# Thornapple River Sedimentation Control and Mitigation Planning

Prepared for

**Cascade Charter Township**

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# Contents

# EXECUTIVE SUMMARY

The Thornapple River Watershed is the largest subbasin of the Lower Grand River Watershed, covering portions of Eaton, Barry, Ionia, and Kent counties in southwest Michigan. Spanning roughly 88 miles from its headwaters to its mouth at the Grand River, the watershed's land is predominantly used for agriculture. The river has multiple dams along its reach, including the Cascade Dam. The next upstream barrier above the Cascade Dam is the LaBarge Dam, just upstream of 84th Street.

Riparian owners along the Thornapple River in Cascade Township have noticed increasing amounts of sediment accumulation along the riverbank in various locations and at several tributary stream mouths upstream of the Cascade Dam. A Sedimentation Control and Mitigation Plan for the Thornapple River was initiated to develop an action plan that manages sedimentation in the river, thereby improving water quality, navigation, and aquatic habitats. This project focuses on reviewing the river bayous and contributing waterways impacting the Thornapple River between 60th Street and the Cascade Dam. This planning document follows the initiative outlined in the Thornapple River Special Assessment District Ten Year Strategic Plan and Roadmap.

An aerial drone survey was performed during the fall river drawdown of 2025. Areas of visible sediment deposition were identified and tributaries with apparent sediment- accumulation were flagged for additional field investigation. Environmental staff walked all flagged individual tributaries, locating- areas of significant erosion while logging GPS locations, collecting field data, and- taking site photographs. Areas of erosion induced by human activities were identified for potential corrective action. Areas of -significant erosion due to natural causes- (i.e. downed trees or unstable embankments) were also documented.

The report provides recommended corrective actions and Best Management Practices to reduce/manage sediment loading and sediment deposition. These recommendations can be used by the Thornapple River Special Assessment District to inform, educate, and coordinate actions with property owners along both the Thornapple Rive and the contributing waterways.

# 1 General Considerations

Sediment accumulation in the Cascade section of the Thornapple River has two primary sources, sediment from contributing waterways and baseload sediment from the upstream area of the Thornapple River Watershed. Regardless of the sediment source, the slowing of the river water created by the backwater of the Cascade Dam inevitably results in the deposition of mobilized sediment, be that light particles such as silts/clays or heavier particles such as sands/gravel. Sediment accumulation in the backwaters of any dam is a continual process that may be slowed with erosion management but can't be stopped completely.

The baseload sediment from the areas upstream of 60$^{th}$ Street could be measured by comparing multiple year river depth surveys of the Cascade portion of the river-, then calculating the volumetric changes in the river basin. Given that rainfall rates, river flow rates, and sediment loads can vary significantly from year to year, a volumetric change study would require multiple years of data collection and analysis to yield a reasonable average sediment accumulation rate. That in-depth analysis of sediment base loading is outside the scope of this study but could provide an estimate of the rate of sediment accumulation and some generalized timelines for decreasing water depths in various areas of the river.

Sediment transport is the result of water energy acting on the soil of a waterway. When the energy of flowing water exceeds the ability of the soil to resist that energy, the soil is eroded and transported downstream. As soil is eroded, the waterway may eventually gain enough space to create meanders. Meanders lengthen the waterway and decrease the bottom slope, thereby reducing the water velocity and energy. Erosion and meandering are natural characteristics of a waterway, They can be managed to a certain degree but not eliminated in any practical way.

Natural causes of erosion include:

- Constrictions which increase water velocity such as steep banks or downed trees
- Increased water volume/velocity due to significant rain events
- Destabilized soil due to changes in vegetative cover such as upended trees (storm damage) and animal activity (stream crossings or burrowing activities)

Human induced causes of erosion include:

- Construction of impervious surfaces such as roadways, driveways, and houses which increase both the frequency and volume of stormwater runoff
- Concentration of stormwater flows from pavement areas, installation of culverts, and discharge of roof/underdrains
- Change in vegetative cover, such as clearing trees or fields and creating lawns, all which can increase stormwater runoff frequency and volume.

# 2 Conditions in the Thornapple River

An aerial drone survey was performed during the fall river drawdown of 2025. Areas of visible sediment deposition were identified and tributaries with apparent sediment- accumulation were flagged for additional field investigation. The map in Appendix A identifies the following items:

- Overall map of the Thornapple River from 60th Street to the Cascade Dam
- Contributing waterways labelled A through M
- Highlighted segments of waterways that are currently designated County Drains
- Segments of the river bank where significant sediment deposition was noted in the drone flight. These segments are numbered to correspond with the photo log in the Appendix.

The photo log in Appendix A contains the following information:

- Identification of the photo area and brief description of the observed condition
- Each photo has an area map showing the drone location at the time of the photo, a compass indicating the viewing direction of the drone, and the accumulated flight distance at the point of the photo location. The flight distance on the photos is also indicated on the distance log in the drone flight video for cross referencing.

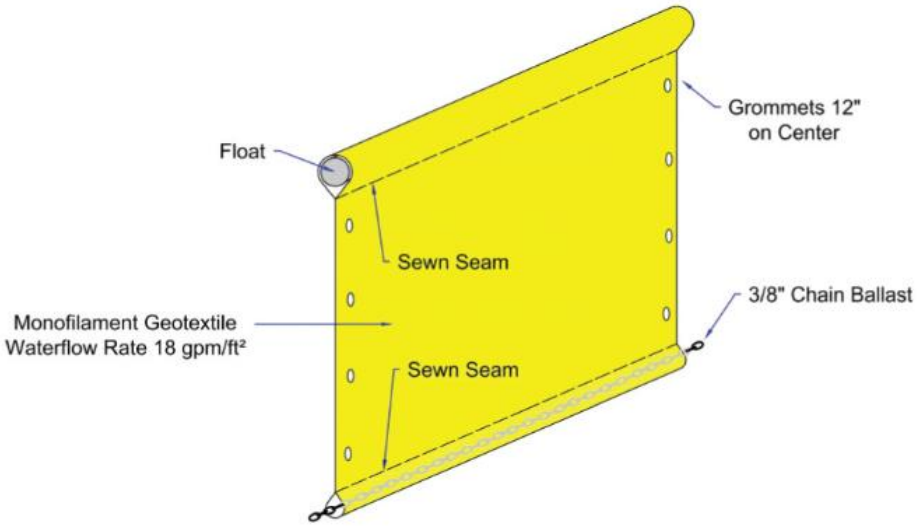
The observed sediment accumulation areas can be grouped into two primary categories:

1. Fine grained sediment accumulation caused by slow water areas on the inside section of the river bends or in bay areas extending away from the main river channel.
2. Coarse grained sediment accumulation areas at the mouths of contributing waterways due to upstream erosion and sediment transport.

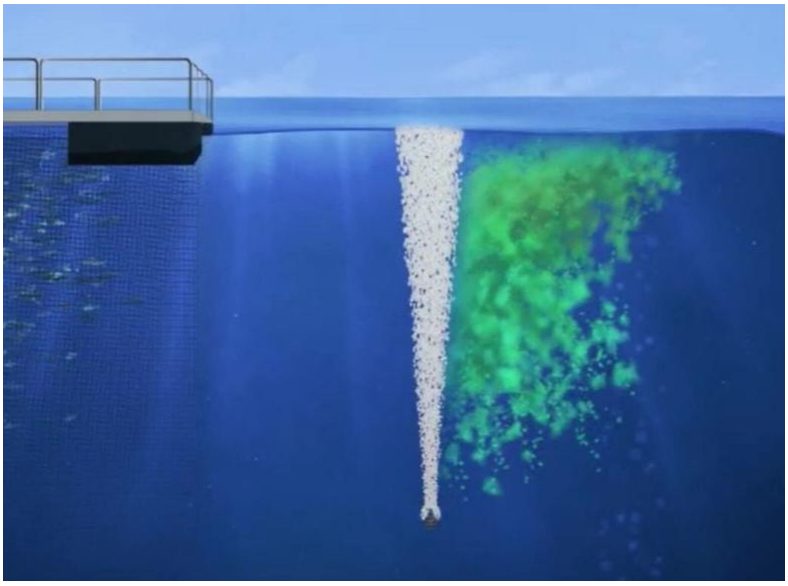
Fine grain sediment erosion is extremely difficult to prevent. Fine grain sediment deposition can be removed by dredging and additional deposition reduced by blocking the suspended soil particles with physical turbidity curtains or bubble curtains. However, blocking sediment deposition also pushes the suspended fine particles farther downstream into either unprotected slow water areas or to the backwater of the dam. These methods can also block the movement of fish and aquatic insects.

The following are examples from the photo log of fine grained sediment deposition areas.


Turbidity curtains are a fabric curtain suspended across a slow water area by floats and secured to the bank. They cannot be traversed by motor boats or anything with a keel/rudder. Because they may present a navigation hazard, regulatory permitting is usually required.




Bubble curtains are created via a submerged air tube and compressor system. They require continuous power for the compressor (and potentially noise attenuators). Their effectiveness is highly dependent on wind/wave/current conditions. Regulatory permitting is usually required for these.



The following are examples from the photo log of coarse grained sediment deposition areas


Coarse grained sediment deposition in the river can be removed by periodic dredging or by one-time removal paired with additional management that captures the mobilized sediment upstream of the waterway discharge into the river. Sediment capture  is usually achieved with a dam structure of sheeting or rock gabion baskets. The structure is placed across the waterway creating an upstream pool  that traps coarse grained sediments which then need to be mechanically removed on a regular basis. The frequency and volume of removal depends on the severity of the upstream erosion and the size of the waterway watershed. There is currently a small gabion basket sediment trap on the Thornapple Hills Drain just upstream of Thornapple River Drive.

# 3 Conditions in the Contributing Waterways

Environmental staff walked 11 individual waterways that appeared to generate moderate/significant coarse grained sediment loads in the Thornapple River. These waterways are noted on the map in Appendix A. Due to the extensive length of these waterways and the number of erosion sites documented, a Geographic Information System (GIS) was created which utilizes an on-line platform to house an aerial map of the Cascade area with erosion sites marked by map points. Utilizing the on-line platform, users can click on each point and see a photograph of the site condition along with field comments and cause determination (human or natural). The map also includes current parcel lines and addresses that can be used to facilitate communications with property owners. This on-line data has been shared with Cascade Township and can be made available to the public for access.

Noted are some examples of both human induced and natural erosion

# 4 Corrective Actions and Best Management Practices

Thornapple River Sedimentation Areas

Areas with either fine or coarse grained sediment accumulation can be dredged to re-establish water depth and useability. Dredging costs can be significant as equipment access and disposal costs are highly variable depending on location.

Once dredged, slow water areas can be protected with turbidity curtains/bubble curtains, -or they can be re-dredged after enough sediment as re-accumulated.

Coarse grained deposition areas can be protected with upstream sediment traps which must be maintained on a regular basis. These traps are most effective when placed just upstream of the waterway discharge into the Thornapple River. Costs for installation and maintenance are again highly variable depending on location and sediment volume. Easements on private property will be required to facilitate both initial construction and future maintenance.

Contributing Waterways

Corrective actions in the contributing waterways will be difficult as many of the erosion causes are natural and on private property. Methods to control erosion include:

Removal of constriction areas by:

- debris removal

- channel widening

- culvert enlargement (including rip rap protection at outlets)

Managing waterway velocity by:

- Installing pool/riffle structures

- Avoid installation of smooth hard armoring along banks, such as sheet piles or concrete slabs, that direct water energy farther downstream

- Install soft/rough bank protection measures such as live staking, coconut fiber logs, brush mattresses, and in extreme cases, rip rap/gabion baskets

- Decreasing runoff volumes/rates by:
    - Increasing vegetative cover thickness (converting lawn areas to natural areas)

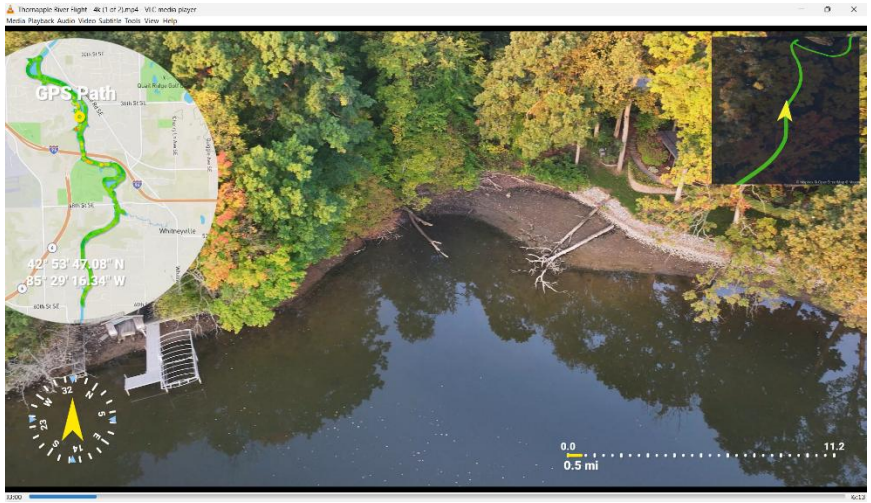
    - Promoting infiltration (infiltration swales, tiered slopes, permeable pavers)

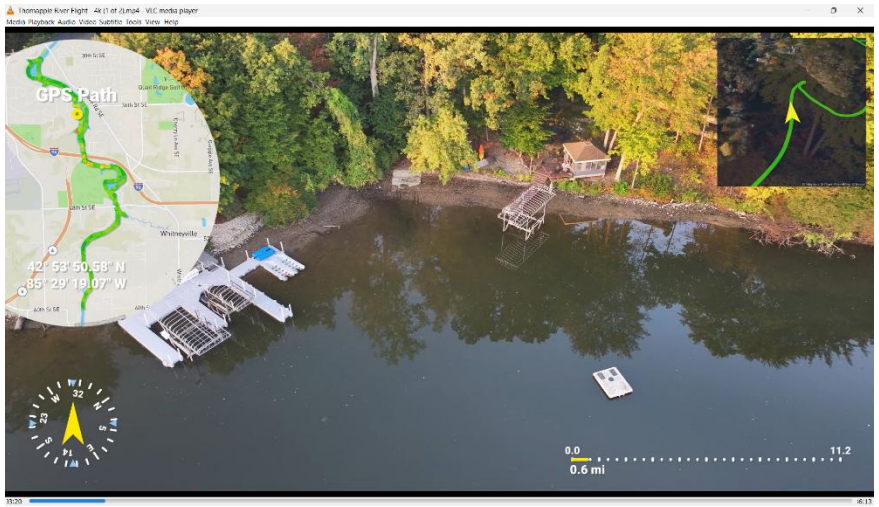
    - Minimizing construction of impervious surfaces

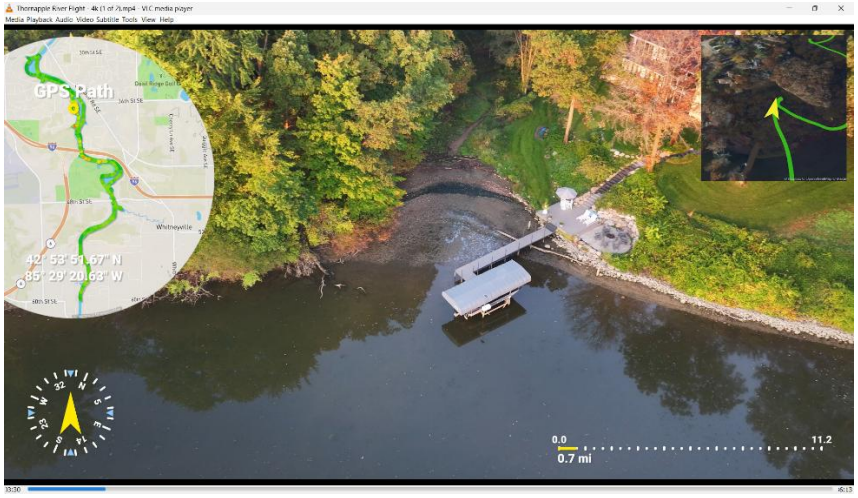
# Appendix A: Thornapple River Project Map

# Thornapple River Sediment Deposition Areas

AREA 1: Some sediment deposition but limited to Forest Valley Creek mouth.



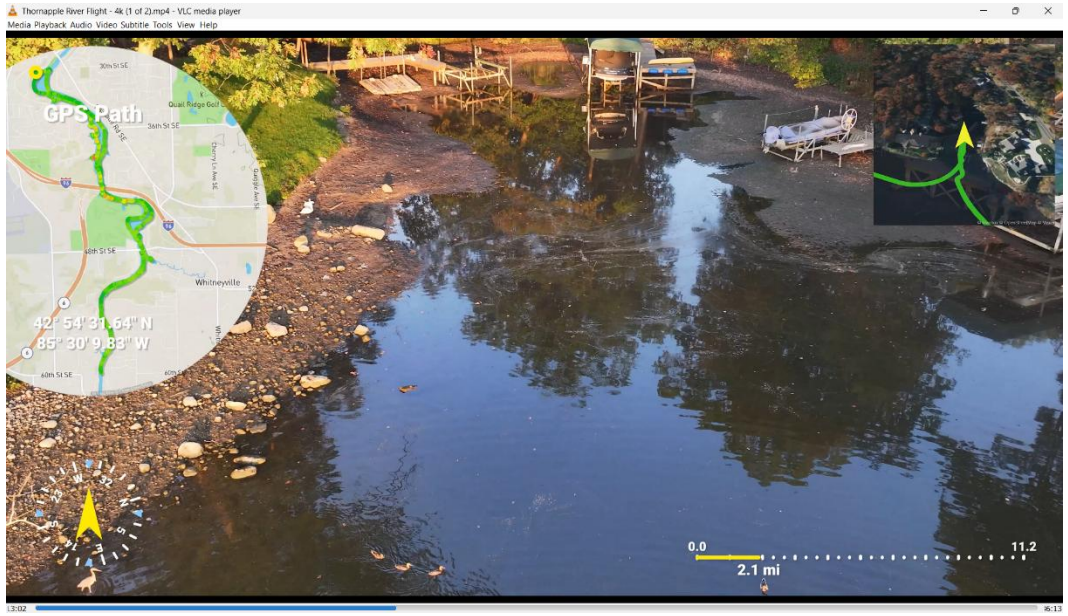

AREA 2: Sedimentation just upstream of Goodwood neighborhood boat ramp on inside of river bend point. Related to slower water area on inside of bend, not related to waterway erosion.


AREA 3: Sedimentation on inside of river bend near 6995 Burger. Related to slower water area on inside of bend, not related to waterway erosion.

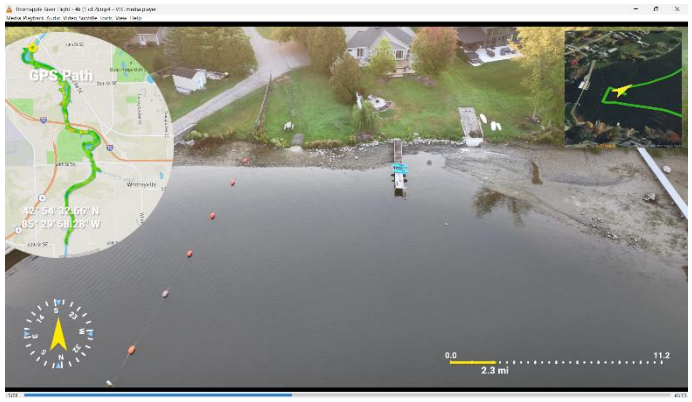


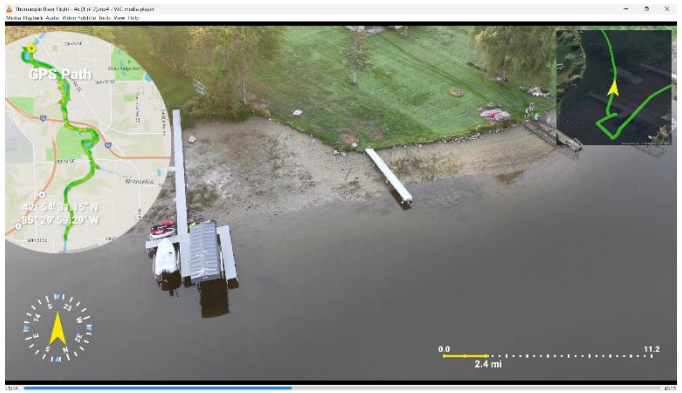
AREA 4: Significant sediment deposition at mouth of Tanglewood Creek due to upstream erosion.

AREA 5: Significant sediment deposition at mouth of Thornapple Hills Drain due to upstream erosion. Also some bank erosion on private property at 3024 Thornapple River Drive.




AREA 6: Sedimentation on inside of river bend, east side of river, upstream of the Cascade dam. Related to slow water area on inside of bend but not related to waterway erosion.






AREA 7: Some sediment deposition but limited to Hidden Hills Drain mouth.

AREA 8: Sediment deposition on east bank between 7476 Cascade Road and 7370 Whispering Ridge. Deposition due to slow water area.


AREA 9: Significant sediment deposition at mouth of Quiggle Lake Creek due to upstream erosion.

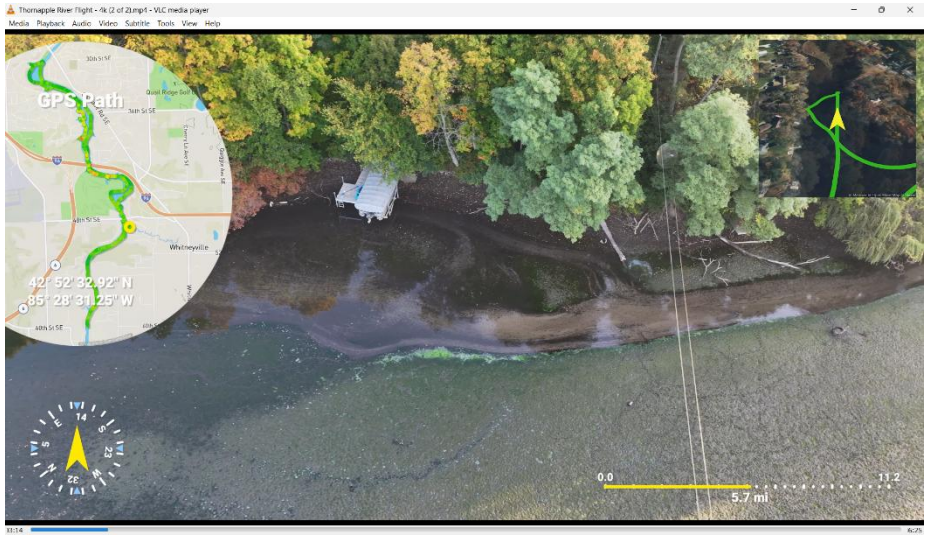
AREA 10: Local deposition at 7447 Kenrob Drive related to slower water area on inside of bend, not related to waterway erosion.

AREA 11: Local deposition at 4105 and 4121 Maricaibo Shores Drive related to slower water area on inside of bend, not related to waterway erosion.

AREA 12: Significant sediment deposition at mouth of Cascade Creek due to upstream erosion.

AREA 13: Local deposition at 4607 Little Harbor Drive. Deposition due to inside bend and slow water area .

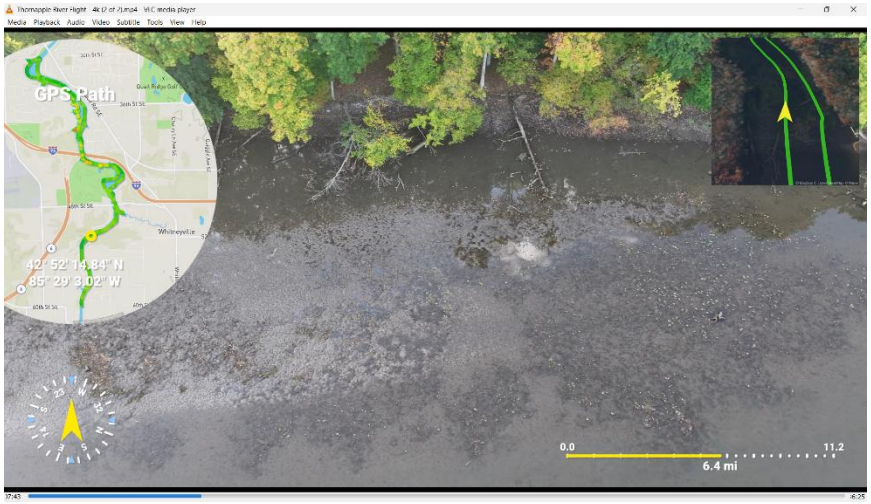
AREA 14: Significant sediment deposition at mouth of 48th Street Bayou Drain due to upstream erosion.



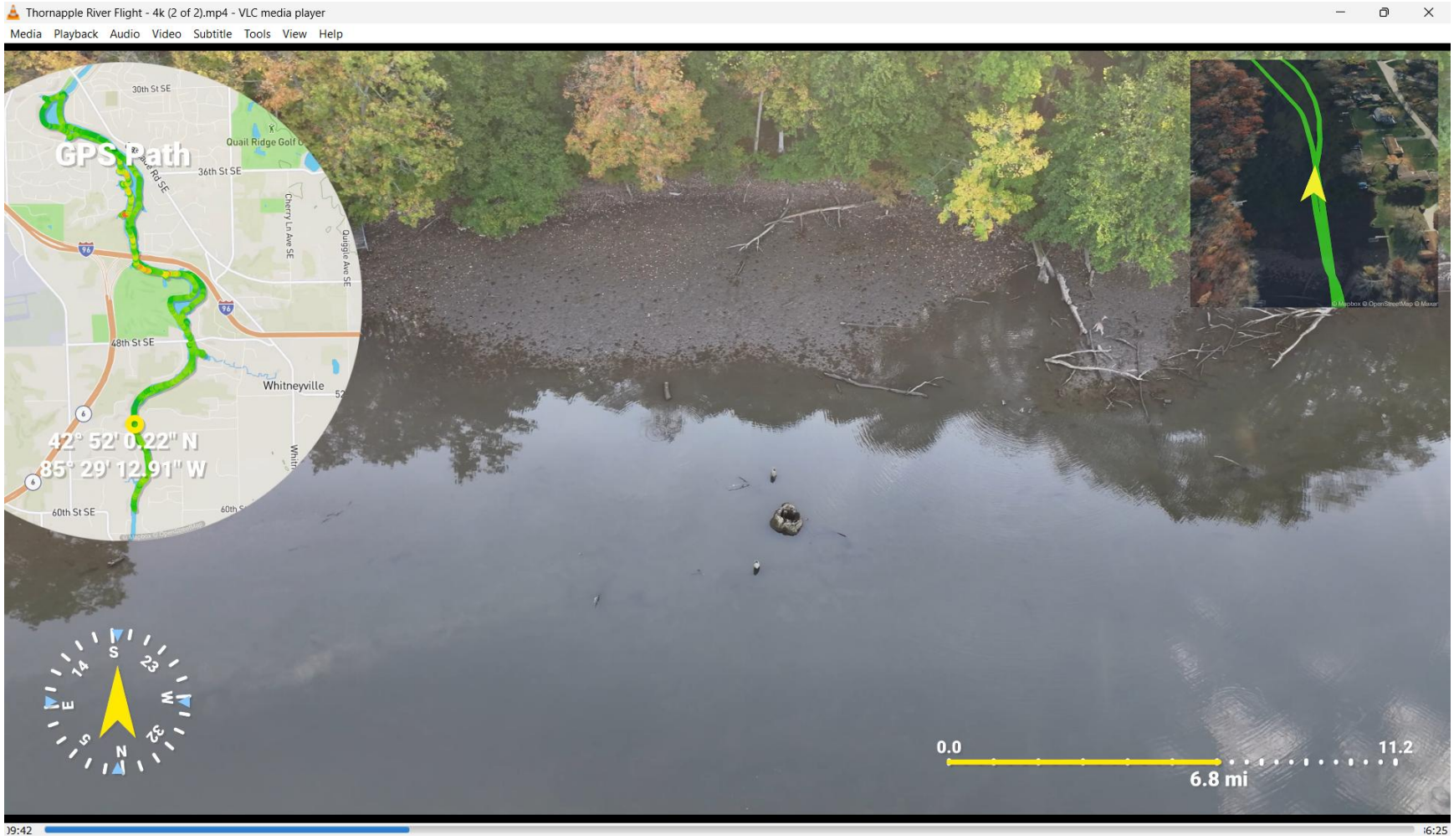


AREA 15: Deposition from localized erosion in small creek originating near Kirkwood Drive.

AREA 16: Sediment deposition on east bank north of Kirkwood Drive. Deposition due to slow water area.


AREA 17: Local deposition at 5407 Buttrick Avenue (end of Peacock Point Pvt.). Deposition due to inside bend and slow water area.



AREA 18: Moderate deposition at mouth of Glenwood Pond Creek.

AREA 19: Significant deposition at mouth of South Beltline Creek due to upstream erosion.

AREA 20: Local deposition along west bank from 7291 Kilmer Drive to 7231 Kilmer Drive. Deposition due to inside bend and inset harbor area which create slow water areas.





AREA 21: Minor localized bank sedimentation.

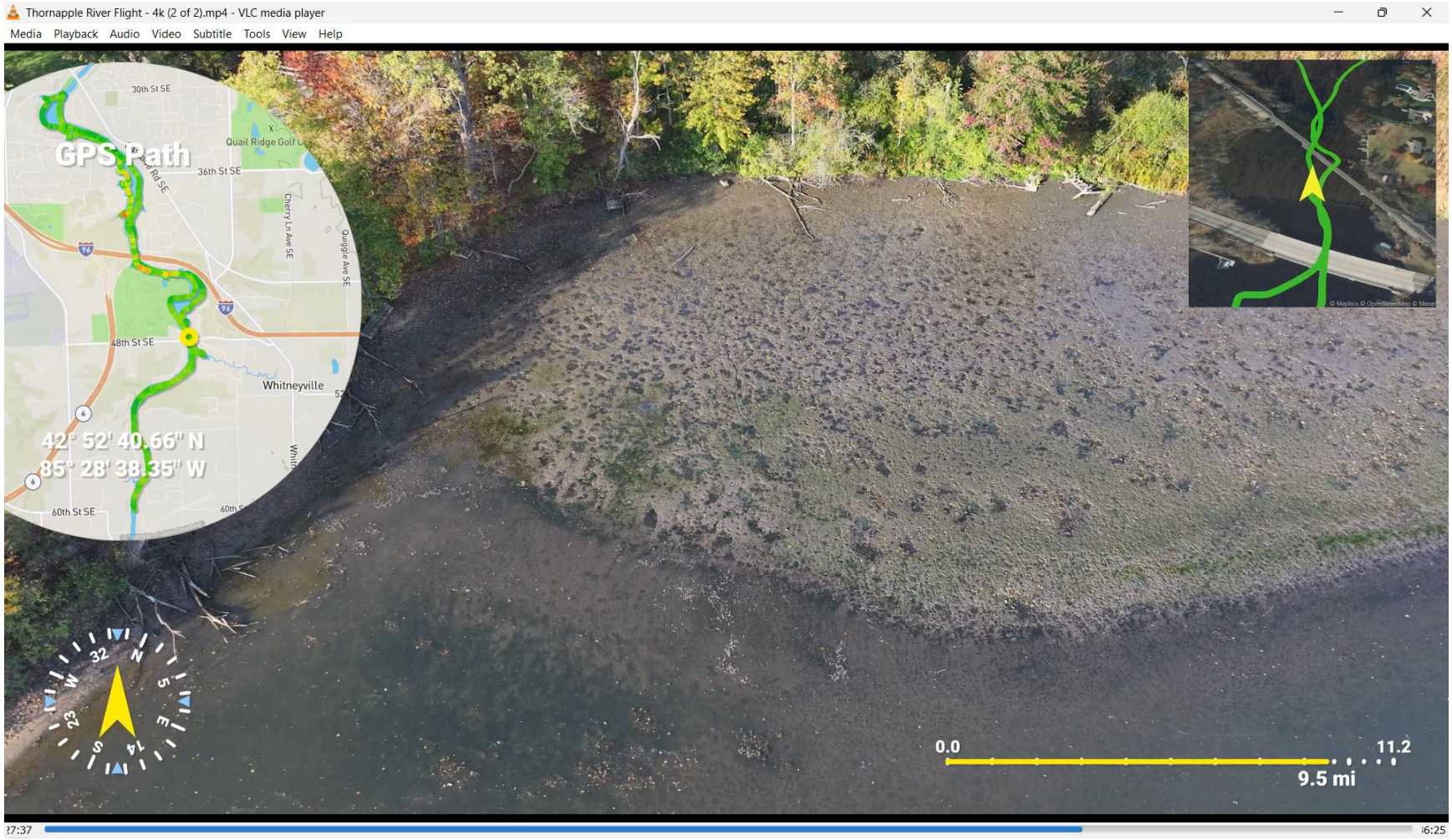

AREA 22: Significant sediment deposition at mouth of Dayenu due to upstream erosion.


AREA 23: Local deposition along west bank from 5016 Sequoia Drive to 4812 Sequoia Drive. Deposition due to inside bend and inset harbor areas which create slow water areas.





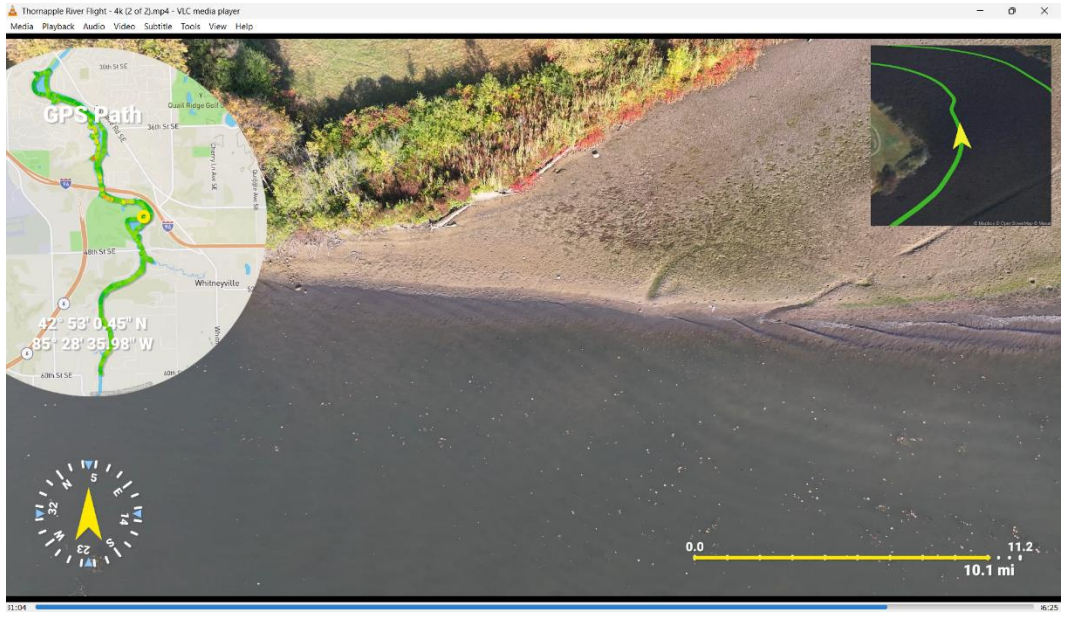
AREA 24: Local deposition along west bank just downstream of 48th Street Bridge. Deposition due to inside bend and inset harbor areas which create slow water areas.



AREA 25: Local deposition along west bank just downstream of 48th Street Railroad Bridge. Deposition due to inside bend and inset harbor areas which create slow water areas.



AREA 26: Local deposition along west bank at Thornapple Pointe Golf Club. Deposition due to inside bend which creates slow water area.




AREA 27: Significant sediment deposition at mouth of Thornapple Pointe Creek from upstream erosion. However, sediment is contained in the local bayou at the golf course and does not extend into main river.