | 0.023 | 22.049 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5249-086 | 1 | 0.482 | 100 | 0 | 38.91 | 20B80D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5249-086 | 2 | 0.786 | 100 | 0 | 38.91 | 20B80D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5249-086 | 3 | 0.183 | 0 | 0 | 38.91 | 20B80D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| CB5249-088 | 1 | 0.019 | 100 | 0.033 | 20.939 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| CB5249-088 | 3 | 0.002 | 0 | 0.033 | 20.939 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5249-090 | 1 | 0.496 | 100 | 0.023 | 33.113 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-090 | 2 | 0.309 | 100 | 0.023 | 33.113 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-090 | 3 | 0.111 | 0 | 0.023 | 33.113 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5053-032 | 1 | 0.397 | 100 | 0.006 | 27.461 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5053-032 | 2 | 0.002 | 100 | 0.006 | 27.461 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5053-032 | 3 | 0.047 | 0 | 0.006 | 27.461 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-014 | 1 | 0.495 | 100 | 0.038 | 48.906 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-014 | 2 | 0.003 | 100 | 0.038 | 48.906 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5051-028 | 1 | 0.045 | 100 | 0.008 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-028 | 2 | 0.161 | 100 | 0.008 | 10 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5051-028 | 3 | 0.042 | 0 | 0.008 | 10 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-037 | 1 | 0.635 | 100 | 0.024 | 41.005 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-037 | 2 | 0.269 | 100 | 0.024 | 41.005 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5052-037 | 3 | 0.195 | 0 | 0.024 | 41.005 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-024 | 1 | 0.09 | 100 | 0.083 | 19.809 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-024 | 2 | 0.089 | 100 | 0.083 | 19.809 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-025 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-027 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-028 | 1 | 0.084 | 100 | 0.022 | 10 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-028 | 2 | 1.44 | 100 | 0.022 | 10 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-028 | 3 | 0.253 | 0 | 0.022 | 10 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-030 | 1 | 0.214 | 100 | 0.01 | 11.81 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-030 | 2 | 0.393 | 100 | 0.01 | 11.81 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-030 | 3 | 0.085 | 0 | 0.01 | 11.81 | No Pervious Area | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-044 | 1 | 0.263 | 100 | 0.025 | 12.894 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-044 | 2 | 0.155 | 100 | 0.025 | 12.894 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-044 | 3 | 0.028 | 0 | 0.025 | 12.894 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-049 | 1 | 0.044 | 100 | 0.004 | 25.644 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-052 | 1 | 0.708 | 100 | 0.011 | 34.133 | 90B10D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-052 | 2 | 0.618 | 100 | 0.011 | 34.133 | 90B10D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-052 | 3 | 0.197 | 0 | 0.011 | 34.133 | 90B10D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-057 | 1 | 0.074 | 100 | 0.022 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-057 | 2 | 0.042 | 100 | 0.022 | 10 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-057 | 3 | 0.002 | 0 | 0.022 | 10 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-072 | 1 | 0.197 | 100 | 0.025 | 12.048 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-072 | 2 | 1.182 | 100 | 0.025 | 12.048 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-072 | 3 | 0.014 | 0 | 0.025 | 12.048 | No Pervious Area | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5250-003 | 1 | 0.065 | 100 | 0.041 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-003 | 2 | 0.575 | 100 | 0.041 | 10 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5250-003 | 3 | 0.005 | 0 | 0.041 | 10 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5250-004 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-001 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-004 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-008 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-009 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-013 | 1 | 0.072 | 100 | 0.065 | 13.871 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-013 | 2 | 0.004 | 100 | 0.065 | 13.871 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5151-019 | 1 | 0.338 | 100 | 0.038 | 41.194 | 70B30C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-019 | 2 | 0.302 | 100 | 0.038 | 41.194 | 70B30C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-019 | 3 | 0.07 | 0 | 0.038 | 41.194 | 70B30C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-020 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-044 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-046 | 1 | 0.159 | 100 | 0.011 | 20.679 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-046 | 2 | 0.226 | 100 | 0.011 | 20.679 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-046 | 3 | 0.17 | 0 | 0.011 | 20.679 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-047 | 1 | 0.322 | 100 | 0.029 | 42.391 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-047 | 2 | 0.183 | 100 | 0.029 | 42.391 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5052-047 | 3 | 0.097 | 0 | 0.029 | 42.391 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-049 | 1 | 1.279 | 100 | 0.016 | 21.756 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-049 | 2 | 2.147 | 100 | 0.016 | 21.756 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-049 | 3 | 1.46 | 0 | 0.016 | 21.756 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5051-034 | 1 | 1.01 | 100 | 0.046 | 34.38 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-034 | 2 | 1.161 | 100 | 0.046 | 34.38 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5051-034 | 3 | 0.649 | 0 | 0.046 | 34.38 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-038 | 1 | 1.017 | 100 | 0.065 | 32.207 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-038 | 2 | 0.419 | 100 | 0.065 | 32.207 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5051-038 | 3 | 0.057 | 0 | 0.065 | 32.207 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-039 | 1 | 1.352 | 100 | 0.05 | 37.172 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-039 | 2 | 0.002 | 100 | 0.05 | 37.172 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5051-039 | 3 | 0.73 | 0 | 0.05 | 37.172 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5051-048 | 1 | 0.204 | 100 | 0.1 | 41.564 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-048 | 2 | 0.127 | 100 | 0.1 | 41.564 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5051-048 | 3 | 0.24 | 0 | 0.1 | 41.564 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5051-049 | 1 | 0.094 | 100 | 0.09 | 20.05 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-049 | 2 | 0.098 | 100 | 0.09 | 20.05 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5051-049 | 3 | 0.108 | 0 | 0.09 | 20.05 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-050 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-052 | 1 | 0.115 | 100 | 0.052 | 16.275 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-052 | 2 | 0.015 | 100 | 0.052 | 16.275 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5051-052 | 3 | 0.056 | 0 | 0.052 | 16.275 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5053-049 | 1 | 0.081 | 100 | 0.013 | 14.314 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5053-049 | 3 | 0.026 | 0 | 0.013 | 14.314 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5053-054 | 3 | 0.005 | 0 | 0.011 | 0 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | 1 | |
| IN5053-056 | 1 | 0.035 | 100 | 0 | 20.899 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5053-056 | 3 | 0.017 | 0 | 0 | 20.899 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5053-057 | 1 | 0.183 | 100 | 0 | 36.075 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5053-057 | 3 | 0.036 | 0 | 0 | 36.075 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-061 | 1 | 0.442 | 100 | 0.002 | 28.814 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-061 | 3 | 0.108 | 0 | 0.002 | 28.814 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-062 | 1 | 0.157 | 100 | 0.004 | 34.118 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-062 | 3 | 0.019 | 0 | 0.004 | 34.118 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IN5052-063 | 1 | 0.022 | 100 | 0.013 | 10 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-063 | 2 | 0.077 | 100 | 0.013 | 10 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-063 | 3 | 0.119 | 0 | 0.013 | 10 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-009 | 1 | 0.208 | 100 | 0.006 | 31.129 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 0 | |
| IN5152-009 | 2 | 0.104 | 100 | 0.006 | 31.129 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5152-009 | 3 | 0.027 | 0 | 0.006 | 31.129 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-010 | 1 | 0.067 | 100 | 0 | 12.139 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-010 | 3 | 0.044 | 0 | 0 | 12.139 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-011 | 1 | 0.127 | 100 | 0 | 23.013 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-011 | 3 | 0.029 | 0 | 0 | 23.013 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-012 | 1 | 0.108 | 100 | 0.005 | 13.892 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-012 | 3 | 0.007 | 0 | 0.005 | 13.892 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5152-014 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-015 | 1 | 0.104 | 100 | 0.004 | 10 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-015 | 2 | 0.165 | 100 | 0.004 | 10 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5152-015 | 3 | 0.195 | 0 | 0.004 | 10 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-016 | 1 | 0.172 | 100 | 0.009 | 46.334 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-016 | 3 | 0.022 | 0 | 0.009 | 46.334 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-018 | 1 | 1.091 | 100 | 0.039 | 34.253 | 10B90D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-018 | 2 | 0.992 | 100 | 0.039 | 34.253 | 10B90D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5152-018 | 3 | 0.541 | 0 | 0.039 | 34.253 | 10B90D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-019 | 1 | 0.17 | 100 | 0.006 | 31.213 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-019 | 3 | 0.075 | 0 | 0.006 | 31.213 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5152-020 | 1 | 0.274 | 100 | 0.005 | 47.202 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5152-020 | 3 | 0.028 | 0 | 0.005 | 47.202 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-025 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-026 | 1 | 0.332 | 100 | 0.051 | 21.313 | 40B60D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-026 | 2 | 1.038 | 100 | 0.051 | 21.313 | 40B60D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-026 | 3 | 0.5 | 0 | 0.051 | 21.313 | 40B60D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-027 | 1 | 0.3 | 100 | 0.001 | 58.509 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-027 | 3 | 0.063 | 0 | 0.001 | 58.509 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-028 | 1 | 0.099 | 100 | 0.006 | 11.712 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-028 | 3 | 0.068 | 0 | 0.006 | 11.712 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-029 | 1 | 0.102 | 100 | 0.003 | 12.266 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-029 | 3 | 0.031 | 0 | 0.003 | 12.266 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-030 | 1 | 0.035 | 100 | 0.263 | 11.662 | 60B40D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-030 | 2 | 0.067 | 100 | 0.263 | 11.662 | 60B40D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-030 | 3 | 0.05 | 0 | 0.263 | 11.662 | 60B40D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-031 | 1 | 0.005 | 100 | 0.02 | 17.142 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-032 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-034 | 1 | 2.197 | 100 | 0.001 | 115.843 | 70B30D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-034 | 3 | 0.105 | 0 | 0.001 | 115.843 | 70B30D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-035 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-037 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5151-038 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-009 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5250-010 | 1 | 0.218 | 100 | 0.015 | 33.211 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5250-010 | 3 | 0.095 | 0 | 0.015 | 33.211 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5250-011 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-076 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-012 | 1 | 0.265 | 100 | 0.003 | 26.792 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-012 | 3 | 0.009 | 0 | 0.003 | 26.792 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-077 | 1 | 1.763 | 100 | 0.028 | 120.06 | 10B90D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-077 | 2 | 0.112 | 100 | 0.028 | 120.06 | 10B90D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-077 | 3 | 0.046 | 0 | 0.028 | 120.06 | 10B90D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-079 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-013 | 1 | 0.168 | 100 | 0.01 | 33.273 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-014 | 1 | 0.194 | 100 | 0.005 | 19.867 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-080 | 1 | 0.197 | 100 | 0.005 | 11.269 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-080 | 2 | 0.001 | 100 | 0.005 | 11.269 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-080 | 3 | 0.087 | 0 | 0.005 | 11.269 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5250-017 | 1 | 0.485 | 100 | 0.004 | 29.278 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-017 | 3 | 0.005 | 0 | 0.004 | 29.278 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5250-018 | 1 | 0.288 | 100 | 0.003 | 42.526 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-018 | 3 | 0.019 | 0 | 0.003 | 42.526 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AE5250-019 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-020 | 1 | 0.238 | 100 | 0.005 | 37.954 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-021 | 1 | 0.283 | 100 | 0.003 | 12.042 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-021 | 2 | 0.047 | 100 | 0.003 | 12.042 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5250-021 | 3 | 0.071 | 0 | 0.003 | 12.042 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AE5250-024 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-073 | 1 | 0.384 | 100 | 0.003 | 21.71 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-073 | 2 | 0.004 | 100 | 0.003 | 21.71 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5052-073 | 3 | 0.015 | 0 | 0.003 | 21.71 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-074 | 1 | 0.059 | 100 | 0.006 | 23.693 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-078 | 1 | 0.139 | 100 | 0.005 | 37.228 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-078 | 3 | 0.012 | 0 | 0.005 | 37.228 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-080 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-081 | 1 | 0.112 | 100 | 0.03 | 25.424 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-081 | 2 | 0.052 | 100 | 0.03 | 25.424 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-081 | 3 | 0.032 | 0 | 0.03 | 25.424 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-082 | 1 | 0.317 | 100 | 0.015 | 23.077 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-082 | 2 | 0.134 | 100 | 0.015 | 23.077 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-082 | 3 | 0.182 | 0 | 0.015 | 23.077 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-083 | 1 | 0.046 | 100 | 0.041 | 16.969 | 50B50D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-083 | 2 | 0.043 | 100 | 0.041 | 16.969 | 50B50D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5052-083 | 3 | 0.017 | 0 | 0.041 | 16.969 | 50B50D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-085 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5052-087 | 1 | 0.113 | 100 | 0.002 | 24.207 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-087 | 2 | 0.003 | 100 | 0.002 | 24.207 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5052-087 | 3 | 0.091 | 0 | 0.002 | 24.207 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-088 | 1 | 0.642 | 100 | 0.018 | 42.15 | 80B20D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-088 | 2 | 0.529 | 100 | 0.018 | 42.15 | 80B20D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-088 | 3 | 0.752 | 0 | 0.018 | 42.15 | 80B20D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-089 | 1 | 0.061 | 100 | 0.047 | 10.464 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-089 | 2 | 0.068 | 100 | 0.047 | 10.464 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-089 | 3 | 0.116 | 0 | 0.047 | 10.464 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-090 | 1 | 0.1 | 100 | 0.024 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-090 | 2 | 0.002 | 100 | 0.024 | 10 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-090 | 3 | 0.015 | 0 | 0.024 | 10 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-091 | 1 | 0.01 | 100 | 0.083 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-092 | 1 | 0.548 | 100 | 0.007 | 40.539 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-092 | 2 | 0.278 | 100 | 0.007 | 40.539 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-092 | 3 | 0.347 | 0 | 0.007 | 40.539 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-093 | 1 | 1.238 | 100 | 0.019 | 57.84 | 20B80D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-093 | 2 | 1.294 | 100 | 0.019 | 57.84 | 20B80D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-093 | 3 | 0.806 | 0 | 0.019 | 57.84 | 20B80D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5052-094 | 1 | 0.262 | 100 | 0.004 | 34.76 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-094 | 2 | 0.187 | 100 | 0.004 | 34.76 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5052-094 | 3 | 0.129 | 0 | 0.004 | 34.76 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-096 | 1 | 0.53 | 100 | 0.022 | 40.487 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-096 | 2 | 0.534 | 100 | 0.022 | 40.487 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-096 | 3 | 0.576 | 0 | 0.022 | 40.487 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-097 | 1 | 0.254 | 100 | 0.003 | 45.136 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-097 | 2 | 0.043 | 100 | 0.003 | 45.136 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-097 | 3 | 0.06 | 0 | 0.003 | 45.136 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-053 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-054 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-055 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-106 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-107 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-056 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| SS5151-041 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| SS5250-025 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5250-026 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5250-027 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-109 | 1 | 0.007 | 100 | 0.012 | 10 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-109 | 3 | 0.005 | 0 | 0.012 | 10 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5051-057 | 1 | 0.155 | 100 | 0.095 | 21.283 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-057 | 2 | 0.007 | 100 | 0.095 | 21.283 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5051-057 | 3 | 0.087 | 0 | 0.095 | 21.283 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| CB5051-063 | 1 | 1.707 | 100 | 0.027 | 20.895 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CB5051-063 | 2 | 0.706 | 100 | 0.027 | 20.895 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| CB5051-063 | 3 | 0.49 | 0 | 0.027 | 20.895 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5051-064 | 1 | 0.287 | 100 | 0.089 | 40.921 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-064 | 2 | 0.769 | 100 | 0.089 | 40.921 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5051-064 | 3 | 0.375 | 0 | 0.089 | 40.921 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-068 | 1 | 0.28 | 100 | 0.023 | 22.761 | 50B50D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-068 | 3 | 0.026 | 0 | 0.023 | 22.761 | 50B50D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-069 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-091 | 1 | 0.667 | 100 | 0.031 | 35.807 | 10B90C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-091 | 2 | 0.002 | 100 | 0.031 | 35.807 | 10B90C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-091 | 3 | 0.222 | 0 | 0.031 | 35.807 | 10B90C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-094 | 1 | 0.503 | 100 | 0.016 | 41.301 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-094 | 2 | 0.007 | 100 | 0.016 | 41.301 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-094 | 3 | 0.02 | 0 | 0.016 | 41.301 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-099 | 1 | 0.565 | 100 | 0.008 | 46.486 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-099 | 2 | 0.089 | 100 | 0.008 | 46.486 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-099 | 3 | 0.001 | 0 | 0.008 | 46.486 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-103 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-106 | 1 | 0.299 | 100 | 0.014 | 31.208 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-106 | 2 | 0.227 | 100 | 0.014 | 31.208 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-106 | 3 | 0.003 | 0 | 0.014 | 31.208 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5051-076 | 1 | 0.766 | 100 | 0.033 | 21.829 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5051-076 | 2 | 0.59 | 100 | 0.033 | 21.829 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5051-076 | 3 | 0.01 | 0 | 0.033 | 21.829 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-050 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-052 | 1 | 0.336 | 100 | 0.051 | 43.101 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-052 | 2 | 0.264 | 100 | 0.051 | 43.101 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-053 | 1 | 0.028 | 100 | 0.06 | 15.944 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-053 | 2 | 0.053 | 100 | 0.06 | 15.944 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-056 | 1 | 0.603 | 100 | 0.054 | 35.545 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-056 | 2 | 0.159 | 100 | 0.054 | 35.545 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-056 | 3 | 0.035 | 0 | 0.054 | 35.545 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5149-091 | 1 | 0.066 | 100 | 0.026 | 22.043 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-091 | 2 | 0.001 | 100 | 0.026 | 22.043 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-049 | 1 | 0.628 | 100 | 0.023 | 24.441 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-049 | 2 | 0.741 | 100 | 0.023 | 24.441 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-049 | 3 | 0.061 | 0 | 0.023 | 24.441 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5149-098 | 1 | 0.018 | 100 | 0.049 | 10 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-098 | 2 | 0.04 | 100 | 0.049 | 10 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-099 | 1 | 0.027 | 100 | 0.044 | 11.796 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-099 | 2 | 0.012 | 100 | 0.044 | 11.796 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-100 | 1 | 0.016 | 100 | 0.066 | 11.77 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-100 | 2 | 0.014 | 100 | 0.066 | 11.77 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-101 | 1 | 0.182 | 100 | 0.033 | 23.323 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IN5149-101 | 2 | 0.16 | 100 | 0.033 | 23.323 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-101 | 3 | 0.002 | 0 | 0.033 | 23.323 | No Pervious Area | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5149-102 | 1 | 0.02 | 100 | 0.027 | 19.914 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-103 | 1 | 0.032 | 100 | 0.035 | 26.408 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-103 | 2 | 0.007 | 100 | 0.035 | 26.408 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-051 | 1 | 2.058 | 100 | 0.01 | 28.381 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5149-051 | 2 | 0.488 | 100 | 0.01 | 28.381 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5149-051 | 3 | 1.803 | 0 | 0.01 | 28.381 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-110 | 1 | 0.095 | 100 | 0.021 | 16.191 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-110 | 2 | 0.008 | 100 | 0.021 | 16.191 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-111 | 1 | 0.047 | 100 | 0.033 | 12.357 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-111 | 2 | 0.056 | 100 | 0.033 | 12.357 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-114 | 1 | 0.052 | 100 | 0.021 | 18.442 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-114 | 2 | 0.001 | 100 | 0.021 | 18.442 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-115 | 1 | 0.16 | 100 | 0.018 | 27.484 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-115 | 2 | 0.008 | 100 | 0.018 | 27.484 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-116 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-117 | 1 | 0.049 | 100 | 0.033 | 10 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-117 | 2 | 0.211 | 100 | 0.033 | 10 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-117 | 3 | 0.002 | 0 | 0.033 | 10 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5052-111 | 1 | 0.245 | 100 | 0.012 | 30.358 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-111 | 2 | 0.024 | 100 | 0.012 | 30.358 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-111 | 3 | 0.079 | 0 | 0.012 | 30.358 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-046 | 1 | 0.025 | 100 | 0.033 | 6.56 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-046 | 2 | 0.03 | 100 | 0.033 | 6.56 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-124 | 1 | 0.135 | 100 | 0.059 | 22.194 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-124 | 2 | 0.037 | 100 | 0.059 | 22.194 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-124 | 3 | 0.032 | 0 | 0.059 | 22.194 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-125 | 1 | 0.026 | 100 | 0.006 | 10 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-125 | 3 | 0.001 | 0 | 0.006 | 10 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5250-006 | 1 | 0.193 | 100 | 0.037 | 21.14 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-006 | 2 | 0.042 | 100 | 0.037 | 21.14 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5250-028 | 1 | 0.576 | 100 | 0.013 | 27.605 | 50B50D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-028 | 2 | 1.059 | 100 | 0.013 | 27.605 | 50B50D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5250-028 | 3 | 0.541 | 0 | 0.013 | 27.605 | 50B50D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5250-029 | 1 | 0.109 | 100 | 0.033 | 18.669 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5250-029 | 2 | 0.111 | 100 | 0.033 | 18.669 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-062 | 1 | 0.014 | 100 | 0.01 | 14.072 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-062 | 2 | 0.015 | 100 | 0.01 | 14.072 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-063 | 1 | 0.977 | 100 | 0.021 | 24.338 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-063 | 2 | 1.02 | 100 | 0.021 | 24.338 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-063 | 3 | 0.031 | 0 | 0.021 | 24.338 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-133 | 1 | 0.138 | 100 | 0.001 | 38.215 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-133 | 3 | 0.01 | 0 | 0.001 | 38.215 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS5149-095 | 1 | 0.102 | 100 | 0.037 | 25.167 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5149-095 | 2 | 0.037 | 100 | 0.037 | 25.167 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-092 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-093 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-094 | 1 | 0.457 | 100 | 0.026 | 41.377 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5249-094 | 2 | 0.333 | 100 | 0.026 | 41.377 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5249-094 | 3 | 0.051 | 0 | 0.026 | 41.377 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-113 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-122 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5250-005 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-128 | 1 | 0.675 | 100 | 0.007 | 65.014 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-128 | 2 | 0.909 | 100 | 0.007 | 65.014 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-128 | 3 | 0.071 | 0 | 0.007 | 65.014 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-129 | 1 | 0.619 | 100 | 0.012 | 15.442 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-129 | 2 | 1.284 | 100 | 0.012 | 15.442 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-129 | 3 | 0.869 | 0 | 0.012 | 15.442 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-087 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-023 | 1 | 0.539 | 100 | 0.038 | 65.638 | 70B30D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-023 | 2 | 0.481 | 100 | 0.038 | 65.638 | 70B30D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-023 | 3 | 0.111 | 0 | 0.038 | 65.638 | 70B30D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-134 | 1 | 0.254 | 100 | 0.003 | 51.997 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-134 | 2 | 0.094 | 100 | 0.003 | 51.997 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-134 | 3 | 0.326 | 0 | 0.003 | 51.997 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-064 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-065 | 1 | 0.182 | 100 | 0.038 | 22.143 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-065 | 2 | 0.162 | 100 | 0.038 | 22.143 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-065 | 3 | 0.038 | 0 | 0.038 | 22.143 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| ND5151-066 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| MI5051-002 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| TP5051-016 | 1 | 0.399 | 100 | 0.023 | 37.949 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| TP5051-016 | 2 | 0.05 | 100 | 0.023 | 37.949 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| TP5051-016 | 3 | 0.001 | 0 | 0.023 | 37.949 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| MI5052-045 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| PL5151-039 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| PL5151-040 | 2 | 0.127 | 100 | 0.008 | 0 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | 1 | |
| PL5151-040 | 3 | 1.987 | 0 | 0.008 | 0 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| TP5151-042 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| TP5151-043 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| MI5151-054 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-067 | 1 | 0.48 | 100 | 0.056 | 30.611 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-067 | 2 | 1.131 | 100 | 0.056 | 30.611 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-067 | 3 | 0.06 | 0 | 0.056 | 30.611 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5051-083 | 1 | 0.053 | 100 | 0.023 | 29.1 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5051-083 | 3 | 0.005 | 0 | 0.023 | 29.1 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IN5151-068 | 1 | 0.366 | 100 | 0.068 | 34.917 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-068 | 2 | 0.008 | 100 | 0.068 | 34.917 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| MI5151-069 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-070 | 1 | 0.191 | 100 | 0.035 | 38.02 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-070 | 3 | 0.027 | 0 | 0.035 | 38.02 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-071 | 1 | 0.139 | 100 | 0.045 | 46.539 | 70B30D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-071 | 2 | 0.013 | 100 | 0.045 | 46.539 | 70B30D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-071 | 3 | 0.01 | 0 | 0.045 | 46.539 | 70B30D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-073 | 1 | 0.39 | 100 | 0.026 | 24.194 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-073 | 2 | 0.554 | 100 | 0.026 | 24.194 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-073 | 3 | 0.011 | 0 | 0.026 | 24.194 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-076 | 1 | 0.188 | 100 | 0.029 | 38.122 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-076 | 2 | 0.002 | 100 | 0.029 | 38.122 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-076 | 3 | 0.012 | 0 | 0.029 | 38.122 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5151-079 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-080 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-081 | 1 | 0.071 | 100 | 0.03 | 22.853 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-081 | 2 | 0.001 | 100 | 0.03 | 22.853 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-081 | 3 | 0.019 | 0 | 0.03 | 22.853 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-082 | 1 | 0.083 | 100 | 0.052 | 10 | 10B90C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-082 | 2 | 1.199 | 100 | 0.052 | 10 | 10B90C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5151-082 | 3 | 0.012 | 0 | 0.052 | 10 | 10B90C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5151-083 | 1 | 0.046 | 100 | 0.047 | 17.542 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5151-083 | 2 | 0.017 | 100 | 0.047 | 17.542 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-084 | 1 | 0.626 | 100 | 0.05 | 47.203 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5151-084 | 2 | 0.323 | 100 | 0.05 | 47.203 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5151-084 | 3 | 0.133 | 0 | 0.05 | 47.203 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-135 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-136 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-137 | 1 | 0.433 | 100 | 0.015 | 53.991 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-137 | 2 | 0.593 | 100 | 0.015 | 53.991 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-137 | 3 | 0.162 | 0 | 0.015 | 53.991 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-138 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-139 | 1 | 0.06 | 100 | 0.023 | 10 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-139 | 2 | 0.638 | 100 | 0.023 | 10 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-139 | 3 | 0.01 | 0 | 0.023 | 10 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-140 | 1 | 0.056 | 100 | 0.026 | 10 | 100Percent Type C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-140 | 2 | 0.447 | 100 | 0.026 | 10 | 100Percent Type C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-140 | 3 | 0.013 | 0 | 0.026 | 10 | 100Percent Type C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-141 | 1 | 0.123 | 100 | 0.021 | 10.791 | 10B90C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-141 | 2 | 0.085 | 100 | 0.021 | 10.791 | 10B90C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-141 | 3 | 0.049 | 0 | 0.021 | 10.791 | 10B90C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-142 | 1 | 0.118 | 100 | 0.025 | 33.759 | 70B30C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-142 | 2 | 0.014 | 100 | 0.025 | 33.759 | 70B30C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |

| Name | Subcatchment | Area acres | Impervious Percentage % | Slope ft/ft | Width ft | Infiltration Reference | Rainfall Reference | Runoff Redirection Type | Runoff Redirection Drain To Subcatchment Number | Active in Runoff Layer | Runoff Redirection Drain To Node |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IN5150-142 | 3 | 0.007 | 0 | 0.025 | 33.759 | 70B30C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| AS5150-143 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-144 | 1 | 0.205 | 100 | 0.013 | 29.267 | 90B10C | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-144 | 2 | 0.035 | 100 | 0.013 | 29.267 | 90B10C | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5150-144 | 3 | 0.031 | 0 | 0.013 | 29.267 | 90B10C | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| IN5150-145 | 1 | 0.011 | 100 | 0.014 | 5.887 | No Pervious Area | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5150-145 | 2 | 0.035 | 100 | 0.014 | 5.887 | No Pervious Area | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-146 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-147 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-148 | 1 | 0.104 | 100 | 0.017 | 14.623 | 100Percent Type B | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-148 | 2 | 0.783 | 100 | 0.017 | 14.623 | 100Percent Type B | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| AS5150-148 | 3 | 0.127 | 0 | 0.017 | 14.623 | 100Percent Type B | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |
| NorthShoreDrOutfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| BroomStOutfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| HamiltonStOutfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| HenryStOutfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| WilsonStOutfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| US151Outfall2 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| US151Outfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| PinckneyStOutfall | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5052-094-01 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| AS5150-049-01 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| MI5150-112 | | 0 | 0 | 0 | 0 | No DA to Structure | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-081-01 | 1 | 0.293 | 100 | 0.008 | 15.957 | 100Percent Type D | 100yr-24hr_1440m | No Redirection | Outlet | 1 | |
| IN5052-081-01 | 2 | 0.657 | 100 | 0.008 | 15.957 | 100Percent Type D | 100yr-24hr_1440m | Impervious Runoff to Pervious | SubCatchment 3 | | |
| IN5052-081-01 | 3 | 0.912 | 0 | 0.008 | 15.957 | 100Percent Type D | 100yr-24hr_1440m | Pervious Runoff to Impervious | SubCatchment 1 | | |

## Table 4. Composite Soil Group Infiltration XP-Table Input Data

| Name | Inch (Impervious Area) Input in | Inch (pervious Area) Input in | Manning's "n" (Impervious Area) Input | Manning's "n" (Pervious Area) Input | Zero Detention (%) Input | Max Infiltration Rate Input in/hr | Min (Asymptotic) Infiltration in/hr | Decay Rate of Infiltration 1/sec | Maximum Infiltration Volume mm;inch |
|---|---|---|---|---|---|---|---|---|---|
| 100Percent Type B | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 2 | 0.5 | 0.07 | 0 |
| 100Percent Type C | 0.05 | 0.2 | 0.016 | 0.2 | 25 | 1 | 0.2 | 0.07 | 0 |
| 100Percent Type D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 0.5 | 0.1 | 0.07 | 0 |
| 10B90C | 0.05 | 0.2 | 0.016 | 0.2 | 25 | 1.1 | 0.23 | 0.07 | 0 |
| 10B90D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 0.65 | 0.14 | 0.07 | 0 |
| 10C90D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 0.55 | 0.11 | 0.07 | 0 |
| 20B80C | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 0.6 | 0.12 | 0.07 | 0 |
| 20B80D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 0.8 | 0.18 | 0.07 | 0 |
| 40B60D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.1 | 0.26 | 0.07 | 0 |
| 50B50D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.25 | 0.3 | 0.07 | 0 |
| 60B40D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.4 | 0.34 | 0.07 | 0 |
| 70B30C | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.7 | 0.41 | 0.07 | 0 |
| 70B30D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.55 | 0.38 | 0.07 | 0 |
| 80B20C | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.8 | 0.44 | 0.07 | 0 |
| 80B20D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.7 | 0.42 | 0.07 | 0 |
| 90B10C | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.9 | 0.47 | 0.07 | 0 |
| 90B10D | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.85 | 0.46 | 0.07 | 0 |
| No DA to Structure | 0 | 0 | 0 | 0 | 0 | 50 | 10 | 0.001 | 0 |
| No Pervious Area | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 0.01 | 0.01 | 0.01 | 0 |
| 30B70C | 0.05 | 0.15 | 0.016 | 0.2 | 25 | 1.3 | 0.29 | 0.07 | 0 |
| 20C80D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 30B70D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 30C70D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 40B60C | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 40C60D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 50B50C | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 50C50D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 60B40C | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 60C40D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 70C30D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 80C20D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |
| 90C10D | 0 | 0 | 0.03 | 0.03 | 25 | 50 | 10 | 0.001 | 0 |

Table 5. WinSLAMM Land Use Parcels within Watershed

| OBJECTID * | Permeability | LUDesc | LUDedit | SADesc | SADedit | RoofType | Roofedit | ConnEdit | ConnType | SoilType | AreaPerRatio | SHAPE_Length | SHAPE_Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 188318 | Impervious | Institutional | Institutional | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 11.747768 | 206.594775 | 2357.985696 |
| 188354 | Impervious | Institutional | Institutional | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 21.252395 | 511.108142 | 10862.2788 |
| 188370 | Impervious | Institutional | Institutional | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 42.411474 | 542.885879 | 2940.549032 |
| 189396 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 18.963734 | 331.576993 | 6287.93672 |
| 189407 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 6.864648 | 168.017212 | 1153.376542 |
| 189408 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 10.852081 | 221.42949 | 2332.984703 |
| 189414 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 10.819027 | 187.316435 | 2026.579839 |
| 189416 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 31.987185 | 664.171665 | 21245.01254 |
| 189419 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 9.381511 | 122.773246 | 1151.796696 |
| 189420 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 5.722718 | 92.318277 | 528.311913 |
| 189421 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 34.623135 | 798.441355 | 27644.50475 |
| 189422 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 35.584419 | 0.279474 | 0.003349 |
| 189425 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 26.501865 | 680.598259 | 18037.16444 |
| 189426 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 21.881378 | 464.608066 | 2868.849871 |
| 189427 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 7.867715 | 92.248672 | 564.892761 |
| 189433 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 9.605001 | 124.316438 | 1194.059649 |
| 189435 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 43.011114 | 790.156266 | 33985.49061 |
| 189437 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 27.400171 | 1505.79488 | 41258.97608 |
| 189438 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 9.798802 | 176.669079 | 1731.143486 |
| 189439 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 15.610241 | 333.691161 | 5208.981064 |
| 189443 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 32.214375 | 493.865222 | 15909.54289 |
| 189446 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 13.591868 | 249.5932 | 3392.408351 |
| 189447 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 28.548165 | 574.771813 | 16408.69736 |
| 189448 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 65.532702 | 1048.86418 | 68734.93647 |
| 189452 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 23.293777 | 692.578073 | 16132.75346 |
| 189460 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 13.540463 | 206.237729 | 1250.450026 |
| 189464 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 42.375585 | 777.822834 | 32960.70237 |
| 189466 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 40.94485 | 907.640962 | 37221.2186 |
| 189469 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 34.996993 | 712.120969 | 24917.75298 |
| 189470 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 14.301956 | 301.118115 | 4331.974608 |
| 189475 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 37.503923 | 621.249891 | 23299.29401 |
| 189480 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 19.869135 | 496.347516 | 9917.933801 |
| 189489 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 45.172525 | 803.424585 | 36292.72235 |
| 189492 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 39.444644 | 897.635285 | 35406.86053 |
| 189497 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 16.568498 | 300.328874 | 4976.007049 |
| 189505 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 49.931309 | 1181.617887 | 59010.85774 |
| 189507 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 14.088444 | 359.726493 | 5067.991622 |
| 189508 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 73.708906 | 1222.900736 | 90138.70979 |
| 189509 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 32.267927 | 591.258901 | 19078.68085 |
| 189510 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 8.821372 | 199.893435 | 1763.337383 |
| 189511 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 14.953378 | 264.537886 | 3955.733938 |
| 189513 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 32.939111 | 739.195481 | 24348.44209 |
| 189539 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 19.429463 | 317.090719 | 6160.899028 |
| 189543 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 30.435507 | 497.69072 | 15147.49164 |
| 189545 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 9.955868 | 176.483979 | 1757.045194 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 189547 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 23.37927 | 804.277308 | 18803.42112 |
| 189550 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 9.527948 | 219.573259 | 2092.083817 |
| 189556 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 14.51917 | 249.975481 | 3629.443494 |
| 189557 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 43.009609 | 719.727906 | 30955.21175 |
| 189564 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 8.129507 | 72.540757 | 216.267091 |
| 189575 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 40.09516 | 964.692243 | 19888.90204 |
| 189576 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 10.306535 | 218.774602 | 2103.462892 |
| 189586 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 49.788586 | 1460.534599 | 27924.77719 |
| 189589 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 25.715546 | 459.836099 | 8764.550326 |
| 189594 | Impervious | Commercial | Commercial | Roofs 1 | Roof | Flat | Roof | | Connected | 0 | 13.753359 | 55.767972 | 146.755714 |
| 219497 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 12.240106 | 234.732793 | 1222.219768 |
| 219509 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 8.274387 | 206.591182 | 1709.413227 |
| 219510 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 8.797123 | 240.462838 | 2115.376804 |
| 219513 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 16.959024 | 294.781649 | 4999.200881 |
| 219516 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 13.417615 | 165.930619 | 1038.057207 |
| 219526 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 1.896397 | 44.100138 | 83.633674 |
| 219530 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 17.558217 | 311.862189 | 5475.740336 |
| 219536 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 7.430818 | 192.937491 | 1433.690592 |
| 219540 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 3.056199 | 96.961293 | 296.330379 |
| 219541 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 8.852722 | 166.874651 | 1477.289357 |
| 219544 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 14.280401 | 287.267127 | 4102.292982 |
| 219547 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 3.618345 | 60.324025 | 218.272927 |
| 219549 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 20.764829 | 355.50485 | 7381.985525 |
| 219550 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 11.939897 | 205.827283 | 1577.909148 |
| 219551 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 30.07039 | 2277.098621 | 68473.28985 |
| 219559 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 14.875804 | 41.836535 | 47.194708 |
| 219560 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 21.69427 | 386.085372 | 8375.840593 |
| 219562 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 27.108789 | 746.760011 | 19325.77021 |
| 219566 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 14.358925 | 275.65978 | 3958.179078 |
| 219581 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 22.126346 | 407.910997 | 9025.561772 |
| 219589 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 19.197727 | 459.545755 | 8822.222705 |
| 219591 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 34.433896 | 696.946632 | 23998.57174 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 219594 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 15.127555 | 329.482543 | 4984.260998 |
| 219597 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 16.322964 | 25.946617 | 34.338029 |
| 219600 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 14.623584 | 56.423823 | 145.054489 |
| 219606 | Impervious | Residential | Residential | Roofs 3 | Roof | Flat | Roof | | Disconnected | Silty | 14.328867 | 74.885493 | 74.375915 |
| 221037 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 29.09909 | 496.222769 | 14439.66009 |
| 221040 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 13.500223 | 399.673749 | 5395.675929 |
| 221053 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 16.627461 | 298.396666 | 4961.5824 |
| 221054 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 7.808691 | 132.366456 | 1033.60742 |
| 221063 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 1.341485 | 135.617502 | 181.938087 |
| 221128 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 11.698889 | 276.354227 | 3233.046006 |
| 221131 | Impervious | Residential | Residential | Roofs 4 | Roof | Flat | Roof | | Disconnected | Clayey | 18.794879 | 725.427705 | 13634.34351 |
| 222616 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 24.28111 | 776.748522 | 6775.322888 |
| 222617 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 7.046576 | 135.412371 | 954.1898 |
| 222618 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 9.068348 | 171.454143 | 1402.748749 |
| 222622 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 16.277498 | 250.277957 | 4073.901965 |
| 222625 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 8.364247 | 29.150775 | 19.530541 |
| 222626 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 8.341429 | 178.284584 | 1487.148185 |
| 222627 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 10.373285 | 197.030519 | 2043.848138 |
| 222628 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 8.280438 | 107.410083 | 889.402448 |
| 222629 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 10.13985 | 96.399197 | 237.258877 |
| 222634 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 1.744676 | 31.138274 | 54.325431 |
| 222669 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 57.232182 | 980.688968 | 35382.72247 |
| 222672 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 4.749871 | 119.02042 | 565.336992 |
| 222682 | Impervious | Commercial | Commercial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 9.591971 | 13.995904 | 6.306729 |
| 223446 | Impervious | Industrial | Industrial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 13.939434 | 151.163694 | 403.003679 |
| 223459 | Impervious | Industrial | Industrial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 3.491498 | 62.210579 | 217.212383 |
| 223463 | Impervious | Industrial | Industrial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 7.489 | 421.573276 | 3157.146064 |
| 223464 | Impervious | Industrial | Industrial | Roofs 7 | Roof | Pitched | Roof | | Connected | 0 | 3.735954 | 66.053668 | 246.773088 |
| 244001 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 3.868265 | 58.500187 | 217.652276 |
| 244106 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.185588 | 165.479565 | 1520.026988 |
| 244144 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.24688 | 186.40993 | 1693.801472 |
| 244177 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.959067 | 210.975148 | 1630.452626 |
| 244206 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.661763 | 174.061982 | 1507.682331 |
| 244228 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.137047 | 178.459693 | 958.233474 |
| 244244 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.745019 | 180.948862 | 1401.449519 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 244303 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.843638 | 199.488053 | 2163.172659 |
| 244327 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.075626 | 165.755998 | 1344.711194 |
| 244355 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.806167 | 173.135048 | 1524.651414 |
| 244367 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.483349 | 155.526973 | 1319.389374 |
| 244371 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 24.298596 | 551.718589 | 12495.38056 |
| 244395 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 12.051159 | 174.48995 | 1514.433054 |
| 244398 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.181854 | 178.292508 | 1815.352457 |
| 244405 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.743874 | 205.574911 | 1797.526888 |
| 244428 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.08314 | 177.925553 | 1616.120792 |
| 244459 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.383233 | 209.781984 | 1968.437913 |
| 244471 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 12.044775 | 312.885598 | 3768.643807 |
| 244472 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 5.957085 | 98.084026 | 584.296504 |
| 244479 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.073284 | 153.272961 | 1390.688725 |
| 244484 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.994584 | 211.841493 | 2013.094736 |
| 244510 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.722433 | 203.363671 | 1773.823994 |
| 244519 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.760762 | 149.359547 | 1159.137932 |
| 244538 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.654071 | 169.731636 | 1638.601974 |
| 244573 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.026403 | 158.724175 | 1409.708664 |
| 244588 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.156525 | 171.259802 | 1568.141324 |
| 244594 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 12.353313 | 206.480694 | 2550.725739 |
| 244598 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.760662 | 140.846058 | 1233.903133 |
| 244602 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.627033 | 199.364197 | 2118.652944 |
| 244633 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.101806 | 167.74162 | 1526.746223 |
| 244635 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.778732 | 158.511561 | 1391.530743 |
| 244667 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.115301 | 146.110183 | 1185.730797 |
| 244684 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.139153 | 162.745085 | 1308.285249 |
| 244705 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 6.836072 | 145.359921 | 938.335134 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 244714 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 5.742948 | 150.010338 | 861.498416 |
| 244747 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.314642 | 186.563086 | 1737.76103 |
| 244758 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 5.387121 | 123.946651 | 667.714917 |
| 244791 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.801391 | 178.471551 | 1570.800371 |
| 244801 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.073421 | 230.986664 | 1864.848925 |
| 244813 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.410955 | 164.986082 | 1552.677484 |
| 244833 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.177563 | 194.500704 | 1785.034642 |
| 244869 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.254653 | 163.935176 | 1517.16234 |
| 244882 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.288434 | 150.650718 | 1248.656724 |
| 244900 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 6.789594 | 147.760851 | 1003.238758 |
| 244919 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.141135 | 155.135229 | 1262.975669 |
| 244933 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 4.883637 | 82.183978 | 401.356174 |
| 244957 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.676659 | 149.477494 | 1147.486088 |
| 244965 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.999871 | 159.376901 | 1274.992576 |
| 244981 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.217546 | 146.003354 | 1199.790941 |
| 244990 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.931075 | 197.894841 | 1965.31052 |
| 245038 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.156808 | 166.412334 | 1357.395841 |
| 245044 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.242345 | 154.682081 | 1274.946106 |
| 245081 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.9799 | 160.132222 | 1277.836039 |
| 245084 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.703304 | 165.089641 | 1436.824178 |
| 245110 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.536705 | 154.313257 | 1317.32756 |
| 245145 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.955958 | 163.930201 | 1468.156808 |
| 245165 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.904155 | 150.597105 | 1340.942016 |
| 245196 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.372406 | 139.487333 | 1028.359538 |
| 245204 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.287677 | 176.958629 | 1820.493225 |
| 245224 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.069257 | 163.956053 | 1486.966417 |
| 245245 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.896399 | 162.698419 | 1447.433085 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 245282 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.062439 | 152.36772 | 1228.460099 |
| 245284 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.920577 | 161.65635 | 1442.067883 |
| 245323 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.6004 | 175.789915 | 1687.658157 |
| 245345 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.049687 | 153.129191 | 1232.640402 |
| 245350 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.475636 | 175.297989 | 1661.059027 |
| 245366 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.977045 | 378.515273 | 3776.471135 |
| 245372 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.938022 | 145.776695 | 1157.179337 |
| 245416 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.840092 | 153.608227 | 1204.296968 |
| 245447 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 6.290116 | 121.169918 | 762.169229 |
| 245451 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.496677 | 199.802896 | 2097.269122 |
| 245468 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.159684 | 164.849932 | 1509.969951 |
| 245547 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.606246 | 175.272623 | 1508.439884 |
| 245556 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.814566 | 149.994868 | 1322.139039 |
| 245563 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 6.518522 | 131.299731 | 855.875032 |
| 245598 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.200952 | 148.227761 | 1215.607475 |
| 245607 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.055167 | 180.715654 | 1636.408825 |
| 245629 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.189292 | 129.481826 | 930.884863 |
| 245650 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.54229 | 186.112776 | 1589.82896 |
| 245654 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 4.835137 | 77.405017 | 374.266584 |
| 245705 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.055884 | 174.450134 | 1405.345532 |
| 245716 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.31431 | 135.444866 | 990.685684 |
| 245733 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 21.530658 | 408.304315 | 8791.057349 |
| 245748 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.613197 | 176.382914 | 1519.215443 |
| 245761 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.761214 | 165.49412 | 1449.938065 |
| 245787 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.58326 | 166.753009 | 1431.282559 |
| 245802 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.20779 | 184.112617 | 1511.151123 |
| 245859 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.507126 | 160.70499 | 1367.138073 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 245875 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.212615 | 172.645735 | 1590.519253 |
| 245918 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.253644 | 196.199445 | 2011.765912 |
| 245927 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.938736 | 144.264189 | 1145.27244 |
| 245946 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.292646 | 130.770322 | 953.663871 |
| 245967 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.816687 | 167.215915 | 1641.506298 |
| 245982 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.535184 | 168.304166 | 1604.812652 |
| 245987 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.53483 | 158.04957 | 1506.975821 |
| 246023 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 11.653961 | 199.667493 | 2326.921658 |
| 246030 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.768797 | 182.937568 | 1604.142172 |
| 246034 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.151168 | 174.177808 | 1419.746882 |
| 246075 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.091459 | 16.928996 | 6.465239 |
| 246077 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.200889 | 170.015349 | 1394.273894 |
| 246083 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 21.140151 | 878.40583 | 18569.61865 |
| 246095 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.97982 | 166.13797 | 1325.758566 |
| 246141 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.375138 | 148.230784 | 1241.454122 |
| 246150 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.254968 | 190.369997 | 1761.868299 |
| 246159 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.501416 | 6.145035 | 0.866527 |
| 246174 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.961301 | 150.813702 | 1200.672916 |
| 246195 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.234115 | 158.948504 | 1149.856532 |
| 246269 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.173324 | 156.174331 | 1432.637331 |
| 246321 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.763046 | 186.84012 | 1637.279768 |
| 246479 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.780904 | 183.150767 | 1608.239142 |
| 246522 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.142677 | 141.847075 | 1155.013888 |
| 246916 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.952003 | 165.155609 | 1313.319511 |
| 249557 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 12.543257 | 319.955221 | 4013.285892 |
| 249570 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 12.057061 | 227.342178 | 2741.072179 |
| 249586 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.747637 | 196.92794 | 1919.589783 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 249632 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.610017 | 186.21769 | 1789.553606 |
| 249719 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 14.799615 | 332.052268 | 4914.232553 |
| 249732 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.712221 | 124.086226 | 493.0084 |
| 249762 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.956455 | 125.637656 | 507.778259 |
| 249775 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.950803 | 182.557655 | 1634.032065 |
| 249796 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.540924 | 222.759612 | 2348.089304 |
| 249813 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.212437 | 117.398294 | 328.258317 |
| 249823 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.528537 | 163.112692 | 1391.119232 |
| 249893 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 7.918333 | 144.077093 | 1140.84475 |
| 249902 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 6.669872 | 12.041291 | 3.112651 |
| 249951 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.426453 | 236.25529 | 2463.308329 |
| 249971 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 10.700915 | 121.443696 | 718.184614 |
| 249999 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.507727 | 17.989667 | 8.745611 |
| 250025 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.984065 | 22.29393 | 19.859019 |
| 250108 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 9.369318 | 105.664135 | 202.657664 |
| 250159 | Impervious | Residential | Residential | Roofs 9 | Roof | Pitched | Roof | | Disconnected | Silty | 8.523116 | 96.817513 | 477.28238 |
| 203733 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 5.730588 | 91.698463 | 525.486884 |
| 203812 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 7.344894 | 124.932672 | 917.619893 |
| 203813 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 8.286623 | 164.47329 | 1362.932076 |
| 203841 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 7.345003 | 124.934363 | 917.651738 |
| 203894 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 19.46628 | 303.556326 | 5909.11302 |
| 204113 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 10.904988 | 213.859231 | 2332.13145 |
| 204116 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 8.124782 | 168.293932 | 1367.345084 |
| 204157 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 9.880602 | 183.565758 | 1813.741388 |
| 204171 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 9.671523 | 162.63114 | 1572.890241 |
| 204178 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 17.565414 | 606.54631 | 10654.23627 |
| 204204 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 5.309037 | 86.390314 | 458.649637 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 204220 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 13.437528 | 279.275153 | 3752.768686 |
| 204257 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 9.191229 | 185.432684 | 1704.356413 |
| 204284 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 8.394505 | 158.832469 | 1333.320021 |
| 204320 | Impervious | Residential | Residential | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 6.219987 | 152.176596 | 946.533003 |
| 218800 | Impervious | Other Urban | Other Roof | Roofs 10 | Roof | Pitched | Roof | | Disconnected | Clayey | 15.836714 | 359.26707 | 5689.610034 |
| 181390 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 18.422922 | 216.055626 | 1243.003978 |
| 181393 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 11.291787 | 343.638742 | 3880.287415 |
| 181394 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 12.510887 | 260.509224 | 3259.218721 |
| 181399 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 13.397628 | 251.960802 | 3375.680948 |
| 181400 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 14.416333 | 245.43981 | 3538.344527 |
| 181404 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 12.630257 | 6.349091 | 1.728713 |
| 181405 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 10.026039 | 197.049837 | 1975.620658 |
| 181411 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 10.948548 | 828.721577 | 9073.286221 |
| 181414 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 18.76257 | 608.53499 | 11417.71019 |
| 181420 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 17.672708 | 388.409848 | 6864.247328 |
| 181421 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 18.515276 | 150.394801 | 229.908019 |
| 181425 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 14.866695 | 359.744449 | 5348.202765 |
| 181426 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 9.418408 | 158.760777 | 1495.268626 |
| 181427 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 5.145558 | 233.512909 | 1201.550149 |
| 181434 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 11.524513 | 275.242503 | 3172.026096 |
| 181436 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 16.063096 | 269.366602 | 4326.864353 |
| 181439 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 20.515112 | 404.769834 | 8303.890589 |
| 181440 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 18.684039 | 406.533849 | 7595.681414 |
| 181441 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 17.416218 | 370.357878 | 6450.228437 |
| 181447 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 11.989226 | 203.493862 | 2439.73566 |
| 181458 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 17.813139 | 284.305881 | 5064.38527 |
| 181461 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 40.589068 | 784.225821 | 11012.43638 |
| 181593 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 5.574607 | 106.646249 | 594.506416 |
| 181611 | Impervious | Residential | Residential | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 13.653115 | 234.827125 | 3206.126898 |
| 185018 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 6.859909 | 359.357823 | 2465.162418 |
| 185021 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 28.858971 | 568.035284 | 14354.84331 |
| 185022 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 4.097162 | 307.927282 | 1261.627944 |
| 185025 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 5.336509 | 91.82521 | 490.025181 |
| 185026 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 5.842696 | 101.855945 | 602.70344 |
| 185028 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 20.620732 | 652.747702 | 13460.13906 |
| 185032 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 18.474131 | 538.392452 | 9946.365348 |
| 185035 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 55.963167 | 918.412916 | 51397.28186 |
| 185039 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 30.052037 | 514.224962 | 14138.11856 |
| 185040 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 1.568399 | 121.233037 | 190.142099 |
| 185075 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 8.676296 | 324.311597 | 2813.814435 |
| 185085 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 13.172175 | 263.93002 | 3476.533234 |
| 185094 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 15.573522 | 314.062701 | 4891.061326 |
| 185097 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 13.955883 | 315.017043 | 4396.336888 |
| 185098 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 15.563885 | 308.889688 | 4807.523148 |
| 185121 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 26.527706 | 163.176942 | 754.397131 |
| 185122 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 19.350298 | 969.737282 | 18764.70681 |
| 185136 | Impervious | Commercial | Commercial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 15.822025 | 314.065681 | 4701.647998 |
| 186743 | Impervious | Industrial | Industrial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 44.46775 | 1170.681294 | 52060.9362 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 186745 | Impervious | Industrial | Industrial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 34.300707 | 725.58358 | 24888.00153 |
| 186746 | Impervious | Industrial | Industrial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 34.316891 | 709.576274 | 24350.44739 |
| 186757 | Impervious | Industrial | Industrial | Paved Parking 1 | Parking | 0 | <Null> | Connected | Connected | 0 | 19.482931 | 824.157908 | 16057.03605 |
| 187382 | Impervious | Other Urban | Other Parking | Paved Parking 3 | Parking | 0 | <Null> | Disconnected | Disconnected | Silty | 10.486273 | 290.981883 | 3051.314147 |
| 187383 | Impervious | Other Urban | Other Parking | Paved Parking 3 | Parking | 0 | <Null> | Disconnected | Disconnected | Silty | 20.665427 | 579.219673 | 11969.82273 |
| 187594 | Impervious | Other Urban | Other Parking | Paved Parking 4 | Parking | 0 | <Null> | Disconnected | Disconnected | Clayey | 20.171179 | 536.450853 | 10820.8574 |
| 187599 | Impervious | Other Urban | Other Parking | Paved Parking 4 | Parking | 0 | <Null> | Disconnected | Disconnected | Clayey | 22.225633 | 614.779958 | 13663.86359 |
| 353589 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 11.870017 | 334.502698 | 1790.262634 |
| 353591 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 10.06308 | 190.040051 | 1844.603086 |
| 353592 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 11.075211 | 192.803857 | 2135.341343 |
| 353593 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 12.623838 | 184.385373 | 2076.643676 |
| 353599 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 15.022801 | 302.672058 | 4546.976192 |
| 353600 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 8.68564 | 311.848355 | 2708.612869 |
| 353601 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 18.562422 | 315.468804 | 5855.872157 |
| 353602 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 14.229789 | 252.218136 | 3589.021223 |
| 353603 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 14.822159 | 242.566381 | 3595.359616 |
| 353604 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 15.251594 | 247.000229 | 3767.14914 |
| 353606 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 11.635698 | 184.164729 | 2142.888225 |
| 353615 | Pervious | Residential | Residential | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 9.76777 | 388.164593 | 3791.505738 |
| 353665 | Pervious | Commercial | Commercial | Unpaved Parking 3 | Parking | 0 | <Null> | | Disconnected | Sandy | 6.166924 | 573.83245 | 3538.764397 |
| 354045 | Impervious | Industrial | Industrial | Unpaved Parking 4 | Parking | 0 | <Null> | | Disconnected | Clayey | 10.714292 | 2868.034437 | 30641.79288 |
| 354046 | Impervious | Industrial | Industrial | Unpaved Parking 4 | Parking | 0 | <Null> | | Disconnected | Clayey | 3.385001 | 21.007791 | 13.815901 |
| 354126 | Impervious | Other Urban | Other Parking | Unpaved Parking 4 | Parking | 0 | <Null> | | Disconnected | Clayey | 11.531779 | 967.047815 | 4403.379897 |
| 354127 | Impervious | Other Urban | Other Parking | Unpaved Parking 4 | Parking | 0 | <Null> | | Disconnected | Clayey | 2.620229 | 72.31222 | 189.472677 |
| 354128 | Impervious | Other Urban | Other Parking | Unpaved Parking 4 | Parking | 0 | <Null> | | Disconnected | Clayey | 11.171108 | 3142.364826 | 35103.67253 |
| 22996 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.383803 | 285.171911 | 2359.390339 |
| 23104 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.461319 | 271.405814 | 1482.228035 |
| 23295 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.376186 | 171.017465 | 551.548728 |
| 23301 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.860877 | 504.514671 | 3461.423872 |
| 23360 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.065022 | 244.509405 | 1238.442563 |
| 23423 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.958795 | 233.786355 | 925.50324 |
| 23441 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.19596 | 85.598964 | 273.571222 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23457 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.504763 | 442.356959 | 2360.639469 |
| 23469 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.885958 | 67.611329 | 262.735706 |
| 23501 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.09552 | 251.176999 | 2284.587816 |
| 23545 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.82473 | 140.295913 | 676.887788 |
| 23616 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.875402 | 195.257882 | 951.963449 |
| 23644 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.397844 | 103.818385 | 352.758342 |
| 23677 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.790063 | 211.732293 | 718.084014 |
| 23732 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.218429 | 232.889339 | 1448.212399 |
| 23826 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.607445 | 202.873085 | 934.725032 |
| 23861 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.155317 | 188.509529 | 783.323551 |
| 23890 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.796433 | 162.125443 | 615.501732 |
| 23926 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.832618 | 50.075821 | 141.844662 |
| 23938 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.577357 | 164.933158 | 590.020642 |
| 23991 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.17364 | 136.876917 | 1255.659603 |
| 24008 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 16.027286 | 552.144739 | 8849.366098 |
| 24050 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.83338 | 50.351362 | 142.664624 |
| 24060 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.187923 | 88.778907 | 371.79875 |
| 24074 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.980271 | 110.881975 | 552.21833 |
| 24086 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.597959 | 198.666575 | 516.120455 |
| 24107 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.867272 | 96.498859 | 469.68718 |
| 24131 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.598229 | 130.863356 | 470.871268 |
| 24172 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.033519 | 252.025041 | 1268.563149 |
| 24181 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.170239 | 119.41434 | 497.984187 |
| 24185 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.72378 | 89.052849 | 420.665562 |
| 24186 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.821745 | 196.739005 | 555.14787 |
| 24318 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.928191 | 221.103999 | 1310.733713 |
| 24403 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 13.597085 | 347.333512 | 4722.723396 |
| 24411 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 11.059078 | 467.84149 | 5173.895604 |
| 24432 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 8.243697 | 178.801389 | 1295.087617 |
| 24433 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.60583 | 166.135581 | 599.057664 |
| 24437 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.589731 | 184.478981 | 1400.145848 |
| 24465 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.448356 | 442.447832 | 4180.414427 |
| 24539 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.825236 | 96.427595 | 368.860031 |
| 24604 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.462363 | 74.670678 | 258.538636 |
| 24605 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.389351 | 175.233913 | 1119.637946 |
| 24645 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.798672 | 71.510164 | 200.134526 |
| 24673 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.779775 | 131.174416 | 291.390776 |
| 24681 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 10.187851 | 562.84857 | 5734.199796 |
| 24684 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.250377 | 92.075893 | 391.358696 |
| 24761 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.845459 | 129.709901 | 887.922122 |
| 24781 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.014307 | 192.25325 | 579.507029 |
| 24881 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.329183 | 257.560862 | 857.46976 |
| 24981 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.560361 | 194.547158 | 692.656614 |
| 24987 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.615618 | 284.585577 | 2167.288554 |
| 24989 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.702287 | 95.726426 | 279.688046 |
| 24994 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.615947 | 130.274035 | 861.887895 |
| 25002 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 10.512204 | 315.063427 | 3312.015965 |
| 25049 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.598482 | 443.250566 | 2924.781932 |
| 25053 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.313874 | 99.693764 | 430.065762 |
| 25062 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.399181 | 86.041542 | 265.069068 |
| 25093 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.405565 | 120.650796 | 893.492296 |
| 25120 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.031195 | 111.166251 | 448.128697 |
| 25125 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.43268 | 110.663187 | 379.8717 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25151 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.357115 | 7.434532 | 1.187571 |
| 25157 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.429456 | 442.058287 | 3284.199214 |
| 25540 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.985405 | 80.544748 | 401.546818 |
| 25547 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.568959 | 114.795275 | 639.285223 |
| 25651 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.080062 | 70.249012 | 286.61991 |
| 26805 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.631101 | 94.181538 | 436.168255 |
| 27964 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 1.626791 | 33.760136 | 54.922603 |
| 27978 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.303226 | 48.715372 | 112.201417 |
| 28017 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.819352 | 509.281531 | 3982.253189 |
| 28029 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 1.611238 | 34.380064 | 55.395401 |
| 28108 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.348329 | 39.807719 | 93.482748 |
| 28111 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.752799 | 89.147034 | 423.698872 |
| 28135 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.016075 | 63.028608 | 190.101824 |
| 28147 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.037245 | 65.615501 | 199.291514 |
| 28191 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.270569 | 196.898558 | 643.969155 |
| 28236 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 1.813287 | 32.153763 | 58.303829 |
| 28256 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.025915 | 334.516214 | 2350.279329 |
| 28286 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.779267 | 107.40042 | 426.172101 |
| 28288 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.285995 | 337.600059 | 1784.557262 |
| 28391 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 7.184254 | 185.189641 | 519.320021 |
| 28445 | Impervious | Residential | Residential | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 2.102519 | 109.024874 | 279.929755 |
| 53339 | Impervious | Institutional | Institutional | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 15.078368 | 300.759925 | 4534.982142 |
| 53481 | Impervious | Institutional | Institutional | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 15.783288 | 930.119524 | 14680.31768 |
| 55653 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 3.566581 | 96.677222 | 344.808463 |
| 55664 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.32342 | 89.184068 | 385.58146 |
| 55673 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.564504 | 156.029002 | 868.227936 |
| 55676 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.545046 | 207.393482 | 1747.690082 |
| 55684 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 12.498735 | 438.073275 | 5475.366263 |
| 55691 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 10.099151 | 172.082135 | 1737.88505 |
| 55696 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 30.278956 | 871.657718 | 26392.90265 |
| 55697 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 20.593166 | 2647.095908 | 54436.21698 |
| 55702 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 11.491913 | 892.288568 | 7585.765652 |
| 55708 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 5.962361 | 115.835191 | 690.657178 |
| 55721 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 8.745705 | 371.793852 | 3251.598539 |
| 55723 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.687602 | 1263.20794 | 12237.43727 |
| 55724 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 4.861872 | 366.016149 | 1787.418941 |
| 55725 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 18.317393 | 493.181647 | 7397.358603 |
| 55735 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.103323 | 97.858595 | 597.260888 |
| 55752 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 11.337536 | 487.873483 | 5531.276258 |
| 55767 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.611924 | 303.052708 | 2912.922682 |
| 55779 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 10.043897 | 173.906342 | 1746.699695 |
| 55784 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 11.108564 | 419.726653 | 2929.625243 |
| 55785 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 6.183327 | 211.540065 | 1308.021963 |
| 55818 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 9.382308 | 106.404776 | 605.305959 |
| 57628 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 12.597745 | 599.277015 | 7549.572529 |
| 57629 | Impervious | Commercial | Commercial | Driveways 1 | Drivways | 0 | <Null> | Connected | Connected | 0 | 21.760009 | 874.892501 | 17545.20726 |
| 58964 | Impervious | Other Urban | Other Driveway | Driveways 3 | Drivways | 0 | <Null> | Disconnected | Disconnected | Silty | 11.647507 | 419.91063 | 4890.907785 |
| 289263 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 3.53573 | 77.104585 | 176.340775 |
| 289338 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.624329 | 122.90035 | 322.530944 |
| 289453 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 4.173596 | 385.304161 | 1480.876021 |
| 289490 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.471932 | 251.332012 | 621.283929 |
| 289500 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.795357 | 126.93725 | 354.829108 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 289546 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.610481 | 309.345346 | 807.543031 |
| 289567 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.382912 | 241.68094 | 575.900476 |
| 289578 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.972143 | 237.389221 | 705.559018 |
| 289592 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.870023 | 473.530182 | 1329.350154 |
| 289600 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.801219 | 124.882484 | 349.826892 |
| 289620 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.379579 | 111.317567 | 264.890477 |
| 289629 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 3.119028 | 223.759149 | 440.153022 |
| 289633 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.494741 | 102.864633 | 256.618402 |
| 289661 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.798878 | 124.297269 | 347.893897 |
| 289728 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.797226 | 125.890487 | 352.142298 |
| 289730 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 3.03945 | 269.885576 | 820.303392 |
| 289771 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.421702 | 57.330095 | 138.8364 |
| 289806 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.438158 | 59.113165 | 144.125857 |
| 289844 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.448086 | 60.604183 | 148.362091 |
| 289867 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.703187 | 780.064816 | 2108.663945 |
| 289870 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.948325 | 255.234772 | 752.495159 |
| 289926 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.85006 | 174.459533 | 497.220142 |
| 289957 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.711073 | 170.780253 | 463.000262 |
| 289960 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 2.560761 | 172.240378 | 441.073884 |
| 289981 | Impervious | Residential | Street Right of Way | Sidewalks 1 | Sidewalks | 0 | <Null> | | Connected | 0 | 7.074866 | 1271.944209 | 8998.85346 |
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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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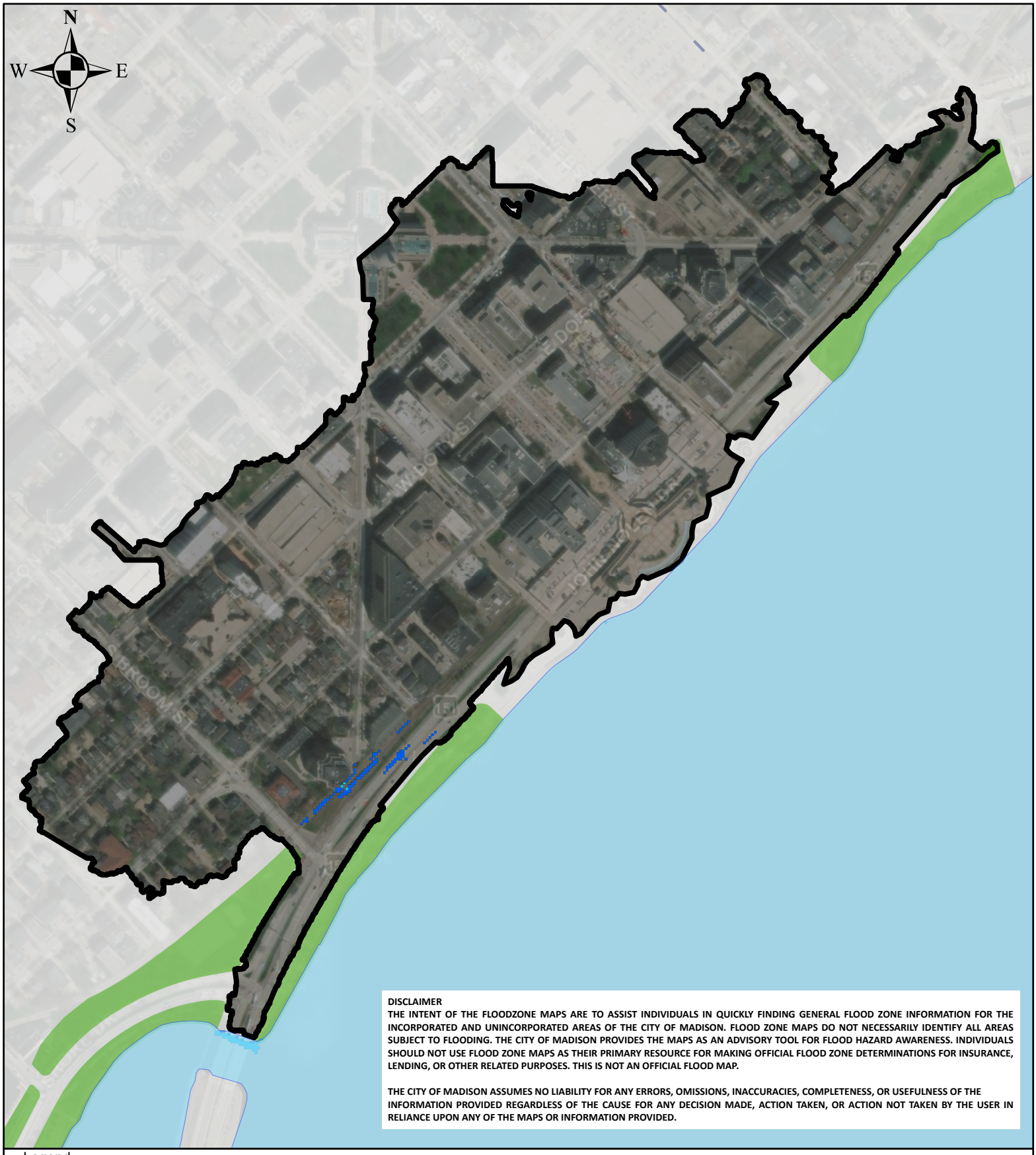
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| 353459 | Pervious | Industrial | Industrial | Undeveloped Areas 2 | Undeveloped | 0 | <Null> | | Disconnected | Silty | 7.010633 | 487.336303 | 3416.531826 |
| 353488 | Pervious | Commercial | Commercial | Undeveloped Areas 4 | Undeveloped | 0 | <Null> | | Disconnected | Clayey | 17.092445 | 796.036769 | 13606.20972 |
| 353497 | Pervious | Industrial | Industrial | Undeveloped Areas 4 | Undeveloped | 0 | <Null> | | Disconnected | Clayey | 11.078484 | 573.153904 | 6349.678813 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 187833 | Impervious | Commercial | Commercial | Paved Playground 3 | Playground | 0 | <Null> | | Disconnected | Silty | 9.859032 | 243.619963 | 2401.847533 |
| 354951 | Pervious | Commercial | Commercial | Water Body Areas | Water | 0 | <Null> | | Disconnected | Clayey | 3.534112 | 69.436798 | 46.189198 |
| 166936 | Pervious | Residential | Residential | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 9.639036 | 358.619188 | 1353.402272 |
| 171499 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 1.591132 | 72.41643 | 115.221797 |
| 171501 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 8.799435 | 186.783081 | 1643.59627 |
| 171506 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 9.794316 | 201.744274 | 1975.9504 |
| 171508 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 4.291168 | 262.27158 | 1125.453232 |
| 171511 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 2.569958 | 65.467402 | 168.255968 |
| 171514 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 16.83934 | 744.24321 | 12532.5627 |
| 171521 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 2 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Silty | 5.018021 | 139.177504 | 698.397208 |
| 174882 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 3 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Clayey | 12.870813 | 451.806057 | 5815.113871 |
| 174904 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 3 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Clayey | 8.17116 | 139.696729 | 1141.480565 |
| 174907 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 3 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Clayey | 6.2756 | 212.425879 | 1335.613474 |
| 174910 | Pervious | Commercial | Commercial | Other Part Con Imp Areas 3 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Clayey | 11.071979 | 374.830723 | 2541.949465 |
| 175085 | Pervious | Industrial | Industrial | Other Part Con Imp Areas 3 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Clayey | 2.938263 | 52.022306 | 152.853535 |
| 175087 | Pervious | Industrial | Industrial | Other Part Con Imp Areas 3 | Other Impervious | 0 | <Null> | Disconnected | Disconnected | Clayey | 0.567535 | 26.472742 | 15.024261 |

# APPENDIX C: FLOOD MAPS




DISCLAIMER
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Legend

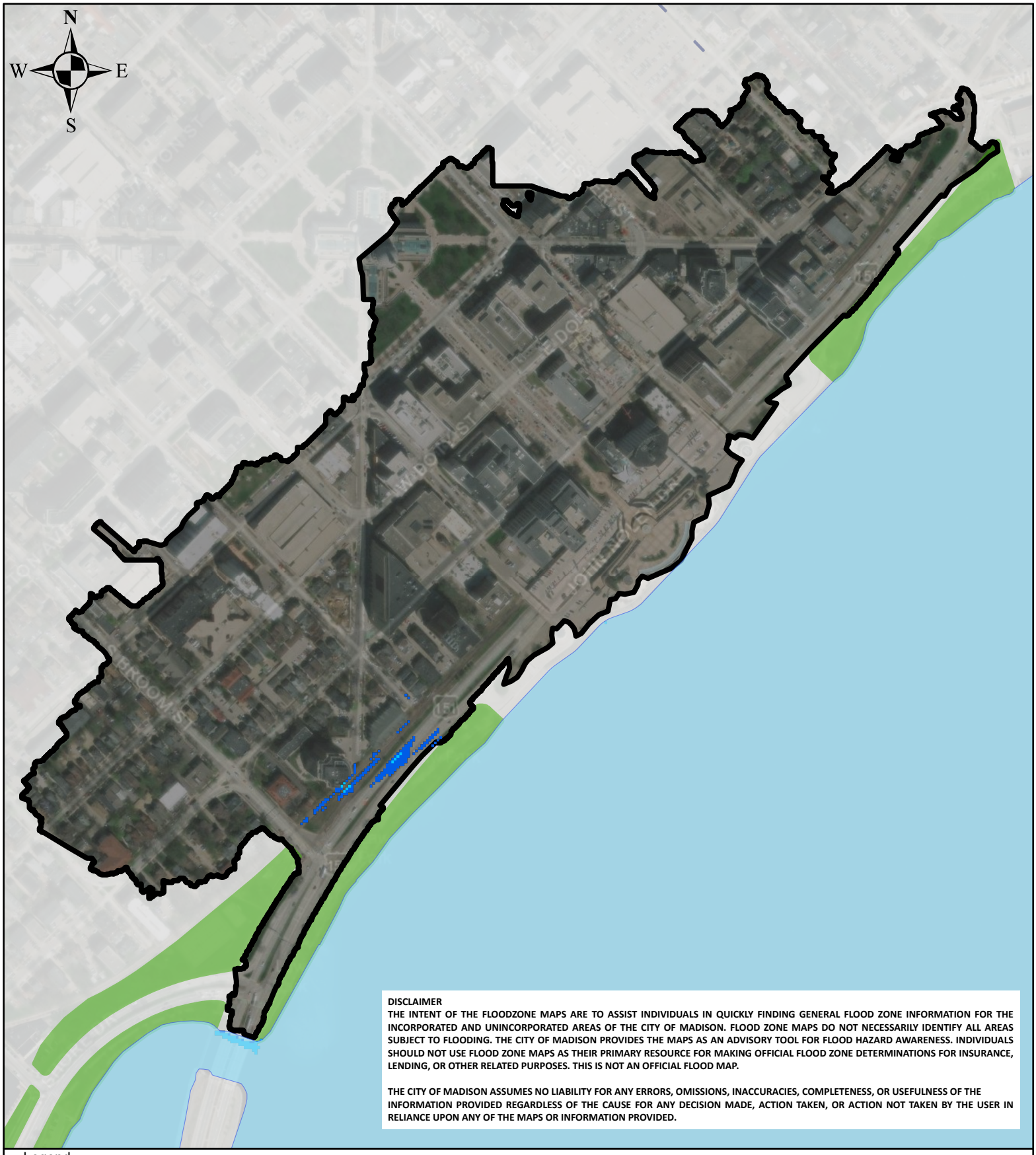
- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Existing Conditions
# 2-year, 24-hour Storm Event
# Lake Level: 845.62' (OHWM)
# Maximum Water Depth

CITY OF MADISON WISCONSIN




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Legend

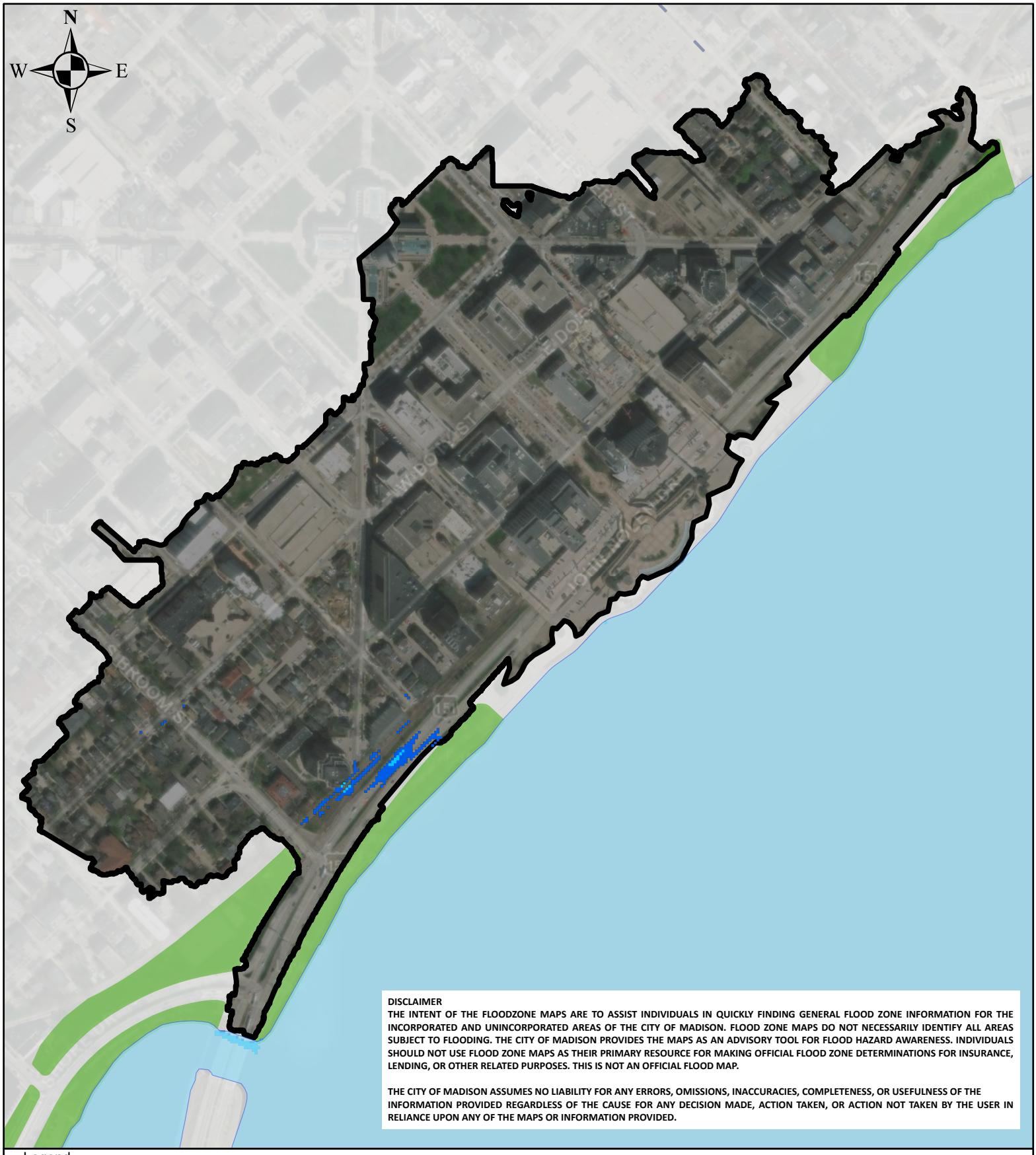
- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
## Existing Conditions
## 5-year, 24-hour Storm Event
## Lake Level: 845.62' (OHWM)
## Maximum Water Depth

CITY OF MADISON WISCONSIN




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Legend

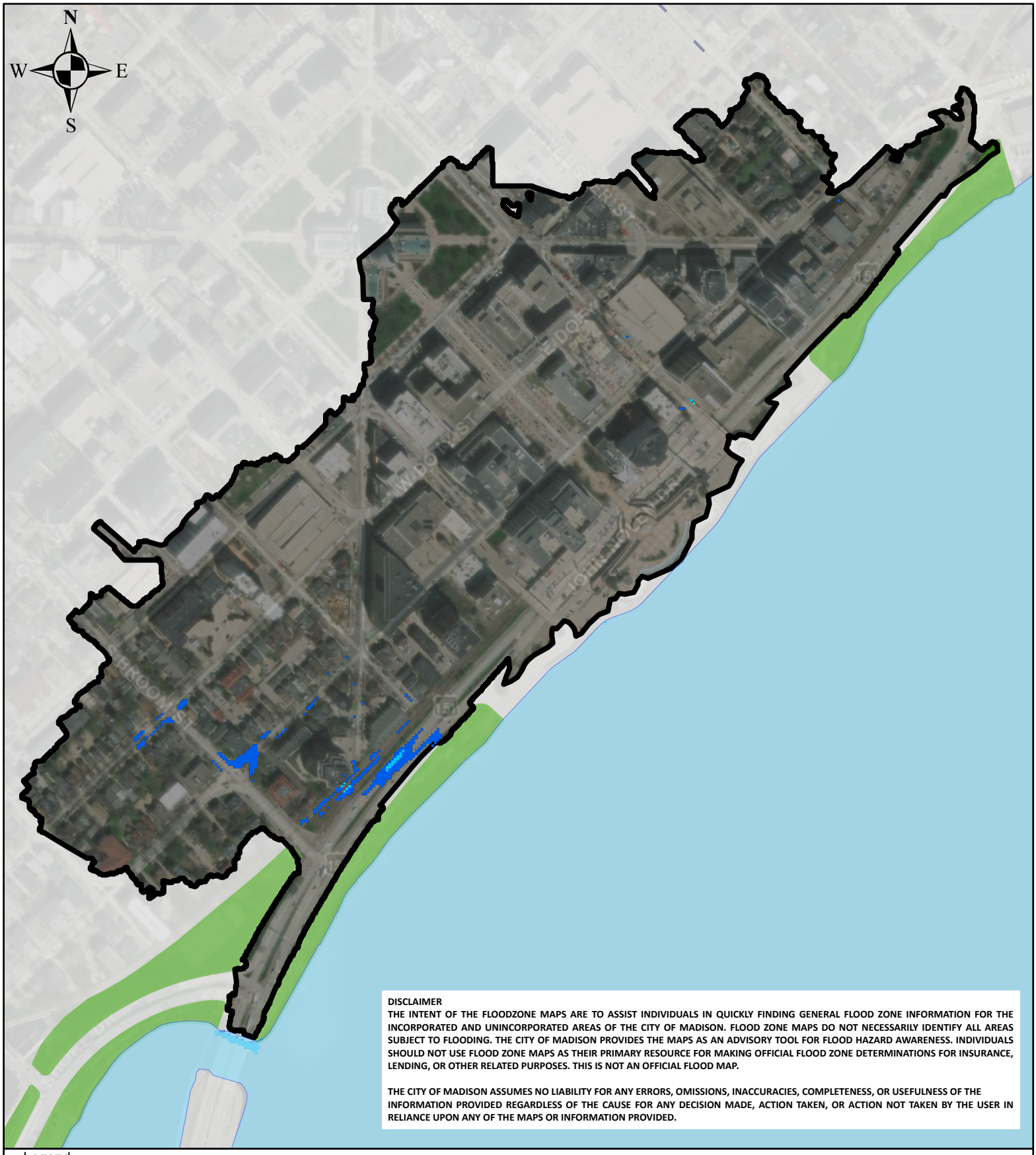
- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
## Existing Conditions
## 10-year, 24-hour Storm Event
## Lake Level: 845.62' (OHWM)
## Maximum Water Depth

CITY OF MADISON WISCONSIN




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Legend

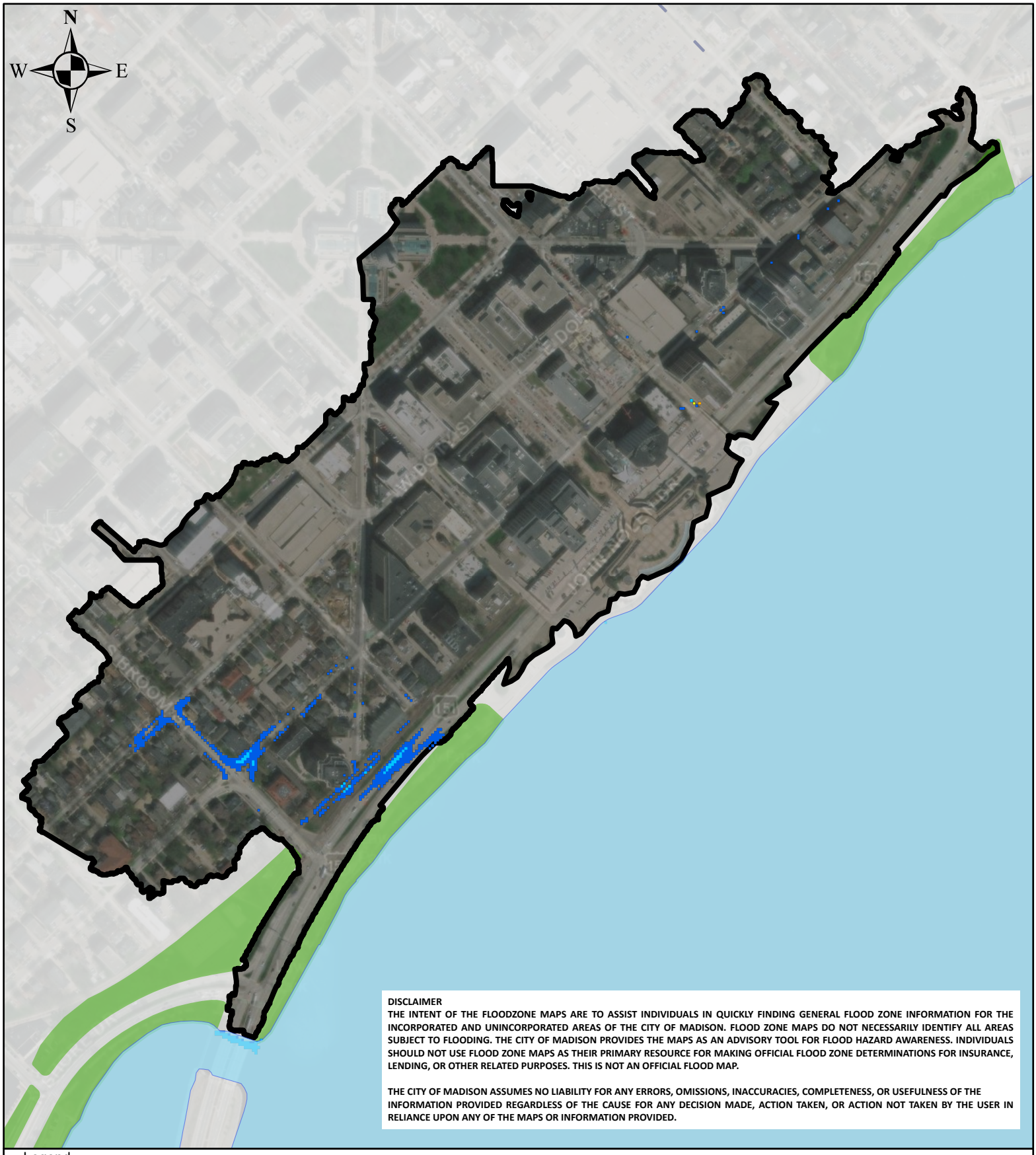
- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
## Existing Conditions
## 25-year, 24-hour Storm Event
## Lake Level: 845.62' (OHWM)
## Maximum Water Depth

CITY OF MADISON WISCONSIN




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Legend

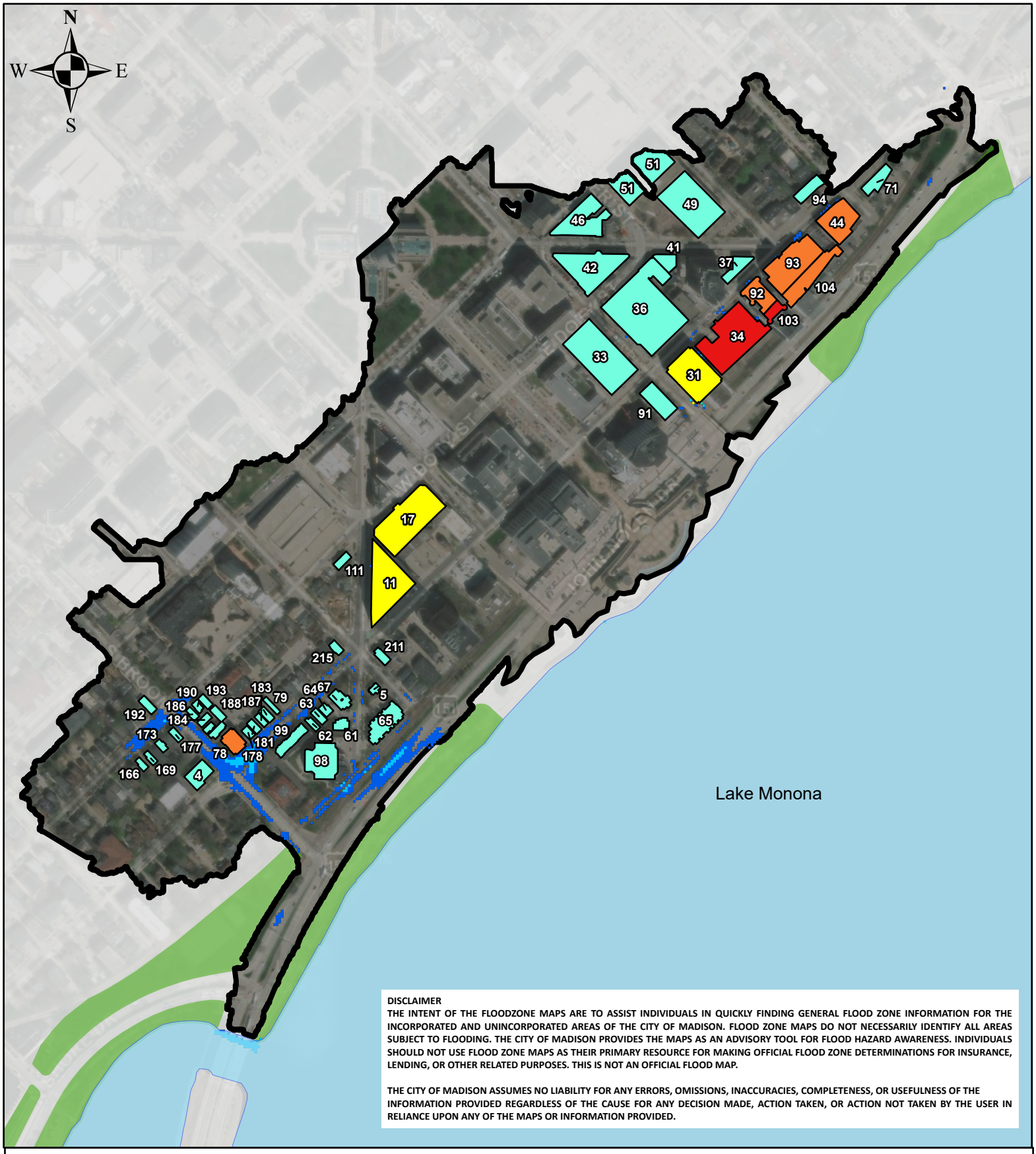
- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
## Existing Conditions
## 50-year, 24-hour Storm Event
## Lake Level: 845.62' (OHWM)
## Maximum Water Depth

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

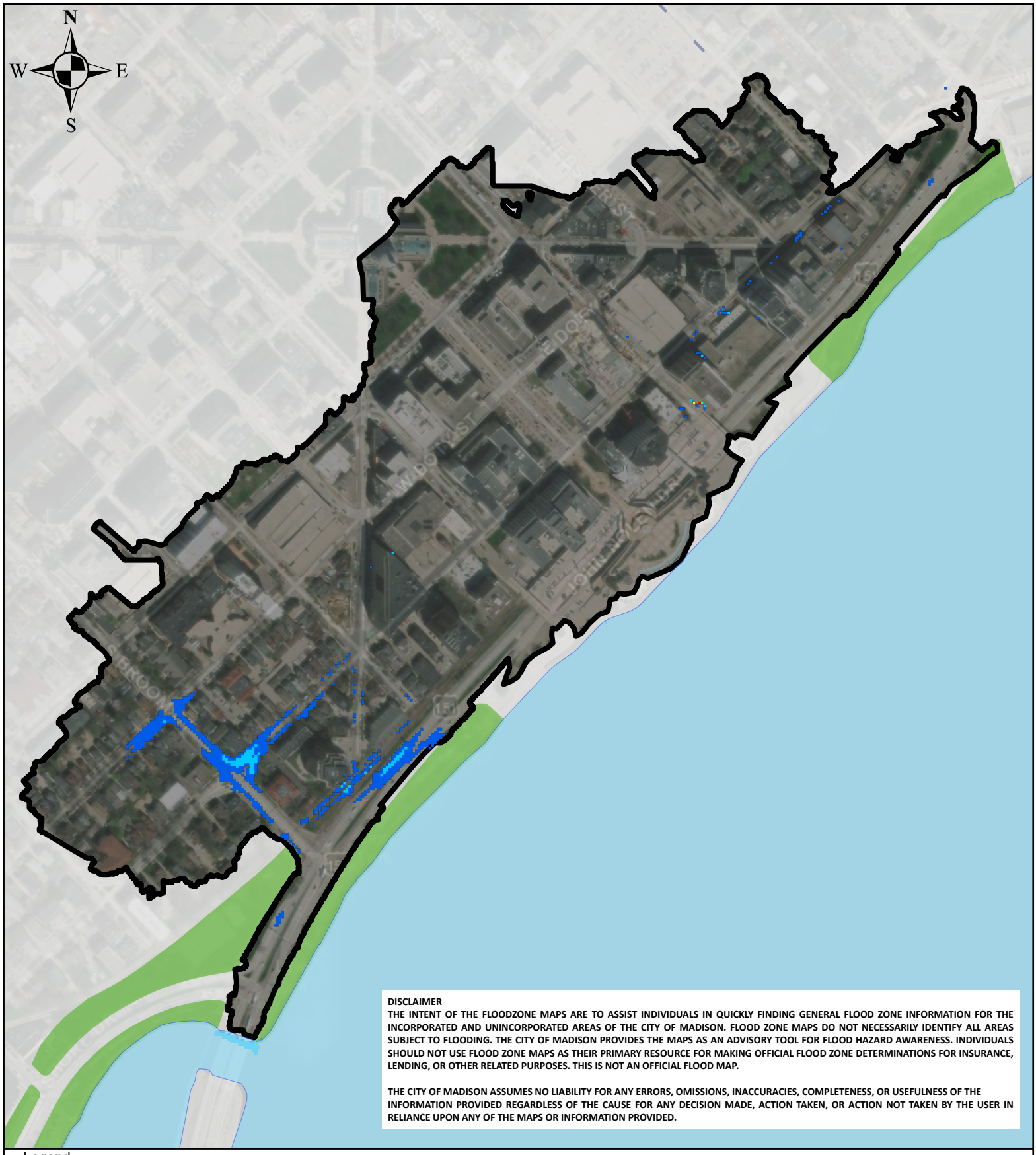
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

Building Flooding (in)

- <6"
- 6"-8"
- 8"-12"
- >12"

# Central Isthmus Watershed Existing Conditions 100-year, 24-hour Maximum Water Depth & Maximum Building Flooding

CITY OF MADISON WISCONSIN




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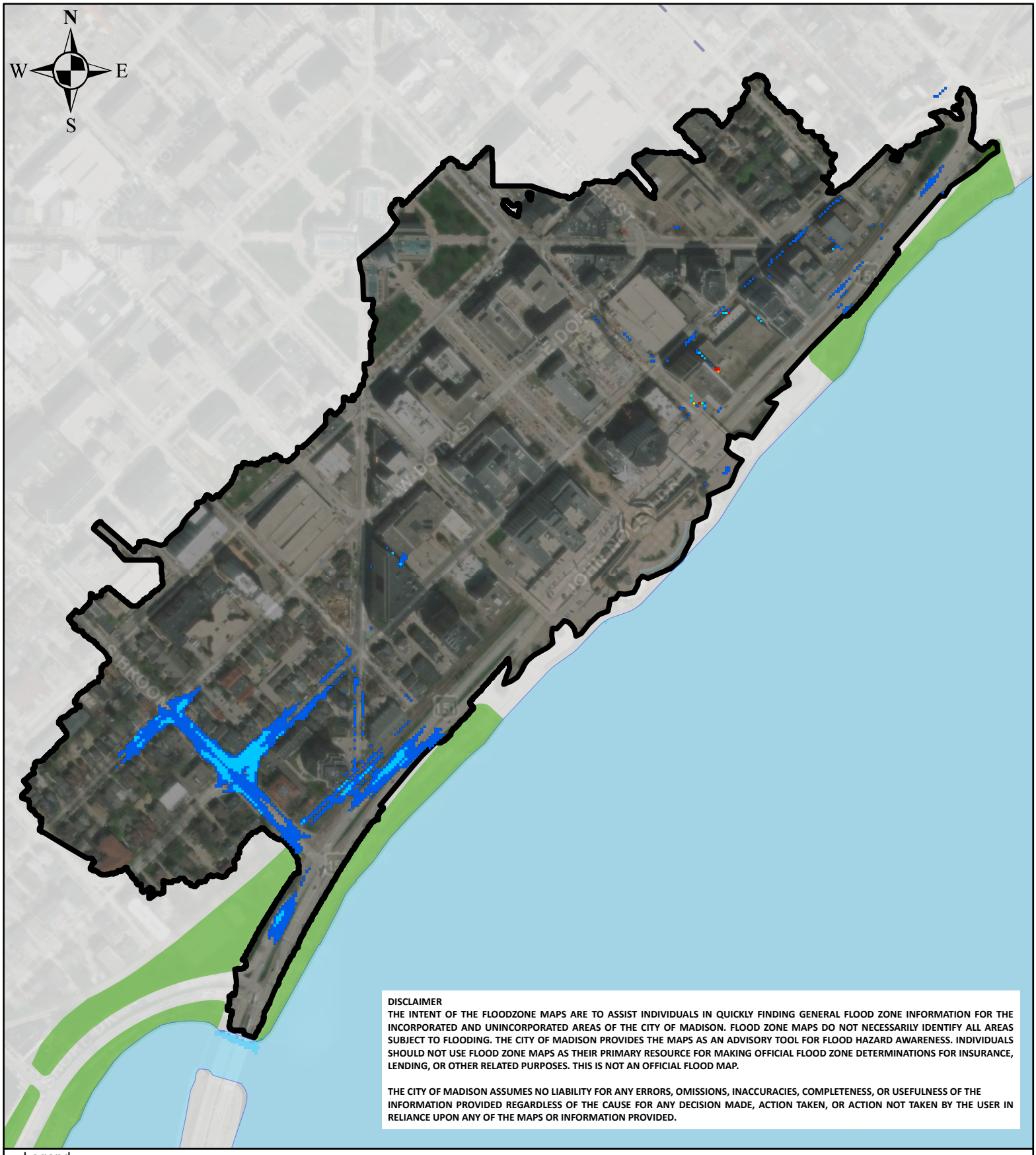
- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
## Existing Conditions
## 100-year, 24-hour Storm Event
## Lake Level: 845.62' (OHWM)
## Maximum Water Depth

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Greenway
- Pond
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
## Existing Conditions
## 500-year, 24-hour Storm Event
## Lake Level: 845.62' (OHWM)
## Maximum Water Depth

CITY OF MADISON WISCONSIN

# APPENDIX D: MITIGATION ALTERNATIVES

N
W
E
S

G. Upsize Existing 15" to 21"

F. Upsize Existing 15" to 18"

H. Upsize Existing 15" to 24"

L. Upsize Existing 12" to 15"

M. Upsize pipe from 12" to 18" to match US and DS pipe sizes.

I. Upsize Existing 12" to 18"

D. Redirect Flow from 21" and 12" pipes on N. Henry to Proposed Sewer (B)

J. Upsize 3 variable sized pipes to 24"

B. ~550LF of New 36" Circular Pipe from Prop. MH-1 to IN5052-090.

E. Redirect Flow from 24" W Wilson to Proposed Sewer (B)

C. Upsize Existing 18" Circular Pipe to 36" pipe to match proposed US pipe (B)

A. Upsize Existing 24" Circular Pipe to 29"x 45" Elliptical to Match Existing DS Pipe.

Lake Monona

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Legend

- Watershed Boundary
- Parks
- Lakes and Rivers
- Inlet
- Existing Pipe - Not Modeled
- Existing Pipe - Modeled
- Proposed or Modified

# Central Isthmus Watershed Proposed Mitigation Alternative 1 Schematic*

**Not Chosen Alternative*

CITY OF MADISON WISCONSIN

N
W
E
S

G. Upsize Existing 15" to 21"

F. Upsize Existing 15" to 18"

H. Upsize Existing 15" to 24"

L. Upsize Existing 12" to 15"

M. Upsize pipe from 12" to 18" to match US and DS pipe sizes.

I. Upsize Existing 12" to 18"

J. Upsize 3 variable sized pipes to 24"

K. Upsize Existing 21" & 24" pipes with 36" pipes

A. Upsize Existing 24" Circular Pipe to 29"x 45" Elliptical to Match Existing DS Pipe.

Lake Monona

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Legend

- Watershed Boundary
- Parks
- Lakes and Rivers
- Inlet
- Existing Pipe - Not Modeled
- Existing Pipe - Modeled
- Proposed or Modified

# Central Isthmus Watershed Proposed Mitigation Alternative 2 Schematic*

**Not Chosen Alternative*

CITY OF MADISON WISCONSIN

N
W E
S

G. Upsize Existing 15" to 21"

F. Upsize Existing 15" to 18"

H. Upsize Existing 15" to 24"

L. Upsize Existing 12" to 15"

M. Upsize pipe from 12" to 18" to match US and DS pipe sizes.

I. Upsize Existing 12" to 18"

J. Upsize 3 variable sized pipes to 24"

D. Redirect Flow from 21" and 12" pipes on N. Henry to Proposed Sewer (B)

N. Redirect Flow from CBs to Proposed Sewer (B)

B. ~550LF of New 36" Circular Pipe from Prop. MH-1 to IN5052-090.

E. Redirect Flow from 24" W Wilson to Proposed Sewer (B)

C. Upsize Existing 18" Circular Pipe to 36" pipe to match proposed US pipe (B)

A. Upsize Existing 24" Circular Pipe to 29"x 45" Elliptical to Match Existing DS Pipe.

O. Upsize Existing 29"x45" Horizontal Ellipse sewer to a 43"x68" Horizontal Ellipse from Wilson to Broom St. Outfall.

Lake Monona

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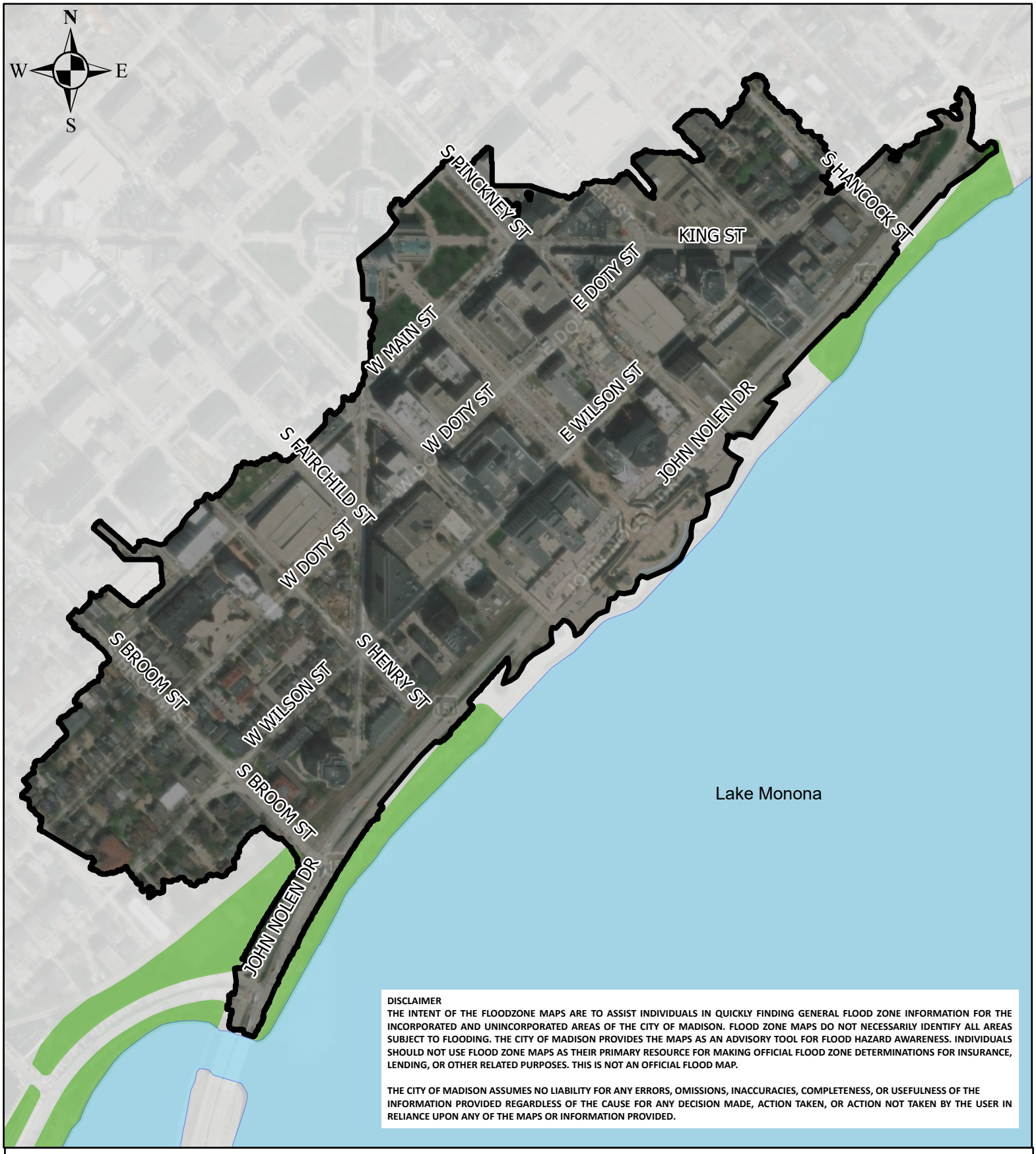
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Legend

- Watershed Boundary
- Lakes and Rivers
- Existing Pipe - Not Modeled
- Existing Pipe - Modeled
- Proposed or Modified

# Central Isthmus Watershed Proposed Mitigation Alternative 3 Schematic *(Chosen Alternative)*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

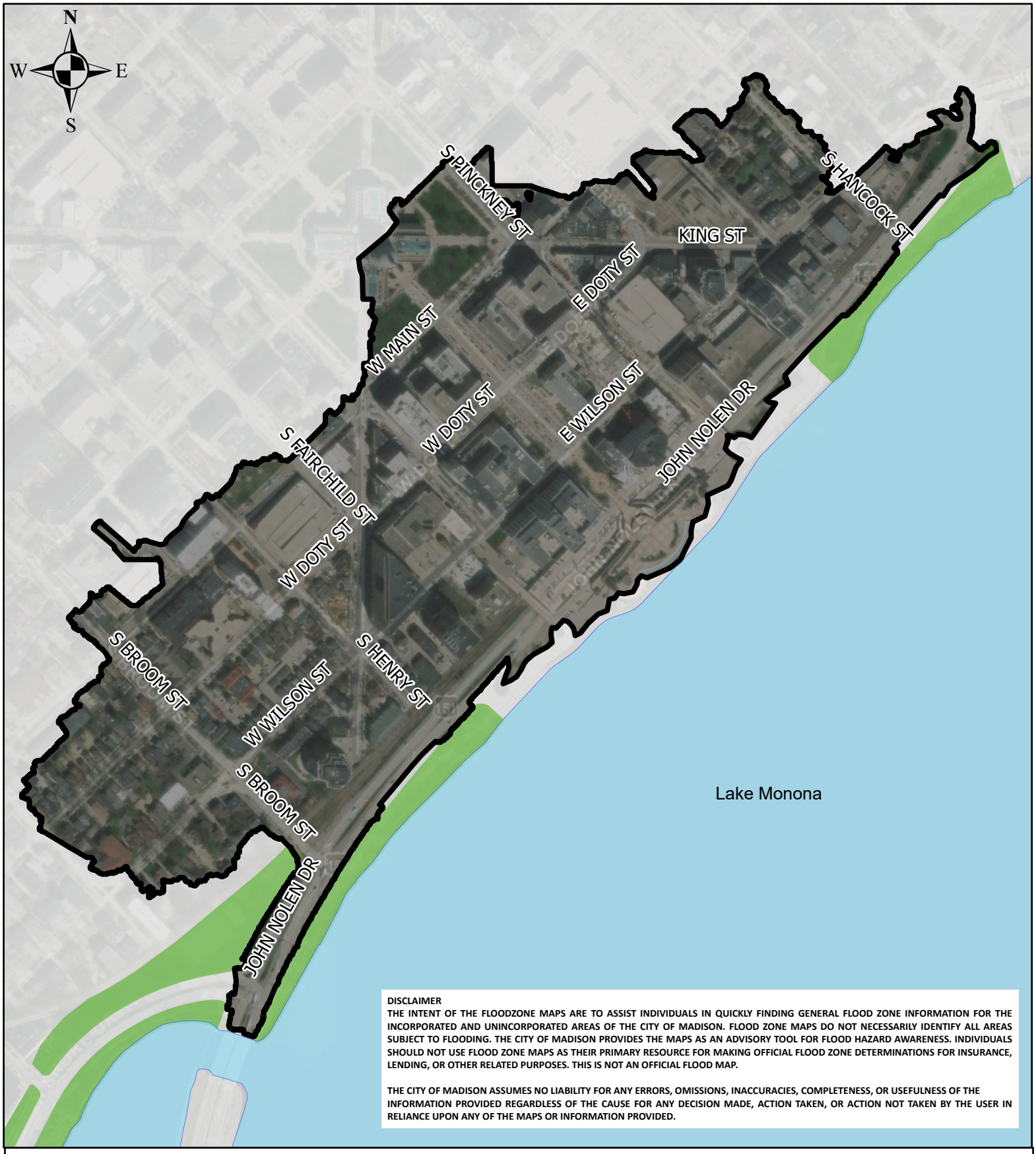
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 2-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

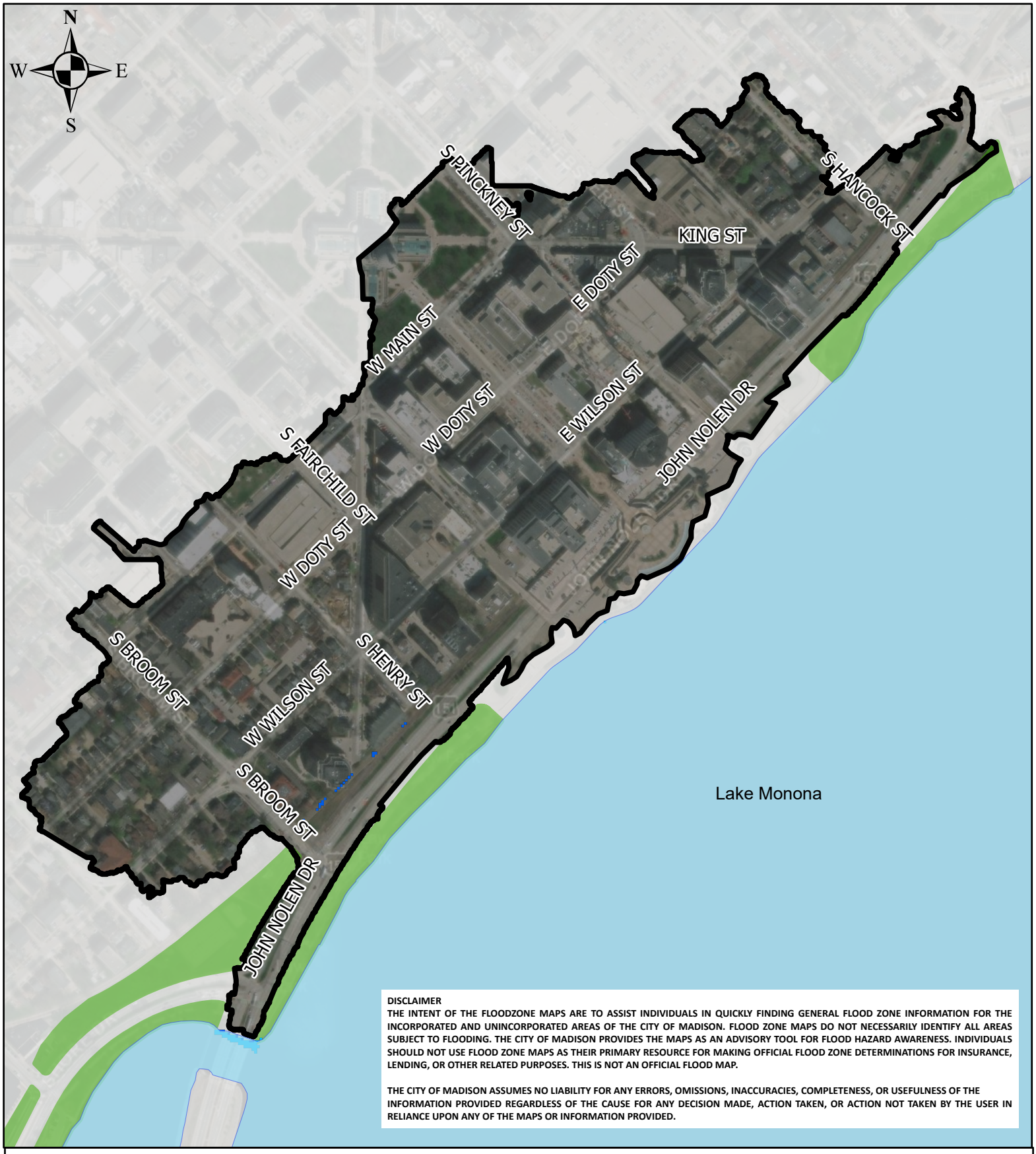
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 5-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 10-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 25-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 50-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 100-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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Legend

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- Park
- Lakes and Rivers

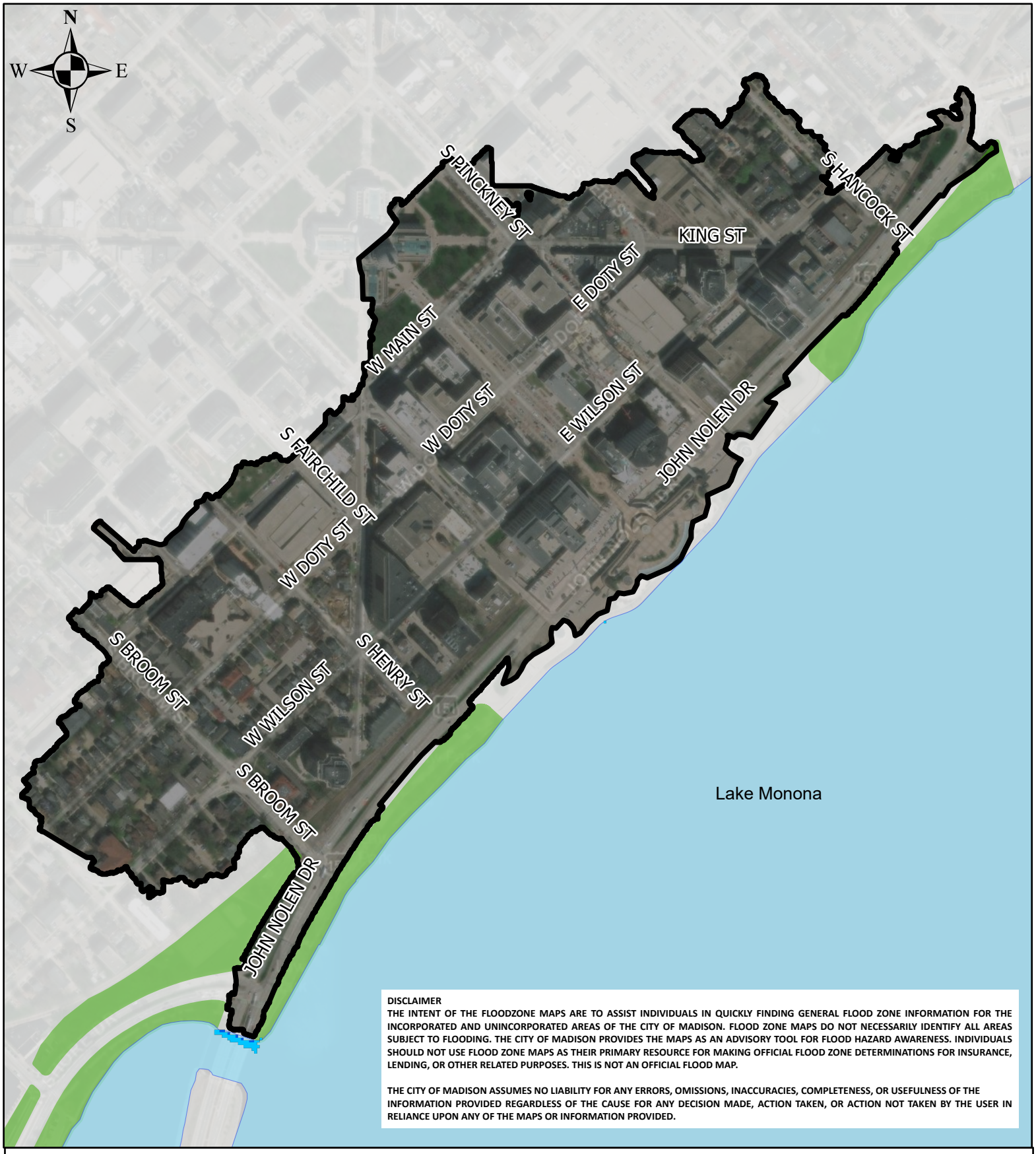
Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 1 Mitigation Results
# 500-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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- Lakes and Rivers

Maximum Water Depth (ft)

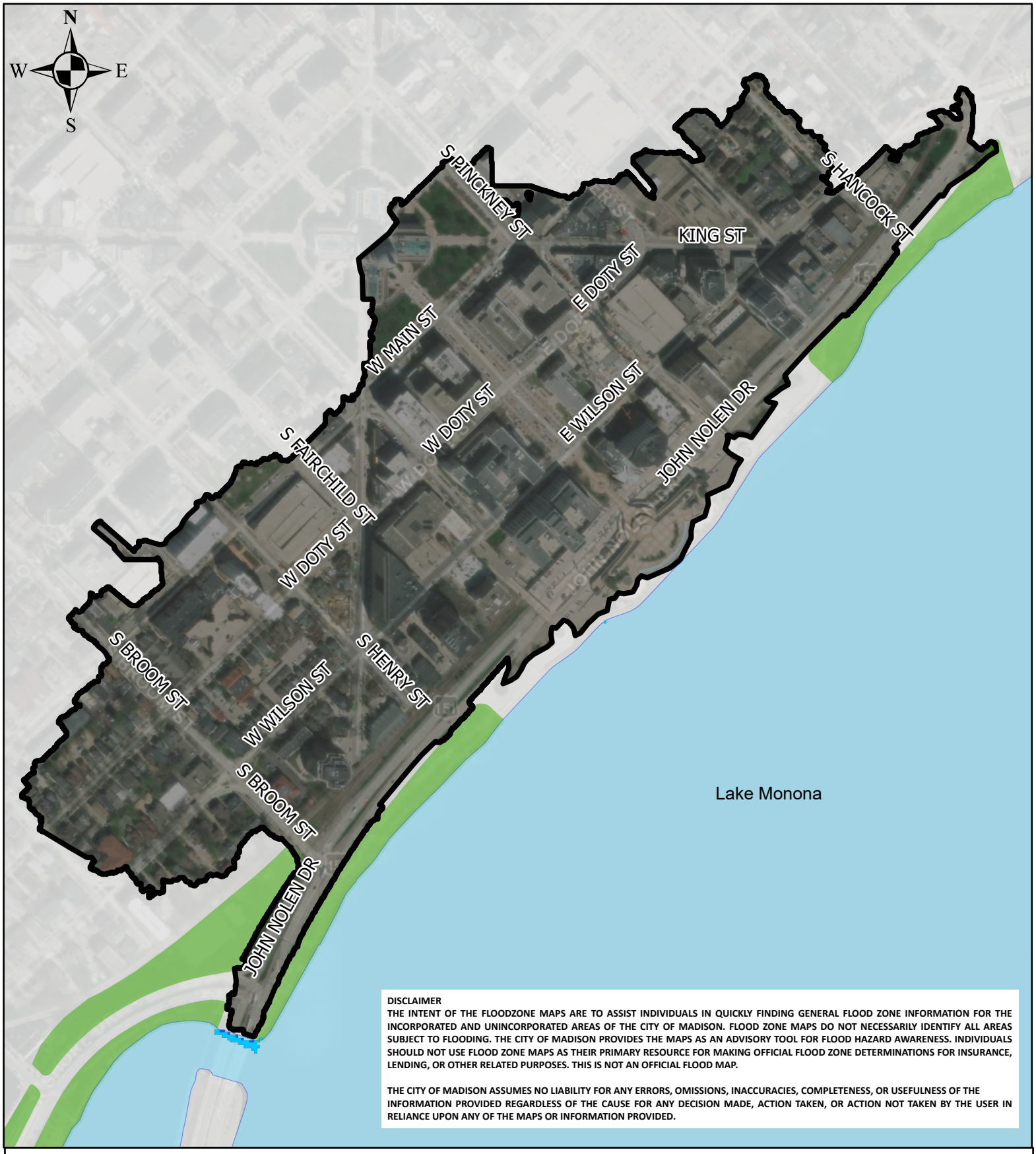
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 2-year, 24-hour
# Maximum Water Depth

*Alternative Not Chosen

*No flooding predicted during this storm event.

CITY OF MADISON WISCONSIN




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- Lakes and Rivers

Maximum Water Depth (ft)

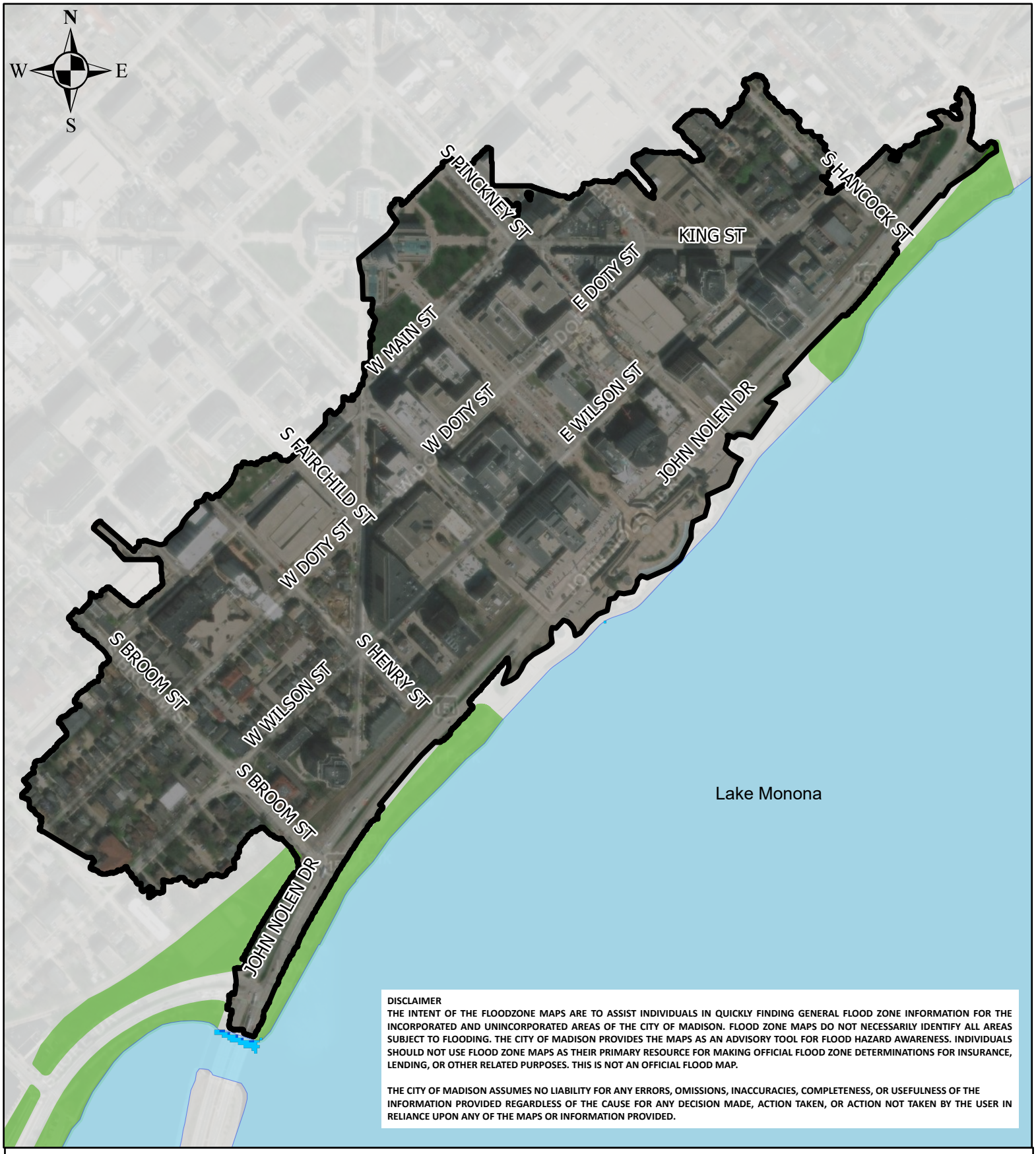
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 5-year, 24-hour
# Maximum Water Depth

*Alternative Not Chosen

*No flooding predicted during this storm event.

CITY OF MADISON WISCONSIN




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Maximum Water Depth (ft)

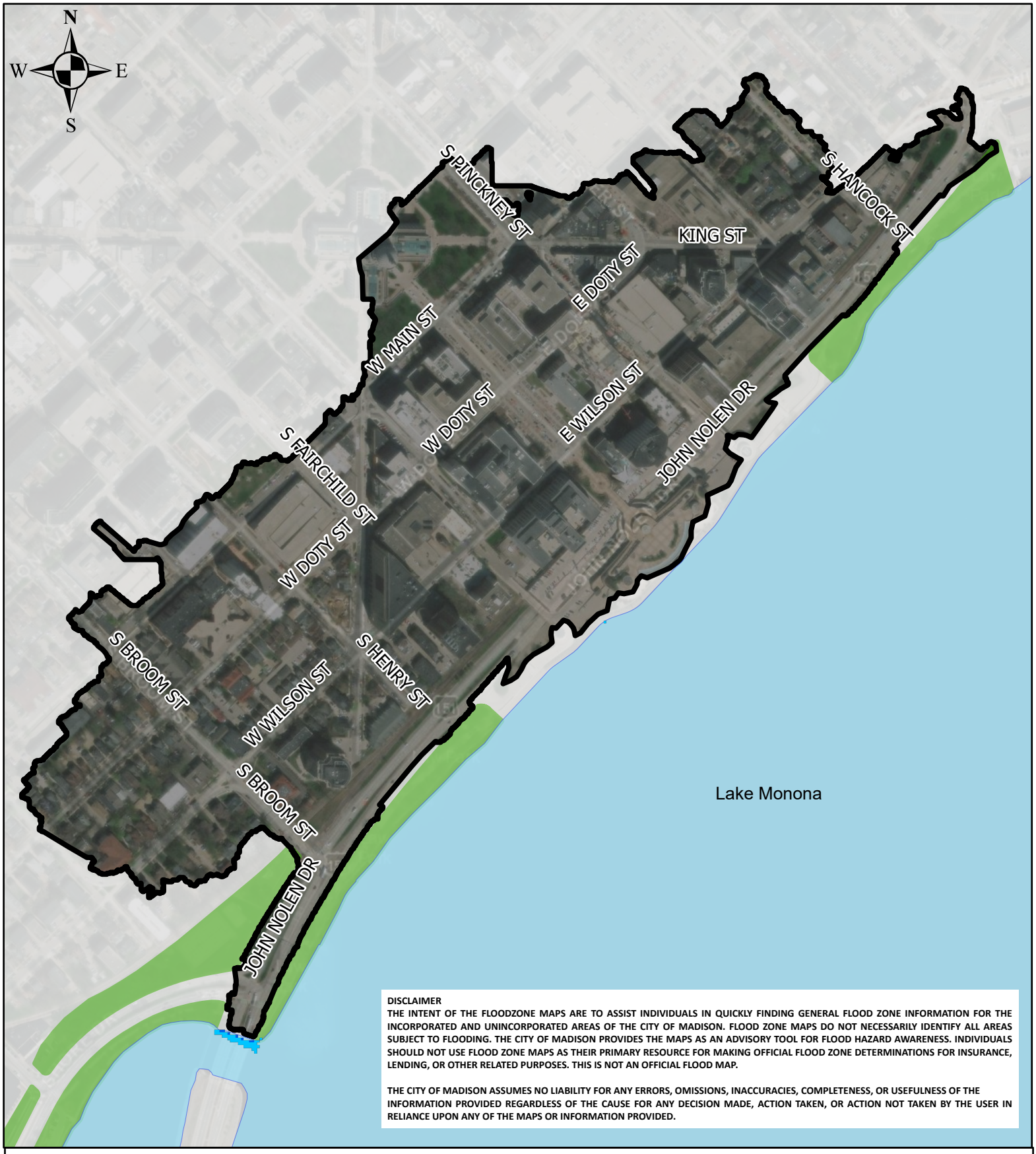
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 10-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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- Park
- Lakes and Rivers

Maximum Water Depth (ft)

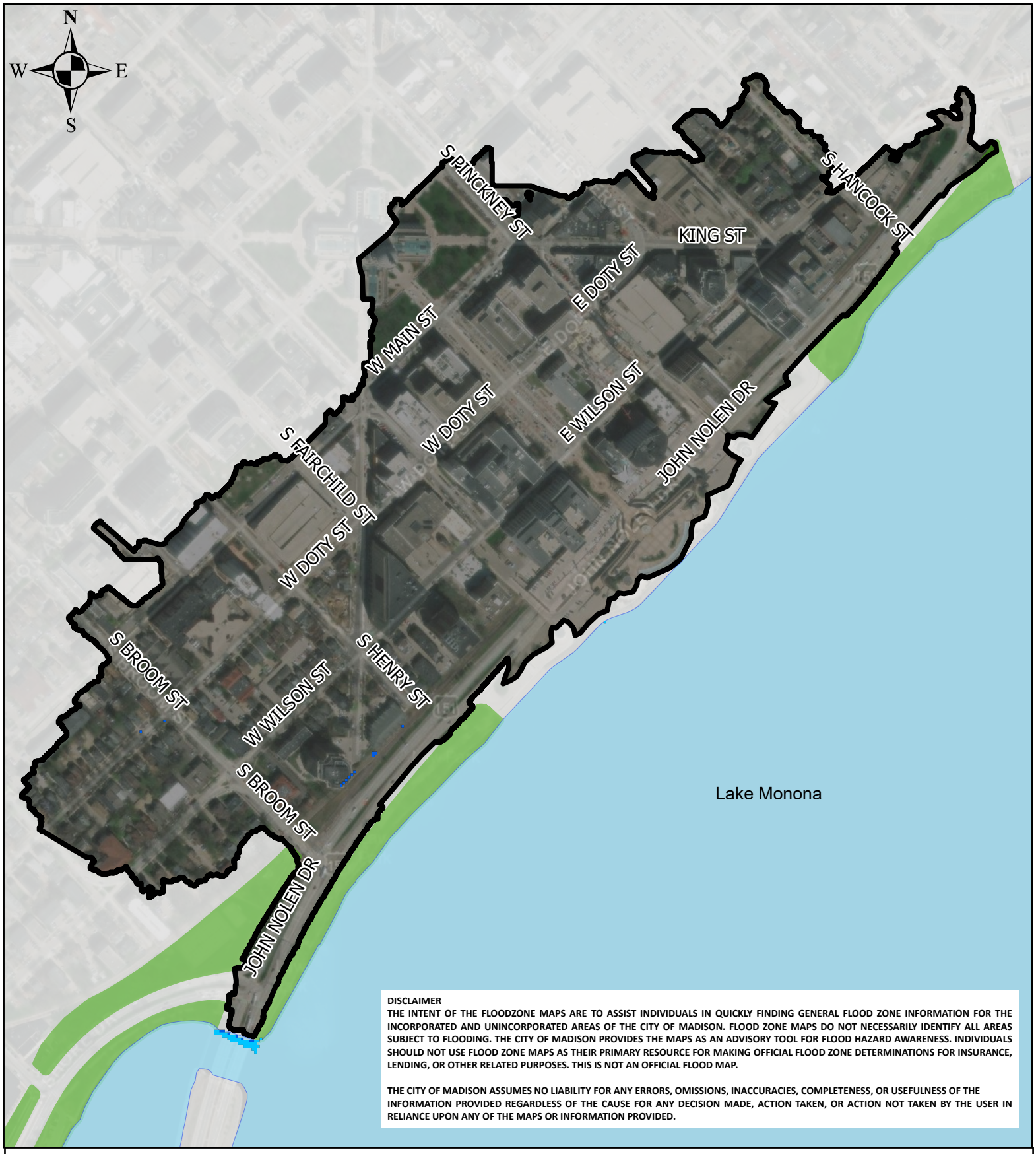
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 25-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 50-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 100-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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- Watershed Boundary
- Park
- Lakes and Rivers

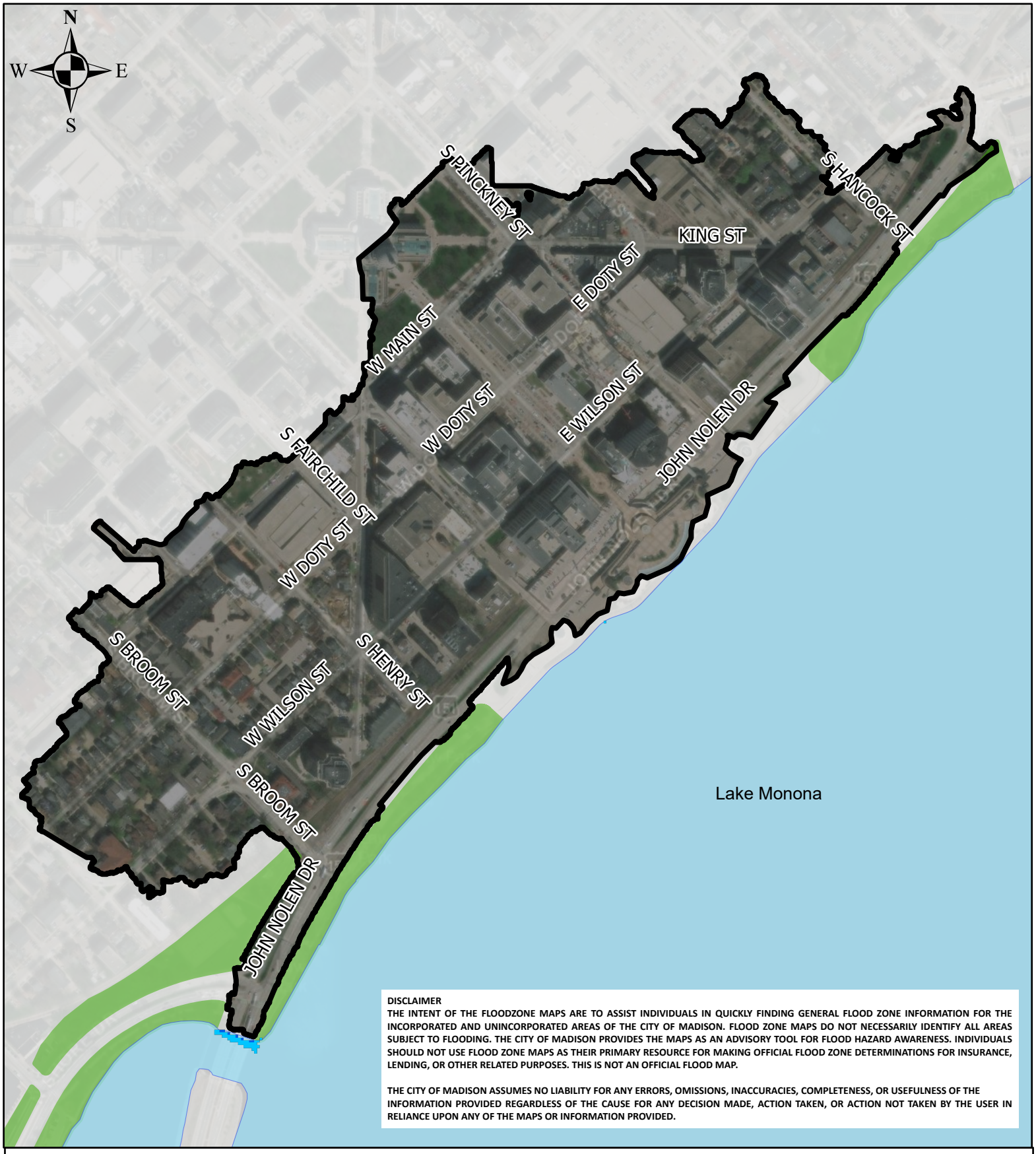
Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 2 Mitigation Results
# 500-year, 24-hour
# Maximum Water Depth

**Alternative Not Chosen*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

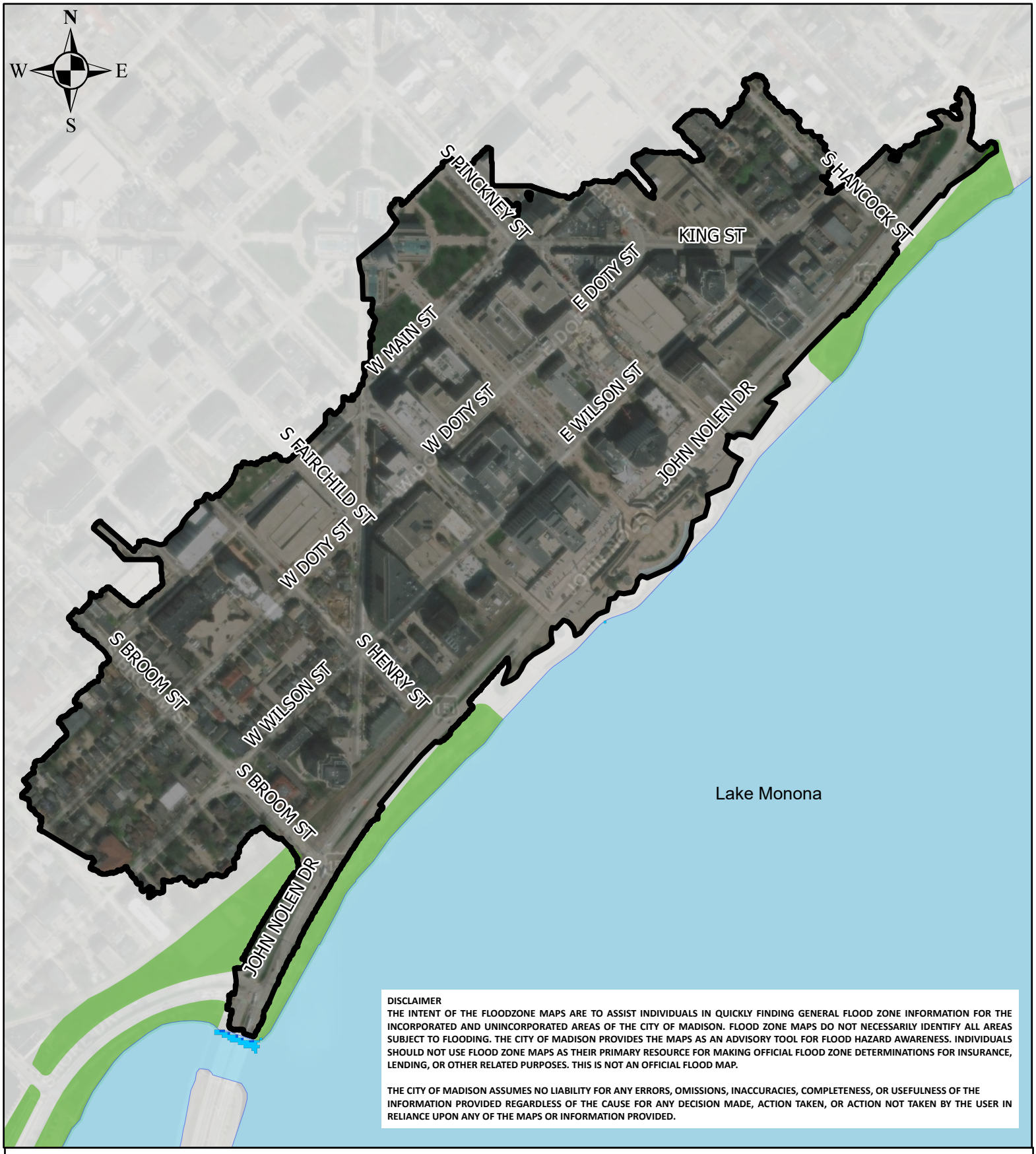
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 2-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

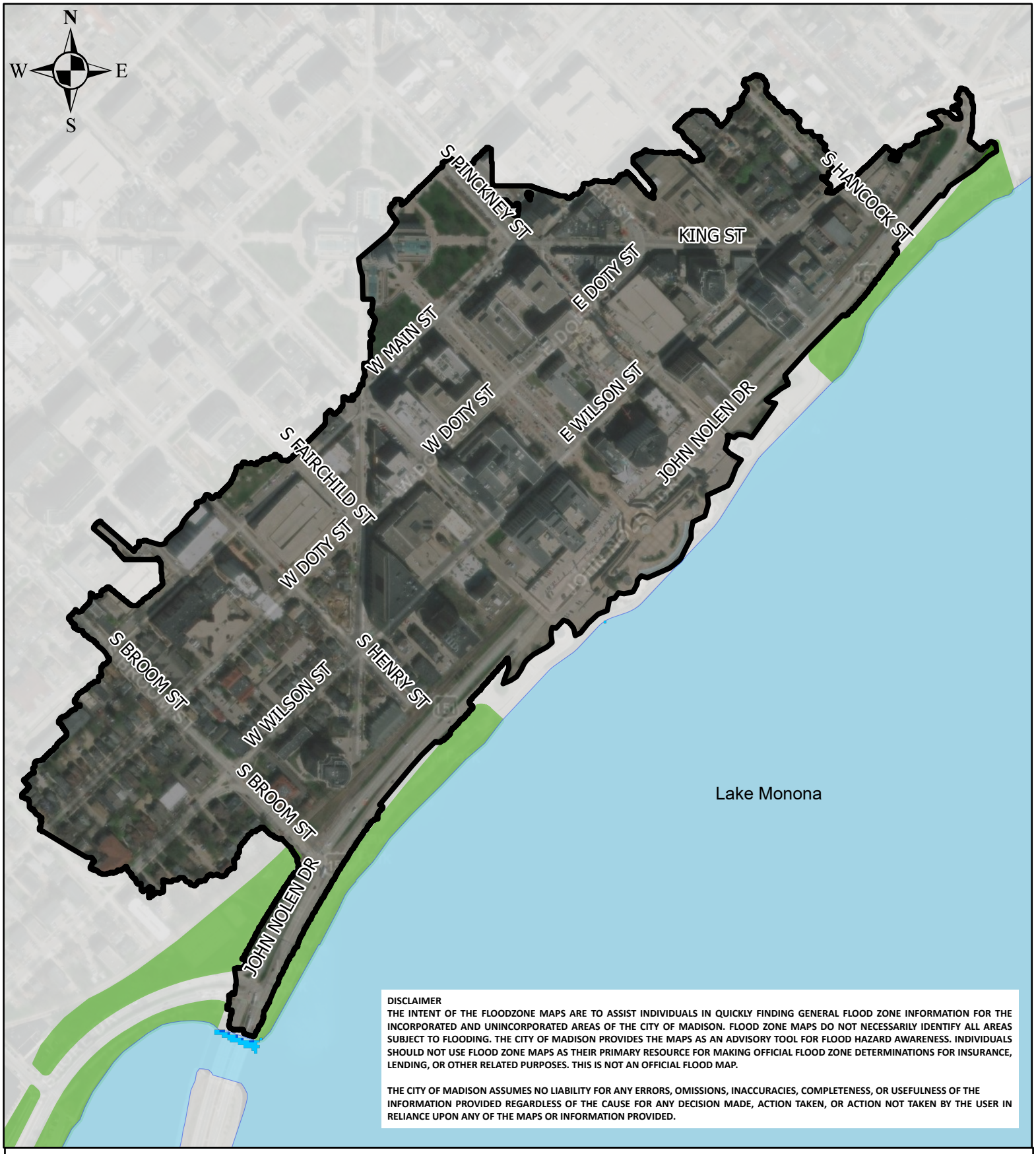
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 5-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

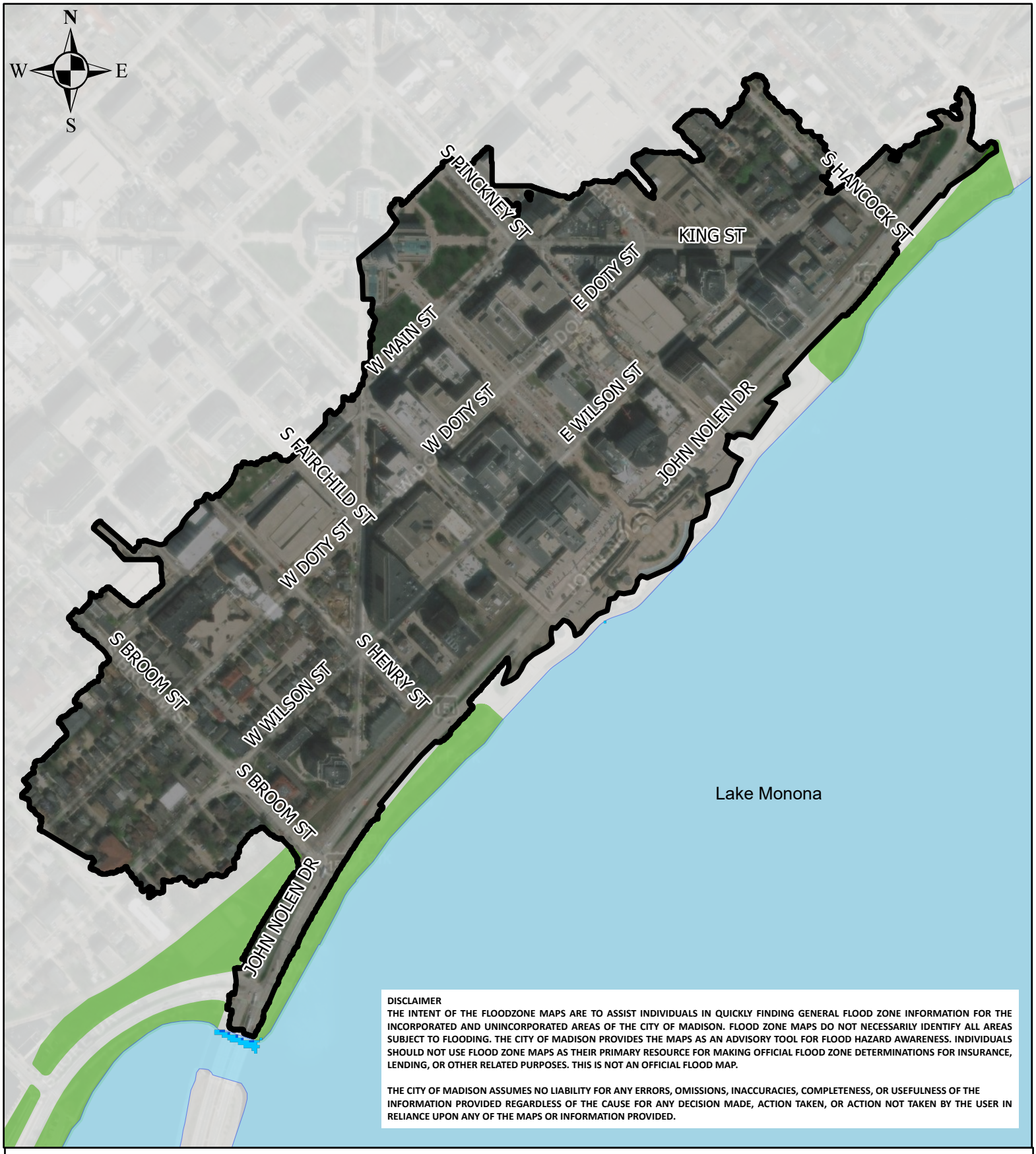
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 10-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

**No flooding predicted during this storm event.*

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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

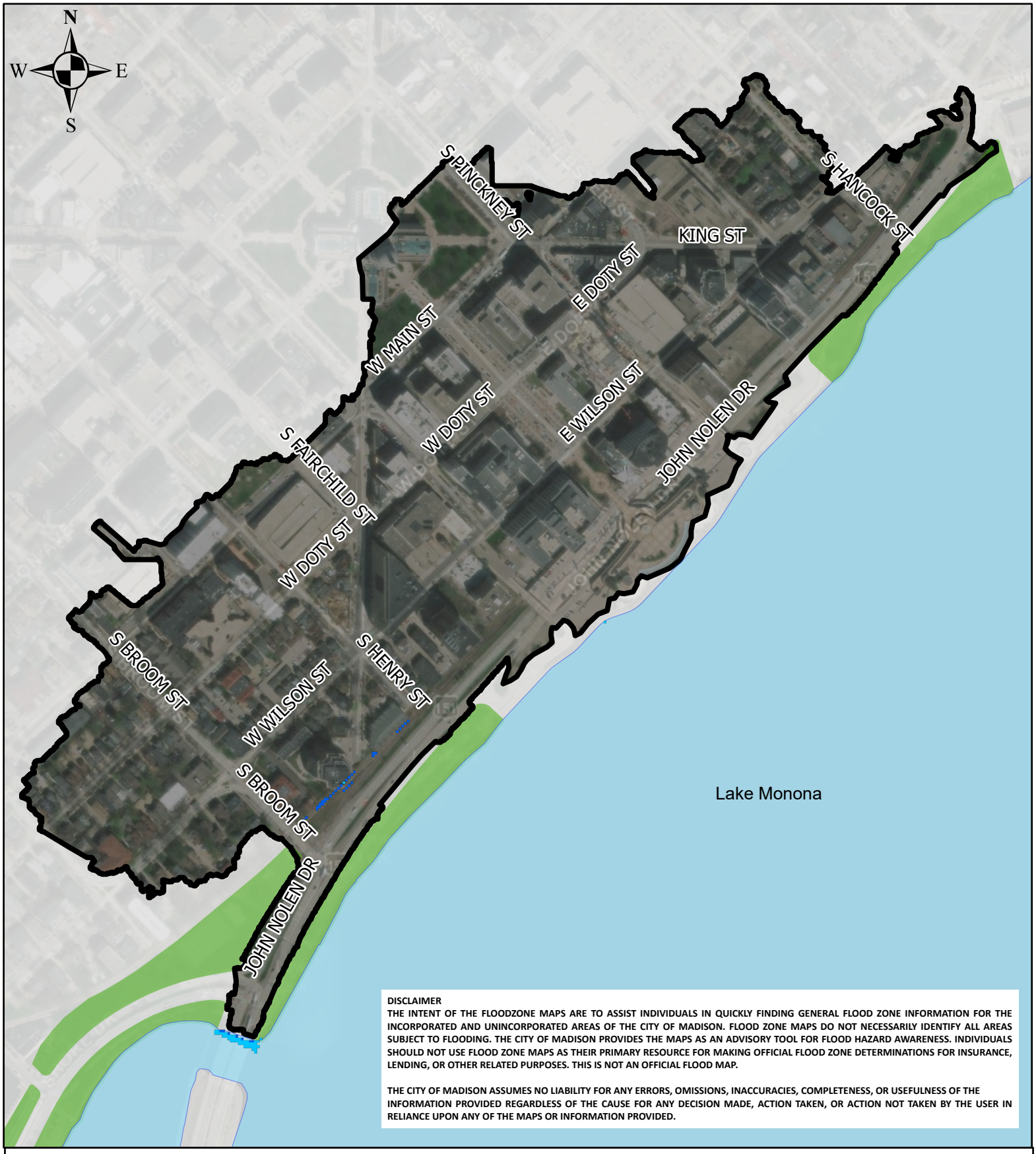
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 25-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

**No flooding predicted during this storm event.*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 50-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 100-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

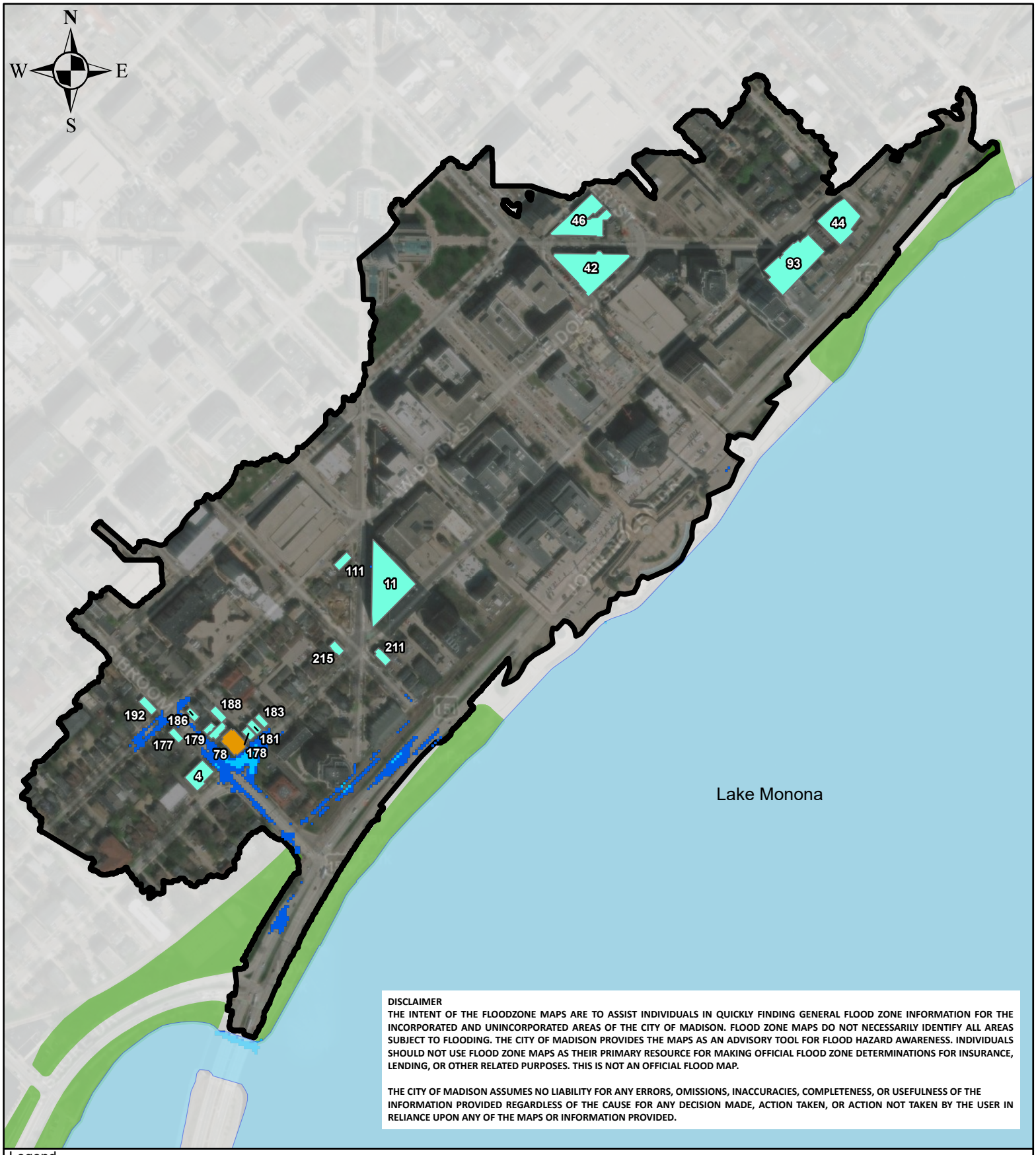
Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

# Central Isthmus Watershed
# Alternative 3 Mitigation Results
# 500-year, 24-hour
# Maximum Water Depth

**Chosen Alternative*

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

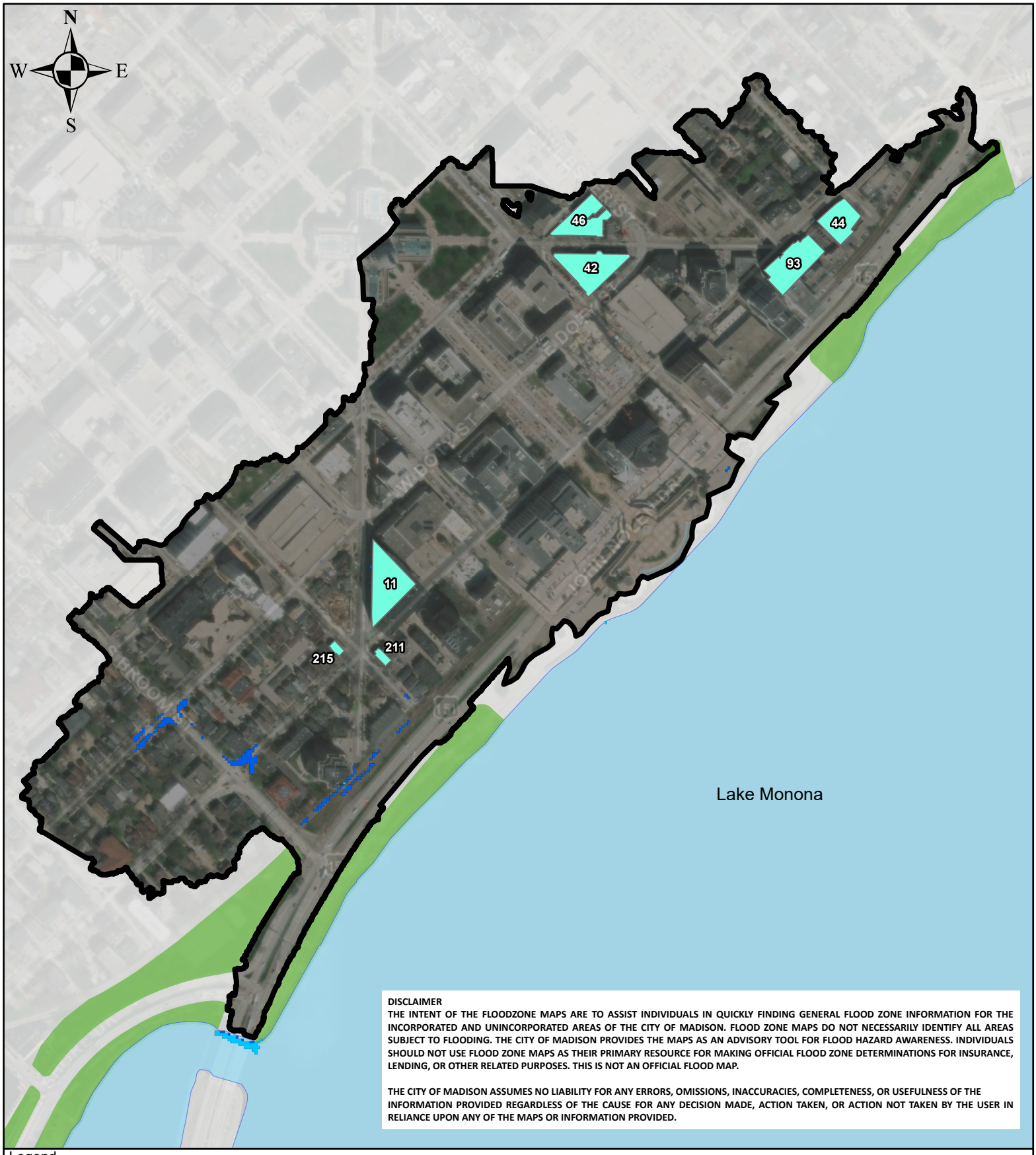
Building Flooding (in)

- <6"
- 6"-8"
- 8"-12"
- >12"

*Note: Buildings flooding 6" and less are considered meeting the City's flood goals.*

# Central Isthmus Watershed Mitigation Alternative 1 100-year, 24-hour Maximum Water Depth & Maximum Building Flooding

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)

- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

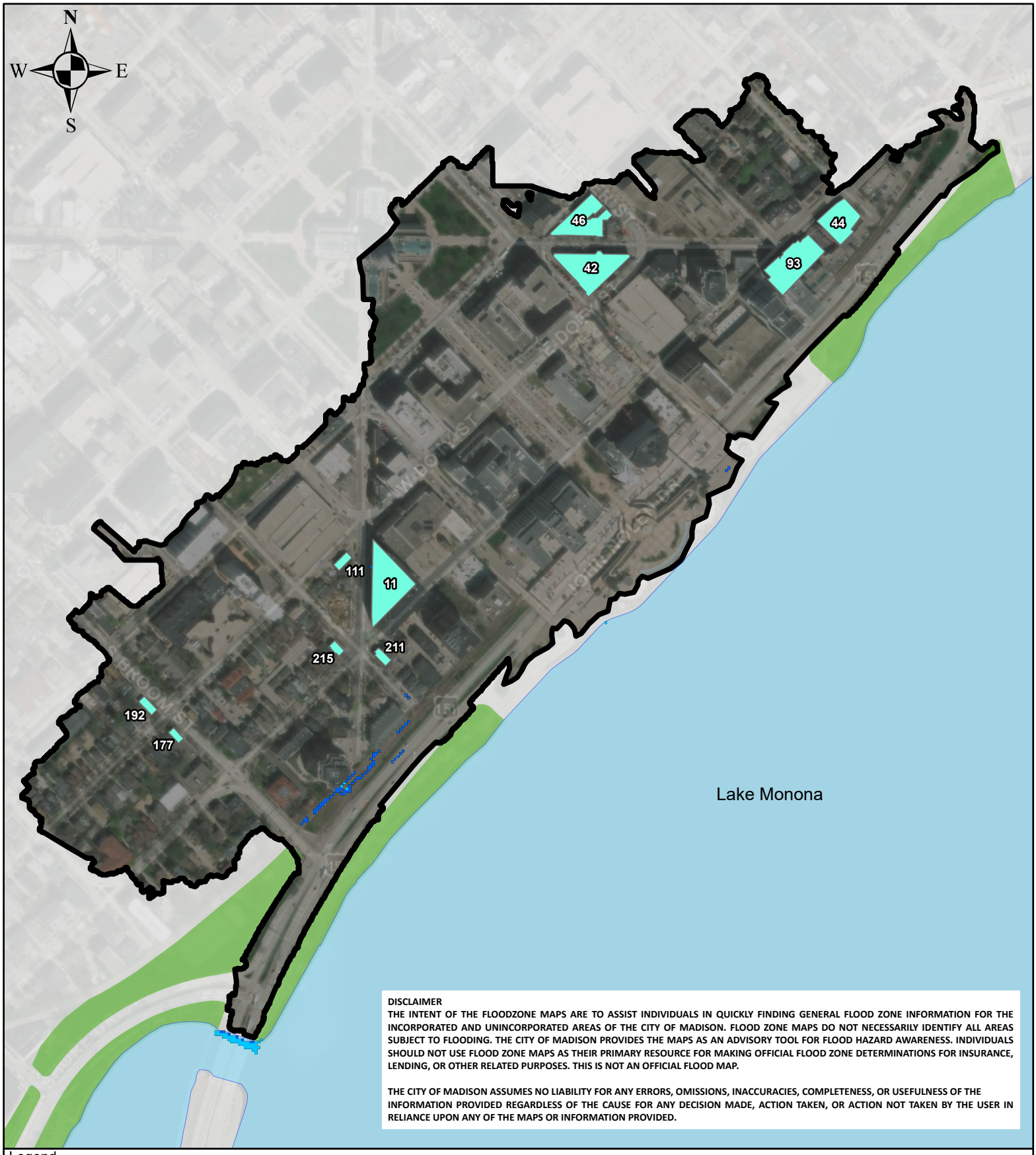
Building Flooding (in)

- <6"
- 6"-8"
- 8"-12"
- >12"

*Note: Buildings flooding 6" and less are considered meeting the City's flood goals.*

# Central Isthmus Watershed Mitigation Alternative 2 100-year, 24-hour Maximum Water Depth & Maximum Building Flooding

CITY OF MADISON WISCONSIN




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Legend

- Watershed Boundary
- Park
- Lakes and Rivers

Maximum Water Depth (ft)
- 0.5-1
- 1-2
- 2-3
- 3-4
- 4-5
- 5+

Building Flooding (in)
- <6"
- 6"-8"
- 8"-12"
- >12"

*Note: Buildings flooding 6" and less are considered meeting the City's flood goals.*

# Central Isthmus Watershed Mitigation Alternative 3 100-year, 24-hour Maximum Water Depth & Maximum Building Flooding

CITY OF MADISON WISCONSIN

# Table 1. Alternative 1 Mitigation Summary

**Table 1. Alternative 1 Mitigation Summary**

| Schematic Ref | Location Ref | Existing Size | Proposed Size | US Node ID | DS Node ID | Pipe ID | Existing | | | | | Proposed | | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | US Inv | DS Inv | Length, LF | Slope, % | Capacity, CFS | US Inv | DS Inv | Length, LF | Slope, % | Capacity, CFS | Design Flow Rate, CFS | Design Recurrence Interval, Years | |
| A | S Broom between W Doty & W Wilson | 24 | 29x45 | AS5052-044 | MI5052-045 | AS5052-044_MI5052-045 | 852.34 | 852.30 | 13 | 0.31% | 12.6 | 852.34 | 852.30 | 13 | 0.31% | 25.2 | 22.7 | 10 | Existing condition 10yr24hr model predicts more than 10,000 CF of manhole surcharge volume (Level of Service Goal #1) at intersection of W Broom Street & W Doty Street as a result of insufficient capacity of downstream S Broom Street sewer. |
| | | 24 | 29x45 | MI5052-045 | AS5052-094-01 | MI5052-045_AS5052-094-01 | 852.30 | 851.55 | 247 | 0.30% | 12.5 | 852.28 | 851.55 | 247 | 0.30% | 37.5 | 22.7 | 10 | |
| | | 24 | 29x45 | AS5052-094-01 | AS5052-094 | AS5052-094-01_AS5052-094 | 851.55 | 850.78 | 247 | 0.31% | 12.7 | 851.08 | 849.97 | 247 | 0.45% | 46.2 | 22.5 | 10 | |
| | | 24 | 29x45 | AS5052-094 | AS5052-087 | AS5052-094_AS5052-087 | 850.77 | 849.59 | 84 | 1.40% | 26.9 | 849.96 | 849.59 | 84 | 0.44% | 45.8 | 26.3 | 10 | |
| B | W Wilson between S Henry & S Broom | New | 36 | Prop.MH-1 | IN5052-090 | Prop.MH-1_IN5052-090 | New | | | | | 855.95 | 850.13 | 564 | 1.03% | 67.8 | 39.9 | 100 | Existing condition 10yr24hr model predicts more than 30,000 CF of manhole surcharge volume at the dead end of S Hamilton Street as a result of insufficient capacity of downstream S Hamilton Street sewer. Rerouting flow to a new sewer in W Wilson Street was chosen over upsizing the S Hamilton Street sewer/outfall due to feasibility constraints associated with John Nolen Drive & train tracks. **The W Wilson sewer was modeled at 36" instead of 24" to reduce flooding at the intersection of Wilson/Henry/Hamilton. The upstream invert of the proposed pipe was dropped to maintain adequate cover and to provide additional capacity (more slope) to IN5051-049_Prop.MH-1 which was surcharging into the intersection and contributing to flooding on S Hamilton dead end apartment building.** |
| C | W Wilson near S Broom intersection | 18 | 36 | IN5052-090 | AS5052-087 | IN5052-090_AS5052-087 | 851.58 | 849.51 | 60 | 3.45% | 19.5 | 850.13 | 849.51 | 60 | 1.03% | 67.8 | 34.7 | 100 | Upsizing to match size of proposed 36" W Wilson sewer. |
| D | W Wilson near S Henry intersection | 15 | 15 | IN5051-049 | Prop.MH-1 | IN5051-049_Prop.MH-1 | 860.60 | 859.80 | 38 | 2.11% | 9.4 | 860.59 | 855.95 | 78 | 5.95% | 15.8 | 10.6 | 10 | No changes to pipes hydraulically but rerouting to proposed new 24" W Wilson sewer. See improvement B notes above for justification. |
| | | 12 | 12 | IN5051-083 | Prop.MH-1 | IN5051-083_Prop.MH-1 | 859.93 | 859.69 | 35 | 0.69% | 3.0 | 859.92 | 859.17 | 41 | 1.83% | 4.8 | 0.6 | 10 | |
| E | S Henry near W Wilson intersection | 24 | 24 | AS5151-071 | IN5151-070 | AS5151-071_IN5151-070 | 863.14 | 855.26 | 194 | 4.06% | 45.7 | 863.14 | 860.27 | 194 | 1.48% | 27.5 | 12.2 | 10 | Rerouting flow that was previously routed to the Hamilton Street outfall. The upstream pipe (AS5151-071_IN5151-070) was also replaced with new invert elevations such that sufficient slope could be provided to the new tie in point at Prop.MH-1. |
| | | 24 | 24 | IN5151-070 | Prop.MH-1 | IN5151-070_Prop.MH-1 | 855.20 | 852.30 | 89 | 3.26% | 40.9 | 860.26 | 855.95 | 71 | 6.07% | 55.7 | 12.8 | 10 | |
| F | S Pinckney near E Doty intersection | 15 | 18 | AS5150-136 | AS5150-138 | AS5150-136_AS5150-138 | 902.52 | 901.95 | 27 | 2.11% | 9.4 | 902.52 | 901.95 | 27 | 2.11% | 14.5 | 12.6 | 100 | Existing condition 100yr24hr model predicted ~12,000 CF of manhole surcharge volume on S Pinckney Street between E Doty Street & E Wilson Street. Due to the steep downward grade on E Wilson Street, the surcharged stormwater flows NE towards S Hancock Street and substantially floods the E Wilson municipal buildings along with other buildings near the intersection of E Wilson & King Street (Level of Service Goal #3). The sewers were sized based on model predicted cumulative flow rates and assuming the usage of existing invert elevations/alignment. Pipes with steep gradients, such as AS5150-122_AS5150-050 (Schematic Ref I), required a smaller pipe size to convey the same amount of flow as pipes with flatter gradients such as AS5150-143_AS5150-122 (Schematic Ref H). |
| | | 15 | 18 | AS5150-138 | IN5150-139 | AS5150-138_IN5150-139 | 901.95 | 899.96 | 70 | 2.84% | 10.9 | 901.95 | 899.96 | 70 | 2.84% | 17.7 | 12.5 | 100 | |
| | | 15 | 18 | IN5150-139 | IN5150-140 | IN5150-139_IN5150-140 | 899.96 | 897.75 | 84 | 2.63% | 10.5 | 899.96 | 897.75 | 84 | 2.63% | 17.0 | 15.4 | 100 | |
| G | S Pinckney between E Doty & E Wilson | 15 | 21 | IN5150-140 | IN5150-142 | IN5150-140_IN5150-142 | 897.75 | 894.78 | 115 | 2.58% | 10.4 | 897.75 | 894.78 | 115 | 2.58% | 25.5 | 18.7 | 100 | |
| H | S Pinckney near E Wilson intersection | 15 | 24 | IN5150-142 | AS5150-143 | IN5150-142_AS5150-143 | 894.78 | 894.49 | 16 | 1.81% | 8.7 | 894.78 | 894.49 | 16 | 1.81% | 22.2 | 24.3 | 100 | |
| | | 15 | 24 | AS5150-143 | AS5150-122 | AS5150-143_AS5150-122 | 894.24 | 894.02 | 24 | 0.92% | 6.2 | 894.24 | 894.02 | 24 | 0.92% | 19.4 | 24.3 | 100 | |
| I | S Pinckney & E Wilson intersection | 12 | 18 | AS5150-122 | AS5150-052 | AS5150-122_AS5150-052 | 894.02 | 884.40 | 67 | 14.36% | 13.5 | 894.02 | 884.40 | 67 | 14.36% | 39.8 | 24.8 | 100 | |
| J | S Hamilton near W Wilson/S Henry intersection | 15 | 24 | IN5051-057 | MI5051-002 | IN5051-057_MI5051-002 | 863.22 | 860.75 | 21 | 11.76% | 22.2 | 863.22 | 860.75 | 21 | 11.76% | 77.6 | 20.8 | 100 | Flooding was predicted at IN5051-057 and it is recommended to upsize the existing pipe to 24-inch pipes. The next two pipes downstream are also recommended to be upsized since they were smaller than 24-inch. |
| | | 18 | 24 | MI5051-002 | AS5051-050 | MI5051-002_AS5051-050 | 860.65 | 859.80 | 30 | 2.83% | 17.7 | 860.65 | 859.80 | 30 | 2.83% | 38.1 | 21.2 | 100 | |
| | | 21 | 24 | AS5051-050 | AS5051-055 | AS5051-050_AS5051-055 | 859.80 | 854.60 | 25 | 20.80% | 72.3 | 859.80 | 854.60 | 25 | 20.80% | 103.0 | 37.9 | 100 | |
| L | E Wilson near intersection of King & S Butler | 12 | 15 | AS5250-005 | IN5250-028 | AS5250-005_IN5250-028 | 875.66 | 871.68 | 55 | 7.24% | 9.6 | 875.66 | 871.68 | 55 | 7.24% | 17.4 | 7.5 | 100 | Two 12" pipes upstream of AS5250-005 merge into a single 12" pipe. In the 100yr24hr storm the pipe downstream of AS5250-005 surcharges as it does not have the capacity to handle the 2 upstream pipes of the same diameter. In the existing condition, more than 12,000 CF of water surcharge from AS5250-005 and flood the buildings downhill of E Wilson street. |
| | | 12 | 15 | IN5250-028 | AS5249-057 | IN5250-028_AS5249-057 | 871.68 | 868.6 | 65 | 4.74% | 7.8 | 871.68 | 868.60 | 65 | 4.74% | 14.1 | 14.2 | 100 | |
| M | W Doty near S Hamilton intersection | 12 | 18 | MI5151-054 | IN5151-053 | MI5151-054_IN5151-053 | 899.88 | 899.33 | 65 | 0.85% | 3.3 | 900.30 | 899.33 | 65 | 1.49% | 12.8 | 8.9 | 100 | Upstream and downstream pipes are 18", but MI5151-054_IN5151-053 is 12". In the 100yr24hr storm, MI5151-054 surcharges about 6,500 CF of stormwater, flooding buildings to the east & southeast of the intersection. |

## Table 2. Alternative 2 Mitigation Summary

**Table 2. Alternative 2 Mitigation Summary**

| Schematic Ref | Location Ref | Existing Size | Proposed Size | US Node ID | DS Node ID | Pipe ID | Existing | | | | | Proposed | | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | US Inv | DS Inv | Length, LF | Slope, % | Capacity, CFS | US Inv | DS Inv | Length, LF | Slope, % | Capacity, CFS | Design Flow Rate, CFS | Design Recurrence Interval, Years | |
| A | S Broom between W Doty & W Wilson | 24 | 29x45 | AS5052-044 | MI5052-045 | AS5052-044_MI5052-045 | 852.34 | 852.30 | 13 | 0.31% | 12.6 | 852.34 | 852.30 | 13 | 0.31% | 25.2 | 22.6 | 10 | Existing condition 10yr24hr model predicts more than 10,000 CF of manhole surcharge volume (Level of Service Goal #1) at intersection of W Broom Street & W Doty Street as a result of insufficient capacity of downstream S Broom Street sewer. |
| | | 24 | 29x45 | MI5052-045 | AS5052-094-01 | MI5052-045_AS5052-094-01 | 852.30 | 851.55 | 247 | 0.30% | 12.5 | 852.30 | 851.55 | 247 | 0.30% | 38.0 | 22.5 | 10 | |
| | | 24 | 29x45 | AS5052-094-01 | AS5052-094 | AS5052-094-01_AS5052-094 | 851.55 | 850.78 | 247 | 0.31% | 12.7 | 851.55 | 850.78 | 247 | 0.31% | 38.5 | 23.5 | 10 | |
| | | 24 | 29x45 | AS5052-094 | AS5052-087 | AS5052-094_AS5052-087 | 850.77 | 849.59 | 84 | 1.40% | 26.9 | 850.78 | 849.59 | 84 | 1.42% | 82.1 | 27.7 | 10 | |
| F | S Pinckney near E Doty intersection | 15 | 18 | AS5150-136 | AS5150-138 | AS5150-136_AS5150-138 | 902.52 | 901.95 | 27 | 2.11% | 9.4 | 902.52 | 901.95 | 27 | 2.11% | 14.5 | 12.6 | 100 | Existing condition 100yr24hr model predicted ~12,000 CF of manhole surcharge volume on S Pinckney Street between E Doty Street & E Wilson Street. Due to the steep downward grade on E Wilson Street, the surcharged stormwater flows NE towards S Hancock Street and substantially floods the E Wilson municipal buildings along with other buildings near the intersection of E Wilson & King Street (Level of Service Goal #3). The sewers were sized based on model predicted cumulative flow rates and assuming the usage of existing invert elevations/alignment. Pipes with steep gradients, such as AS5150-122_AS5150-050 (Schematic Ref I), required a smaller pipe size to convey the same amount of flow as pipes with flatter gradients, such as AS5150-143_AS5150-122 (Schematic Ref H). |
| | | 15 | 18 | AS5150-138 | IN5150-139 | AS5150-138_IN5150-139 | 901.95 | 899.96 | 70 | 2.84% | 10.9 | 901.95 | 899.96 | 70 | 2.84% | 17.7 | 12.5 | 100 | |
| | | 15 | 18 | IN5150-139 | IN5150-140 | IN5150-139_IN5150-140 | 899.96 | 897.75 | 84 | 2.63% | 10.5 | 899.96 | 897.75 | 84 | 2.63% | 17.0 | 15.4 | 100 | |
| G | S Pinckney between E Doty & E Wilson | 15 | 21 | IN5150-140 | IN5150-142 | IN5150-140_IN5150-142 | 897.75 | 894.78 | 115 | 2.58% | 10.4 | 897.75 | 894.78 | 115 | 2.58% | 25.5 | 18.7 | 100 | |
| H | S Pinckney near E Wilson intersection | 15 | 24 | IN5150-142 | AS5150-143 | IN5150-142_AS5150-143 | 894.78 | 894.49 | 16 | 1.81% | 8.7 | 894.78 | 894.49 | 16 | 1.81% | 22.2 | 24.3 | 100 | |
| | | 15 | 24 | AS5150-143 | AS5150-122 | AS5150-143_AS5150-122 | 894.24 | 894.02 | 24 | 0.92% | 6.2 | 894.24 | 894.02 | 24 | 0.92% | 19.4 | 24.3 | 100 | |
| I | S Pinckney & E Wilson intersection | 12 | 18 | AS5150-122 | AS5150-052 | AS5150-122_AS5150-052 | 894.02 | 884.40 | 67 | 14.36% | 13.5 | 894.02 | 884.40 | 67 | 14.36% | 39.8 | 24.8 | 100 | |
| J | S Hamilton near W Wilson/S Henry intersection | 15 | 24 | IN5051-057 | MI5051-002 | IN5051-057_MI5051-002 | 863.22 | 860.75 | 21 | 11.76% | 22.2 | 863.22 | 860.75 | 21 | 11.76% | 77.6 | 20.8 | 100 | Flooding was predicted at IN5051-057 and it is recommended to upsize the existing pipe to 24-inch pipes. The next two pipes downstream are also recommended to be upsized since they were smaller than 24-inch. |
| | | 18 | 24 | MI5051-002 | AS5051-050 | MI5051-002_AS5051-050 | 860.65 | 859.80 | 30 | 2.83% | 17.7 | 860.65 | 859.80 | 30 | 2.83% | 38.1 | 21.2 | 100 | |
| | | 21 | 24 | AS5051-050 | AS5051-055 | AS5051-050_AS5051-055 | 859.80 | 854.60 | 25 | 20.80% | 72.3 | 859.80 | 854.60 | 25 | 20.80% | 103.0 | 37.9 | 100 | |
| K | S Hamilton from N Henry /W Wilson intersection to Outfall | 24 | 36 | AS5051-056 | AS5051-069 | AS5051-056_AS5051-069 | 853.10 | 851.87 | 66 | 1.86% | 91.2 | 853.10 | 851.87 | 66 | 1.86% | 91.1 | 66.3 | 100 | Upsize the Hamilton Street sewer and outfall downstream of the intersection with N Henry Street & W Wilson Street to an uniform 3ft diameter circular pipe. Upsizing this pipe and outfall relieves the need for a W Wilson diversion sewer or any work with intersection of Hamilton. While the pipes are being design tot he 100yr 24-hr storm, they do not need to have the capacity for full flow. Surcharging at the end segments of the Hamilton sewer does not cause building flooding. |
| | | 24 | 36 | AS5051-069 | AS5051-068 | AS5051-069_AS5051-068 | 851.87 | 851.70 | 28 | 0.61% | 52.1 | 851.87 | 851.70 | 28 | 0.61% | 50.2 | 66.3 | 100 | |
| | | 24 | 36 | AS5051-068 | AS5052-107 | AS5051-068_AS5052-107 | 851.70 | 850.82 | 110 | 0.80% | 59.8 | 851.70 | 850.82 | 110 | 0.80% | 59.7 | 67.7 | 100 | |
| | | 24 | 36 | AS5052-107 | AS5052-106 | AS5052-107_AS5052-106 | 850.82 | 847.01 | 160 | 2.38% | 103.1 | 850.82 | 847.01 | 160 | 2.38% | 102.9 | 67.7 | 100 | |
| | | 27 | 36 | AS5052-106 | AS5052-037 | AS5052-106_AS5052-037 | 847.01 | 846.83 | 31 | 0.58% | 50.9 | 847.01 | 846.83 | 31 | 0.58% | 50.8 | 58.2 | 100 | |
| | | 21 | 36 | AS5052-037 | AS5052-109 | AS5052-037_AS5052-109 | 846.83 | 846.15 | 16 | 4.25% | 137.8 | 846.83 | 846.15 | 16 | 4.25% | 100.4 | 61.9 | 100 | |
| | | 21 | 36 | AS5052-109 | IN5152-009 | AS5052-109_IN5152-009 | 846.15 | 844.51 | 86 | 1.91% | 92.3 | 846.15 | 844.51 | 86 | 1.91% | 92.1 | 62.0 | 100 | |
| | | 21 | 36 | IN5152-009 | IN5152-010 | IN5152-009_IN5152-010 | 844.51 | 844.30 | 35 | 0.60% | 51.8 | 844.51 | 844.30 | 35 | 0.60% | 51.7 | 62.0 | 100 | |
| | | 21 | 36 | IN5152-010 | AS5152-014 | IN5152-010_AS5152-014 | 844.30 | 844.27 | 5 | 0.60% | 51.8 | 844.30 | 844.27 | 5 | 0.60% | 21.1 | 62.2 | 100 | |
| | | 21 | 36 | AS5152-014 | IN5152-011 | AS5152-014_IN5152-011 | 844.27 | 844.22 | 10 | 0.50% | 47.3 | 844.27 | 844.22 | 10 | 0.50% | 27.2 | 62.2 | 100 | |
| | | 21 | 36 | IN5152-011 | IN5152-012 | IN5152-011_IN5152-012 | 844.22 | 844.05 | 35 | 0.49% | 46.6 | 844.22 | 844.05 | 35 | 0.49% | 46.5 | 62.8 | 100 | |
| | | 21 | 36 | IN5152-012 | AE5152-013 | IN5152-012_AE5152-013 | 844.05 | 843.60 | 90 | 0.50% | 47.3 | 844.05 | 843.60 | 90 | 0.50% | 47.2 | 63.3 | 100 | |
| L | E Wilson near intersection of King & S Butler | 12 | 15 | AS5250-005 | IN5250-028 | AS5250-005_IN5250-028 | 875.66 | 871.68 | 55 | 7.24% | 9.6 | 875.66 | 871.68 | 55 | 7.24% | 17.4 | 7.5 | 100 | Two 12" pipes upstream of AS5250-005 merge into a single 12" pipe. In the 100yr24hr storm the pipe downstream of AS5250-005 surcharges as it does not have the capacity to handle the 2 upstream pipes of the same diameter. In the existing condition, more than 12,000 CF of water surcharge from AS5250-005 and flood the buildings downhill of E Wilson street. |
| | | 12 | 15 | IN5250-028 | AS5249-057 | IN5250-028_AS5249-057 | 871.68 | 868.6 | 65 | 4.74% | 7.8 | 871.68 | 868.60 | 65 | 4.74% | 14.1 | 14.2 | 100 | |
| M | W Doty near S Hamilton intersection | 12 | 18 | MI5151-054 | IN5151-053 | MI5151-054_IN5151-053 | 899.88 | 899.33 | 65 | 0.85% | 3.3 | 900.30 | 899.33 | 65 | 1.49% | 12.8 | 8.9 | 100 | Upstream and downstream pipes are 18", but MI5151-054_IN5151-053 is 12". In the 100yr24hr storm, MI5151-054 surcharges about 6,500 CF of stormwater, flooding buildings to the east & southeast of the intersection. |

# Table 3. Alternative 3 Mitigation Summary

Table 3. Alternative 3 Mitigation Summary

| Schematic Ref | Location Ref | Existing Size | Proposed Size | US Node ID | DS Node ID | Pipe ID | Existing | | | | | Proposed | | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | US Inv | DS Inv | Length, LF | Slope, % | Capacity, CFS | US Inv | DS Inv | Length, LF | Slope, % | Capacity, CFS | Design Flow Rate, CFS | Design Recurrence Interval, Years | |
| A | S Broom between W Doty & W Wilson | 24 | 29x45 | AS5052-044 | MI5052-045 | AS5052-044_MI5052-045 | 852.34 | 852.30 | 13 | 0.31% | 12.6 | 852.34 | 852.28 | 13 | 0.46% | 30.8 | 22.6 | 10 | Existing condition 10yr24hr model predicts more than 10,000 CF of manhole surcharge volume (Level of Service Goal #1) at intersection of W Broom Street & W Doty Street as a result of insufficient capacity of downstream S Broom Street sewer. |
| | | 24 | 29x45 | MI5052-045 | AS5052-094-01 | MI5052-045_AS5052-094-01 | 852.30 | 851.55 | 247 | 0.30% | 12.5 | 852.28 | 851.09 | 247 | 0.48% | 47.9 | 22.5 | 10 | |
| | | 24 | 29x45 | AS5052-094-01 | AS5052-094 | AS5052-094-01_AS5052-094 | 851.55 | 850.78 | 247 | 0.31% | 12.7 | 851.08 | 849.97 | 247 | 0.45% | 46.2 | 23.5 | 10 | |
| | | 24 | 29x45 | AS5052-094 | AS5052-087 | AS5052-094_AS5052-087 | 850.77 | 849.59 | 84 | 1.40% | 26.9 | 849.96 | 849.59 | 84 | 0.44% | 45.8 | 27.7 | 10 | |
| B | W Wilson between S Henry & S Broom | New | 36 | Prop.MH-1 | IN5052-090 | Prop.MH-1_IN5052-090 | New | | | | | 855.95 | 850.13 | 564 | 1.03% | 62.9 | 47.2 | 100 | Existing condition 10yr24hr model predicts more than 30,000 CF of manhole surcharge volume at the dead end of S Hamilton Street as a result of insufficient capacity of downstream S Hamilton Street sewer. Rerouting flow to a new sewer in W Wilson Street was chosen over upsizing the S Hamilton Street sewer/outfall due to feasibilty constraints associated with John Nolen Drive & train tracks. **The W Wilson sewer was modeled at 36" instead of 24" to reduce flooding at the intersection of Wilson/Henry/Hamilton. The upstream invert of the proposed pipe was dropped to maintain adequate cover and to provide additional capacity (more slope) to IN5051-049_Prop.MH-1 which was surcharging into the intersection and contributing to flooding on S Hamilton dead end apartment building.** |
| C | W Wilson near S Broom intersection | 18 | 36 | IN5052-090 | AS5052-087 | IN5052-090_AS5052-087 | 851.58 | 849.51 | 60 | 3.45% | 19.5 | 850.13 | 849.51 | 60 | 1.03% | 67.8 | 64.5 | 100 | Upsizing to match size of proposed 36" W Wilson sewer. |
| D | W Wilson near S Henry intersection | 15 | 15 | IN5051-049 | Prop.MH-1 | IN5051-049_Prop.MH-1 | 860.60 | 859.80 | 38 | 2.11% | 9.4 | 860.59 | 855.95 | 78 | 5.95% | 14.6 | 10.6 | 10 | No changes to pipes hydraulically but rerouting to proposed new 24" W Wilson sewer. See improvement B notes above for justification. |
| | | 12 | 12 | IN5051-083 | Prop.MH-1 | IN5051-083_Prop.MH-1 | 859.93 | 859.69 | 35 | 0.69% | 3.0 | 859.92 | 857.95 | 41 | 4.80% | 7.3 | 0.6 | 10 | |
| E | S Henry near W Wilson intersection | 24 | 24 | AS5151-071 | IN5151-070 | AS5151-071_IN5151-070 | 863.14 | 855.26 | 194 | 4.06% | 45.7 | 863.14 | 860.27 | 194 | 1.48% | 27.5 | 12.2 | 10 | Rerouting flow that was previously routed to the Hamilton Street outfall. The upstream pipe (AS5151-071_IN5151-070) was also replaced with new invert elevations such that sufficient slope could be provided to the new tie in point at Prop.MH-1. |
| | | 24 | 24 | IN5151-070 | Prop.MH-1 | IN5151-070_Prop.MH-1 | 855.20 | 852.30 | 89 | 3.26% | 40.9 | 860.26 | 855.95 | 71 | 6.07% | 51.8 | 18.5 | 10 | |
| F | S Pinckney near E Doty intersection | 15 | 18 | AS5150-136 | AS5150-138 | AS5150-136_AS5150-138 | 902.52 | 901.95 | 27 | 2.11% | 9.4 | 902.52 | 901.95 | 27 | 2.11% | 14.5 | 12.6 | 100 | Existing condition 100yr24hr model predicted ~12,000 CF of manhole surcharge volume on S Pinckney Street between E Doty Street & E Wilson Street. Due to the steep downward grade on E Wilson Street, the surcharged stormwater flows NE towards S Hancock Street and substantially floods the E Wilson municipal buildings along with other buildings near the intersection of E Wilson & King Street (Level of Service Goal #3). The sewers were sized based on model predicted cumulative flow rates and assuming the usage of existing invert elevations/alignment. Pipes with steep gradients, such as AS5150-122_AS5150-050 (Schematic Ref I), required a smaller pipe size to convey the same amount of flow as pipes with flatter gradients such as AS5150-143_AS5150-122 (Schematic Ref H). |
| | | 15 | 18 | AS5150-138 | IN5150-139 | AS5150-138_IN5150-139 | 901.95 | 899.96 | 70 | 2.84% | 10.9 | 901.95 | 899.96 | 70 | 2.84% | 17.7 | 12.5 | 100 | |
| | | 15 | 18 | IN5150-139 | IN5150-140 | IN5150-139_IN5150-140 | 899.96 | 897.75 | 84 | 2.63% | 10.5 | 899.96 | 897.75 | 84 | 2.63% | 17.0 | 15.4 | 100 | |
| G | S Pinckney between E Doty & E Wilson | 15 | 21 | IN5150-140 | IN5150-142 | IN5150-140_IN5150-142 | 897.75 | 894.78 | 115 | 2.58% | 10.4 | 897.75 | 894.78 | 115 | 2.58% | 25.5 | 18.7 | 100 | |
| H | S Pinckney near E Wilson intersection | 15 | 24 | IN5150-142 | AS5150-143 | IN5150-142_AS5150-143 | 894.78 | 894.49 | 16 | 1.81% | 8.7 | 894.78 | 894.49 | 16 | 1.81% | 22.2 | 24.3 | 100 | |
| | | 15 | 24 | AS5150-143 | AS5150-122 | AS5150-143_AS5150-122 | 894.24 | 894.02 | 24 | 0.92% | 6.2 | 894.24 | 894.02 | 24 | 0.92% | 19.4 | 24.3 | 100 | |
| I | S Pinckney & E Wilson intersection | 12 | 18 | AS5150-122 | AS5150-052 | AS5150-122_AS5150-052 | 894.02 | 884.40 | 67 | 14.36% | 13.5 | 894.02 | 884.40 | 67 | 14.36% | 39.8 | 24.8 | 100 | |
| J | S Hamilton near W Wilson/S Henry intersection | 15 | 24 | IN5051-057 | MI5051-002 | IN5051-057_MI5051-002 | 863.22 | 860.75 | 21 | 11.76% | 22.2 | 863.22 | 860.75 | 21 | 11.76% | 77.6 | 20.8 | 100 | Flooding was predicted at IN5051-057 and it is recommended to upsize the existing pipe to 24-inch pipes. The next two pipes downstream are also recommended to be upsized since they were smaller than 24-inch. |
| | | 18 | 24 | MI5051-002 | AS5051-050 | MI5051-002_AS5051-050 | 860.65 | 859.80 | 30 | 2.83% | 17.7 | 860.65 | 859.80 | 30 | 2.83% | 38.1 | 21.2 | 100 | |
| | | 21 | 24 | AS5051-050 | AS5051-055 | AS5051-050_AS5051-055 | 859.80 | 854.60 | 25 | 20.80% | 72.3 | 859.80 | 854.60 | 25 | 20.80% | 103.0 | 37.9 | 100 | |
| L | E Wilson near intersection of King & S Butler | 12 | 15 | AS5250-005 | IN5250-028 | AS5250-005_IN5250-028 | 875.66 | 871.68 | 55 | 7.24% | 9.6 | 875.66 | 871.68 | 55 | 7.24% | 17.4 | 7.5 | 100 | Two 12" pipes upstream of AS5250-005 merge into a single 12" pipe. In the 100yr24hr storm the pipe downstream of AS5250-005 surcharges as it does not have the capacity to handle the 2 upstream pipes of the same diameter. In the existing condition, more than 12,000 CF of water surcharge from AS5250-005 and flood the buildings downhill of E Wilson street. |
| | | 12 | 15 | IN5250-028 | AS5249-057 | IN5250-028_AS5249-057 | 871.68 | 868.6 | 65 | 4.74% | 7.8 | 871.68 | 868.60 | 65 | 4.74% | 14.1 | 14.2 | 100 | |
| M | W Doty near S Hamilton intersection | 12 | 18 | MI5151-054 | IN5151-053 | MI5151-054_IN5151-053 | 899.88 | 899.33 | 65 | 0.85% | 3.3 | 900.30 | 899.33 | 65 | 1.49% | 12.8 | 8.9 | 100 | Upstream and downstream pipes are 18", but MI5151-054_IN5151-053 is 12". In the 100yr24hr storm, MI%151-054 surcharges about 6,500 CF of stormwater, flooding buildings to the east & southeast of the intersection. |
| N | W Wilson near intersection with S Hamilton & S Henry | 15 | 15 | IN5151-067 | IN5151-013 | IN5151-067_IN5151-013 | 858.45 | 858.35 | 17 | 0.59% | 5.0 | 860.96 | 860.86 | 17 | 0.59% | 3.7 | 7.4 | 100 | With the Broom Street outfall being upsized, all flow previously routed to the S Hamilton sewer was diverted to the proposed W Wilson diversion sewer. In Alt1, flow from the West side of the intersection was diverted to the W Wilson sewer (Schematic Ref D), but in Alt3 intersection flow from the East side of the interesction was also diverted. |
| | | 15 | 15 | IN5151-013 | IN5151-070 | IN5151-013_IN5151-070 | 858.35 | 857.93 | 77 | 0.55% | 4.8 | 860.86 | 860.26 | 40 | 1.50% | 7.3 | 7.7 | 100 | |
| | | 12 | 12 | MI5151-069 | IN5151-070 | MI5151-069_IN5151-070 | 862.88 | 859.8 | 60 | 5.13% | 8.1 | 862.88 | 860.26 | 50 | 5.24% | 7.6 | 1.7 | 100 | |
| O | S Broom from W Wilson intersection to Outfall | 29x45 | 43 x 68 | AS5052-087 | AS5052-085 | AS5052-087_AS5052-085 | 849.47 | 848.25 | 77 | 1.58% | 83.2 | 849.47 | 848.25 | 77 | 1.58% | 255.4 | 119.1 | 100 | Upsized existing 29"x45" horizontal ellipse sewer to a 34"x53" horizontal ellipse sewer. While the model did not predict surcharging of this sewer extent in the existing condition, significant additional flow was added via the 36" W Wilson diversion sewer as well as by upsizing the upstream sewer between W Doty & W Wilson. |
| | | 29x45 | 43 x 68 | AS5052-085 | AS5052-083 | AS5052-085_AS5052-083 | 848.23 | 847.4 | 77 | 1.08% | 68.6 | 848.23 | 847.40 | 77 | 1.08% | 210.7 | 119.0 | 100 | |
| | | 29x45 | 43 x 68 | AS5052-083 | AS5052-080 | AS5052-083_AS5052-080 | 847.42 | 846.28 | 100 | 1.14% | 70.6 | 847.42 | 846.28 | 100 | 1.14% | 216.7 | 119.5 | 100 | |
| | | 29x45 | 43 x 68 | AS5052-080 | AS5052-078 | AS5052-080_AS5052-078 | 846.28 | 845.93 | 70 | 0.50% | 46.7 | 846.28 | 845.93 | 70 | 0.50% | 143.5 | 126.0 | 100 | |
| | | 29x45 | 43 x 68 | AS5052-078 | AS5052-074 | AS5052-078_AS5052-074 | 845.93 | 845.68 | 62 | 0.40% | 42.0 | 845.93 | 845.68 | 62 | 0.40% | 128.9 | 126.7 | 100 | |
| | | 29x45 | 43 x 68 | AS5052-074 | AS5052-073 | AS5052-074_AS5052-073 | 845.66 | 845.12 | 82 | 0.66% | 53.6 | 845.66 | 845.12 | 82 | 0.66% | 164.7 | 126.9 | 100 | |
| | | 29x45 | 43 x 68 | AS5052-073 | AE5052-075 | AS5052-073_AE5052-075 | 845.12 | 844.35 | 91 | 0.85% | 60.8 | 845.12 | 844.35 | 91 | 0.85% | 186.7 | 128.6 | 100 | |

| Table 4. Flooded Buildings Summary (100-year, 24-hour Storm - LOS#3) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Building ID | Existing Peak Flooding (inches) | Alt 1 Peak Flooding (inches) | Alt2 Peak Flooding (inches) | Alt3 Peak Flooding (inches) | Alt1 Reduction from Existing | Alt2 Reduction from Existing | Alt3 Reudction from Existing |
| 4 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 5 | 2 | 0 | 0 | 0 | 2 | 2 | 2 |
| 11 | 7 | 3 | 1 | 2 | 4 | 6 | 5 |
| 17 | 7 | 0 | 0 | 0 | 7 | 7 | 7 |
| 31 | 7 | 0 | 0 | 0 | 7 | 7 | 7 |
| 33 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 34 | 12 | 0 | 0 | 0 | 12 | 12 | 12 |
| 36 | 5 | 0 | 0 | 0 | 5 | 5 | 5 |
| 37 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 41 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 42 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 44 | 8 | 3 | 3 | 3 | 5 | 5 | 5 |
| 46 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 49 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 51 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 56 | 7 | 0 | 0 | 0 | 7 | 7 | 7 |
| 61 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 62 | 4 | 0 | 0 | 0 | 4 | 4 | 4 |
| 63 | 4 | 0 | 0 | 0 | 4 | 4 | 4 |
| 64 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 65 | 5 | 0 | 0 | 0 | 5 | 5 | 5 |
| 67 | 5 | 0 | 0 | 0 | 5 | 5 | 5 |
| 71 | 2 | 0 | 0 | 0 | 2 | 2 | 2 |
| 78 | 11 | 9 | 0 | 0 | 2 | 11 | 11 |
| 79 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 91 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 92 | 8 | 0 | 0 | 0 | 8 | 8 | 8 |
| 93 | 9 | 3 | 3 | 3 | 6 | 6 | 6 |
| 94 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 98 | 4 | 0 | 0 | 0 | 4 | 4 | 4 |
| 99 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 103 | 16 | 0 | 0 | 0 | 16 | 16 | 16 |
| 104 | 10 | 0 | 0 | 0 | 10 | 10 | 10 |
| 111 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 166 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 169 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 173 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 177 | 5 | 3 | 0 | 2 | 2 | 5 | 3 |
| 178 | 3 | 1 | 0 | 0 | 2 | 3 | 3 |
| 179 | 4 | 2 | 0 | 0 | 2 | 4 | 4 |
| 181 | 3 | 1 | 0 | 0 | 2 | 3 | 3 |
| 183 | 5 | 3 | 0 | 0 | 2 | 5 | 5 |
| 184 | 3 | 0 | 0 | 0 | 3 | 3 | 3 |
| 186 | 5 | 2 | 0 | 0 | 3 | 5 | 5 |
| 187 | 4 | 0 | 0 | 0 | 4 | 4 | 4 |
| 188 | 5 | 4 | 0 | 0 | 1 | 5 | 5 |
| 190 | 2 | 0 | 0 | 0 | 2 | 2 | 2 |
| 192 | 5 | 3 | 0 | 1 | 2 | 5 | 4 |
| 193 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 211 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 215 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |

# APPENDIX E: EAST ISTHMUS YAHARA WATERSHED STUDY CALIBRATION

# Excerpt from the East Isthmus Yahara Watershed Study Report - 5.0 MODEL CALIBRATION

Calibration is the process by which model inputs are adjusted such that model results reasonably match the measured data. A calibrated model has less uncertainty than an un-calibrated model.

Flow and rainfall monitoring was completed in the East Isthmus Yahara watershed to provide data for calibration. Calibration was completed for flow volume, rate, and depth at two locations and for depth at three locations.

## 5.1 BASEFLOW CONDITIONS

The baseflow simulated in the sewers at the calibration locations is zero based on the flow monitoring data.

## 5.2 RECORDED RAINFALL AND FLOW DATA

### 5.2.1 Monitoring Locations

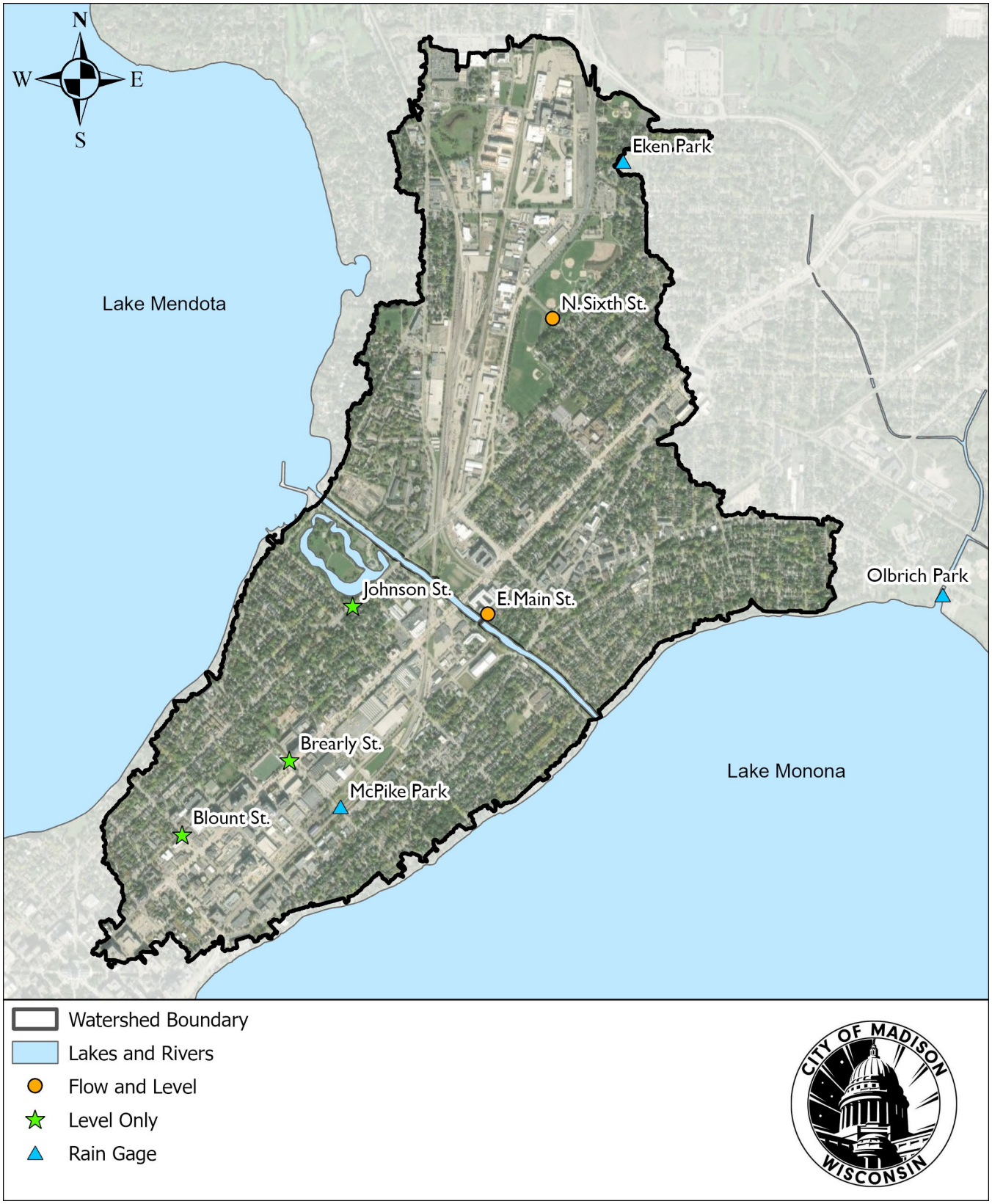
Flow meters were placed in five locations within the watershed to provide data for calibration. Three rain gauges in and near the watershed were used to correlate the measured flow data to rainfall. The flow monitoring locations were chosen in areas of historical flooding or because the location represented a relatively uniform location representative of the general characteristics of the watershed.

Monitoring occurred from June 2020 to September 2021, exclusive of the winter months from November through March. Level recorders were added at Blount, Brearly, and Johnson Streets southwest of the Yahara River and two area/velocity probes were installed on East Main and North Sixth Streets on the northeast side of the Yahara River. Table 5-1 lists the flow and rainfall monitoring locations.

Table 5-1. Flow and Rainfall Monitoring Locations

| Monitoring Location | Meter Name | Tributary Area (acres) | Data Collected |
|---|---|---|---|
| Blount Street | -- | 30 | Water Level |
| Brearly Street | EIY03 | 11 | Water Level |
| Johnson Street | EIY07 | 55 | Water Level |
| East Main Street | EIY02 | 26 | Flow, Velocity, Water Level |
| North Sixth Street | EIY01 | 22 | Flow, Velocity, Water Level |
| McPike Park | -- | -- | Rainfall |
| Eken Park | -- | -- | Rainfall |
| Olbrich Park | -- | -- | Rainfall |

Figure 5-1. Map of Flow and Rainfall Monitoring Locations



### 5.2.2 Calibration Events

Three storms were chosen as calibration events based on rainfall depth, peak rainfall intensity, and quality of flow monitoring data. Since the monitoring period in 2020 was characterized by dry conditions with limited rainfall and flow monitoring difficulties, all three storms that were selected, May 3, June 18, and August 7, occurred in 2021.

Rainfall can vary significantly across a larger watershed, so rainfall from three rain gages was used in calibration. Each modeled subwatershed was assigned to the nearest rain gauge using a Theissen polygon approach, shown in Figure 14-9 in Section 14.0. Table 5-2 summarizes the rainfall data from the three gages for the calibration events.

Table 5-2. Rainfall Data for Calibration Events

| Event | Total Rainfall (inches) | | | Peak Hour Rainfall Intensity (inches per hour) | | | Approx. Recurrence Interval+ |
|---|---|---|---|---|---|---|---|
| | McPike Park | Eken Park | Olbrich Park | McPike Park | Eken Park | Olbrich Park | McPike Park |
| May 3, 2021 | 1.13 | 0.80 | -* | 0.74 | 0.50 | -* | 100% annual chance |
| June 18, 2021 | 1.83 | 1.70 | 1.83 | 1.09 | 1.10 | 1.11 | 50% annual chance |
| August 7, 2021 | 1.46 | 0.87 | 1.20 | 1.41 | 0.83 | 0.87 | 100% annual chance |

* The rain gage at Olbrich Park did not log a rain event on May 3, 2021. Subwatersheds assigned to the Olbrich Park rain gauge for the other calibration events were assigned to one of the remaining gauges for this event.
+ Approximate Recurrence Intervals were estimated using the peak rainfall intensity.

### 5.2.3 USGS Data

Flooding in the East Isthmus Yahara watershed is known to be impacted by flows in the Yahara River and the level of Lake Monona. Data recorded by the United States Geological Survey (USGS) was used to approximate the flows in the Yahara River and the level of Lake Monona for each calibration event. Table 5-3 lists the Yahara River discharge and Lake Monona water surface elevation for the calibration events. The flow rates and lake levels added to the model are the daily mean on the days of the events. The model dynamically routes runoff from the watershed through the Yahara River adding to the discharge input at the upstream end of the river entering from Lake Mendota. While Lake Monona levels fluctuate, they typically fluctuated over a period of days rather than hours as simulated in the model.

Table 5-3. USGS Gage Data for Yahara River and Lake Monona

| Event | Yahara River Daily Mean Discharge (cfs) USGS Gaging Station 05428500 | Lake Monona Daily Mean WSE (feet NAVD88) USGS Gaging Station 054290000 |
|---|---|---|
| May 3, 2021 | 92.7 | 844.76 |
| June 18, 2021 | 48.5 | 844.91 |
| August 7, 2021 | 67.5 | 844.84 |

## 5.3 CALIBRATION PROCESS

For stormwater collection systems, the calibration process begins by calibrating the hydrology (flow volume and peak flow rate) first. Then the hydraulic calibration, the flow depth or hydraulic grade line, is calibrated.

The two locations where both depth and velocity were recorded were calibrated first to establish the hydrologic conditions in the metered areas, which were the applied to the un-metered areas of the watershed.

Once the hydrologic conditions were applied throughout the watershed, the flow depth at all five monitoring locations could be calibrated. Modeled depth may be impacted by pipe and channel roughness coefficients, minor losses at manholes, and sediment depth in the sewers. At the level meters on Blount Street, Brearly Street, Johnson Street, the sewer invert was below the water surface elevation of either the Yahara River or Lake Monona. In these cases, the water depths measured when the meters were installed, were used to confirm the depths recorded at the meters during no rainfall conditions. Adjustments of up to 0.5 feet were made at the Brearly Street meter so that the depth and boundary condition matched during no rainfall conditions.

Each of the model inputs and the adjustments made during calibration are summarized in the list below.

### 5.3.1 Model Inputs Adjusted during Calibration

- Area. Drainage areas were initially delineated to all individual catch basins in the City's GIS dataset. During calibration, the delineation and subsequent areas were only adjusted to account for private catch basins not in the City's GIS dataset or to keep individual buildings within a single subwatershed.
- Width. The width was used to calibrate peak flow rate. Madison's modeling guidance requires the width of all three subcatchments within a subwatershed to have the same width. The width of the directly connected impervious area is most important to the peak flow rate.
- Maximum and minimum infiltration rates. Infiltration rates were area-weighted and were based on the City's modeling guidance. Maximum infiltration rates were not adjusted but minimum infiltration rates were adjusted to aid in the calibration of flow volume. Many of the soils in the watershed are classified as urban soils by NRCS, which may not be similar to neighboring soils that have hydrologic soil group classifications.

### 5.3.2 Model Inputs Not Adjusted during Calibration

- Imperviousness (Total). Not adjusted because impervious cover mapping available in the watershed.
- Directly connected impervious area. Based on the impervious cover mapping. Not adjusted as part of the calibration.
- Slope. Not adjusted during calibration because it is a term in the same equation as the width and the average slope data estimated from topographic data are more accurate than the width.
- Impervious and pervious area Manning roughness coefficients. Set to 0.016 and 0.20, respectively based on the City's modeling guidance. These values were not changed during the calibration.

- Impervious and pervious area depression storage. Set to 0.05 and 0.15 inches, respectively, based on the City's modeling guidance. The City's modeling guidance sets the fraction of impervious area with zero depression storage at 25%. These values were not changed during the calibration.
- Subarea routing. The non-directly connected impervious area was routed to the pervious area as defined in the hydraulic modeling guidance. These values were not changed during calibration as it was based on the impervious cover mapping.
- Infiltration decay constant. Set to 4.0 in/hr based on the City's modeling guidance.
- Manning roughness coefficients for pipes and channels. Selected based on pipe material or channel condition following the City's modeling guidance. No adjustments were made during the calibration.
- Pipe sedimentation. Many of the pipes in the watershed are known to have sediment deposition. Pipe sedimentation was evaluated during the process of building the model, but ultimately it was decided that there was not enough data to incorporate a standard level of sedimentation across the pipe network. See section 4.4.2 for more details. No adjustments were made during the calibration.

While several of the variables were adjusted slightly, the subwatershed widths had to be reduced significantly to match the measured peak flow rate. The widths were systematically reduced by 50% until the widths were approximately 15 to 30 feet, which corresponds to the typical width of a street. The street comprises most of the directly connected impervious area and factors greatly into the modeled peak flow rate.

In the upper NE corner of the watershed, the widths were increased. After discussions with the City, it was decided that the model was not predicting the flooding that had been observed. Therefore, the previously calibrated widths were increased by 25% in this section of the watershed.

## 5.4 CALIBRATION RESULTS

For purposes of this project, the model is considered well calibrated if the overall average model bias for water surface elevations is within +/- 5% with reasonable effort made to minimize the largest absolute error while at the same time balancing that effort with the relative importance of the model results at each monitoring site location. The largest absolute error at each monitored location is defined as +/- 25%. Where the calibration could not be achieved within these tolerances, the reasons and potential impacts were described.

Calibration results at each monitoring location are included in Table 5-4 through Table 5-8 and in Figure 5-2 through Figure 5-10. The figures show an overview of calibration by plotting the measured data versus the modeled data. On these figures, a perfect calibration would show all the data points on the blue diagonal (1:1 line) where measured and modeled values are equal.

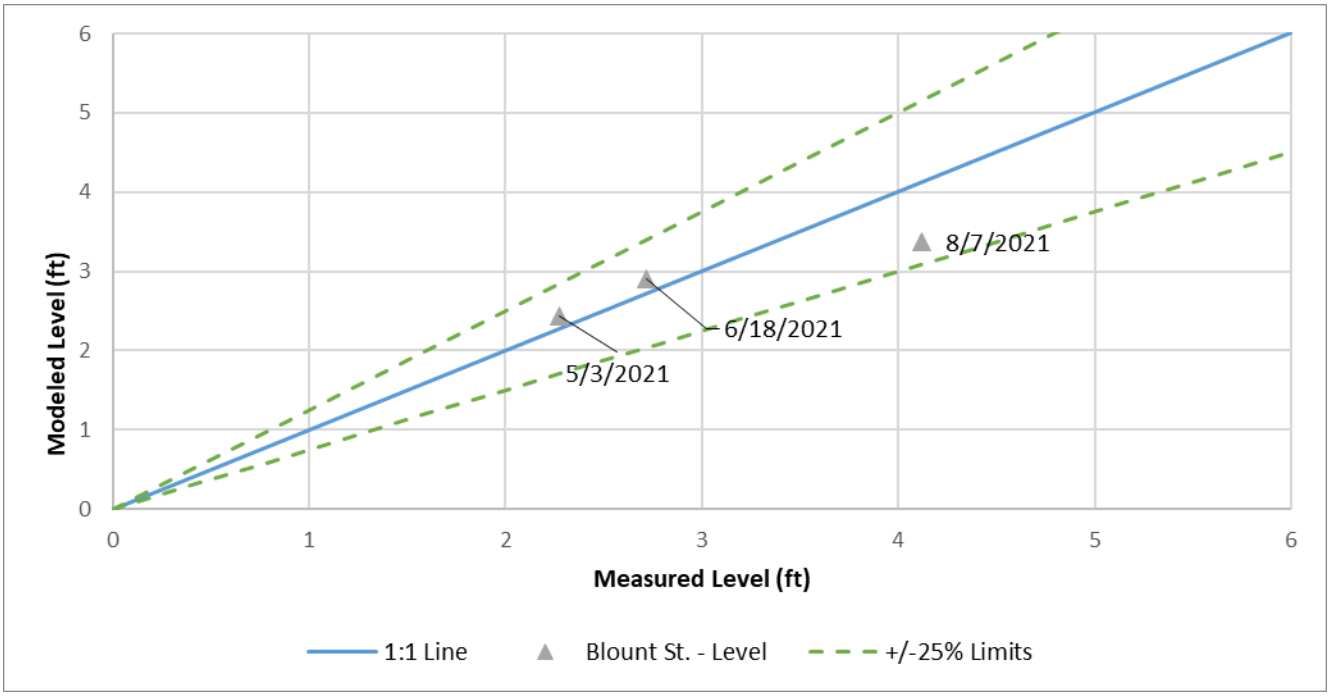
### 5.4.1 Blount Street

The Blount Street meter recorded level only and was greatly impacted by the Lake Monona water surface elevation because the meter elevation was similar to the lake's water surface elevation. The tributary area to the meter was 30 acres. The model overestimated depth at the site for two of the three storms; however, all three events were withing the +/- 25% tolerance.

Table 5-4. Blount Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Peak Level (feet) | 2.27 | 2.72 | 4.12 |
| Modeled Peak Level (feet) | 2.44 | 2.90 | 3.37 |
| Difference (%) | +7 | +7 | -18 |

Figure 5-2: Blount Street Level Calibration Plot



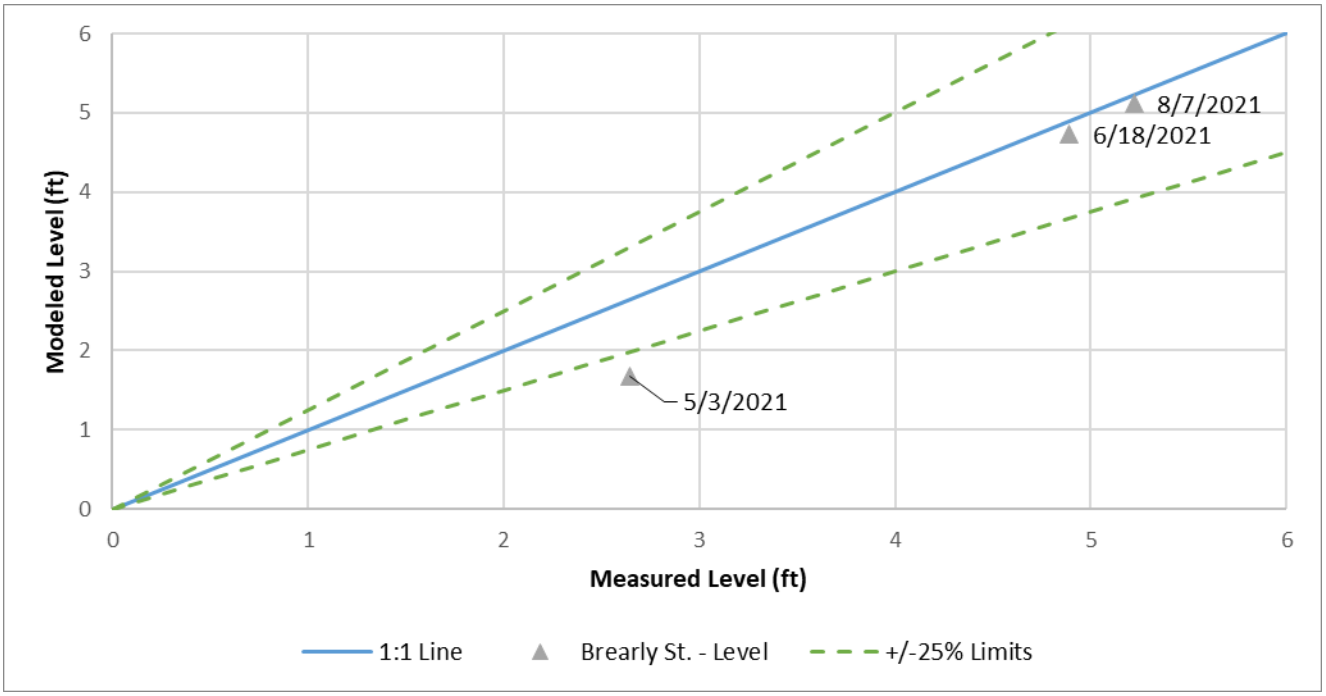
## 5.4.2 Brearly Street

The Brearly Street meter recorded level only and the tributary area to the meter was approximately 11 acres. During the May 3, 2021 event, the model underestimated depth at the site resulting in less projected flooding once the hydraulic grade line reaches the ground surface. The model results had a similar shape as the metered results however the peak depth was lower in the modeled results.

Table 5-5. Brearly Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Peak Level (feet) | 2.64 | 4.89 | 5.22 |
| Modeled Peak Level (feet) | 1.68 | 4.73 | 5.12 |
| Difference (%) | -36 | -3 | -2 |

Figure 5-3: Brearly Street Level Calibration Plot



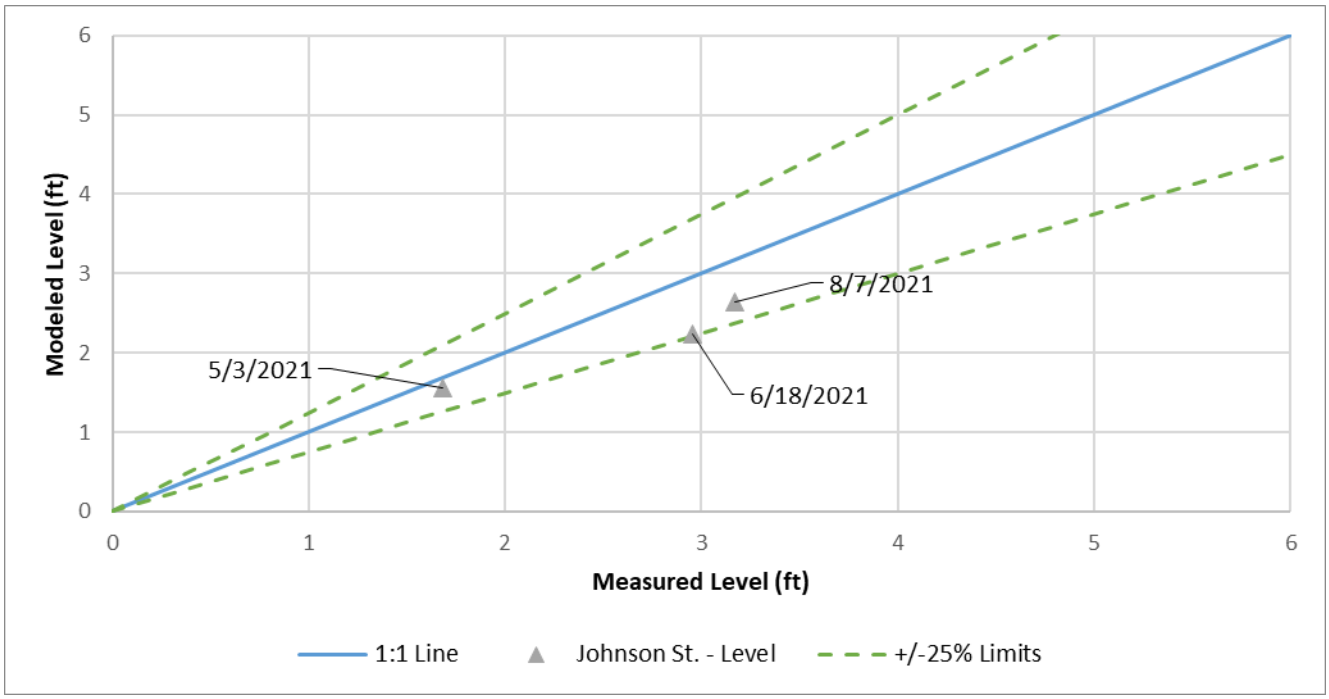
### 5.4.3 Johnson Street

The Johnson Street meter recorded level only and had a tributary area of approximately 55 acres. The model underestimated depth at the site but the modeled and measured levels were all within the calibration tolerances.

Table 5-6. Johnson Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Peak Level (feet) | 1.68 | 2.96 | 3.17 |
| Modeled Peak Level (feet) | 1.56 | 2.24 | 2.64 |
| Difference (%) | -7 | -24 | -17 |

Figure 5-4: Johnson Street Level Calibration Plot




### 5.4.4 East Main Street

Both velocity and depth were recorded at the East Main Street meter and were used to calculate a measured flow rate and volume. The tributary area to the meter is 26 acres.

The data collected for the May 3 event was difficult to calibrate as the rain gage assigned to most of the tributary area, Olbrich Park, did not log this event. For the June 18 and August 7 events, the depth at the monitoring location was tied closely to the Yahara River level as was well calibrated. However, only the June 18 event provided quality volume and flow rate data for calibration because the flow rates and volume measured during the August 7 storms were unrealistically low for the contributing drainage area and the amount of rainfall received. No level of calibration was able to match all three events.

Table 5-7. East Main Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Volume (cubic feet) | 54,700 | 42,000 | 5,700 |
| Modeled Volume (cubic feet)* | 27,500 | 58,400 | 41,000 |
| Difference (%) | -50 | +39 | +619 |
| | | | |
| Measured Peak Flow Rate (cfs) | 10.97 | 9.48 | 4.44 |
| Modeled Peak Flow Rate (cfs) | 6.7 | 8.79 | 13.61 |
| Difference (%) | -39 | -7 | +206 |
| | | | |
| Measured Peak Level (feet) | 1.52 | 1.93 | 2.05 |
| Modeled Peak Level (feet) | 1.08 | 2.08 | 2.08 |
| Difference (%) | -29 | +8 | +2 |

**Modeled volumes do not include volume past the peak time of measured data*

Figure 5-5: East Main Street Volume Calibration Plot

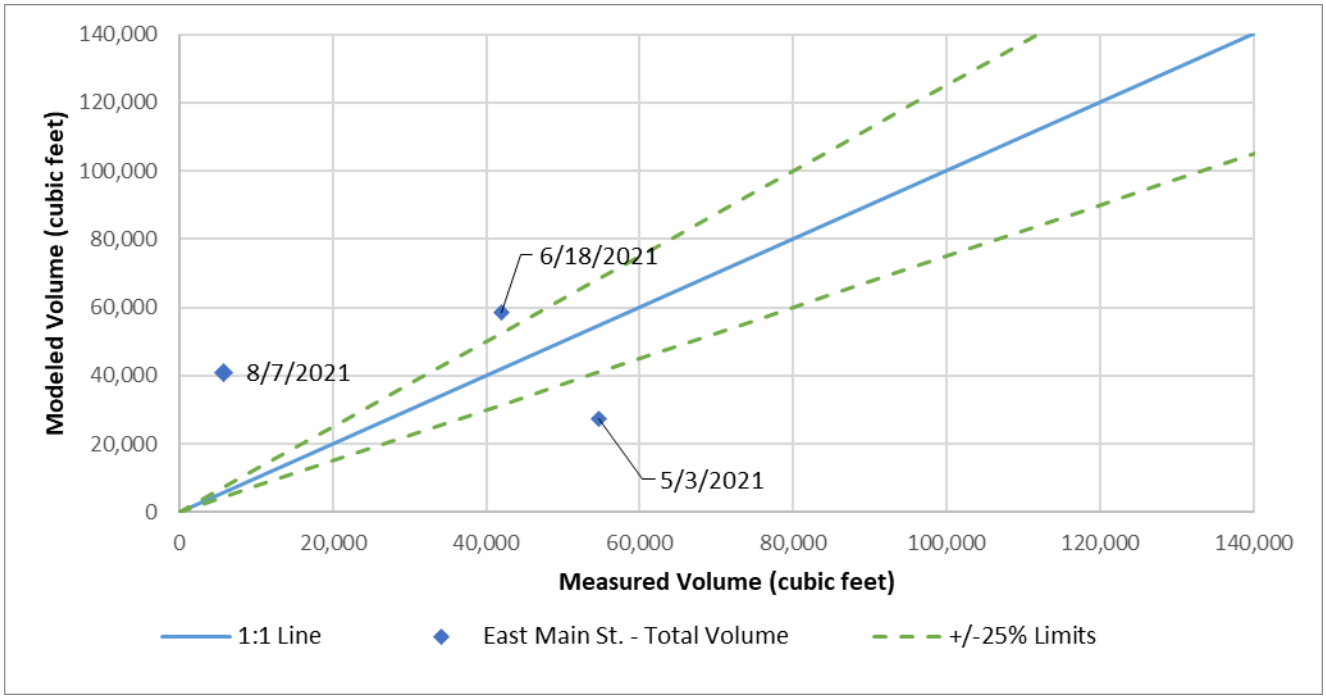


Figure 5-6: East Main Street Peak Flow Rate Calibration Plot

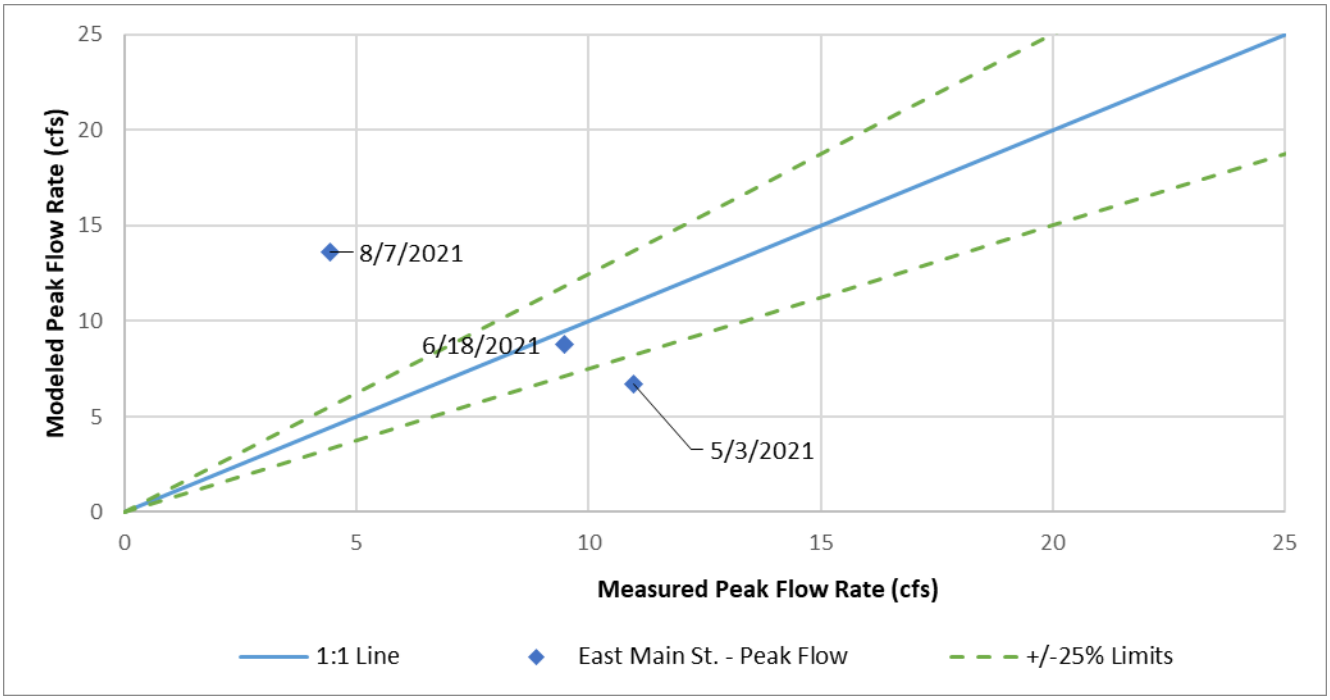
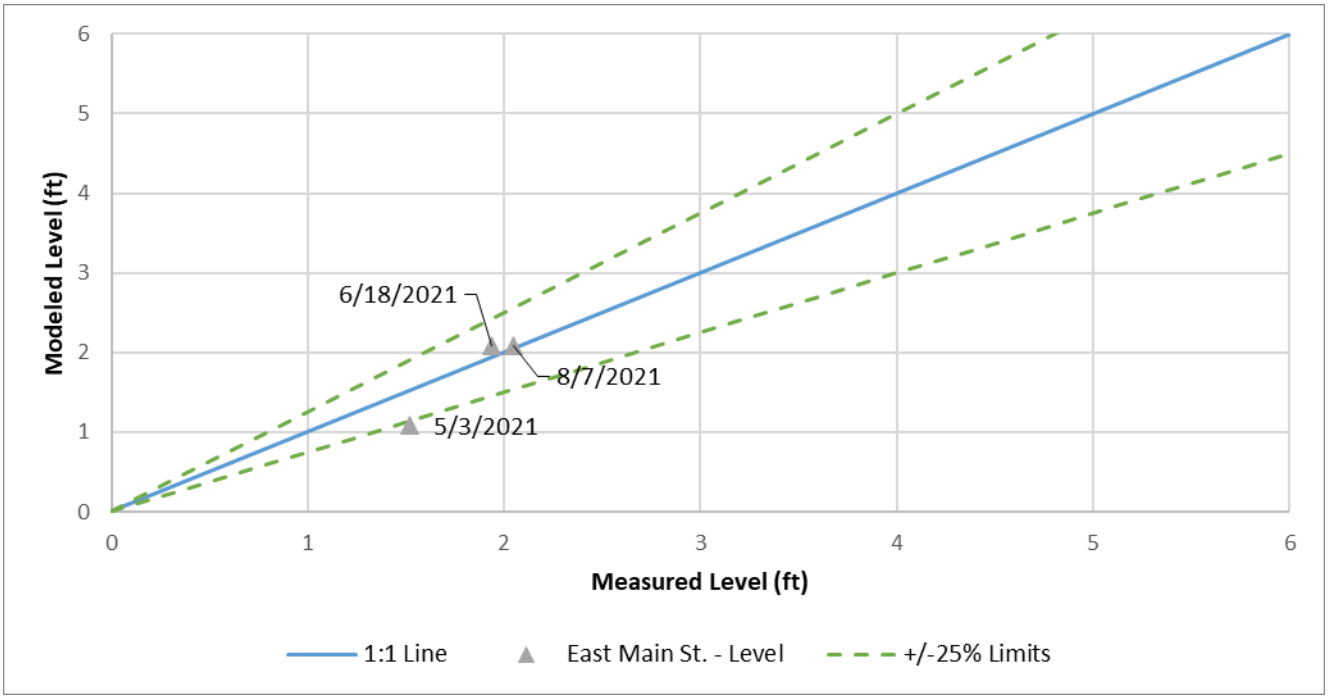



Figure 5-7: East Main Street Level Calibration Plot



### 5.4.5 North Sixth Street

Both velocity and depth were recorded at the North Sixth Street meter and were used to calculate a measured flow rate and volume. The tributary area to the meter is 22 acres.

The August 7 storm was calibrated within the acceptable tolerances for the volume, flow rate, and level. Two of the three storm events were calibrated within the acceptable tolerances for volume and level. No level of calibration was able to match all three events.

Table 5-8. North Sixth Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Volume (cubic feet) | 5,700 | 13,700 | 37,300 |
| Modeled Volume (cubic feet) * | 4,200 | 13,800 | 31,800 |
| Difference (%) | -26 | +1 | -15 |
| | | | |
| Measured Peak Flow Rate (cfs) | 10.26 | 13.28 | 20.23 |
| Modeled Peak Flow Rate (cfs) | 6.19 | 19.30 | 19.55 |
| Difference (%) | -40 | 45 | -3 |
| | | | |
| Measured Peak Level (feet) | 1.48 | 3.54 | 2.24 |
| Modeled Peak Level (feet) | 1.42 | 2.16 | 2.20 |
| Difference (%) | -4 | -39 | -2 |

**Modeled volumes do not include volume past the peak time of measured data*

Figure 5-8: North Sixth Street Volume Calibration Plot

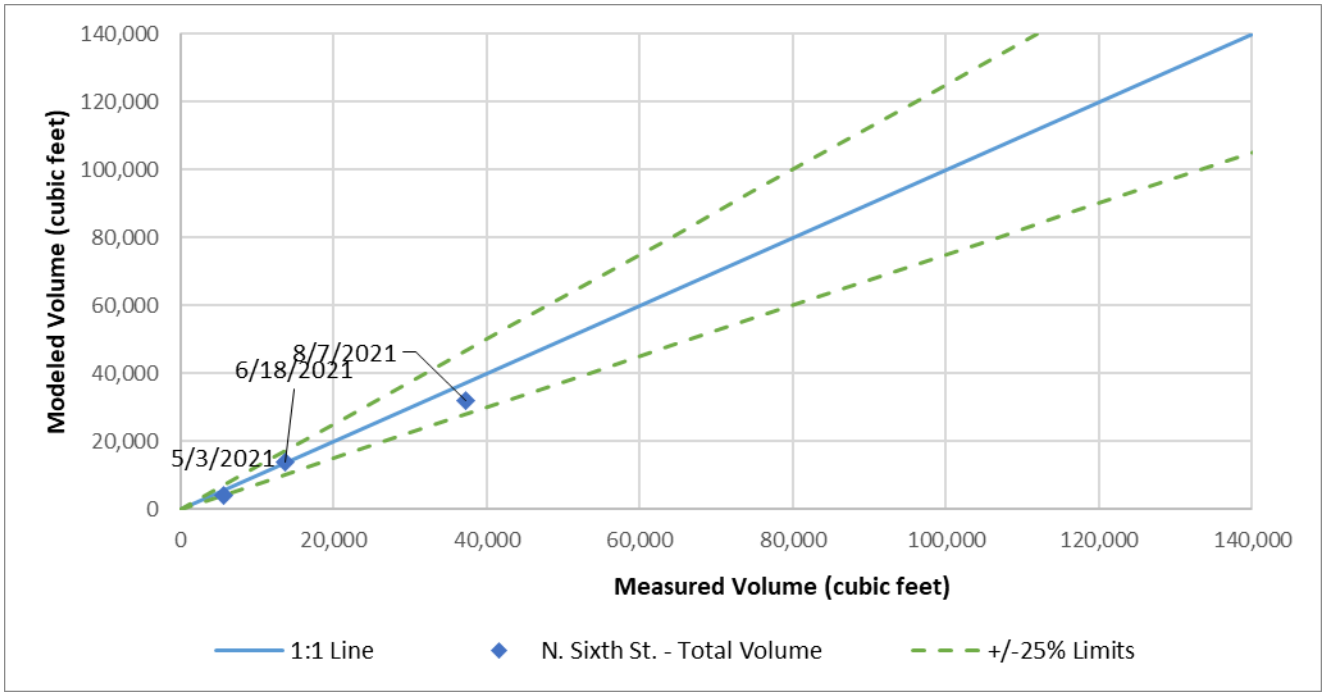



Figure 5-9: North Sixth Street Peak Flow Rate Calibration Plot

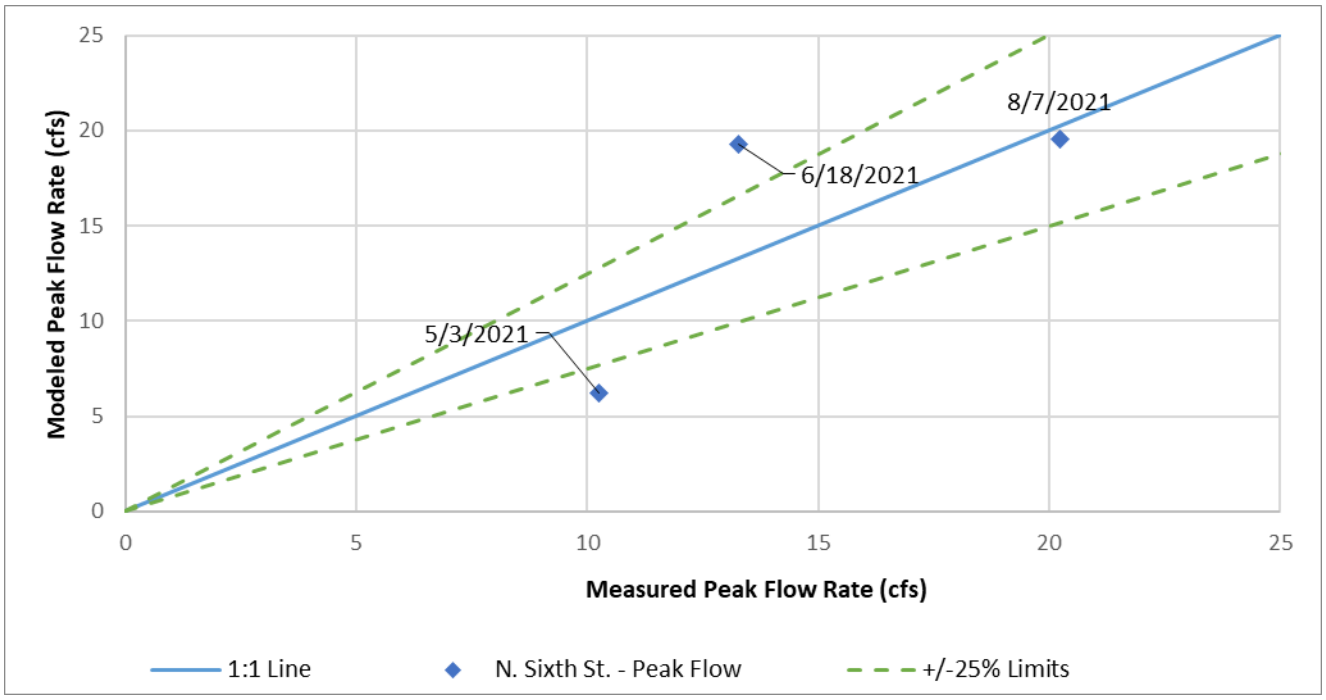
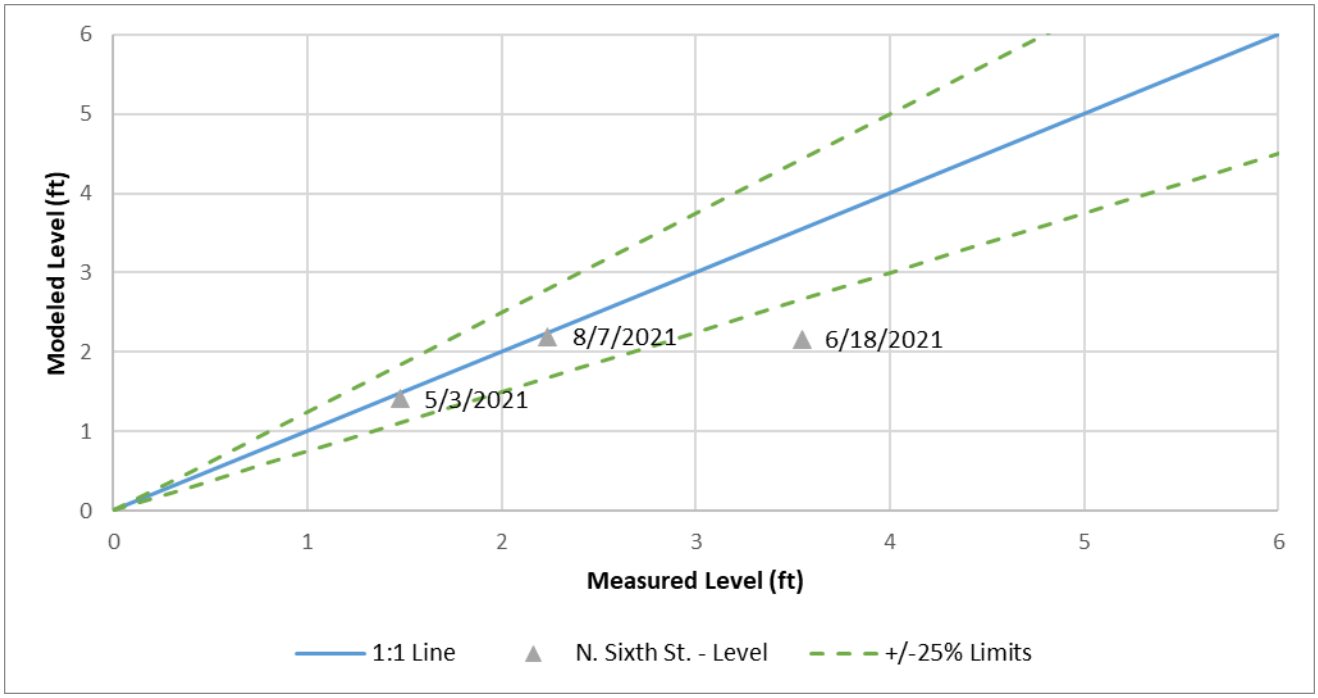


Figure 5-10: North Sixth Street Level Calibration Plot




## 5.5 CALIBRATION CONCLUSIONS

The North Sixth and East Main Street meters were used to define the hydrologic parameters of the watershed. The calibration for both locations resulted in a consistent subwatershed width, which nicely represented the typical width of a street. For the storm events that had quality measured data, the model calibration was within specified tolerances for volume, peak flow rate, and depth. The calibrated hydrology was applied to the un-metered areas of the watershed.

At the three monitoring locations with levels, the shape of the model outputs is very similar to the monitoring results. The modeled depths are typically within 25% of the measured depths for at least two of the three storms at every level location.

TETRA TECH

# Memo

| | |
|---|---|
| ***To:*** | Jojo O'Brien, Alaina Baker (City of Madison) |
| ***From:*** | Dan Christian; Justin Voss (Tetra Tech) |
| ***Date:*** | March 10, 2023 |
| ***Subject:*** | East Isthmus Calibration Review |

Flow monitoring within the East Isthmus and Yahara River watershed was conducted in 2020 and 2021. The flow monitoring included three level sensors and two depth-velocity meters. Tetra Tech completed the model calibration in 2021 after the end of flow monitoring. Since the model was calibrated, several changes have been made to the model, including:

- Upgrading XPSWMM to version 2021.3 to avoid a bug in the software that prevented batch simulations.
- Simulating manhole entrance and exit losses in the conduit factors dialog.
- Making changes along the Yahara River to reduce model instability.

The purpose of this memorandum is to summarize the impacts of the changes on the original model calibration.

While the precise peak flow rates, volumes, and levels changed somewhat from the initial calibration, the calibration overall is very similar to what it was previously. Additional calibration details will be presented in the Watershed Study Existing Conditions Report.

Given the limited data set for calibration, an upper and lower bound of 25 percent was identified as a calibration tolerance. At least two of the three events had to fall within this calibration tolerance.

**Tetra Tech**
3497 Coolidge Road, East Lansing, Michigan 48823
**Tel** +1.517.316.3940 | tetratech.com

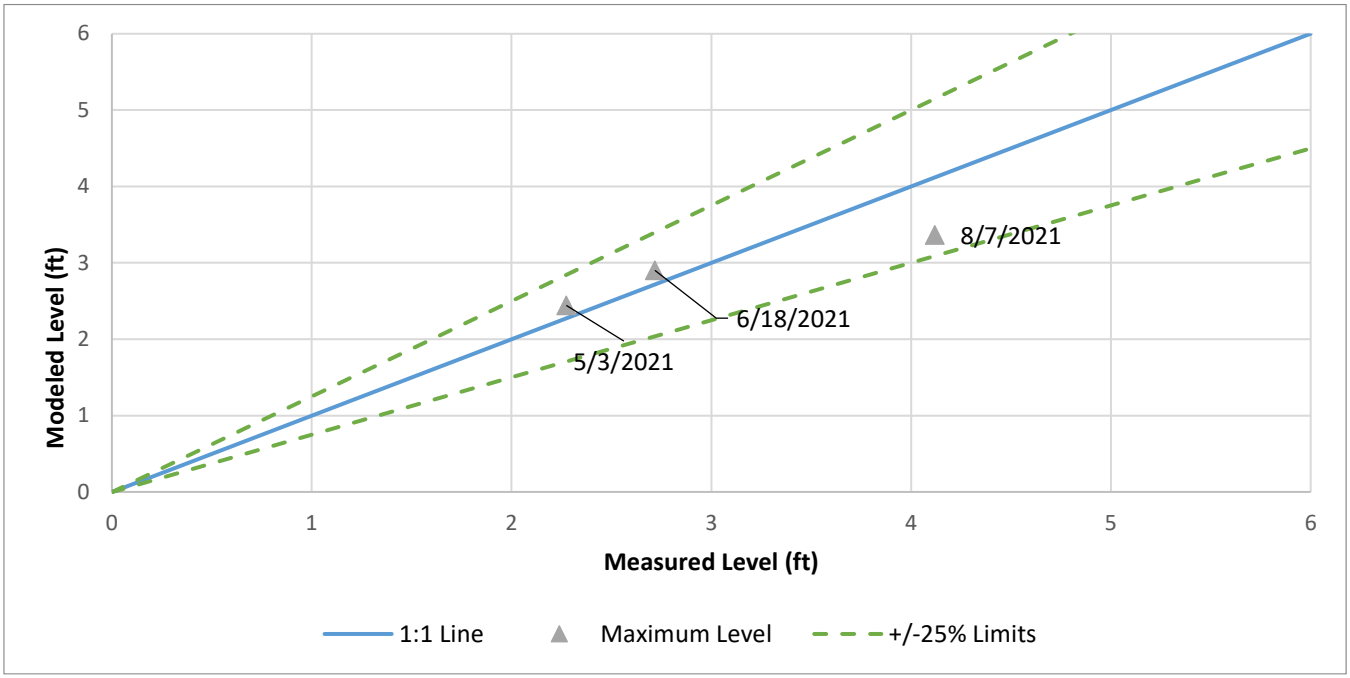
# 1.0 BLOUNT STREET LEVEL SENSOR

The changes to the model, likely primarily the additional entrance and exit losses, moved the model from slightly underestimating the measured levels to slightly overestimating the levels, on average. The model calibration is within the acceptable tolerances. Table 1-1 and Figure 1-1 summarize the model calibration results.

Table 1-1. Blount Street Level Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Peak Level (feet) | 2.27 | 2.72 | 4.12 |
| Modeled Peak Level (feet) | 2.44 | 2.90 | 3.37 |
| Difference | +7% | +7% | -18% |

Figure 1-1: Blount Street Level Calibration Plot



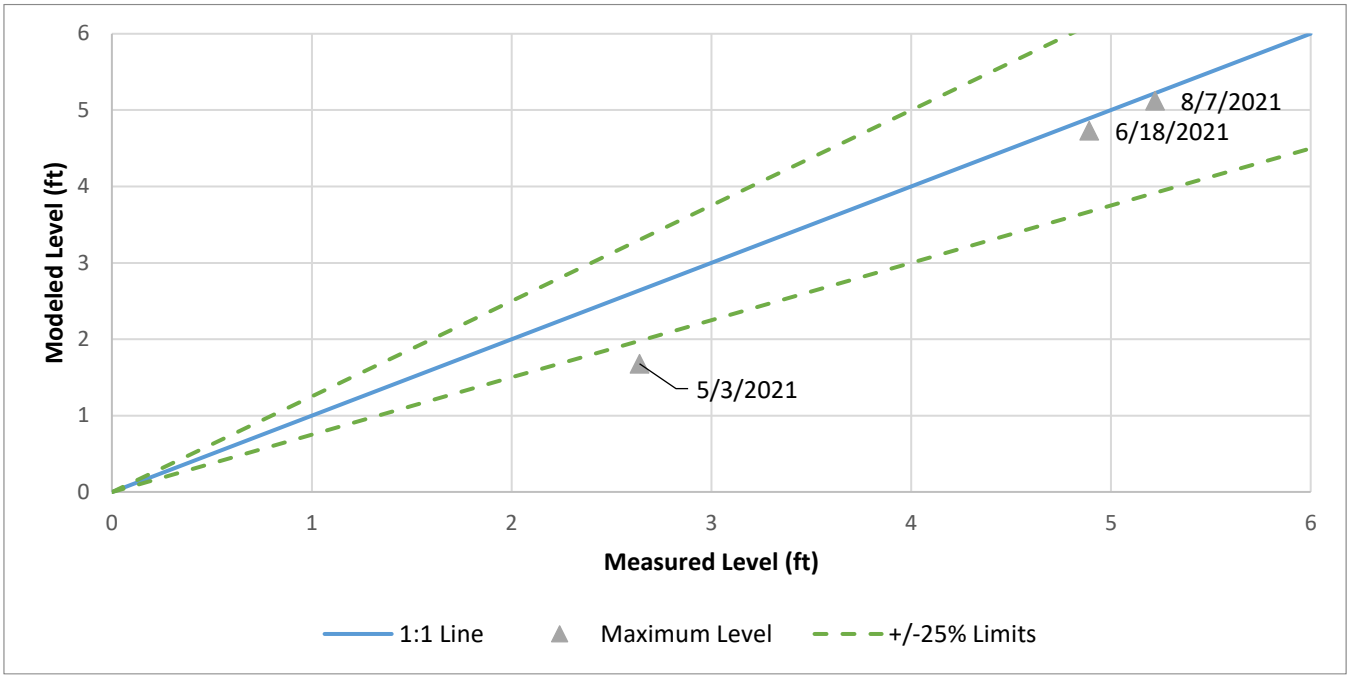
## 2.0 BREARLY STREET LEVEL SENSOR

The changes to the model did not substantially impact the June 18 or August 7 model results, but the modeled level decreased for the May 3 event. The model calibration is within the acceptable tolerances. Table 2-1 and Figure 2-1 summarize the model calibration results.

Table 2-1. Brearly Street Level Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Peak Level (feet) | 2.64 | 4.89 | 5.22 |
| Modeled Peak Level (feet) | 1.68 | 4.73 | 5.12 |
| Difference | -36% | -3% | -2% |

Figure 2-1: Brearly Street Level Calibration Plot



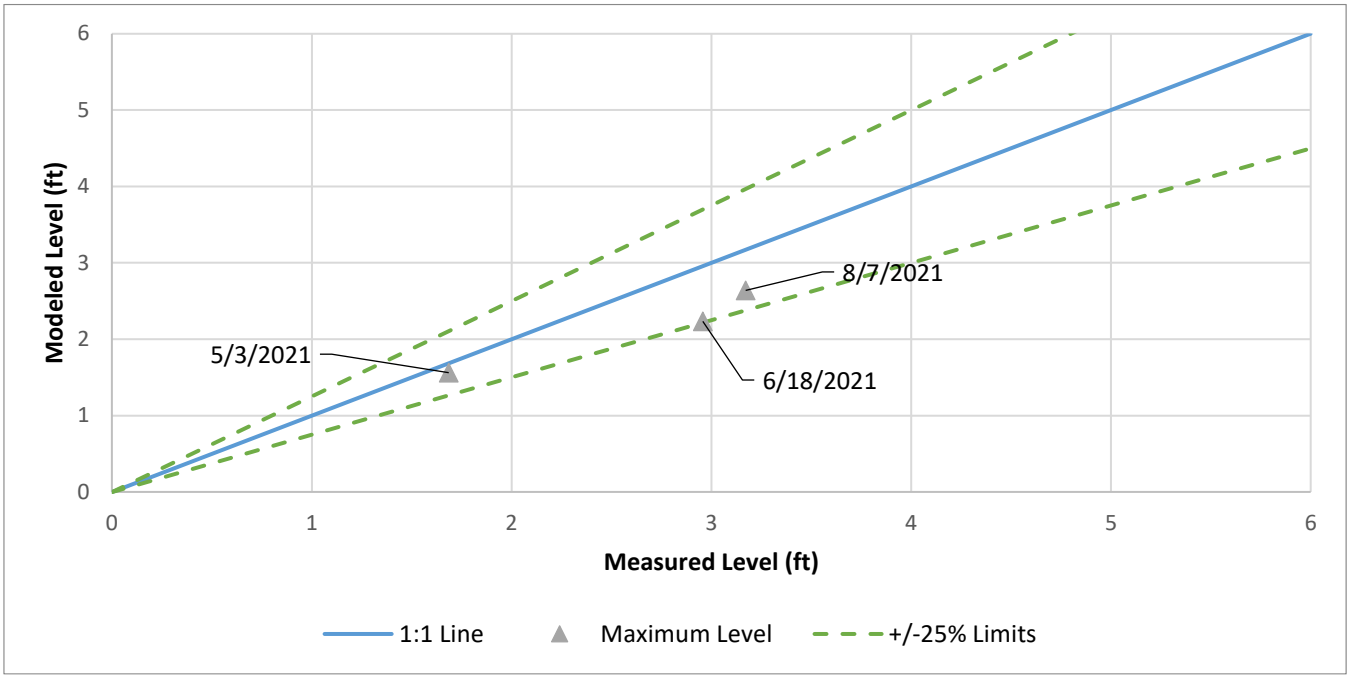
# 3.0 JOHNSON STREET LEVEL SENSOR

The model underestimates depth at the Johnston Street monitoring location, which is the same as before. The modeled levels are lower than before but still within the acceptable tolerances. Table 3-1 and Figure 3-1 summarize the model calibration results.

Table 3-1. Johnson Street Level Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Peak Level (feet) | 1.68 | 2.96 | 3.17 |
| Modeled Peak Level (feet) | 1.56 | 2.24 | 2.64 |
| Difference | -7% | -24% | -17% |

Figure 3-1: Johnson Street Level Calibration Plot



# 4.0 E. MAIN STREET FLOW METER

Previously, the model generally overestimated the measured peak flow rate and volume at the E. Main Street flow meter and matched the level closely. The model now predicts a more neutral volume and peak flow rate relative to the measure data (i.e. points are more evenly over and underestimating the calibration parameters), but the points are generally outside the 25 percent tolerance. Given that the model overestimates some calibration points and underestimates others, the peak flow rate and volume calibration is more balanced than before, but there is still limited confidence in the calibration, in part due to the limitations of the monitoring data, particularly the peak flow and volume data. The level was not impacted by the changes to the model. Table 4-1 summarizes the model calibration results. Figure 4-1, Figure 4-2, and Figure 4-3 show the measured and modeled volume, peak flow rate, and level.

Table 4-1. E. Main Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Volume (cubic feet) | 54,700 | 42,000 | 5,700 |
| Modeled Volume (cubic feet) | 27,500 | 58,400 | 41,000 |
| Difference | -50% | +39% | +619% |
| | | | |
| Measured Peak Flow Rate (cfs) | 10.97 | 9.48 | 4.44 |
| Modeled Peak Flow Rate (cfs) | 6.70 | 8.79 | 13.61 |
| Difference | -39% | -7% | +206% |
| | | | |
| Measured Peak Level (feet) | 1.52 | 1.93 | 2.05 |
| Modeled Peak Level (feet) | 1.08 | 2.08 | 2.08 |
| Difference | -29% | 8% | 2% |

Figure 4-1: E. Main Street Volume Calibration Plot

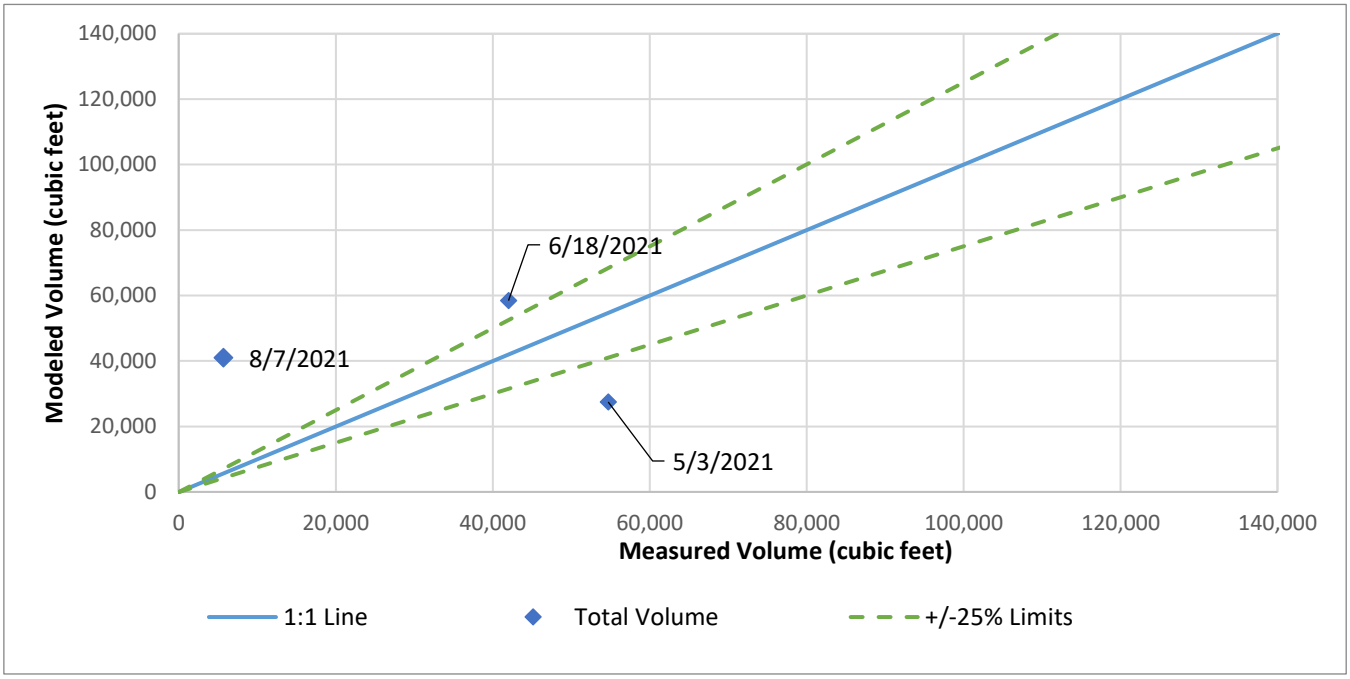



Figure 4-2: E. Main Street Peak Flow Rate Calibration Plot

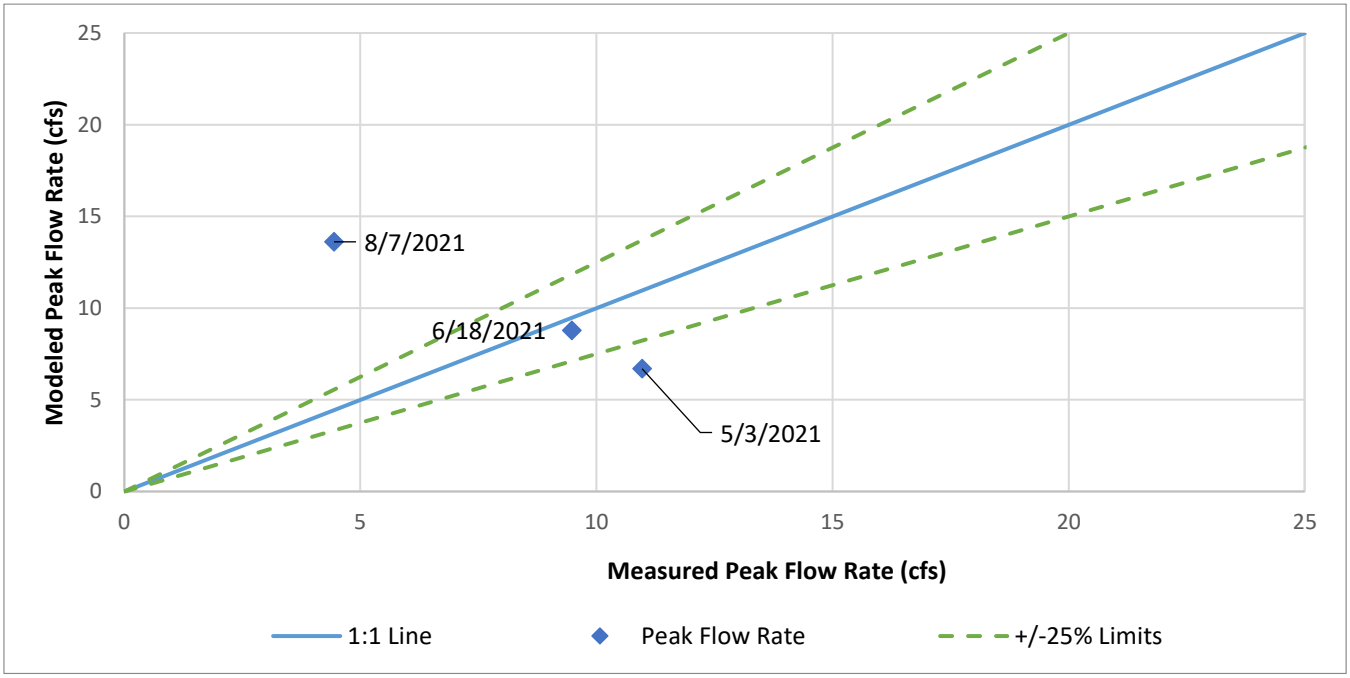
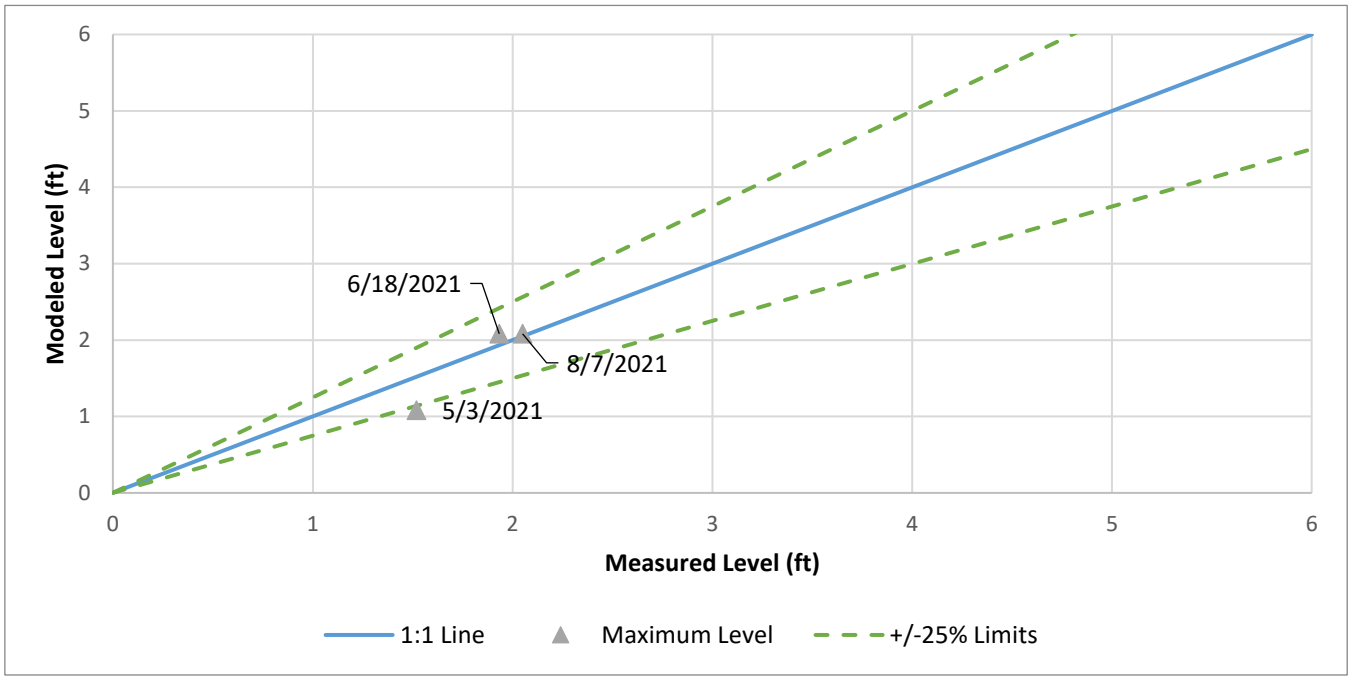


Figure 4-3: E. Main Street Level Calibration Plot



# 5.0 N. SIXTH STREET FLOW METER

The N. Sixth Street flow meter dropped out immediately after the peak of the storm during the events, so the volume calibration was only evaluated up to the peak of the event and there is limited confidence in the tail event. Since there are no detention practices expected to evaluated in the East Isthmus and Yahara River watershed, the volume in the tail of the hydrology likely will not impact the flood evaluations or flooding mitigation solutions.

The changes to the model improved the volume calibration and brought them within the calibration tolerances but created more spread in the peak flow calibration. Even though there is more spread in the peak flow calibration the model predictions are approximately evenly over and underestimated the measured data for the three events. The modeled level is approximately the same as it was previously. Table 5-1 summarizes the model calibration results. Figure 5-1, Figure 5-2, and Figure 5-3 show the measured and modeled volume, peak flow rate, and level.

Table 5-1. N. Sixth Street Calibration Results

| | May 3, 2021 | June 18, 2021 | August 7, 2021 |
|---|---|---|---|
| Measured Volume (cubic feet)† | 5,700.00 | 13,700.00 | 37,300.00 |
| Modeled Volume (cubic feet)† | 4,200.00 | 13,800.00 | 31,800.00 |
| Difference | -26% | +1% | -15% |
| | | | |
| Measured Peak Flow Rate (cfs) | 10.26 | 13.28 | 20.23 |
| Modeled Peak Flow Rate (cfs) | 6.19 | 19.30 | 19.55 |
| Difference | -40% | +45% | -3% |
| | | | |
| Measured Peak Level (feet) | 1.48 | 3.54 | 2.24 |
| Modeled Peak Level (feet) | 1.42 | 2.16 | 2.20 |
| Difference | -4% | -39% | -2% |

† Comparison is only made up to the peak of the event.

Figure 5-1: N. Sixth Street Volume Calibration Plot

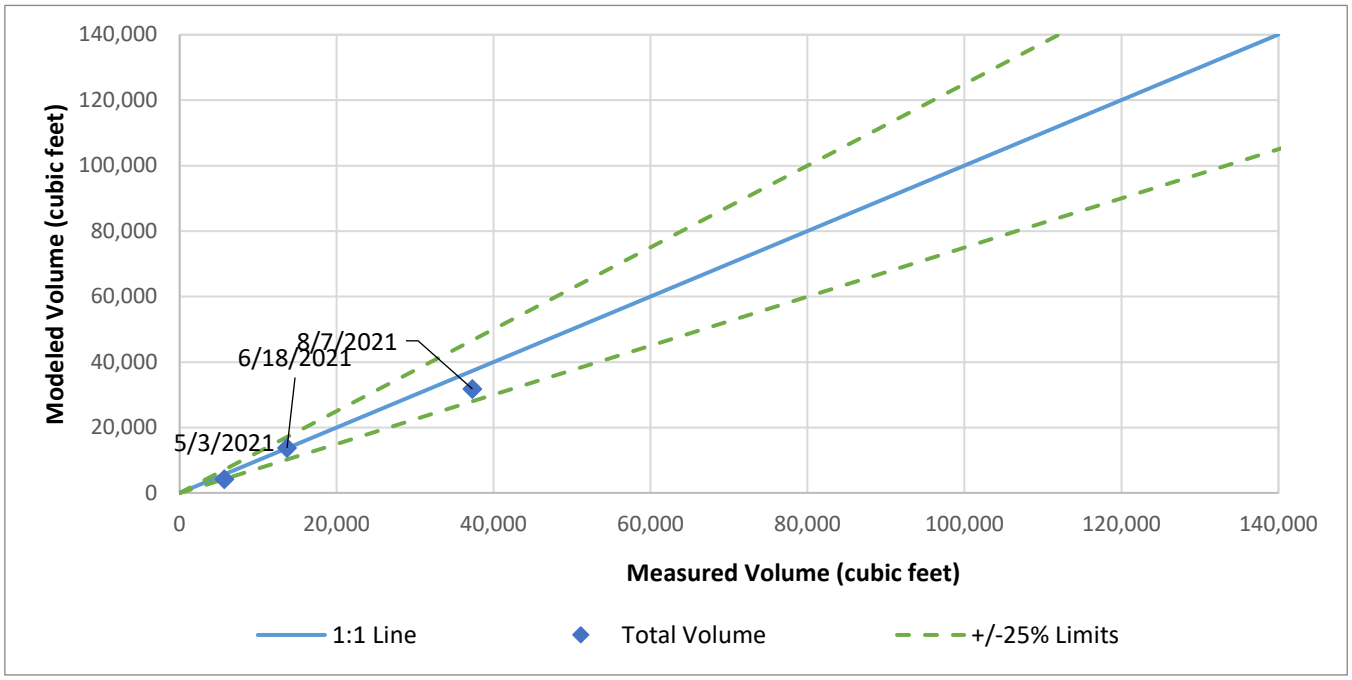



Figure 5-2: N. Sixth Street Peak Flow Rate Calibration Plot

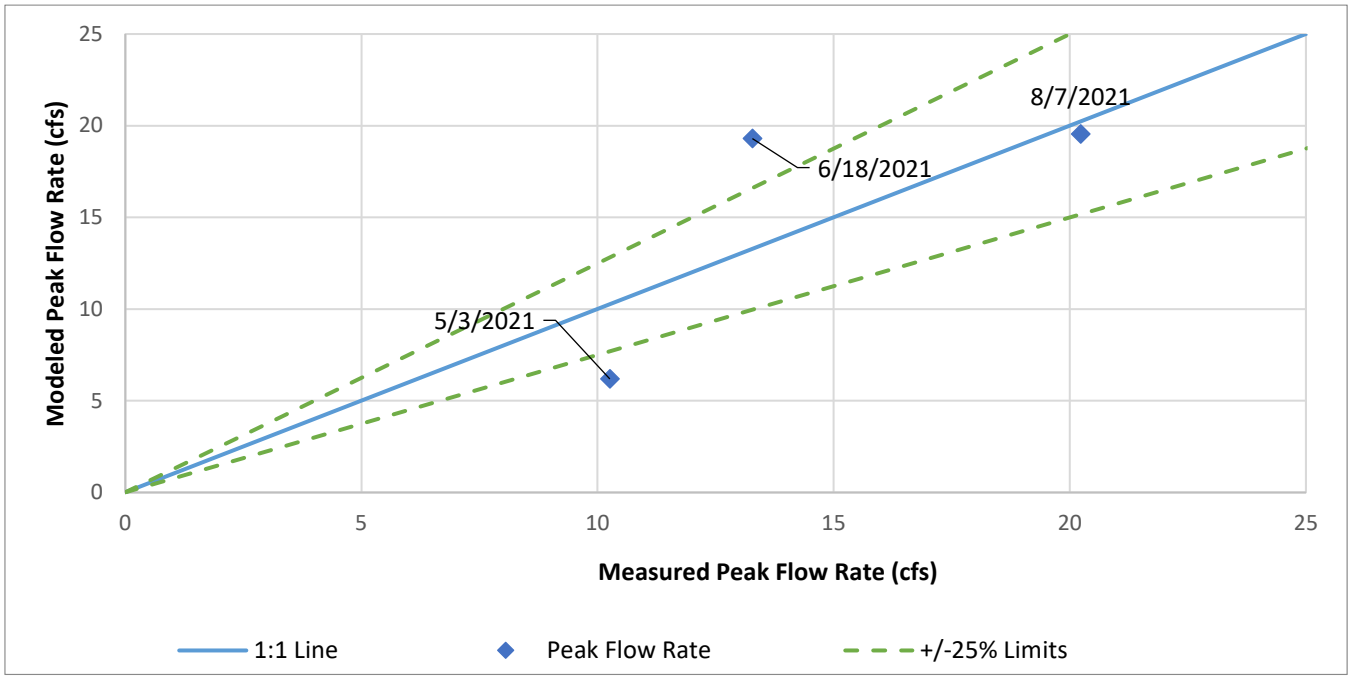


Figure 5-3: N. Sixth Street Level Calibration Plot

