Aurora Shores Flooding Assessment

Informational Meeting

August 18, 2025

Reminderville City Hall

Agenda

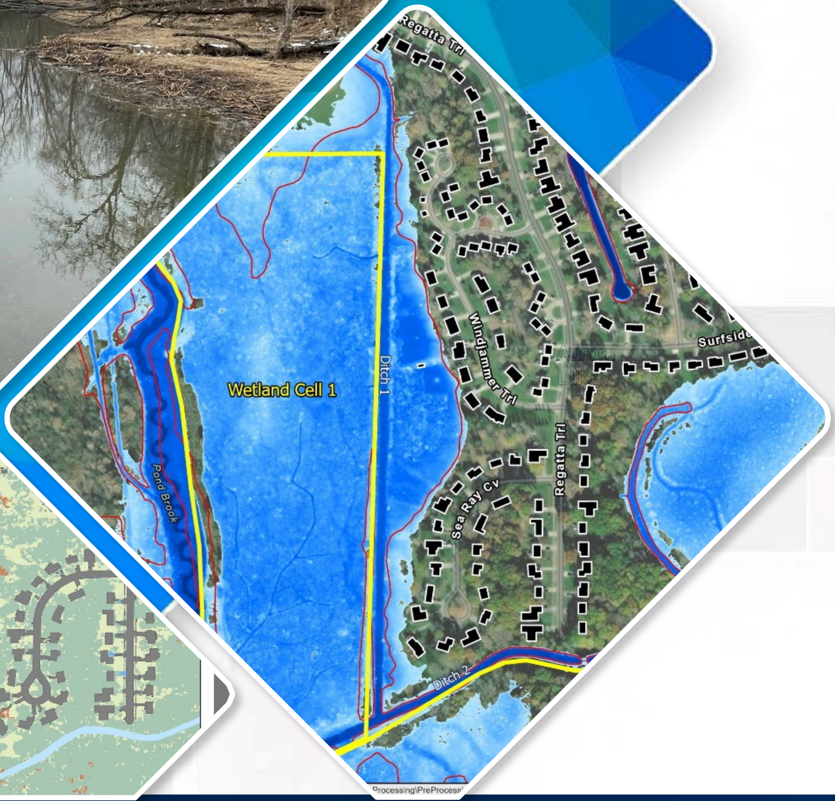
5:00PM Welcome/Introduction

5:05PM Presentation

- About the Summit County Surface Water Management District
- Cuyahoga River Watershed Study
- Aurora Shores
  - Understanding the Stream Network
  - Historic Land Use and Precipitation
- Overview of HEC RAS Model
  - Scenarios and Results
- Potential Solutions

5:45PM Questions and Discussion

7:00PM Adjourn



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ALAN BRUBAKER, P.E., P.S.
SUMMIT COUNTY ENGINEER
1840

HEC-RAS Modeling Assessment of Aurora Shores Flooding

Leading with Science®

Introductions and Agenda

- Summit County Surface Water Management District (SWMD)
- Cuyahoga River Watershed Study
- Aurora Shores
  - Understanding the Stream Network
  - Historic Land Use and Precipitation
- HEC RAS Model
  - Set up
  - Scenarios and Results
- Potential Solutions

Summit County SWMD

Surface Water Management District
Purpose

- Manage and improve stormwater facilities and stormwater discharges
- Protect surface and groundwater quality
- Reduce property damage due to excess stormwater discharge
- Meet the requirements of Ohio EPA's Stormwater Management Program for Municipal Separate Storm Sewer Systems (MS4)
- Aurora Shores identified as area of concern due to severity of flooding and number of properties impacted.

Surface Water Management District
Stormwater Solutions

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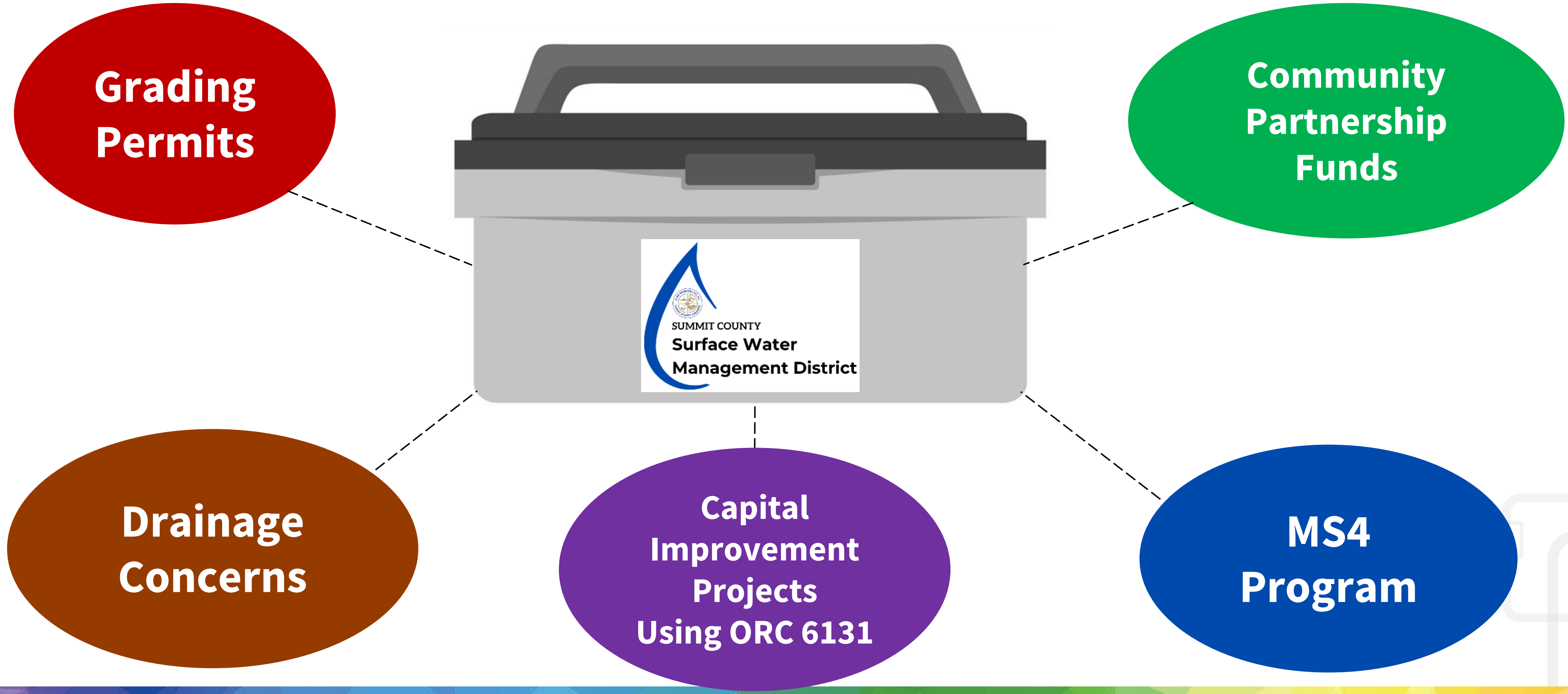
"The tools that drive our success"



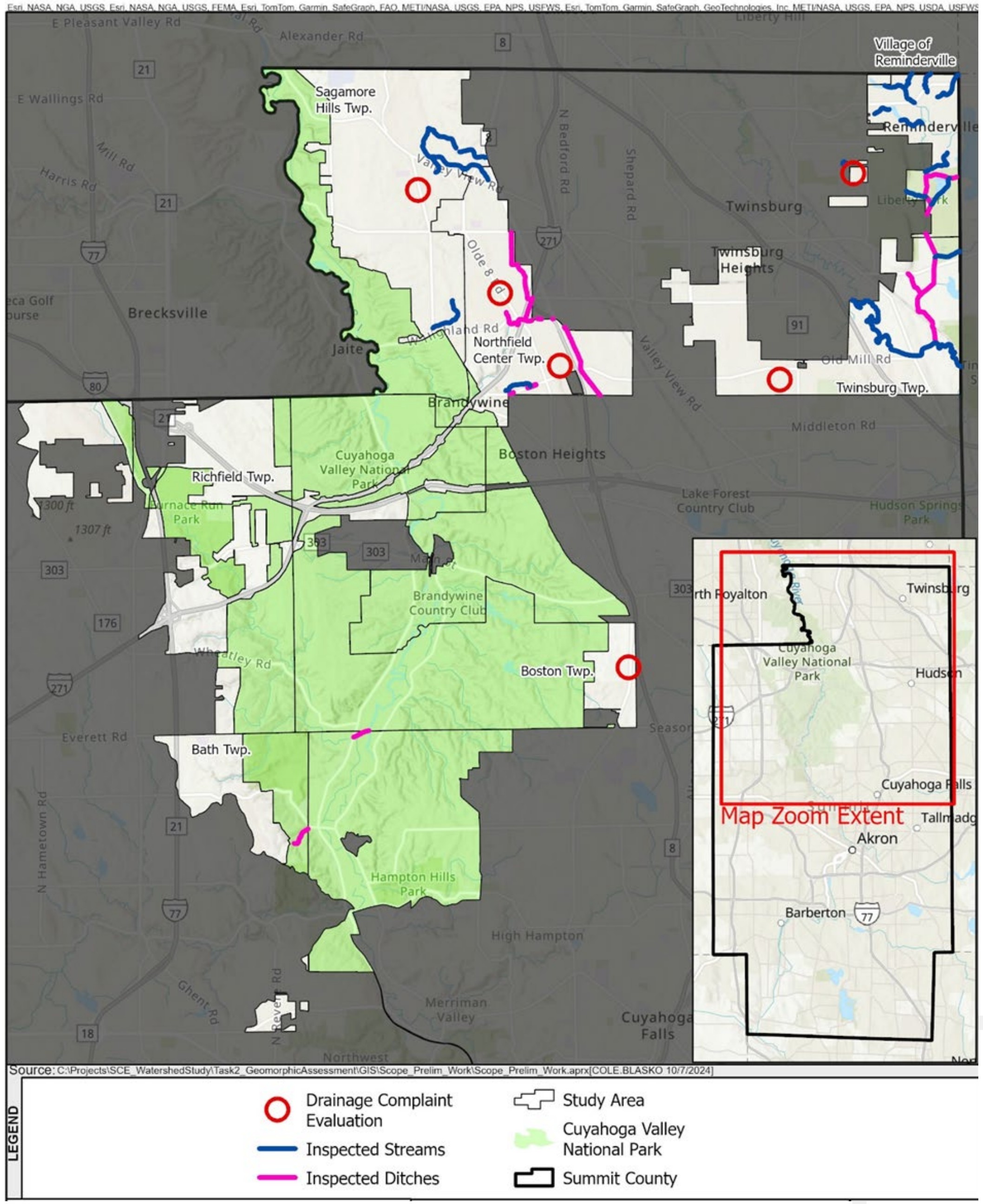
Cuyahoga River Watershed Study

Study Area

Intersection of the Cuyahoga River Watershed and municipalities within the SWMD

Field assessments of select streams, ditches, and drainage complaints

- Included Pond Brook, Channel Brook, other tributaries, wetlands, and ditches



Baseline Recommendations

Locations of minor drainage issues, erosion, or unauthorized dumping

Did not receive full Problem Area designation

Problem Areas

Capital improvement projects

Aurora Shores in Problem Area 6 of the report

- Erosion component
  - Erosion along tributary at Pirates Trail
- Flooding component
  - Backyards adjacent to wetland
  - Model developed

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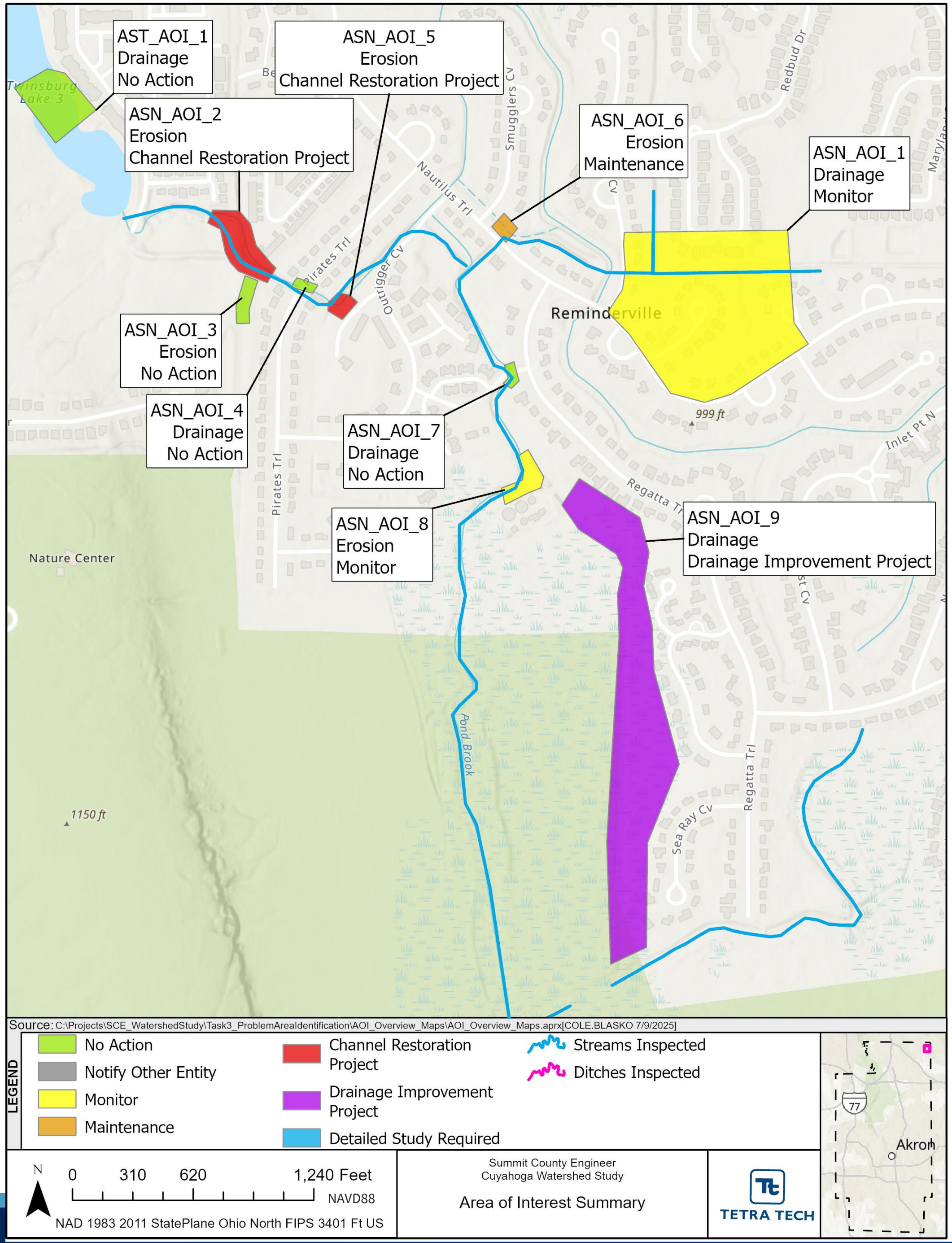
Aurora Shores Overview

The Clipper Cove culvert replacement is assumed to have solved the flooding at Nautilus Trail.

Impacts of additional storage being explored by OHM Advisors.



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Aurora Shores History

Previous Work

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Multiple studies, restoration projects, and modeling efforts:

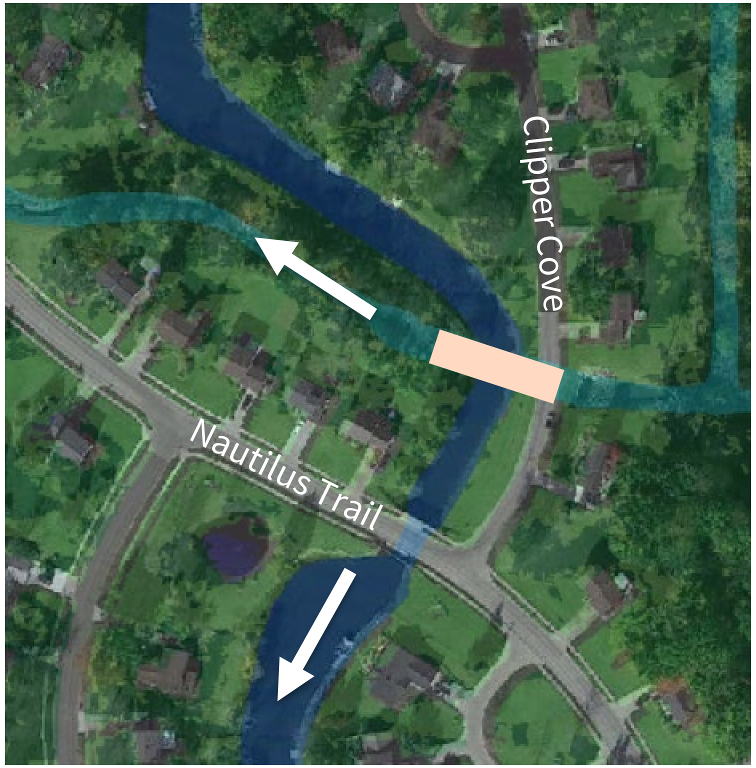
- 1960s – 1970s: Pond Brook channelized, Aurora Shores developed
- 2004 – 2009: Pond Brook study, design, and restoration
- 2017: Stantec peer review of restoration. Model showed decrease in water surface elevations as result of restoration
- 2021: Buckeye Engineering estimated 100-year flows in Channel Brook at Glenwood Blvd. crossing
- 2021: OHM Advisors built model for Clipper Cove Culvert replacement
- 2024: Clipper Cove culvert replaced

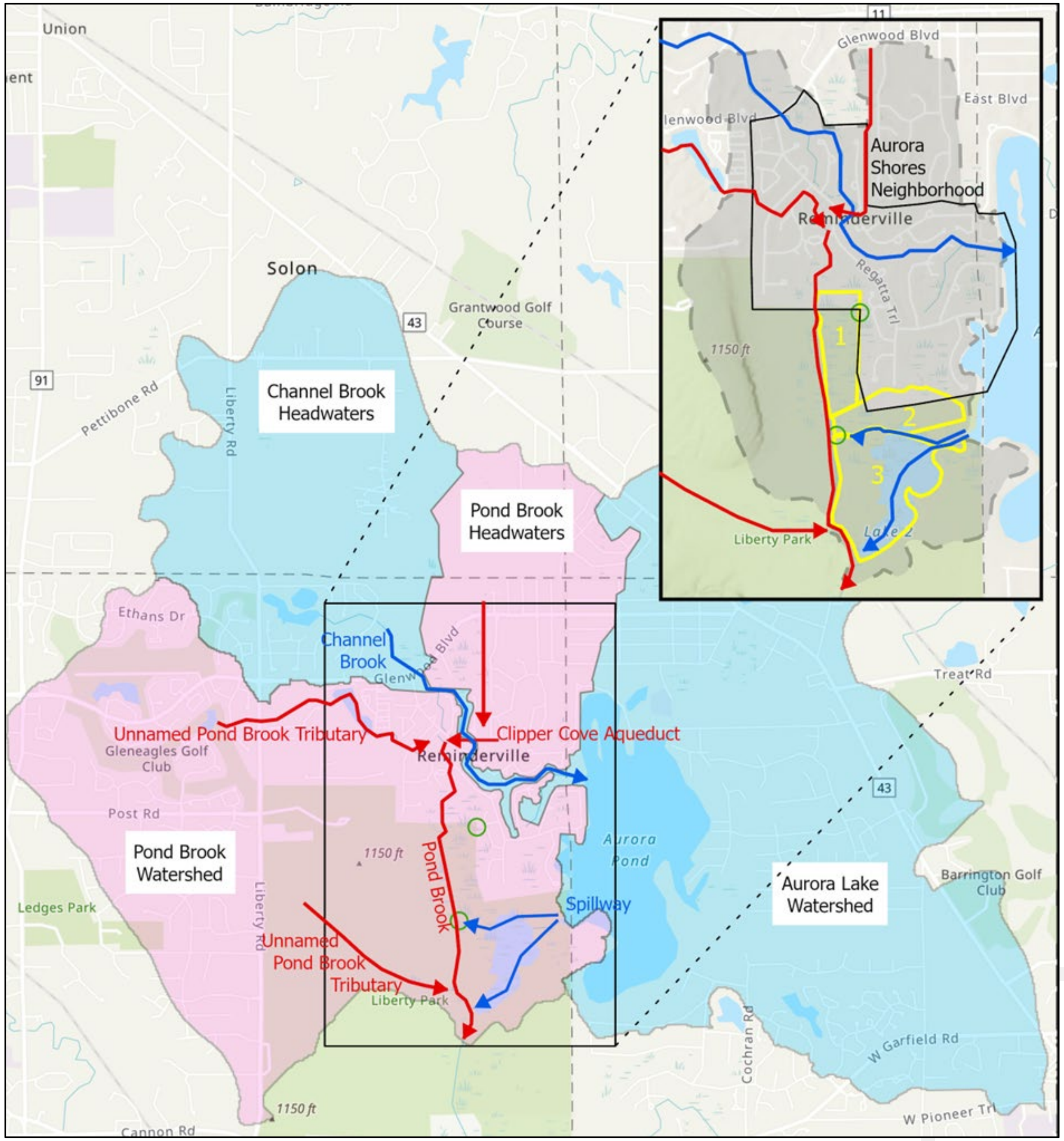
Hydrology Overview

Complex stream network

1. Pond Brook
2. Channel Brook

Cross each other at the Clipper Cove aqueduct.





Historic Maps

1906

Aurora Lake elevation = 996-ft

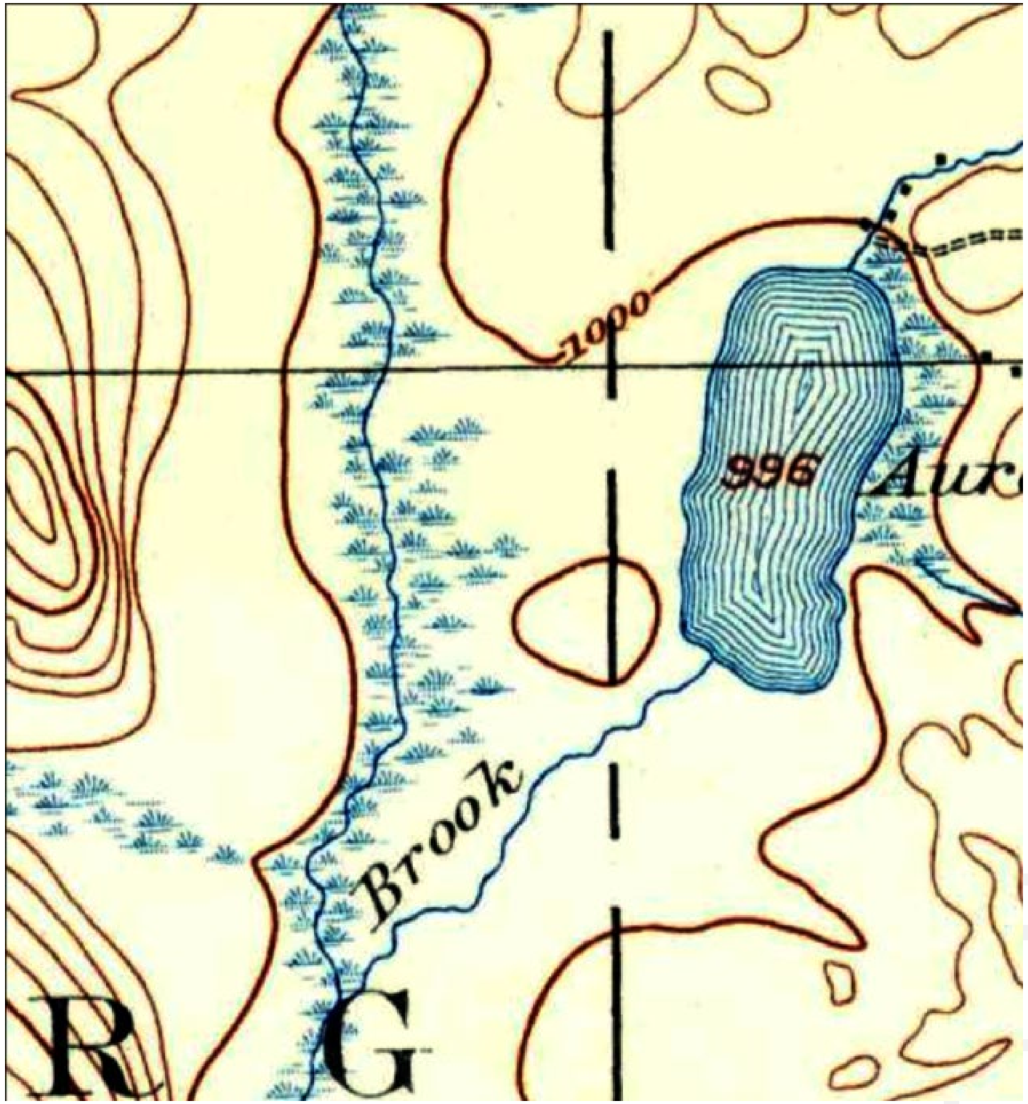
1963

US Geological Survey topographic map wetlands

Aurora Lake elevation = 1000-ft

1970s

Most roads and buildings constructed



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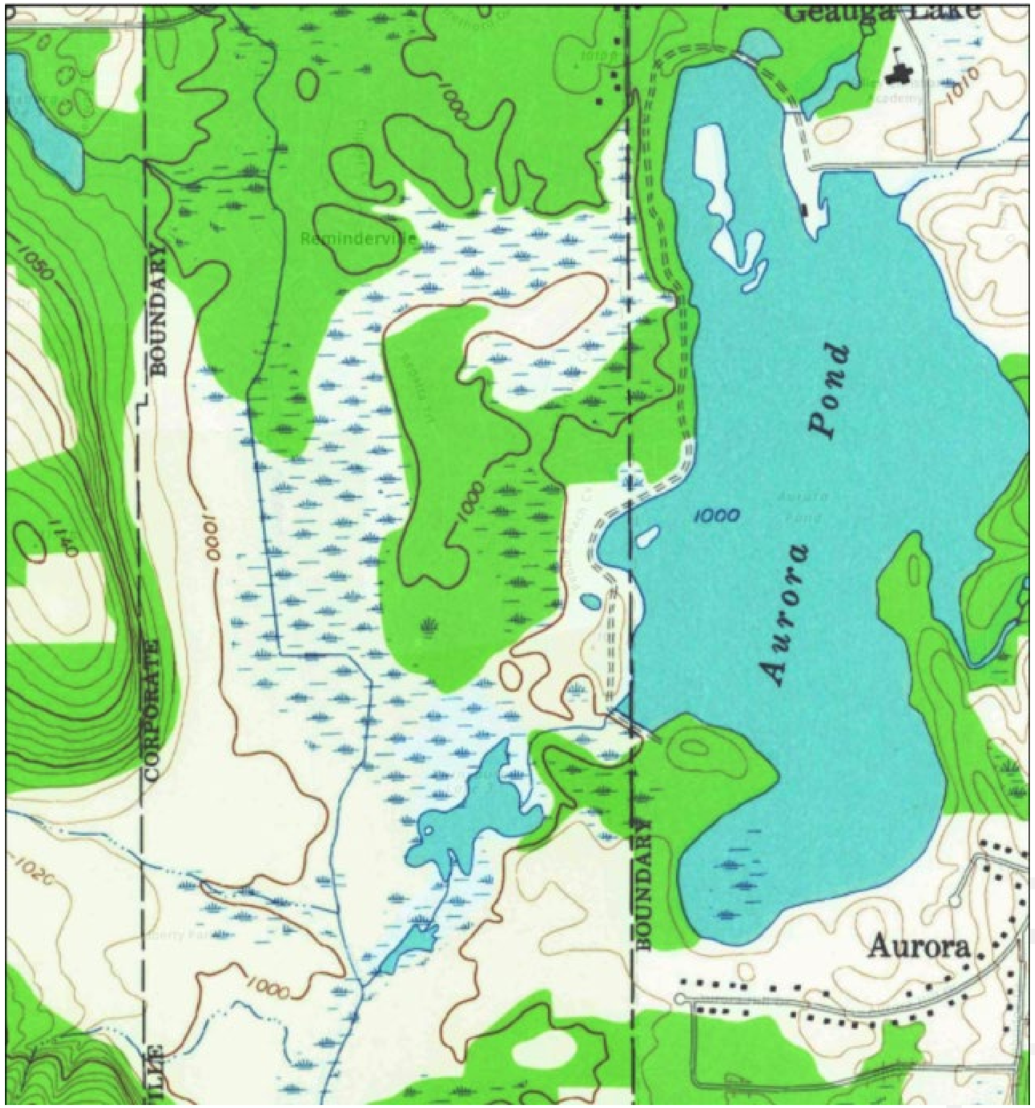

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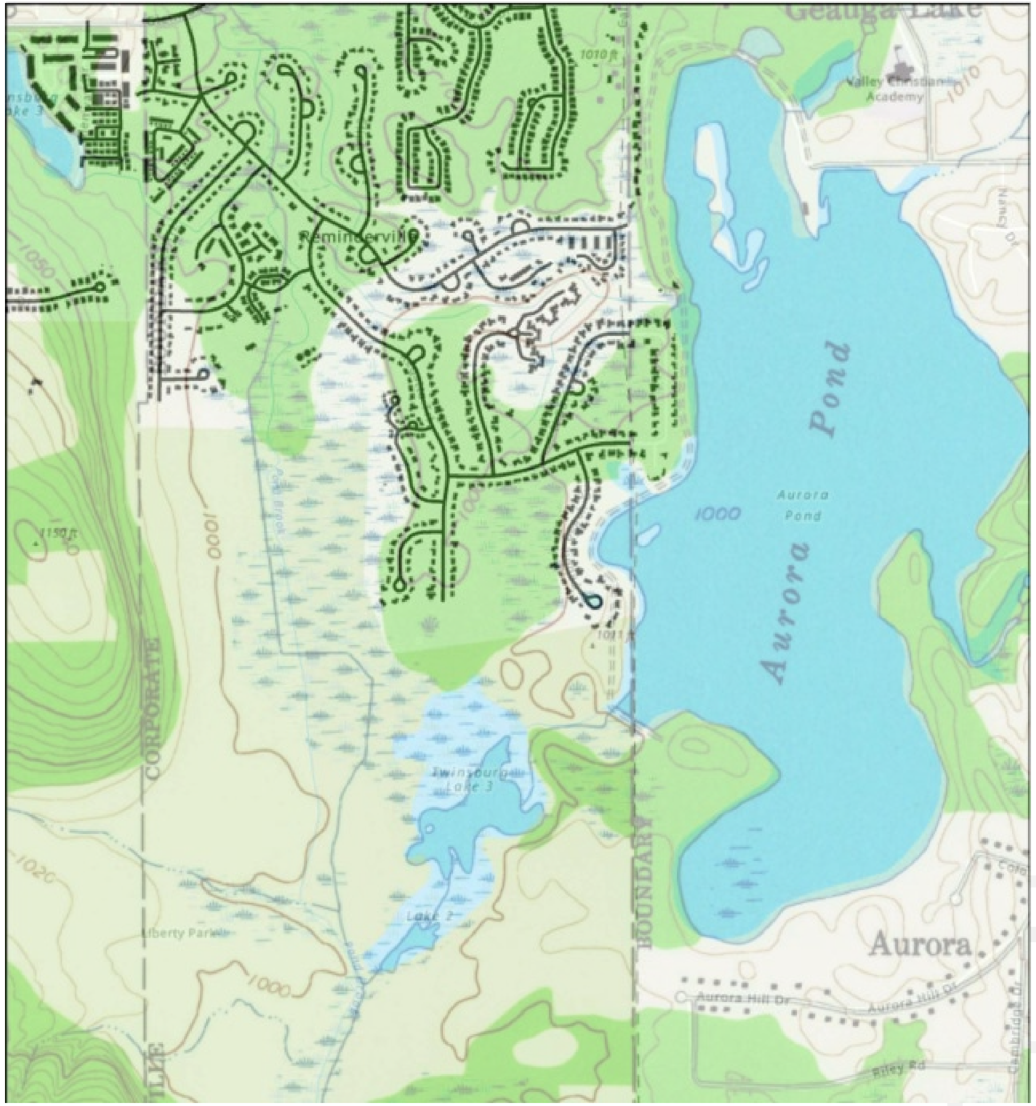

Historic Maps – Current Elevation

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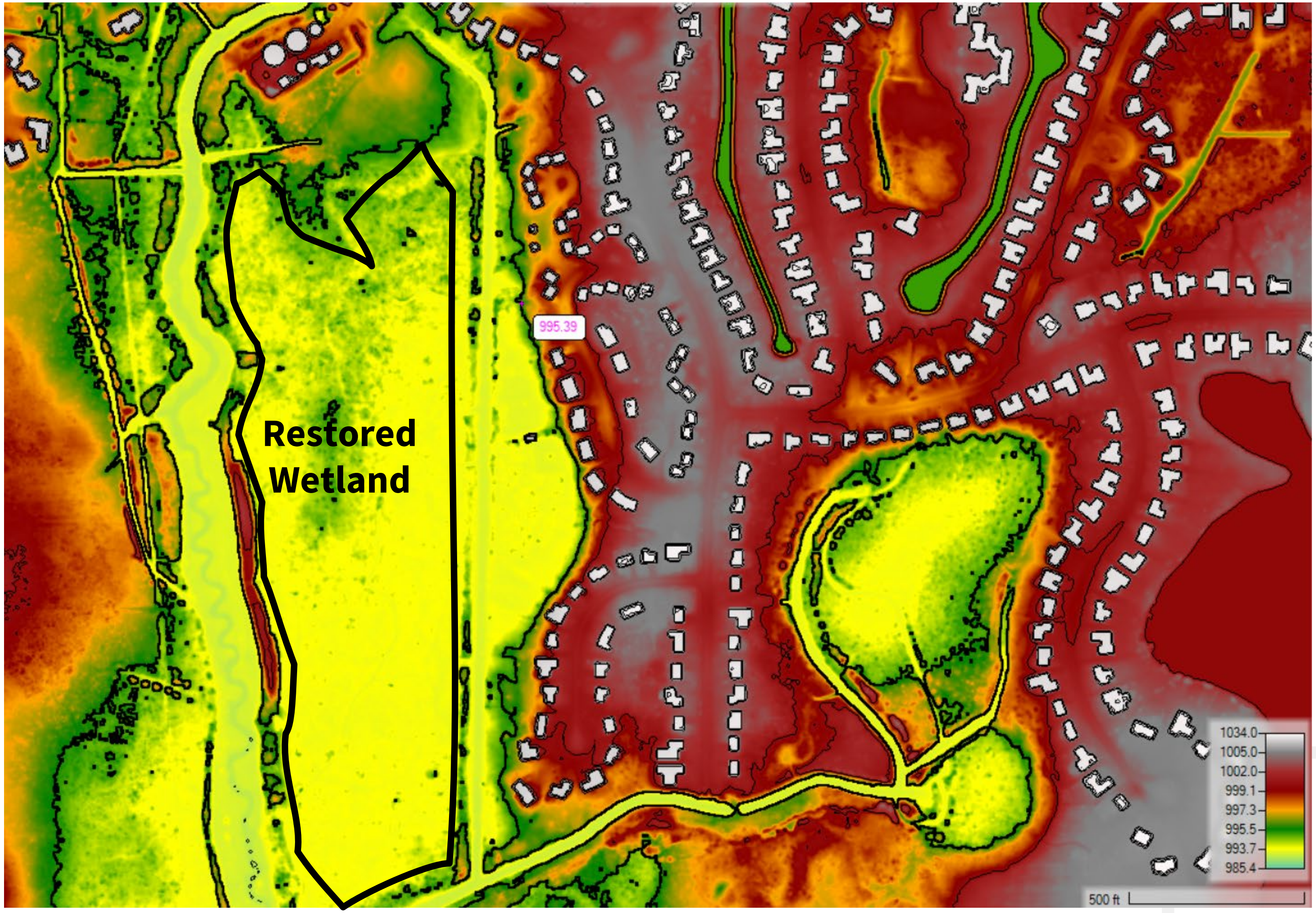
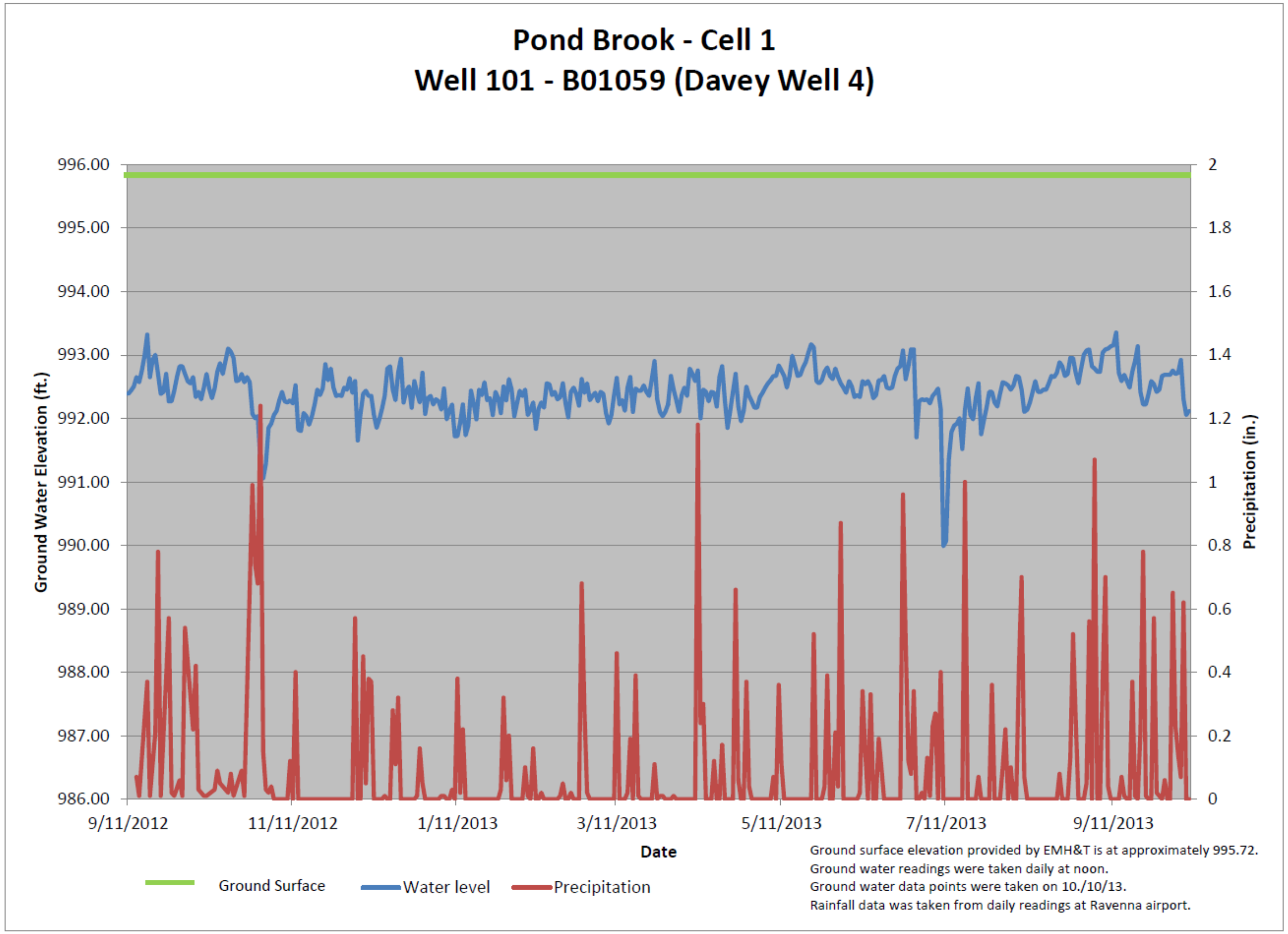
Wetland footprint still present today in low elevation that extends far into backyards despite the restored extent ending at the ditch.

Historic extent remains hydrologically connected and is functioning how it always has.



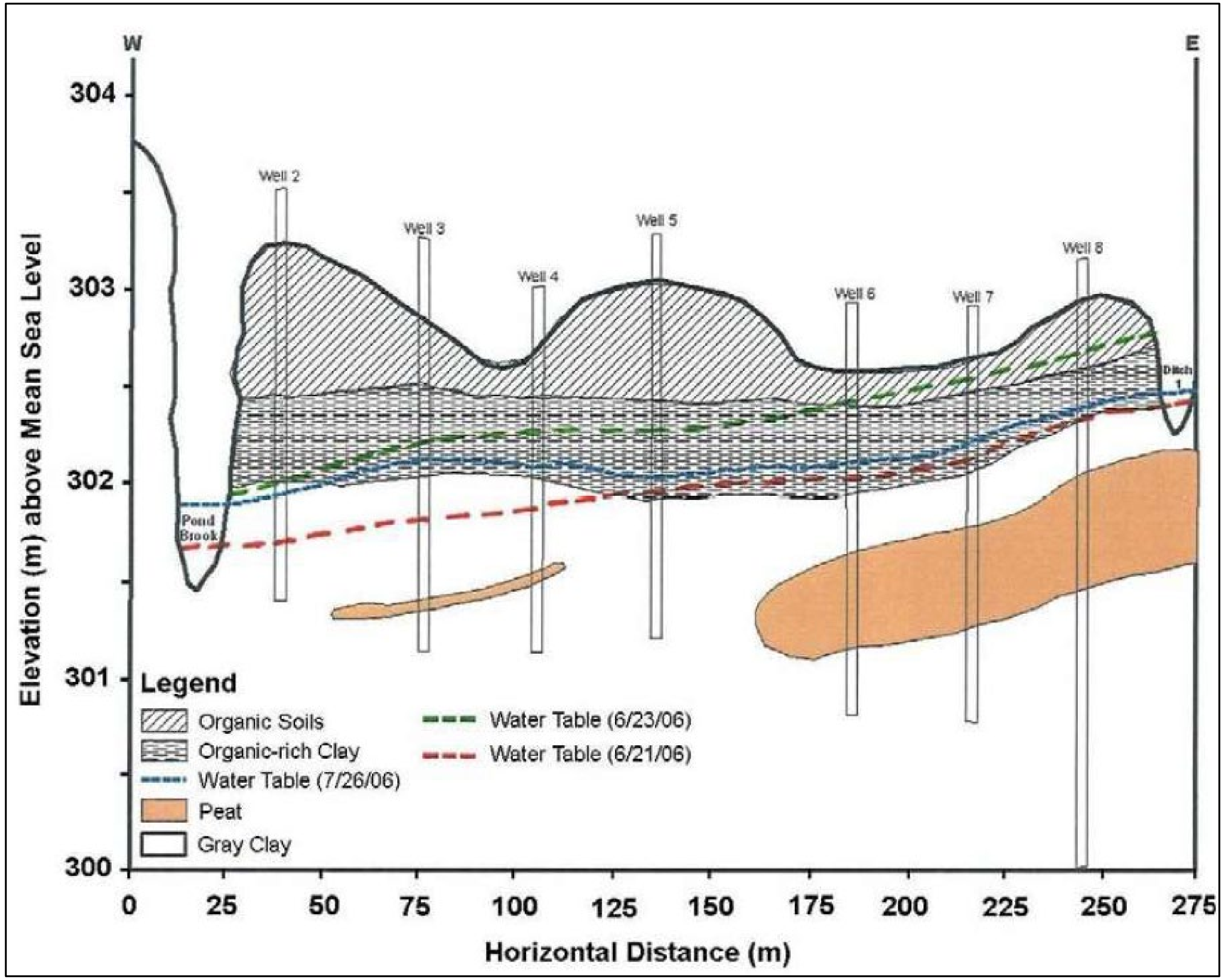
Historic Groundwater Levels

- Water Table elevations fluctuate by ~1-ft.
- No correlation between water table elevation and precipitation.
- Water table remains subsurface.



(Davey Resource Group, 2013)

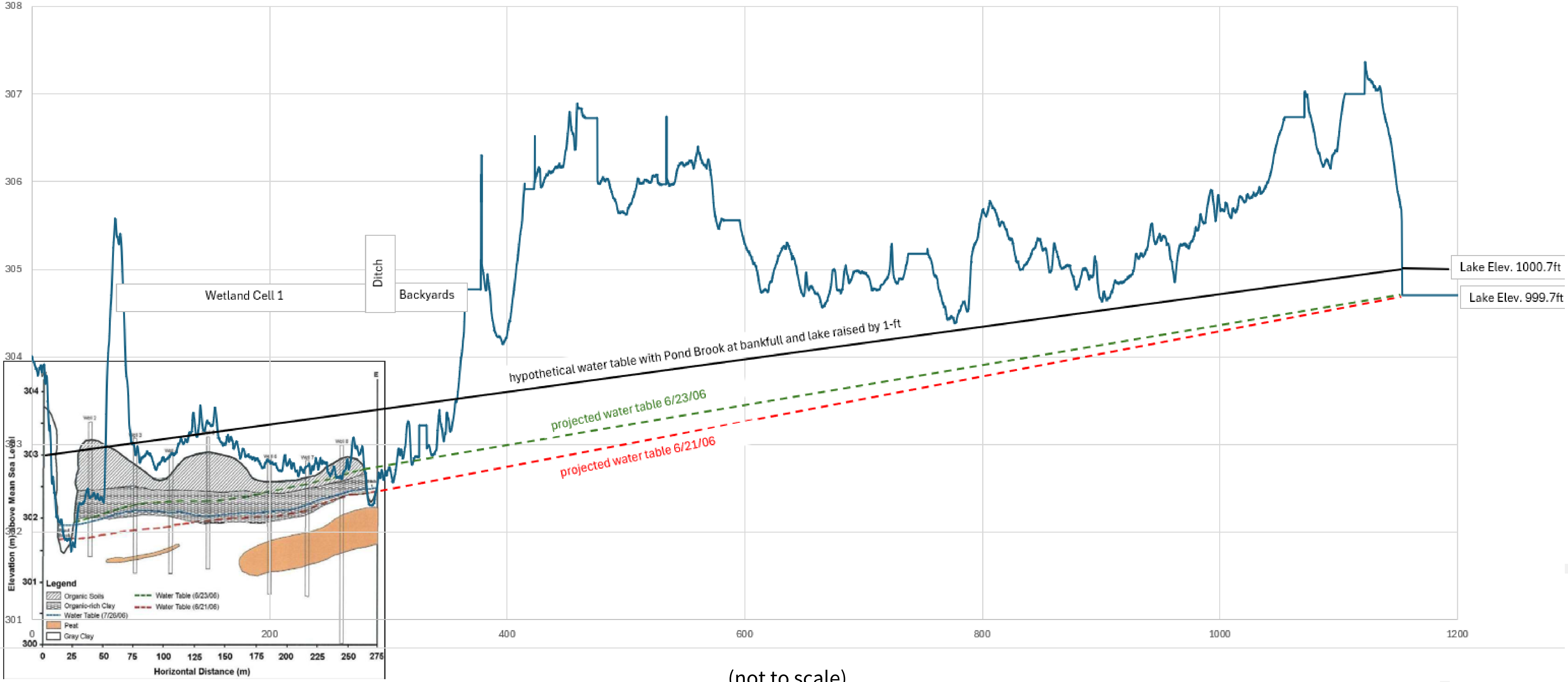
Water Table Profile



(Dzirasah, 2008)

- Water table slopes east to west – towards Pond Brook.
- Water table higher in backyards compared to wetland.

Water Table Projections

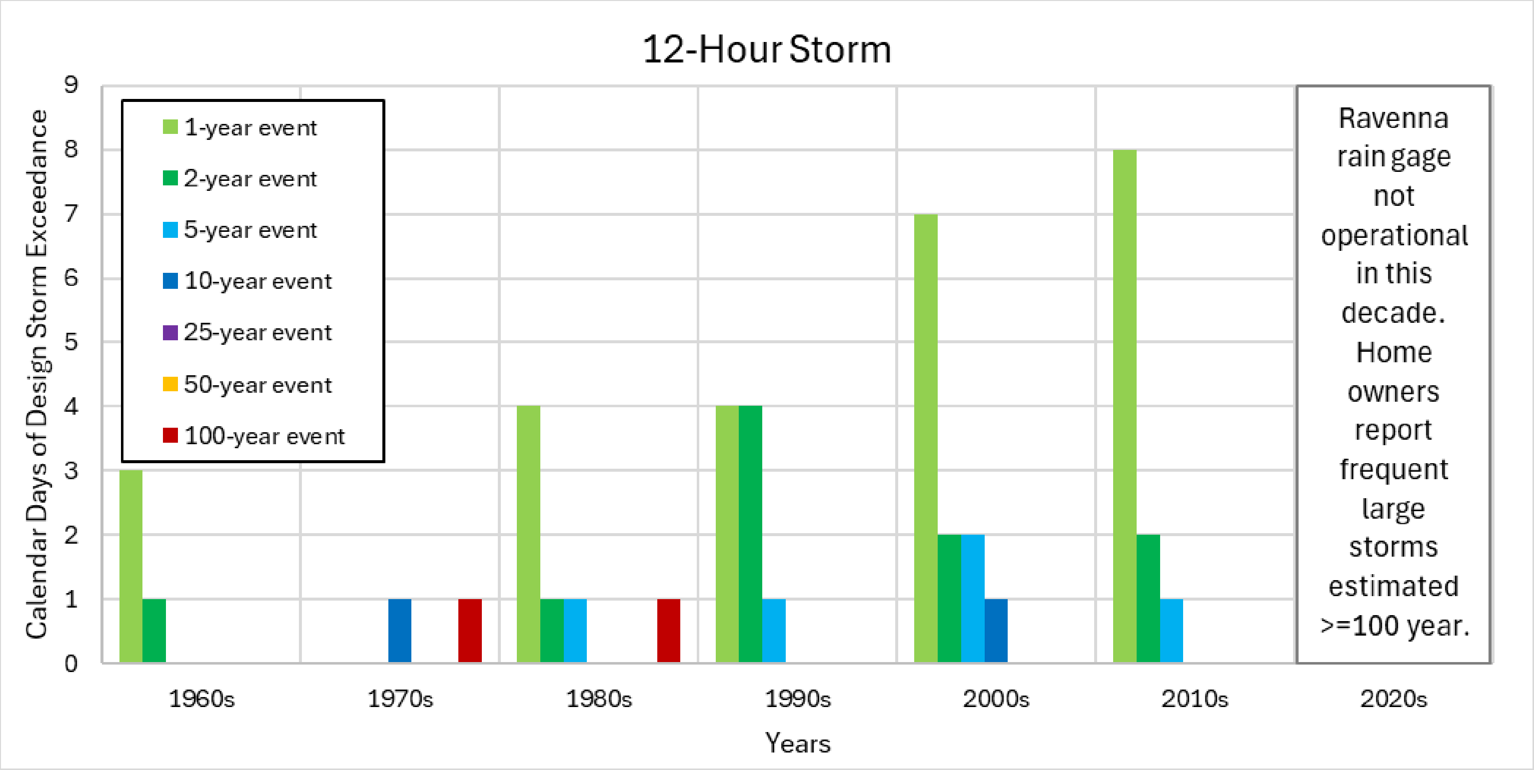


(not to scale)

Historic Precipitation

- 12-hour design storms (NOAA Atlas 14)
  - Ravenna (~13 miles away)

- Sept 7th 2020
  - ~6.5 inches local rain gage (OHM Advisors, 2021)
- July 17th 2021
  - Precip depth unknown
- June 19th 2025
  - 3.96 inches over 3 days = 5 year storm
  - Depth taken ~6miles away at Auburn Corners gage



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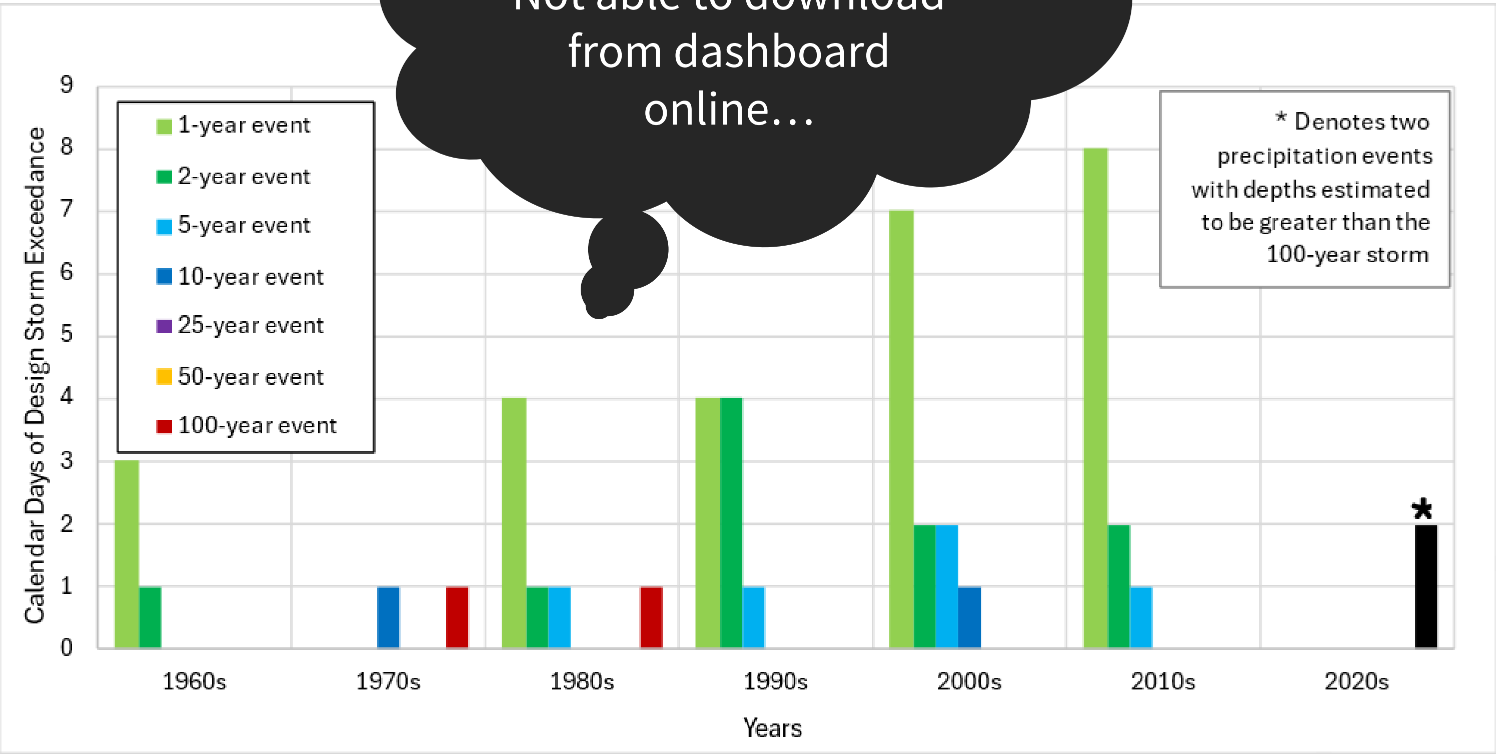
Is data collected at Aurora Lake available? Not able to download from dashboard online…



6/19/2025 – Various Locations

6/19/2025 – Regatta Trail

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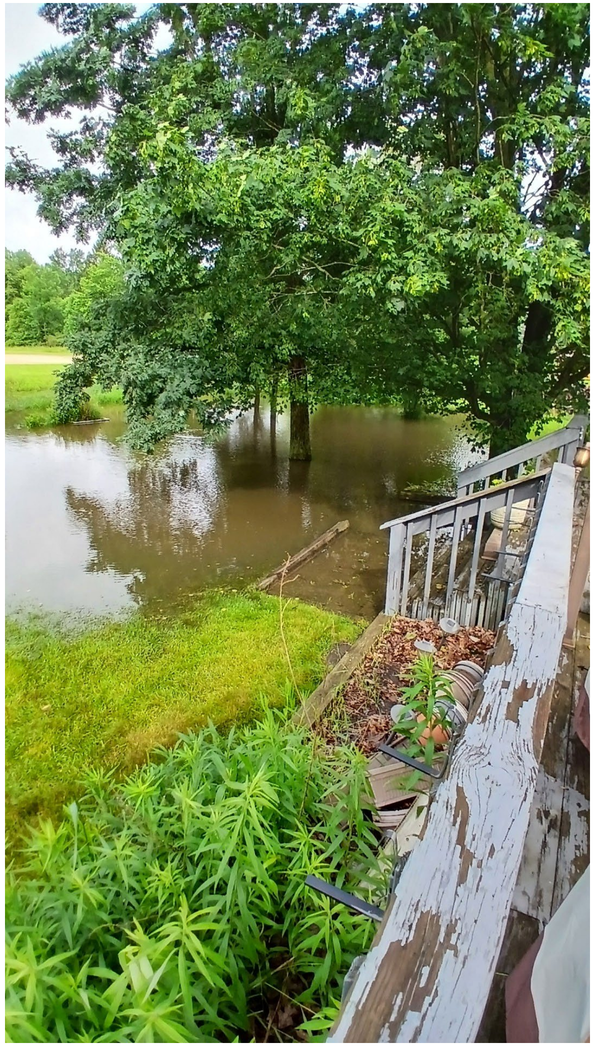
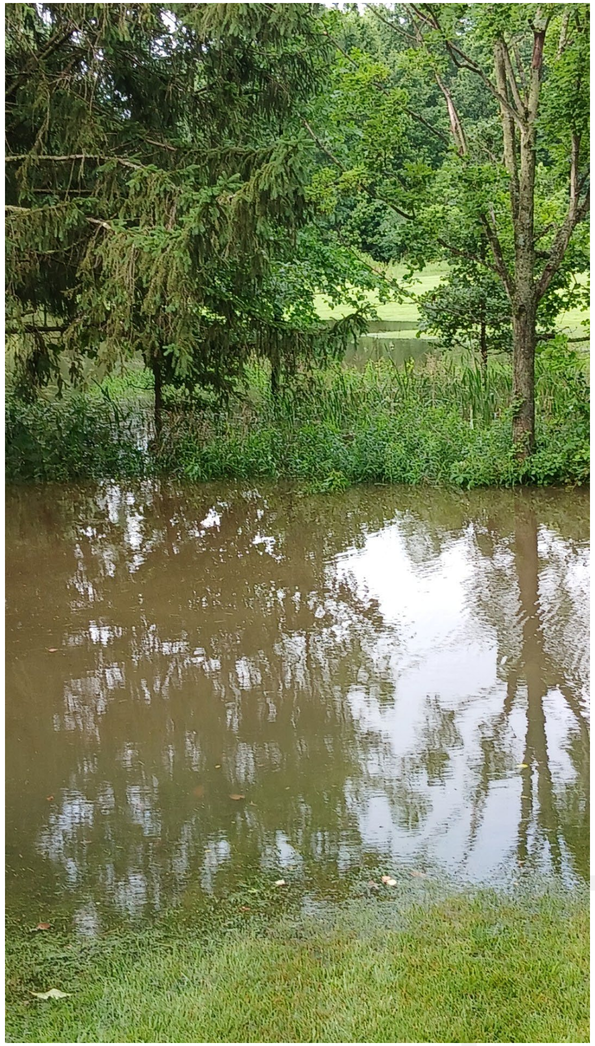



6/19/2025 – Regatta Trail



Windjammer Cove

7/17/2021

6/19/2025

Windjammer Cove

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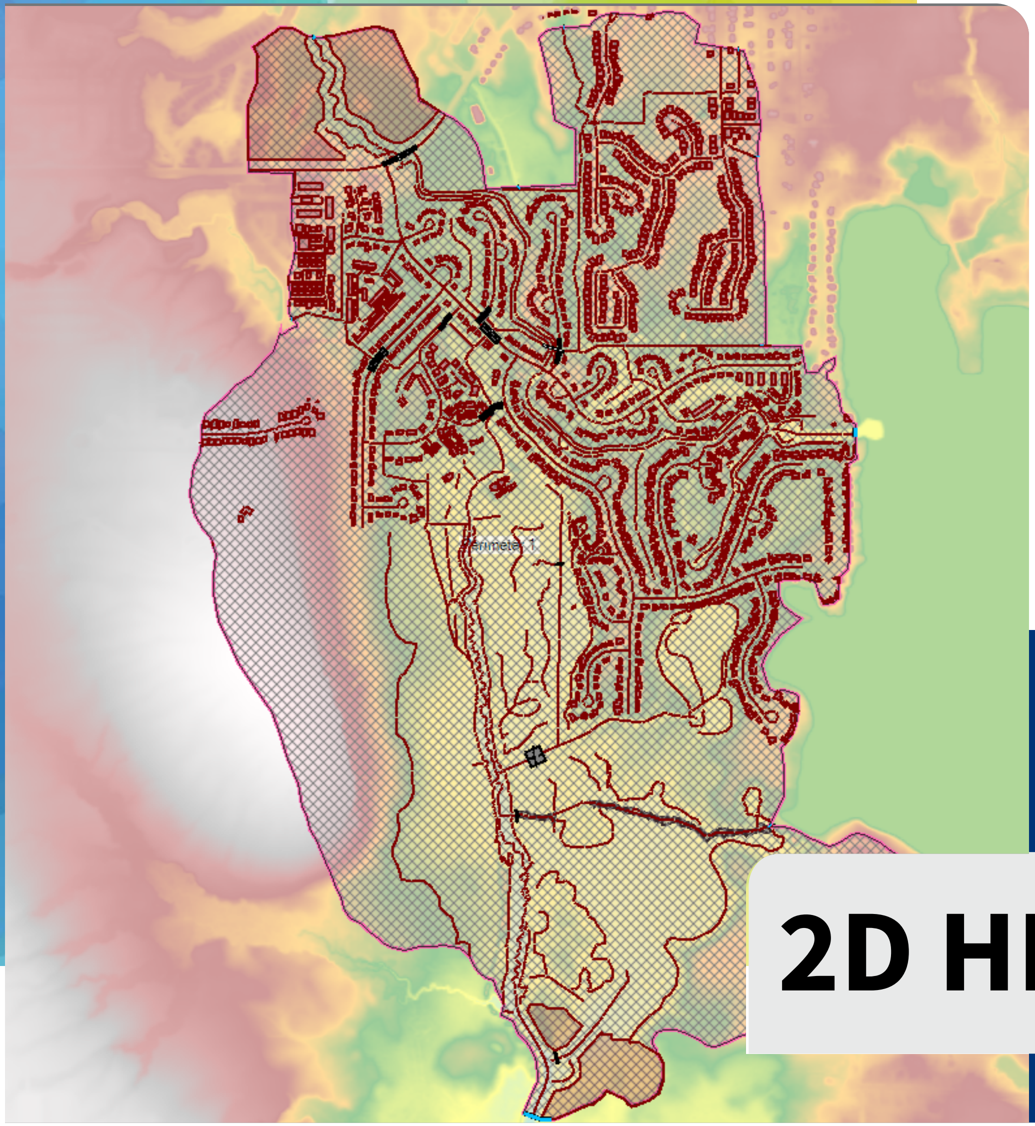
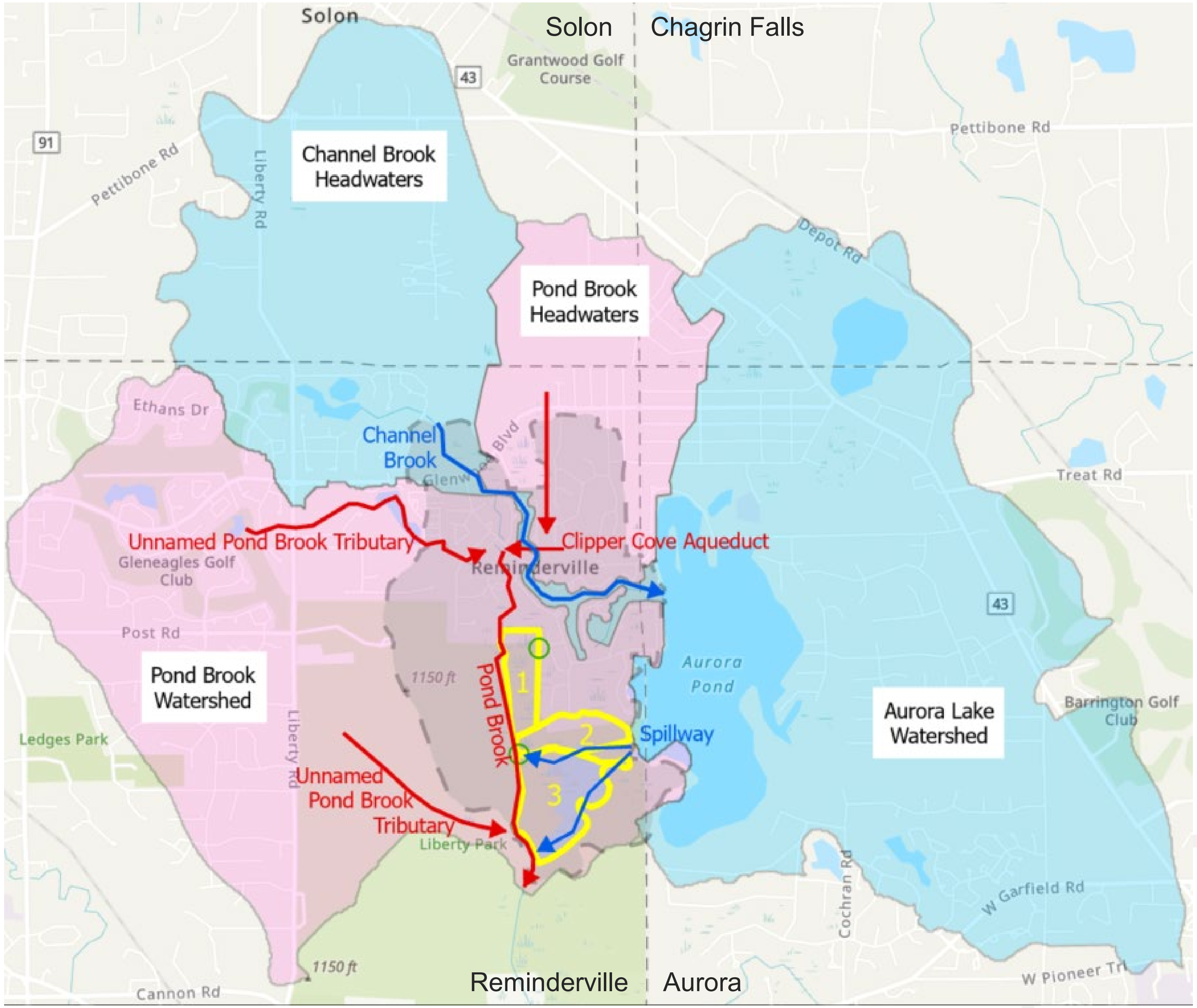
7/17/2021 6/19/2025



2D HEC-RAS Model

Scenario Overview

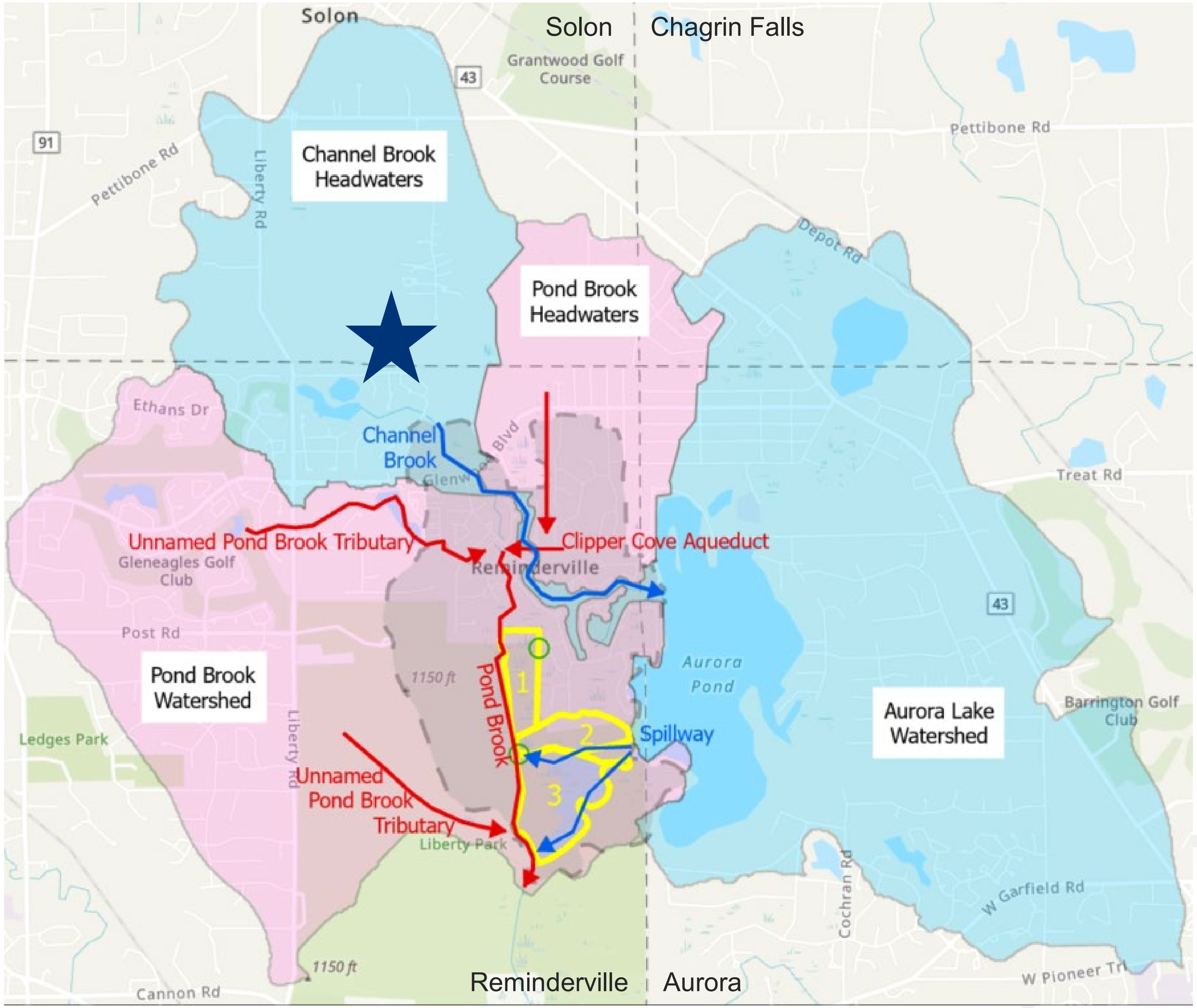
1. Channel Brook 100 Year Event
2. Aurora Lake Stage Increase
3. Aurora Lake Spillway Release
4. Agri-Drain Design Elev. = 992.5’
5. Agri-Drain Raised Elev. = 994.5’
6. Increased Hydraulic Capacity Downstream



Scenario Overview

1. **Channel Brook 100 Year Event**
   - **Do 100-year flows in Channel Brook cause flooding?**

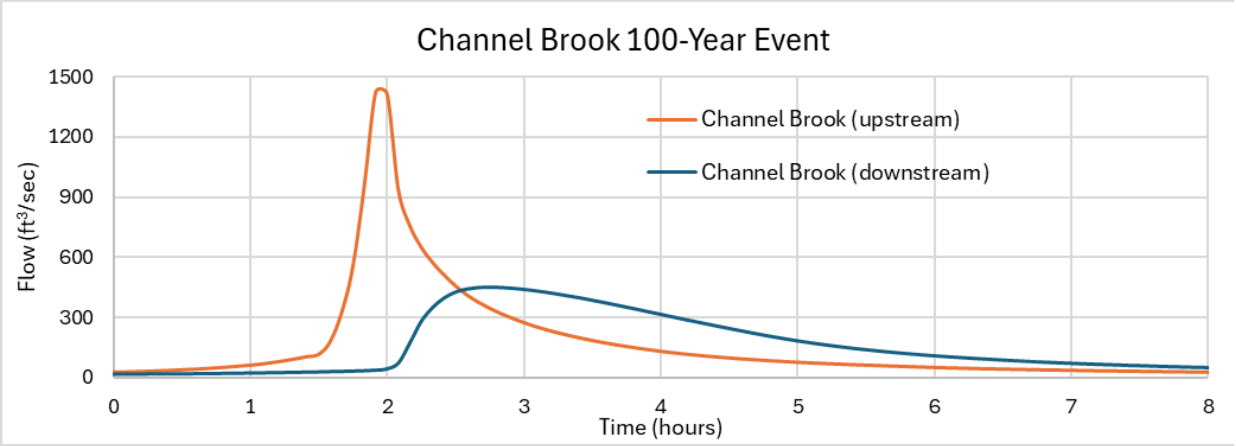
- 100-year flows applied to Channel Brook upstream of Glenwood Blvd.

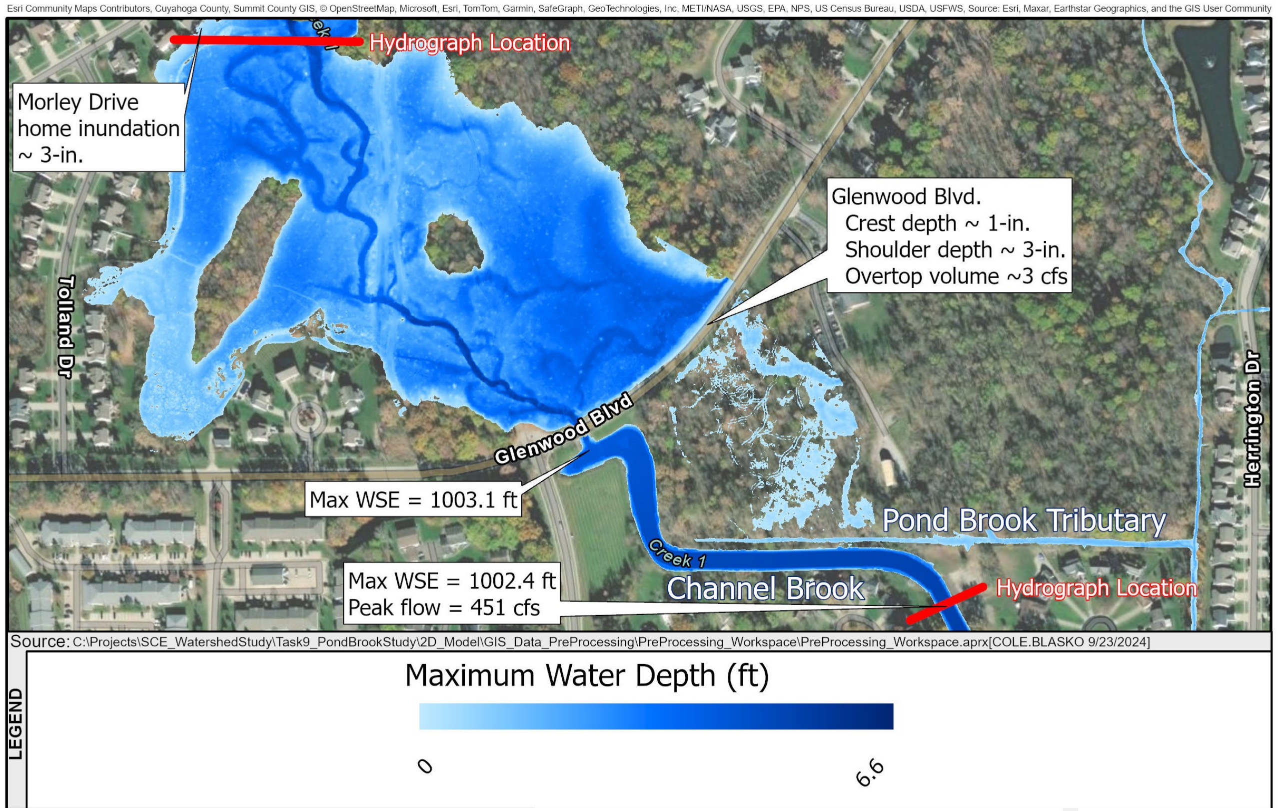


Scenario 1 – Channel Brook 100-Year Event

- Glennwood Blvd. bridge reduces peak flows downstream

- No overtopping of boating canal



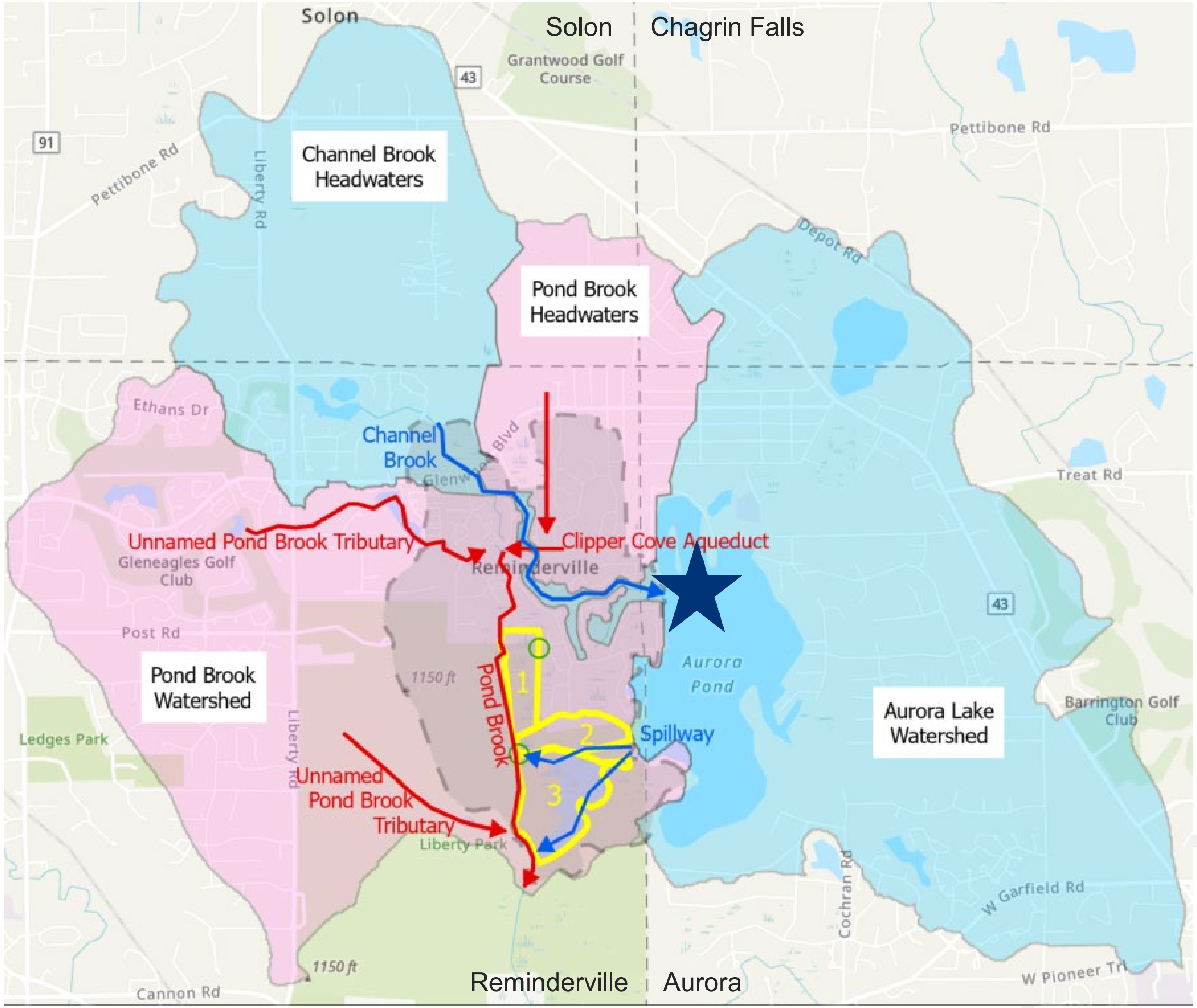


Scenario Overview

2. Aurora Lake Stage Increase

- At what elevation does Channel Brook Boating Canal overtop due to an increase in the water levels of Aurora Lake?

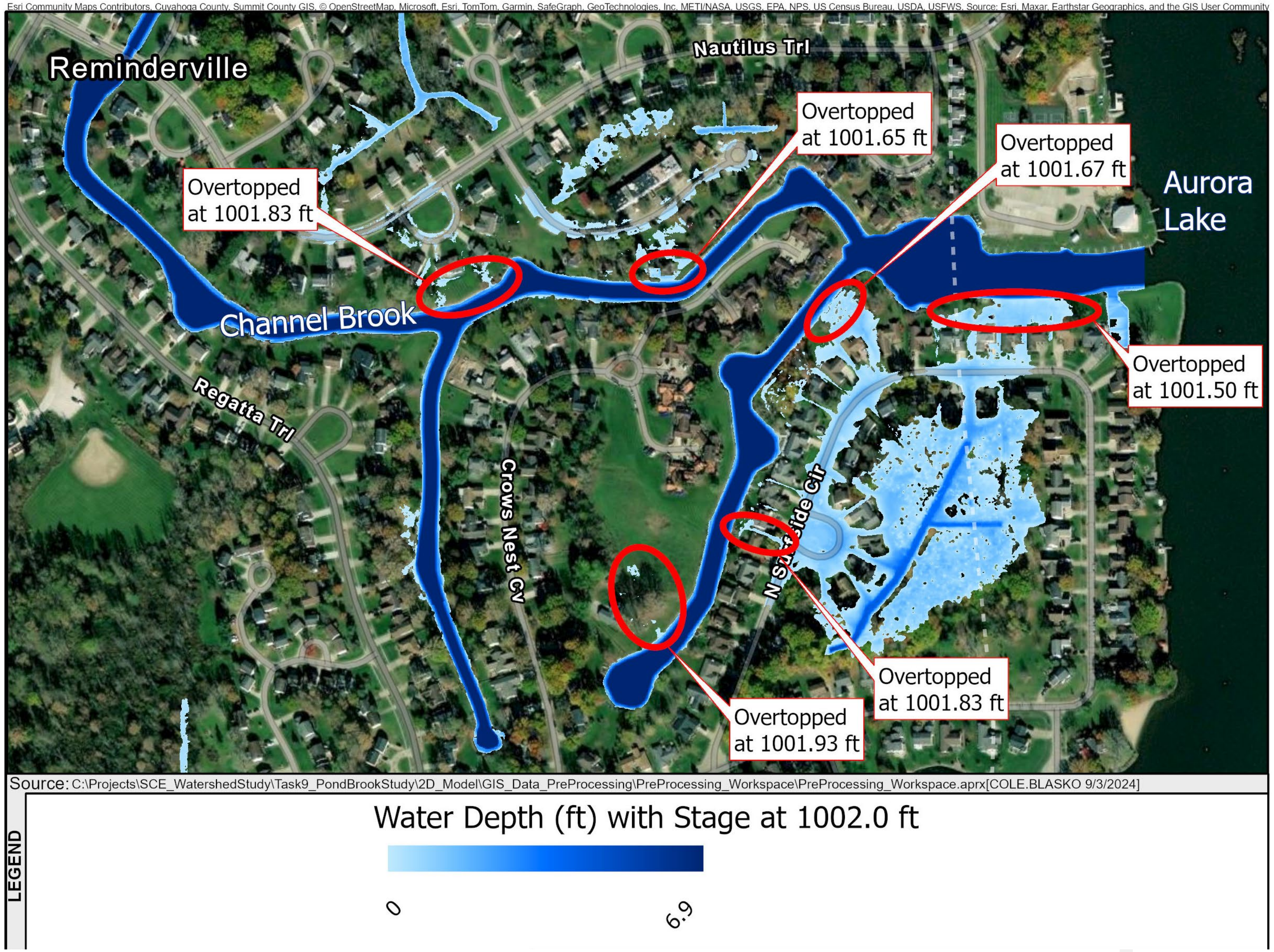
- Steadily increased the water levels within Aurora Lake.



Scenario 2 – Aurora Lake Stage Increase

- Channel Brook Boating Canal first overtops at elevation of 1001.5 feet

- This elevation would not be reached under normal dam operations which lowers the lake level prior to storms

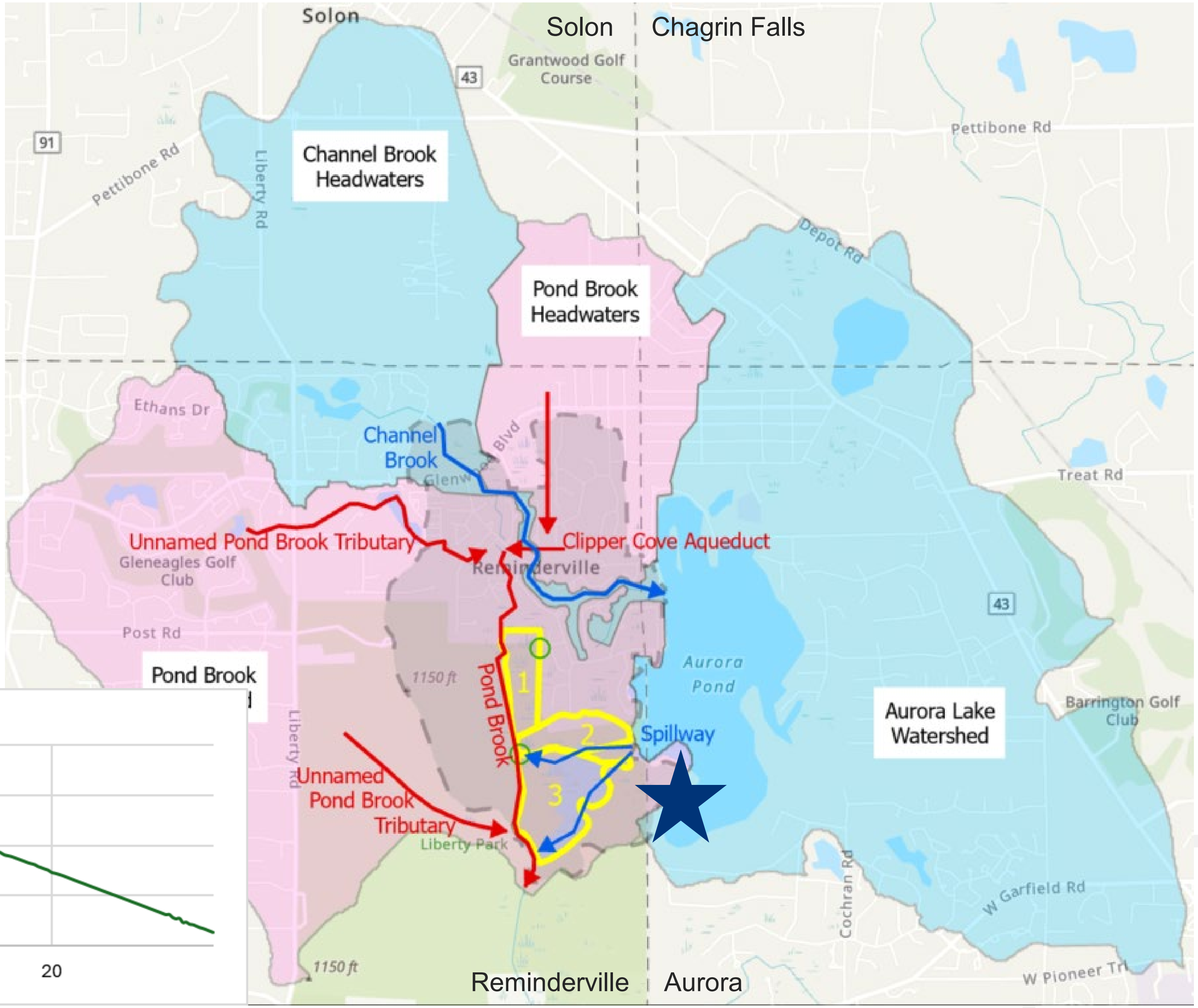


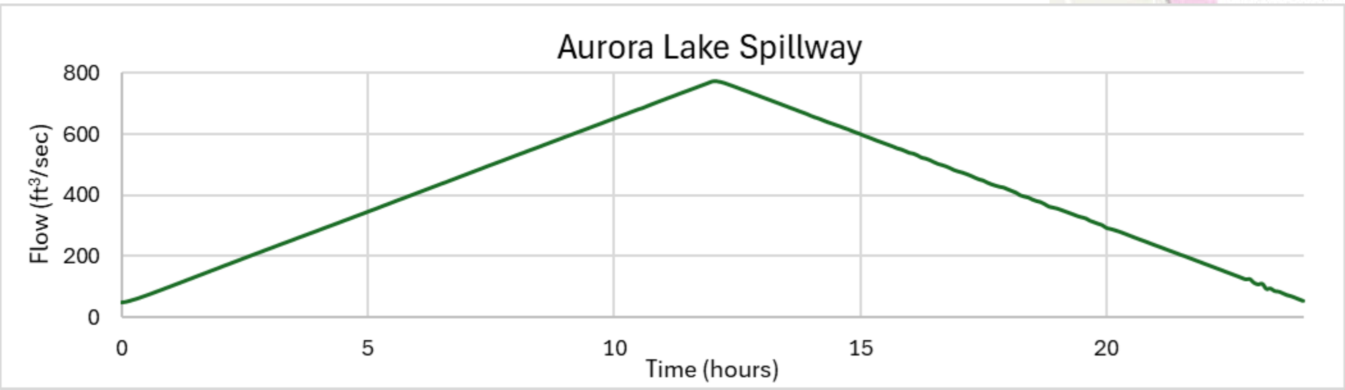
Scenario Overview

3. Aurora Lake Spillway Release

- **Does a large release from the Aurora Lake spillway cause the localized flooding via backwater effect?**

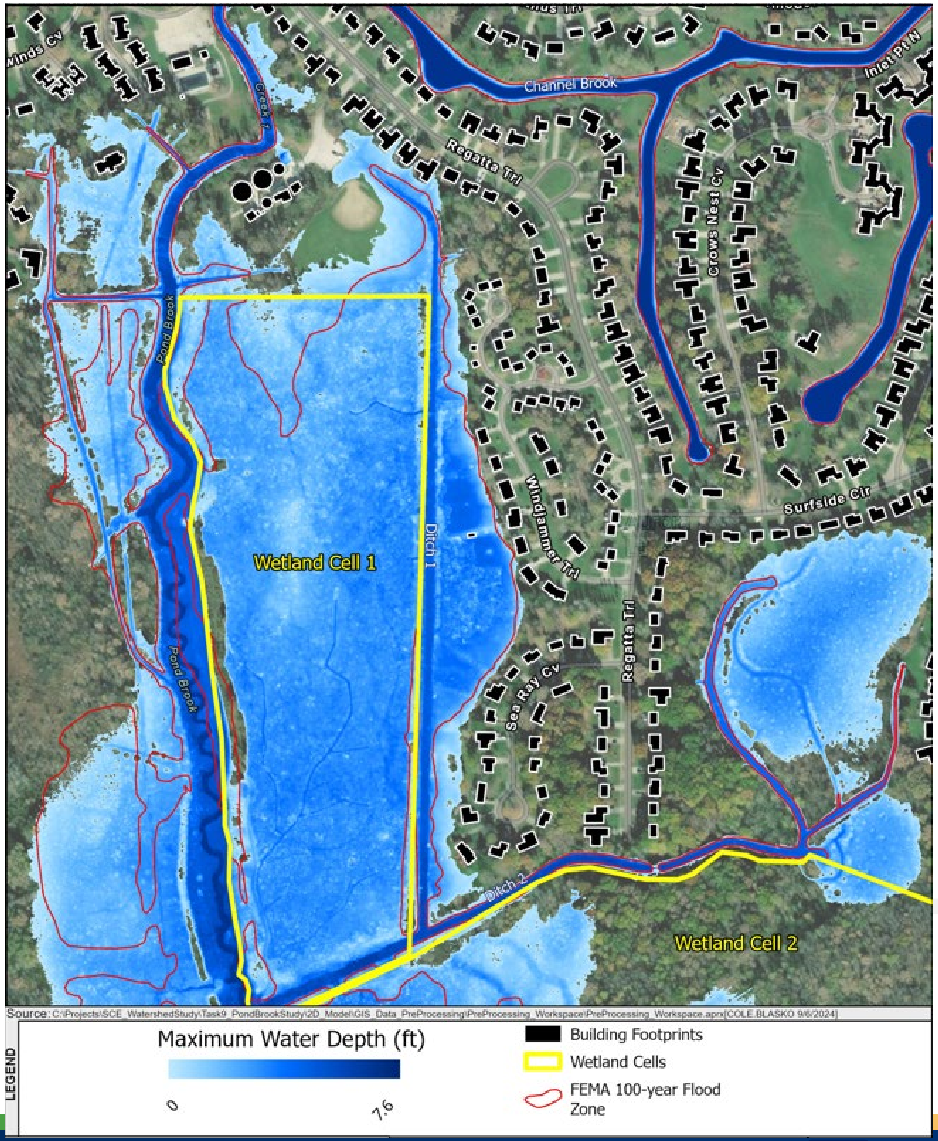
- Peak flow = 779 cfs
- Volume = 822 acre feet





Scenario 3 – Aurora Lake Spillway Release

- Flood extent shown on map
- Volume released is 2.3 times greater than 100-year event entering Aurora Lake
  - Very rare event
- May occur if emergency spillway is overtopped or sudden lowering of spillway gate
  - Not expected under normal dam operations



Scenario Overview

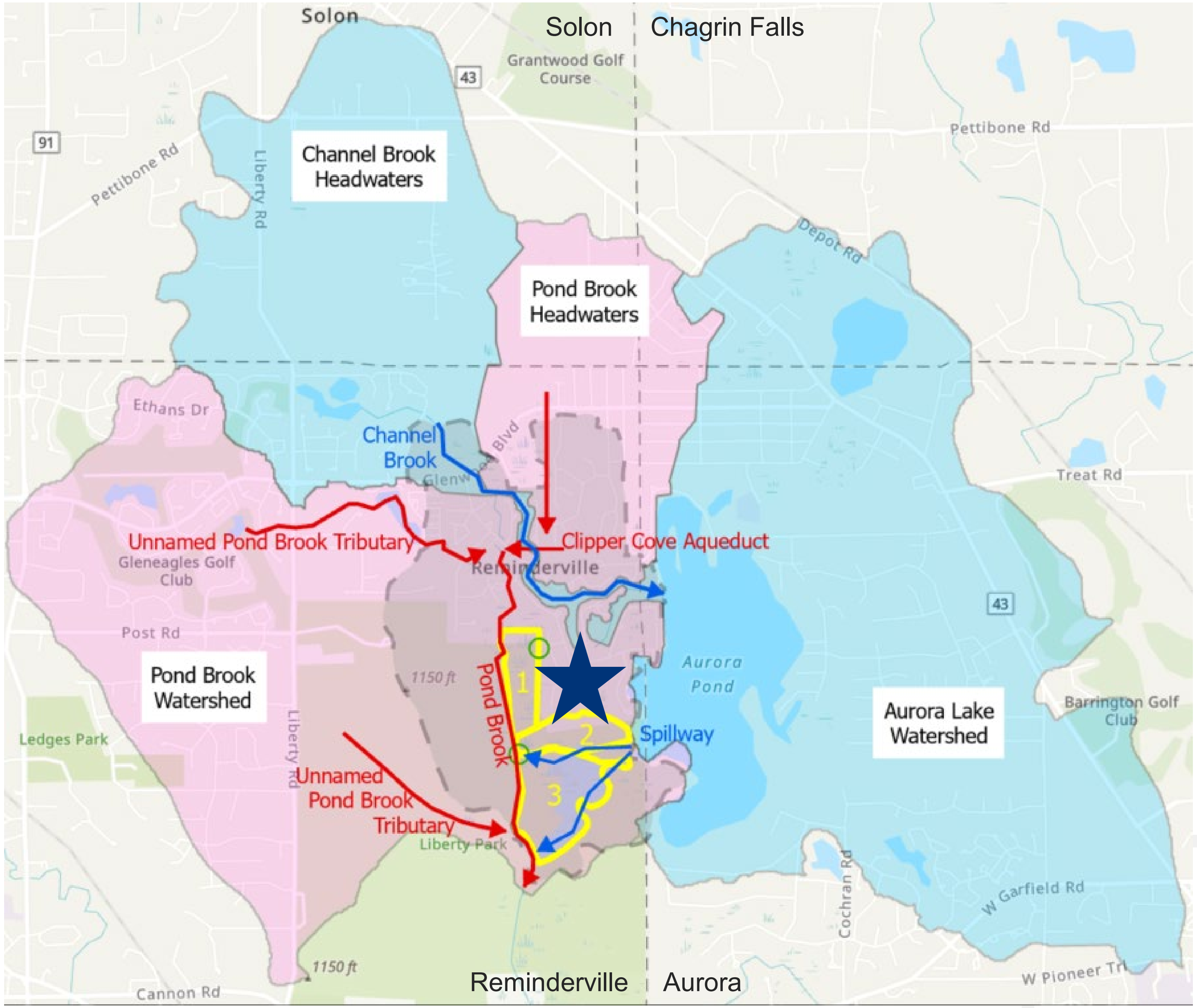
4. Agri-Drain Design Elev. = 992.5’

- **Do Agri-Drains at this design elevation impact flood depths or extent?**

5. Agri-Drain Raised Elev. = 994.5’

- **Can the Agri-Drain elevations be modified to decrease flooding in backyards?**

- Applied 100-year precipitation to model



Scenarios 4 & 5 Hydrology Overview

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- Elevation raised with goal of diverting more water to wetland and less to ditch 1
- 100-year precipitation closely matches FEMA 100-year flood zone

Scenario 5 – Agri-Drain Raised Elevation = 994.5’

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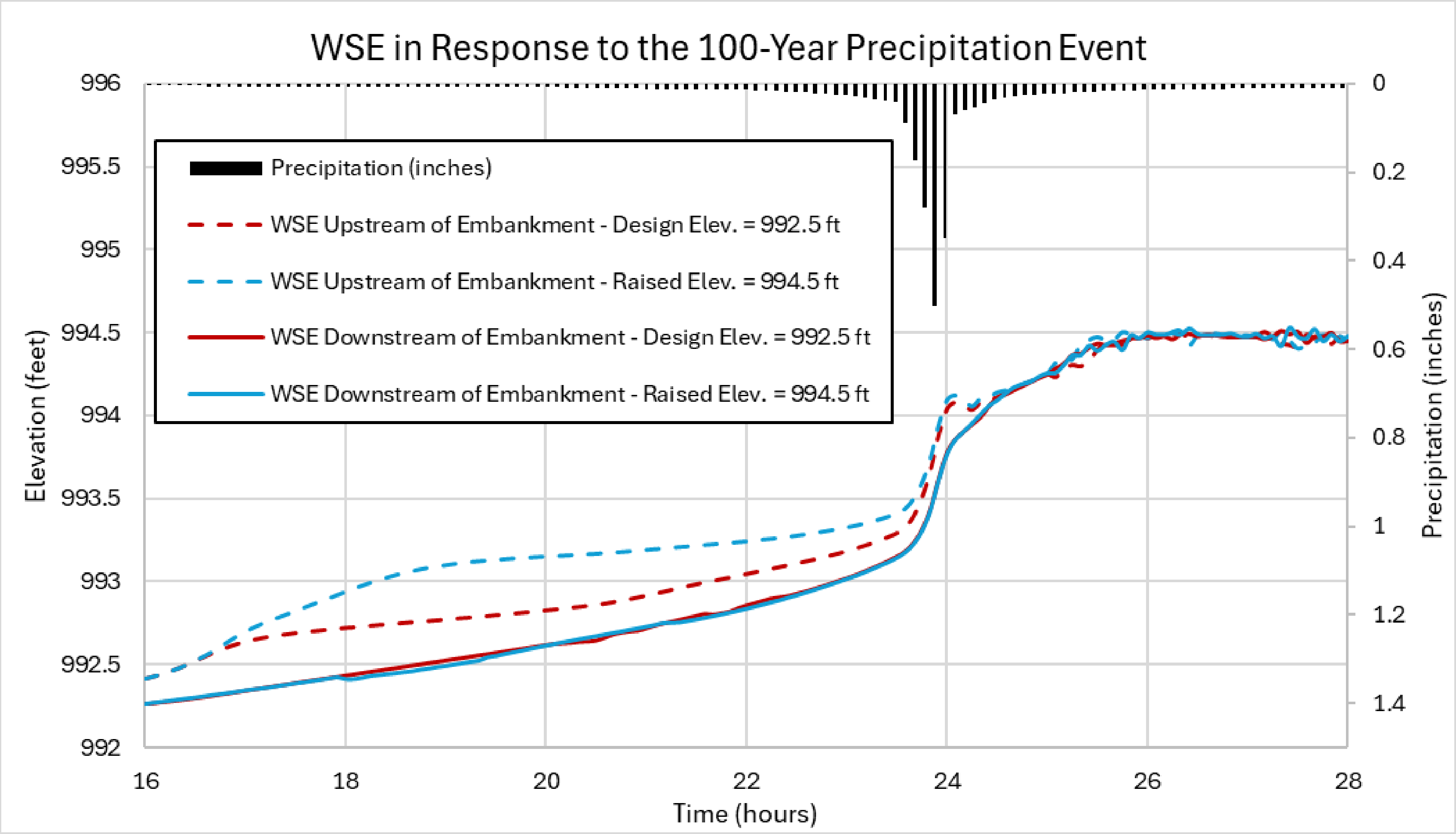
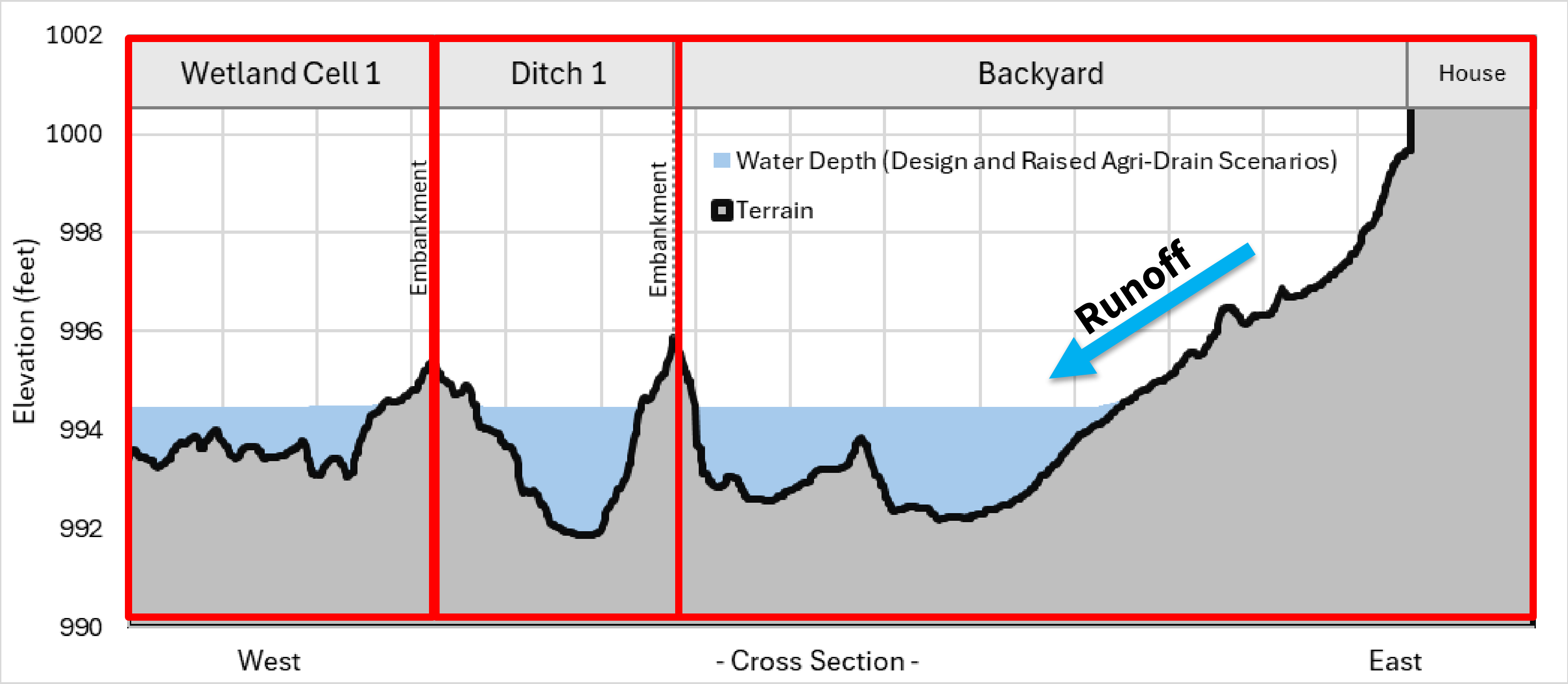


- Water surface elevations are the same after peak precipitation regardless of Agri-Drain elevation.
- 100-year precipitation with peak at 0.5 inches per hour

Scenario 5 – Agri-Drain Raised Elevation = 994.5’

- Low elevation of backyards relative to the ditch and wetland is main driver of localize flooding



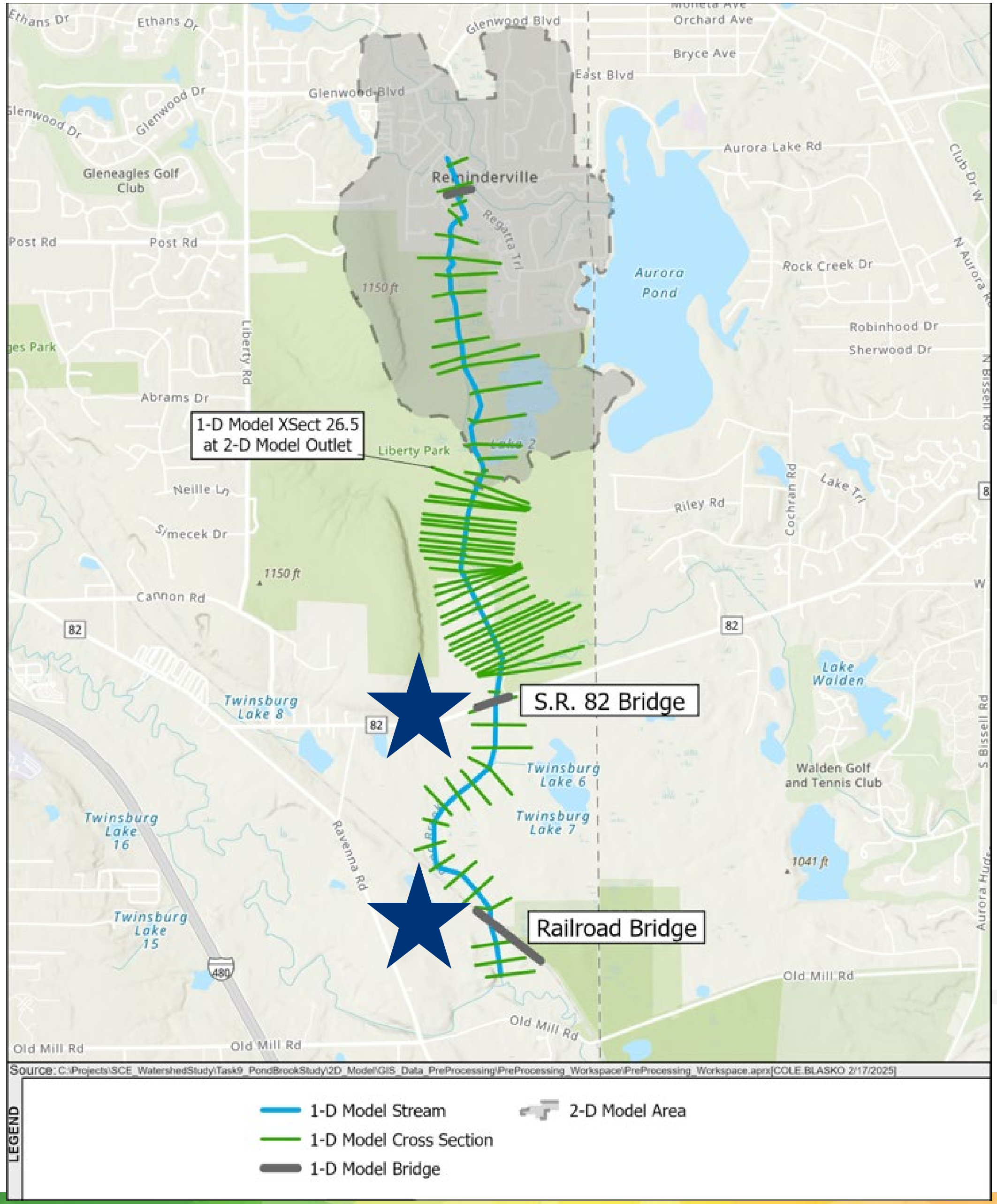
Direct precipitation and runoff from backyards pools in low area.

Scenario Overview

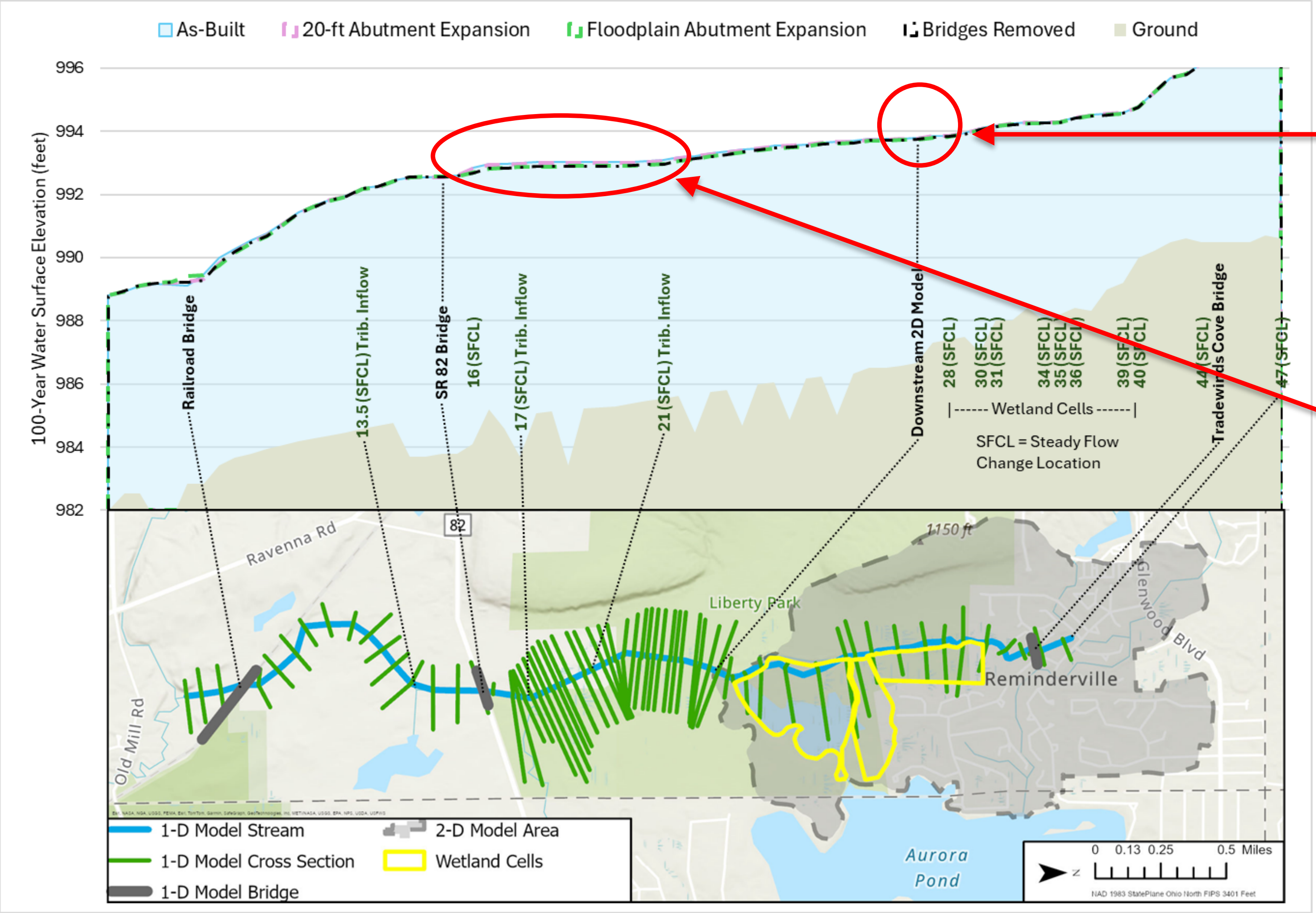
6. Increased Hydraulic Capacity Downstream

- **Will increasing the hydraulic capacity of the S.R. 82 and Railroad bridges improve flooding in Aurora Shores?**

- Utilized 1-D HEC-RAS model with greater spatial extent (Stantec, 2017)



Scenario 6 – Increased Hydraulic Capacity Downstream



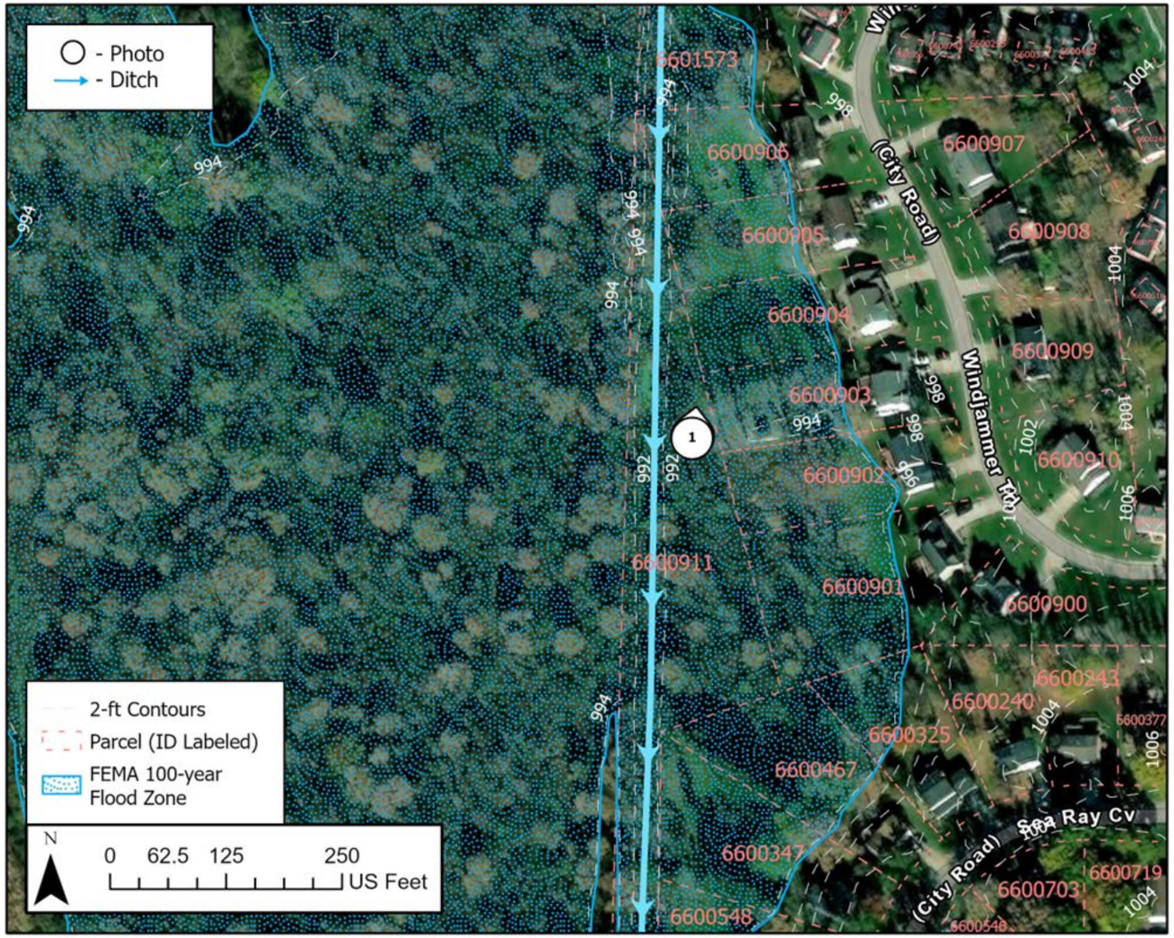
WSE Results:

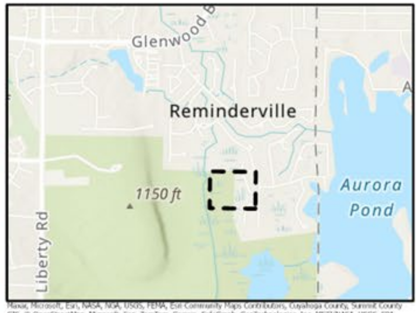
- Negligible difference at 2-D model down-stream extent
  - ~0.5 inches
- Minimal elevation differences in restored reaches
  - ~1.5 inches

Scenario Conclusions

- Localized flooding is not sourced from the Channel Brook drainage network
  - 100-year flows (scenario 1), increases in lake elevation (scenario 2), and large spillway releases (scenario 3) did not show the ability to cause the observed flooding
- Flooding along Windjammer Trail and Sea Ray Cove remains under existing and modified Agri-Drain elevations
  - Flooding is primarily sourced from precipitation(scenarios 4 & 5) – not from increases in ditch stage – and is worsened by the low lying, poorly drained soils that are natural to the wetlands and high water table
- Increasing the hydraulic capacity of downstream bridges does not impact flooding in Aurora Shores (scenario 6)

Potential Solutions





Project Details

Watershed: Pond Brook
HUC12: 041100020501
Municipality: City of Reminderville

Field Visit Date:3/20/2024

Project Narrative

Flooding along backyards of Regatta Trail, Windjammer Trail, and Sea Ray Cove is longstanding and well documented. Historically a natural wetland / swamp, flooding occurs due to the pooling of direct precipitation and lack of adaquate grade to drain the area. The adjacent ditch has not been shown to overtop. Alternative 1 proposes maintaining the existing conditions and allow the area to flood within the FEMA 100-year floodplain which extends up to, but does not inundate, the homes.

Summit County Engineer
Cuyahoga River Watershed Study
ASN_AOI_9
Aurora Shores Flooding Alternative 1

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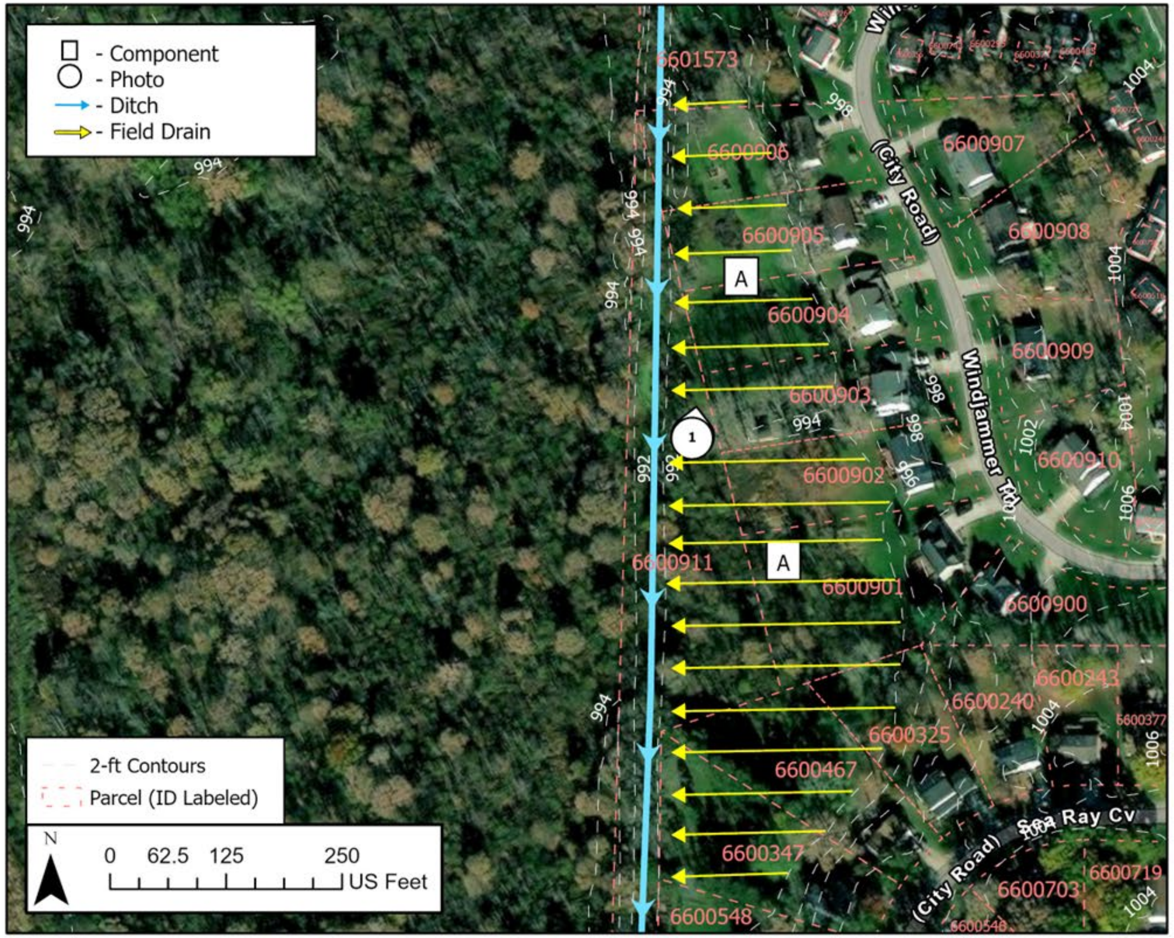

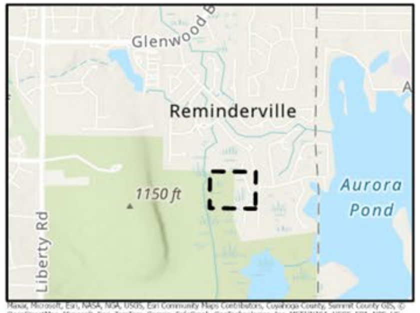

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Summit County Engineer
Cuyahoga River Watershed Study
ASN_AOI_9
Aurora Shores Flooding Alternative 2

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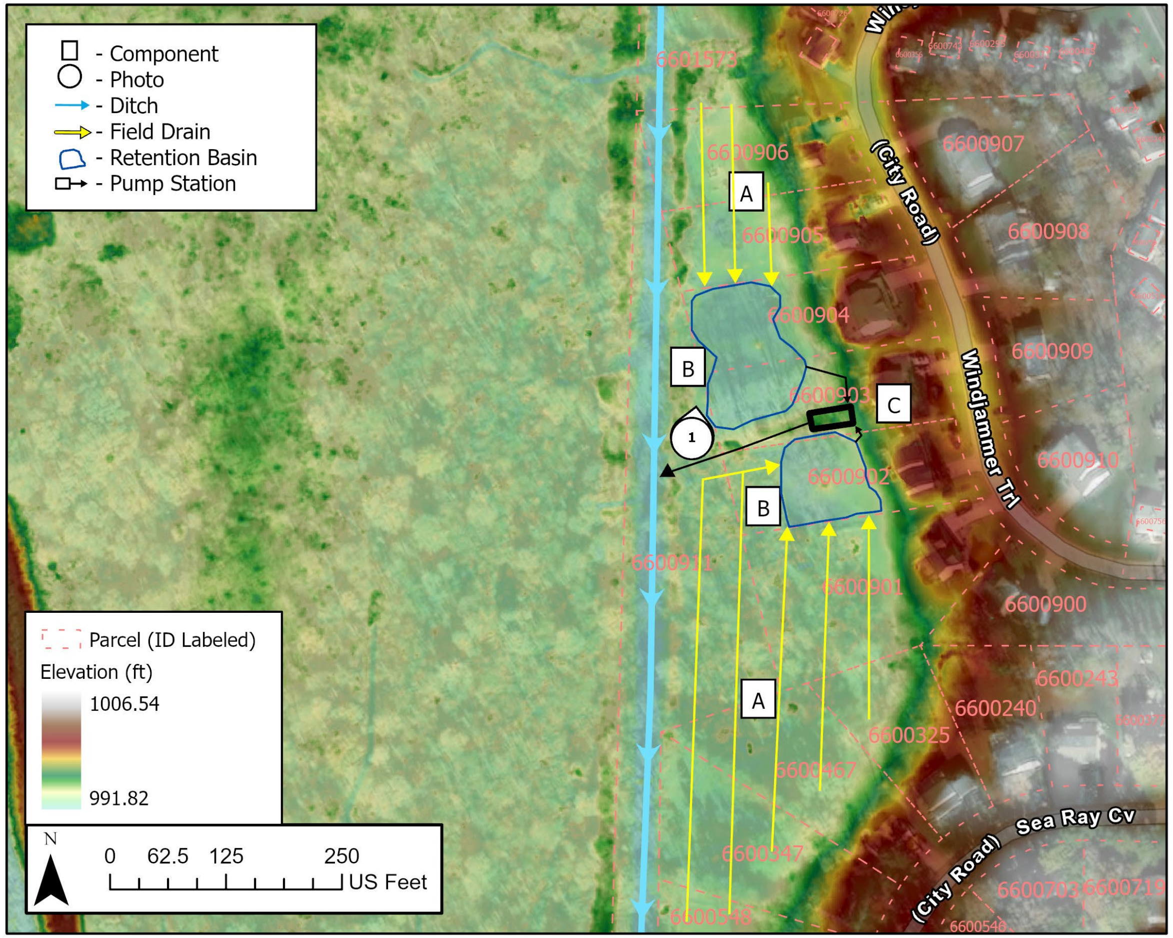

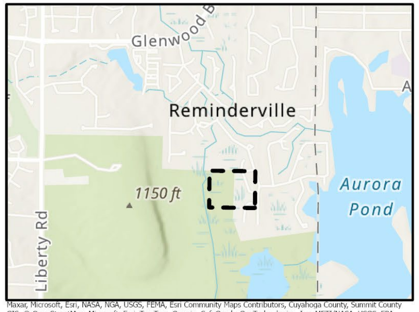

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Field Visit Date:3/20/2024

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Flooding along backyards of Regatta Trail, Windjammer Trail, and Sea Ray Cove is longstanding and well documented. Historically a natural wetland / swamp, flooding occurs due to the pooling of direct precipitation and lack of adaquate grade to drain the area. The adjacent ditch has not been shown to overtop. Alternative 3 proposes to remove water from the area using the following three components: [A] - install field drains to convey water out of backyards; [B] - construct 2 retention basins with impermeable lined bottoms; and [C] - install a pump station. The retention basins and pump stations will require the aquisition of 3 properties where elevations are most suitable (6600902, 6600903, 6600904). Feasibility and design specifications have not yet been established.

Summit County Engineer
Cuyahoga River Watershed Study
ASN_AOI_9
Aurora Shores Flooding Alternative 3

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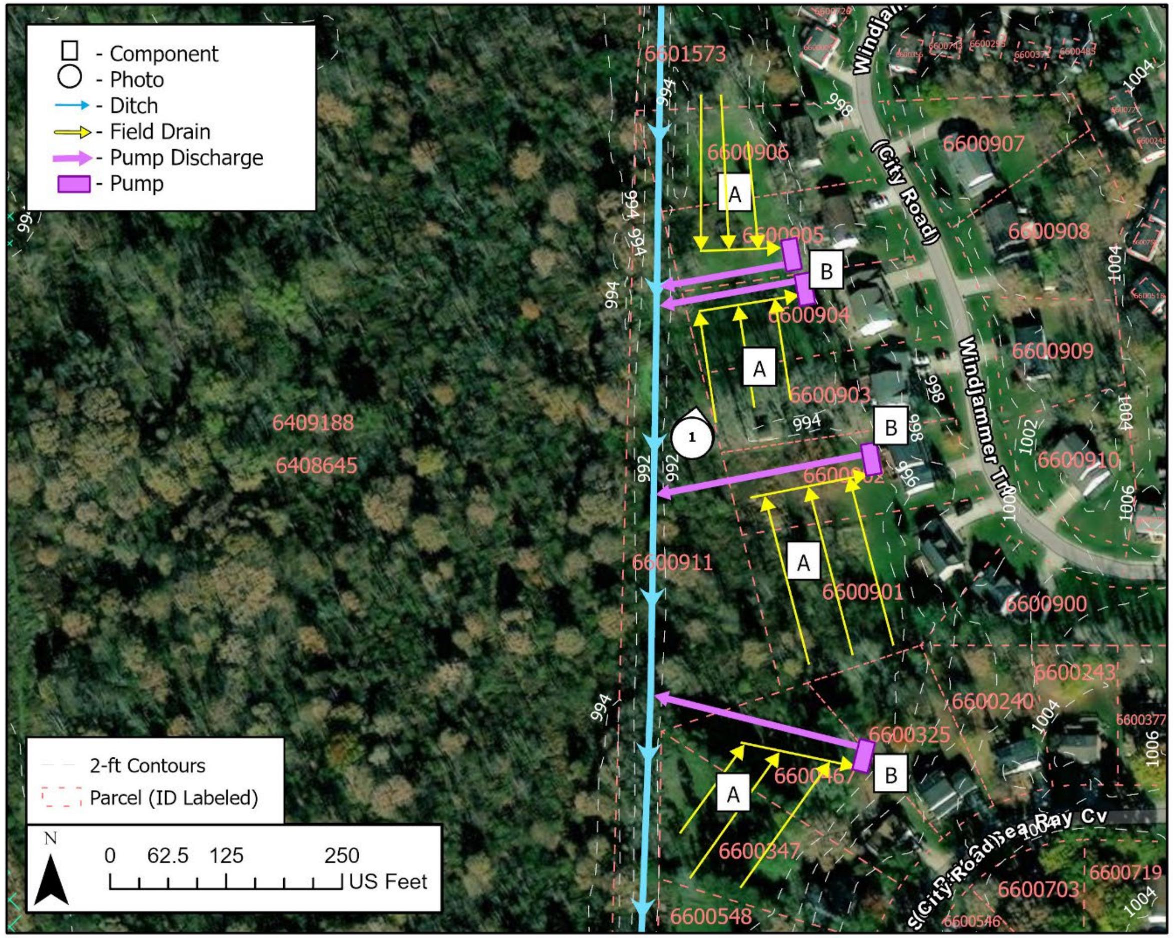

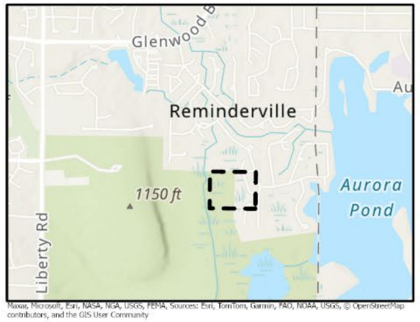

Project Details

Watershed: Pond Brook
HUC12: 041100020501
Municipality: City of Reminderville

Field Visit Date:3/20/2024

Project Narrative

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Summit County Engineer
Cuyahoga River Watershed Study
ASN_AOI_9
Aurora Shores Flooding Alternative 4

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Surface Water Management District
For More Information:

Please Visit Our Website at:
https://www.summitengineer.net/pages/Surface-Water-Management-District.html

Regional Watershed Studies can be found at:
https://www.summitengineer.net/projects/

Or Email us at:
SWMD@summitengineer.net

Or Call Us at:
330-643-8010

Questions/Discussion

Supplemental Slides

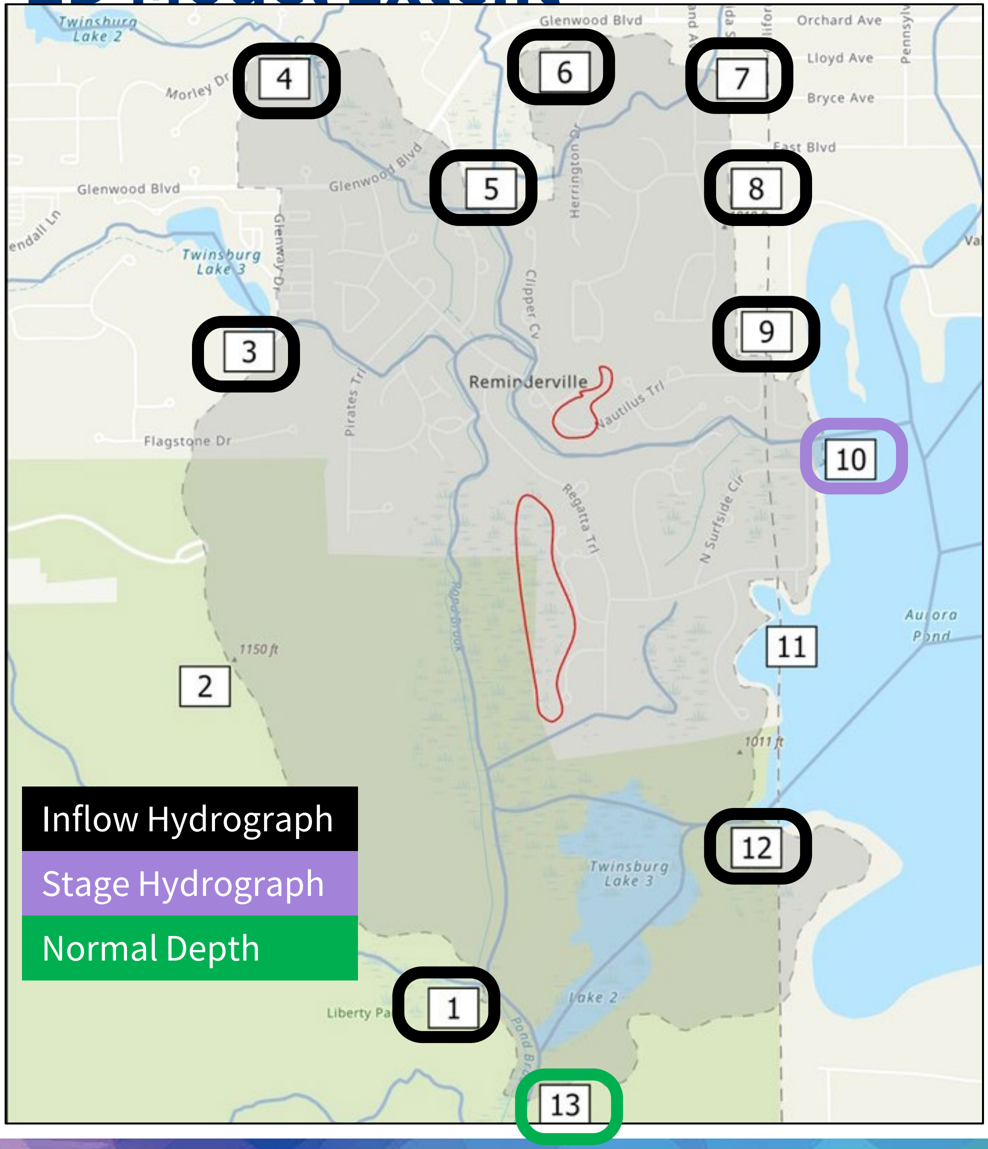
Supplemental Slide
Why HEC-RAS 2D Model?

- Previous studies did not account for full extent or all components of the stream network.

- 2-D model provides better prediction of the extent and depth of inundation in areas with complex channel and overbank conditions compared to 1-D models.

- This 2-D model will provide a good basis for future studies and restoration designs.

Supplemental Slide
2D Model Extent



Defined by boundary conditions

1, 3, 4: Ungaged tributaries – hydrographs developed based on USGS regression equations

5 – 9: SWMM model hydrographs (OHM, 2021)

10: Channel Brook outlet to Aurora Lake

12: Aurora Lake spillway13: Watershed outlet

2 & 11: Watershed boundaries

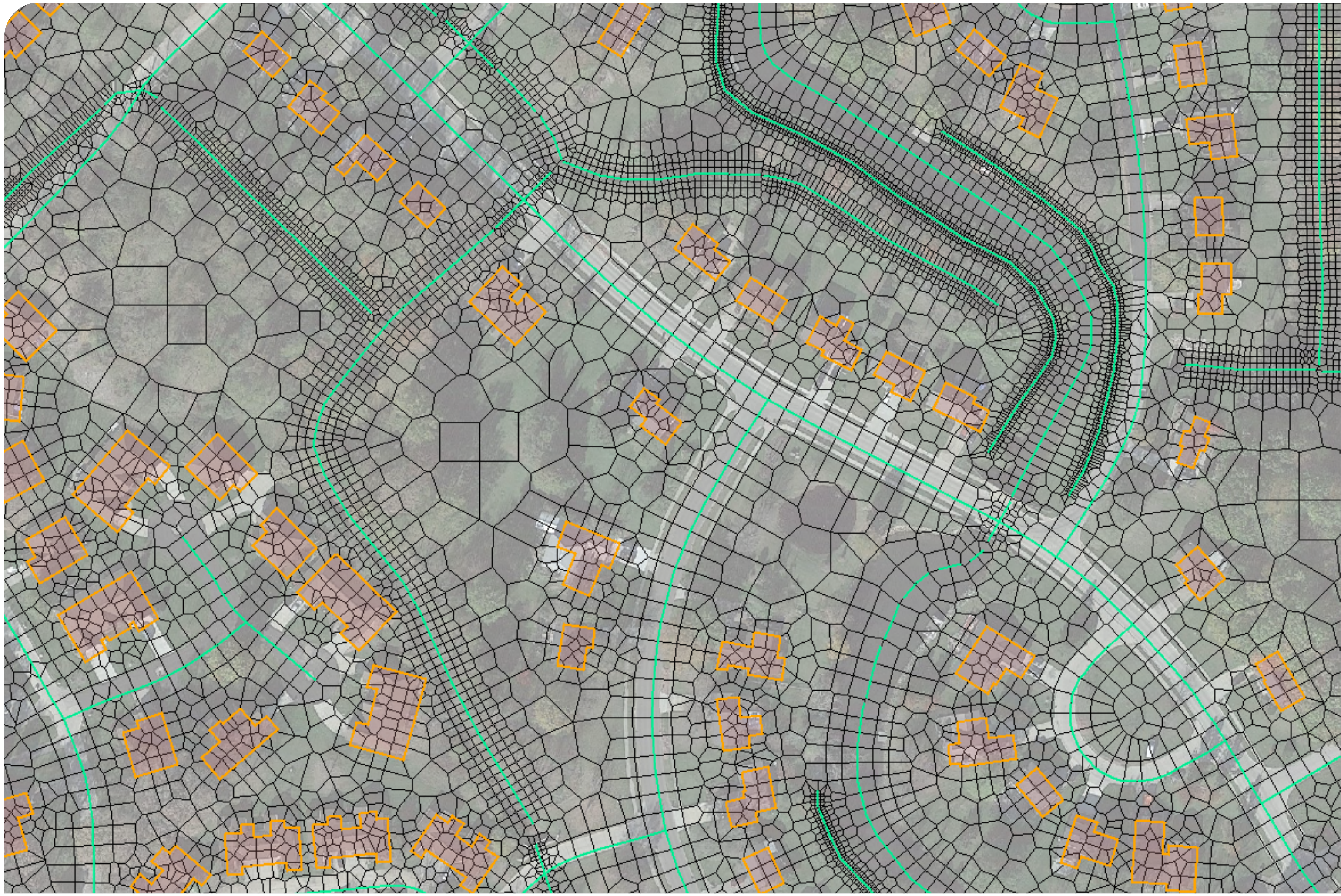
Supplemental Slide
2D Mesh

Breaklines

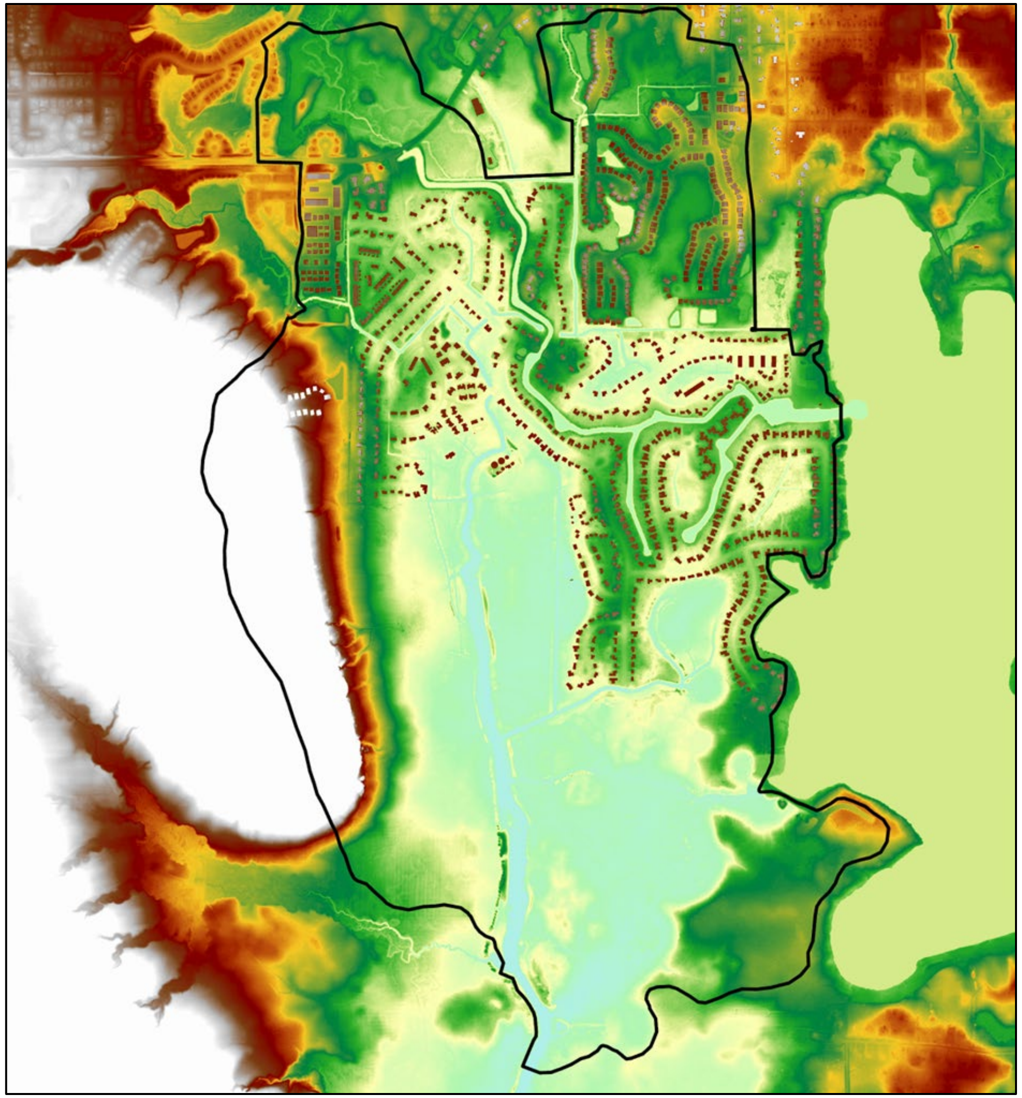
- Streams and banks
- Road Centerlines
- Other elevation changes

Refinement regions

- Building footprints



Supplemental Slide
Terrain



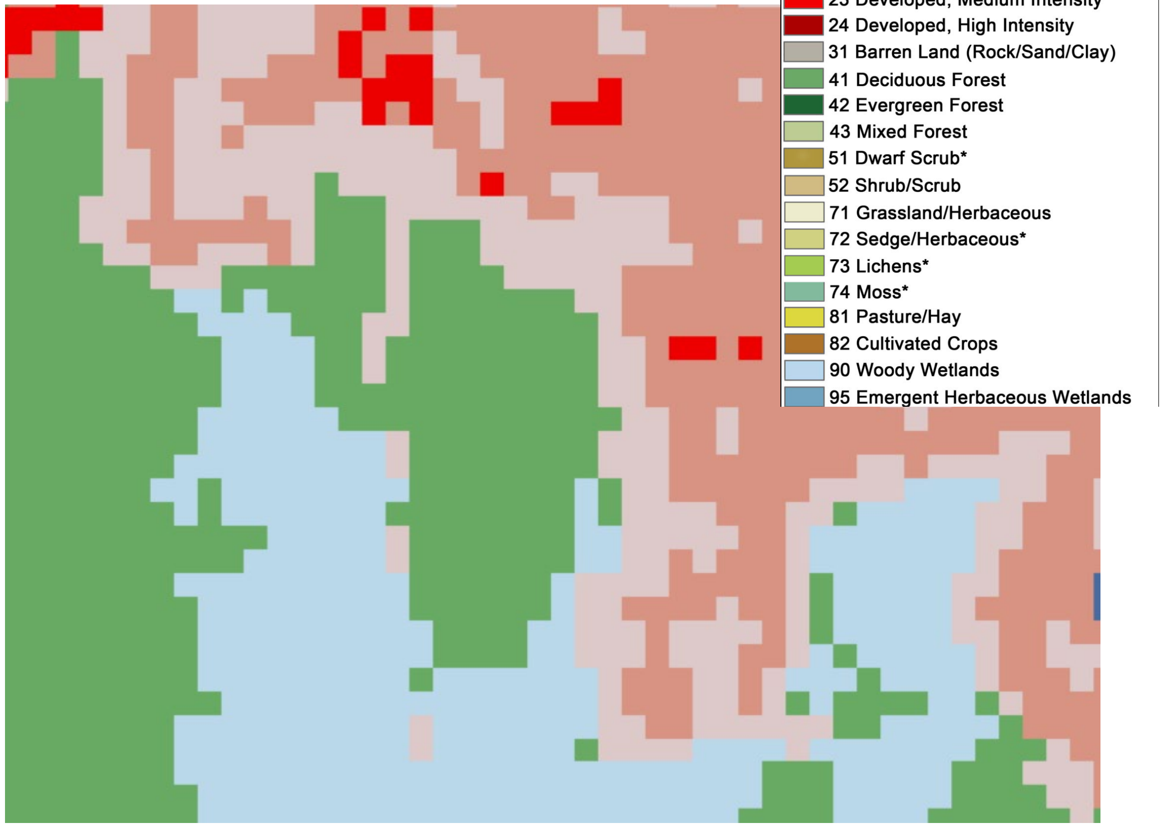
USGS data at 1.25-ft resolution

Manually modified the following:

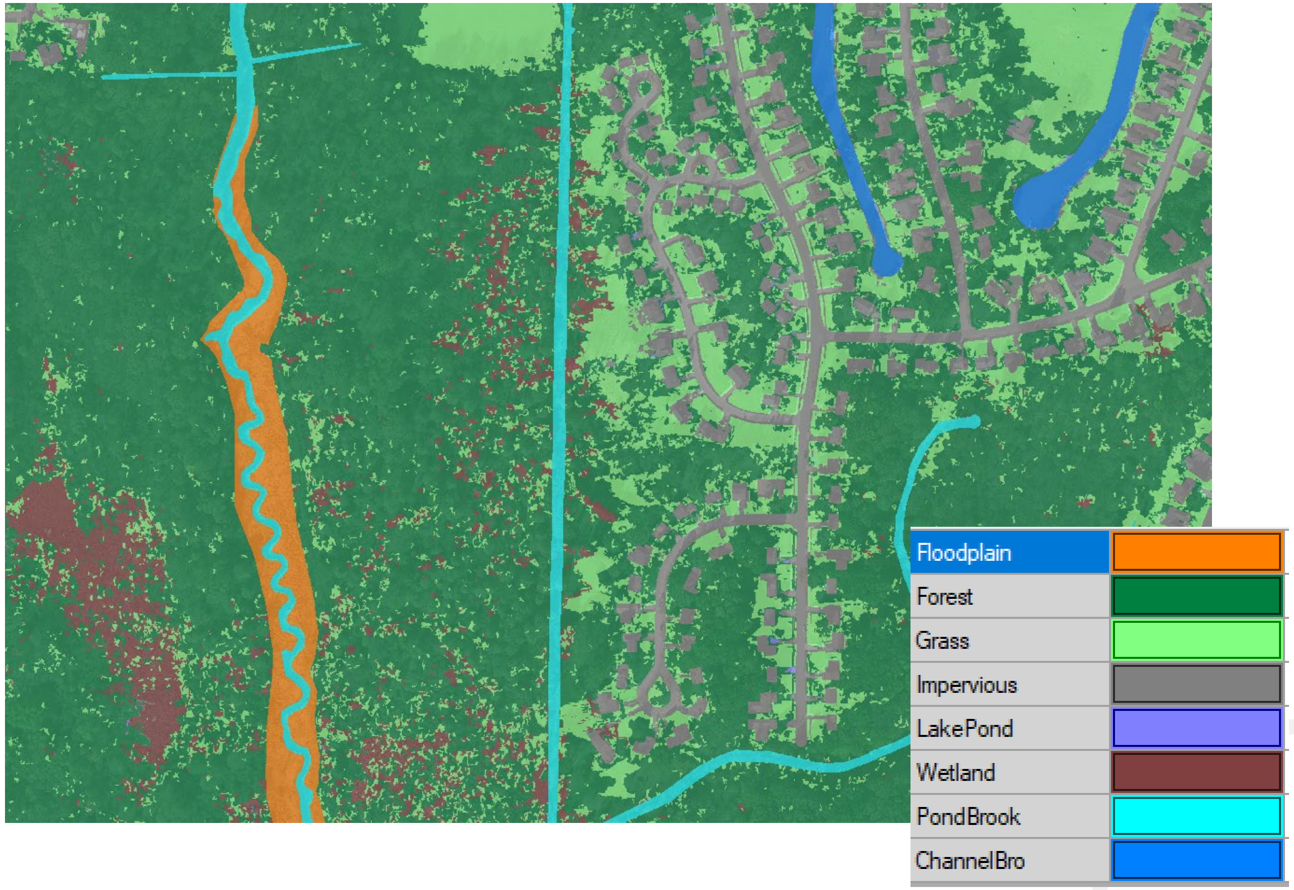
- Building footprints raised 20-ft
- Channel Brook bathymetry per FEMA FIRM
- Aurora Lake spillway outlet ditch

Supplemental Slide
Land Cover – Manning's n

NLCD



Supervised NAIP Classification



Supplemental Slide
Land Cover – Manning's n

	Chow, 1959	HEC-RAS 2-D User's Manual	FEMA FIS	OHM PCSWMM	HEC-RAS Modeled Value
Forest	0.08 – 0.120	0.08 – 0.20	--	--	0.140
Grass	0.025 – 0.035	0.025 – 0.05	--	--	0.040
Channel Brook	0.022 – 0.033	0.025 – 0.05	0.034 – 0.036	--	0.030
Pond Brook	0.033 – 0.045	0.025 – 0.05	0.032 – 0.043	0.032 – 0.038	0.035
Impervious	0.016	0.12 – 0.20	--	--	0.016
Wetland	0.100 – 0.160	0.045 – 0.15	--	--	0.120
Lake/Pond	0.025 – 0.033	0.025 – 0.05	--	--	0.030
Floodplain	0.040 – 0.080	0.025 – 0.05	0.034 – 0.068	0.049	0.060

Supplemental Slide
Structures

7 Bridges

- Main Channels

2 Agri-Drains

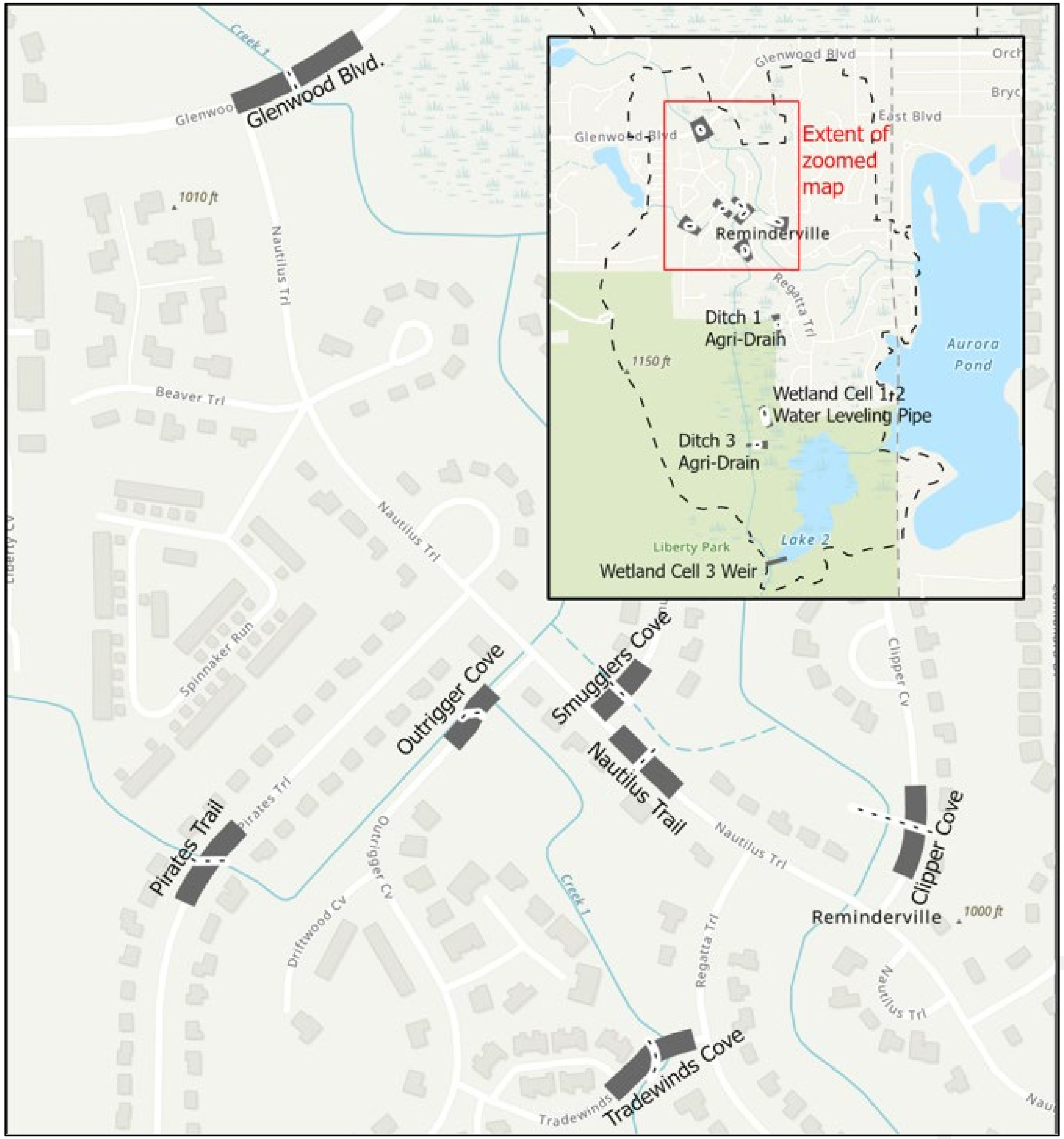
- Controls water level in ditches

1 Water Leveling Pipe

- Controls water level between wetland cells 1 & 2

1 Wetland Cell Weir

- Controls outflow from wetland cell 3



Supplemental Slide
Bridge Parameters

Table 4. Parameters of road crossing structures modeled explicitly in HEC-RAS

	Chart #	Scale #	Shape	Span (feet)	Rise (feet)	Length (feet)	Upstream Invert (feet)	Downstream Invert (feet)	Manning's n Top	Manning's n Bottom
Clipper Cove	58-Rectangular concrete	2-Side Tapered; More favorable edges	Box	16	4	185	991.1	990.9	0.011	0.011
Glenwood Blvd.	58 – Rectangular concrete	2 – Side Tapered; More favorable edges	Box	22	5	45.33	999.85	999.3	0.011	0.03 [a]
Nautilus Trail - Pond Brook	58 – Rectangular concrete	2 – Side Tapered; More favorable edges	Box	16	4	80	990.84	990.5	0.011	0.011
Outrigger Cove	58 – Rectangular concrete	2 – Side Tapered; More favorable edges	Box	10	5	58	991.23	991	0.011	0.011
Pirates Trail	58 – Rectangular concrete	2 – Side Tapered; More favorable edges	Box	12	4	90	993.75	993.2	0.011	0.011
Smugglers Cove	55 – Circular culvert	1 – Smooth tapered inlet throat	Circle	3	3	48	992.01	991.8	0.024	0.024
Tradewinds Cove	58 – Rectangular concrete	2 – Side Tapered; More favorable edges	Box	16	6	78.7	989.32	989	0.011	0.011

a. The Glenwood Blvd. crossing has a natural channel bottom and therefore the Manning's n was set to match that of Channel Brook.

Supplemental Slide
Other Structure Parameters

Table 5. Parameters of wetland control structures modeled explicitly in HEC-RAS

	Structure Type	Chart #	Scale #	Height (feet)	Width (feet)	Invert (feet)	Length (feet)	Manning's n Top	Manning's n Bottom
Ditch 1 Agri-Drain	Gate – Overflow (closed top)	--	--	2	2	992.5	--	--	--
Ditch 3 Agri-Drain	Gate – Overflow (closed top)	--	--	2	2	992.5	--	--	--
Wetland Cell 1-2 Water Leveling Pipe	Culvert	2 – Corrugated Metal Pipe Culvert	3 – Pipe projecting from fill	2.5	2.5	Upstream: 993.25 Downstream: 993.25	193.21	0.021	0.021
Wetland Cell 3 Weir	Weir / Embankment	--	--	992.5	20	--	12	--	--

Supplemental Slide
Agri-Drain Schematic

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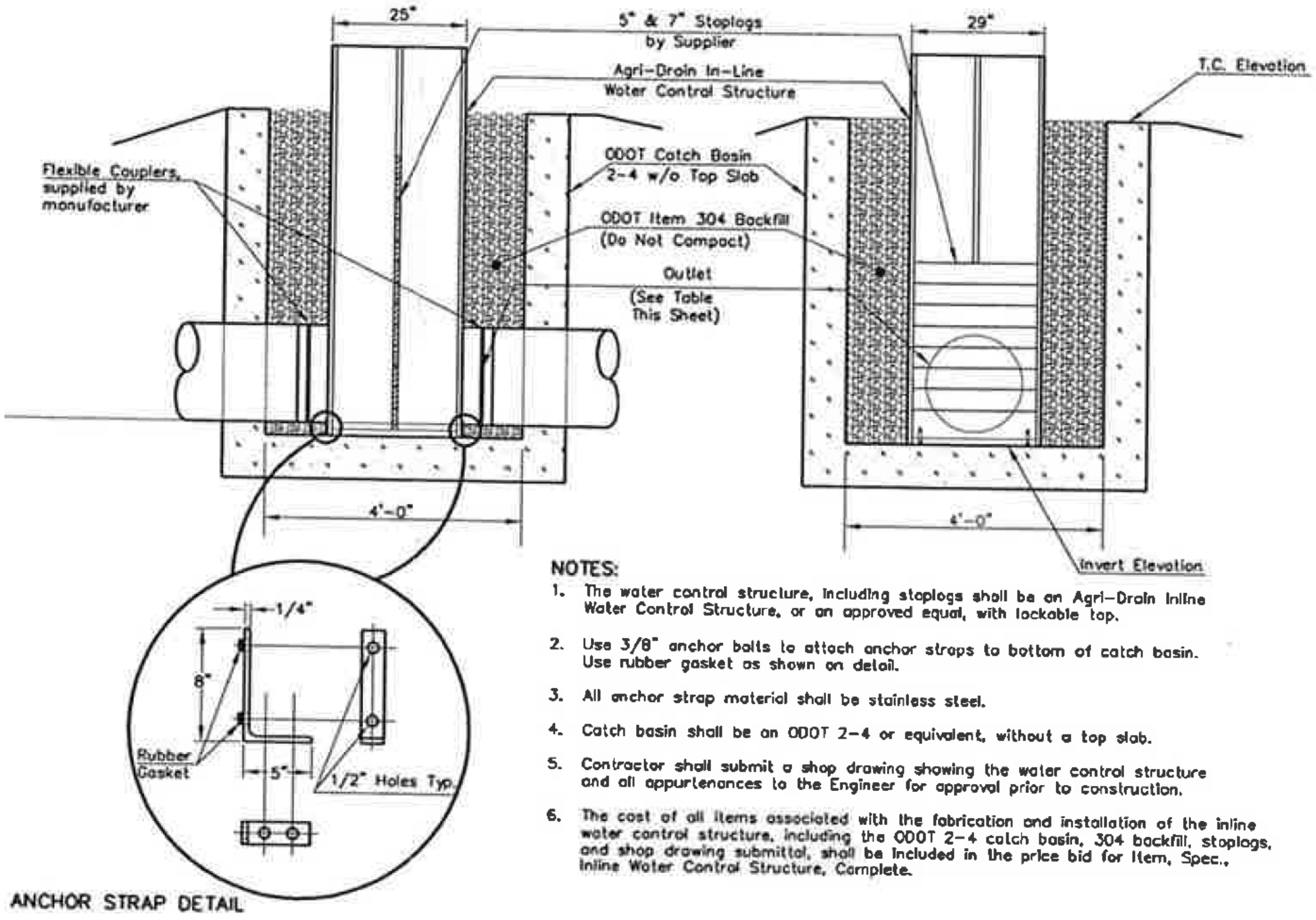


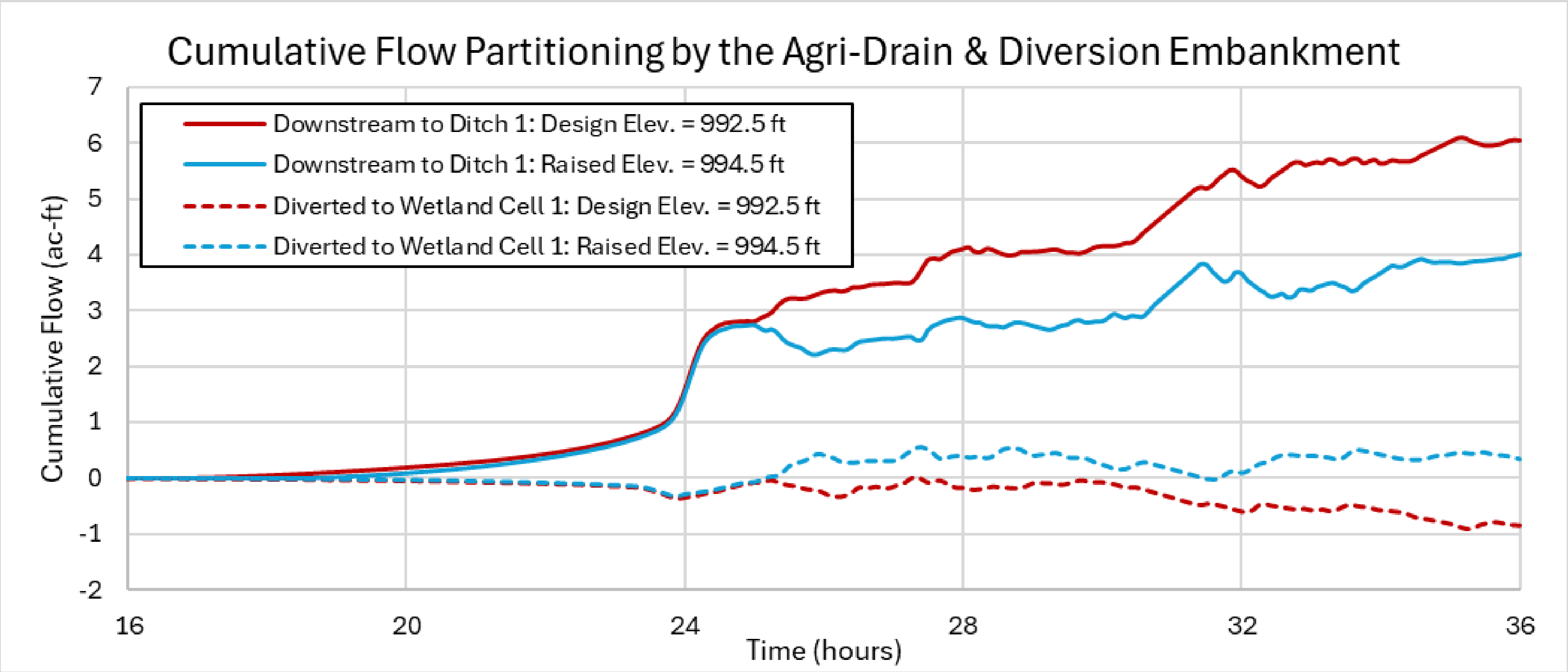
NOTES:

1. The water control structure, including stoplogs shall be an Agri-Drain Inline Water Control Structure, or an approved equal, with lockable top.
2. Use 3/8" anchor bolts to attach anchor straps to bottom of catch basin. Use rubber gasket as shown on detail.
3. All anchor strap material shall be stainless steel.
4. Catch basin shall be an ODOT 2-4 or equivalent, without a top slab.
5. Contractor shall submit a shop drawing showing the water control structure and all appurtenances to the Engineer for approval prior to construction.
6. The cost of all items associated with the fabrication and installation of the inline water control structure, including the ODOT 2-4 catch basin, 304 backfill, stoplogs, and shop drawing submittal, shall be included in the price bid for Item, Spec., Inline Water Control Structure, Complete.

Supplemental Slide
Scenario 5 – Agri-Drain Raised Elevation = 994.5’

TETRA TECH

- Cumulative flow to ditch 1 is decreased with raised Agri-Drain elevations



Supplemental Slide
Scenario 6 – Increased Hydraulic Capacity Downstream

TETRA TECH

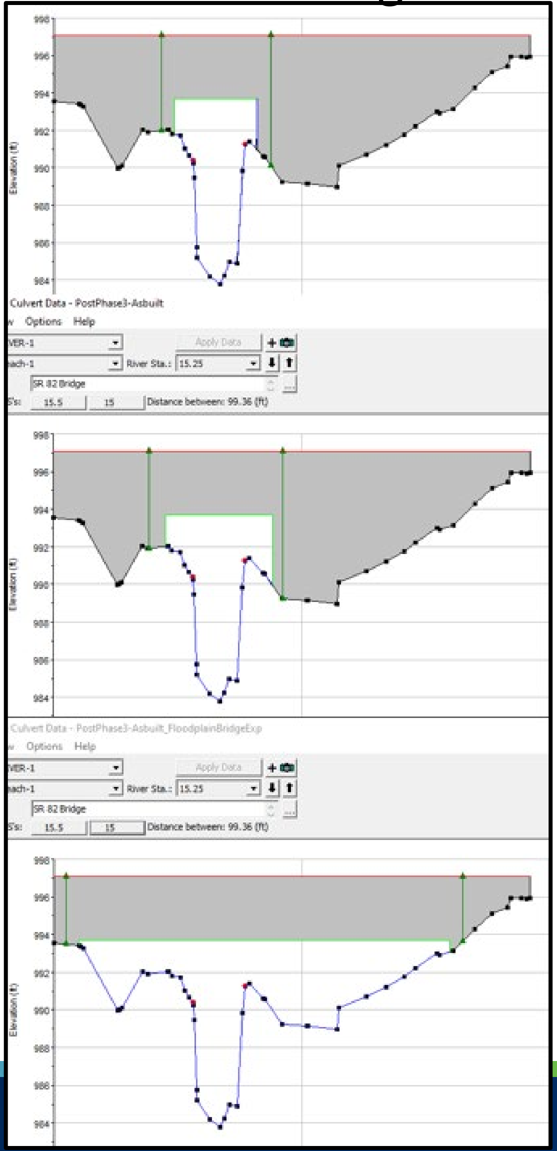
- Stage-Discharge relationships of 1-D and 2-D models are comparable where they overlap
  - 2-D model normal depth downstream boundary condition is within reason and accounts for downstream effects outside of 2-D model domain
- Unable to directly compare 1-D and 2-D model 100-year events due to uncertainties in 100-year flow estimates
- 1-D model scenarios showed negligible impacts resulting from bridge modifications.
  - No need to modify or re-run 2-D model

Supplemental Slide
Scenario 6 – Increased Hydraulic Capacity Downstream

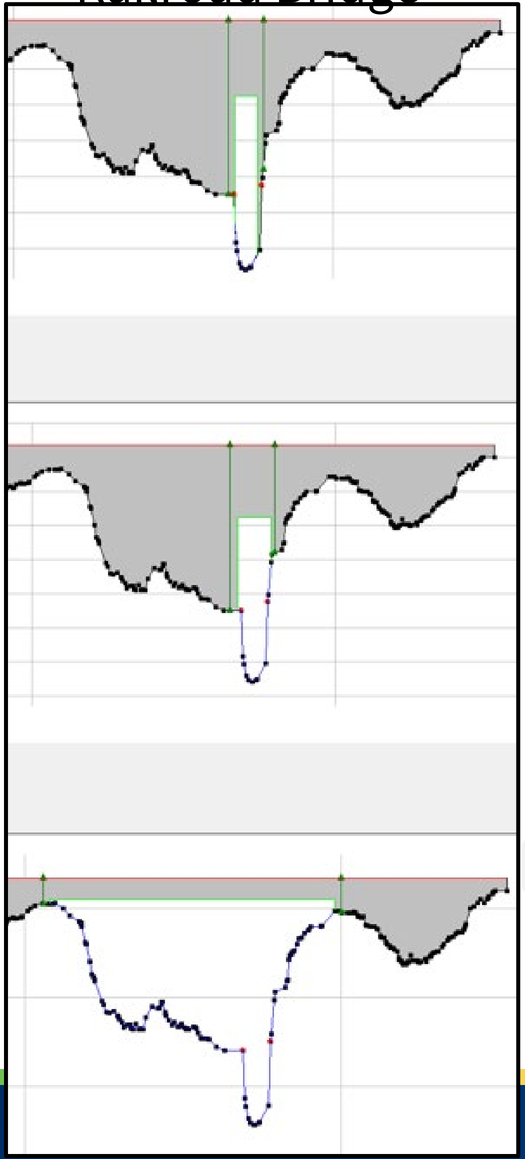
TETRA TECH

- Bridge Scenarios:
  1. As-Built
  2. 20-ft Abutment Expansion
  3. Floodplain Abutment Expansion
  4. Bridge Removed
- Ineffective flow areas modified to same ratios as As-Built conditions in Stantec model

S.R. 82 Bridge



Railroad Bridge



SUMMIT COUNTY
Surface Water
Management District

Understanding Flooding in Aurora Shores

TETRA TECH

Prepared by the Summit County Stormwater Management District (SWMD) and Tetra Tech

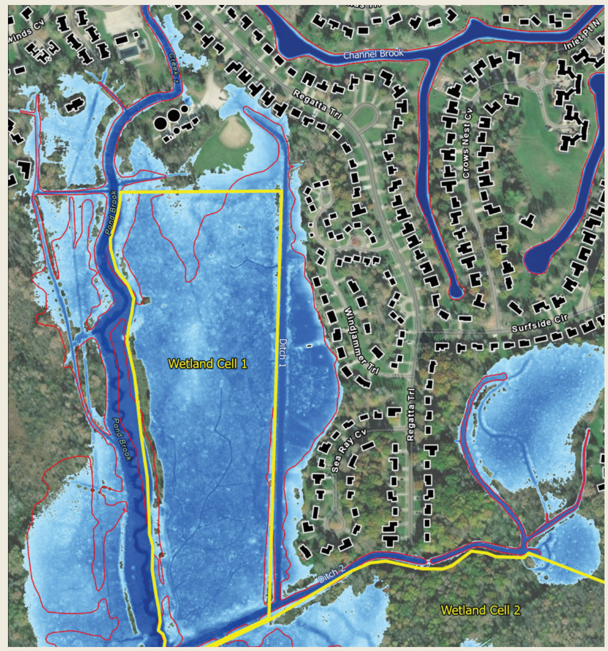
Working Together for a Resilient Aurora Shores

About the Summit County Stormwater Management District (SWMD)

The SWMD works to manage and improve stormwater facilities and stormwater discharges; protect surface and groundwater quality; reduce property damage due to excess stormwater drainage; and meet the requirements of Ohio EPA's Stormwater Management Program for Municipal Separate Storm Sewer Systems.

If you experience drainage or flooding problems on your property, please report them using the drainage concern form found here: Surface Water Management District | Summit County Engineer

More information on regional watershed studies, including the Aurora Shores study, can be found here: Project: SWMD: Regional Watershed Studies | Summit County Engineer



Why Was This Study Conducted?

Aurora Shores was selected for focused analysis as part of the Cuyahoga River Watershed Study due to:

- Frequent flooding in backyards along Windjammer Trail and Sea Ray Cove
- Water backup near Nautilus Trail and Anchorage Cove
- Concerns raised by residents and previous studies

The goal was to better understand where flooding originates, how water moves through the neighborhood, and determine realistic, science-based solutions.

What the Science Says

We used a 2D computer model called HEC-RAS, developed by the U.S. Army Corps of Engineers. This is a trusted and nationally accepted tool that simulates how water flows during heavy storms by applying real-world topography and rainfall data. We systematically tested five unique flooding scenarios to better pinpoint the cause of the flooding.

Scenario 1: Stormwater Flow From the North (Channel Brook Headwaters)

- **Finding:** The stormwater flowing into Aurora Shores from the north does not overtop the canal or levees.
- **Conclusion:** This is not a source of neighborhood flooding.

Scenario 2: High Water in Aurora Lake

- **Finding:** Aurora Lake water must rise significantly to overflow into the neighborhood. This happens only if the lake exceeds 1001.5 ft elevation.
- **Conclusion:** Lake level control (lowering before storms) can prevent this.

Scenario 3: Spillway Releases from Aurora Lake

- **Finding:** Large dam releases could cause temporary flooding similar to FEMA's flood zone—but this would only occur in rare, emergency situations.
- **Conclusion:** This is a low-probability contributor under normal operations.

Scenarios 4 & 5: Rainfall Directly on the Neighborhood

- **Finding:** Water pools in low backyard areas along Windjammer Trail and Sea Ray Cove after heavy rain events.
  - The yards are 6–12 inches lower than nearby land.
  - The soils are muck-like and drain poorly.
  - The area was historically a wetland/swamp, with low natural infiltration.
  - There's nowhere for the water to go—the nearby ditch is nearly the same elevation.
- **Conclusion:** This is the primary cause of flooding. Changes to wetland control devices (Agri-Drains) do not solve the problem, since the entire area floods together.

Scenario 6: East Aurora Road and Railroad Bridges

- **Finding:** Increasing the size of the bridge openings has no impact on flood elevations upstream.
- **Conclusion:** Bridges downstream of Auroa Shores do not cause the flooding.

What Did We Learn?

The source of the flooding is not from Channel Brook, Pond Brook, or Aurora Lake.

- Channel Brook boating canal levees hold up during a 100-year storm.
- Pond Brook does not overtop its banks within the neighborhood.
- Aurora Lake cannot cause flooding under normal dam operations.

Backyard flooding comes from rain that can't drain well due to:

- Historic Development: The neighborhood was built on former swampland, which naturally held water.
- Soil Type: "Willette Muck" soils beneath these homes are classified as very poorly draining.
- Flat Topography: There's not enough slope to help gravity move the water away.
- Heavier Rainfall: Intense storms have become more common, overwhelming the already limited drainage.
- Water Table: prior studies show a shallow water table, likely influenced by water levels in Aurora Lake.

What Happens Next?

Tetra Tech has outlined four alternatives to address backyard flooding:

Alternative 1: ***No changes***. Flooding would still occur during major storms.

Alternative 2: ***Install field drains*** to speed up how quickly yards dry out after storms.
(***Reduces duration, not occurrence, of flooding.***)

Alternative 3: ***Most Comprehensive***. Build a Drainage System – Install field drains, two new lined retention basins, and a pump station to remove water (most effective, but complex/costly and requires property acquisition).

Alternative 4: ***Combination.*** *Install field drains and sump/grinder pumps* on a house-by-house basis to speed up how quickly yards dry out after storms. *(**Reduces duration, not occurrence, of flooding**.)*

These options will be further studied and evaluated based on feasibility, cost, and public input.

What Can You Do Now?

- Report new drainage problems to the SWMD
- Stay informed through the Aurora Shores HOA and public meetings
- Understand the natural challenges of your area – we are working with nature and your community to find smart, effective solutions

This handout was prepared by Tetra Tech and the Summit County Engineer's Office.
Thank you for participating in protecting your neighborhood from flooding!