Delavan Lake Sanitary District
of the Towns of Delavan and Walworth

Delavan Lake and Brown's Channel Watershed Improvement Project

Aim of project: To improve water quality in Delavan Lake and its watershed.

This project is ultimately aimed at improving the water quality of Delavan Lake. The watershed of Delavan Lake is 26,000+ acres, 23.9% of which comes from the Brown's Channel sub-watershed. Nutrients from this watershed flow into Delavan Lake by way of Brown's Channel. Delavan Lake has a high watershed-to-lake area ratio of 13:1. The high input of nutrients from this large watershed makes Delavan Lake very vulnerable to eutrophication. If the community can obtain this land and proceed with watershed improvements it is hoped that it will pave the way for additional watershed protection initiatives and extend their efforts to reduce the nutrients and suspended solids that enter Delavan Lake. This project is expected to provide educational opportunities as well, allowing University programs and students a study area, as well as an area for elementary to high school students to get a hands on view of watershed conservation and wetland ecology.

Key Points:

- Sediment and nutrient reduction
- Water quality improvement
- Stream bank rehabilitation
- Invasive plant eradication
- Community education and participation
- Native plant propagation

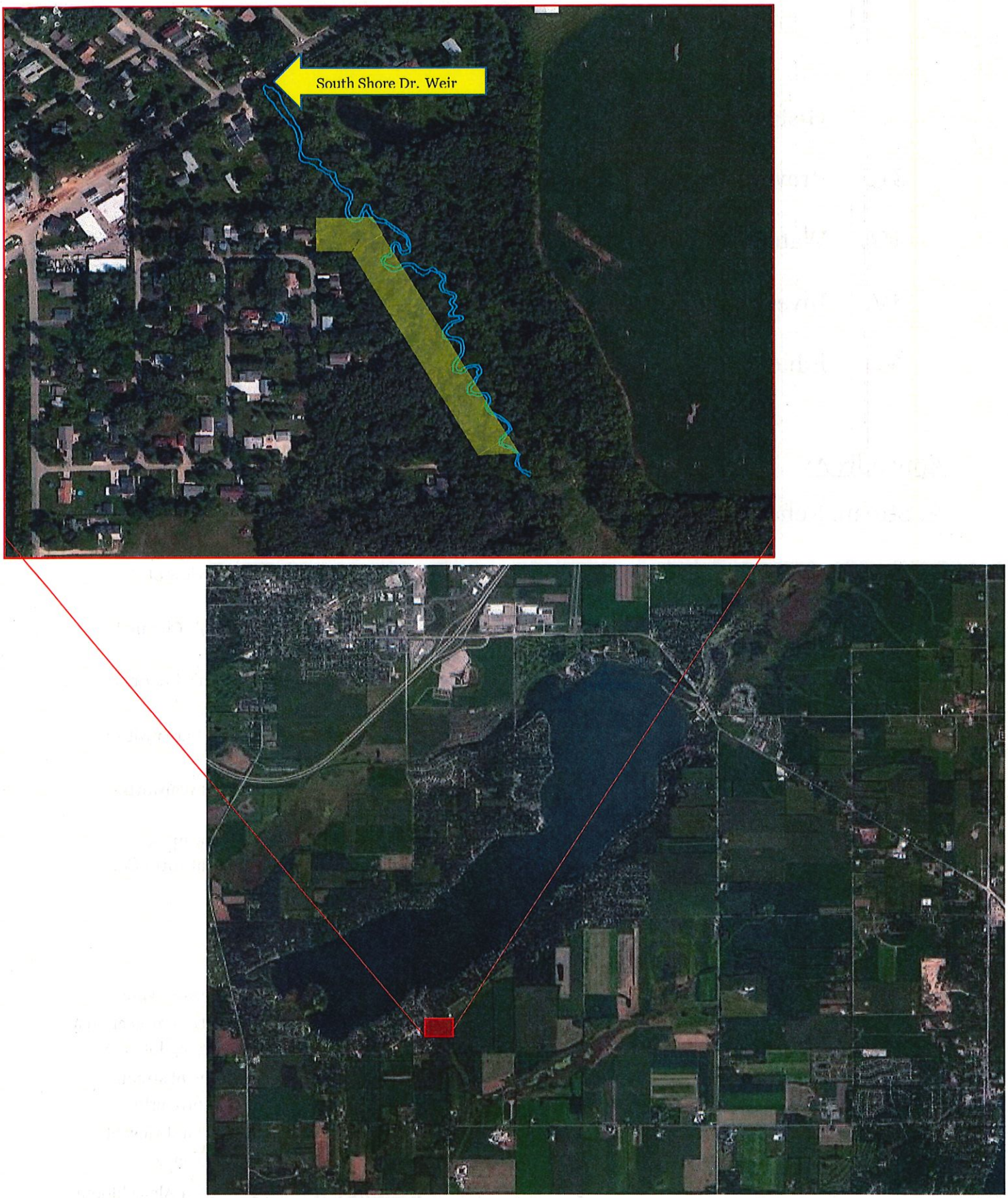

Figure 1: Aerial view of Delavan Lake and a blown-up image of the project area highlighted in yellow.

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I. History of Delavan Lake

In the 1960's Delavan Lake was pea soup green all summer long due to pollution and heavy algae blooms. The Delavan Lake Sanitary District was formed and septic systems were replaced with sewers at a cost of $50 million dollars. Yet, heavy algae blooms continued into the 1980's.

Delavan Lake has a huge watershed of 26,000 acres which deliver water to the lake. A watershed captures and directs all water falling within its boundaries to a single water body. Non-point source pollution within the watershed contributes to the nutrient load of the lake.

In 1989 a major rehabilitation project to improve water quality was undertaken on Delavan Lake at a cost of $7.1 million dollars. The project was successful due to a collaborative approach that included federal, state and regional agencies, and the local community.

The rehabilitation project involved several actions between 1989 and 1993 to reduce algae, rough fish populations and phosphorous in the lake. The result of these efforts was a substantial improvement in the water quality of the lake.

Current Status

While Delavan Lake continues to be a vital natural resource, scientific data collected since the completion of the rehabilitation project shows that the lake has returned to a nutrient rich state and nuisance algae blooms are increasing despite substantial efforts to remove sediments from the inlet. Nutrients are transported from the land surface to Delavan Lake and its tributaries through surface water runoff when precipitation events occur. The water picks up contaminants from urban and rural areas as it travels. This polluted runoff water ends up in Delavan Lake, which over time, will cause water quality to decline.

Action to reduce polluted runoff within the watershed is crucial if the decline in water quality is to be reversed.

II. Brown's Channel Watershed Vision

The project proposed in the following pages is the beginning of a larger vision for the continued improvement of the Brown's Channel Watershed and ultimately the water quality of Delavan Lake. Action to reduce non-point source pollution and sediment laden runoff within the watershed is crucial if this decline in water quality is to be reversed. The success of this proposed project is needed to pave the way for additional watershed improvement projects pertaining to Delavan Lake, such as an important reach on the upstream end of the project site that includes the vegetated wetland system noted in Figure 2 below. This portion of the stream can be subdivided into two parts. Section 1 consists of the meandering forested stream channel from the weir to the 0.5 acre pond; Section 2 consists of the 0.5 acre pond to the upstream end of the vegetated wetland.

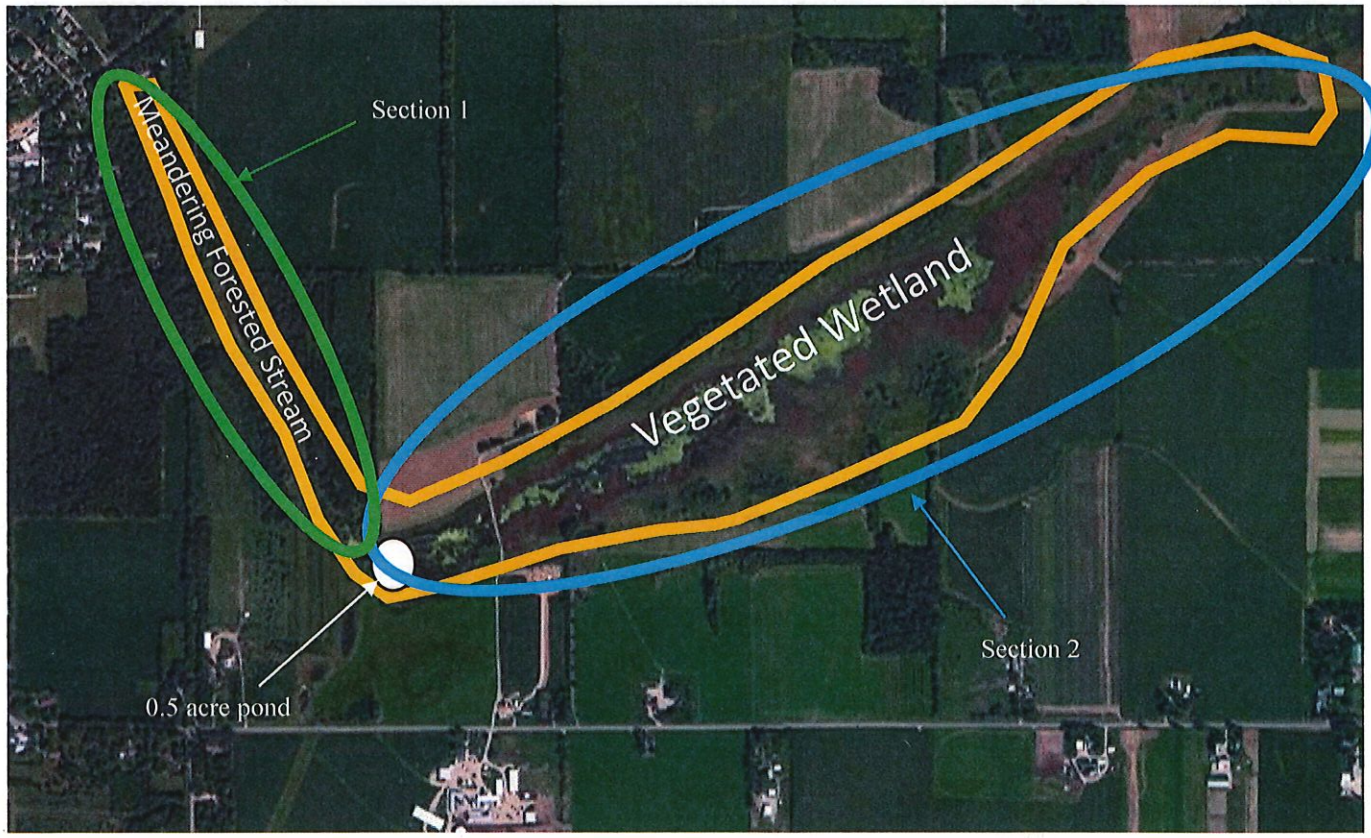

Section 1
Meandering Forested Stream
Vegetated Wetland
Section 2
0.5 acre pond

Figure 2: Image displaying Sections 1 and 2, as well as the dividing feature: the existing 0.5 acre pond.

II. Watershed Improvement: The Need for Planning

The protection and improvement of the Delavan Lake watershed is aimed to ultimately improve the Lake. This is the reasoning that has already led to the Jackson Creek Watershed Protection Project conducted by a partnership including the Kettle Moraine Land Trust (KMLT), Delavan Lake Improvement Association (DLIA), Delavan Lake Sanitary District (DLSD), Wisconsin Department of Natural Resources (WDNR), Southeastern Wisconsin Regional Planning Commission (SEWRPC), Wisconsin Association of Lakes, USDA Farm Service Agency, USDA Natural Resources Conservation Service, and Walworth County Lakes Association. The Browns Channel watershed encompasses approximately 6,251 acres, or 23.9 percent of the entire watershed of Delavan Lake (see Figure 3). The combined effect of both watershed improvement projects are expected to have a synergistic effect on one another, which will provide continuing improvement and protection of Delavan Lake's water quality.

Careful planning will be critical for the success of a project such as this. The proposed project site includes 2.1 acres of land approximately 300 feet south of the South Shore Dr. weir within Delavan Lake's Browns Channel area. (See Figure 4). The highlighted property parcels on Figure 4 are zoned Lowland Conservation District (C4) on the Walworth County Land Information Division website (www.co.walworth.wi.us). The planned use of this area will meet the requirements for the Walworth County 2035 Land Use Plan. This section of the watershed has deteriorated due to the amount of woody debris that has fallen in the stream, subsequently promoting channel alteration and degradation. The stream bank in this area has been observed to contain many undercut areas with considerable erosion. This area is home to many invasive plant species such as bush honeysuckle, buckthorn and black swallow-wort, which have overgrown and displaced significant percentages of native vegetation. The stream bed is hard with a rocky substrate that is filling in with soft sediment.

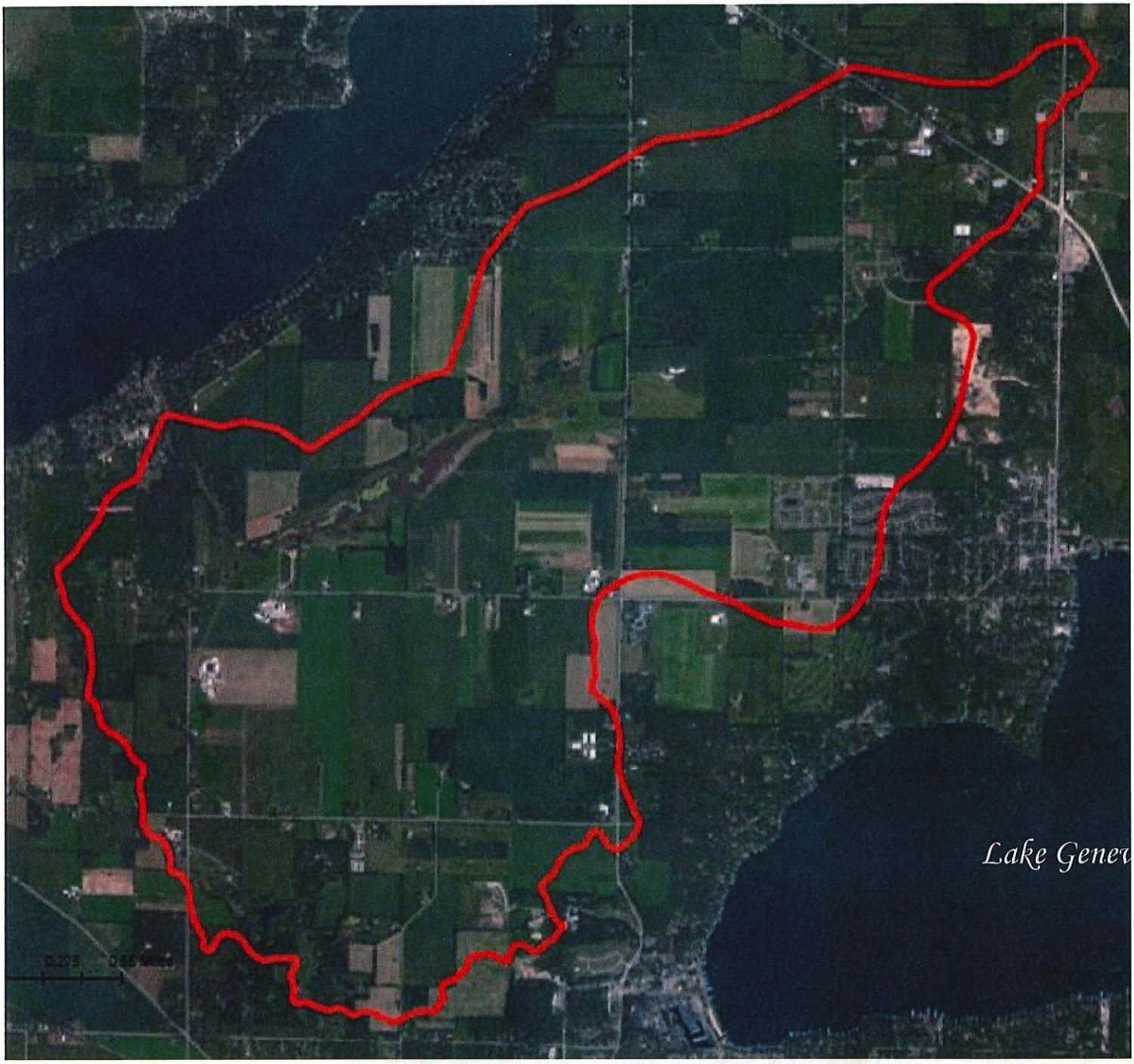
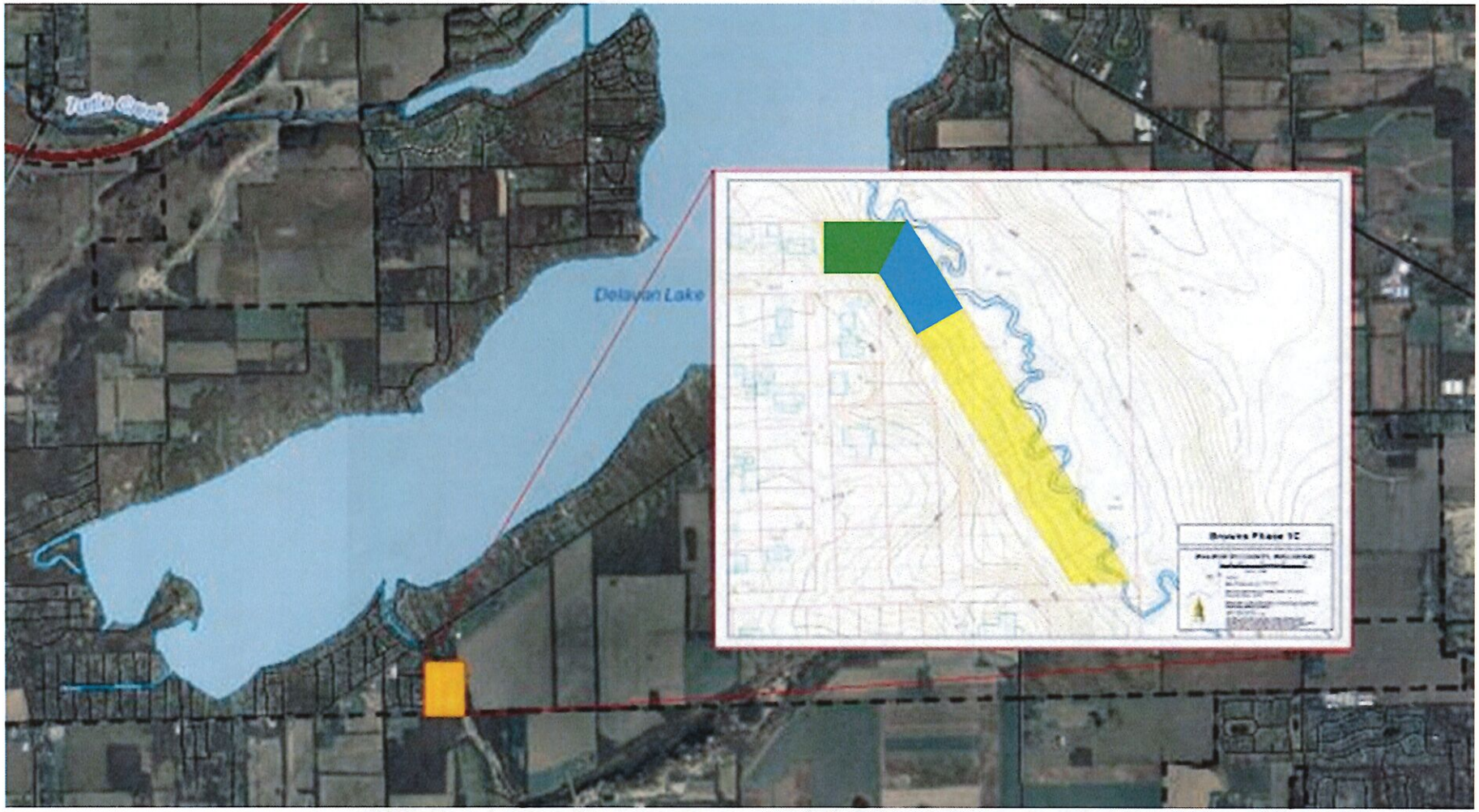


Figure 3: Brown's Channel Watershed Area.



Property Owner #1

DLSD Owned

Property Owner #2

Figure 4: Map 4 Proposed project area within the Delavan Lake/ Brown's Channels Watershed.

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The removal of woody debris blocking the channel and the repair of damaged stream banks is hoped to improve the natural flow and allow for removal of the trapped soft sediment from the stream bed. It is anticipated that a more continuous rocky substrate will allow impacted macro-invertebrate populations to recover and thrive, which will in turn provide improved fisheries habitat. Along with an improved habitat for native flora and fauna, sediment loads contained in the storm water runoff flowing into Brown's Channel located further downstream are expected to decrease as well. There is approximately 1,200 feet of stream bank located within the property, an estimated 26% of which is in need of some degree of stabilization and protection.

Improvement to Delavan Lake will be accomplished by reducing the amount of sediment and nutrients that run-off through Brown's Channel. Improvements such as bank stabilization, clearing of brush and woody debris, and stream habitat improvement of Brown's Channel and its associated watershed will decrease sediment load, reduce nutrient run-off from agricultural fields and provide better habitat for native species. It is hoped that adjacent landowners to the North and to the East of the project site will work in conjunction with DLSD to further improve the Brown's Channel stream reach on which their property is located. Stabilization and protection of this area is aimed to improve the waters which flow directly into Delavan Lake by way of Browns Channel.

Sections upstream of the proposed improvement site have already been altered to suit best management practices by the installation of grass waterways and vegetated filter strips. The soil conservation practices observed within the Brown's Channel watershed are considered "relatively good" by HDR Engineering, Inc. who performed an evaluation of the watershed that was completed in December 2011. The report strongly encourages additional grass waterways and vegetated filter strips be implemented along all concentrated flow channels located within the Browns Channel watershed. The report also indicates that the stretch of stream just south of the weir near South Shore Dr. is heavily

silted, with up to 2'6" of sediment and 6" of water depth. With areas upstream of the proposed site already improved, it is only logical to enhance and protect the section of stream that drains directly into the Delavan Lake's Browns Channel area.

Acquisition and maintenance of the project lands from a financial standpoint is key to implementing a successful restoration project as well. Funds for this project will be provided in part from donations and funds budgeted annually from the DLSD. Partnerships with outside entities such as other municipalities, government sources, environmental/lake groups, activists and local universities are encouraged and are anticipated to provide support to the project and its longevity. Grants awarded from the WDNR for Lakes Protection and Stewardship are considered a priority for this project. DLSD will pursue additional grants for the planning and implementation of this project.

Stage 1 is outlined below. Subsequent stages pertaining to section 2, which is located between the initial project site and the upstream wetland area, will be determined as funding and land opportunities become available.

Stage 1:

- **Phase I** will consist of the removal of woody debris that hinder stream flow and leads to channel alteration and degradation, while allowing important habitat structures to remain intact. Phase I will also include the identification and stabilization of eroding stream bank sections. Phase I is planned to be completed within the first two years from the start of the project. Maintenance of the stream will continue after Phase I is completed, which will include removing woody debris from the stream as it accumulates and monitoring the stabilization of the stream bank.

- **Phase II** will focus on the construction of a parking area for the public and a walkway to a viewing area which will include information about local, native and invasive flora and fauna observed to be present in the surrounding area. Phase II will also include the reduction of invasive plant species such as bush honeysuckle, buckthorn and black swallow-wort located on the property. The eradicated plants will be hauled off-site to a compost location. Reduction of invasive plants will be considered complete once 80% of the property is cleared of identified problem plant species. Phase II is planned to be completed within 2 and 3 years after the start of the project.

- **Phase III** is focused on promoting native plant growth by replacing the cleared invasive plant species with native plants, some of which will be provided from the Delavan Lake Sanitary Districts own "Native Rain garden". This "Native Rain Garden" is an improvement project located on the front lawn of the Delavan Lake Sanitary District's main building at 2990 HWY F Delavan, Wisconsin 53115. The "Native Rain Garden" project was completed in 2010 and includes dozens of Wisconsin native wetland plant species. If any additional plants are required, outside vendors will be contracted to complete the project on schedule. Phase III is planned to be completed between 3 and 5 years after the start of the project.

Additional stages will involve pursuit of land acquisition and/or easement conservation as the owners of property surrounding the project area become receptive to partnering with the District to promote watershed conservation.

- ❖ The timeline of this project is based on weather conditions, State, County, and local approval and permitting processes as well as availability of educational resources.

III. Inventory

Programs from the University of Wisconsin Whitewater (Whitewater, WI), George Williams College, (Williams Bay, WI), Wisconsin Department of Natural Resources, and SEWRPC will be involved in determining the biological inventory within the project site.

IV. Education Aspects and Group Involvement

The opportunities this site can provide for informational and educational purposes are significant. Local universities, including the University of Wisconsin Whitewater (Whitewater, WI) and George Williams College (Williams Bay, WI) will use the area for student research projects that may include watershed management, stream ecology, botany and more. Local schools and students from elementary up to high school level can use this area as an educational tool to get a hands on feel for natural resource conservation and wetland restoration and their importance in our world today. Local environmental groups including the Delavan lake Improvement Association (DLIA) are willing to lend support to help improve Delavan Lake and the Brown's Channel watershed.

APPENDIX A

A. Stream Rehabilitation

Woody debris and other vegetation which hinder flow and lead to channel alteration will be cleared. Areas considered important for stream habitat will be allowed to remain in place for best possible habitat; including riffles and pools. Professors and other professionals will be included for these assessments and stream evaluations. DLSD staff, DLSD seasonal staff, volunteers and partners will maintain the area each month for the first year or two. Once the area is functioning properly DLSD staff and volunteers will monitor and control site as needed.

B. Stream Bank Stabilization

Undercut stream banks will be identified and stabilized under the guidance of public/private universities and professionals. Depending on the intensity of the bank erosion different techniques will be used including but not limited to: Bio-rolls, brush layering, wattles/fascines, brush mattress, soil wraps. DLSD staff, DLSD seasonal staff, volunteers and partners will maintain the area each month for the first year or two. Once the area is functioning properly DLSD staff and volunteers will monitor and control the site as needed. The area will be monitored by DLSD staff after any major rainfall events (>2in.).

C. Invasive Species Control

Buckthorn, bush honeysuckle and other invasive species including black swallow-wort (Image 1) will be removed to allow new growth of desirable species which consist of native and habitat enhancing vegetation. Public/private universities and professionals will be used for plant identification and restoration. DLSD staff, DLSD seasonal staff, volunteers and partners will maintain the area monthly for the first two years at a minimum.

Image 1: Invasive vines suffocating underlying vegetation

D. Natural Vegetation Propagation

Delavan Lake Sanitary District installed a major "Native Rain Garden" consisting of native plant species, which will provide a bank of natural plants for propagation where appropriate, including: stream bank stabilization and habitat enhancement. If additional vegetation is required native plantings/ seeds will be purchased. DLSD staff, DLSD seasonal staff, volunteers and partners such as gardening groups/associations will maintain the area each month for the first year or two. Once the area is functioning properly DLSD staff and volunteers will monitor and control the site as needed.

E. Trails

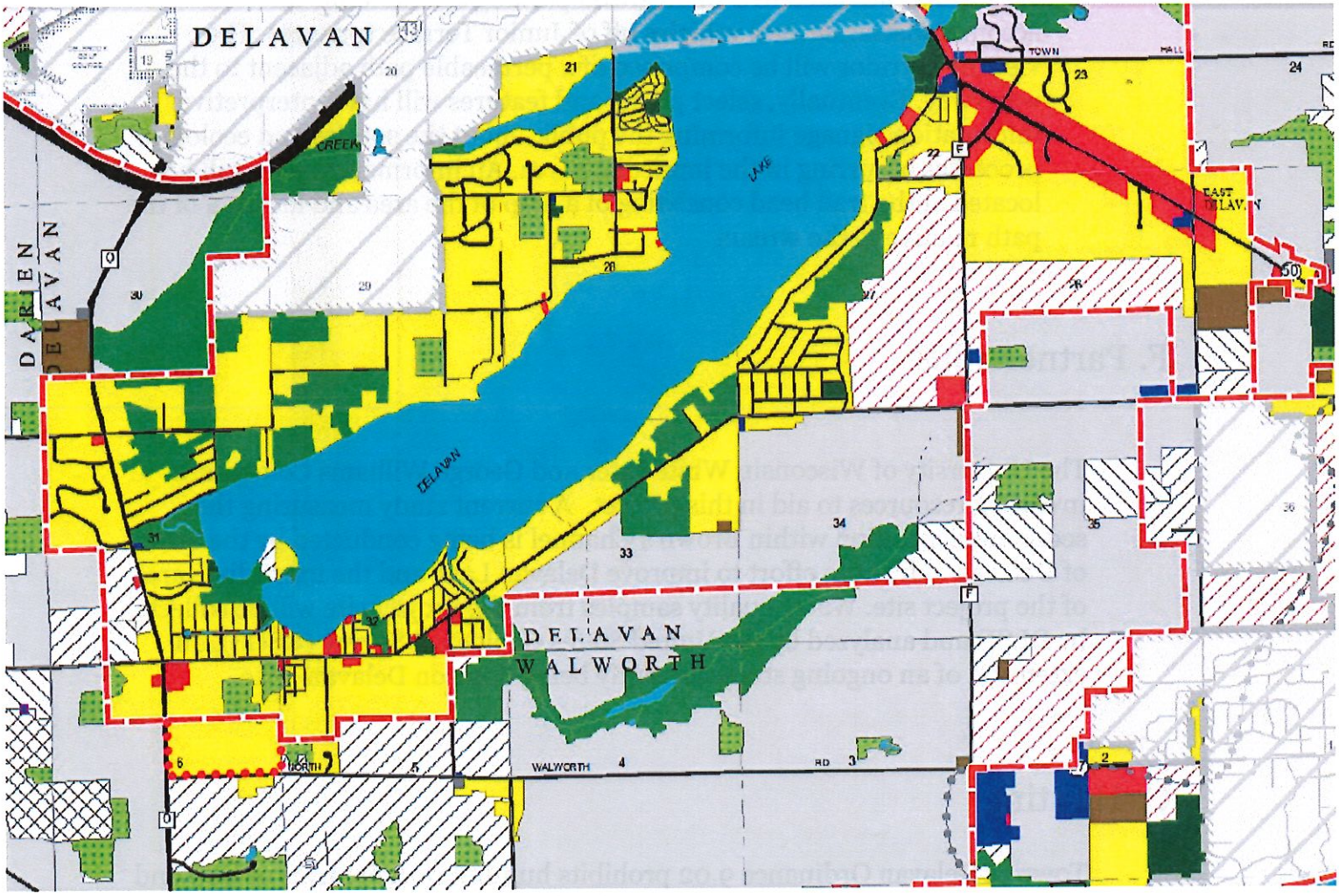
A viewing trail will be installed within the northern section of the property. This will be attached to a small gravel parking area suitable for accommodating several vehicles off of Junior Terrace (private). The viewing corridor will be comprised of a permeable path adjacent to the waterway. Eventually, select plants and features will have interpretive information signage informing the public about the species and ecological processes occurring in the immediate area. An information post will be located at the trail head consisting of a map of the area and location of the path relative to the stream

F. Partnerships

The University of Wisconsin Whitewater and George Williams College are investing resources to aid in this project. A current study measuring the sediment deposition within Brown's Channel is being conducted by the Town of Delavan aiding the effort to improve Delavan Lake and the immediate area of the project site. Water quality samples from the project site will be collected by DLSD and analyzed by the United States Geological Survey (USGS), an extension of an ongoing study currently being done on Delavan Lake.

G. Hunting

Town of Delavan Ordinance 9.02 prohibits hunting with firearms or bow and arrow within 300 feet of any building that is normally utilized for human occupancy. This ordinance makes it impossible for the District to open this proposed project site up to hunters because of the residences which are located to the south and west of the project area.



Legend:

- URBAN DENSITY RESIDENTIAL (LESS THAN 5.0 ACRES PER DWELLING)
- RURAL DENSITY RESIDENTIAL (AT LEAST 5.0 ACRES PER DWELLING)
- COMMERCIAL
- COMMERCIAL/RECREATIONAL
- MIXED USE
- INDUSTRIAL
- GOVERNMENTAL AND INSTITUTIONAL
- RECREATIONAL
- TRANSPORTATION, COMMUNICATION, AND UTILITIES
- AGRICULTURAL RELATED MANUFACTURING, WAREHOUSING, AND MARKETING
- STREETS AND HIGHWAYS
- URBAN RESERVE
- EXTRACTIVE
- SANITARY LANDFILL
- PRIME AGRICULTURAL (MINIMUM PARCEL SIZE: 35 ACRES)
- OTHER AGRICULTURAL, RURAL RESIDENTIAL, AND OTHER OPEN LAND (5 TO 34 ACRES PER DWELLING)
- OTHER AGRICULTURAL, RURAL RESIDENTIAL, AND OTHER OPEN LAND (5 TO 19 ACRES PER DWELLING)
- OTHER AGRICULTURAL, RURAL RESIDENTIAL, AND OTHER OPEN LAND (20 TO 34 ACRES PER DWELLING)
- PRIMARY ENVIRONMENTAL CORRIDOR
- SECONDARY ENVIRONMENTAL CORRIDOR
- ISOLATED NATURAL RESOURCE AREA
- DNR/DOT LAND OUTSIDE ENVIRONMENTAL CORRIDORS
- OTHER OPEN LAND TO BE PRESERVED
- SURFACE WATER
- PLANNED SEWER SERVICE AREA
- TOWN PROPOSED ADDITION TO SEWER SERVICE AREA
- SPECIAL SEWER SERVICE AREA (Mallard Ridge)

Figure 5: 2035 Walworth County Land Use Plan and legend

Figure 6: 2035 Walworth County land use map showing Primary Environmental Corridor (green), Urban Density less than 5 acres per dwelling (yellow) and Commercial (red). Proposed parking lot (White square) path and viewing area (pink) is shown. Property is outlined in Purple.

Image 3: Current view of the proposed parking lot area.

Image 4: View of the stream from the property.

Image 5: View of the land within the property.

Figure 6: Algae bloom on Delavan Lake during summer 2014.

Jan 2018 update

RE: Grant LPT-483-15 Brown's Channel Watershed Land Acquisition #1

I. Timetable for Implementation

Goal and Objective Purchase property within project area				
No.	**Activities/Methods**	**Year**	**Quarter**	**Notes**
1.1	Complete purchase of property from current landowners	2015	Apr-June	Complete
Goal and Objective Stream bank repair and stabilization				
No.	**Activities/Methods**	**Year**	**Quarter**	**Notes**
2.1	Identification of eroding stream bank sections	2017-2018	July-Sept Jan - March	Sections have been roughly identified. Need GPS points where stream enters/exits DLSD property. Contacted vendor Dec 2017.
2.2	Repair of eroded stream bank sections	2018-2019	March-August	Plan bank stabilization with matting, soil wraps, Christmas tree wraps and native plants.
Goal and Objective Create parking and viewing area for information regarding invasive versus native flora and fauna				
No.	**Activities/Methods**	**Year**	**Quarter**	**Notes**
3.1	Create parking area	2018-2019	July-Sept	Parking area needs entrance
3.2	Identification of invasive and native plants	2018-2019	July-Sept	Trees/shrubs ID complete; Herbaceous plants to be ID
Goal and Objective Removal of invasive plants and promotion of native flora and fauna				
No.	**Activities/Methods**	**Year**	**Quarter**	**Notes**
4.1	Removal of at least 80% of identified invasive plants	2018-2021	Varies	Removal of invasive trees/shrubs best when ground is frozen. Removal of invasive herbaceous/grass species best during growing season
4.2	Replace invasive plants with native plants to promote project area stabilization	2018-2021	Varies	Replacement of invasive plants with native plants to follow removal at best time of year to provide best survival chances