Control and Management of Purple Loosestrife (*Lythrum salicaria*) & *Phragmites* (*Phragmites australis*) in the Bear River Watershed

Tip of the Mitt Watershed Council
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INTRODUCTION

The Tip of the Mitt Watershed Council initiated the Healing the Bear campaign in 2001 with the intent of protecting and improving the aquatic ecosystem of the Bear River and its tributaries. During the last 10 years, the Watershed Council has initiated and completed myriad monitoring and restoration projects in the Bear River Watershed. These projects have ranged from volunteer water quality monitoring to streambank stabilization and restoration. Most recently, the Watershed Council engaged in invasive species management in the Bear River Watershed.

Invasive species are defined as non-native species whose introduction does or is likely to cause environmental or economic harm. There are over 180 aquatic non-native species now documented in the Great Lakes basin, many of which are considered invasive due to their impacts to native species and ecosystems. The Watershed Council decided that invasives species management in the Bear River should begin with two of the aquatic invasive species of greatest concern: purple loosestrife (*Lythrum salicaria*) and *Phragmites* (*Phragmites australis*).

During the summer of 2010, lakes, streams, and roads in the Bear River Watershed were surveyed for the presence of *Phragmites* and purple loosestrife with funding provided by the Petoskey Harbor Springs Area Community Foundation. The location of each infestation was recorded using a GPS (Global Positioning System) and the areal extent and density of the stands were noted on a datasheet. Many stands of purple loosestrife were found, particularly along the main stem of the Bear River. Fortunately, the invasive type of *Phragmites* was only found at two locations.

Different options are available for managing and controlling the spread of these invasive species. Data collected during the 2010 inventory provide valuable information for selecting the most effective short-term control methods. Considering the unlikelihood of eradicating either of these species from the Watershed, development of a long-term management plan is necessary to adequately control these invasive species and reduce the risk of widespread ecosystem disturbance.

BEAR RIVER WATERSHED

The Bear River is located in the Northwest Lower Peninsula of Michigan. Its main channel flows 14.5 miles from Walloon Lake north to Lake Michigan, emptying into Little Traverse Bay at Petoskey (Figure 1). The average slope of the main channel is approximately seven feet per mile. Major tributaries of the Bear River include Hay Marsh Creek, a warm-water tributary draining extensive wetlands in the southern headwaters, and Spring Brook, a cold-water tributary draining the headwaters to the southeast. Walloon Lake is one of just a few lakes in the watershed and by far the largest with 4,600 acres of surface area and a maximum depth of 100 feet.

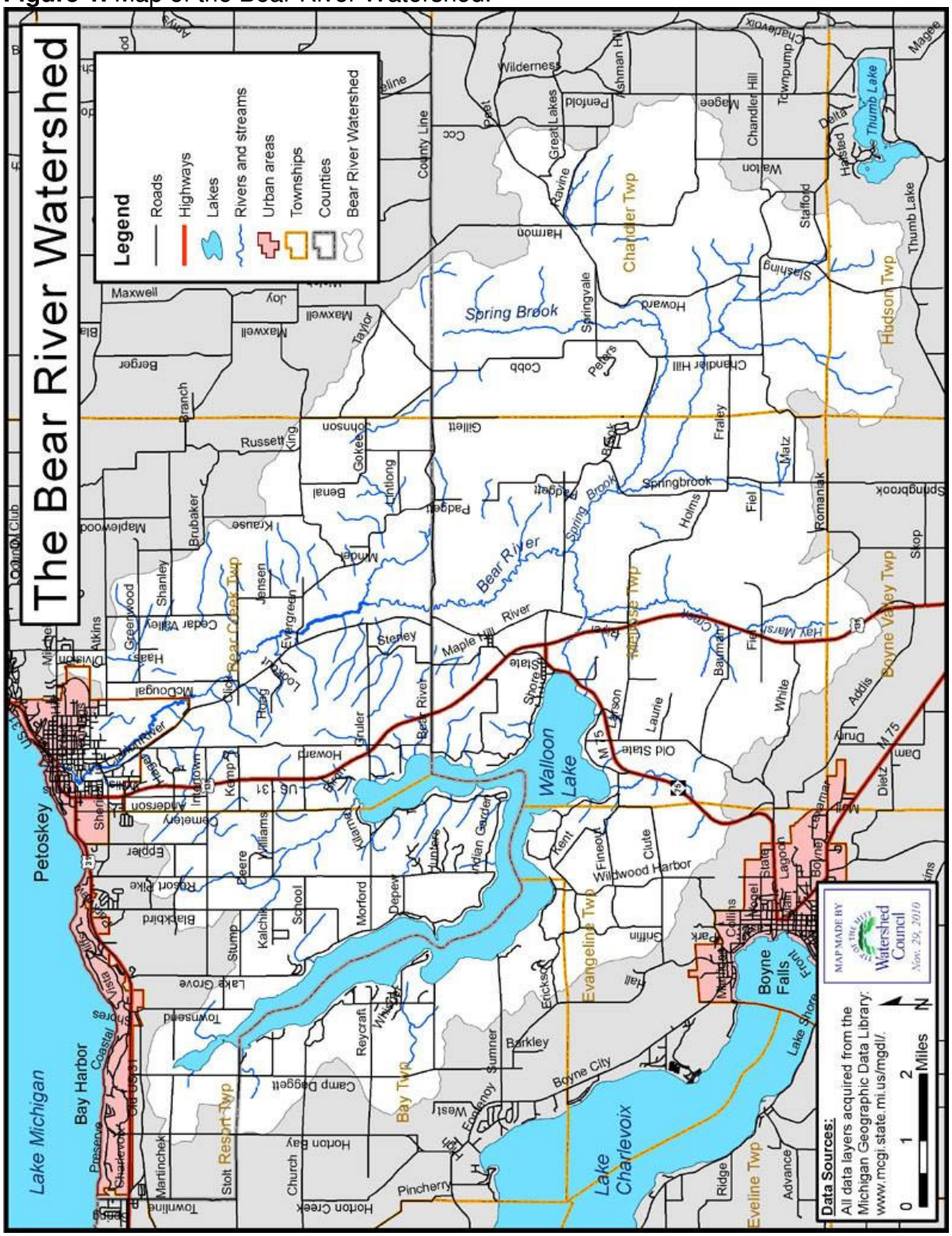
The Bear River Watershed drains approximately 74,215 acres of land and water in Emmet and Charlevoix Counties. The watershed includes land in Bear Creek, Resort, and Springvale Townships of Emmet County and in Bay, Boyne Valley, Chandler, Evangeline, Hudson and Melrose Townships of Charlevoix County. Based on 2006 remote sensing data from the Coastal Great Lakes Land Cover project, landcover in the watershed is mostly natural with 49% forested and 18% wetland (Table 1). Agricultural and urban landcover account for 18% of the watershed area.

Table 1. Bear River Watershed land-cover statistics.

Land Cover Type	2000 Acreage*	2000 Percent*	2006 Acreage*	2006 Percent*	Change (%)
Agriculture	10199.96	13.73	10625.43	14.31	0.57
Barren	157.79	0.21	169.06	0.23	0.02
Forested	35557.38	47.88	36213.36	48.76	0.88
Grassland	7314.87	9.85	4629.60	6.23	-3.62
Scrub/shrub	1410.95	1.90	1645.73	2.22	0.32
Urban	2045.96	2.76	2821.68	3.80	1.04
Water	4823.54	6.50	4727.00	6.37	-0.13
Wetland	12752.60	17.17	13431.20	18.09	0.91
TOTAL	74263.05	100.00	74263.05	100.00	NA

**Land-cover data from the NOAA Coastal Change Analysis Program.*

Figure 1. Map of the Bear River Watershed.



INVASIVE SPECIES BIOLOGY AND IMPACTS

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) is an emergent aquatic plant of Eurasian origin that can reach six feet of height and blooms in late summer (July through September) with purplish/pink flowers. Purple loosestrife inhabits wet areas, but can persist in a range of conditions, including some upland habitats. It is typically found on the margins of lakes, ponds, streams, and wetlands. The purple loosestrife plant roots in the soil, and is not a submerged or floating aquatic plant. The plant typically likes sunny conditions and oftentimes occupies the same niche as cattails and bulrushes.

The reproductive capacity of purple loosestrife is one of the most significant and relevant life history characteristics of this herbaceous perennial plant. Each mature plant can produce up to 2 million seeds each year (Blossey, 2003). Densities as high as 80,000 stalks per acre have been recorded, with the potential of producing as many as 24 billion seeds per acre. The seeds can remain viable even after 20 months of submergence in water. Seeds may be dispersed by water, wind, and in mud attached to animals. Purple loosestrife also spreads vegetatively. Root or stem segments can form new flowering stems.

Purple loosestrife is a highly invasive wetland perennial plant that is considered a threat to native wetland flora and fauna. Although the overall impact of purple loosestrife on native plant communities has heeded debate, research (Mal et al., 1992; Thompson et al., 1987; Farnsworth et al., 2001) shows that purple loosestrife is responsible for displacement of native plant communities. Once it becomes established, purple loosestrife oftentimes becomes the dominant vegetation by out-competing native plants. As a result, as native plant communities are degraded, so too are the wildlife species that depend on them. Studies show that declines in ducks, geese, and other wetland birds as well as muskrats, mink, and some amphibians are correlated with purple loosestrife establishment. Purple loosestrife also reduces spawning habitat for some fish. Because its stiff stems collect silt and debris, purple loosestrife can change shallow water habitats into more

terrestrial ones, which do not accommodate the feeding and breeding habits of native aquatic animals (Thompson et al., 1987).

Purple loosestrife-congested waterways may also obstruct recreational activities such as boating and swimming by restricting water access (Goldblatt, 2004). Other recreational activities such as hunting and trapping may be impacted, as hunting grounds are often lost to monotypic stands of purple loosestrife.

In 1997, Michigan State University and the Michigan Sea Grant College Program, together with Michigan Department of Natural Resources, U.S. EPA, Michigan Department of Agriculture, public schools, nature centers, and citizen groups from across the state came together to form the Purple Loosestrife Project. The innovative project joined students, educators, citizens, and scientists in the biological control of purple loosestrife using its natural insect enemies, namely the *Galerucella* beetle. The extensive effort has created a successful model for future purple loosestrife control and management projects.

Phragmites

Phragmites australis is a perennial, tall grass species attaining up to 15 feet in height that is commonly found in wet areas throughout Michigan, whether along lake and river shorelines, amidst wetlands, or in roadside ditches. There is a native variety of *Phragmites* that coexists in harmony with native plants, but the invasive type tends to dominate wet areas where it becomes established, crowding out native plants, and altering the ecosystem in myriad forms ranging from diminished waterfowl habitat to changes in local hydrology. Both are the same species, though the native variety has been given the sub-species name *Phragmites australis americanus.* Native *Phragmites* has been in North America for thousands of years, whereas the invasive type was probably introduced in the 1870s (Meyerson et al. 2009). Native populations appear to be declining while the invasive type expands.

Invasive *Phragmites* has been a problem in the Southern Lower Peninsula of Michigan for a number of years, but only recently began to appear in the Northern Lower Peninsula. Once established, it can become a monoculture and dominate wet areas in the period of a few years. It has been a highly successful invader for a

number of reasons. It has a high biomass and is tolerant to a wide range of physical and chemical conditions (Meyerson et al. 2009). Studies show that invasive *Phragmites* outcompetes other wetland plants for available light, allowing little to no sunlight to penetrate to the ground. Furthermore, invasive *Phragmites* spreads readily by producing large numbers of seeds, rhizome fragmentation, and surface runners.

Phragmites has come to the forefront of water resource management in the Northern Lower Peninsula because the invasive type has taken root in many locations, particularly along Great Lakes and directly connected inland lake shorelines. Recently, organized groups along the Lake Michigan shoreline in the Northwestern Lower Peninsula and in the Lake Charlevoix area have carried out projects to control *Phragmites* on their shorelines. As the invasive type becomes more prevalent along Great Lakes shorelines, it is expected to become more common in inland areas.

SURVEY METHODS AND RESULTS

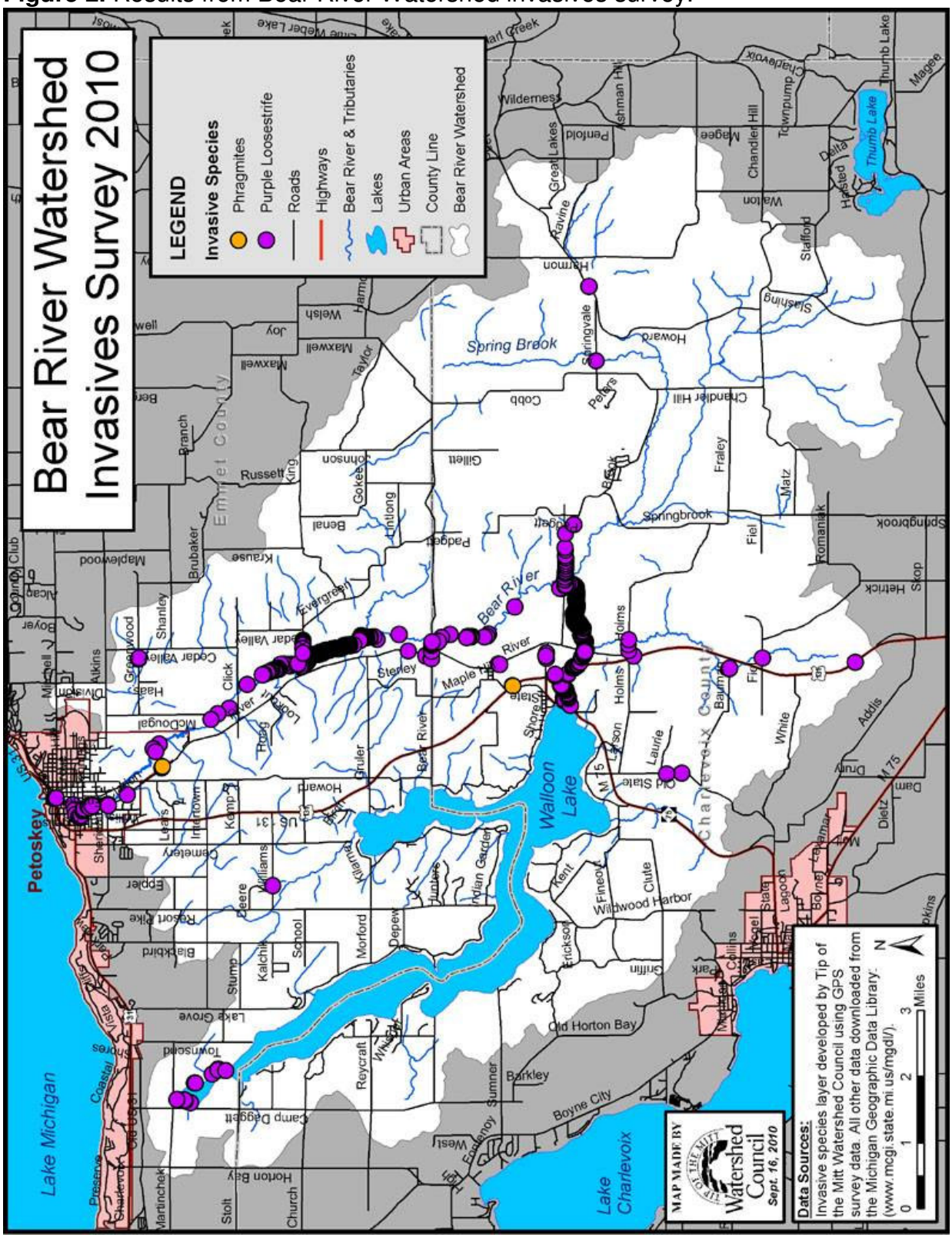
The Walloon Lake shoreline, the entire main channel of the Bear River, and most roads in the Bear River Watershed were surveyed during the summer of 2010 to document occurrences of purple loosestrife and *Phragmites*. The small tributaries feeding into the Bear River and Walloon Lake were not surveyed because they were too difficult to access. The survey was carried out in mid to late summer, which is when it is easiest to spot and identify purple loosestrife and *Phragmites* due to flowers and plant height. Fieldwork began on July 21st and was completed on August 11th.

The Bear River and Walloon Lake were surveyed by boat (canoe and kayaks) and roads were surveyed by car. At each location where purple loosestrife or *Phragmites* were found, data were collected to record the location and describe the stand. Locations were recorded using a Ricoh 500SE digital GPS camera with a reported accuracy of 3-10 meters. Information noted on datasheets included the date, site location description, habitat type, stand size, stand density, native versus invasive (*Phragmites*), and whether there was evidence of *Galerucella* beetles (purple loosestrife).

A total of 175 purple loosestrife stands were documented in the Bear River Watershed; 127 streamside, 11 on lakeshore, 36 roadside, and one in the backyard of a private residence (Figure 2). Stand densities were classified as: dense=4, medium=8, and sparse=163. The estimated area of stands ranged from 1 square foot to 270,000 square feet. The total estimated area of all purple loosestrife stands was 1,330,079 square feet. Evidence of *Galerucella* beetles was only found on one stand. However, many stands could not be checked for beetle damage due to inaccessibility.

Phragmites was found at only two locations, both along roadsides, and both determined to be of the invasive variety. The larger stand was densely vegetated with an estimated area of 4,400 square feet. The other stand was sparsely vegetated and limited to 150 square feet.

Figure 2. Results from Bear River Watershed invasives survey.



DISCUSSION

Both purple loosestrife and *Phragmites* are emerging threats to the inland water bodies of the Northern Lower Peninsula of Michigan that need to be addressed in a timely matter to minimize impacts to native ecosystems. The invasive species survey completed in 2010 was a very important step in the process. The information collected during the surveys can now be applied to develop effective and comprehensive management strategies.

Purple loosestrife was found to occur commonly in the Bear River Watershed, particularly in the main channel of the Bear River and along roads near the river corridor. However, the vast majority (93%) of stands were sparsely vegetated (low density). Although many stands were found, controlling purple loosestrife in the Bear River Watershed should be achievable by focusing management efforts on the river corridor. Focusing biological control efforts (using the *Galerucella* beetle) in the headwaters of the Bear River should result in drift and migration of the beetle downstream, which will ultimately control infestations in lower river sections.

The limited occurrence of *Phragmites* as documented by the survey is encouraging and provides direction for management. Invasive *Phragmites* was only found at two locations, which should be treated as soon as possible for effective containment. Following treatment, management should focus primarily on preventing the spread of invasive *Phragmites* into other areas of the Bear River Watershed.

Follow-up surveys to identify new infestations and track the spread or control of known infestations are vital to successful management. The Bear River is the largest tributary and sub-watershed in the Little Traverse Bay Watershed and, though comprehensive in nature, the surveys conducted were not exhaustive. Future surveys should retain focus on the main channel of the river, Walloon Lake, and heavily travelled roads, though smaller lakes, streams and roadways should also be surveyed; albeit less frequently.

Management Recommendations

1. Control purple loosestrife infestations. Considering the number of purple loosestrife infestations documented during the survey, biological control using the *Galerucella* beetle should begin in the next field season (summer, 2011). *Galerucella* beetles should be collected from locations where they are known to exist in Northern Michigan and released in upstream locations (headwaters) within the Bear River Watershed. The Watershed Council coordinates a volunteer *Galerucella* beetle collection event in early summer, which could potentially supply the required beetles. In addition, beetles can be purchased through commercial operations to supplement those collected and released by volunteers. Biological treatment should be repeated continually for several years for best results.
2. Control *Phragmites* infestations. The invasive *Phragmites* stands found during the survey should be treated as soon as possible to prevent their spread. The two invasive *Phragmites* infestations were found on a state highway and a county road. Therefore, the Michigan Department of Transportation and the Emmet County Road Commission should be alerted to the problem and encouraged to undertake control measures immediately. Treatment measures, usually entailing herbicide application, require at least three seasons of follow-up to ensure effectiveness.
3. Information and Education. Considering the size of the Bear River Watershed and its myriad water features, an effective information and education campaign is essential for monitoring and controlling invasive species. The Tip of the Mitt Watershed Council and other organizations in the region have worked hard to inform and educate the populace of Northern Michigan regarding purple loosestrife, *Phragmites*, and other invasive species of concern. Such efforts should continue because engaged and informed residents will help limit the spread of the target invasives, help identify new infestations, and an informed public is more receptive to proposed control measures. Education efforts should focus on general information regarding the biology, impacts, and spread of invasive species, current status and

information specific to the target invasive species, identification of target invasives, and feasible, safe, control measures. A tiered approach is recommended with more intensive information and education efforts, such as presentations and workshops, directed toward natural resource managers, water resource organizations, and local government officials. Less intensive efforts, such as press releases and the development of informational brochures, should be directed toward the general populace.

4. Research and implement prevention measures. Past efforts to control the spread of invasive species in the watershed, such as informational signs at boat launches, need to be documented. Approaches to preventing the introduction or spread of target invasive species need to be researched and evaluated to determine most appropriate and feasible prevention measures. Locations for implementation and types of control measures should be prioritized on a watershed scale for guidance in focusing prevention efforts.
5. Conduct follow-up surveys. Identifying new infestations and monitoring control efforts applied to known infestations is vitally important for managing the target invasives. Although an informed public will undoubtedly help, comprehensive surveys need to be performed on an ongoing basis. Major water bodies and roads should be surveyed every 2-3 years, while 3-5 year intervals are suggested for smaller water bodies and roads.

Prioritizing Management

Although all areas should be subject to appropriate management at some point in time, it is important to prioritize management areas. Priorities for management indicate where education, prevention, and control efforts should be focused. Concentrating on high priority areas and gradually proceeding to lower priority areas will benefit the overall management of purple loosestrife and *Phragmites* in the watershed. The following criteria were used to establish priority among management areas:

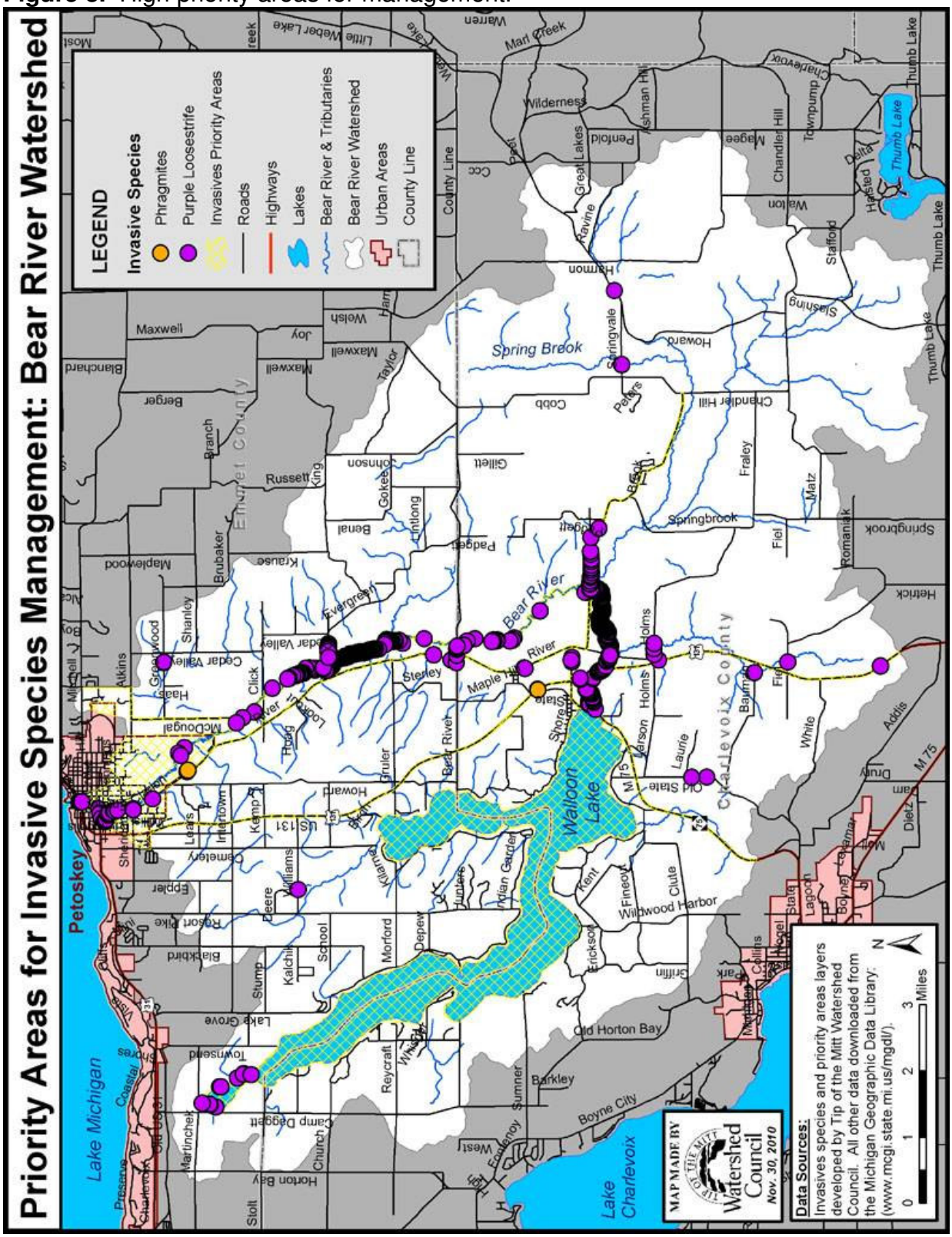
1) Infestation occurrence. Areas within the watershed infested with the target invasives receive the highest priority. Currently, these are concentrated in the Bear River corridor.
2) Heavily used lakes and rivers receive higher priority. The major water bodies in the Bear River Watershed that should be surveyed frequently include Walloon Lake and the main channel of the Bear River.
3) Heavily traveled roads receive higher priority. Major highways in the watershed include: US131, and M75. Other major roadways include: Camp Daggett Road, Cemetery Road, Evergreen Trail, Howard Road, McDougal Road, Resort Pike Road, River Road, and Springvale Road.
4) Water bodies and roadways surrounding urban areas receive higher priority. Urban areas in or adjacent to the Bear River Watershed that should be part of this designation include Petoskey and Walloon Lake Village.

Based on these criteria, the highest priority area in the watershed extends from Walloon Lake to Petoskey and includes the entire main stem of the Bear River (Figure 3). Additionally, due to high traffic, US131, M75, McDougal Road, Springvale Road, and River Road are considered to be high priority areas. Future efforts in education, monitoring, and control of purple loosestrife and invasive *Phragmites* should be concentrated in the high priority areas.

Sustainable Management

The Watershed Council will continue to monitor the project area over time, collaborating with lake associations, local governments, and other stakeholders throughout the watershed to manage invasive species. Baseline survey results and the management plan will be used to assist with management efforts. Follow-up will be carried out in treatment areas to ensure effectiveness and additional surveys will be conducted to identify and control any new infestations. Prevention and control efforts will need to be reevaluated periodically and adjusted as necessary for maximum effectiveness.

Figure 3. High priority areas for management.



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