

Vilas County Lakes & Watersheds:
A Comprehensive Study - Phase 2
Final Report
LPT-471-15



FROM THIS

TO THIS



Grantee

Vilas County Land and Water Conservation Committee

Project Title

Vilas County Lakes & Watersheds: A Comprehensive Study – Phase 2

Vilas County Land and Water Conservation Committee

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Phase II – Lakes & Watersheds: A Comprehensive Study

Introduction

In a county where there are more than 1,320 lakes that require protection and only 3 staff persons employed in the Conservation Department, we sought a tool similar to *Lakes Classification* that would help us to focus where our lake and watershed protection work efforts would be most beneficial. The county Land and Water Resource Management Plan (LWRMP) is one tool that currently exists to help us define and focus priority goals. Although that plan is useful for annual planning purposes, we needed to delve deeper to further define our future lakes and watersheds project workload. A second (and very notable) purpose of our Lakes & Watersheds project here was to identify location and types of ecological threats that exist around the county. This will help us when we begin selecting targeted areas for watershed management projects.

In Phase 1 of the Vilas County Lakes & Watersheds project (LPT-457-14; 2014-2016) we developed a workload prioritization strategy for county conservation staff that focused on lake organizations. We identified Vilas County lake organizations that were thinking about (or needing to implement) lake management plans. Since that time, county staff have continued to offer technical support to lake organizations in a variety of ways, but specifically, to encourage lake groups to progress in their lake management planning efforts. In alternating years, we host workshops to target lake groups to encourage initial lake management planning or lake management implementation for existing plans.

Under Chapter 92 of Wisconsin Statutes, all counties are purposed to protect and conserve surface waters and groundwater at the local level. All Wisconsin counties receive an annual financial allocation from Department of Agriculture, Trade, and Consumer Protection (DATCP) to address their locally identified water resource concerns, including soil erosion and pollution runoff issues. The Vilas County Land and Water Conservation Department provides financial and technical assistance to the public in response to these issues, and in a typical summer will handle approximately 25-30 phone calls to this end. We then educate and enroll private landowners in soil erosion and pollution abatement conservation programs. This process involves a significant amount of staff time annually, and because of the voluntary nature of these programs for the private landowner, we may not be addressing the most severe pollution occurrences throughout the county.

The primary focus of the Phase 2 Lakes & Watersheds project was to identify areas around the county with the most resource concern from soil erosion and water pollution perspectives, so that the most problematic environmental issues around the county could be addressed in the future by Vilas County Conservation Department staff. We accomplished this identification process geographically by twelve-digit hydrologic unit watersheds (HUC 12s) to pave the way for future watershed-scale management planning efforts in Vilas County.

Project Scope

The scope of the Phase 2 Lakes and Watersheds project included the following activities. Each item is described further in the next sections.

- (1) Assess & rank the health status of all HUC 12 watersheds, and identify lakes within each that are currently in excellent, good, or fair condition based on factors such as Total Phosphorus (TP), 303(d) impairment listings, AIS status, Outstanding / Exceptional Resource Waters status, and TMDL Priority.
- (2) Increase the focus of wetland work in the Land & Water Conservation Department by field monitoring, identifying size & type, and identifying wetlands that may be most vulnerable to nearby development or invasive species.
- (3) Prioritize future Conservation Department watershed work efforts into 3 status categories: Remediation (Tier 1), Threatened (Tier 2), or Protection (Tier 3)
- (4) Assist the regional WDNR with accomplishing their work plan objectives & support activities within the WI Lakes Partnership
- (5) Provide education and technical assistance to lake organizations and to the public
- (6) Administer the grant for reimbursement purposes

Project Methods

The US Environmental Protection Agency defines a healthy watershed as one in which “natural land cover supports dynamic hydrologic and geomorphic processes within their natural range of variation; habitat of sufficient size and connectivity supports native aquatic and riparian species; and water quality supports healthy biological communities” (US EPA, 2012).

By understanding the overall health status of our watersheds and the surface waters within them, we were able to identify areas across Vilas County that could use some improvement or protection by way of future targeted work effort from the Land and Water Conservation Department.

In the following sections we describe what data was collected and how. The process began by first mapping the county watersheds by twelve-digit hydrologic unit codes (HUC 12s). Then various resources were used to help us rank the watersheds on a 3-Tier scale. Lake health status was then ranked, followed by wetland vulnerability via ecosystem service provisions.

Methods of Data Collection

WATERSHED MAPPING

The spatial framework where this project focused was on the 12-digit hydrologic unit (HUC 12). The HUC 12 is small enough at this scale for the Vilas County Conservation Department to define priority workloads for future years, yet large enough to consider the cumulative impacts from a broader upstream area. In future years, when Vilas County staff begin to conduct some management projects within prioritized watersheds, we will be able to focus efforts at the HUC 12 scale rather than at the larger countywide level.

The GIS Specialist from the Vilas County Mapping Department created a HUC 12 watershed base map as a starting point. There are 42 HUC 12 watersheds located in Vilas County, however, note that some of those watersheds extend beyond the borders of the county. Map 4, on page 5 outlines all of the HUC 12 watersheds in Vilas County (Vilas County Mapping Department, 2018).

A watershed is defined as “a ridge of high land dividing two areas that are drained by different river systems. On one side of a watershed, rivers and streams flow in one direction; on the other side they flow in another direction” (Dictionary.com). The picture at right is a visual interpretation of that simple definition.



Map 1. Major Wisconsin Watersheds HUC 8 size; Vilas County circled in red.

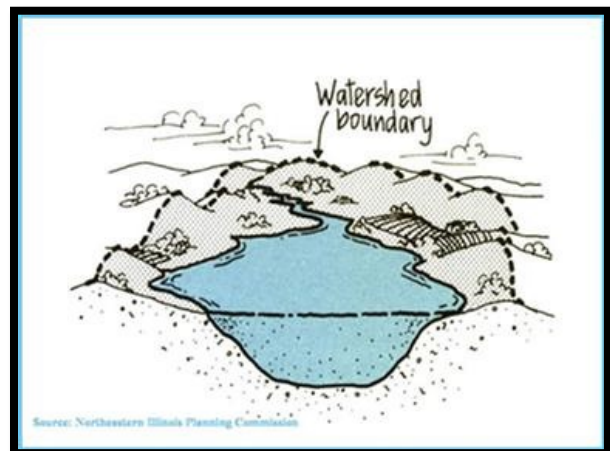
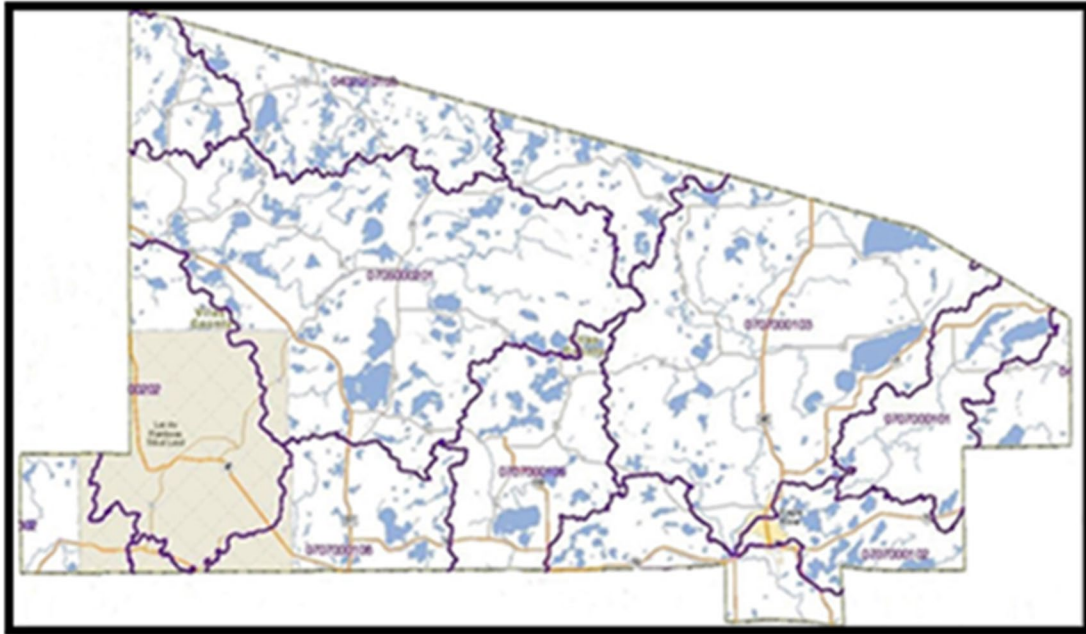


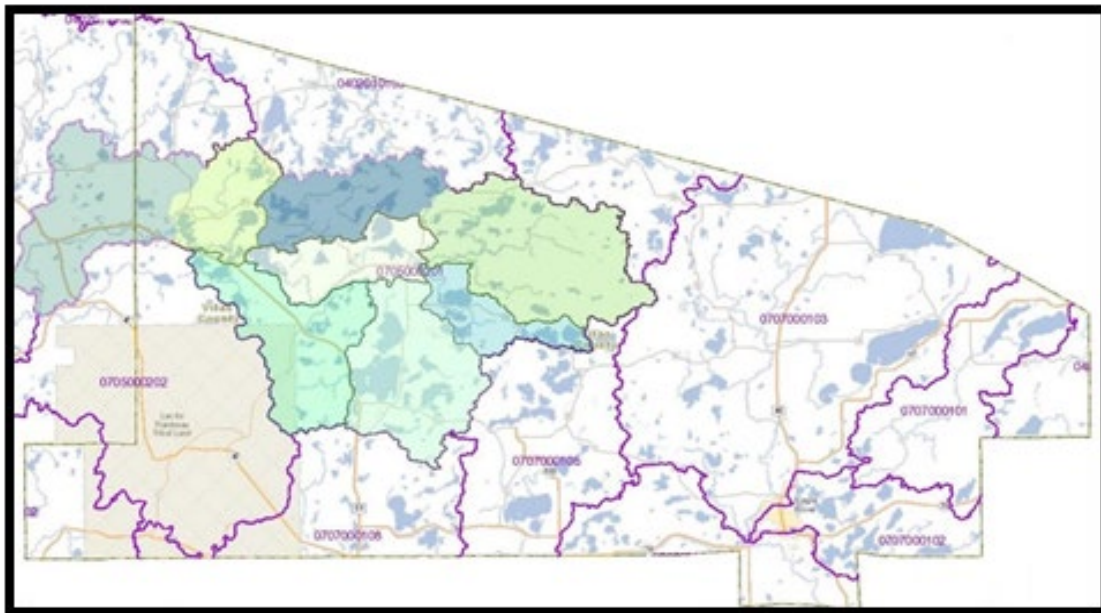
Figure 1. Visual description of a simple watershed

All lands are located within given watersheds of various size. Watersheds can be defined on small or modest areas of land, as is the case for a single small lake (a drainage basin or catchment), or for larger geographic areas of very large size scales (the Great Lakes Basin). Each watershed is defined by numeric codes based on size – specifically as Hydrologic Unit Codes (HUC). The larger the HUC watershed area, the fewer digits are used to identify it. For example, a HUC watershed that is described using 8 digits (HUC 8) is

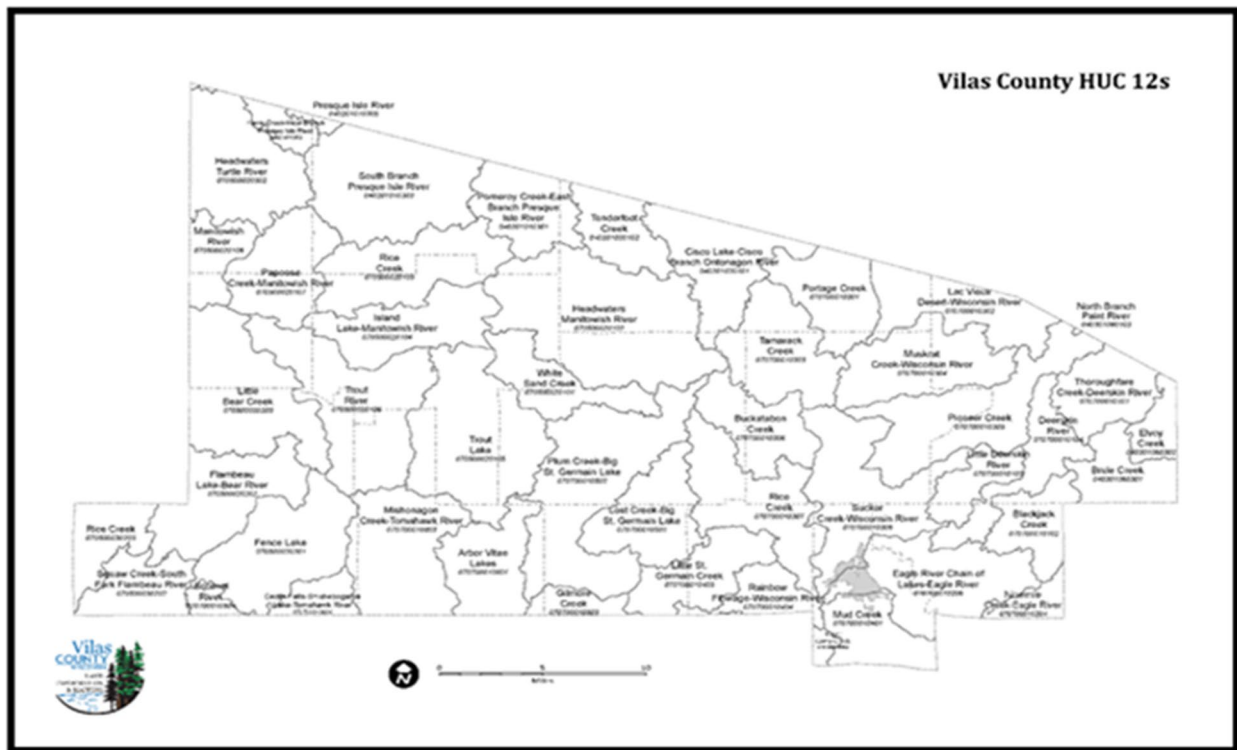


Map 2. Vilas County HUC 10 Watersheds outlined in purple.

much bigger in size than is a HUC watershed that is identified in 12 digits (HUC 12). A HUC 12 watershed is “nested” within a HUC 10 watershed, and a HUC 10 is “nested” within a HUC 8 and so on. Refer to Maps 1-3 which depict the nesting concept.



Map 3. Nested HUC 12 Sub-Watersheds contained within a HUC 10, HUC 12 sub-watersheds are highlighted in shades of green



Map 4. Vilas County's 48 - HUC 12 Sub-Watersheds outlined in black.

WATERSHED HEALTH RANKING

Several resources were consulted to gather information about the HUC 12 watersheds throughout Vilas County. For purposes of this project, we focused only on existing items of information that would give us a perspective of the overall health of a watershed, emphasizing those items that the County Land and Water Conservation Department programs and staff could assist with in their current programs (for example, placing erosion control BMP's to decrease pollutant runoff).

The DNR Healthy Watersheds Initiative (HWI) was one of the existing resources that were consulted for climate change, land use, and water uses. The Vulnerability Index scores within the HWI project were used to identify watersheds "vulnerability" to the potential that climate change would impact an area, how different land-uses might impact natural hydrology patterns, and how the use(s) of water may alter natural hydrology. In future conservation planning efforts (protection or restoration management planning), the county will take these items into consideration.

Another existing resource used was the state's EVAAL model. The acronym is short for "Erosion Vulnerability Assessment for Agricultural Lands". This modeling procedure allowed us to learn more about specific locations in the county that potential soil erosion may be the greatest, so we can place soil erosion abatement practices in targeted areas to ultimately conserve soil and protect the quality of surface waters. A factsheet about EVAAL is available in Appendix 1.

These components were then combined (along with wetland information) to create a “generalized” HUC 12 health score. Below is more information about each of these component resources along with details of the scoring and ranking processes.

HEALTHY WATERSHEDS INITIATIVE (HWI)

The DNR Healthy Watersheds Initiative vulnerability index scores were used for our ranking process. The Healthy Watersheds Initiative was a collaboration project between the Environmental Protection Agency (EPA) and the Wisconsin Department of Natural Resources (WDNR) back in March 2014. Data was collected and examined across agencies to arrive at watershed health and vulnerability metrics that could predict potential degradation within watersheds throughout Wisconsin. Vilas County utilized the results from this project for the initial ranking of our HUC 12 watersheds. Numerical data from the *Healthy Watersheds Assessment* project were to be used in a comparative sense when measured against all other watersheds statewide. For example, “bad” watersheds in Vilas County might be considered “good” elsewhere in Wisconsin. As such, the results here were used as a broad-level screening tool to identify “problem” areas locally within the county where monitoring or management efforts may prove a more beneficial use of financial and human resources in the future.

For this prioritization project, we singled out and used the *Watershed Vulnerability Metric*. Watershed Vulnerability was defined in the assessment as the potential for degradation of watershed function and overall aquatic ecosystem health over time (2010 – 2050). Data attributes that were incorporated into the watershed vulnerability assessment were: Climate Change Vulnerability; Land Use Vulnerability; and Water Use Vulnerability.

Climate Change Vulnerability: Along with predicted changes in temperature and precipitation patterns in the next few decades, it is likely that shifts in material and energy input to aquatic ecosystems will occur simultaneously. Climate change vulnerability scores in this assessment account for these predictions through subsequent increases in surface water runoff volume and increased load yields of total nitrogen, total phosphorus, and total suspended solids that enter into lakes and streams.

Land Use Vulnerability: Natural hydrology processes are affected by the way humans change the landscape. Depending on any changes to the landscape, aquatic ecosystems may be at increased risk of polluted runoff, higher inputs of nutrient, or degraded habitat for wildlife or fisheries. Change is inevitable when human populations move to more “preferable” locations. For this reason, predicted changes in natural land cover over time were incorporated into the *Watershed Vulnerability* metric, and the rank of each watershed reflects the likelihood of that land use change.

Water Use Vulnerability: Increased volumes of water withdrawn from wells or surface waters can negatively alter a watershed's hydrologic regime. As human populations increase over time as predicted, demands on available water resources will be on the rise. For purposes of the *Watershed Vulnerability* metric, water use demands were included as part of a watershed's vulnerability rank.

For more detailed information about the entire *Healthy Watersheds Initiative Project*, and all metrics included in the model, refer to the following document on the Wisconsin DNR website.

Priority Ranking Process: HEALTHY WATERSHEDS

The Vilas County GIS Specialist created a map with HWI modeled scores that were representative of the landscape vulnerability in small sub-sections of the HUC 12 from Land-use, Water-use, and Climate Change factors. The HWI model is coded into 10 distinct categories ranging from low to high vulnerability and were color coded to create the small polygons shown on a Healthy Watersheds Vulnerability Index Map specific to Vilas County. The HUC 12 GIS layer for Vilas County was then applied as shown in Appendix 2.

Next, a spreadsheet was created to display the total size (in square meters) of each HUC 12 watershed and how the size distributions for each of the 10 vulnerability raw scores were broken out. This was completed for each of the HUC 12 watersheds and the spreadsheet is available in Appendix 3. For purposes of setting workload ranks into 3 tiers, it was then necessary to combine the 10 vulnerability categories into only 3 vulnerability threshold ranges as follows: 0% - 30% (low vulnerability); 30% - 70% (medium vulnerability); and 70% - 100% (highly vulnerable).

Land area (in square meters) in each of the 3 vulnerability thresholds were totaled and the percentage of land area in each range was calculated on the spreadsheet. Point values for the vulnerability thresholds were distributed as follows: the greatest percentage of land area falling into any of the 3 vulnerability thresholds received points for the entire watershed. Examples: If the greatest percentage fell into the low vulnerability range, the watershed scored 0 points; If the greatest percentage was in the medium vulnerability range, the watershed scored 1 point; and if the greatest percentage was in the high vulnerability range, the watershed scored 2 points. Exceptions to this rule included: 1) If the watershed had a fairly equal distribution of land over all the of the 3 vulnerability thresholds, it scored 1 point; or 2) If the watershed had a fairly equal distribution between only two of the three vulnerability thresholds, the watershed received the highest point value as if it fell into the more vulnerable category – either 1 or 2 points. Refer to Appendix 4 for HWI point values given for each HUC 12.

EROSION VULNERABILITY ASSESSMENT for AGRICULTURAL LANDS

Vilas County is not known to be highly agricultural as the title of EVAAL would imply. However, the purpose of using this model was to pinpoint specific areas around the county with higher likelihood for soil erosion problems, regardless of land-use. The EVAAL model is a GIS-based tool that uses topographic, soil type, and land-use information to measure the potential of a given landscape to erode soil and export available nutrients to adjacent surface waters during rainfall. This model was created to support projects such as this one. Many counties use it to prioritize areas on the landscape that would benefit most from the placement of conservation best management practices (BMP) to reduce erosion by slowing or diverting stormwater runoff.

Each of the watersheds throughout Vilas County were modeled by the GIS Specialist using the EVAAL tool to identify the most erosive location(s) within the HUC 12 areas. EVAAL maps were created for each of the HUC 12 watersheds as a visual tool to help locate the areas within a watershed that are most likely vulnerable to erosion. ****VERY IMPORTANT NOTE:** In order to accurately depict the hydrological character and stormwater runoff patterns over the Vilas County landscape, a complete revision of records for the existing culverts located throughout the county was necessary before the time-consuming EVAAL modeling process could begin *(and the primary reasoning for multiple time extensions of this grant project). This process alone took three years to complete.

Priority Ranking Process: EVAAL

Cadastral boundaries do not follow those of watershed boundaries. Several of the hydrological unit areas that are outlined on the Vilas County maps extend beyond the border of the county itself. Since EVAAL literally pinpoints locations on a map where the most soil erosion may occur, maps will be used to identify specific locations in a given watershed to prioritize future workload for BMP placement. But, for purposes in this project we needed to identify those HUC 12's that had higher percentages of erosion vulnerability based on EVAAL scores and size of the watershed.

During the EVAAL modeling procedure, raw numerical scores for high, medium and low soil erosion vulnerability (based on topography, soil types, and land-use) were generated within each HUC 12 and color coded on a map. The Vilas County GIS Mapping Specialist completed a spreadsheet of watershed information that included: the total size of the HUC 12 watershed in square meters (regardless of cadastral boundary); the total area of the watershed that exist within the boundaries of Vilas County; and the total number of square meters of land within Vilas County that fell into the low, medium, or high EVAAL raw score categories. The EVAAL size distribution table is provided in Appendix 5.

Percentages of land that fell into the highest vulnerability category were then calculated. If the area of a watershed was .65% or greater, it was considered highly vulnerable to erosion (Tier 1). If the area percentage fell between .31% - .64%, it was considered in the moderate vulnerability category (Tier 2). For watersheds that had 0 -.30% of area in the highly vulnerable category, it was considered in the low vulnerability category (Tier 3).

RANKING of GENERALIZED WETLAND HEALTH within the WATERSHEDS

Generalized information was collected about the wetlands that exist within the HUC 12 areas, regardless of wetland type. We gathered existing information on items that would give us a general perspective of the health, amount of ecological services, or quantity of wetlands within each watershed throughout the county. A spreadsheet was used to hold wetlands information, points were given to represent health status, and then scores were combined to create the overall “general wetland health” score for each HUC 12 watershed. More information about each of the spreadsheet components and how points were distributed is given below.

WETLANDS BY DESIGN – ECOSYSTEM SERVICES

Wetlands by Design (WBD) is a Nature Conservancy website that provided important information to rank each HUC 12 watershed based on the condition of the wetlands contained within them. The WBD program involves extensive GIS analysis of land and water features to identify wetlands that are most likely (or least likely) to provide “ecosystem services”. The Ecosystem Services considered were flood water storage, water supply, water quality treatment, shoreline protection, and habitats provided for fish, aquatic life, wildlife, and plant communities. The general premise behind WBD is that any loss of wetlands within a given watershed (through filling, development, etc), would result in the loss of those vital ecological services that were previously provided. Over time wetlands (& watershed health) would degrade with the incremental loss of any ecological service.

Priority Ranking Process: WETLANDS BY DESIGN

We used WBD to identify the loss of ecosystem services within each of the county HUC 12 watersheds as a means to rank their overall wetland health. The loss of ecosystem services in a given watershed was only compared to the other HUC 12 watersheds nested within the same shared HUC 10. Comparisons could not be made between watersheds that are not within the same nested HUC 10 watershed. Scoring went as follows: Those HUC 12’s with the least loss of ecosystem services (identified by WBD) scored 1 point, those with moderate losses were given 2 points, and those with the most loss scored 3 points.

WETLAND ACREAGE

The amount of wetland acreage in each of the HUC 12 watersheds was calculated by dividing the total HUC 12 watershed acreage by the acreage of wetland within the HUC 12 (regardless of wetland type). The watersheds were then sorted from the least to the highest wetland acreage. The reasoning here is that the wetlands in those watersheds with

the fewest acres would have heightened negative effects with any losses of ecosystem services than those watersheds containing greater wetland acreage. That is to say any loss of those precious few acres of wetland area within a watershed with fewer wetland acres would amount to greater losses of ecological services provided for that watershed.

Priority Ranking Process: WETLAND ACREAGE

Percentages of wetland amount within each of the HUC 12 watersheds were calculated by dividing total wetland acreage by the watershed size. The greater the amounts of intact wetland present within the watersheds themselves, the greater the likelihood that water quality is better protected, water storage capacity is unharmed, flood resiliency is higher, and there is greater accessibility of wetland related ecological services. If the watershed holds $\geq 25\%$ wetlands, it received only 1 point. If wetland acreage was $\leq 10\%$ within the watershed, it received 3 points. The watershed was given 2 points for acreages between 10% - 25%.

PRIVATELY HELD WETLANDS

Large portions of Vilas County are held in public hands; National Forest, State Forest, and County Forest. Public lands are managed for multi-use purposes (Forestry included), with the exception of a few wilderness areas. There are ordinances, statutes, and other types of protections that are associated with public wetlands (WI DNR PUB FR-093 2010 Wisconsin's Forestry Best Management Practices for Water Quality/FIELD MANUAL). Wetland habitats located within private properties are less likely to be protected or managed with these protections in mind. This may be especially true for wetlands that have lost protections under the *Waters of the US* decision (<https://www.epa.gov/nwpr/final-rule-navigable-waters-protection-rule>). We wanted to identify the extent and location of wetlands privately held, hence identifying those watersheds that may be “less protected” from losses of wetland habitat and ecological services.

Priority Ranking Process: PRIVATELY HELD WETLANDS

Using GIS on each of the HUC 12 watersheds, percentages of privately held wetland acres were calculated by dividing the total wetland acreage by privately owned wetland acres. Because publicly held wetlands are more likely to have protective management measures in practice by resource managers, it made sense that they could rank low for priority work purposes. For this reason, the greater the amount of privately held wetland acreage, the higher the ranking score as follows: $<10\% = 1$ point (Low Vulnerability); $10-25\% = 2$ points (Moderate Vulnerability); and $>25\% = 3$ points (High Vulnerability).

LOSS OF WETLANDS

There have been few wetland losses in Vilas County primarily due to the areas' large amount of public lands, limited agricultural lands, and limited development of private lands. Vilas County is fortunate to still have most of its original wetlands intact, unlike other counties across Wisconsin according to the WDNR.

Although losses are small here, they still exist. We are concerned about future loss of wetlands that may have a detrimental impact to the overall hydrologic regime of the county. Loss of wetlands criteria in our assessment of wetland health was included to identify which HUC 12s had the most loss or vulnerability to loss. This way, we could address this issue in the future through targeted education and information campaigns.

Priority Ranking Process: LOSS OF WETLANDS

Wetland losses for each HUC 12 in the county were looked up in the WRAM user guide referenced above. The less wetland acreage lost, the healthier the wetland (and the HUC 12 watershed) will be. The scoring for this component went as follows: 0% – 7.9% loss = 1 point (Tier 3); 8.0% - 9.9% loss = 2 points (Tier 2); and $\geq 10\%$ loss = 3 points (Tier 1).

RANKING of GENERALIZED LAKE HEALTH within the WATERSHEDS

Information was compiled about each of the lakes contained within a given HUC 12 watershed. Here, we focused only on existing components of information that would give us a perspective of the overall health of a given lake, with emphasis given to items that the Land and Water Conservation Department programs could address (for example, by placing BMPs or assisting a lake organization with AIS prevention efforts). A spreadsheet was created to gather and hold information for each lake in a given HUC 12 watershed throughout Vilas County. Each of the individual component scores were then added together to create a “generalized” HUC 12 lake health score. Below is more information about each of these components along with details of the scoring and ranking processes.

WILD RICE PRESENCE

Wild rice is tremendously important for both cultural and ecological reasons in tribal communities. For the Menominee Indians, whose name comes from the native word for wild rice - Manoomin, the grain plays a significant cultural role. In Indian culture, it is believed that wild rice is a sacred gift from the Creator and is an important food source for many tribes in the Great Lakes region. So important is this gift both historically and today, that many tribal rituals, ceremonies, and Thanksgiving feasts center around it.

From an ecological standpoint, wild rice serves to boost wildlife biodiversity and plays an important role in water quality protection. Wild rice populations benefit a large number of species due to the structure, cover, or food sources it contributes. Rice areas provide nursery sites for small fish, frogs, and other aquatic organisms which provide food sources for the Common Loon, the Great Blue Heron, and other bird species. Water quality also benefits from wild rice because of its ability to bind loose soils, tie up nutrients like phosphorus, and act as an energy buffer by slowing the wind across shallow lake areas. By inhibiting soil erosion potential, algal blooms are reduced and water quality/clarity is protected.

Priority Ranking Process: WILD RICE PRESENCE

The presence of wild rice was looked up on the DNR Surface Water Data Viewer for each Vilas County HUC 12 watershed. Because of its' importance as a cultural resource to the tribal community within the county, and its ability to protect water quality, if rice was present in any of the surface waters within a HUC, the watershed scored 1 point. If the watershed received a point for the presence of wild rice, the HUC 12 received an automatic threatened status and was placed in the minimum of a Tier 2 category.

TMDL PRIORITY & 303 (d) LISTING STATUS

Section 303(d) of the Federal Clean Water Act states that waterbodies that are not meeting their designated use (fishable, swimmable, etc), due to pollutant overloads, must be placed on a state-wide impaired waters list which is updated every 2 years. The 2018 WI DNR 303(d) impairment listing was used for this project. Only 303 (d) listings for excessive total phosphorus or algae were included because if mercury contamination was the reason for the listing of a waterbody, the current Vilas County Land & Water Conservation programs could do very little to help in the future “de-listing” process.

Total Maximum Daily Load, or TMDL, is the maximum amount of all point and non-point pollutant sources that a given waterbody can “absorb” and still meet the state’s minimum water quality standards (WisCALM). A requirement under Section 303 (d) of the Federal Clean Water Act is that all waters on the impaired waters list must have a TMDL developed. Wisconsin prioritizes the waters that are 303 (d) listed with a high, medium, or low rank as follows: a “high” ranking means that the given waterbody is within an area where a TMDL is currently being developed; a “medium” rank indicates that information is being gathered for a TMDL to be developed at a later date; and “low” ranks mean that a TMDL will be developed when fiscal and staff resources allow (information from WDNR website).

Priority Ranking Process: TMDL / 303 (d) IMPAIRMENT

Information was gathered from the 2018 303 (d) listing for excessive algae and total phosphorus categories. For each waterbody in a HUC 12 that had been ranked by the DNR as high priority for TMDL development, 2 points were given. No waterbodies were listed in Vilas County in the medium TMDL priority category. Any of the waterbodies within a HUC 12 that have received low TMDL priority, 1 point was added. For final scoring purposes, all waterbodies that contained even 1 waterbody with a priority TMDL, the HUC 12 was listed as a Tier 1. For each lake on the current 303 (d) impairment listing within a given HUC 12, 1 point was added. Watersheds that had only 1 waterbody on this listing, the HUC 12 was listed as a Tier 2 workload. If more than 1 of the lakes in a given HUC 12 was included on the current 303 (d) listing, the HUC was automatically ranked as Tier 1 workload.

AIS SMART PREVENTION TOOL 2.0

The AIS Smart Prevention tool is an online, interactive mapping system that helps pinpoint water bodies where certain invasive species are likely to thrive based on certain habitat criteria being offered by the waterbody that make it “suitable” for the invasive species. The prediction models used in the mapping tool are different and dependent on the invasive species. **Important Note, the AIS Smart Prevention Tool includes lakes with current infestations of AIS, so “current AIS status” of lakes were not included as a separate component to measure lake health.

For purposes of the Vilas County Phase 2 Lakes and Watersheds Project, we screened all HUC 12 watersheds within the county for lakes that would provide suitable habitat for populations of Eurasian watermilfoil (EWM), Zebra Mussels (ZM), or Spiny waterflea (SW). EWM has a broad range of environmental tolerances and can survive under a wide range of conditions, but it is not equally likely to be introduced to lakes across the state. The model identifies locations where it is likely to be present either currently, or in the future. Zebra mussels must have a certain amount of dissolved calcium available in order to be suitable habitat. Lakes that had calcium measurements available were included in the model. Spiny waterflea populations thrive with the right combination of the following factors: degree days above 20 Celsius, mean surface temperatures in October, and log10 maximum observed lake depth. ** Important Note, as future temperature variances may shift with the effects of climate change, so may the likelihood of lakes that provide suitable conditions for the Spiny waterflea.

Priority Ranking Process: AIS SMART PREVENTION

Each lake in a given HUC 12 received 2 points for each species within the “suitable” categories; Each lake received 1 point for each species in the “borderline” category. For example, if a lake was “suitable” for EWM and SW, and “borderline” for ZM, it received 5 points. If a lake had nothing listed in the mapping system for AIS Prevention, it received 0 points. Once this step was completed for all HUC 12’s in the county, they were totaled for a final score. For final ranking purposes in Smart Prevention, HUC 12’s that received 0 to 10 points were placed into a Tier 3 workload status, those receiving 11 to 30 points were placed as Tier 2 workload, and a Tier 1 workload status was placed on HUC’s that received greater than 30 points.

OUTSTANDING / EXCEPTIONAL RESOURCE WATER

Outstanding resource waters (ORW) and Exceptional resource waters (ERW), simply stated, are some of Wisconsin’s highest quality surface waters. These waters are given a designation of ORW or ERW for various reasons because they provide wonderful recreational opportunities or in some way they provide excellent cultural or ecological services. Nineteen lakes in Vilas County have been identified by the state as Outstanding Resource Waters, and an additional twelve lakes have been given the status of Exceptional

Resource Waters. These totals do not include the additional miles of rivers and streams throughout the county that also have been designated as such. Because these surface waters have been given this designation, they also receive additional protections from the state from point or non-point sources of pollution. We wanted to include these waterbodies as part of our report of the generalized lake health within each of the HUC 12 watersheds.

Priority Ranking Process: ORW/ERW

Lakes included on the ORW or ERW state lists are considered very healthy, and as such would rank as a Tier 3 (Excellent condition) workload priorities for purposes of this project. Thus, for each lake in a HUC 12 watershed that has the status of outstanding or exceptional resource water, 1 point was subtracted from the total because it is a positive trait for a lake to have. These lakes are already healthy, and we need to keep them that way by giving them a protection status rank.

Results & Work Priorities

Once the ranking processes above were completed, tables and maps were created to summarize all of the information. In general, the less concerns or issues occurring within the HUC 12 meant that final point allotments were low. The opposite was true for watersheds with more (or current) concerns or issues. Attributes were given higher scores and received ranks for Tier 1 status if issues were present. Depending on the type of management we go with in the future (restoration or protection), these results can steer us in the right direction.

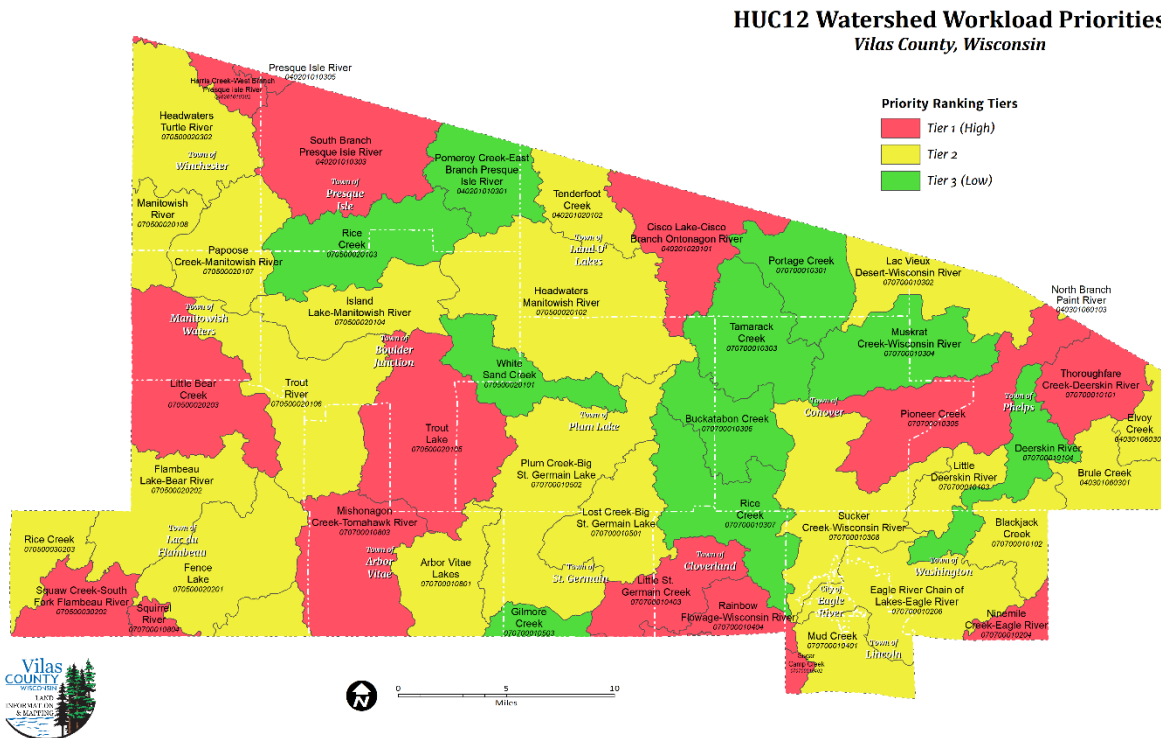
COMBINED RESULTS - WATERSHEDS

Map 5 shows the final combined and summarized results and tiered priorities for each of the HUC 12 sized watersheds in Vilas County. Information pertaining to each of the individual resources we consulted to get to this point are discussed in the Data Collection Methods Section of this report (HWI, EVAAL, and Wetlands by Design).

Tier 1 watersheds are colored in red on the map and represent the most “degraded” areas, so we ranked them as the highest workload priority. This does not mean that they are totally wrecked landscapes, but rather, when compared to other watersheds in Vilas County the Tier 1 areas have the most problematic issues that the county Land & Water Conservation Department could address in future workplans. We can focus-in on these areas, look at the reasons behind the given ranking, and begin to work on the particular issue(s).

The yellow watersheds on the map represent the Tier 2 areas within the county that are likely to be ecologically threatened in some way. As is the case with Tier 1 watersheds, we will have the ability to take a closer look at the reasons behind the ranking and begin to address any problems or potential problems that were identified. The Tier 3 areas marked in green on Map 5, represent the most “pristine” areas within the county. These watersheds are worth protecting into the future

and will be managed as such. If during future watershed management planning the county takes a protection approach, the Tier 3 watersheds will be selected first in the workload. If the county takes a remediation approach to watershed management planning, it is the Tier 1 watersheds that will be selected first. *However, these factors would not be exclusive of project selection and many other considerations would factor in to site selection(s).



Map 5. Final combined Generalized Watershed Status by HUC 12. Colors represent tiered rank for each of the watersheds in Vilas County.

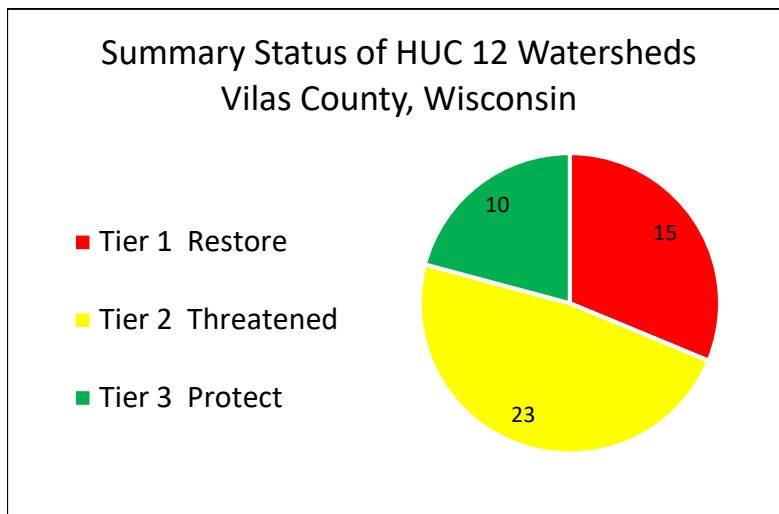


Figure 2. Pie chart illustrates the total numbers of HUC 12 watersheds in Vilas County that fall into tier categories 1, 2, or 3.

The summarized status of all HUC 12 watersheds in Vilas County is illustrated in Figure 2. Of the 48 HUC 12 watersheds that exist (wholly or partially) within the cadastral boundaries of Vilas County, 15 of them ranked in fair condition, 23 ranked in good condition, and the remaining 10 are in excellent condition. The primary reasons for these ranks vary based on the most “limiting” factor. Criteria considered for ranking the general health of the HUC 12’s were: a) threatened wetland areas; b) overall healthy watershed vulnerability scores from the DNR; and c) the potential for soil erosion to occur as modeled in EVAAL. Results for each of these individual criteria are shared in the “Individual Results” section.

We were curious about why each of the HUC 12 watersheds ranked as they did. In other words, what was the primary reasoning why each of them received the particular rank. To know the reasoning “at a glance”, we created Tables 1 – 3 on the following page. This will make it easier for staff to select certain watersheds over others in future decision-making in watershed management planning. Of particular interest in county work efforts will be the “Erosion” findings. In those watersheds where soil erosion was most vulnerable, the Land & Water Conservation Department can make sure that these areas receive first priority best management projects placed on the land. Further, we can go directly to the EVAAL maps for a given HUC 12 and see the locations where soil erosion is most likely to occur. This may actually give us a head start when looking for it on the landscape.

For a final ranking of the general health of Vilas County watersheds, we combined results in a spreadsheet. Simply, each watershed ranked the highest vulnerability across all of the separate components. Example 1: if the HUC 12 scored tier 3 (green) across all components, it received final tier 3 status. Example 2: if the HUC 12 scored as tier 3 with two components, but a tier 1 (red) status on a different component, the watershed was given a tier 1 final rank.

Table 1 - Tier 1 *Restore / Remediate* Watersheds

PRIMARY REASON	
040201010302	Wetlands
040201010303	Wetlands
040201010305	Wetlands
040201020101	HWI
070500020105	HWI
070500020203	HWI
070500030202	Erosion
070700010101	Wetlands
070700010204	Erosion
070700010305	Wetlands
070700010402	Erosion
070700010403	HWI
070700010404	Wetlands
070700010803	Wetlands
070700010804	Erosion

Table 2 - Tier 2 *Threatened* Watersheds

PRIMARY REASON	
040201020102	HWI
040201060103	HWI
040301060301	Erosion
040301060302	HWI
070500020102	HWI
070500020104	HWI
070500020106	HWI
070500020107	Wetlands
070500020108	Erosion
070500020201	HWI
070500020202	Erosion
070500020302	Erosion
070500030203	Erosion
070700010102	HWI
070700010103	HWI
070700010206	All
070700010302	Wetlands
070700010308	HWI
070700010401	Erosion
070700010501	HWI
070700010502	Wetlands
070700010801	Wetlands
070700010806	HWI

Table 3 - Tier 3 *Protection* Watersheds

040201010301	
070500020101	
070500020103	
070700010104	
070700010301	
070700010303	
070700010304	
070700010306	
070700010307	
070700010503	

INDIVIDUAL RESULTS - WATERSHED COMPONENTS

Results - Healthy Watersheds Initiative (HWI) – Mapped results of the Vilas County HWI Vulnerabilities by HUC 12 are shown in Appendix 2. Refer to page 8 of this document to understand how the points were allotted. Table 4 shows the summarized results for the Healthy Watersheds Initiative. Eighteen of the HUC 12 watersheds had the majority of area within a low vulnerability, thus they received 0 points (green). Twenty-three watersheds in Vilas County had the majority of land area fall into the medium vulnerability and they received 1 point (yellow). The remaining seven watersheds in Vilas County had greater land areas that fell into the high vulnerability category. The results for HWI shown here then became a part of the

generalized watershed spreadsheet for final watershed ranking purposes.

Table 4. HWI final point values for each watershed				
HUC 12	Point Value		HUC 12	Point Value
040201010301	0		070700010102	1
040201010302	1		070700010103	1
040201010303	0		070700010104	0
040201010305	1		070700010204	0
040201020101	2		070700010206	1
040201020102	1		070700010301	0
040201060103	1		070700010302	0
040301060301	1		070700010303	0
040301060302	1		070700010304	0
070500020101	0		070700010305	0
070500020102	1		070700010306	0
070500020103	0		070700010307	0
070500020104	1		070700010308	1
070500020105	2		070700010401	1
070500020106	1		070700010402	0
070500020107	1		070700010403	2
070500020108	0		070700010404	2
070500020201	1		070700010501	1
070500020202	1		070700010502	1
070500020203	2		070700010503	0
070500020302	0		070700010801	0
070500030202	2		070700010803	2
070500030203	1		070700010804	1
070700010101	1		070700010806	1

Results - EVAAL Modeling – Results for each of the HUC 12 watersheds in Vilas County were mapped and are electronically available along the information that was submitted with this report. Most areas within Vilas County look stable regarding soil erosion potential. Areas that show potentially high vulnerability to erosion are mostly located along shorelines of lakes and streams, or within wetlands or wetland fringe areas. Table 5 shows the numerical results for all of the HUC 12 watersheds in Vilas County. Only 4 of the HUC 12 watersheds had high percentages of land area that fell into the “highly susceptible” category for sheet, rill, or gully erosion. Eleven of the watersheds had high percentages of land acreage in the medium vulnerability category for soil erosion.

HUC 12	High % Area	HUC 12	High % Area
040201010301	0.22	070700010104	0.18
040201010302	0.24	070700010204	0.77
040201010303	0.19	070700010206	0.36
040201010305	0.20	070700010301	0.24
040201020101	0.21	070700010302	0.21
040201020102	0.14	070700010303	0.25
040201060103	0.00	070700010304	0.20
040301060301	0.58	070700010305	0.29
040301060302	0.03	070700010306	0.17
070500020101	0.29	070700010307	0.26
070500020102	0.25	070700010308	0.27
070500020103	0.24	070700010401	0.39
070500020104	0.20	070700010402	0.65
070500020105	0.37	070700010403	0.39
070500020106	0.28	070700010404	0.33
070500020107	0.27	070700010501	0.07
070500020108	0.43	070700010502	0.30
070500020201	0.06	070700010503	0.28
070500020202	0.31	070700010801	0.17
070500020203	0.17	070700010803	0.36
070500020302	0.32	070700010804	1.74
070500030202	0.70	070700010806	0.17
070500030203	0.45		
070700010101	0.13	.00 - .30	Low Vulnerability
070700010102	0.20	.31 - .64	Med Vulnerability
070700010103	0.23	.65 - 1.0+	High Vulnerability

The results for EVAAL shown here then became a part of the generalized watershed spreadsheet for final watershed ranking purposes.

Types of Wetlands in Vilas County, WI – Ecosystem services that are provided by wetlands are vital to the health of any ecosystem. Over time, any loss of those services will incrementally break-

Table 6. The types (& acreages) of wetlands found in Vilas County, WI.

WETLAND CLASSIFICATION	~Acres in Vilas County	Ecosystem Services Present	Abbreviations Ecosystem Services	Abbreviations Ecosystem Services
Aquatic Bed	81	FS, WH, WR, FP, RH, RC	(FS) Fisheries Support	(GF) Groundwater Filter
Emergent / Wet Meadow / Open Water	3178	SP, GF, WS, WH, WR, FP, RH, RC, PH	(WH) Wildlife Habitat	(WS) Water Storage
Drained / Filled Wetland	35		(WR) Wild Rice	(PH) Pollinator Habitat
Forested	41951	GF, WS, WH, FP, RH, RC, TB	(FP) Flood Protection	(CS) Carbon Sequester
Forested / Emergent / Wet Meadow	1773	CS, GF, WS, WH, FP, RH, RC, TB, PH	(RH) Rare Sps Habitat	(TB) Timber
Forested / Open Water	710	SP, GF, WS, WH, FP, RH, RC, FS	(RC) Recreation	(SP) Shore Protection
Forested / Scrub / Shrub	23430	CS, GF, WS, WH, FP, RH, RC, TB, PH	Source: WI Wetland Inventory (Ramsar website)	
TOTAL	71159			

down the dynamics of an entire ecosystem. Vilas County is a mecca of wetlands and wetland activity (see Map 6). Before the individual results of the wetlands are discussed, we want to share Table 6, so that we can see for ourselves the remarkable ecosystem richness that different types of wetlands can provide to the environment.

Results - Wetlands Vulnerability – To measure the health and vulnerability of Vilas County wetlands, a combination of four components of information were collected to gain an overall rank for each HUC 12 watershed. The loss of wetland ecosystem services could be identified for each HUC 12 using the Wetlands by Design program. We then scored each HUC 12 watershed for the amount of wetland area (acres) contained in them, and for how many of those acres were in private land ownership. The final component that was scored was information taken from the WDNR regarding percentage of lost original wetland area in Vilas County. Results for all components were stored in a spreadsheet and the total scores are listed in Table 7.

Most watersheds within Vilas County ranked in a low vulnerability status and need to be protected as such. Five watersheds ranked in the medium vulnerability category for wetlands, which means that they are threatened in some capacity and should be watched. The remaining seven watersheds ranked in the high category for wetland vulnerability. The results for wetlands shown here then became a part of the generalized watershed spreadsheet for final watershed ranking purposes.

Table 7. Vulnerability scores of the wetlands in each HUC 12 of Vilas Co.

HUC 12	Point Value	HUC 12	Point Value
040201010301	8	070700010104	8
040201010302	10	070700010204	7
040201010303	10	070700010206	9
040201010305	10	070700010301	7
040201020101	8	070700010302	9
040201020102	6	070700010303	7
040201060103	0	070700010304	7
040301060301	8	070700010305	10
040301060302	7	070700010306	7
070500020101	6	070700010307	8
070500020102	7	070700010308	8
070500020103	8	070700010401	8
070500020104	7	070700010402	7
070500020105	7	070700010403	7
070500020106	8	070700010404	10
070500020107	9	070700010501	8
070500020108	7	070700010502	9
070500020201	8	070700010503	8
070500020202	8	070700010801	9
070500020203	7	070700010803	10
070500020302	8	070700010804	8
070500030202	7	070700010806	7
070500030203	6		
070700010101	11	5 - 8	Low Vulnerability
070700010102	8	9	Med Vulnerability
070700010103	6	10-12	High Vulnerability

WETLAND INITIATIVES

Vilas County had placed additional wetlands efforts as one of the goals in the Land & Water Conservation Plan so that we could begin to clarify what the Conservation Department could do to raise awareness of, and protect, these vital natural resources. In addition to prioritization of watersheds, we set out on various tasks to reach that end as a part of this grant project. A review of the existing Vilas County Zoning Ordinance was completed to determine wetland protection factors that may be improved in the future. Next, a simple monitoring protocol was created, specific to Vilas County, so that we could accomplish field assessments quickly and efficiently, and begin to collect information about the wetland resources that exist throughout the county. Finally, we wanted to increase awareness of wetlands and the way they function, so we incorporated educational efforts.

County Ordinance Review - Prior to Wisconsin's Legislature Act 55 changes to local shoreland zoning in 2017, Vilas County had a lake classification system in place that may have incidentally provided more protections to wetlands. As part of the local lake classification system, lakes of a size greater than 50 acres were classified based upon sensitivity to development and the level of existing development along privately-owned shoreline. Wetlands associated with high and medium sensitivity waters with low to medium development levels might have been indirectly protected by the larger lot sizes and width requirements that facilitated the avoidance of wetland impacts. However, this classification system is no longer in place.

Nonetheless there are wetland provisions in the Vilas County Shoreland Zoning Ordinance. In Section 1.3, the Shoreland Zoning Ordinance identifies "preserving wetlands and other fish and aquatic habitat" as a way to achieve the goals of "promoting the public health, safety, convenience and welfare, and to: 1) Further the maintenance of safe and healthful conditions; 2) Protect spawning grounds, fish and aquatic life; 3) Preserve and restore shoreland vegetation and natural scenic beauty; 4) Prevent and control water pollution; 5) Prevent erosion of the soil; 6) Preserve the compatibility of proposed development with existing land and water usage; and 7) Control building sites, development, placement of structures and land uses."

The shoreland ordinance only applies to lands located within 1,000 feet of the ordinary high-water mark (OHWM) of navigable lakes, ponds or flowages, or to lands within 300 feet of the OHWM of navigable rivers or streams, or to the landward side of the floodplain, whichever distance is greater. It protects all wetlands that are within the shoreland-wetland district and are identified on the Wisconsin Wetland Inventory maps available from the Department of Natural Resources (DNR) Surface Water Data Viewer online. In addition, if a wetland is not correctly mapped and field conditions meet wetland criteria as identified by a staff member of the Vilas County Zoning Department, it can be treated as a wetland.

Outside of the shoreland-wetland district, wetlands are regulated by the U.S. Army Corps of Engineers and the Wisconsin DNR. This includes wetlands that are identified as Waters of the

US, i.e. navigable bodies or those that are connected to navigable bodies. The Wisconsin DNR regulations address the waters of the state which include wetlands (including what are now called *non-federal wetlands*), as identified by the state's wetland inventory maps. Under these rules provisioned under Chapter 30 WI Statutes, development levels in wetlands should be limited to the greatest extent possible. When development is permitted in a wetland, it should occur in a manner that minimizes the adverse impacts upon the wetland ecosystem.

Currently, neither the Vilas County Shoreland Ordinance nor the General Zoning Ordinance contain permitting requirements that encourage applicants to avoid and minimize indirect wetland impacts. There are no required setbacks from wetland edges. There are no rules to prevent changes in hydrology. There are no provisions that facilitate the approval of conservation subdivisions. Vilas County is proposing to put a wetland setback in the General Zoning Ordinance. This would require a 10-foot buffer around a wetland area for any structure placements. This proposed change may occur sometime in the first quarter of 2021, pending County Board approval.

Vilas County has no current plans to address other wetland protection methods at the local level. It is of our opinion that certain wetland protections placed now could be beneficial to protecting the water quality of Vilas County into the future. At a minimum, we would suggest an accounting of: 1) the acreage of different wetland habitat types; 2) those wetlands at most risk from potential development action; or 3) a valuation of the ecosystem services created by wetlands. Perhaps protections could be developed to incentivize wetland owners of those wetland types at most risk from development, or highly productive wetlands, to be protected with conservation easements or large buffer zones? Another option might be to target wetland protection within a high-risk watershed to benefit from a desired ecosystem service? Perhaps downstream users, who benefit from those ecosystem services, would contribute financially to protect those wetlands in a way that benefits the landowners? There is a ripe opportunity to address wetland protections in Vilas County now, while those wetlands are in relatively good condition.

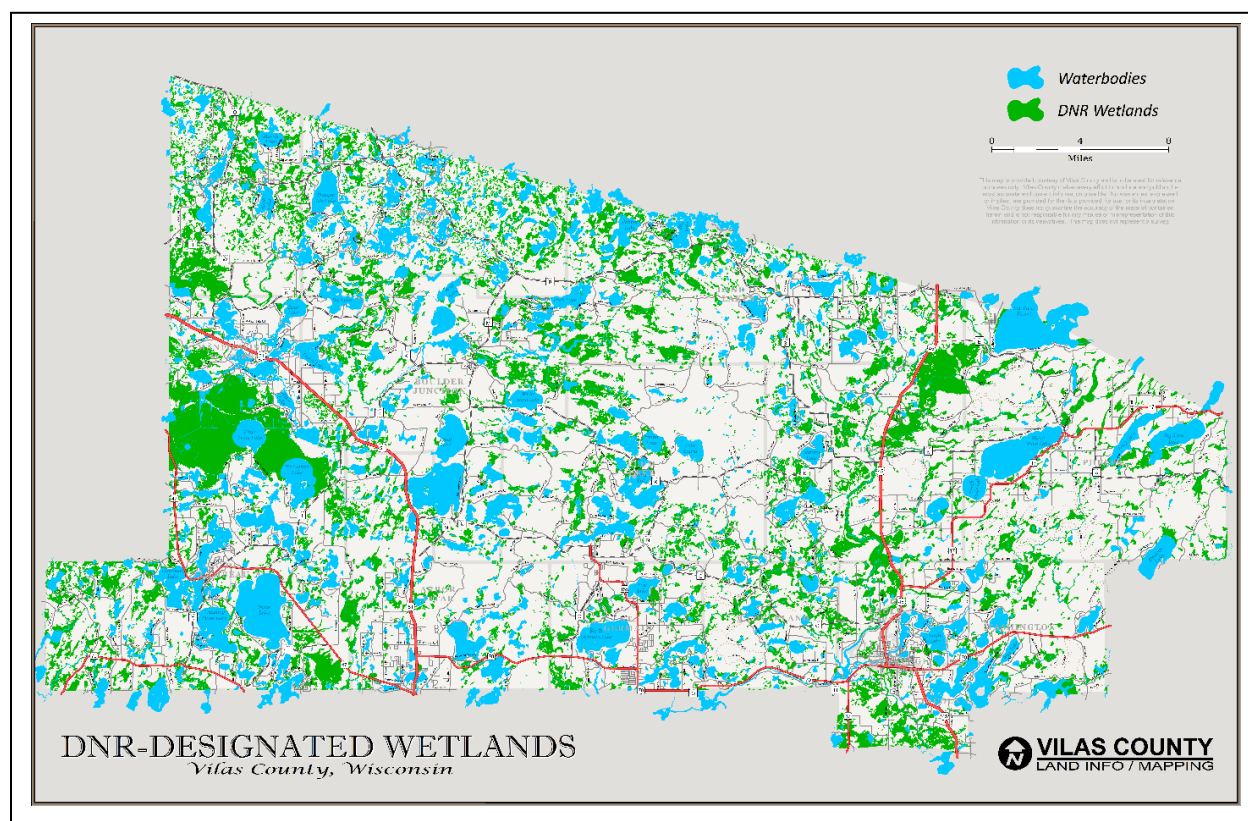
Wetland Monitoring Protocol - One of the objectives of this project was the development of a process to prioritize wetlands within Vilas County based on vulnerability to development, invasive species, endangered species, and to determine the proximity of wetlands to recreational trails. The wetland monitoring protocol will be used on wetlands of Vilas County HUC 12 watersheds that have been identified as being most at risk of degradation to further pinpoint sources of threats to water quality.

A number of states already have wetland monitoring protocols in existence, such as those from Ohio (ORAM), Minnesota (MNRAM), Florida (FWRAP), Massachusetts (Coastal Zone Management Method), Washington (State Wetlands Rating System [Western]), and Wisconsin (WI Rapid Assessment Method). From our review, we identified the Wisconsin Rapid Assessment Method as being the most useful for staff to use in Vilas County. The WRAM is designed specifically for Wisconsin wetlands, and the data collected can be shared with others in

the state. The fact that it focuses on measuring the performance of wetland functions compliments our objective of ranking watersheds to identify those that are more likely to be compromised.

The WRAM is a methodology used to rapidly assess wetland condition and function, based on observation and professional judgement. Some data collection is from databases and map sources online. The rest of the data collection are observed directly in the field. Nested within the WRAM protocol is a Floristic Quality Assessment for wetlands. This provides a tool for Vilas County Conservation to zoom into more detail on our wetland monitoring in the future.

Wetland Awareness & Education - Wetlands encompass nearly 20% of the land base in Vilas County. The landscape includes many large northern bogs in addition to black spruce and other conifer swamps. Many streams are bordered by mixtures of alder thickets and poor fens. Unfortunately, many residents and visitors think of wetlands as “wasteland - good for nothing but breeding mosquitos”. Many people are even scared of walking through wetland areas. What most people don’t realize is how very important wetlands are, or how many ecological services and functions they provide – so sadly, they aren’t likely to see the value in protecting them.



Map 6. The surface and wetland water resources of Vilas County, Wisconsin.

Wetlands serve as living habitat for plants, birds and other wildlife species, they act as sponges for water infiltration, serve to recharge groundwater supplies, they soak up and store large volumes of stormwater to prevent flood disaster, and recharge surface waters during drought periods. The old

adage definitely applies here to wetlands, “to value and protect something, you need to learn about it”. Vilas County Land & Water Conservation recognized our role and responsibility to educate the public about wetlands. Our challenge was (and still is) to make wetlands less scary to people and to create an understanding about the value and enjoyment that wetlands can provide. We included information about the function and value of healthy wetlands in Vilas County whenever we were invited by public groups to present information about lake health, water quality, and/or shoreline buffers. We used Map 6, to show how the county is so rich in water resources and wetlands.

During slide presentations or at information booths, this map image has been an effective visual tool to demonstrate how integral wetlands are to the county landscape. Using this as a starting place, we moved on to discuss the ecosystem services provided by wetlands, the interconnectedness of wetlands, lakes and groundwater stores, and the high costs of restoring those services if we should lose them.

In 2016 Vilas County staff began to give talks about the economic value of Vilas County waters and introduced participants to the concept of wetland values. That year, we gave the presentation to 170 people at two lake organization meetings and to 29 people at a chamber of commerce meeting. For three consecutive years following that, we reached an additional 550 people at nine annual lake organization meetings.

Wetland specific topics and presentations started to become popular. In 2016, we presented to a *Bog Ecology* class of 51 students for the Nicolet College Learning in Retirement program, and later-on took 12 interested members of that same group into a Black Spruce bog for a hands-on field experience. During the Wisconsin Legislature *Isolated Wetland* discussions in 2017, we informed the Land & Water Conservation Committee about these changes and how they would impact the high-quality wetland resources of the county. At the 2019 Lac du Flambeau annual Lake Festival, we set up an



Figure 3. A Nicolet College Learning in Retirement program taught by Vilas County staff.



Figure 4. Experiencing a paddle into a Vilas County wetland complex, Summer 2017.

information table and shared information about the types of wetlands within Vilas County to interested participants. Around 150 people stopped at the table that generated follow-up calls and requests for additional information.

The best way to get people to move past their fear of wetlands is to actually spend time in one. County staff regularly lead tours on foot (or paddle) into wetland complexes for local outdoor groups, schools, or as part of regional nature festivals. From field seasons 2016 through 2019, over 100 people have visited wetlands while participating in these specialized tours. During these fun field experiences information was shared about how wetlands were formed, why they occur in that particular spot in relation to the landscape, what the dominant vegetation is, unique plant survival strategies, and about what types of wildlife are dependent on these communities. Tour participants learned about the foundational function of sphagnum moss by picking it up, pulling it apart, and even tasting it! And finally, transition zones between uplands & lowlands and between different types of wetland communities were also explored during the field experiences.



Vilas County staff were also invited to teach the wetlands section of a Master Naturalist program at Trees for Tomorrow (Figure 6). After a short slide presentation, we took 12 Master Naturalist students into a wetland complex from lake edge into conifer bog, exploring the geology, hydrology,

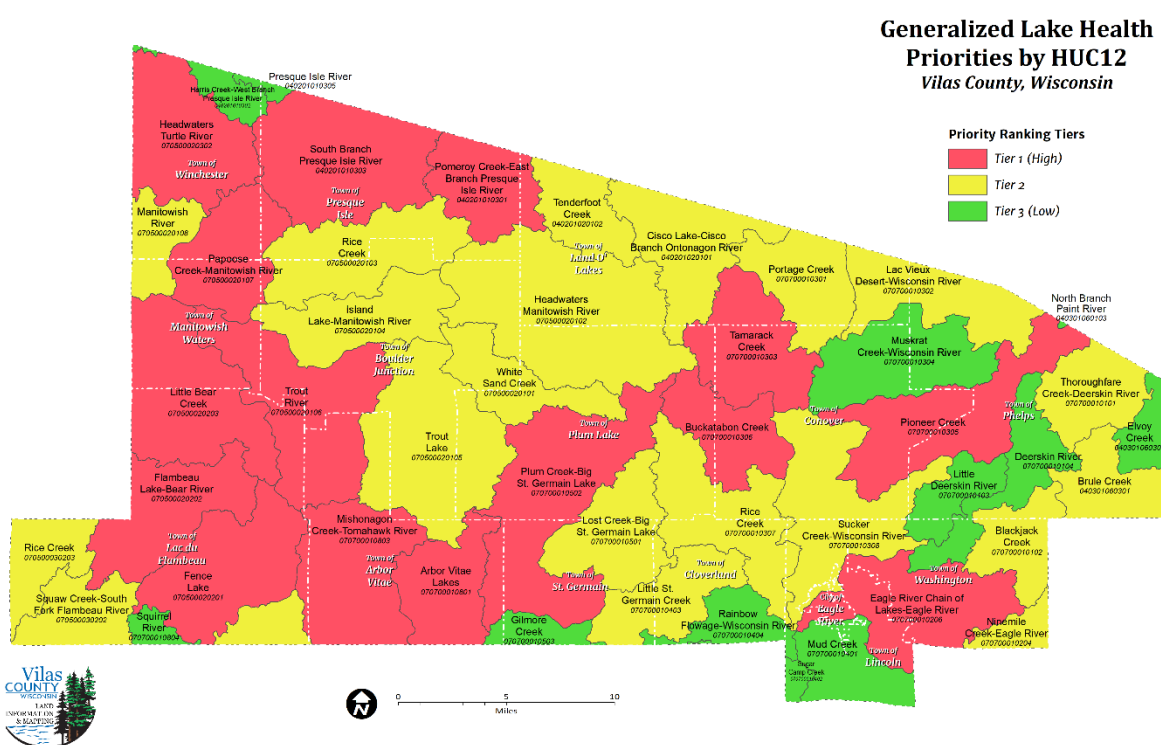
Figure 5. Exploring a Vilas County Shrub-Carr wetland as part of a Master Naturalist program, 2019.

vegetation, and soils of the area. It is our hope that this relationship will continue well into the future.

Vilas County staff also tries to include wetland information into other types of presentations or trainings on a regular basis. For example, during a regular Clean Boats Clean Waters training session, information about wetland invasive species (also found on shorelands) like purple loosestrife and yellow iris are discussed with participants. Approximately 50-100 people annually are introduced to wetlands with this approach. Vilas County involves local school-aged kids in learning adventures as well, and in 2018, we saw an opportunity to introduce them to wetlands during the conservation poster contest themed *Watersheds*. We presented to approximately 80 5th grade kids and 100 middle school students about watershed concepts, including the important functions and values that wetlands provide within our watersheds.

COMBINED RESULTS - LAKE HEALTH

Map 7 shows the final combined lake health results and rankings for each of the HUC 12 sized watersheds in Vilas County. Information and results pertaining to each of the individual resources we consulted to get to this point are discussed later in this section (Wild Rice, TMDL, 303 d, Smart Prevention, AIS, and OERW).



Map 7. Generalized Lake Health by HUC 12. Colors represent prioritized rank.

Tier 1 watersheds are colored in red on the map and represent the most “degraded” lake areas, so we ranked them as the highest priority. This does not mean that lakes in these watersheds are totally rotten, but rather, when compared to general lake health in other watersheds in the county the Tier 1 areas either have the most problematic lake issues, or they have more lakes with issues. We can focus-in on these watersheds, look at the reasons behind the given ranking, and begin to work on the particular issue(s) on affected lakes.

The yellow watersheds on the map represent the Tier 2 areas within the county with less severe or fewer issues on lakes than those colored in red. In other words, these watersheds have threats on a lake or lakes that we need to watch. As is the case with Tier 1 watersheds, we will have the ability to take a closer look at the reasons behind the ranking and begin to address any problems or potential problems that were identified. The Tier 3 areas shown as green on Map 7, represent the most “pristine” areas within the county in regard to lake health. The lake health in these watersheds is generally good and there are fewer issues of concern.

The summarized status of lake health in Vilas County watersheds is illustrated in Figure 6. Of the 48 HUC 12 watersheds that exist (wholly or partially) within the cadastral boundaries of Vilas County, 17 of them ranked in fair condition, 19 ranked in good condition, and the remaining 12 are in excellent condition for lake health.

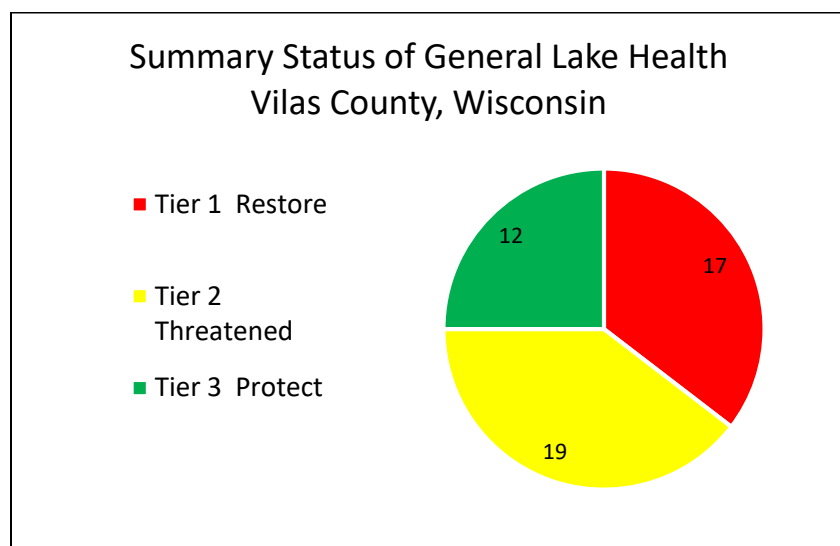


Figure 6. Pie chart illustrates the breakdown of HUC 12 watersheds in Vilas County that fall into tier categories for lake health.

Top reasons or criteria considered for ranking the general health of lakes within a given watershed were: a) presence/absence of wild rice; b) TMDL Priority Listings; c) 303(d) Impairment Listings; d) Findings from AIS Smart Prevention; and e) outstanding or exceptional resource waters listings. Results for each of these individual criteria are shared in the “Individual Results” section.

We were curious about why each of the HUC 12 watersheds ranked as they did for lake health. In other words, what was the primary reasoning why each of them received the particular rank. To know the reasoning “at a glance”, we created Tables 8 – 10. This will make it easier for Vilas

County staff to select certain watersheds over others in future decision-making for watershed or lake management planning. Of particular interest in county work efforts if we select remediation watershed management, we would look closely at the “303 (d) or TMDL” findings. In those watersheds where lakes have current impairment status, the county can make sure that these areas receive first priority best management projects placed on the land, or perhaps we will scour the watershed further to find potential causes of issues responsible for the impairment(s). The same would be true of lakes with containing wild rice or current AIS infestation. These findings may actually give us a head start when looking for areas in the county where particular issues are of interest for management purposes.

For the final ranking of the lake health within Vilas County watersheds, we combined results in a spreadsheet. Simply, each watershed ranked the highest vulnerability across all of the separate components. Example 1: if the HUC 12 scored tier 3 (green) across all components, it received final tier 3 status. Example 2: if the HUC 12 scored as tier 3 with 1 component, but a tier 1 (red) status on a different component, the watershed was given a tier 1 final rank.

Table 8 - Tier 1 <i>Restore / Remediate</i> General Lake Health					
TOP REASONS					
040201010301	Smart Prevention				
040201010303	Smart Prevention			303 (d)	
070500020102	Smart Prevention				
070500020105	Smart Prevention				
070500020106	Smart Prevention	AIS	Wild Rice		
070500020107	Smart Prevention	AIS	Wild Rice	303 (d)	
070500020201	Smart Prevention				
070500020202	Smart Prevention		Wild Rice		
070500020203	Smart Prevention		Wild Rice		
070500020302	Smart Prevention			303 (d)	
070700010206	Smart Prevention	AIS		303 (d)	TMDL
070700010303	Smart Prevention			303 (d)	TMDL
070700010305	Smart Prevention	AIS		303 (d)	TMDL
070700010306	Smart Prevention	AIS		303 (d)	TMDL
070700010502	Smart Prevention		Wild Rice	303 (d)	TMDL
070700010801	Smart Prevention	AIS		303 (d)	TMDL
070700010803	Smart Prevention	AIS	Wild Rice		

Table 9 - Tier 2 <i>Threatened</i> General Lake Health					
TOP REASONS					
040201020101	Smart Prevention	AIS	Wild Rice		
040201020102	Smart Prevention		Wild Rice		
040301060301		AIS		303 (d)	
070500020102	Smart Prevention		Wild Rice		
070500020103	Smart Prevention	AIS	Wild Rice	303 (d)	
070500020104	Smart Prevention	AIS	Wild Rice		
070500020108			Wild Rice	303 (d)	
070500030202	Smart Prevention			303 (d)	
070500030203			Wild Rice	303 (d)	
070700010101		AIS			
070700010102		AIS			
070700010204			Wild Rice		
070700010301	Smart Prevention		Wild Rice		
070700010302	Smart Prevention	AIS	Wild Rice		
070700010307	Smart Prevention	AIS	Wild Rice	303 (d)	
070700010308	Smart Prevention				
070700010403	Smart Prevention	AIS		303 (d)	
070700010501	Smart Prevention	AIS			
070700010806	Smart Prevention				

Table 10 - Tier 3 <i>Protection</i> General Lake Health					
TOP REASONS					
040201010302	Smart Prevention	AIS			
040201010305					
040201060103					
040301060302	Smart Prevention				
070700010103	Smart Prevention				
070700010104					
070700010304	Smart Prevention				
070700010401	Smart Prevention				
070700010402					
070700010404	Smart Prevention	AIS			
070700010503					
070700010804	Smart Prevention				

INDIVIDUAL RESULTS – LAKE HEALTH COMPONENTS

Results – Presence of Wild Rice – Surface waters that have a known presence of wild rice population(s), received an automatic “threatened” status for the entire watershed since we know that it’s so important to the overall health and sustainability of water quality. Nineteen watersheds within Vilas County have existing populations of wild rice in one or more waterbodies. Table 11 shows the watersheds with existing wild rice populations. Wild rice grain production does not do well in years with flooded conditions, so considering potential increases to flooding or drought as anticipated results of climate change, this should be a top consideration when conservation planning for the future. The results shown here then became a part of the generalized lake health spreadsheet for final watershed ranking purposes.

Table 11. Watersheds with existing Wild Rice waters.			
040201020101		070500020202	
040201020102		070500020203	
070500020101		070500030203	
070500020102		070700010204	
070500020103		070700010301	
070500020104		070700010302	
070500020105		070700010307	
070500020106		070700010502	
070500020107		070700010803	
070500020108			

Results – TMDL Status – The state of Wisconsin prioritizes TMDL’s according to low, medium and high priority. By law, for those waters ranking in the high priority category, it is required that a TMDL for point and non-point sources of pollution be developed. Table 12 is the listing of watersheds in Vilas County with one or more waterbodies on the required TMDL development list. For each waterbody in a watershed that had been ranked by the DNR as high priority for TMDL development, 2 points were allotted. Six watersheds in the county have TMDL waterbodies that ranked as high by the state. Four of those six have at least 2 waterbodies that meet this requirement.

Table 12. Watersheds with a high priority TMDL requirement.			
070700010206	4	070700010306	4
070700010303	2	070700010502	4
070700010305	4	070700010801	2

Results – 303(d) Impairment – For each lake that was listed on the 2018 303 (d) impairment list (for excessive algae or total phosphorus), the watershed received 1 point. If there was even 1 lake that was on the impairment list, the watershed ranked in the medium vulnerability tier 2 (yellow). If the watershed had greater than 1 lake on the impairment list, it was given a high vulnerability rank tier 1 (red). The final results in this category are shared in Table 13. Sixteen watersheds in Vilas County have at least 1 lake on the 2018 303 (d) impairment list. Of the sixteen watersheds, five had more than one lake on the impairment list. The results for 303(d) status shown here then became a part of the generalized lake health spreadsheet for final watershed ranking purposes.

Table 13. Watersheds with lake(s) on the 303(d) list (2018).			
040201010303	1	070700010206	3
040301060301	1	070700010303	1
070500020103	1	070700010305	2
070500020107	1	070700010306	2
070500020108	1	070700010307	1
070500020302	1	070700010403	1
070500030202	1	070700010502	2
070500030203	1	070700010801	2

Results – AIS Smart Prevention Tool – Graphed results of the AIS Smart Prevention Tool for Vilas County lakes are shown on Figure 7. Results include lakes that are currently infested with one or more AIS. We were surprised to find that 304 lakes have suitable conditions for spiny waterflea infestation; 114 lakes are either borderline or suitable for zebra mussels, and 82 lakes are suitable for Eurasian watermilfoil infestation. Table 15 shows the listing of watersheds in Vilas County that ranked in each tier for vulnerability. Twelve watersheds scored in the highly

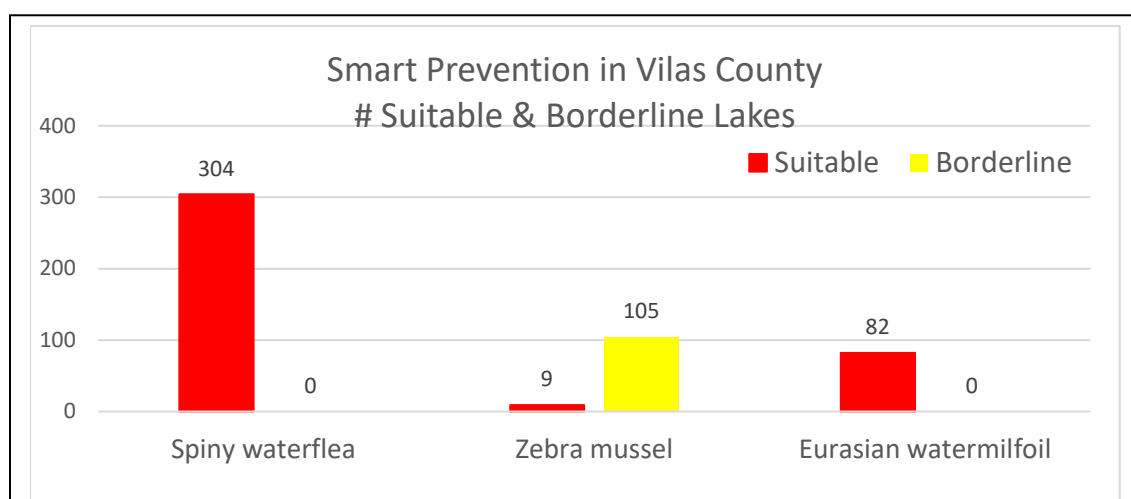


Figure 7. Results of the AIS Smart Prevention Tool program used on Vilas County watersheds. Graph illustrates the number of lakes with suitable or borderline conditions for AIS species.

vulnerable category (tier 1) for AIS infestation; 18 watersheds scored in the medium vulnerability category, and the remaining 18 ranked in the lowest vulnerability category. The results shown here then became a part of the generalized lake health spreadsheet for final watershed ranking purposes. Specific information about how the AIS Smart Prevention scoring was completed is available in the Methods Section of this document.

Results – Presence of Outstanding or Exceptional Resource Waters – There are thirty-one lakes within Vilas County that have been categorized as outstanding or exceptional resource waters. Table 15 shows the sixteen watersheds where these healthy waters are located. Refer to page 13 of this document to understand how the points were allotted. The results for outstanding and exceptional resource waters shown here then became a part of the generalized lake health spreadsheet for final watershed ranking purposes.

Table 14. Watersheds with lakes listed as Outstanding or Exceptional Resource Waters				
040201010303			070500020203	
070500020101			070500030202	
070500020102			070700010301	
070500020105			070700010302	
070500020106			070700010305	
070500020108			070700010306	
070500020201			070700010307	
070500020202			070700010502	

Table 15. Smart Prevention point values for each watershed				
HUC 12	Point Value		HUC 12	Point Value
040201010301	31		070700010102	6
040201010302	5		070700010103	2
040201010303	58		070700010104	0
040201010305	0		070700010204	6
040201020101	29		070700010206	62
040201020102	20		070700010301	23
040201060103	0		070700010302	17
040301060301	11		070700010303	22
040301060302	2		070700010304	4
070500020101	14		070700010305	23
070500020102	33		070700010306	12
070500020103	26		070700010307	14
070500020104	16		070700010308	12
070500020105	33		070700010401	4
070500020106	49		070700010402	0
070500020107	33		070700010403	21
070500020108	7		070700010404	6
070500020201	35		070700010501	15
070500020202	33		070700010502	27
070500020203	32		070700010503	0
070500020302	38		070700010801	25
070500030202	13		070700010803	36
070500030203	8		070700010804	8
070700010101	10		070700010806	12

Project Impacts & What's Next?

Funding obtained from this grant for Phase 2 of the Vilas County Lakes and Watersheds project allowed us to realize our goal in workload priority setting, along with several other public outreach and education goals. As time marched on and forward progress was made, there was a substantial evolution that occurred from the original tools we envisioned for use in this project. As we learned of new processes or tools that would serve us either better or faster, adjustments were made to incorporate them. Consequently, we believe that our outcomes reflect a fairly accurate picture of the current environment in Vilas County as it exists today.

One thing that became very clear early on - we grossly under-estimated the time it would take to complete this ambitious project. Live and learn. In a quick review of the project goals, we met or exceeded each. It is how we completed them that may have varied from the original plan. The health and management tier ranking of each HUC 12 watershed - complete. The health and management tier ranking of lake health within watersheds - complete. Review wetland health and types of wetlands, and improve the publics' awareness of them – complete. Support the WI Lakes Partnership and provide public assistance on lake and water quality issues – complete.

From the results of this project, Vilas County Land & Water has an improved focus in which to begin protection and/or enhancement of natural resources, not only at the individual lake level, but at the HUC 12 watershed level as well. We can now make forward progress on some much-needed watershed management projects. By using the results, we could go in any number of management directions – protection management, threatened areas management, or go in the restoration management direction. Whichever direction we plan to go, we now have the data collections that will help us to make educated decisions and forward progress. Like the title page of this document indicates, we went from chaos to being bit more organized!

Acknowledgements

Thanks goes to Adam Grassl, the Vilas County GIS Specialist, for his pain-staking patience and persistence with running the EVAAL model on every HUC 12 watershed in the county (which started by hiring a consultant to update the hydrology layer for the county). Without his help, the EVAAL piece of this puzzle would not have come to fruition. I wish to also thank Quita Sheehan, Vilas County Conservation Specialist, for her pioneering spirit in creating and enhancing the LWCD wetlands program. With her help, more people will understand and appreciate how wetlands are an integral piece of a healthy lake environment, not merely “swamps”. Finally, much appreciation goes out to the various WDNR grant staff for their patience and understanding when granting us multiple extensions to complete this project. Just know that you made it much easier for me to breathe when wanting to properly complete each facet of this project.

Sources

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Appendices

Appendix 1 – EVAAL model factsheet

Appendix 2 – Mapped Results of HWI Vulnerability by HUC 12

Appendix 3 – Spreadsheet of HWI Vulnerability scores by HUC 12

Appendix 4 – Final Combined Summary Rankings Table

Appendix 5 – EVAAL Size Distribution Spreadsheet



Wisconsin Department of Natural Resources Erosion Vulnerability Assessment for Agricultural Lands

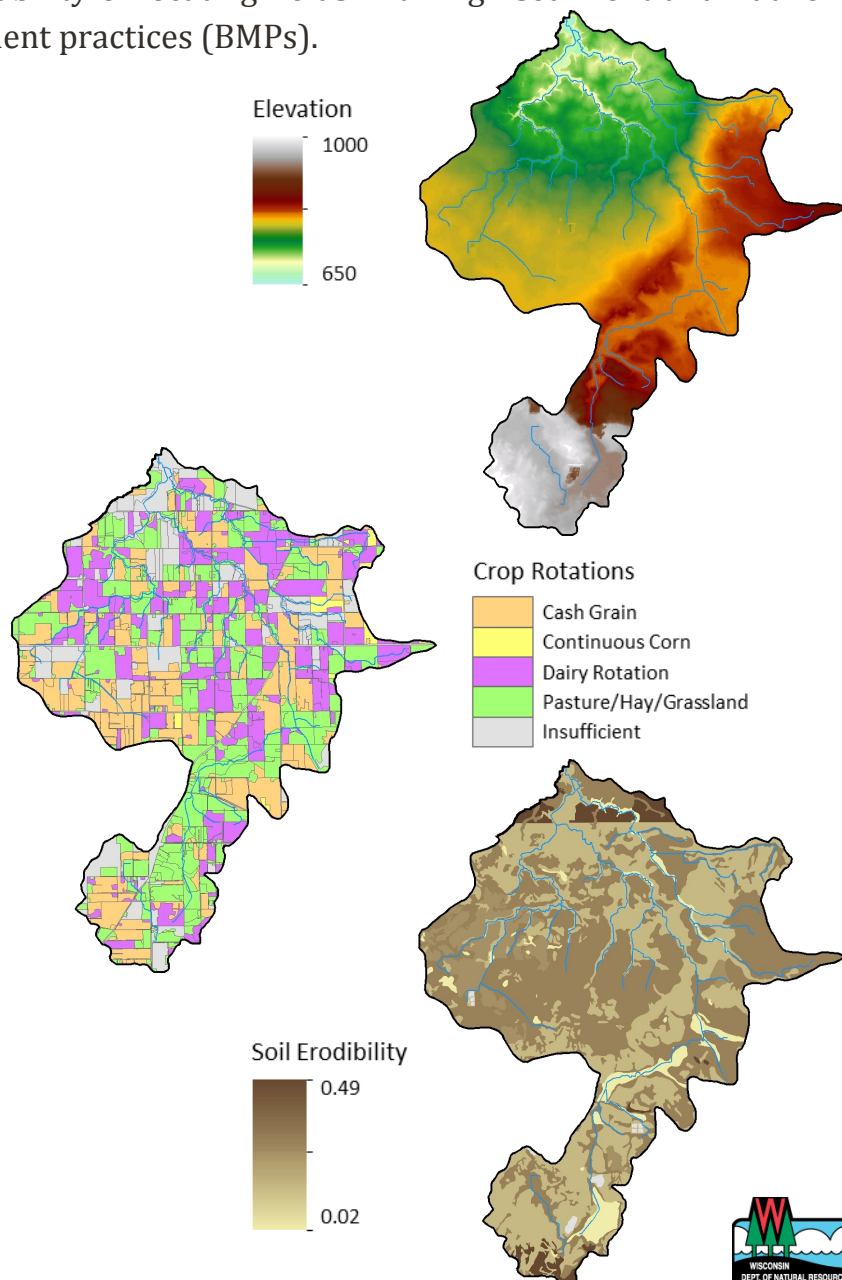
EVAAL is a GIS-based tool that uses readily-available topographic, soils, and land use information to assess vulnerability of agricultural lands to erosion and nutrient export

Why was EVAAL developed?

EVAAL was developed to support the prioritization and implementation of agricultural best management practices for improving surface water quality. It evaluates locations of relative vulnerability to sheet, rill, and gully erosion using information about topography, soils, rainfall, and land cover. This tool enables watershed managers to prioritize and focus field-scale data collection efforts, thus saving time and money while increasing the probability of locating fields with high sediment and nutrient export for implementation of best management practices (BMPs).

How does EVAAL work?

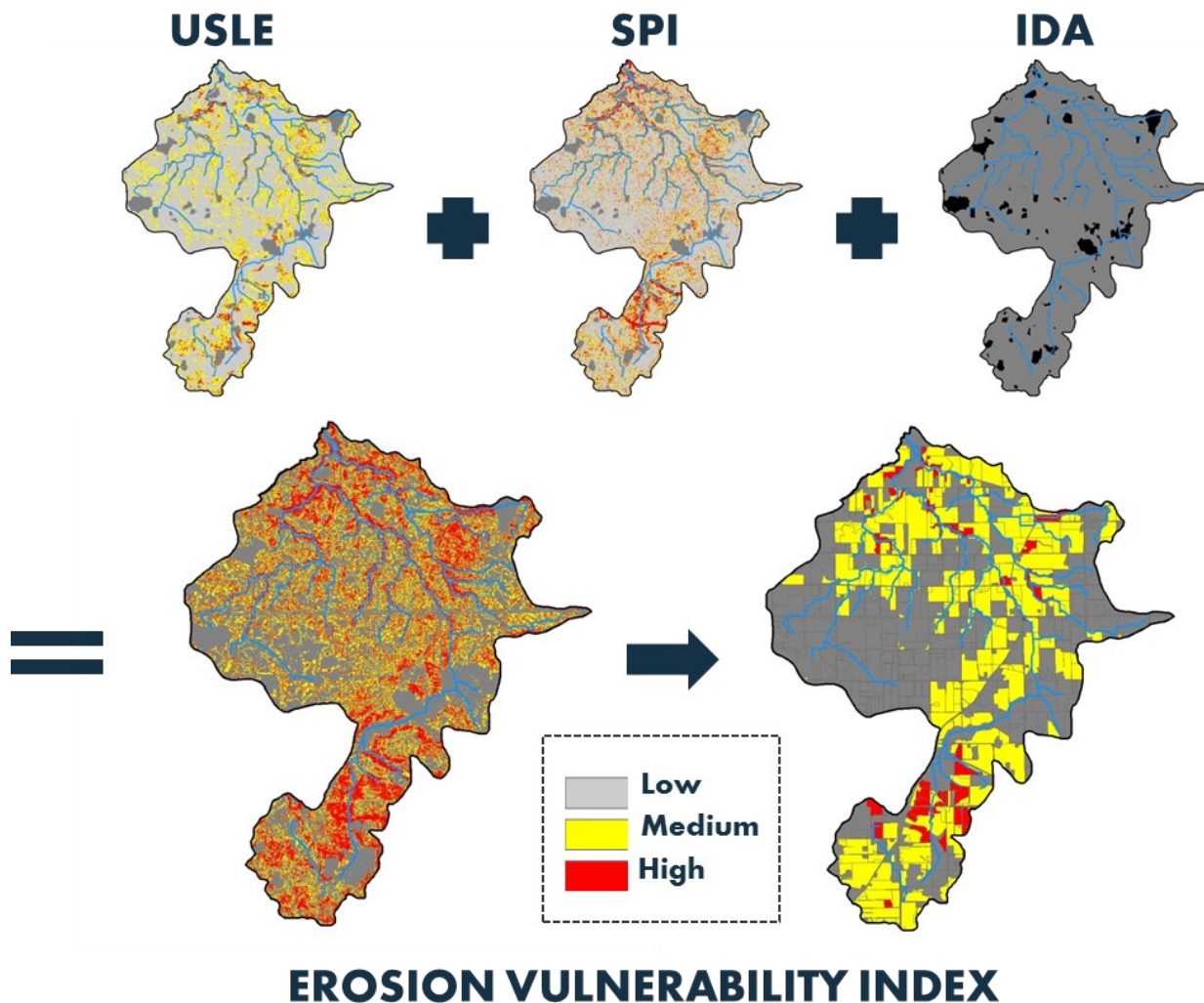
EVAAL was developed using the Python scripting language within ESRI's ArcGIS 10.x Desktop. The tool exists as an ArcToolbox, requiring ArcMap and the Spatial Analyst Extension. It utilizes several readily-available GIS datasets including topography, land cover, and soils. EVAAL was designed to quickly identify areas vulnerable to erosion, and thus more likely to export nutrients like phosphorus, using readily available data and a user-friendly interface. This tool estimates vulnerability by separately assessing the risk for sheet and rill erosion (using the Universal Soil Loss Equation, USLE), and gully erosion (using the Stream Power index, SPI), while deprioritizing those areas that are not hydrologically connected to surface waters (also known as internally drained areas, IDA). These three pieces are combined to produce an erosion vulnerability index value that can be assessed at the grid scale or aggregated to areas, such as field boundaries.



What information does EVAAL provide?

The intention of EVAAL is to locate *where* BMP assessment should be prioritized. Therefore, the results are provided as a series of maps. The primary results of EVAAL are the erosion vulnerability index and then the components of this index: soil loss, stream power index, and internally drained areas. Any of these results can be interpreted at their base resolution or aggregated to the level of an agricultural field or other boundary dataset.

It is important to note that EVAAL is designed to prioritize lands vulnerable to erosion, however an assumption can be made that loss of soil may also coincide with nutrient loss. Water quality monitoring has demonstrated that measured high concentrations of sediment are often associated with high concentrations of total phosphorus.



Is EVAAL available to download?

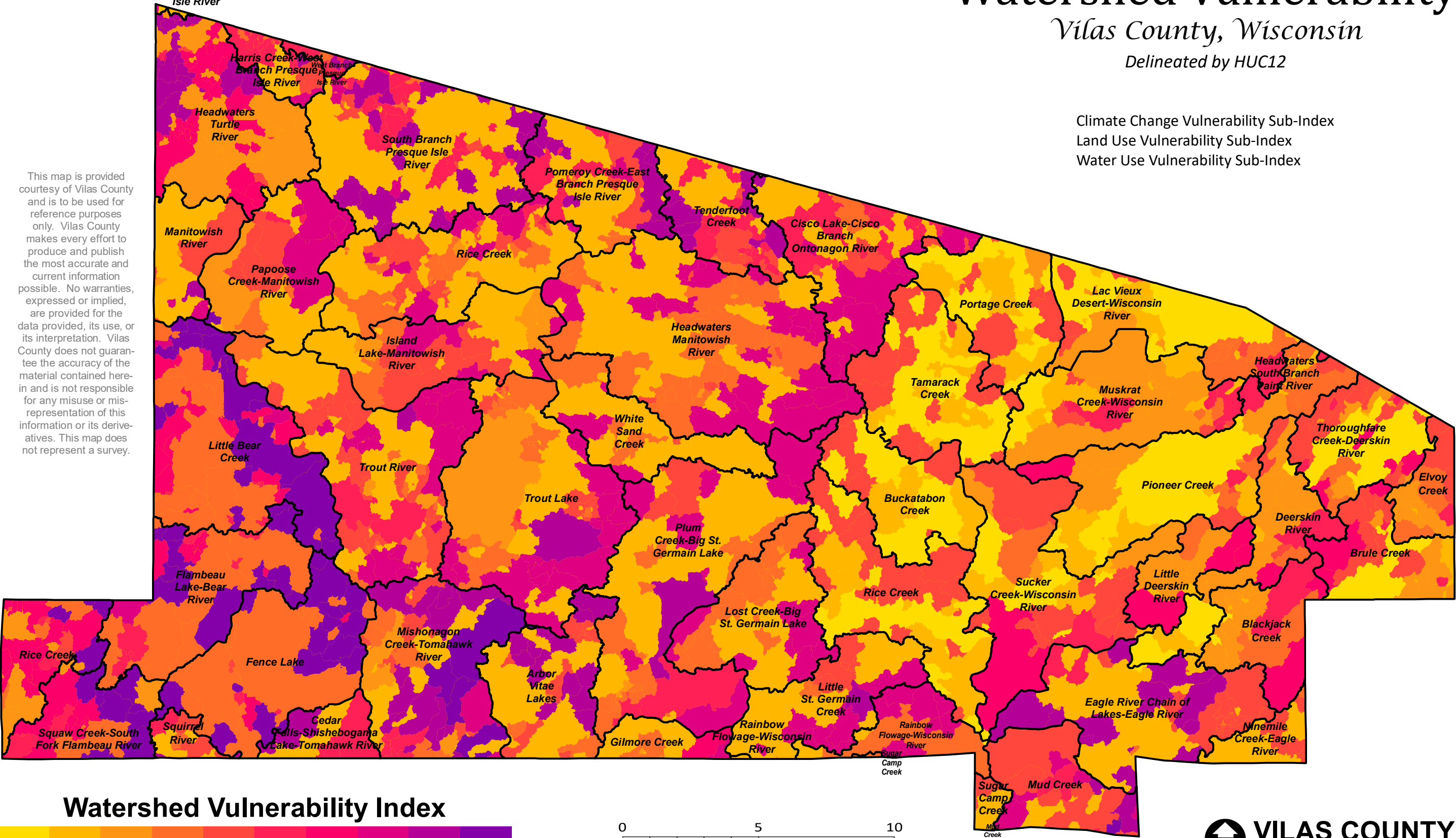
The EVAAL Toolbox (Version 1.0), Methods Documentation, Tutorial, and Tutorial Datasets can be downloaded from the DNR website (Keyword: EVAAL). For additional questions please contact the Water Quality Modeling Technical Team: dnrwqm@wisconsin.gov or 608.266.7037.

Watershed Vulnerability

Vilas County, Wisconsin
Delineated by HUC12

Climate Change Vulnerability Sub-Index
Land Use Vulnerability Sub-Index
Water Use Vulnerability Sub-Index

This map is provided courtesy of Vilas County and is to be used for reference purposes only. Vilas County makes every effort to produce and publish the most accurate and current information possible. No warranties, expressed or implied, are provided for the data provided, its use, or its interpretation. Vilas County does not guarantee the accuracy of the material contained herein and is not responsible for any misuse or misrepresentation of this information or its derivatives. This map does not represent a survey.

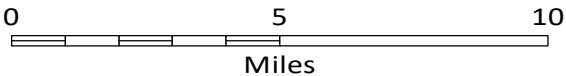


Watershed Vulnerability Index



Low

High



APPENDIX 3 - Healthy Watershed Vulnerability Index

	Protection				Threatened					Restoration				
Percent Vulnerability Scores and Area Distributions of Each														
HUC12	0% - 10%	10% - 20%	20% - 30%	Tot %	30% - 40%	40% - 50%	50% - 60%	60% - 70%	Tot %	70% - 80%	80% - 90%	90% - 100%	Tot %	TOTALS
County	221,521,329	655,089,269	244,885,593		368,500,375	333,252,782	146,536,399	124,320,332		257,570,072	158,180,331	123,980,176		2,633,836,657
040201010301	0	20,967,994	0	43	1,719,046	6,701,412	7,695,616	0	33	1,152,600	10,862,597	0	24	49,099,266
040201010302	0	5,006,155	0	33	82,437	3,084,520	5,601,660	0	57	1,089,567	390,083	0	10	15,254,421
040201010303	0	59,483,978	0	58	640,340	2,191,320	13,243,545	190,074	16	2,006,424	24,272,187	0	26	102,027,869
040201010305	0	0	0	0	325,199	115,062	2,182,208	0	77	0	768,413	0	23	3,390,882
040201020101	0	18,951,997	0	29	2,905,351	3,752,910	14,796,876	0	33	24,872,762	451,032	0	39	65,730,928
040201020102	0	12,051,831	0	32	1,191,344	5,307,127	9,884,316	0	43	0	9,245,633	0	25	37,680,252
040301060103	0	0	0	0	0	0	281,139	0	100	0	0	0	0	281,139
040301060301	9,617,645	1,632,602	7,115,662	49	0	11,562,113	542,300	7,112,410	51	0	0	0	0	37,582,731
040301060302	0	51,900	5,875,083	32	6,183,137	5,653,505	858,499	0	68	0	0	0	0	18,622,124
070500020101	0	29,608,640	0	67	9,298,522	184,828	0	0	22	4,929,412	0	0	11	44,021,402
070500020102	0	54,812,074	495,400	37	47,374,869	1,319,688	11,100	0	33	45,554,684	0	0	30	149,567,815
070500020103	0	38,041,589	479,800	52	12,922,192	11,116,162	916,294	0	33	11,096,042	0	0	15	74,572,079
070500020104	0	19,269,553	6,485,098	43	6,635,959	18,166,987	0	0	41	9,391,291	0	0	16	59,948,888
070500020105	0	21,403,216	30,993,438	47	15,208,011	4,252,453	249,900	0	18	31,278,076	9,046,900	0	36	112,431,994
070500020106	0	35,510,105	1,378,800	35	7,175,423	23,922,043	10,619,600	0	40	24,950,156	1,379,259	0	25	104,935,387
070500020107	0	13,160,916	10,341,615	41	2,977,200	11,351,673	734,500	0	26	18,801,667	0	547,122	33	57,914,693
070500020108	0	17,929,948	470,702	64	0	8,302,318	0	0	29	1,177,401	996,787	0	8	28,877,156
070500020201	0	0	0	0	52,216,568	244,800	488,200	1,517,200	66	0	0	27,703,203	34	82,169,970
070500020202	0	0	0	0	38,946,068	0	5,402,516	3,585,126	69	2,115,007	0	19,829,108	31	69,877,824
070500020203	0	0	0	0	41,290,557	55,900	722,896	13,862,910	58	2,326,082	0	38,077,784	42	96,336,128
070500020302	0	0	41,520,730	53	0	535,000	284,500	21,861,825	29	0	14,198,008	0	18	78,400,063
070500030202	0	0	3,036,037	8	6,805,486	0	3,530,156	11,337,075	57	0	0	13,201,707	35	37,910,461
070500030203	0	0	9,168,835	27	2,967,100	1,649,396	1,054,266	14,719,919	60	0	0	4,598,022	13	34,157,538
070700010101	19,997,762	94,700	3,736,540	54	3,377,907	12,189,291	961,161	3,598,735	46	0	0	0	0	43,956,096
070700010102	501,816	120,067	11,526,559	33	7,955,333	0	8,662,114	7,880,423	67	0	0	0	0	36,646,312
070700010103	0	865,981	10,002,517	42	3,071,434	0	0	11,933,995	58	0	0	0	0	25,873,927
070700010104	9,211,584	3,555,976	19,613,349	74	1,485,049	2,983,448	5,135,896	1,795,794	26	0	0	0	0	43,781,096
070700010204	0	10,037,801	115,200	70	239,936	4,171,767	0	0	30	0	0	0	0	14,564,705
070700010206	0	33,739,269	47,700	42	216,200	15,448,721	3,866,047	0	24	0	27,137,919	0	34	80,455,857
070700010301	20,079,523	14,983,623	2,292,937	74	0	13,421,258	0	0	26	0	0	0	0	50,777,341
070700010302	29,309,275	6,109,623	7,617,335	73	9,051,060	3,863,601	3,285,123	0	27	0	0	0	0	59,236,017
070700010303	29,972,651	10,867,001	0	62	0	25,279,785	0	0	38	0	0	0	0	66,119,437
070700010304	5,711,426	11,134,314	40,022,139	82	1,123,248	2,836,424	8,171,673	0	18	0	0	0	0	68,999,224
070700010305	37,495,028	14,666,596	15,368,318	74	12,207,444	4,151,818	3,296,897	3,564,138	26	0	0	0	0	90,750,239
070700010306	22,738,174	13,309,120	0	76	0	11,588,902	0	0	24	0	0	0	0	47,636,196
070700010307	24,432,558	20,735,782	0	60	0	30,580,768	0	0	40	0	0	0	0	75,749,108
070700010308	12,453,887	9,409,832	9,466,710	34	6,559,289	31,578,893	4,391,065	18,464,242	66	0	0	0	0	92,323,919
070700010401	0	3,537,971	0	9	0	24,230,445	3,047,996	0	69	5,060,490	2,869,322	606,351	22	39,352,574
070700010402	0	3,525,749	0	64	351,185	1,612,131	0	0	36	0	0	0	0	5,489,064
070700010403	0	25,773,378	0	54	995,565	6,413,816	0	0	15	12,282,286	2,370,852	0	31	47,835,896
070700010404	0	2,175,579	0	8	13,099,352	0	0	0	49	11,288,528	0	0	42	26,563,459
070700010501	0	20,338,394	131,400	35	21,695,910	0	0	0	38	15,508,647	0	0	27	57,674,350
070700010502	0	48,268,783	471,200	39	17,356,435	8,304,142	14,169,466	0	32	27,131,175	9,423,123	0	29	125,124,324
070700010503	0	8,583,537	89,736	57	2,701,898	0	0	2,896,465	37	853,272	0	0	6	15,124,909
070700010801	0	24,754,576	61,400	49	3,157,798	6,439,738	8,300	0	19	0	16,743,818	0	33	51,165,630
070700010803	0	12,264,626	6,961,353	24	6,391,823	5,241,303	3,084,817	0	18	4,704,504	23,111,091	19,416,880	58	81,176,398
070700010804	0	2,588,612	0	30	598,700	3,441,014	1,613,174	0	66	0	292,039	0	3	8,533,539
070700010806	0	5,765,883	0	32	0	6,298	7,742,582	0	43	0	4,621,267	0	25	18,136,030

APPENDIX 4. Priority Ranking - Final Summary					GENERALIZED LAKE HEALTH					
HUC 12	WATERSHEDS				Wild Rice Presence	TMDL Priority	303 (d) Listed	AIS Smart Prevention	ORW/ERW	FINAL LAKE Vulnerability RANK
	Healthy Watersheds Initiative	EVAAL Erosion Vulnerability	Wetland Vulnerability	FINAL WS Vulnerability RANK						
040201010301	0	0	8					31		
040201010302	1	0	10					5		
040201010303	0	0	10				1	58	-1	
040201010305	1	0	10					0		
040201020101	2	0	8		1			29		
040201020102	1	0	6		1			20		
040201060103	1	0	0					0		
040301060301	1	1	8				1	11		
040301060302	1	0	7					2		
070500020101	0	0	6		1			14	-1	
070500020102	1	0	7		1			33	-1	
070500020103	0	0	8		1		1	26		
070500020104	1	0	7		1			16		
070500020105	2	1	7		1			33	-3	
070500020106	1	0	8		1			49	-2	
070500020107	1	0	9		1		1	33		
070500020108	0	1	7		1		1	7	-3	
070500020201	1	0	8					35	-4	
070500020202	1	1	8		1			33	-2	
070500020203	2	0	7		1			32	-4	
070500020302	0	1	8				1	38		
070500030202	2	2	7				1	13	-2	
070500030203	1	1	6		1		1	8		
070700010101	1	0	11					10		
070700010102	1	0	8					6		
070700010103	1	0	6					2		
070700010104	0	0	8					0		
070700010204	0	2	7		1			6		
070700010206	1	1	9			4	3	62		
070700010301	0	0	7		1			23	-1	
070700010302	0	0	9		1			17	-1	
070700010303	0	0	7			2	1	22		
070700010304	0	0	7					4		
070700010305	0	0	10			4	2	23	-2	
070700010306	0	0	7			4	2	12	-1	
070700010307	0	0	8		1		1	14	-1	
070700010308	1	0	8					12		
070700010401	1	1	8					4		
070700010402	0	2	7					0		
070700010403	2	1	7				1	21		
070700010404	2	1	10					6		
070700010501	1	0	8					15		
070700010502	1	0	9		1	4	2	27	-2	
070700010503	0	0	8					0		
070700010801	0	0	9			2	2	25		
070700010803	2	1	10		1			36		
070700010804	1	2	8					8		
070700010806	1	0	7					12		

 Tier 1 Restore
 Tier 2 Threatened
 Tier 3 Protect

APPENDIX 5 - EROSION VULNERABILITY INDEX (EVI)
HUC 12 Distributions

HUC12	Map Green / Yellow Low (m², EVI 0-4)	Map Yellow / Orange Mid (m², EVI 4-10)	Map Red High (m², EVI 10+)	High % Area	Vilas County Total EVI (m²)	Total HUC12 (m²)
County	600,243,459	16,858,398	1,698,252		618,800,109	2,634,068,348
040201010301	10,383,309	239,451	22,965	0.22	10,645,725	49,117,088
040201010302	3,098,394	56,592	7,644	0.24	3,162,630	15,258,515
040201010303	21,208,383	561,312	40,908	0.19	21,810,603	102,073,228
040201010305	841,458	30,732	1,713	0.20	873,903	3,395,195
040201020101	14,446,197	348,162	30,945	0.21	14,825,304	65,780,372
040201020102	6,999,978	310,845	10,203	0.14	7,321,026	37,742,926
040301060103	69,789	7,107	0	0.00	76,896	281,603
040301060301	10,025,430	317,466	60,693	0.58	10,403,589	37,581,672
040301060302	5,447,943	19,086	1,908	0.03	5,468,937	18,623,558
070500020101	8,550,912	408,648	26,355	0.29	8,985,915	44,021,402
070500020102	35,762,754	1,577,097	92,595	0.25	37,432,446	149,567,815
070500020103	16,457,496	643,806	40,416	0.24	17,141,718	74,569,795
070500020104	13,335,570	539,283	27,252	0.20	13,902,105	59,930,490
070500020105	24,560,259	1,002,057	94,077	0.37	25,656,393	112,431,994
070500020106	24,521,775	579,720	71,520	0.28	25,173,015	104,935,387
070500020107	14,017,284	385,392	39,273	0.27	14,441,949	58,006,402
070500020108	6,761,238	137,346	29,808	0.43	6,928,392	28,811,863
070500020201	15,603,729	75,681	9,876	0.06	15,689,286	82,307,184
070500020202	14,000,847	417,753	45,468	0.31	14,464,068	69,698,454
070500020203	10,326,966	129,714	18,261	0.17	10,474,941	96,380,456
070500020302	17,217,801	570,852	57,201	0.32	17,845,854	78,399,481
070500030202	8,886,162	301,758	64,848	0.70	9,252,768	37,912,990
070500030203	6,691,482	356,997	31,530	0.45	7,080,009	34,154,459
070700010101	9,704,040	282,918	13,365	0.13	10,000,323	43,958,523
070700010102	10,219,920	210,366	20,703	0.20	10,450,989	36,645,244
070700010103	6,707,175	248,796	16,044	0.23	6,972,015	25,873,927
070700010104	12,572,112	265,653	23,397	0.18	12,861,162	43,534,150
070700010204	3,300,342	200,331	27,147	0.77	3,527,820	14,564,991
070700010206	18,156,687	605,388	67,722	0.36	18,829,797	80,727,236
070700010301	11,408,505	293,451	28,188	0.24	11,730,144	50,789,039
070700010302	12,876,288	338,028	27,990	0.21	13,242,306	59,249,237
070700010303	16,700,979	470,004	43,218	0.25	17,214,201	66,119,437
070700010304	16,889,079	541,083	35,439	0.20	17,465,601	68,999,224
070700010305	21,168,873	520,356	62,694	0.29	21,751,923	90,751,793
070700010306	12,081,861	182,157	20,616	0.17	12,284,634	47,636,196
070700010307	19,141,074	423,423	51,021	0.26	19,615,518	75,761,197
070700010308	24,976,392	556,929	69,243	0.27	25,602,564	92,201,442
070700010401	9,109,707	240,972	36,348	0.39	9,387,027	39,352,224
070700010402	1,145,934	37,671	7,794	0.65	1,191,399	5,488,645
070700010403	11,323,746	322,599	45,660	0.39	11,692,005	47,835,543
070700010404	6,956,805	125,946	23,589	0.33	7,106,340	26,667,225
070700010501	14,368,923	208,062	9,495	0.07	14,586,480	57,674,350
070700010502	29,525,202	658,584	90,876	0.30	30,274,662	125,132,457
070700010503	4,008,411	81,456	11,307	0.28	4,101,174	15,115,663
070700010801	12,140,019	312,960	21,267	0.17	12,474,246	51,164,966
070700010803	21,386,106	474,225	78,714	0.36	21,939,045	81,175,414
070700010804	1,805,328	179,481	35,046	1.74	2,019,855	8,532,826
070700010806	3,354,795	60,702	5,910	0.17	3,421,407	18,135,069