

## Flood Management

### Tittabawassee River Watershed<sup>1</sup>

The Tittabawassee River is the largest tributary to the Saginaw River. The main stem of the Tittabawassee River is 91 miles long with a network of contributing tributaries totaling 621 miles. The main stem of the river generally flows in a southerly and southeasterly direction to its confluence with the Shiawassee River to form the Saginaw River.

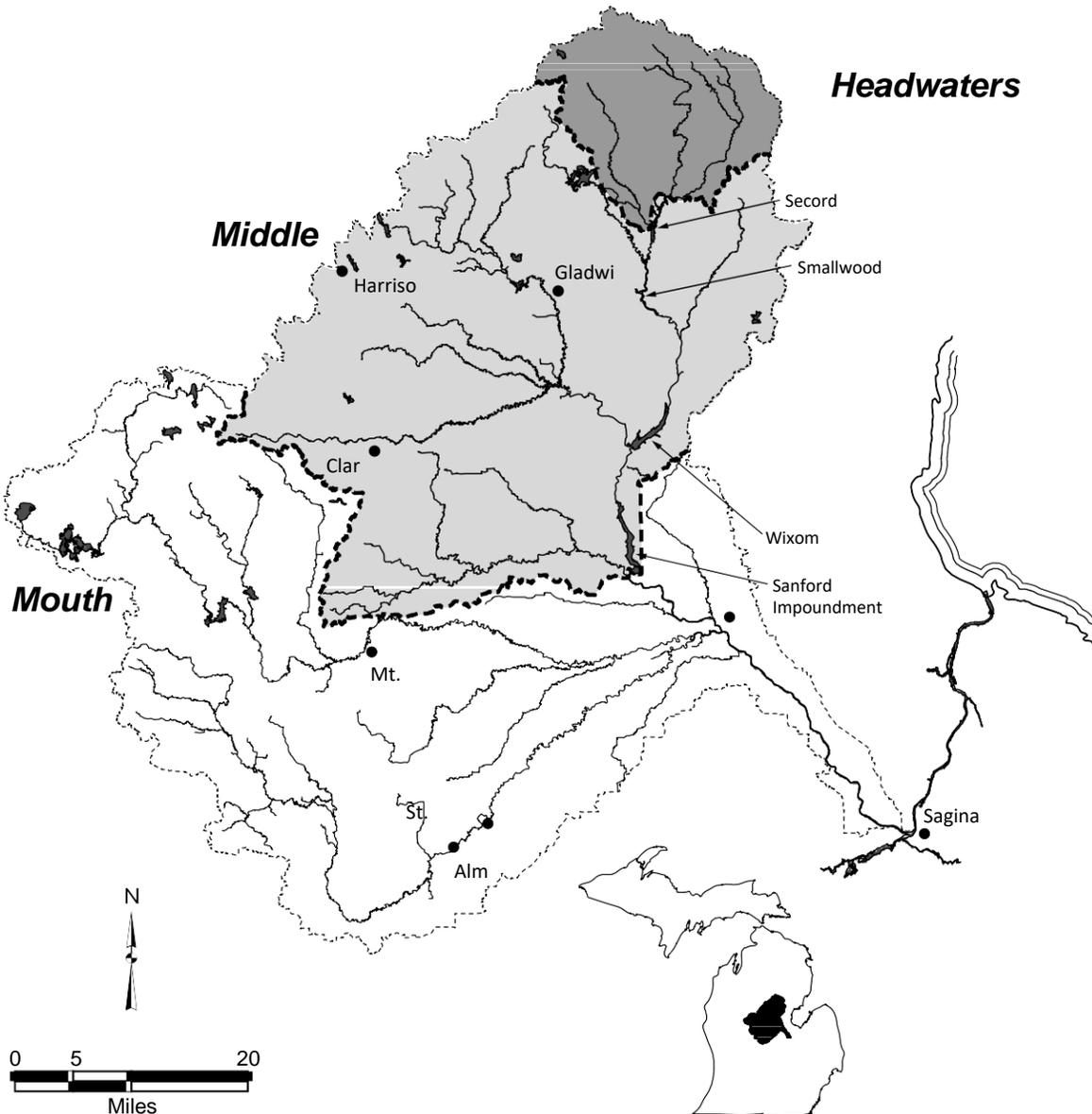


Figure 1: Tittabawassee River Watershed

<sup>1</sup> Unless otherwise noted, watershed data and figures are from Michigan DNR Report SR52, Tittabawassee River Assessment, September 2009



The Tittabawassee River has a contributory watershed of 2,471 square miles (mi<sup>2</sup>), the fifth-largest in Michigan. The topography of the eastern and southeastern part of the watershed (i.e., the lower part of the basin) is relatively flat. The western and northern portions of the basin (the headwaters) are characterized by rolling hills. Compared to other Michigan rivers, the mean gradient (4.7 feet per mile) of the main stem of the Tittabawassee River is relatively steep and varies from 0.9 feet per mile near the mouth to 68.8 feet per mile in the headwaters.

For descriptive purposes, analysts divide the main stem of the Tittabawassee River into three segments, the headwaters, the middle segment and the mouth. The headwaters segment is composed of the middle, east and west branches of the Tittabawassee River. The middle segment begins at the upper end of Secord Lake and extends south 36 miles to the Sanford Dam. A major tributary, the Tobacco River, enters the Tittabawassee River at the downstream end of Lake Wixom. The mouth segment extends 35 miles from the Sanford Dam to the confluence with the Saginaw River. Major tributaries in this section include Carroll Creek Drain (also referred to as Carrol Creek Drain), Sturgeon and Bullock creeks and the Salt, Chippewa and Pine rivers.

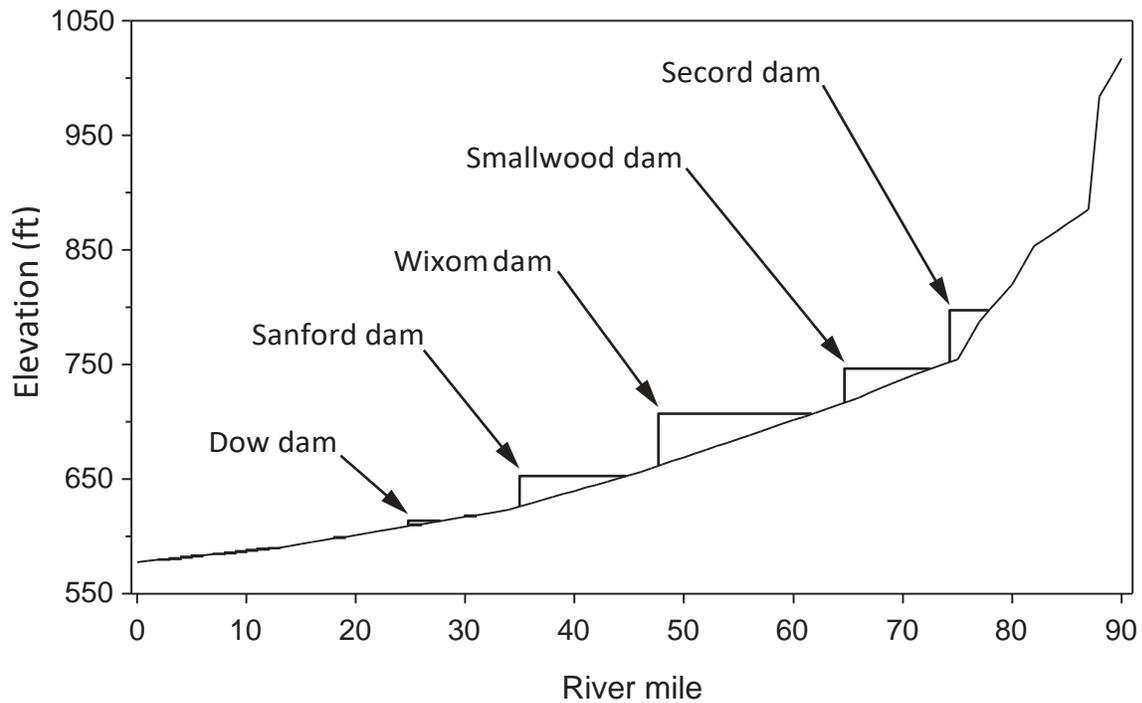


Figure 2: Tittabawassee River Profile



The City of Midland lies at the junction of the middle and mouth segments of the Tittabawassee River. It has a total contributory watershed of 2,336 mi<sup>2</sup>, 40% of which comes from the drainage area above Sanford Dam. Drainage areas contributing to the City of Midland’s watershed are tabulated below.

Component	Square Miles (mi <sup>2</sup> )	Percent (%) of Total
Sanford Dam	945	40%
Remaining Middle Segment	365	16%
Mouth Segment	1,025	44%
Total, City of Midland	2,336	100%

*Figure 3: City of Midland Watershed*

The lower portion of the middle segment and the mouth segment of the river have a relatively low gradient and are characterized by urban development and industrial activity.

### Four Lakes Watershed

The Four Lakes watershed encompasses the entire headwaters portion of the basin at Secord Lake and incrementally increases downstream to the Sanford Dam where it includes the bulk of the middle segment drainage area. Drainage areas for each of the Four Lakes are tabulated below.

Lake	Square Miles (Mi <sup>2</sup> )	Percent (%) of Total
Secord Lake	190	20%
Smallwood Lake	308	33%
Wixom Lake	932	99%
Sanford Lake	945	100%

*Figure 4: Drainage Areas by Lake<sup>2</sup>*

The headwaters are composed of the middle, east and west branches of the Tittabawassee River. The middle and east branches begin in southern Ogemaw County and the west branch begins in southern Roscommon County. The three branches flow south for a relatively short distance ranging from 15 to 20 miles before entering Secord Lake.

Predominate land use in the catchment of the headwaters is uplands, followed by wetlands and then agriculture. The overall mean gradient for the headwater segment is 14.5 feet per mile.

The middle segment begins at the upper end of the Secord Lake impoundment and extends south 36 miles to just below the Sanford Dam. Like the headwaters, the middle catchment, excluding the Tobacco River, is mostly composed of uplands, followed by wetlands and agriculture. The middle segment of the Tittabawassee River has a mean gradient of 3.2 feet per mile.

The Tobacco River is one of the largest drainages contributing to the Tittabawassee River middle drainage. It constitutes 51% of the contributory watershed to Wixom Lake or approximately 932 square

<sup>2</sup> Mead & Hunt PMF Study, 1994



miles. The dominant land uses in the Tobacco watershed are uplands and agriculture. The mean gradient for the Tobacco River is 9.9 feet per mile.

## Flooding

The Tittabawassee River has a long history of flooding and damaging communities located in the middle and lower portions of the basin. A 1932 United States Army Corps of Engineers (USACE) study<sup>3</sup> attributed the flooding to the relatively impervious soils, high water table and steep slopes in the headwaters, resulting in a “rapid concentration of run-off” and concluded that “substantial damage is inevitable.”

More recently, the City of Midland has experienced significant flood events in 1986, 1996, 2013, 2017 and the catastrophic May 2020 event. The City and County of Midland face large-scale economic hardships unless measures are implemented to address frequent flood events in the area. Historically, flooding in Midland has resulted from flows from multiple rivers, streams and creeks (Pine River, Chippewa River, Salt River, Tobacco River, Cedar River, Sturgeon Creek, Snake Creek and others) draining into the Tittabawassee River, which flows through Midland. As a result, a rain event of any magnitude is likely to result in significant flooding in Midland and surrounding communities absent adequate mitigation measures in place.

Facts and figures in the 1932 USACE Report suggest it would take the equivalent of more than nine Wixom Lakes, operated as flood storage reservoirs with 9.5 feet of drawdown, to control flooding in the middle and lower portions of the watershed. In addition to the flood storage limitations, the Four Lakes watershed represents only 40 percent of the tributary drainage area to the City of Midland. It is simply not possible for the four lakes to eliminate flooding in Midland and other communities downstream.

Federal agencies, including the Federal Energy Regulatory Commission (FERC) and USACE, recognized the limited flood control capabilities of the Four Lakes. The regulatory focus was on ensuring that the operation of the dams did not contribute to downstream flooding, pose a risk to public safety, or fail. Under FERC criteria, all four dams were classified as high hazard potential under the risk that failure poses to life and property. High hazard dams are required to meet stringent requirements for structural adequacy, integrity and spillway capacity. Unfortunately, under the previous owner, the four dams did not meet these requirements and were unable to safely pass the May 2020 flood.

As the dams transition to state jurisdiction, they will be required to meet the dam safety requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE). Following the dam failures, EGLE formed a 19-member Michigan Dam Safety Task Force to thoroughly review Michigan’s existing dam safety program and recommend policy, legislative, budgetary and enforcement reforms “to prevent a catastrophe of this kind from happening again.”

The Dam Safety Task Force’s findings are summarized in their February 12, 2021 report, which recommends revising or adopting laws and/or rules to meet Federal Emergency Management Agency’s (FEMA’s) Model Dam Safety Program (MDSP). The MDSP is a forward-looking program that provides sound guidance for dam safety that is consistent with the latest national and international industry

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<sup>3</sup> USACE Preliminary Examination of Tittabawassee River and Chippewa River with a View to the Control of Their Floods, January 18, 1932. Presented to the 72<sup>nd</sup> Congress on March 15, 1932.



standards. FLTF is committed to working with EGLE to rebuild the four dams in accordance with FEMA's Model Dam Safety Program.

To this end, Four Lakes Task Force (FLTF) is undertaking flood studies to establish design criteria for dam safety and spillway capacity and to better understand the impacts of restoration in the floodplains and shorelines. FLTF has also prepared updated Emergency Action Plans (EAPs) that reflect the current state for each of the Four Lakes dams. These plans provide a communication network and instructions for responsible parties during emergency events, such as extreme high river flows and/or dam failures.

FLTF'S flood studies include a Probable Maximum Precipitation (PMP) study of the entire Tittabawassee River basin. FLTF will share the results of the PMP study to allow FEMA and downstream stakeholders to update their flood studies and refine the magnitude and frequency of flood events. FLTF will also share the results of the studies and work with downstream partners, the State of Michigan, USACE and FEMA to support the development of a basin-wide plan to control flooding.

A basin-wide study could address flood inundation impacts on multiple levels, climatic, economic and policy. Understanding the impacts of a changing climate and the importance of providing necessary data and tools to evaluate and forecast the potential impact of future flooding; inform flood mitigation planning efforts; and guide local and regional decision-making, including public education and emergency preparedness and response activities. The study could also examine the level of protection for citizens that reside in high-risk priority areas. To assist in implementing more natural methods of flood mitigation, rather than the conventional flood control measures<sup>4</sup> such as dikes, levies and floodwalls, the purchase and/or leasing of land and the construction of environmentally sensitive marshlands to slow the speed of rivers, creeks and streams will help alleviate the severity of flooding and provide for the creation of eco-sensitive floodplains.

## FEMA Floodplains and The National Floodplain Insurance Program

### Summary of Existing Flood Insurance

Multiple communities within the Tittabawassee River watershed, including the City of Midland, participate in the National Flood Insurance Program (NFIP). The NFIP was established in the National Flood Insurance Act of 1968 and is operated under FEMA. The NFIP allows communities to establish actuarial flood insurance rates for areas located within defined Special Flood Hazard Areas (SFHAs) representing the 1% annual chance floodplain. The minimum requirements for floodplain management under the NFIP are defined in 40 CFR 60.3. Counties collaborate with FEMA to publish countywide Flood Insurance Studies (FISs) to define flood-prone areas and SFHAs, and to produce Flood Insurance Rate Maps (FIRMs) in the NFIP community. Under the authority of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973, properties located within the SFHA are required to be

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<sup>4</sup> Conventional efforts to prevent flooding typically reduce and destroy essential habitat and compound flood waters. For example, field tiling prevents percolation of water into groundwater aquifers, increases transfer of water from the land to the river and increases the magnitude and frequency of flooding events. Creation of county drains, channelization, straightening of rivers becomes necessary to handle the increased volume of storm water delivered to the channel, which in turn transfers their effects downstream.



covered under a flood insurance policy when the property is subject to a federally backed mortgage. Properties within the SFHA without a federally backed mortgage, or properties outside of the SFHA, still have the option to be covered under a flood insurance policy, although it is not required.

#### Overview of Community Floodplain Permits

44 CFR 65.12 describes the different requirements of a community participating in the NFIP (or has applied to participate in the NFIP) for development or improvement projects which may affect flood elevations of the flood-prone area or SFHA. In a community that has applied to participate in the NFIP, permits are required for proposed development to determine if it is to be built in a flood-prone area, governmental permits are to be received from governmental agencies required by federal and state laws, and that the proposed development is designed to minimize flood damage to the structure. If the community does participate in the NFIP and the proposed development is located within any Zone A or AE floodplain, construction permits are required. These permits are to ensure that development within any designated SFHA will not adversely increase the water surface elevations in the community. New development should be designed to have the lowest floor above the base flood elevation. If an improvement or development project shows the development will be above the SFHA or that the base flood elevation would decrease, then the owner may apply for a Letter of Map Change (LOMC) to prove to be exempt from flood insurance requirements and to update the SFHA shown on the community FIRM.