***Chapter 3***

***Maps and tables for chapter 3: Monitoring data; assessment categories; run-off table, Map of phosphorus by subwatershed, septiic systems table, road crossing map, campgrounds map (w/ORV trails?)***

Non-point pollution inventories

By its very nature, Non Point Source pollution is difficult to quantify. This is especially true in a rural area such as the Little Manistee River Watershed, where surface waters meet or exceed the numerical and narrative quality standards, and stressors tend to be widely separated.

Despite that challenge, it is important to create an inventory of actual and potential sources, and to estimate current pollution loads. The source inventory and load estimates may help to identify problem sites and also provide a baseline to monitor progress in meeting the Watershed Management Plan goals.

The Little Manistee Watershed has no watershed-wide impairments. Most loadings are moderate and well below levels that threaten the designated and desired uses of lakes and streams. The watershed has no “point source” pollution permits—that is, there are no commercial, industrial or municipal discharges regulated under the National Pollutant Discharge Elimination System (NPDES).

 The major stressors of concern – nutrients, thermal issues and sediments – are not present in such concentrations as to impair the designated uses of surface waters. For this reason, the WMP has not calculated Total Maximum Daily Loads (TMDLs). The plan adopts a non-degradation standard, requiring that pollutant loads must not be allowed to increase from the present levels. Achieving this standard will require long-term monitoring of water quality, along with application of Best Management Practices (BMPs) to identified stressors. Those plan elements are discussed in later chapters.

Pollutants enter the water from a number of sources. This chapter provides estimates and identifies several potential sources, such as land use practices, septic systems, recreational infrastructure and road crossings.

These causes of ecological stress have not been systematically or comprehensively monitored for the overall watershed. For that reason, much of the information presented here is based on estimates, derived through the best available data. As in other sections of the plan, it must be noted here that long-term monitoring (See Chapter 6) is a necessary element for preservation of the resource.

Nutrient and sediment loadings in runoff

Map and table of phosphorus runoff by subwatersheds

Sediment and nutrients in runoff from rainstorms and snowmelt are often directly correlated to land uses. For example impervious surfaces such as parking lots and roofs yield both higher volumes of runoff and higher pollutant loads than pervious surfaces such as grasslands or forest. Lowest runoff volumes are generally associated with forested areas and sandy soils, which promote infiltration and evapo-transpiration of water.

As a general statement, pollutant levels are correlated with runoff, which simply means that greater volumes of water are capable of carrying more sediment and nutrients. Areas with higher runoff volumes can be assumed to also produce higher pollutant loadings.

The Little Manistee Watershed – as a consequence of its forested land cover and permeable soils – has relatively low runoff loadings, as compared to other regions.

(It should be noted well-drained sands do tend to reduce runoff, but also pose their own challenges. Chemicals and other materials applied to the surface, may leach through these soils and potentially pollute groundwater.)

To help in estimating sediment and nutrient loadings where specific monitoring is not available, the United States Environmental Protection Agency has developed the Spreadsheet Tool for Estimating Pollutant Loads (STEPL).

Watershed modeling software from the Stroud Water Research Center (wikiwatershed.org) was used to estimate runoff volumes and concentrations of nitrogen, phosphorus and total suspended solids. The estimates are reported both as an annual average and as runoff from a hypothetical storm producing 2.09 inches of rainfall in a 24 hour period. That rain volume is considered the 50-percent probability storm for this region – meaning the probability is that such a storm should occur on average once every two years.

The program employs STEP-L and other software to analyze data from national land cover and soil type databases.

For this WMP, the model was applied for the entire Little Manistee Watershed and for each of the six subwatersheds. Results are presented in the accompanying table, and shown on the accompanying map. (Insert map and table)

The calculations show that, in each of the Little Manistee subwatersheds, the majority of stormwater is infiltrated into the soil, with relatively small percentages of runoff. This is to be expected, given the forested land cover and highly permeable soil types.

On a per-acre basis, the largest volumes of runoff and of phosphorus, nitrogen and sediment occur in the two easternmost subwatersheds, which also contain the majority of the watershed’s agricultural land covers.

 These calculations provide a baseline which can be adjusted in the future to gauge the impact of changing land uses or installation of best management practices associated with agricultural systems, transportation infrastructure or low-impact development.

The WMP envisions long-term monitoring of water quality parameters and stream flow to better define loadings in the future.

**Septic systems**

Insert septic systems table

Nearly all dwellings in the Little Manistee Watershed are served by on-site wastewater systems that rely on septic tanks and drain fields to process wastewater from toilets, sinks and showers. Homeowners in much of the watershed have no alternative to these systems, since properties are widely dispersed, and municipal sewer lines are both non-existent and impractical to construct.

In a typical system, household wastewater flows by gravity or pumps to a large septic tank, typically with two chambers and a capacity of at least 1,000 gallons. Microbes in the tank break down some organic wastes which precipitate to the bottom of the tank. Partially cleared effluent then flows out and is dispersed into the drainfield – a network of perforated pipes laid in a level bed of gravel.

Under ideal conditions – widely spaced residences and proper separation of the drain field from groundwater or surface water – these on-site systems are highly efficient. Problems may occur, allowing phosphorus and other nutrients to migrate away, when the system is improperly maintained, overloaded, or constructed too close to a waterway.

Data from the 2010 United States Census indicate the watershed has an estimated 4,471 dwellings, of which 1,934 are used year-round and 2,537 are of “occasional or seasonal use.” It is possible to use this estimate, along with national data on septic system efficiency, to approximate the impact of septic systems on the soils of the watershed.

The estimates used here are for phosphorus, which is an important component of household waste, and is considered to be the limiting factor in growth of algae in surface waters.

A large number of national studies have been conducted over the years, producing a wide range of estimates of both the volume and the phosphorus concentration of septic tank effluents. (citation 3-1)

Taking approximate median values of those estimates, the calculations used in this section assume residential wastewater flows of about 60 gallons (230 liters) per person per day, and phosphorus concentration in the effluent of 10 mg/L.

Applying those assumptions to a full year and an average of 2.5 residents per dwelling (and converting all measures to pounds and gallons) would indicate that the effluent flowing from an average home into a properly functioning septic system will carry about four to five pounds of phosphorus annually.

In a high functioning system, 85 to 95 percent of the phosphorus is taken up in the septic and drainfield system through processes knows as precipitation and adsorption. (National Environmental Services Center; 2013)

Unfortunately, studies by the U.S. Environmental Protection Agency indicate that 10 to 20 percent of systems will fail during their “intended” lifespan. Michigan officials estimated in 2016 that 10 percent of the state’s 1.3 million on-site septic systems are failing.

 Applying those estimates to the Little Manistee Watershed indicates the watershed has about 4,000 dwellings with properly working systems, and nearly 450 with low- or non-functioning systems.

The accompanying table estimates the phosphorus released to the watershed’s environment through the usage of septic tanks. The calculations assume that “seasonal” dwellings are in use for 180 days a year, that 90 percent of the systems are high functional, and that phosphorus removal efficiency averages 90 percent in high functioning systems and 30 percent in those with low or no function.

Based on those assumptions, systems throughout the watershed release some 2,300 pounds of phosphorus into the environment each year. Upgrading all of the low-function systems could reduce that total number by more than 870 pounds, or about 37 percent.

Road Stream crossings

Insert map of severe and moderate crossings per CRA

Pollutants including sediment, nutrients and gas and oil products often enter surface water at points where transportation infrastructure interacts with streams. This includes the sites of bridges, and culverts, as well as roadside ditches which may ultimately drain to lakes or streams.

Improperly sized or maintained culverts may also stress waterways by hindering fish passage or creating eroded “plunge pools” which can warm water and accumulate sediment or trash.

These problems tend to be exacerbated by high water or “flashiness,” which can increase sediment loads and overload ditches and culverts. The issues are somewhat naturally mitigated in the Little Manistee Watershed, where forest cover and porous soils limit the volume of stormwater runoff.

Though road-stream crossings are not presently considered a critical threat to water quality, the WMP recognizes the value of monitoring the crossings and correcting those that do create stress on water quality or aquatic habitats.

Public roadways cross streams at 82 sites in the Little Manistee Watershed, according to an inventory completed and updated by Conservation Resource Alliance in 2014. The crossings range from small culverts carrying unnamed tributaries under forest roads, to major bridges such as that at state Highway M37 in Lake County.

The majority of the crossings are classified as being of moderate severity, according to the ranking criteria used in the inventory. Six are listed as “minor,” the least severe classification, and four are ranked as severe. The cost of repairing the four severe crossings is estimated at a total of $242,000.

Two sites – a bridge on the mainstream and a culvert on an unnamed tributary have been restored in the past few years.

The WMP recommends repairing the severe sites, as well as two moderate-severity sites associated with the Cool Creek critical area.

The full inventory of road stream crossings may be viewed online at [www.northernmichiganstreams.com](http://www.northernmichiganstreams.com).

Streambank Erosion

Modest rates of bank erosion can be regarded as a natural, and even beneficial, process. Flowing steams naturally cut into banks on the outside of meanders, adding new material and habitat to the streambed and creating a richly vegetated flood plain on the inner curve.

However, the process was accelerated to an unnatural degree by historic log drives and timber-cutting practices which removed all streamside vegetation. Erosion from the timbering era introduced huge volumes of sand, which covered prime gravel spawning beds and left the river warmer and wider than its natural state. After more than 100 years, scars are still evident at sites like the Chicago Boy Rollway in the National Forest, though much of the stream has recovered.

Modern logging methods are less stressful to the stream, but continued human activities such as vegetation removal and development of impervious surfaces may still lead to bank erosion in excess of natural levels. Unregulated access by hikers, fishermen and boaters may also compromise streambanks at some sites.

The Conservation Resource Alliance conducted an inventory of streambank erosion sites on the mainstream of the Little Manistee River in 2012.

The project identified 69 sites, ranging from minor to severe on the bank erosion index. They varied in size from a 10 foot erosion site caused by concentrated foot traffic on National Forest land, to several riverbend locations with bank heights up to 40 feet and eroding banks from 100 to 250 feet in length.

In all, the inventory recorded 26 minor erosion sites, 31 moderate sites and 12 severe erosion sites. The severe sites covered a total of just less than 1,100 feet. A general estimate for erosion mitigation using whole tree revetments is $120 per foot.

The Little Manistee Conservation Council, working with the Conservation Resource Alliance, has identified funding for using woody debris to enhance fish habitat. In many cases this installation may serve a double duty of stabilizing eroding banks.

The WMP recommends mitigation of the severely eroded sites, as well as continued monitoring and mitigation of additional areas as funding becomes available.

The full inventory of streambank erosion sites may be viewed online at [www.northernmichiganstreams.com](http://www.northernmichiganstreams.com).

**Agriculture**

There are no large confined animal operations in the Little Manistee Watershed. Where agriculture exists in the watershed it consists of pastured livestock and moderately scaled row-crop cultivation, chiefly corn.

The National Land Cover Database (NLCD) shows 3.5 percent of the land in the Little Manistee Watershed is used for cultivated crops, hay or pasture. This limited area, approximately 19 square kilometers (4,700 acres) does not appear to have a noticeable impact on the watershed as a whole, but should be further evaluated for site-specific impacts.

The majority of the agricultural lands are in Ellsworth and Newkirk townships, upstream from the Luther Dam. Streams in this headwaters region of the watershed have not been systematically monitored in the past. The WMP envisions increased monitoring.

One agricultural impact area noted by MDEQ is along Cool Creek, on the Manistee-Lake county line, where pastured cattle have access to several hundred feet of stream. The WMP recommends that state officials work with the property owner to develop a more environmentally sound method for the animals to access drinking water.

Many parcels which formerly supported crops or pasture have been allowed to transition to grassland or forest for hunting, recreation or scenic values.

While agriculture is not a major economic driver in the watershed it remains an important component of the community, significant for its ecological value and its connection to the community’s food system and rural roots.

**Recreational Infrastructure**

Map(s) showing locations of campgrounds

Economy and lifestyles in the Watershed are closely associated with boating, fishing, camping, motorized and non-motorized trail use, and other forms of outdoor recreation. As such, the watershed has a significant recreational infrastructure in the form of campgrounds, trails, guide services, boating access sites, and paddlecraft liveries.

These facilities provide economic value to the community and are vital to allowing the public to enjoy the designated and desired uses of the waters.

However, careful management must be practiced to minimize pollution. Of particular concern are erosion at poorly designed or casual river entry sites; nutrient loadings from concentrated uses such as campsites near the water, and the spread of invasive species at campgrounds, trails and water access sites.

None of these issues have been quantified locally, though erosion is evident at several sites. The emerald ash borer was likely transported to the region in campfire wood and has since destroyed thousands of trees in the watershed and adjacent areas.

Additionally, there is a well-documented risk of introducing aquatic invasives such as New Zealand mud snails at fishing entry sites. In addition, milfoil, zebra mussels and other nuisance species are known to “hitchhike” from one water body to another on boats and trailers. (citation 3-3)

The WMP recommends educational displays and wader cleaning stations at river access sites along with monitoring for the introduction of additional species. Concern about spread of invasive species through boat traffic can be addressed through use of mobile boat-washing equipment available from Manistee County or the Benzie Conservation District. Invasive species are also addressed in the WMP’s educational component detailed in Chapter 7.

Recreational access to the forests and waterways of this watershed need not be compromised. A goal of the WMP is to ensure that best management practices are applied in all situations to minimize the negative impacts.

Footnotes:

3-1 National Environmental Services Center; “Phosphorus and On-site Wastewater Systems,” Pipeline, Summer 2013 Vol 24, No. 1

3-2 Michigan Turfgrass Environmental Stewardship Program (<http://www.mtesp.org)>

3-3 Monitoring confirms that boaters, not ducks, moving aquatic invasive species around. University of Wisconsin-Madison, March 5, 2013