



Guidance for considering natural background when assessing lakes for eutrophication

Introduction

After many years of investigating impaired streams, the Minnesota Pollution Control Agency (MPCA) saw a greater need to consider in a more formal manner natural conditions that may be responsible for low dissolved oxygen concentrations observed in some stream reaches. In some cases, there were indications that natural background conditions were wholly responsible for river dissolved oxygen impairments. As of early 2009, there was no written procedure for considering natural background conditions during assessment or for re-assessing resources already on the 303(d) list. The distinction between whether a resource is impaired due to natural or anthropogenic factors is an important one. If a resource is determined to not meet water quality standards due to natural conditions, a Total Maximum Daily Load (TMDL) study is not required and the natural background condition becomes the standard (Minn. R. 7050.0170). Natural background standards have consequences for future sources since loading increases that result in a “discernable impact from point or nonpoint source pollutants attributable to human activity” are not permissible.

It was essential for the MPCA to develop a clear procedure and a way to formally document the review of a resource for natural background to ensure a rigorous and transparent process that could be consistently applied from case to case. A Natural Background for Streams workgroup was formed in June 2009, to develop an approach for considering natural background conditions when assessing streams for dissolved oxygen. Environmental Analysis and Outcomes Division and Regional Division staff realized that a similar process was needed to consider natural background conditions when assessing lakes for eutrophication.

Formation of natural background for lakes workgroup

In June 2010, a work group consisting of MPCA staff from the Environmental Analysis and Outcomes Division and Regional Division formed to develop a process to determine how natural background conditions can be considered when reviewing lake data during the assessment process. The workgroup's purpose, as described in the team charter (Appendix A), is to review the current process for considering natural conditions in streams during the assessment process for dissolved oxygen, and develop a similar approach for natural eutrophication in lakes. This approach is to be ready for use with the 2011 assessments. For consistency, the workgroup sought to create a parallel process to the one developed by the Natural Background for Streams workgroup, and modified many documents created by the Natural Background for Streams group for the lake review process.

Natural background definition

Any consideration of natural background conditions requires defining “natural background”. The Natural Background for Streams workgroup researched federal and state definitions of natural background as used in water programs. Their guidance document notes that there are many references to natural background in rules, statutes, effluent limits, impaired waters, and assessments. Following are the federal and state definitions.

U.S. Environmental Protection Agency (USEPA 2008): Natural background level: *"...chemical, physical, and biological levels representing conditions that would result from natural processes, such as weathering and dissolution".*

Minn. R. 7050.0150, subp. 4: *Natural causes: "...the multiplicity of factors that determine the physical, chemical, or biological conditions that would exist in a waterbody in the absence of measurable impacts from human activity or influence."*

Minn. Stat 114D.15, subd. 10 (Clean Water Legacy Act): *"Natural background" means characteristics of the water body resulting from the multiplicity of factors in nature, including climate and ecosystem dynamics, that affect the physical, chemical, or biological conditions in a water body, but does not include measurable and distinguishable pollution that is attributable to human activity or influence.*

As noted in the Natural Background for Streams Guidance Document, the common thread among these definitions is that natural background is considered to be the condition that occurs outside of human influence. That is, anthropogenic sources of stress are clearly not a component of natural background as it has been defined by U.S. Environmental Protection Agency (EPA) and in Minnesota statutes and rules. The purpose of the Lakes workgroup was to build a parallel natural background review process to the one developed for streams, not to revisit the decision that had been made on how to implement natural background as defined in regulations. Therefore, the Lakes workgroup agreed to the appraisal made by the streams workgroup that a reasonable effort must be made to demonstrate an absence of human impacts before an impaired waterbody can be identified as impaired due to natural conditions and therefore warranting site-specific standards, but not a TMDL.

Current assessment process

The current assessment process entails compiling and reviewing all credible chemical and biological data annually in accordance to the watershed schedule. A pre-assessment dataset is created based on minimum data requirements defined in the MPCA assessment and listing guidance document (MPCA, 2009). Watershed assessment teams made up of subject matter experts (water chemist, fisheries biologist, wetland ecologist, etc.) make preliminary assessment determinations that are brought to Professional Judgment Group (PJG) meetings. During PJG meetings, which include MPCA staff beyond the watershed assessment team and external partners, attendees review any additional information brought forward, finalize determinations of data adequacy and appropriateness for use in waterbody assessments, and assign each waterbody into a Consolidated Assessment and Listing Methodology (CALM) category (Table 1). Occasionally, assessment decisions are postponed while additional information is gathered.

The comprehensive list of all the current impaired assessment unit/pollutant combinations (i.e. the 303(d) list) is comprised of waterbodies assigned to categories 4 and 5. Waterbodies assigned to category 5 require a TMDL plan, whereas waterbodies assigned to category 4 do not require a TMDL due to factors listed in Table 1 (though site-specific standards are required for resources assigned to 4D). Once a final category assignment has been made by the PJG for each resource reviewed, a draft 303(d) list is completed for public review and comment before submittal to the EPA for approval.

Table 1. Minnesota CALM categories and subcategories

| Category/ subcategory | Category/subcategory description |
|--------------------------|---|
| 1 | All designated uses are met and no use threatened. |
| 2 | Some uses are met; none are threatened and insufficient data to assess other uses. |
| 3A | No data or information to determine if any designated use is attained. |
| 3B | Data are available for a review and generally indicate non-support, but insufficient data and information to determine TMDL impairment. (Example: single lake data point showing non-support) |
| 3C | Data available that currently has no assessment tools to allow its use in assessing. (Example: data with only eco-region expectation standards) |
| 3D | Data are available for a review and generally indicate full support, but insufficient data and information to assess for category 1 or 2. |
| 3E | Data are available for a review, but insufficient data and information to determine full support or TMDL impairment. (Example: lake data just below the threshold showing non-support) |
| 4A* | Impaired or threatened but all needed TMDLs have been completed. |
| 4B* | Impaired or threatened but does not require a TMDL because it is expected to attain standards in the near future. |
| 4C* | Impaired or threatened but does not require a TMDL because impairment not caused by a pollutant. |
| 4D* | Impaired or threatened but does not require a TMDL because impairment is solely a result of natural sources. |
| 5A | Impaired or threatened by multiple pollutants and no TMDL plans approved. |
| 5B | Impaired or threatened by multiple pollutants and either some TMDL plans approved but not all or at least one impairment is the result of natural conditions. |
| 5C | Impaired or threatened by one pollutant. |

* Assessment units falling into category 4 are impaired waters, but are not part of the 303(d) list because of the reasons given above in the category descriptions. EPA has identified subcategories 4A, 4B, and 4C for classifying a segment, where *available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed*. Minnesota has chosen to further subdivide Category 4C into subcategories 4C and 4D to differentiate between cases of impairment due to non-pollutants (4C) and natural background (4D). All category 4 waters appear with the category 5 waters on an impaired waters inventory, which is a comprehensive list of all the current impaired assessment unit/pollutant combinations.

Natural and anthropogenic sources of nutrients to lakes

To determine if high nutrient conditions in a lake are due solely to natural factors means that we must understand known natural sources of nutrients in the lake catchment, and we must be able to confidently conclude that no human factors exist that also contribute to the condition. The Natural Background for Lakes workgroup has identified a number of likely anthropogenic phosphorus sources to lakes including: industrial and domestic wastewater treatment plant discharge, feedlots, stormwater, row cropping, pastured lands, forestry, physical changes from agricultural drainage or shoreline development, individual sanitary treatment systems, and practices that lead to enhanced decomposition (e.g., peat mining). It is also important to identify the presence of channelized streams/ditching that provide direct conveyances of stormwater runoff to lakes. Reservoirs and dams can also factor into nutrient loading. Using these factors as a guide, members of the work group developed a geographic information system (GIS) project (NatBackground.mdx in X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes) to evaluate the extent to which each of these factors may contribute to the

nutrient impairment for a given lake. The GIS project allows the assessment team to make a comprehensive desktop evaluation of each potential stressor, including natural factors.

An accompaniment to the GIS tool is a questionnaire designed to identify past and existing conditions or activities that can't be captured in the GIS project (Appendix B; X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes). The questions are designed to provide supplemental information to be considered with available water quality data and GIS layers to more completely round out what is known about the lake and possible sources of nutrient loading to that resource.

Process for determining natural eutrophication in lakes after initial assessment

The most efficient way to consider whether or not natural conditions are responsible for lake eutrophication is during the annual assessment process. Subject matter experts are already gathered, and the PJG meeting is an ideal opportunity to bring interested parties together to jointly review chemistry data and other available information about a given lake.

Is a natural background review warranted?

Each year and in accordance with the watershed schedule, the lake chemist will make preliminary assessment decisions for all lakes for which assessment-level data exists, and communicate those preliminary decisions with MPCA staff several weeks prior to the PJG meeting. MPCA staff (and their external partner contacts) should carefully review those preliminary decisions and decide if a request to review a lake for natural background is warranted. The best candidates for the natural background review will be lakes with *very minimal to no current or historic shoreline or catchment disturbance*. Since the anthropogenic phosphorus contribution to lakes that receive/have received point source discharges or have/have had notable point/nonpoint source activity within the lake's catchment can likely be measured, such lakes will probably not meet the definition of impaired due to natural background conditions. Once a decision has been made to request a natural background review, the champion will need to prepare some information to be presented by the lake chemist and the champion during the PJG meeting.

How to submit a review request

The lake/stream water chemist and other PJG attendees must have as much information as possible about the lake in question in order to determine if natural background conditions are responsible for eutrophication. Someone wishing to request a natural background review ('champion') is encouraged to notify the lake/stream water chemist (typically a Lakes and Streams Monitoring Unit staff) for the watershed in question as soon as possible that a request for natural background review is going to be made. Then, the champion must complete the Request Form for Assessing Lakes for Natural Background Conditions (Appendix B; X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes) and provide it to the lake/stream water chemist. Since the champion is likely to be a Regional staff person or a local stakeholder with familiarity with the lake in question, they are best able to explain why a natural background review is a reasonable approach. In addition, their knowledge of the lake and surrounding area means they are best suited to gather the supplemental information requested on the form. This form, with any supporting documentation, must be delivered to the lake chemist one week prior to the scheduled PJG meeting. The watershed assessment teams will not delay an assessment decision if a

natural background request has been made but no supporting information has been provided, so the champion must be committed in this request to spend the time to compile the needed supporting information. That said, the champion may not be able to provide detailed answers to **all** questions on the Request Form for Assessing Lakes for Natural Background Conditions. If this happens, the assessment team will review the lake based upon the information that the champion has been able to gather.

Reviewing a request

At the PJG meeting, the lake/stream water chemist will bring forward requests for natural background review. An evaluation form (Appendix C; X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes) has been created to be used in the evaluation of potential natural and anthropogenic stressors. The review team must complete one form for each lake reviewed for natural background.

The watershed assessment team will begin their assessment by reviewing assessment data, and referring to the GIS project to explore sources of natural and anthropogenic nutrients. Each stressor will be evaluated based on its proximity of the lake and the extent of disturbance relative to the size of the waterbody, and the assessment team's finding will be recorded on the evaluation form. The assessment team will also rely on supplemental information captured in the responses to the questions on the Request Form for Assessing Lakes for Natural Background Conditions. It is not necessary to demonstrate the complete absence of any human disturbance in a watershed to reasonably conclude that the waterbody in question is being influenced solely by natural background conditions. Rather the review team must be able to reasonably conclude that anthropogenic influences present in the lake catchment do not contribute to a eutrophic condition and that natural factors present at the site and the catchment exist and likely account for all of the eutrophication observed.

After completion of the review, the watershed assessment team members will make a final CALM category recommendation and document their reasoning in the recommendation section of the evaluation form. As a result of the work completed by the Natural Background for Streams workgroup, a new CALM category 4E (*"Impaired or threatened but existing data strongly suggests that a TMDL is not required because impairment is solely a result of natural sources; a final determination of Category 4D will be made in the next assessment cycle pending confirmation from additional information (i.e. water quality or land use)"*) was created for resources where the evidence strongly suggests that natural background conditions are the sole factor in the impairment, but where a limited amount of additional information would be helpful to make the determination. For resources placed into CALM category 4E, the watershed assessment team will make a recommendation regarding additional information that should be gathered will be documented on the natural background evaluation form. For lakes designated as 4E, the watershed assessment team will delay a final decision until the next assessment cycle to allow time for the champion to gather additional needed information, but no longer than that. If sufficient information is not available for the subsequent review, the resource in question will be assigned one of the category 5 options.

Conclusion

There is a need for clear, written guidance for how natural background conditions will be considered during the assessment process. In June 2010, a work group consisting of MPCA staff from the Environmental Analysis and Outcomes Division and Regional Division formed to develop a process to determine how natural background conditions can be considered when assessing lakes for eutrophication.

The following process has been developed and will be implemented starting with the 2011 assessments:

1. Watershed assessment team makes preliminary determination of assessment.
2. Regional/external partners review the preliminary assessments and considers whether a natural background review for any lake is warranted.
3. If natural background review is warranted, the champion notifies the lake/stream water chemist (typically a Lakes and Streams Monitoring Unit staff) for the watershed in question as soon as possible that a request is going to be made.
4. Champion completes the Request Form for Assessing Lakes for Natural Background Conditions (Appendix B; X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes) and submits it to the lake/stream water chemist one week prior to PJG.
5. The natural background review will be made at the PJG and the findings documented on an evaluation form (Appendix C; X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes).
6. For lakes designated as 4E, the watershed assessment team will make a recommendation regarding additional information that should be gathered. In such cases, a final decision will be delayed until the next assessment cycle to allow time for the champion to gather additional needed information, but no longer than that. If sufficient information is not available for the subsequent review, the resource in question will be assigned one of the category 5 options.

This process and the supporting programs/documents will be updated and revised as needed after each assessment cycle. Staff and leadership will be alerted to changes to the process during Integrated Assessment and Listing Policy Group meetings.

References

Heiskary, S. and E. Swain. 2002. Water quality reconstruction from fossil diatoms: applications for trend assessment, model verification and development of nutrient criteria for Minnesota lakes. MPCA, St. Paul, Minnesota.

<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/lakes/lake-water-quality/lake-water-quality.html>

MPCA. 2009. Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment, 305(b) report and 303 (d) list, 2010 Assessment Cycle.

MPCA. June 3, 2009. Water Quality Condition Monitoring-Watershed Sampling Design: Intensive Watershed Monitoring. August 28, 2009, <http://www.pca.state.mn.us/water/monitoring/monitoring-watersheds.html>.

U.S. EPA. October 15, 2008. Impaired Waters and Total Maximum Daily Loads, Glossary. August 28, 2009. <http://www.epa.gov/owow/tmdl/glossary.html>.

Appendix A. Natural background team charter

Assessment of natural background eutrophication in lakes team charter

Final: June 15, 2010

| | |
|---------------------------------------|--|
| Team Name | Natural Background in Lakes Team |
| Purpose/ Mission | Review the current process for considering natural background dissolved oxygen conditions in streams during the assessment and listing process, and develop a parallel approach for natural background of eutrophication in lakes for assessments beginning in 2011. |
| Membership | Sponsors: Shannon Lotthammer and Glenn Skuta Members: Steve Heiskary, Pam Anderson, John Erdmann, Tim James, Howard Markus, Dana Vanderbosch, and Mark Tomasek |
| Accountabilities/ Expectations | Team members are accountable to the team sponsors. Team members will consult with other division/agency staff as the approach is developed. Team members will review and document existing process and procedures. Team members will develop and recommend those processes and procedures necessary to consider the potential for natural background eutrophication in lakes into the IWM and new assessment process. The evolution of the approach will be iterative: The team will outline the initial approach, and changes will be made to this procedure as more experience on determining natural background conditions is gained. |
| Authority | Recommendations will be made for review and approval by the Water Manager Team/Water Quality Forum |
| Outcomes and Results | Recommend an approach and draft a written guidance manual for evaluating natural background conditions for the 2011 assessment process; note that the approach must not jeopardize our ability to submit the draft 303(d) list to EPA on time (and therefore may address some of the questions, and defer others to future listing cycles). Identify further considerations/questions that will need to be addressed for future cycles. In recommending an approach for addressing natural background in lakes, consider the following: <ol style="list-style-type: none">1. How the quantity and quality of the assessment data may affect our ability to make a listing decision when natural background may be a factor;2. Appropriate consolidated assessment and listing methodology categories;3. The implications on use attainability analyses and site-specific standards efforts; and4. The potential point-source regulation implications. A recommendation and guidance manual must be developed for presentation at August 4th Integrated Assessment and Listing Policy Group Meeting. |
| Customer Focus | The primary customers for the natural background process are the staff participating in the assessment and listing process. Those customers of the results of the natural background process (including an interest in transparency and rigor of the process) are MPCA monitoring, TMDL, watershed management, and permitting staff; sister agencies; EPA; the regulated and environmental advocacy communities and local government. |
| Team Processes and Procedures | The team will meet as needed to complete the work in the required timeframe; sub-teams can be identified as needed to accomplish the work. Normally, decisions are made on an informed consent model (everyone will live with and support the decision). If agreement cannot be reached, the team will ask for input and, if necessary, a decision from the sponsors. |

Appendix B. Request form

Request form for assessing lakes for natural background conditions

In order to make an informed decision, the lake/stream water chemist must have as much information as possible about the lake in question in order to determine if natural background conditions are responsible for eutrophication. Champions should gather as much of the following information as possible and provide it to the lake/stream water chemist (typically a Lakes and Streams Monitoring Unit staff) for the watershed in question. **This form, with any supporting documentation attached, must be delivered one week prior to the scheduled professional judgment group (PJG) meeting.** Depending on how much time is available during the PJG, a follow-up meeting to the PJG may be needed to finish discussion and reach a decision.

| Champion's name: | | | |
|---------------------------------|---------------------------------|------------------|---|
| Cover | Recommended Sources: | Lake name (ID#): | Ecoregion Specific Land Use Ranges from table on next page: |
| Lake Ecoregion | US EPA Level III (revised 2000) | | |
| Lake surface area | 1:24,000 NDH area | | |
| Lake maximum depth | DNR Fisheries | | |
| Lake mean depth | | | |
| Lake % littoral | | | |
| Watershed area (total) | DNR Catchment layer | | |
| Watershed: lake area | | | |
| Forest (% total) | 2001 NLCD Land Use (or newer) | | |
| Water/wetland (% total) | | | |
| Pasture/open (% total) | | | |
| Cultivated (% total) | | | |
| Urban (% total) | | | |
| Assessed data (# obs) | MPCA STORET data | | |
| TP µg/L (10-year average) | | | |
| Chl-a µg/L (10-year average) | | | |
| Secchi meters (10-year average) | | | |
| IWM year | MPCA | | |
| Local sampling (years) | | | |
| Secchi trend (from CLMP trends) | MPCA | | |
| Watershed name (HUC#) | | | |

Champion can ask the assigned lake chemist (usually someone from the Lakes and Streams Monitoring Unit) for help in completing the table above.

| Land Use % | NLF (NMW) | NCHF (DA & RRV) | WCBP | NGP |
|-------------------|-----------|-----------------|---------|---------|
| Forest | 54 – 81 | 6 – 25 | 0 – 15 | 0 – 1 |
| Water and Wetland | 14 – 31 | 14 – 30 | 3 – 26 | 8 – 26 |
| Pasture and Open | 0 – 6 | 11 – 25 | 0 – 7 | 5 – 15 |
| Cultivated | < 1 | 22 – 50 | 42 – 75 | 60 – 82 |
| Urban | 0 – 7 | 2 – 9 | 0 – 16 | 0 – 2 |

Notes:

- If you believe that the lake in question should be assessed against alternative ecoregion standards, that request should be taken directly to the watershed assessment team during the professional judgment group meeting. Such cases will not be considered through a natural background review process.
 - Direct point source discharges to the lake or notable point/nonpoint source activity within the lake's watershed will likely result in a negative decision for the natural background request. See the guidance document for more information.
1. Have there been any changes to fisheries management in recent years? Fisheries staff at the nearest Department of Natural Resources (DNR) regional and area offices can help staff determine this.
 2. Provide a summary, and the locations on a map, of ditching or stormwater conveyances that lead directly to the lake. Local (i.e., county) records may be available to help staff determine this.
 3. Provide information on the number of cabins, year-round lake homes, and resorts on the lake shoreline, and a map showing the location of this development.
 4. Provide summary information as to the status of septic systems of dwellings on the shoreline. Local offices may have such records.
 5. Provide information pertaining to changes to aquatic vegetation in the lake over time. Has there been chemical or mechanical removal of vegetation in response to shoreland development? Staff may be able to consider changes over time through aerial photos or by contacting the aquatic plant management (APM) staff in the DNR fisheries office nearest the lake to see if APM permits have been issued in the past.
 6. Are their permitted point source discharges (wastewater treatment facilities (WWTF) or feedlots) to the lake in question or within the watershed? If yes, please provide details on the nature of the discharge, the maximum capacity (millions of gallons per day for WWTFs; maximum animal units for feedlots) the receiving water, proximity to the lake, etc.
 7. Provide any known information on unpermitted activities that occur on or near the lakeshore (i.e., unpermitted feedlot activities, etc.).
 8. Provide information pertaining to the historical use of, or impacts to, the lake (i.e., previous feedlot operations or point-source discharge, previous development around the lake, etc.). Local staff and even landowners can often provide this perspective. An approach for assembling/researching historical land use and related activities from county/local records and archives is presented in Heiskary and Swain (2002).
 9. Have lake sediment cores been collected from the lake (or a nearby lake) that were used to reconstruct pre-European phosphorus concentrations or other relevant information? (Materials that can help with this are located at: X:\Agency_Files\Water\Condition Monitoring\Lakes\Sediment diatom work.)

Appendix C. Natural background evaluation form

Evaluation form for determination of nutrient impairment in lakes due to natural background conditions

GIS project is called NatBackground.mxd and is located in X:\Agency_Files\Water\303D List\Natural Background Folder\Lakes.

| | |
|----------------------|--|
| Review date: | |
| Lake name; ID #: | |
| Review team members: | |

| Stressor | Present in watershed (yes/no) | Stressor contribution potential (high, moderate, low, none) | Comments (see below for possible factors to consider in evaluating each stressor) |
|--|-------------------------------|---|---|
| Anthropogenic sources | | | |
| Overall land use disturbance | | | |
| Forest harvest sites | | | |
| Row crop agriculture | | | |
| Pasture and hay land | | | |
| Roads | | | |
| Feedlots (permitted) | | | |
| Feedlots (unpermitted) | | | |
| Direct conveyances to lake (ditches or streamflows) | | | |
| Shoreline development (cabins, lake homes, resorts) | | | |
| Unsewered communities | | | |
| Industrial or municipal wastewater facilities | | | |
| Stormwater | | | |
| Stormwater unpermitted | | | |
| Removal of aquatic vegetation | | | |
| Reservoirs and dams (manmade) | | | |
| History of anthropogenic use of lake or within watershed | | | |

**Do not proceed if anthropogenic factors suggest nutrient loading is measurable.
Lake is not a candidate for natural background.**

| | | | |
|------------------------|--|--|--|
| Natural Factors | | | |
| Forest cover | | | |
| Wetland cover | | | |

| | |
|---|--|
| Natural background review team recommendation. Include CALM designation or follow-up monitoring recommendation. Combine and attach all natural background evaluation forms used to evaluate an AUID. | |
|---|--|

One evaluation form is required for each lake. The evaluation of stressor potential is based primarily on the proximity of the stressor within the watershed and the degree of disturbance relative to the size of the waterbody. All stressors identified have the potential to contribute to a nutrient impairment through one or more pathways.

In the evaluation of all stressors consider the following evaluation criteria (EPA 2008):

- Does the source contain or emit any of the critical parameters?
- Are there one or more pathways?
- Is the key parameter persistent enough to impact the reach?
- Does the source discharge the key parameters in the same time period that the impairment occurs?

The determination of natural condition will be based upon a weight of evidence approach utilizing the stressors and criteria defined below:

Process

1. Determine and view catchment and watershed boundaries.
2. Turn on aerial photos and view watershed and lake.
3. View stream flow lines and pourpoint of lake to determine if there are conveyances into the lakes and how water drains from the lake.
4. Systematically turn on and off layers in GIS tool to consider the natural and anthropogenic impacts potentially affecting the lake.
5. Consider additional information brought forward by champion (i.e., past historical use of lake, past anthropogenic activity in watershed, changes to fisheries management, presence of ditches or streams to lake that cannot be seen on GIS layers, nature of septic systems along the lakeshore, presence of shoreline disturbance that can't be viewed by GIS layers, etc.).
6. Consider assessment information and data.
7. Record findings and natural background team decision on form above.

Factors to consider in evaluating the potential contribution from each stressor

Industrial or municipal wastewater facilities

- location/proximity of discharge to lake or within lake catchment
- type of wastewater
(noncontact cooling water, publicly owned treatment works, industrial discharge)
- discharge pollutant levels vs. receiving water pollutant levels
- discharge volume versus receiving water volume
- discharge type (seasonal, daily, land application)

Feedlots (permitted)

- location/proximity to lake, catchment or upstream conveyance to lake
- Verify accuracy of GIS points using aerial photos.
- permit compliance (no discharge); fish kill history
- manure application areas in relation to lake, catchment or upstream conveyance to lake, on tiled fields within lake catchment, cattle in lake

Stormwater (permitted)

- location/proximity to lake and shoreland
- discharge volume versus receiving water volume
- type of stormwater (likely stressors include fertilizer/nutrients and animal waste)
- What stormwater controls are in place?

Reservoirs and dams (man-made)

- location/proximity to lake and shoreland
- nutrient status of the reservoir, if known
- type of release (surface versus hypolimnetic)
- water level manipulation, eutrophic ambient conditions

Feedlots/pasture (unpermitted)

- location/proximity to lake and shoreland
- fish kill history
- manure application areas in relation to lake, catchment or upstream conveyance to lake, cattle in lake, manure application on tiled fields within lake catchment

Forestry/row crop/pasture and hay lands

- location/proximity to lake and shoreland
- percentage of watershed in row crop
- type of terrain (hilly, soil type, etc.)

Physical alterations to the lake or shoreland

- Is the shoreland intact around the lake?
- Is there development within the lake's catchment?
- Are dams and reservoirs present within the watershed?
- Are channelized streams present within the watershed?
- What is the likelihood of agricultural tile drainage within system?
- What are the natural factors?
- Is the lake's catchment undisturbed by human-induced land use conversion?
- Is the lake a flow-through lake?
- If so, is there any human disturbance of upstream lakes' catchment?
- Is/are upstream lake(s) impaired? If so, can the impairment(s) be linked to anthropogenic causes?
- Determine the presence of forested areas, natural prairies or unaltered wetlands.