Section H: Critical and Priority Areas

Areas of particular significance for restoration and protection within the Greater Bear Watershed are described below. Critical areas represent those where restoration may be necessary; priority areas represent those where protection is important. These areas are described in Exhibits 81 and 87 along with the known or suspected pollutant or threat. Some of the identified critical and priority areas are broad because of limited information of specific sources or because they may be susceptible to impairment in the future and are in need of ongoing protection. These areas were identified to help develop goals and objectives and to guide future monitoring, planning, and management efforts. The areas described are either the sources of pollutants identified or those areas most susceptible to activities that could degrade water quality or valuable aquatic habitats.

CRITICAL AREAS

As described earlier, controllable sources of phosphorus entering Bear Lake include leaching from onsite wastewater treatment systems (OWTS) adjacent to the lake and runoff from land areas that drain directly to the lake. It is estimated that there are more than 500 OWTS within 500 feet of the lake, a majority of which are over 30 years old. There are 36 identified grated storm drains connected to discharge points along the shore of Bear Lake and 13 known exit storm drains entering the lake. While nutrient loading is the primary concern from these priorities, the potential health risks from human pathogens entering the lake from OWTS and from runoff (household pets, farm animals, and large concentrations of waterfowl) are also a concern. Storm water runoff from urbanized impermeable surfaces and agricultural lands adjacent to the lake can also be a source of hazardous materials, sediments, and litter that can degrade the quality of Bear Lake.

The historical removal of shoreline vegetation concurrent with residential and business development on the shoreline of Bear Lake and on riparian properties along portions of Bear Creek and its tributaries has had an impact on the quality and quantity of nearshore aquatic vegetation and riparian natural vegetative buffers. The remaining wetlands (see Exhibit 29) adjacent to these watercourses serve a valuable function in filtering storm water runoff and providing aquatic habitat. Restoration and enhancement of native vegetation on the shoreline to provide a natural buffer strip between existing shoreline uses and the water can help reduce nutrients and other pollutants from entering the waterway from storm water runoff as well as enhance near shore aquatic habitat. Modification of existing hardened shoreline erosion devices (concrete, wood, or metal breakwalls) and the design of any new shoreline structures to incorporate features to filter storm water runoff and encourage nearshore aquatic habitat would be valuable.

Bear Creek and its tributaries are less susceptible to degradation from OWTS since the density of riparian residences and businesses adjacent to the river is less than that adjacent to Bear Lake. However, where homes and temporary residences are concentrated and immediately adjacent to Bear Creek, the localized, potential problems of nutrients and human pathogens leaching from OWTS into the stream are a concern. In addition, a number of sites have been identified during past surveys indicating that row crop production and animal grazing occurs to the edge of the stream that allows runoff and eroded bank materials to directly enter the waterway, increasing the risk of nutrient loading, sedimentation, and the transport of agricultural chemical residues.

Historical logging practices in the area left many raw banks exposed without vegetation to control erosion and sedimentation in the areas adjacent to Bear Creek and its tributaries. While substantial stream bank erosion control practices and in-stream habitat improvement have been implemented at a number of sites over the last decade to address these concerns, some work remains to be completed and long-term maintenance may be needed at some sites. Re-establishment of trees and shrubs on the banks that were

removed during the clear-cutting logging era is necessary to provide shade to maintain stream temperature favorable to trout and to establish streamside cover and a source of wooded debris for in-stream habitat.

Road stream crossings and foot paths used by recreationalists are also a source of eroded sand and silt to the river. It is important to improve and maintain road crossings and erosion control at river recreational access areas in order to prevent active erosion sites from contributing to sedimentation of the river system. Road stream crossings can also act as a barrier to aquatic species as they attempt to move through a water course if they are not designed appropriately.

EXHIBIT 81. Critical Areas of Concern in the Greater Bear Watershed

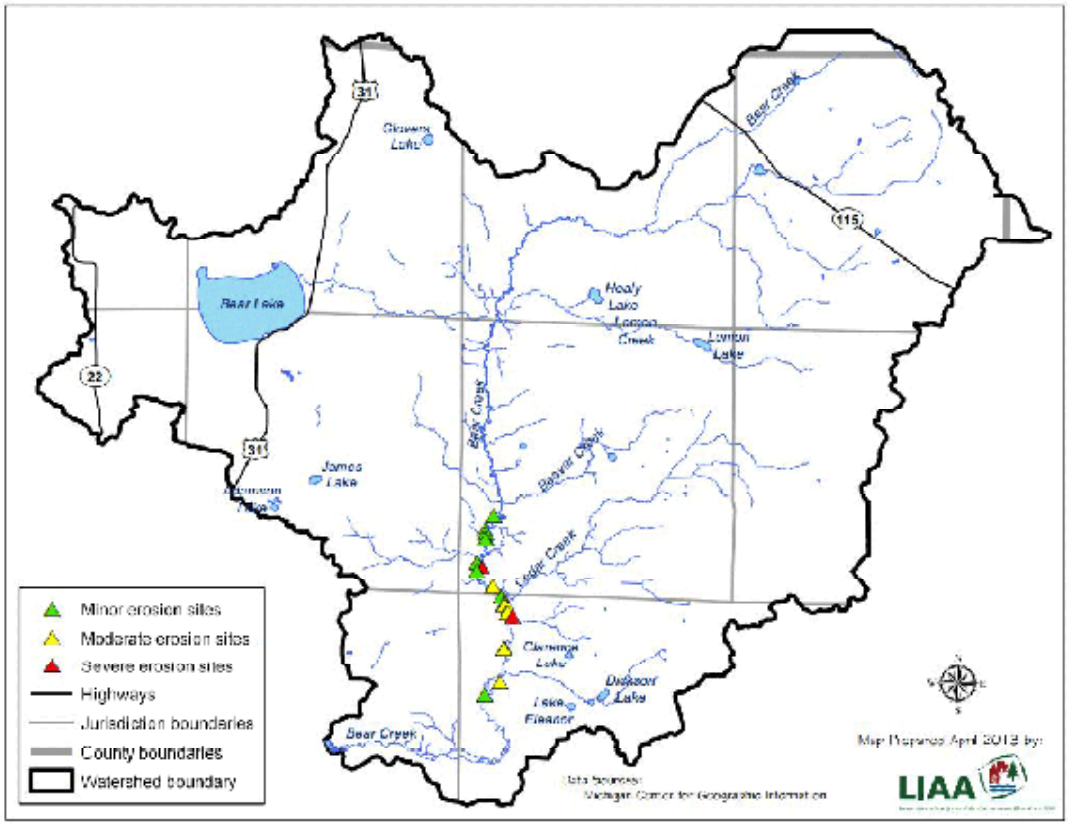
Critical Area	Description	Pollutant/Threat
Riparian lake and stream properties where all streamside vegetation has been removed, hardened bank/shore erosion devices have been installed	Occupied waterfront properties where restoration/enhancement of shoreline vegetation is possible. A shoreline inventory along Bear Lake is recommended to further refine the extent of this critical area.	Loss of natural vegetation to prevent nutrients and other storm water pollutants from entering waterway and loss of critical shoreline and nearshore aquatic habitat.
Private agricultural lands adjacent to and within 300 feet of Bear Lake, Bear Creek and tributaries.	Active crop and grazing riparian lands without protective vegetative buffers and/or fencing. Information is not available at this time to further refine the areal extent of this critical area. An agricultural inventory is recommended using 2013 aerial photos commissioned by Manistee County. If lands adjacent to Bear Lake are identified as agricultural lands that are within this buffer, then they would be of a higher priority than Bear Creek due to the residence time of the lake.	Nutrients (fertilizers and manure), hazardous chemicals, sediments, and pathogens.
Active stream bank erosion sites in Bear Creek and tributaries related to historical logging practices and recreational access on public and private lands	High and moderate erosion sites identified in stream surveys that have not been addressed, or are in need of maintenance.	Sand and silt sedimentation causing impairment of stream habitat and increases in stream temperature.
Road stream crossings along Bear Creek and tributaries.	Road stream crossings that limit aquatic connectivity of native species, affect water chemistry, as well as nutrient and sediment transport.	Nutrient and sediment transport and can affect aquatic populations.
Locations where the lack of streamside shade and in-stream cover limits trout and salmon abundance	DNR Fisheries has identified a critical area of high public use at Coates Road and downstream of there as an area where fish populations can be enhanced.	Reduction in available year-round habitat for adult trout and juvenile salmon due to high temperatures and lack of cover.
OWTS located at permanent residences, vacation homes, and businesses adjacent to Bear Lake	Occupied properties within 500 feet of Bear Lake with OWTS in the Village of Bear Lake, and Bear Lake and Pleasanton townships. Information is not available at this time to further refine the areal extent of this critical area.	Nutrients, human pathogens and other contaminants potentially leaching to the lake from OWTS.
OWTS located at permanent residences, vacation homes and businesses adjacent to Bear Creek and tributaries.	Occupied properties within 500 feet of Bear Creek and tributaries; primarily in the river area located between Coates Road and 13 Mile Road.	Nutrients, human pathogens and other contaminants potentially leaching to the river from OWTS.

SOURCE: Public Sector Consultants, 2012.

Stream Bank Erosion Sites

The Conservation Resource Alliance (CRA), through collaborative efforts with local partners, maintains an inventory of stream bank erosion sites that it has prioritized for restoration. As of July 2012, the CRA identified 21 stream bank erosion sites in the Greater Bear Watershed, two of which are identified as the highest priority for restoration along Bear Creek (see Exhibit 82). The CRA has indicated that few stream bank erosion sites exist in the northern portion of the watershed because of restoration efforts that have occurred. More information is available on the CRA-supported website: www.northernmichiganstreams.org.

EXHIBIT 82. Greater Bear Watershed Stream Bank Erosion Sites

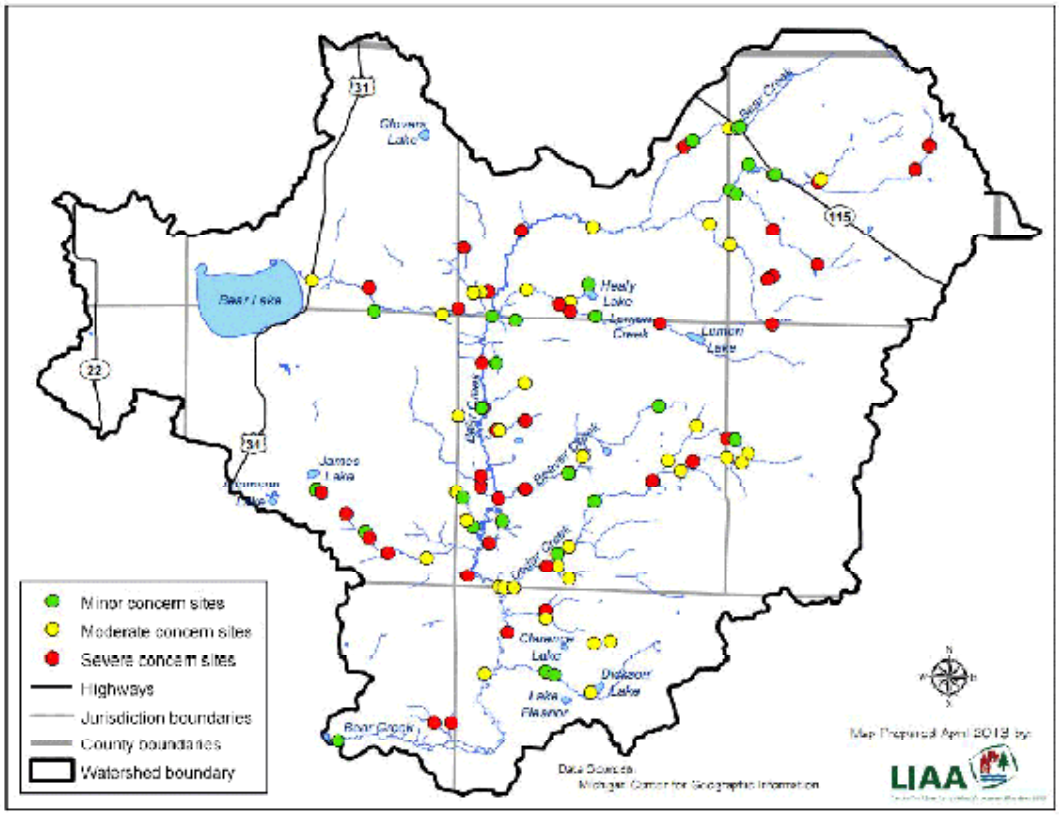


SOURCE: Land Access Information Association using information from the Conservation Resource Alliance, 2013.

Road Stream Crossings

Similarly, the Conservation Resource Alliance (CRA), through collaborative efforts with local partners, maintains an inventory of road stream crossings that it has prioritized for restoration. In total, 112 road stream crossings have been identified within the watershed and rated as either minor (31 locations), moderate (37 locations), or severely impaired (44 locations) in terms of their impact on aquatic habitat (see Exhibit 83). Members of the steering committee determined that the CRA's inventory and prioritization process is the most effective way to determine priority locations for restoration. The CRA updates this information as it and other groups continue to restore impaired locations within the watershed. More information is available on the CRA-supported website: www.northernmichiganstreams.org.

EXHIBIT 83. Greater Bear Watershed Road Stream Crossing Sites

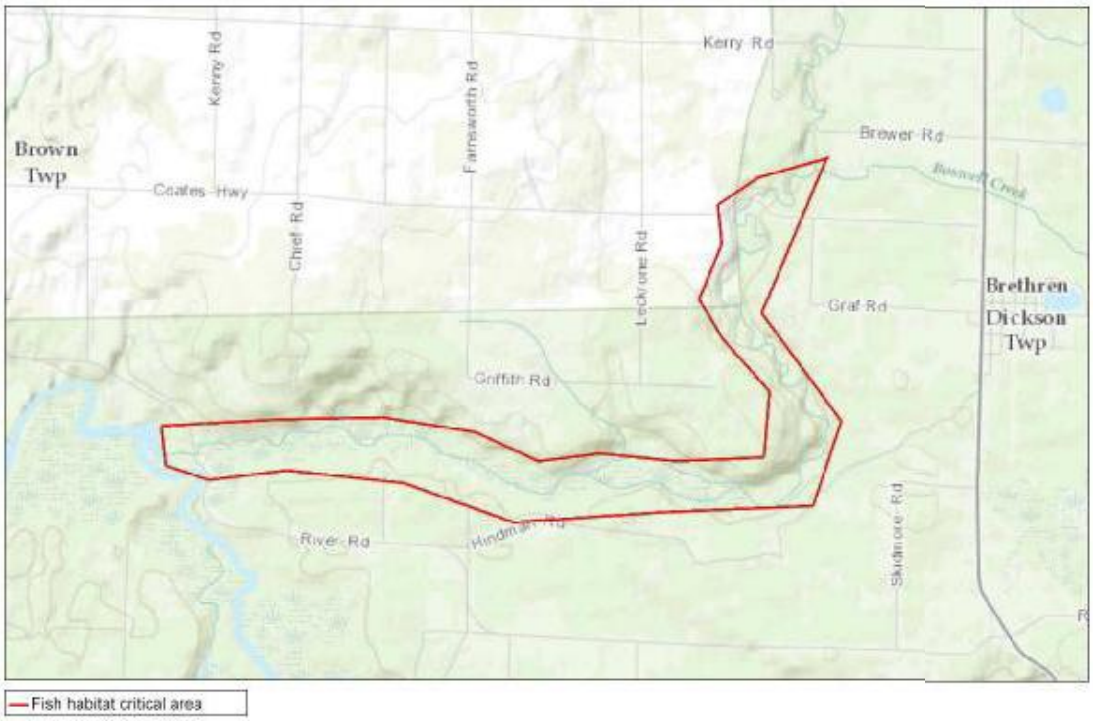


SOURCE: Land Access Information Association using information from the Conservation Resource Alliance, 2013.

Fish Habitat

DNR Fisheries has identified a critical area of high public use on Bear Creek from Coates Road downstream to its confluence with the Manistee as an area where fish populations can be enhanced by improving streamside shade and in-stream cover to enhance trout and salmon abundance. This area is depicted in Exhibit 84.

EXHIBIT 84. Fish Habitat Critical Area

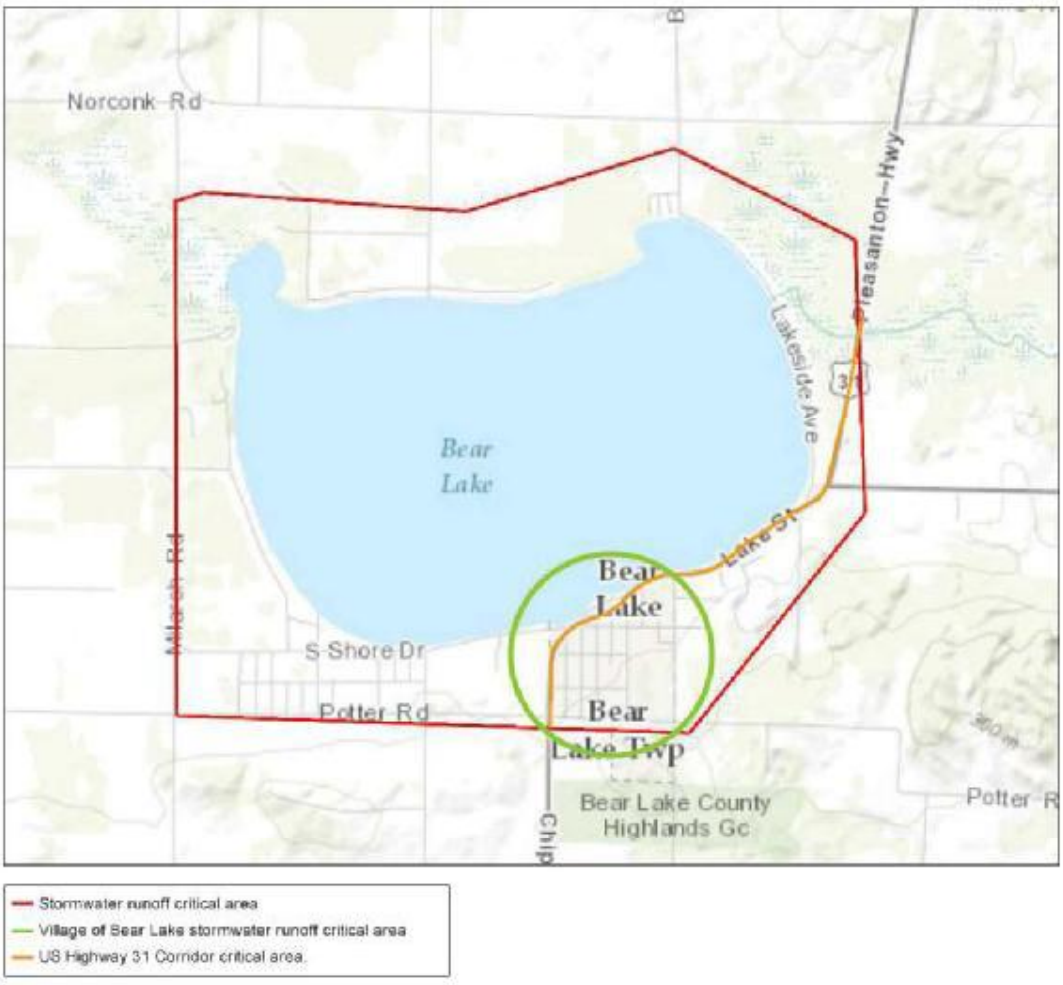


SOURCE: Public Sector Consultants, 2013.

Bear Lake Storm Water Runoff

Storm water runoff from residences, business, agricultural lands, and roadways adjacent to Bear Lake are a potential source of pollution including nutrients, sediments, human pathogens, hazardous materials, and litter. A broad critical area is defined within 1,300 feet surrounding Bear Lake. The Village of Bear Lake is a more significant critical area because of a high amount of impervious surfaces and a storm water sewer system with outlets that drain directly to the lake. Additionally, the U.S. Highway corridor through the Village of Bear Lake is a higher priority critical area due to the potential risk of a spill of hazardous materials. These areas are shown in Exhibit 85.

EXHIBIT 85. Storm Water Runoff Critical Areas

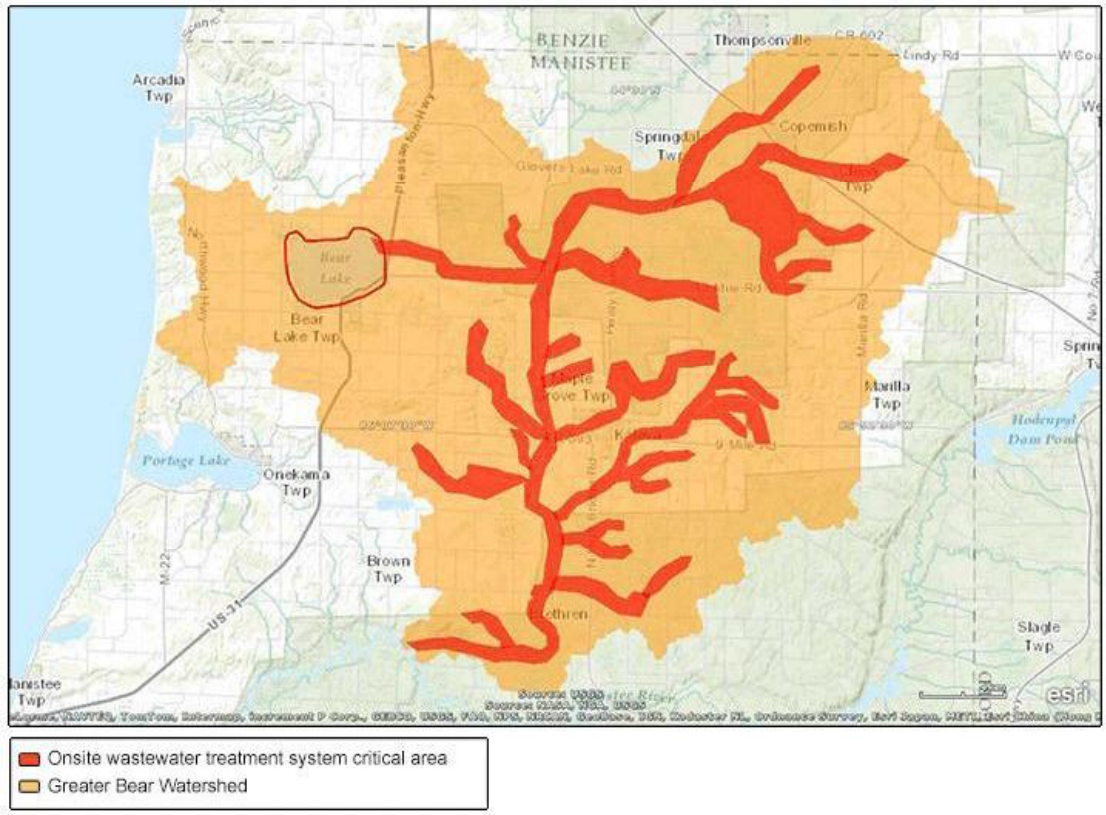


SOURCE: Public Sector Consultants, 2013.

Onsite Wastewater Treatment Systems Adjacent to Bear Lake, Bear Creek and Tributaries

Onsite wastewater treatment systems located at permanent residences, vacation homes, and businesses within 500 feet of Bear Lake and Bear Creek are a potential source of nutrients, human pathogens, and other contaminants to the watershed. A general depiction of these areas is shown in Exhibit 86.

EXHIBIT 86. Onsite Wastewater Treatment Systems Critical Area



SOURCE: Public Sector Consultants, 2013.

Over the last 30 years, Bear Lake has seen expanded uses and increasing development in the form of permanent homes and seasonal cottages adjacent to the lake, prompting concerns related to increasing nutrient loadings to the lake. Investigations by property owners revealed that a majority of OWTS serving residences around Bear Lake have not been upgraded for over 30 years. After considerable discussion, a sewer system to serve a majority of residences on Bear Lake was proposed. Michigan Public Act 188 was the basis to develop a special assessment district to pay for the sewer. PA Act 188 requires owners of more than 50 percent of the acres in the district to sign a petition in favor of the sewer. This was accomplished. Considerable vocal opposition was heard at meetings at the Pleasanton and Bear Lake township board meetings when the petitions were presented. By a narrow margin, the boards voted to stop the proposed sewer project before final engineering design and cost estimates were developed.

Measures of Increased Productivity (Nutrient Enrichment)

Thirty years of annual volunteer monitoring of traditional and relatively easily measured parameters of the trophic status (productivity) of Bear Lake, namely transparency (Secchi disk readings) and chlorophyll *a*, has not indicated a significant increase in productivity due to increased nutrient loadings to the lake. Unfortunately, these parameters that are used to measure productivity using a Trophic State Index (TSI) are not very effective in relatively shallow lakes such as Bear Lake, where the majority of productivity may be due to rooted aquatic plants versus algae. Periodic measures of total phosphorus in Bear Lake, an alternative measure used in determining the TSI of lakes, have been infrequent and inconclusive with respect to detecting any trends in productivity. Other measures that can be used to detect changes in productivity in lakes include the increase in the abundance of rooted aquatic plants, the increase in algal species indicative of nutrient enrichment, increasingly wide swings in 24-hour dissolved oxygen concentrations, and changes in abundance of certain bryozoans (freshwater sponges). It is expensive to systematically measure these parameters over time, however, and technical expertise and/or equipment beyond the capability of volunteers is often needed.

The invasion of zebra mussels into Bear Lake is complicating the use of traditional sampling parameters to measure increases in productivity. The water clarity (transparency) of the Great Lakes and large inland lakes has dramatically increased as a result of the introduction of invasive aquatic zebra mussels and, more recently, quagga mussels. Zebra mussels and quagga mussels are extremely efficient filter feeders that consume available algae. The effects of the introduction of zebra and quagga mussels on the food web of aquatic ecosystems can be dramatic, and likewise the effects of these invasive species on traditional measures of productivity in inland lakes are poorly understood.

Another complicating factor in measuring the productivity of Bear Lake is the presence of yet another invasive species, Eurasian milfoil. The ecosystem response over the long term to both the invasion of Eurasian milfoil and the annual chemical treatments to control its abundance is not yet known. While the chemicals used are targeted to milfoil, the herbicides applied may well affect the abundance of other rooted aquatic plants.

State Water Quality Standards

Three water quality standards relate directly or indirectly to inputs from OWTS. The primary standard related to public health is a measure of the abundance of human pathogens as measured by the number of *E. coli* bacteria present in water samples. While pets and wildlife can be a source of *E. coli*, the most likely human source in Bear Lake is inadequate or failing OWTS of adjacent homes and businesses. Unfortunately, no systematic measurements of *E. coli* have occurred in Bear Lake, and bacteria levels at popular swimming and wading areas around the lake are unknown.

The water quality standard most directly related to excessive nutrients is the frequency of nuisance algae blooms that interfere with protected water uses, and no reports of such blooms have surfaced from either members of the Greater Bear Steering Committee or riparian residents on Bear Lake who attended the public hearings.

While the water quality standard for dissolved oxygen is designed to protect fish in Bear Lake, a designated warmwater lake, dissolved oxygen concentration reflects productivity indirectly. Wide fluctuations from super saturation of dissolved oxygen during the day to concentration below the water quality standard in the early morning usually indicate excessive nutrient inputs. Phosphorus is the key limiting nutrient in Bear Lake, and storm water as well as OWTS are the most likely sources of phosphorus in Bear Lake. Only single daytime readings of dissolved oxygen are currently available from Bear Lake, and these are insufficient to determine whether the state warmwater lake standard is being met.

Implications for Property Owners

Manistee County has adopted the District 10 Health Department regulation that requires OWTS to pass an inspection prior to the sale of property. If an OWTS fails to pass inspection (i.e., sewage backs up into the home, it discharges to the ground surface, or contaminates the surface water or drinking water supplies), the homeowner must repair or replace the system to meet current standards before the sale can occur. The inspection criteria are based upon a health standard related to human pathogens and do not take into consideration the potential for an older system to be leaching nutrients such as phosphorus into nearby lakes or streams. If the failure requires construction of a new drain tile field and the lot size or elevation of groundwater prevents replacement, a so-called "mounded" system is approved where additional pervious fill material is brought to the site to add separation between tile field and groundwater.

Riparian property owners with limited lot sizes or near surface groundwater adjacent to Bear Lake have little option but to construct a mounded drain field if they would like to expand the use of their residence by adding bathrooms, a washing machine or dishwasher, or by installing a garbage disposal; any such expanded use is likely to cause their current OWTS to fail.

While physical separation of the tile field and groundwater can be effective in preventing the movement of human pathogens into drinking water supplies or surface water, the capacity of drain field soils to capture and hold nutrients such as phosphorus is limited. Over time the capacity of soils to capture phosphorus is saturated and the nutrients leach to the groundwater and, if near a lake or stream, discharge to a surface water body. In general, septic tile fields with the routine pumping of solids from septic tanks are designed to last for approximately 30 years of year-round use provided the size of the home and the number of wastewater-generating appliances remain the same. The U.S. Environmental Protection Agency estimates that the failure rate for OWTS is between 15 and 20 percent per year. In Michigan counties where inspections at the time of sale have been ongoing for a number of years and the performance of the tile field is tested, a 15 to 20 percent failure rate is common.

OWTS Recommendations

The age and outdated design of existing OWTS surrounding Bear Lake, as well as expanded wastewater inputs into these systems, will likely require residents to replace current systems due to failures at an increasing rate over the next few years. The options currently available are limited to construction of expensive mounded systems or the installation of a holding tank, pump-out system that has a very high operating cost. At some point, property owners are likely to decide that the most cost- effective course will be to construct a municipal sewer system for all or a significant portion of the riparian properties which will preserve their property values and water quality, and protect current uses of Bear Lake. In the interim the following actions, also included in Exhibit 89 in the Goals and Objectives section, are recommended:

- Maintain current voluntary measurements of transparency and chlorophyll *a*
- Expand annual sampling for total phosphorus to determine if this limiting nutrient exceeds acceptable levels for protecting existing uses
- Initiate periodic testing for *E. coli* based upon state standards during the open water season to assure residents, their guests, and visitors that the lake is safe for full and partial body contact recreational uses
- Implement at least one year of sampling to determine whether or not the state water quality standard for minimum dissolved oxygen levels is being met
- Plan and implement a sampling (to occur every five years) to estimate the biomass of aquatic rooted plants in the lake to establish a baseline and trends
- Prepare and distribute to lake residents information on the operation, design, maintenance, and limitations of current OWTS

- Advocate for provisions in the sanitary code that would require new or replacement OWTS be designed in such a way that the cost of conversion to a municipal sewer system will be minimized
- Actively pursue alternatives for control of storm water discharges to the lake to minimize both nutrients and *E. coli* inputs
- Perform an engineering study to identify sources and contribution of pollutants from unmanaged storm water entering the lake and recommend best management practices to reduce loadings
- Explore alternative means to effectively measure trends in lake productivity that may be more sensitive in predicting degradation of water quality

PRIORITY AREAS

Priority areas within the Greater Bear Watershed are regions where continued protection is important to maintain and enhance the ecological conditions in the watershed. These include existing wetlands and other properties of ecological significance along Bear Lake, Bear Creek, and tributaries, and other upland areas in the Greater Bear Watershed. These priorities are described in Exhibit 87.

EXHIBIT 87. Priority Areas of Concern in the Greater Bear Watershed

Priority Area	Description	Pollutant/Threat
Existing undeveloped wetlands adjacent to Bear Lake, Bear Creek, and tributaries	Riparian lake and stream properties where valuable shoreline wetlands remain intact.	Loss of natural vegetation to prevent nutrients and other storm water pollutants from entering waterway and loss of critical shoreline and nearshore aquatic habitat.
Properties of conservation significance identified through Grand Traverse Regional Land Conservancy (GTRLC) prioritization process	Wetlands and habitat areas adjacent to Bear Lake, Bear Creek, and its tributaries, and other targeted lands in the watershed.	Sedimentation, surface runoff, nutrients, and chemicals.

SOURCE: Public Sector Consultants, 2012.

Wetland Preservation

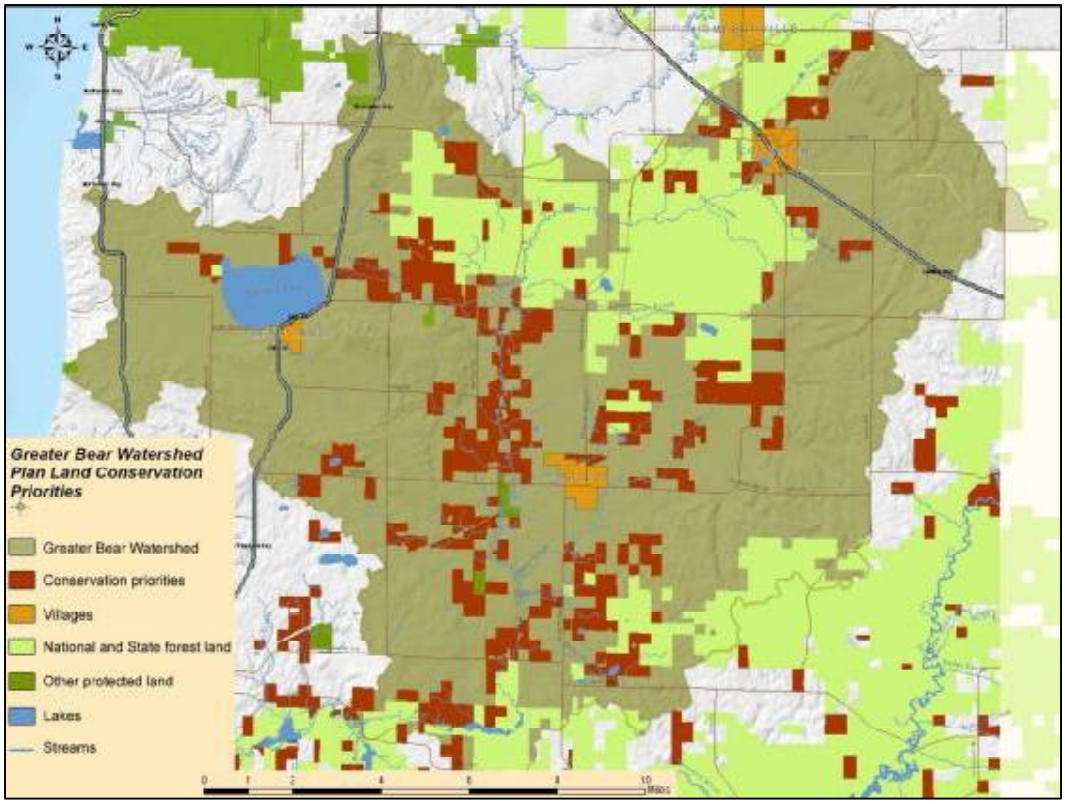
As summarized in the Description of the Greater Bear Watershed section of this report, wetlands provide many ecological services of significance to watershed management. Priority wetlands for continued protection should be further evaluated by Greater Bear Watershed steering committee members to further define those of particular importance. Many of these lands are already within public ownership and many others are included in priority lands for continued preservation described below.

Conserved Lands

The Grand Traverse Regional Land Conservancy (GTRLC) developed an approach to identify priority lands for conservation in the northwest Lower Peninsula, and some of this land is within the Greater Bear Watershed (see Exhibit 88). The factors used to prioritize these lands are parcel area (size), adjacency to protected land, habitat fragmentation, presence and contiguity of wetlands, endangered species occurrence, and shoreline length. This process identified many regions adjacent to Little Bear Creek, and the main stem of Bear Creek, as the highest priorities for conservation. Many other tributaries to Bear Creek are identified as medium priority for conservation.

The information from the GTRLC was reviewed by members of the Greater Bear Watershed Plan Steering Committee; the members agreed that the method is well developed and is the best approach to identify areas for conservation through acquisition of fee simple or lesser interests in land within the watershed. The GTRLC updates its priority list from time to time as new parcels are acquired or as conditions change. More information is available on its website: www.gtrlc.org. In addition to lands identified by the GTRLC, wetlands areas adjacent to Bear Lake were also identified as priorities for conservation.

EXHIBIT 88. Greater Bear Watershed Priority Lands for Preservation



SOURCE: Grand Traverse Regional Land Conservancy, prepared for the Greater Bear Watershed Steering Committee.