2015 Nebraska Water Monitoring Programs Report

Nebraska Department of Environmental Quality
Water Quality Division
Water Quality Assessment Section
January 2016

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Acknowledgements:

The following Nebraska Department of Environmental Quality staff have contributed to this report with their photos, maps, numbers, words, and editing. Their efforts are greatly appreciated and gratefully acknowledged here: Mike Archer, John Bender, Dave Bubb, Jeremy Hammen, Nancy Harris, Tom Heatherly, Dan Inman, Laura Johnson, Carla McCullough, Greg Michl, Dave Miesbach, Dave Schumacher, and Elbert Traylor.

Individual staff should be contacted with specific questions about specific programs; their contact information is provided at the end of each monitoring program description.

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Photo on Front Cover:

Nebraska Department of Environmental Quality (NDEQ) staff conducting a habitat assessment for the Stream Biological Monitoring Program at South Fork Big Nemaha River, Pawnee County.

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Introduction

The Nebraska Department of Environmental Quality (NDEQ) is charged with monitoring, assessing, and to the extent possible, managing the state's water resources. The purpose of this work is to protect and maintain high quality water and encourage or execute activities to improve poor water quality. Monitoring is done on nearly 17,000 miles of flowing rivers and streams, more than 134,000 acres of surface water in lakes and reservoirs, as well as the vast storage of groundwater in Nebraska's aquifers.

This document brings together a short summary of many of the monitoring programs performed (or required) by the NDEQ. In many cases, recent results are highlighted in the descriptions. There are also examples of how the data that are collected are used. Individual program summaries, in some cases, include descriptions or explanations of water quality trends or observations.

This document is not meant to be a comprehensive or exhaustive scientific report; rather, it is a starting place for describing the numerous monitoring programs carried out by the NDEQ, its contractors, or, in some cases, the regulated community. Other NDEQ reports and documents have more in-depth data and descriptions for many of the programs. The reader will be directed to these in the individual program descriptions, or can contact the author cited at the end of each program description for further information.

Partners

NDEQ gathers much of the data discussed in this document; however, many partners have contributed as well. Without the contractual and voluntary assistance we receive from our many sister agencies and partners, we would not be able to detail the successes that we have accomplished. The state's Natural Resources Districts, Nebraska Public Power District, US Army Corps of Engineers, US Environmental Protection Agency, US Geological Survey, University of Nebraska-Lincoln, Lincoln-Lancaster County Health, Nebraska Game and Parks Commission, Nebraska Department of Agriculture, and others all contributed time, money, resources, and/or data to our water monitoring programs.

Many thanks.

Public Beach Monitoring Program – Bacteria and Microcystin

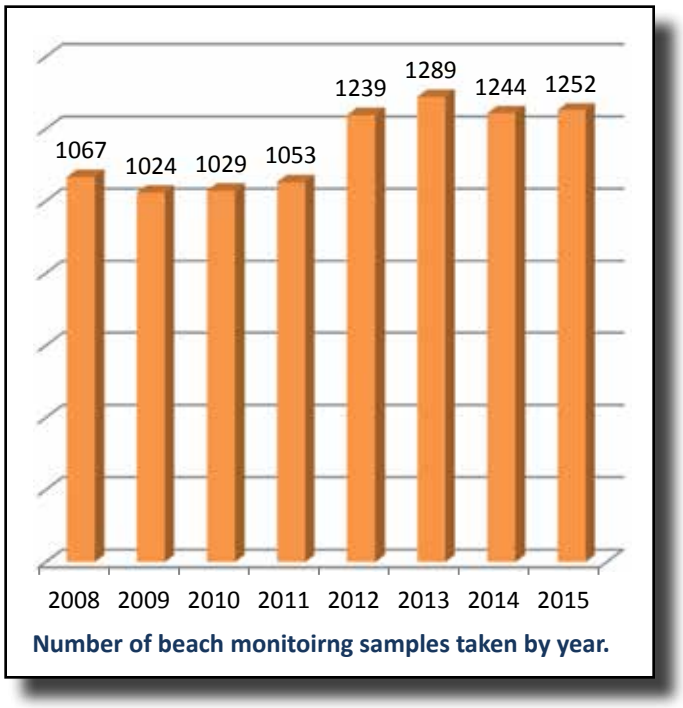
Why Does NDEQ Monitor Public Beaches?

Full contact recreation activities such as swimming, tubing, skiing, and jet skiing are popular pastimes at Nebraska's lakes and reservoirs. NDEQ and its collaborators want to ensure that the users of these waters have access to the most current water quality information possible.

When and Where is the Monitoring Conducted?

Sampling for bacteria at Nebraska's beaches has been occurring for many years. Nebraska Game and Parks Commission initiated sampling at a number of locations in the 1970s. NDEQ eventually took over the sampling program in the 1990s.

In 2004 NDEQ began sampling for the toxin, microcystin after it was determined that high levels in some Nebraska lakes attributed to the deaths of several dogs that had ingested the water. In 2005, NDEQ and its partners began a more comprehensive plan for collecting samples from publicly owned and operated lakes. Weekly sample collection of 53 sites from 50 lakes coincides with the recreation season (May 1 to September 30). Since the inception of NDEQ's comprehensive beach monitoring program in 2005, nearly 10,000 samples have been analyzed for microcystin and E. coli bacteria.



Number of beach monitoirng samples taken by year.

What is Monitored at the Beaches?

E. coli bacteria and blue-green algae toxins, primarily microcystin, are monitored to give an indication of the quality of water at Nebraska swimming beaches.


Preparing algae samples for microcystin analysis.

E. coli bacteria are monitored to provide an "indirect" indication of potentially harmful (pathogenic) bacteria. While not all E. coli bacteria are considered a threat to human health, some bacteria strains are. The larger the population of E. coli bacteria measured, the greater are the odds of having harmful pathogenic bacteria. Using this rationale, the value of 235 colonies of E. coli bacteria is established as the upper limit for supporting full body contact recreation. Ingesting water with higher levels of E. coli bacteria may cause illness with most symptoms being exhibited within the intestinal tract.

Nebraska lake under health alert.

E. coli bacteria are primarily associated with animal and human waste. Animal sources of E. coli bacteria commonly enter our waters from livestock and wildlife wastes that runoff the landscape during significant rainfall events. Human sources of contamination can include improperly maintained septic systems and wastewater treatment facilities that discharge untreated wastewater.

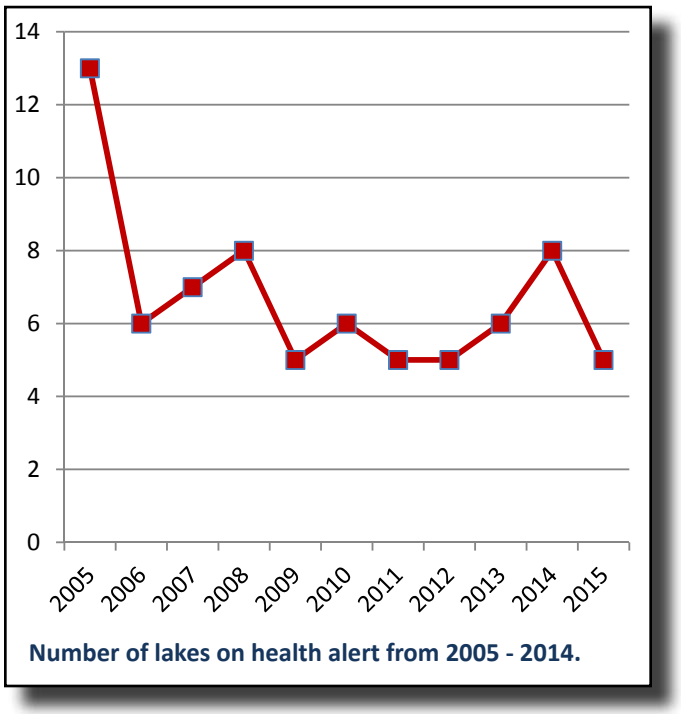
Toxins, including microcystin, are produced by certain types of blue-green algae. Microcystin in the water can cause skin rashes, lesions, and blisters on people who have been swimming or wading. If toxins are swallowed they can cause headaches, nausea, muscle or stomach pain, diarrhea, or vomiting. Though rare, severe cases can include seizures, liver or respiratory failure, or even death. A microcystin level of 20 ppb is established as the criterion for full body contact recreational activities.

While not all types of blue-green algae are toxic, the greater the population of blue-green algae, the greater is the chance of having toxic algae problems. In the absence of direct microcystin toxin measurements, one should recognize a severe blue-green algae bloom and treat it with caution. Blue-green algae often have a "John Deere green" or "pea green soup" color, appear as thick green paint or oil floating on the surface of the water, and usually have a strong septic odor.

How are the Data Used?

NDEQ and its partners (typically local NRDs) collect the lake water sample at the beaches early each week. Because the sample collectors do their own bacteria analysis and NDEQ analyzes the microcystin samples as opposed to sending them out to a contract lab, the results are quickly available and are posted on the Department's internet site by Thursday of the same week (www.deq.ne.gov). This schedule provides information to the public prior to the weekend, when they are more likely to be using the lakes.

When levels of microcystin exceed 20 micrograms per liter (µg/l, or ppb, parts per billion), the NDEQ, Nebraska Game and Parks Commission and Health and Human Services jointly issue a Health Alert. During a Health Alert at a public lake, signs are posted advising the public to use caution and avoid full body recreational activities such as swimming, wading, skiing, jet skiing, sailing and particularly avoid drinking the water. Affected swimming beaches are closed. Camping, picnics, boating, fishing, and other non-contact



Number of lakes on health alert from 2005 - 2014.

recreational activities are allowed. The lake remains on Health Alert until levels of microcystin are measured below the 20 µg/l criterion for two consecutive weeks. If one has prolonged contact with water suspected to have high levels of the microcystin toxin, it is recommended that they shower with fresh water as soon as possible.

In situations where E. coli bacteria exceed counts of 235/100ml of water for a single sample, the water is considered at a higher risk for illness when used for full-body contact recreation . Lakes that exceed this level are specifically identified on the NDEQ's website weekly, in the Environmental Alerts section. Unlike with high toxic algae levels, signs are not specifically posted and beaches are not closed for high bacteria levels. This is primarily because bacteria values change quickly while microcystin levels are more persistent and can remain for several weeks. This bacteria information, rather, is provided to allow the public to make their own decision on whether or not to use the lake. Guidance provided to assist the public in the decision making process includes:

- Assessing the length of time from heavy rainfall to the time of use.
- Assess the condition of a lake and consider avoiding abnormally turbid waters.
- Consider chronic problems where bacteria levels are consistently high even in the absence of rainfall.
- Avoid activities which could result in a higher potential of swallowing lake water.
- When bacteria levels are high, shower after coming in contact with the water.
- Wash hands before eating if you have been in contact with lake water.

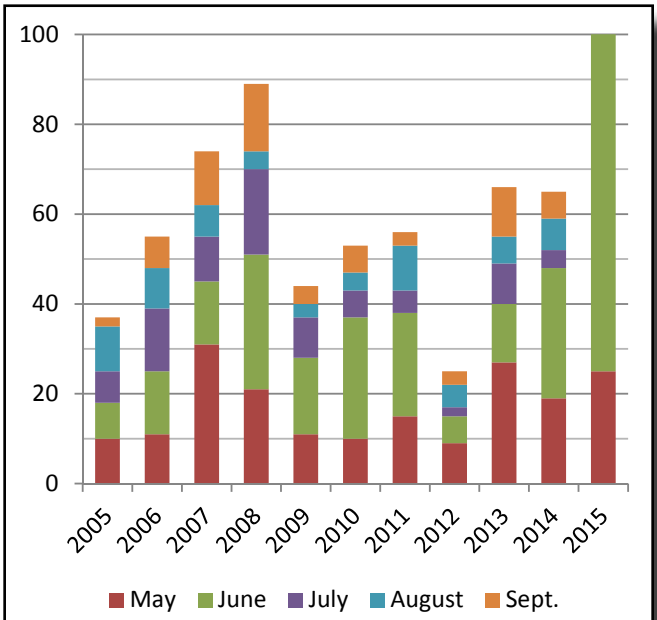
Lakes that repeatedly exceed the E. coli and microcystin water quality standard may be put on Nebraska's Clean Water Act 303d list of impaired waters.

2015 Results

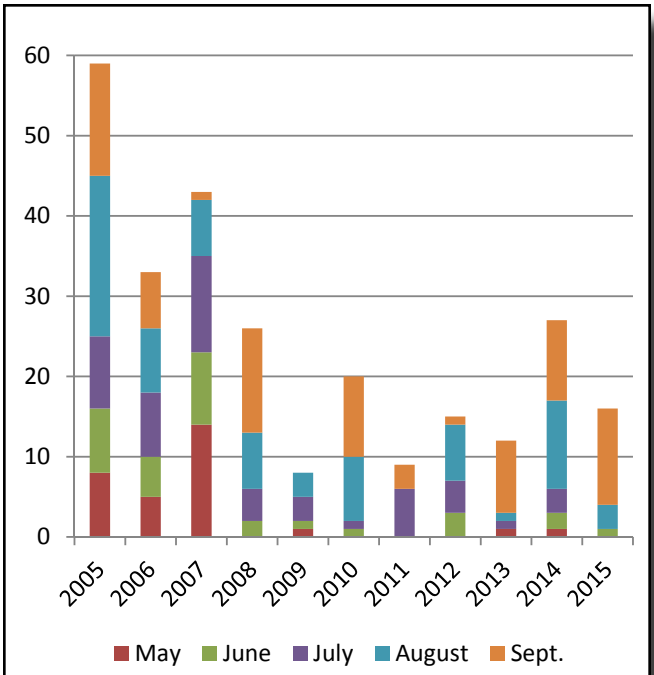
In 2015, the Beach Monitoring program collected and analyzed more than 1,200 samples for E. coli and the microcystin toxin.

Bacteria

Of the bacteria samples taken and analyzed during 2015, 126 samples (10%) exceeded the 235 counts/100ml of water standard. In the figure below, the number of samples that exceeded 235/100 ml criterion for bacteria by month for 2005 through 2015 is shown. This figure also provides the combined totals per month as well as per year. Note that most high levels occur in the spring and early summer months, in times of higher precipitation (and the associated higher run-off). Extremely low amounts of precipitation in 2012 led to a lower than normal number of bacteria readings that exceeded the water standard. Conversely, 2015 saw precipitation considerably higher than normal and as a consequence more E.coli samples exceeded the Health Alert Criterion.



Beach samples exceeding the 235 counts/100 ml E.Coli bacteria criterion.



Beach samples exceeding the 20 ppb Microcystin criterion.

Toxic Algae (Microcystin)

Of the samples collected and analyzed for the microcystin toxin during 2015, 18 samples exceeded the 20 ppb threshold for closing a beach. This accounts for only 1.4% of the total samples collected.

In 2015, five lakes were placed on Health Alert. The map below shows the lakes that had samples exceed the 20 ppb health standard and the number of weeks they were under a Health Alert.

The following table illustrates the number of samples exceeding the 20 ppb microcystin criterion monthly for 2005 through 2015. It also shows the totals for each year as well as for each month through the years. Unlike with bacteria where high levels are more frequently observed in the springtime, blue-green algae (microcystin) impacts are usually observed later in the summer, after lake water has warmed and algae growth is more significant.

In general, algae production is affected by temperature, sunlight, and the nutrients of nitrogen and phosphorus.

Why are there problems at some lakes and not others?

Biological communities such as algae are very complex systems and are affected by many variables. The toxic algae issue gets even more complicated as some species of blue-green algae sometimes produce toxins while other times do not. Research is being conducted worldwide to answer these questions. Additionally, NDEQ is working with numerous collaborators to determine what factors are driving the growth of blue-green algae in Nebraska reservoirs and lakes. Certain conditions seem to consistently have significant affects.

The following conditions are often associated with blue-green algae blooms:

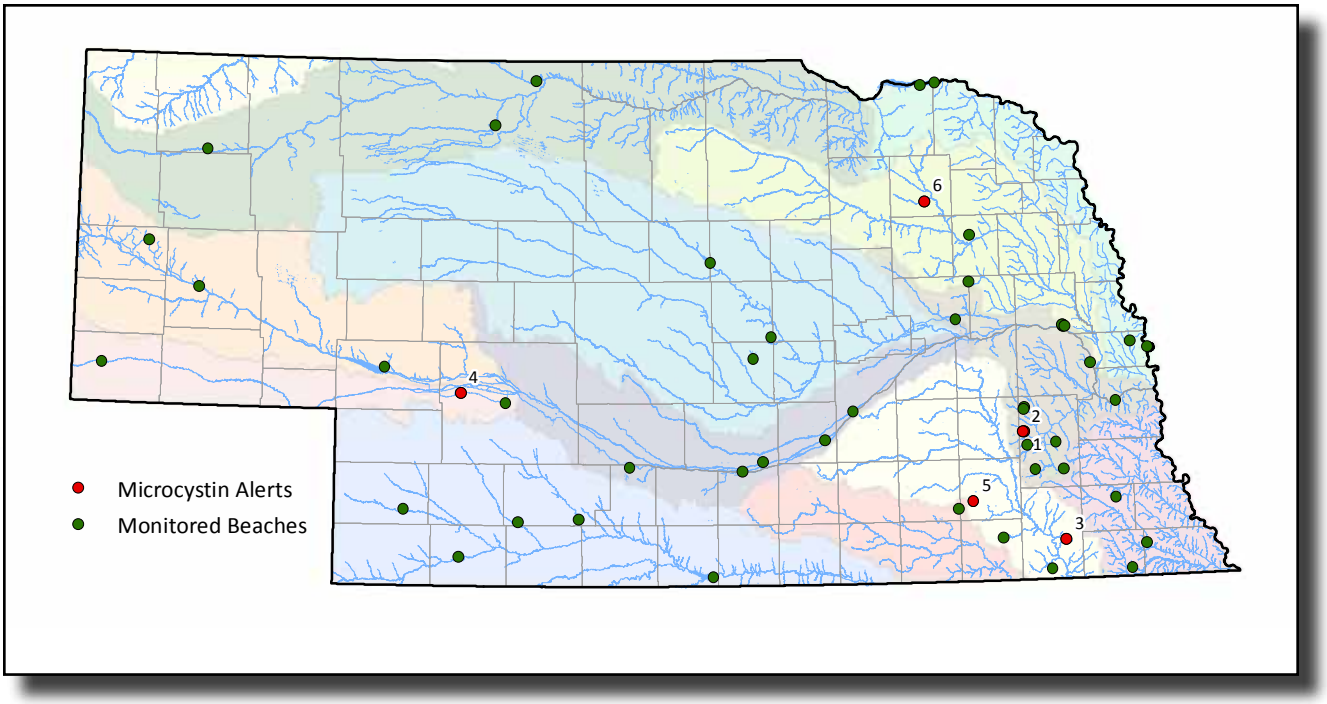
- General weather of each year including the temperature, amount of sunlight and rainfall;
- Low lake water levels. During drought years, problems seem to be more frequent; and
- Increased cloud cover which implies reduced sunlight and lower water temperatures.

Algal bloom in a Nebraska reservoir.

Toxic algae conditions during 2005 were significantly worse when compared to the other years. 2005 was characterized by lower rainfall, higher temperatures and was toward the end of a major drought. In general, lake levels were significantly lower across the State. In contrast, 2015 was characterized by very heavy spring rainfall, relatively full lakes, and relatively lower water temperatures which led to a low number of lakes that experienced toxic algal blooms.

While the issue of toxic algae and its causes is quite complex, it is easier to understand by reducing the problem to simpler terms. In general, algae production is affected by temperature, sunlight, and the nutrients of nitrogen and phosphorus. Higher temperature, sunlight, and nutrients result in greater blue-green algae production and therefore, a greater chance for toxic algae problems.

While temperature and sunlight are beyond our control, we can reduce the amount of nutrients reaching rivers, streams, and lakes. Any management practice that can be incorporated in a watershed that reduces these inputs into waters will reduce algae production and therefore the potential for toxic algae problems.



Map #	Waterbody	County	Samples Exceeding Health Limit	Weeks on Health Warning
1	Pawnee Lake at East Beach	Lancaster	2	4
2	Pawnee Lake at West Beach	Lancaster	2	2
3	Rockford Lake at SW Beach	Gage	2	3
4	Sutherland Lake at Hershey Beach	Lincoln	1	2
5	Swan Creek Lake #5A at South Beach	Saline	3	4
6	Willow Creek Lake at South Beach	Madison	8	9

More Information:

http://deq.ne.gov/NDEQProg.nsf/Beaches2015.xsp
Mike Archer, mike.archer@nebraska.gov or (402) 471-4201.
David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

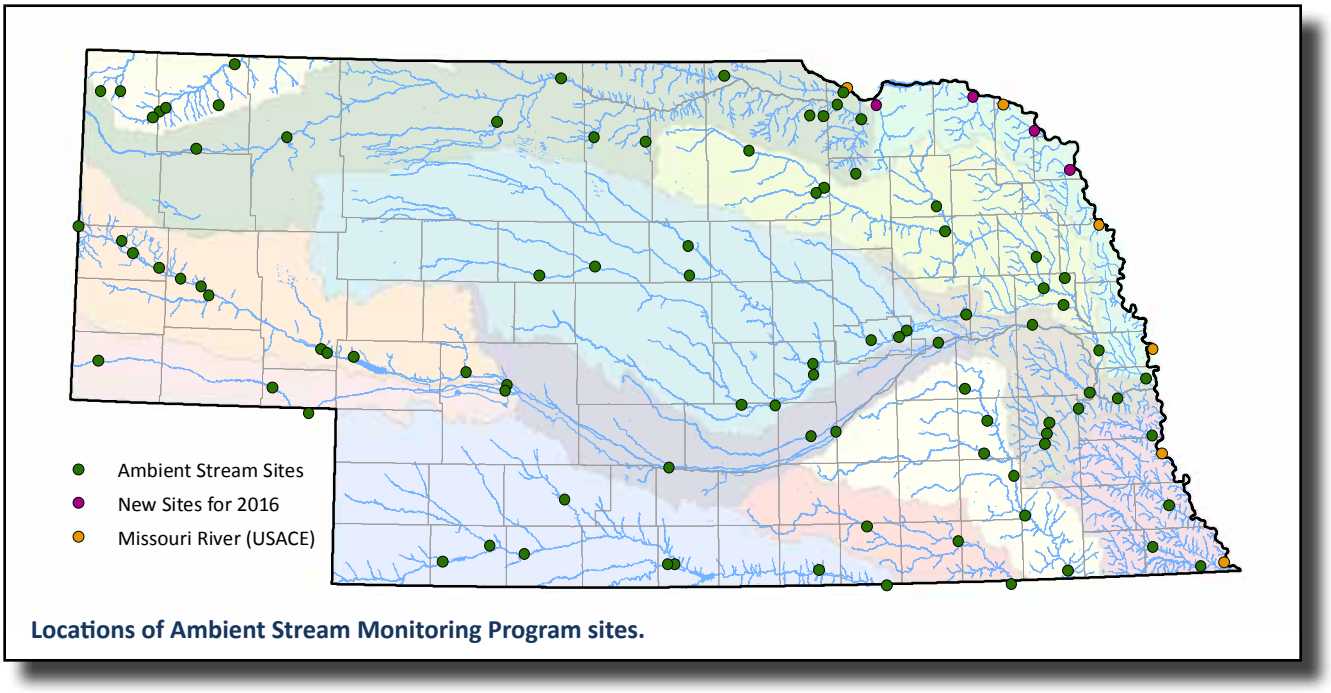
Ambient Stream Monitoring Program

Why Does NDEQ Monitor Streams?

Nebraska's streams and rivers provide essential resources to the residents of our state. These streams supply irrigation and drinking water, support diverse fish and wildlife communities, offer numerous recreational opportunities, and are integral to the state's industry and electricity production. However, many of these streams also serve as conveyances to dispose of agricultural, industrial, and municipal wastewater and runoff. Assuring that Nebraska's streams can safely support these numerous, and at times, conflicting uses is the responsibility of the NDEQ.

Collecting field measurements from the Platte River east of Grand Island, Merrick County.

Regular stream monitoring allows NDEQ to determine if water quality conditions meet state and federal standards to safely support the assigned designated uses. If the monitoring data indicate a water quality problem, NDEQ uses these data to locate potential pollutant sources and develop point and non-point source pollution control plans. Regular monitoring also allows NDEQ to recognize trends in stream water quality that may lead to more efficient and effective pollution controls. Finally, NDEQ uses stream monitoring data to generate a portion of the Water Quality Integrated Report to submit to the United States Environmental Protection Agency, as required by the Federal Clean Water Act. This report is submitted in April of even numbered years and is used by NDEQ as part of the prioritization process for the development of pollution control or watershed management plans.



Locations of Ambient Stream Monitoring Program sites.

Where and When is the Monitoring Done?

The Ambient Stream Monitoring Program (ASMP) consists of 97 fixed monitoring sites designed to collect data from all 13 of Nebraska's major river basins. Samples are collected from each site on the first week of each month, year-round with monitoring assistance provided by the US Army Corps of Engineers (USACE) and South Platte and Middle Niobrara NRDs. Four monitoring stations will be added to this program in 2016. These stations will be located in the Missouri Tributaries basin bringing the number of sites within that basin to five. The map below shows the locations of the 101 monitoring sites scheduled for sampling as part of the new 2016 ASMP network.

Collecting water samples from the Platte River east of Grand Island, Merrick County.

How were the Monitoring Sites Selected?

Nebraska's ASMP was designed to evaluate surface water quality in each of the State's 13 major river basins. To achieve this goal, the 13 major basins were subdivided by geology, land-use, soil type, and topography. Three types of monitoring sites were then established in each basin: indicator sites, stream integrator sites, and basin integrator sites. Indicator sites are located on streams that drain areas of homogenous land-use, soil type, and geology, and provide background water quality information for the predominant ecoregions of each basin. Stream integrator sites are located at key intersections in the drainage network so that the most significant tributaries or contaminant sources in a basin are sampled by at least one of these sites. Basin integrator sites are located at the bottom of each major basin and provide insight into the water quality of the entire river basin.

What is Monitored?

NDEQ monitors numerous water quality parameters to establish general water quality trends and to ensure each stream is able to support its designated uses. The following physical and chemical parameters are collected at each site every month:

- water temperature
- dissolved oxygen
- pH
- conductivity
- total suspended solids
- ammonia
- nitrate/nitrite nitrogen
- kjeldahl nitrogen
- total phosphorus
- chloride

An ASMP site located on the Platte River, east of Grand Island, Merrick County.

Pesticide samples are collected at all sites from May through September. Arsenic and selenium are collected at all sites quarterly, as are a complete suite of metals at each basin integrator site.

Filtering water sample to be analyzed for various heavy metals.

History of the Ambient Stream Monitoring Program

NDEQ has maintained a network of stream monitoring sites since the inception of the agency in 1971. In the early 1970s, 365 sites were monitored on a quarterly basis to gather baseline data on streams where there was limited information. In 1978, the program was reorganized to consist of 90 sites that were monitored monthly. The program was again restructured in 2001 to its current configuration and sampling has been conducted monthly at each of the 97 sites ever since, resulting in approximately 1,164 water quality samples being collected annually. As mentioned previously, additional changes to the ASMP network are scheduled for 2016 when four sites will be added to the network bringing the total number of sites sampled to 101.

Impairments and Sources

The most recent assessment of the Ambient Stream Monitoring Network found that 76 of the 97 monitored stream segments were impaired (some segments had multiple impairments). An impairment means the stream water quality does not meet state requirements for at least one of its designated uses (either recreation, drinking water, irrigation water, or the support of aquatic life).

More information about all surface water impairments is available in the 2014 Water Quality Integrated Report. This report combines the Clean Water Act 303(d) impaired waters list with the 305(b) summary of the health of Nebraska's surface waters. This report is available on NDEQ's website at http://deq.ne.gov or directly at http://deq.ne.gov/publica.nsf/pages/WAT214

Preserving water samples collected at an ASMP site.

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/ASM
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Jeremy Hammen, jeremy.hammen@nebraska.gov or (402) 471-4232.

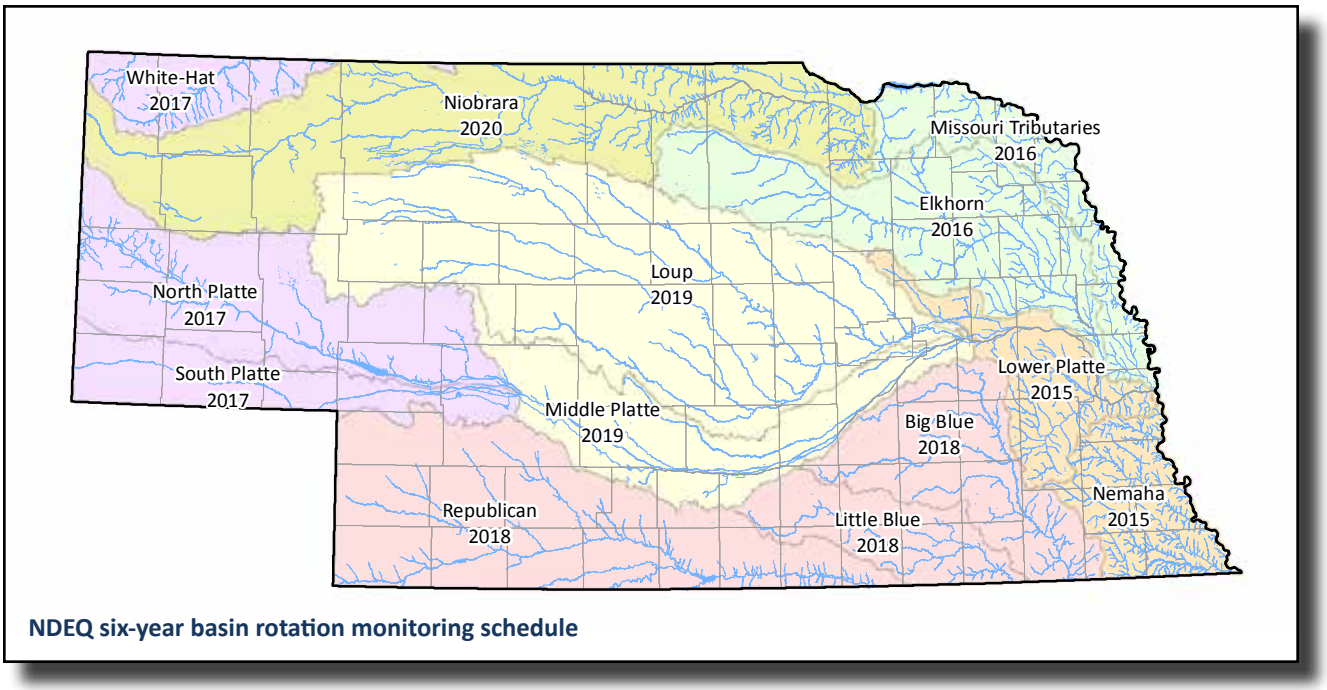
Basin Rotation Monitoring Program

Why Does NDEQ Conduct Basin Rotation Monitoring?

A goal of the federal Clean Water Act is that each state assess the water quality of "all navigable waters of the State". In Nebraska, this means assessing nearly 17,000 miles of perennial streams and rivers, and more than 134,000 acres of lakes and reservoirs. These water quality assessments are used to determine if the sampled waterbodies are safe for recreation and if they can support aquatic life and industrial or agricultural uses. If the data shows that a waterbody cannot support all of its designated uses due to pollution, NDEQ begins a process to determine the source of the pollution and develop a pollution control strategy. This process can be both time consuming and costly, so it is imperative that NDEQ has sufficient data about a waterbody before it makes a determination on the water quality. The Basin Rotation Monitoring Program (BRMP) was developed so that NDEQ can work towards the goal of assessing all waterbodies within the state, while at the same time, insuring sufficient data is collected to determine if a waterbody is impaired by pollution. By focusing sampling efforts in 1-3 river basins each year for intensive monitoring, NDEQ can collect enough water quality samples to perform accurate assessments, while at the same time, collect data from many waterbodies because of the reduced size of the sampling area.

Where and When is the Monitoring Done?

Monitoring is done on a six-year rotation in the 13 major river basins in the state. Monitoring in each basin, during its rotation year, is done on a weekly basis from May 1 through September 30. In 2015, a total of 43 streams and 4 lakes were sampled in the Lower Platte and Nemaha Basins with monitoring assistance provided by the Nemaha NRD. This sampling resulted in 1,034 water quality samples being collected. The map below shows the basins and their rotation schedule.



NDEQ six-year basin rotation monitoring schedule

Collecting a water sample from the North Fork Little Nemaha River, Otoe County.

How are the Monitoring Sites Chosen?

One of the primary objectives for the BRMP is the protection of public health. To meet this objective, NDEQ aims to assess 100% of the stream segments and public lakes that support primary contact recreation (swimming and wading). For this reason, the majority of monitoring sites in this program have been designated for recreation.

What is Monitored?

NDEQ monitors a suite of water quality parameters to establish general water quality trends and to ensure each stream and lake is able to support its designated uses. The following physical and chemical parameters are collected at each stream site: ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus, chloride, total suspended solids and pesticides. Water temperature, pH, conductivity, dissolved oxygen, and *E. coli* bacteria are collected at both stream and lake sites.

Impairments and Sources

According to the most recent 2014 integrated report, *E. coli* is the most common water quality impairment. *E. coli* samples are collected from water bodies used for recreational uses such as swimming and boating. *E. coli* in lake water can cause gastrointestinal problems if swallowed. *E. coli* exists naturally in the environment and can become elevated in lakes and rivers from runoff following a rainfall event. A few sources of *E.coli* include wildlife and livestock feces and failing septic systems. The herbicide atrazine is the second most common impairment detected. Atrazine is a widely used herbicide that is commonly applied in the spring when rain events can cause cropland runoff to enter nearby streams and rivers.

Data from the BRMP are combined with the Ambient Stream and other surface water monitoring programs to make up the data package used for all assessments of the status of Nebraska's waters.

More Information

http://deq.ne.gov/NDEQProg.nsf/OnWeb/ASM
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Dave Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Collecting field measurements from the North Fork Little Nemaha River, Otoe County.

Stream Biological Monitoring Program

Why Biological Monitoring?

Nebraska has over 81,000 miles of streams of which nearly 17,000 miles flow continuously. Streams in Nebraska are capable of containing a rich diversity of aquatic life including aquatic macroinvertebrates (i.e. small animals living in water that can be seen with a naked eye), fish, amphibians, and mammals. Nitrogen, phosphorus, pesticides, sediment, and other pollutants are stressors that can degrade stream conditions for aquatic life, and can be potentially harmful to people. The aim of the Stream Biological Monitoring Program (SBMP) is to provide accurate statewide assessments of the biological conditions of Nebraska's streams so that sound decisions in management, planning, and regulation can be made.

Sampling aquatic macroinvertebrates in Pawnee Creek, Lincoln County.

History of the Stream Biological Monitoring Program

The Department began biological monitoring in 1983 with a targeted approach for classifying stream segments for Title 117 (Nebraska Surface Water Quality Standards). These sites were typically located at stream bridge crossings. Over 900 stream sites were sampled for fish and macroinvertebrates over a 14 year period. In 1997, the Department added a probabilistic monitoring design that involved the sampling of randomly selected sites to its SBMP in order to address statewide and regional questions about water quality. Data to answer such questions as "How good is the water quality in Nebraska?" are best obtained such that all streams have an equal chance of being sampled. These monitoring sites are generated by a computer program that randomly chooses sites on streams throughout Nebraska. From 1997-2013, the biological communities of 580 randomly selected stream sites were sampled.

Where is the Monitoring Conducted?

Each year, 34-40 randomly selected wadeable stream sites (i.e. streams that are shallow enough to sample without boats) are chosen for study in one to three river basins throughout Nebraska. During a six-year cycle, all 13 major river basins in the state are intensively monitored (see previous map).

What is Monitored?

Routine chemical analyses of water samples provide water quality information for a snapshot in time, meaning short-term pollution events may never be detected. Chemical analyses also provide no indication of the stream's physical nature or habitat. The "health" of a stream depends not only on the contaminants present or absent, but the quality of the habitat and the creatures living there. NDEQ's SBMP assesses the health of streams by evaluating the composition and numbers of resident aquatic macroinvertebrate and fish communities. Assessments are made by comparing the macroinvertebrate and fish communities at "reference condition" streams where there are no significant disturbances, to the communities collected from the randomly selected stream sites.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are small creatures that live in streams attached to rocks, vegetation, woody debris, or burrowed into the stream bottom. They include aquatic larval stages of insects such as mayflies and dragonflies; crustaceans such as crayfish and clams; and worms and snails. Because they are extremely sensitive to pollutants, macroinvertebrate populations often respond to changes in water quality caused by the introduction of various contaminants into the stream. Department personnel have collected nearly 600 different species of macroinvertebrates since 1997 through the sampling effort associated with the SBMP. In addition, numerous new species not previously found in Nebraska have been recorded.

Belostoma water bug with eggs from Pawnee Creek, Lincoln County.

Fish

From small coldwater trout streams to large warm rivers, Nebraska streams support about 50 species of fish. As with macroinvertebrates, fish display varying habitat requirements and water quality tolerances making them excellent indicators of stream health. The majority of Nebraska's species are small, with adults generally less than five inches long. The Department's fish surveys have also provided information on changing abundances and ranges of fish in the state. Some species occur in many more places than previously thought, while others have shown dramatic declines over the last 30 years.

Northern Shorthead from North Loup River, Cherry County.

How are the Data Used?

The biological data collected through the SBMP are used to inform a variety of management activities, such as:

- Documenting current statewide biological conditions in Nebraska's streams to track water quality status and trends.
- Identifying streams that do not attain their assigned environmental goals and are in need of restoration or remedial action. Where significant problems were found (i.e. streams were assessed as having poor biological conditions), these stream segments are placed on the 303(d) List of Impaired Water Bodies (as required by the federal Clean Water Act) with regard to aquatic life.
- Identifying exceptional stream segments (reference conditions).
- Providing accurate biological distribution information.

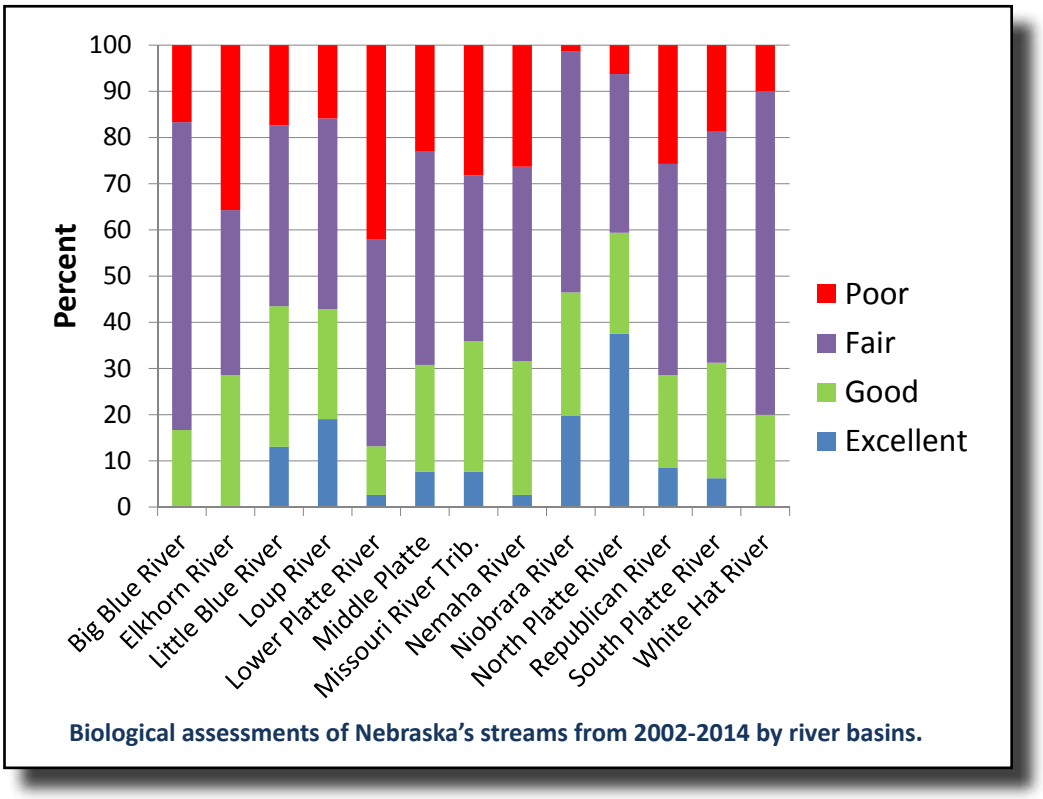
Under the federal Clean Water Act, states are required to develop programs to evaluate the physical, chemical, and biological integrity of the Nation's waters and to adopt water quality standards to restore and maintain that integrity. States are required to prepare a biennial water quality report called the Integrated Report, which provides a comprehensive summary of the status and trends of surface water quality and includes a list of impaired surface waters that do not support their assigned beneficial uses. The information collected by the Department's SBMP satisfies these requirements for assessing the biological integrity of Nebraska's streams.

Identifying fish collected from Pawnee Creek, Lincoln County.

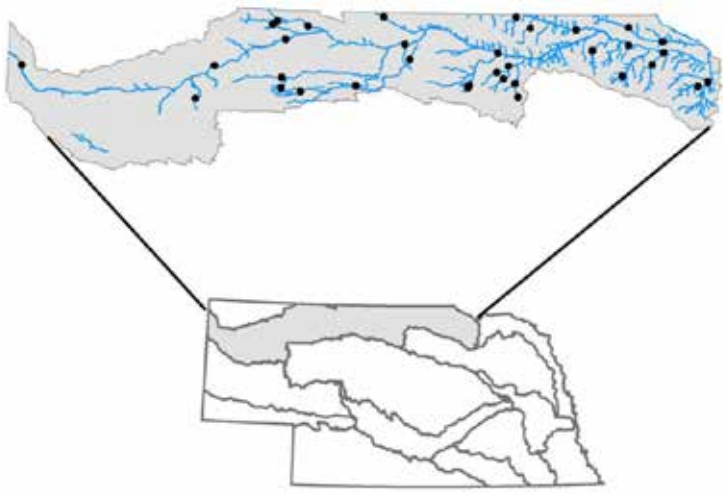
Results

Biological data from 459 random sites were used to characterize the condition of wadeable streams in the 13 major river basins in Nebraska (see bar graph). The results of the survey show the North Platte and Niobrara Basins are in the best condition of the basins evaluated with 59% and 47% of the streams in good condition, respectively. The streams in the Lower Platte Basin present the most concerns with only 14% of the streams in good condition and 42% of the streams in poor condition.

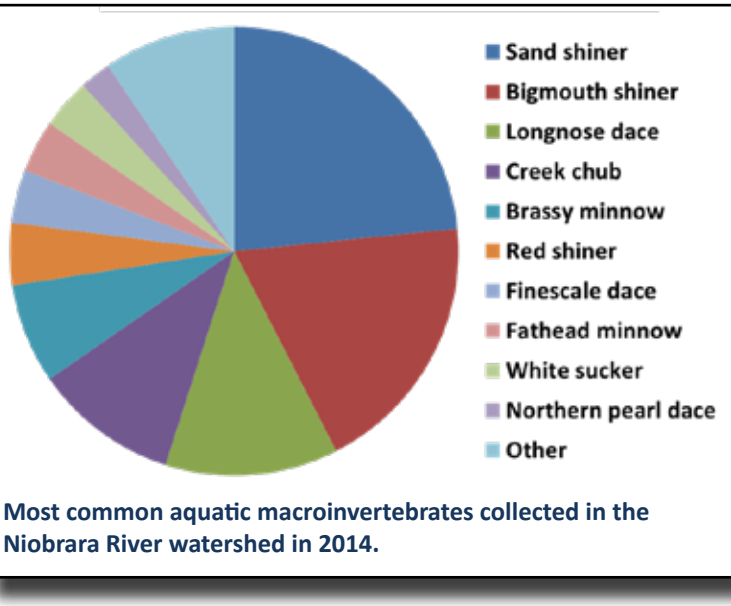
The Wadeable Streams Assessment done in 2004-2005 by EPA reported that increases in nutrients (e.g., nitrogen and phosphorus) and streambed sediments have the highest negative impact on biological condition. These contaminants are commonly introduced into the streams by non-point source pollution from agricultural practices such as crop production and livestock operations and by point source pollution such as discharge from sewage treatment facilities. In order to protect and improve the condition of the streams in Nebraska, it is important that proper management measures are implemented to reduce the impacts of these pollutants. Analyses within Nebraska have shown that the availability of quality habitat may be more important than nutrients for promoting aquatic biodiversity in some cases.



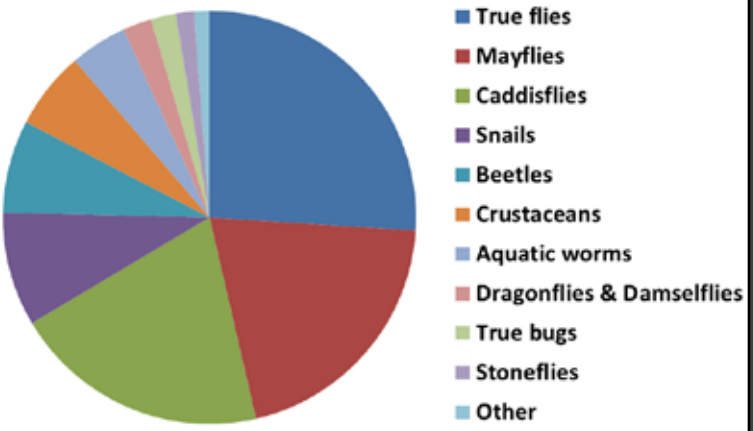
Biological assessments of Nebraska's streams from 2002-2014 by river basins.



2014 sampling locations in the Niobrara basin.



Most common aquatic macroinvertebrates collected in the Niobrara River watershed in 2014.



Most common fish species collected in the Niobrara River watershed in 2014.

2014 Update

We sampled 34 wadeable streams within the Niobrara watershed in 2014 for the SBMP (see map). The most common species of fish and macroinvertebrates are presented in the accompanying figures. We collected 38 species of fish from the rivers as well as one northern pearl dace hybrid. The most common fish collected by abundance were the sand shiner, bigmouth shiner, longnose dace, and creek chub. Although less abundant within streams, fathead minnow and white sucker were also collected in most of the streams. Dace species tend to be sensitive to pollution, and thus the high numbers of dace species collected are an excellent sign that the streams are healthy.

Macroinvertebrates are difficult to identify to species, and thus it is common to have a mixture of identifications at the levels of species, genus, and family, which are collectively referred to as taxa. NDEQ collected 272 unique taxa of macroinvertebrates from the Niobrara watershed. The most common groups of macroinvertebrates collected were true flies, mayflies, caddisflies, and snails. As with dace, mayflies, caddisflies, and stoneflies are more sensitive to pollution than other groups, and the high numbers of these macroinvertebrates are another sign of high quality stream ecosystems.

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/SBMP

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Ambient Lake Monitoring Program

Why Monitor Lakes and Reservoirs?

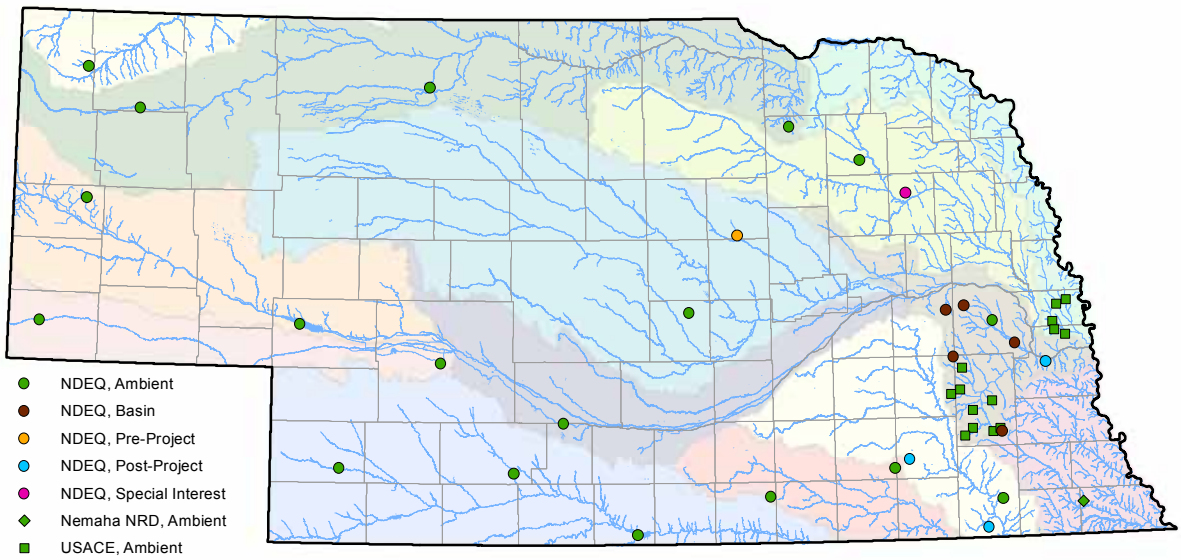
Nebraska's natural lakes and man-made reservoirs have different public usage throughout the year. NDEQ monitors these resources to determine if water quality is sufficient for recreational activities such as swimming and water skiing, and suitable for fish and other aquatic organisms to survive and reproduce.

Sample set collected from Merritt Reservoir, Cherry County.

Monitoring involves the collection of monthly water samples from May through September from publicly owned lakes and reservoirs across the state. In some cases, the streams that flow into reservoirs are also monitored. Since reservoirs are a reflection of their watersheds, data on streams that flow into reservoirs can provide useful information in evaluating water quality problems. In 2015, 45 lakes were sampled for physical/chemical parameters by NDEQ and its lake monitoring partners which currently include the US Army Corp of Engineers and Nemaha NRD.

What is monitored?

To determine if water quality is sufficient to meet its intended uses in these lakes, samples are taken monthly near the surface at the deep-water site (deepest area) of each lake. These sites are sampled for physical/chemical parameters such as water clarity, total suspended solids, ammonia, nitrate-nitrite nitrogen, kjeldahl nitrogen, total and dissolved phosphorus, alkalinity, chlorophyll a,



Lake sampling locations for 2015 (does not include fish tissue sites).

and select pesticides. In addition, surface to bottom profiles are collected for temperature, dissolved oxygen (DO), pH, and conductivity at both deep-water and mid-lake locations. Profile data is collected every 0.5 meters starting at the water surface and are used to determine at what depth lake stratification may take place.

Determining water clarity at Merritt Reservoir, Cherry County.

How are the Data Used?

Collected data are compared to a Water Quality Standard or a benchmark that will indicate if there is a concern. For most parameters, a minimum number of violations or excursions will be allowed before the waterbody is considered to be impaired or not to have sufficient quality. If a waterbody is considered to be impaired, it will be placed on Nebraska's Section 303(d) List of Impaired Waters. Once on this list, more information is collected to develop water quality targets and pollutant reduction goals. These targets and reductions are incorporated into a document called a Total Maximum Daily Load (TMDL). The TMDL then provides the basis for water quality improvement projects sponsored by various resource management and funding agencies such as Natural Resources Districts, Nebraska Game and Parks Commission, USDA-Natural Resources Conservation Service and municipalities to name a few. While the Section 303(d) list is revised every two years, assessments on each lake or reservoir are conducted on an annual basis. Results of the assessments are presented in the Water Quality Integrated Report that is prepared by NDEQ on even numbered years. The 2014 report is available on-line at: http://deq.ne.gov/publica.nsf/pages/WAT214

Measuring field parameters at Enders Reservoir, Chase County.

Statewide Concerns

Nutrients and algae related issues are the most common lake impairments. Excessive algae growth can increase the pH of the water which can make some parameters, like ammonia, more toxic to aquatic organisms. Excessive nutrients can also lead to blooms of blue green algae and high concentrations of microcystin, which is a toxin produced by this algae.

The accumulation of contaminants in the tissue of fish is a growing concern across the country. Approximately 57 percent of the ambient lakes monitored from 2008 - 2014 had unacceptable concentrations of contaminants in fish tissue (see "Fish Tissue Monitoring" section of this report). In most cases, the impairments were due to mercury which is believed to be entering lakes through atmospheric deposition.

Filtering water for a chlorophyll sample at Homestead Lake, Saunders County.

Filter disc ready for chlorophyll analyses.

Lake Improvement Programs

When water quality programs were first initiated at NDEQ, most efforts were aimed at reducing the impacts of point source discharges. From the early 1970s through the present, lake and reservoir management has evolved to include nonpoint sources. Several programs administered by NDEQ, as well as other local, state, and federal programs, work to protect impounded waters. Some of the programs administered by NDEQ that are protective of the quality of impounded waters include Livestock Waste, Wastewater, Storm Water, and Nonpoint Source.

Numerous agencies, including local, state, and federal, are involved in different aspects of lake and reservoir management whether it be the collection and/or assessment of data, water quality planning, or implementing projects to address water quality problems. The coordination of efforts among these entities has allowed for a more comprehensive and cost effective approach to lake and reservoir management.

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Merritt Reservoir, Cherry County

Fish Tissue Monitoring Program

Why NDEQ Does this Monitoring

Each year fish samples are collected from numerous streams and lakes across Nebraska to determine their suitability for human consumption. This is important because certain contaminants have a tendency to bio-concentrate in fish tissue and, when eaten, can cause an increased risk for human health problems. In waterbodies where contaminant levels in fish are of concern, "fish consumption advisories" are issued. These advisories do not ban the consumption of fish from a particular waterbody. Rather, advisories are designed to inform the public of how to safely prepare and eat what they catch, and provide suggested guidelines for limiting consumption. As a food source, fish are a high quality protein, low saturated fat, and high omega-3 fatty acid food source, so anglers should not be discouraged from consuming fish in moderation.

History of Fish Tissue Program

Fish tissue sampling in Nebraska was initiated in the late 1970s, primarily to identify potential pollution concerns throughout the State. Monitoring efforts were focused on whole fish samples collected on large rivers near the bottom of their drainage areas. In the late 1980s, more emphasis was placed on evaluating human health concerns and the Department began analyzing the fillet portions from fish that are most-often consumed. These efforts have continued to the present day.

Where is the Monitoring Conducted?

Monitoring is generally conducted at locations where most fishing occurs; therefore, where the potential risk to human health is greatest. Fish species targeted for collection included those that are most frequently sought by fisherman, including: catfish, largemouth bass, walleye, crappie, and carp. From July 1 to September 30 each year, the Department collects fish samples from approximately 40-50 pre-selected streams and publicly owned lakes in one to three of Nebraska's 13 major river basins (see map and table on the following pages for historic sampling locations and information). Fish tissue sampling activities are rotated through all 13 basins on a six-year cycle. In 2015, a total of 121 fish tissue samples were collected from 11 streams and 51 lakes in the Lower Platte and Nemaha River Basins for analysis of contaminants.

Collecting fish sample utilizing electrofishing,

What is Monitored?

Fish tissue samples prior to 2014 were analyzed for a variety of parameters including heavy metals, pesticides, and other organic compounds. Of the parameters screened, those of primary concern are:

- *polychlorinated biphenyl compounds* (PCBs) – prior to 1971, they were used in heat transfer fluids, hydraulic fluids, lubricants, and wax extenders, and later in electrical transformers and capacitors.
- *methyl mercury* (organic mercury) – occurs naturally and is released into the environment from mining operations, fossil fuel combustion, refuse incineration, and industrial waste discharges.
- *dieldrin* – a breakdown product of the insecticide Aldrin, generally used on corn prior to 1974.

Fish tissue sample preparation.

Future monitoring by the U.S. Environmental Protection Agency (U.S. EPA) Region 7 laboratory will only be for one contaminant, mercury. Like other States across the nation, mercury is responsible for the majority of our fish consumption advisories (>95%). Locations where other contaminants are of concern will be given special consideration for additional contaminant analysis.

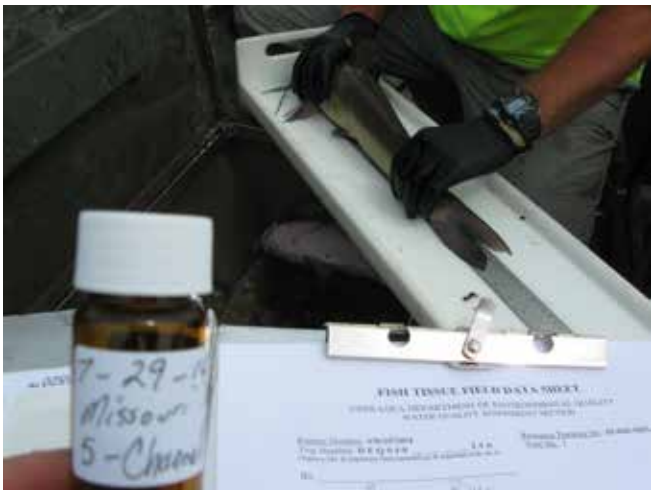
How are the Data Used?

Fish tissue data collected are used to assess human health risks utilizing a risk-based assessment procedure. For non-cancer (noncarcinogenic) effects, the assessment procedure results in a *Hazard Quotient* (HQ) value for each contaminant and takes into account an average adult body weight, ingestion rate, exposure frequency and duration, and percent absorption of contaminants. If more than one contaminant is present in the fish tissue, then the HQs are summed to derive a Hazard Index (HI). If the HI is less than 1.0, then adverse noncarcinogenic effects are not anticipated. If the HI equals or exceeds 1.0 then an advisory is issued.

For a contaminant that may also be associated with a cancer risk, the risk-based assessment procedure results in a *Cancer Risk* (CR) estimate that represents the probability of an individual developing cancer during their lifetime as a result of exposure to the potential carcinogen. If more than one potential carcinogen is present in fish tissue then the risk estimates are summed. Advisories are issued if the estimated CR equals or exceeds 0.0001 (1 in 10,000).

While mercury (methylmercury) is a contaminant accounted for in the HI, Nebraska also utilizes a fish tissue residue criterion (TRC) in place of a water column criterion for the protection of human health. Nebraska's TRC represents the mercury (0.215 mg/kg) concentration in fish tissue that should not be exceeded on the basis of a consumption rate of eight ounces (0.227 kg) per week. Advisories are issued if the mercury concentration in fish tissue equals or exceeds the TRC of 0.215 mg/kg. Exposure to high levels of mercury have been shown to adversely affect the developing nervous system, so women of child-bearing age, pregnant women, and children less than 15 years of age are the most sensitive to the effects of mercury.

Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with the NDEQ, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where high concentrations of contaminants may indicate a health risk for consumers. Waterbodies where sampling has revealed exceedances of health risk criteria and subsequent consumption advisories have been issued will be re-sampled following the six-year rotating basin monitoring approach. Re-sampled sites will be removed from the advisory list if their respective samples indicate contaminant levels below health risk criteria.

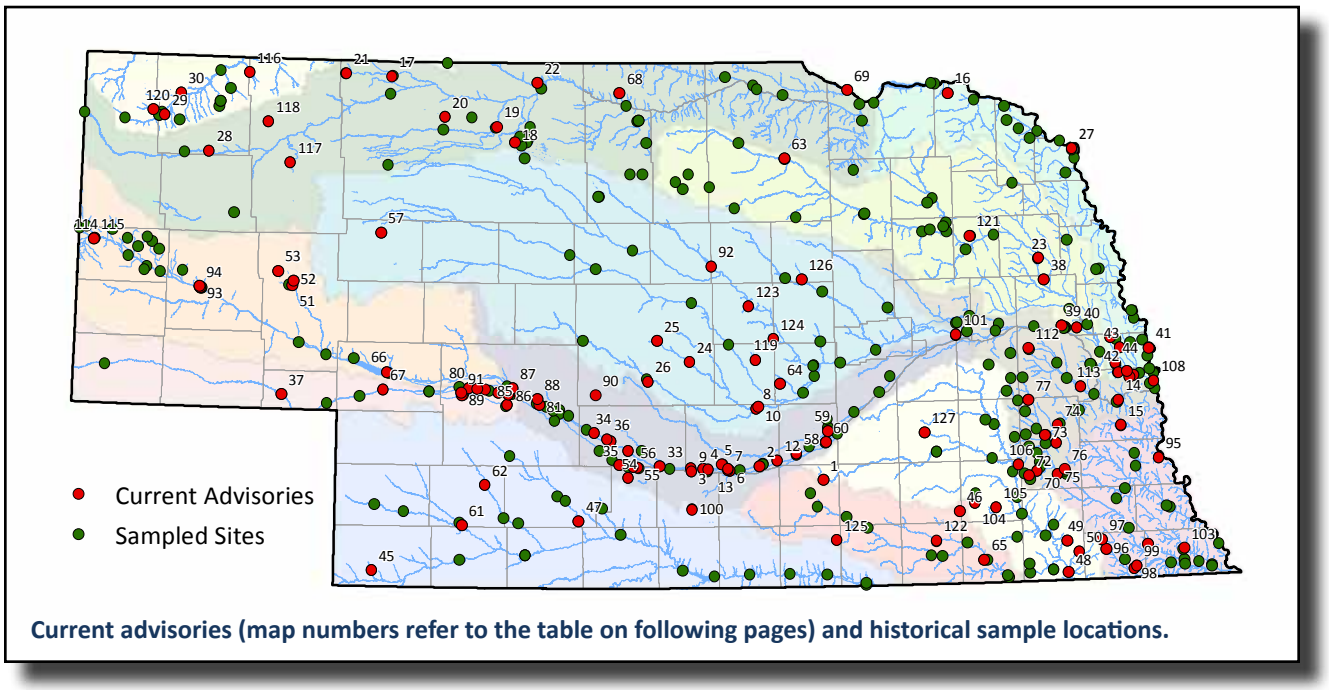


Fish tissue sample preparation.

Fish tissue data are also utilized to assess impairment of Nebraska's waterbodies. Where fish consumption advisories exist, the NDEQ places those waters on the State's Section 303(d) List of Impaired Waterbodies with regard to aquatic life. Nebraska does not have an assigned beneficial use of "fish consumption" in Title 117 Surface Water Quality Standards, therefore the assumption is made that if contaminant loads to fish can affect human health, it is probable that these contaminants can impact aquatic life health.

Current Advisories

As of July 2015, the NDHHS, in cooperation with the NDEQ, the NGPC, and the NDA, has issued fish consumption advisories for 127 waterbodies, which includes 14 designated stream segments and 113 lakes/reservoirs. These advisories are not bans on eating fish, rather a warning to limit the consumption of specified fish. The map below and following table display advisory locations and information.



Current advisories (map numbers refer to the table on following pages) and historical sample locations.

Nebraska Fish Consumption Advisories Through 2014

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
1	Lake Hastings	Adams	Carp	PCBs
2	Bassway Strip Lake No. 5	Buffalo	Largemouth Bass	Mercury
3	Blue Hole Lake - WMA	Buffalo	Largemouth Bass	Mercury
4	Coot Shallows Lake - WMA	Buffalo	Largemouth Bass	Mercury
5	Cottonmill Lake	Buffalo	Largemouth Bass	Mercury
6	Kea Lake	Buffalo	Largemouth Bass	Mercury
7	Kea West Lake - WMA	Buffalo	Largemouth Bass	Mercury
8	Ravenna Lake	Buffalo	Largemouth Bass	Mercury
9	Sandy Channel Lake - SRA	Buffalo	Largemouth Bass	Mercury
10	South Loup River	Buffalo	Channel Catfish	Mercury
11	Union Pacific Lake - SRA	Buffalo	Largemouth Bass	Mercury
12	Wax Axe Lake -SRA	Buffalo	Smallmouth Bass	Mercury
13	Yanney Park Lake	Bufflalo	Largemouth Bass	Mercury
14	Platte River	Cass	Channel Cat	PCBs, Mercury
15	Weeping Water City Lake	Cass	Largemouth Bass	Mercury, Selenium
16	Chalkrock Reservoir	Cedar	Largemouth Bass	Mercury, Selenium
17	Cottonwood Lake	Cherry	Largemouth Bass	Mercury
18	Duck Lake	Cherry	Largemouth Bass	Mercury
19	Merritt Reservoir	Cherry	Walleye / Largemouth Bass	Mercury
20	Schoolhouse Lake	Cherry	Northern Pike / Largemouth Bass / Black Crappie	Mercury
21	Shell Lake	Cherry	Largemouth Bass	Mercury
22	Valentine Mill Pond	Cherry	Largemouth Bass / Bluegill	Mercury
23	West Point City Lake	Cuming	Largemouth Bass	Mercury
24	Ansley City Lake	Custer	Largemouth Bass	Mercury
25	Melham Park Lake	Custer	Largemouth Bass	Mercury
26	Pressey Pond -WMA	Custer	Largemouth Bass	Mercury
27	Crystal Cove Lake	Dakota	Largemouth Bass	Mercury
28	Box Butte Reservoir	Dawes	Northern Pike / Largemouth Bass	Mercury
29	Grabel Pond No. 5	Dawes	Largemouth Bass	Mercury, Selenium
30	Whitney Reservoir	Dawes	White Bass	Mercury
31	Cozad Lake - WMA	Dawson	Largemouth Bass	Mercury
32	Darr Lake -WMA	Dawson	Largemouth Bass	Mercury
33	Dogwood Lake -WMA	Dawson	Largemouth Bass	Mercury
34	East Gothenburg Lake - WMA	Dawson	Largemouth Bass	Mercury
35	Plum Creek Canyon Reservoir	Dawson	Carp	PCBs
36	West Cozad Lake - WMA	Dawson	Largemouth Bass	Mercury
37	Chappell Interstate Lake	Deuel	Largemouth Bass	Mercury, Selenium
38	Dead Timber Lake	Dodge	Largemouth Bass	Mercury
39	Fremont Lake No. 1	Dodge	Largemouth Bass	Mercury
40	Johnson Lake	Dodge	Largemouth Bass	Mercury
41	Carter Lake	Douglas	Largemouth Bass	PCBs
42	Prairie View Lake	Douglas	Largemouth Bass	Mercury

43	Standing Bear Lake	Douglas	Largemouth Bass	Mercury
44	Zorinsky Lake	Douglas	Largemouth Bass	Mercury
45	Rock Creek Lake	Dundy	Largemouth Bass	Mercury
46	Lone Star Reservoir	Fillmore	Largemouth Bass	Mercury
47	Medicine Creek Reservoir	Frontier	Largemouth Bass	Mercury
48	Big Blue River	Gage	Carp	PCBs, Dieldrin
49	Rockford Lake	Gage	Largemouth Bass	Mercury
50	Wolf-Wildcat Lake	Gage	Largemouth Bass	Mercury
51	Crescent Lake	Garden	Largemouth Bass	Mercury
52	Island Lake	Garden	Largemouth Bass	Mercury
53	Smith Lake	Garden	Largemouth Bass	Mercury
54	Elwood Reservoir	Gosper	Northern Pike / Largemouth Bass	Mercury
55	Phillips Lake	Gosper	Carp	Mercury
56	Tri-County Supply Canal -below J1 Hydro	Gosper	Carp	PCBs
57	Frey Lake - WMA	Grant	Largemouth Bass	Mercury
58	Cheyenne Lake - SRA	Hall	Largemouth Bass	Mercury
59	L.E. Ray Lake	Hall	Largemouth Bass	Mercury
60	Mormon Island Middle Lake - SRA	Hall	Largemouth Bass	Mercury
61	Frenchman WMA Lake	Hayes	Largemouth Bass	Mercury
62	Hayes Center WMA Lake	Hayes	Largemouth Bass	Mercury
63	O'Neill City Lake	Holt	Largemouth Bass	Mercury
64	Farwell South Reservoir	Howard	Largemouth Bass / Carp	Mercury
65	Crystal Springs NW Lake	Jefferson	Channel Catfish	PCBs, Mercury
66	Lake McConaughy	Keith	Walleye	Mercury, Selenium
67	Ogallala City Park Lake	Keith	Channel Catfish	PCBs, Chlordane
68	Cub Creek Lake	Keya Paha	Largemouth Bass	Mercury
69	Missouri River	Knox	Flathead Catfish	Mercury
70	Bluestem Lake	Lancaster	Channel Cat	Mercury
71	Holmes Lake	Lancaster	Largemouth Bass	Mercury
72	Merganser Lake	Lancaster	Largemouth Bass	Mercury
73	Oak Creek	Lancaster	Channel Cat	PCBs, Mercury
74	Salt Creek	Lancaster	Carp	PCBs, Mercury
75	Stagecoach Lake	Lancaster	Largemouth Bass	Mercury
76	Wagon Train Lake	Lancaster	Largemouth Bass	Mercury
77	Wildwood Reservoir	Lancaster	Largemouth Bass	Mercury
78	Birdwood Lake	Lincoln	Largemouth Bass	Mercury
79	East Hershey Lake	Lincoln	Largemouth Bass	Mercury
80	East Sutherland Lake	Lincoln	Largemouth Bass	Mercury
81	Fort McPherson Lake	Lincoln	Largemouth Bass	Mercury
82	Fremont Slough - WMA	Lincoln	Largemouth Bass	Mercury
83	Hershey Lake	Lincoln	Largemouth Bass	Mercury
84	Interstate Lake	Lincoln	Largemouth Bass	Mercury
85	Maloney Res. Outlet Canal - above hydro	Lincoln	Carp	PCBs, Mercury
86	Maloney Res. Outlet Canal - below hydro	Lincoln	Channel Cat / Smallmouth Bass	PCBs / Mercury
87	North Platte River	Lincoln	Largemouth Bass	Mercury
88	Pawnee Slough Lake	Lincoln	Largemouth Bass	Mercury

89	Sutherland Cooling Pond	Lincoln	Carp / Largemouth Bass	Mercury, Selenium / Mercury
90	Sutherland Outlet Canal	Lincoln	Channel Catfish	PCBs, Mercury
91	Sutherland Reservoir	Lincoln	Carp	PCBs, Mercury
92	Calamus Reservoir	Loup	Carp	Mercury
93	Bridgeport Middle Lake	Morrill	Largemouth Bass	Mercury
94	North Platte River	Morrill	Carp	Mercury, Selenium
95	Steinart Park Lake	Otoe	Largemouth Bass	Mercury
96	Burchard Lake	Pawnee	Largemouth Bass	Mercury
97	Mayberry Lake - WMA	Pawnee	Largemouth Bass	Mercury
98	Iron Horse Trail Lake	Pawnee	Largemouth Bass	Mercury
99	Prairie Knoll Lake	Pawnee	Largemouth Bass	Mercury
100	Holdredge Park Lake	Phelps	Largemouth Bass	Mercury, Selenium
101	Columbus City Park Pond	Platte	Largemouth Bass	Mercury
102	Kirkman's Cove Lake	Richardson	Carp, Largemouth Bass	Mercury
103	Verdon Lake	Richardson	Largemouth Bass	Mercury
104	Swan Creek 5A	Saline	Largemouth Bass	Mercury
105	Swanton Lake - Swan Lake No. 67	Saline	Largemouth Bass	Mercury
106	Walnut Creek Lake No. 2	Saline	Largemouth Bass	Mercury
107	Halleck Park Lake	Sarpy	Largemouth Bass	Mercury, Selenium
108	Offutt Lake	Sarpy	Channel Cat	PCBs
109	Walnut Creek Lake	Sarpy	Largemouth Bass	Mercury
110	Wehrspann Lake	Sarpy	Largemouth Bass	Mercury
111	West Papillion Creek	Sarpy	Carp	PCBs, Mercury
112	Czechland Lake	Saunders	Largemouth Bass	Mercury
113	Memphis Lake	Saunders	Largemouth Bass	Mercury
114	Morrill Sandpit - North	Scottsbluff	Largemouth Bass	Mercury, Selenium
115	Morrill Sandpit - Southwest	Scottsbluff	Largemouth Bass	Mercury
116	Isham Dam Lake	Sheridan	Largemouth Bass	Mercury
117	Smith Lake	Sheridan	Largemouth Bass	Mercury
118	Walgren Lake	Sheridan	Largemouth Bass	Mercury
119	Sherman Reservoir	Sherman	White Bass	Mercury
120	Carter P. Johnson Lake	Sioux	Largemouth Bass	Mercury
121	Maskenthine Lake	Stanton	Largemouth Bass	Mercury
122	Big Sandy Creek	Thayer	Channel Catfish	Mercury
123	Auble Pond	Valley	Largemouth Bass	Mercury
124	Davis Creek Lake	Valley	Carp / White Bass	Mercury
125	Liberty Cove	Webster	Largemouth Bass	Mercury
126	Pibel Lake	Wheeler	Largemouth Bass	Mercury
127	Recharge Lake	York	Largemouth Bass	Mercury

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/FTMP
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Monitoring for Fish Kills and Surface Water Complaints

Why do we sample after fish kills and complaints?

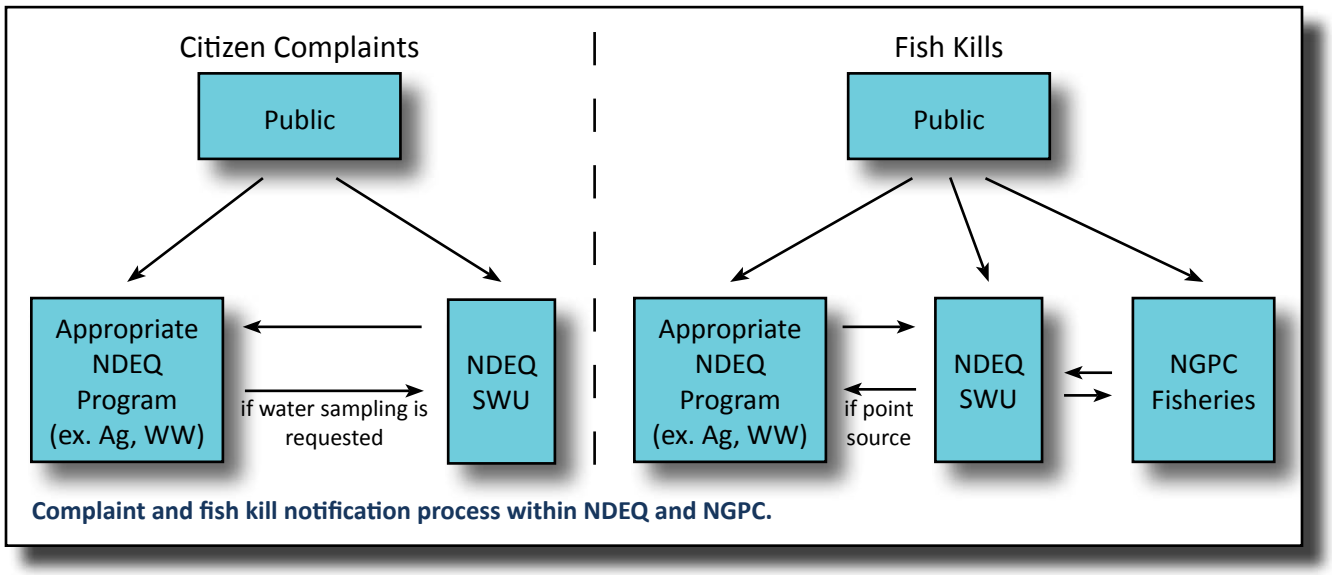
The agency responds to numerous fish kills and surface water complaints annually. In many cases, the investigations surrounding a fish kill may require sampling to document the cause of the water quality problem, the magnitude and extent of the water quality problem, the source of pollution and/or a responsible party. Because a fish kill could result in legal action, sampling requires a relatively high level of data quality.

How does the notification process work?

If a call comes in from the public regarding a surface water complaint to NDEQ's Surface Water Unit (SWU) the SWU notifies NDEQ personnel within the program most closely related to the problem (ex. Agriculture, Waste Water). That program may then ask for SWU assistance in the investigation if water samples are requested.

Pawnee Creek impacted by livestock waste run-off, Adams County.

Nebraska Game and Parks Commission (NGPC) fisheries personnel become involved upon notification of a fish kill. If NGPC personnel receive a call of a fish kill from the public they will notify the SWU who will in turn notify the appropriate NDEQ program unless the cause is natural and not the result of pollution. Natural fish kills can be the result of such stresses as spawning, disease, and oxygen depletion due to snow and ice cover on surface waters. If the SWU receives the call from the public, SWU staff will notify the NGPC of all fish kills and the appropriate NDEQ program if the kill is related to a pollution event. Within the NDEQ, the SWU is always notified of a fish kill regardless of cause or water body affected.



Complaint and fish kill notification process within NDEQ and NGPC.

Confluence of Pawnee Creek (right) and the Little Blue River (left), with Pawnee Creek being impacted by livestock waste run-off, Clay County.

What types of data are collected?

The cause of fish kills is determined from information collected from the reporting party and/or follow-up investigation and sampling. The types of data collected are determined on a case-by-case basis. Initially, the types of data to be collected is based on information provided by the person who reports the problem. A final determination of data needed is made by the investigator once an initial site evaluation has been made. In many cases, field measurements of pH, temperature, conductivity, and dissolved oxygen are used as screening parameters to determine if a problem exists, but further sampling and investigation may be needed to determine the cause of the fish kill.

Fish Kills Reported

From July 1, 2014 through June 30, 2015 a total of nine fish kills were reported to NDEQ. Four of the reported fish kills were attributed to low dissolved oxygen levels within the waterbody, whereas three were the result of disease and two were the result of an undetermined pollutant.

Fish kills in the summer are typically caused by low dissolved oxygen concentrations stemming from "eutrophic" conditions. Eutrophication is a term that describes water quality conditions as a lake or reservoir ages. Lakes or reservoirs that are eutrophic tend to be shallow with high nutrient concentrations and exhibit frequent algae blooms, warmer water temperatures, and lower dissolved oxygen concentrations. Winter fish kills are often caused by low dissolved oxygen concentrations which are the result of prolonged ice and snow cover on lakes and ponds. When lakes are frozen over and have significant snow cover, the amount of oxygen slowly decreases due to decreased photosynthetic activity, low light, and no exposure to atmospheric oxygen.

Citizen Complaints

Between July 1, 2014 and June 30, 2015 the SWU received 46 notifications of concern regarding surface water issues. While many of these cases were referred to other agency programs that more closely relate to the problem, the SWU provided assistance through investigations and/or sample collection to help document conditions.

Junk dumped from a bridge in Bell Creek, Dodge County.

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Surface Water Sampling Summary

As discussed in the previous short reports, the NDEQ performs surface water monitoring throughout the state. This section summarizes the number of samples and parameters analyzed for each monitoring program in 2015. Several of the State's 23 Natural Resources Districts (NRDs) (among other partners) provide monitoring support; the NRD abbreviations and headquarter cities are listed at the end of this section.

Ambient Stream Monitoring Program

Collecting water samples from the Little Blue River.

Network: 97 sites statewide.

Frequency: monthly (first full week), 12 months per year.

Parameters:

- **Traditional:** total suspended solids (TSS), chloride, ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus.
- **Field Measurements:** water temperature, dissolved oxygen (DO), pH, conductivity, turbidity, stream discharge.
- **Pesticides:** monthly, May – September; atrazine, acetochlor, metolachlor.
- **Quarterly Metals:** 4 times per year (January, April, July, October).
- **Bottom of Basin Sites:** all metals, 17 sites (11 NDEQ + 6 USACE). Total – selenium, mercury and; Dissolved – sodium, magnesium, calcium, arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc.
- **All other Sites:** "partial metals list", Total – selenium; Dissolved - sodium, magnesium, calcium, arsenic.

Collecting water samples from the Little Blue River.

Sample Totals by Parameter:

- **Traditional & Field:** = 1164
- **Pesticides:** = 582
- **Metals (all metals):** = 68
- **Metals (partial metals list):** = 320

Assistance: MNNRD, SPNRD, US Army Corps of Engineers (USACE).

Basin Rotation Monitoring Program

As explained in a previous section (Basin Rotation Monitoring), the state is covered by more intensive sampling on a six year rotating schedule, shown below.

Year	River Basin(s)
2015	Lower Platte and Nemaha
2016	Elkhorn and Missouri Tributaries
2017	North Platte, South Platte and White-Hat
2018	Big Blue, Little Blue and Republican
2019	Loup and Middle Platte
2020	Niobrara

Network: 44 stream sites (including 12 shared Ambient Stream sites) and 4 lake sites in the Lower Platte and Nemaha River Basins.

Frequency: weekly, May 1 - September 30 (22 weeks).

Parameters:

- **Traditional (streams):** TSS, chloride, ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus.
- **Field Measurements (streams and lakes):** water temperature, DO, pH, conductivity, turbidity, stream discharge.
- **Pesticides (streams):** weekly, May – June; atrazine, metolachlor, acetochlor.
- **Bacteria (streams and lakes):** *E. coli.*

Sample Totals - All Parameters: = 1,034

Assistance: NNRD.

Collecting water samples from Plum Creek, Brown County.

Blue-green algae bloom at Merritt Reservoir, Cherry County.

Public Beach Monitoring Program

Network: 53 sites statewide from 50 lakes

Frequency: weekly, May 1 - September 30 (22 weeks)

Parameters: bacteria, toxic algae (microcystin)

Bacteria & Toxic Algae

Routine Samples**:** = 1,166

Additional Toxic Algae Samples

Fish Kill/Complaint Samples: = 5

Assistance: MNNRD, NNRD, URNRD, LRNRD, LLNRD, LENRD, SPNRD, Nebraska Public Power District (NPPD), Central District Health Department (CDHD), USACE.

Ambient Lake Monitoring Program

Network: Deep Water Sites (45 lakes).

NDEQ:	28 lakes	= 140
USACE:	15 lakes	= 75
NNRD:	2 lakes	= 10
Total Deep-Water Samples:		= **225**

Frequency: Monthly from May through September.

Filtering water for a chlorophyll sample at Merritt Reservoir, Cherry County.

Parameters:

- **Traditional:** TSS, total phosphorus, dissolved orthophosphorus, ammonia, nitrate/nitrite nitrogen, kjeldahl nitrogen, alkalinity, water clarity.
- **Pesticides:** atrazine, metolachlor, acetochlor.
- **Chlorophyll-a**
- **Field Measurements (depth profiles taken at deep-water and mid-lake locations):** pH, conductivity, water temperature, DO, turbidity.

Additional Lake Monitoring Projects (Nonpoint Source Programs).

Study/Lake	Parameter
Fremont State Lakes Project Renovation Plan	nutrients, biological, and fish tissue
Phosphorus Cycling Study	nutrients

Assistance: University of Nebraska-Lincoln (UNL), Nebraska Game and Parks Commission (NGPC), LENRD, United States Geological Survey (USGS).

Fish Tissue Monitoring Program

Network: 120 fish samples collected from 61 sites (10 rivers/streams and 51 lakes) in the Lower Platte and Nemaha River Basins.

Assistance: Nebraska Game and Parks Commission (NGPC), Nebraska Dept. of Health & Human Services, Nebraska Dept. of Agriculture, UNL School of Natural Resources, and USEPA.

Preparing a fish tissue sample collected from the Missouri River, Knox County

Stream Biological Monitoring Program

Network: 34 stream sites in the Lower Platte and Nemaha River Basins.

Field measurements: water temperature, pH, DO, conductivity, turbidity and stream discharge, fish and aquatic insect communities, and habitat assessments.

Electrofishing for the Stream Biological Monitoring Program at Leander Creek, Cherry County.

Fish Kills and Surface Water Complaints

Timeframe: July 1, 2014 to June 30, 2015

A total of nine fish kills were reported between July 1, 2014 and June 30, 2015. During this same timeframe, the Department received 46 notifications of complaints concerning surface water issues. Many of these cases were referred to other agency programs that more closely relate to the problem, sometimes the Surface Water Unit assisted by providing observations or samples to help document conditions.

Assistance: NGPC, NRDs, Lincoln Lancaster County Health Department (LLCHD).

Fish kill at a private pond, Saline County.

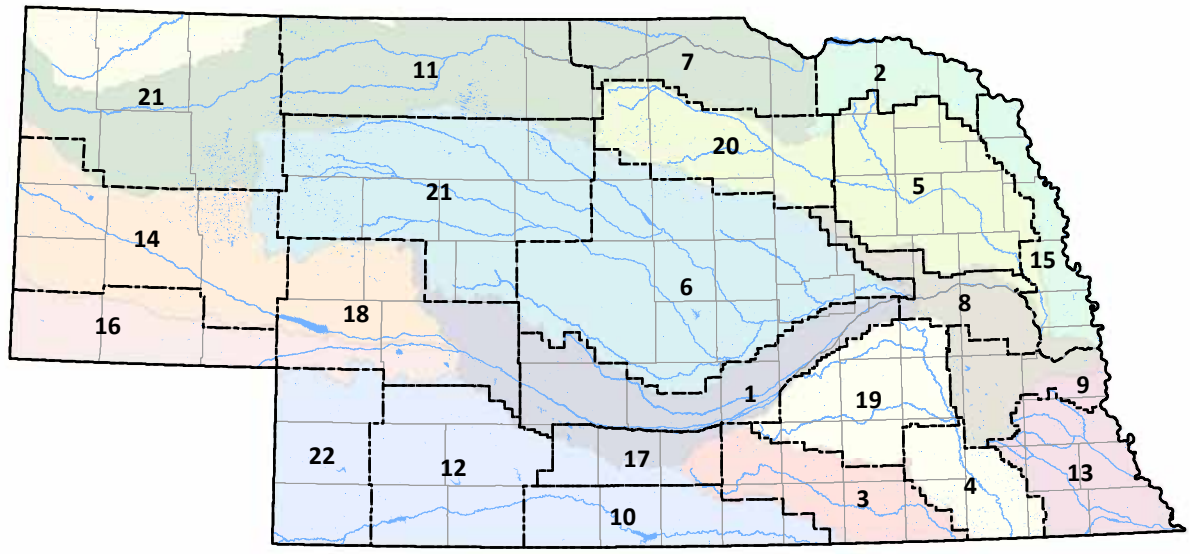
More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/SWMA
David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

More information about the State's 23 Natural Resources Districts can be found at www.nrdnet.org.

Natural Resources Districts, Abbreviations, and Headquarter Cities

Map #	Natural Resources District	Abbreviation	Headquarter City
1	Central Platte NRD	CPNRD	Grand Island
2	Lewis and Clark NRD	LCNRD	Hartington
3	Little Blue NRD	LBNRD	Davenport
4	Lower Big Blue NRD	LBBNRD	Beatrice
5	Lower Elkhorn NRD	LENRD	Norfolk
6	Lower Loup NRD	LLNRD	Ord
7	Lower Niobrara NRD	LNNRD	Butte
8	Lower Platte North NRD	LPNNRD	Wahoo
9	Lower Platte South NRD	LPSNRD	Lincoln
10	Lower Republican NRD	LRNRD	Alma
11	Middle Niobrara NRD	MNNRD	Valentine
12	Middle Republican NRD	MRNRD	Curtis
13	Nemaha NRD	NNRD	Tecumseh
14	North Platte NRD	NPNRD	Scottsbluff
15	Papio-Missouri River NRD	PMRNRD	Omaha
16	South Platte NRD	SPNRD	Sidney
17	Tri-Basin NRD	TBNRD	Holdrege
18	Twin Platte NRD	TPNRD	North Platte
19	Upper Big Blue NRD	UBBNRD	York
20	Upper Elkhorn NRD	UENRD	O'Neil
21	Upper Loup NRD	ULNRD	Thedford
22	Upper Niobrara-White NRD	UNWNRD	Chadron
23	Upper Republican NRD	URNRD	Imperial



Nebraska's Natural Resources Districts (NRD).

Stream Nutrient Assessment Procedure Pilot Study

What is SNAP?

Most existing numeric aquatic life water quality assessments are based upon criteria developed from well-defined dose-response relationships between individual pollutants and aquatic organisms. However, nutrient pollution and its effects on aquatic life are indirect and not predictable through simple dose-response relationships, unlike toxicants and oxygen-demanding substances where impacts can be assessed based on specific criteria. Because of these indirect effects, the impacts of nutrients can best be assessed with a weight of evidence approach that combines several metrics related to nutrients to determine whether nutrients are impairing the aquatic life use.

Multi-parameter meter to measure 24 hour dissolved oxygen variation, Loseke Creek, Platte County.

Ohio EPA has developed a methodology that is independent of highly variable instream nutrient concentrations and looks at three metrics that relate to impacts caused by nutrients (Ohio EPA, 2014). The Stream Nutrient Assessment Procedure (SNAP) evaluates biological criteria, DO swing, and benthic chlorophyll values in a step-wise matrix that determines whether the aquatic life condition of a stream is likely the result of excess nutrients.

NDEQ's pilot

During the summer of 2015, the Department adapted Ohio's SNAP methodology and piloted it to assess impacts from nutrients on the biology of wadeable streams in Nebraska. The purpose of this year's pilot program was to see whether the methodology could be successfully implemented in Nebraska and whether meaningful data could result from the effort. Seven Basin Rotation Monitoring Program (BRMP) sites were chosen to collect metrics on fish, aquatic macroinvertebrates, 24-hour dissolved oxygen variation, habitat, and benthic chlorophyll *a* and algal composition.

The biological metrics are a pass/fail measure based on Nebraska's fish and macroinvertebrate bio-indices that meet or exceed the fair level. The 24-hour dissolved oxygen swing is based on swings that are less than or equal to 6.5 mg/l or those greater than 6.5 mg/l. Benthic chlorophyll metrics are based on three levels: less than or equal to 182 mg/m^2; greater than 182 mg/m^2 but less than or equal to 320 mg/m^2; and greater than 320 mg/m^2.

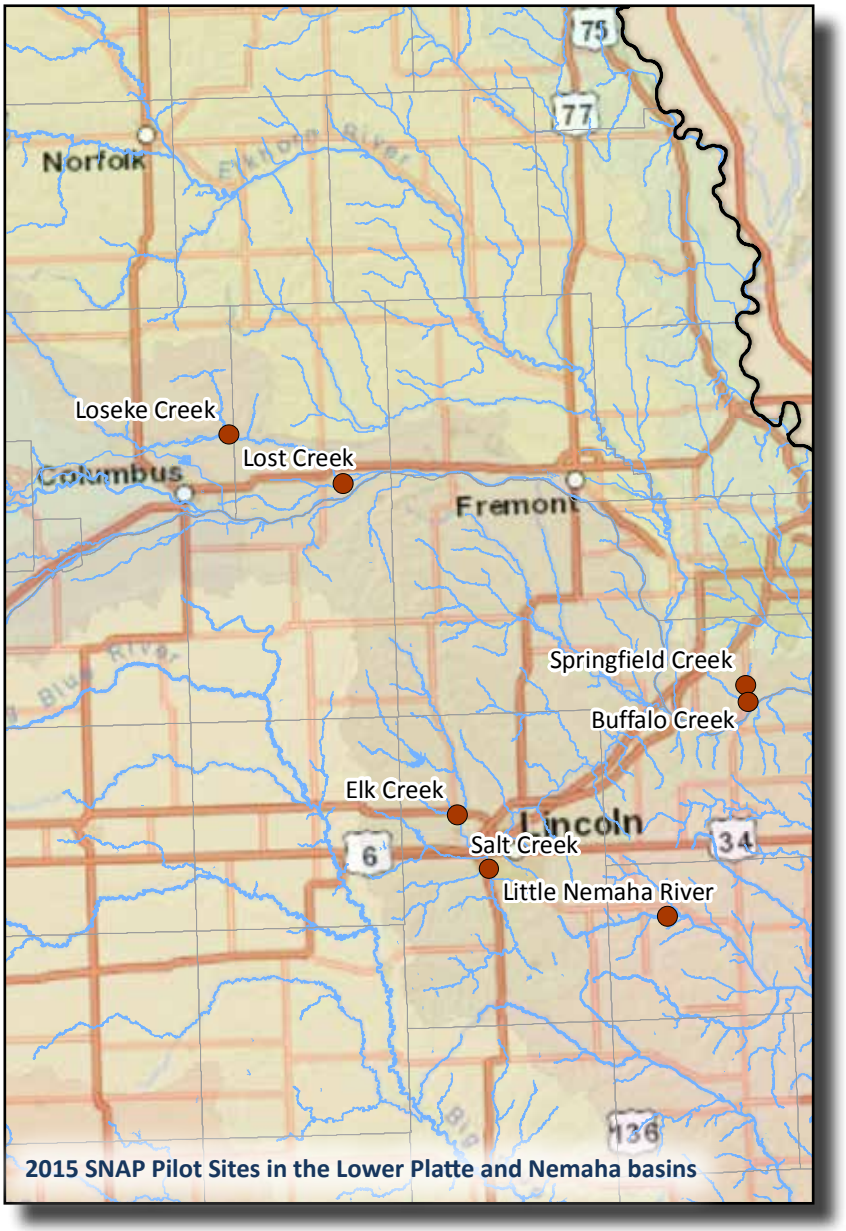
Benthic algae sampler constructed of two 6"x6" ceramic tiles zip-tied to a concrete block.

Results of these metrics in the matrix if produce an assessment that indicates a stream is:

- attaining use, not threatened,
- attaining use, but may be threatened,
- impaired, but causes are other than nutrients,
- impaired, likely nutrient enriched, or
- impaired, nutrient enriched.

These categories will be evaluated based on other factors to determine whether the SNAP holds promise in Nebraska for determining nutrient impact in streams or whether modifications are needed before adopting this methodology for stream assessments.

Benthic algae sampler used to collect benthic chlorophyll and algal composition data, Lost Creek, Colfax County.



2015 SNAP Pilot Sites in the Lower Platte and Nemaha basins

What we did

Seven stream sites from the 2015 BRMP network were established for this initial SNAP pilot.

Biological Assessments

The NDEQ conducts stream bioassessments to determine biological integrity based on the degree to which the communities of macroinvertebrates and fish deviate from known high quality conditions. The high quality, reference conditions were determined based on water chemistry, habitat quality, historical records of aquatic life, and expert opinion (see Bazata 2011, 2013; Heatherly 2013). This system is based on ecoregions in which the streams reside.

Benthic algae sampler upon removal from a stream after a three week deployment.

Fish were collected from each site by electrofishing and/or seining and stream lengths varied from 150 – 300 m in length. Fish were identified in the field when applicable and released except for species difficult to identify, which were preserved and sent to the Biology Department of Fort Hayes University for identification. Total numbers of the fish population were tallied and the length and weight of game fish was measured before release.

Aquatic macroinvertebrates were also collected from each site. D-nets and sieves were used to collect samples from overhanging vegetation, pools, riffles, woody debris, and other instream habitat. Macroinvertebrate samples were pooled together and sent to a taxonomic lab to be identified. Identification was taken to the lowest taxonomic classification possible and total number of individuals recorded.

24-Hour Dissolved Oxygen

Continuous monitoring of dissolved oxygen was conducted at every site using a multi-parameter meter. The meter was placed in a secure location that would receive constant flow through the duration of the 24-hours. Readings were taken every 30 minutes.

Scraping algae tiles for benthic chlorophyll and algae composition analyses.

Benthic Chlorophyll and Periphyton Collection

Periphyton is a complex community of organisms including algae, fungi, microbes, and detritus that are attached to submerged surfaces in most aquatic ecosystems. Periphyton in stream and rivers are important components of aquatic ecosystems that provide food for the entire aquatic ecosystem. Periphyton growth

Scraping algae tiles for benthic chlorophyll and algae composition analyses.

in a stream is strongly linked to the nutrients within that system. Periphyton samples were collected at all stream sites. Two ceramic tiles were attached to cement blocks and placed at the bottom of the stream channel. These tiles were exposed to the stream for two weeks after which the tiles were scraped and rinsed clean. The contents of one tile were made into slurry for chlorophyll *a* analysis. The contents of the second tile was placed in a 120 ml bottle and filled with formalin for preservation. These samples were shipped to a taxonomic lab to be identified. Identification was taken to the smallest taxonomic classification possible and total number of cells recorded.

Physical Habitat Assessment

At each site, physical conditions and habitat were assessed along the reach of the stream. Physical habitat was measured in the reach at 11 evenly spaced stream cross-sections transects at 100 points along the thalweg, in accordance with the Environmental Protection Agency (EPA) EMAP protocol (U.S. EPA 1994; Kaufman et al. 1999). Additionally, at each transect, depth, substrate size class, and substrate embeddedness were measured at five equally spaced points between the wetted edges of the stream.

Field methodologies were successful and the logistics of implementing SNAP have been worked out. Sample collections have yet to be processed so that data can be assessed. NDEQ anticipates another pilot season of SNAP in 2016.

More Information:

John Bender, john.bender@nebraska.gov or (402) 471-4201.

Filtering a benthic chlorophyll sample obtained from scrapings removed from the surface of algae tiles.

Water Quality and Biological Integrity of Lost Creek and Shonka Ditch, Colfax County, Nebraska

Nitrogen may be harmful to aquatic life in streams, to livestock that drink from streams, and to people if the nitrogen infiltrates groundwater wells. The Environment America Research and Policy organization reported in 2012 that Shonka Ditch in Colfax County (near Schuyler), Nebraska was highly polluted with nitrogen from a meat processing plant. In response, NDEQ instigated a major effort to examine the effects of the meat processing effluent on the water chemistry and aquatic life of Shonka Ditch and further downstream in Lost Creek.

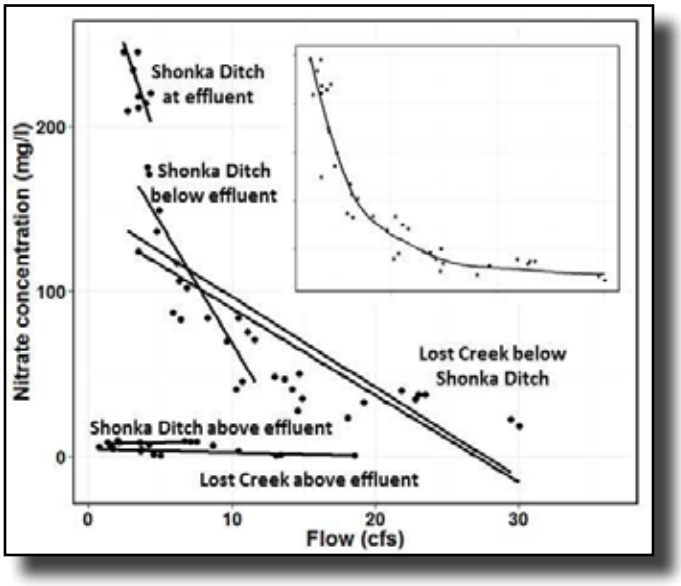
Discolored water at Lost Creek below Shonka Ditch, Colfax County.

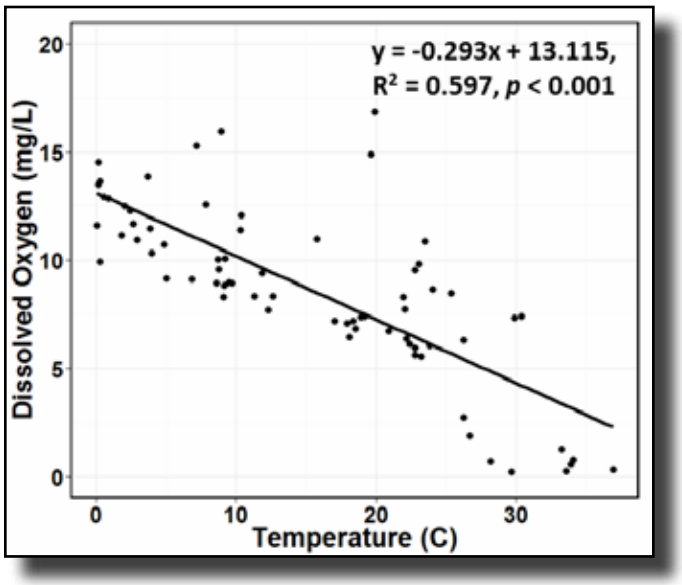
Monitoring

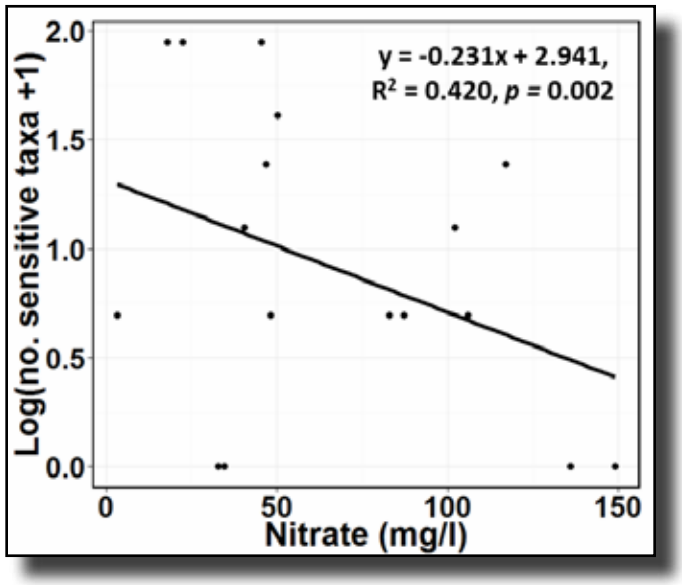
The monitoring effort occurred from September 2012 until September 2013. NDEQ collected water chemistry samples once per month, including nitrate-nitrite and ammonia, total phosphorus, conductivity, and other parameters. The physical habitat for the streams was also assessed at the outset of sampling. Aquatic macroinvertebrates were sampled approximately every two months using Hester-Dendy artificial substrate samplers, which are circular plates mounted on an eyebolt and separated by different-sized washers, and which provide a standardized surface area. Fish were sampled four different times by electrofishing each sample reach of ~280 m. NDEQ applied their stream biological assessment protocol to estimate the ecological integrity of the sample locations, and used linear regression models to better examine direct connections between aquatic organisms and the chemistry of the effluent.

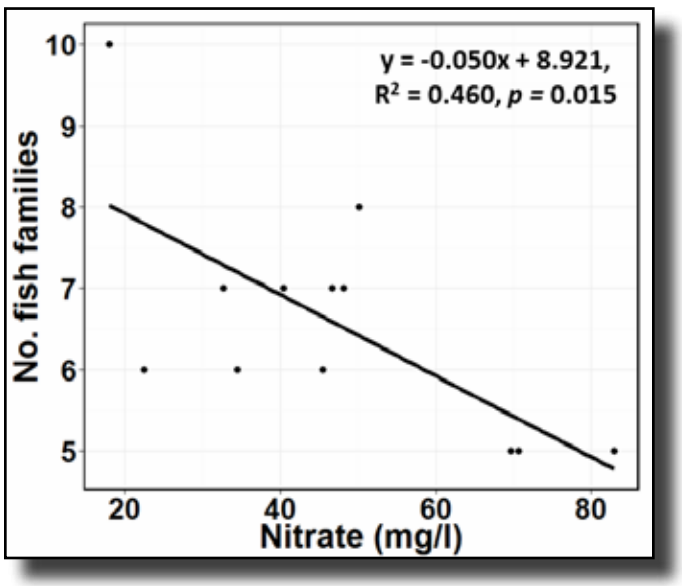
Findings

NDEQ found that there were always high concentrations of nitrate-nitrite and total phosphorus. The acceptable limit for nitrate in agricultural surface waters is 100 mg/l and for groundwater is 10 mg/l. The nitrate in the effluent ranged from 175 – 245 mg/l, and during times of low flow, the concentrations of nitrate could exceed 100 mg/l in Lost Creek more than two miles downstream from the meat processing plant. The nitrate was rapidly diluted in the streams, but not to acceptable concentrations. In addition, the current wastewater treatment process heated the effluent, and this caused summer temperatures to exceed the 32°C limit in Shonka Ditch that is deemed to be protective of aquatic life. Water temperatures also









appeared responsible for reducing the availability of oxygen in the water to aquatic life. Finally, the effluent had high levels of specific conductivity and Shonka Ditch exceeded the allowable levels for agricultural waters on five different dates.

The physical habitat structures of Shonka Ditch and Lost Creek in the study area were good to excellent quality with the streams banks well vegetated and having a diverse suite of grasses and some trees.

The macroinvertebrate assemblages were rated as poor on some dates, but the ratings did not indicate any systemic worsening nearer to the effluent source. However, linear regression analyses indicated that the effluent was indeed suppressing the macroinvertebrate assemblages, with notable losses to pollution tolerant macroinvertebrates when the effluent was most concentrated. It is important to note that even though the figures presented have nitrate listed on the x-axes, NDEQ could not separate the potential effects of nitrate, phosphorus, or conductivity because they all originated from the same source. The fish assemblage had very good ratings throughout the study streams, but as with the macroinvertebrates, linear regression analyses showed that there was less fish diversity near the source of the effluent.

Implications

Nutrients are one of the most serious threats to aquatic ecosystems and drinking water. Additionally, alterations to stream temperature and specific conductivity can have profound impacts on the natural functioning of stream ecosystems. NDEQ determined that the nitrate, specific conductivity, and water temperature were indeed beyond acceptable levels, and likely were impacting the stream ecosystems. As a result of this survey, NDEQ now has scientifically-based information to take the necessary actions to protect the quality of this stream and the groundwater in the region.

More Information:

Tom Heatherly, tom.heatherly@nebraska.gov or (402) 471-2192.

Fremont State Recreation Area Lakes Renovation and Evaluation

Who Conducted the Renovation and Evaluation of Fremont State Recreation Area

Two Environmental Protection Agency non-point source grants were awarded through NDEQ to address water quality issues at Fremont State Recreation Area Lakes. The Nebraska Game and Parks Commission (NGPC) was awarded a grant to help fund lake renovation work. That grant money was matched by a grant awarded from the Nebraska Environmental Trust. Dr. Amy Burgin and co-investigators Dr. Mark Pegg and Dr. Kevin Pope with UNL's School of Natural Resources were awarded a grant to study the effects of the common lake restoration techniques that were conducted. That money combined with financial and technical assistance from NGPC allowed them to study of the efficacy of aluminum sulfate (alum) as well as its effects of on the water chemistry, nutrient concentrations, and ecology on the lakes within Fremont State Park. This is the first study in which lakes within immediate proximity to each other could be tested using a Before-After-Control Impact study design to evaluate the effectiveness of alum and alum in conjugation with a fish renovation.

Identifying and counting fish that were removed from a Fremont SRA lake using retenone.

Where is Fremont State Recreation Area

Fremont State Recreation Area is located west of Fremont, NE and is bordered by the Platte River to the south. It is comprised of approximately 265 acres of water covering 20 sandpit lakes.

A Fremont SRA lake during alum treatment.

Why Did NDEQ Do These Projects

The lakes at Fremont State Recreation Area had long been suffering from excessive nutrients (eutrophication). Eutrophication can lead to blooms of cyanobacteria, a harmful and toxic type of blue green algae. This has caused many of these lakes to be unusable for full contact recreation activities, such as swimming, skiing, and jet skiing. People that come into contact with the toxins produced by blue green algae can suffer from rashes, lesions, and blisters. While ingesting water containing toxins can cause vomiting, nausea, headaches, and diarrhea. Long term effects of ingestion by humans include damage to the liver. Ingestion of toxin laden water by animals, wildlife, and livestock are often times fatal.

The Nebraska Department of Environmental Quality's mission is to protect the quality of Nebraska's environment – our air, land, and water resources. Considering the eutrophication of the lakes at Fremont State park and the danger that those lakes posed to the public and the wildlife within the park it was incumbent on us to work to meet our mission statement. Additionally, we wanted to use this opportunity to further our understanding of a popular lake restoration technique.

When and How Was the Work Conducted

In the fall of 2012, 15 lakes received one of two types of renovation. Eleven lakes were restored using only alum while 4 were renovated using a combination of alum and rough fish removal (biomanipulation). Evaluating the effects of both treatments began following the renovations and continued through 2014.

The application of alum is becoming a popular choice to mitigate the issue of lake eutrophication. Alum works by binding with available phosphorus and settling into a floc on the bottom of the lake. This floc then continues to bind with more phosphorus as long as binding sites are available on the alum molecule. The resulting precipitate remains on the bottom of the lake where the phosphorus remains bound and unusable by cyanobacteria, algae, and other plant growth.

Biomanipulation consisted of an application of the chemical rotenone by NGPC employees. Because rotenone causes mortality in all fish species present, desirable species of sport fish, i.e. largemouth bass, bluegill, and catfish were restocked later in treated lakes. Species of fish like common carp, gizzard shad, and bigmouth buffalo can lead to the eutrophication of a lake by disturbing the lake bottom while searching for food. This action of disturbing the bottom and suspending nutrient laden sediment is called bioturbation. Once these nutrients are suspended in the water column they are more readily available to be used by cyanobacteria and algal species.

What was accomplished and what did we learn

Eight of the twenty lakes in Fremont State Recreation Area are listed as impaired on Nebraska's 2014 List of Impaired Waters (EPA Section 303(d) List). All of these lakes are listed as impaired due to issues related to eutrophication. The two treatments (alum and alum + rotenone) used both were effective at reducing the amount of total phosphorus in the lakes. Additionally, the alum + rotenone treatment reduced the density of cyanobacteria (blue green algae) present. Neither treatment was effective in completely eliminating cyanobacteria and the corresponding toxins from the lakes.

A sample from Fremont SRA lake.

In short, the application of alum can be a useful tool in lakes that suffer from eutrophication caused by internal nutrient loading, especially when combined with biomanipulation. However, this study also demonstrated that even though these methods will reduce the amount of cyanobacteria. the concentration of the toxin produced was not statistically different from what would be expected in annual variation within a lake that did not receive any treatment for eutrophication. This may change as the lake continues to age following the renovations and algae and phytoplankton reestablish themselves. NDEQ will continue to monitor toxin levels at the beaches in Fremont State Recreation Area as well as monitoring other parameters such as Chlorophyll A, Total Phosphorus, and Total Nitrogen in these lakes.

Collecting a plankton sample at a Fremont SRA lake.

For More information Contact:

Mike Archer, mike.archer@nebraska.gov or (402) 471-4224.

Renovation of Big Springs Community Lake Restores Beneficial Use

Waterbody Improved

Complaints by local residents about excessive accumulation of woody debris led the Nebraska Department of Environmental Quality to list Big Springs Community Lake for Aesthetic Use impairment in the Nebraska 2012 Water Quality Integrated Report. The pond also had a historic accumulation of sediment that precluded a viable fishery. A community planning effort resulted in renovation of the pond to remove the sediment and debris and make other changes to the pond. Big Springs Community Lake will be delisted in the Nebraska 2016 Water Quality Integrated Report.

Big Springs Community Lake prior to renovation, Deuel County.

Problem

Big Springs Community Lake is a one-acre pond in the community of Big Springs, Deuel County, in southwest Nebraska. Age and historic management practices in the watershed took a toll on the pond since its construction in 1927. Sediment accumulated from the watershed and shoreline erosion left the pond with shallow stagnant water and steep banks. The pond also had an excessive accumulation of woody debris and had developed a significant leak. It no longer supported a fishery nor provided an appealing place for recreation and community activities. The Nebraska Department of Environmental Quality (NDEQ) listed the pond for Aesthetic Use Impairment in the Nebraska 2012 Water Quality Integrated Report. Restoration of the aesthetic use benefit required removal of the accumulated sediment and woody debris.

Project Highlights

The one-acre pond was the center piece of a small community park adjacent to the South Platte High School in Big Springs. Sources of sediment in the pond resulted from historical agricultural management practices or erosion within the parkland immediately surrounding the pond. Row crop production was once prominent in the watershed, but most of the land has been converted back to grassland for forage or pasture production or enrolled in the conservation reserve program. Current sediment inputs from the watershed were considered fully controlled. Other sources of impairment to the pond, such as woody debris, were considered natural.

Community partners working on woody debris removal, Big Springs Community Lake, Deuel County.

Restoration of the pond in 2010 included removing debris; excavating 2,500 yd^3 of sediment; reshaping, armoring and re-vegetating the shoreline; installing a pond liner to reduce leakage; and installing habitat structures to enhance the fishery. The depth of the pond was increased from a maximum of five feet to an average depth greater than ten feet over 25% of the surface area so that the pond will sustain a warm water fishery year-round. Grading and stabilization of the shoreline improved ease and safety of access and provided protection from shoreline erosion. The pond was stocked with bluegill, largemouth bass, and channel catfish of catchable size to complete the project.

Newly installed habitat structures to enhance the fishery, Big Springs Community Lake, Deuel County..

Results

The renovation project removed 2,169 tons of sediment, 1,800 pounds of phosphorus and 1,041 pounds of nitrogen from the pond. Today the pond is again a destination for community activities and recreation. Outdoor classroom activities bring students from the adjacent school to learn about water quality and other natural resources issues. The pond supports a vigorous fishery with water clarity exceeding three feet. Inspection of the pond in 2015 determined that restoration had removed the aesthetic impairment. Big Springs Community Lake will be delisted for Aesthetic Impairment in the 2016 Nebraska Integrated Report.

Partners and Funding

The Big Springs Community Lake restoration project was accomplished under the Community Lakes Enhancement and Restoration (CLEAR) Program; a partnership of the Nebraska Department of Environmental Quality (Section 319 Program), Nebraska Game and Parks Commission, University of Nebraska Extension and the Nebraska Environmental Trust. Other participants in the project included the City of Big Springs, South Platte High School, and the Panhandle Resource Conservation and Development District. Total cost of the renovation project was $215,771 provided by Nebraska Department of Environmental Quality – Section 319 ($53,000), Nebraska Environmental Trust ($123,810), and the City of Big Springs ($38,961).

Big Springs Community Lake after renovation, Deuel County.

More Information:

Elbert Traylor, elbert.traylor@nebraska.gov or (402) 471-2585.

Groundwater Quality Monitoring Report to the Legislature

Why NDEQ Does this Report

The 2001 Nebraska Legislature passed LB329 (Neb. Rev. Stat. §46-1304) which, in part, directed the Nebraska Department of Environmental Quality (NDEQ) to report on groundwater quality monitoring in Nebraska.

History of this Report

Beginning in December 2001, the Department has prepared a report outlining the extent of groundwater quality monitoring conducted by Natural Resources Districts (NRDs) during the preceding calendar year. The Department uses the data submitted by the districts in conjunction with all other readily available and compatible data for the purpose of the annual ground water quality trend analysis.

Where is the Monitoring Conducted?

The State of Nebraska is a large geographic area, over 77,000 square miles. There are approximately 177,000 active registered wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2014, 4,323 wells were sampled. Since 1974, over 25,000 wells across the state have been sampled by state agencies, University of Nebraska, federal agencies, and local NRDs. Monitoring is typically conducted in areas of Nebraska with groundwater problems.

Irrigation well sampling in Lower Platte South Natural Resources District.

1920's 10 ft Elgin Model "L" Hummer in Waverly Nebraska, Lancaster County.

What is Monitored?

There are over 240 compounds monitored for since 1974 and used in this report. Some of the compounds that have been detected more than just a few times throughout this period include nitrate-nitrogen and atrazine. Nitrate is a form of nitrogen common in human and animal waste, plant residue, and commercial fertilizers. Atrazine is a herbicide used for weed control in a variety of crops such as corn and sorghum.

Dedicated monitoring wells in the Lower Loup Natural Resources District.

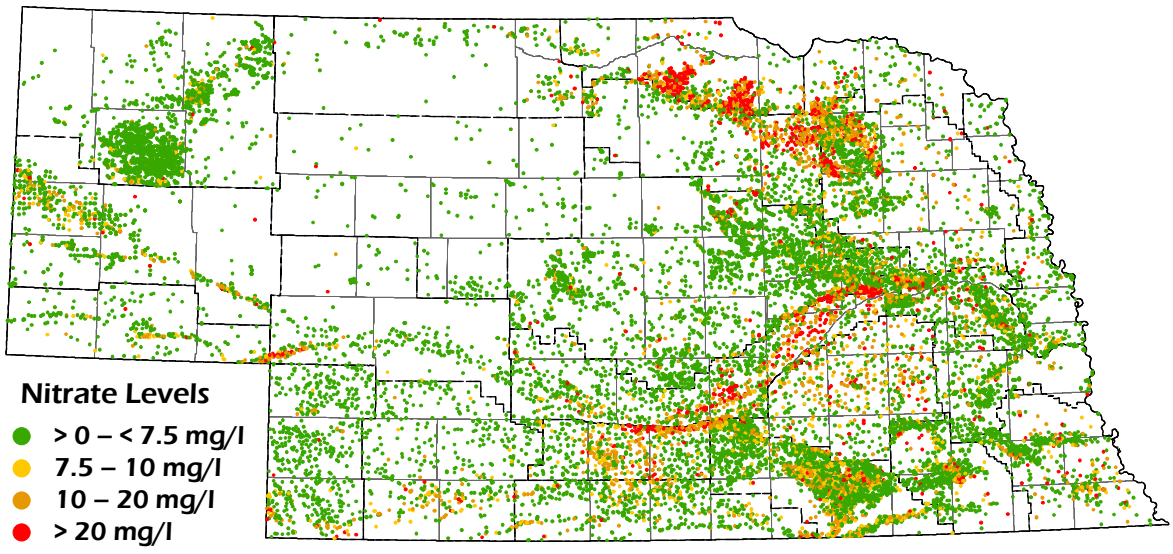
Sampling monitoring wells near Clearwater Nebraska, Antelope County.

How is the Data Used?

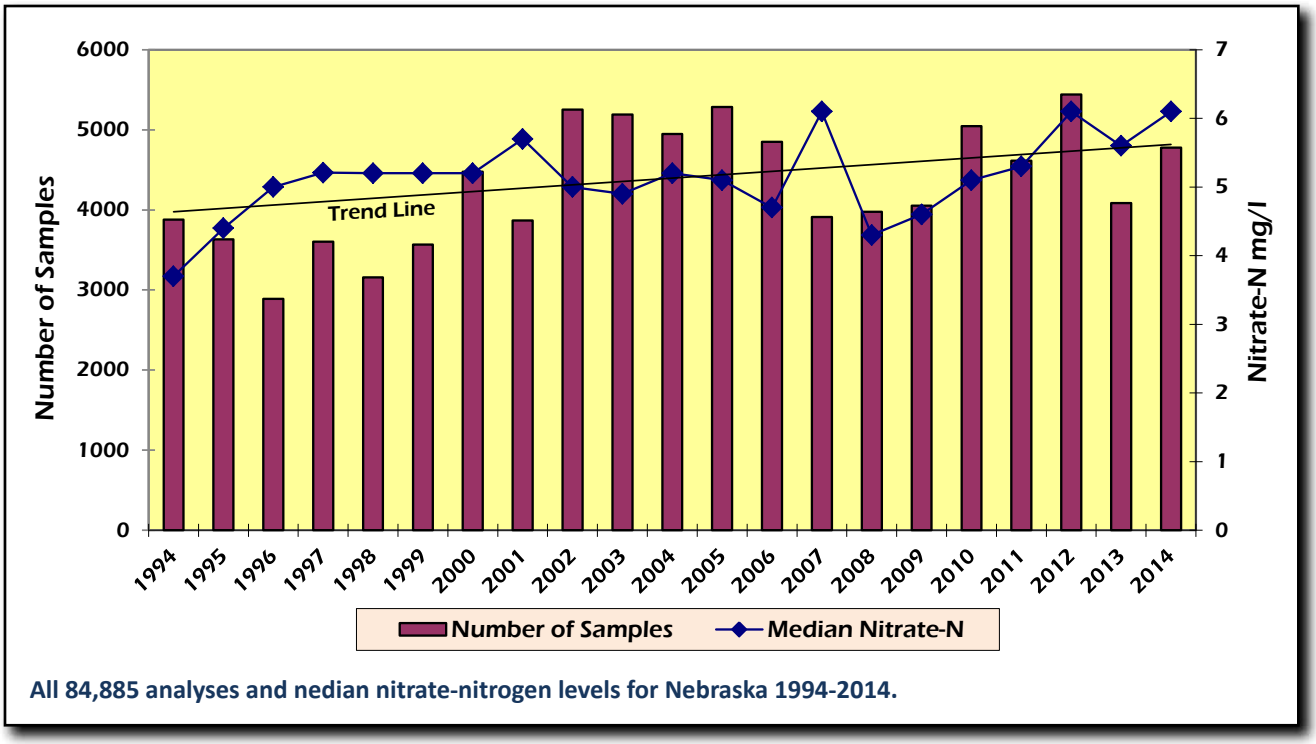
The Department analyzes the data collected for the purpose of determining whether or not groundwater quality is degrading or improving and presents the results to the Natural Resources Committee of the Legislature beginning December 1 of each year. The State's 23 NRDs use the data to make decisions on the management of groundwater. To date, 21 NRDs have formed Groundwater Management Areas over part or all of their districts to address groundwater quality problems.

Results as of 2014

The majority of Nebraska's residents rely on groundwater for drinking water, agriculture, and industry. Most public water supplies that utilize groundwater do not require any form of treatment for drinking water before serving it to the public. Nitrate is Nebraska's number one groundwater contaminant. There are some limited areas in Nebraska where the nitrate concentration is greater than the drinking water standard of 10 mg/L (see map below).



Most recent recorded concentration of nitrate from 1994-2014. (Source: Quality-Assessed Agrichemical Database for Nerbaska Groundwater, 2015) Empty areas indicate no data reported, not the absence of nitrate in groundwater.



All 84,885 analyses and nedian nitrate-nitrogen levels for Nebraska 1994-2014.

The most representative picture of the statewide nitrate concentration is from the time period from 1994 to 2014 due to the number and spatial relationship of the samples collected. The overall trend indicates only a slight increase in nitrate median concentrations statewide (see chart above).

All of the results for agricultural chemicals (including nitrate) can be found on the Nebraska Department of Natural Resources (NDNR) website (http://dnrdata.dnr.ne.gov/Clearinghouse/Clearinghouse.aspx). The entire database can be accessed at NDNR's website, where the database may be searched or 'queried' for numerous subsets of data, such as results by county, type of well, Natural Resources District, etc.

More Information:

http://deq.ne.gov/Publica.nsf/Pages/WAT222
David Miesbach, david.miesbach@nebraska.gov or (402) 471-4982.

Sampling a dedicated monitoring well in the Lower Loup Natural Resources District.

Groundwater Monitoring at Permitted Livestock Facilities

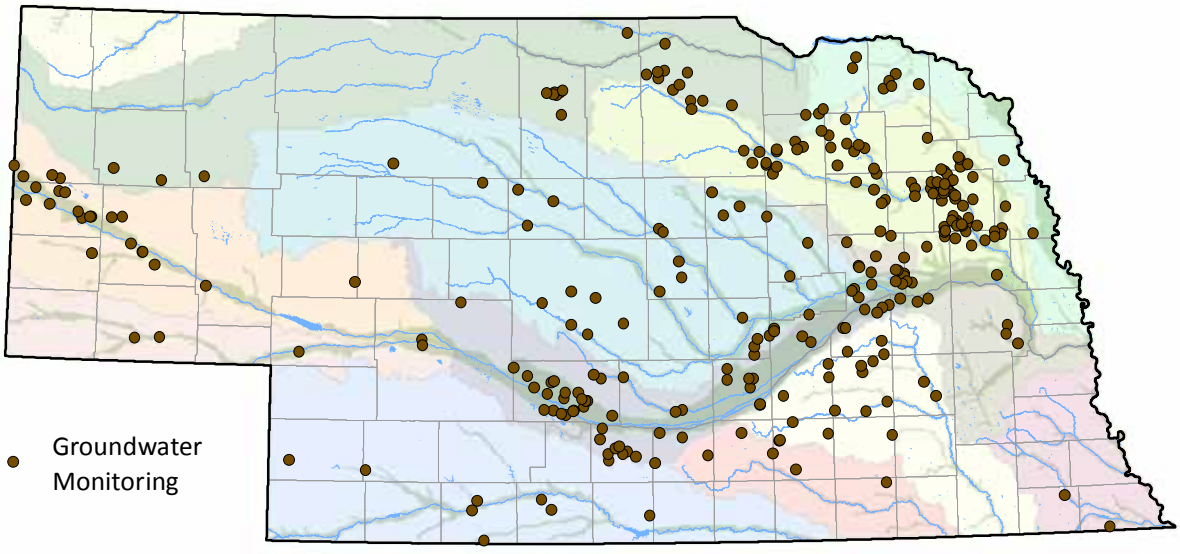
Why require monitoring at livestock facilities?

Nebraska's groundwater may be negatively impacted by leakage from holding ponds or lagoons at livestock waste control facilities (LWCFs). The liquid waste in the holding ponds has elevated levels of nitrate-nitrogen, ammonia, and chloride ions. The NDEQ requires monitoring of these chemical parameters to document any impact to groundwater. The contaminated groundwater may negatively impact public water supplies and domestic wells. The NDEQ oversees the investigation and remedial measures conducted by the owners of the facilities if groundwater has been impacted.

Feedlot in Central Nebraska.

History of the monitoring program

The NDEQ's Groundwater Unit began reviewing permitting plans for LWCFs in 1997. The site-specific hydrogeology, soils, depth to water, and use of the groundwater are reviewed to determine the vulnerability of the groundwater. The Groundwater Unit has reviewed 1,200 LWCFs (as of the beginning of November 2015) and recommended monitoring at 414 of them. Currently, there are 357 approved groundwater monitoring plans with 301 operations where semi-annual monitoring is conducted. Eight operations conduct annual sampling due to little or no change in the water quality. The map below shows the locations of the facilities where groundwater monitoring is conducted.



Livestock Operations with Ongoing Ground Water Monitoring.

What is monitored?

Groundwater samples are collected from monitoring wells installed around the lagoons or holding ponds and analyzed at a laboratory for

- nitrate-nitrogen,
- ammonia, and
- chloride concentrations.

Groundwater naturally has low concentrations of chloride and nitrate-nitrogen while ammonia is not naturally present in groundwater. Additionally,

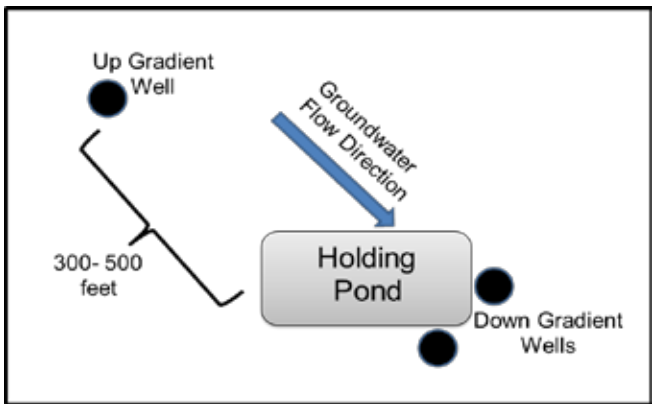
- depth to water,
- pH,
- temperature, and
- specific conductivity

are collected from each monitoring well. The groundwater quality and the flow direction are monitored in the spring (before irrigation season) and the fall (after irrigation season).

Samples from groundwater monitoring wells near a lagoon.

Where are the wells installed?

A typical livestock facility with groundwater monitoring has three monitoring wells. One well is located 300-500 feet up gradient of the holding pond to record the water quality conditions prior to flowing down gradient under the lagoon. Two monitoring wells are located adjacent to each holding pond in the down gradient flow direction to more quickly identify possible impacts to groundwater. The adjacent diagram shows a generic map of recommended locations for groundwater monitoring wells.



Recommended locations for groundwater monitoring wells.

How are the data used?

The LWCF is responsible for conducting the semi-annual monitoring and submitting a report to NDEQ twice a year. Monitoring is conducted either by a hired consulting firm or by the owner of the livestock operation. Groundwater Unit staff review the results from the groundwater sampling. A facility that has had at least three sampling events is evaluated to determine if groundwater has been negatively impacted. In the event a facility has impacted groundwater, the facility is required to address the issues. Currently there are less than five LWCFs with more comprehensive groundwater investigations underway. To date, NDEQ does not know of any private or public drinking water wells that have been contaminated from a livestock waste control facility.

More Information:

Dan Inman, dan.inman@nebraska.gov or (402) 471-0294.
David Miesbach, david.miesbach@nebraska.gov or (402) 471-4982.

Crow Butte Resources, Inc. Groundwater Monitoring

Crow Butte Resources, Inc. in-situ recovery uranium facility. Dawes County.

Crow Butte Resources, Inc. uranium mine has been operating in western Nebraska for over three decades. The site consists of several thousand Class III injection wells used for In-Situ Recovery (ISR) uranium mining, and it has been regulated and monitored by the Nebraska Department of Environmental Quality (NDEQ) since active mining began in 1985. Part of this regulation includes a local ban on drilling any water wells in the permitted area other than those associated with the mining process.

The Class III production/injection wells are used in the ISR method of uranium mining. The U.S. Nuclear Regulatory Commission (NRC) defines ISR uranium mining as a process using a leaching solution to extract uranium from underground ore bodies in place (in other words, in-situ). The leaching agent, called lixiviant, contains an oxidant such as oxygen with sodium bicarbonate. The uranium in the aquifer is in a reduced environment and therefore in a solid state, occupying some of the pore spaces in the aquifer. The lixiviant is injected through injection wells into the ore body in a confined aquifer to oxidize the reduced environment and liberate the uranium. The solution is then pumped via other wells, called production wells, to the surface for processing.

Crow Butte Resources, Inc. (CBR) operates on a "3-5-5" rule. This means that no more than three units can be constructed in advance of active mining, no more than five mine units may be engaged in active mining, and no more than five mine units can be in restoration. There are currently 11 mine units constructed at the facility. Mine Unit 1 has reached restoration and stabilization goals as determined by NDEQ. Mine Units 2 and 3 are being monitored for stabilization. Mine units 4, 5, and 6 are currently undergoing restoration activities. Mine units 7, 8, 9, 10, and 11 are being actively mined. To date, CBR has no plan to extend mining at their current facility beyond Mine Unit 11.

Groundwater Monitoring at the facility

There are two types of groundwater monitoring wells at the CBR uranium mining facility – deep (production zone) monitoring wells and shallow (Brule Formation) monitoring wells. The wells are screened through the entire aquifer to ensure that the mining fluids do not migrate laterally or vertically outside the portion of the aquifer being mined. Deep monitoring wells are drilled into the Chadron Formation, where the mining is occurring. These deep wells surround each mine unit and are located no more than 300 feet from the mine unit (or

Drilling rig at Crow Butte Resources Inc., Dawes County.

production zone) and approximately 400 feet apart. Shallow monitoring wells are spatially distributed throughout the mine units, with at least one well every four acres. These wells are drilled into the Brule Formation aquifer, which locally serves as a drinking water source, to ensure mining fluids are not migrating upward. Both the shallow and the deep monitoring wells are sampled biweekly (once every two weeks) for chloride, conductivity, alkalinity, water level, and barometric pressure. The shallow monitoring well samples are also, at a minimum, analyzed annually for uranium and radium-226 to the lowest detection limit available.

Well field at Crow Butte Resources, Inc., Dawes County.

Currently, 429 monitoring wells are actively sampled on a biweekly basis, 226 of these are deep monitoring wells and 203 are shallow monitoring wells. If chloride, conductivity, or alkalinity concentrations increase in any of these wells, the well is re-sampled within 24 hours. If the parameters do not exceed the permitted limits, the well is sampled again within 48 hours of the time the first sample was taken. If the second or third samples indicate parameters exceeding the permitted limits, the well in question is placed on "parameter exceedance status," which means that a well surrounding the mine unit, laterally or vertically, has exceeded one or more of the parameter control limits. This means that the lixiviant is migrating toward the edge of the mine unit, but it is still within the permit boundary. Corrective action is initiated and the well on parameter exceedance status is then monitored on a weekly basis. This corrective action typically consists of an increase in the pumping rate of the production wells to pull the mining fluids back into the mining area. When three consecutive one-week samples are below the permitted limit, the exceedance status is removed from the well; however weekly sampling continues for an additional three weeks. If the parameters remain below the permitted limit for those three weeks, biweekly sampling resumes.

Reporting Requirements

The NDEQ is notified within 24 hours of the time the "confirmation" sample was taken for parameter exceedance. CBR sends laboratory data from all the samples and a plan or corrective action to the NDEQ within five days of the confirmation. Typically, corrective action consists of turning off the injection wells in the area the exceedance occurred and increasing the production/pumping rate to bring those fluids back into the mining area. If a shallow well exhibit elevated levels of any of the monitored constituents, corrective action includes testing production and injection wells in the area for mechanical integrity to ensure that they are not leaking fluids into the shallow aquifer.

Mechanical integrity test at Crow Butte Resources Inc., Dawes County.

CBR submits monitoring well analyses to the NDEQ in a quarterly report, and each quarter NDEQ randomly checks laboratory analyses by splitting samples from the monitoring wells with the facility. The samples are collected by NDEQ field staff and are sent to the State Health Lab to be analyzed for chloride, conductivity, and alkalinity. The analytical result from both CBR laboratory and the State Health Lab are statistically compared for quality assurance purposes. NDEQ takes a duplicate sample of one well during each split sampling event to ensure the quality of the lab analyses.

Groundwater monitoring well at Crow Butte Resources Inc., Dawes County.

Quality Assurance/Quality Control in 2015

In 2015, approximately 8,688 groundwater monitoring well samples were collected and analyzed by the laboratory at CBR. The NDEQ randomly split 56 of those groundwater samples (28 from deep monitor wells and 28 from shallow wells each quarter) with CBR. Samples collected by NDEQ are sent to the State Health Lab for analysis. Comparisons between CBR laboratory's analyses and NDEQ's analyses for the samples were within a statistically reasonable margin of error.

As of November 2015, ten shallow monitoring wells and one deep monitoring well had parameter exceedances reported by CBR in 2015. CBR reported all parameters exceedances to the NDEQ and the Nuclear Regulatory Commission (NRC). In all cases, corrective action was taken immediately, and the wells were returned to biweekly sampling within weeks.

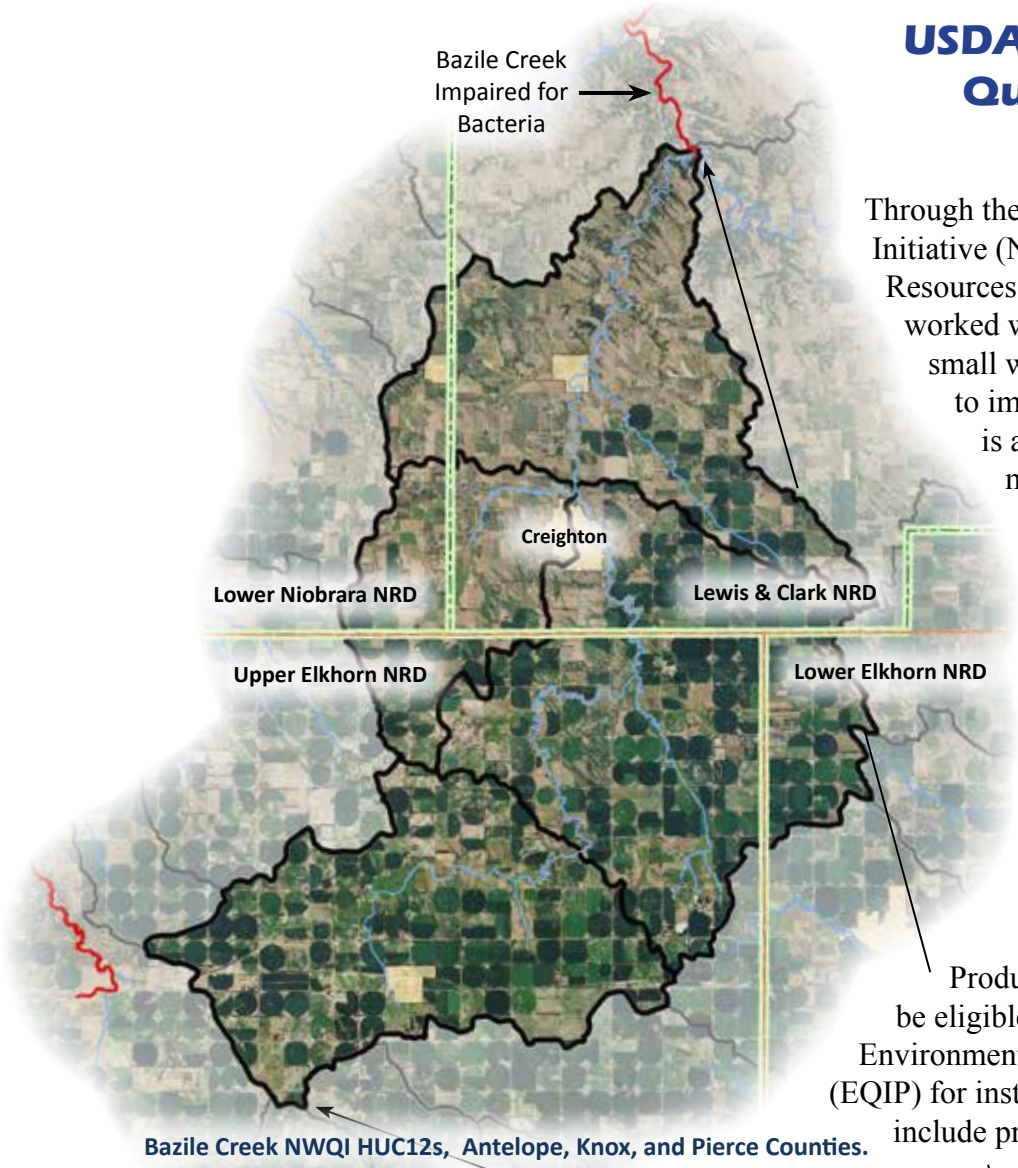
Future expansion is planned at two satellite facilities, Marsland and Three Crow. Applications have already been received and initial review conducted for Marsland. These satellite facilities are expected to have similar groundwater monitoring plans and requirements as the current CBR mining operation.

Old drilling rig.

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/UIC
Nancy Harris, nancy.harris@nebraska.gov or (402) 471-4290.

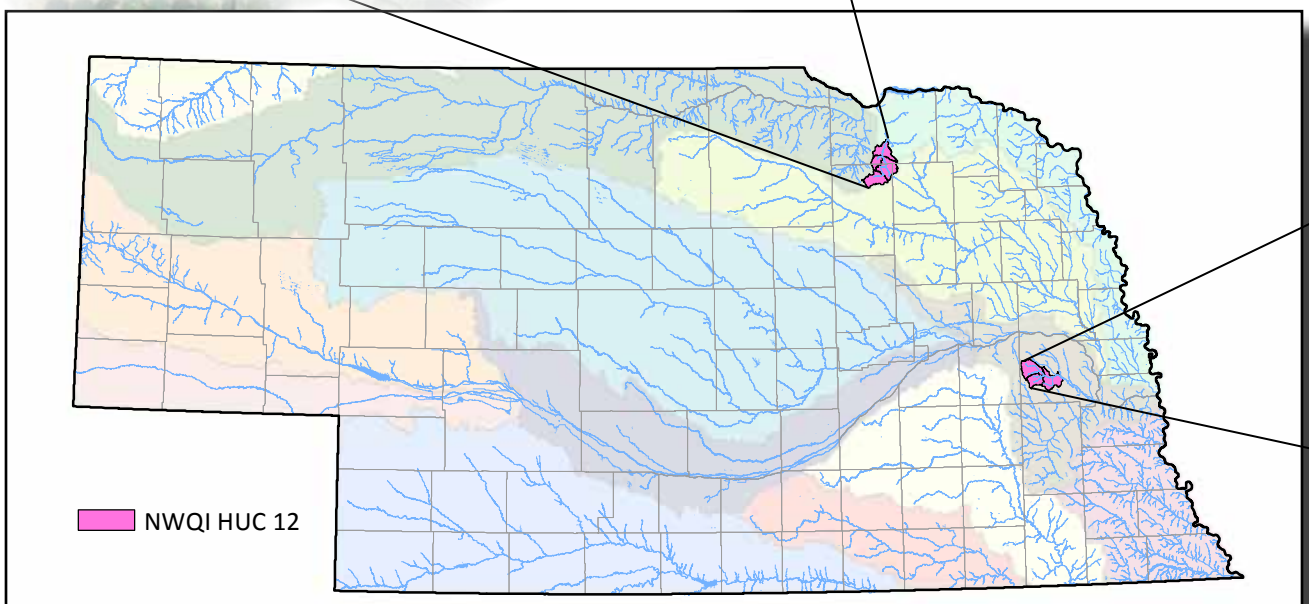
USDA National Water Quality Initiative



Bazile Creek NWQI HUC12s, Antelope, Knox, and Pierce Counties.

Through the National Water Quality Initiative (NWQI) in 2015, the Natural Resources Conservation Service (NRCS) worked with farmers and ranchers in 174 small watersheds throughout the Nation to improve water quality where this is a critical concern, providing $25 million in financial assistance to help farmers and ranchers implement conservation systems to reduce nitrogen, phosphorous, sediment and pathogen contributions from agricultural land. This was the fourth year of the initiative, and builds on an over $85 million NRCS investment since 2012 (retrieved from www.nrcs.usda.gov).

Producers in NWQI watersheds may be eligible to receive assistance under the Environmental Quality Incentives Program (EQIP) for installing conservation systems that include practices such as terraces, filter



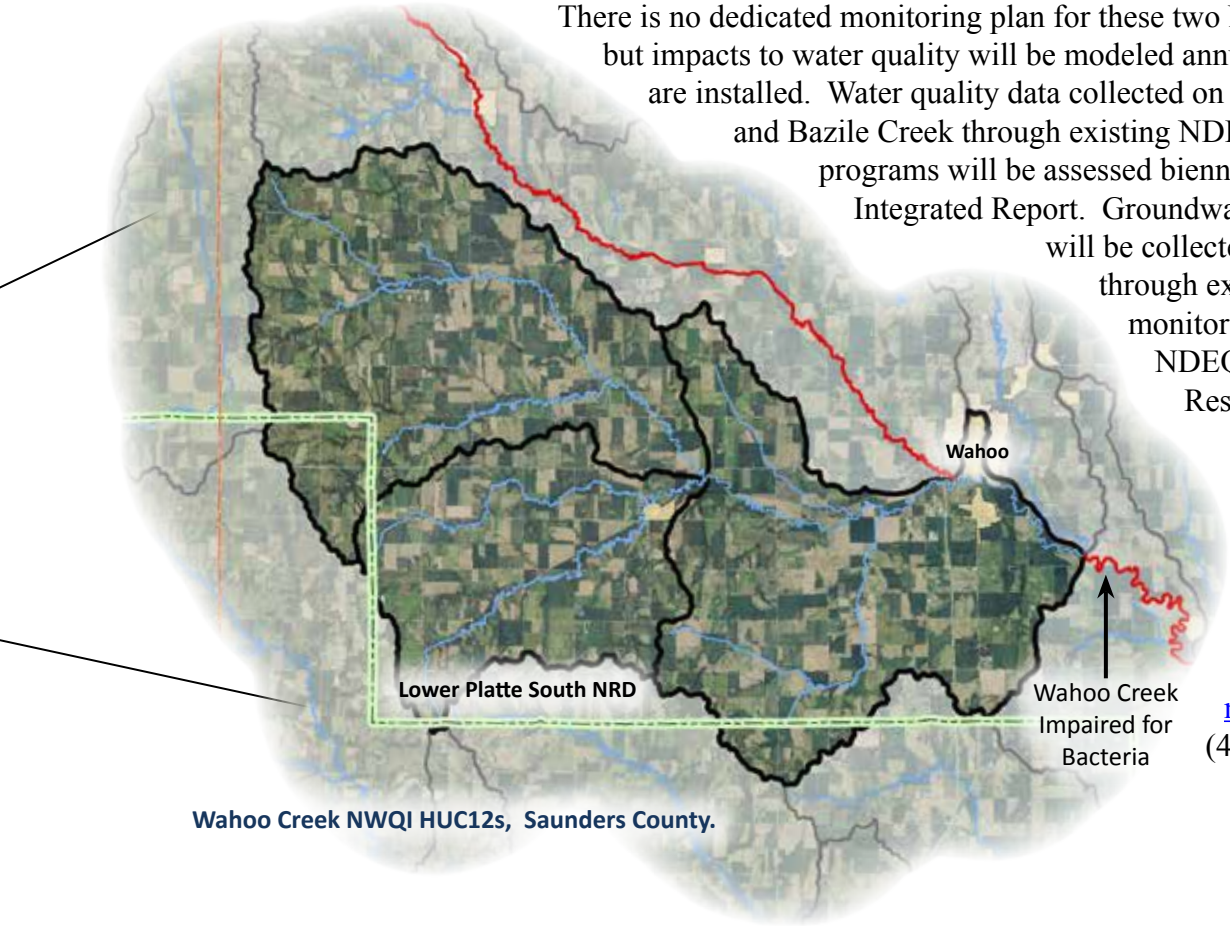
General location for the 2015 National Water Quality Initiative (NWQI) HUC 12s.

strips, cover crops, and nutrient management. In Nebraska, collaboration between USDA NRCS and the NDEQ Section 319 Program has resulted in leveraging funding from both programs for NWQI watersheds. USDA NRCS and NDEQ have worked closely together to select two NWQI areas for Nebraska: Wahoo Creek Watershed and Bazile Creek Water Quality Area. This is the second year these watersheds were selected to participate in this program.

Wahoo Creek Watershed has been a designated NWQI area since 2014. The area consists of three Hydrologic Unit Code subwatersheds (HUC 12) for a total of 70,245 acres. No additional HUC 12s were added in 2015. This watershed was chosen due to impairment of recreation by E.coli and lack of aquatic habitat. The primary conservation practices in this watershed are cover crops, no till, and terraces. In this NWQI area, the Lower Platte North Natural Resources District is the sponsor of the Clean Water Act Section 319 portion of the program and the Wahoo Creek Watershed Stakeholder Group has been involved in the planning process.

Bazile Creek Water Quality Area has been a designated NWQI area since 2014. In 2015, the Bazile Creek watershed eligibility area was expanded by another HUC 12, bring the area up to four HUC12s and a total of 87,059 acres. This watershed was chosen due to impaired recreational use of Bazile Creek due to high E.coli concentration and high concentration of nitrates in groundwater. Bazile has groundwater nitrate levels ranging from 3.7 to 18.9 mg/L and an average of 13 mg/L across the area. There are four Natural Resources Districts in this NWQI area that are serving as sponsors for the Clean Water Act Section 319 portion of the program: Lower Niobrara NRD, Lewis and Clark NRD, Upper Elkhorn NRD and Lower Elkhorn NRD. In addition, a local technical and community advisory council was established for this project to review information and establish goals and objectives for the area. Conservation practices funded through NWQI in this area include cover crops, nutrient and irrigation management.

There is no dedicated monitoring plan for these two NWQI projects, but impacts to water quality will be modeled annually as practices are installed. Water quality data collected on Wahoo Creek and Bazile Creek through existing NDEQ monitoring programs will be assessed biennially for the Integrated Report. Groundwater quality data will be collected annually through existing groundwater monitoring programs by NDEQ and local Natural Resources Districts.



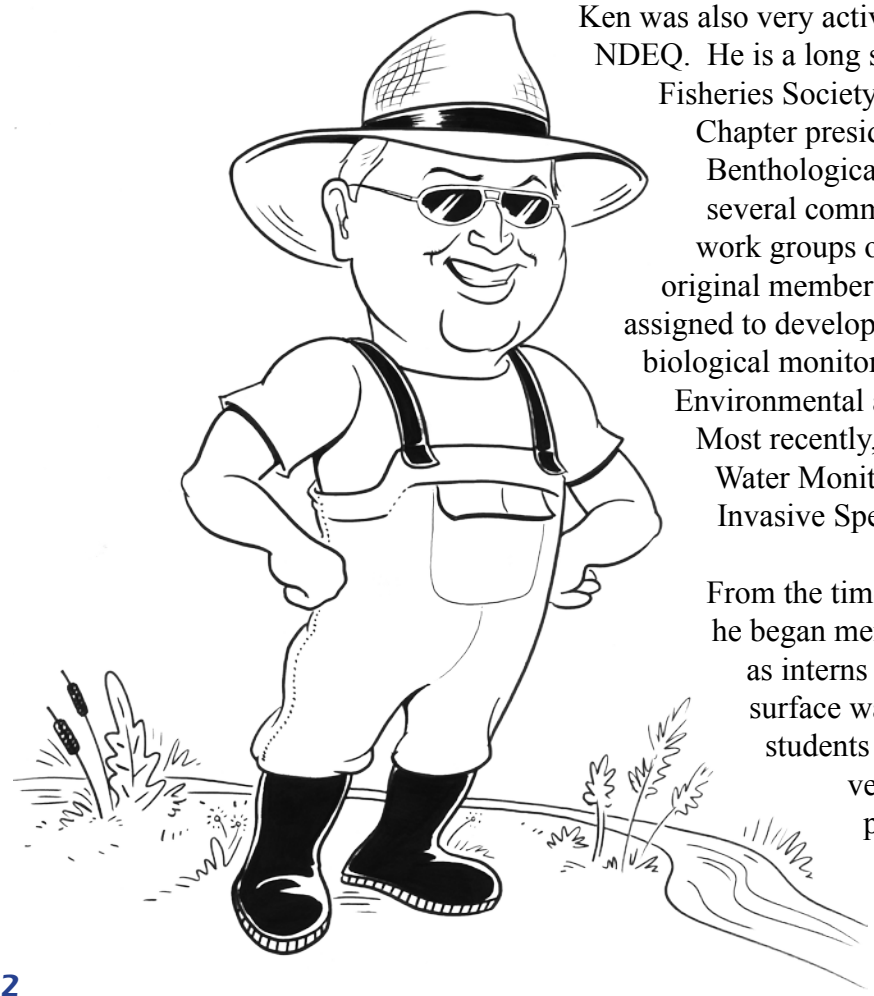
Wahoo Creek NWQI HUC12s, Saunders County.

More Information: Carla McCullough, carla.mccullough@nebraska.gov or (402) 471-3382.

Ken Bazata Retires from Department

This last July, Ken Bazata retired from NDEQ after working for the Department for over 30 years. Ken began working at NDEQ in 1985 after spending several years working for an environmental consulting firm. Given his background and experience working with aquatic systems and specifically aquatic macroinvertebrate community dynamics, Ken was assigned the task of assessing fish and macroinvertebrate data upon his arrival at NDEQ. Over the years, Ken became an authority on aquatic macroinvertebrate identification as well as biological community assessment. His work in refining these assessment procedures was instrumental in determining the biological condition of Nebraska's streams and identifying stream impairments. Ken maintained the Department's biological database which serves to provide fish and aquatic macroinvertebrate distribution information. Ken was very dedicated to the work he performed and ultimately to the protection and proper management of Nebraska's rivers and streams.

Ken Bazata recording stream habitat data at Hat Creek, Sioux County.



Ken was also very active outside of his regular duties at NDEQ. He is a long standing member of the American Fisheries Society including being a former Nebraska Chapter president and the North American Benthological Society. He has also served on several committees and has been a part of numerous work groups over his career. Ken was one of the original members of the work group formed by EPA assigned to develop stream sampling methodologies and biological monitoring assessments for the Regional Environmental and Assessment Program (REMAP). Most recently, Ken served on the Nebraska Surface Water Monitoring Council and the Nebraska Invasive Species Council.

From the time Ken first started working at NDEQ, he began mentoring young adults as they worked as interns for the Department. Working as a surface water intern is often the first job for students and recent graduates. Ken worked very hard to make sure that they utilized proper methodology, honed their identification skills, and continually

Ken Bazata recording stream habitat data at Hat Creek, Sioux County.

learned and enjoyed their work experiences. Over the years, approximately 180 interns have gained valuable career experience working alongside Ken in the field, laboratory, and office and many have went on to successful careers in water resources, environmental sciences, and related fields. In late 2015, Ken was worthy recipient of the Nebraska Chapter of the American Fisheries Society Distinguished Service Award and the Nebraska Wildlife Federation Wildlife Conservation Award based upon the expertise, guidance, and training that he has provided throughout his career as well as his commitment towards protecting and improving the environment and specifically the surface waters of Nebraska.

Ken Bazata (center) explaining aquatic insect identification to other NDEQ staff at Pawnee Creek, Lincoln County.

Documenting in-stream habitat, Cherry County.

We at NDEQ would like to thank Ken for the hard work and dedication he provided to our Department over the many years and also to congratulate him for receiving these awards. Best wishes and happy retirement Ken!

2005 REMAP sampling.