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Geodesign for Sustainability - Protecting a Two-Story Fishery on Lac Courte Oreilles

Douglas Miskowiak, Senior GIS Education Specialist

Lake Lac Courte Oreilles (LCO) is one of only five lakes of Wisconsin's 15,089 lakes that sustains both cold-water whitefish and cisco (lake herring). This exceptionally rare two-story stratified fishery is facing tragedy from excessive nutrients, in particular Phosphorus (P), that are fueling excessive growth of algae and aquatic plants, both native and invasive species. As the excessive biomass dies and decays over the summer, the process consumes dissolved oxygen (DO2) and suffocates cisco and whitefish inhabiting the cold-water strata. Furthermore, climate change warms LCO's waters so that these fish no longer have an escape hatch to reach oxygen rich waters in the autumn months. July 2016 marked a massive whitefish and cisco die off on LCO. The death of whitefish and cisco are tragic signs of declining water quality.

Dead cisco retrieved after the July 2016 die-off.



Water quality sampling on Lac Courte Oreilles.



LCO is part of the 125-square mile Upper Couderay River Watershed that contributes approximately 12 billion gallons of water annually – almost all of which eventually flows into LCO. To improve water quality on LCO, the Courte Oreilles Lakes Association (COLA)

Geodesign on LCO continued on page 4.

www.uwsp.edu/geo
www.uwsp.edu/gis

You can get there from here!



Chair's Corner

Dr. David Ozsvath - Professor and Chair, Department of Geography and Geology



In this issue of *UWSP GeoNews* I would like to highlight some of the accomplishments of our faculty and staff during this past year.

Kevin Hefferan has been on sabbatical for the spring semester, working on a new textbook for use in environmental geology classes. He also coauthored a paper on the age of Pan African metamorphism in Morocco that was published in the *Journal of African Earth Sciences* and was presented at the American Geophysical Union Annual Meeting.

Neil Heywood, along with three other UW-Stevens Point faculty members and two undergraduate students, received funding to travel to western Nebraska this summer. The research team includes a biologist, a physicist, an archeologist, and (of course) a geographer, who will observe and chronicle the total eclipse of the sun on August 21st.

Samantha Kaplan authored two reports and two poster presentations related to her ongoing paleobotany and climate change research. She also received a grant to attend the National Association of Geoscience Teachers – a five-day workshop on geoscience education held in Madison, collecting ideas to improve educational programs at UWSP.

Tim Kennedy coauthored a paper on parcelization in rural Wisconsin, and presented the results of this research at the Association of American Geographers annual meeting. Tim continues to promote the use of UAS (drones) to collect geospatial data, supervising student research and demonstrating UAS capabilities to members of the Wisconsin State Legislature and the UW-Board of Regents.

Christine Koeller received funding from Cason & Associates, LLC and the Legend Lake Protection and Rehabilitation District to supervise the development of a bathymetric map series for the Legend Lake system. She also mentored students to investigate tax revenue generation by parcel and to map cross-country ski trails for the Iola Sportsmans Club.

Eric Larsen authored two annual reports summarizing his recent work in the Yellowstone National Park and continued his partnership with the Yellowstone National Park Center for Resources. The highly publicized impacts of wolf reintroduction on ecosystems within the park include the results of Eric's longitudinal study of aspen growth as affected by changing elk populations.

Karen Lemke continued her participation in the UW-System Women and Science National Science Foundation Advance Project: Horizontal Mentoring. Both students and peers have benefited from her experience in this project.

Doug Miskowiak supervised and presented the assessment of erosion vulnerability of agricultural lands for Lake Lac Courte Oreilles. He recently acquired funding from the Alexander Foundation to develop the Digital Concierge, using story maps and apps to present the area's amenities and assets to tourists and young professionals.

Ismaila Odogba participated in the year-long UW-Stevens Point Teaching Partners Program, which culminated in a presentation at the UW-System Conference on Teaching and Learning in a session titled Researching Student Motivation and Learning.

Keith Rice continues as Director of the GIS Center, which has undertaken several new outreach projects while developing curricula for the FLEX Master's degree in Geodesign and GIS. Keith continues in his advisory role as a GIS expert to the Wisconsin Department of Natural Resources, the Portage County Planning and Zoning Department and the Portage County Land Modernization Committee.

Michael Ritter continued the development and revision of his online textbook, *The Physical Environment*, for Pearson Publishing.

Lisa Theo, who spends half of her time as Coordinator of the Office of Student Creative Activity and Research (OSCAR), still manages to mentor some of our majors and teach courses in human geography. She once again led a field trip to the Mississippi Delta, presenting the interdisciplinary nature of geography to both students and campus administrators.

David L. Ozsvath



Graduates - Class of Spring 2017

in scientia opportunitas - In knowledge there is opportunity

Bachelor of Arts in Geography

Zachary Ott

Cassandra Wentzel

Environmental Geography and GIS and
Spatial Analysis Minors

Matthew Zacherl

Bachelor of Science in Geography

Elizabeth Corbin

GIS and Spatial Analysis Minor

Pamela Hartwig

Ronald Hetzel

GIS and Spatial Analysis Minor

Anthony Rockweit

Brady Spierings

Peter Strommen

GIS and Spatial Analysis Minor

Ryan Weber

Matthew Weise

Geology and GIS and Spatial Analysis
Minors

Nathan Werner

Environmental Geography Minor

Bachelor of Science in Geoscience

Katherine Bober

Earth Science Minor

Megan Kelsey

Earth Science, Geology and Natural
Science-Broadfield Minors

Tyler Phillip

Geology Minor

Colin Schmenk

Geology Minor

Robert Sorgel

Geography and Geology Minors

Alexander Sukupcak

Geology and GIS and Spatial Analysis
Minors

Paul Swartz

Earth Science and Geology Minors

John White

Geology and GIS and Spatial Analysis
Minors

The degrees recognized on this page are those offered by the UWSP Department of Geography and Geology. Academic credentials awarded by other departments are not acknowledged.



Geodesign on LCO continued from page 1.

knows that it must address issues at the watershed scale. With educational assistance from the UW-Stevens Point GIS Center, COLA is employing Geodesign methods and GIS techniques to analyze the potential vulnerability of agricultural lands to erosion. The analysis summarizes indicators of soil erosion by individual tax parcels. The results provide conservationists with tools to identify landowners and future collaborators in the fight to limit erosion and keep nutrients on agricultural fields and out of LCO.

A Geodesign Fix for Excessive Phosphorus (P)

Nutrient-laden sediments have been accumulating on LCO over many decades and from various sources. Dredging and treating existing sediments to bind P offer a few short-term fixes. A Geodesign approach first looks to science and land management practices. Not long ago, farmers commonly prepared their soils for seed by turning plant residues under the soil with a moldboard plow and tilling with a disc harrow – a practice known as clean tillage. Soil science process models reveal that this practice oxygenates the soil and activates microorganisms that accelerate the breakdown of crop residues and soil organic matter. It also disturbs the creation of a soil substance named glomalin. Glomalin is a protein

Geo students compare water runoff from a clean till soil (left) and a no till soil (right). No till or conservation tillage produces significantly less erosion and keeps water cleaner.



produced by a type of beneficial soil fungi that acts as a glue, binding soil particles tightly to each other. Glomalin is present in undisturbed and no-till systems as compared to conventionally clean-tilled soils. No-till or conservation tillage is an example of Agricultural Best Management Practices (BMPs) designed to keep nutrients on the land where they benefit crops and producers and out of nearby waterways. Furthermore, Geodesign employs modern GIS technology and data to identify agricultural lands potentially most vulnerable to erosion. These areas offer producers and conservationists the greatest opportunity for economic gains and water quality protection.

GIS Tools and Techniques - EVAAL Model

The Erosion Vulnerability Assessment for Agricultural Lands (EVAAL) is a set of GIS tools designed by the Wisconsin Department of Natural Resources (WDNR) to identify agricultural lands potentially most vulnerable to erosion. EVAAL does not measure actual erosion, but rather offers a relative index that ranks vulnerable areas within a specified area. Geospatial data used for EVAAL is available for all of Wisconsin and most of America, however, EVAAL recommends the use of LiDAR elevation data, which was not available for the project area and is still limited nationally.

EVAAL offers scripts and tools for ESRI’s ArcGIS software platform. Investigators employed ArcGIS version 10.3.1 for this project. EVAAL guides analysts through the a process of: 1) conditioning a digital elevation model (DEM), 2) creating internally draining areas, 3) estimating gully erosion, 4) estimating sheet and rill erosion, and 5) normalizing and adding the results of gully and sheet and rill erosion into a single erosion vulnerability index (EVI).

Geography Major and GIS Center Intern, Kyle McNair was responsible for executing EVAAL under the supervision of Douglas Miskowiak. Overcoming the limitations of the 10-meter DEM within an oversized watershed was most challenging. Improving how EVAAL modeled the natural flow of water proved cumbersome. Kyle manually



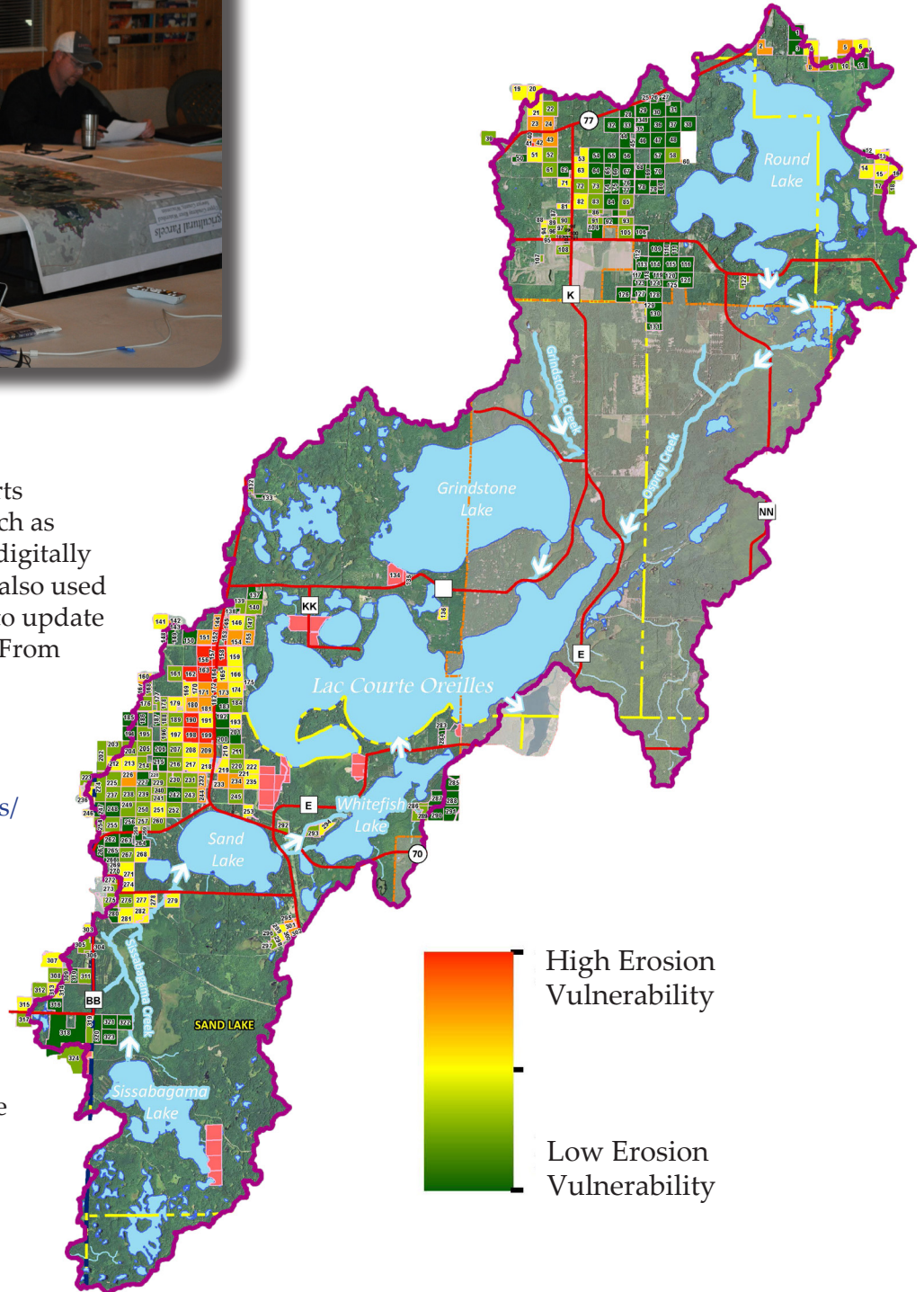
Geo intern, Kyle McNair (foreground), updates EVAAL data inputs parcel by parcel based upon field inspections and discussion with local conservationists.

Erosion Vulnerability Index by Parcel



inspected the DEM to place culverts that would break digital dams, such as raised roadbeds and bridges that digitally restricted the flow of water. Kyle also used input from local conservationists to update data representing crop rotations. From DEM conditioning to the final erosion index, Kyle documented each step of the process with maps. The maps are available at: www.uwsp.edu/cols-ap/GIS/Pages/COLA.aspx.

EVAAL generates a single erosion vulnerability index (EVI) that combines the vulnerability for sheet and rill erosion with vulnerability for gully erosion. EVAAL normalizes both using a common measurement scale before adding them together. The index excludes areas considered internally draining. The EVI identifies areas in the landscape that are potentially most vulnerable to erosion.



Aggregate the Index to the Tax Parcel – The Unit of Land Management

Ultimately, the EVI was aggregated at the tax parcel level as a means to support pragmatic land planning and management. Importantly, landowner information (name and address) is explicit and identifies the individuals or entities responsible for land management and the potential partner to keep soil on land and out of water. Next, each parcel receives an aggregated score, normalized by area. The single score helps conservationists identify parcels most and least vulnerable to erosion and a means to prioritize conservation efforts where they can do the most good. Finally, the details about how the aggregated score was calculated are also attached to the parcel. The details help conservationists and producers understand, “*Is erosion likely due to slope, crop rotations, soil type, or a combination of these factors?*” The details are anticipated to help choose agricultural BMPs custom tailored to fight erosion for each parcel of land. The aggregated EVI has only just been shared with conservationists (January 2017) and its ability to educate land owners and negotiate effective land management strategies and implementation has not yet been evaluated.

Conclusion

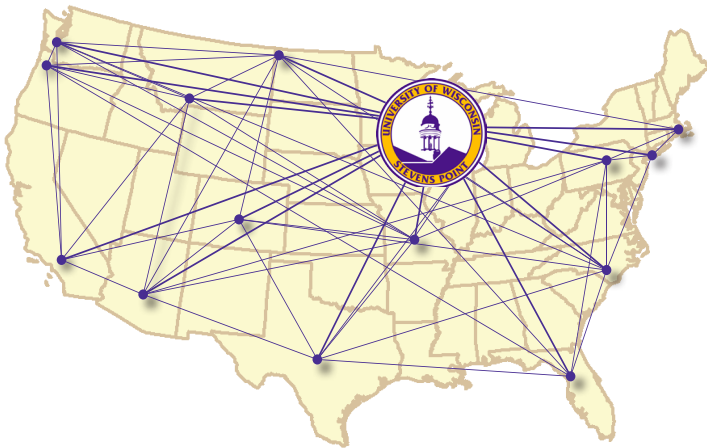
LCO offers a classic narrative illustrating the tragedy of the commons. People acting rationally to maximize their own self-interests, whether it be for leisure, profit, or to minimize effort, consume a resource beyond its carrying capacity, until it is diminished of value. LCO is a commons resource owned by every citizen of Wisconsin and the United States by way of the Wisconsin State Constitution and the Public Trust Doctrine. Instead of tragedy by taking something from the commons, the tragedy on LCO is born by a deposit of something damaging to the commons. Excessive nutrients and atmospheric carbon are deposits to the LCO commons that have diminished habitat (well oxygenated, cold water) capable of sustaining cisco and whitefish. The die off of whitefish and cisco on LCO is a classic indicator of this tragedy of the commons. Whitefish and cisco are the most vulnerable species and the first affected by polluted waters and a warming atmosphere.

Humans have a solid scientific understanding of the problems concerning LCO related to fisheries, climate, soils, biology, and chemistry. Geography and GIS help humans understand the context of the problem and the importance of place to addressing the problem. How humans respond to manage the commons is now in question. Technical fixes, such as dredging or treating LCO are short term fixes that do not treat the source of the problem. LCO requires a fix designed with greater imagination and collaboration among many human stakeholders. Fortuitously, the fix that limits P from agricultural sources benefits all stakeholders. Implementation of BMPs keep soils and nutrients on the land where producers want them and need them to grow crops and out of LCO where they degrade water quality and fish habitat. With Geodesign and GIS, investigators have identified priority zones where implementation of BMPs are anticipated to have the greatest effect. With the tax parcel, conservationists can identify actors and develop the human partnerships necessary to negotiate other fixes that address the source of the problem.



Topologies

Maintaining Relationships with Alumni



Topology, defined in the geographic sense, maintains spatial relationships among geographic features.

This newsletter column entitled, *Topologies*, is meant to maintain relationships among our treasured alumni and their alma mater—the University of Wisconsin-Stevens Point.

No matter where GEO takes you, stay connected!

Validate your topology today.

Alumni, let us know how to contact you and what you've been up to. Please share your stories of personal and professional success with the UWSP community of students, alumni, colleagues, and friends.

- E-mail us at GIS@uwsp.edu
- Subject Heading: Alumni Topologies

Kristine Bucholtz, Class of 2007

Bachelor of Science in
Geography - Physical
Geology Minor



Coming to UW-Stevens Point with no formal introduction to Geography or Geoscience in high school, Kristine Bucholtz found a promising career trajectory in the Department of Geography and Geology. Geography 101, Introduction to Physical Geography with Professor Ritter, exposed her to the scientific method, systematic observation, measurement, and experiment. Professor Ritter's course still guides the way Kristine looks at the world today. Her GIS courses offered a set of practical techniques to analyze a complex world and communicate spatial information to others. Kristine looks back on Dr. Rice's courses fondly. *"I have kept all my detailed lab manuals from my various GIS courses and I reference them frequently."* Kristine remembers too the day that Dr. Heywood encouraged her to apply her classroom knowledge to an internship. *"His advice was invaluable. I applied my education to an internship with the United States Forest Service, placing and retrieving leaf specimens to discover the presence of sudden oak death syndrome (phytophthora ramorum). Thankfully, no specimens presented with the disease."*

Graduating in 2007, Kristine turned the challenges presented by the great recession toward opportunities. *"I found my place in the larger world traveling throughout China and Tibet with a fellow Pointer, retirees, professionals, and new friends. It was a humbling cultural experience that helped me realize how connected Earth's cultural and physical systems are to each other."* Later Kristine joined students from all corners of the globe for the Hessen International Summer University in Kassel, Germany where she studied seismic and climate engineering.

Bucholtz Interview continued on page 8.



Bucholtz Interview continued from page 7.

Kristine’s career path started with the Wisconsin Department of Natural Resources (WDNR) at Hartman Creek State Park where she worked in visitor services. *“I worked regularly with foresters and wildlife biologists along with the Friends of Hartman Creek who indulged my ‘questions of the day.’ They recognized my passion for the natural sciences and nurtured me to take on the Naturalist position.”* In this position, she led day hikes helping travelers understand Wisconsin’s glacial history and the local flora and fauna.

Still at the WDNR, her Geography and Geoscience background prepared her for a new position as a Forestry Technician and Fire Control Dispatcher where she integrated natural resources and emergency management issues. She was responsible for smoke and fire reporting, maintaining training and certification records for her team, and analyzing fire-weather conditions. Outside the fire season, she learned how to conduct forest reconnaissance and timber sales and analyze tree regeneration metrics. She also contributed to a study that analyzed the cultural dimensions and utility of the Emergency Fire Warden Program. This yearlong study evaluated information and input from over 4,000 respondents.

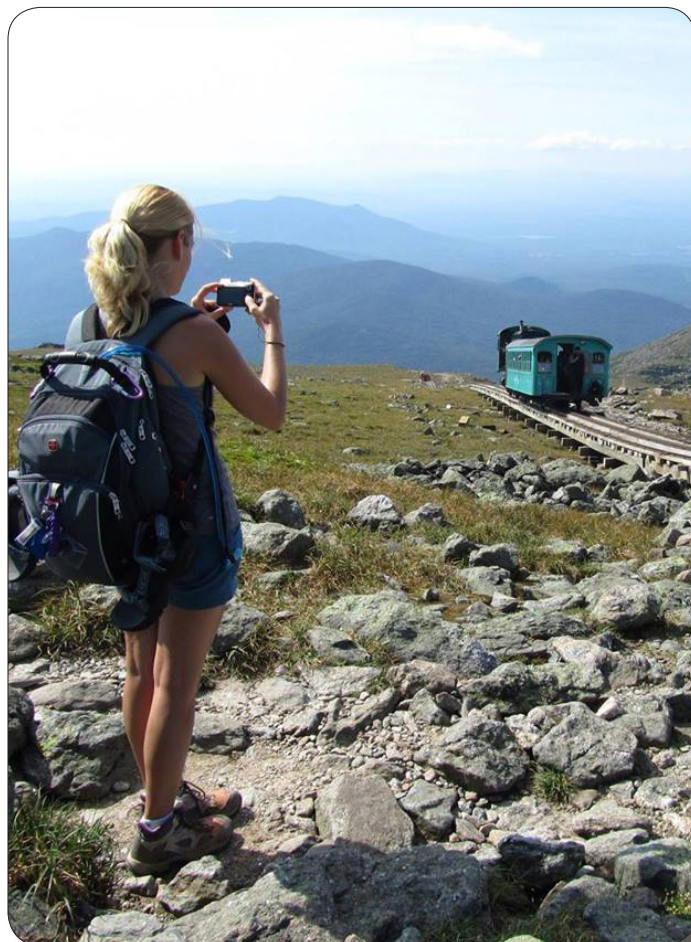
Conducting forest reconnaissance for the WDNR in Woodruff, Wisconsin.



In 2015, Kristine found herself trading Wisconsin’s lakes for Concord, New Hampshire and the majesty of the White Mountains range. There she worked for the New Hampshire Department of Safety, a Division of Homeland Security and Emergency Management. *“I supported federal, state and local agencies to obtain training and achieve emergency exercise objectives. In this capacity, my department developed, marketed and administered the Emergency Management Academy that launched in April 2016.”* The academy is a series of courses taught online, in the classroom or as a seminar that provide basic tools to build, sustain and improve emergency management capabilities.

www.nh.gov/safety/divisions/hsem/emacademy.html

Hiking near the summit of Mt. Washington, New Hampshire.



"Wisconsin is again home for me. I am presently the Fire Program Staff Specialist for the WDNR, stationed in Madison." The position involves facilitating program strategic alignment, decommissioning state-owned fire towers, GIS mapping and analysis, and administering the Statewide All-Hazards Incident Management Team. More information about this program and fire protection resources can be found at:

www.dnr.wi.gov/topic/ForestFire/.

Kristine's parting message is, *"Students of Geography and Geoscience are invaluable assets helping address society's pressing problems. These sciences cultivate our ability to see the world at the macro-level, while simultaneously developing our understanding of the minutiae of Earth's cultural and natural systems. While my path was not linear, it most certainly is rewarding."*

Pictured from left to right; New Hampshire Governor Maggie Hassan, Kristine Bucholtz, and First Gentleman Thomas Hassan.



Monitoring a severe storm system in the New Hampshire Emergency Operations Center. Photo courtesy of WMUR Twitter Page. Kristine is pictured middle, right.



The interview between Dr. Kevin Hefferan and Kristine Bucholtz was conducted in person on March 29th, 2017.



GIS and Geo Students Support Management Decisions on Legend Lake

Casey Trickle, Ethan Bott and Kyle McNair

It is springtime and plants will soon be in full bloom, both on land and in water. While some people are busy fertilizing their lawns to promote lush growth, the Legend Lake Protection and Rehabilitation District (LLP&RD) is thinking about ways to control excessive plant growth in the Legend Lake system located in Menominee County, Wisconsin. Legend Lake suffers from excessive aquatic invasive plant growth and the effectiveness of past herbicide treatments was inconsistent. LLP&RD and Cason and Associates, LLC, a lake management company, suspected that estimating water volumes accurately is the solution to more effectively controlling plant growth with herbicides. Chemical prescriptions to treat excessive plant growth are tied to water volume. Under the supervision of Christine Koeller, Faculty Associate, UWSP students Isaac Sargent, Casey Trickle, Ethan Bott, and Kyle McNair used data collected by Cason and Associates, LLC in 2016 and Geographic Information Systems (GIS) to determine new, more accurate volume estimates for Legend Lake and create useful maps for the community.

Data Collection - Shorelines, Lake Perimeter, Area and Depth

Lake surface area for this project represents the area where depth is measured or estimated. The lake's surface area also represents where the action of wind and waves affect the dissipation of chemical treatments. Eighteen inch, leaf-off orthoimagery, acquired in 2015 and captured at a scale of 1:800, provided data for delineating shorelines. Students manually inspected the imagery using ArcMap 10.3.1 to determine the location of the shoreline and measure the lake's perimeter and area.

Bathymetry data that measures the depth and volume of water was captured between July 16 and August 16, 2016 by Cason and Associates, LLC. The organization used a Trimble R6 receiver coupled to a TSC2 field computer to acquire a geographic location and the elevation of the lake at its surface. The TSC2 was also coupled to a Trimble SonarMite echo sounder to measure lake depth. Over 120,000

measurements on Legend Lake captured geographic locations, surface water elevations and lake depths. Lake depths were subtracted from a full-pool surface water elevation of 845 feet above sea level to determine adjusted lake-bottom elevations.

Depth Accuracy Assessment

The echosounder was field tested for accuracy in comparison to depth measurements conducted manually with a lead line. UW-Stevens Point graduate GIS certificate student, Isaac Sargent, navigated to randomly selected locations on the lake and lowered a 10-ounce lead ball to measure depth while simultaneously recording depth from the echosounder. A comparison of echosounder and manually derived depths using T-test and linear regression statistics revealed no significant difference between measurements ($p < 0.05$).

Construction of Lake Depth Contour Lines

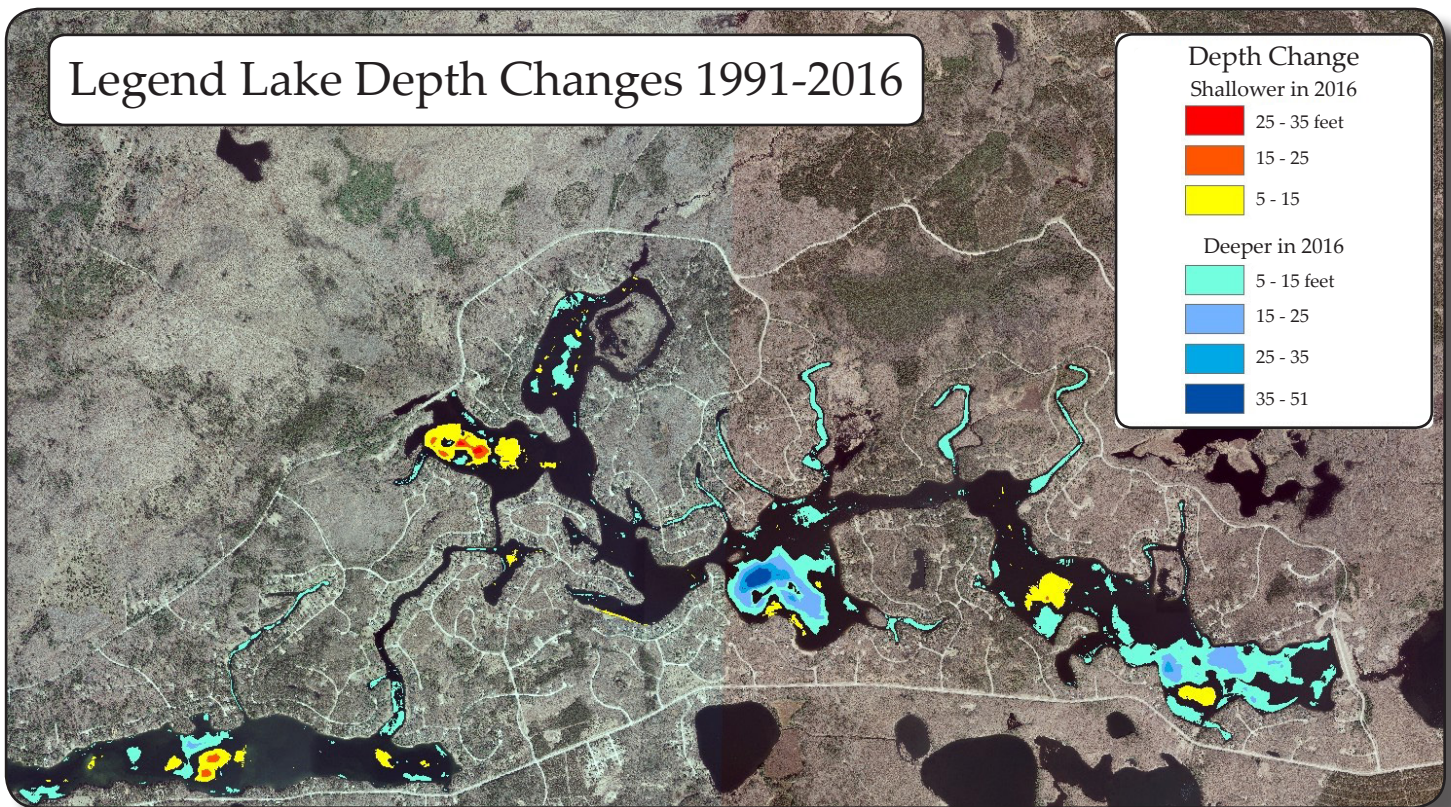
A polygon representing Legend Lake's surface area and the X, Y and Z depth points were used to construct a three-dimensional (3D) lake model. First, student analysts assigned a depth of zero to the shoreline, where land and water meet. Then analysts carefully examined depth measurements to establish breaklines, or lines of uniform depth values. In subsequent 3D modeling, the breaklines provide known values to ensure smooth and accurate depth transitions. In the final step, a Triangulated Irregular Network (TIN) interpolates depth values based upon actual X,Y,Z depth measurements and the established breaklines. The TIN provides the 3D surface model necessary for delineating contour lines based on uniform depth.

Volume Calculations and Change (1991 - 2016)

Management decisions on Legend Lake are made individually for each of its basins, so ArcMap software was applied to determine lake volume for each basin. TINs were converted to floating point raster data with 5-foot cell resolution. The 3D Analyst Surface Volume tool was used to calculate volume of the region between the surface model (Legend Lake's bottom) and the reference plane (Legend Lake's water surface).

Before comparing new volume data from 2016 to that from 1991, a hardcopy bathymetric map from





1991, accessed from the WDNR was digitally scanned. Using ERDAS Imagine software, the scanned map was georectified to overlay Legend Lake's geographic coordinates. Any areas not mapped in 1991 were excluded from comparison. Once rectified, 1991 lake depth contour lines were manually digitized and used to construct the 3D depth model. Again, data were converted to floating-point rasters with 5-foot resolution, and resampled to ensure that raster cells from 1991 and 2016 were spatially aligned.

To measure depth differences between 2016 and 1991, the Subtract function, a local area map algebra technique, was employed. Raster cells representing 1991 elevation values were subtracted from overlaying raster cells representing 2016 elevation values. The result shows elevation differences, cell-by-cell, between the two time-periods.

Volumes, surface area, shoreline perimeter, average depth, and maximum depth were calculated for each of Legend Lake's basins. The total volume of the Legend Lake system totaled 14,054 acre-feet, a 6.9 percent increase in total volume reported in 1991. Shoreline miles increased by 2.1 percent, surface area increased 9.3 percent and average depths

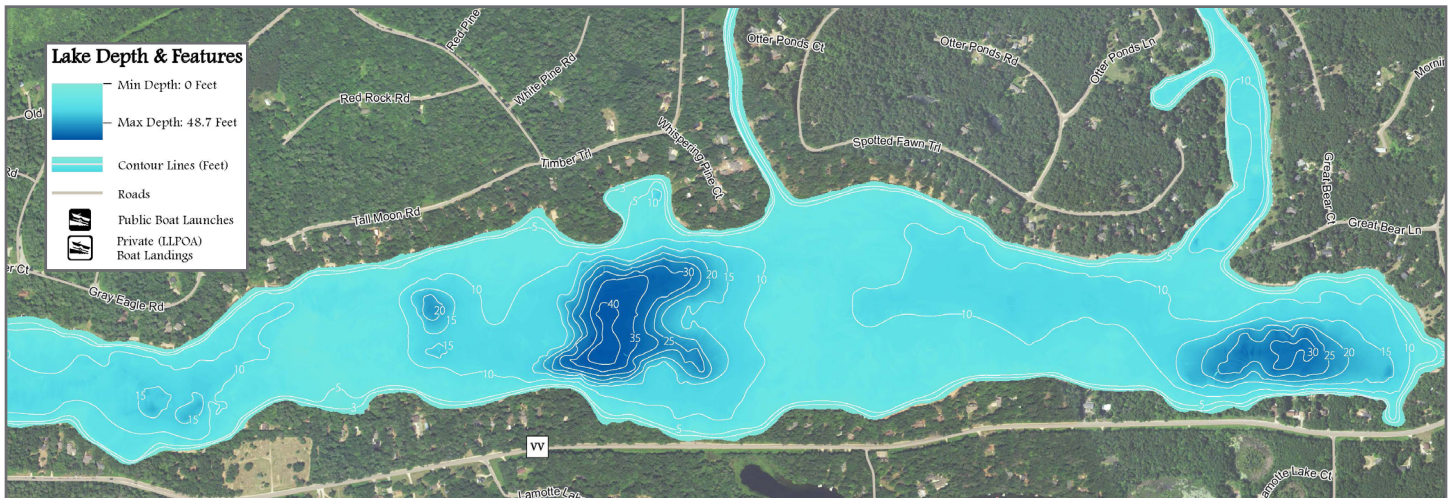
increased 36.1 percent. Differences between 1991 and 2016 could be the result of equipment errors and measurement differences between the two time periods and physical differences caused by sedimentation and sediment movement in the lake.

Cartography

Booklets and individual maps were crafted for the basins of Legend Lake, designed for 11 by 17 inch paper. Booklets display a title page and three individual basin maps compiled on the same medium. Basin maps are scaled and compass oriented individually to compensate for uniquely sized and shaped basins, yet create a highly legible and aesthetic four-page map booklet. Individual maps of the basins, like the booklets, include: basins, contour lines, roads, basin measurements, inset maps, scale bars, and north arrows. In addition, the individual map products include a coordinate grid for location reference to help while navigating Legend Lake. ArcMap, Adobe Illustrator and Map Publisher software were applied to develop map and booklet products. Maps will be printed and distributed by the LLP&RD this spring.



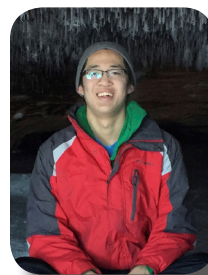
A subset example of the cartographic products derived for the Legend Lake system.



Conclusion

Geographic information and evidence fosters effective management of Legend Lake. Accurate volume measurements are informing herbicide treatments that are anticipated to better control aquatic invasive plants. Maps and informational booklets provide the local community and tourists with a useful tool while recreating on lake they love, void of the invasive nuisances they disdain. The work of Isaac, Casey, Ethan, and Kyle showcases the importance of Geography, the science of where, to create pragmatic solutions.

UW-Oshkosh. He is pursuing employment in GIS for natural resources and wants to use GIS to address wildlife conservation.



Ethan Bott is a senior at UW-Stevens Point majoring in hydrology and minoring in GIS and spatial analysis. He intends to use GIS to combat social, economic and environmental problems for underprivileged communities. He is passionate about supporting populations

exposed to lead and preventing future lead poisonings. According to Ethan, *“There are plenty of unnoticed environmental problems in communities. I want to be part of the solutions to address them.”*



Isaac Sargent has recently completed his Graduate Professional GIS Certificate and holds a bachelor's degree in resource management and law enforcement. He is returning to the U.S. Army to train new recruits at Fort Sill, OK and Fort Leonard Wood, MO.



Kyle McNair is a recent graduate of UW-Stevens Point, who majored in geography. He presently works for the City of Marshfield, Wisconsin, conducting GIS for the Department of Engineering and Developmental Services.

“With the skills and passion I have developed with GIS I will develop evidence-based solutions to address real-world problems.”



Casey Trickle is a student working on his Graduate Professional GIS Certificate at UW-Stevens Point. He has a Bachelor of Science Degree in Biology and a minor in environmental studies from





UWSP GeoClub and Student Scrapbook



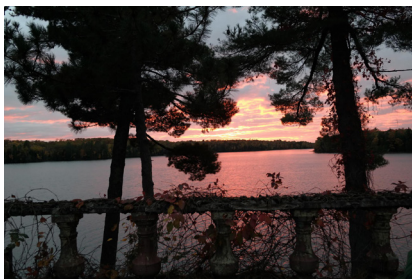
*Bucket list: Poniatowski, WI.
Visiting 45°N, 90°W (almost).*



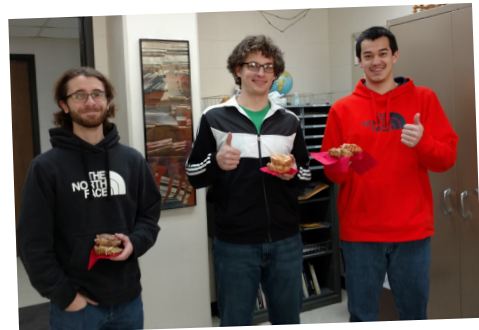
*Munising Falls in Upper Michigan,
Pictured Rocks National Lakeshore.*



*Grand Sable Dunes.
Pictured Rocks National Lakeshore.*



*Students enjoy dinner with a
view of the headwaters of the
National Scenic Riverway at
Lake Namekagon.*

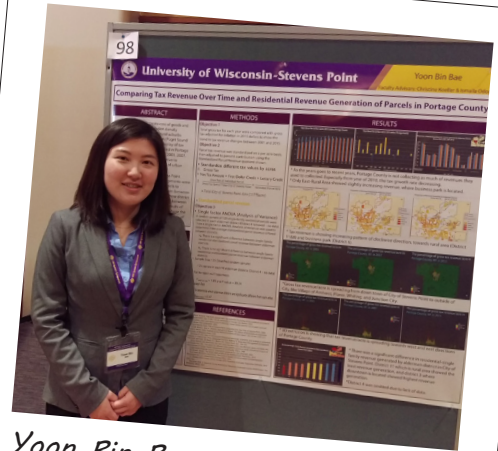


*"Yum from an Alum"
Geo students enjoy a treat
courtesy of alumnus, Kyle Pepp.*





Assisting fish biologist, Frank Pratt, with a fish survey on Lac Courte Oreilles using a seine net.



Yoon Bin Bae presents her work at the College of Letters and Science Student Symposium.



Students from Mobile GIS establish geographic positions using the TSC2 field computer and R6 GPS receiver.



Geomorphology of the Tomorrow River.



Professor Neil Heywood leads the Geog393 field trip through the Rocky Mountains.



Measuring the Baraboo Syncline fold hinge in Structural Geology.





We made it to the top of Wisconsin, but missed the nearby "Hill of Beans" Coffee Shop & Restaurant.



Sarah, Elizabeth and Kyle present their work using GIS to analyze risk for Location Analytics at the American Family Insurance corporate offices.



Geography field trip to the Upper Couderay River Watershed. After learning about water quality issues and impacts on the fishery, students enjoy a canoe trip down the Couderay River.



A brief respite on the Ice Age Trail Corridor near Medford, WI, before heading home.



Devil's Lake State Park. Structural Geology.





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- ▶ Christine Koeller, Faculty Associate
- ▶ Eric Larsen, Professor
- ▶ Karen Lemke, Professor
- ▶ Douglas Miskowiak, Senior GIS Education Specialist
- ▶ Ismaila Odogba, Associate Professor
- ▶ Eric Olmanson, Instructor
- ▶ Ray Reser, Director of Museum of Natural History
- ▶ Keith Rice, Professor and Director of GIS Center
- ▶ Michael Ritter, Professor
- ▶ Diane Stelzer, GIS Center Associate
- ▶ Lisa Theo, Instructor

Calendar of Events

Wisconsin Land Information Association Spring Meeting
June 1 - 2, 2017. Fond du Lac, WI
www.wlia.org

ESRI International User Conference
July 10 - July 14, 2017. San Diego, CA
www.esri.com/events/user-conference

American Institute of Professional Geologists
National Conference
September 23 - 26, 2017. Nashville, TN
www.aipg.org/annualmeeting

National States Geographic Information Council
Annual Conference
September 25 - 29, 2017. Providence, RI.
www.nsgic.org/upcoming-conferences

AAG West Lakes States Regional Division Fall Meeting
October 19 - 21, 2017. West Plains, MO
www.community.aag.org/westlakes/home

GIS Day
November 15, 2017
www.gisday.com

You can get there from here!

