Portage County 2012 Shoreland Survey Results

University of Wisconsin – Stevens Point

Center for Watershed Science and Education

Acknowledgments

Portage County

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Introduction

Portage County is located in central Wisconsin and is part of the Central Sands Formation. Its citizens and municipalities have invested significant time and effort to ensure that their lakes are healthy for swimming, fishing, boating and aesthetic enjoyment. Thirty lakes in Portage County were studied in 2002-2003 to determine the health of their aquatic ecosystems. This was followed by community-wide efforts to develop lake management plans for these lakes. The plans addressed a variety of topics, but focused on addressing existing problems and averting future problems. All of the plans had goals related to shoreland vegetation, ranging from shoreland restoration activities to the protection of existing healthy shorelands.

This report summarizes findings from a project designed as a follow-up to the 2002-2003 study and lake management planning, intended to measure lake management successes and determine where information about the importance of shorelands may not be reaching property owners.

Shoreland vegetation plays important roles in providing habitat for terrestrial and aquatic animals, improving water quality, reducing erosion, and providing privacy for those on shore. Vegetation on a lake's shore offers a buffer between the lake and activities occurring on the surrounding land. It helps to slow and filter runoff entering the lake, reducing the amounts of sediment and contaminants that reach the lake. Healthy shoreland vegetation consists of a combination of native grasses, wildflowers, shrubs, trees and wetlands.

Other shoreland disturbances also impact water quality and habitat of a lake which can result in decreased property and economic value. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in habitat loss. Erosion contributes sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from rooftops of structures contribute more runoff to the lake, often resulting in delivery of more sediment to the lake. Docks result in altered in-lake habitat. Denuded lakebeds adjacent to docks provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Solutions exist to mitigate the impacts from many of these disturbances.

Because of the importance of shoreland vegetation and shoreland health, state statutes and county shoreland zoning ordinances require that shoreland property owners maintain a vegetated buffer 35 feet inland from the water's edge. One 30-foot wide access corridor is allowed. It is recommended that shoreland property owners become aware of the special rules that exist to protect water quality and habitat for our lakes and rivers. These rules are part of Portage County's shoreland zoning ordinance. More information can be found at http://co.portage.wi.us/planningzoning/new/zoning/ordinances.html.

Methodology

Surveys of the shoreline vegetation around 29 lakes in Portage County were conducted in summer 2012 and summer 2013. The goal was to evaluate shoreland health around the lakes and make comparisons to the 2002-2003 surveys. The measurements used in the surveys were different between 2002 and 2012. The early survey used a design created by Wisconsin Department of Natural Resources biologists. It estimated overall health of the shoreline, but lacked detail needed to measure incremental changes over time. In the most current surveys, shoreline vegetation was categorized by height and by the extent of vegetation inland from the water's edge (vegetative buffer depth).

2012 data was gathered from a canoe by the team of researchers. Two passes were required to collect the data. During the first pass around a lake's shoreline, researchers evaluated the height and depth of the shoreland vegetation. The starting and ending points for each section of contiguous similar vegetation were marked using a handheld Garmin 78s GPS and were marked on an aerial photo. The depth of the shoreland vegetation for each classification was assessed for each contiguous length of shoreline. Classifications of vegetation height included: less than 0.5 feet, 0.5 to 3 feet, greater than 3 to 15 feet, greater than 15 feet. Other classifications that were inventoried included: wetlands, mowed lawn, wetlands, organic (leaf pack, detritus), barren or bare dirt, and woody structure at the water interface. The second pass of the survey included GPS points of "human influence" which included artificial beach, seawall, rip-rap, dam/spillway, dock/pier at water, boat landing, and erosion. See the appendix for example data sheets. In addition, geo-referenced photographs of the shoreland were taken to better document existing conditions.

The survey data were used to develop maps using ArcGIS 10.1 ESRI software. Statistics of buffer depth categories were also calculated for each vegetation height classification. The maps and statistics for each lake are included in this report.

Although direct comparisons cannot be made, this document includes the maps from the shoreline vegetation surveys conducted in 2002-03 for 20 Portage County Lakes (Paloski, 2006). These surveys assessed shoreline vegetation quality based on the type of vegetation categories and relative amount of disturbance within 15 feet of the water's edge for the entire shoreline of each lake (Table 1). The data that was collected followed similar protocol used by Wisconsin Department of Natural Resources (WDNR) Bureau of Endangered Resources' Meyer, Woodford, and Gillum (1997), specifically the section '*Measuring the effect of lakeshore development on green frog distribution and abundance in northern Wisconsin*.' This method was used by the authors to provide consistency and comparability with previous WDNR studies which evaluated the relationships between lakeshore development on green frog distribution and abundance in northern Wisconsin. Vegetation and substrate types were mapped onto aerial photos by either walking or canoeing the length of the shoreline, and in the cases of smaller lakes, by visual inspection from vantage points.

Since the most recent surveys did not assess habitat based on species type or substrate, a direct comparison to the previous surveys cannot be made on a category by category basis. Although the shoreline surveys from 2002-03 were conducted very differently from surveys completed during summer 2012, some comparisons could be made when large changes in shoreline vegetation were evident. In order to compare the two surveys, it was necessary to combine Paloski's shoreline lengths in feet for all the vegetation categories, and compare them to the most current shoreline length calculations. Most current data only combined shoreline lengths for buffers with depths that were greater than 5 feet along with wetlands. The 2002 high-disturbance areas from Paloski's surveys could then be compared to the 2012 results. These methods of comparison between differing shoreline surveys allowed for qualitative comparisons. The newer survey design, with distance estimates (rather than observations constrained to 15 feet from shore), will allow for quantitative estimates in future surveys.

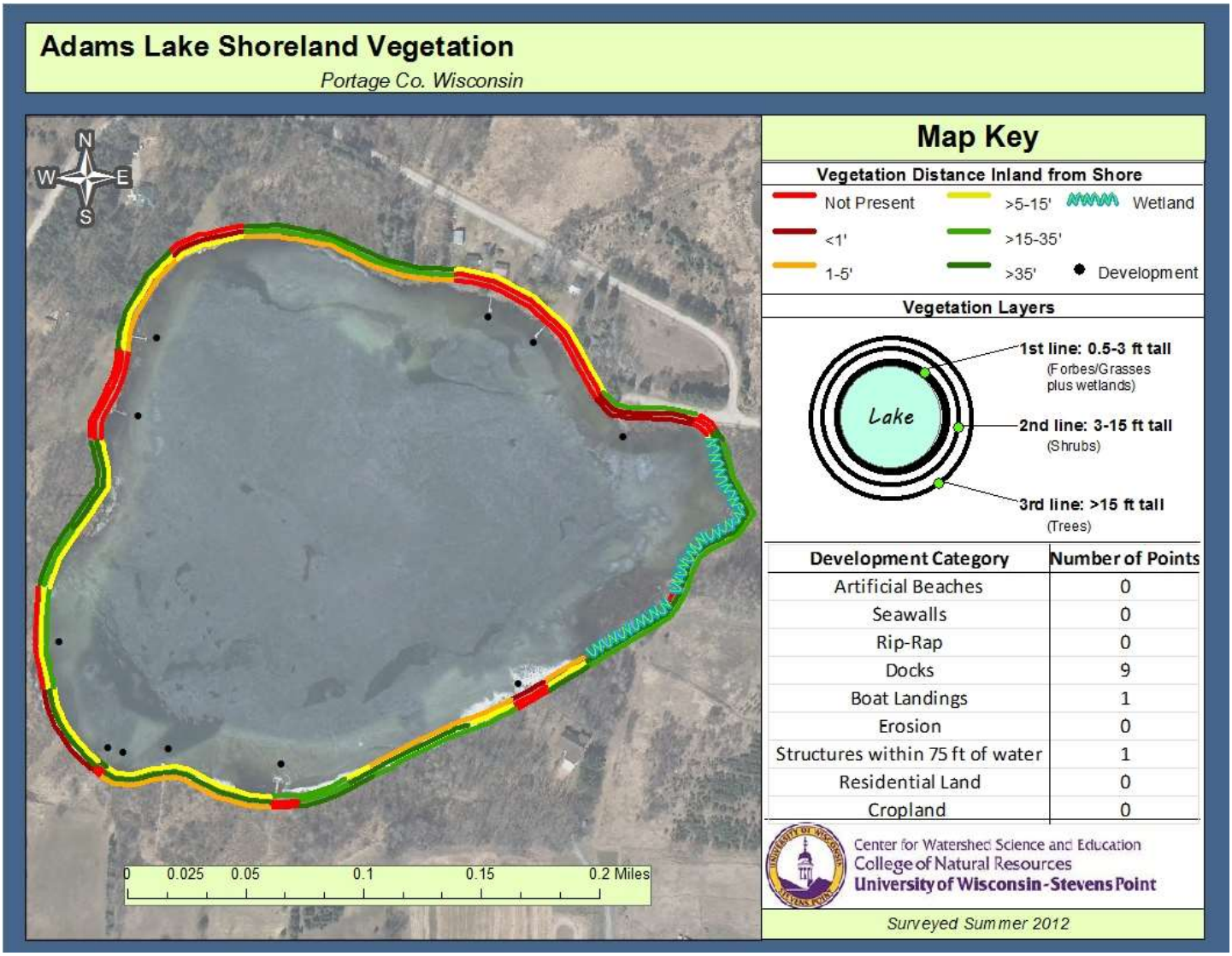
Table 1. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

Adams Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Adams Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Adams Lake's shoreland are shown in Figure 1. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). The northeastern and portions of the western sides of Adams Lake are areas that lack a shoreland vegetative buffer. For the short vegetation category, approximately 4,460 feet of Adams Lake shoreline had a vegetative buffer depth less than 35 feet inland in 2012; however, some of this length may be due to low water levels in earlier years. To ensure good water quality and habitat, measures should be taken to bring all of the shoreland up to state and county standards.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	9
Boat Landings	1
Erosion	0
Structures within 75 ft of water	1
Residential Land	0
Cropland	0

Figure 1. Shoreland vegetation survey around Adams Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 2). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 2.

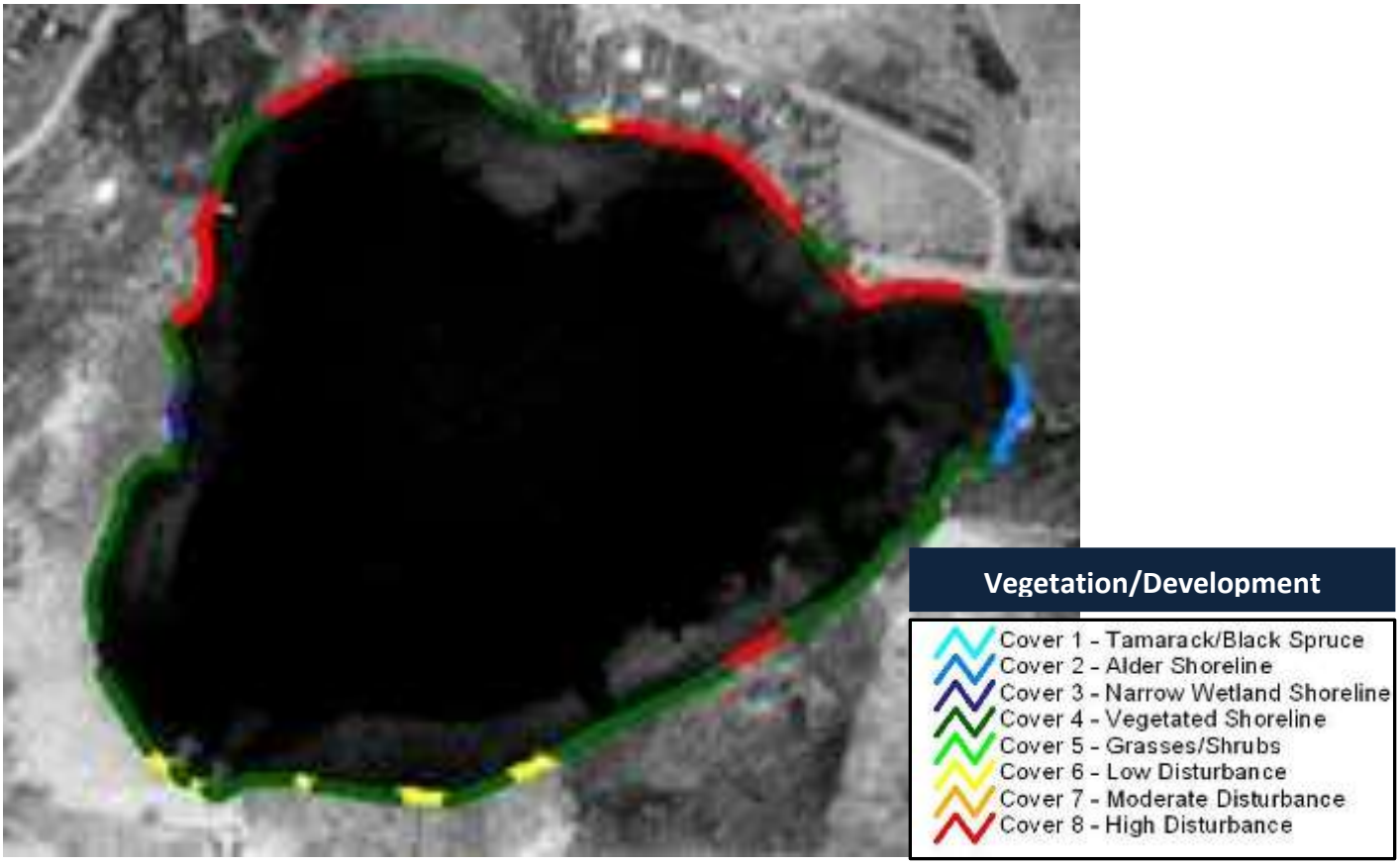


Figure 2. Shoreland vegetation survey around Adams Lake, 2002-2003.

Table 2. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code	Cover-type Description
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

An assessment of human influence features was also conducted around Adams Lake. These features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge (Figure 3). Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for Adams Lake's habitat and water quality.

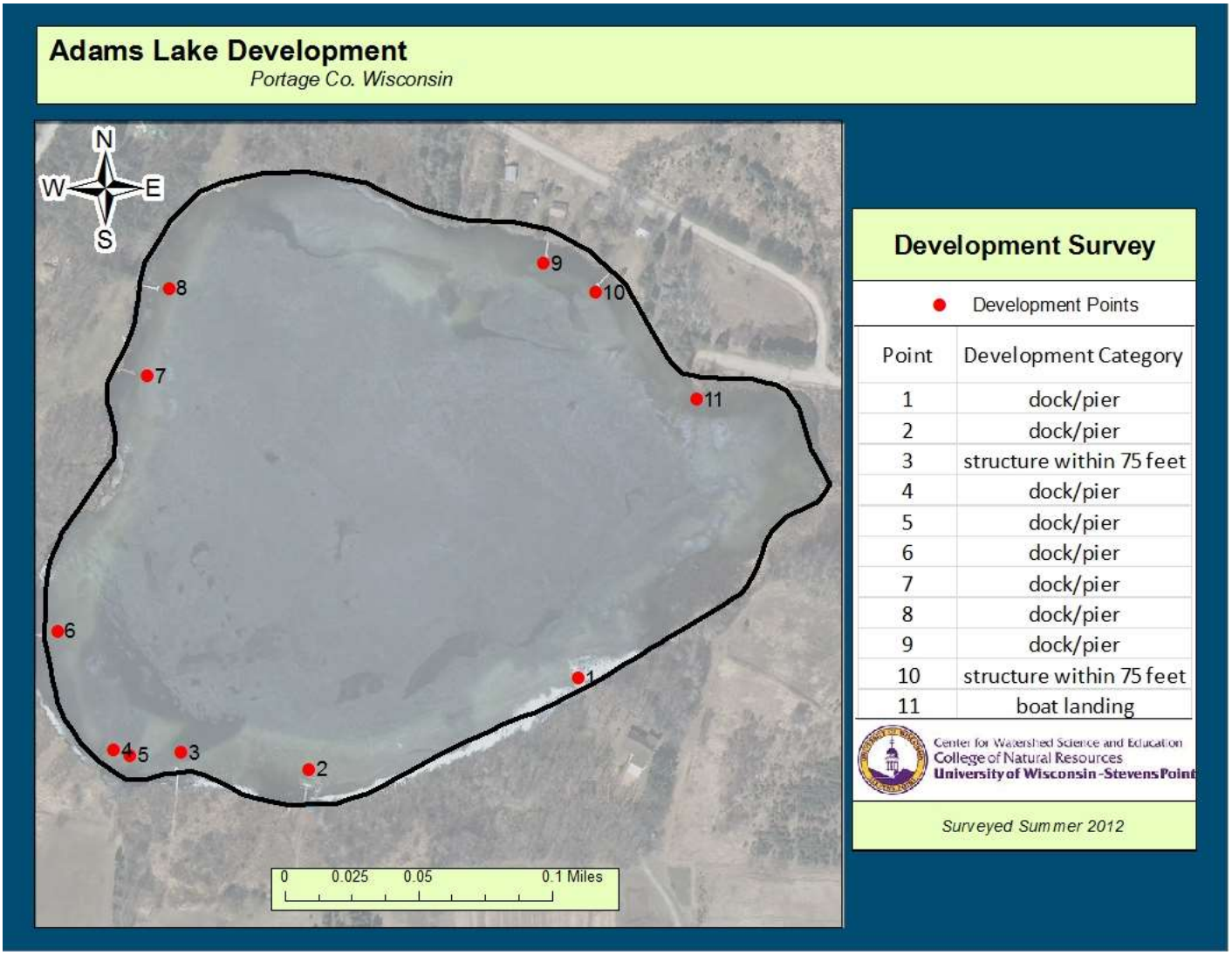
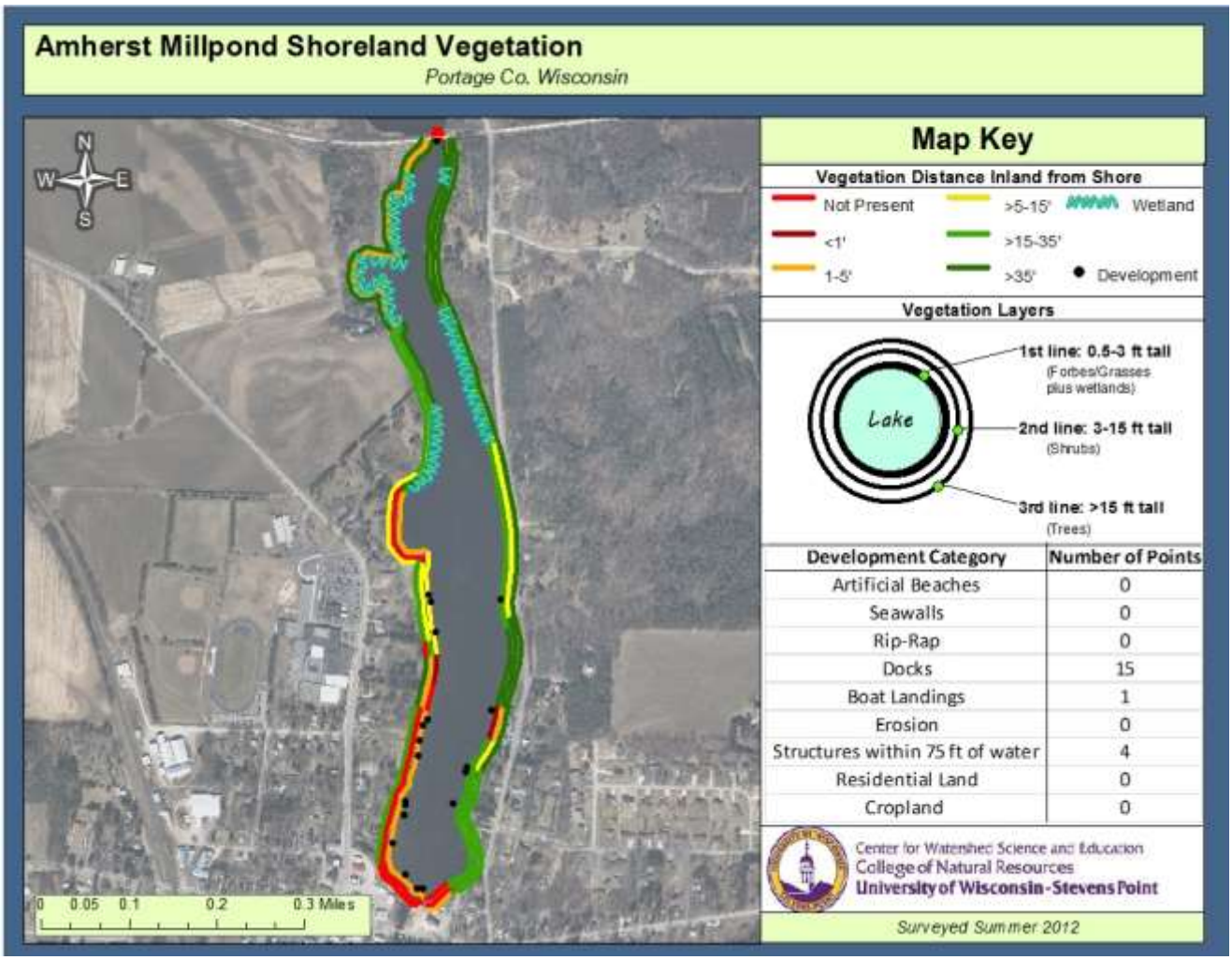


Figure 3. Features of human influence around Adams Lake, summer 2012.

Amherst Millpond Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Amherst Millpond. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Amherst Millpond's shoreland are shown in Figure 4. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). The majority of the shoreland disturbance exists on the southwestern side of Amherst Millpond, with vegetative buffers less than 35 feet inland for more than 6,900 feet of shoreland. Even in urban areas, attractive vegetative buffers help to improve water quality and habitat. Residents living around Springville Pond in the Village of Plover have significantly improved their shoreland and may serve as inspiration for Amherst Millpond residents.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	15
Boat Landings	1
Erosion	0
Structures within 75 ft of water	4
Residential Land	0
Cropland	0

Figure 4. Shoreland vegetation survey around Amherst Millpond, summer 2012.

An assessment of human influence features was also conducted around Amherst Millpond (Figure 5). These features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for Amherst Millpond's habitat and water quality.

Figure 5. Features of human influence around Amherst Millpond, summer 2012.

Bear Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Bear Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Bear Lake's shoreland are shown in Figure 6. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). In 2012, parts of Bear Lake's shoreline lacked the short vegetation layer; however, this may be due to changes in water levels in recent years.

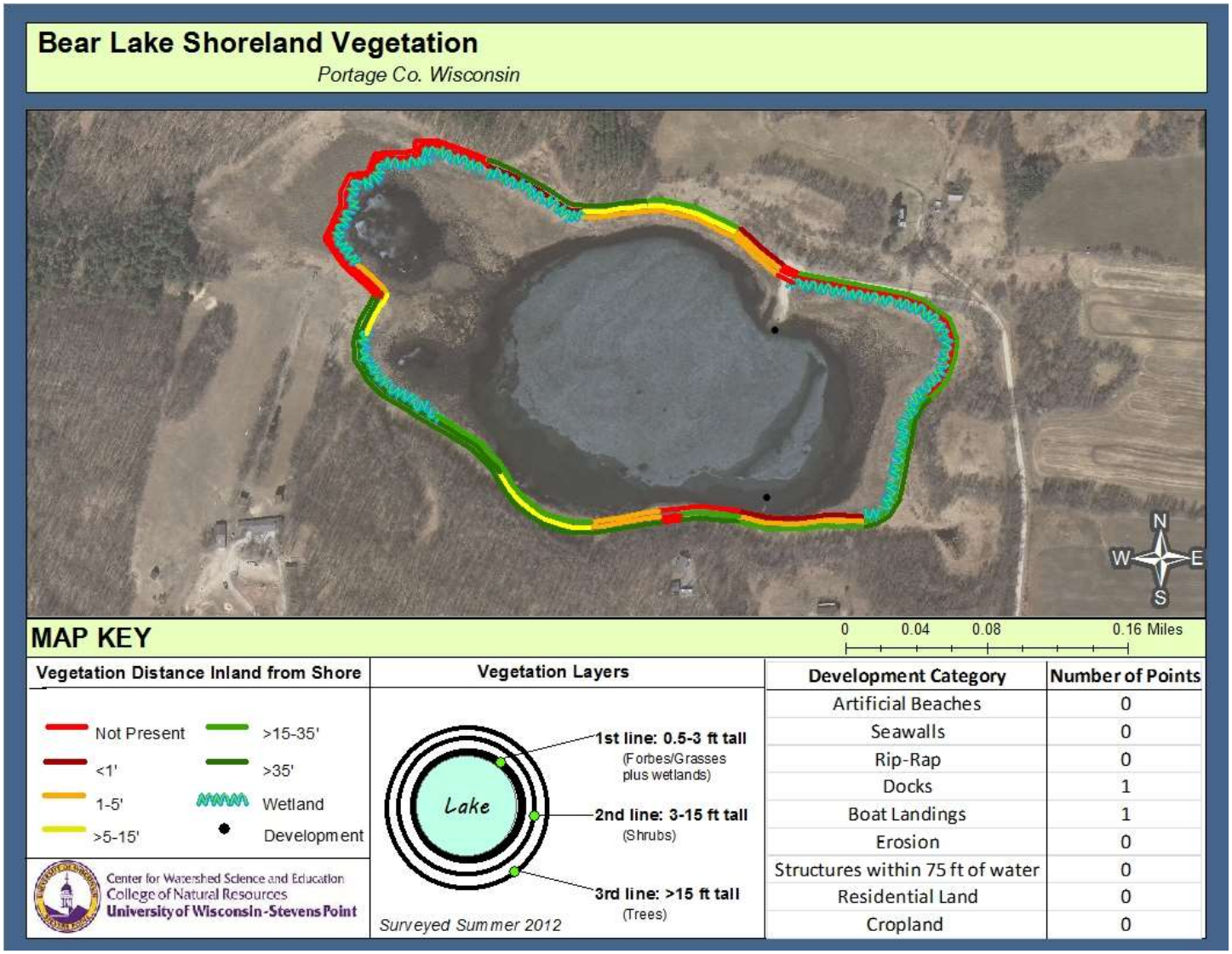


Figure 6. Shoreland vegetation survey around Bear Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 7). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 3.

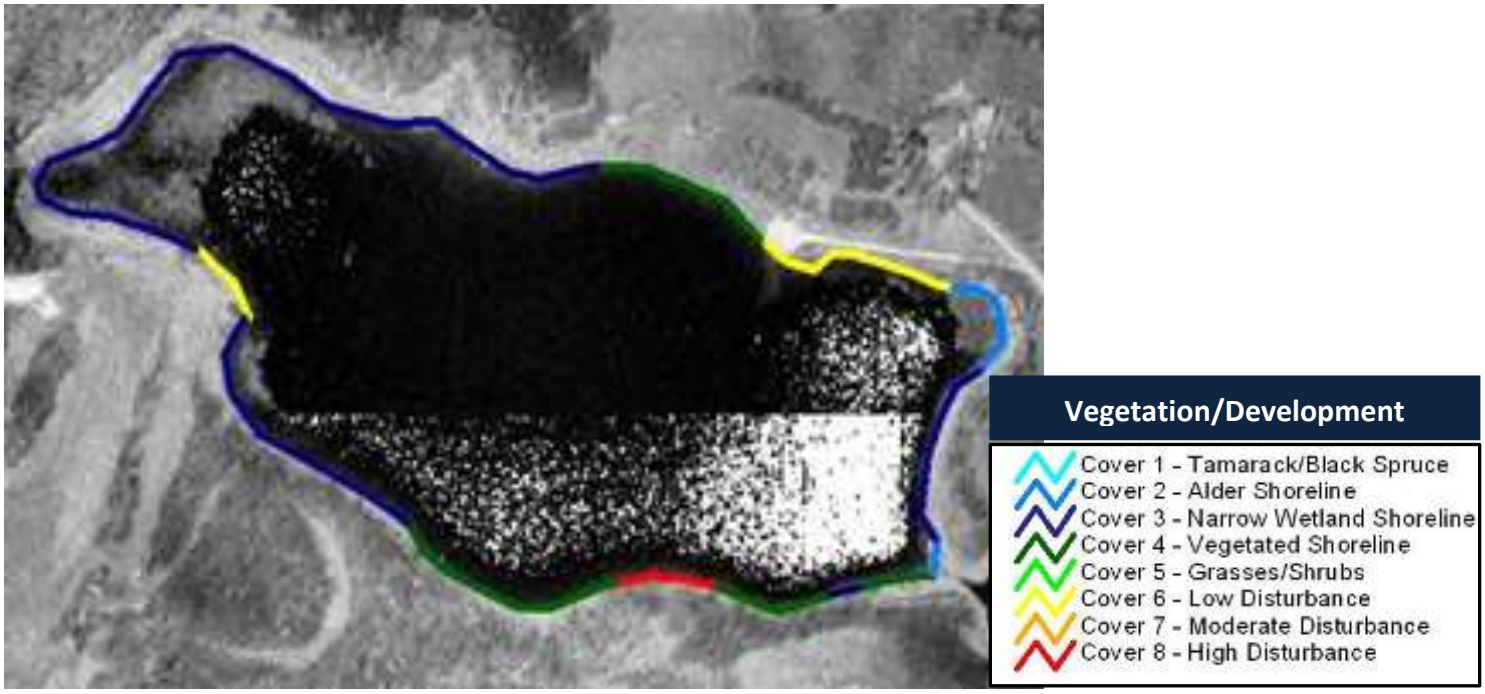


Figure 7. Shoreland vegetation survey around Bear Lake, 2002-2003.

Table 3. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Bear Lake (Figure 8). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. During the survey, one dock and one boat launch were identified around Bear Lake.

Figure 8. Features of human influence around Bear Lake, summer 2012.

Becker Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Becker Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Becker Lake's shoreland are shown in Figure 9. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Becker Lake's shoreland was in good condition in 2012.

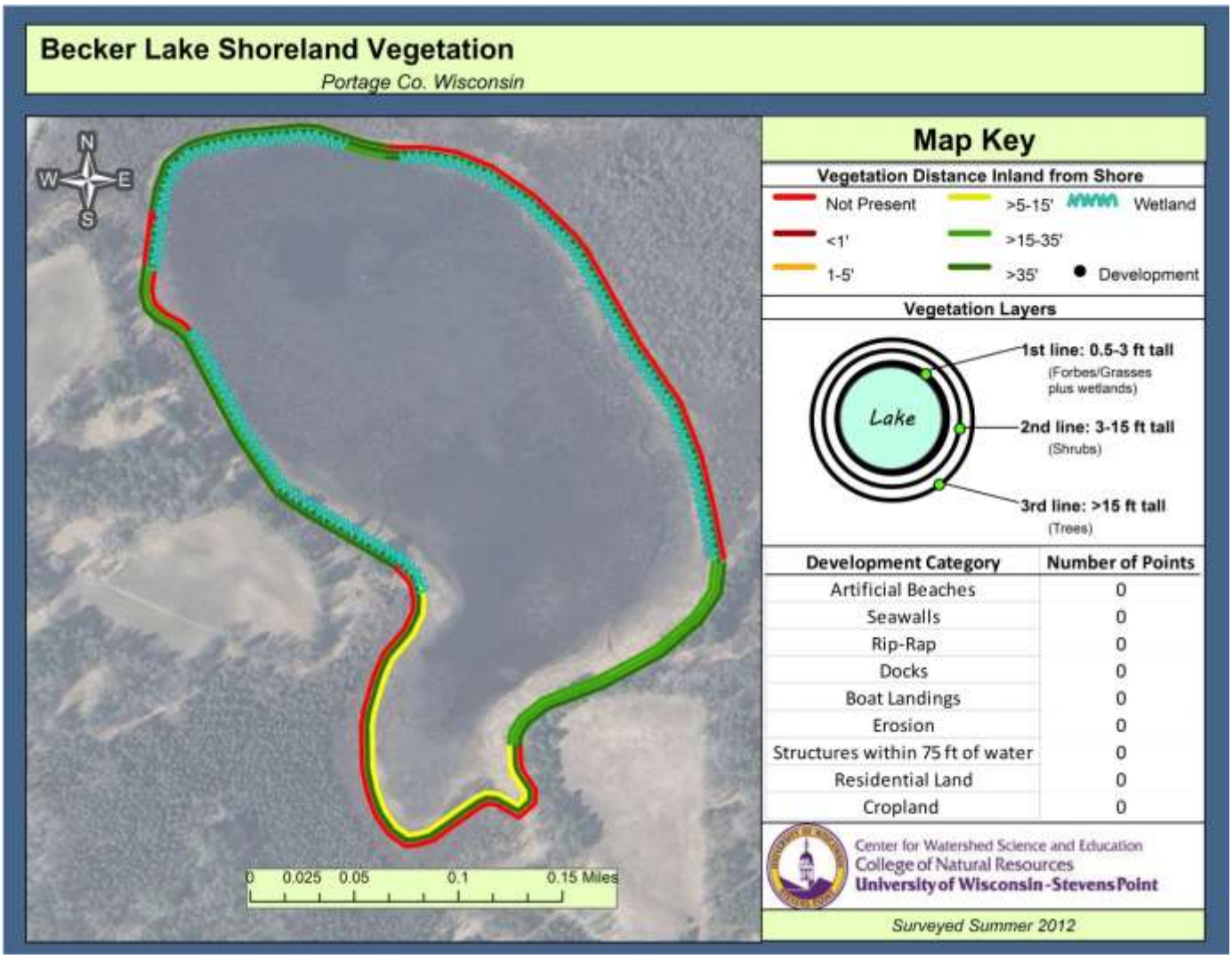


Figure 9. Shoreland vegetation survey around Becker Lake, summer 2012.

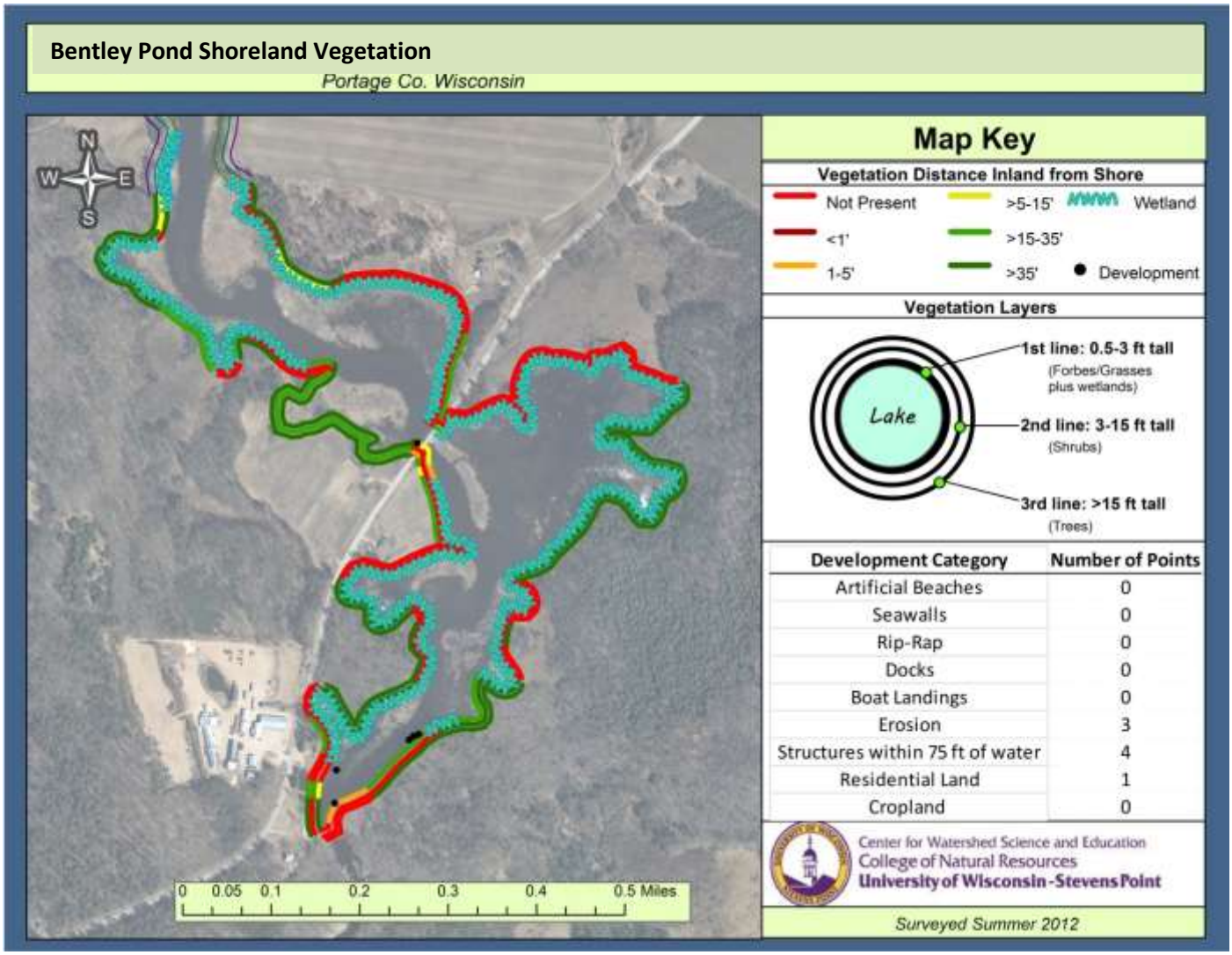
During the 2012 survey, an assessment of human influence features was also conducted around Becker Lake. These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. During the 2012 survey, Becker Lake did not have any of the inventoried features (Figure 10).

Figure 10. Features of human influence around Becker Lake, summer 2012.

Bentley Pond Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Bentley Pond. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Bentley Pond's shoreland are shown in Figure 11. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Much of Bentley Pond's shoreline is comprised of wetlands. In summer 2012, only a few sites were lacking the shorter shoreland vegetation.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	0
Boat Landings	0
Erosion	3
Structures within 75 ft of water	4
Residential Land	1
Cropland	0

During the 2012 survey, an assessment of human influence features was also conducted around Bentley Pond. These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. Several types of inventoried features were identified on Bentley Pond (Figure 12). If possible, the sites with erosion should be addressed and runoff from nearby structures should be mitigated.

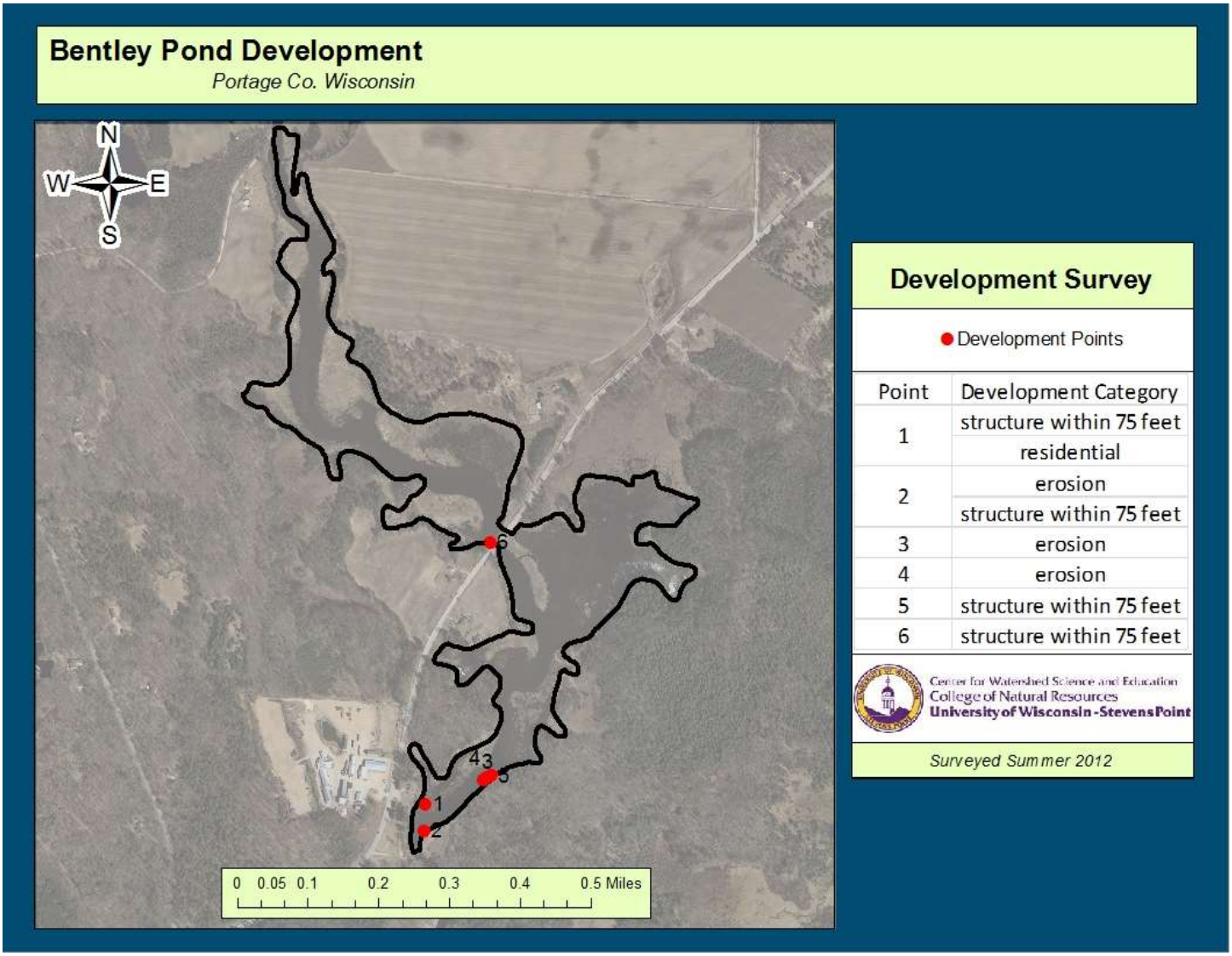


Figure 12. Features of human influence around Bentley Pond, summer 2012.

Boelter Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Boelter Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Boelter Lake's shoreland are shown in Figure 13. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). For the shorter vegetation class, approximately 2,390 feet of shoreland are less than 35 feet inland from the water's edge. If possible, shorelands should be restored to meet state and county standards.

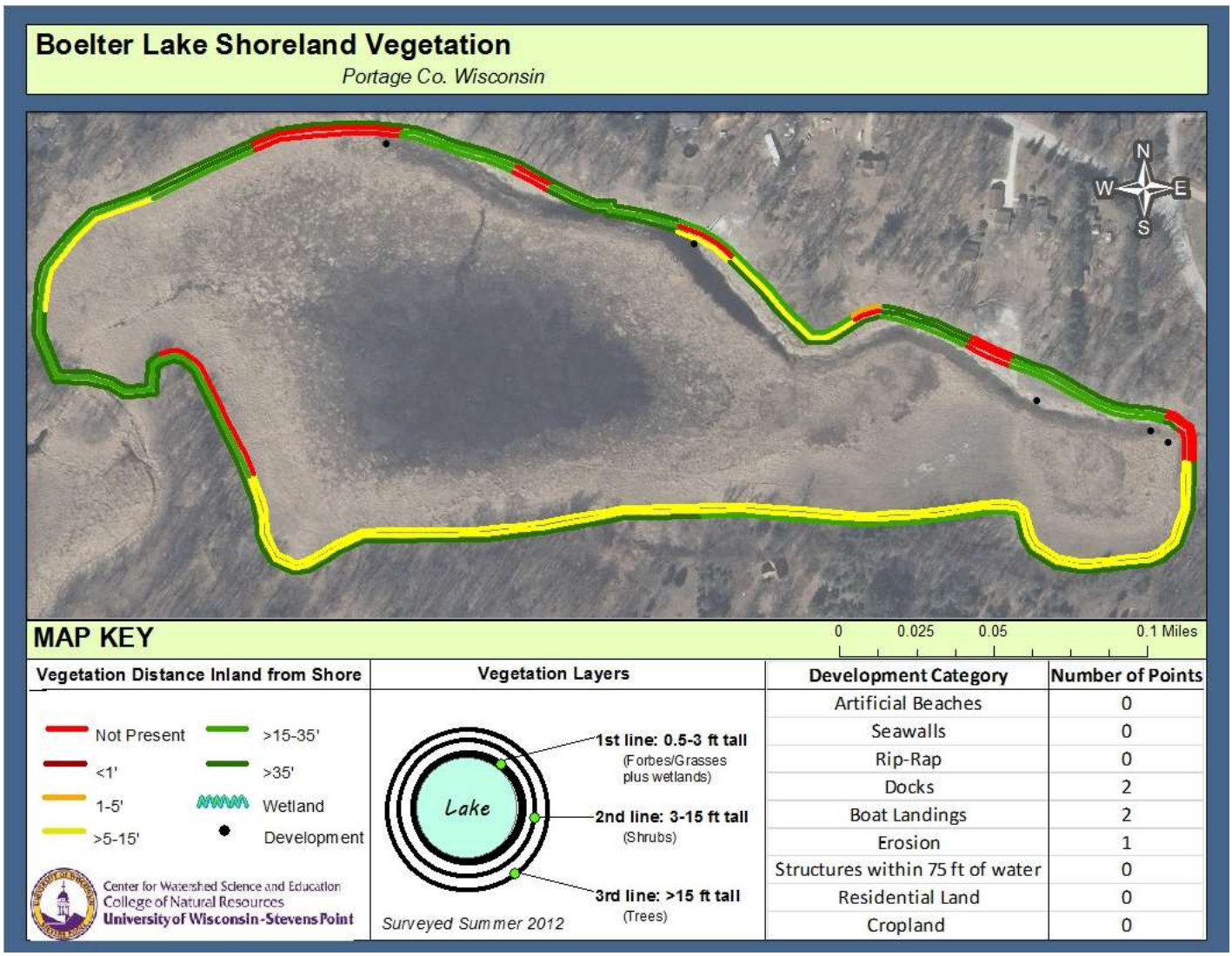


Figure 13. Shoreland vegetation survey around Boelter Lake, summer 2012.

During the 2012 survey, an assessment of human influence features was also conducted around Boelter Lake (Figure 14). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. During the 2012 survey, erosion was identified at one site. If possible, the erosion from this site should be controlled.

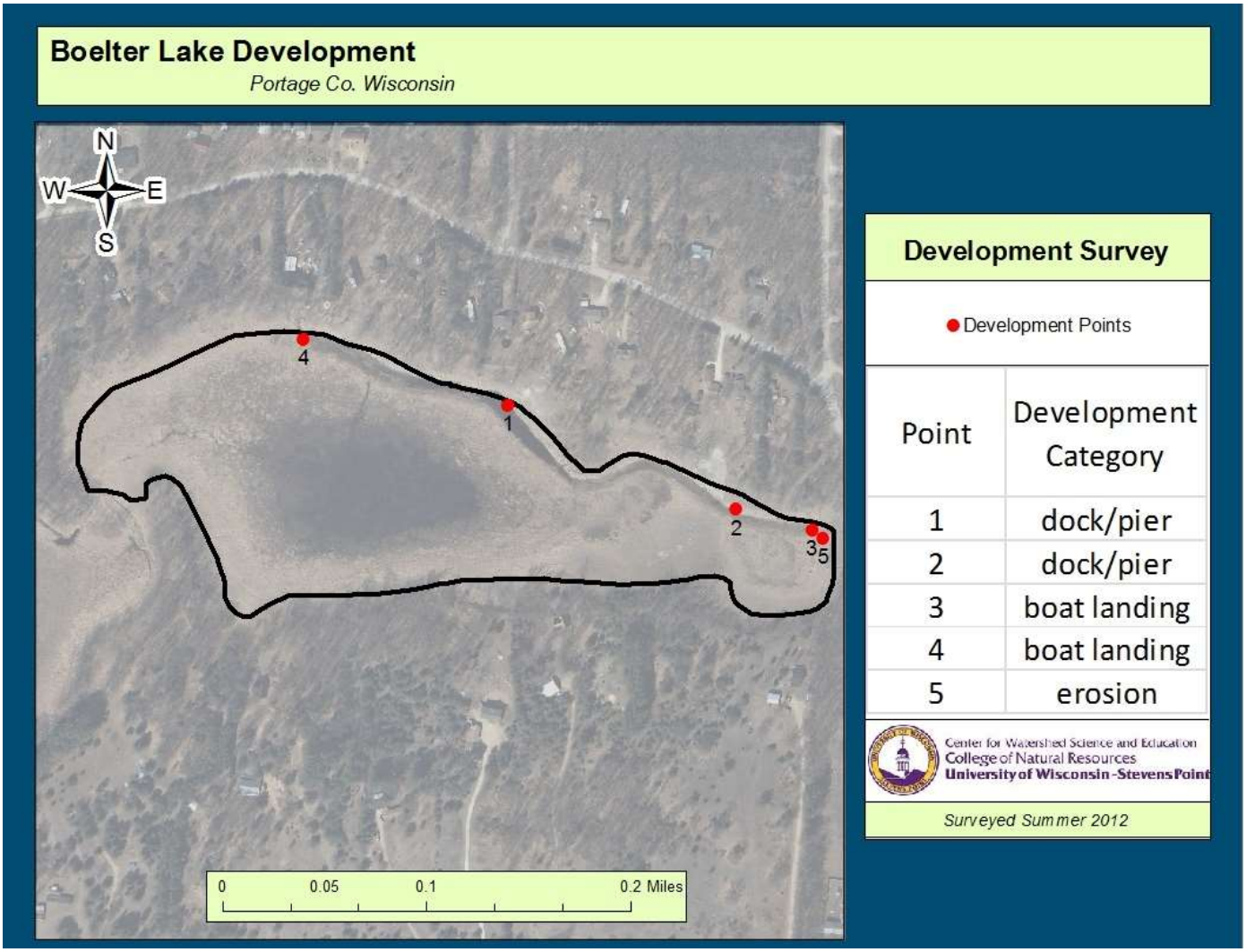


Figure 14. Features of human influence around Boelter Lake, summer 2012.

Collins Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Collins Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Collins Lake's shoreland are shown in Figure 15. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Approximately 3,800 feet of its 8,000 feet of shoreland have vegetative buffers that are less than 35 feet inland, but significant improvements have been made on the northern and eastern ends since the 2002-2003 survey (Figure 16).

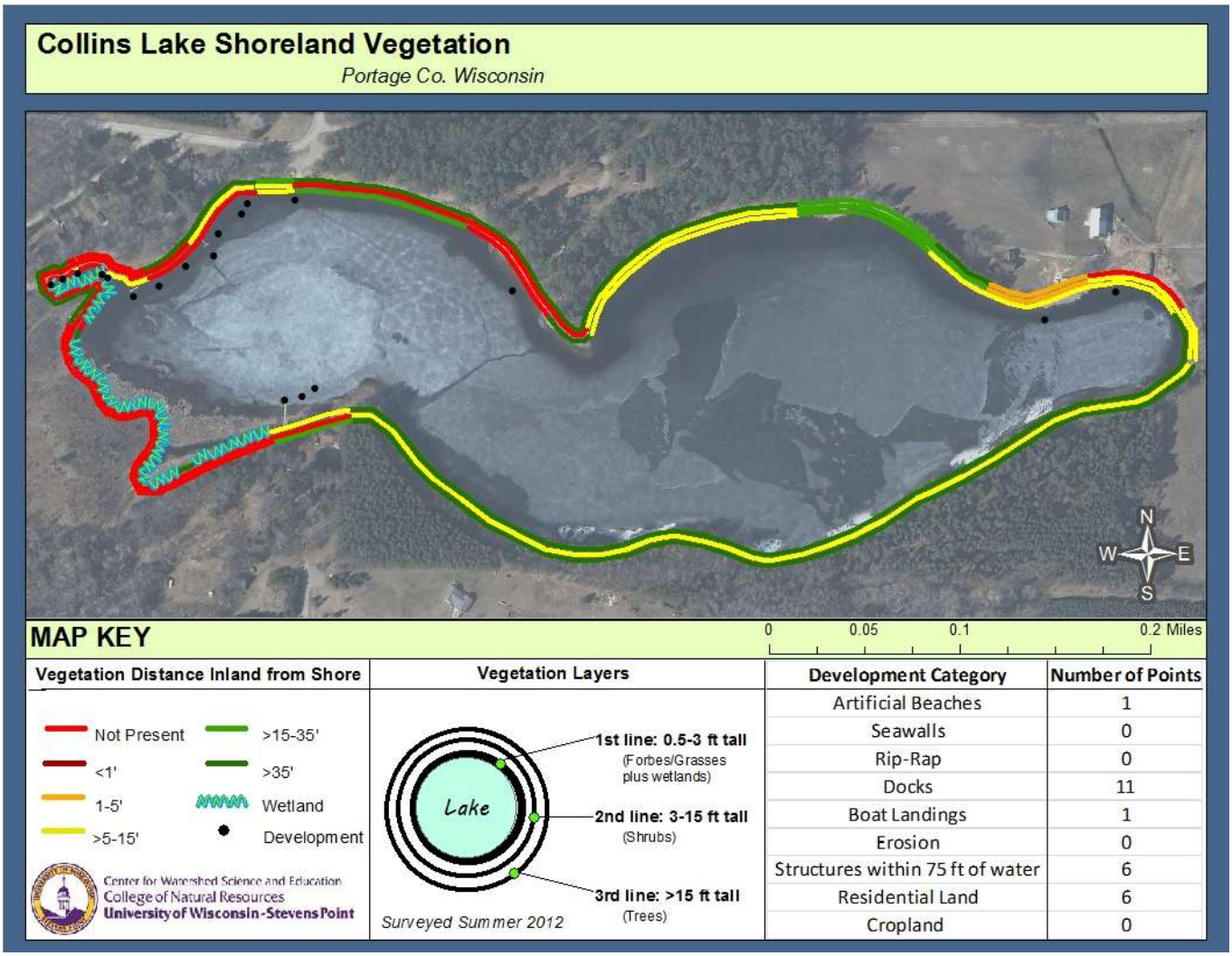


Figure 15. Shoreland vegetation survey around Collins Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 16). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 4.

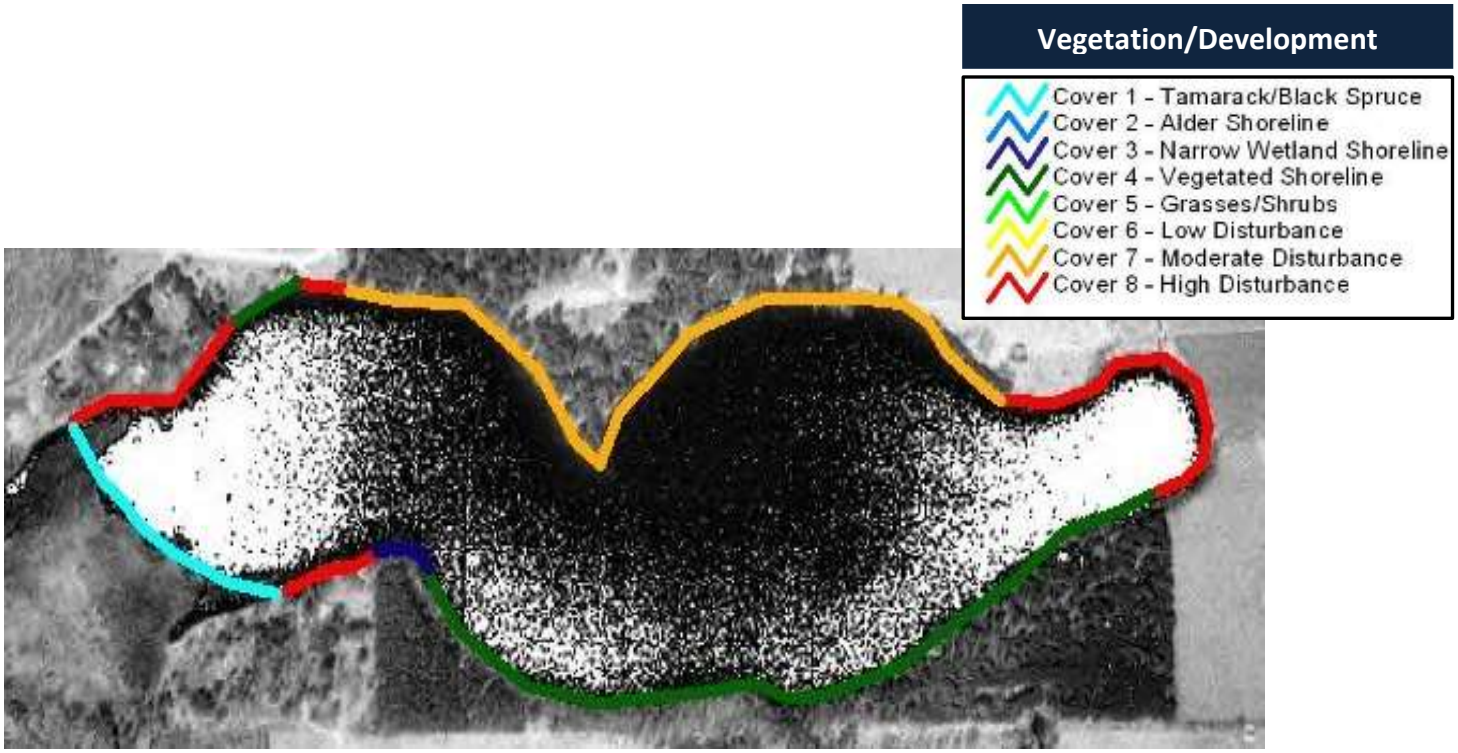
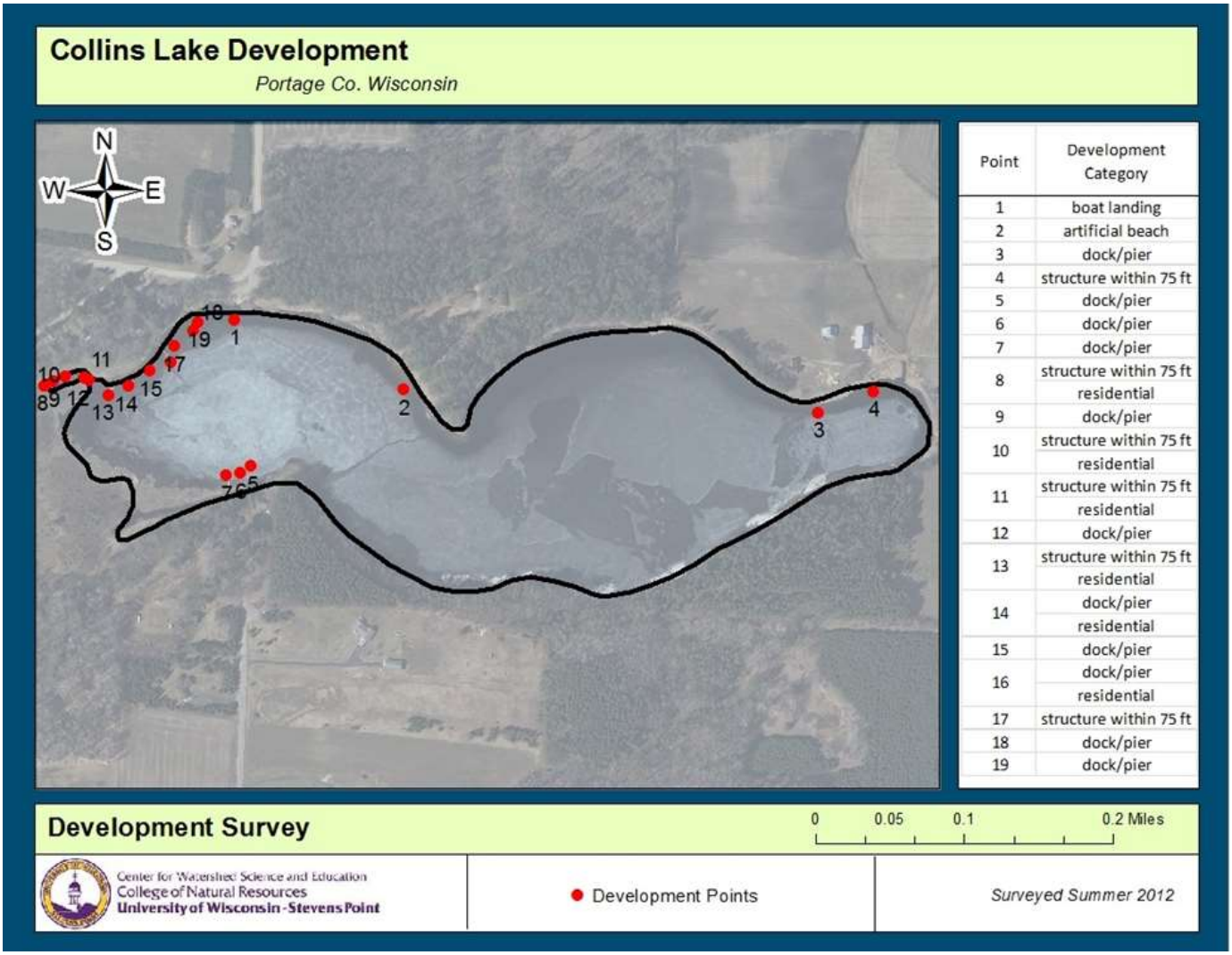


Figure 16. Shoreland vegetation survey around Collins Lake, 2002-2003.

Table 4. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Collins Lake. These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. During the 2012 survey, six structures were located near the shoreline (Figure 17). Many options are available to mitigate the additional runoff that is generated from these impervious surfaces and reduce their negative effects on the water quality in Collins Lake.



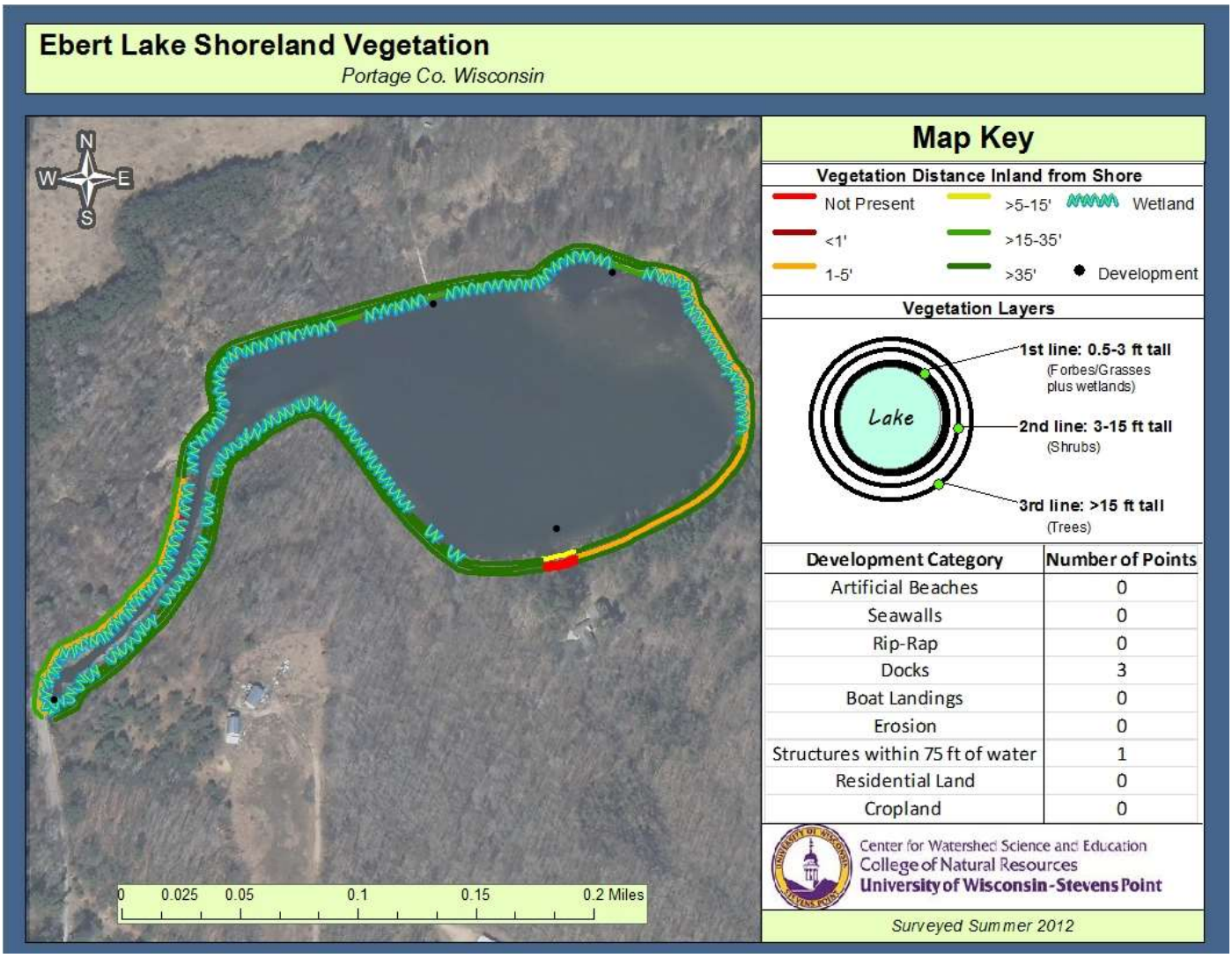
Point	Development Category
1	boat landing
2	artificial beach
3	dock/pier
4	structure within 75 ft
5	dock/pier
6	dock/pier
7	dock/pier
8	structure within 75 ft residential
9	dock/pier
10	structure within 75 ft residential
11	structure within 75 ft residential
12	dock/pier
13	structure within 75 ft residential
14	dock/pier residential
15	dock/pier
16	dock/pier residential
17	structure within 75 ft
18	dock/pier
19	dock/pier

Figure 17. Features of human influence around Collins Lake, summer 2012.

Ebert Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Ebert Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Ebert Lake's shoreland are shown in Figure 18. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). During the 2012 survey, approximately 4,200 of the 4,500 feet of shoreland around Ebert Lake were in excellent condition.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	3
Boat Landings	0
Erosion	0
Structures within 75 ft of water	1
Residential Land	0
Cropland	0

Figure 18. Shoreland vegetation survey around Ebert Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 19). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 5. No significant changes were observed in undisturbed shoreline lengths on Ebert Lake between 2002 and 2012.

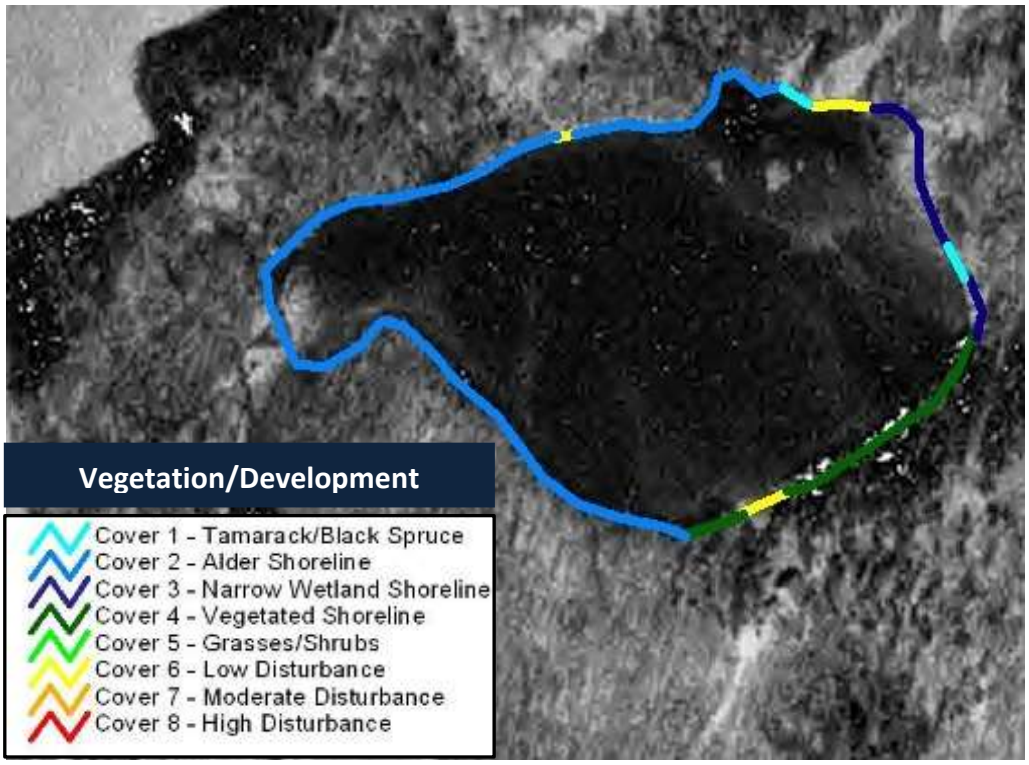


Figure 19. Shoreland vegetation survey around Ebert Lake, 2002-2003.

Table 5. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Ebert Lake (Figure 20). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality.

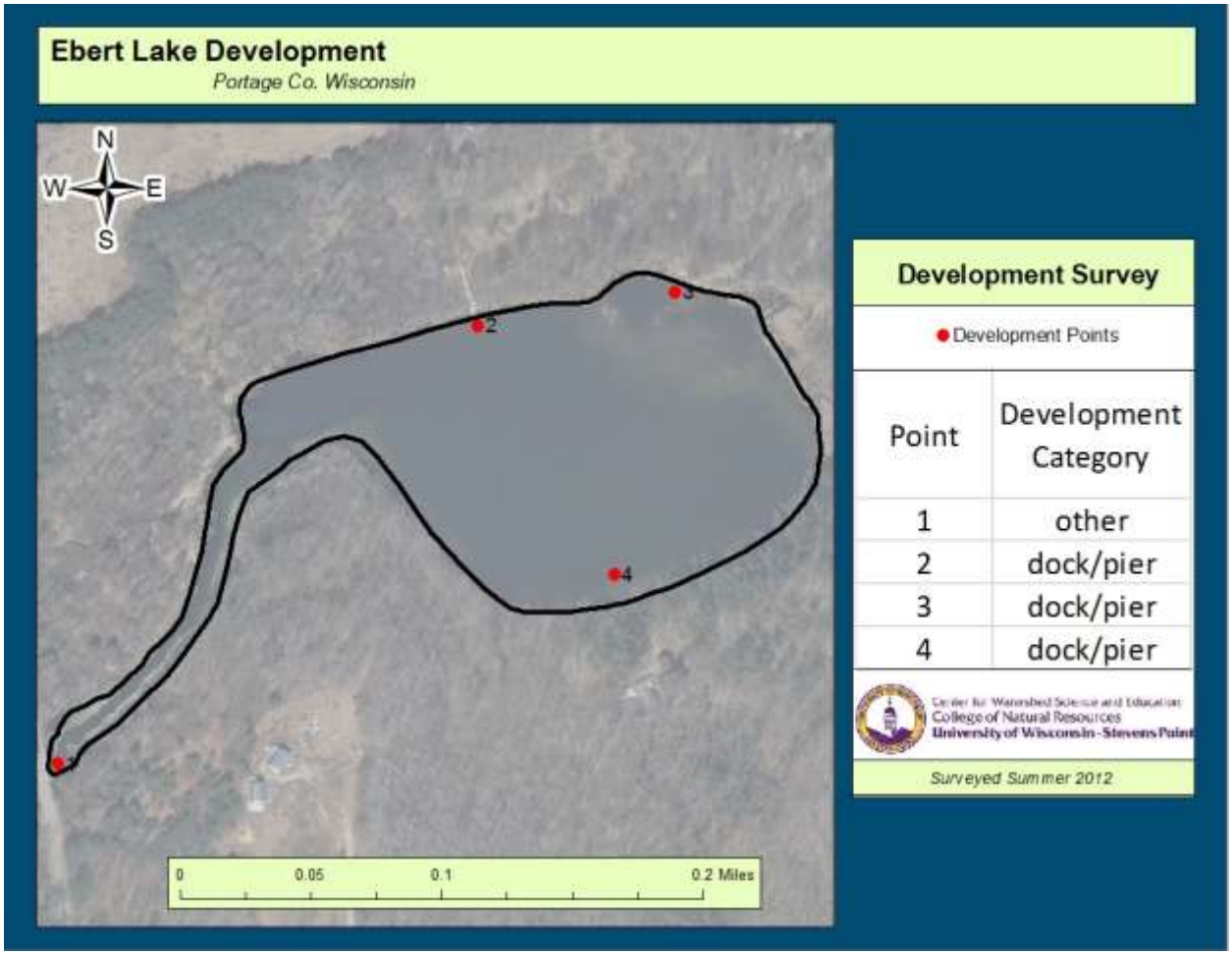


Figure 20. Features of human influence around Ebert Lake, summer 2012.

Lake Emily Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Lake Emily. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Lake Emily's shoreland are shown in Figure 21. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Aproximately 7,500 of the 15,335 feet of shoreland have vegetative buffer depths less than 35 feet inland. For improved water quality and habitat, efforts should be made to restore Lake Emily's shoreland to county and state shoreland zoning standards.

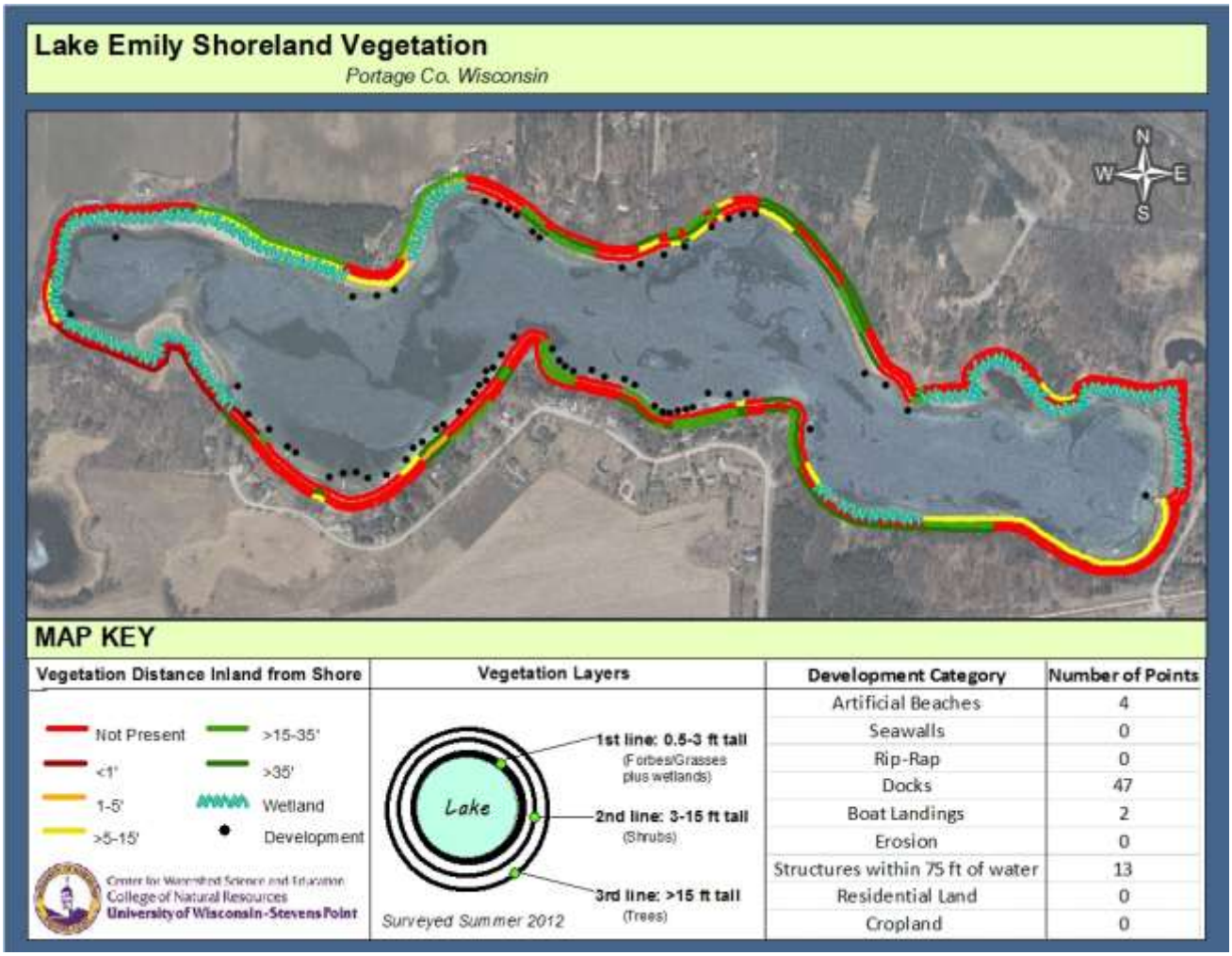


Figure 21. Shoreland vegetation survey around Lake Emily, summer 2012.

During the 2012 survey, an assessment of human influence features was also conducted around Lake Emily (Figure 22). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by iself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. Sixty-five sites had structures (including docks) or artificial beach around Lake Emily's shoreland in summer 2012. The structures direct more runoff towards the lake, which can negatively affect water quality. There are a number of ways to divert or capture this water, including rain gardens, rain barrels, and swales in the landscape. Efforts should be made to address these problems.

Figure 22. Features of human influence around Lake Emily, summer 2012.

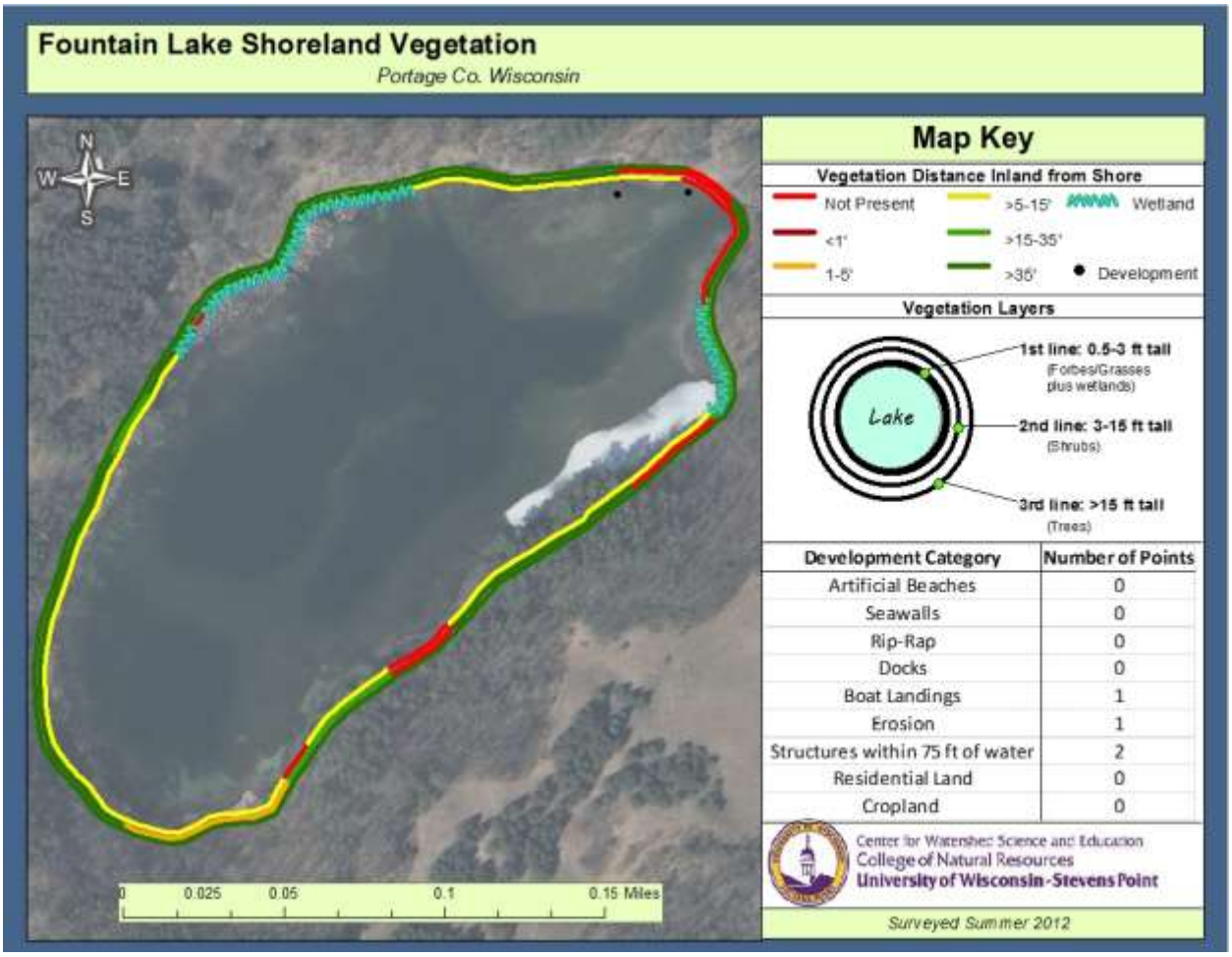
Table 6. Lake Emily human influence survey results, summer 2012.

Point	Development Category	Point	Development Category	Point	Development Category
1	dock/pier	22	structure within 75 ft	44	structure within 75 ft
2	dock/pier	23	structure within 75 ft	45	structure within 75 ft
3	dock/pier	24	dock/pier	46	artificial beach
	boat landing	25	dock/pier	47	artificial beach
4	dock/pier	26	dock/pier	48	dock/pier
5	artificial beach	27	dock/pier	49	dock/pier
6	artificial beach	28	dock/pier	50	dock/pier
7	structure within 75 ft	29	dock/pier	51	dock/pier
8	dock/pier	30	boat landing	52	dock/pier
9	dock/pier	31	dock/pier	53	structure within 75 ft
10	dock/pier	32	dock/pier	54	dock/pier
11	dock/pier	33	dock/pier	55	dock/pier
12	dock/pier	34	dock/pier	56	dock/pier
13	dock/pier	35	dock/pier	57	dock/pier
14	dock/pier	36	structure within 75 ft	58	dock/pier
15	dock/pier	37	dock/pier	59	dock/pier
16	structure within 75 ft	38	dock/pier	60	structure within 75 ft
17	dock/pier	39	structure within 75 ft	61	structure within 75 ft
18	dock/pier	40	dock/pier	62	dock/pier
19	structure within 75 ft	41	dock/pier	63	dock/pier
20	dock/pier	42	structure within 75 ft	64	dock/pier
21	dock/pier	43	dock/pier	65	dock/pier

Fountain Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Fountain Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Fountain Lake's shoreland are shown in Figure 23. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). The primary areas of disturbance are located near the boat launch on the east end and on part of the south shoreline. This is more disturbance than was observed during the 2002-2003 shoreland survey (Figure 24).



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	0
Boat Landings	1
Erosion	1
Structures within 75 ft of water	2
Residential Land	0
Cropland	0

Figure 23. Shoreland vegetation survey around Fountain Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 24). The survey categories (Table 7) differed from those in the 2012 survey, but some comparisons can be made.

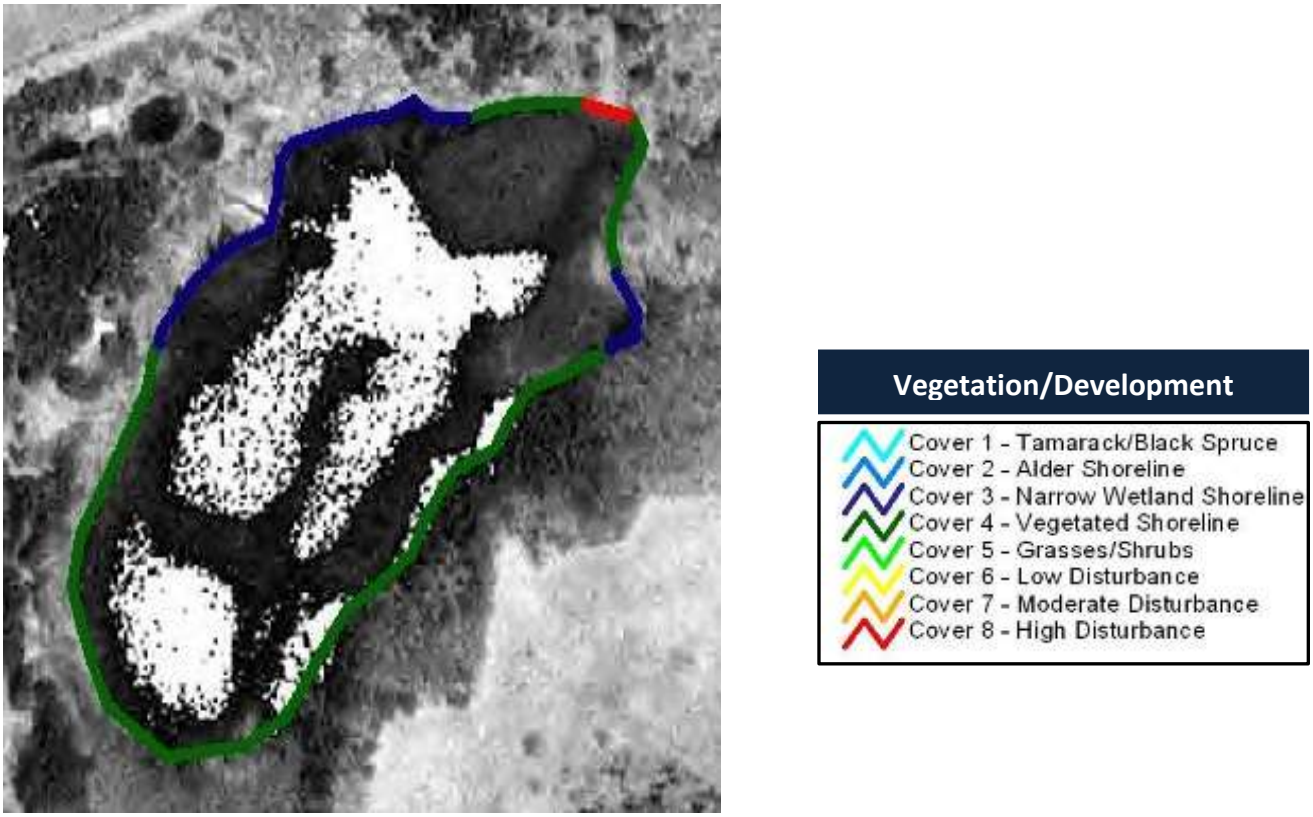


Figure 24. Shoreland vegetation survey around Fountain Lake, 2002-2003.

Table 7. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Fountain Lake (Figure 25). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide good opportunties for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality.

Figure 25. Features of human influence around Fountain Lake, summer 2012.

Lake Helen Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Lake Helen. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Lake Helen's shoreland are shown in Figure 26. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Approximately 300 feet of shoreland have improved around Lake Helen since the 2002-2003 survey (Figure 27); however, an estimated 98% of the shoreline needs restoration to improve water quality, provide habitat, and meet county and state shoreland standards.

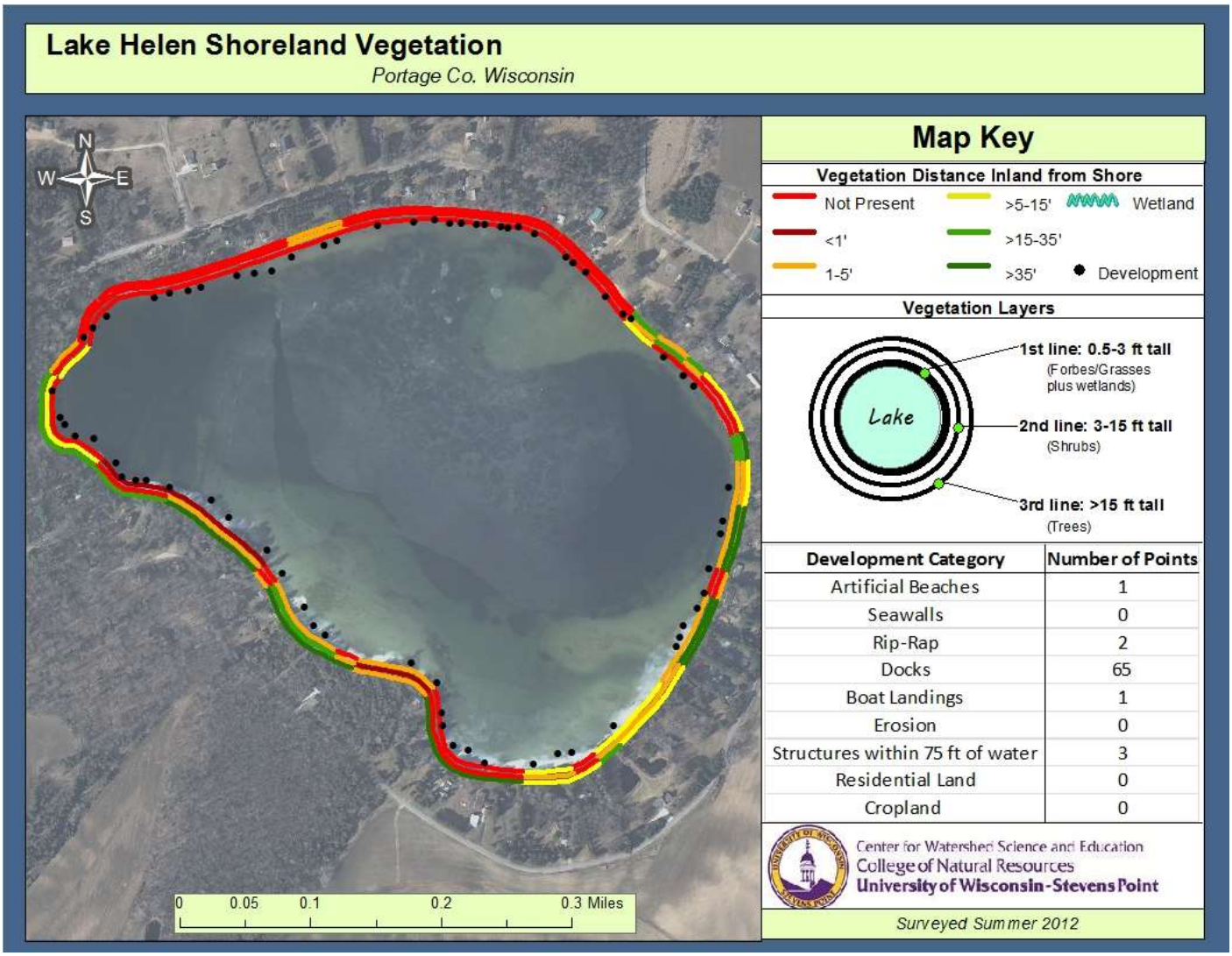


Figure 26. Shoreland vegetation survey around Lake Helen, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 27). The survey categories (Table 8) differed from those in the 2012 survey, but some comparisons can be made.

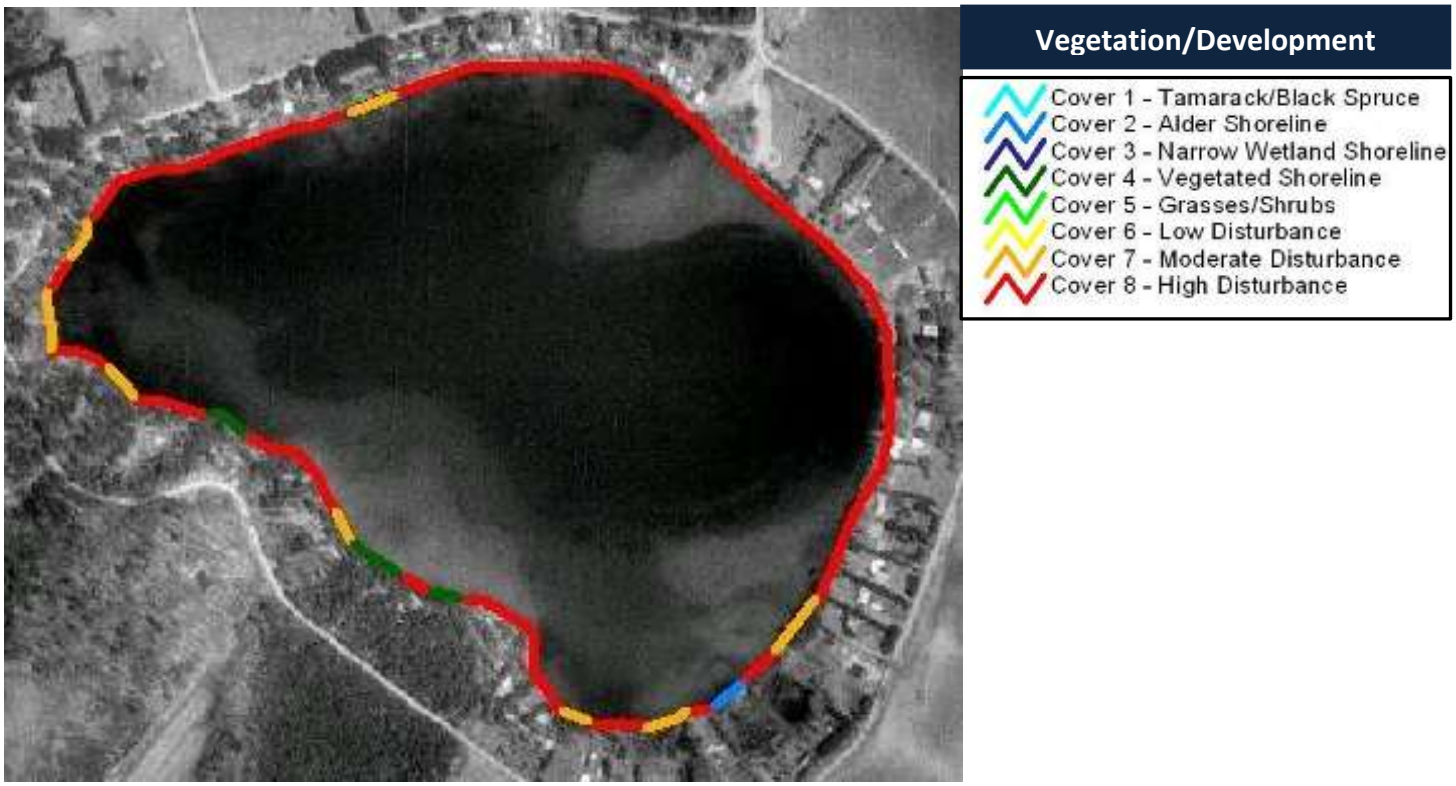


Figure 27. Shoreland vegetation survey around Lake Helen, 2002-2003.

Table 8. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Lake Helen (Figure 28). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality.

In 2012, Lake Helen had a combination of docks/piers, structures near the lake, and rip-rap at 70 locations (Table 9 and Figure 28). Wherever possible, runoff from the near shore structures should be mitigated through the installation of rain gardens, swales and rain barrels to reduce impacts to water quality. Rip-rap is a problem because it lacks habitat. It can be replaced with bio-logs and natural shoreland vegetation. If erosion from the lake is a concern at these sites, the disturbance of near shore aquatic plants should be minimized. The presence of aquatic plants helps to break waves. For example, water lilies make good wave "baffles".

Figure 28. Features of human influence around Lake Helen, summer 2012.

Table 9. Lake Helen human influence survey results, summer 2012.

Point	Development Category	Point	Development Category	Point	Development Category
1	dock/pier	26	dock/pier	47	structure within 75 ft
2	boat landing	27	dock/pier	48	dock/pier
3	dock/pier	28	dock/pier	49	dock/pier
4	dock/pier	29	dock/pier	50	dock/pier
5	dock/pier	30	dock/pier	51	dock/pier
6	dock/pier	31	dock/pier	52	dock/pier
7	dock/pier		residential	53	dock/pier
8	dock/pier	32	dock/pier	54	dock/pier
9	dock/pier	33	dock/pier	55	dock/pier
10	dock/pier	34	structure within 75 ft	56	dock/pier
11	dock/pier		residential	57	dock/pier
12	dock/pier	35	dock/pier	58	dock/pier
13	dock/pier	36	dock/pier	59	dock/pier
14	dock/pier	37	dock/pier	60	dock/pier
15	dock/pier		rip-rap	61	dock/pier
16	structure within 75 ft	38	dock/pier	62	dock/pier
17	dock/pier	39	dock/pier	63	dock/pier
18	dock/pier	40	dock/pier	64	dock/pier
19	dock/pier	41	dock/pier	65	dock/pier
20	dock/pier	42	dock/pier	66	dock/pier
21	dock/pier	43	dock/pier	67	dock/pier
22	dock/pier	44	dock/pier	68	dock/pier
23	dock/pier	45	dock/pier	69	dock/pier
24	dock/pier		rip-rap	70	artificial beach
25	dock/pier	46	dock/pier		

Jacqueline Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Jacqueline Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Jacqueline Lake's shoreland are shown in Figure 29. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). In 2012, approximately 4,513 feet of Jacqueline Lake's 5,886 foot total shoreline had shoreland buffers less than 35 feet inland. A buffer depth of 35 feet helps water quality and habitat and is supported by county and state shoreland standards. Since the 2002-2003 shoreland survey (Figure 30), it appears that restoration of shoreland has improved in areas in the southern part of the lake, but degradation has occurred on the eastern side. Efforts should be made to restore shoreland vegetation to a depth of at least 35 feet.

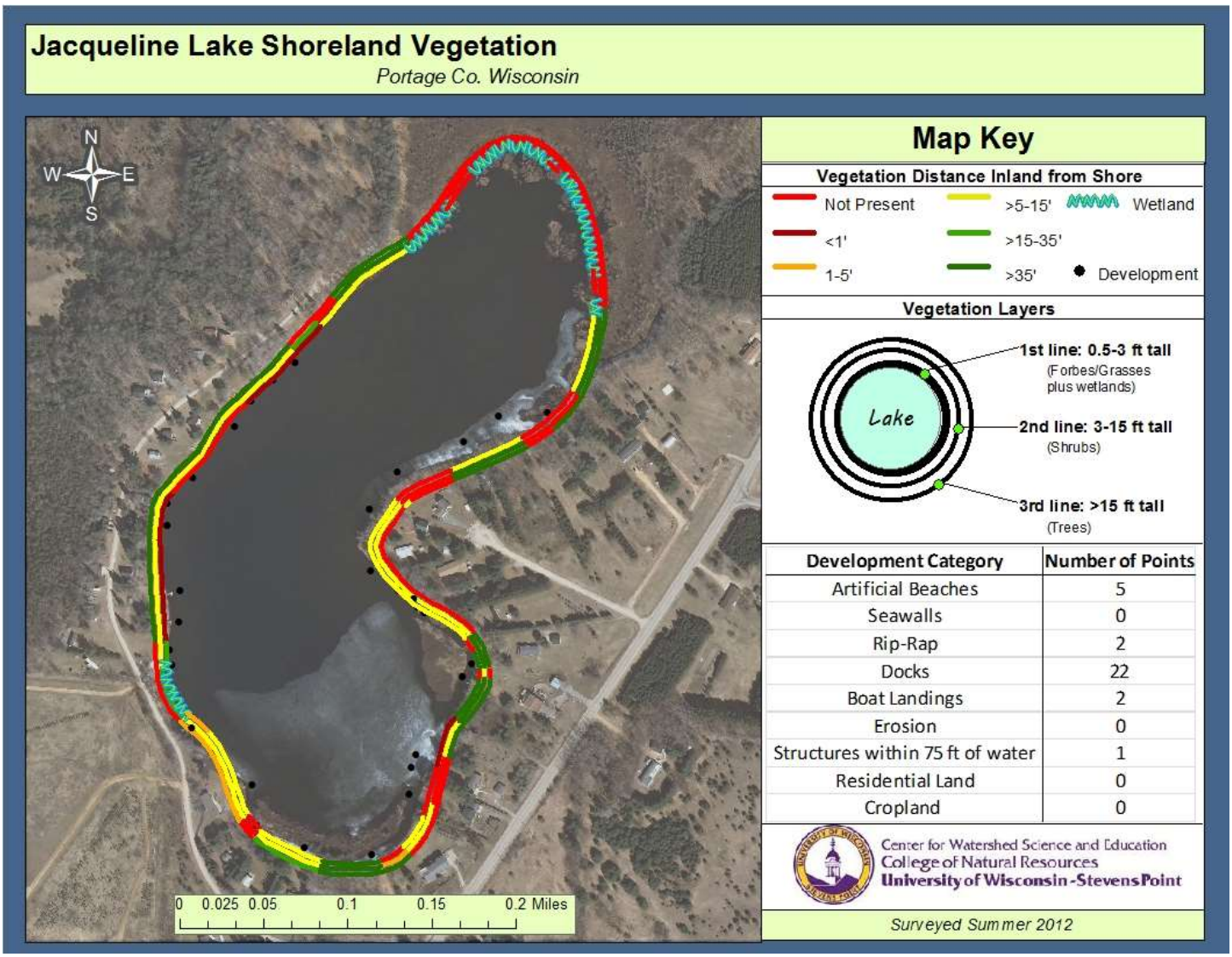


Figure 29. Shoreland vegetation survey around Jacqueline Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 30). The survey categories (Table 10) differed from those in the 2012 survey, but some comparisons can be made.

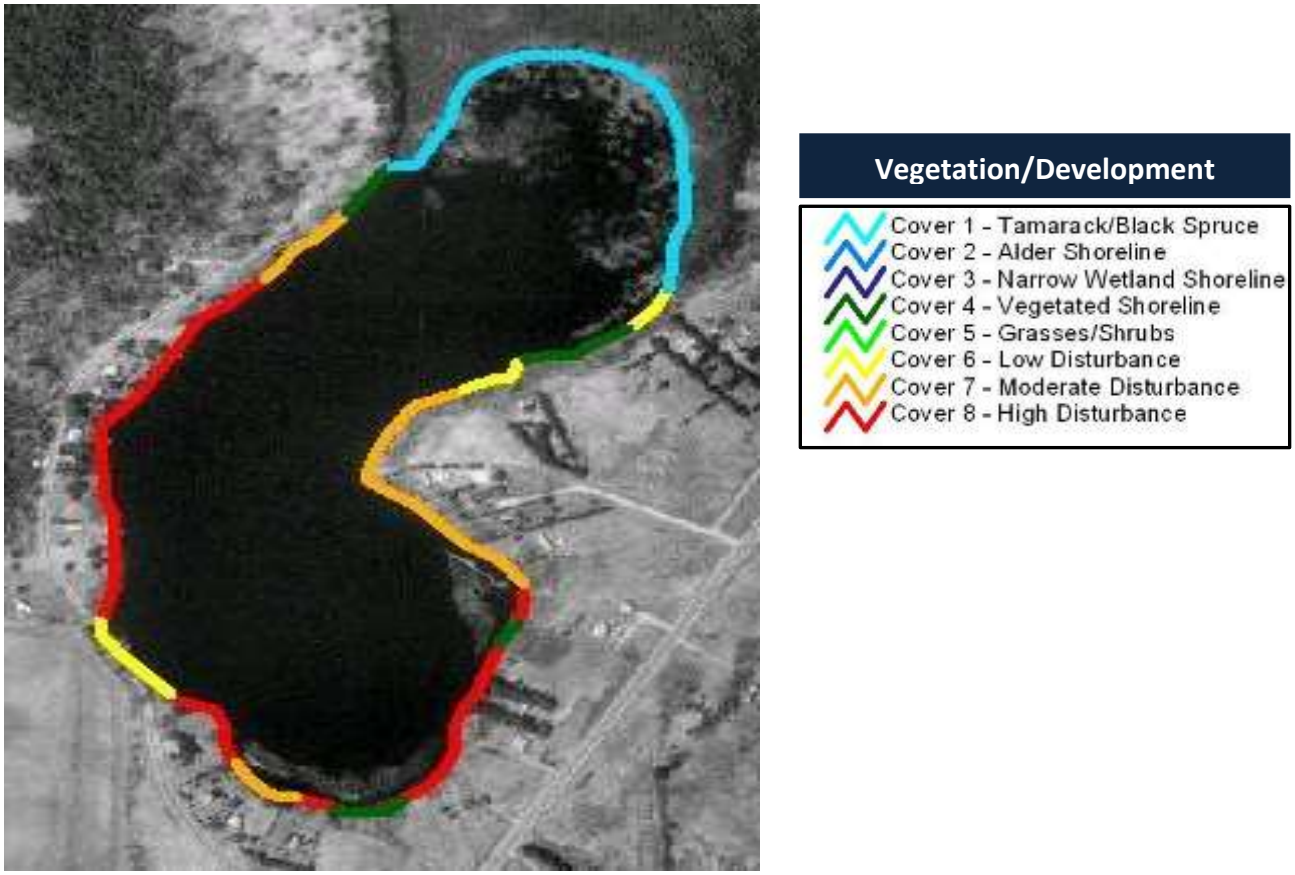
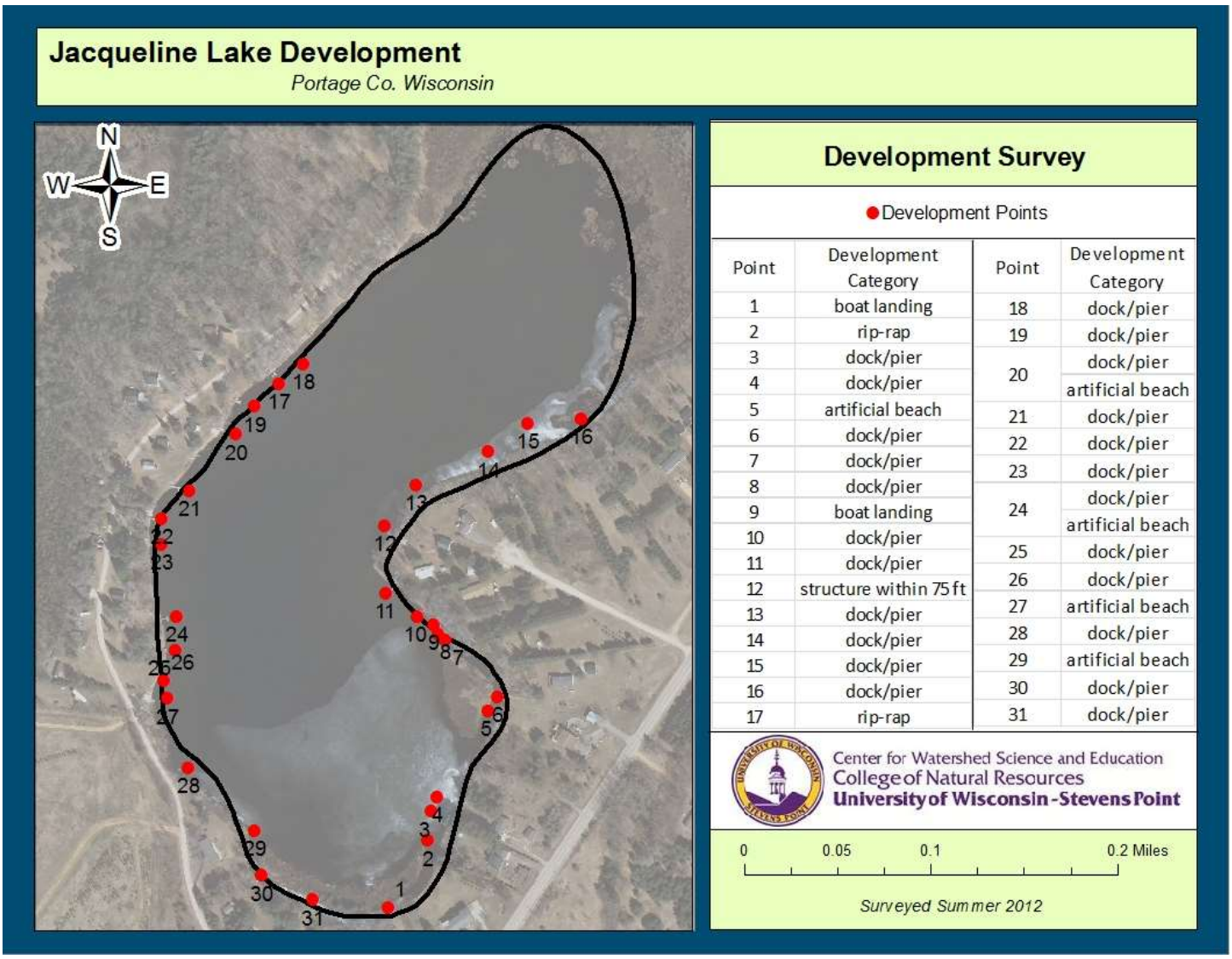


Figure 30. Shoreland vegetation survey around Jacqueline Lake, 2002-2003.

Table 10. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Jacqueline Lake (Figure 31). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, 31 points of human impact around Jacqueline Lake included docks/piers, artificial beaches, rip-rap, and near shore development. The artificial beaches and rip-rap reduce shoreland habitat and could be replaced with native vegetation. Aquatic vegetation located near shore can reduce wave action if erosion is a concern. For example, water lilies make good "baffles" for the waves. Runoff from structures near the lake can result in the reduction of water quality. This runoff can be mitigated by the installation of rain gardens, swales and rain barrels. Efforts should be made to reduce problems caused by human made features.



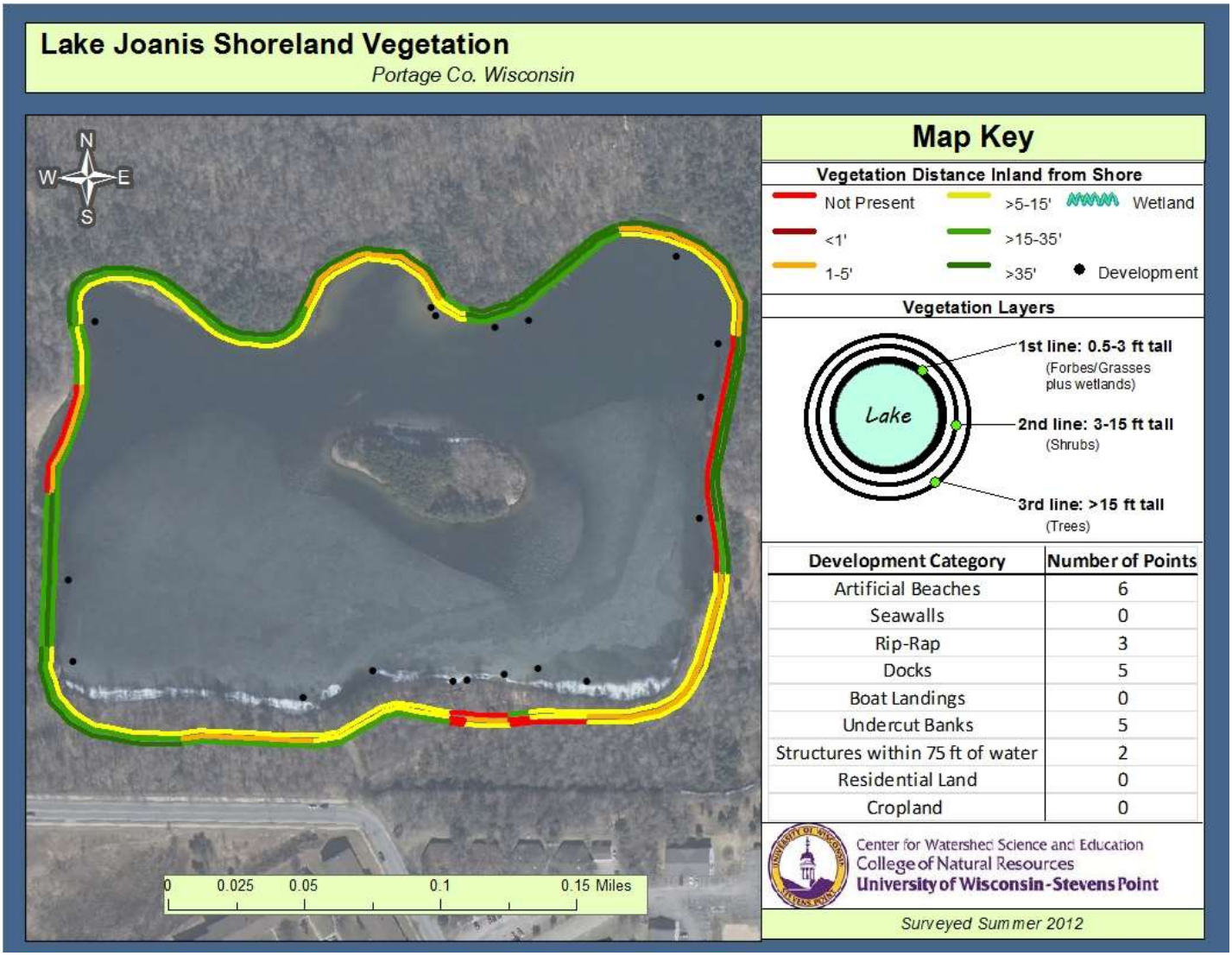
Point	Development Category	Point	Development Category
1	boat landing	18	dock/pier
2	rip-rap	19	dock/pier
3	dock/pier	20	dock/pier
4	dock/pier		artificial beach
5	artificial beach	21	dock/pier
6	dock/pier	22	dock/pier
7	dock/pier	23	dock/pier
8	dock/pier	24	dock/pier
9	boat landing		artificial beach
10	dock/pier	25	dock/pier
11	dock/pier	26	dock/pier
12	structure within 75 ft	27	artificial beach
13	dock/pier	28	dock/pier
14	dock/pier	29	artificial beach
15	dock/pier	30	dock/pier
16	dock/pier	31	dock/pier
17	rip-rap		

Figure 31. Features of human influence around Lake Jacqueline, summer 2012.

Lake Joanis Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Lake Joanis. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Lake Joanis's shoreland are shown in Figure 32. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Little has changed around Lake Joanis since the 2002-2003 survey (Figure 33).



Development Category	Number of Points
Artificial Beaches	6
Seawalls	0
Rip-Rap	3
Docks	5
Boat Landings	0
Undercut Banks	5
Structures within 75 ft of water	2
Residential Land	0
Cropland	0

Figure 32. Shoreland vegetation survey around Lake Joanis, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 33). The survey categories (Table 11) differed from those in the 2012 survey, but some comparisons can be made.

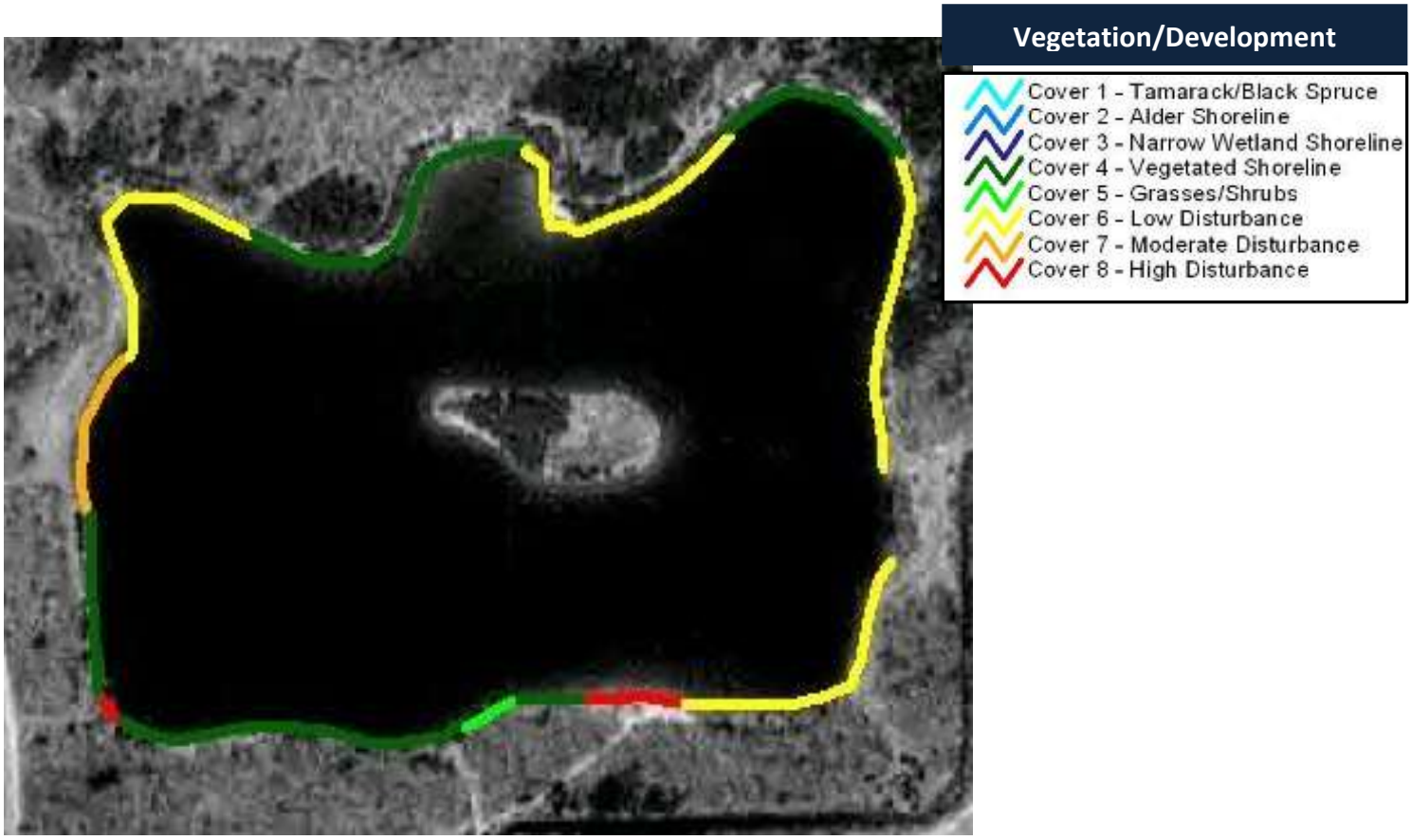


Figure 33. Shoreland vegetation survey around Lake Joanis, 2002-2003.

Table 11. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Lake Joanis (Figure 34). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality.

Figure 34. Features of human influence around Lake Joanis, summer 2012.

Jordan Pond Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Jordan Pond. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Jordan Pond's shoreland are shown in Figure 35. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). In 2012, approximately 9,330 feet of shoreland lacked 35 foot depths of shoreland vegetation. Efforts should be made to improve the shoreland buffers to at least meet the county and state shoreland standards, which were developed to improve water quality and habitat around lakes and rivers.

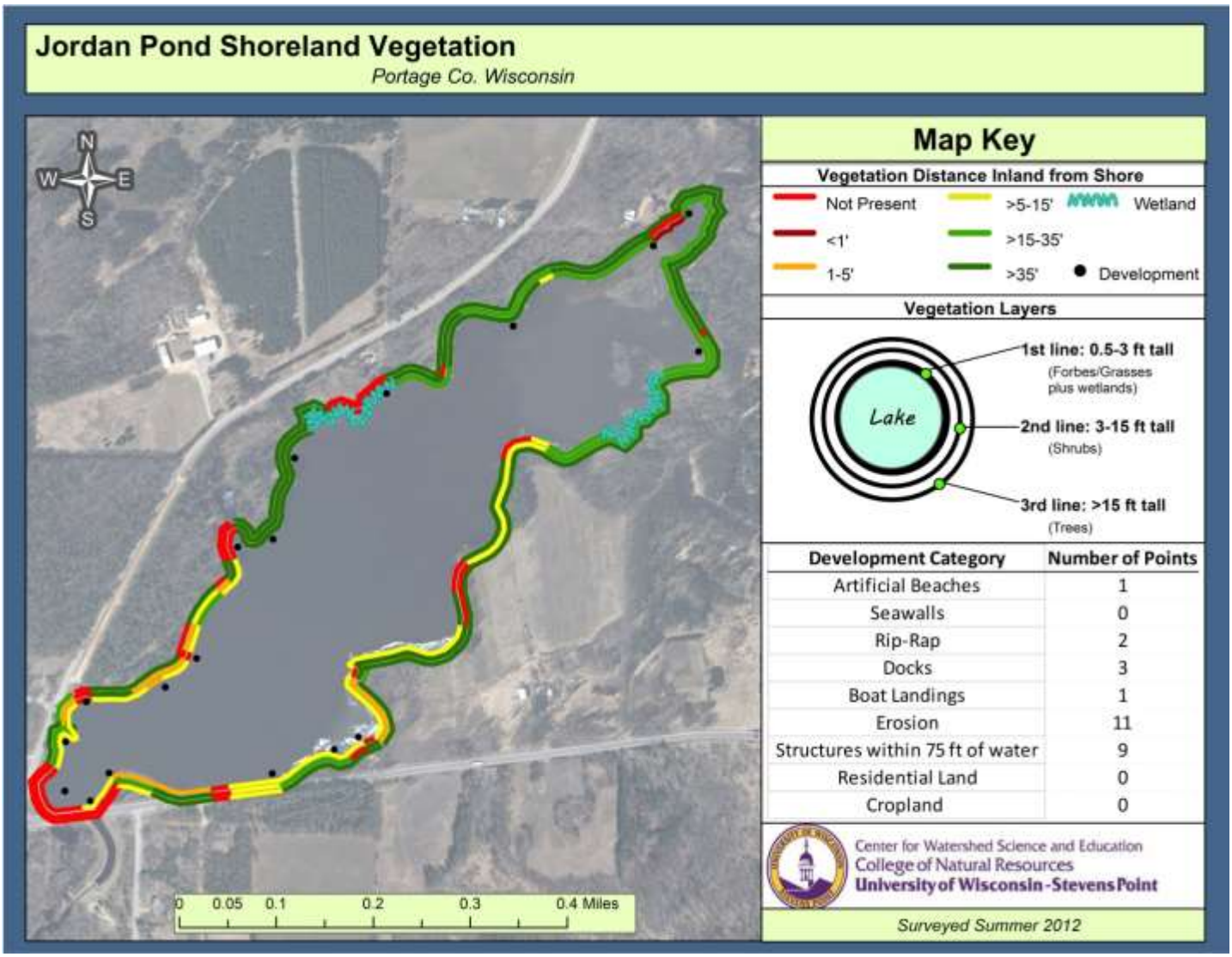


Figure 35. Shoreland vegetation survey around Jordan Pond, summer 2012.

During the 2012 survey, an assessment of human influence features was also conducted around Jordan Pond (Figure 36). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, near shore structures, erosion, rip-rap, artificial beach, and dock/piers/boat launches were identified at a total of 18 sites around Jordan Pond. Sites with erosion should be stabilized. Mitigation for runoff from near shore structures could include rain gardens, swales and rain barrels. To provide better habitat, rip-rap could be replaced with bio-logs and native vegetation.

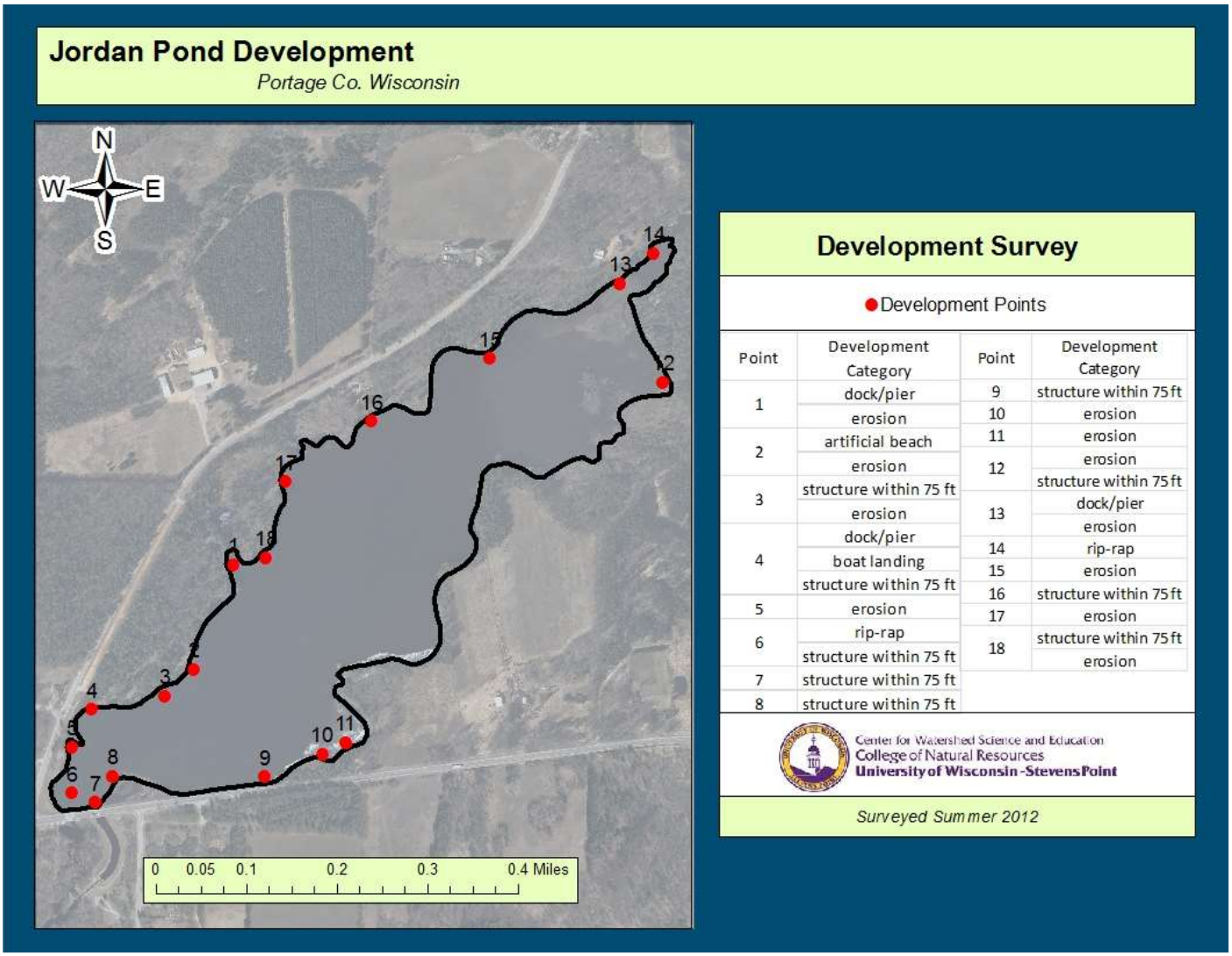
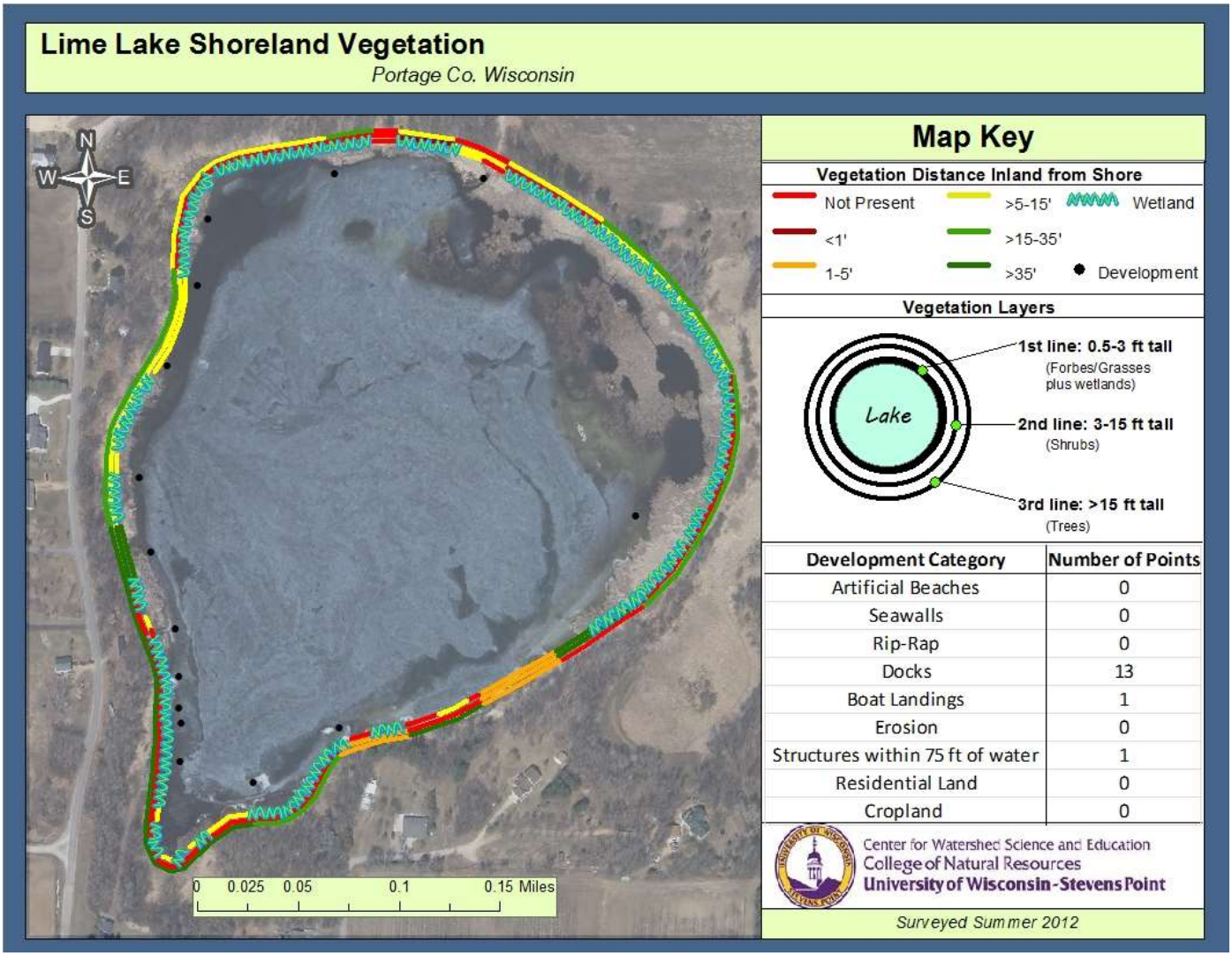


Figure 36. Features of human influence around Jordan Pond, summer 2012.

Lime Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Lime Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Lime Lake's shoreland are shown in Figure 37. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). A fair amount of shoreland disturbance has occurred around Lime Lake since the 2002-2003 survey (Figure 38), particularly on the southern/southeastern ends. Vegetation should be restored to provide at least a 35 foot depth inland from the water's edge. This vegetative buffer provides habitat, improves water quality, and a 35 foot depth would meet county and state shoreland standards.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	13
Boat Landings	1
Erosion	0
Structures within 75 ft of water	1
Residential Land	0
Cropland	0

Figure 37. Shoreland vegetation survey around Lime Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 38). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 12.

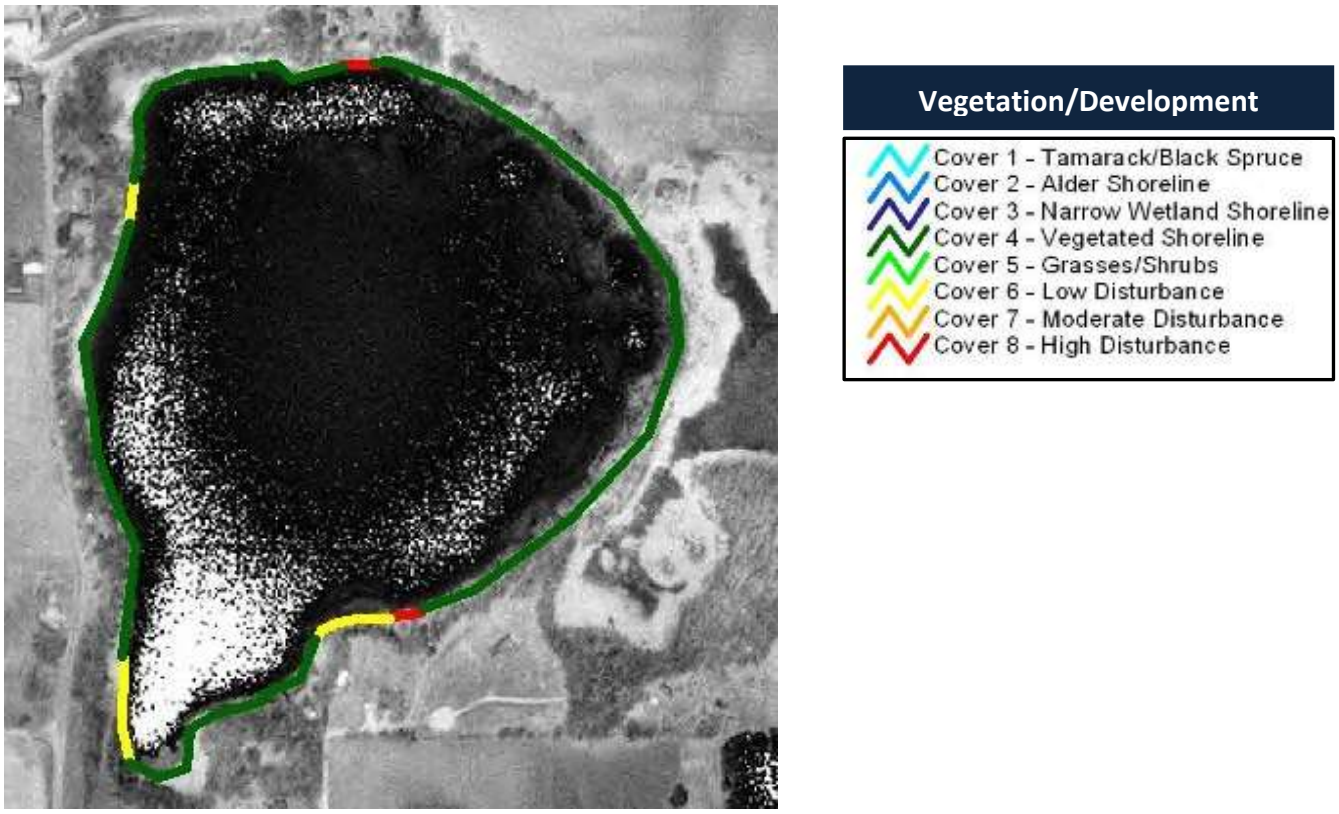
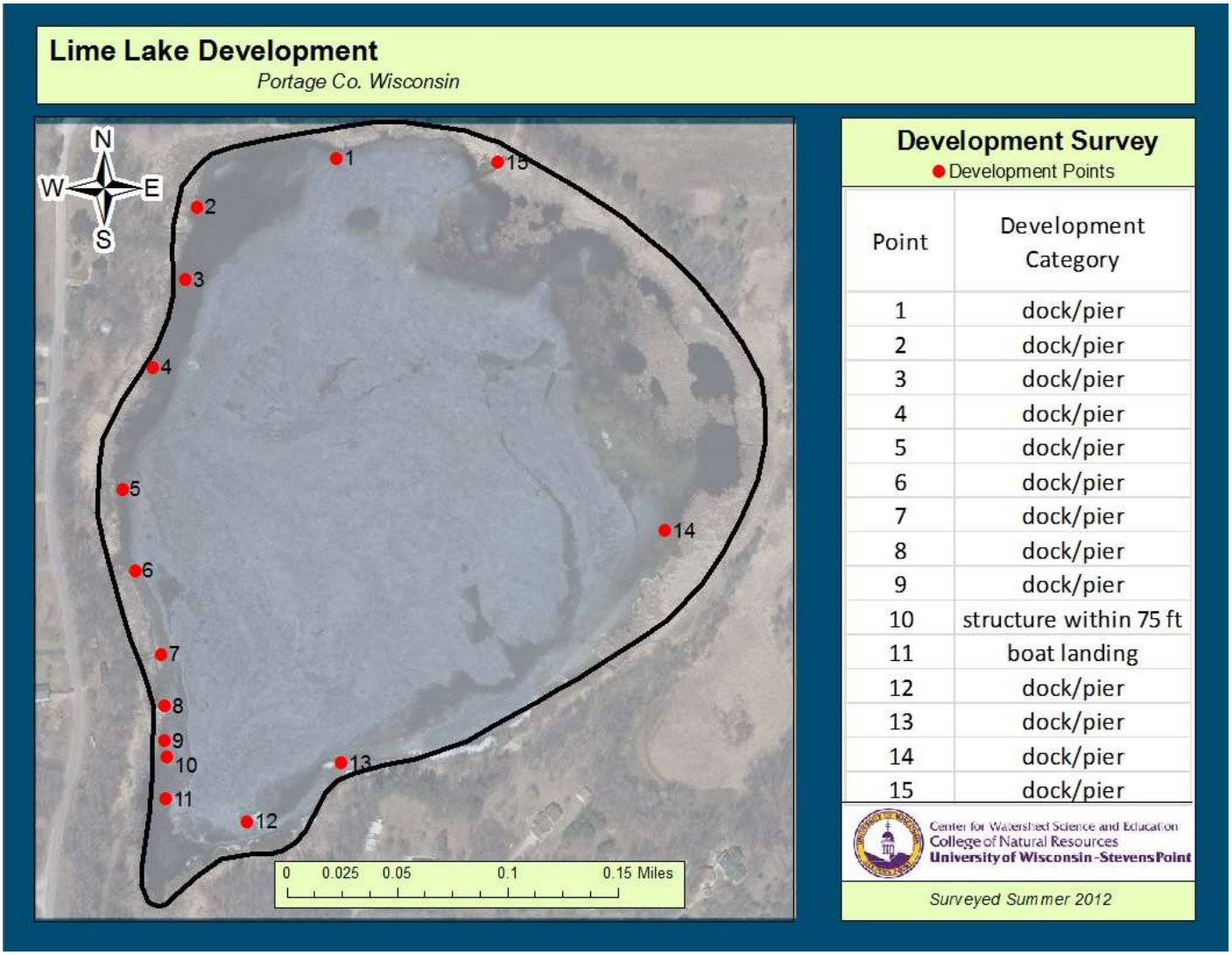


Figure 38. Shoreland vegetation survey around Lime Lake, 2002-2003.

Table 12. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Lime Lake (Figure 39). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, docks/piers/boat launches accounted for the majority of the 15 human-made features that were identified around Lime Lake. One near shore structure was identified. Reducing runoff from this structure would be desirable, and could be achieved by installing a swale, rain garden, or rain barrel.



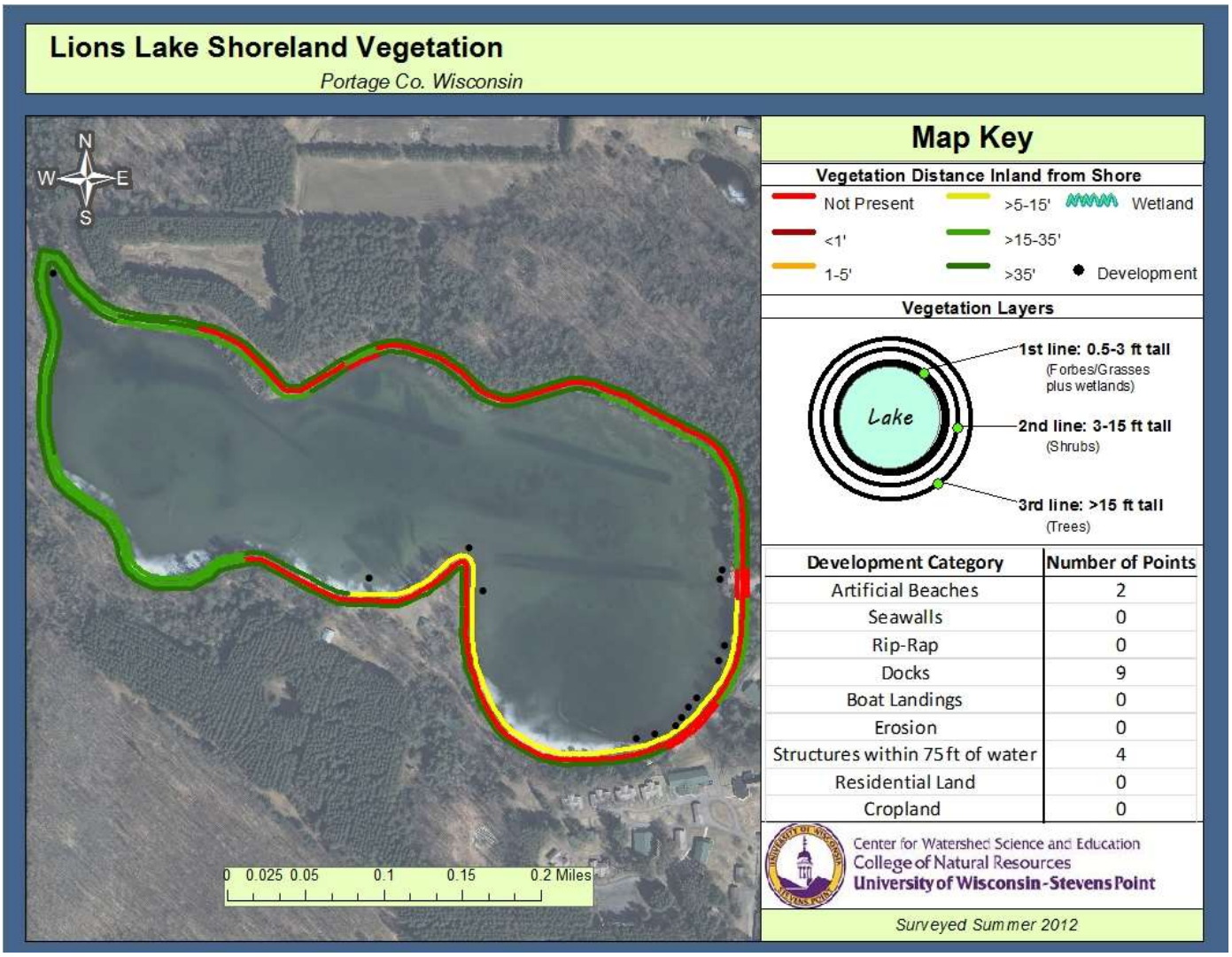
Point	Development Category
1	dock/pier
2	dock/pier
3	dock/pier
4	dock/pier
5	dock/pier
6	dock/pier
7	dock/pier
8	dock/pier
9	dock/pier
10	structure within 75 ft
11	boat landing
12	dock/pier
13	dock/pier
14	dock/pier
15	dock/pier

Figure 39. Features of human influence around Lime Lake, summer 2012.

Lions Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Lions Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Lions Lake's shoreland are shown in Figure 40. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Shoreline health has improved around Lions Lake. Multiple areas around the lake totaling more than 900 feet have increased from no buffer to the greater than 5 to 15 foot buffer depth category.



Development Category	Number of Points
Artificial Beaches	2
Seawalls	0
Rip-Rap	0
Docks	9
Boat Landings	0
Erosion	0
Structures within 75 ft of water	4
Residential Land	0
Cropland	0

Figure 40. Shoreland vegetation survey around Lions Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 41). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 13.

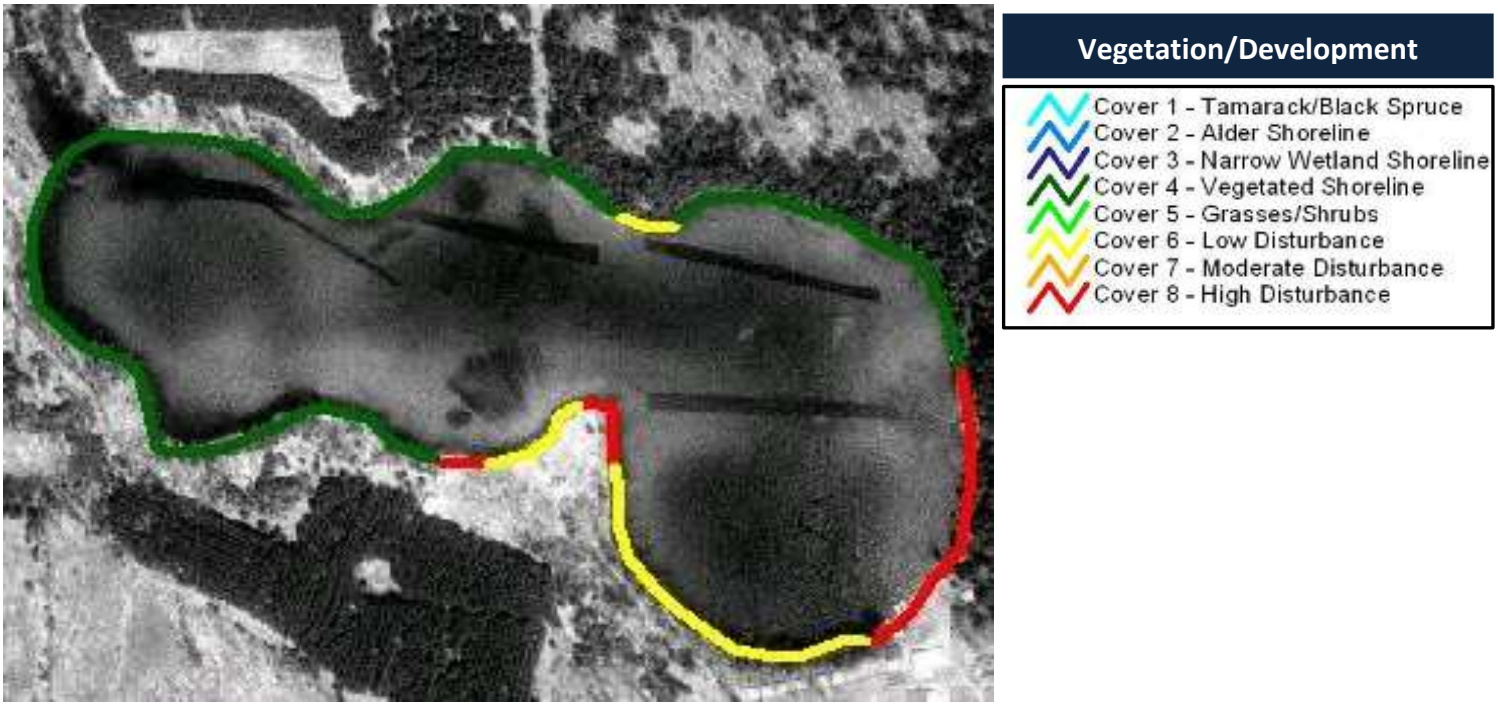
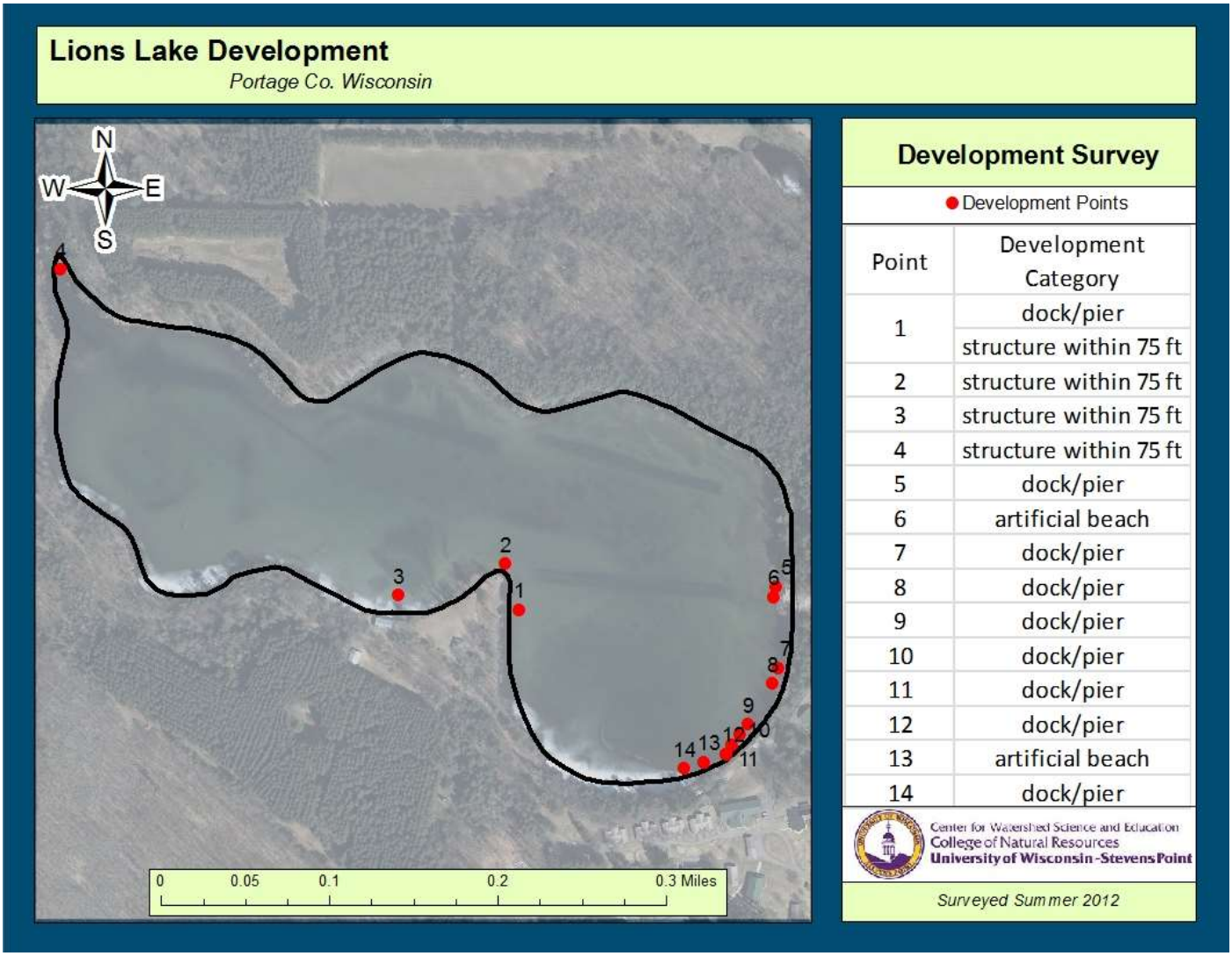


Figure 41. Shoreland vegetation survey around Lions Lake, 2002-2003.

Table 13. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Lions Lake (Figure 42). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, 14 locations around Lions Lake were identified with human influence; nine were docks and piers. Runoff from near shore structures can be reduced to improve water quality by installing swales, rain gardens, and rain barrels.



Point	Development Category
1	dock/pier
	structure within 75 ft
2	structure within 75 ft
3	structure within 75 ft
4	structure within 75 ft
5	dock/pier
6	artificial beach
7	dock/pier
8	dock/pier
9	dock/pier
10	dock/pier
11	dock/pier
12	dock/pier
13	artificial beach
14	dock/pier

Figure 42. Features of human influence around Lions Lake, summer 2012.

McDill Pond 2013 Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around McDill Pond. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

A 2012 survey was not conducted due to low water drawdown levels, and thus the shoreland suvey conducted during summer/fall 2013 had a different design than the rest of the Portage County lakes. The survey analyzed the shoreland vegetation with respect to the depth inland of the forbs layer only. Additionally, the shrubs and trees were collapsed into one layer showing their presence or absence around the shoreline. The ring nearest the lake depicted the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses) and the outer ring depicted the presence or absence of vegetation greater than 15 feet in height (trees), which are shown in Figures 43-45. McDill Pond's results, unlike other Portage County lakes, are displayed via a three-map series rather than one map. This was due to the high variablility in McDill Pond's shoreland vegetation buffers, and also to highlight details that might otherwise go unnoticed on a single map.

McDill Pond's 2013 shoreland disturbance survey was conducted simultaneously with its shoreland vegetation survey. The results of this survey are shown shown in Figures 46-57. As with the shoreland vegetation survey results,the disturbance survey results are displayed via three-map series: Figures 46-48 show the boat landings, docks/piers, and dam/spillways; Figures 49-51 show all the culverts present on the lake; Figures 52-54 show the shoreline erosion, stretches of rip-rap, seawalls, and barren portions of the shoreland; and, Figures 55-57 show all structures that are in close proximity to the shoreland interface.

The results of McDill Pond's shoreland inventory are slightly different from other Portage County lakes, as a new shoreland inventory survey was developed after the 2012 surveys and then used for McDill Pond; however, it should be noted that assessments on the status of shoreland health were conducted in a similar manner.

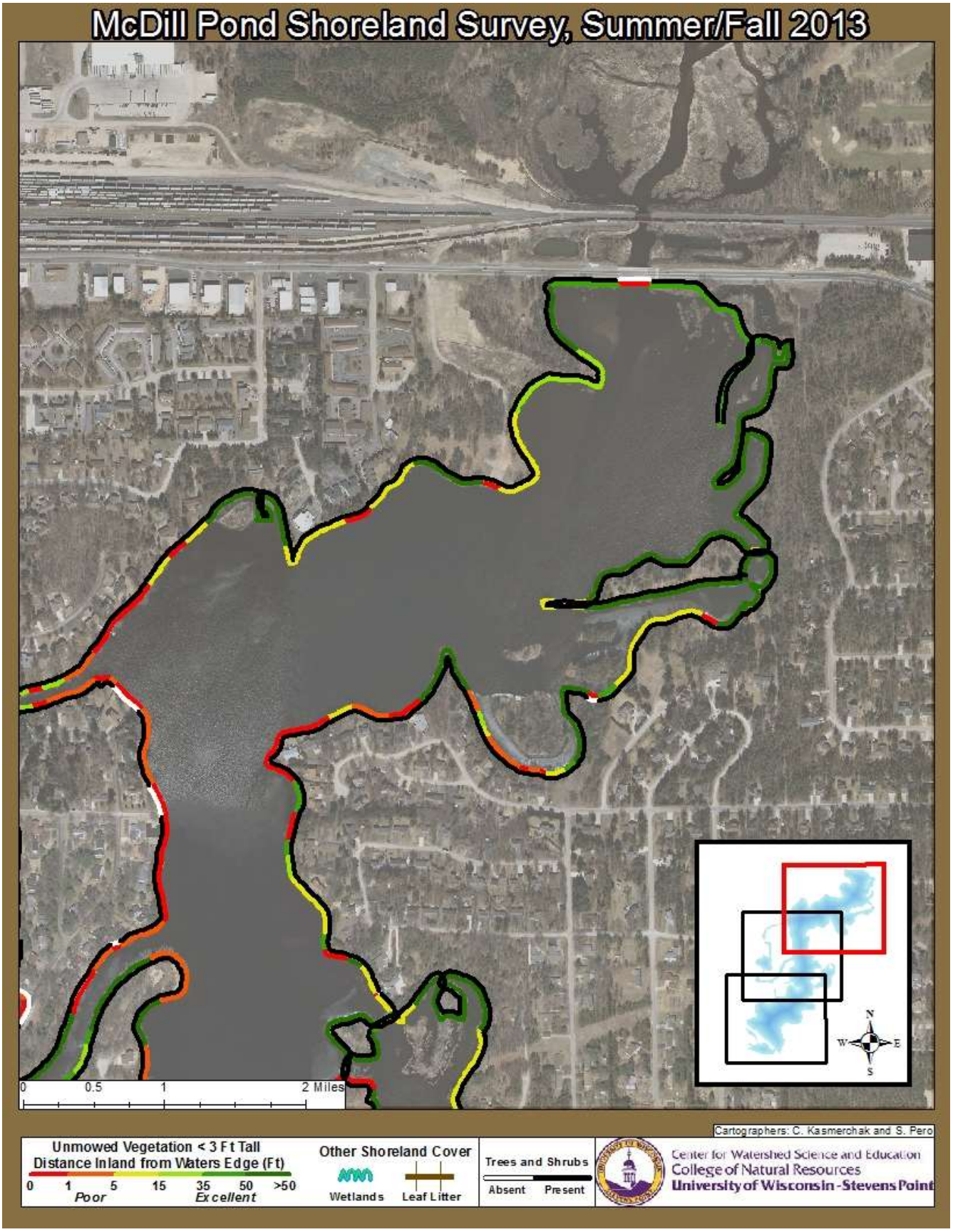


Figure 43. Map 1 of McDill Pond shoreland survey, early summer/fall 2013.

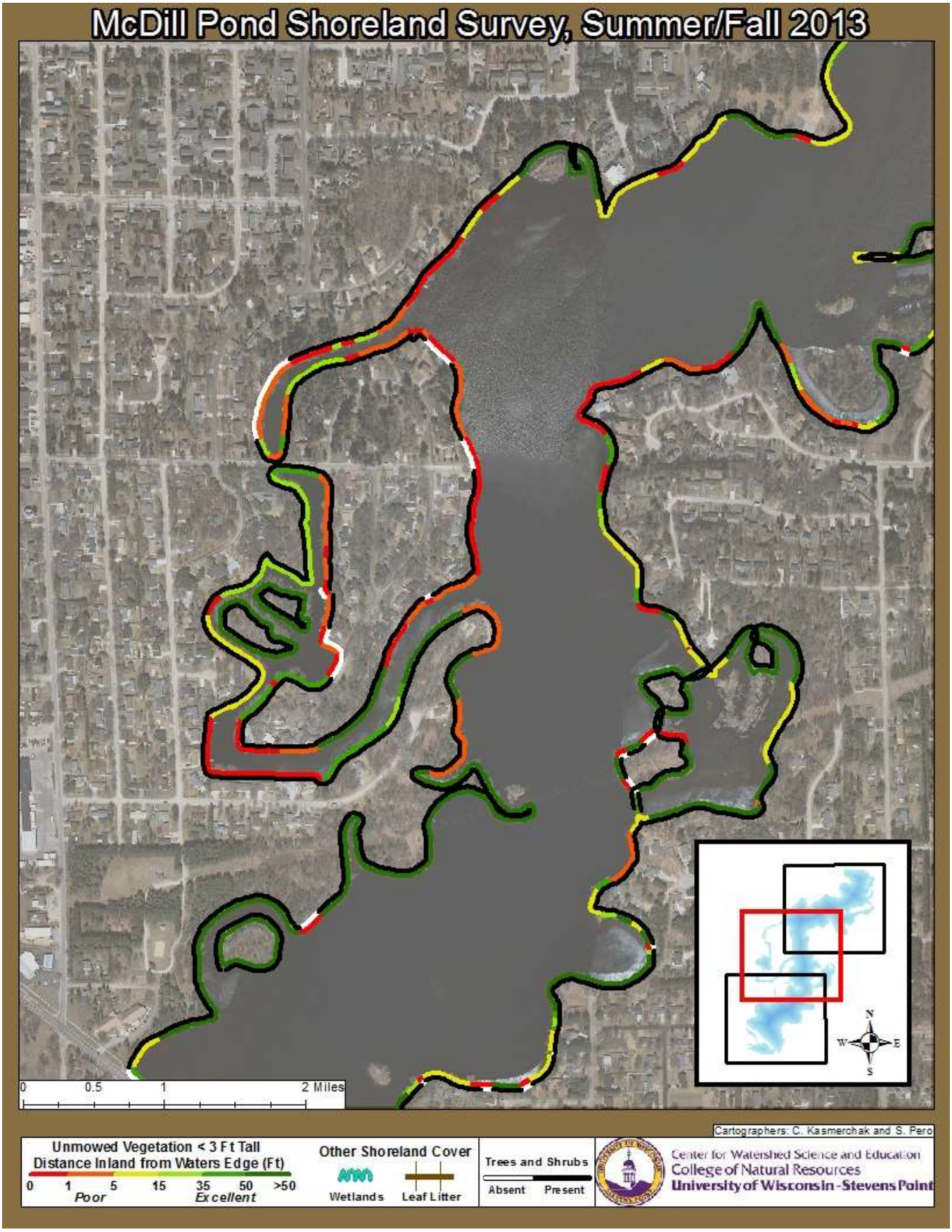


Figure 44. Map 2 of McDill Pond shoreland survey, early summer/fall 2013.

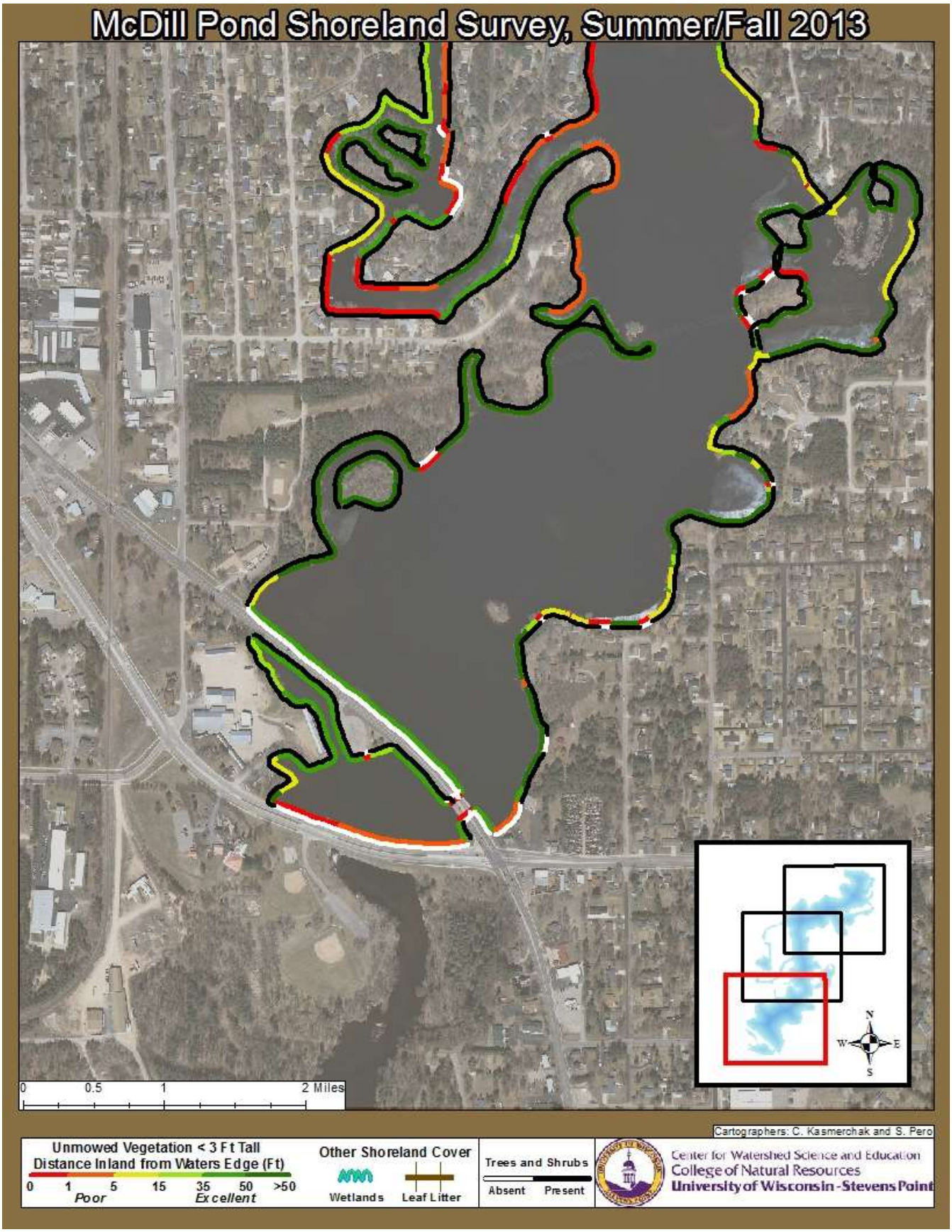


Figure 45. Map 3 of McDill Pond shoreland survey, early summer/fall 2013.

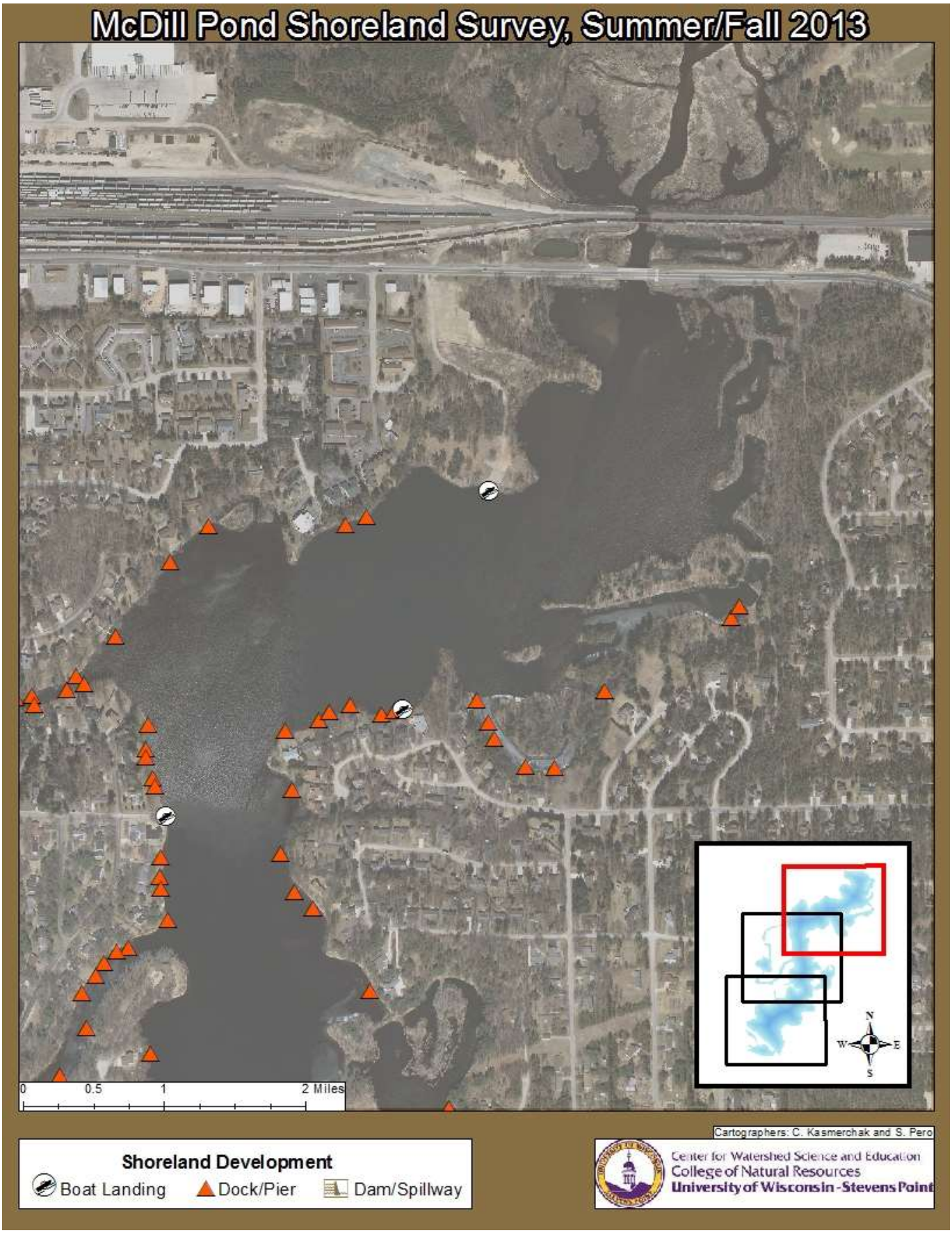


Figure 46. Map 1 of McDill Pond shoreland disturbance survey showing boat landings, docks/piers and dam/spillways, early summer/fall 2013.

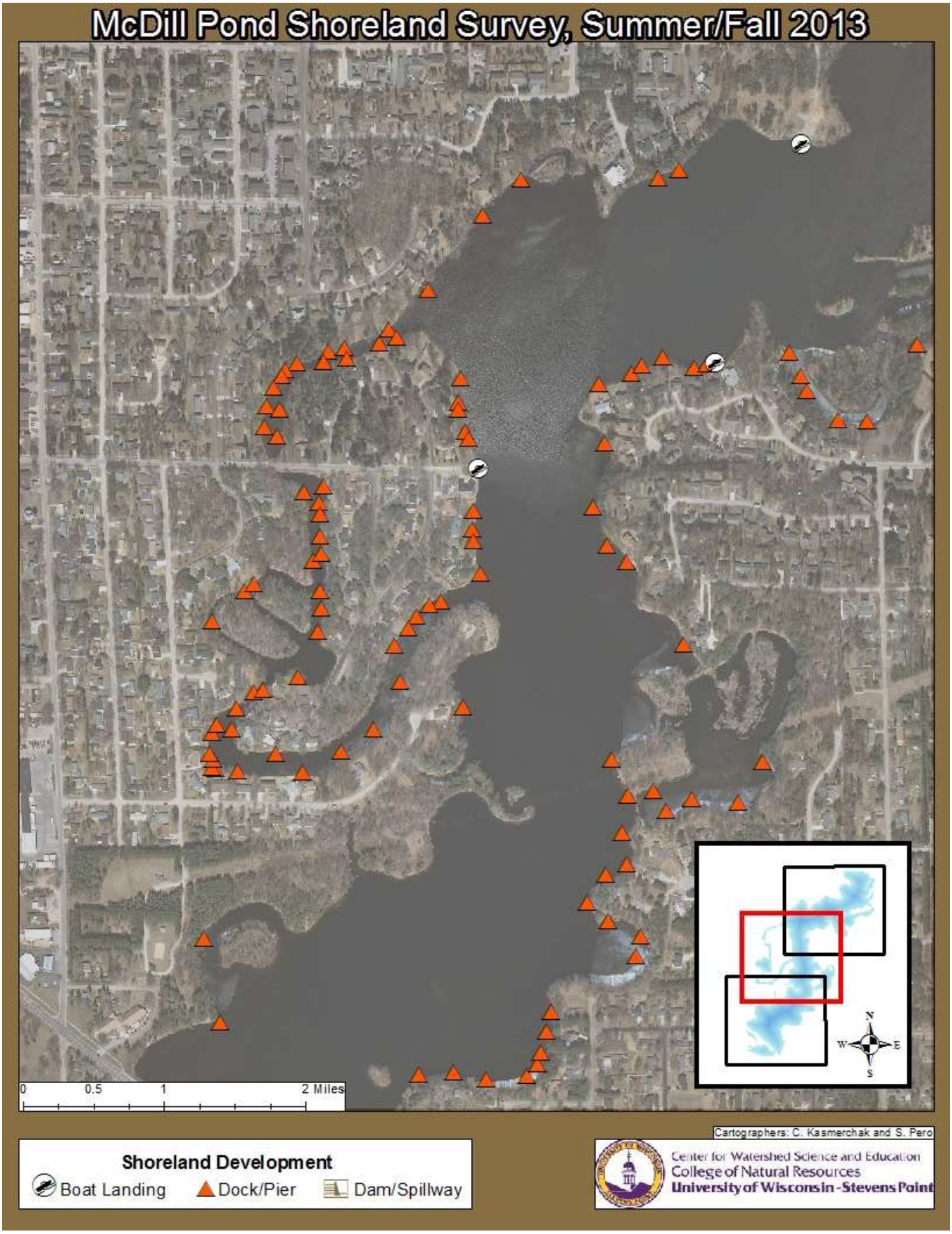


Figure 47. Map 2 of McDill Pond shoreland disturbance survey showing boat landings, docks/piers and dam/spillways, early summer/fall 2013.

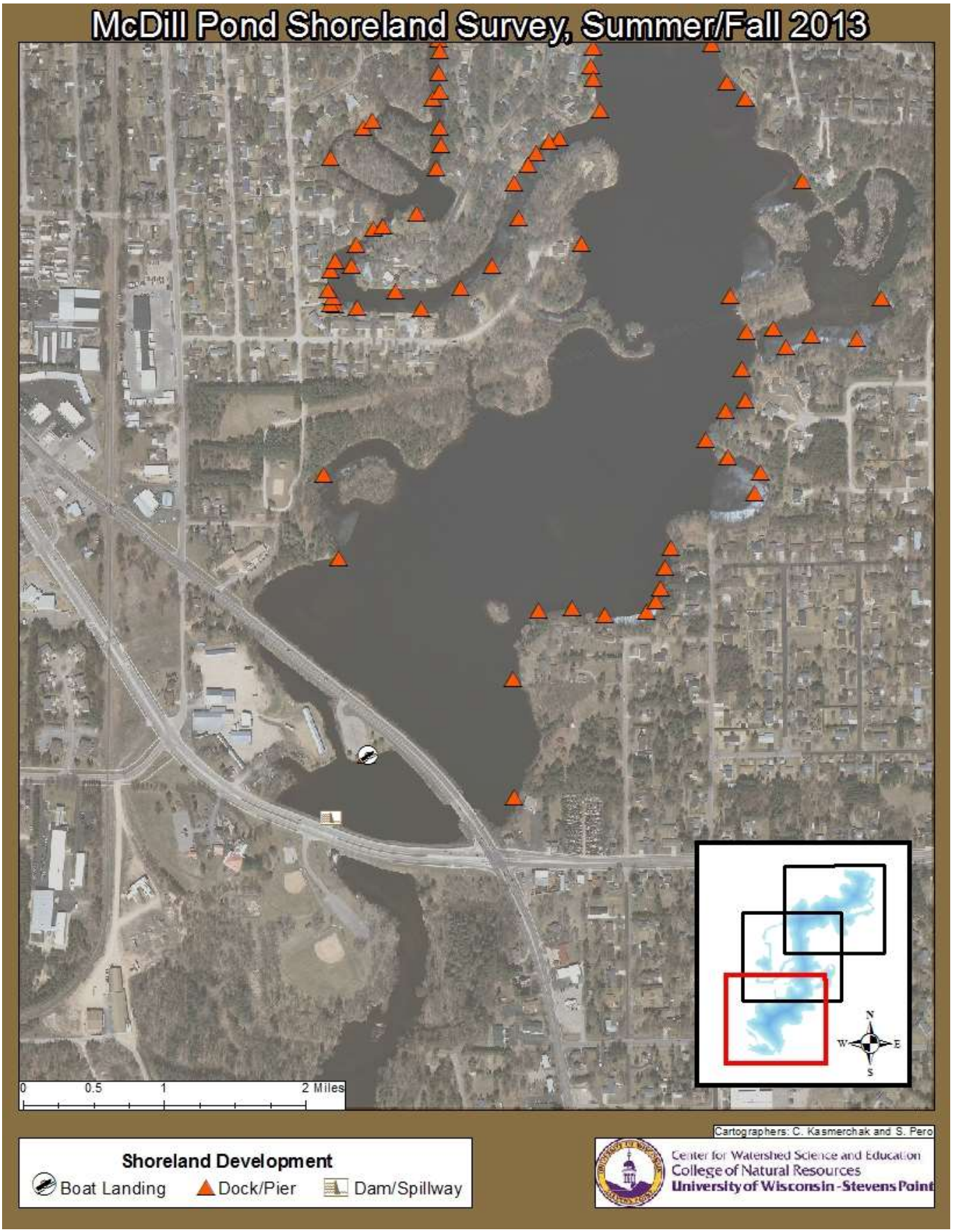


Figure 48. Map 3 of McDill Pond shoreland disturbance survey showing boat landings, docks/piers and dam/spillways, early summer/fall 2013.

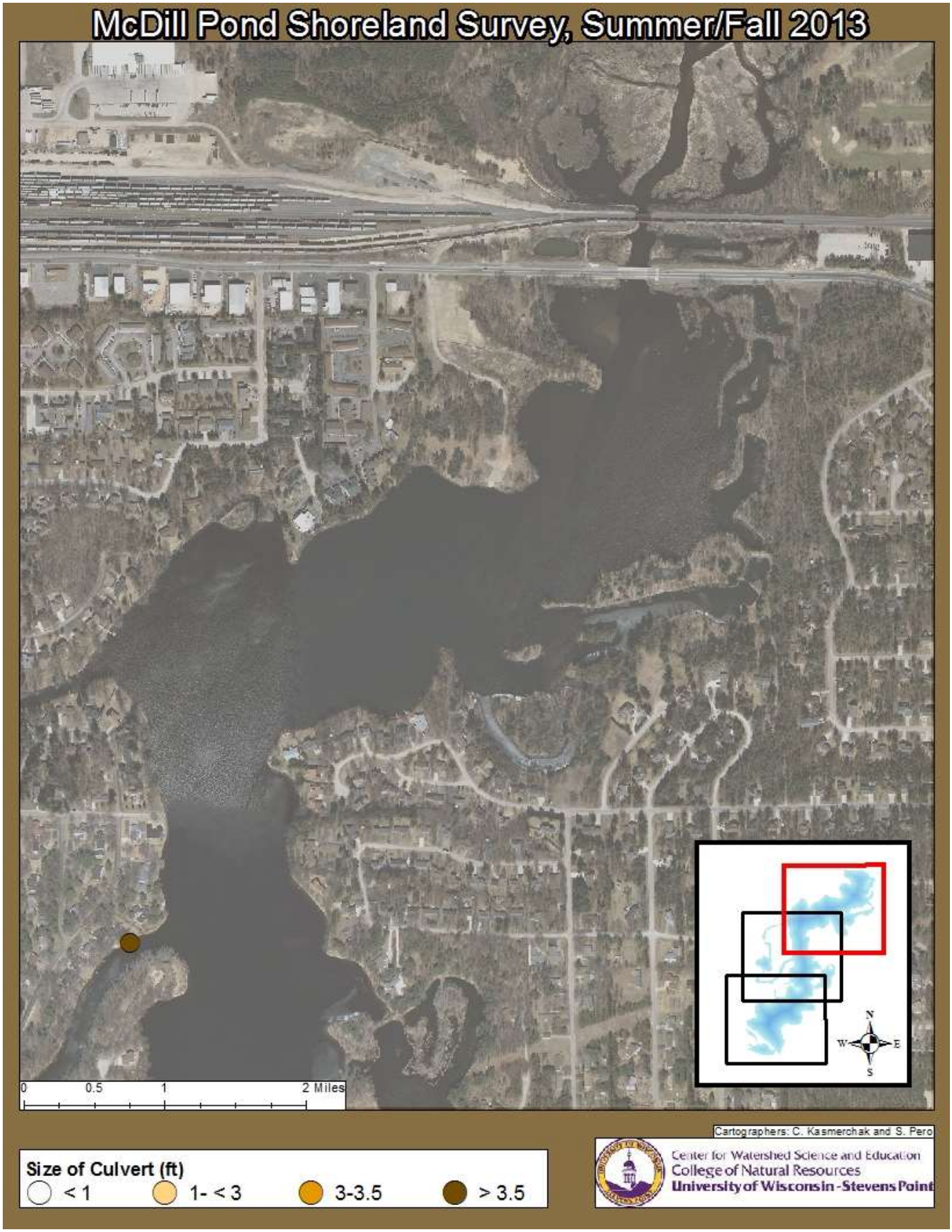


Figure 49. Map 1 of McDill Pond shoreland disturbance survey showing culverts, early summer/fall 2013.

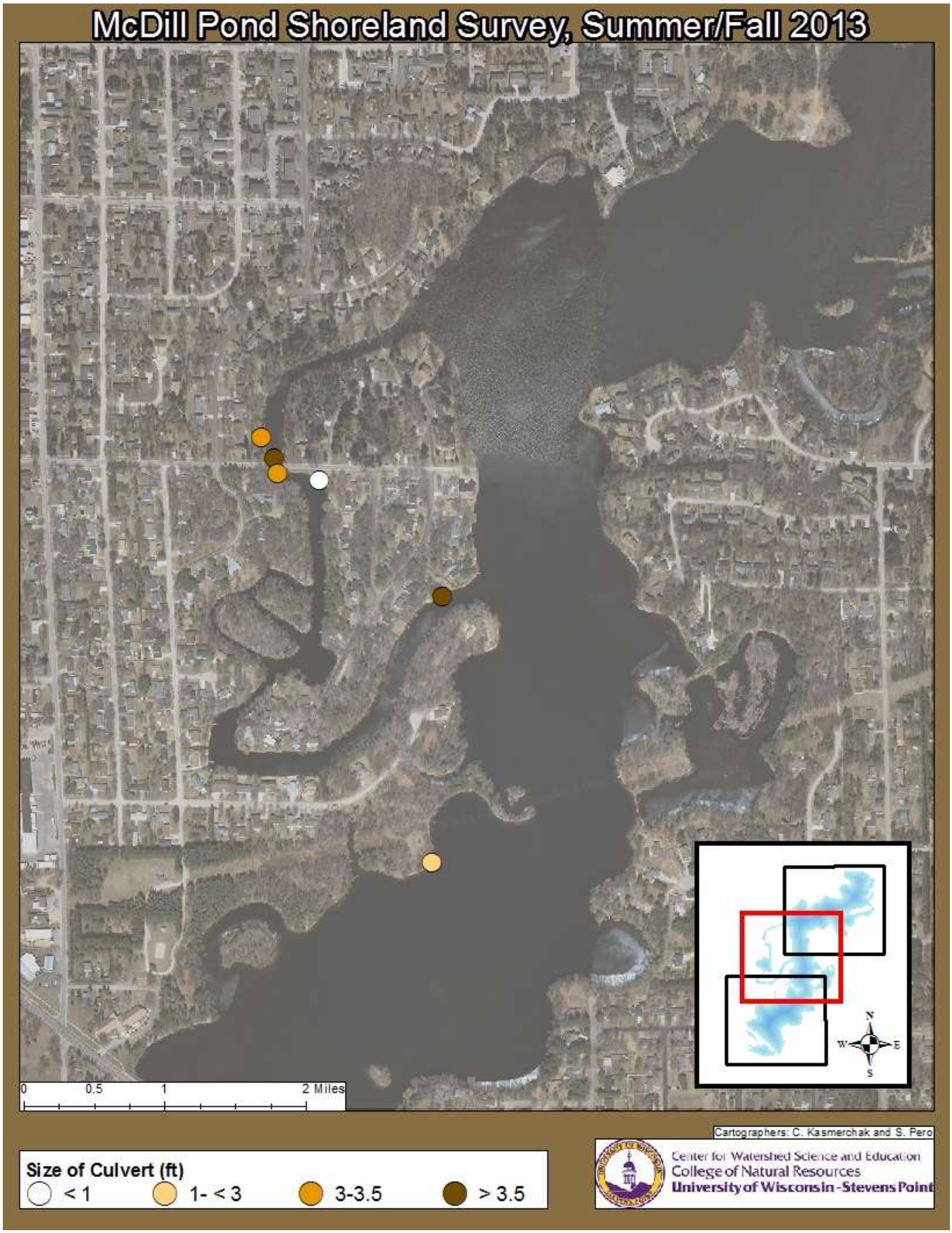


Figure 50. Map 2 of McDill Pond shoreland disturbance survey showing culverts, early summer/fall 2013.

Figure 51. Map 3 of McDill Pond shoreland disturbance survey showing culverts, early summer/fall 2013.

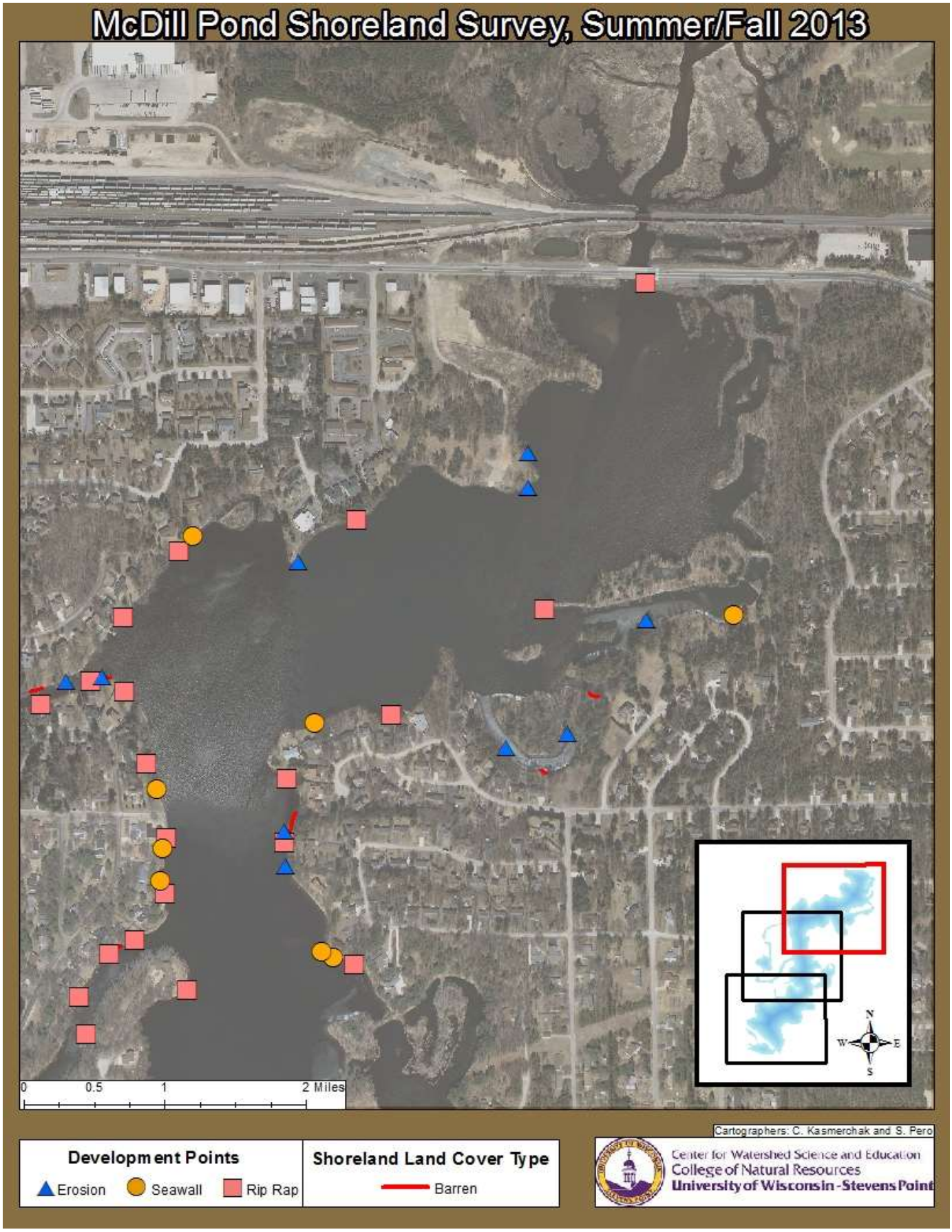


Figure 52. Map 1 of McDill Pond shoreland disturbance survey showing erosion, seawalls, rip-rap and barren areas, early summer/fall 2013.

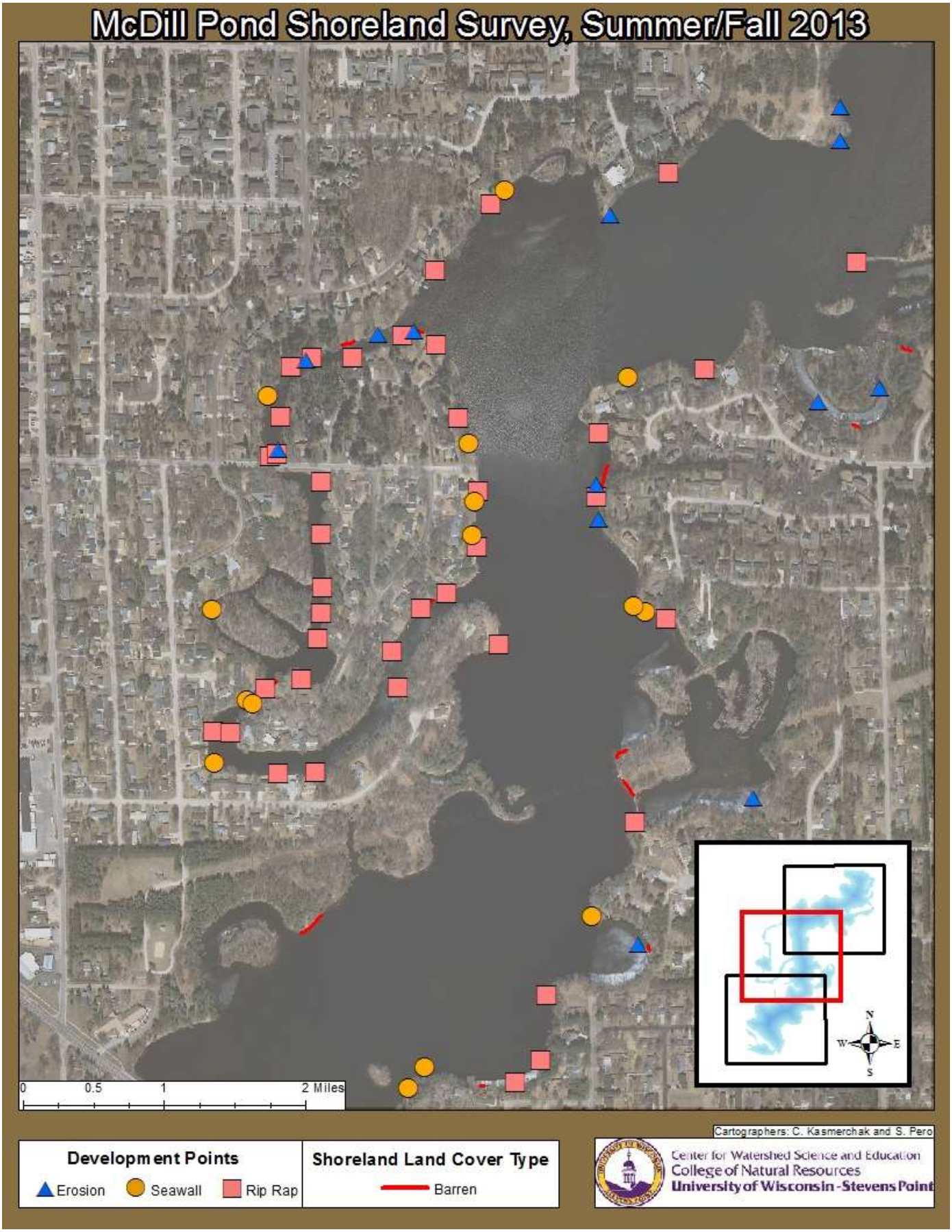


Figure 53. Map 2 of McDill Pond shoreland disturbance survey showing erosion, seawalls, rip-rap and barren areas, early summer/fall 2013.

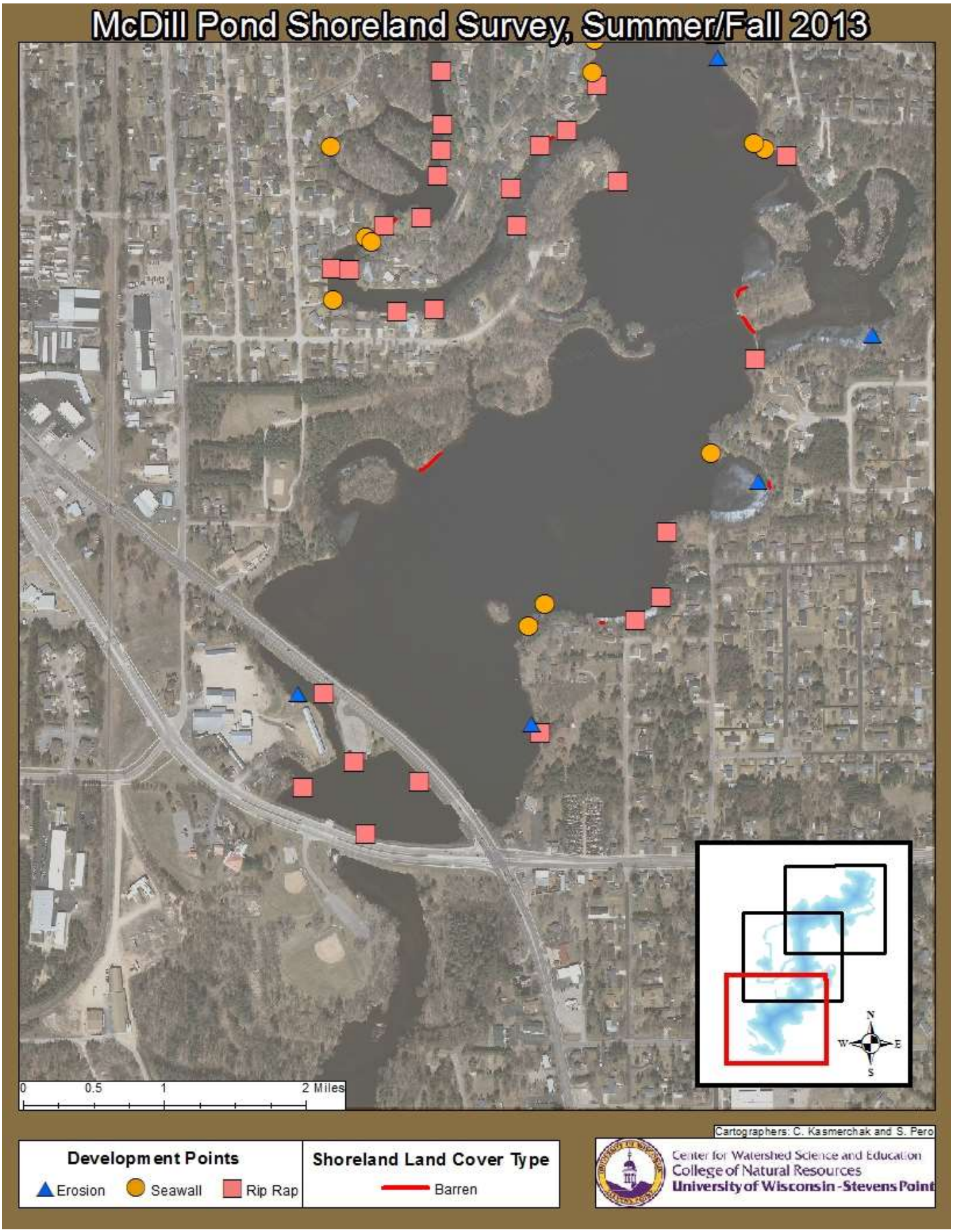


Figure 54. Map 3 of McDill Pond shoreland disturbance survey showing erosion, seawalls, rip-rap and barren areas, early summer/fall 2013.

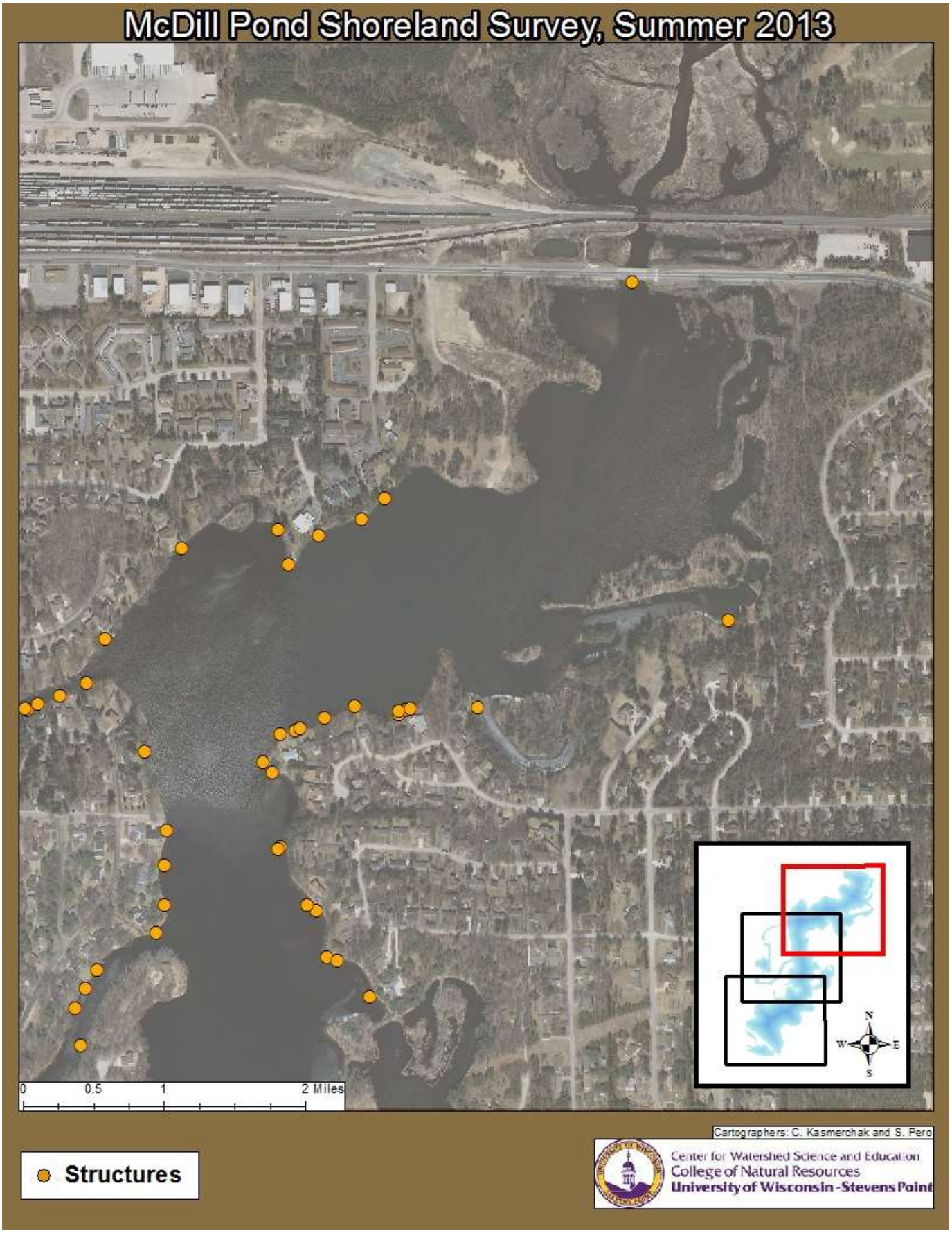


Figure 55. Map 1 of McDill Pond shoreland disturbance survey showing structures near the shoreland, early summer/fall 2013.

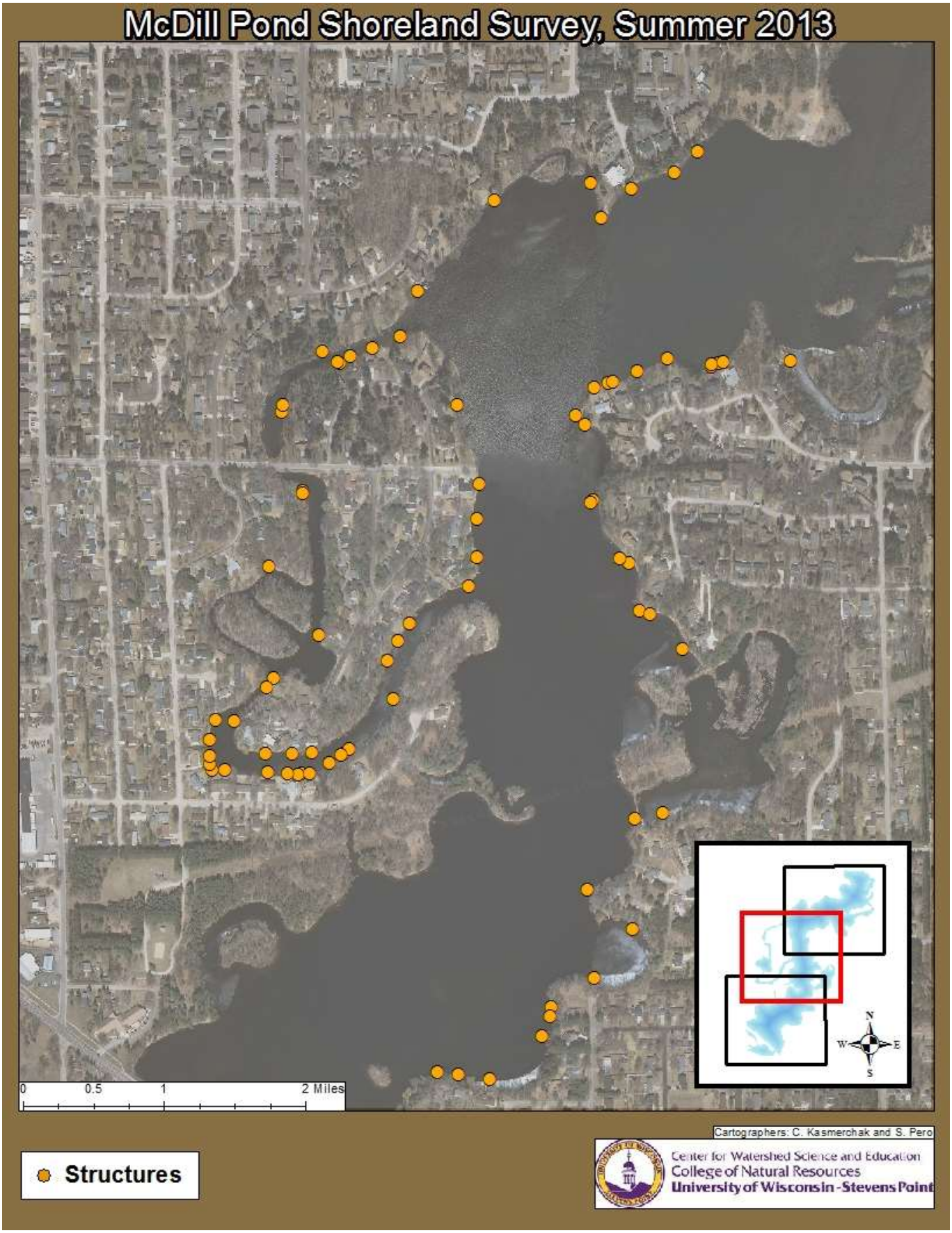


Figure 56. Map 2 of McDill Pond shoreland disturbance survey showing structures near the shoreland, early summer/fall 2013.

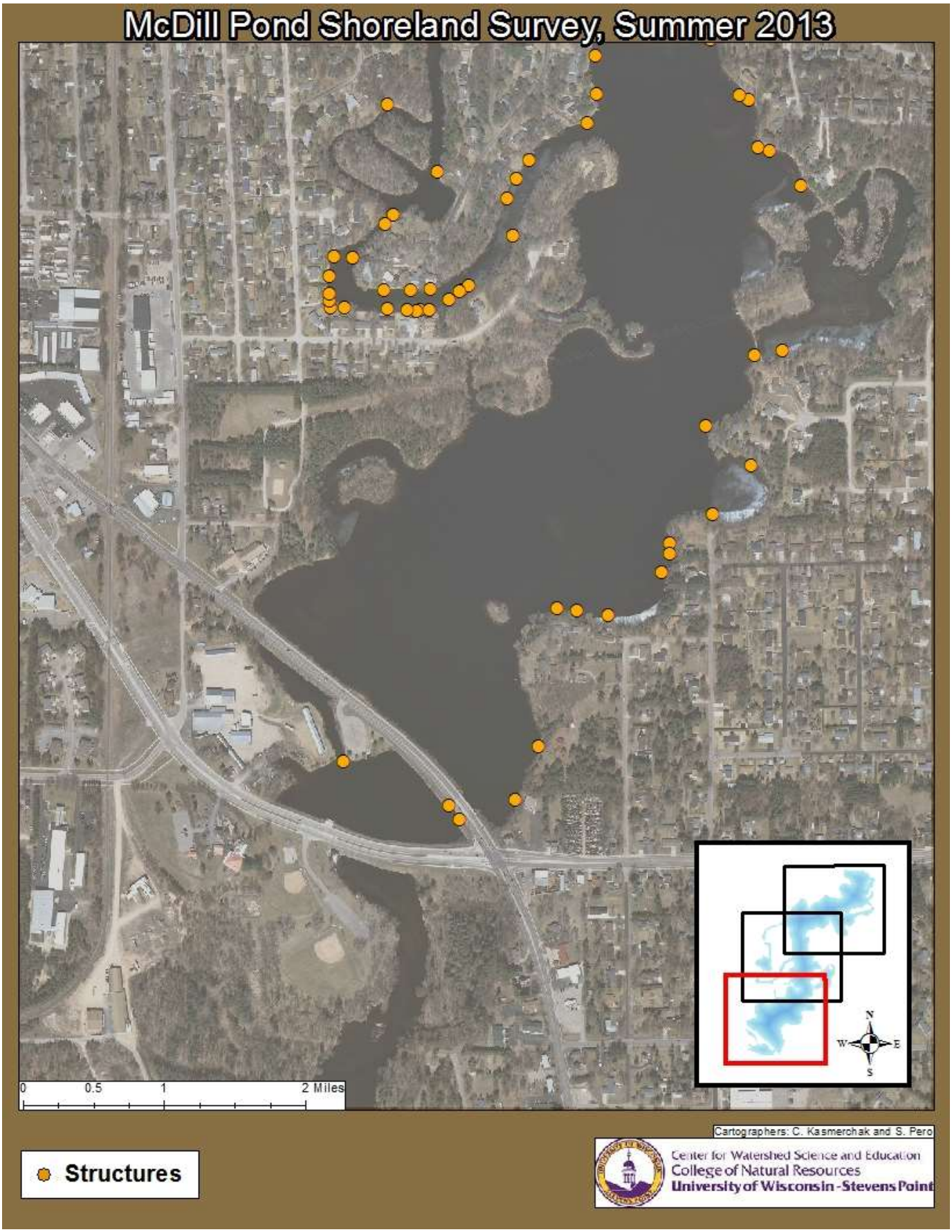


Figure 57. Map 3 of McDill Pond shoreland disturbance survey showing structures near the shoreland, early summer/fall 2013.

McDill Pond 2010 Shoreland Inventory

Shoreland surveys were conducted annually from 2007 to 2010 to measure the extent of changes as residents and the Village of Plover worked to improve the shores. The survey categories were changed over the years to provide a better measure of incremental improvements. Changes to McDill Pond's shoreland vegetation can be seen by comparing Figures 44-46 to Figure 58 below .

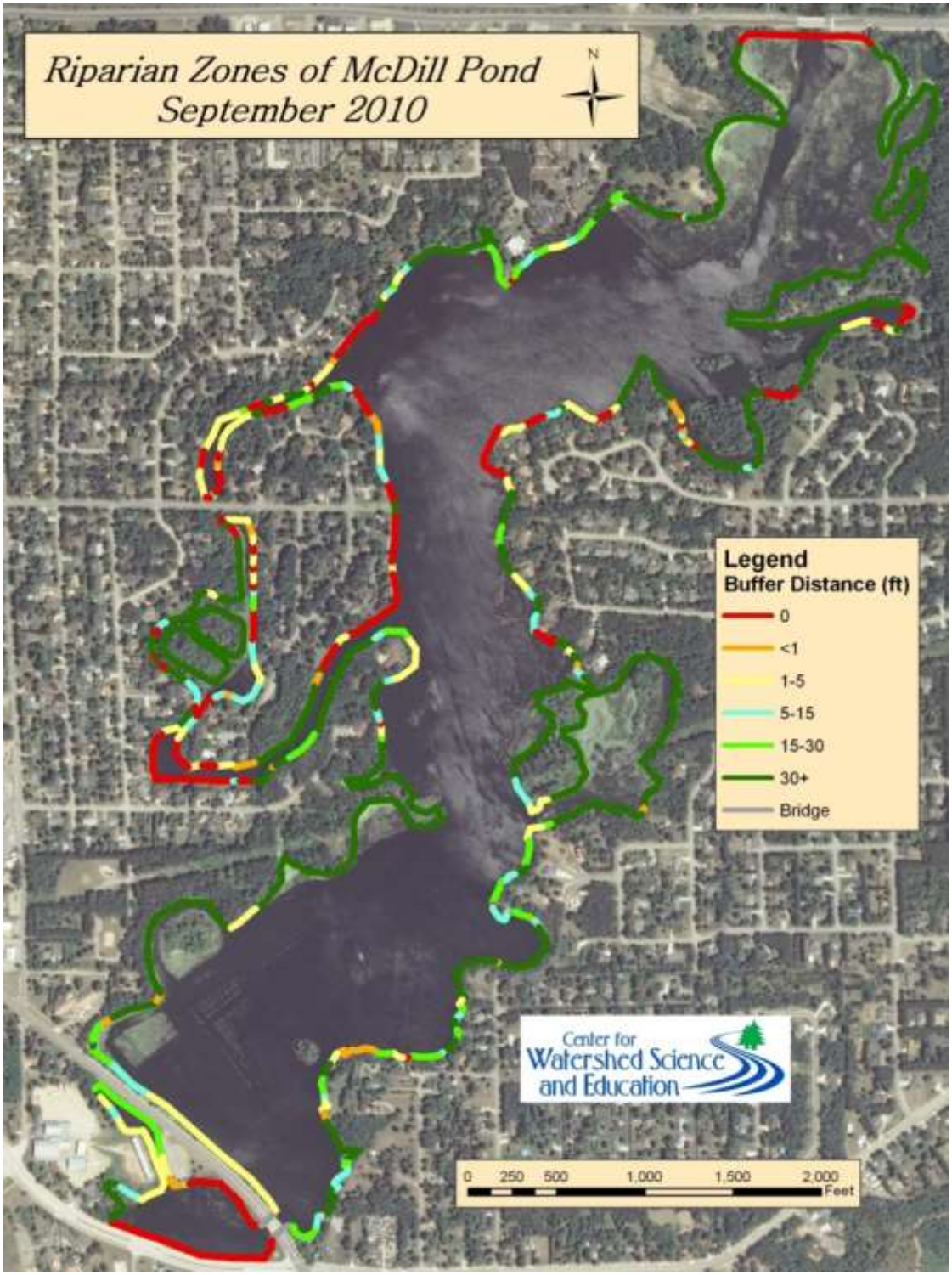


Figure 58. McDill Pond shoreland survey, early fall 2010.

McDill Pond 2010-2013 Shoreland Inventory Comparison

The shoreland surveys on McDill Pond in 2010 and 2013 were conducted slightly differently; however, changes in shoreland buffers can still be quantified. This was done by combining some of the buffer depth categories from the 2010 survey to better mirror the 2013 survey. In the 2010 survey, the "0 ft" buffer category was combined with the "bridge" category, since the 2013 survey marked the bridge as a "0 ft" buffer. Additionally, the "<1 ft" category in the 2010 survey was combined with the "1-5 ft" category for easier comparision with the "1-5 ft" category in the 2013 survey. The largest shoreland vegetative buffer category in the 2010 survey was "30+ ft," whereas the largest buffer category in the 2013 survey was ">50 ft." In order to compare the largest buffer categories between the two surveys, the "35-50 ft" and ">50 ft" categories were combined in the 2013 survey. Table 14 and Table 15 show the total feet of shoreland buffers falling into the survey categories for 2010 and 2013.

Table 14. Length of shoreland buffers around McDill Pond by category, 2010.

McDill Pond 2010	
Buffer Category	**Length (ft)**
0 ft	7790
<1 ft	1378
1-5 ft	6451
5-15 ft	3249
15-30 ft	3735
30+ ft	27031
Bridge	248

Table 15. Length of shoreland buffers around McDill Pond by category, 2013.

McDill Pond 2013	
Buffer Category	**Length (ft)**
0 ft	6968
1-5 ft	5812
>5-15 ft	8579
>15-35 ft	6546
>35-50 ft	3642
>50 ft	21758

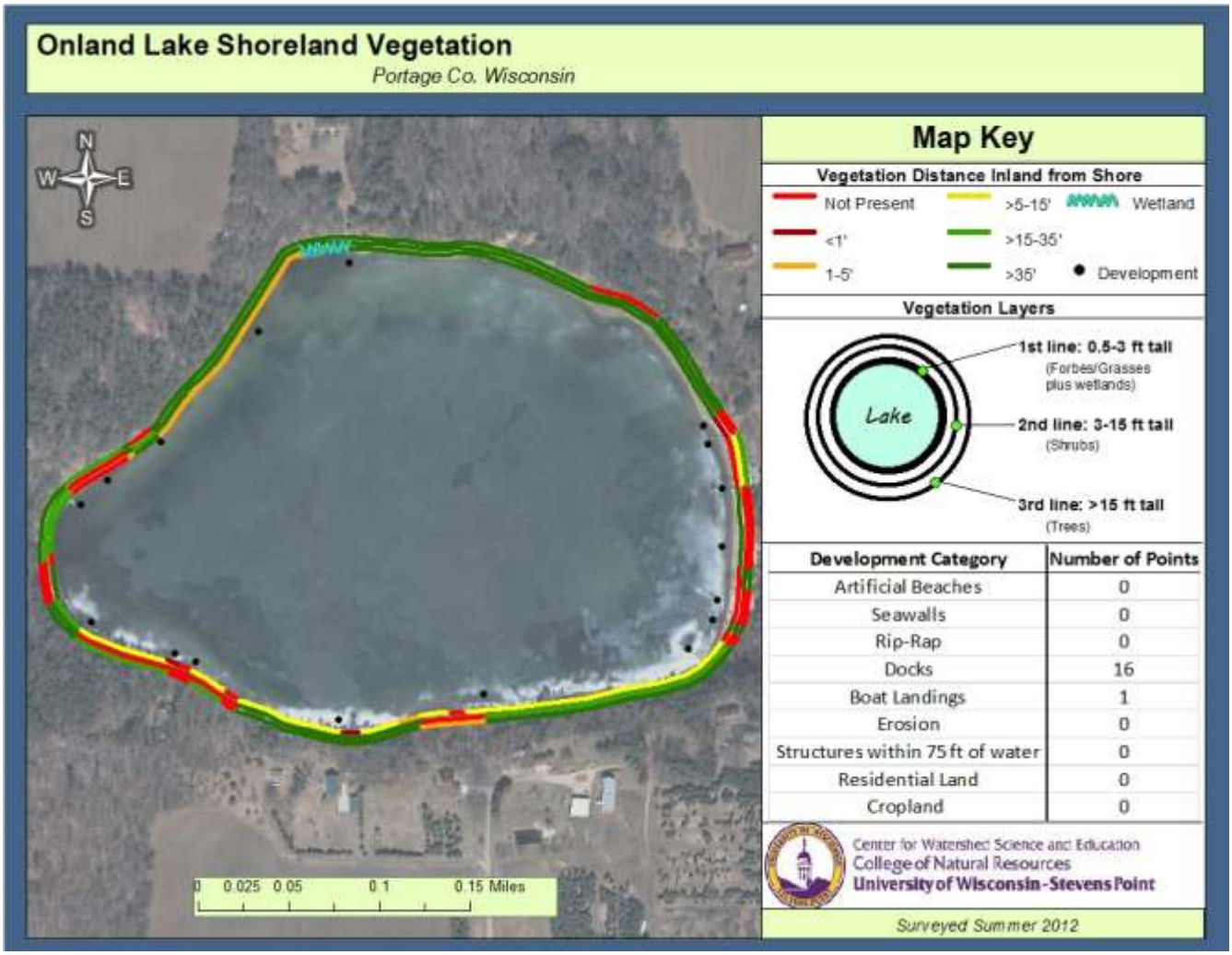
Based on the comparison between the 2010 and 2013 surveys of McDill Pond, it can be concluded that vegetative buffers falling into the '>5-15 ft' and '>15-35 ft' categories have increased. Additionally, there has been a decrease in buffer depths less than 5 feet. This demonstrates that vegetative buffers along the shoreland of McDill Pond have increased over the past three years. With the increase of buffers in the '>15-35 ft' category, lake property owners are increasing their compliance with county shoreland zoning ordinances. An interesting aspect of this is that the '>35 ft' category has decreased in total length of shoreline since the 2010 survey. This may be a result of increased shoreland development on McDill Pond over the past three years, and thus vegetative buffers greater than 35 feet inland have decreased.

Onland Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Onland Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Onland Lake's shoreland are shown in Figure 59. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees).

The 2012 survey shows improvements to shoreland vegetation on the northern and southwestern ends of Onland Lake since the 2002-2003 survey (Figure 60). Degradation of shoreland vegetation has occurred on the eastern side of the lake. Further efforts should be made to restore shoreland vegetation around Onland Lake to a depth of at least 35 feet inland from the shoreline. This distance is consistent with county and state shoreland standards.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	16
Boat Landings	1
Erosion	0
Structures within 75 ft of water	0
Residential Land	0
Cropland	0

Figure 59. Shoreland vegetation survey around Onland Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 60). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 16.

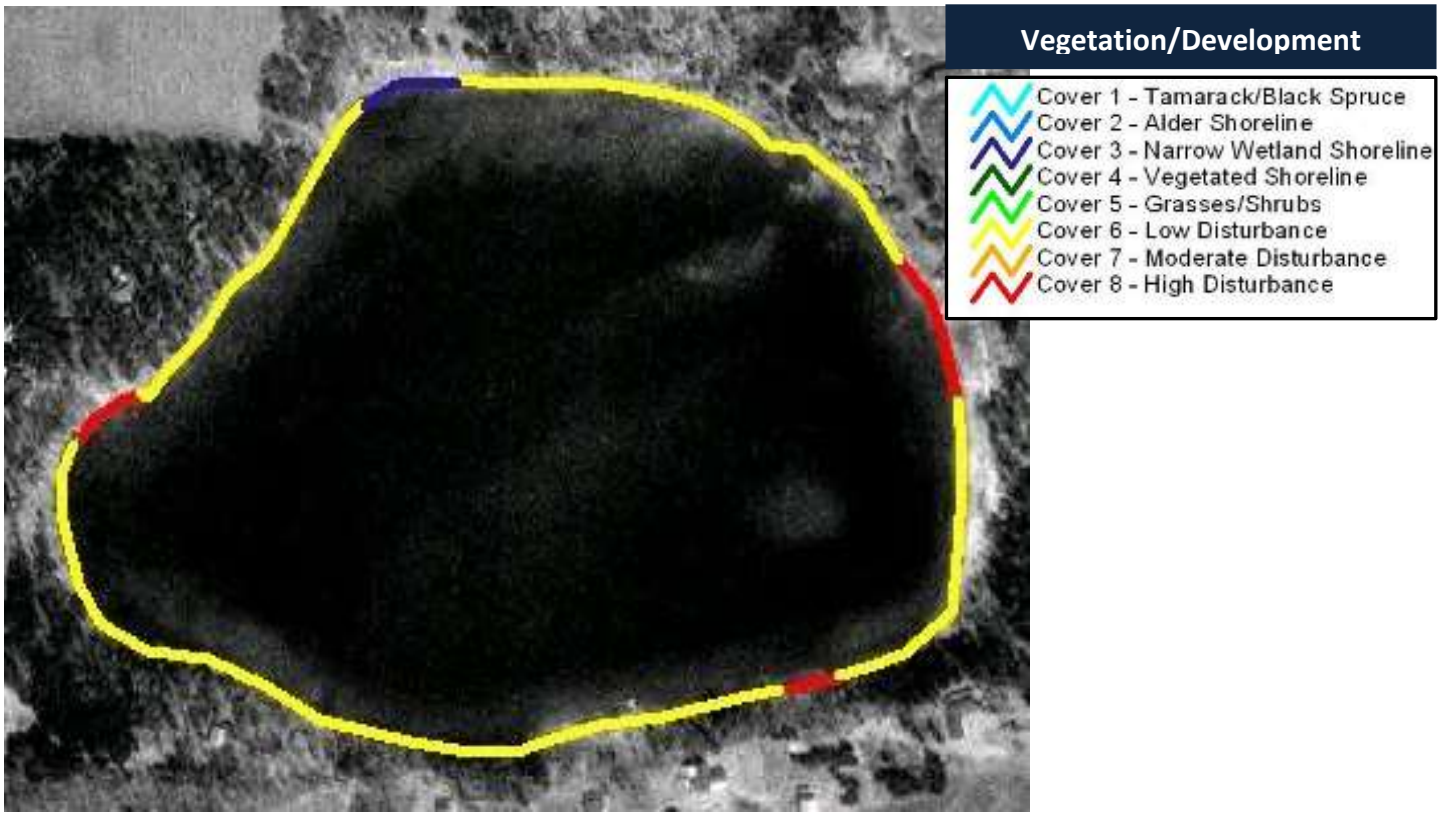
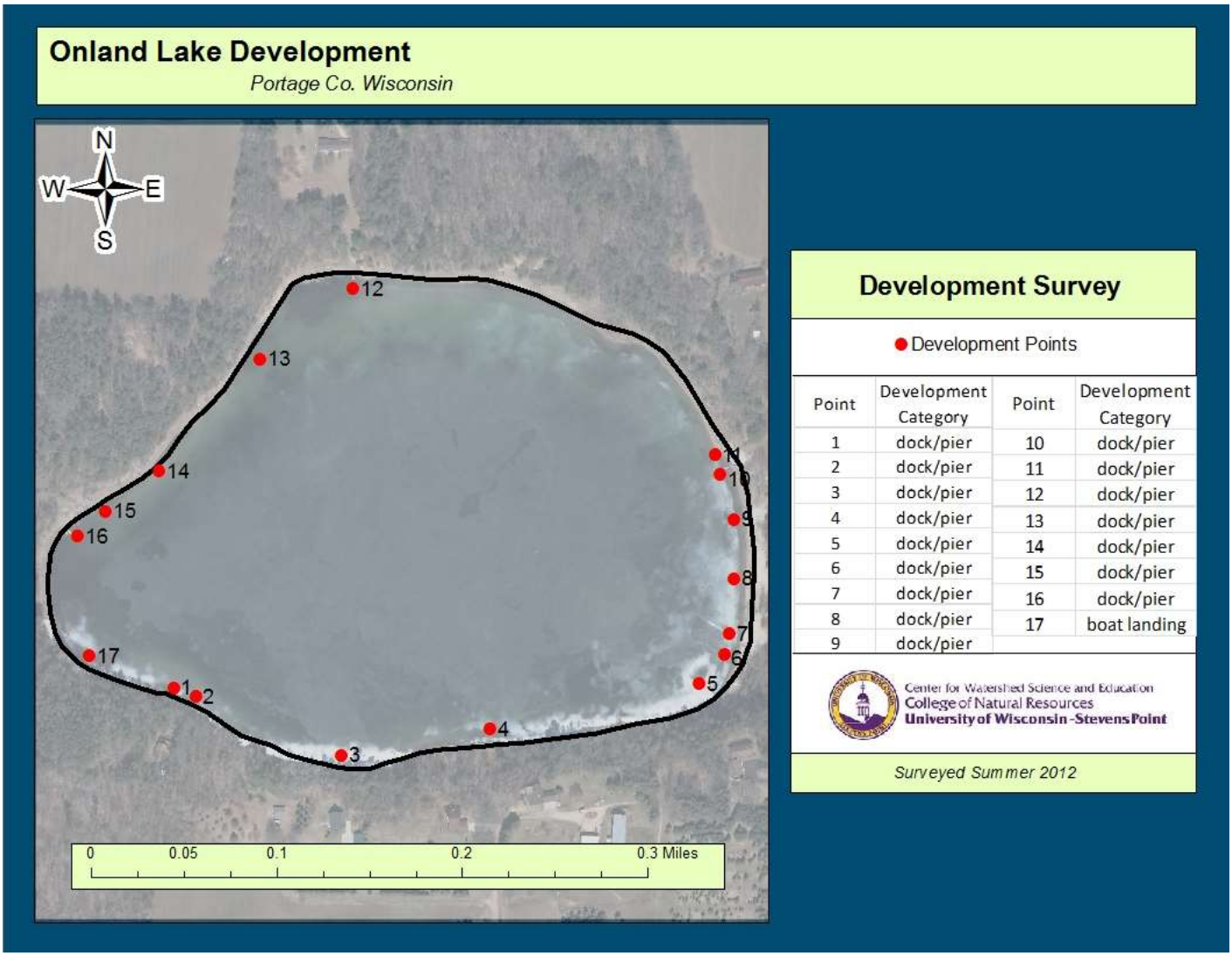


Figure 60. Shoreland vegetation survey around Onland Lake, 2002-2003.

Table 16. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Onland Lake (Figure 61). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. Seventeen locations of human influence were identified around Onland Lake - all were docks/piers/boat launches.



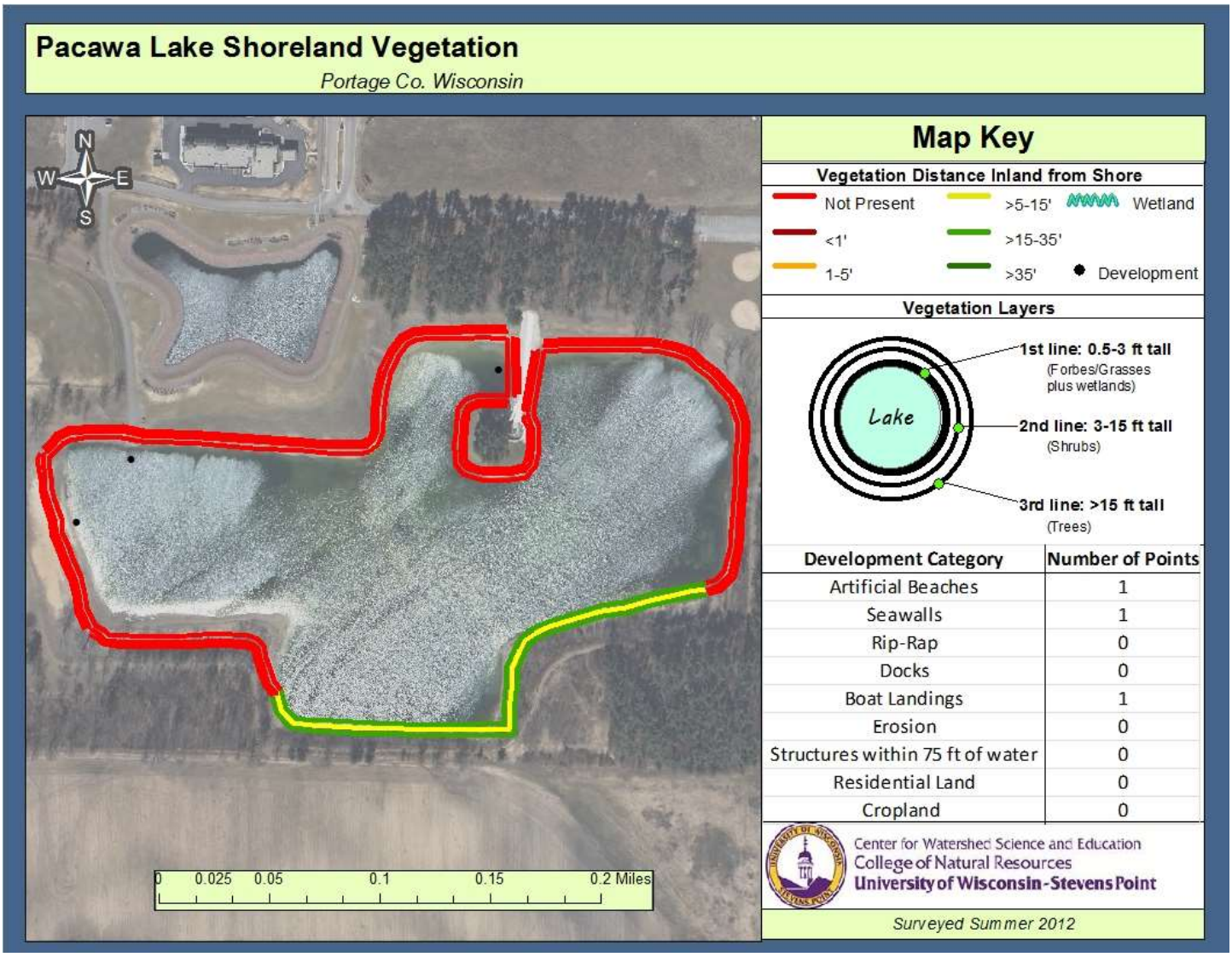
Point	Development Category	Point	Development Category
1	dock/pier	10	dock/pier
2	dock/pier	11	dock/pier
3	dock/pier	12	dock/pier
4	dock/pier	13	dock/pier
5	dock/pier	14	dock/pier
6	dock/pier	15	dock/pier
7	dock/pier	16	dock/pier
8	dock/pier	17	boat landing
9	dock/pier		

Figure 61. Features of human influence around Onland Lake, summer 2012.

Lake Pacawa Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Lake Pacawa. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Lake Pacawa's shoreland survey are shown in Figure 62. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). The southeastern shores of Lake Pacawa have good vegetative buffers, but the rest of the shoreland is in a disturbed state, which impacts the water quality, habitat and fishery. A plan should be developed that incorporates better shoreland practices with public use and access.



Development Category	Number of Points
Artificial Beaches	1
Seawalls	1
Rip-Rap	0
Docks	0
Boat Landings	1
Erosion	0
Structures within 75 ft of water	0
Residential Land	0
Cropland	0

Figure 62. Shoreland vegetation survey around Lake Pacawa, summer 2012.

During the 2012 survey, an assessment of human influence features was also conducted around Lake Pacawa (Figure 63). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. Three sites were identified around Lake Pacawa during the survey.

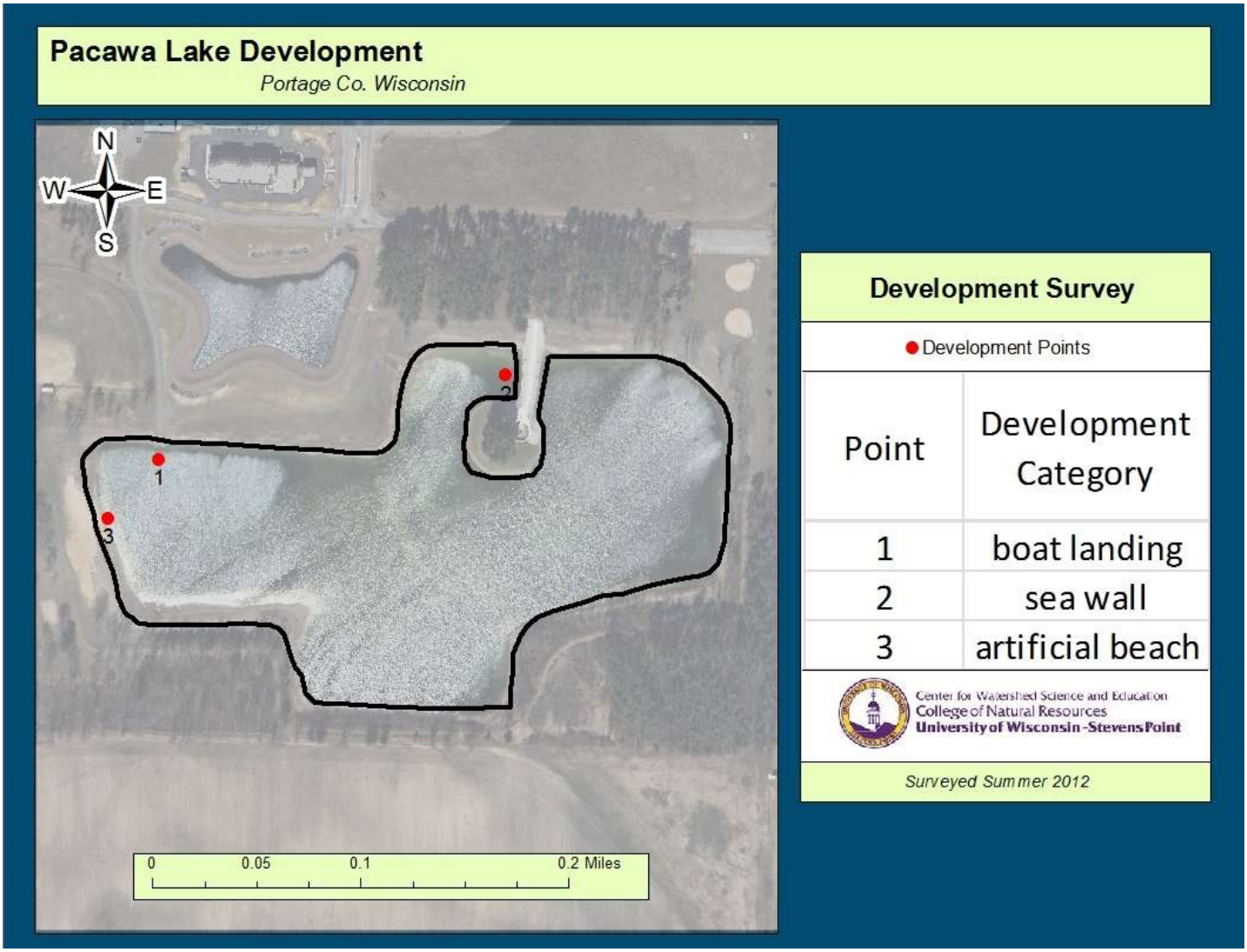


Figure 63. Features of human influence around Lake Pacawa, summer 2012.

Pickerel Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Pickeral Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Pickerel Lake's shoreland are shown in Figure 64. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Most of the shoreline has vegetation, with the exceptions of the camp access and the public boat launch. Water levels have been low, making it difficult to plan and manage these access points, but efforts should be made to balance public access with ensuring that runoff from roads does not carry sediment and nutrients to the lake.

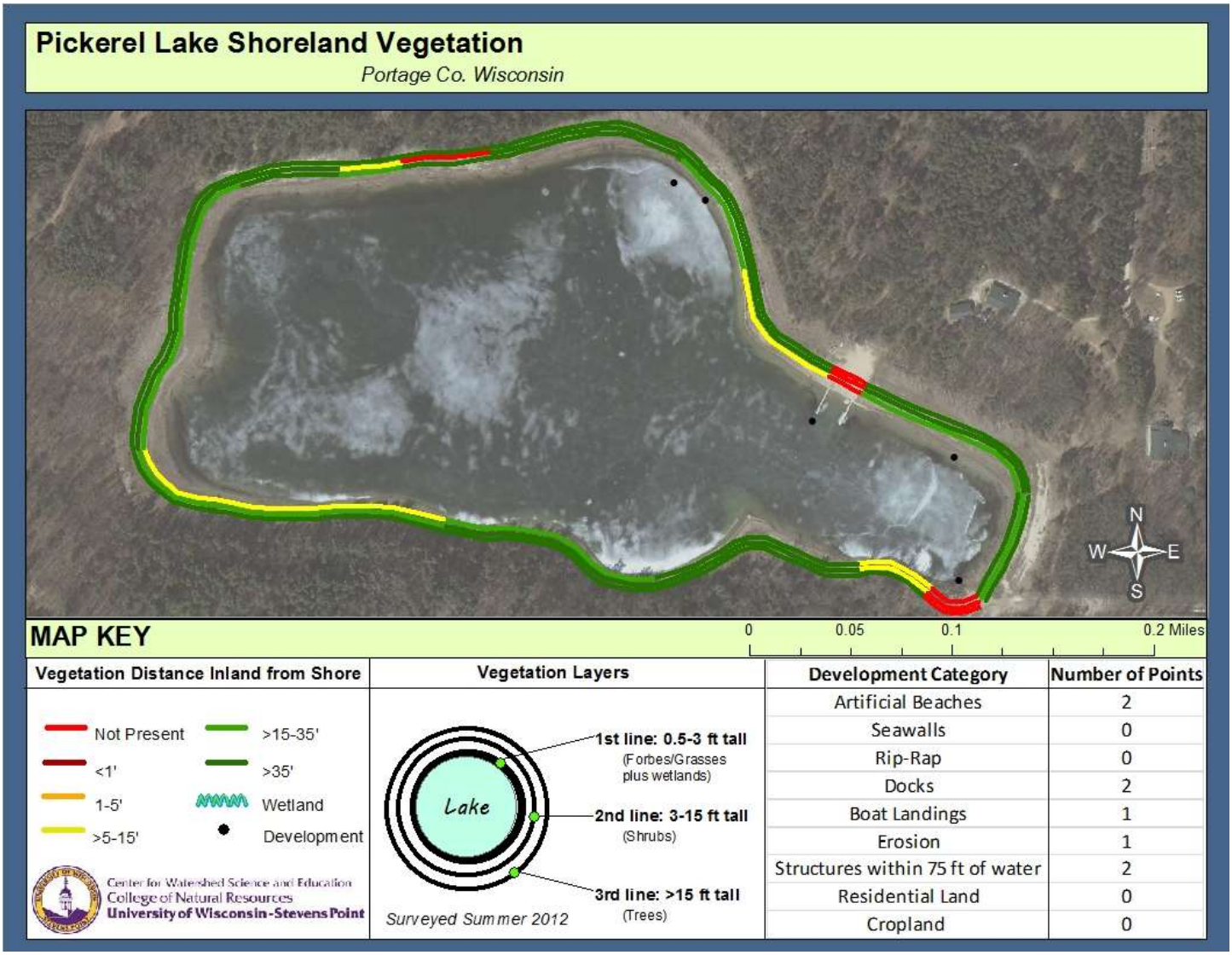


Figure 64. Shoreland vegetation survey around Pickerel Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 65). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 17. There were several improvements in the lengths of undisturbed shoreline around Pickerel Lake between 2002 and 2012.

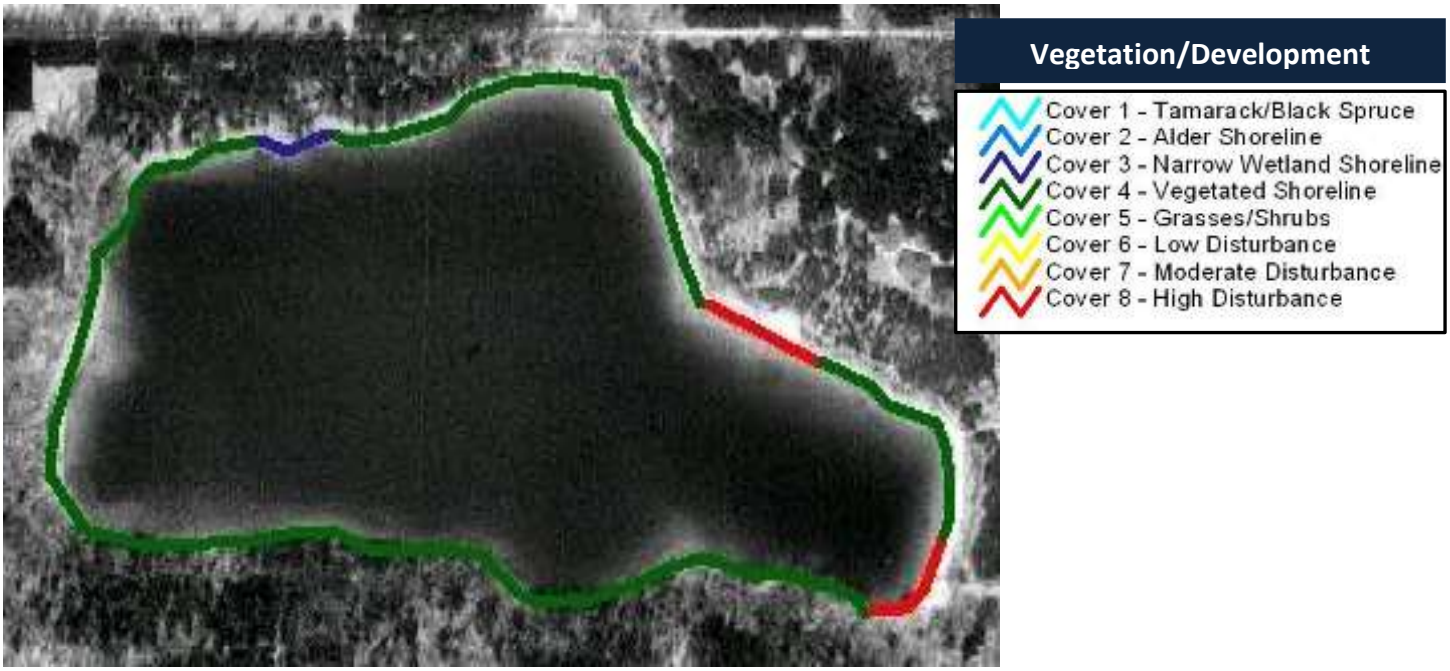


Figure 65. Shoreland vegetation survey around Pickerel Lake, 2002-2003.

Table 17. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Pickerel Lake (Figure 66). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. Five sites were identified around Pickerel Lake. Runoff from near shore buildings should be mitigated by use of rain gardens, swales or rain barrels.

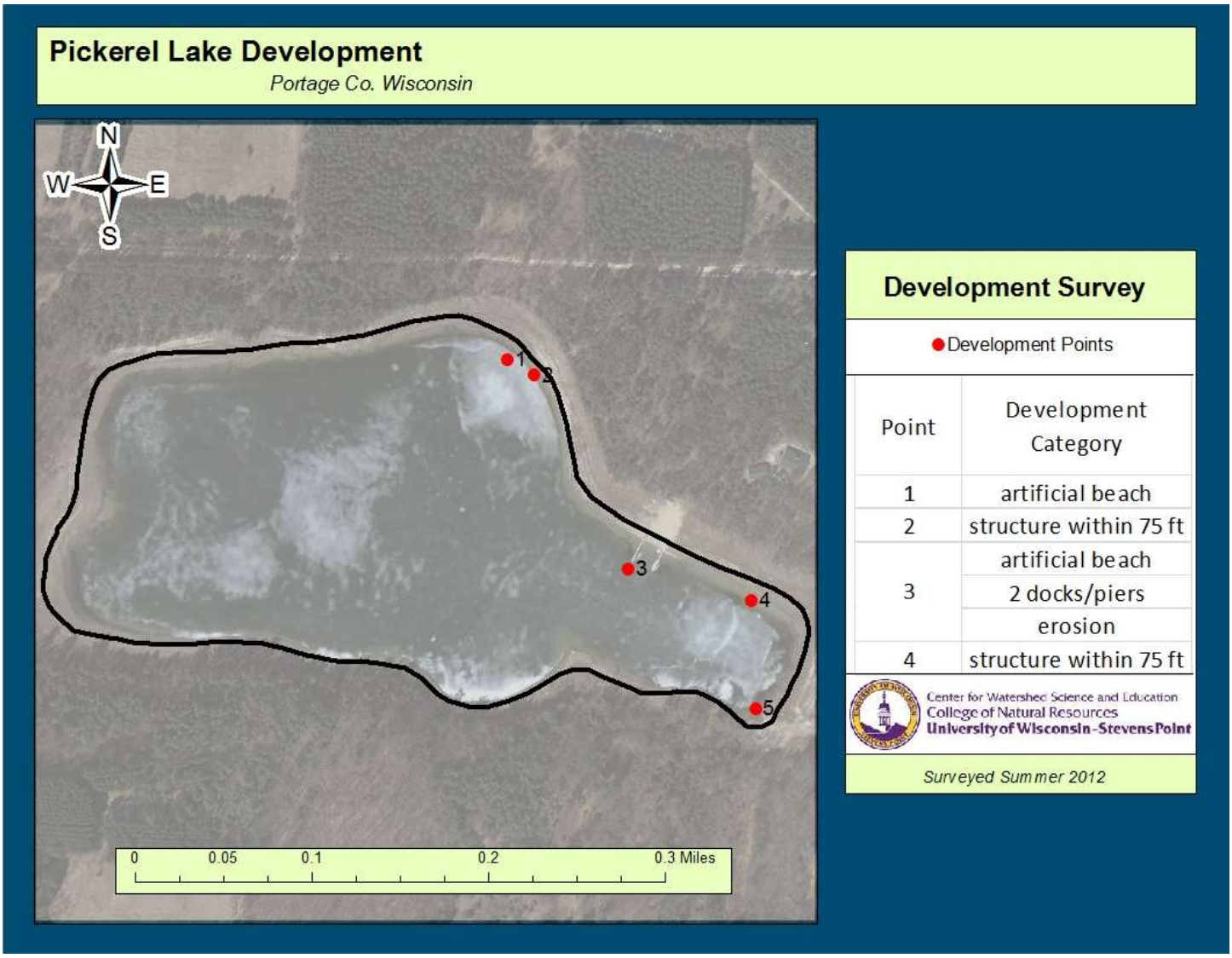
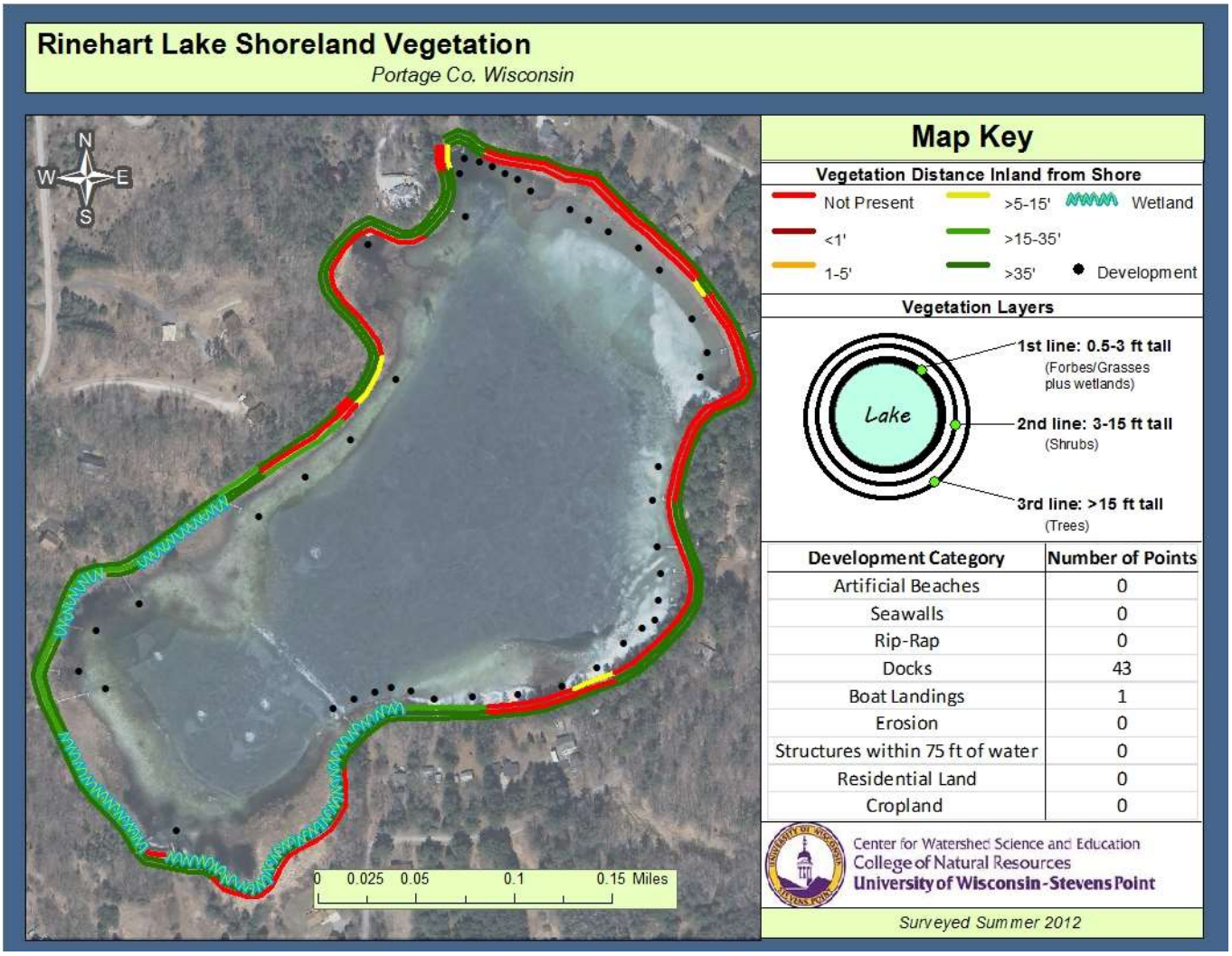


Figure 66. Features of human influence around Pickerel Lake, summer 2012.

Rinehart Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Rinehart Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Rinehart Lake's shoreland are shown in Figure 67. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). In 2012, approximately 3,700 feet of the 6,364-foot shoreline lacked shorter vegetation to a depth of 35 feet inland. The shorter vegetation provides filtration for runoff heading to the lake and habitat for many animals in and near the lake. Efforts should be made to restore the vegetative buffer to at least 35 feet inland which is consistent with county and state shoreland standards.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	0
Docks	43
Boat Landings	1
Erosion	0
Structures within 75 ft of water	0
Residential Land	0
Cropland	0

Figure 67. Shoreland vegetation survey around Rinehart Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 68). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 18. Little change in disturbed shoreline lengths from 2002 to 2012 was observed for Rinehart Lake. Further efforts should be made to improve shoreland health and quality.

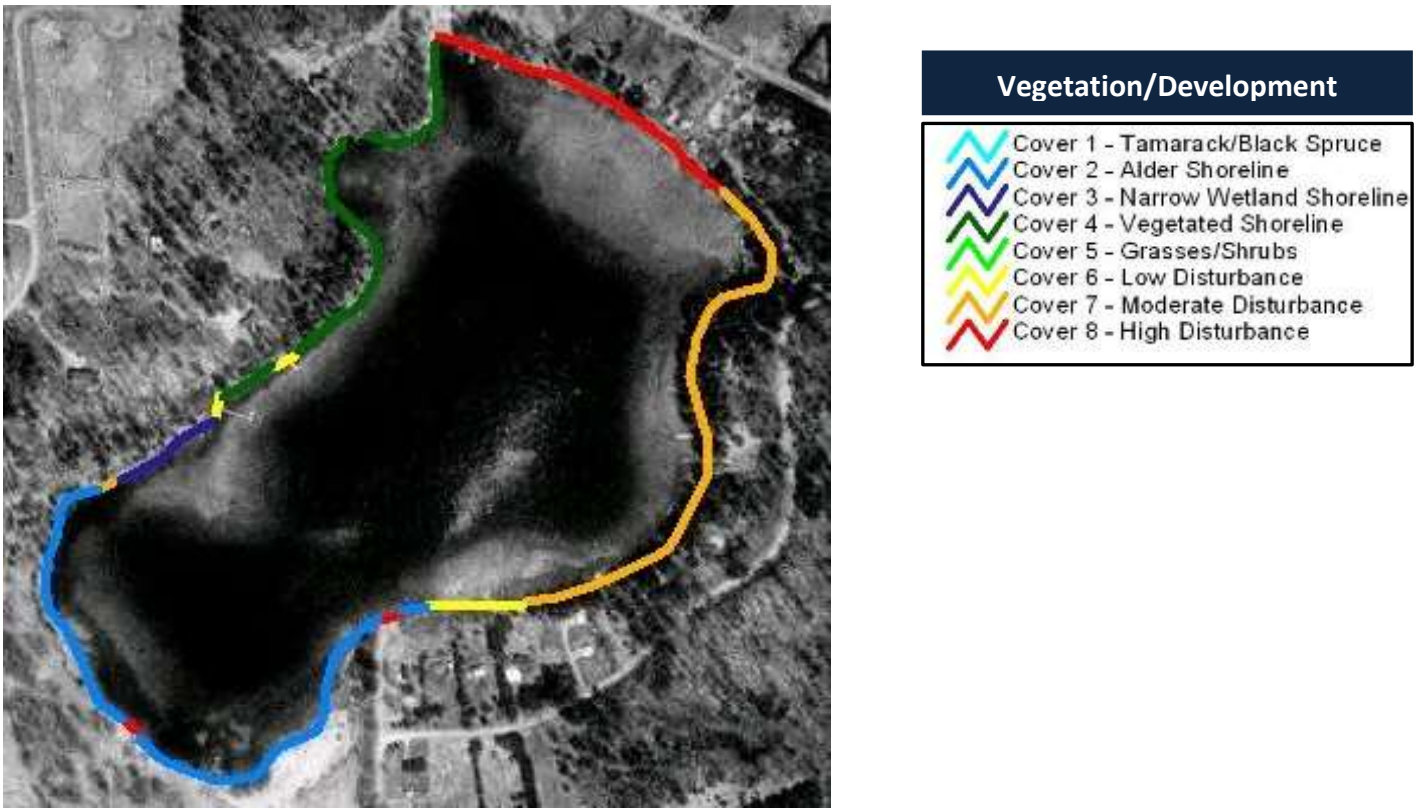
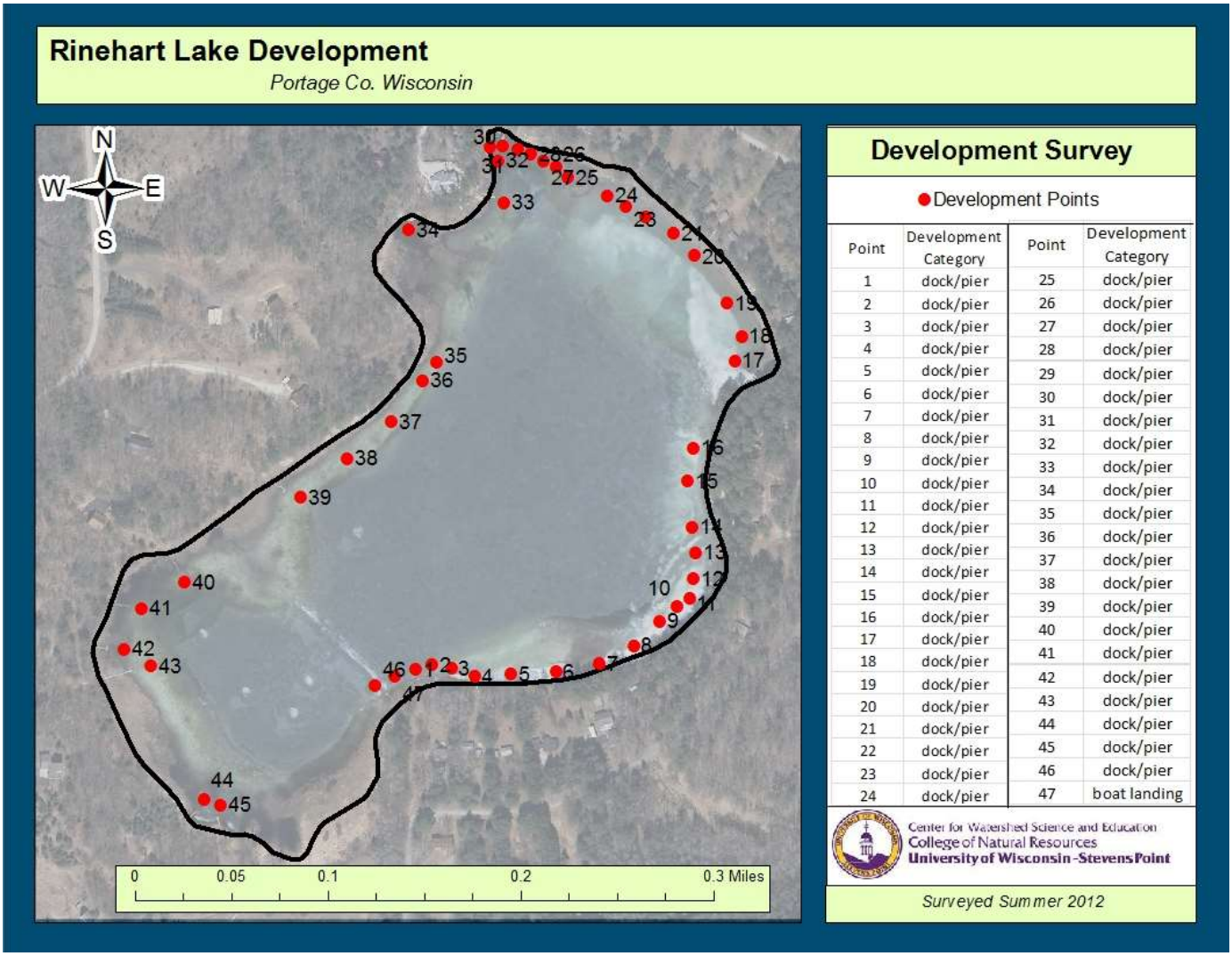


Figure 68. Shoreland vegetation survey around Rinehart Lake, 2002-2003.

Table 18. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Rinehart Lake (Figure 69). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. All 47 sites of disturbance around Rinehart Lake were docks/piers/boat launches.



Point	Development Category	Point	Development Category
1	dock/pier	25	dock/pier
2	dock/pier	26	dock/pier
3	dock/pier	27	dock/pier
4	dock/pier	28	dock/pier
5	dock/pier	29	dock/pier
6	dock/pier	30	dock/pier
7	dock/pier	31	dock/pier
8	dock/pier	32	dock/pier
9	dock/pier	33	dock/pier
10	dock/pier	34	dock/pier
11	dock/pier	35	dock/pier
12	dock/pier	36	dock/pier
13	dock/pier	37	dock/pier
14	dock/pier	38	dock/pier
15	dock/pier	39	dock/pier
16	dock/pier	40	dock/pier
17	dock/pier	41	dock/pier
18	dock/pier	42	dock/pier
19	dock/pier	43	dock/pier
20	dock/pier	44	dock/pier
21	dock/pier	45	dock/pier
22	dock/pier	46	dock/pier
23	dock/pier	47	boat landing
24	dock/pier		

Figure 69. Features of human influence around Rinehart Lake, summer 2012.

Rosholt Millpond Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Rosholt Millpond. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Rosholt Millpond's shoreland are shown in Figure 70. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Most of the disturbed shorter vegetation around the shoreline occurred on the northeastern side of the millpond. Since this is near the road, it is especially important to improve the vegetation to better filter out sediment and nutrients that are flowing to the millpond in runoff. In addition, swales or rain gardens could be installed to help collect runoff and settle out sediment before it reaches the millpond.

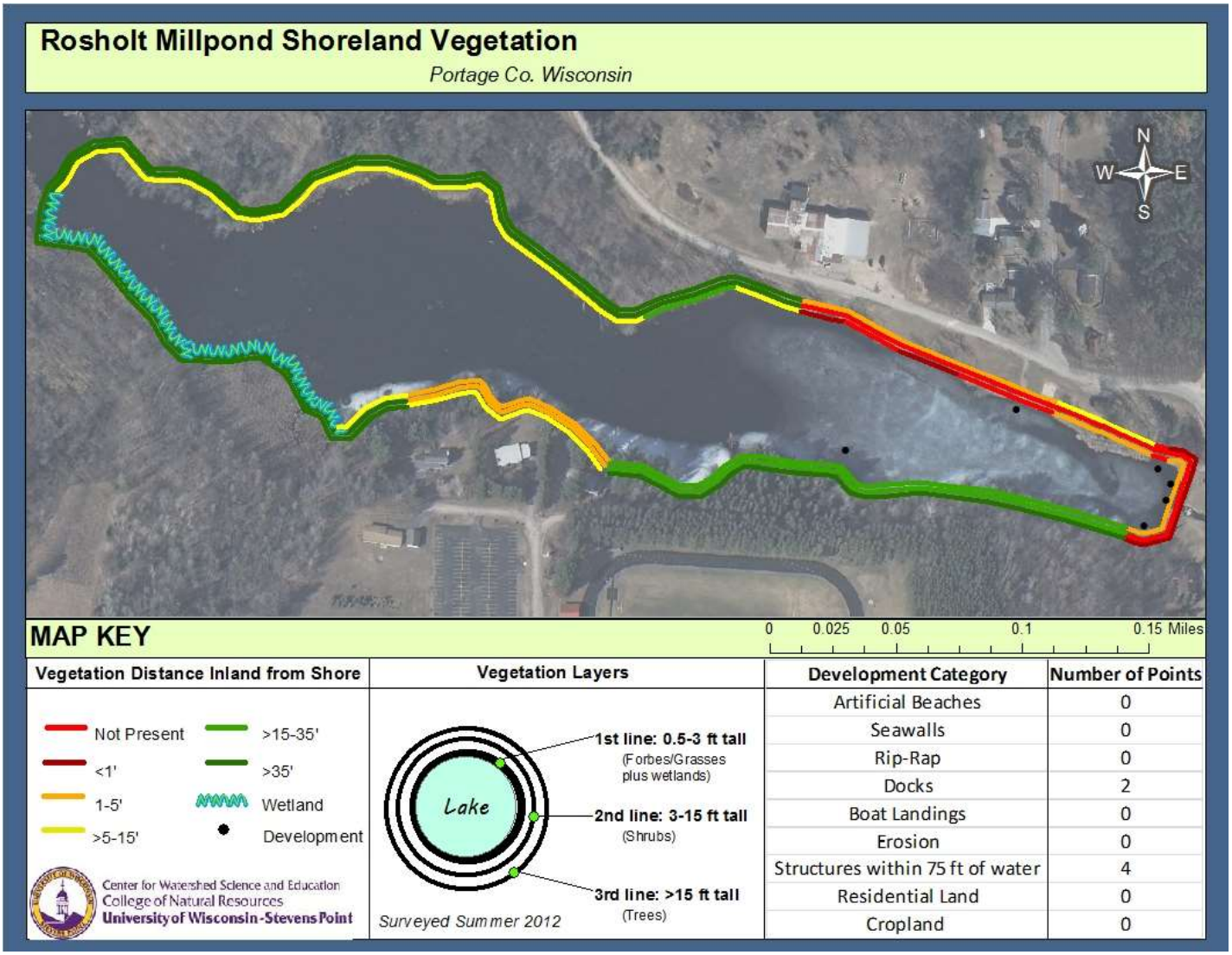


Figure 70. Shoreland vegetation survey around Rosholt Millpond, summer 2012.

During the 2012 survey, an assessment of human influence features was also conducted around Rosholt Millpond (Figure 71). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, docks/piers and the dam accounted for the sites identified during this survey.

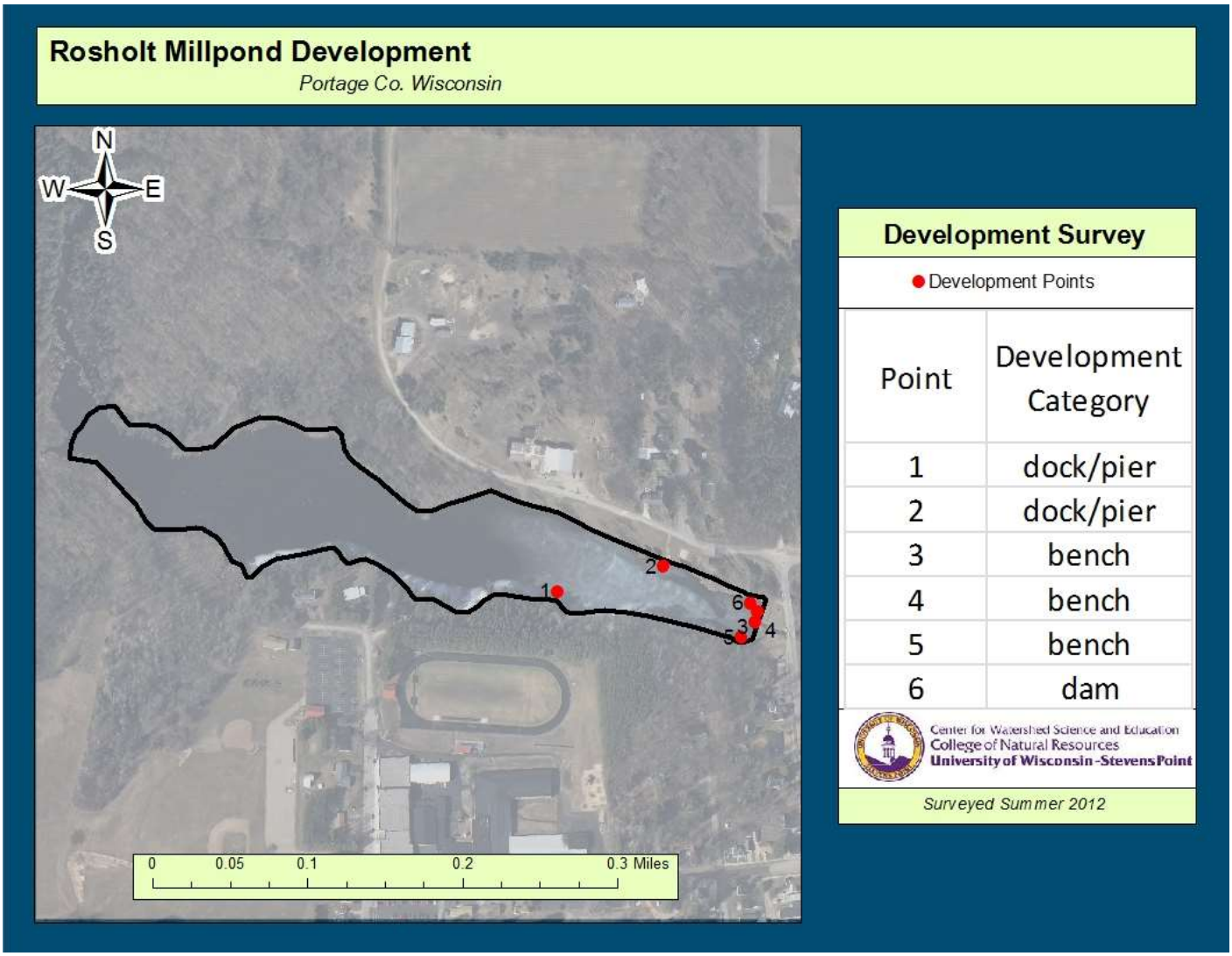
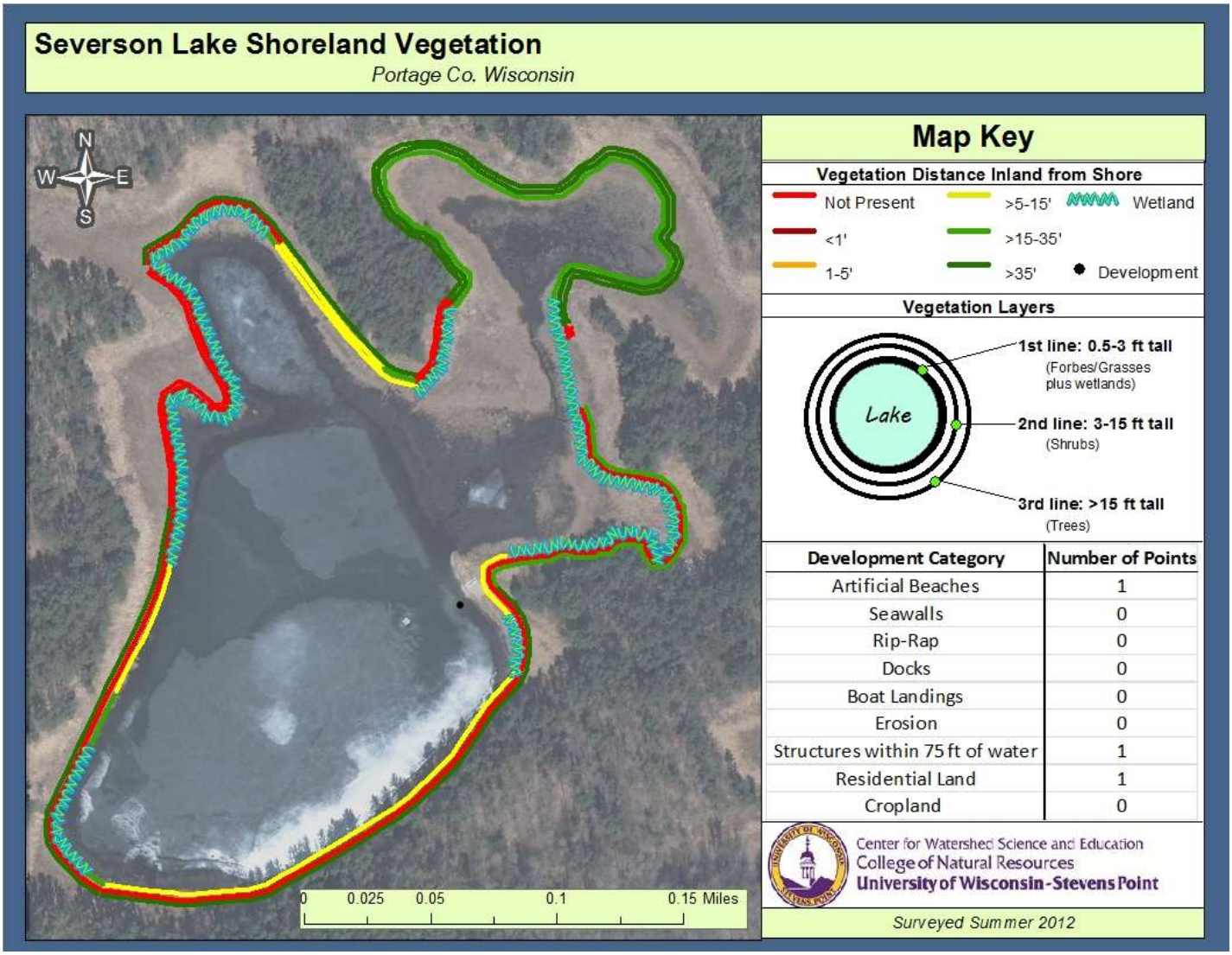


Figure 71. Features of human influence around Rosholt Millpond, summer 2012.

Severson Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Severson Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Severson Lake's shoreland are shown in Figure 72. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). The shores of Severson Lake were similar in 2002 (Figure 73) and 2012. Undisturbed shoreline length decreased slightly on Severson Lake from 2002 to 2012. This is most likely due to low water levels on the lake during the 2012 surveying period.



Development Category	Number of Points
Artificial Beaches	1
Seawalls	0
Rip-Rap	0
Docks	0
Boat Landings	0
Erosion	0
Structures within 75 ft of water	1
Residential Land	1
Cropland	0

Figure 72. Shoreland vegetation survey around Severson Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 73). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 19.

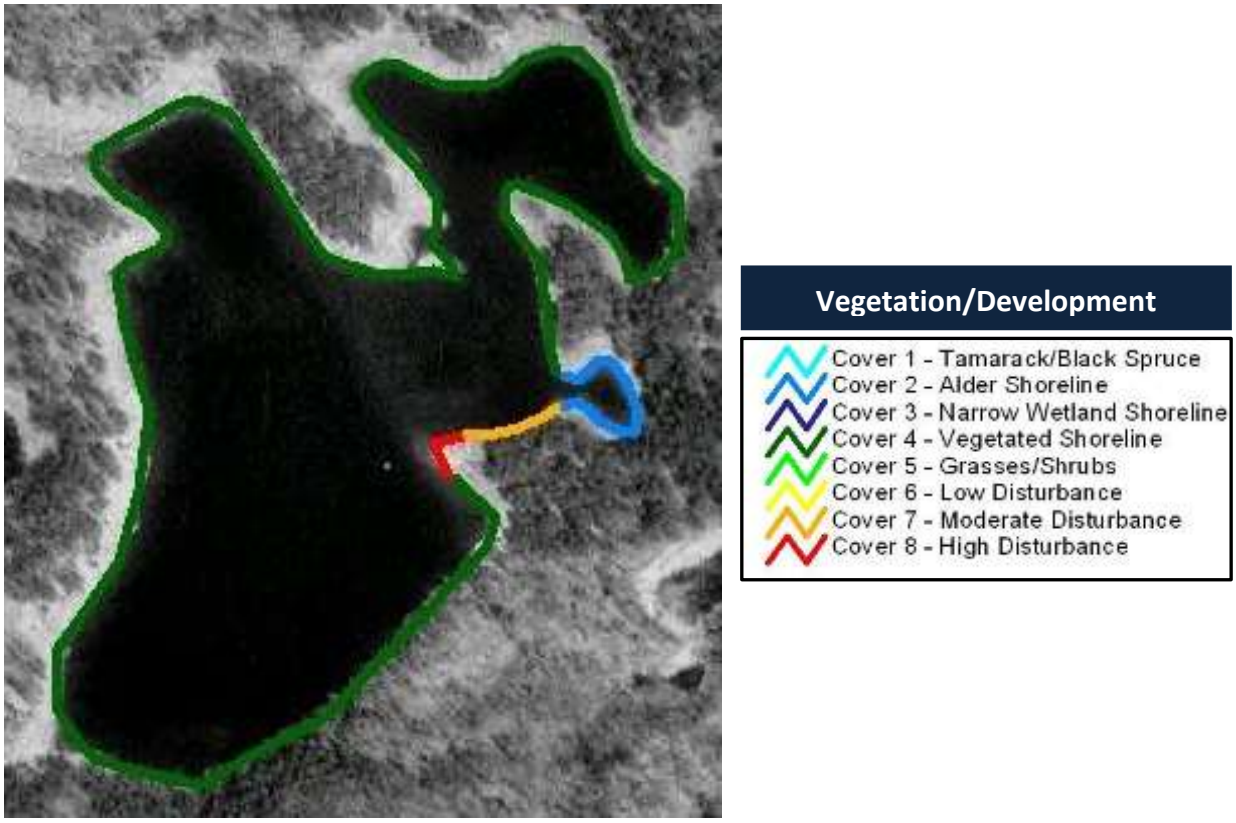


Figure 73. Shoreland vegetation survey around Severson Lake, 2002-2003.

Table 19. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Severson Lake (Figure 74). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, one location was identified on Severson Lake during this survey. Impacts from near shore structures can be reduced by controlling runoff through the installation of rain gardens, swales or rain barrels.

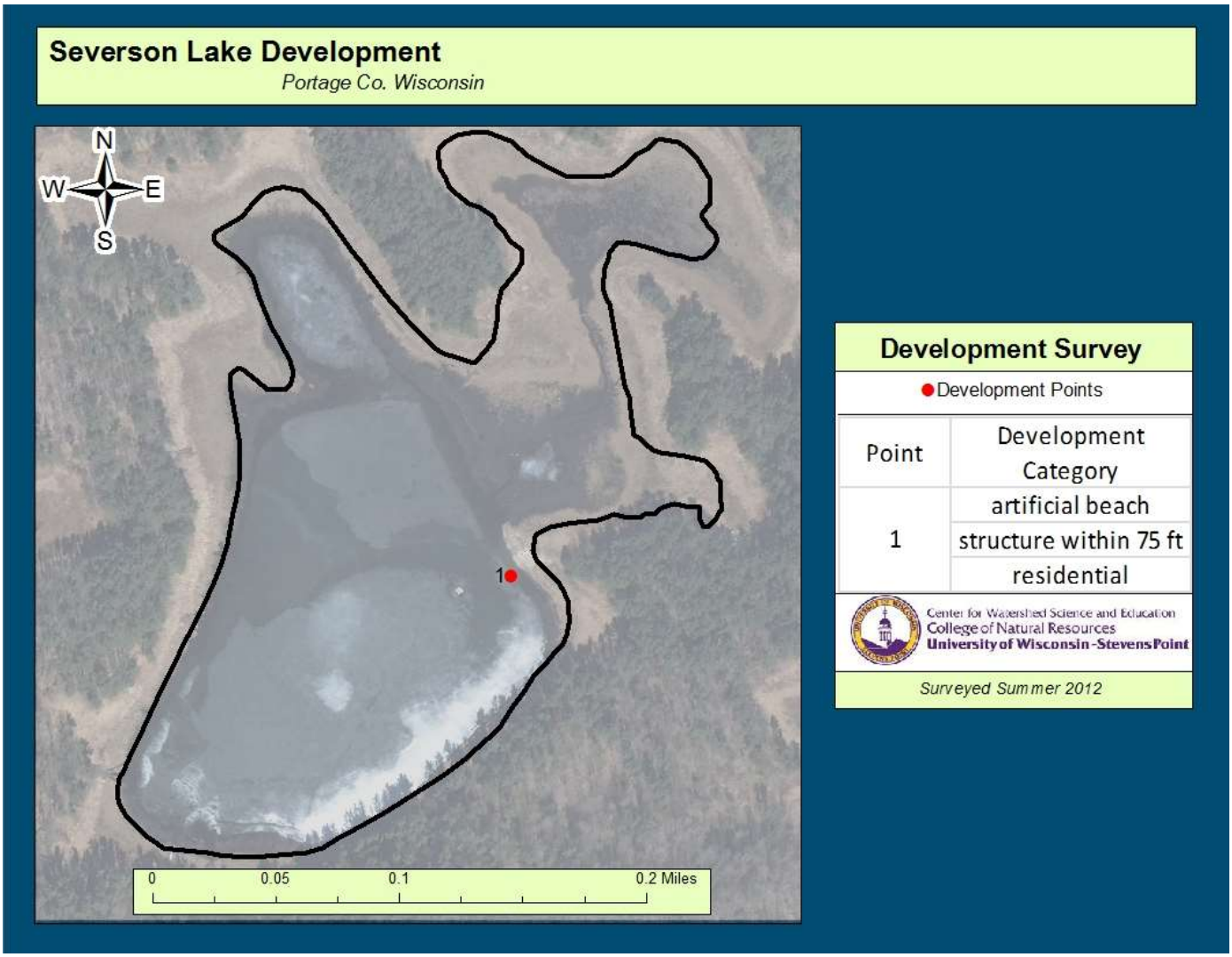


Figure 74. Features of human influence around Severson Lake, summer 2012.

South Twin Lake 2002-2003 Shoreland Inventory

An updated shoreland survey was not conducted for South Twin Lake during the summer of 2012. Information collected during the 2002-2003 survey is shown in Figure 75. Classifications for the 2002-2003 survey are described in Table 20. At that time, South Twin Lake was observed to have areas of high disturbance on the northern and southern shores. These disturbances were comprised of two access corridors that exceeded the 30 foot width maximum specified in county and state shoreland standards. Corridors exceeding 30 feet in width impact water quality and habitat in a lake, and therefore should be brought into compliance.

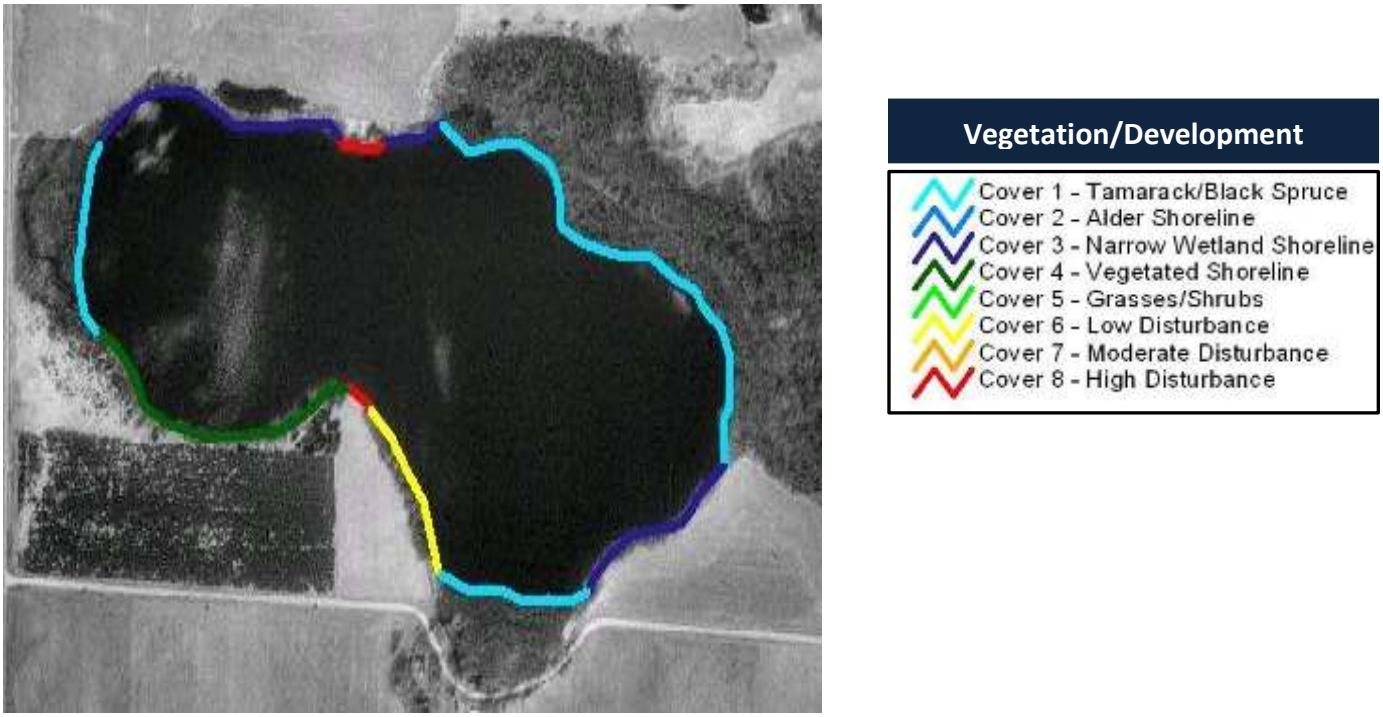


Figure 75. Shoreland vegetation survey around South Twin Lake, 2002-2003.

Table 20. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

Spring Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Spring Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Spring Lake's shoreland are shown in Figure 76. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). In 2012, the shoreline had vegetation on parts of the northern and southern sides that extended less than 35 feet inland from shore. This may result in water quality problems and habitat issues. Mowing within 35 feet of the water's edge should be discontinued and the shoreland in these areas should be restored. Details about shoreland regulations can be found in the county and state shoreland standards.

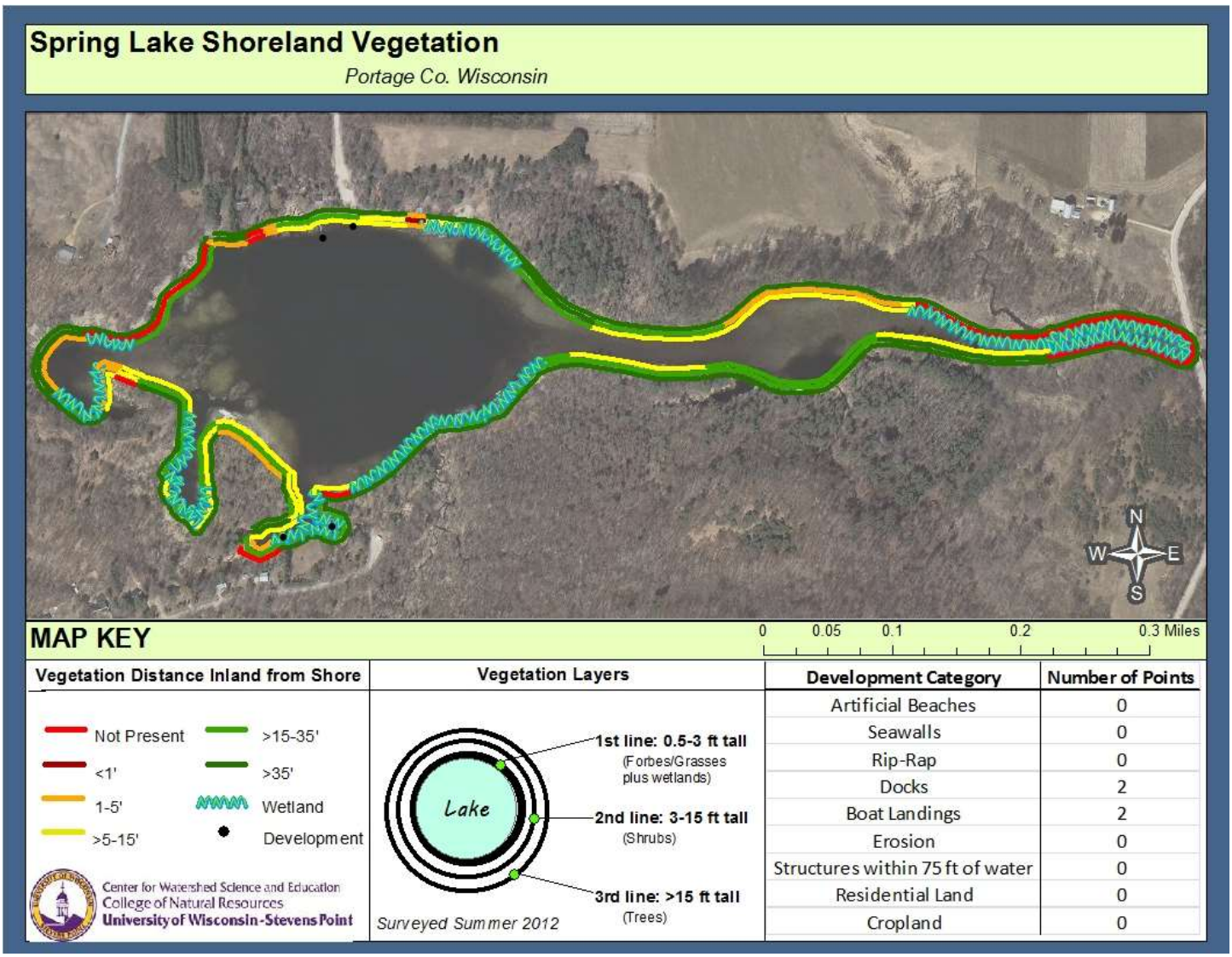


Figure 76. Shoreland vegetation survey around Spring Lake, summer 2012.

During the 2012 survey, an assessment of human influence features was also conducted around Spring Lake (Figure 77). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality.

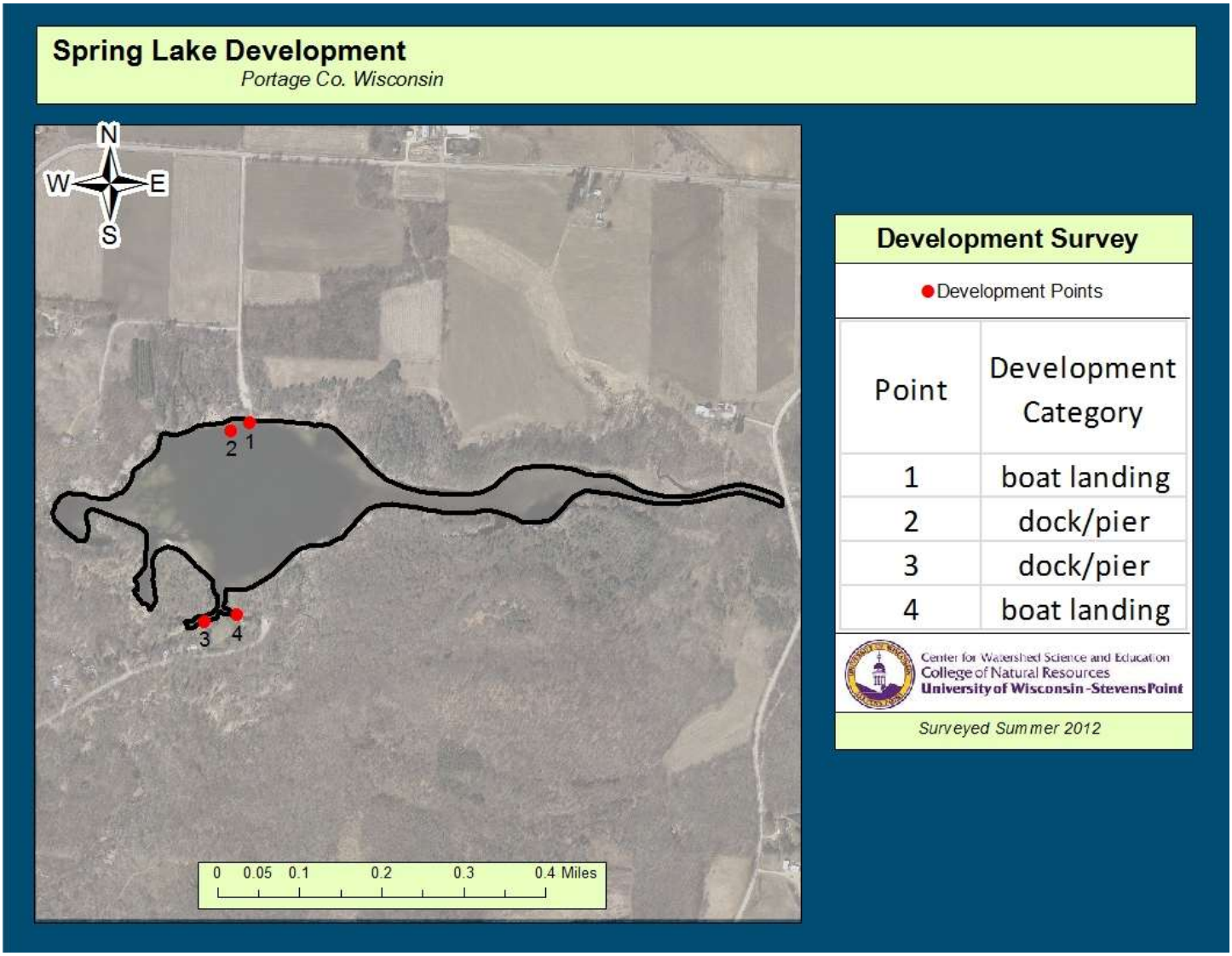


Figure 77. Features of human influence around Spring Lake, summer 2012.

Springville Pond Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Springville Pond. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Springville Pond's shoreland are shown in Figure 78. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Shoreland management for Springville Pond has improved significantly since 2002, although there is still room for additional improvement. Several properties on the northern side are still mowed to the water's edge, which affects water quality and habitat. Continued efforts should be made to improve shoreland vegetative buffers on Springville Pond.

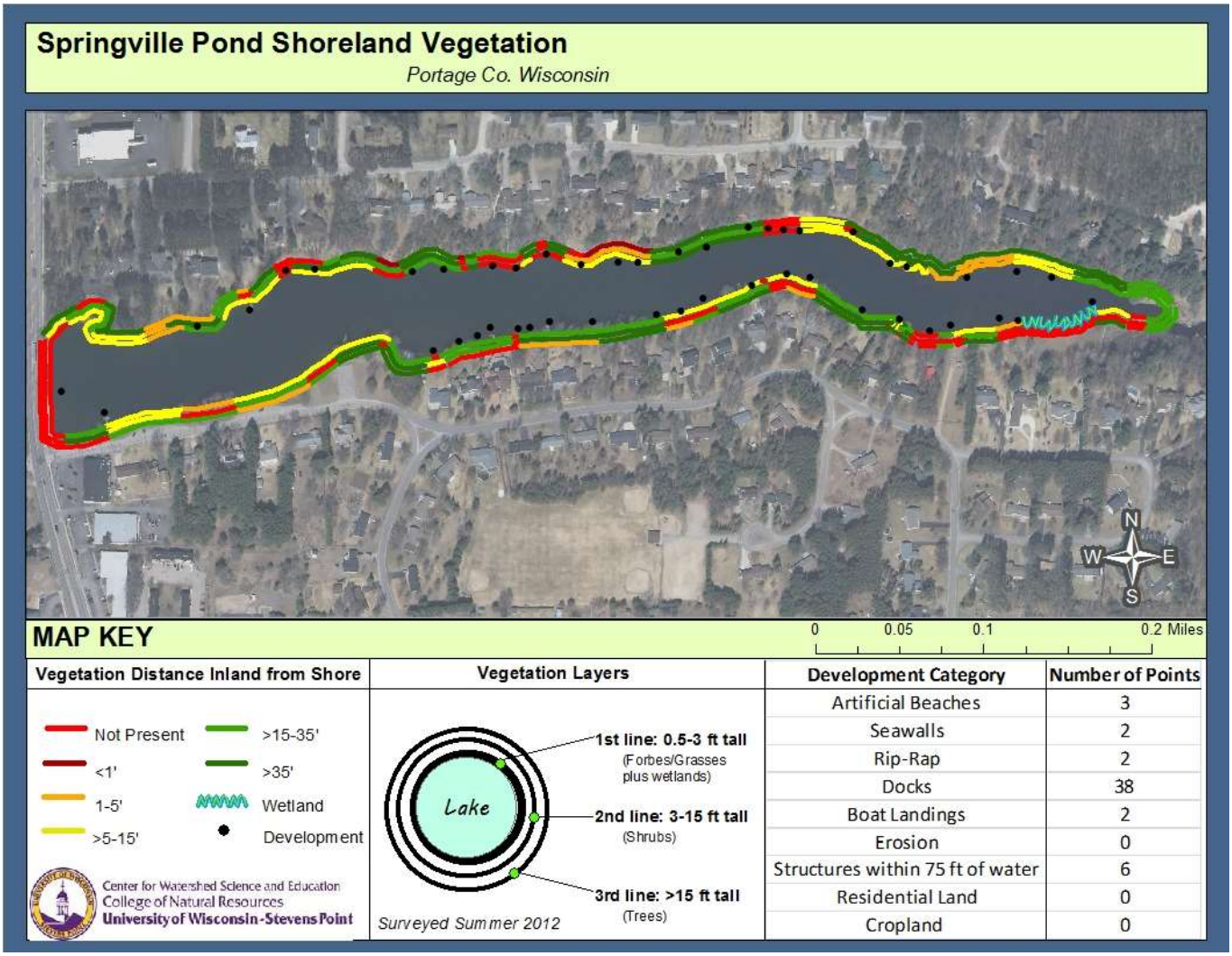


Figure 78. Shoreland vegetation survey around Springville Pond, summer 2012.

Shoreland surveys were conducted annually from 2007-2010 to measure the extent of changes as residents and the Village of Plover worked to improve the shores. The survey categories were changed over the years to provide a better measure of incremental improvements. Figures 79-82 show the changes over this time period.

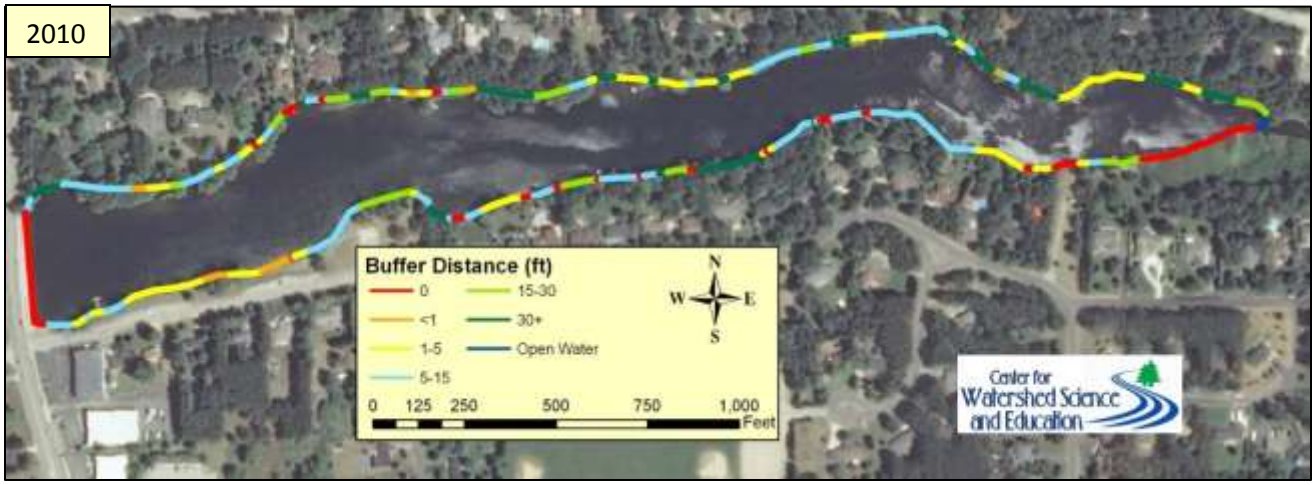


Figure 79. Shoreland vegetation survey around Springville Pond, 2010.

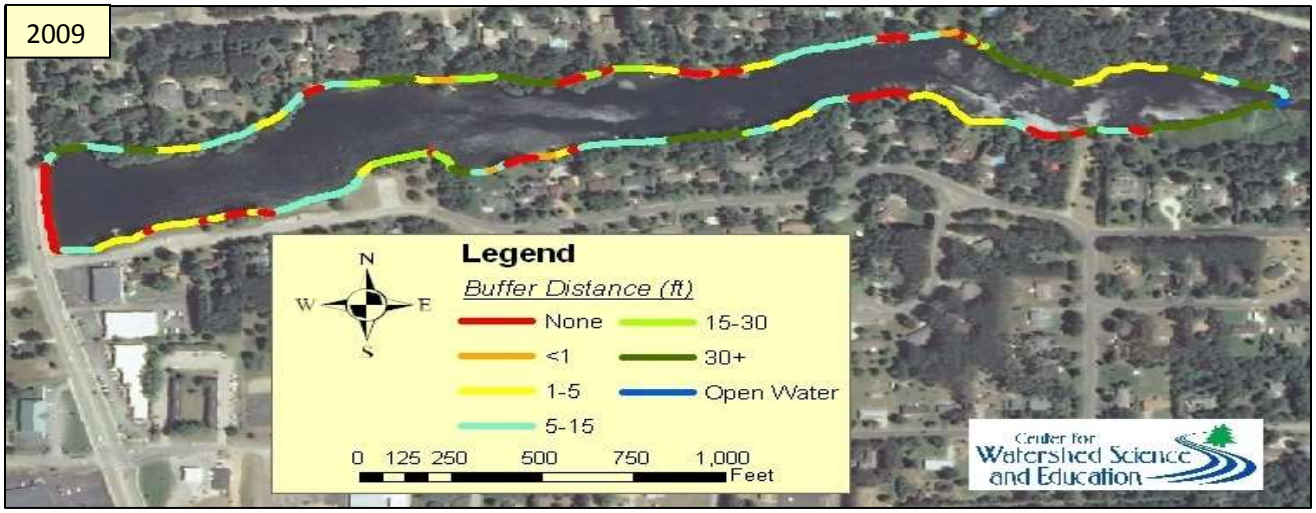


Figure 80. Shoreland vegetation survey around Springville Pond, 2009.

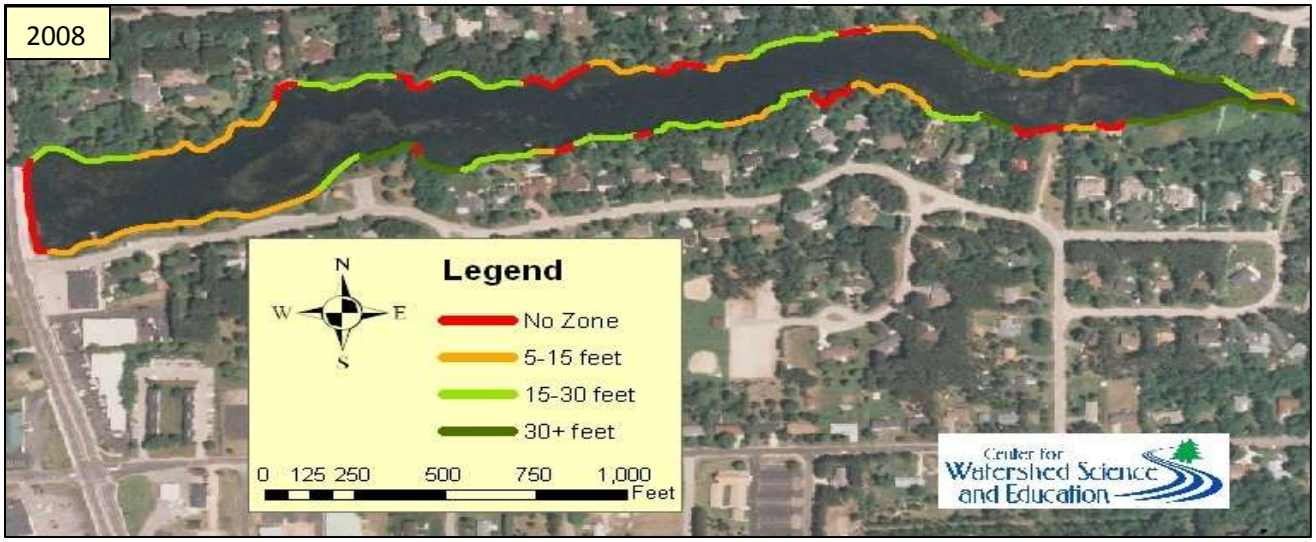


Figure 81. Shoreland vegetation survey around Springville Pond, 2008.

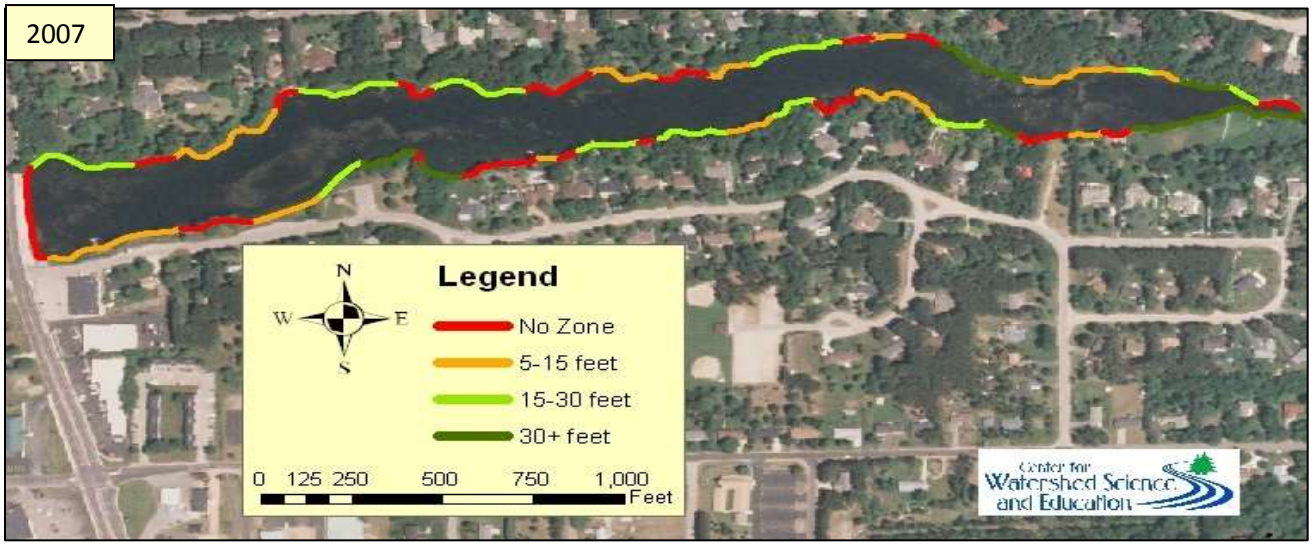


Figure 82. Shoreland vegetation survey around Springville Pond, 2007.

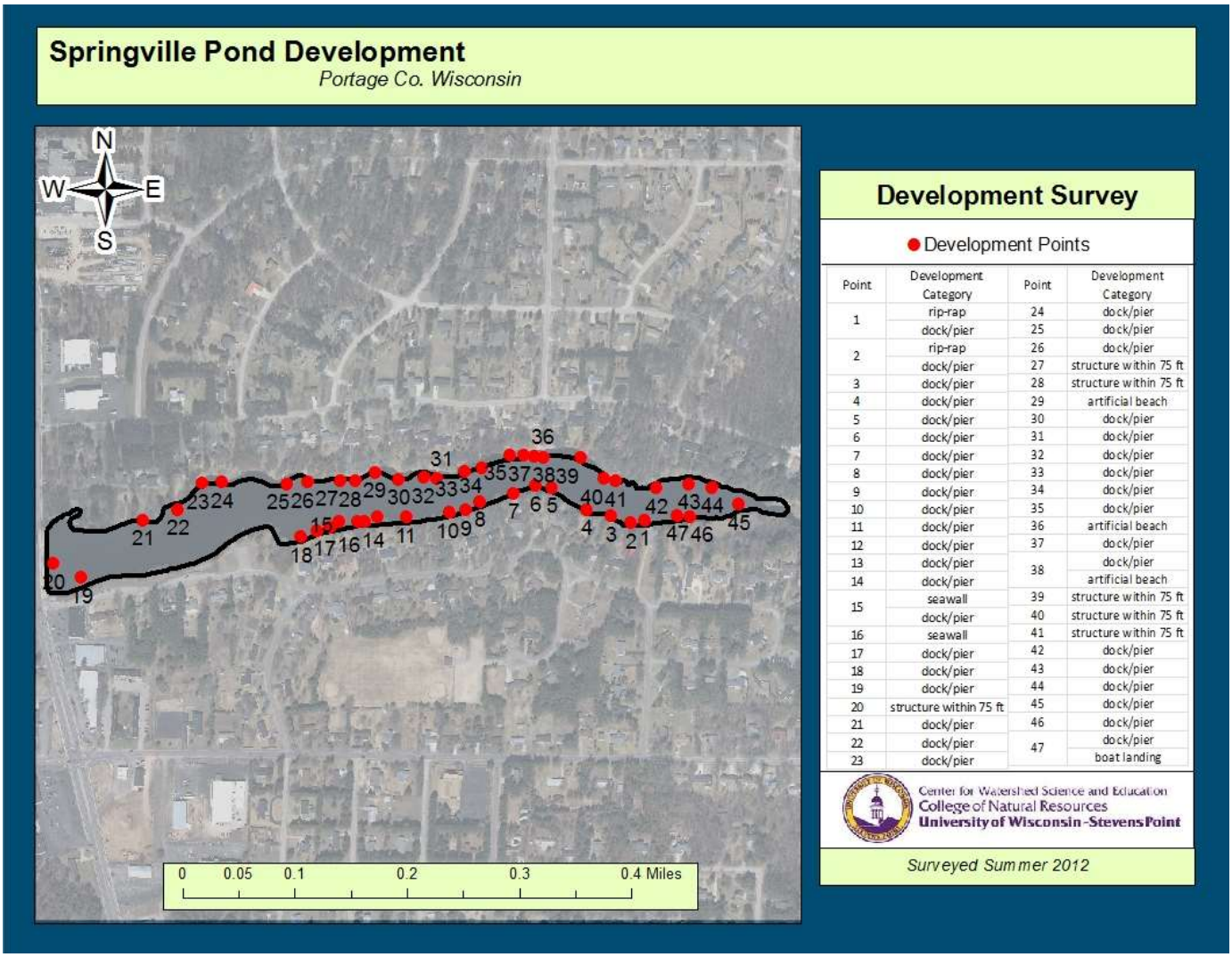
A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 83). The survey categories differed from those in later surveys, but some comparisons can be made. Classifications for the 2002-2003 survey are described in Table 21. Springville Pond's length of undisturbed shoreline greatly increased during the ten years between 2002 and 2012.

Figure 83. Shoreland vegetation survey around Springville Pond, 2002-2003.

Table 21. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Springville Pond (Figure 84). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, 47 sites around Springville Pond were noted. Thirty-eight were docks/piers. Three were artificial beaches, which significantly affect habitat, the fishery, and water quality. If artificial beaches are desired by the public, these areas should be restricted to the 30-foot width maximum allowed for access corridors. Runoff into the lake from near shore structures can be reduced by the installation of rain gardens, swales and rain barrels.



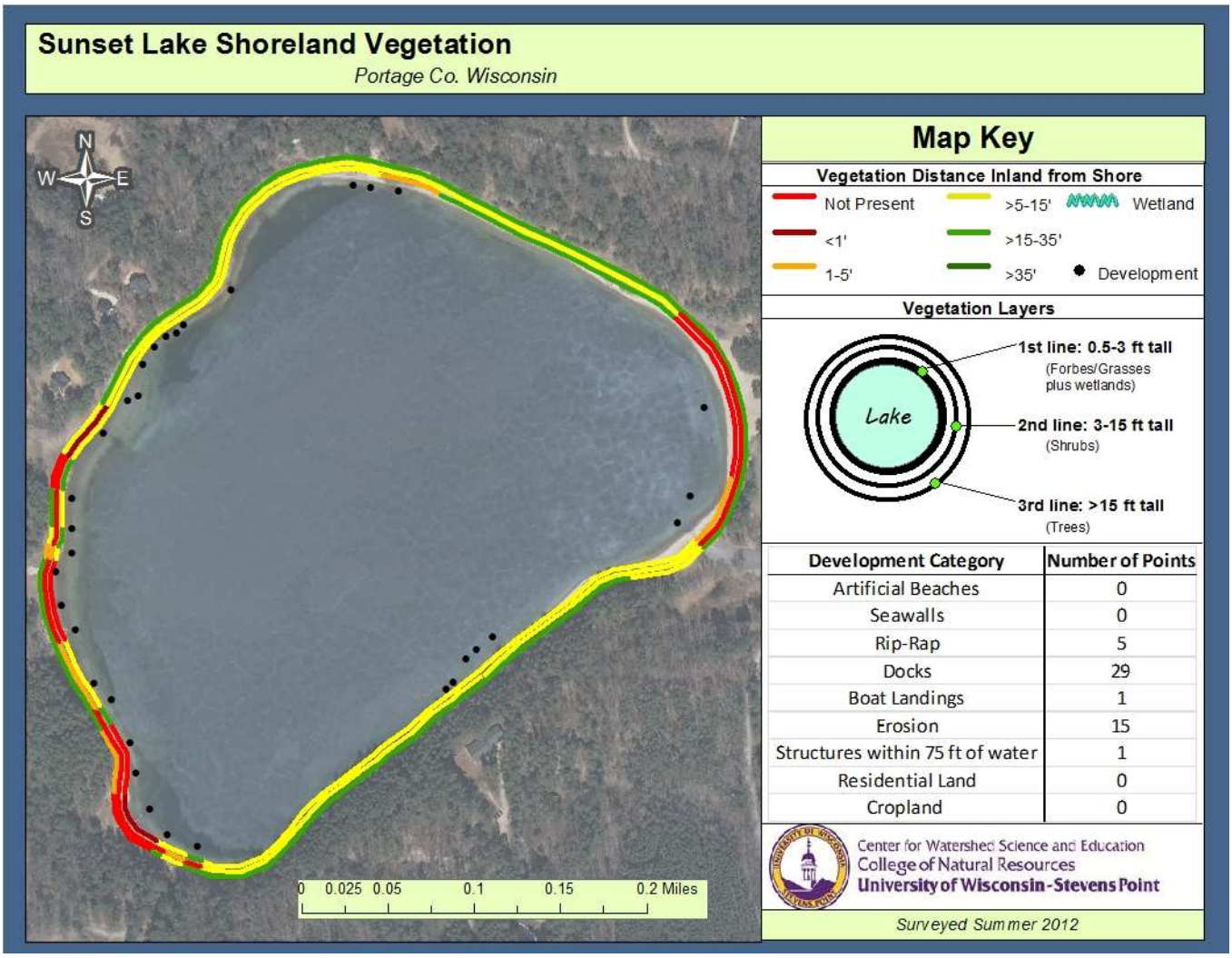
Point	Development Category	Point	Development Category
1	rip-rap	24	dock/pier
	dock/pier	25	dock/pier
2	rip-rap	26	dock/pier
	dock/pier	27	structure within 75 ft
3	dock/pier	28	structure within 75 ft
4	dock/pier	29	artificial beach
5	dock/pier	30	dock/pier
6	dock/pier	31	dock/pier
7	dock/pier	32	dock/pier
8	dock/pier	33	dock/pier
9	dock/pier	34	dock/pier
10	dock/pier	35	dock/pier
11	dock/pier	36	artificial beach
12	dock/pier	37	dock/pier
13	dock/pier	38	dock/pier
14	dock/pier		artificial beach
15	seawall	39	structure within 75 ft
	dock/pier	40	structure within 75 ft
16	seawall	41	structure within 75 ft
17	dock/pier	42	dock/pier
18	dock/pier	43	dock/pier
19	dock/pier	44	dock/pier
20	structure within 75 ft	45	dock/pier
21	dock/pier	46	dock/pier
22	dock/pier	47	dock/pier
23	dock/pier		boat landing

Figure 84. Features of human influence around Springville Pond, summer 2012.

Sunset Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Sunset Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Sunset Lake's shoreland are shown in Figure 85. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). While approximately 900 feet of the shore on the eastern end of the lake have improved since 2002 (Figure 86), significant degradation has occurred on the western end of the lake. Efforts should be made to restore the shoreline where problems exist. Except for a 30 foot wide viewing corridor, the shorter (0.5 -3 ft high) vegetation should extend from the water's edge to at least 35 feet inland. This helps water quality, habitat, and the fishery and is consistent with county and state shoreland standards.



Development Category	Number of Points
Artificial Beaches	0
Seawalls	0
Rip-Rap	5
Docks	29
Boat Landings	1
Erosion	15
Structures within 75 ft of water	1
Residential Land	0
Cropland	0

Figure 85. Shoreland vegetation survey around Sunset Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 86). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 22.

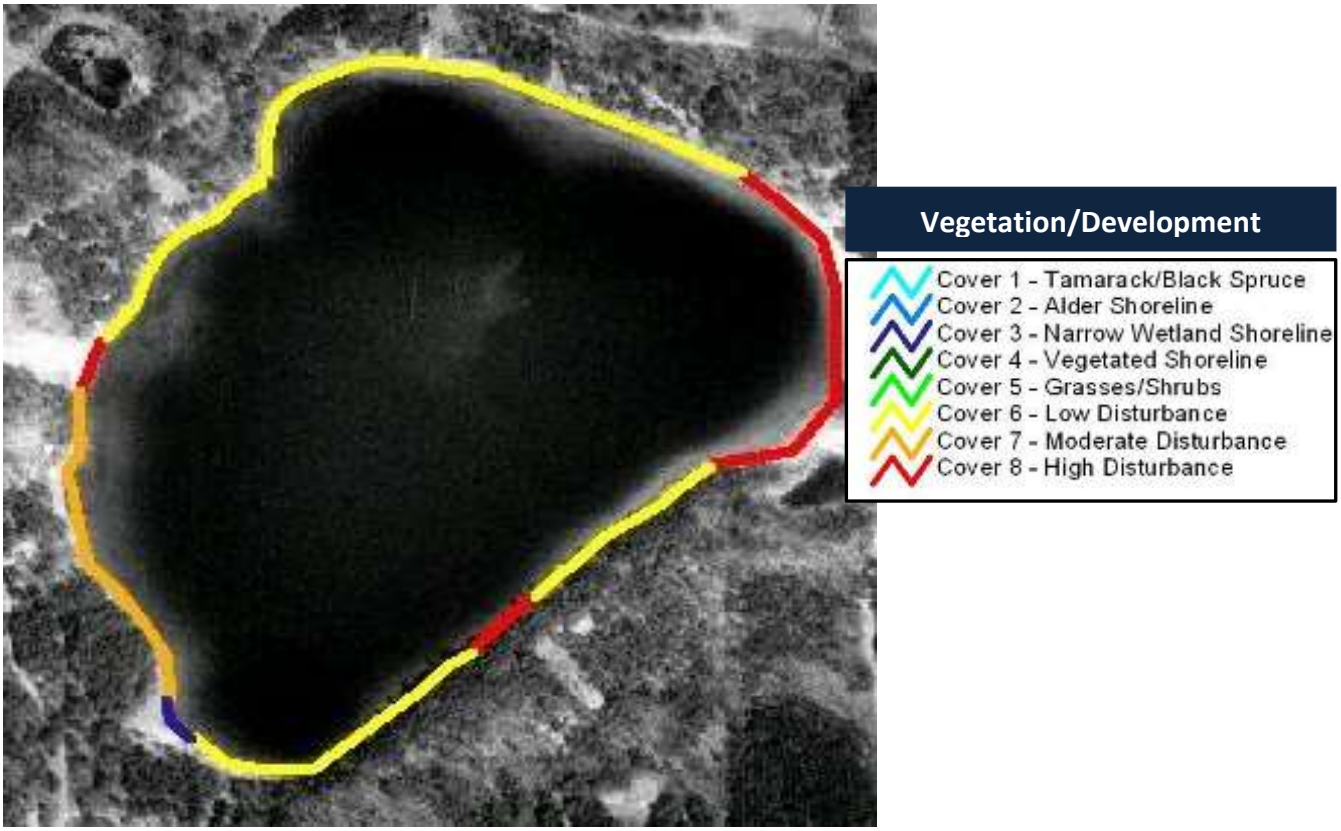
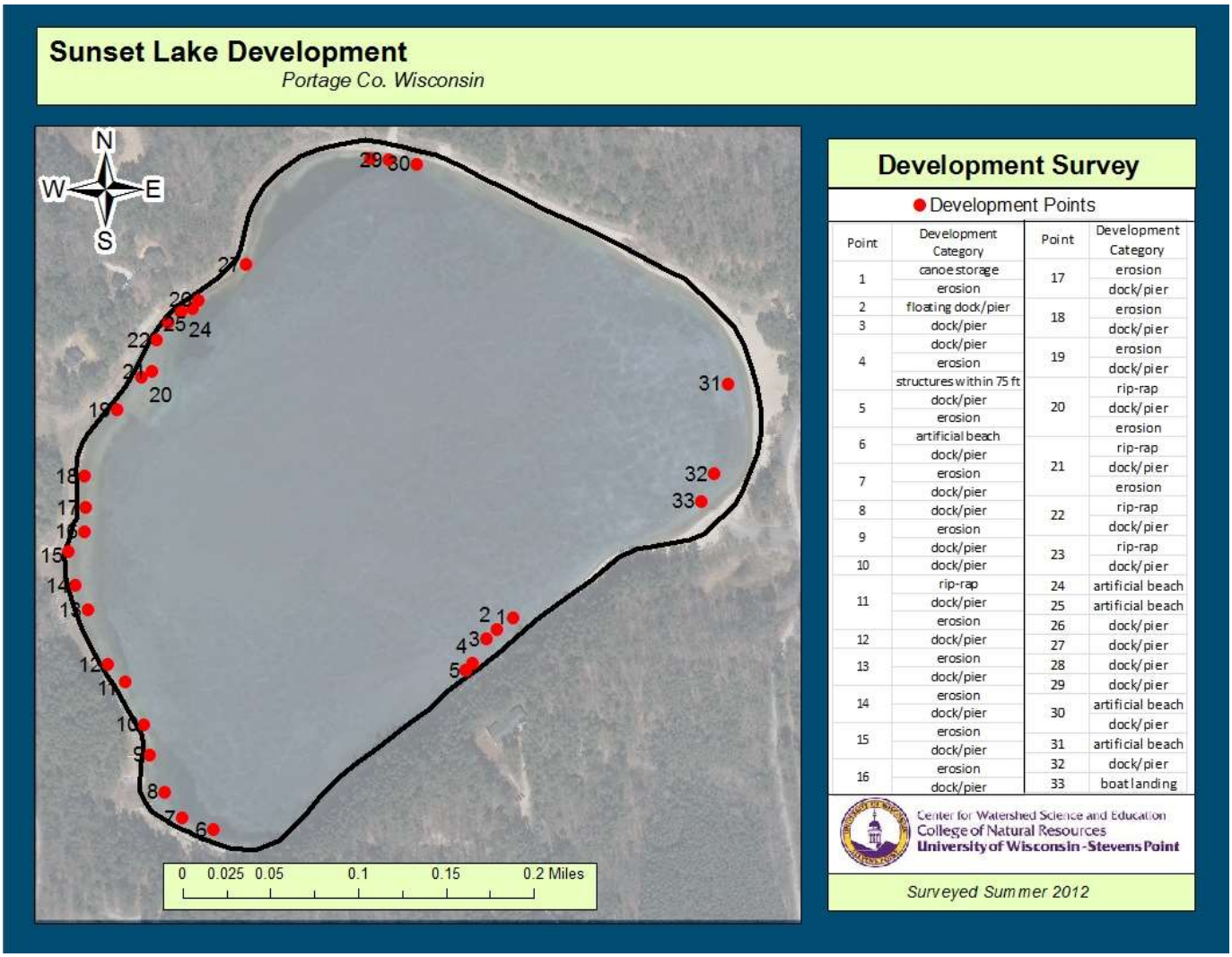


Figure 86. Shoreland vegetation survey around Sunset Lake, 2002-2003.

Table 22. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Sunset Lake (Figure 87). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, 33 sites were identified around Sunset Lake. Most of the sites were docks/piers/boat launches. Some rip-rap exists which should be replaced with bio-logs and native vegetation. If erosion is a concern, undisturbed aquatic vegetation helps to buffer wave action. To improve shoreland habitat and remain consistent with county and state shoreland standards, artificial beaches should be limited to 30 feet wide, the maximum allowed for access corridors. Fifteen sites with erosion existed and should be addressed.



Point	Development Category
1	canoe storage
	erosion
2	floating dock/pier
3	dock/pier
4	dock/pier
	erosion
	structures within 75 ft
5	dock/pier
	erosion
6	artificial beach
	dock/pier
7	erosion
	dock/pier
8	dock/pier
9	erosion
	dock/pier
10	dock/pier
11	rip-rap
	dock/pier
	erosion
12	dock/pier
13	erosion
	dock/pier
14	erosion
	dock/pier
15	erosion
	dock/pier
16	erosion
	dock/pier
17	erosion
	dock/pier
18	erosion
	dock/pier
19	erosion
	dock/pier
20	rip-rap
	dock/pier
	erosion
21	rip-rap
	dock/pier
	erosion
22	rip-rap
	dock/pier
23	rip-rap
	dock/pier
24	artificial beach
25	artificial beach
26	dock/pier
27	dock/pier
28	dock/pier
29	dock/pier
30	artificial beach
	dock/pier
31	artificial beach
32	dock/pier
33	boat landing

Figure 87. Features of human influence around Sunset Lake, summer 2012.

Thomas Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Thomas Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Thomas Lake's shoreland are shown in Figure 88. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Since 2002 (Figure 89), approximately 900 feet of the shoreland around Thomas Lake have improved, mostly on the eastern side. Unfortunately, areas with increased disturbance were also observed, particularly on the southern and western shores. Except for a 30 foot wide viewing corridor, the shorter (0.5 -3 ft high) vegetation should extend from the water's edge to at least 35 feet inland. This helps water quality, habitat, and the fishery and is consistent with county and state shoreland standards.

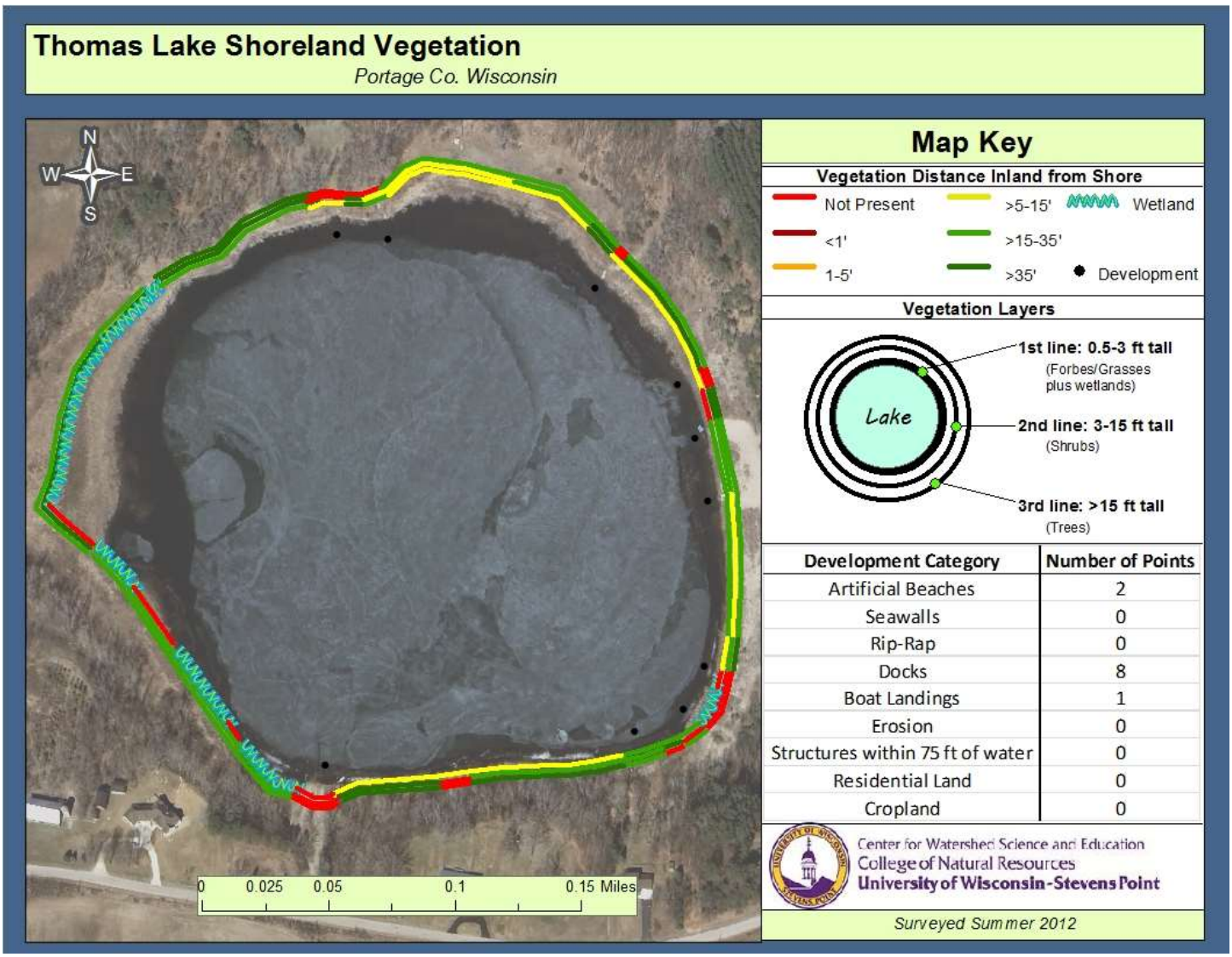


Figure 88. Shoreland vegetation survey around Thomas Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 89). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 23.

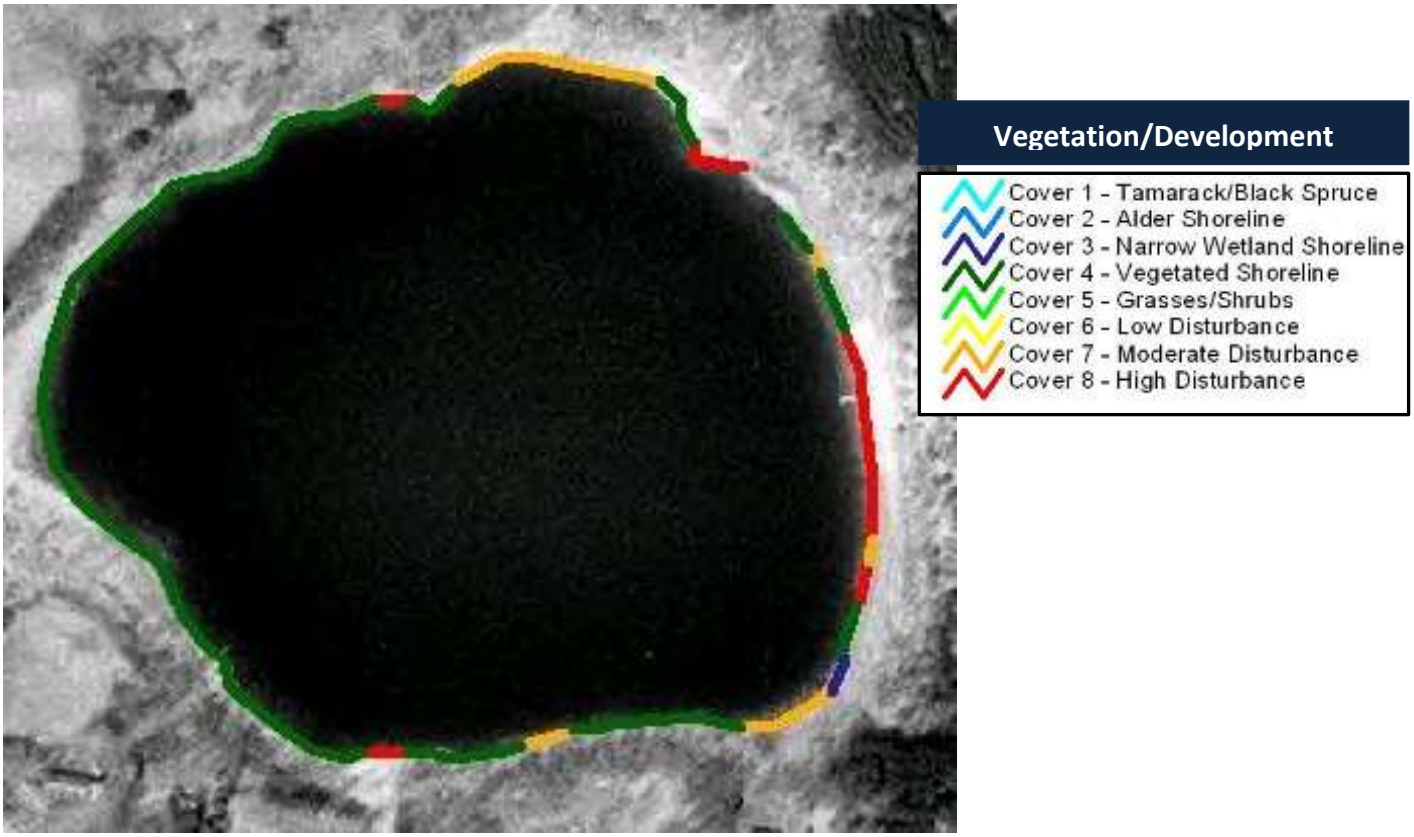


Figure 89. Shoreland vegetation survey around Thomas Lake, 2002-2003.

Table 23. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Thomas Lake (Figure 90). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, nine sites were identified around Thomas Lake. Most were docks/piers, but several artificial beaches existed. These beaches provide no habitat for near shore animals, including weevils that overwinter in shoreland vegetation. The weevils help to control the Eurasian watermilfoil in Thomas Lake.

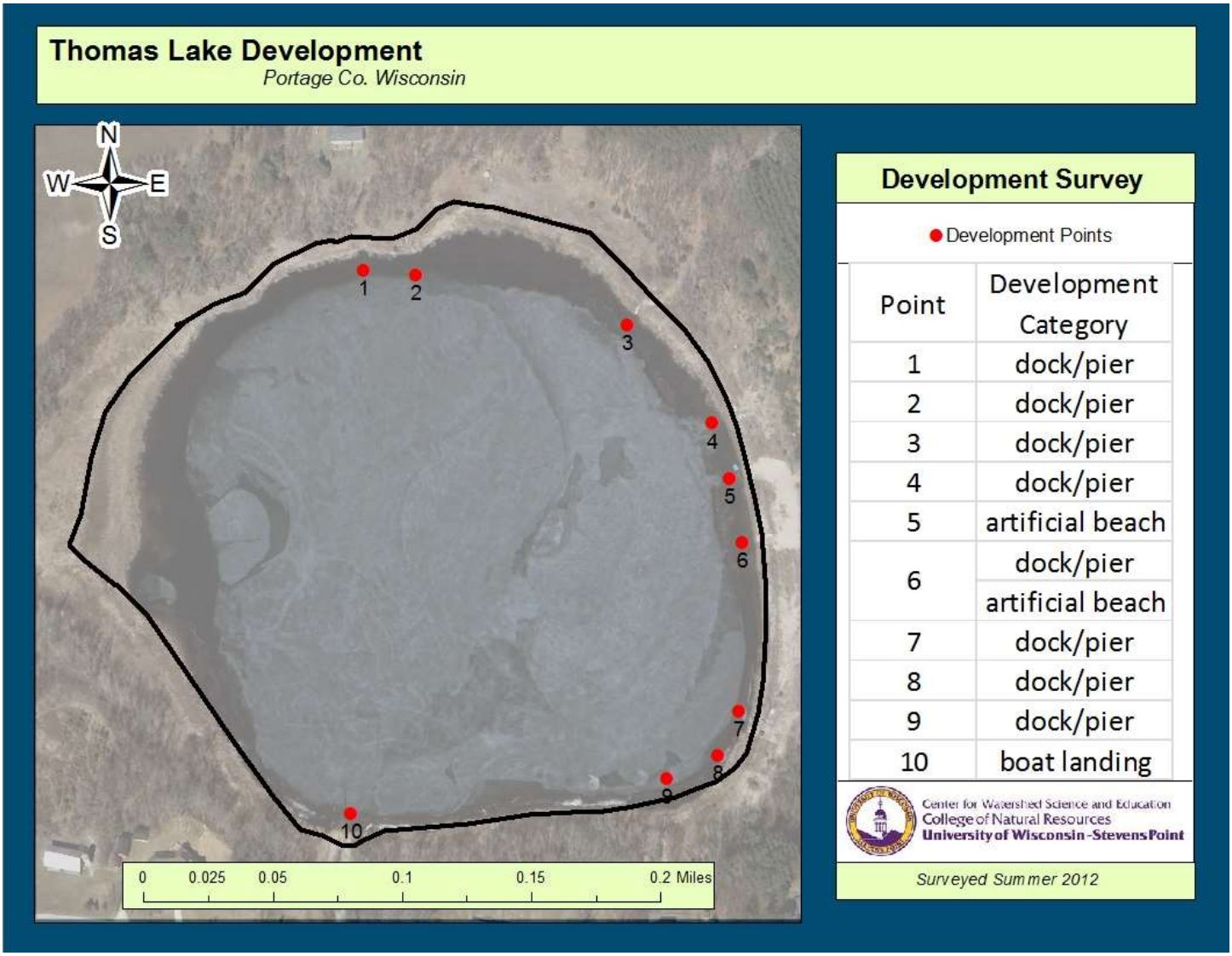
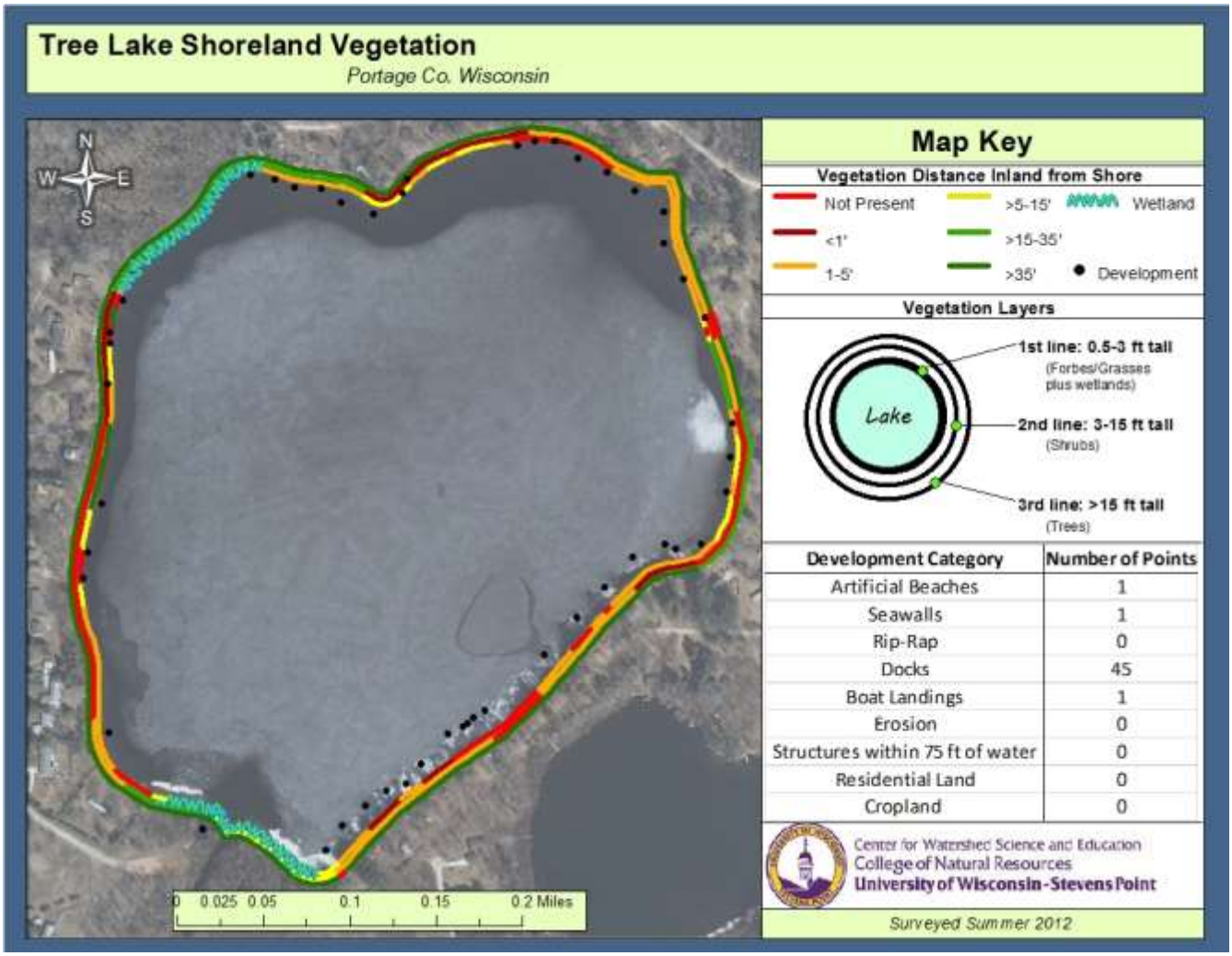


Figure 90. Features of human influence around Thomas Lake, summer 2012.

Tree Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Tree Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Tree Lake's shoreland are shown inFigure 91. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). Since 2002 (Figure 92), approximately 1,200 feet of shoreline have improved. Additional improvements could be made to increase how far the shorter vegetative layer (0.5-3 ft high) extends from the water's edge inland. Increasing this to 35 feet would provide habitat, improve water quality, and bring the vegetation depth into compliance with county and state shoreland standards.



Development Category	Number of Points
Artificial Beaches	1
Seawalls	1
Rip-Rap	0
Docks	45
Boat Landings	1
Erosion	0
Structures within 75 ft of water	0
Residential Land	0
Cropland	0

Figure 91. Shoreland vegetation survey around Tree Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 92). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 24. There has been significant improvement in the length of undisturbed shoreline for Tree Lake from 2002 to 2012.

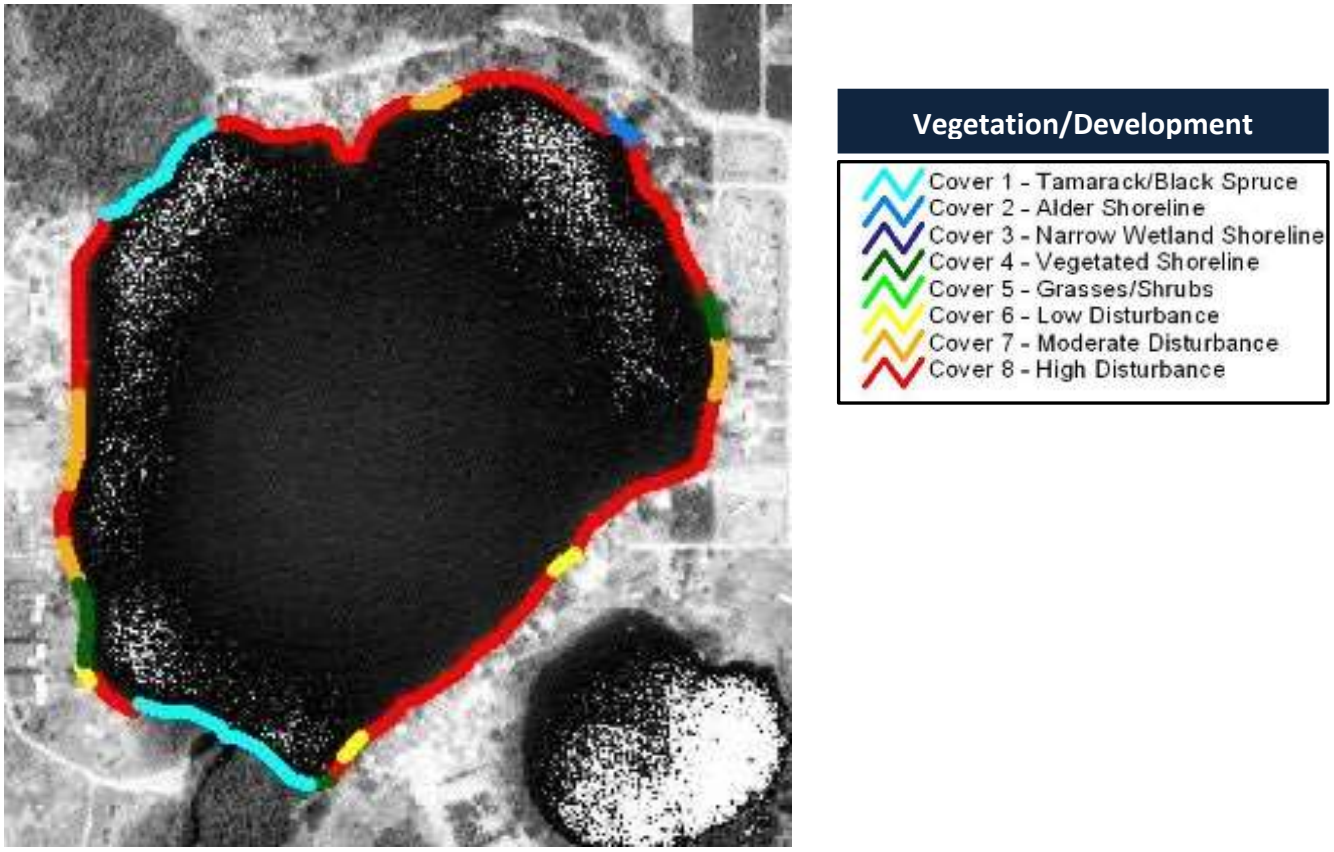
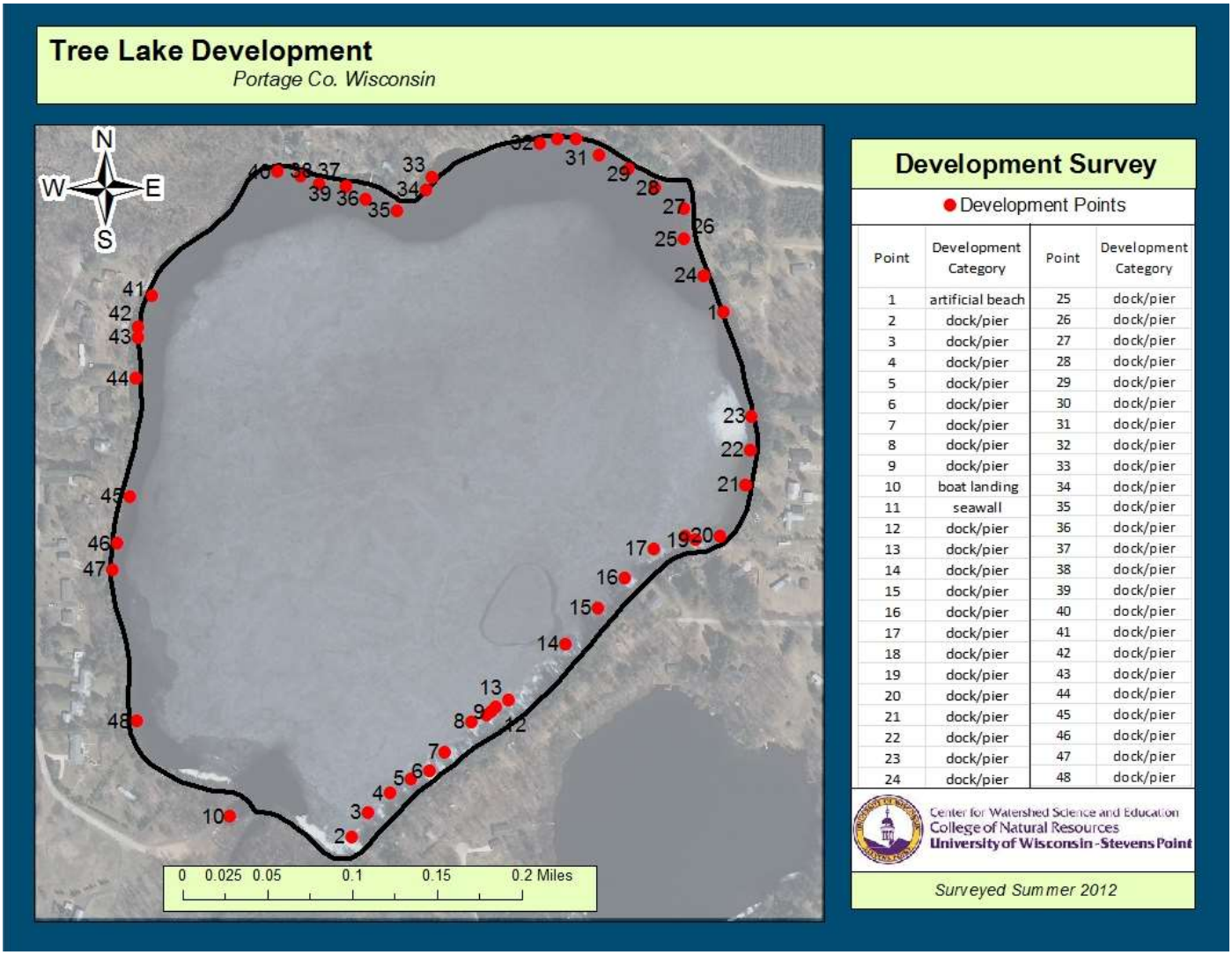


Figure 92. Shoreland vegetation survey around Tree Lake, 2002-2003.

Table 24. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Tree Lake (Figure 93). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality. In 2012, 48 sites were identified around Tree Lake. Most of the sites were docks/piers. One seawall and one artificial beach were also identified, which provide little to no habitat. The seawall should be replaced with a bio-log and native shoreland vegetation. If erosion from waves is a concern, aquatic plants such as water lilies may be usednear shore to help baffle waves.



Point	Development Category	Point	Development Category
1	artificial beach	25	dock/pier
2	dock/pier	26	dock/pier
3	dock/pier	27	dock/pier
4	dock/pier	28	dock/pier
5	dock/pier	29	dock/pier
6	dock/pier	30	dock/pier
7	dock/pier	31	dock/pier
8	dock/pier	32	dock/pier
9	dock/pier	33	dock/pier
10	boat landing	34	dock/pier
11	seawall	35	dock/pier
12	dock/pier	36	dock/pier
13	dock/pier	37	dock/pier
14	dock/pier	38	dock/pier
15	dock/pier	39	dock/pier
16	dock/pier	40	dock/pier
17	dock/pier	41	dock/pier
18	dock/pier	42	dock/pier
19	dock/pier	43	dock/pier
20	dock/pier	44	dock/pier
21	dock/pier	45	dock/pier
22	dock/pier	46	dock/pier
23	dock/pier	47	dock/pier
24	dock/pier	48	dock/pier

Figure 93. Features of human influence around Tree Lake, summer 2012.

Wolf Lake Shoreland Inventory

Shoreland vegetation is critical to a healthy ecosystem in and around Wolf Lake. It provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The results of the 2012 survey of Wolf Lake's shoreland are shown in Figure 94. The ring nearest the lake depicts the shoreland vegetation depth inland from the water's edge for the 0.5 to 3 foot tall vegetation (forbs and grasses), the middle ring depicts the depth of the vegetation that is 3 to 5 feet tall (shrubs), and the outer ring depicts the depth of the vegetation that is greater than 15 feet in height (trees). In 2012, low water levels existed. Other than effects from the low water levels, most of the shoreland remained unchanged from 2002 (Figure 96).

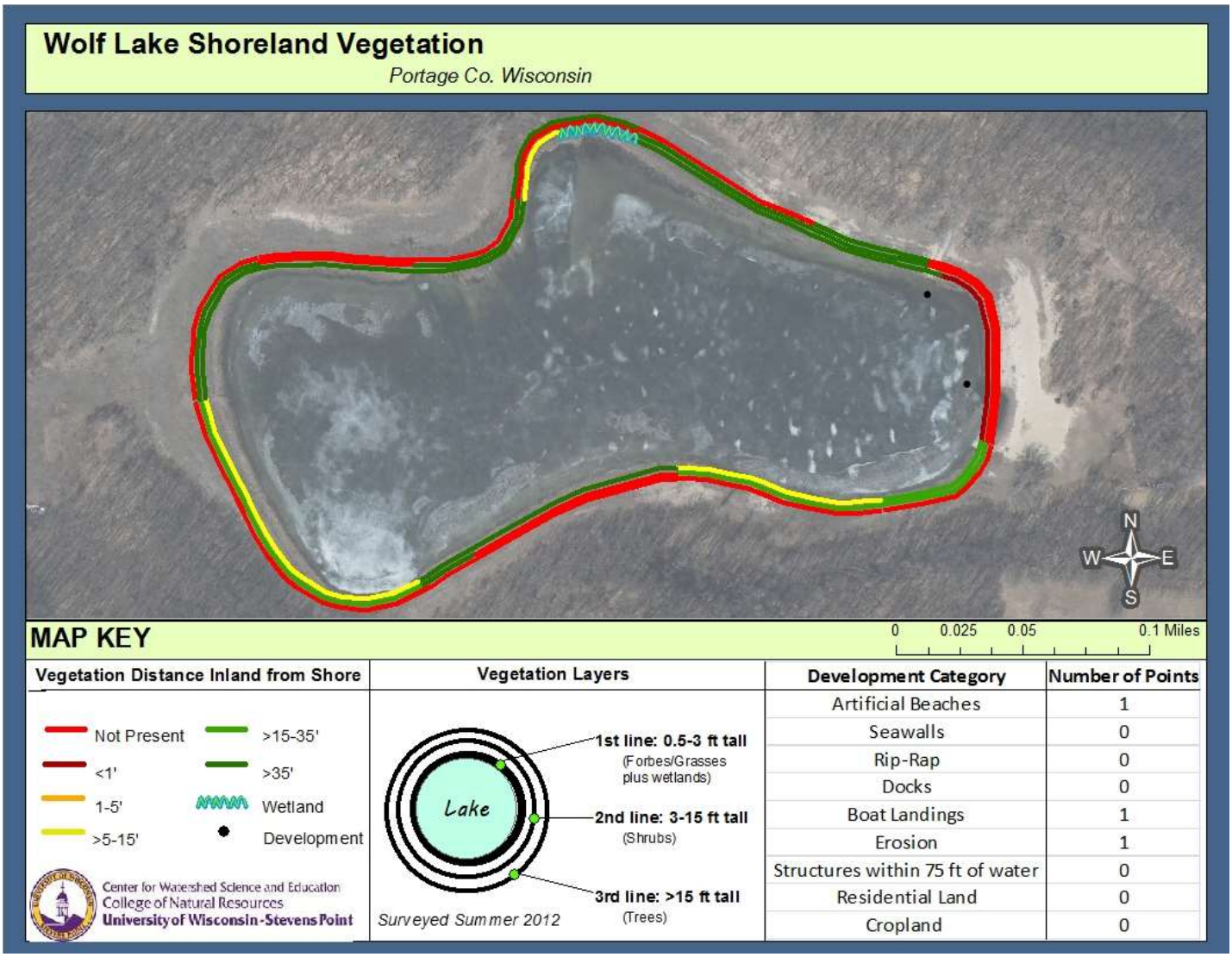


Figure 94. Shoreland vegetation survey around Wolf Lake, summer 2012.

2002-2003 Portage County Shoreland Inventory

A shoreland survey was conducted in 2002-2003 during the Portage County Lakes Study (Figure 95). The survey categories differed from those in the 2012 survey, but some comparisons can be made. Survey classifications for the 2002-2003 survey are described in Table 25. Undisturbed shoreline length for Wolf Lake did not changed significantly between 2002 and2012.

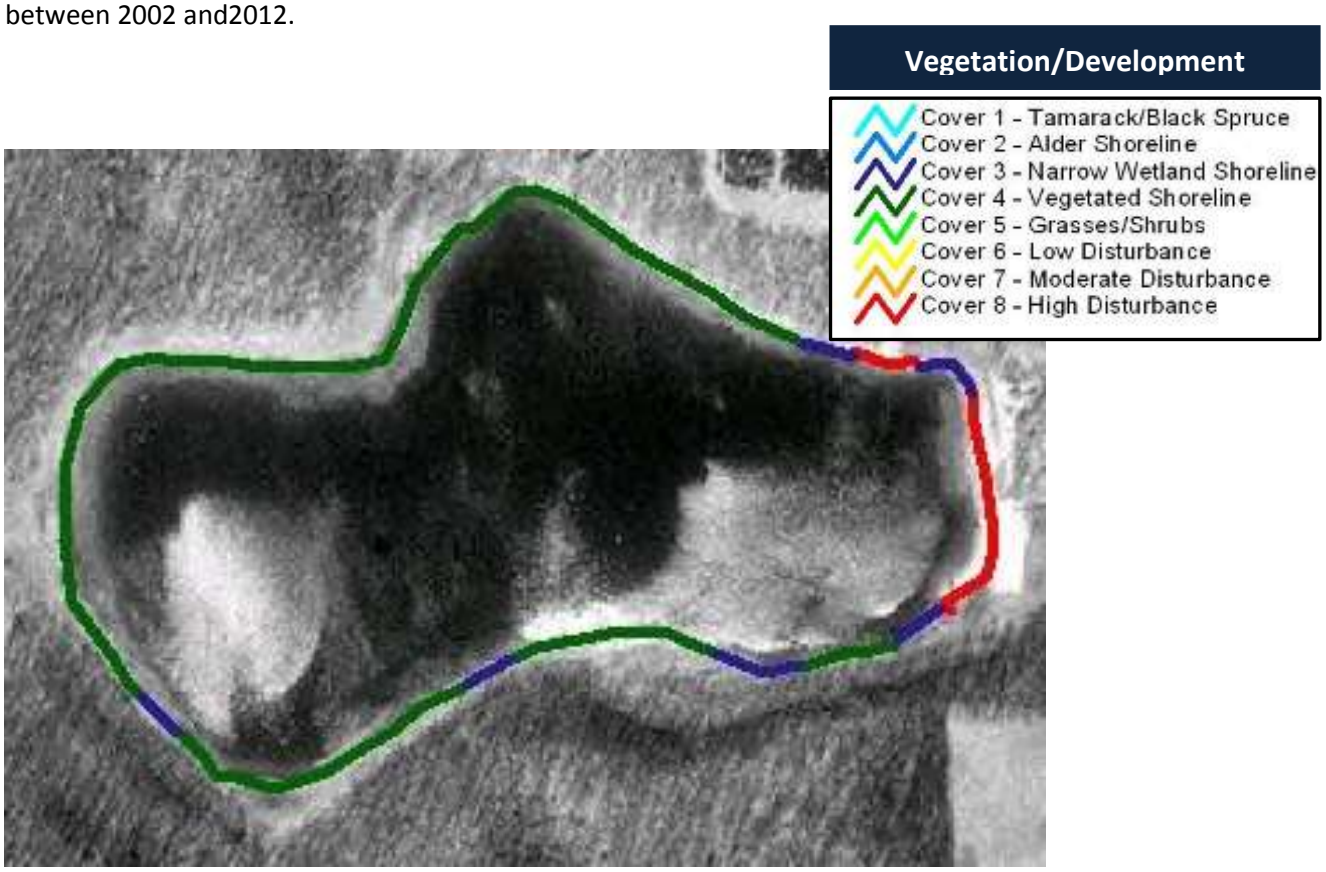


Figure 95. Shoreland vegetation survey around Wolf Lake, 2002-2003.

Table 25. Categories applied during the 2002-2003 shoreland survey of Portage County lakes. Observations were predominant category 15 feet inland from the water's edge.

Category Code and Cover-type Description	
Wetlands	
Cover 1	All wetland shore zone with a weet gale or leather leaf shrub layer associated with tamarack or black spruce.
Cover 2	All wetland shore zone with an alder shrub layer.
Cover 3	Narrow wetland shore zone (< 5 m) with an adjacent upland component that was not developed.
Upland with No Development	
Cover 4	Upland shore zone with a densely vegetated shoreline component (i.e., tall grasses or dense shrub component adjacent to the water). Also has a non-rocky substrate within the water zone area.
Cover 5	Upland shore zone that lacked dense shoreline grasses or shrubs, or a water zone area with a rocky substrate.
Development Categories	
Cover 6	Low level of vegetation disturbance: Unaltered shore zone except for pier access.
Cover 7	Moderate level of vegetation disturbance: Shore zone area containing mowed lawn but having intact overstory.
Cover 8	High level of vegetation disturbance: Highly disturbed cover including shorelands that were mowed to the water line (e.g., beach, rip-rap, or seawall).

During the 2012 survey, an assessment of human influence features was also conducted around Wolf Lake (Figure 96). These inventoried features included artificial beaches, docks, rip-rap, seawalls, erosion, and structures built near the water's edge. Structures such as seawalls, rip-rap (rocked shoreline), and artificial beach result in reduction of habitat which directly impacts the fishery and wildlife. Docks and artificial beaches can result in altered in-lake habitat, and denuded lake beds provide opportunities for invasive species to become established and reduce habitat that is important to fish and other lake inhabitants. Erosion can contribute sediment to the lake, which can alter spawning habitat and carry nutrients into the lake. Unmanaged runoff from the rooftops of structures located near shore can also contribute more sediment to the lake. Each human-made feature by itself may not result in a large impact to the lake, but when these features occur more frequently around the lake, the cumulative impact can be a problem for habitat and water quality.

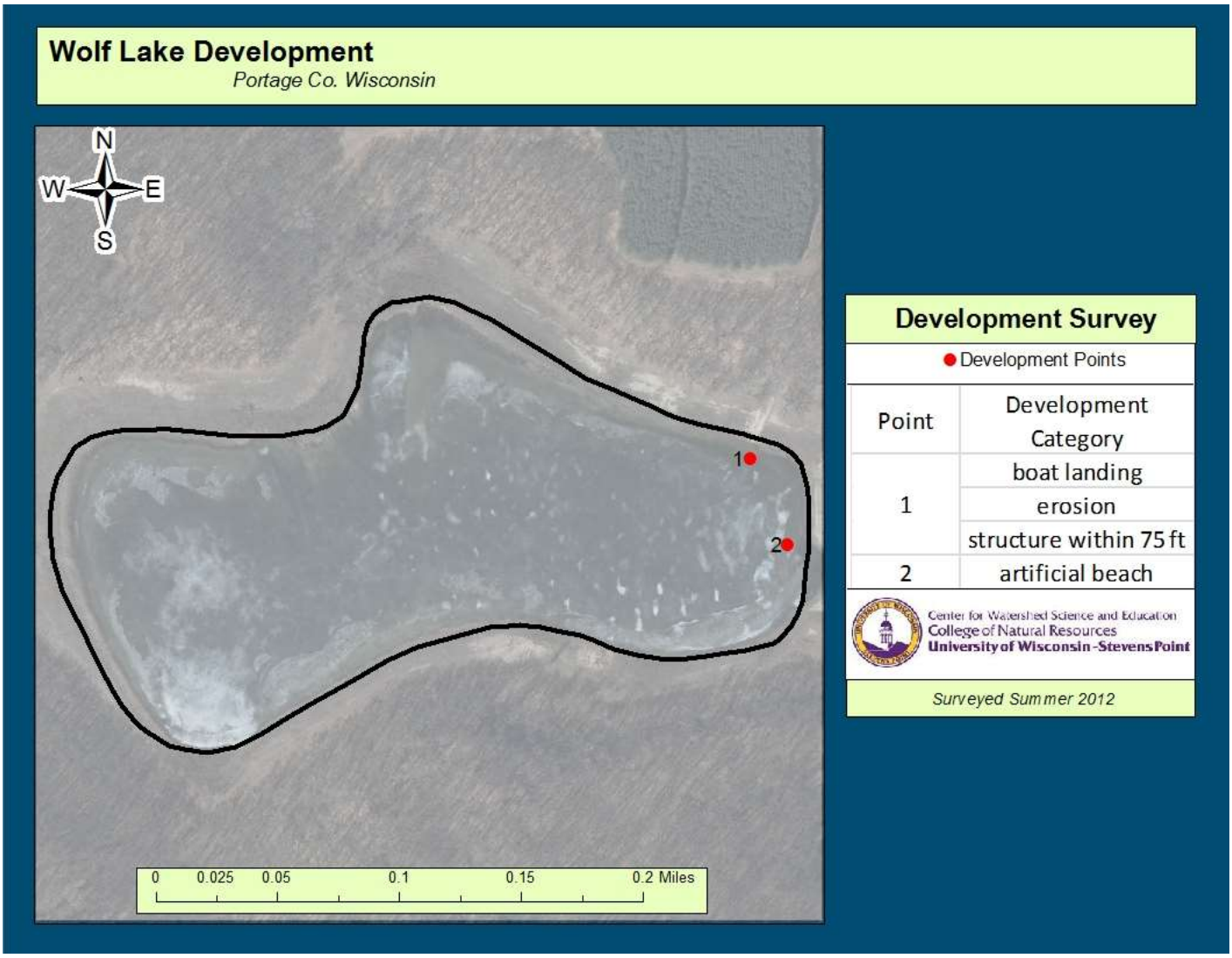


Figure 96. Features of human influence around Wolf Lake, summer 2012.

References

Meyer, Michael W, and James E. Woodford, 2003. Impact of lakeshore development on green frog abundance. Biological Conservation 110, 277–284.

Paloski, Rori A., 2006. Relationship between lakeshore development and anuran populations in Portage County, Wisconsin. Master's Thesis. University of Wisconsin-Stevens Point Learning Resource Center. (Accession Order No. QL653.W6P35)

Appendix

Datasheets for 2012 Shoreland Survey in Portage County, WI

Portage County Shoreland Survey (VEGETATION)

Lake Name:

Waypoint number (or range):

	Max Distance from Water (ft)						Percent Cover		
VEGETATION	0	<1	1-5	>5-15	>15-35	Max Distance (>35)	0-30	30-70	70-100
Height > 15 ft									
Height 3 - 15 ft									
Height 0.5 - 3 ft									
Height < 0.5 ft									
Mowed lawn									
Wetlands									
Organic (leaf pack, detritus)									
Barren, bare dirt									
New shoreland Restoration									
Woody structure at water interface									

Portage County Shoreland Survey (HUMAN INFLUENCE)

Lake Name:

Waypoint number (or range):

Comments:

HUMAN INFLUENCE	
Artificial beach	
Seawall	
Rip-rap	
Dam/ Spillway	
Dock / pier at water	
Boat landing	

Erosion - Type		
None		
Undercut banks/slumping		
Furrow/gullies		

Erosion - Length (ft)		
<20	21-60	>60

Erosion - % Slope		
Flat <10	Moderate (10-25)	Steep (>25)

Within 75 feet of Ordinary High Water		
Buildings	**0-35**	**35-75**
Principal Structure		
Detached Deck/Patio/Gazebo/Boathouse		
Other Accessory Building/Impervious		
Land use	**0-35**	**35-75**
Residential		
Cropland		
Fallow		
Forest		

Mark on Map
Approx location of waypoint
Erosion
Preferred flow channels/Culverts