

Shoreland Assessment of Shell Lake

Washburn County, Wisconsin

C. Stoughtenger, C. Kasmerchak, N. Turyk, D. McFarlane

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Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin - Stevens Point

Acknowledgements

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Introduction

Shell Lake, located in southern Washburn County, is Wisconsin's largest landlocked seepage lake at over 2,500 acres with 11.1 miles of shoreland (Figure 1). Periodically, Shell Lake experiences high water levels which can affect local structures. To address this problem, the City of Shell Lake worked with professionals from the Wisconsin Department of Natural Resources to install a diversion pipe. Periodic assessment of the shoreland is required as a part of the permit for the diversion. These assessments are intended to evaluate the progress of improvements in shoreland habitat. Three surveys along the shoreland were conducted in August of 2013. The surveys included shoreland vegetation, disturbance above and below the high water mark. Surveys were designed by professionals with the Center for Watershed Science and Education (CWSE) and Center for Land Use Education (CLUE) at the University of Wisconsin-Stevens Point (UWSP). The field surveys were conducted by CWSE with assistance by Shell Lake residents and city officials.

As well as meeting the permitting requirements for the Shell Lake diversion pipe, understanding where Shell Lake's water originates is vital when trying to comprehend the lake's health. During a rain event or snowmelt, water moves across the surface of the landscape, also known as runoff, towards lower elevations such as lakes, streams, and wetlands. This makes the areas of land around a water body vital to the health of the ecosystem within the water body.

The capability of the landscape to shed or retain water determines the amount of erosion that may occur and the water quality. Landscapes with the ability to retain water during a rain event or snowmelt help reduce and slow the supply of water that drains into the lake. While forests and grasslands allow a moderate amount of runoff to be soaked into the ground, other land uses can result in an increase in runoff, and could be a source of pollutants and excess nutrients that could stimulate algae growth and other aquatic plants within the lake.

The shoreland around a water body provides habitat that is important to a lake's ecosystem. Healthy, mixed shoreland vegetation includes a combination of native flowers and grasses, shrubs, and trees which provides habitat for birds, frogs, turtles, and many mammals. Ideally, vegetation should extend from the shoreland into the lake. Shoreland vegetation also helps to improve water quality by reducing and slowing the amount of runoff and sediment flowing towards the lake. Lack of shoreland vegetation can result in a number of problems such as reduction of bird species, frogs, turtles and impacts to the fishery. Other problems may include poorer water clarity, sedimentation in fish spawning beds, and increased algae/aquatic plants due to higher nutrient levels. With careful planning and restoration, even developed shorelands can be managed in a manner that can contribute to a healthy lake.



Figure 1. Aerial view of Shell Lake Washburn County, Wisconsin

Methods and Materials

The shoreland survey for Shell Lake was conducted by boat from August 5-9, 2013. Staff from the Center for Watershed Science and Education received assistance from local residents. The Shell Lake shoreland survey contained three components: shoreland vegetation and estimates of shoreland disturbance above and below the high normal water level. The survey below the normal water level was conducted because of low water levels in 2013, which resulted in an exposed lakebed. From a boat on the water, these components were surveyed separately. The survey also included photographing the shoreline from the boat. The survey was conducted as a whole lake survey; parcel boundaries were not identified. To enable measurement of different categories of vegetation, GPS points were marked at the start and end of a similar stretch of vegetation. Disturbance sites were marked by GPS as a single point near the location.

Each survey required the identification of the “normal” water level to identify the typical water’s edge. This level was identified by Dave Vold, Lake Coordinator for the City of Shell Lake, using a tape measure and hand-held level. According to the USGS, the average water level from 1936 to 2011 is 1218.81 cm. When the survey was conducted during the summer of 2013, Shell Lake’s water level was lower at 1217.23 cm. City ordinances consider the normal water level to be 1221.8 cm.

To determine the difference between the lower and normal water levels, vertical measurements were made from the surface of the lake upwards. This height above the current lake level was then transferred onto a wooden stick as it was held vertically on the watercraft. As the surveys progressed, the wooden stick with the marking for the normal lake level was held vertically on the boat and a hand level was placed at the mark. The normal lake level was identified by Mr. Vold using shoreland features (vegetation, structures, lawn furniture, etc.) as points of reference for the research assistants as the watercraft moved around the lake perimeter and the surveys progressed.

During the vegetation survey, distance was estimated from the normal water’s edge inland for the dominant ground cover or short vegetation (less than 3 feet high). The dominant ground cover/vegetation was selected from one of following categories: wetlands, organic (pine needles, leaves), barren/disturbed, new shoreland restoration, mowed vegetation, short unmowed vegetation (less than 3 feet tall), or impervious surface (Appendix A). Also noted (but not mapped) was less dominant ground cover/vegetation. At the beginning and end of each segment of similar dominant ground cover/vegetation, a waypoint was marked using a hand-held Garmin GPSmap 78s unit. The name of each waypoint was entered into the GPS to match the waypoint name noted on the survey data form and corresponding paper map. Taller shoreland vegetation (greater than 3 feet high) was identified as present or absent within each segment. This process was used for the balance of the Shell Lake shoreland.

The shoreland disturbance survey was broken into three primary categories: shoreland alterations, erosion, and culverts/outfalls (Appendix B). All categories except a dock/pier included a GPS waypoint and an estimate of the length of the feature. Areas with erosion were identified as either undercut banks/slumping or furrow/gullies and the slope was estimated as a percent. The diameter of each culvert and outfall was estimated along with the shape and type of material.

The inventory of disturbance for sites located below the normal water level and above the current water level in Shell Lake was designed to identify any areas on the exposed lakebed with uses or

practices that required a permit or are not allowed (Appendix B). These features were marked as a waypoint with the GPS unit. Categories from this section of the survey included: motor vehicle tire tracks, cut/mowed areas greater than 30 feet wide, tilled or eroded areas, and woody structure at the water's interface.

All GPS-marked features were recorded at their approximate location on paper copies of aerial maps using their respective waypoint names. These maps served as a back-up to the GPS data. Any specific notes about features were also recorded on the maps, as needed.

A second pass around Shell Lake was performed to photograph the shoreland. When possible, the operator of the watercraft maintained a 100 foot distance from the shoreland as a GPS equipped digital camera was used (RICOH Caplio 500SE GPS enabled digital camera system). Each consecutive photograph overlapped to ensure complete coverage of the shoreland. The photographs retain a record of current conditions in August 2013 and can be used to evaluate and interpret changes in the future.

All GPS data were uploaded at the end of each day to a computer equipped with ArcGIS 10.2 software. The photographs were also uploaded into ArcGIS 10.2 and converted to geotagged photo points. The GPS data points were overlaid onto a map of Shell Lake to validate their correct locations. Field data sheets were reviewed for missing or unclear information needing to be collected the following day.

Data from the field survey sheets were input into an ArcGIS database at UWSP. Line features were created for each vegetation segment at this time as well. The collected GPS points and photographs were used to accurately locate the point features as well as the starting and ending points of each vegetation line segment.

All data input into the ArcGIS database were used to calculate the final survey statistics for Shell Lake. The number of sites exhibiting manmade disturbance above and below the normal water level was summed as well as the total length of each type of vegetation type. The final lake numbers were then separated into three geographical lobes for ease of display within the report: northwestern, eastern, and southern (Figure 2).

Results and Discussion

Shoreland Vegetation Survey - Above Normal Water Level

Shoreland vegetation is critical to a healthy lake's ecosystem. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. A healthy shoreland helps reduce the amount of flooding by slowing down runoff, filtering out sediment and allowing it to soak into the soil. Reducing runoff can also be beneficial by reducing erosion.

Shoreland vegetation also provides privacy to people on land as well as those recreating on the lake, which is desirable to many lake enthusiasts. Ideally, shoreland vegetation should include a mix of vegetation including tall grasses/flowers, shrubs, and trees and should extend inland at least 35 feet. Shorter vegetation helps to filter runoff and provide habitat for ground-dwelling animals, while shrubs and trees provide habitat for birds and help to shade the near-shore area in the lake. All of these categories of vegetation help to stabilize shoreland soil and their roots capture nutrients moving towards the lake in groundwater or runoff.

The results of the shoreland survey conducted on Shell Lake will serve as a planning tool for Shell Lake citizens as well as city, county, and state officials to help identify possible shoreland restoration locations, as well as recognize natural shorelines for protection. In addition, this information will provide a baseline database from which to measure and monitor future changes in the composition of the shoreland.

The vegetation categories used for the shoreland vegetation survey above the normal water level were: wetlands, organic, barren, new shoreland restoration, mowed vegetation, and short unmowed vegetation less than 3 feet in height (Figure 2). Wetlands were assigned to areas that supported aquatic or water-loving vegetation on the shore. Wetlands provide habitat that supports a wide variety of plant and animal species, and play an important role in the life cycles of fish, amphibians, birds, and mammals, while helping to slow runoff and diffuse wave energy. The "organic" category was assigned to shoreland areas that were predominantly covered by pine needles or leaf litter, which can act like a sponge and slow runoff. Barren land can contribute sediments and nutrients to the lake. The additions can result in the additional growth of algae and aquatic plants and may plug up gravel that would be used by spawning fish. New shoreland restoration is characterized by shorelines being restored back to their natural state. No shoreland restorations were observed during this survey. Mowed vegetation was assigned to shorelands that were mowed all the way to the normal water level. In a shoreland, with the exception of an access path, mowed vegetation is not desirable because it provides little habitat and minimal filtration of runoff. Impervious surfaces included areas where water could not infiltrate into the ground, allowing runoff and pollutants to quickly enter the lake and do not provide habitat. Rooftops, stairways, boat landings, structures are examples of impervious surfaces. To better understand the results of the surveys, we will discuss the lake as a whole, and as three sections, the northwestern, eastern, and southern lobes (Figure 2). Thirty-six percent of Shell Lake's shoreline had good shoreland vegetation, with the "vegetative buffers" extending at least 35 feet inland from the normal high water. The southern section had the greatest extent of healthy shoreland. Ten percent of the shoreland had some vegetation in place (inland 5 -35 feet), and the majority of the shoreline (54%) lacked any vegetative buffer (Table 1).

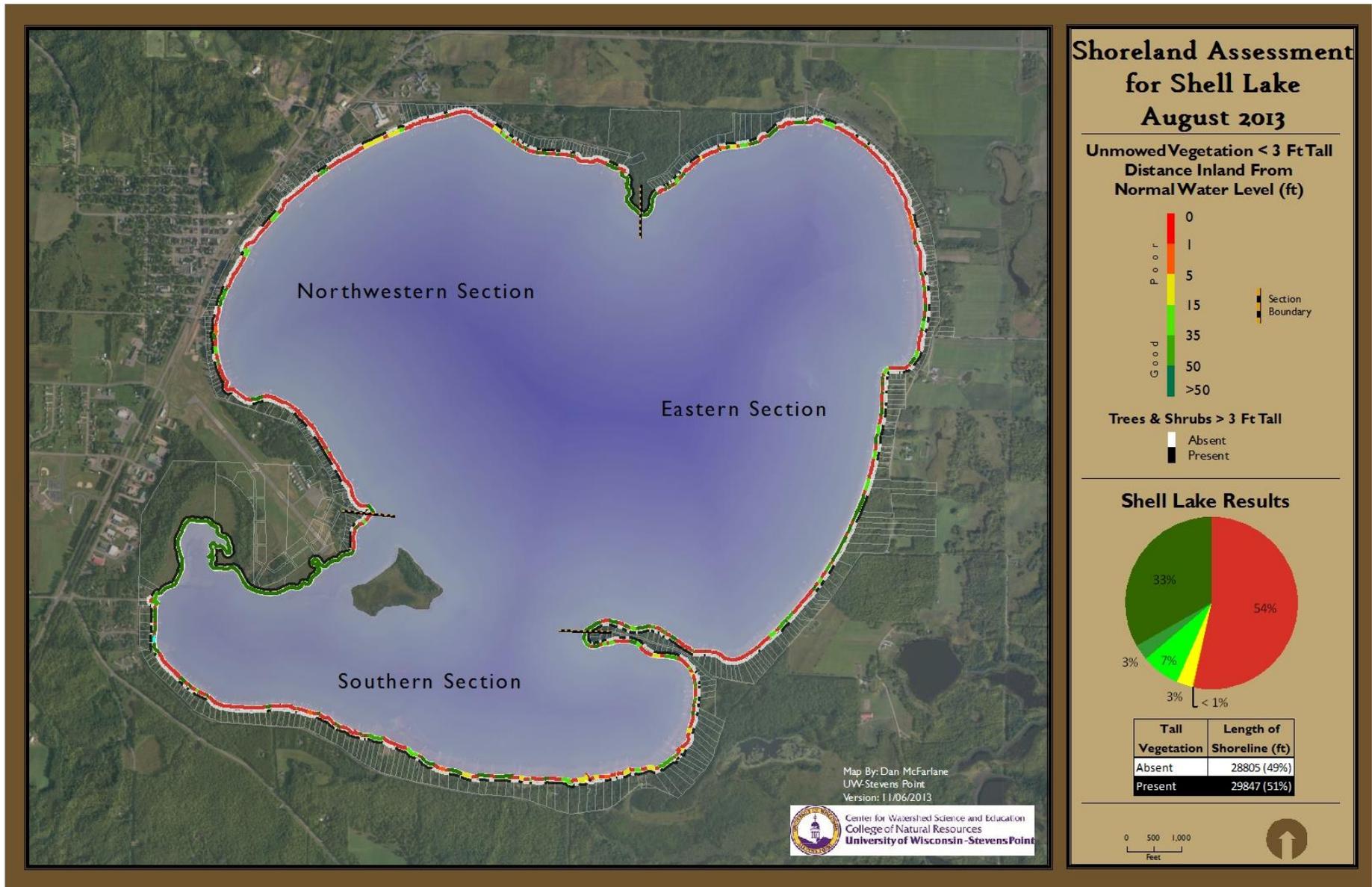


Figure 2: Distance of unmowed vegetation (< 3 feet high) inland from normal water level around the Shell Lake shoreland.

Table 1. Distance of unmowed vegetation (< 3 feet high) inland from normal water level around the Shell Lake shoreland.

Distance of unmowed vegetation inland from normal water level (ft)	Shell Lake	Northwestern Section	Eastern Section	Southern Section
0	31,809 ft 54%	11,254 ft 72%	11,083 ft 58%	9,472 ft 40%
1	-	-	-	-
5	1,670 ft 3%	561 ft 4%	300 ft 2%	809 ft 3%
15	2,235 ft 4%	715 ft 5%	419 ft 2%	1,101 ft 5%
35	3,603 ft 7%	747 ft 5%	1,687 ft 9%	1,169 ft 5%
50	1,636 ft 3%	66 ft < 1%	443 ft 2%	1,127 ft 5%
> 50	17,699 ft 30%	2,371 ft 15%	5,161 ft 27%	10,167 ft 43%
Total	58,652 ft	15,714 ft	19,093 ft	23,845 ft

Northwestern Section of Shell Lake - Highlights of Shoreland Vegetation Survey

The northwestern section of Shell Lake includes the campgrounds and swimming areas. Given that this is an area of high activity, it is susceptible to erosion which may lead to an increase of sediments and pollutants flowing into Shell Lake during storms and snow melt. Seventeen percent of the northwestern section had vegetative buffers of 35 feet or more inland from the normal water level. Most of this land was located on the peninsula in the northern portion of this section, at the section boundary on the map in Figure 3. Additional shoreland in this category was scattered intermittently throughout this section. Eleven percent of this section had unmowed vegetation that ranged from 5 to 35 feet inland. These areas, although in small amounts, can be easily improved by ceasing mowing or through restorative efforts. Unfortunately, the majority of this section lacked vegetative buffers for 70% of its length (Figure 3). A large volume of sand occupies the shoreline in this section, making it very susceptible to erosion and increased sediment supply to Shell Lake. Forty-three percent of the shoreland in this section had shrubs/trees present.

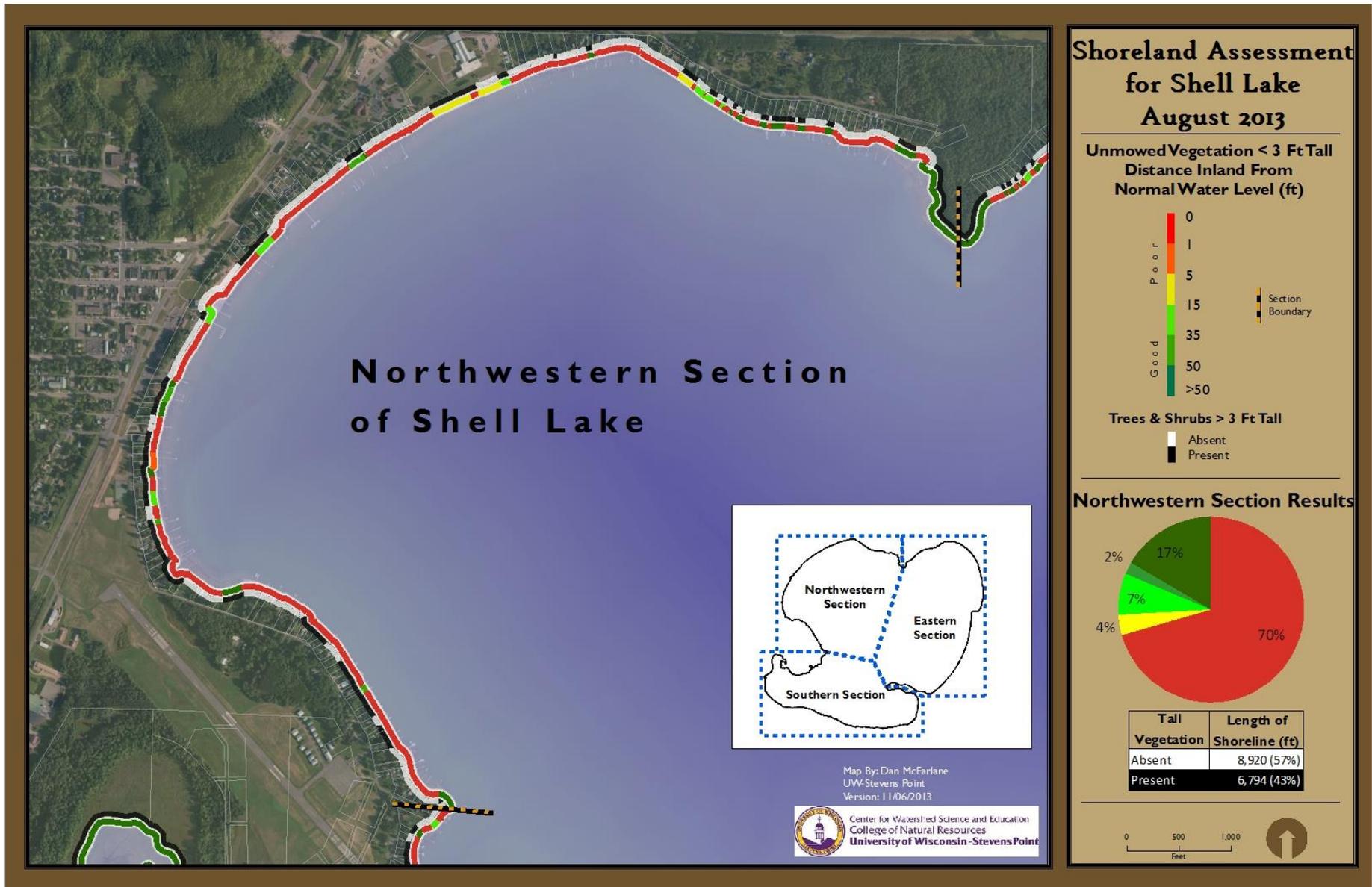


Figure 3: Distance of unmulched vegetation (< 3 feet high) inland from normal water level around the Shell Lake shoreland for the northwestern section, 2013.

Eastern Section of Shell Lake - Highlights of Shoreland Vegetation Survey

The eastern section had unmowed shoreland vegetation more than 35 feet inland from the normal water level for 33% of its length. Vegetation ranging from 5 to 35 feet inland occupied 10% of the eastern section's shoreline. If improvements were made to increase the extent of unmowed vegetation to a depth of 35 feet or greater inland, 43% of its shoreline would be in good condition. Unfortunately, 57% of the shoreline in the eastern section lacked unmowed vegetation (Figure 4). Shrubs/trees were present on 37% of the shoreline in the eastern section of Shell Lake.

Southern Section of Shell Lake - Highlights of Shoreland Vegetation Survey

Fifty percent of the southern section's shoreline had unmowed vegetation that extended 35 or more feet inland from the normal water level. The majority of this length occurred in publically-owned land. In addition, there were scattered parcels with shoreline exhibiting high quality buffers. Unmowed vegetation ranging between 5 and 35 feet inland comprised 10% of the shoreline in this section. Thirty-nine percent of the shoreline in the southern section of Shell Lake was mowed to the water's edge (Figure 5). Sixty-seven percent of the shoreline in the southern section of Shell Lake had shrubs/trees.

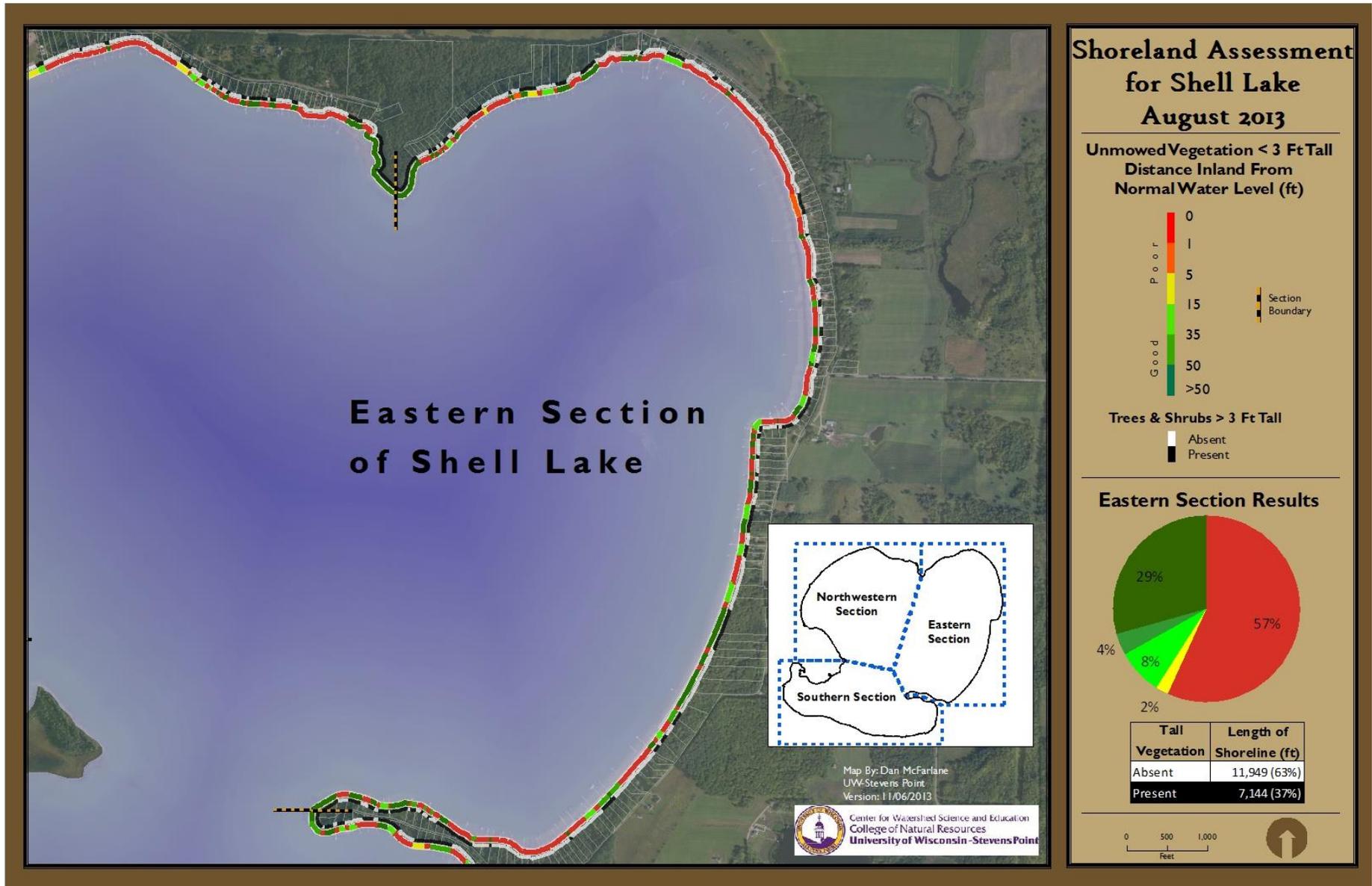


Figure 4: Distance of unmowed vegetation (< 3 feet high) inland from normal water level around the Shell Lake shoreland 2013 for the eastern section.

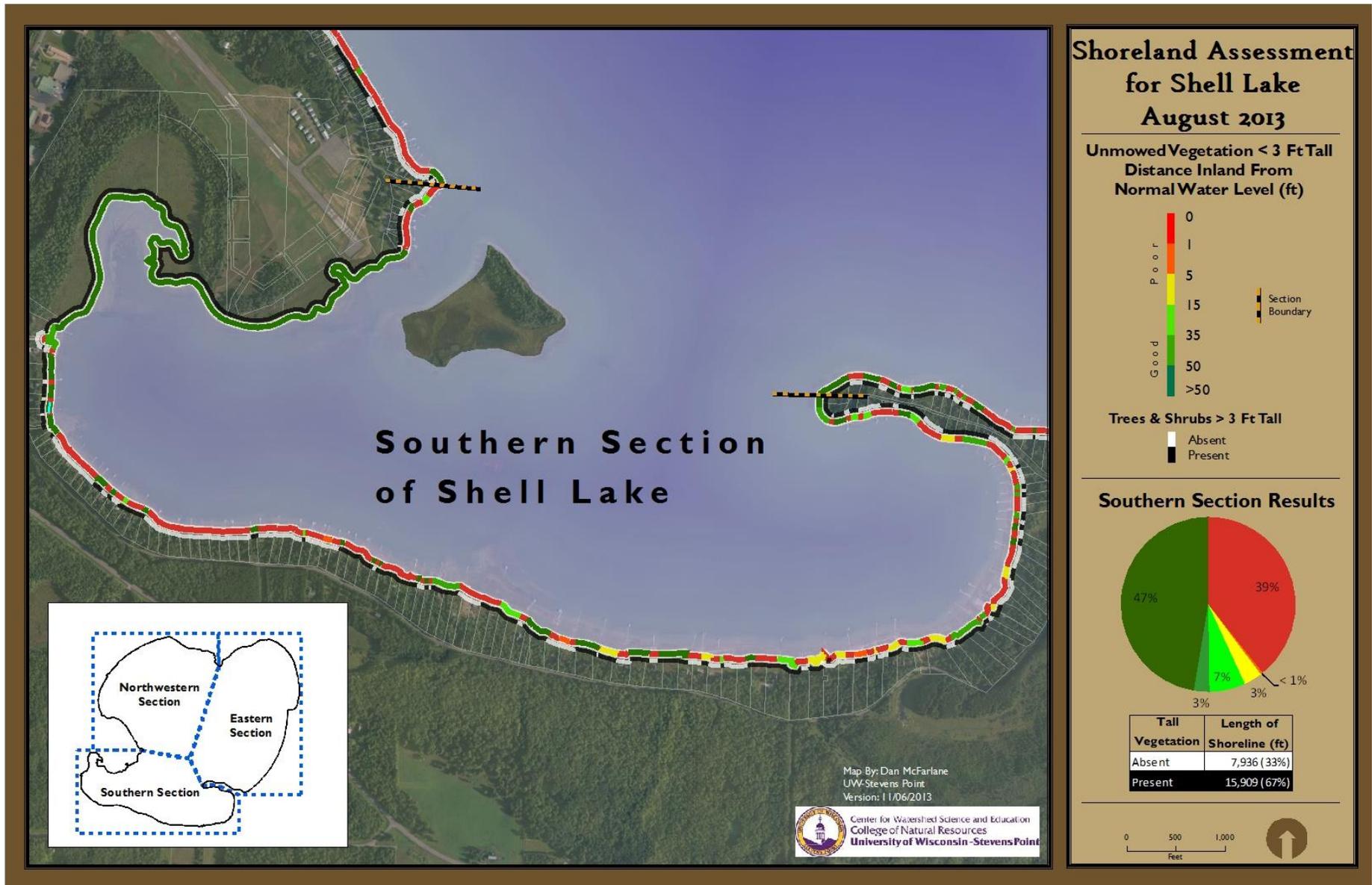


Figure 5: Distance of unmowed vegetation (< 3 feet high) inland from normal water level around the Shell Lake shoreland 2013 for the southern section.

Shoreland Disturbance Survey – Above the Normal Water Level

Although many activities can occur near or in a lake without disrupting habitat or degrading water quality, some disturbances can impact one or more of these attributes. In general, it is the cumulative effect of disturbance that results in negative impacts to the health of the lake and its ecosystem. The shoreland disturbance survey inventoried the location of seawalls, rip-rap (rock), artificial beaches, boat landings, dams/spillways, erosion (undercut banks/slumping and furrows/gullies), culverts and docks/piers. The survey datasheet can be found in the appendix of this document.

Seawalls and rip-rap replace native vegetation and habitat. Unless there are issues with ice heave or unusual wave action, they are rarely warranted to reduce erosion on small inland lakes. Most shoreline erosion can be minimized by ensuring that runoff from the landscape is reduced prior to reaching the shoreland with the use of landscaping, addition of rain gardens, use of rain barrels, etc. Ensuring that aquatic plants remain in place in the lake helps to reduce the energy from waves before they hit the shore. Floating-leaf aquatic plants such as water lilies and emergent plants like bulrush are especially good at dissipating the energy from a wave that's headed to shore. Both seawalls and rip-rap are constructed where the land meets the water. Seawalls are constructed from cement while rip-rap typically consists of rocks, boulders, or even broken pieces of concrete. During the 2013 survey, there were 22 sites with rip-rap around Shell Lake, which comprised an estimated length of 2,020 feet of shoreline. Unless some of these sites have issues that can't be mitigated by controlling runoff from the landscape and/or allowing in-lake vegetation to grow, the rip-rap should be removed, and replaced with properly engineered native vegetation restoration.

The boat landings around Shell Lake consisted of both public and private boat launches. Although they are necessary to provide access to the lake, boat launches increase runoff to the lake, carrying sediment and pollutants with the runoff. These impacts can be reduced by ensuring that measures are in place to minimize or control the runoff from nearby landscape. A few examples include the use of pervious pavement or swales for nearby parking lots, directing the runoff from roads away from the lake, etc. Dams and spillways are structures constructed to restrict the flow of water into and out of a body of water. No dams or spillways were present on Shell Lake.

Several types of erosion may occur in a lake's shoreland. Areas with undercut banks/slumping are caused by water movement along the shoreline which removes the lower layers of shoreline soil. Furrows/gullies appear on the landscape where concentrated runoff occurs during rainstorms and snowmelt, carrying soil and debris into the lake. Once furrows and gullies develop, they can quickly expand unless they are mitigated. With the exception of the artificial beaches, no points of erosion were documented around Shell Lake during this survey.

Culverts are pipes or tubes that carry water from surface runoff, sump pumps, retaining ponds, et cetera directly into the lake. They are installed to quickly rid the nearby landscape of water, which eliminates infiltration to groundwater and does not allow garbage, sediment, and pollutants to settle out on the landscape before it enters the lake. No culverts were documented during the Shell Lake survey.

While docks provide access to the water and boats, they do alter to the shoreland by breaking up habitat. Shell Lake had 321 docks during this survey (Figure 6).

To better understand the localities of disturbance, Shell Lake was analyzed as three sections based on natural breaks around the lake.

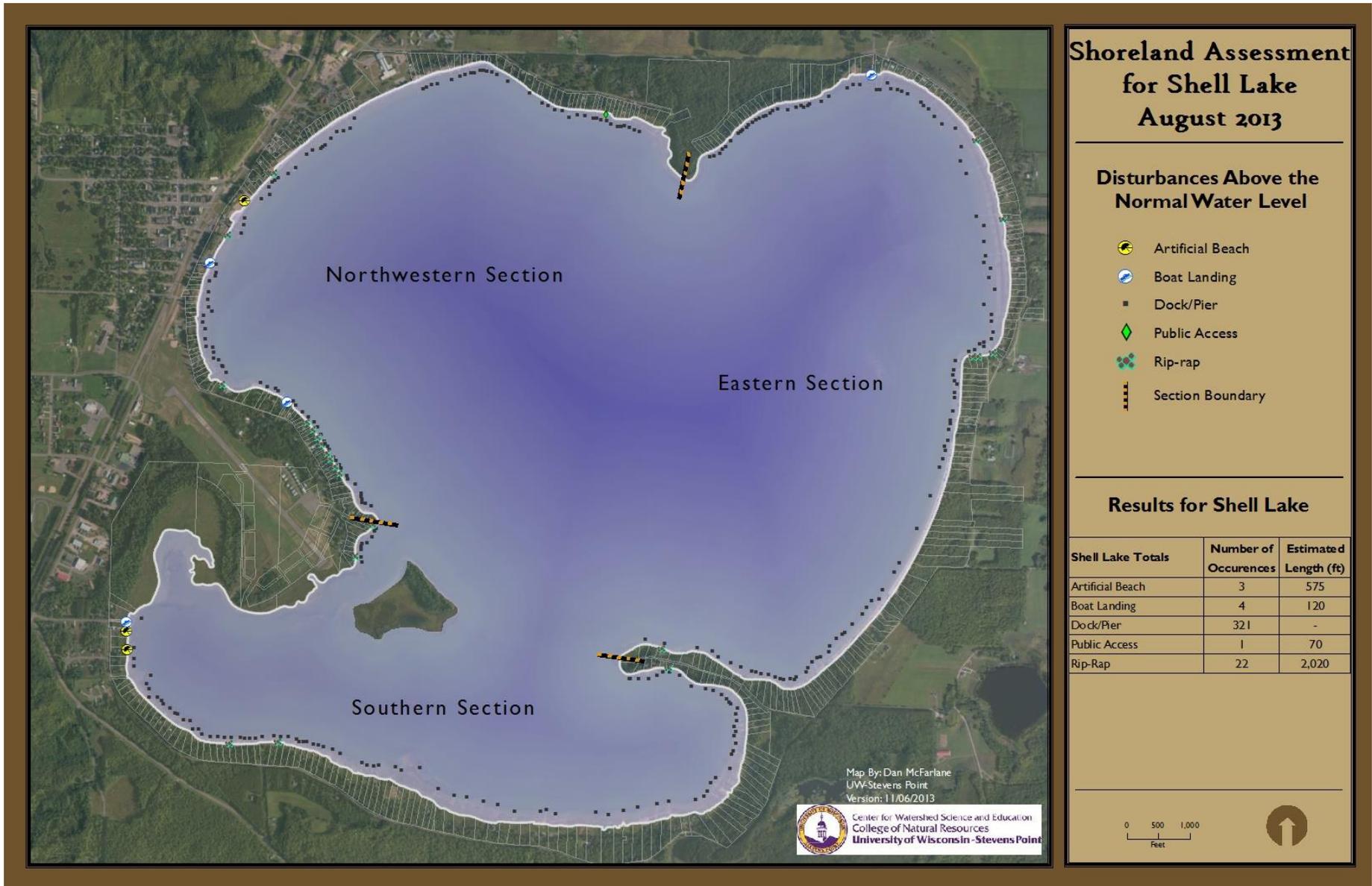


Figure 6: Shoreland disturbances above the normal water level in Shell Lake, 2013.

Shoreland Disturbance Above the Normal High Water Level

Northwestern Section of Shell Lake - Highlights for the Shoreland Disturbance Survey

This section of the lake was host to the majority of the shoreland disturbance. The 11 rip-rap locations account for an estimated length of 1,335 feet of the shoreline in this section. Nine of the 11 rip-rap locations are concentrated adjacent to each other in the southwestern portion of this section (Figure 7). This is a large stretch with little shoreland habitat and no healthy shoreland vegetation. Whenever possible rip-rap should be removed and replaced with properly engineered shorelines where native shoreland vegetation can be reestablished. One artificial beach exists in the Northwestern section of Shell Lake, and its estimated length is 500 feet. This beach is located near the campgrounds, one of the two boat landings, and between two rip-rap locations. Beach activity contributes to sediment supply to the lake, but is largely unavoidable if the beach is to remain present. Attempts may be made to break up the beach by planting trees or adding terraces.

Eastern Section of Shell Lake - Highlights for the Shoreland Disturbance Survey

Most of the disturbance in the eastern section was docks, which totaled 117 (Figure 8). There were six areas with rip-rap with an estimated length of 325 feet.

Southern Section of Shell Lake - Highlights for the Shoreland Disturbance Survey

A large percentage of the southern section's shoreline is owned and managed by the Wisconsin Department of Natural Resources. At present, no shoreland disturbance existed along this stretch of shoreline. There were two occurrences of artificial beaches in this section with a total estimated length of 75 feet (Figure 9). Artificial beaches are most exposed and do not contain vegetative buffers. They are therefore the areas of shoreline that are most susceptible to erosion and contribute the most sediment into the lake. Ideally, a minimal number of locations of artificial beaches should be present on a lake's shoreline, enough to provide opportunities for beach-lovers that are looking for a stretch of sand. Five locations had rip-rap in the southern section, which occupied an estimated length of 360 feet of shoreline. Whenever possible rip-rap should be removed and replaced with properly engineered shorelines where native shoreland vegetation can be reestablished.

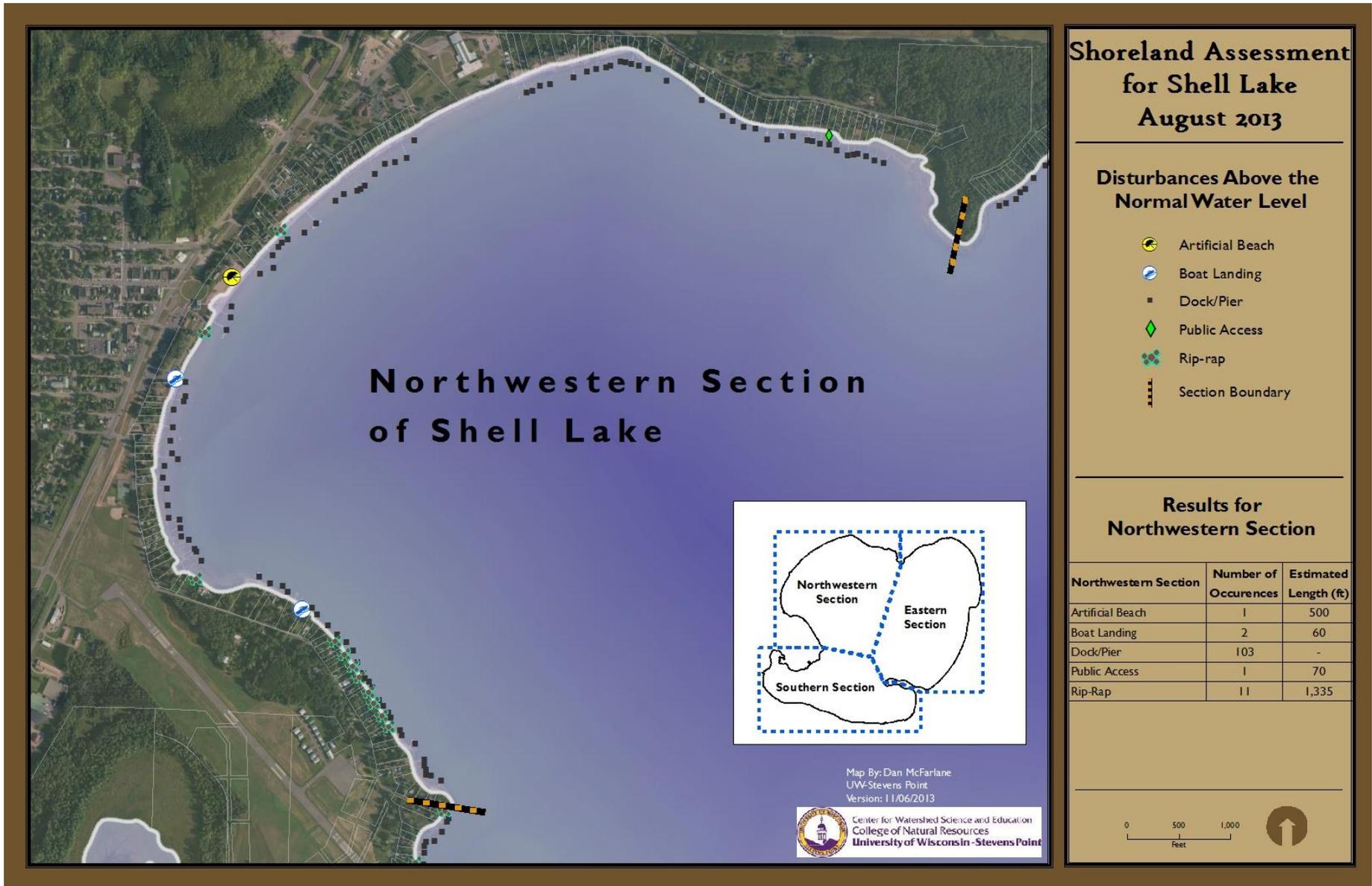


Figure 7: Shoreland disturbances above the normal water level in Shell Lake for the northwestern section, 2013.

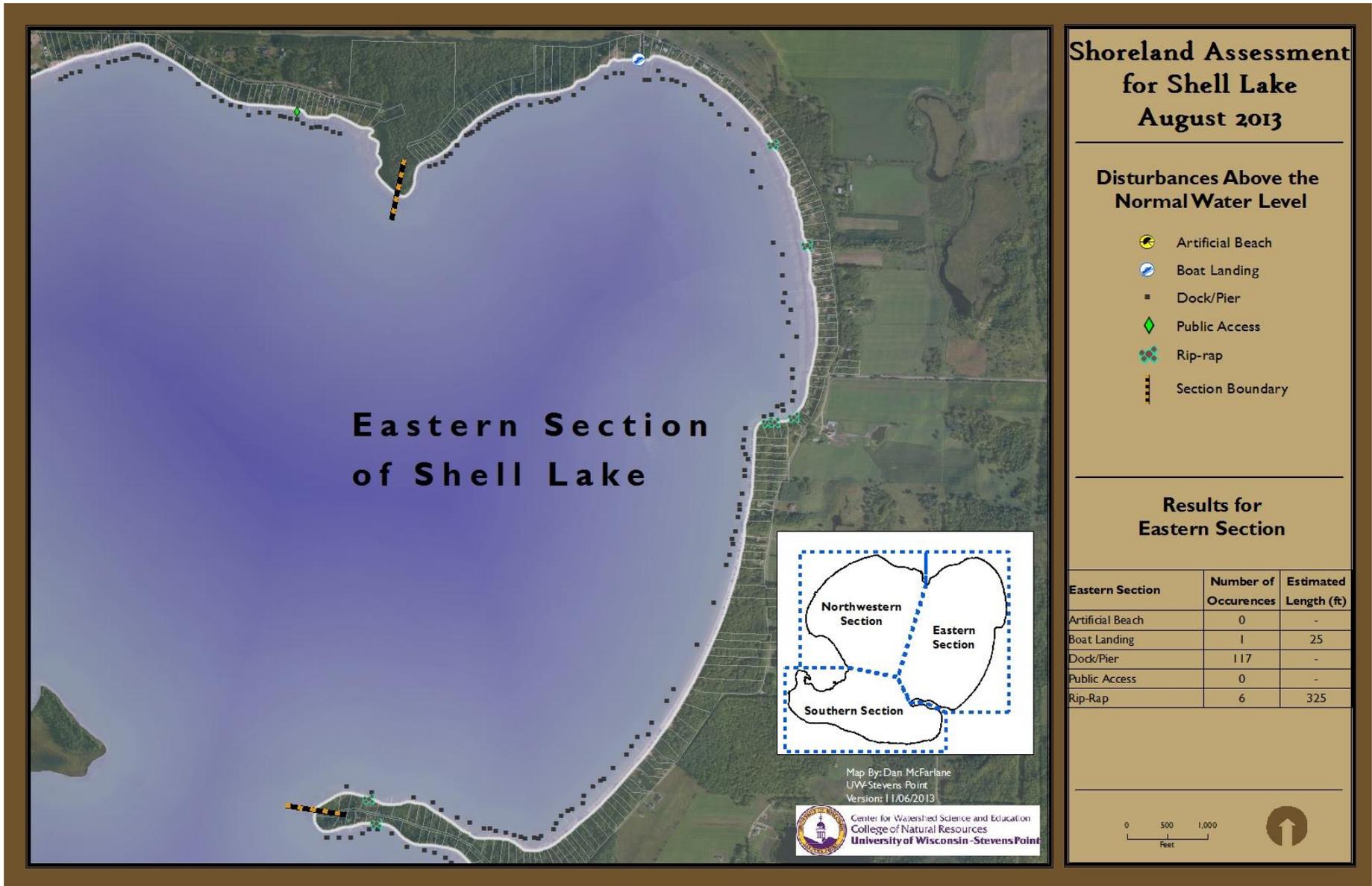


Figure 8: Shoreland disturbances above the normal water level in Shell Lake for the eastern section, 2013.

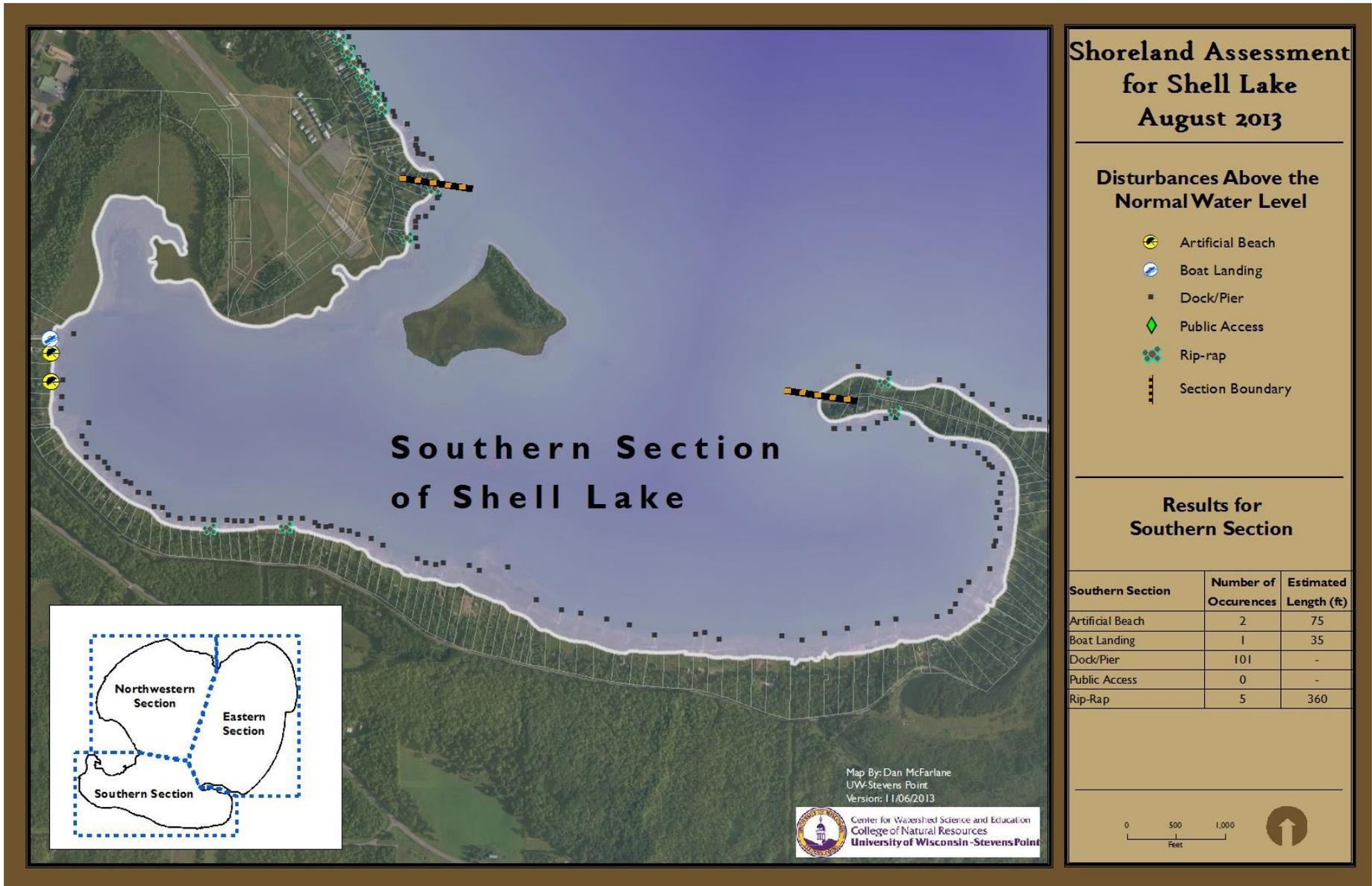


Figure 9: Near shore disturbances above the normal water level in Shell Lake for the southern section, 2013.

Shoreland Disturbance Survey - Below Normal Water Level

Shell Lake was surveyed for disturbances below the normal water level to evaluate the extent of alterations within this fragile area. The low water level in Shell Lake during the 2013 survey left parts of what would normally be the lake bed exposed. In the future, as the lake level increases, this area will once again provide important habitat for fish, amphibians, waterfowl, and many other species. Therefore, it is important to minimize disturbance to this area while water levels are low and the lakebed is exposed.

The categories of disturbance that were documented in this survey were based on activities that are either not allowed, or are only allowed with a permit from the state. They included areas that were cut/mowed (greater than 30 feet in width), tilled or eroded, had evidence of motor vehicles, lacked woody structure, or any other notable man made disturbances. The field sheet for this survey can be found in the appendix.

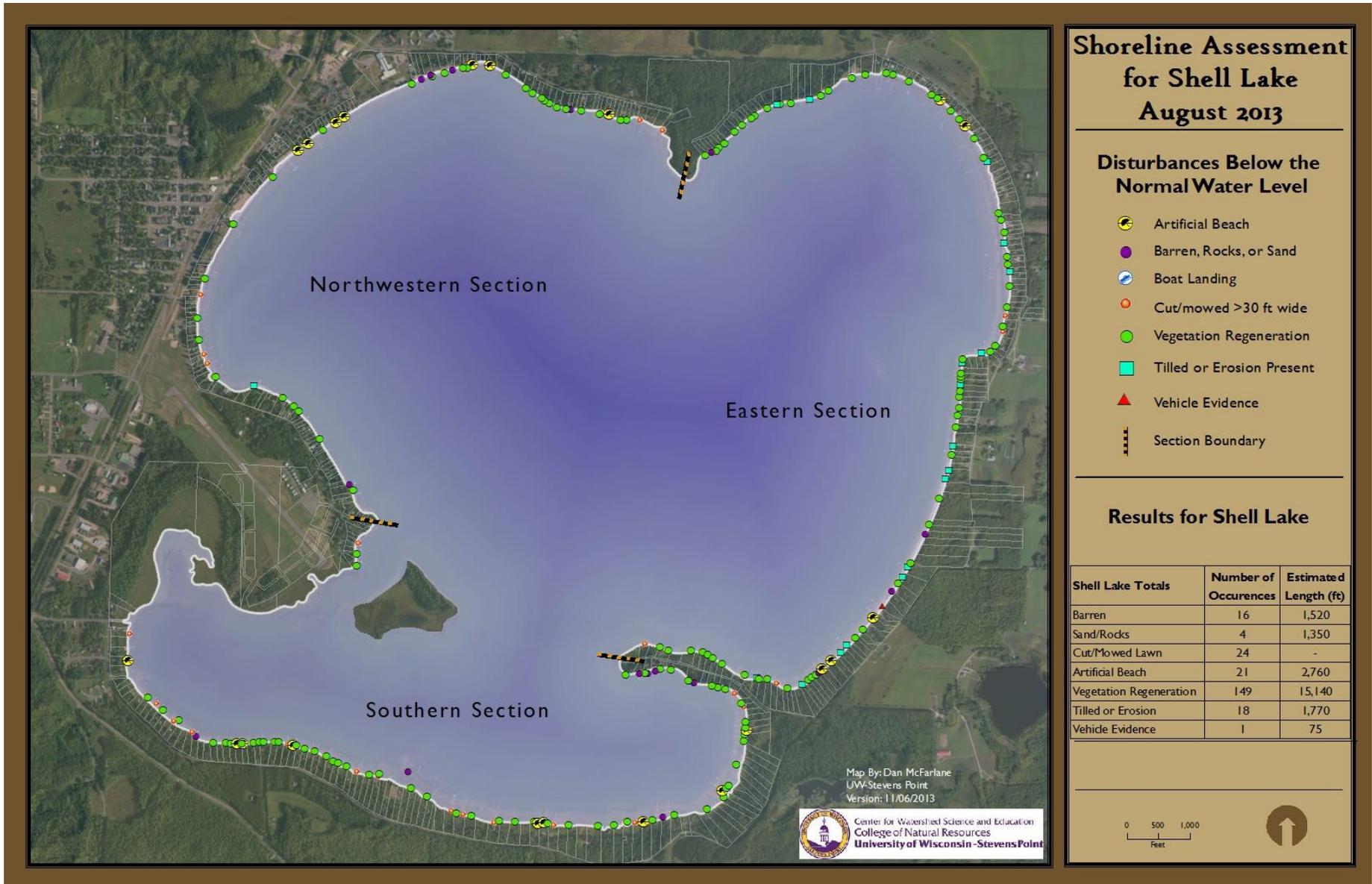
The locations where cutting or mowing greater than a 30 foot wide corridor occurred were identified as a point, without estimates of total width of disturbance. The tilled or erosion category consisted of areas below the normal water level either disturbed by tilling or soil exposure and erosion. Both the site location and estimated width for these categories was recorded for each site. The use of motor vehicles on the exposed lake bed can lead to significant disturbance; both the location and estimated length of the motor vehicle tire imprints were recorded. Woody structure on the lakebed provides significant habitat for aquatic organisms. Although it is tempting to many people to “clean up” or remove woody structure when the lakebed is exposed, it is desirable to leave it in place. No woody structure was documented in the Shell Lake survey.

The final category recorded during this survey, other notable man made disturbances, allowed the surveyors to document disturbances that did not fall into any of the other survey categories. Features that were documented as “other” included areas below the normal water level that were lacked disturbance. Most typically, these areas exhibited natural restoration, with emergent vegetation, grasses, and trees regenerating naturally. This vegetation will provide habitat and nutrients to the lake as water levels in Shell Lake increase. Location and width estimates were made for of some of the features identified in this category.

Regenerating vegetation was present for an estimated 15,140 feet of the lakebed shoreline (at 149 sites). It is good that these areas on the exposed lakebed are not being disturbed. While many property owners are attempting to protect these fragile areas, there were 21 locations with mowed lawn on the lakebed that extended all the way to the water’s edge. Tilt/erosion existed at 18 sites around Shell Lake, and artificial beaches at 21 sites.

To better understand the localities of shoreland disturbance below normal water levels, Shell Lake was split into three sections and analyzed independently. Each map displays the location of disturbance and summaries of the estimated lengths of shoreline effected (Figures 11-13).

Figure 10: Near shore disturbances below the normal water level in Shell Lake, 2013.



Northwestern Section of Shell Lake - Highlights for the Shoreland Disturbance Survey Below the Normal Water Level

The northwestern section had a significant amount of vegetation regeneration occupying its shoreline. There were 29 total restoration occurrences with an estimated length of 3,350 feet. As these locations continue to resemble the shoreline's natural state they will provide suitable habitat for fish and other wildlife when lake levels increase. Sand and rock comprised two which accounted for 1,200 feet of the shoreline. There were seven occurrences of artificial beaches with an estimated length of 1,550 feet of shoreline (Figure 11).

Eastern Section of Shell Lake - Highlights for the Shoreland Disturbance Survey Below the Normal Water Level

The eastern section had a significant amount of regeneration on its shoreline. There were 64 sites with an estimated length of 6,715 feet (Figure 12). Seventeen sites were tilled and/or had erosion in this section, comprising an estimated length of 1,370 feet. Tilling the substrate prevents these fragile habitats from returning to their natural state. Likewise, areas of erosion make it difficult for natural vegetation to grow, and contributes increased movement of sediment to the lake. There was one instance of vehicle use, with a total estimated length of 75 feet in this section. Vehicles operation on the exposed lakebed disturbs natural vegetation that is attempting to regrow.

Southern Section of Shell Lake - Highlights for the Shoreland Disturbance Survey Below the Normal Water Level

The southern section had 56 sites with regeneration totaling an estimated length of 5,075 feet (Figure 13). No evidence of vehicle use, tilled areas of erosion was identified in this section. This section had fifteen occurrences with lawns mowed to the water's edge. During the periods of low water, this activity increases runoff to the lake and eliminates shoreland habitat and when the lake levels increase the shallow water will lack habitat for fish and other aquatic animals.

Figure 11: Near shore disturbances above the below water level in Shell Lake for the northwestern section, 2013.

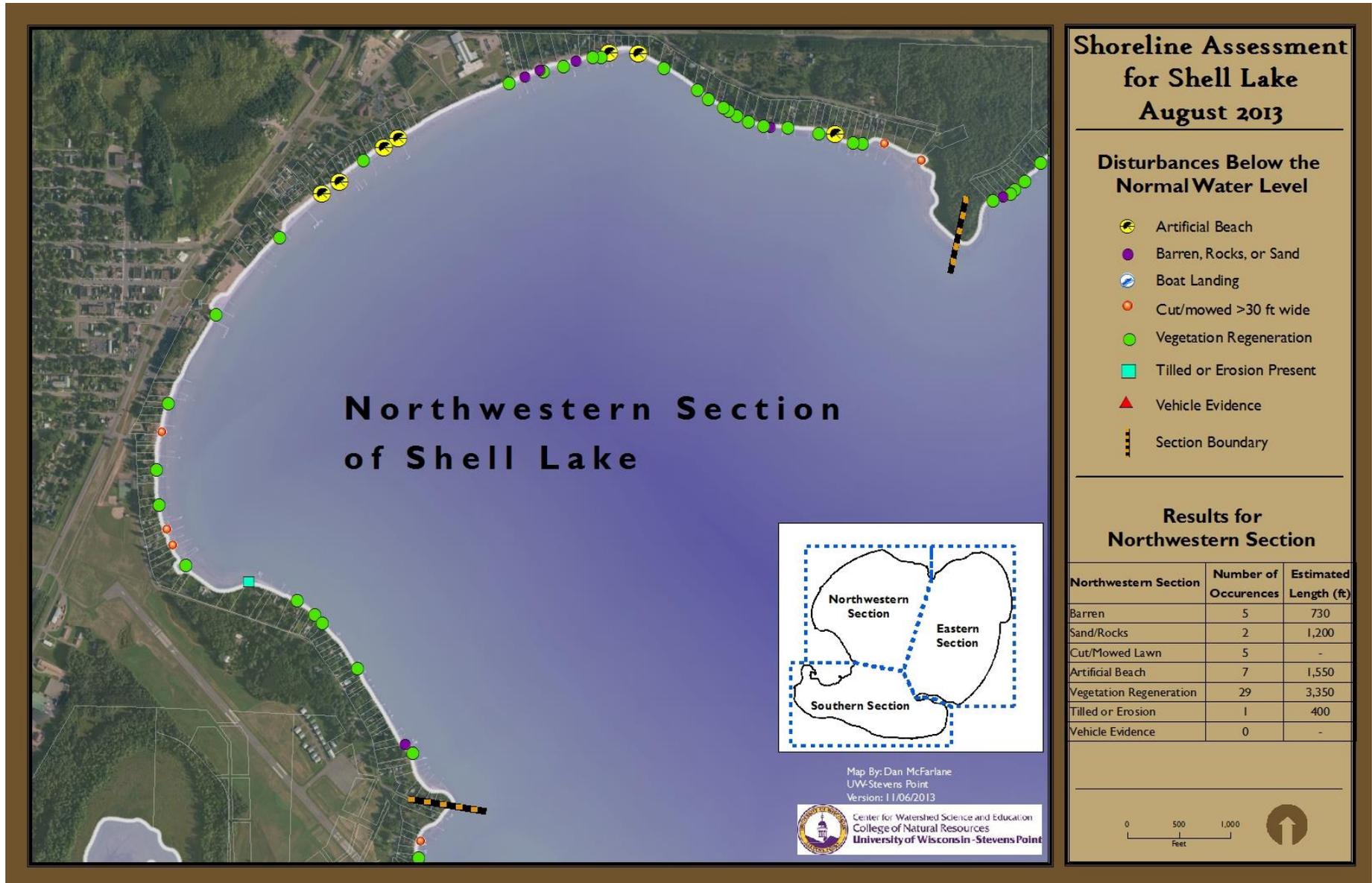


Figure 12: Near shore disturbances above the below water level in Shell Lake for the eastern section, 2013.

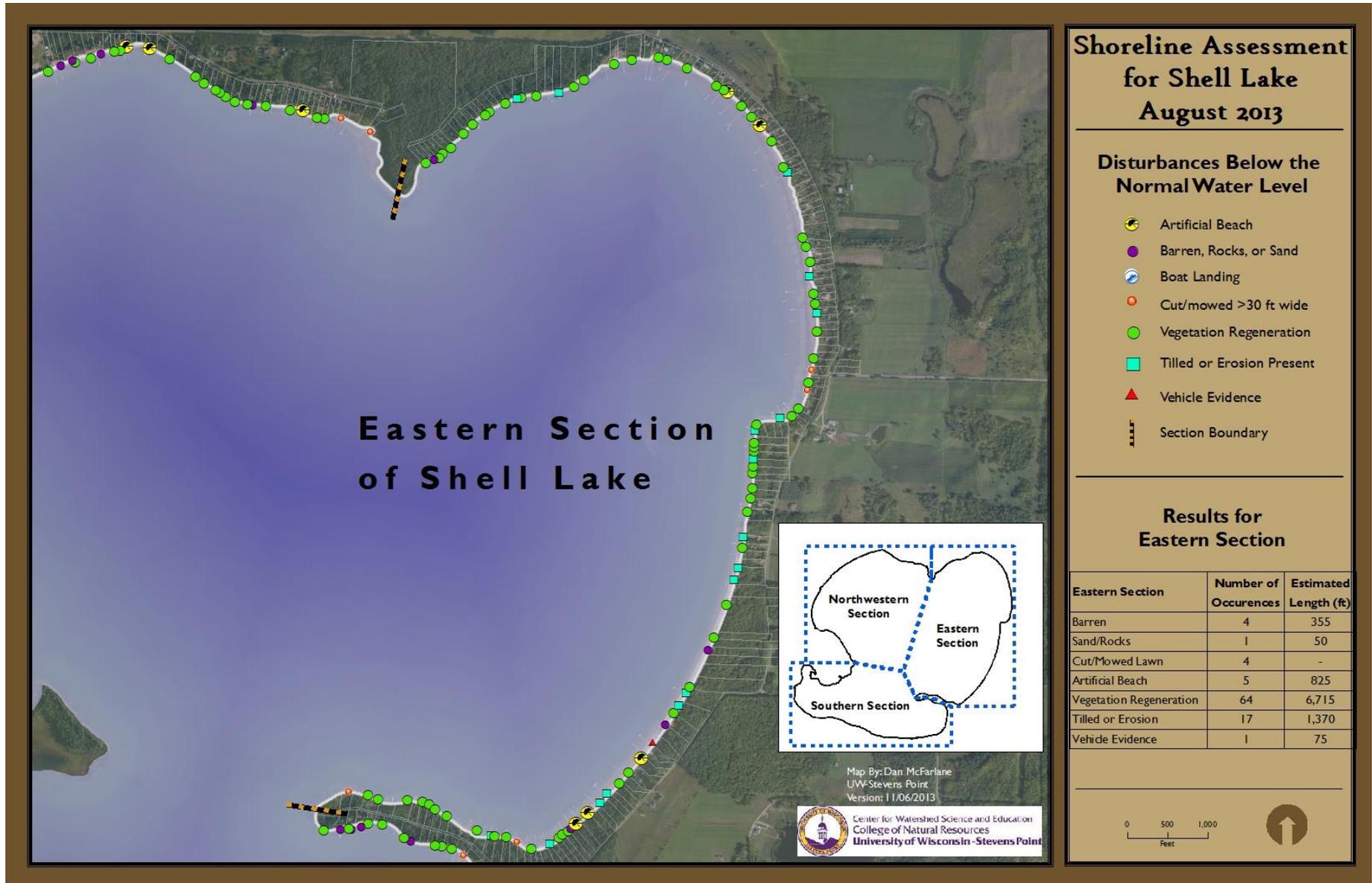
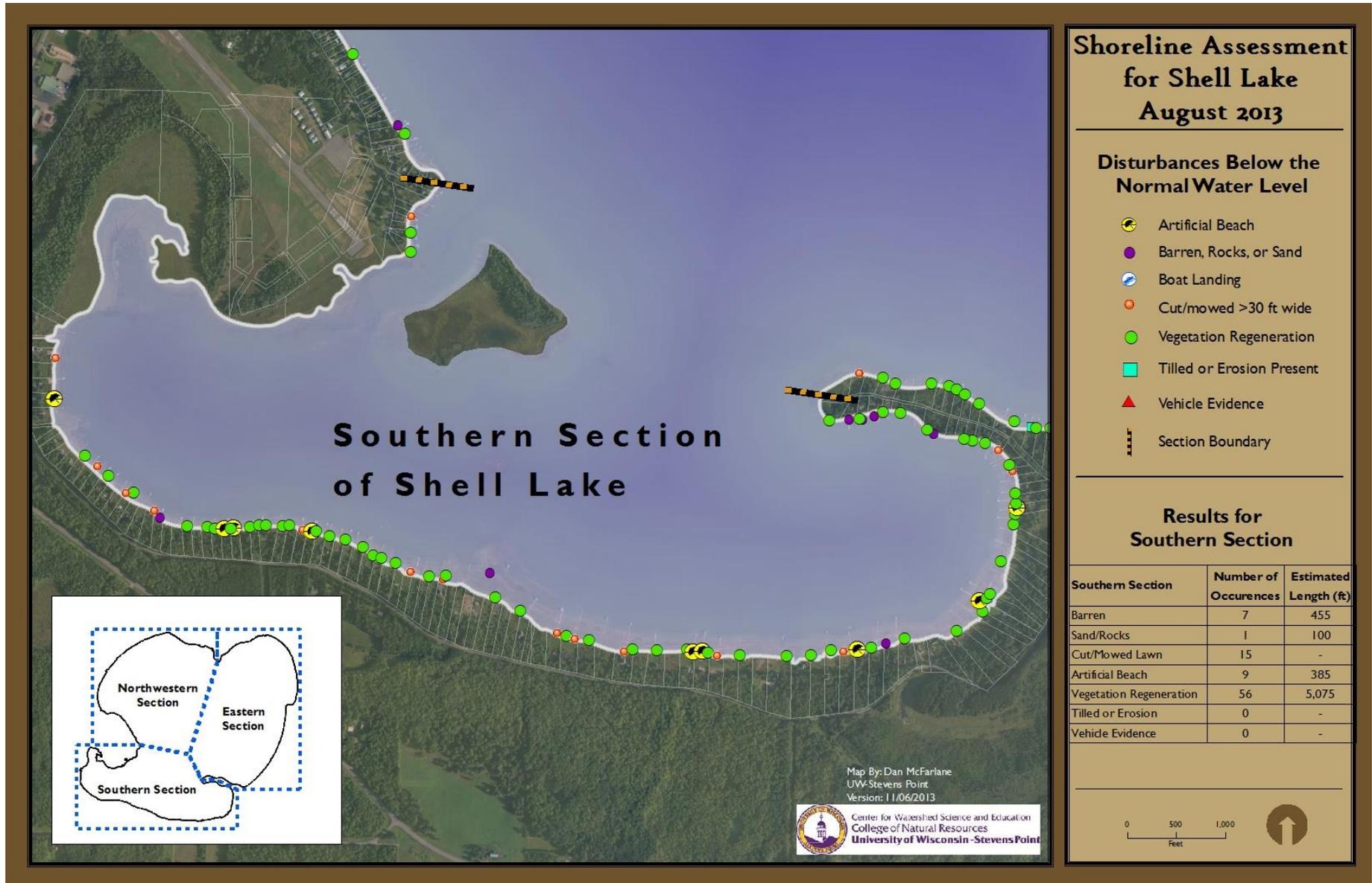


Figure 13: Near shore disturbances above the below water level in Shell Lake for the southern section, 2013.



References Cited

1. 2013, Official Website of City of Shell Lake, Wisconsin. Web
<http://www.shelllake.org/>

Appendices

Appendix A - Survey Datasheets

Datasheet for the Shoreland Vegetation Survey

SHELL LAKE SHORELAND VEGETATION SURVEY						
Lake Name	Shell Lake		Researcher Names	Chase Kasmerchak Cory Stoughtenger		
Date			GPS UNIT USED			
Weather						
Survey Segment GPS Start and End Points						
	Start (from)	End (to)				
Waypoint ID						
Short Shoreland Vegetation and Ground Conditions (estimates from the shoreland/water's edge INLAND)						
Category	Max Distance Inland (ft)	Not Dominant	Not Present			
Wetlands (NOT CATTAILS)		<input type="checkbox"/>	<input type="checkbox"/>			
Organic - leaf pack/needles UNDISTURBED		<input type="checkbox"/>	<input type="checkbox"/>			
Barren, bare dirt (erosion) DISTURBED		<input type="checkbox"/>	<input type="checkbox"/>			
New shoreland restoration		<input type="checkbox"/>	<input type="checkbox"/>			
Mowed vegetation		<input type="checkbox"/>	<input type="checkbox"/>			
Short Unmowed Vegetation <3 ft tall		<input type="checkbox"/>	<input type="checkbox"/>			
Impervious surface		<input type="checkbox"/>	<input type="checkbox"/>			
Tall Shoreland Vegetation (estimates from the shoreland/water's edge INLAND)						
>3 ft tall (shrubs and trees)		Present	Absent			
		<input type="checkbox"/>	<input type="checkbox"/>			
Survey Segment GPS Start and End Points						
	Start (from)	End (to)				
Waypoint ID						
Short Shoreland Vegetation and Ground Conditions (estimates from the shoreland/water's edge INLAND)						
Category	Max Distance Inland (ft)	Not Dominant	Not Present			
Wetlands (NOT CATTAILS)		<input type="checkbox"/>	<input type="checkbox"/>			
Organic - leaf pack/needles UNDISTURBED		<input type="checkbox"/>	<input type="checkbox"/>			
Barren, bare dirt (erosion) DISTURBED		<input type="checkbox"/>	<input type="checkbox"/>			
New shoreland restoration		<input type="checkbox"/>	<input type="checkbox"/>			
Mowed vegetation		<input type="checkbox"/>	<input type="checkbox"/>			
Short Unmowed Vegetation <3 ft tall		<input type="checkbox"/>	<input type="checkbox"/>			
Impervious surface		<input type="checkbox"/>	<input type="checkbox"/>			
Tall Shoreland Vegetation (estimates from the shoreland/water's edge INLAND)						
>3 ft tall (shrubs and trees)		Present	Absent			
		<input type="checkbox"/>	<input type="checkbox"/>			
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Datasheet for the disturbance surveys.

SHELL LAKE SHORELAND DISTURBANCE SURVEY ABOVE AND BELOW OHWM			
Lake Name	Shell Lake	Researcher Names	Chase Kasmerschak Cory Stoughtenger
Date			
Shoreland Alterations		Shoreland Alterations	
Waypoint ID	Est Length (ft)	Waypoint ID	Est Length (ft)
Dock/Pier		Dock/Pier	
Seawall		Seawall	
Rip-rap		Rip-rap	
Artificial Beach		Artificial Beach	
Boat Landing		Boat Landing	
Dam/Spillway		Dam/Spillway	
Other (Specify)		Other (Specify)	
Erosion		Erosion	
Erosion - Type	Waypoint ID	Waypoint ID	Est. Length (ft)
Undercut banks/slumping		Undercut banks/slumping	Est. Slope (%)
Furrow/gullies		Furrow/gullies	
Culverts/Outfalls		Culverts/Outfalls	
Waypoint ID		Waypoint ID	
Size and measurement units		Size and measurement units	
Shape		Shape	
Material		Material	
Photo Taken?	Yes <input type="checkbox"/> No <input type="checkbox"/>	Photo Taken?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Area BELOW the Ordinary High Water Mark			
Waypoint ID		Present	
Cut/mowed area >30 ft wide	<input type="checkbox"/>	Cut/mowed area >30 ft wide	<input type="checkbox"/>
Tilled or erosion	<input type="checkbox"/>	Tilled or erosion	<input type="checkbox"/>
Motor vehicle tire imprints	<input type="checkbox"/>	Motor vehicle tire imprints	<input type="checkbox"/>
Woody structure	<input type="checkbox"/>	Woody structure	<input type="checkbox"/>
Other	<input type="checkbox"/>	Other	<input type="checkbox"/>
Mark on Map			
Approx location of waypoints			
Erosion			
Preferred flow channels/Culverts			
			
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Appendix B – Photographic Examples of Categories in the Shoreland Vegetation Survey

Examples of wetlands category in the shoreland vegetation survey.



Examples of organic category in the shoreland vegetation survey.



Example of barren category in the shoreland vegetation survey.



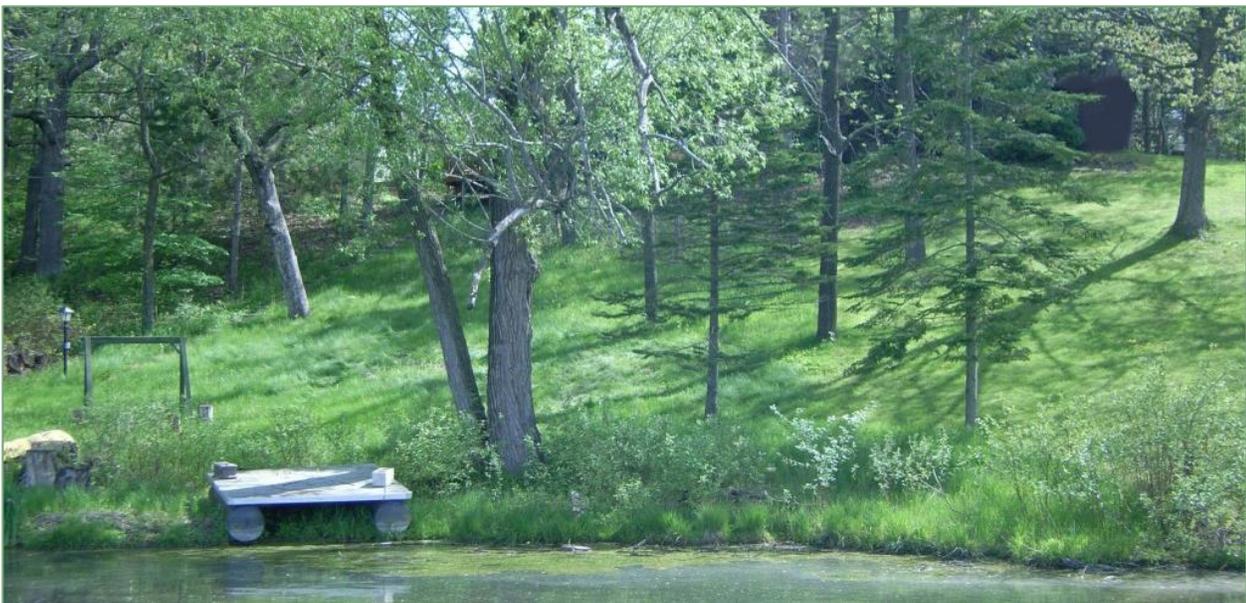
Examples of mowed vegetation category in the shoreland vegetation survey.



Example of unmowed vegetation category with a depth of 1 foot inland from the water.



Example of unmowed vegetation category with a depth of 5 feet inland from the water.



Example of unmowed vegetation category with a depth of approximately 15 feet inland from the water and shrubs/trees present.



Example of unmowed vegetation category with a depth of greater than 35 feet inland from the water and shrubs/trees present.



Examples of impervious surface category in the shoreland vegetation survey.

