

Unit 03:

Understanding Simulation Outputs

WEB-BASED FLOOD INUNDATION MODELING WITH DSS-WISE WEB

A SHORT COURSE ON RECENT UPDATES WITH HANDS-ON TRAINING



Developed by

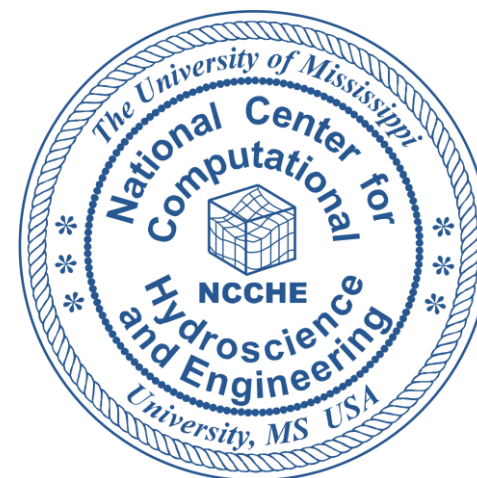
NATIONAL CENTER FOR COMPUTATIONAL
HYDROSCIENCE AND ENGINEERING
THE UNIVERSITY OF MISSISSIPPI

For

FEDERAL EMERGENCY
MANAGEMENT AGENCY



FEMA



Technical Workshop

September 3rd, 2026
Raleigh Convention Center
500 S. Salisbury Street, Raleigh, NC 27601

Agenda

Time	Topic
8:30 AM – 9:20 AM	Introduction/Overview of DSS-WISE Web
9:20 AM – 9:45 AM	Simulation scenario setup and data entry
9:45 AM – 9:55 AM	SHORT 10 MINUTE BREAK
9:55 AM – 10:20 AM	Understanding simulation outputs
10:20 AM – 11:20 AM	Hands-on exercises using the new system features
11:20 AM – 11:30 AM	SHORT 10 MINUTE BREAK
11:30 AM – 11:45 AM	Tips and Tricks/Advanced Techniques
11:45 AM – 12:15 PM	Current and Future Developments for DSS-WISE Web
12:15 PM – 12:30 PM	Questions / Discussion

Status & Results Page

Status & Results Page

Status & Results

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Portal

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Help

Nuttita Popphet

#76659 • VA15302

May 12, 2024 7:25:02 pm

Nuttita Popphet

UNITED STATES

Layers

Query Tool

Base Layers

Maps

Imagery

Elevation

Human Consequences: Finished

Simulation: Finished

Data Prep: Finished

Simulation Details

Downloads

Layers

Query Tool

Human Consequences: Finished

Simulation: Finished

Data Prep: Finished

Simulation Details

Downloads

Simulation Results Package

Human Consequences Results Package

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Download

Status & Results Page has three main sections: **Layers**, **Query Tool**, and **Simulation Status, Details, and Downloads**.

Layers

Query Tool

Simulation Status and Details

Downloads

Load this simulation as a new simulation in the Prep Tool

Links to download full or individual simulation results files

Status & Results Page: Layers

Status & Results Page: Layers

Layers tab has two sections:

- “**Base Layers**” provide Maps, Imagery and USGS Elevation.
- “**Overlay Layers**” include Data, Inputs, Simulation Results, and HCOM Results (if launched)

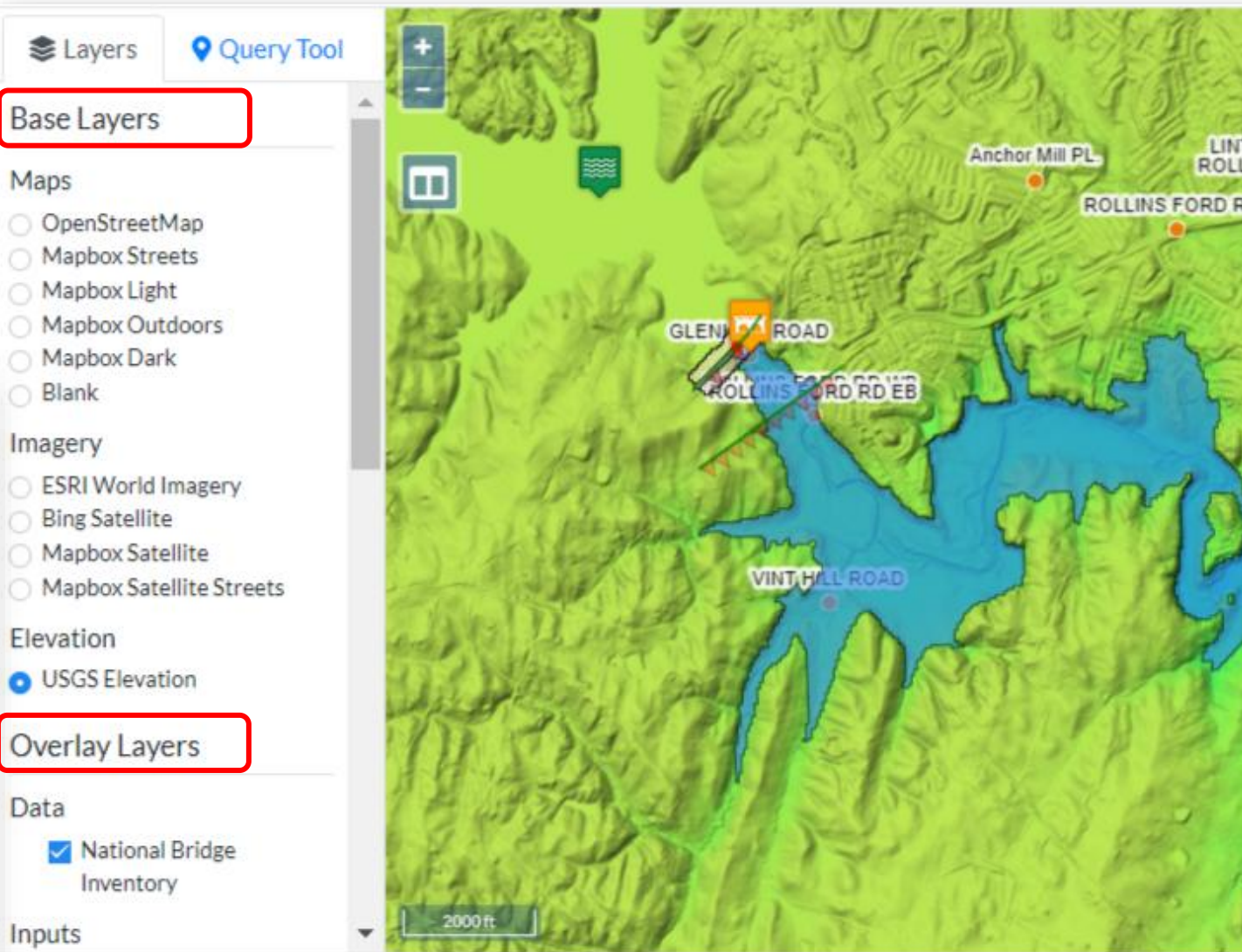
Overlay Layers

Data

- ☐ National Bridge Inventory

Inputs

- ☒ Observation Lines
☒ Bridge Points
☒ Breach Center
☒ Reservoir Point(s)
☒ Breached Width
☒ Impounding Structures
☒ Impounding Structure
Base Footprints
☐ Filled Reservoir(s)
☐ Simulation Domain Extent



Simulation Results

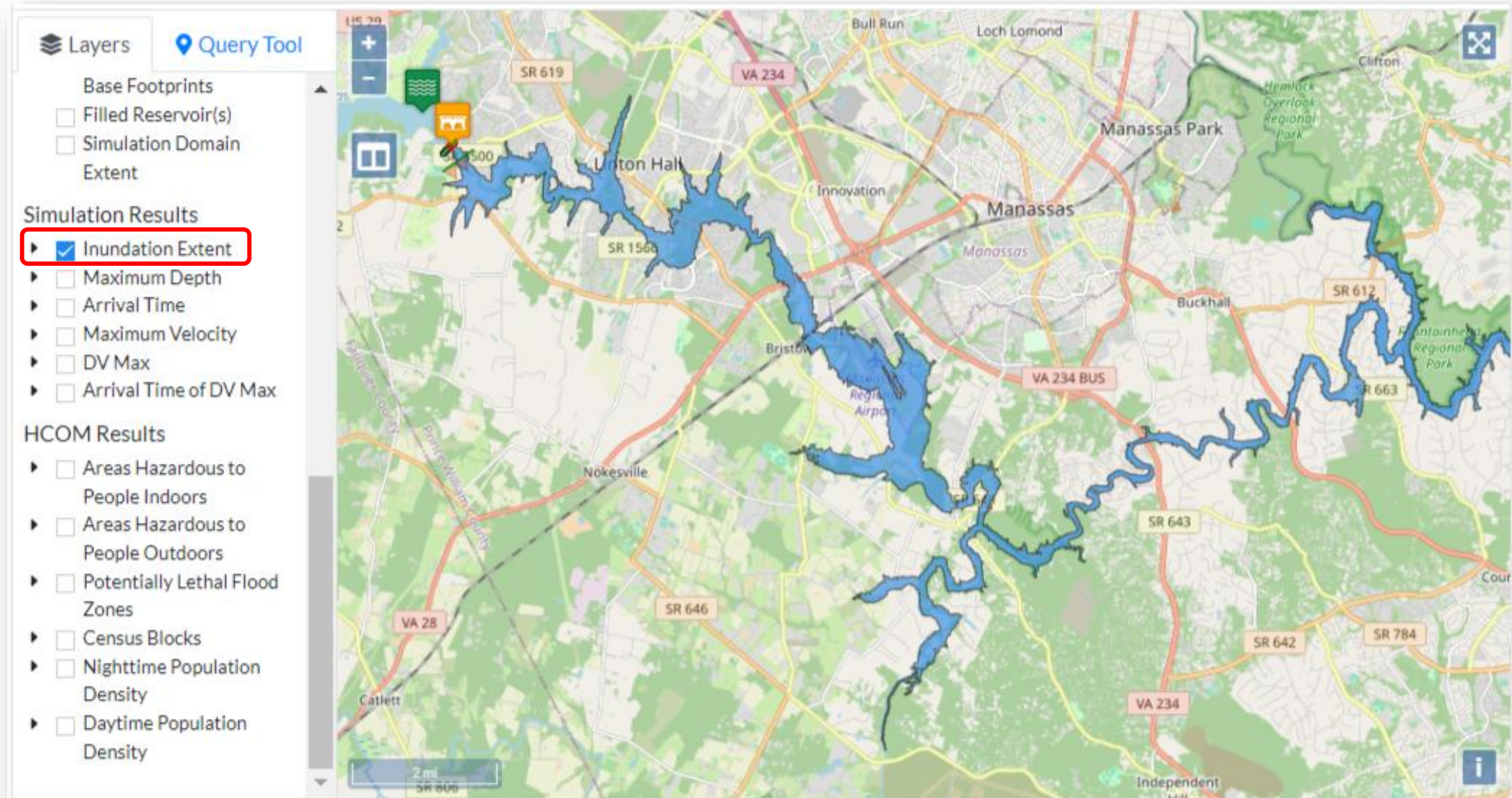
- ▶ ☒ Inundation Extent
- ▶ ☐ Maximum Depth
- ▶ ☐ Arrival Time
- ▶ ☐ Maximum Velocity
- ▶ ☐ DV Max
- ▶ ☐ Arrival Time of DV Max

HCOM Results

- ▶ ☐ Areas Hazardous to People Indoors
- ▶ ☐ Areas Hazardous to People Outdoors
- ▶ ☐ Potentially Lethal Flood Zones
- ▶ ☐ Census Blocks
- ▶ ☐ Nighttime Population Density
- ▶ ☐ Daytime Population Density

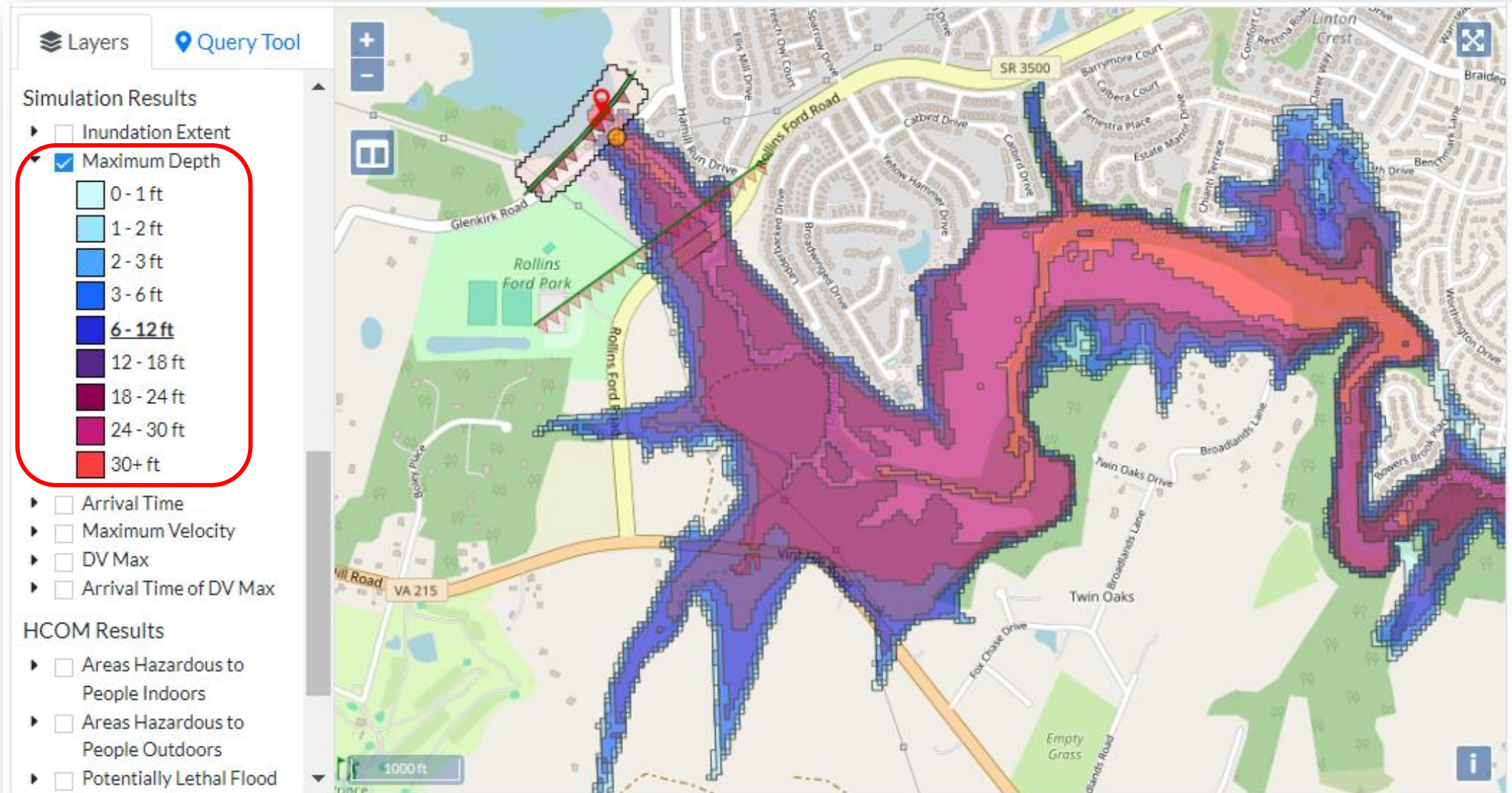
Simulation Results: Inundation Extent

The inundation extent layer has been displayed on the map.



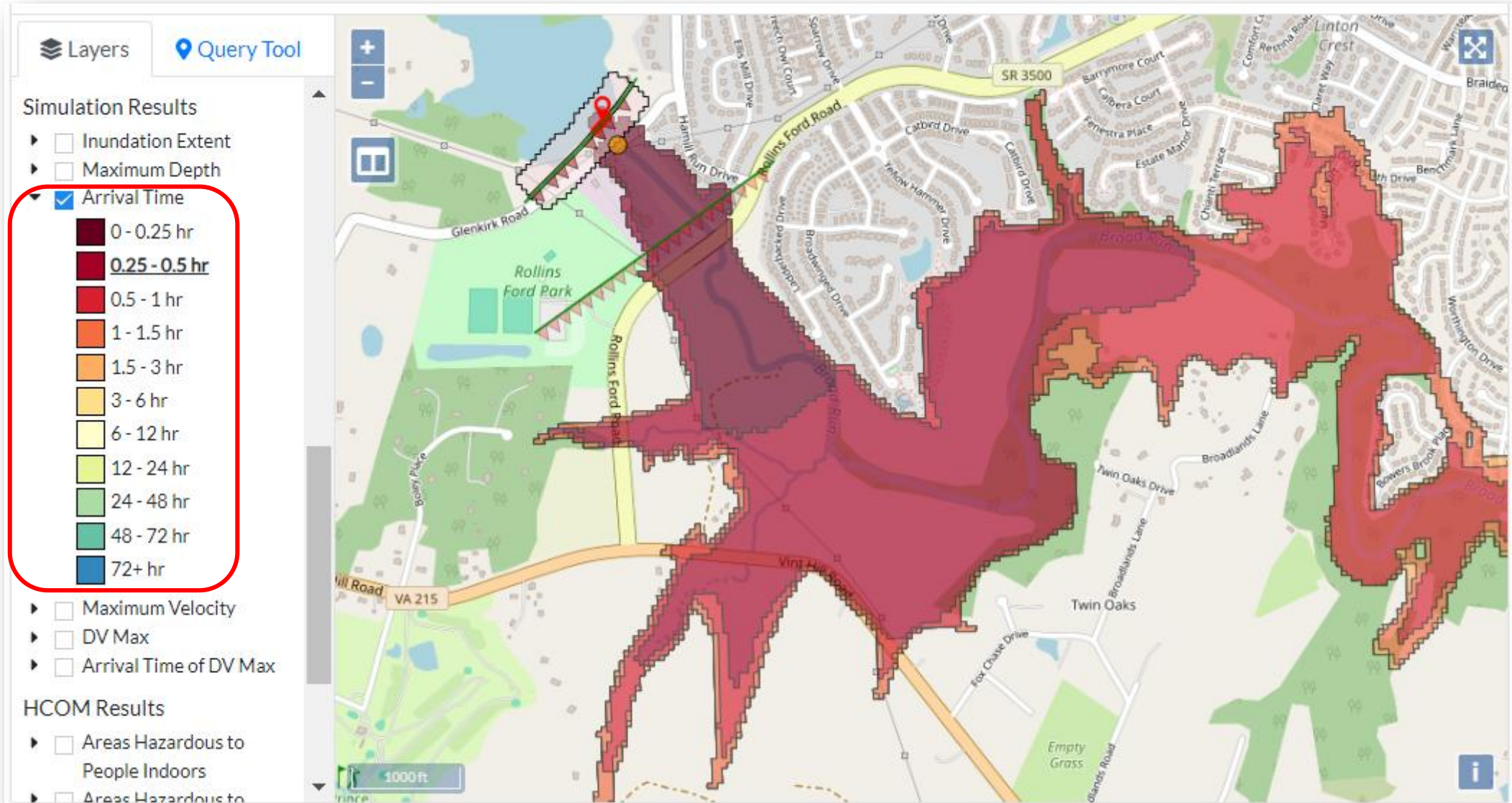
Simulation Results: Maximum Depth

The **maximum depth layer** has been displayed on the map.



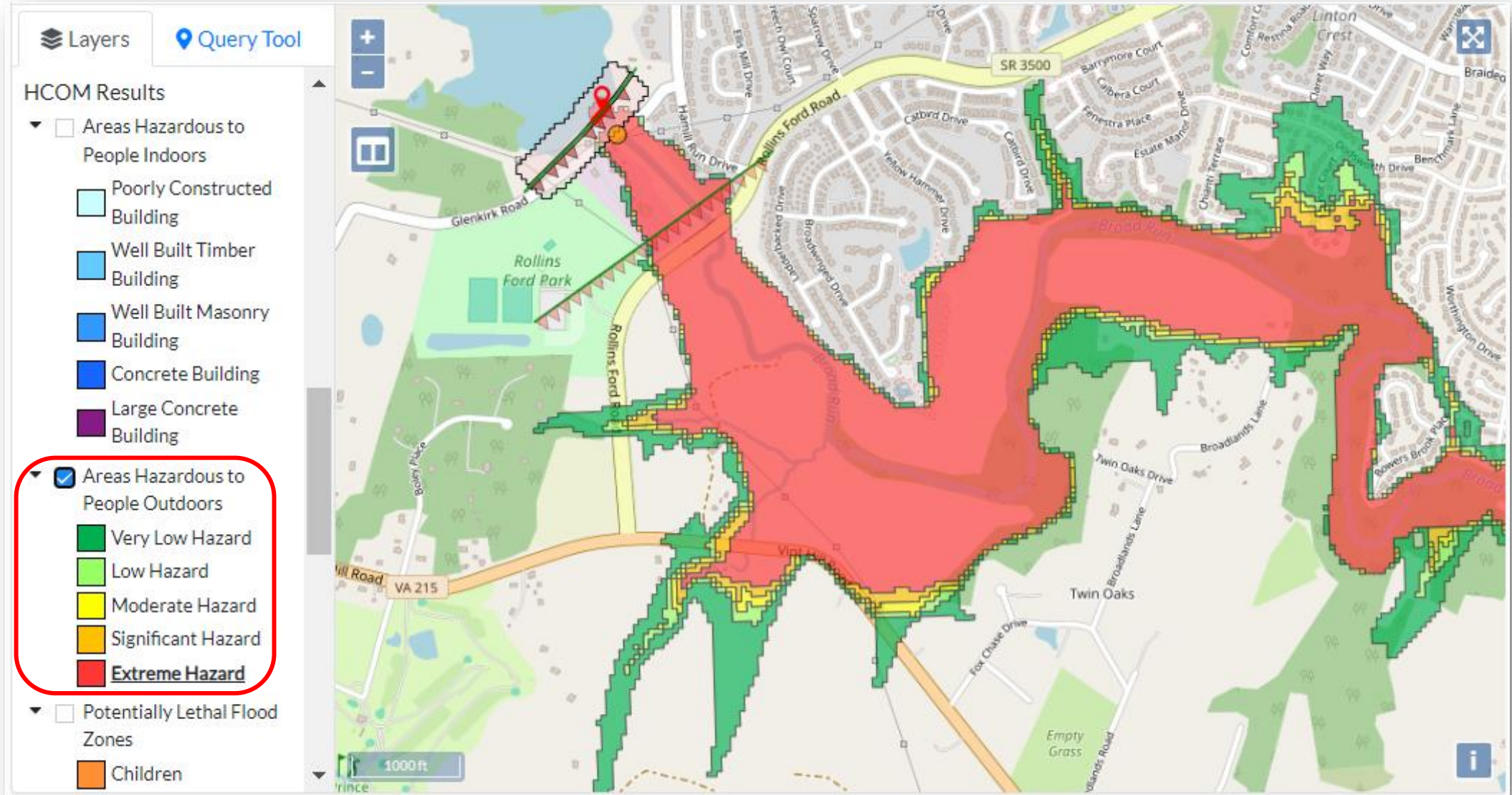
Simulation Results: Arrival Time

The arrival time layer has been displayed on the map.



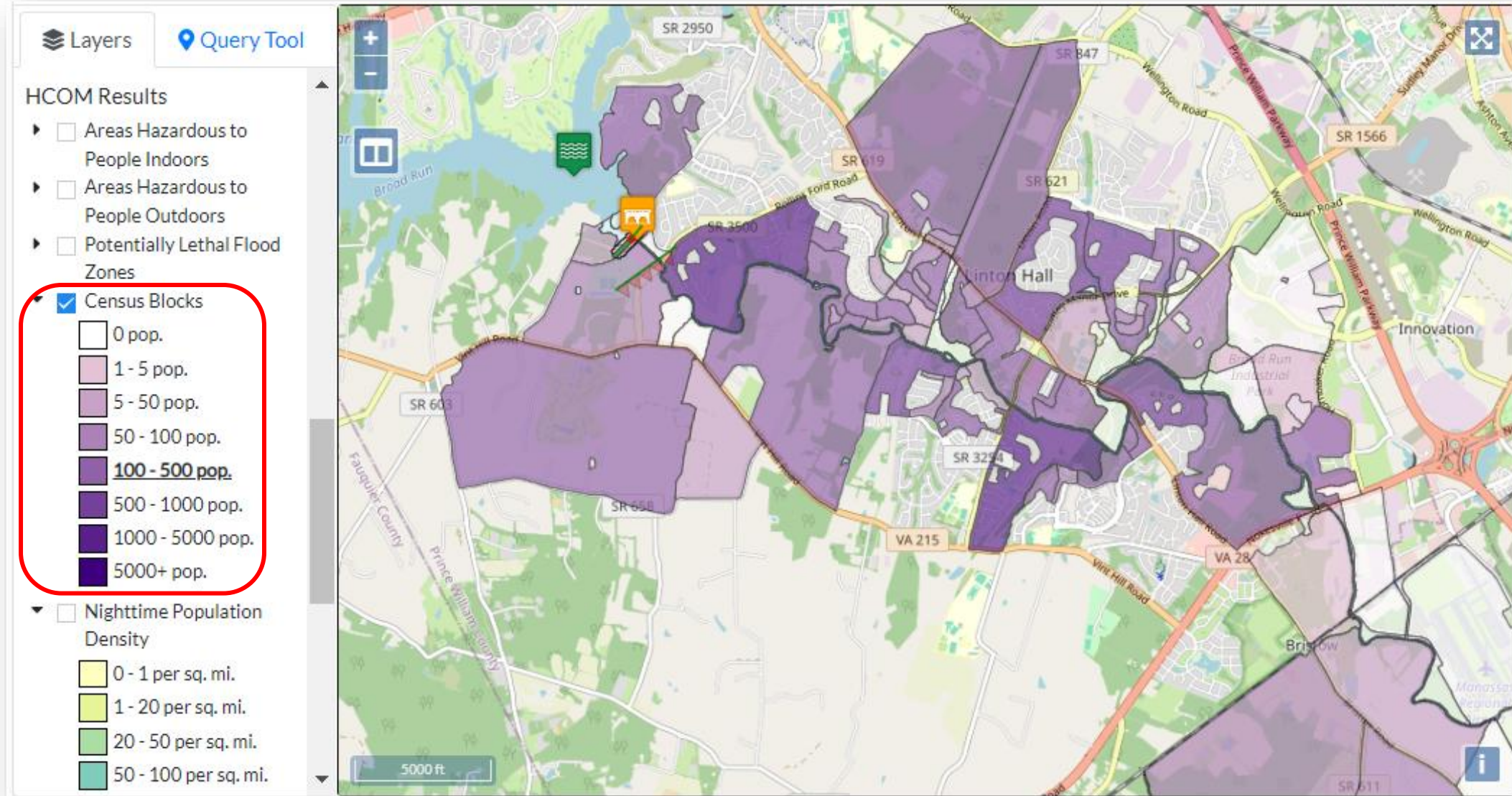
HCOM Results: Areas Hazardous to People Outdoors

The areas hazardous to people outdoors layer has been displayed on the map.



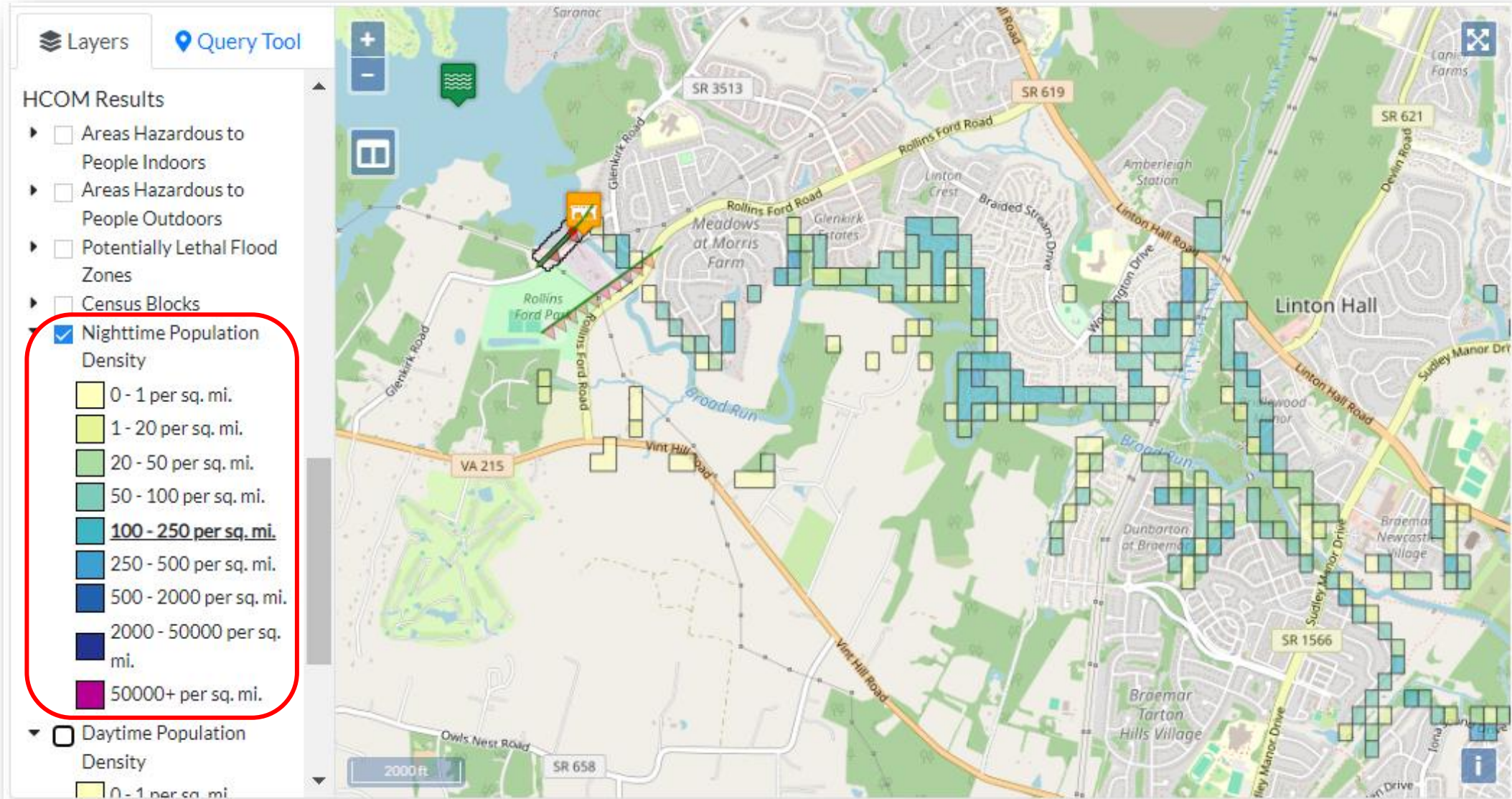
HCOM Results: Census Blocks

The census block layer has been displayed on the map.



HCOM Results: Nighttime Population Density

The nighttime population density has been displayed on the map.

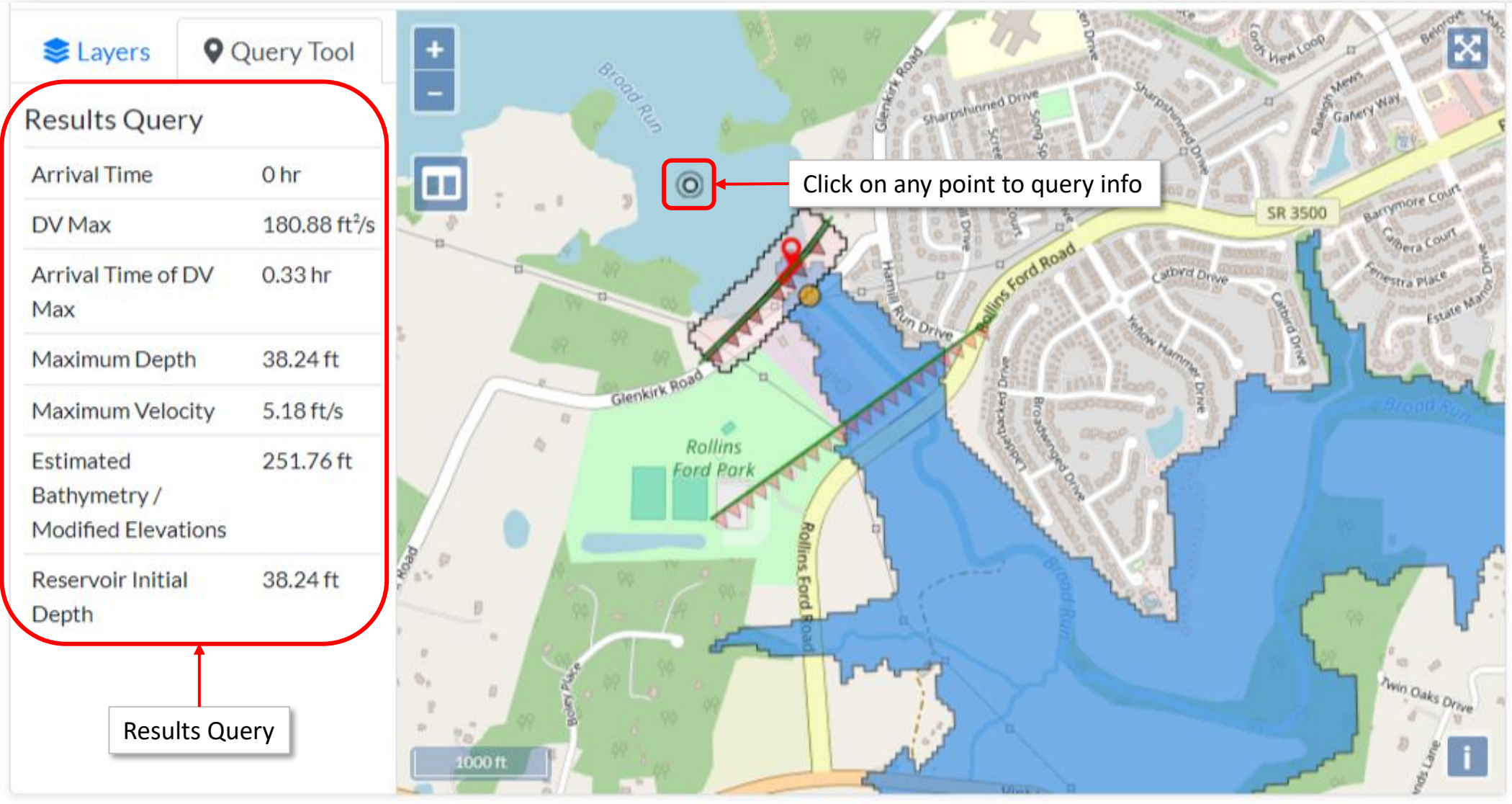


Status & Results Page: Query Tool

Query Tool



Query Tool



Status & Results Page:

Simulation Status, Details and Downloads

Simulation Status, Details, and Downloads

Human Consequences: Finished

May 07, 2024 0:37:47 pm 2 mins

Nighttime PAR: 2,028

Daytime PAR: 818

Inundated Area: 4,765 acres

Virginia counties: 3

Simulation: Finished

May 06, 2024 4:54:19 pm 4 mins

Distance Achieved

15.5 miles

Breaching Reservoir Vol.

99.9% Released

0.1% Remaining

Time Achieved

1 day

120,269 compute cells

Data Prep: Finished

May 06, 2024 4:53:30 pm less than a minute

Filled reservoir volume match:

1. Reservoir 1: 100%

Simulation Details

Project name

T. Nelson Elliott Dam

Scenario name

Partial Breach Sunny Day Failure

Scenario description

180 ft breach Reservoir at Max Pool

This simulation was created from #26469

Scenario Properties

Cell size: 45 ft

Breach type: Partial breach

Breach width: 180 ft

Breach formation time: 0.3 hr

Breach invert elevation: 242 ft

Reservoir 1: Reservoir 1 290 ft / 15,951 ac-ft

Load

Downloads

Request Intermediate Results

Simulation Results Package 10.21 MB

Zipped results package containing final report, shapefiles, gridded raster files, and other outputs

List

Human Consequences Results Package 20.55 MB

Zipped results package containing final report, shapefiles, gridded raster files, and other outputs

List

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DSS-WISE Web Simulation and HCOM Results Packages

Simulation Results Package

**Simulation Results Package** 10.21 MB

Zipped results package containing final report, shapefiles, gridded raster files, and other outputs

DEM Coverage 132.19 kB

Shapefile containing polygons of DEM source and resolution

Final Report 2.45 MB

PDF Document describing simulation

Maximum Specific Discharge Arrival Time Polygons 74.44 kB

Shapefile containing polygons of maximum specific discharge arrival time intervals

Maximum Specific Discharge Polygons 209 kB

Shapefile containing polygons of maximum specific discharge intervals

Arrival Time Polygons 95.45 kB

Shapefile containing polygons of arrival time intervals

Maximum Depth Polygons 247.65 kB

Shapefile containing polygons of maximum depth intervals

Input Features 4.77 kB

Shapefiles containing drawn input features

Inundation Extent at 15 miles 42.5 kB

Shapefile containing inundation extent at 15 miles

Inundation Extent at 3 miles 6.6 kB

Shapefile containing inundation extent at 3 miles

List





















Inundation Extent at 3 miles 6.6 kB

Shapefile containing inundation extent at 3 miles

Inundation Extent at 7 miles 13.26 kB

Shapefile containing inundation extent at 7 miles

Inundation Extent KMZ File 41.48 kB

Google Earth KMZ file showing final inundation extent

Final Inundation Extent 43.1 kB

Shapefile containing inundation extent at the end of the simulation at 15.498 miles

Observation Lines 8.38 kB

Tabulated CSV files of time vs. discharge and cumulative volume

Raster Files 6.86 MB

Gridded raster files for DEM, maximum depth, and arrival time

Reservoir Time History 3.05 kB

Comma-separated values file containing time history of the breaching reservoir's elevation at its given upstream point and approximate remaining volume

Reservoir Volume(s) 3.95 kB

Comma-separated values file containing elevations and volumes of the filled reservoir(s)

Maximum Velocity Polygons 136.06 kB

Shapefile containing polygons of maximum velocity intervals





















Links to download full or individual simulation results files

HCOM Results Package

	Human Consequences Results Package 20.55 MB Zipped results package containing final report, shapefiles, gridded raster files, and other outputs	 List 
	HCOM PAR Analysis Results 91.44 kB MS Excel spreadsheet containing tabulated results of population at risk analysis	
	HCOM PAR by Census Blocks 571.3 kB Shapefile containing polygons of census blocks in the inundation extent	
	HCOM Daytime Population Density 19.14 kB Shapefile containing polygons of daytime population density derived from LANDSCAN data	
	HCOM Final Report 20.1 MB PDF Document describing the results of this HCOM calculation	
	HCOM Hazard Level to People Indoors 18.15 kB Shapefile containing polygons of hazard levels to people caught indoors in the flooded extent	
	HCOM Nighttime Population Density 22.5 kB Shapefile containing polygons of nighttime population density derived from LANDSCAN data	
	HCOM Hazard Level to People Outdoors 188.61 kB Shapefile containing polygons of hazard levels to people caught outdoors in the flooded extent	
	HCOM Potentially Lethal Flood Zones 85.89 kB Shapefile containing polygons of flood zones potentially lethal to adults and children	

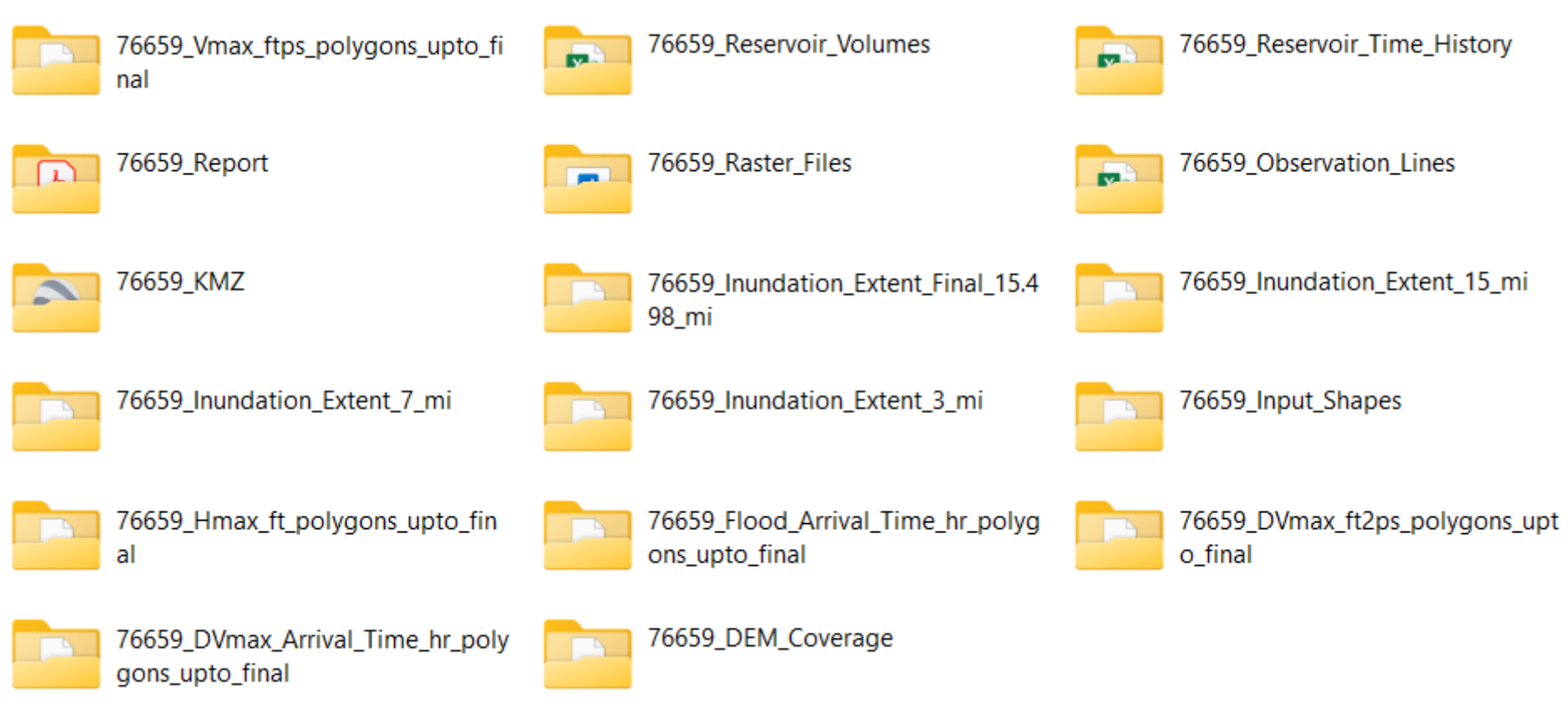
Links to download full or individual simulation results files

Viewing and Analysis of DSS-WISE Web Simulation Results

Contents of the DSS-WISE Web Results Package

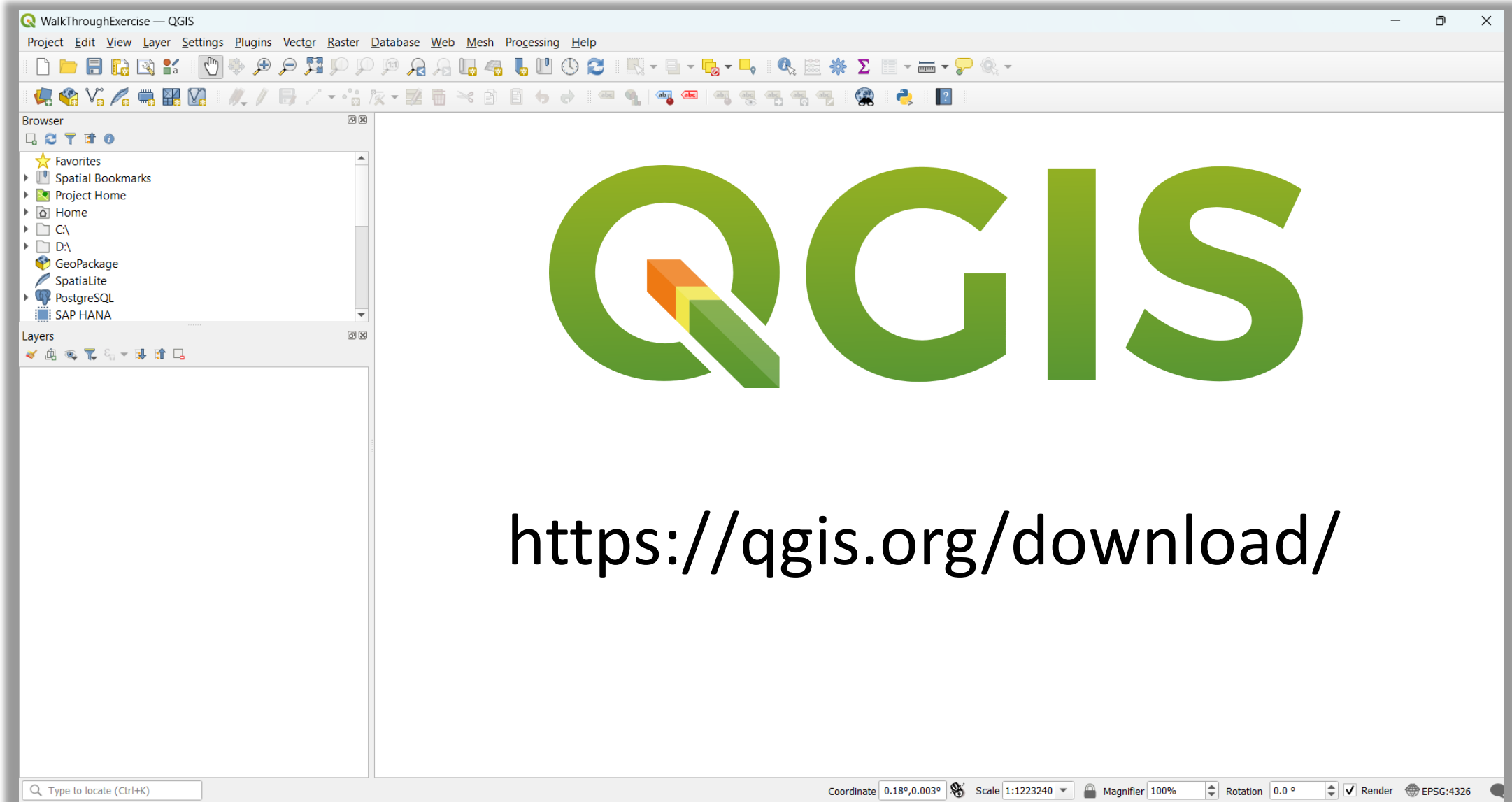
If the package is downloaded as a single compressed file, unzip the file. The contents of the unzipped file is shown below.

- The folder “**76659_Report**” contains DSS-WISE Web Final Report in PDF format. The pdf report must be read using Adobe Acrobat Reader
- The folder “**76659_KMZ**” contains the flood extent polygon in KMZ format. The KMZ file can be viewed in Google Earth (you can also view KMZ files on some GIS software, such as QGIS)
- The folders “**76659_Observation_Lines**”, “**76659_Reservoir_volumes**”, and “**76659_Reservoir_Time_History**” contains “csv” (comma separated value) files for the observation files, the reservoir volume files and the reservoir time history file. Generally, these csv files would be viewed and analyzed using a spreadsheet program
- All other folders contain **geospatial files** that must be viewed using a GIS software. These course notes will use QGIS software.



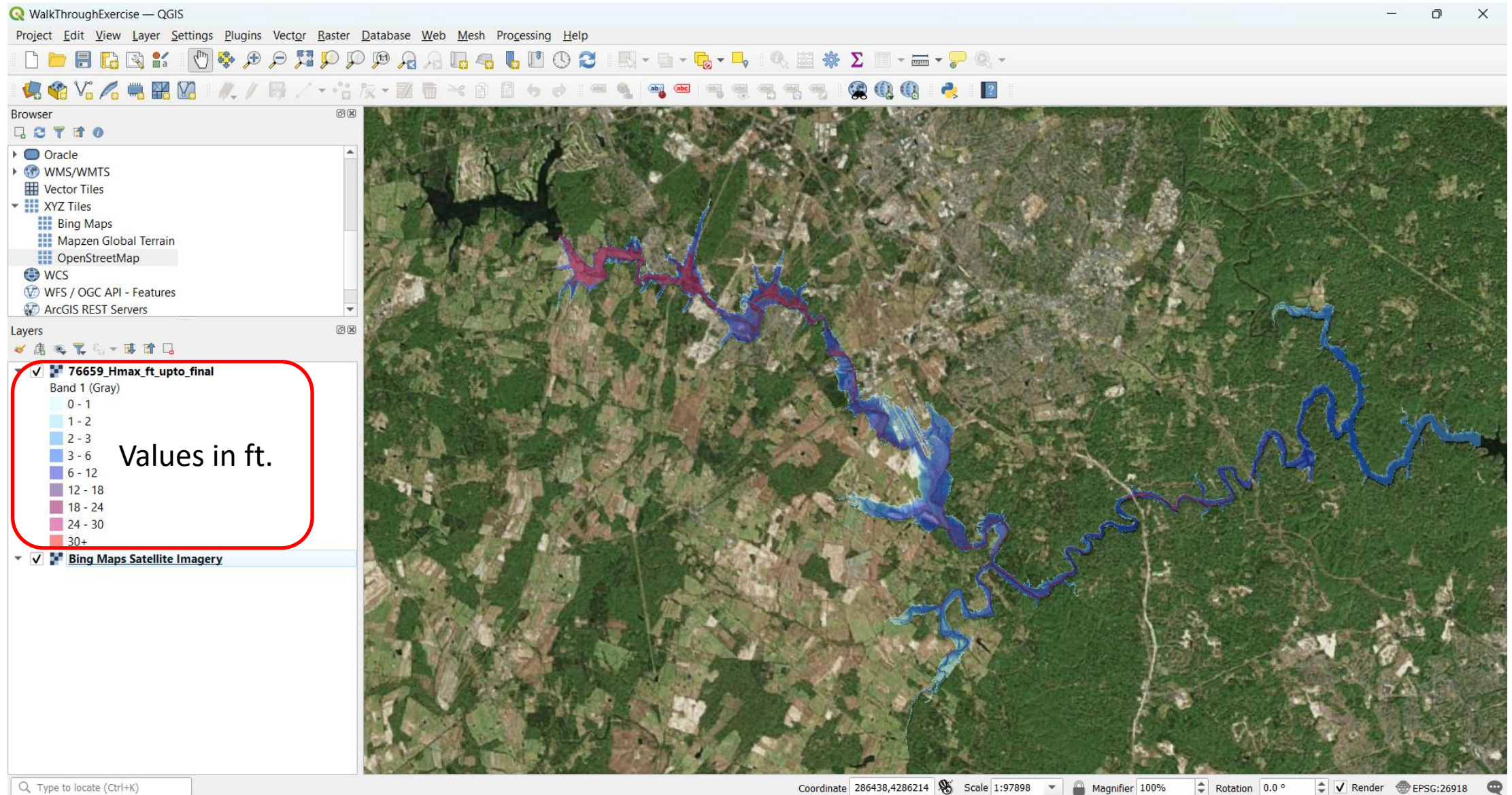
Mapping Results Using QGIS Software

Launch QGIS software and create a new project. In this case, the project is named “WalkThroughExercise”. The empty document is shown below.



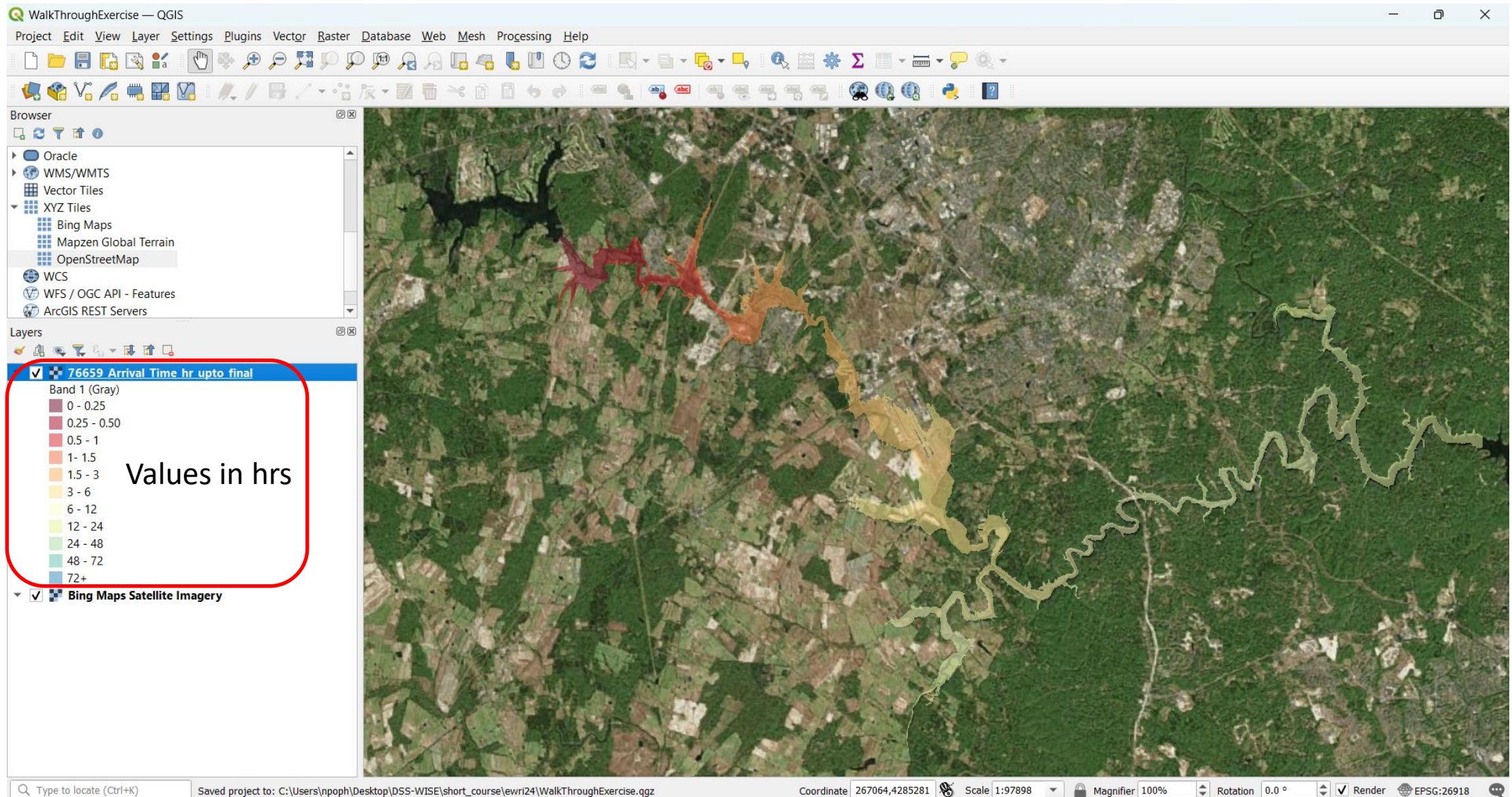
Maximum Flood Depth Raster Map

Maximum Flood Depth raster is displayed using proposed color ramp (76659_Hmax_ft_upto_final.tif).



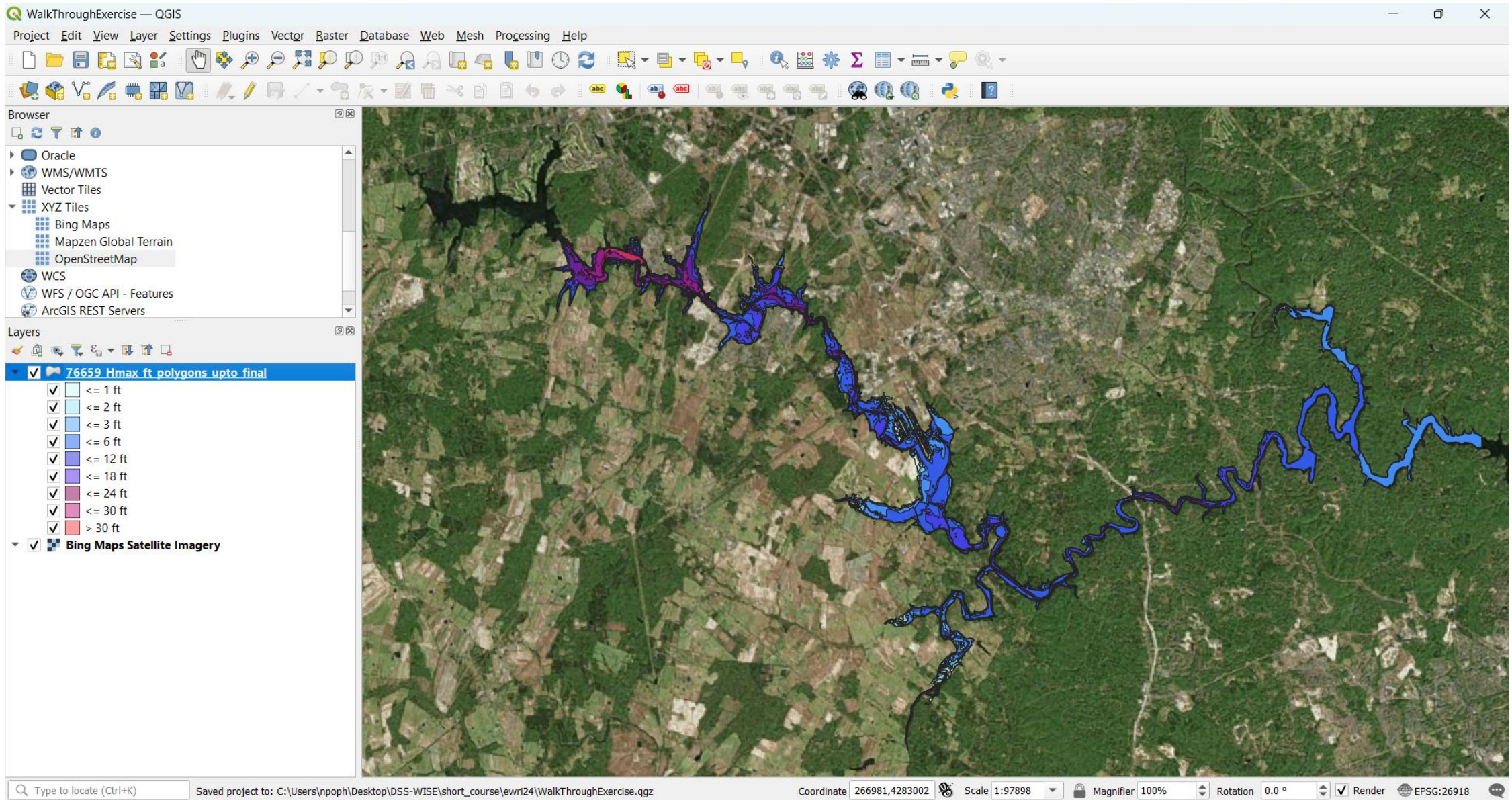
Flood Arrival Time Raster Map

Flood Arrival Time raster is displayed using proposed color ramp (76659_Arrival_Time_hr_upto_final.tif).



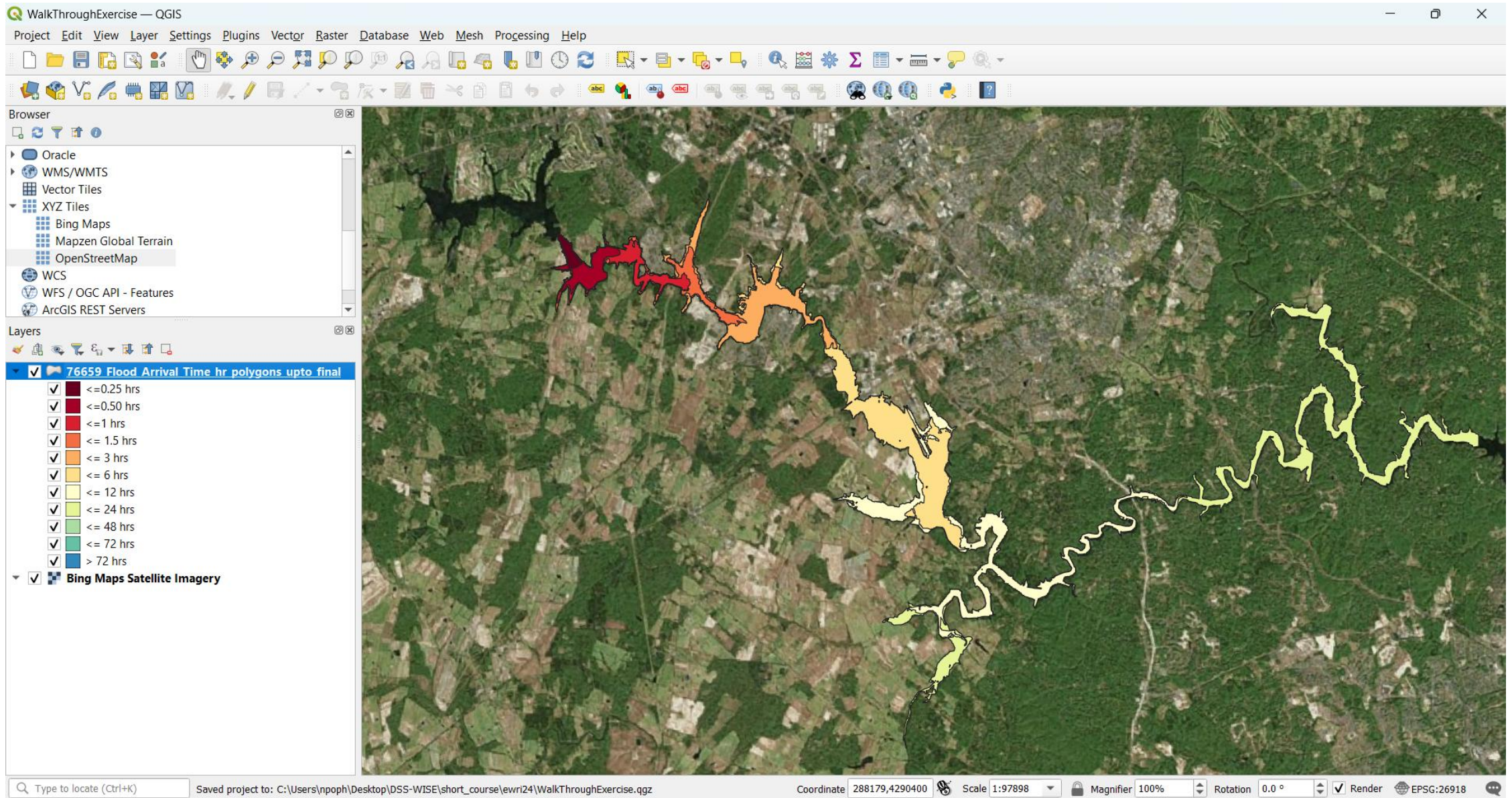
Maximum Flood Depth Map

Maximum Flood Depth polygon shapefile is displayed using proposed color ramp (76659_Hmax_ft_polygons_upto_final.shp).



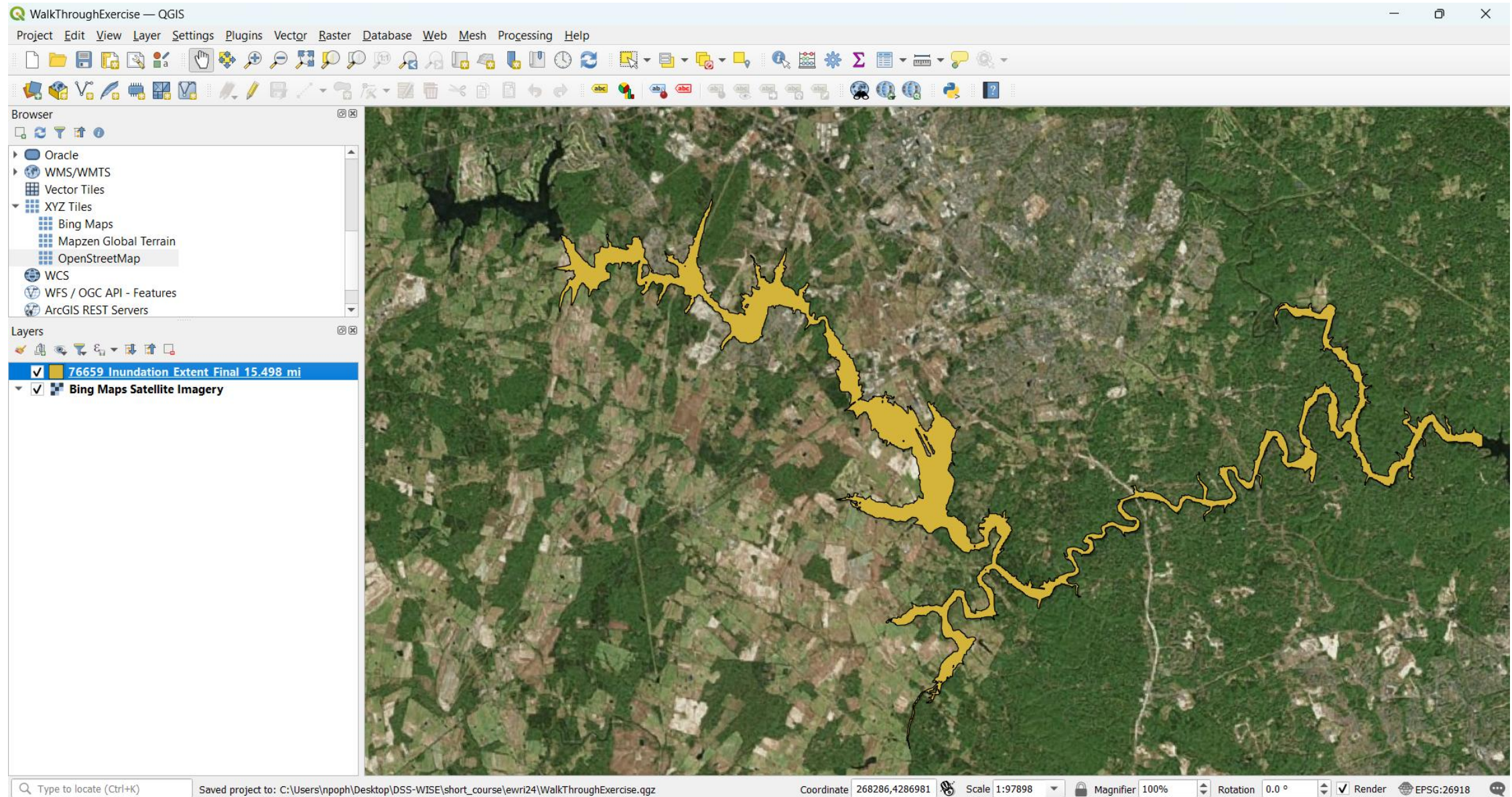
Flood Arrival Time Map

Flood Arrival Time polygon shapefile is displayed using proposed color ramp (76659_Flood_Arrival_Time_hr_polygons_upto_final.shp).



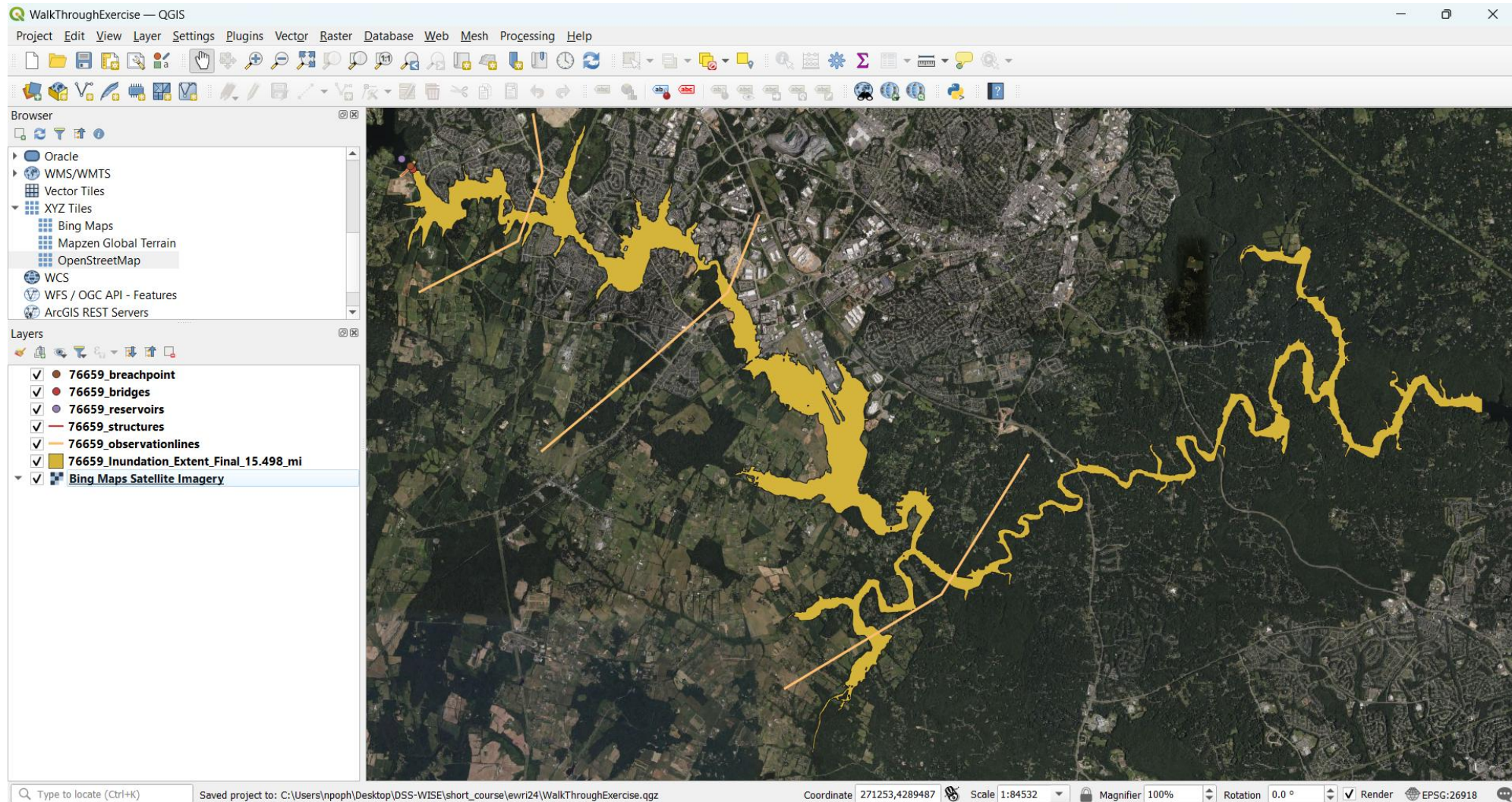
Maximum Inundation Extent

The polygon shapefile of maximum inundation extent is displayed (76659_Inundation_Extent_Final_15.498_mi.shp).



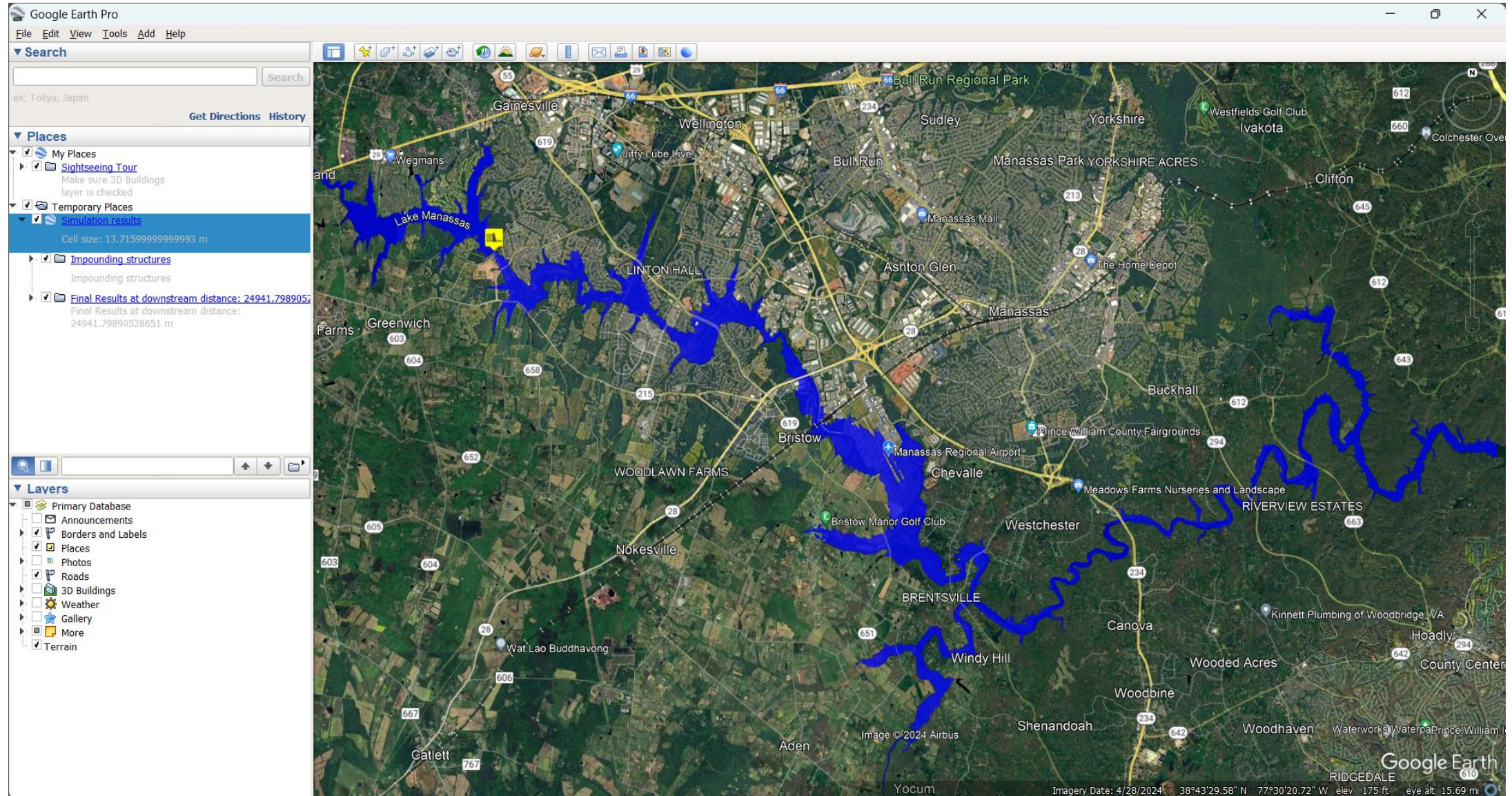
Displaying Shapefiles of Input Data

The folder “76659_Input_Shapes” contain several point and polygon shapefiles. In the present case, the following shapefiles have been uploaded: “76659_structures.shp” (polyline shapefile), “76659_observationlines.shp” (polyline shapefile), “76659_reservoirs.shp” (Point shapefile), “76659_breachpoint.shp” (point shapefile), “76659_bridges.shp” (point shapefile)



Displaying KMZ file on Google Earth

Start Google Earth. Drag and drop the KMZ file (76659_Inundation_Extent_Final_15.498_mi.kmz) onto the Google Earth satellite imagery. Google Earth will automatically zoom to the full extent of the area represented in the KMZ file.



Plotting Hydrographs Extracted at Observation Lines and Stored in Individual “csv” Files

The folder “76659_Observation_Lines” contain 4 “csv” files, which were written by DSS-WISE Web at the end of the simulation.

Name	Date modified	Type	Size
 OLIN_0000001.csv	5/12/2019 8:14 PM	Microsoft Excel C...	20 KB
 OLIN_0000002.csv	5/12/2019 8:14 PM	Microsoft Excel C...	17 KB
 OLIN_0000003.csv	5/12/2019 8:14 PM	Microsoft Excel C...	19 KB
 OLIN_0000004.csv	5/12/2019 8:14 PM	Microsoft Excel C...	27 KB

As an example, contents of “OLIN_0000001.csv” are shown

Time (hr): time in hours since beginning of simulation

Q+ (ft^3/s): Discharge crossing the observation line in positive flow direction

Q- (ft^3/s): Discharge crossing the observation line in negative flow direction

V+ (ft^3): Cumulative volume that crossed the observation line in positive direction

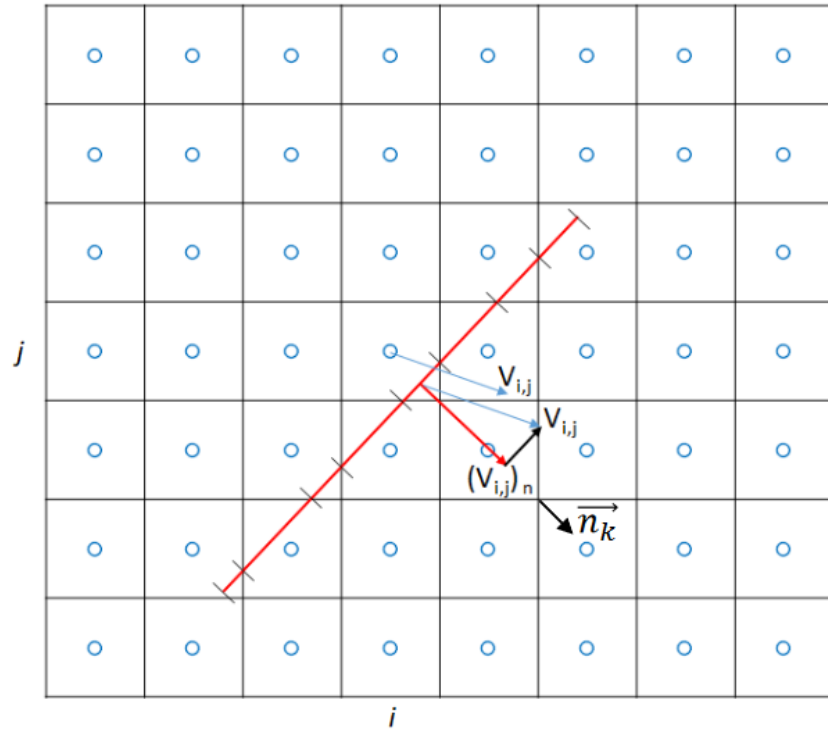
V- (ft^3): Cumulative volume that crossed the observation line in negative direction

Contents of “OLIN_0000001.csv” as viewed in Microsoft Excel spreadsheet software

	A	B	C	D	E
1	Observation Line 1				
2	Time (hr)	Q+ (ft^3/s)	Q- (ft^3/s)	V+ (ft^3)	V- (ft^3)
3	4.74E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.166667	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.333333	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
202	27	3.25E+00	8.51E-04	1.22E+09	1.46E+06
203	27.16667	3.15E+00	8.38E-04	1.22E+09	1.46E+06
204	27.33333	3.08E+00	8.26E-04	1.22E+09	1.46E+06
205	27.5	3.01E+00	8.13E-04	1.22E+09	1.46E+06
206	27.66667	2.94E+00	8.01E-04	1.22E+09	1.46E+06
207	27.83333	2.87E+00	7.90E-04	1.22E+09	1.46E+06
208	28	2.80E+00	7.78E-04	1.22E+09	1.46E+06
209	28.16667	2.73E+00	7.67E-04	1.22E+09	1.46E+06

Calculating discharge along an observation line

Discharge along each small reach is calculated by considering velocity normal to the line.



Positive discharges and negative discharges along small reaches are summed up to give the total positive and negative discharges crossing the line.

$\vec{n}_k$ Unit vector normal (vertical) to the small reach k in the cell (i, j)

$\vec{V}_{i,j}$ Velocity vector normal at the center of the cell (i, j)

d_k Length of the small reach k

Discharge crossing the small reach k is computed from

$$\Delta q_k = (\vec{V}_{i,j} \cdot \vec{n}) d_k = \left| (\vec{V}_{i,j})_n \right| d_k$$

Note that the dot product of the velocity vector at the center of the cell (i, j) with the unit vector normal (vertical) to the small reach k gives the component of velocity vector normal to the reach k .

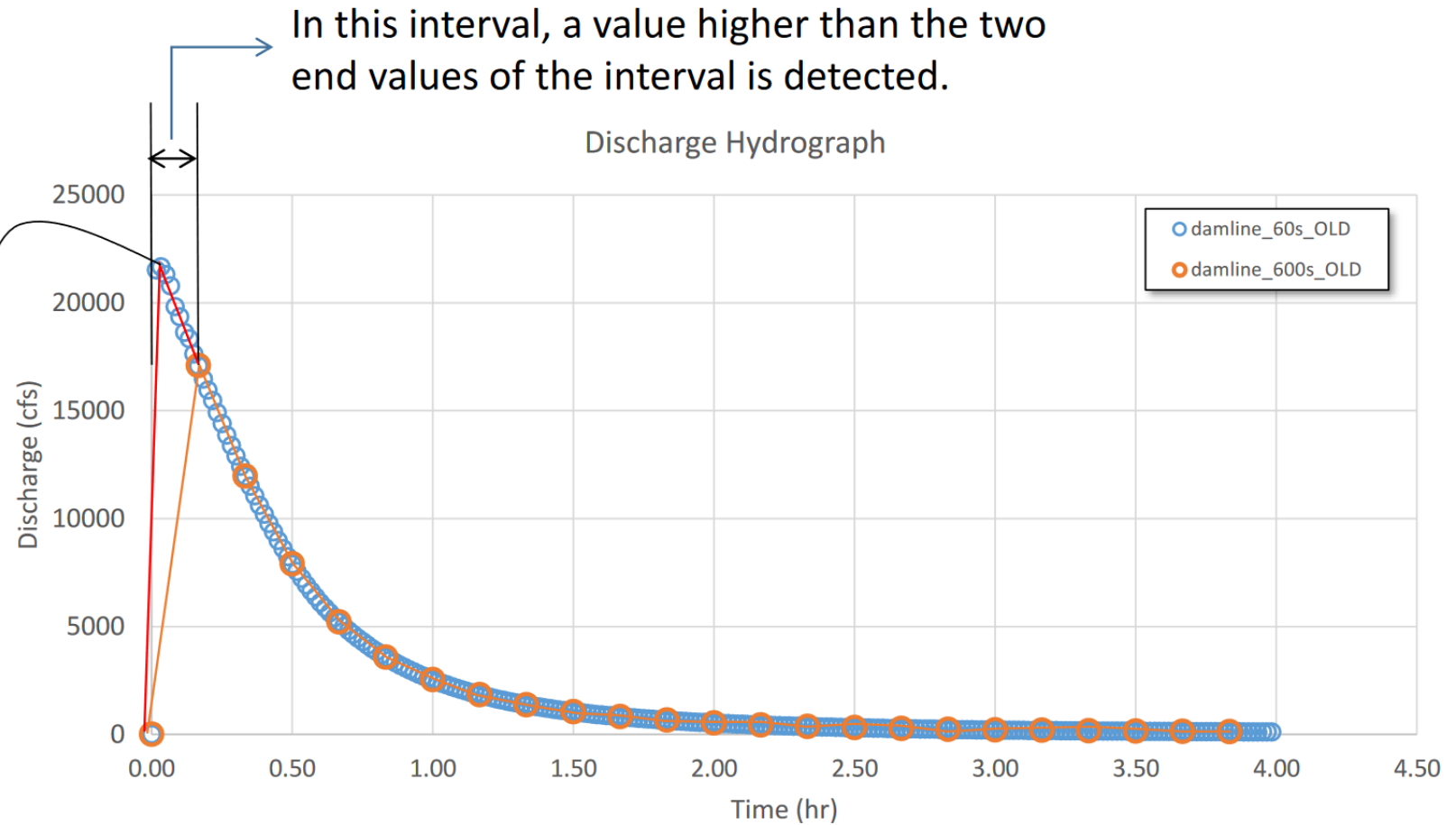
Total volume crossing the small reach k during the time interval reach Δt_m is computed from

$$(\Delta V_k)_m = \Delta q_k \Delta t_m$$

Writing the calculated discharge values into the csv file

The highest value in the interval is added to the list of data written into the csv file.

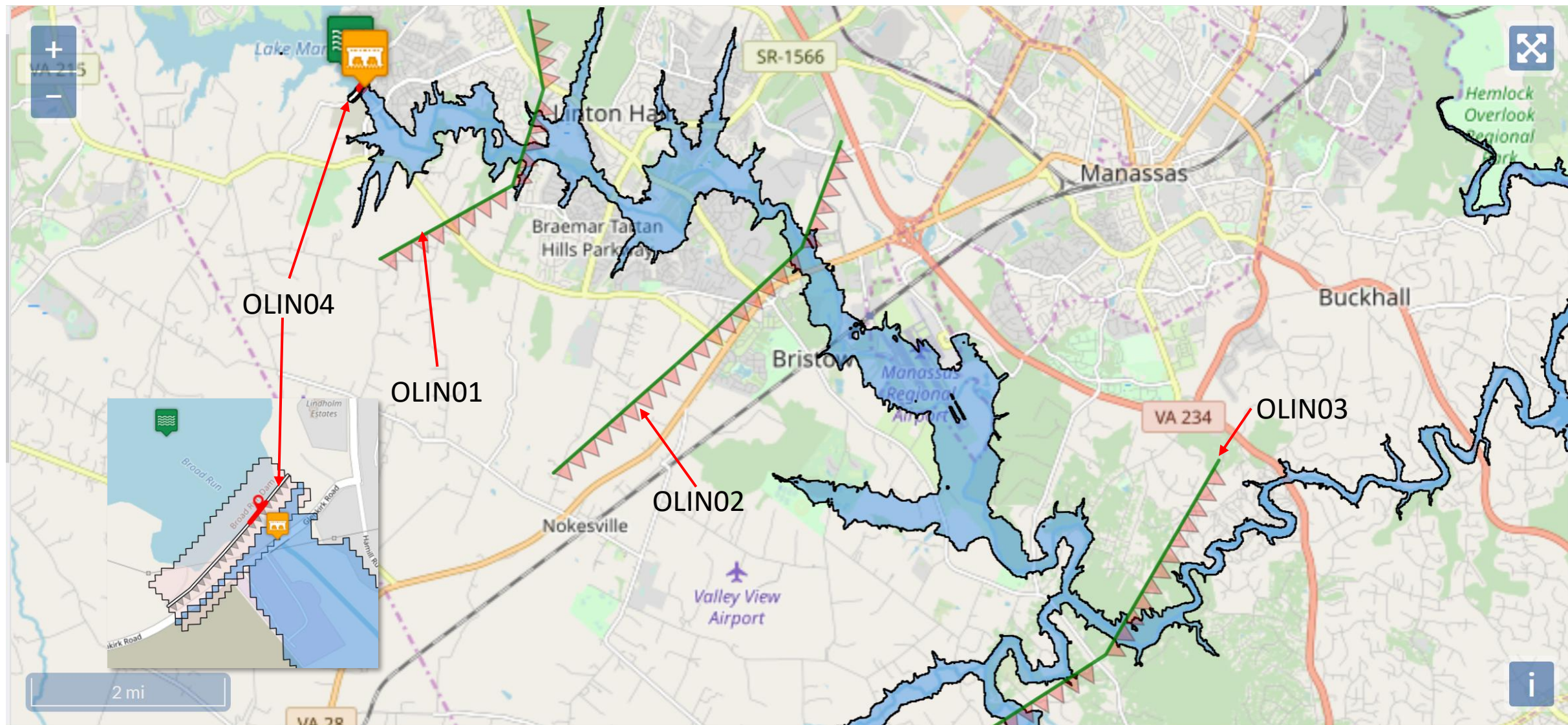
This procedure allows capturing the shape of the hydrograph with better accuracy.



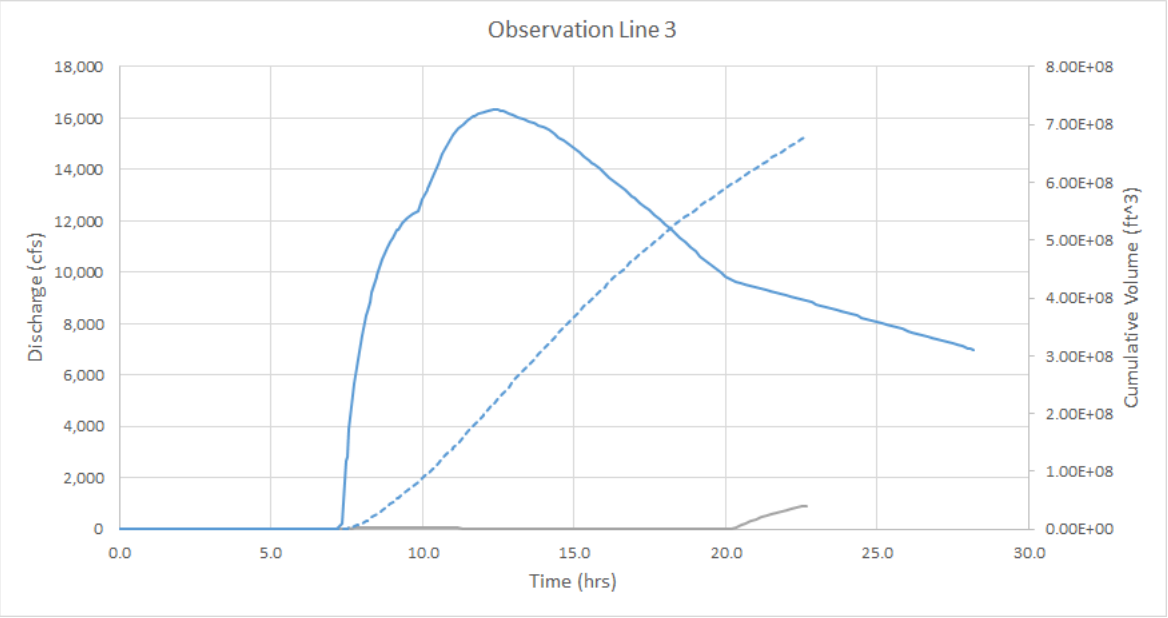
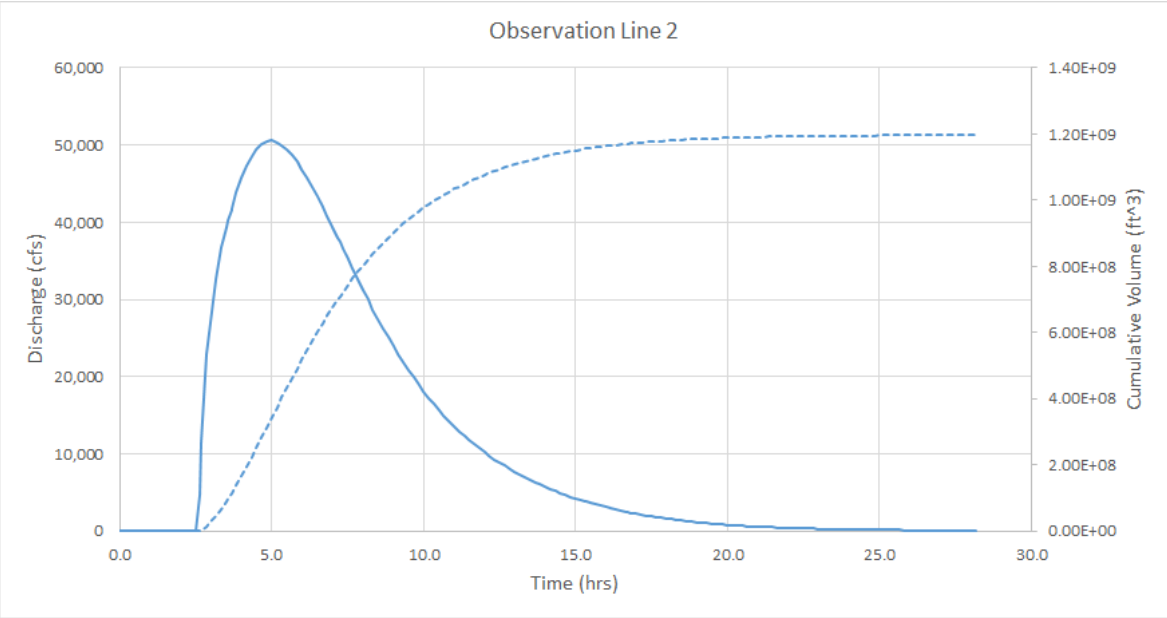
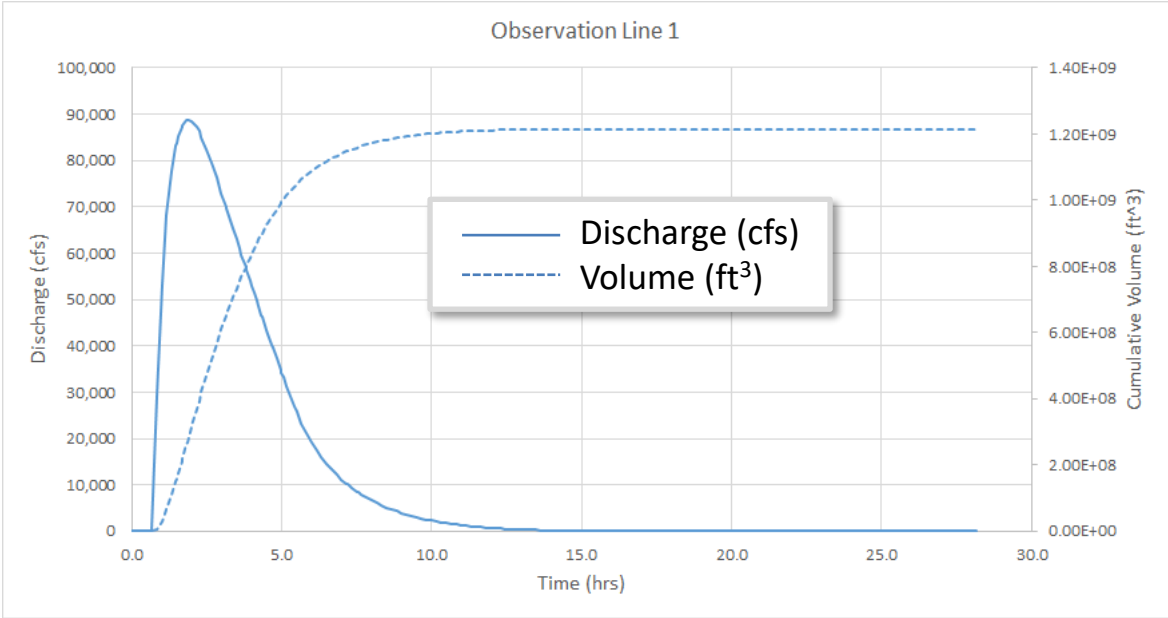
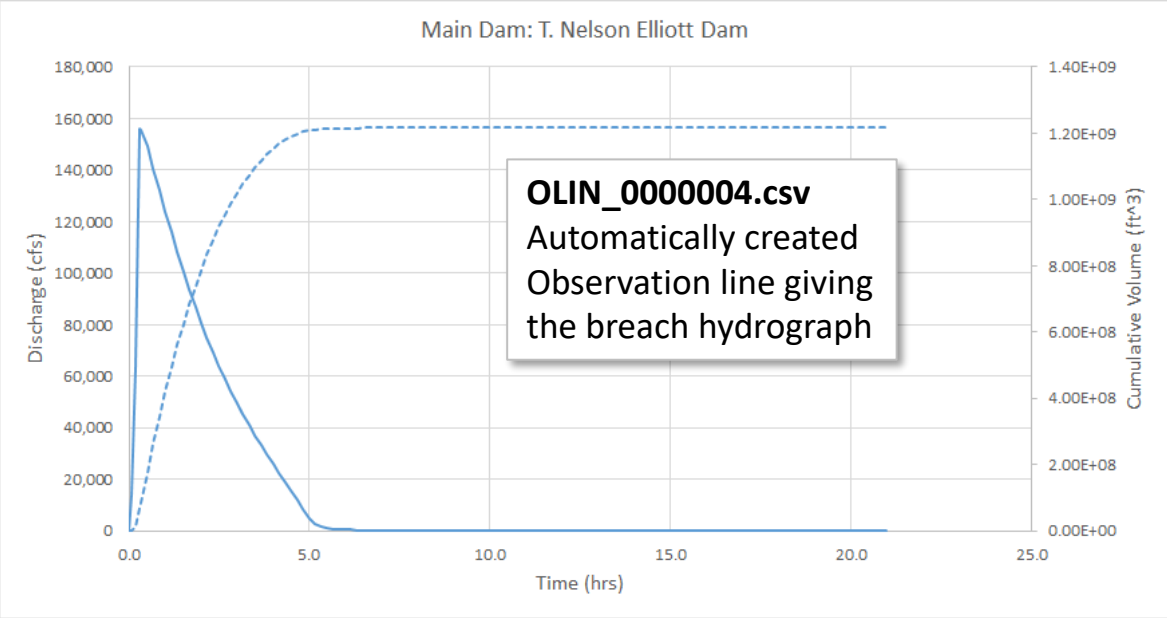
At the end of a write interval, all the values in that interval are checked. If there are values larger than the discharge values at the two ends of the interval, the largest of them is inserted into the interval as a new data pair with its corresponding time. Thus the values in the csv file do not necessarily have a constant time interval.

Locations of Observation Lines and Maximum Flood Extent

The hydrographs from observation lines must be interpreted by taking into account the specific location of the observation line and the maximum inundation map.

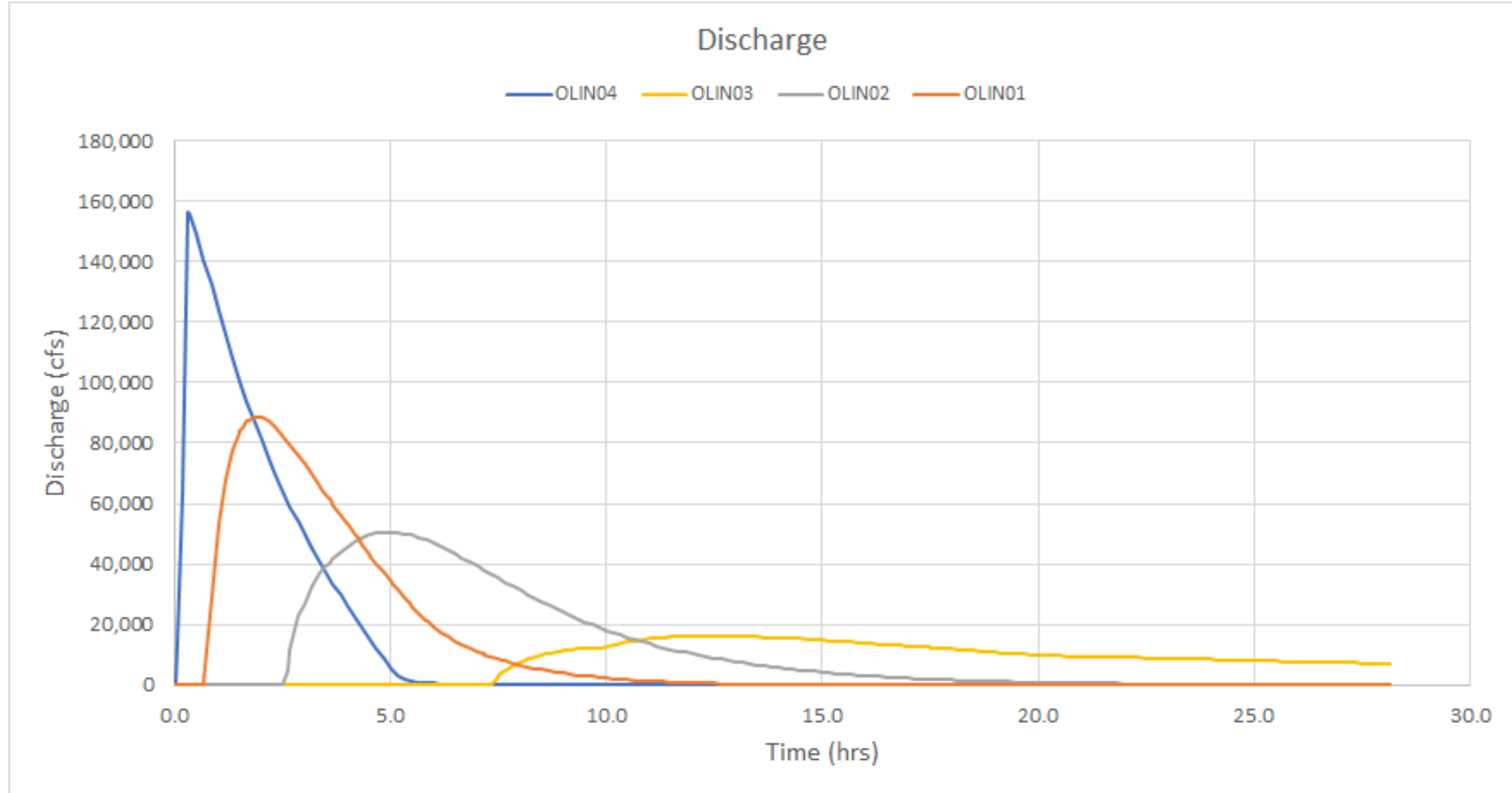


Discharge Hydrographs and Cumulative Volume Plots for Observation Lines



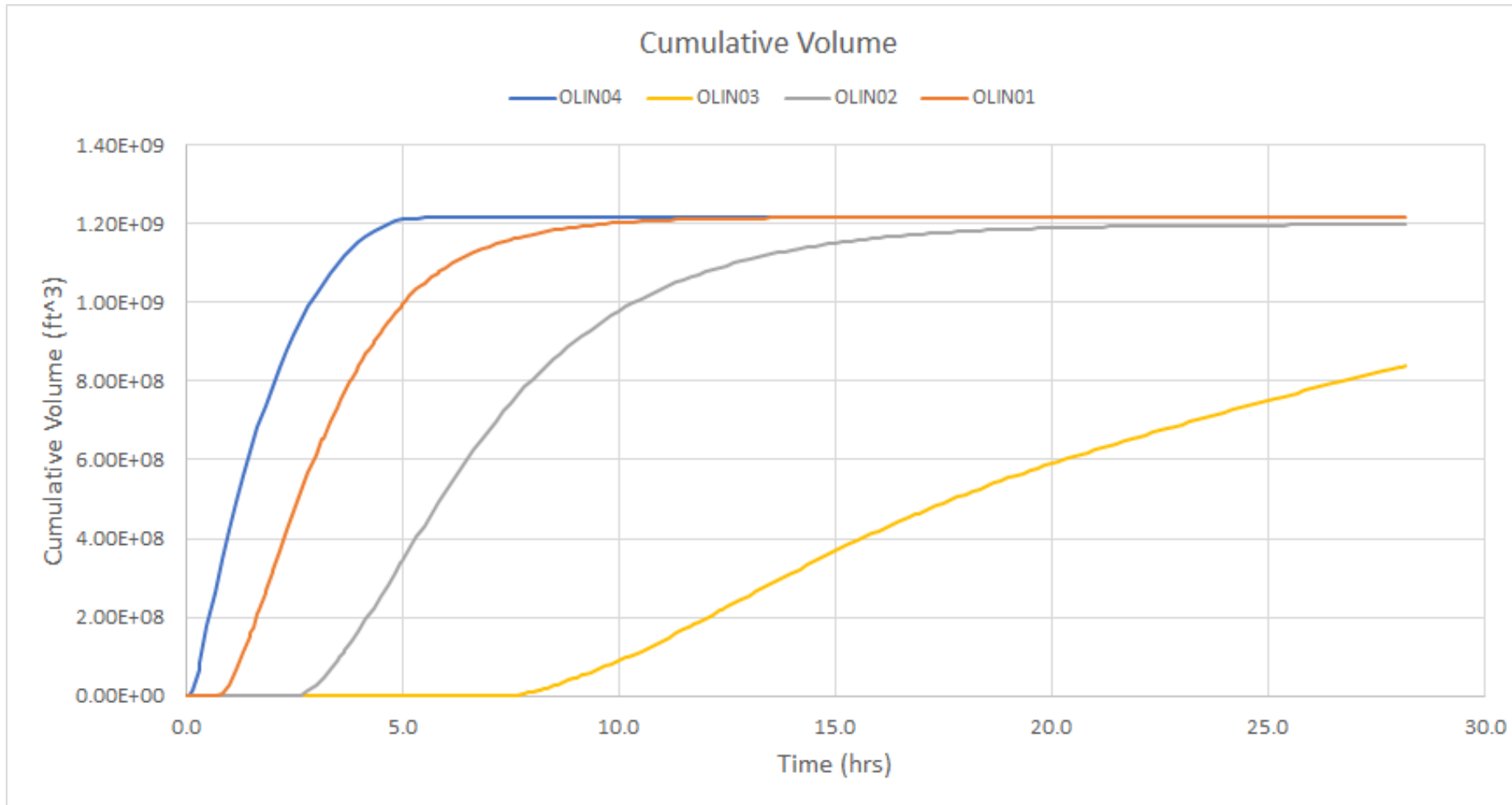
Discharge Hydrographs for All Observation Lines

Note the decrease of the peak discharge with distance from the breach. This is due to friction and spread of the flood.



Cumulative Volume Plots for All Observation Lines

- Note that **OLIN04**, **OLIN01**, **OLIN02** converge to the same constant value of cumulative volume (incidentally, this shows that DSS-WISE Web has excellent mass conservation properties).
- The flood has not yet fully passed through OLIN03. The simulation duration should be increased to see the discharge hydrograph go through **OLIN03**.



Viewing and Analysis of DSS-WISE Web HCOM Results

Contents of the DSS-WISE HCOM Results Package

If the package is downloaded as a single compressed file, unzip the file. The contents of the unzipped file is shown below.

- The folder “**76659_HCOM_Report**” contains DSS-WISE HCOM Final Report in PDF format. The pdf report must be read using Adobe Acrobat Reader
- The folder “**76659_HCOM_Analysis**” contains a Microsoft Excel spreadsheet file with the results of DSS-WISE Web HCOM Par analysis using both the 2020 Census Block data and the LandScan USA gridded nighttime and daytime population data
- All other folders contain geospatial files that must be viewed using a GIS software. These course notes will use QGIS software.
 - **76659_HCOM_Census_Block_polygons**
 - **76659_HCOM_Indoor_Hazard_Categories_polygons**
 - **76659_HCOM_Outdoor_Hazard_Categories_polygons**
 - **76659_HCOM_PLFZ_polygons**
 - **76659_HCOM_NT_PopDensity_persqmi_polygons**
 - **76659_HCOM_DT_PopDensity_persqmi_polygons**



76659_HCOM_Analysis



76659_HCOM_Census_Block_polyg
ons



76659_HCOM_DT_PopDensity_pers
qmi_polygons



76659_HCOM_Indoor_Hazard_Cate
gories_polygons



76659_HCOM_NT_PopDensity_pers
qmi_polygons



76659_HCOM_Outdoor_Hazard_Cat
egories_polygons



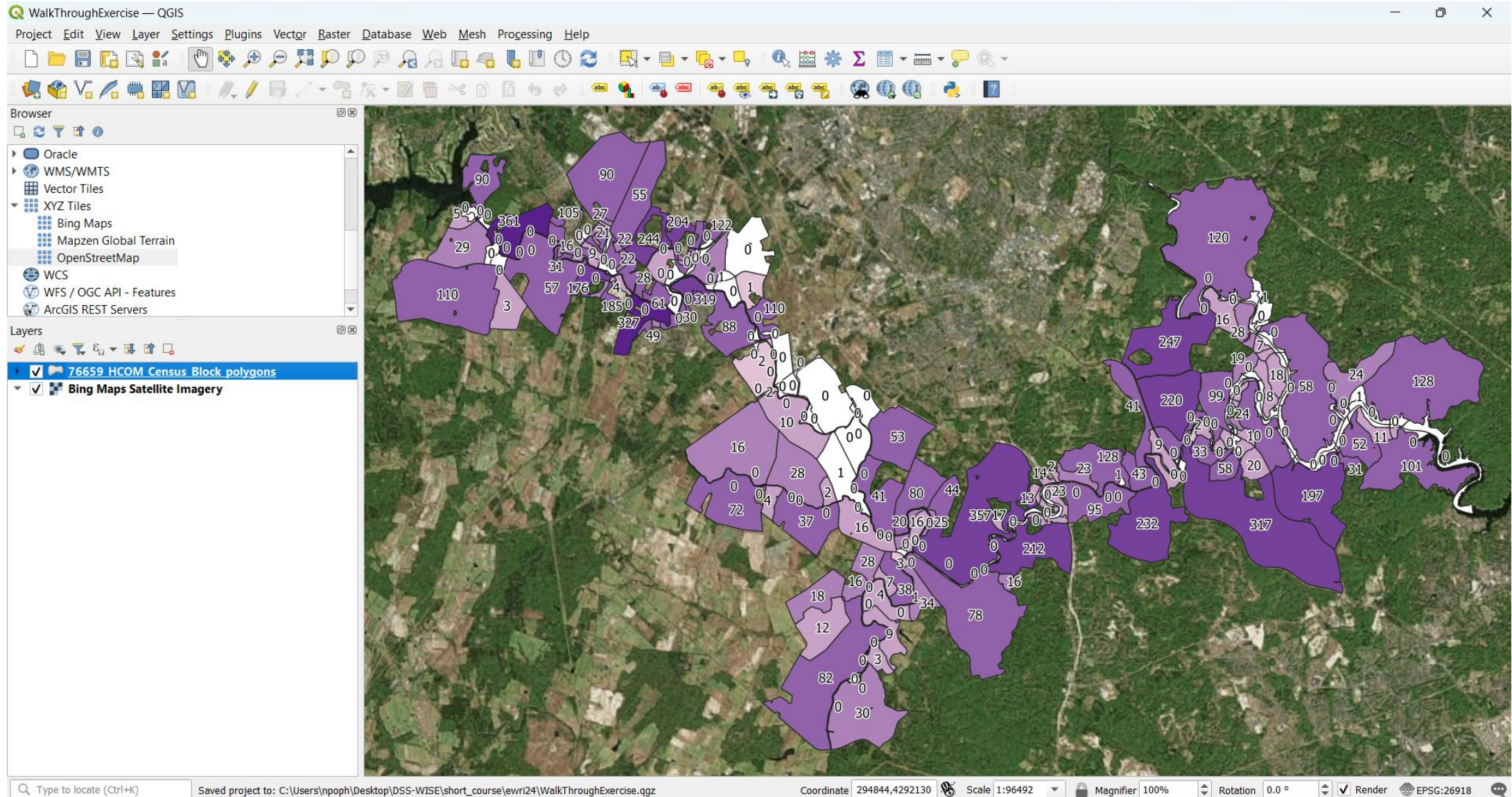
76659_HCOM_PLFZ_polygons



76659_HCOM_Report

2020 Census Block Polygons

2020 Census Block polygons (**76659_HCOM_Census_Block_polygons.shp**) are colored based on the population numbers (attribute **"POP20"**). The numbers indicate number of housings (attribute **"HOUSING20"**).



Flood Hazard Category Polygons for People Caught Outdoors

Flood hazard polygons for people caught outdoors (76659_HCOM_Outdoor_Hazard_Categories_polygons.shp) are displayed using proposed color ramp.

