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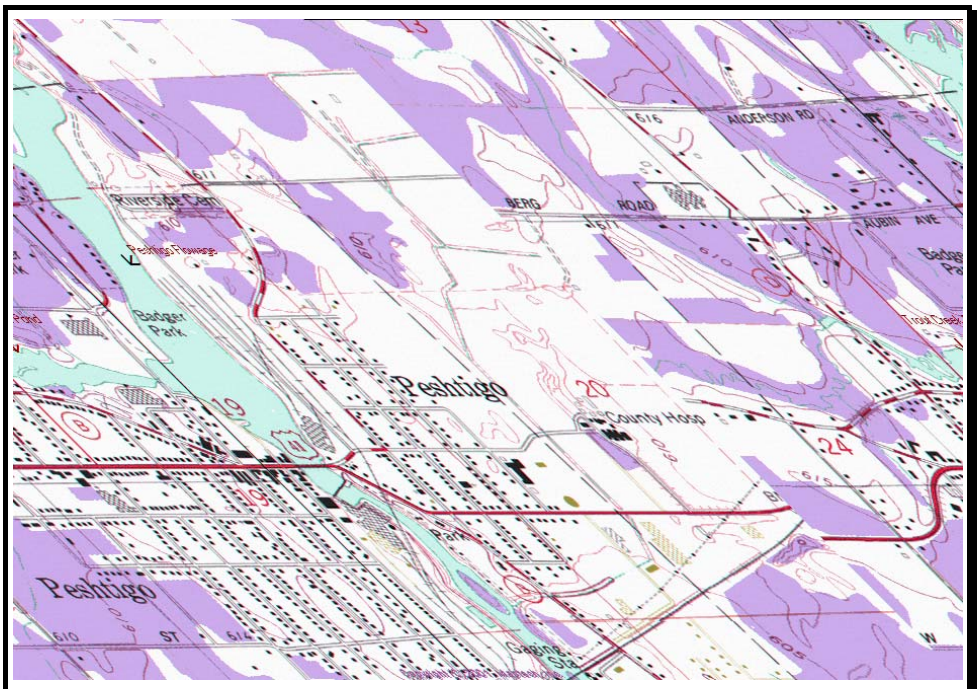
Peshtigo Flowage and Trout Creek Pond Management Plan

Setting

Peshtigo Flowage is an impoundment of the Peshtigo River located in Southern Marinette County (figure 1). Trout Creek Pond is a side channel of Peshtigo Flowage which consists of lower reaches of Trout Creek where the water level is controlled by the flowage. The Peshtigo Dam, the lower Peshtigo Flowage and all of Trout Creek Pond are located in the City of Peshtigo.

Physical Features

According to the Wisconsin DNR the Peshtigo Flowage has a surface area of 232 acres and a maximum depth of 15 feet. The flowage is maintained by the Peshtigo Dam which is owned by the Wisconsin Public Service Corporation and has a maximum head of 13 feet. The surface area of a flowage is typically measured from the dam upstream to the point where river is free flowing. In practice it is often difficult to determine where the flowage stops and the river begins. According to the WDNR, Peshtigo Flowage ends, and the Peshtigo River begins, approximately 2.5 river miles upstream from the dam.



Peshtigo Flowage is classified as a drainage The Peshtigo Flowage and Peshtigo River between the Peshtigo Dam and the Potato Rapids dam has lake, which means it receives most of its water from overland drainage. The area of land draining to the flowage, known as the watershed, is approximately 675,000 acres in size. In general, drainage lakes have a high flushing rate compared to seepage lakes which have no inlets or outlets. The flushing rate is the number of times a lake's entire volume is replaced annually with "new" water from runoff, groundwater inflow, and precipitation. Accurately measuring the flushing rate requires extensive ground and surface water flow monitoring. Alternatively, a "flushing index" can be calculated which closely approximates the flushing rate. The flushing index for Peshtigo Flowage is 440. This means that, on average, the entire volume of the flowage is replaced more than once per day by incoming water.

approximately 10.3 miles of shoreline excluding

the numerous islands. Approximately 2.6 miles of shoreline are located within the City of Peshtigo.

Trout Creek Pond has a surface area of approximately 5.4 acres and a maximum depth of 5 feet. The water level in Trout Creek Pond is controlled by the Peshtigo Flowage upstream approximately to the intersection with Sucker Brook, just west of Lake Street. The Trout Creek Pond watershed is 25,076 acres in size. The flushing index for the pond is in excess of 1,500.

Typically, a flowage has three distinct zones; a deep lake-like zone near the dam, a transitional zone which is narrower but still deep with reduced flows and a riverine zone with a narrow, more shallow basin and higher flows. Due to it's high flushing rate, Peshtigo Flowage has no true lake-like zone.

Watershed Area & Land Use

The greatest source of nutrients and contaminants to most impoundments is surface runoff from within the watershed. Land cover and land use are important since the nutrient content in runoff is directly related to land use. Forested land typically exports less than 0.1 pounds of phosphorus per acre per year. Agricultural land generates 10 to 20 times as much phosphorus per acre depending on farm density, crop rotation, and other management factors. Urban areas typically generate as much or more phosphorus than agricultural land.

The Peshtigo Flowage watershed covers more than 695,000 acres and stretches from Peshtigo to the Town of Argonne in the Nicolet National Forest in Florence County. Land cover in the watershed is primarily forest. Peshtigo, Crandon and Crivitz are the largest urban areas in the watershed. Agricultural Land draining to the Flowage is concentrated in south and central Marinette County. Most agricultural runoff enters the Peshtigo River and Flowage via Beaver Creek, Little Peshtigo River, Gravelly Brook, Mud Brook, and Trout Creek. Windshield surveys confirm that even during high flow events the Peshtigo River tends to remain clear (low sediment load) as it flows through Crivitz. Significant sediment, and other nonpoint source pollutants are delivered to the system from the aforementioned tributaries.

An inventory of nonpoint sources of pollution in the Trout Creek watershed was conducted as part of the management plan. Analysis of the data is included later in the report.

Shoreline Land Use

A survey of the shoreline was conducted to determine shoreline land use and evaluate shoreline habitat. Within the city limits park and open space, which includes shoreline frontage owned by the City and the Peshtigo School District, accounts for 0.92 miles of shoreline. Industrial and business use can be found along 0.32 miles of shoreline. Presently, there are approximately 0.38 miles of previously industrial shoreline being converted to single family and multi-family residential use. Riverside Cemetery occupies 0.34 miles of shoreline. Within the City of Peshtigo there are 23 private residences located along approximately 0.71 miles of shoreline.

There are approximately 8.5 miles of shoreline between the city limits and the Potato Rapids Dam not including the many islands. There are 110 homes and cottages and one resort in this stretch. Approximately 5.2 miles of this shoreline frontage is undeveloped. Most (76%) of this shoreline frontage is in private ownership. The balance is owned by the Wisconsin Public Service Corporation and is held in conservancy for public use.
the City of Peshtigo is typically "urban".

Manicured lawns and formal landscaping is the rule. In these areas natural shoreline vegetation is generally lacking. The industrial shoreline frontage typically has a fringe of natural vegetation 5 to 20 feet in depth behind which lies roads, buildings, parking lots and other impervious surfaces. These areas contain some large overhanging woody structure.

Water Quality

Water quality is actually a very subjective term. Water "quality" as perceived by those who use the flowage is affected by many factors which have little to do with the actual physical properties of the water. These include the depth and shape of the water body, aquatic plant population, recreational pressure, shoreline development and quality of the fishery.

For this lake study we investigated many physical and chemical properties of Peshtigo Flowage, Trout Creek Pond, and Trout Creek. A summary of these results and a discussion concerning each parameter is presented in this section. A detailed listing of water quality results can be found in Appendix A.

Dissolved Oxygen and Temperature From a biological point of view, dissolved oxygen is one of the most important water quality parameters. Dissolved oxygen is required by all fish and most other aquatic life. The oxygen content of a water body is determined by a number of factors, including basin shape (morphometry), water temperature, weather patterns, nutrient inputs, and biological activity within the water and sediment. The water quality standard for dissolved oxygen is 5 mg/l (milligrams per liter or parts per million). Below this level many fish become stressed and reproduction may be Dissolved oxygen was measured on Peshtigo Flowage and Trout Creek Pond several times during the study. This monitoring revealed adequate dissolved oxygen in the flowage impaired.

The solubility of oxygen in water varies with temperature. Water at 32^0F (0^oC) can contain 14.6 mg/l of oxygen when 100% saturated. At 70^0F (21^0C) the same water can hold only 8.8 mg/l of oxygen. The primary source of oxygen in water is gas exchange with the atmosphere. Ice cover, thermal stratification and windless periods all reduce mixing and can lead to oxygen depletion.

Winter is the most critical time for oxygen stress since ice cover prevents oxygen exchange with the atmosphere while heavy snow cover reduces photosynthetic oxygen production below the ice. When plants begin to die their decomposition can reduce oxygen to critical levels, resulting in the death of fish (winter kill). Due to the constant inflow of oxygen rich river water, winter kill in the flowage is very unlikely. Stratification is the division of the water into two distinct layers caused by temperature and density differences. In stratified lakes the lower cold water is isolated from the atmosphere during the warm summer months. The shallow depth of the Flowage and Trout Creek Pond, and the high flushing rates prevent stratification.

Aquatic plants add oxygen to the water column through photosynthesis and consume oxygen through respiration. On calm sunny days plants and algae can experience high rates of photosynthesis and oxygen production leading to oxygen super-saturation. During nighttime hours plant respiration can lead to localized oxygen depletion. This phenomenon is most likely to occur in shallow water with abundant aquatic plants and poor water circulation.

throughout the year. Due to the abundant aquatic plants and low flow, dissolved oxygen levels in Trout Creek Pond showed quite a bit of fluctuation. Monitoring in mid February in 2000

revealed dissolved oxygen levels approaching zero. Likewise, dissolved oxygen was depressed during early morning hours. The variability in dissolved oxygen in Trout Creek is the result of limited flushing during dry weather and the dense aquatic plants. These aquatic plants produce large amounts of oxygen during the day but use oxygen in respiration during nighttime hours. The low dissolved oxygen in Trout Creek Pond should not be detrimental to the fishery since fish can leave the pond during periods of oxygen stress and find better water quality upstream or in the flowage.

Phosphorus Phosphorus is an essential nutrient required for the growth of all plants. In natural waters phosphorus is generally found in a very low concentration in relation to other major plant nutrients and is usually the limiting factor controlling aquatic plant and algae growth. As a growth limiting factor, small inputs of phosphorus can cause significant increases in the growth of algae and aquatic plants. Phosphorus comes from many natural sources including soil particles, decaying vegetation, and rainfall. Many sources of phosphorus are also generated by people including detergents, fertilizers and septic system discharge. Many of the land use changes we make to a watershed also lead to increased phosphorus delivery. Disturbance of natural vegetation, cultivation, and shoreline alteration can all increase runoff and the amount of phosphorus delivered to a water body.

Phosphorus is measured in two basic forms, total and ortho-phosphorus. Total phosphorus is a measure of all forms of phosphorus. Ortho-phosphorus is a biologically available form Phosphorus levels in Peshtigo Flowage and Trout Creek Pond were monitored during a two year period. Figure 2 depicts the phosphorus concentration for both the Flowage and Trout Creek Pond. The annual average surface total

which is quickly taken up by plants and algae.

Phosphorus entering a reservoir can undergo many transformations and be recycled within the reservoir for many years. Incoming phosphorus attached to larger sediment particles quickly settles to the bottom where it becomes available to rooted macrophytes. Fine sediment and it's phosphorus load may be flushed out of the reservoir before it is used. Dissolved or ortho-phosphorus is biologically available and most is taken up by aquatic plants or algae. As plants and algae die and decompose much of the phosphorus contained within them is released to the overlying waters where it is again available or is flushed out of the system. A fraction also falls to the bottom of the reservoir where it is trapped in the sediment.

In the sediment, phosphorus forms relatively stable compounds with iron if oxygen is present. When bound in this manner, the phosphorus is unavailable for use by algae. However, rooted aquatic plants can still extract this phosphorus from the sediment. When water overlying the sediment becomes anoxic (oxygen depleted) phosphorus is released from the sediment into the overlying water where it can trigger algae blooms.

Phosphorus concentration is commonly reported in micrograms per liter(ug/l) which is equal to parts per billion (ppb). Waters with total phosphorus concentrations below 20 ug/l typically do not experience nuisance algae blooms. The average phosphorus concentration for Wisconsin natural lakes is 25 ug/l. The average phosphorus concentration for Wisconsin impoundments is approximately 65 ug/l.

phosphorus concentration for Peshtigo Flowage for the two year period was 26.9 ug/l. This level is well below the average for Wisconsin impoundments. Ortho-phosphorus was also found in low concentrations in the Flowage

(Average 5.3 ug/l). The low phosphorus level can be attributed to the relatively undisturbed condition of the upstream watershed.

Phosphorus levels in Trout Creek Pond were significantly higher than in Peshtigo Flowage. Over the same two year sampling period, the average surface total phosphorus concentration in Trout Creek Pond was 52.2 ug/l while ortho-phosphorus was 25.7 ug/l. The higher phosphorus level is due to increased nutrient loading from the highly agricultural watershed and phosphorus release from enriched sediments during periods of anoxia.

Chlorophyll-a All green plants contain the pigment chlorophyll-a which is used in photosynthesis. The chlorophyll-a concentration in a water sample is used as a measure of the amount of algae in water. Low levels of chlorophyll-a indicate low levels of algae production and usually correspond to clear water. Chlorophyll-a concentrations greater than 10 ug/l indicate a eutrophic or nutrient rich condition.

The average chlorophyll-a concentration in Peshtigo Flowage during the study period was 3.6 ug/l, which is less than would be expected based on the phosphorus concentration. Trout Creek Pond averaged 7.2 ug/l of chlorophyll-a but the results are skewed by one sample which contained 18 ug/l. Both Trout Creek Pond, and Peshtigo Flowage are aquatic plant dominated systems. That is, nutrients are tied up in rooted aquatic plants and generally unavailable to the algae. Peshtigo Flowage is unlikely to experience dense algae blooms since any algae is quickly flushed out of the system.

Secchi Disk Depth Secchi disk depth is a measure of water clarity taken by lowering a 20-centimeter black and white disk into the water until it is no longer visible. This measurement, the Secchi depth, is affected by a number of factors including the amount of algae and sediment in the water column and natural staining of the water by organic compounds such as tannins.

The average Secchi disk depth in Peshtigo Flowage was 5.3 feet (1.6 meters). The water clarity is less than would be expected based on the chlorophyll-a level. This is due to naturally stained water in the Flowage. The dark staining is entirely natural. It is due to the presence of tannins and lignins which are organic compounds released from decaying vegetation. These compounds are washed into the flowage from large wetland areas in the watershed. Secchi disk readings were not possible in Trout Creek Pond since the disk would hit the bottom before it disappeared from sight.

Trophic State Index Trophic state indices (TSI's) are popular water quality indicators used to classify waters based on phosphorus concentration, chlorophyll-a concentration and Secchi disk depth. Lakes and reservoirs classified as oligotrophic are nutrient poor and have clear unproductive water. Mesotrophic waters have moderate nutrient levels, are productive and have occasional algae blooms. Waters classified as eutrophic are nutrient rich and commonly exhibit water quality problems such as frequent algae blooms, severe oxygen depletion and poor water clarity.

The phosphorus and Secchi disk TSI values for Peshtigo Flowage were consistently in the eutrophic range (> 50) , while the chlorophyll TSI was in the mesotrophic range (40-50) during the summer months (figure 3). Although the phosphorus value indicates a eutrophic state, the flowage does not exhibit the algae blooms characteristic of nutrient rich waters. This is due in part to the high flushing rate and the stained water which restricts algae and rooted aquatic plant growth.

Trophic state values for Trout Creek Pond were significantly higher than those for the Flowage. The higher trophic state is due to increased phosphorus loading from Trout Creek and possibly sediment release of phosphorus from enriched sediment.

Nitrogen Nitrogen is another important nutrient required for plant growth. Due to its relative abundance, and the ability of some algae to obtain nitrogen from the atmosphere, nitrogen content in the water does not typically limit algae growth. However, elevated levels of nitrogen in the sediment have been linked to increased growth of aquatic plants. Studies have documented increased growth of Eurasian water milfoil (*Myriophyllum spicatum*) in response to elevated sediment nitrogen. Eurasian water milfoil is currently found at nuisance levels in the flowage. In most cases the nitrate level in surface water corresponds to local land use. Surface runoff and groundwater high in nitrogen may come from a variety of sources including agricultural land, fertilized lawns, and septic systems.

Total nitrogen levels in Peshtigo Flowage averaged 516 ug/l. This level is below the average for drainage lakes in northeast Wisconsin and is indicative of a largely undisturbed forested watershed. Total Nitrogen levels in Trout Creek Pond averaged more than 4-times higher at 2,340 ug/l. This level is well above average for northeast Wisconsin drainage lakes. Nitrogen levels of this magnitude indicate agricultural nonpoint source pollution in the watershed. Agricultural sources of nitrogen include runoff of animal waste and inorganic fertilizer.

Inlet Chemistries Water quality monitoring was conducted in Trout Creek and its tributaries to evaluate nonpoint source pollution to Trout Creek Pond and Peshtigo Flowage. Samples were analyzed for phosphorus, nitrogen and suspended solids. A complete list of sample results can be found in Appendix A.

Flows were measured on Trout Creek to help determine the relationship between flow volume and nutrient content. Water level and stream flow were originally monitored, and chemistries were collected at the Lake Street Bridge. However, it was soon determined that water levels at this location were being controlled by the Peshtigo Dam and a stage-discharge relationship could not be developed. Subsequent sample collection and flow monitoring was moved upstream to the bridge at Town Line Road. Additional samples were collected from Sucker Brook at Aubin Street and from an unnamed tributary near the intersection of Aubin Street and Town Line Road.

The average total phosphorus concentration in Trout Creek during the sample period was 80.7 mg/l. The lowest nutrient readings (37 to 69 mg/l) occurred during low flow conditions in summer and in April during runoff from snow melt. The highest readings occurred during late spring and early summer rain events when phosphorus levels between 100 and 140 mg/l were measured. These readings occurred during and shortly after spring planting season when fields are plowed and crops planted. At this time soils are exposed and runoff of phosphorus laden sediment is greatest.

Fish Community A fisheries survey was not conducted as part of this lake management planning grant. However, WDNR Fisheries Technician Greg Kornely was interviewed and previous fisheries evaluations were reviewed. Several fisheries surveys of Peshtigo Flowage have been conducted. Most recently in 1988 and 1999.

Both fisheries surveys indicate a healthy panfish population with good growth rates for Bluegill, Black Crappie and Yellow Perch. According to Mr. Kornely, the panfish population in Peshtigo Flowage seems to be underutilized. Game fish in Peshtigo Flowage include Walleye, Northern Pike, Largemouth Bass and Smallmouth Bass. As with the panfish, all of the above game fish are experiencing good natural reproduction and have self sustaining populations.

Since 1995 Peshtigo Flowage has had special regulations for Northern Pike. The rule places a 26" minimum length limit on Northern Pike and limits the daily bag to 2 fish. This regulation was implemented by the Wisconsin DNR to address the poor size structure of the Northern Pike population. During the 1988 survey it was found that more than 90% of the Northern Pike were smaller than 15" but growth rates remained good. The Northern Pike size structure and growth rate was almost identical to the population immediately upstream in Bagley Flowage. Only four years after the new rule went into effect, the 1999 fish survey showed a noticeable shift in the Northern Pike population to a better size structure with more large fish. On Bagley Flowage where the special rule is not in effect, the Northern Pike size structure has remained the same. According to Mr. Kornely,

the Northern Pike rule will be evaluated after the next fisheries survey which should occur around 2009.

The key to maintaining a healthy fishery is protecting important near-shore habitat used for spawning and as a nursery area for young fish. According to Mr. Kornely, there is good Walleye spawning habitat below the Potato Rapids Dam and Excellent Northern Pike spawning habitat throughout Peshtigo Flowage. Northern Pike prefer shallow water with abundant emergent vegetation. Care should be taken to protect these important spawning areas.

The Wisconsin DNR does not stock fish in Peshtigo Flowage. However, DNR records show that a private landowner has stocked Rainbow Trout in the past. According to Mr. Kornely, the stocking was permitted but was surely a futile effort since the high predator population would almost certainly eat the trout before they reached a catchable size. Water temperatures in the flowage are also too warm to support a trout fishery.

Riparian Development Unlike most northern Wisconsin lakes and flowages, where cottages and weekend retreats are the norm, riparian development on Peshtigo Flowage and Peshtigo River is dominated by permanent residences. Unfortunately the current pattern of shoreline development has not been beneficial to fish and wildlife. Up and down the flowage, there is a proliferation of urban style lawns, conspicuous houses, and all manner of decks, patios, docks and unnatural lighting. Many of these modifications do not fit into the natural setting and add to shoreline clutter. While this may not be a concern in the City of Peshtigo where the waterway is expected to be more "urban", this development pattern is copied in upstream areas where it takes away from the wild character of the river. Beyond aesthetic concerns, this type of shoreline development increases nutrient delivery, decreases shoreline stability and destroys important natural habitat.

An unofficial survey of waterfront properties on Peshtigo Flowage was conducted to assess shoreline habitat and rate the impact of development on the shoreline. The survey shows that within the City Limits of Peshtigo, 100% of the residential structures have inadequate shoreline habitat which is defined as at least 30 feet of dense or natural vegetation along the shore outside of the 30 foot view and access corridor allowed by shoreland zoning rules. Outside of the city limits development did not fare much better. In these areas shoreline habitat was inadequate on 83% of the lots. Only 3% the developed lots had adequate shoreline habitat while habitat was marginal on 14% of the lots.

Current shoreline zoning rules were designed to protect shoreline habitat in rural areas by limiting the placement of structures within 75 feet of the water, restricting vegetation removal along the shore and by preventing overcrowding

by requiring 100 feet of shoreline frontage. Within the City of Peshtigo, many County zoning requirements are not applicable and a more urban shoreline is permitted. The shoreline

development survey reveals that in areas outside of the City at least 20% of the developed lots have less than 100 feet of frontage, 34% of the homes are built too close to the water, and 8% have detached decks or other structures located in the 75-foot setback area. Most (83%) of the developed lots have removed more natural vegetation than is currently allowed. While some of these "violations" occurred before adoption of the current shoreland zoning standards and are "grandfathered" in, many have occurred since the ordinance was enacted.

Although natural shoreline habitat is still abundant in upstream areas, the trend towards more shoreline development and larger shoreline homes has and will continue on Peshtigo Flowage and the river. In the future, this development trend may begin to harm fish and wildlife that depend on the shoreline and near-shore aquatic habitat.

Aquatic Plant Communities An aquatic macrophyte (plant) survey of Peshtigo Flowage and Trout Creek Pond was completed to characterize the aquatic plant community. A total of 15 transects were surveyed using SCUBA gear. Each transect was divided into multiple sample plots one meter long by 0.1 meter wide. All plant species found rooted or floating in the sample plots were recorded and specimens were collected for positive identification. All transects began on shore and were located perpendicular to shore to the depth where plants did not grow, to the opposite shore, or to the center of the water body. All transects were located in the City limits. A complete listing of the aquatic plant survey data can be found in Appendix B.

The aquatic plant community of Peshtigo Flowage is quite diverse. During the survey, 29 different species of submerged, emergent, and floating leaf aquatic plants were recorded. In many areas however, the aquatic plant community is dominated by exotic and/or nuisance species.

The aquatic plant population in the flowage and upriver areas differs greatly by location. In Trout Creek Pond, and in the shallow areas around the mouth of Trout Creek, the rooted aquatic plant population is dominated by Eurasian water milfoil (*Myriophyllum spicatum*), Variable-leaf water milfoil *(Myriophyllum heterophyllum*), and Coontail *(Ceratophyllum demersum*). Where there is higher flow, Long-leaf pondweed (*Potamogeton nodosus*) can be found. Many of the plants found in this area can be classified as nuisance species. Eurasian water milfoil is an invasive exotic that quickly grows to the surface and forms a canopy which shades out beneficial native species. Variable leaf milfoil is native but may not be endemic to this area of Wisconsin. This species is very problematic in Lake Noquebay which is located upstream from the flowage. Coontail is a native species that also grows to nuisance proportions

in shallow nutrient rich waters. In these areas the floating vegetation is dominated by small duckweed (*Lemna minor*), Forked duckweed (*Lemna trisulca*), and Large duckweed (*Spirodela polyrhiza*). All of the duckweeds are common in nutrient rich waters with little flow.

Along the east shore of the flowage adjacent to the old pulp log storage area, the aquatic plant population is quite sparse. In this area Coontail dominates followed closely in abundance by Common waterweed (*Elodea canadensis*) Eurasian water milfoil, and Wild celery (*Vallisneria americana*). The relative lack of aquatic plants here is due largely to the increased water depth, gravely substrate and heavy boat traffic.

Aquatic plant diversity was greatest near the dam and upstream from Riverside Cemetery. In these areas Coontail is still the most commonly found plant followed by Common waterweed and Water celery. Eurasian water milfoil and Variable-leaf water milfoil are also found growing in these areas at somewhat lower densities. The native Northern water milfoil (*Myriophyllum sibericum*) is found growing in this area along with several native pondweeds including; Long-leaf pondweed, Leafy pondweed *(Potamogeton foliosus*), Illinois pondweed (*P. illinoensis*), Flat-stem pondweed (*P. zosteriformis*), Sago pondweed (*P. pectinatus*), and two small pondweeds which could not be identified (*Potamogeton sp.*). These areas have a mucky bottom and seem to be impacted less by boat traffic.

Peshtigo Flowage is home to an aquatic plant which is on the Wisconsin endangered species list. Lake cress (*Amoracia aquatica*) was found in the flowage near the bridge and in a couple of upstream areas. The plant was not abundant in any area but several areas had many floating plant fragments. This plant can spread via fragmentation where plant fragments settle to the bottom, take root and grow. No lake cress was found in the harvest areas.

In Peshtigo Flowage, low water transparency limits the maximum depth of aquatic plant growth to approximately six feet. Beyond this depth, the amount of light available is not sufficient to support plants. In general, plant growth is sparse in water deeper than 5 feet.

Although many people see aquatic plants as a nuisance, they play a vital role in maintaining good water quality in any lake or flowage. Aquatic plants bind loose organic sediments together to prevent resuspension by wave action. They also protect shorelines from erosion and tie up nutrients that would otherwise be available for algae growth. Aquatic plants are also necessary for a healthy fishery as they provide food, cover and spawning habitat.

An aquatic plant survey was also conducted in 1992 by a private consultant as required for an aquatic plant harvester grant. Although the survey methodology was different, several significant changes are evident. In the early survey, Eurasian water milfoil was only found at 30% of the sample sites and was not found at all in Trout Creek Pond. In 1999 Eurasian water milfoil was found growing at more than 60% of the sites and was the most abundant plant in Trout Creek Pond. Also since the 1992 survey, there has been an across the board decrease in the abundance of most of the common aquatic plants and large decreases in Wild rice (Zizania aquatica), Water marigold (*Megalodanta beckii*), and White pond lily (*Nymphea tuberosa*) in the lower flowage. Clasping-leaf pondweed *(Potamogeton richardsonii*) was not found in the

current survey while it was found at almost 19% of the sites previously. Several species were identified in the most recent survey that were not found in 1992 including; Illinois pondweed, Leafy pondweed (*P. foliosus*), Large-leaf pondweed *(P. amplifolius*), Bushy pondweed *(Najas flexilis*), and water star grass *(Heteranthera dubia*).

The aquatic plant survey was not conducted in upriver areas. However it was noted that aquatic plant growth is very dense in several backwater areas where homes are present. In these areas Eurasian water milfoil, variable leaf milfoil, coontail, water marigold (*Megalodanta beckii*), and water lilies were so dense that navigation was severely restricted by mid summer.

Exotic Species Eurasian water milfoil and Purple loosestrife (*Lythrum salicaria*) are the only true exotic species found during the survey. Eurasian milfoil has become a problem in several of the upstream flowages and has expanded in Peshtigo Flowage since the last survey. Variable-leaf water milfoil may also be an exotic as it is thought to be introduced to this part of the country. Lake Noquebay, which drains to the Peshtigo River north of Crivitz, harvests extensively to control variable-leaf water milfoil. Purple loosestrife is a tall, attractive, purple flowering invader of local wetlands. A large population of purple loosestrife was noted in wetlands on the west side of the river just upstream from the power transmission lines.

The most common method of introduction for exotic species is the transferring of boats between lakes with weeds attached and improperly disposing of bait bucket or live-well contents. Unfortunately, the Peshtigo Flowage is at great risk of invasion because of its proximity to Green Bay where many of these exotics are common. Also, any introductions to lakes and flowages upstream will likely spread to the Peshtigo Flowage. Species for which the Flowage is most at risk of invasion include the Zebra mussel, White perch, Round goby and River ruffe, and curly-leaf pondweed.

Trout Creek Watershed Inventory and Analysis

The Trout Creek Watershed is located almost entirely in the Town of Grover in a region dominated by agriculture, primarily dairy farming (see attached map). The Trout Creek watershed covers 25,076 acres. Approximately 18,300 acres, or 74% of the watershed, is upland. Of this, more than 14,000 acres is devoted to agricultural production. The balance of the upland area is woodland, with lesser amounts of developed, fallow, and urban land. Wetlands occupy approximately 6,600 acres (26%) of the watershed area.

Nonpoint Sources of Pollution For this plan, a detailed inventory of agricultural nonpoint source pollution was conducted in the Trout Creek watershed. Since phosphorus is the limiting nutrient in this and most aquatic systems, inventory methods are designed to estimate or rank phosphorus runoff. Agricultural sources of phosphorus include animal waste from feed lots and other areas with high animal concentrations, runoff of land spread manure, runoff of commercial fertilizer, and erosion of phosphorus rich topsoil. Some inventory methods estimate phosphorus runoff while others provide a relative ranking of nutrient sources and runoff potential.

Barnyard Runoff Barnyards, feedlots, and other animal concentrations are a significant source of pollution in the Trout Creek watershed. Runoff from these sites often carries several components that can damage aquatic life in streams, wetlands, and ultimately in Trout Creek Pond and Peshtigo Flowage. Animal waste contains nitrogen which, when converted to ammonia, can

be toxic to aquatic life in high concentrations. Manure also contains a lot of organic matter which is high in biological oxygen demand (BOD). When runoff high in BOD enters a stream, oxygen levels are depressed and aquatic life suffers. Animal waste also contains high levels of phosphorus, the nutrient most often responsible for algae blooms and excessive aquatic plant growth.

Forty animal lots in the Trout Creek watershed were inventoried and modeled to estimate annual phosphorus runoff. The model uses animal numbers, physical characteristics of the feed lot, up-slope areas contributing runoff, and buffering capacity below the feed lot to estimate phosphorus runoff during a typical year. There are 40 animal lots in the Trout Creek watershed that contribute an estimated 1,554 lbs of phosphorus annually. The top 10 contributing animal lots account for more than half (57%) of the phosphorus and the top 20 contributing animal lots are responsible for 87% of the phosphorus.

Land Spread Manure Land spreading of manure is a necessary management tool in all dairy farming operations. Due to its high nutrient content, manure which was once treated as a "waste product" is more commonly being managed as an asset to reduce the need for commercial fertilizer. Land spreading of animal waste is most often a concern for water quality when it is done in the winter on frozen or snow covered ground, when spread on steep slopes, and when applied in flood plains, near water bodies, and in areas of concentrated flow. Under these conditions, snow melt and rain can carry the animal waste to nearby streams. The impact of this runoff is the same as animal waste runoff from feed lots.

Computer modeling of phosphorus from manure spreading is very difficult and it would be exceedingly difficult to collect the required information on a watershed scale. Instead, a manure storage rating was used on all farms that have crop land in the watershed to determine the availability and suitability of their land for winter spreading. The rating factors in the amount of manure produced, field availability due to crop rotation, field slope and distance from surface waters or other concentrated flow areas.

In all, 59 farm operations have land located in the Trout Creek watershed. Of these, 44 farms do not have enough suitable land for winter spreading of manure. The cumulative acre deficit for these farms is 978 acres. Five of the farms are short on land suitable for winter spreading by more than 50 acres. An additional 12 farms are at least 20 acres short.

Most of the acreage identified as high hazard for winter spreading of manure can be used for spreading during the growing season if the manure is incorporated immediately after being spread. The construction of adequate manure storage on most farms would allow operators to better manage their manure and time application to obtain the greatest benefit from the nutrients. Additional nutrient management planning can also reduce manure and commercial fertilizer applications and reduce nonpoint source pollution.

Stream Buffers Nutrient runoff from agricultural fields is a concern in the Trout Creek watershed and throughout Marinette County. Maintaining dense, vigorous native vegetation along streams and in areas of concentrated flow is an effective way of reducing nutrient and sediment concentrations in runoff. The width of buffer required varies based on soil type, slope of the land, and condition of the buffer. In addition to the water quality benefits, stream buffers also moderate water temperature, reduce peak storm flows, and provide important wildlife habitat for upland and aquatic species alike.

For this plan, an inventory of streams in the Trout Creek watershed was completed to determine the adequacy of buffers. Adequate buffer vegetation was defined as at least 30 feet of non-crop vegetation along a steam or drainage. Buffer vegetation was measured on the most current USDA Farm Service Agency air photos and checked for accuracy in the field. All perennial and intermittent streams shown on the USGS 7.5 minute maps were inventoried as well as drainage ditches. Each bank of the stream was counted separately. A total of 304,147 feet of stream frontage in the watershed was inventoried. Of this, more than 28% of the frontage was not adequately buffered. This is a conservative estimate of the buffer needs in the Trout Creek watershed since an in depth field by field analysis is needed to identify many areas of concentrated flow which are not shown on the USGS topographic maps.

Peshtigo Flowage User Survey

A user survey was conducted to examine how local residents use Peshtigo Flowage, what they perceive to be the problems facing the flowage, and to gauge support for management actions. Many of the questions in the Peshtigo Flowage Survey were the same as those in a recent survey mailed to more than 530 Marinette County landowners regarding all Marinette County lakes.

The survey was mailed to 54 landowners randomly chosen from the Marinette County tax listing and living in the Trout Creek watershed area and the City of Peshtigo. A follow up letter was mailed two weeks later. The number of surveys was determined based on the population of the area. A response rate of 44% was obtained.

Survey results can be divided into four main categories; flowage use patterns, water quality conditions & outlook, activities which impact the flowage, and possible solutions to problems. A complete listing of survey results can be found in Appendix C.

Flowage Use Patterns The amount of time that respondents use the flowage ranged from zero to 365 days per year. The average number of days was 66.5. Only one survey respondent did not use the flowage at all. Use was defined as any on water activity or activity which is enhanced by the presence of the flowage such as picnicking, camping etc. Twenty five (25) percent of the respondents owned property on the flowage or Trout Creek. It is not known how many of the surveys were sent to waterfront property owners. However, it is likely that a higher percentage of waterfront property owners returned the survey since they are more

directly affected by management decisions on Peshtigo Flowage.

Respondents were also asked to rank activities that they participate in while using Peshtigo Flowage (figure 4). The top ranking activity was enjoying the scenery, followed closely by fishing from motorized boats, fishing from shore, and relaxing along the shore. The least important activity was operating a personal watercraft (Jet Ski). These results mirror the county-wide survey results obtained in 2001.

Water Quality Conditions & Outlook The survey contained three questions designed to explore how landowners perceive the condition of, and the outlook for, Peshtigo Flowage. When asked about the water quality of the flowage, responses indicate that 50 percent believe water quality has remained the same over the last ten years. Among those who indicated that they have witnessed a change, slightly more (25%) believe that water quality has worsened than believe water quality has improved (21%). Fifty (50) percent of respondents also noted no change in the natural scenic beauty of the flowage. Among those who did note a change, 33 percent indicated natural scenic beauty has worsened while only 8 percent believe it has improved. Thirty seven (37) percent of respondents reported that fishing has worsened during the last ten years.

Activities That Impact the Flowage
The survey also explored perceptions regarding impacts to water quality, natural beauty, and enjoyment of the flowage. Survey recipients were asked to rate the severity of negative impact that several factors and activities have on water quality. A second set of questions explored the impact (positive or negative) that different activities and changes to the landscape have on the natural scenic beauty and peoples enjoyment of the flowage.

Survey respondents identified septic systems, lawn fertilizers & chemicals, and pollution from industrial and commercial operations as the top three factors most negatively effecting water quality of the flowage. Aquatic plants and polluted agricultural runoff were also identified by at least half of the respondents as negatively effecting water quality on Peshtigo Flowage and Trout Creek.

Industrial & commercial development, filling of near shore wetlands, and roads & utility lines close to shore were listed as factors that most negatively impact natural scenic beauty on the flowage (figure 5). Reshaping the shoreline, large docks and boat lifts, urban style lawns, tree & shrub cutting on the shoreline, and home development were all identified by 50 percent or more of the respondents as negatively effecting natural scenic beauty.

When asked to identify factors impacting their enjoyment of the flowage, a clear majority of respondents identified seeing wildlife, natural shorelines, and resident geese as the factors which most positively effect their enjoyment of Peshtigo Flowage (figure 6). All other factors effecting peoples enjoyment received more negative than positive responses. Survey respondents were also asked if they had stopped using the flowage for any reason. Seventy-five (75) percent of the respondents had. The most common reason given was increased motorized recreation (33%) followed by recreational use conflicts (19%).

Solutions to Problems The survey explored peoples opinions concerning possible solutions to problems facing Peshtigo Flowage. Survey recipients were asked to indicate whether they support, oppose, or have no position regarding eleven different actions.

Results indicate very broad based support for most of the proposed alternatives (figure 7). All of the proposed actions received support from a majority of respondents except for dredging of appropriate shallow areas. No alternative was opposed by more than seventeen (17) percent of respondents. Educating people about the impact of home chemical and fertilizer use was the most popular alternative (92%), followed closely by setting and enforcing slow-no-wake hours (87%). Reducing runoff pollution from urban & agricultural areas, better enforcement of existing shoreland protection laws, and increased protection of fish & wildlife habitat were tied for third with eighty-three (83) percent support.

Past & Present Management Efforts

Over the past several years, the City of Peshtigo and Marinette County have actively managed Peshtigo Flowage and the Trout Creek watershed to improve water quality and recreational opportunities. These efforts have met with varying degrees of success. As with any long term project, these efforts should be reviewed on a regular basis.

Aquatic Plant Management The City of Peshtigo has been managing aquatic plant growth in Peshtigo Flowage and Trout Creek Pond for more than a decade. Past efforts included the use of herbicides and weed cutting. Herbicide use was discontinued 1989 due to inconsistent results and concerns for fish. Weed cutting was done with a 'Hockney' weed cutter between 1989 and 1992. The plants had to be collected by hand. This cutting method was abandoned since many weeds escaped collection and fouled the shoreline and clogged water intakes at Badger Paper Mill and the Peshtigo Dam.

In 1993 the City received a grant from the Wisconsin Waterways Commission for the purchase of an aquatic plant harvester to manage nuisance aquatic plants in the flowage. Harvesters are much more efficient than cutters since they cut and collect the plants. The original proposal called for harvesting approximately 31 acres in the Flowage and Trout Creek Pond. Since the harvester cannot navigate under the bridge on Emery Avenue, Trout Creek Pond is not harvested. The old Hockney weed cutter is still used on occasion to cut weeds in the pond and the harvester picks up plants that float under the bridge. Harvesting is in many ways analogous to mowing your lawn. In the flowage, most aquatic plant harvesting takes place in two to three feet of water. In order to reduce damage to the harvester the cutter head is held approximately one foot above the bottom. Unfortunately, this means that only one to two feet of the plants can be removed with each cutting. With such a shallow cutting depth the plants quickly grow back to the surface.

According to Parks and Recreation Director Steve Sharpe, the harvester is in operation two to three days per week during the summer months. The City spends about 385 man hours per year harvesting and annually removes approximately 900 cubic yards of plants from the Flowage. The Parks and Recreation Department harvesting budget is approximately $5,000 per year. Forty (40) percent of the budget is for operation, maintenance and repair of the harvester.

Nonpoint Source Pollution Control The Marinette County Land & Water Conservation Department (LWCD) has made reducing nonpoint source pollution to Trout Creek a high priority. The most recent County Land & Water Resource Management Plan developed by the LWCD lists the Lower Peshtigo River watershed and Trout Creek subwatershed as a high priority for remediation of nonpoint source impacts. The LWCD currently receives a basic grant allocation from the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) for nonpoint source pollution control in Marinette County. In 2002 the grant totaled approximately $81,000. The LWCD also applies annually for Wisconsin DNR Targeted Runoff

Management (TRM) grants to reduce nonpoint source pollution. The TRM grants are competitive on a state-wide basis. In 2003 the LWCD will be working with five farms in the Trout Creek watershed to install manure storage facilities. This practice eliminates winter spreading of manure and allows for better nutrient management on the farms. One watershed farm operator has already received TRM grant funding for manure storage facility installation.

The Marinette County UW Extension Office has also been active in providing educational and nutrient management services in the Trout Creek watershed. In the fall of 2000 a nutrient management planning grant was received to cost-share the development of whole-farm nutrient management plans covering 9,000 acres of crop land in and around the Trout Creek watershed. To date, 17 farms with 6,500 acres of crop land have taken advantage of the grant. It is likely that the goal of 9,000 acres will be met by the end of 2003.

In addition to the grant funded activities, the Marinette County LWCD regularly provides technical assistance to farms in the Trout Creek watershed to reduce nonpoint source pollution. This assistance often includes the design, installation oversight, and inspection of manure transfer and storage facilities and barnyard runoff control practices.

Other Management Efforts The Marinette County LWCD and the Wisconsin DNR have also been working toward a wetland restoration project at the WDNR Service Center in Peshtigo to restore beneficial uses to a degraded wetland located on the property.

Management Alternatives

This report has detailed the current state of Peshtigo Flowage and Trout Creek Pond, trends in water quality and other related issues. However, the future of Peshtigo Flowage lies with the local residents and the actions of each and every landowner in the watershed.

It is obvious that most residents care deeply about the quality of Peshtigo Flowage and want to maintain the resource for the future enjoyment of their families. It is also clear that many residents have serious concerns about the present state of the Flowage. Primarily, increasing recreational use conflicts, over development and loss of natural aesthetics and increased aquatic plant growth. The following management options were developed in response to these concerns.

Do Nothing This is the easiest management alternative to implement. It does not require personal or financial sacrifice, cooperation, or effort. In the short term it allows everyone to enjoy the flowage rather than worry about the future. However, this option is clearly short sighted and will only lead to declining water quality and further environmental degradation.

Organize a Peshtigo Flowage Landowners Group Around many lakes and flowages in Marinette County landowners have organized into formal groups to undertake lake management projects and promote healthy lakes and flowages. These organizations take two basic forms, lake associations and lake districts.

Lake Districts are special units of government organized for the protection and rehabilitation of one or more water bodies. Districts are a specialized unit of local government that operates under Chapter 33 of the Wisconsin State Statutes. Districts have taxing powers and once formed, participation (via taxes) is not voluntary. Lake Districts are usually formed when a lake undertakes expensive and/or long term management programs such as aquatic plant harvesting, dam operation, etc. Lake District membership is not limited to shoreline property owners and often includes landowners who do not live on a lake but benefit from their proximity to the lake.

Associations are also formed for the protection and improvement of local water resources. However, they are much less formal than lake districts and participation in an association is voluntary. In order to be eligible for state grant funding, lake associations must be open to anyone who owns land within a mile of the water body for which it was formed.

Both lake districts and eligible lake associations can apply for state grants to protect and improve water quality and shoreline habitat. These grants include Lake Planning Grants, Lake Implementation Grants, and Lake Classification Grants which are funded by the Wisconsin DNR. Eligible grant activities include among other things, water quality sampling & analysis, lake management planning, purchase & protection of sensitive areas, and ordinance writing & updating. The Wisconsin Waterways Commission also has grant funding available for the purchase of aquatic plant harvesters, acquisition and improvement of boat access facilities, dredging of navigation channels and harbors, and other boating related activities.

Organized lake groups benefit from strength in numbers. A lake association or district can help build a sense of community and create a valuable information network. These organizations are also better able to work with local government to effect changes in ordinances and lake management programs.

a. *Shoreline property owners on Peshtigo Flowage and those in upriver areas should form a landowners association to explore additional lake management options and grant opportunities*.

b. *Any newly formed group should become a member of the Wisconsin Association of Lakes (WAL). WAL lobbies for laws and programs which protect and benefit lakes in Wisconsin and provides educational opportunities for its members.*

Reduce Recreational Use Conflicts

Complaints about personal watercraft and water skiing, and broad support for regulating these activities points to a high incidence of recreational use conflicts on Peshtigo Flowage. Indeed, these conflicts are becoming more common on lakes and flowages throughout Wisconsin as more and more people choose to recreate on a fixed number of lakes. The face of boating is also changing. Fifty years ago the average outboard motor was approximately 15 horsepower, ski boats were a rarity and personal watercraft had not yet been invented. By 1996, personal watercraft accounted for one third of all new recreational boats.

There are only three outcomes possible when dealing with the recreational use conflicts seen on Peshtigo Flowage. The first is that without intervention “fast and loud” will eventually win. It is true that “your noise will always disturb my quiet, but my quiet will never disturb your noise”. The slow and quiet crowd gets pushed to the fringes and they often give up and take their business elsewhere - if there is an elsewhere. The second outcome is that one type of use gets banned. The third

outcome is that the two types of uses are restricted in space and/or time to reduce the conflicts. Slow-no-wake times and no-wake zones are often designed to partition the water and let everyone have "their" time. The following options should be considered to reduce recreational use conflicts without banning certain uses.

a. *Set slow-no-wake times on Peshtigo Flowage to allow for undisturbed fishing in the morning and evening and to reduce noise during quiet periods of the day.*

b. *Restrict water skiing and personal watercraft use to the lower portion of the flowage and/or make upriver areas slow-no-wake. The upriver channels are too narrow and twisting to allow for these uses. There is also the danger of increasing bank erosion in the upstream areas as this type of boating activity increases.*

Implement "Lake Friendly" Home and Garden Practices Many of the household cleaning products we use every day contain hazardous and/or persistent toxic substances which can be harmful to the environment. Often these products are not broken down by on-site septic systems and can contaminate groundwater. Also, many automotive products such as oil, grease and radiator fluid are hazardous to the environment.

Extra care should be taken when using and disposing of toxic substances near the flowage or river. Proximity to the water combined with the sensitive nature of riparian systems increases the risk of environmental contamination. To reduce this risk the following practices should be implemented.

a. *Reduce dependence on harmful household products by reading labels and choosing environmentally friendly alternatives. Non-toxic alternatives to many cleaning products are commercially available or can be made at home from common ingredients*.

b. *Dispose of used or unwanted household chemicals properly. Take advantage of household "clean sweeps". Clean sweeps are locally sponsored events where residents can take hazardous substances to be properly disposed of for no charge.*

c. *Take automotive products such as oil, radiator fluid and batteries to garages or local collection centers. Never dispose of these products in septic systems or on the ground.*

Protect and Improve Aesthetics on Peshtigo Flowage and the Peshtigo River As mentioned earlier, shoreline areas within the city limits have been urbanized to a high degree while much of the upstream frontage remains undeveloped. Regardless of where they live, the survey indicates that people want to see natural shorelines and wildlife. Enjoying the scenery is the number one rated activity on the flowage. In order to save the remaining views and maintain some peace and quiet for relaxation, shoreline property owners will have to resist the urge to further "improve" their property with unnecessary structures and landscapes that are more at home in the suburbs than in the northwoods. The following recommendations are designed to ensure that existing and future development does not take away from the aesthetics of Peshtigo Flowage and the ability of all residents to enjoy this resource.

a. *All residents must consider how their actions effect the aesthetics of the flowage and the ability of their neighbors to enjoy the flowage.*

b. *Landowners should support stronger enforcement of current zoning regulations which are designed to protect*

the natural beauty and water quality of Marinette County lakes and flowages.

c. *A landowners association should set voluntary standards for development and communicate the need for these standards to Association members. A policy to remove nonconforming decks and boat houses from the shoreline should be adopted.*

Protect Sensitive Areas Every municipality in Wisconsin must have a land use plan in place by 2010. The town of Peshtigo is in the process of developing a land use plan. The Town of Grover is currently in the inventory phase of the planning process. These land use plans should delineate sensitive areas and provide for their protection. Concerned landowners should get involved in the land use planning process.

a. *Sensitive areas along the flowage and river such as wetlands, steep slopes, highly erodible shoreline areas, and other areas of significance should be mapped and addressed in the appropriate land use plans.*

b. *Land use planning in the Town of Grover should address much needed stream buffers to reduce nutrient and sediment delivery to Trout Creek and other tributaries of the Peshtigo Flowage.*

Prevent Introduction of Exotic Species
The introduction of exotic species can have a devastating effect on the aquatic ecosystem. Many exotic plant species out-compete native vegetation and have little or no wildlife value. Many of these exotics have growth forms which interfere with boating and fishing. Eurasian water milfoil which is currently found in the flowage is one of the most problematic aquatic species in the state. This plant forms dense floating mats that shade out native vegetation. The exotic purple loosestrife is also common in the area and is found in wetlands along the flowage.

Most exotic species are introduced to lakes on boats and trailers and in live-wells and bait buckets. The public access on Peshtigo Flowage is a likely avenue for the unintentional introduction of exotics. All upstream waters must be protected to prevent exotic species introduction to the flowage. Landowners, lake associations, and local governments can help slow the spread of exotics by adopting the following recommendations.

a. *Purple loosestrife should be mapped and controlled where ever it is found in the flowage and river. A new biological control is available in the form of a beetle which feeds only on purple loosestrife. In some areas 4-H clubs and Scout troups have been raising these beetles for introduction to affected wetlands.*

b. *A new state law makes it illegal to transfer boats between waters with weeds attached or water in the live wells. Boats which are used on other waters should be checked carefully before use in the flowage. Any plant material from other lakes should be removed from boats and trailers. Water and fish from live-wells and bait buckets should never be transferred to another lake. Many exotic species have been introduced in this way.*

c. *Signs should be erected at the boat landing educating boaters about the danger of transferring exotics and reminding them to clean their boat trailers. The local DNR office can often supply these signs for free.*

d. *A healthy aquatic plant community should be maintained in the flowage. This will help prevent invasion by exotic plants.*

Implement Waterfront Best Management Practices The riparian (near shore) zone of the flowage provides vital fish and wildlife habitat. When left in a natural condition it also filters nutrients and sediment from runoff. When converted to lawn, this same area becomes an important source of nutrients and chemicals. Although an individual home, road or lawn may not appear to be a problem, the cumulative impact of this development on the chemistry and ecology of the flowage can be significant. To protect Peshtigo Flowage from the effects of current and future development the following management actions should be implemented:

a. *Reduce or eliminate the use of lawn fertilizers. Runoff from fertilized lawns transports phosphorus to the lake which feeds weed and algae growth.*

b. *Maintain septic systems with regular pumping and inspections. Replace those that are not functioning properly.*

c. *Restore natural buffer areas along the water to reduce the amount of runoff from developed areas and to filter nutrients and other pollutants from the runoff.*

d. *Maintain natural buffer areas where they already exist. Contact new landowners to educate them concerning the importance of natural buffers.*

Fisheries Enhancement The results of the landowner survey showed that a significant number of residents feel fishing has suffered in Peshtigo Flowage. Previous fish surveys conducted by the Wisconsin DNR showed that Peshtigo Flowage has a healthy fishery with a good mix of panfish and game fish.

When attempting to manipulate the fish population, it is important to recognize the water's potential and accept its limitations. In the past, WDNR fisheries management policy was very aggressive with regular fish stocking and new species introduction to many lakes and flowages. However, the stocking of fish is expensive and often ineffective. According to WDNR Fisheries Technician Greg Kornely, current policy focuses on improving populations through habitat improvement and harvest control. Stocking is usually done only to reestablish a fishery.

WDNR fish managers recommend managing Peshtigo Flowage to maximize the existing fishery. A variety of projects can be undertaken to improve in-lake habitat for the fish population, including:

a. *Stop destruction of the near-shore littoral zone habitat. The key to maintaining a healthy fishery is protecting valuable fish habitat.*
b. *Leave trees and shrubs which are leaning over the water or have fallen in. This provides shade and cover for predator fish and a feeding area for many young fish. Also, large fallen woody debris is important spawning habitat for perch as it suspends their eggs above the bottom.*

c. *Consider the fishery in any harvesting plan. Extensive removal of weed beds for purely aesthetic reasons only damages the fishery. However, the fishery may benefit by cutting lanes through dense aquatic plant beds. These lanes allow predator fish to access prey which take refuge in these areas*.

d. *Protect spawning habitat. The best spawning substrate for bass and bluegill is firm sand and gravel. These areas are especially valuable when located adjacent to natural shorelines. The many upstream wetlands are valuable for northern pike spawning.*

e. *Get involved with the DNR and provide input to the fish management plan. Invite DNR Fish Managers to an annual meeting to discuss the fishery and additional management options.*

Sediment Removal Although the aquatic plant harvesting program has been somewhat successful at improving Peshtigo Flowage, the shallow water around the mouth of Trout Creek severely limits harvester efficiency. The limited cutting depth allows quick regrowth of the plants. Repeated harvesting is required to achieve adequate control. The shallow water also continues to restrict boat traffic in much of the lower flowage and in Trout Creek Pond. According to longtime residents much of the problem area used to be more than five feet deep but has filled in with sediment from Trout Creek. Sediment removal (dredging) may be a viable option to reduce nuisance aquatic plant growth and improve water quality, fish habitat, and recreational opportunities in this area.

Dredging is the only proven way to remove large amounts of sediment. There are two primary methods of dredging, mechanical and hydraulic. Mechanical dredging is accomplished with the use of a dragline, clamshell bucket or backhoe which scoops sediment from the lake bottom. Hydraulic dredging employs a cutter head to suck up a sediment and water slurry through a hose. Both methods of dredging require a dewatering area where dredged material is deposited to settle and dry. Mechanical dredging removes far less water than hydraulic dredging and requires a smaller dewatering area. This method is best suited to removing well consolidated sediment. Hydraulic dredging is best suited to removing soft organic sediment. This type of sediment is readily mixed up and easy on the pumping equipment. The main drawback to hydraulic dredging is the need for a large dewatering area to handle the dredge spoils.

The amount of dredging necessary to eliminate regrowth of aquatic plants in Peshtigo Flowage can be easily inferred from the existing plant population. During the aquatic plant surveys it was noted that aquatic plants are limited to water less than six feet in depth. Due to natural staining of the water light is insufficient to support dense aquatic plant growth below this depth. Dredging the problem area to a depth of seven to eight feet would be adequate to eliminate aquatic plant growth.

The nuisance weed growth covers approximately 15 acres in the flowage and Trout Creek Pond. Dredging four feet of sediment from a ten acre area between the boat landing and the beach would remove 64,500 cubic yards of material. Trout Creek Pond could also be dredged to reduce weed growth and water stagnation, and to serve as a trap for incoming sediment. Periodic dredging of the sediment trap would be much cheaper than re-dredging the flowage. Deepening 1.5 acres to 10 feet deep would remove an additional 14,500 cubic yards.

Large scale dredging can be an expensive management tool. Typically, the price ranges from $3.00 to $6.00 per cubic yard. At $4.50 per cubic yard, dredging 79,000 cubic yards of sediment from the flowage and pond would cost $355,500.00. Although expensive, this should be compared to the long term cost of continuing the harvesting program. Dredging a smaller area may also provide adequate benefits.

a. *Dredging to manage aquatic plants and improve recreational opportunities should be explored. Additional cost savings might be realized if a dredging project were conducted during a draw down of the flowage. This would have to be coordinated with Wisconsin Public Service and Badger Paper Mill.*

Any amount of dredging would require a WDNR and possibly a U.S. Army Corps of Engineers permit. Dredging projects which remove more than 3,000 cubic yards of sediment may require contaminant testing of the dredged material and an environmental impact assessment.

Drawdown Water level drawdowns are commonly used as a management tool on reservoirs and lakes with water level control structures. The benefits of controlled drawdowns can include reduction of some species of aquatic vegetation, reduction of ice damage and compaction of loose flocculent sediment.

Drawdowns to reduce aquatic vegetation have met with varying success. Some species common in Peshtigo Flowage are readily controlled by drawdown, including white and yellow water lily. However, many species reportedly increase in response to drawdown such as water marigold, coontail and water celery (*Vallisneria americana*). Many other species are variable in their response. Drawdowns are typically a temporary control measure since most aquatic plants can quickly re-colonize an area.

The Wisconsin Public Service Corporation (WPS) conducted a 6-foot drawdown of High Falls Reservoir during the winter of 2001-02 to control Eurasian water milfoil and improve dissolved oxygen. According to WPS Environmental Analyst Shawn Puzen, the drawdown was very effective at reducing milfoil growth during the summer of 2002. Survey results show a dramatic decrease in the number of Eurasian milfoil colonies in areas where they were once abundant. Further monitoring will be conducted to determine the longevity of the milfoil control on High Falls Reservoir.

The consolidation of soft sediment due to drawdown is a possibility where the sediment is primarily organic. Most of the sediment near the mouth of Trout Creek is sand and silt which will not compact appreciably. Also, consolidation effects are best with drawdowns lasting at least a year.

a. *Although a winter drawdown of the flowage is technically feasible, it would require the cooperation of Badger Paper Mill and WPS and would reduce generating capacity at the dam. The City should wait and see how long the control lasts on High Falls Reservoir before exploring the idea further.*

Aquatic Plant Management The two most popular methods of aquatic plant management are chemical treatment and harvesting. Each method has its good and bad points, and each method has many secondary effects on the fish and plant community of the lake.

When properly applied, chemical treatment can be fast and efficient, however a WDNR permit is required and any liquid herbicide application must be performed by a licenced

applicator. Chemical treatment is not suitable for flowing water when longer contact times are required. Most chemicals kill the entire plant. This opens up the bottom to increased wave action and leaves openings for invasion by less desirable species. Plants killed through chemical treatment also stay in the water where they decompose. The nutrients Harvesting removes the upper portions of the plant, leaving the roots to bind the sediment and allow for plant regrowth. Harvesting also removes the nutrients tied up in the plant material from the flowage. In addition, harvesting allows for more precise management of areas to be conserved. On the negative side, harvesting is labor intensive. In the flowage this is compounded by the fact that most dense growth occurs in very shallow areas where harvester cannot be used to its full potential. Shallow cutting allows for faster regrowth.

Currently the City of Peshtigo only harvests plants within the city limits. Several upstream areas would also benefit from limited harvesting to create lanes to the main river channel.

a. *The City of Peshtigo should continue the harvesting program while exploring other alternatives, such as drawdown and dredging.*

b. *Upriver landowners should explore contract harvesting or a harvest agreement with the City to maximize use of the existing machine*.

Reduce Runoff Pollution In the Watershed.

As mentioned previously, Marinette County is actively working to reduce agricultural nonpoint source pollution throughout the county. Special emphasis has been placed on obtaining grant funding in the Trout Creek watershed area. To date the Marinette County LWCD has, or will be entering into cost-share agreements with 5 watershed

released from the decomposing plants can stimulate algae blooms and cause increased plant growth. Although aquatic plants vary in their susceptibility to different herbicides, it is still difficult to accurately target certain species or areas with chemical treatment.

farms to install agricultural best management practices (BMP's) and with 17 farms to conduct nutrient management planning.

Urban sources of nonpoint source pollution are also sure to rise as the City of Peshtigo grows. Currently, planning is underway to build new school facilities or renovate and expand the current facilities. Most of the runoff from the present school complex already enters Trout Creek Pond and the flowage. Any increase in impervious surface will increase peak flow and nutrient concentration. The old pulp log storage area is also currently being developed as multi-family and single family residences. Runoff from this site has already been channeled directly to the flowage with no provision for flow reduction or treatment of the runoff. Construction site erosion can have serious impacts in urban areas where buffer vegetation is scarce and most runoff is channeled directly to the receiving water without treatment.

As with most pollution problems, it is much cheaper and easier to prevent runoff pollution through proper planning and construction than it is to reduce runoff pollution from existing sources. The following recommendations are designed to reduce both urban and agricultural nonpoint source pollution and prevent future sources.

a. *The Marinette County LWCD should continue to seek new grant funding sources to install agricultural BMP's in the Trout Creek watershed.*

b. *The Marinette County UW Extension office should continue to offer nutrient management planning assistance to farms in the Trout Creek Watershed.*

c. *The Marinette County LWCD and UW Extension Office should also work to reduce nonpoint source pollution throughout the Lower Peshtigo River Watershed, particularly in the Little Peshtigo River, Gravely Brook, Mud Brook, and Beaver Creek subwatersheds.*

d. *The City of Peshtigo should require runoff controls for all new development that drains to the Peshtigo Flowage or Trout Creek. Reduced impervious surface area, grass swales, detention ponds, and other runoff controls should be included in all new development plans.*

g. *New development at the old pulp mill site should incorporate runoff controls in*

e. *The City of Peshtigo should require the installation and maintenance of construction site BMP's to reduce sediment and nutrient runoff from construction sites.*

f. *The Peshtigo School District should incorporate runoff controls into the plans for any new additions or buildings that drain to Trout Creek or the Peshtigo Flowage.*

planning and construction.

Goose Control Although it did not rank very high as a concern by survey respondents. The City of Peshtigo has been working for several years to reduce the impact of urban geese on the flowage. Geese litter the park, beach, and other city owned frontage with their droppings. This can be an aesthetic concern as well as a public health issue. Geese can also be aggressive when nesting and guarding their young. In very large numbers, geese have even been shown to be a significant source of nutrients to smaller ponds and lakes and goose droppings are thought to be responsible for several beach closings in the State.

Goose control in urban areas is increasingly difficult as the population of Giant Canada geese continues to climb. The options available include methods to kill the geese, move the birds, reduce or eliminate reproduction, or discouraging them from using areas. Killing the geese is generally not feasible within urban areas, however the DNR has set increasingly liberal early goose

seasons to reduce the local population. Reproduction of geese can be eliminated by "addling" the eggs. This is done be vigorously shaking the eggs, pricking small holes in them, or coating them with oil to suffocate them. Addled eggs must be left in the nest. If eggs are removed, the birds will immediately re-nest. Destroying eggs is time intensive and probably not practical in
Most efforts at goose control fall under the category of discouraging their use of certain areas. This is often accomplished by fencing. Fencing can be effective in certain situations, but spacing of the wires and maintenance is critical. Unfortunately, geese will often fly over fences if there is sufficient area behind the fence to land. Scare tactics can also be employed. These include predator decoys, scare cannons, dogs, or other harassment techniques. Goose repellents have also been developed which make the grass unpalatable to geese and causes them to seek better grazing sites. Timing is key and the application may need to be repeated after rains.

Federal and state laws protect geese and all migratory waterfowl. Most goose control efforts need to be approved by the local DNR and the US Fish and Wildlife Service.

According to Parks and Recreation Department Director Steve Sharpe, the City has had mixed success with its goose control efforts. In his experience, fencing and scare tactics only work for a short while before the birds adapt. Repellants have been tried but success has been poor. Recently the City has been rounding up goose chicks in early summer and relocating them to other areas of the State. This method has proven successful at reducing the number of resident geese during the summer months. Swan decoys have also had some success keeping geese off of the lawn.

Spring and fall migration still brings large numbers of geese to the flowage. However, Peshtigo where much of the nesting probably takes place in the extensive upriver wetlands. Moving geese is only practical early in the summer during the molt and before the young can fly. Relocated chicks usually adopt their new home but relocated adults often return. It can be difficult to find places willing to take the relocated birds.

since use of the park and beach is low during these times the geese are tolerated.

a. *The City of Peshtigo should continue to remove/relocate geese to reduce the local population.*

b. *The City should continue to vary their control efforts to dissuade geese from using the park and beach area.*