2014 Nebraska Water Monitoring Programs Report

Nebraska Department of Environmental Quality
Water Quality Division
Water Quality Assessment Section
January 2015

2014 Nebraska Water Monitoring Programs Report

Nebraska Department of Environmental Quality – Water Quality Division

January 2015

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, Ken Bazata, John Bender, Dave Bubb, Jeremy Hammen, Dan Inman, Laura Johnson, Carla McCullough, Greg Michl, Dave Miesbach, Lindsey Phillips, Brad Routt, and Dave Schumacher.

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

Please direct any general questions related to this report to the editors of this document, Marty Link, NDEQ, at (402) 471-4270 or marty.link@nebraska.gov or Ryan Chapman, NDEQ, at (402) 471-4227 or ryan.chapman@nebraska.gov.

Photo on Front Cover:

Nebraska Department of Environmental Quality (NDEQ) staff sampling aquatic macroinvertebrates for the Stream Biological Monitoring Program at Rush Creek, Sheridan County.

Table of Contents

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.

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 175,000 active registered wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2013, 3,415 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.

Windmill and Chimney Rock. Morrill 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.

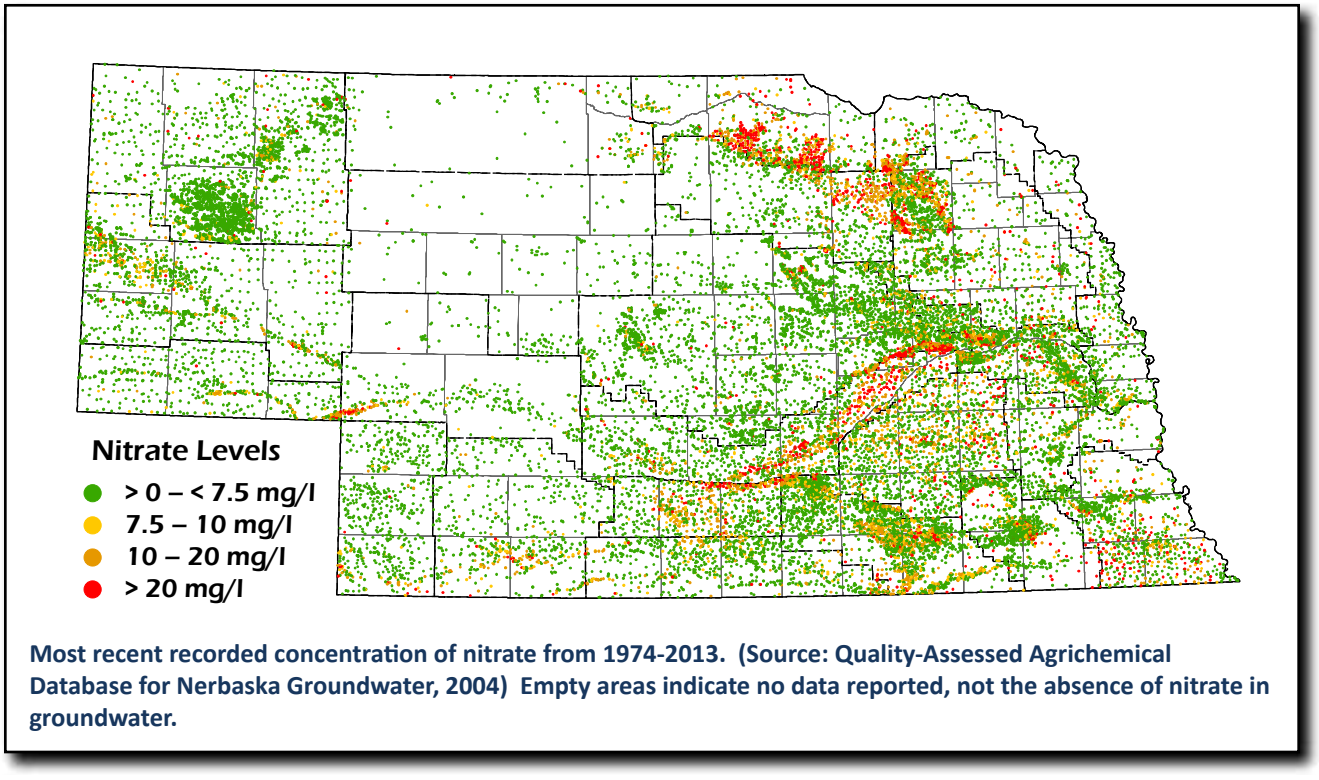
How is the Data Used?

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.

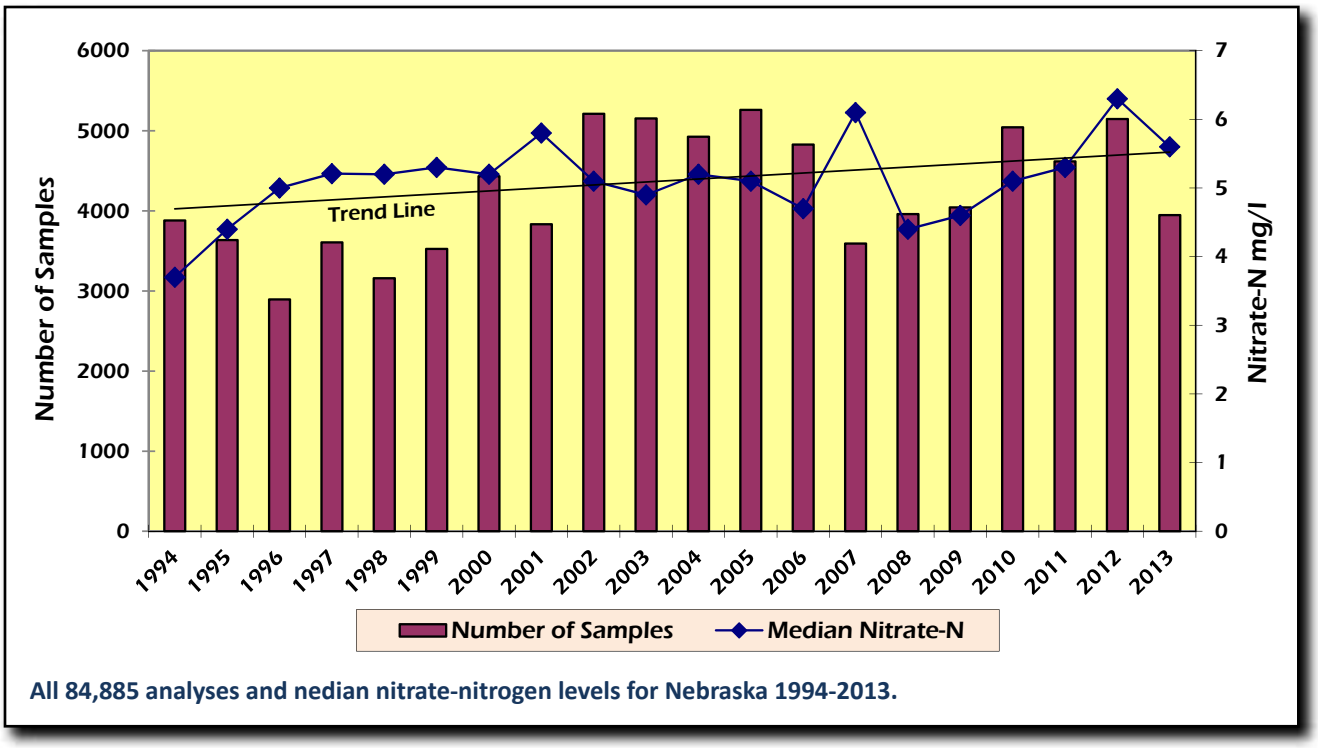
Sampling monitoring wells near Clearwater Nebraska, Antelope County.

Results as of 2013

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 1974-2013. (Source: Quality-Assessed Agrichemical Database for Nerbaska Groundwater, 2004) Empty areas indicate no data reported, not the absence of nitrate in groundwater.



All 84,885 analyses and nedian nitrate-nitrogen levels for Nebraska 1994-2013.

The most representative picture of the statewide nitrate concentration is from the time period from 1994 to 2013 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 Quality Monitoring Network Expansion

Why NDEQ Expanded The Network

In 2002, the State's Natural Resources Districts (NRD) and the Nebraska Department of Environmental Quality (NDEQ) began discussing a Statewide Monitoring Network (a defined subset of wells from the Database) with regularly sampled wells to help better assess Nebraska's groundwater quality and better develop and analyze trends. The first data for this network were assessed in the 2005 Groundwater Quality Monitoring Report using 1280 wells that were sampled in 2004. The 2006 report used 1,437 network wells, followed by 1,427 wells in 2007, 1,404 wells in 2008 and 2009, and 1,386 wells from 2010 through present for the Statewide Network trend analysis.

University of Nebraska Conservation and Survey Division (CSD) drilling test holes in the Lower Loup Natural Resources District (NRD) for the design of groundwater monitoring network wells.

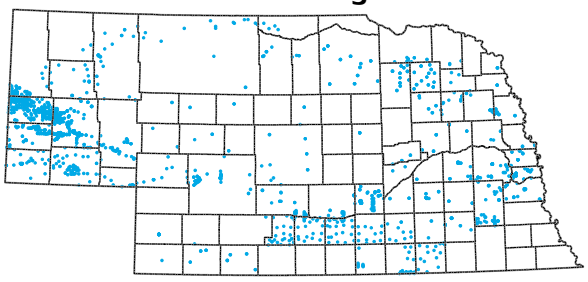
The Network wells were set up to be sampled on an annual basis to make data assessment more reliable and to complete trend analyses. Unfortunately, resources are not always available to the NRDs and not all of the wells are sampled on an annual basis. The data that are collected are still very useful and can still be used for trend analysis.

University of Nebraska Conservation and Survey Division (CSD) drilling test holes in the Lower Loup Natural Resources District (NRD) for the design of groundwater monitoring network wells.

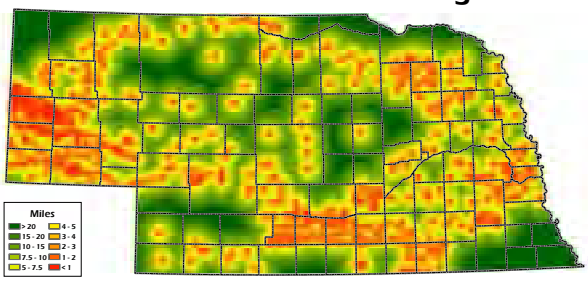
How Were the Locations Determined?

In 2014, the NDEQ had the opportunity to expand the Network utilizing federal and state funds. General locations for new Network wells were determined utilizing a Geographic Information System (GIS) computer model to analyze the locations of existing NRD dedicated monitoring wells, Wellhead Protection (WHP) areas, and Conservation and Survey Division (CSD) test holes (figure on next page). The map generated by this model was distributed to the NRDs and CSD to refine drilling/well locations. Using this method, NDEQ was able to place monitoring wells in areas that would benefit not only the Network, but also CSD for geologic information, NRD for management issues, and local communities. Since a majority of the wells were placed in or close to WHP areas, local communities will be able to use the information gathered from these wells to monitor any groundwater quality issue associated with their system.

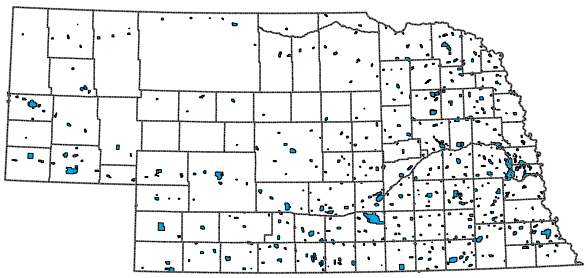
NRD Monitoring Wells



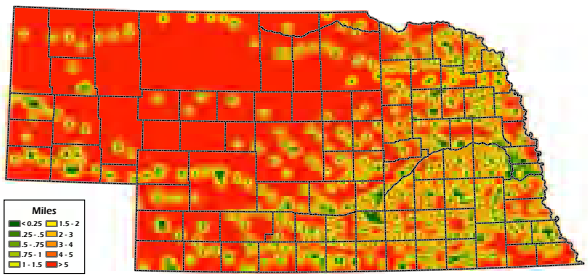
Distance From NRD Monitoring Wells



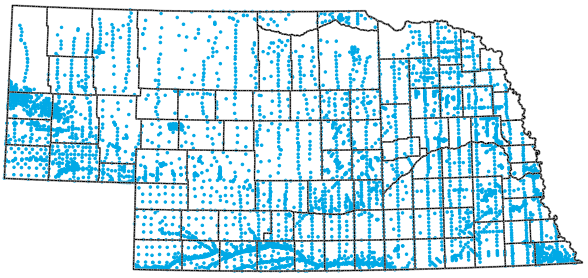
WHP Areas



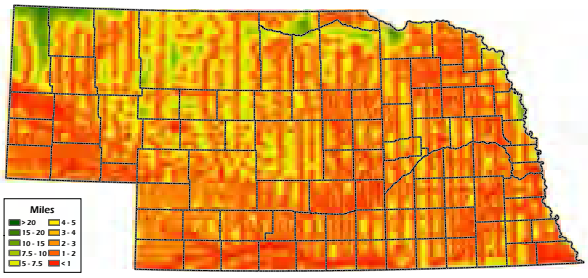
Distance From WHP Areas



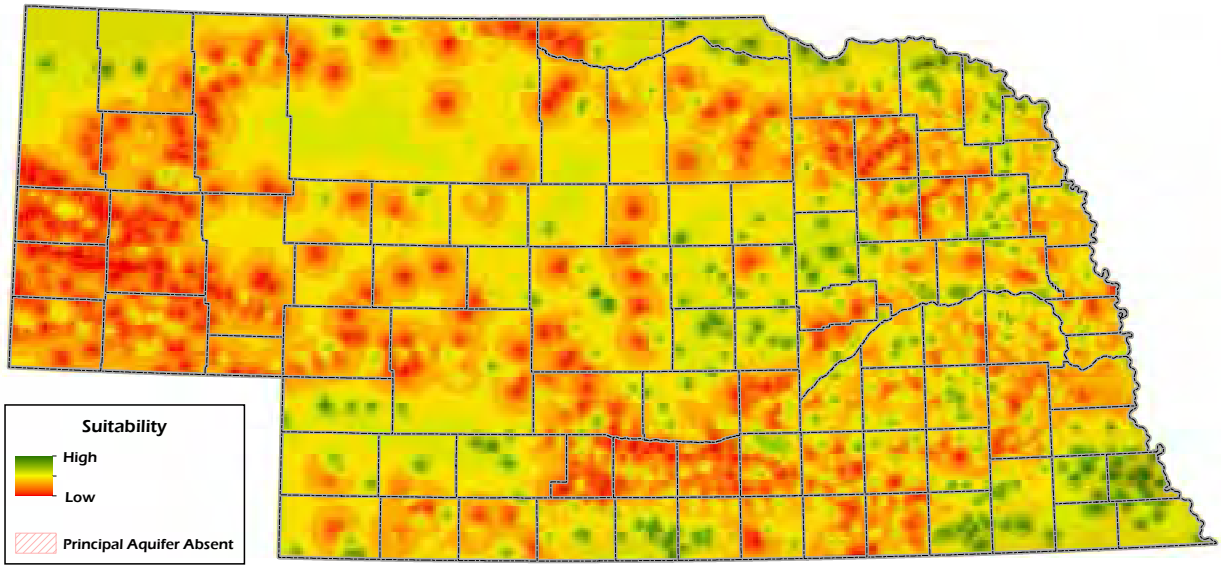
CSD Test Holes



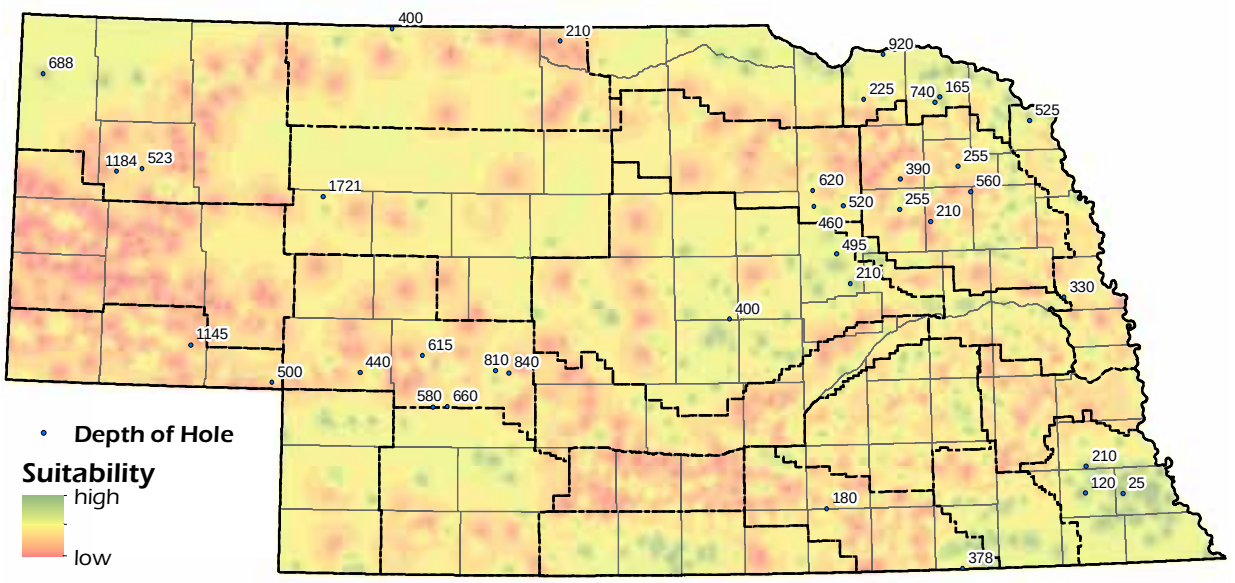
Distance From CSD Test Holes



Weighted Overlay = 50% Monitoring Wells, 40% WHP Areas, 10% Test Holes



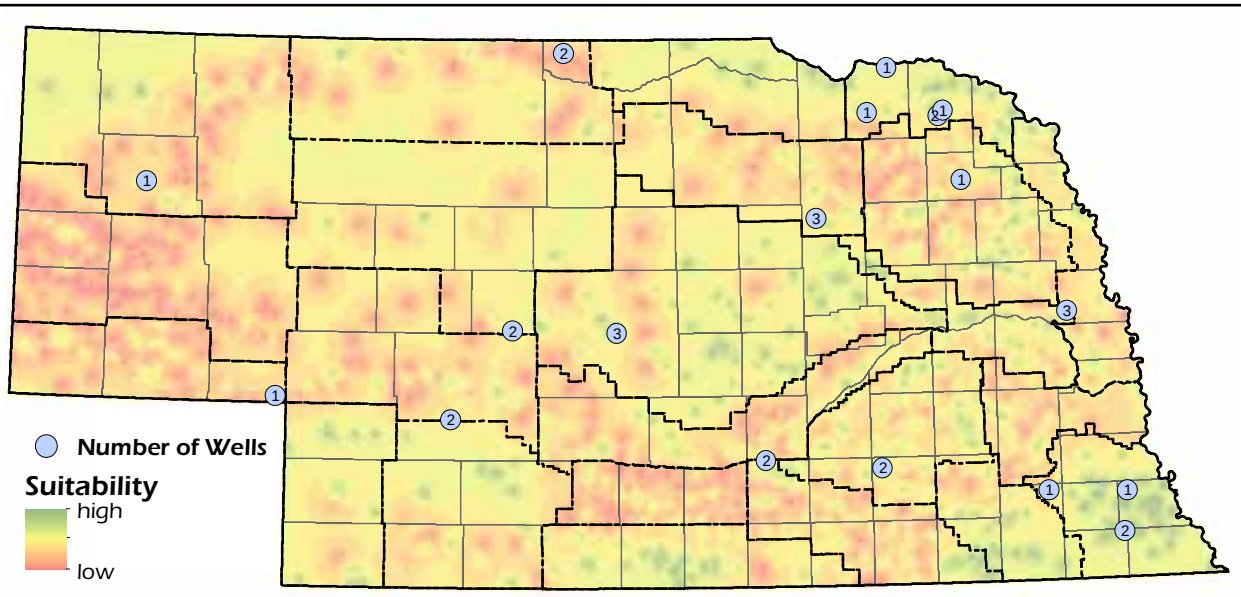
Modeling used to determine locations of test holes and new network wells.



Location of 37 test holes drilled by Conservation Survey Dicision (CSD) for new monitoring well network.

What Happened During the Project?

NDEQ contracted with CSD to drill and log a test hole at each proposed monitoring location. Test holes were drilled in 37 locations (in 13 NRDs) and representative samples of the sediments were collected and archived (map above). Also, CSD developed a lithological and geophysical log for each test hole (example on next page). Most of the test holes were drilled through the entire depth of the aquifer. In one case, the test hole was drilled to a depth of over 1,720 feet below ground level. After the test holes were completed, CSD provided NDEQ with a recommended monitoring well design. Two to three monitoring wells were recommended in a majority of the new locations. In these instances, each of the wells were screened in different portions of the aquifer instead of one long screen across the entire aquifer (typical in production wells). This method will allow making a distinction in water quality throughout the aquifer.



18 locations of 31 new monitoring wells to be utilized in the statewide groundwater monitoring network.

NDEQ contracted with a water well driller to construct 31 dedicated monitoring wells at 18 locations (bottom map on previous page). The NRDs secured access to the drill locations and committed to signing agreements to assume ownership, sample annually, and submit to the Database the sample results of each well.

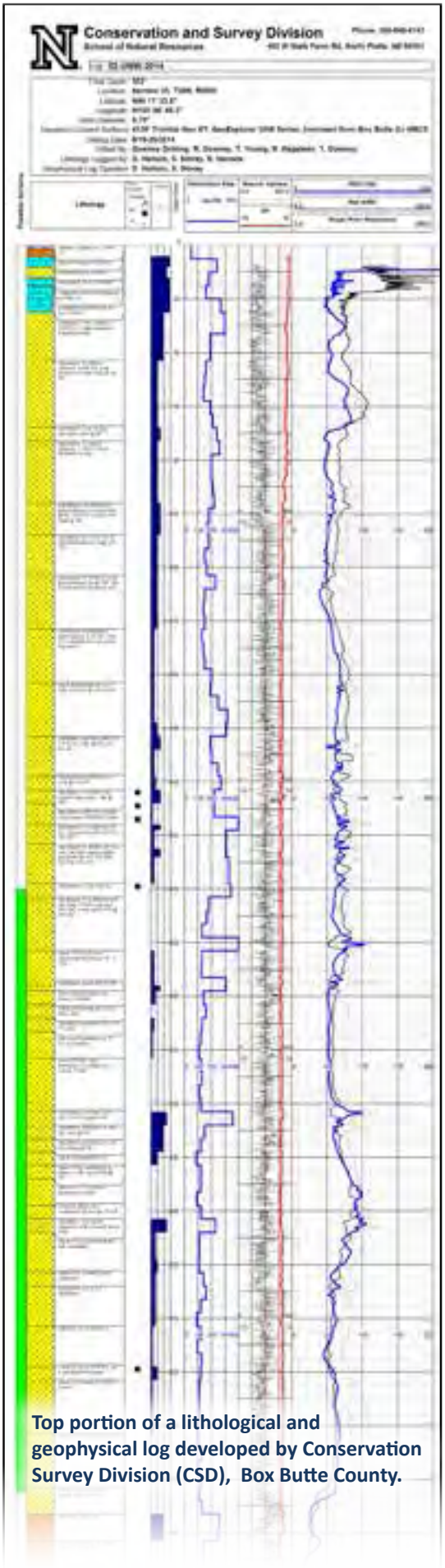
The most important aspect of the current Network is the ability to sample the wells on a regular basis. Some of the gaps in the Network actually have existing monitoring wells, but these wells may not get sampled because of access issues, time commitment, or poor data quality involved in manually bailing each well for samples. Equipping these wells with dedicated pumps for sampling allows Nebraska to greatly expand the Network without the cost of drilling new wells. These existing wells will receive dedicated sampling equipment in order to quickly sample groundwater without disturbing the water column and affecting the accuracy and precision of the data. Pump controls and electric generators were also purchased so that multiple sampling crews can operate statewide. Altogether, the equipment, pumps, controls, and generators allow for the collection of physical and chemical data on groundwater in locations where monitoring does not exist or is inadequate. Utilizing irrigation wells requires the well to be running at the time the sampler arrives. If the well is not running the sampler must return another time which in turn uses more resources. Monitoring wells with dedicated sampling equipment can be sampled anytime which reduces personnel costs. Therefore, NDEQ provided funds to 15 NRDs to purchase dedicated sampling equipment to be placed in over 100 active Network monitoring wells and the 31 new monitoring wells added this year.

How Will the Wells be Used?

The new monitoring wells will become part of the Network and dedicated pumping equipment will enable regular sampling. In addition to the wells the NDEQ funded, several NRDs took it upon themselves to contract the drilling of additional monitoring wells in locations where CSD drilled test holes.

More Information:

David Miesbach, david.miesbach@nebraska.gov or (402) 471-4982.



Top portion of a lithological and geophysical log developed by Conservation Survey Division (CSD), Box Butte County.

Groundwater Monitoring at Permitted Livestock Facilities

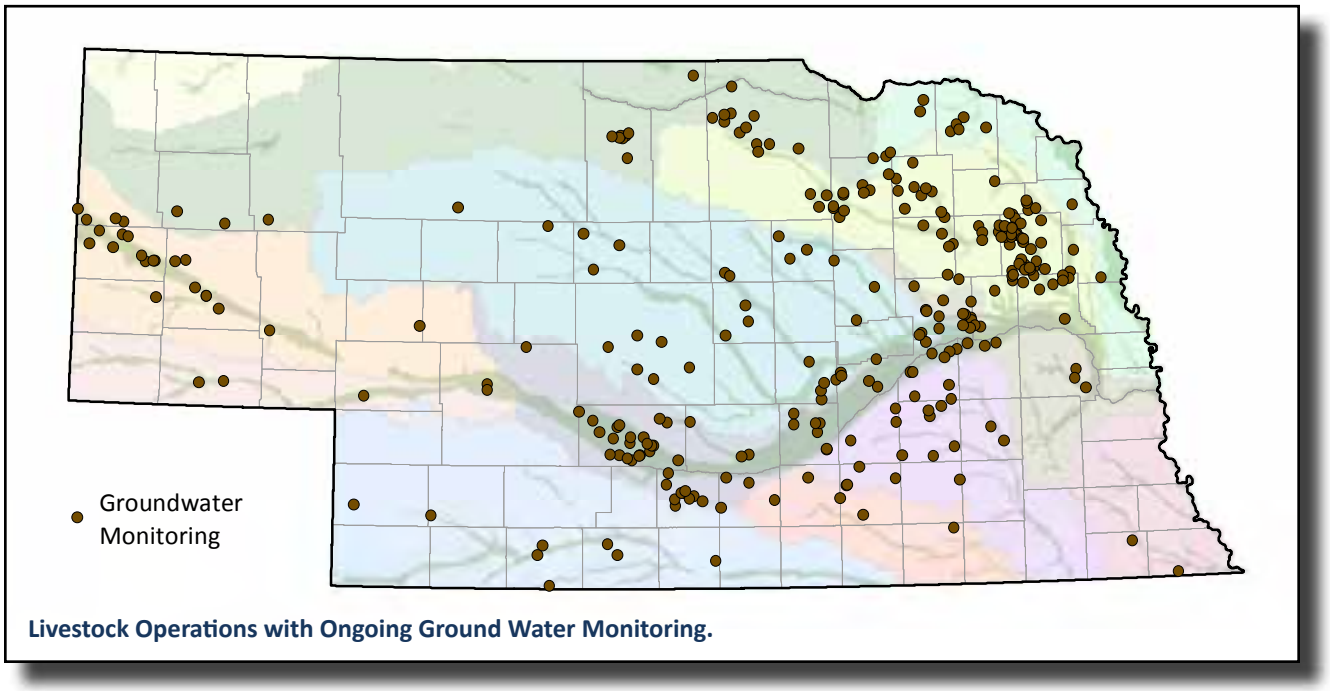
Why require monitoring at livestock facilities?

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 1,158 LWCFs (as of the beginning of November 2014) and recommended monitoring at 406 of them. Currently, there are 368 approved groundwater monitoring plans with 294 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 being 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,

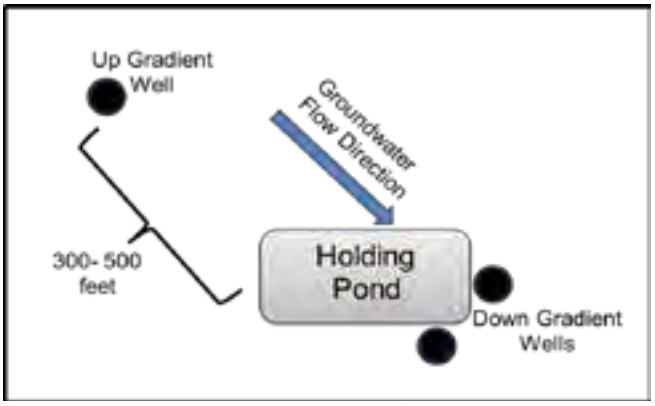
- depth to water,
- pH,
- temperature, and
- specific conductivity

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 diagram above 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 two 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.

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

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 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 (one 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.

Currently, 362 monitoring wells are actively sampled on a biweekly basis, 162 of these are deep monitoring wells and 200 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.

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.

Quality Assurance/Quality Control in 2013

In 2013, 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 (7 from deep monitor wells and 7 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.

Mechanical Integrity Test at Crow Butte Resources Inc., Dawes County.

During the 2013 calendar year, CBR reported two parameter exceedances. As of November 2014, two shallow monitoring wells and one deep monitoring well had parameter exceedances reported by CBR in 2014. All of these exceedances have been removed from excursion status. 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.

More Information:

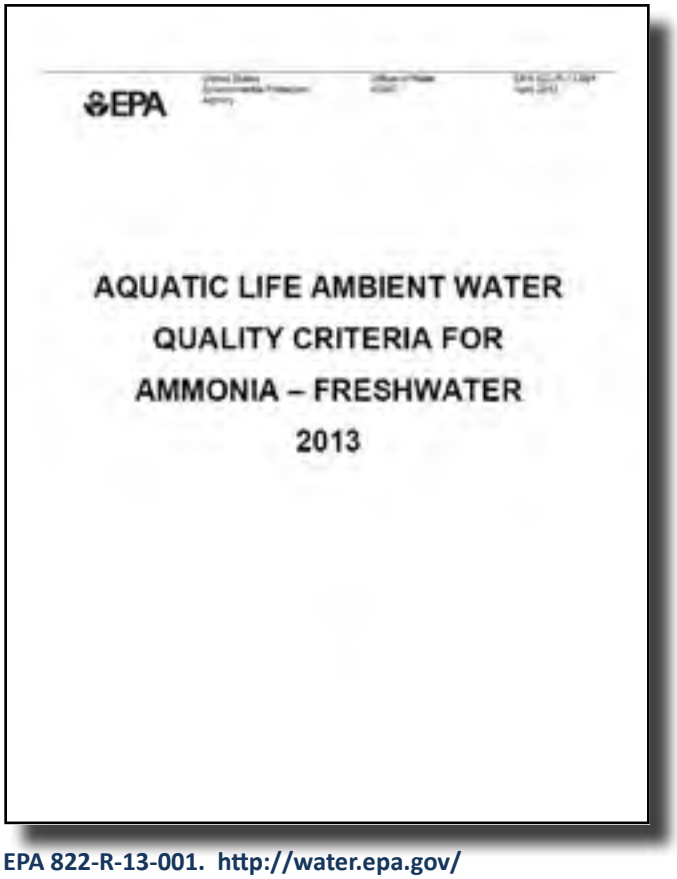
http://deq.ne.gov/NDEQProg.nsf/OnWeb/UIC
Nancy Harris, nancy.harris@nebraska.gov or (402) 471-4290

Title 117 (Surface Water Quality Standards) Update

Freshwater unionid mussels. Colfax County.

NDEQ develops water quality standards that designate the beneficial uses to be made of surface waters and the water quality criteria to protect these assigned uses. Title 117 - Nebraska Surface Water Quality Standards forms the basis of water quality protection for all surface water quality programs conducted by the Department. The federal Clean Water Act specifies that States review their water quality standards and revise where appropriate once every three years. NDEQ prepared proposed revisions to Title 117 as part of a triennial review package that was considered by the Environmental Quality Council in October 2014. Proposed revisions included more stringent ammonia criteria, new criteria for carbaryl, addition of new lakes and reservoirs, and a number of housekeeping changes.

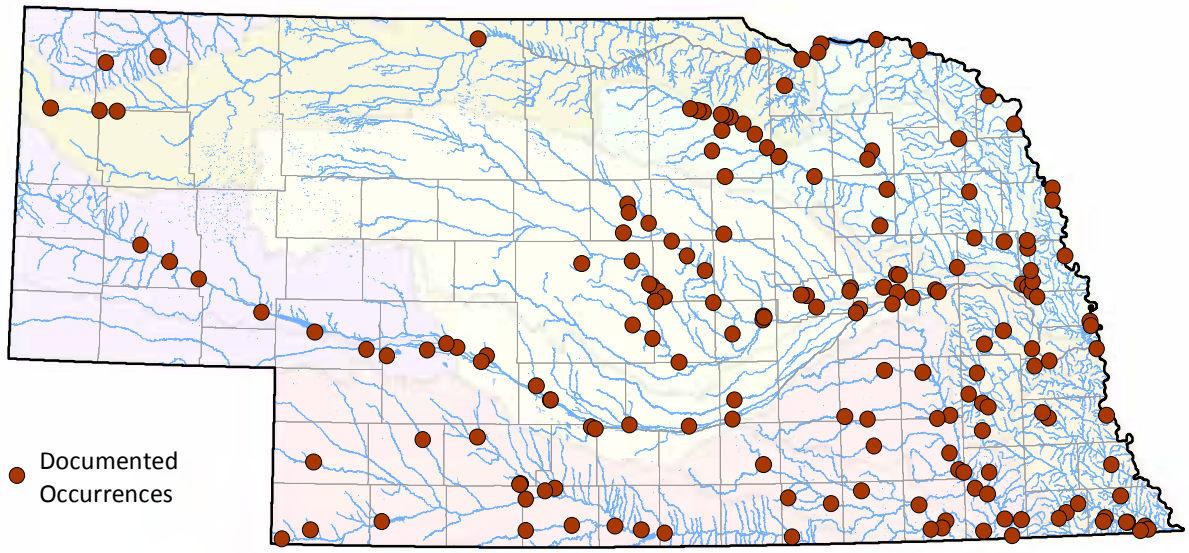
The most significant of these revisions deal with water quality criteria for ammonia. The US Environmental Protection Agency has adopted new Clean Water Act Section 304(a) criteria recommendations for ammonia based on new information about the toxicity of ammonia to aquatic life, specifically freshwater unionid mussels. EPA's new Section 304(a) ammonia recommendations are lower than their previous criteria recommendation. The proposed revisions to ammonia criteria in Title 117 are consistent with EPA's recommendations and are lower than what is currently adopted in Title 117. Considerable outreach was conducted with permittees, wastewater treatment plant operators, consultants, and other affected parties regarding the proposed ammonia criteria revisions.



EPA 822-R-13-001. http://water.epa.gov/

The proposed new criteria for carbaryl are identical to EPA's newly recommended Section 304(a) criteria to protect aquatic life from both acute and chronic toxicity. Prior to 2012, EPA had no recommended criteria, thus Nebraska had not adopted criteria. Carbaryl is a pesticide, commonly known as Sevin®.

Three newly constructed reservoirs were proposed to be added to the list of lakes and



Doccumented locations of freshwater mussels in Nebraska.

Freshwater unionid mussels. Colfax County.

reservoirs. Nine additional lakes or reservoirs that are under public management were proposed to be added to the list of lakes and reservoirs.

The proposed revisions were adopted by the Environmental Quality Council at their meeting on October 16, 2014. The revisions were forwarded to the Attorney General for review and the Governor for approval and filing with the Secretary of State. The Governor approved these revisions and they became effective State Regulations on December 13th, 2014. The revisions are awaiting EPA approval to be used in our Clean Water Act delegated programs. It is anticipated that this could occur by summer 2015.

None of the changes are anticipated to affect monitoring programs other than the addition of lakes as reservoirs to Chapter 6. These waterbodies will all be considered for monitoring as part of NDEQ's basin rotation network.

More Information:
http://deq.ne.gov/RuleAndR.nsf/Title_117.xsp
John Bender, john.bender@nebraska.gov or (402) 471-4201.

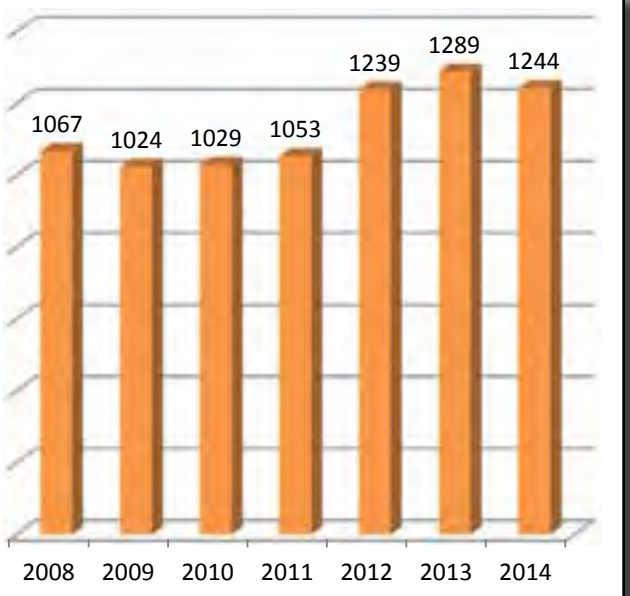
Public Beach Monitoring Program – Bacteria and Microcystin

Why Does NDEQ Monitor Public Beaches?

Nebraska's lakes and reservoirs provide a multitude of opportunities for visitors to enjoy the outdoors. Visitors to these areas often enjoy activities such as swimming, boating, skiing, jet skiing, etc. NDEQ wants to ensure that the users of these waters are have available 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 were attributed to deaths of a few 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 the odds are 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.

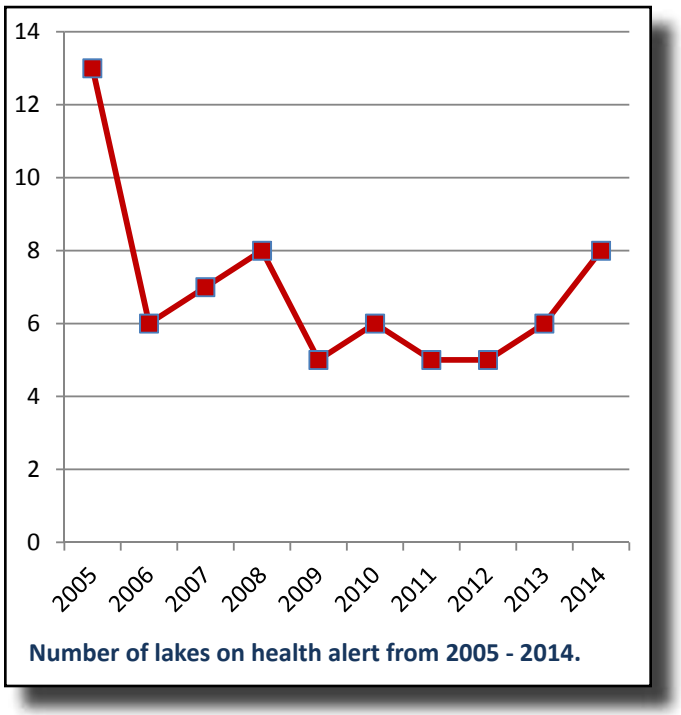
Toxins, including microcystin, are produced by certain types of blue-green algae. Microcystin in the water can cause skin rashes, lesions, and blisters on people who have been swimming or wading. If toxins are swallowed they can cause headaches, nausea, muscle or stomach pain, diarrhea, or vomiting. 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 soup green" 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 lake water sample at beaches early in the 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 (http://deq.ne.gov/NDEQProg.nsf/Beaches2014.xsp). 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 and the Nebraska Department of Health and Human Services (DHHS) 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.



Number of lakes on health alert from 2005 - 2014.

Camping, picnics, boating, fishing, and other non-contact 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 a person 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.

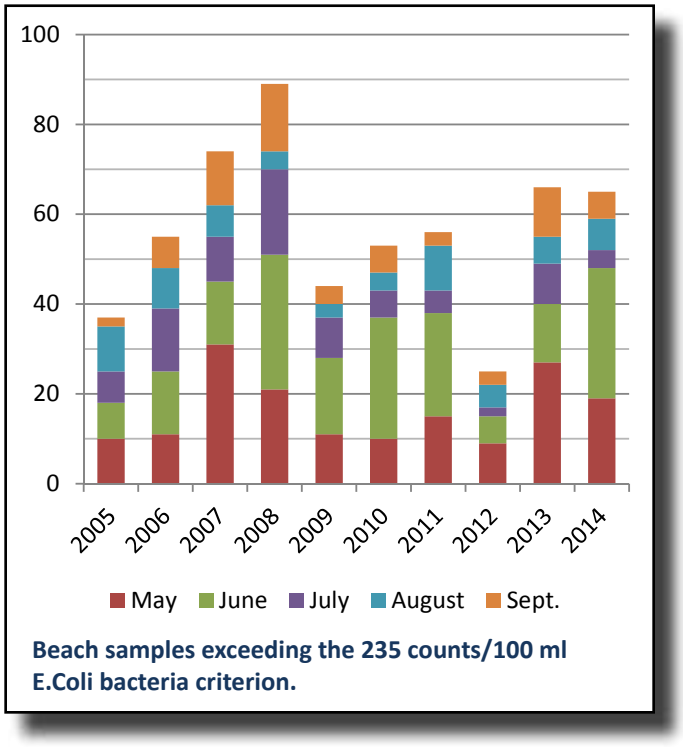
Lakes that repeatedly exceed the E. coli and microcystin water quality standard may be put on Nebraska's Clean Water Act 303d list of impaired waters.

2014 Results

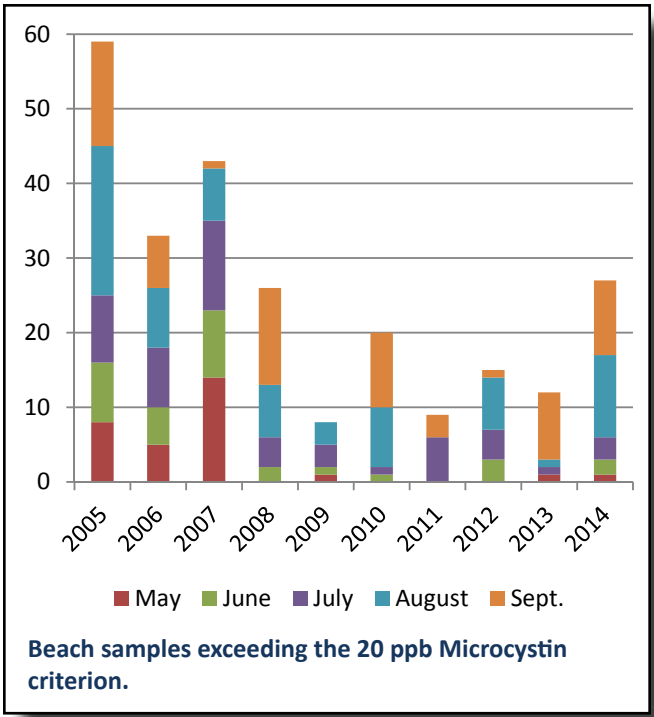
In 2014, the Beach Monitoring program collected and analyzed more than 1,200 samples for E. coli and the microcystin toxin.

Bacteria

Of the bacteria samples taken and analyzed during 2014, 65 samples (5.2%) exceeded the 235 counts/100ml of water standard. In the figure to the right, the number of samples that exceeded 235/100 ml criterion for bacteria by month for 2005 through 2014 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, 2008 saw higher than normal precipitation 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 2014, 26 samples exceeded the 20 ppb threshold for closing a beach. This accounts for only 2.0% of the total samples collected.

In 2014, eight lakes were placed on Health Alert. The map on the following page shows the lakes that had samples exceed the 20 ppb health standard and the number of weeks they were under a Health Alert.

The chart (left) illustrates the number of samples exceeding the 20 ppb microcystin criterion monthly for 2005 through 2013. 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 at 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

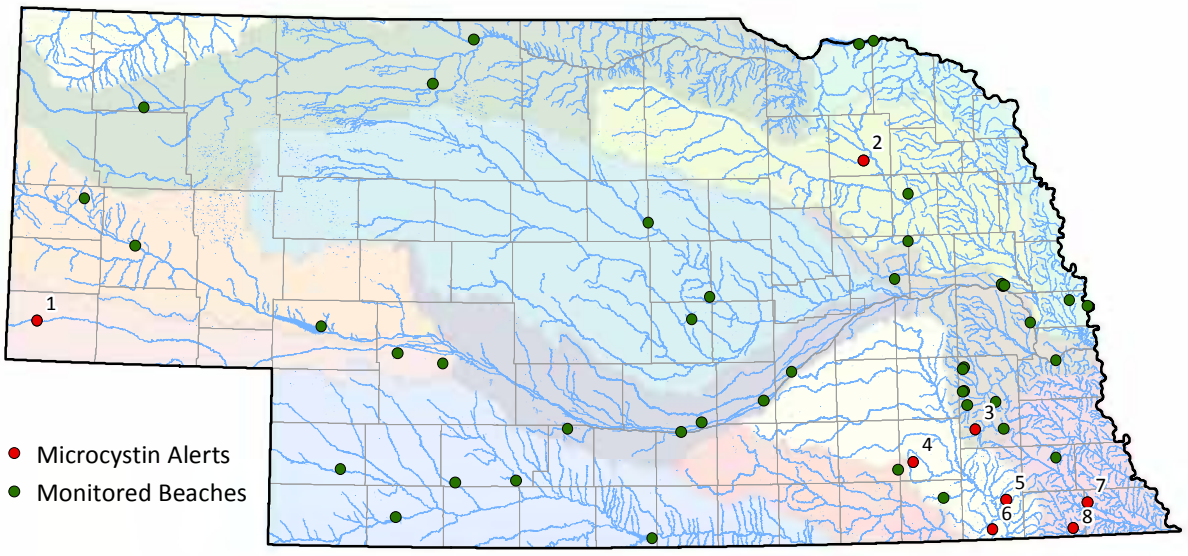
Algal bloom in a Nebraska reservoir.

• Increased cloud cover which implies reduced sunlight and lower water temperatures.

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, 2011 was characterized by very heavy spring rainfall and relatively full lakes 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.



Public beaches monitored and those with microcystin alerts in 2014. Numbers correspond to the table below.

Map #	Waterbody	County	Samples Exceeding Health Limit	Weeks on Health Warning
1	Oliver Reservoir	Kimball	1	2
2	Willow Creek	Madison	4	6
3	Bluestem	Lancaster	3	5
4	Swan Creek	Saline	2	4
5	Rockford Lake	Gage	1	2
6	Big Indian	Gage	4	7
7	Kirkmans Cove	Richardson	6	11
8	Iron Horse	Pawnee	5	6

More Information:
http://deq.ne.gov/NDEQProg.nsf/Beaches2014.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

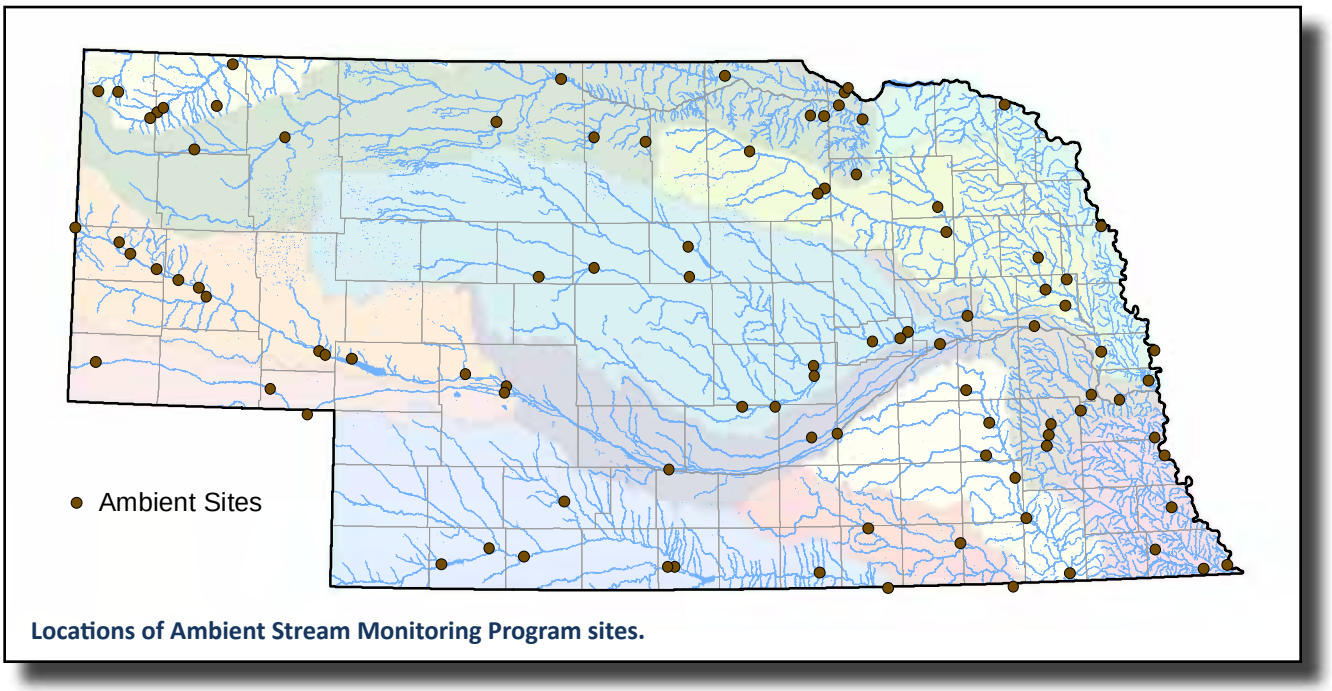
Why Does NDEQ Monitor Streams?

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 industrial 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.

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 indicates a water quality problem, NDEQ uses this 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.

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. The map below shows the locations of the 97 monitoring sites.



Locations of Ambient Stream Monitoring Program sites.

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 regions 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 Verdigre Creek, South of Verdigre, Knox County.

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

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.

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 . The report's direct URL is: http://deq.ne.gov/NDEQProg.nsf/PubsForm.xsp?databaseName=CN=DEQSER6/O=NDEQ!!Publica.nsf&documentId=3EEEED335D69116C86257CCB004D835C&action=editDocument

Preserving an Ambient Stream Monitoring Program (ASMP) sample.

Ammonia		
Waterbody Name	**Trend**	**P-value**
Big Blue River	Stable	0.28
West Fork Big Blue River	Stable	0.43
Elkhorn River	Stable	0.11
Pebble Creek	Decreasing	<0.01
Little Blue River	Stable	0.28
Big Sandy Creek	Stable	0.22
Loup River Power Canal	Stable	0.87
South Loup River	Stable	0.87
Platte River	Stable	0.18
Salt Creek	Decreasing	<0.01
Missouri River	Decreasing	0.05
Papillion Creek	Stable	0.10
Big Nemaha River	Stable	0.19
Little Nemaha River	Decreasing	0.03
Niobrara River	Increasing	0.02
Plum Creek	Stable	0.70
North Platte River	Stable	0.07
Winters Creek	Stable	0.48
Republican River	Decreasing	0.01
Medicine Creek	Stable	0.75
South Platte River	Stable	0.31
Lodgepole Creek	Stable	0.31
White Creek	Stable	0.33

Trend analysis results for ammonia from NDEQ's Ambient Stream Monitoring Network.

Trends

The design of the Ambient Stream Monitoring Program also allows the NDEQ to recognize trends in stream water quality and determine the efficacy of current pollution control strategies.

For example, the table (left) shows the trend results from one parameter (Ammonia). The results of the analysis can be: increasing trend observed, decreasing trend observed, and stable water quality (not increasing or decreasing). The Department considers a trend to be significant when the p-value is ≤ 0.05 (the probability of the observed trend being due to random chance is less than 5%).

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/ASM\

David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.
Jeremy Hammen, jeremy.hammen@nebraska.gov or (402) 471-4232.

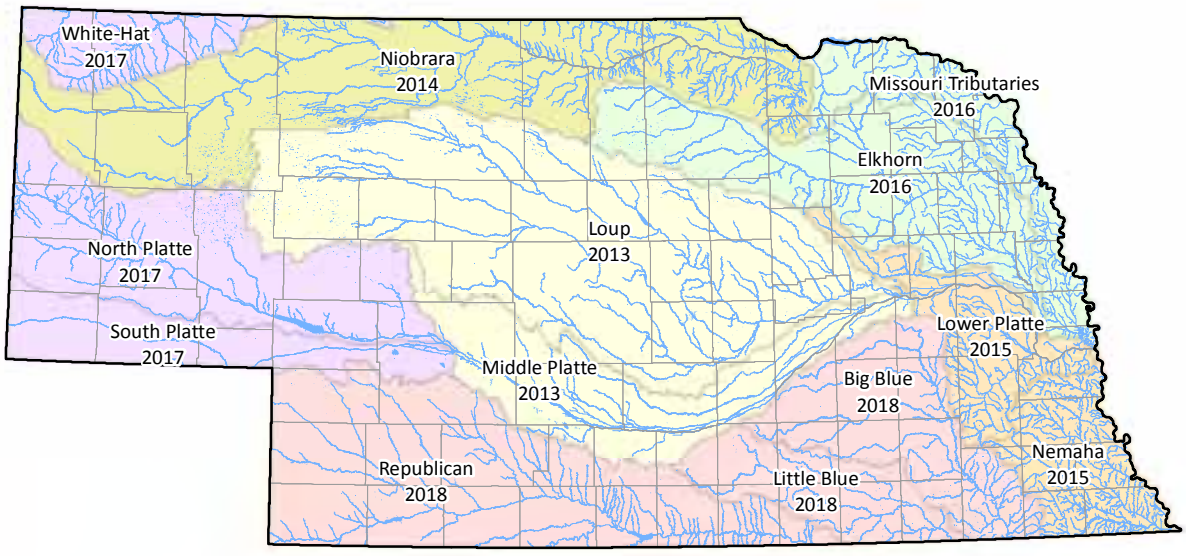
Basin Rotation Monitoring Program

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 to 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 2014, a total of 41 streams were sampled in the Niobrara Basin with monitoring assistance provided by the National Park Service (Agate National Monument), and the Middle Niobrara and Upper Elkhorn NRDs. This sampling resulted in 902 water quality samples being collected. The map below shows the basins and their rotation schedule.



NDEQ six-year basin rotation monitoring schedule

Collecting water samples from Plum Creek, Brown 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 is able to support its designated uses. The following physical and chemical parameters are collected at each site: ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus, chloride, total suspended solids, turbidity, pH, water temperature, conductivity, dissolved oxygen, E. coli bacteria, and pesticides.

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/PubsForm.xsp?databaseName=CN=DEQSER6/O=NDEQ!!Publica.nsf&documentId=3EEEED335D69116C86257CCB004D835C&action=editDocument

Jeremy Hammen, jeremy.hammen@nebraska.gov or (402) 471-4232.
Dave Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Reading stream guage height, Brown County

Stream Biological Monitoring Program

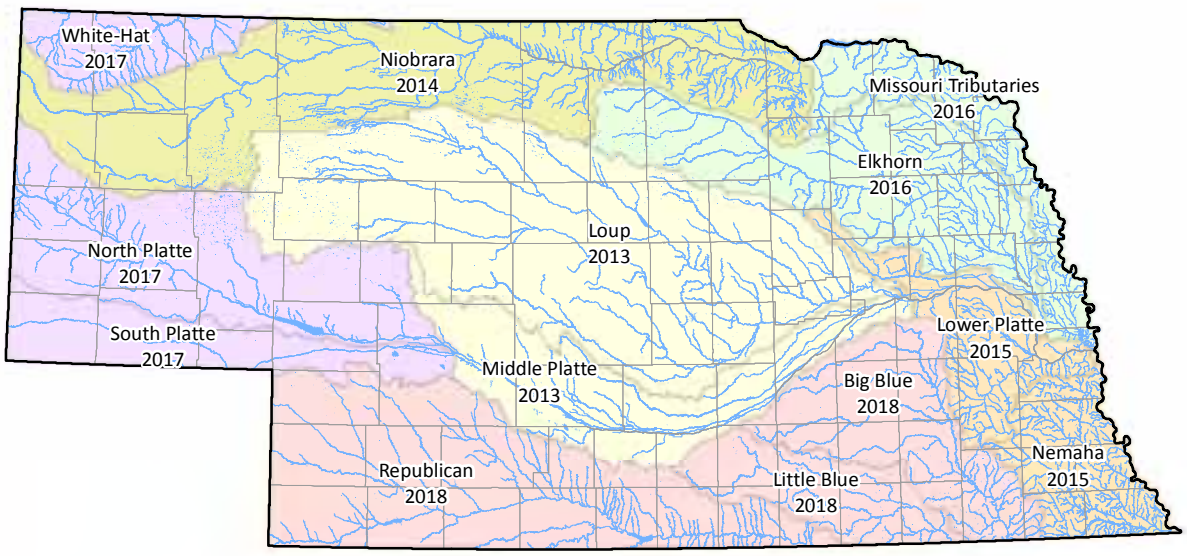
Why Biological Monitoring?

Nebraska has over 81,000 miles of streams of which nearly 18,000 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.



NDEQ six-year basin rotation monitoring schedule

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 Redhorse 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.

Sampling aquatic macroinvertebrates in Pawnee Creek, Lincoln County.

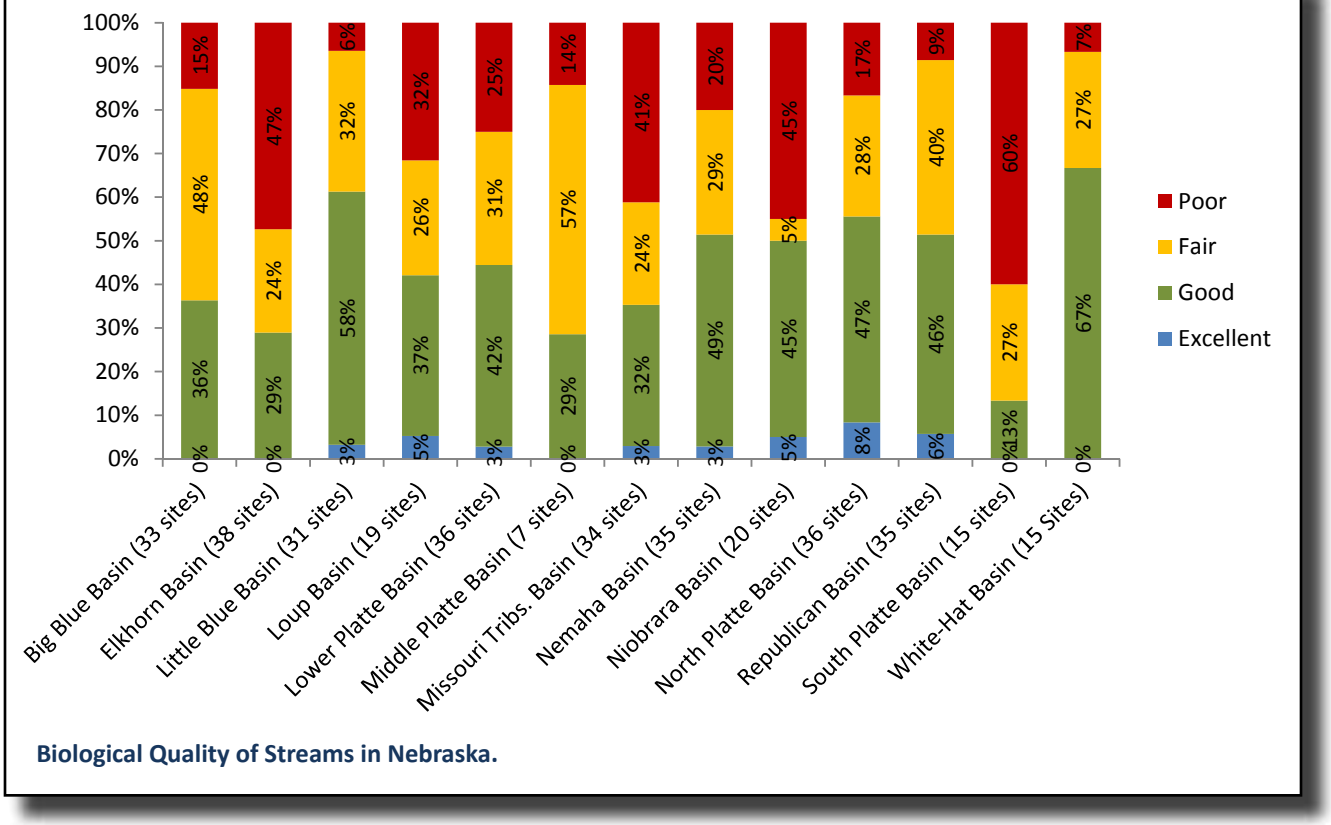
Under the federal Clean Water Act, states are required to develop programs to evaluate the physical, chemical, and biological integrity of the Nation's waters and to adopt water quality standards to restore and maintain that integrity. States are required to prepare a biennial water quality report called 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.

Results

Biological data from 354 random sites were used to characterize the condition of wadeable streams in the 13 major river basins in Nebraska (see bar graph below). Data from the latest completed round of surveys (2004-2012) were used to assess the water quality of streams in the Big Blue, Elkhorn, Little Blue, Loup, Lower Platte, Middle Platte, Missouri Tributary, Nemaha, Niobrara, North Platte, Republican Basins, South Platte, and White-Hat Basins.

The results of the survey show the White-Hat and Little Blue Basins are in the best condition of the basins evaluated with 67% and 58% of the streams in good condition, respectively. The streams in the remaining basins are considerably

Sampling aquatic macroinvertebrates in Pawnee Creek, Lincoln County.



Biological Quality of Streams in Nebraska.

lower in quality. The South Platte Basin presents the most concerns with only 13% of the streams in good condition and 60% of 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 introducedinto the streams by non-point source pollution from agricultural practices such as crop production (see photo below) 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.

2013 Update

Thirty-four stream locations were sampled as part of the 2013 SBMN (see figure to right).

Preliminary assessments of the biological collections made in 2013 are provided in the following charts. Relative species abundance and species richness describe key elements of biodiversity which the Department uses to determine stream

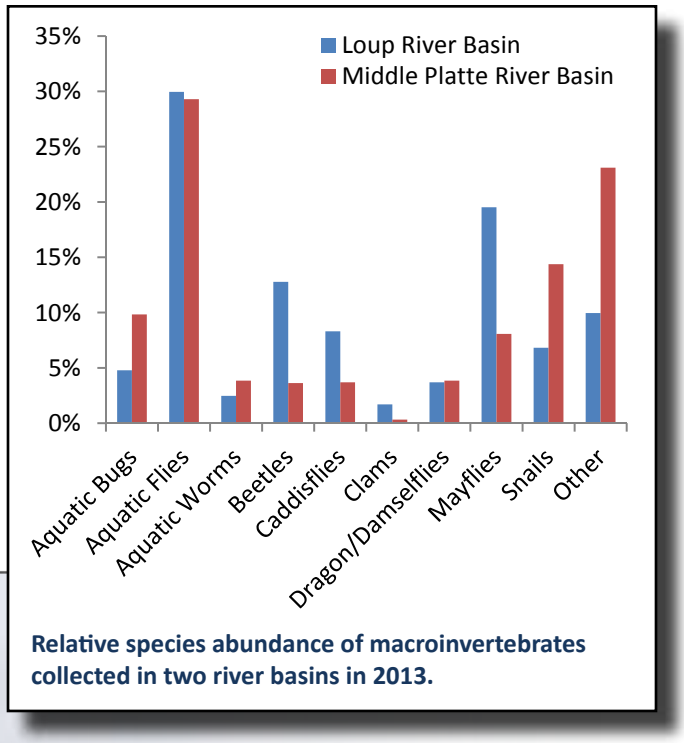
2013 sampling locations in the Loup & Middle Platte basins.

health. Relative species abundance refers to how common or rare a species is relative to other species in a given stream location while species richness simply refers to the number of species collected.

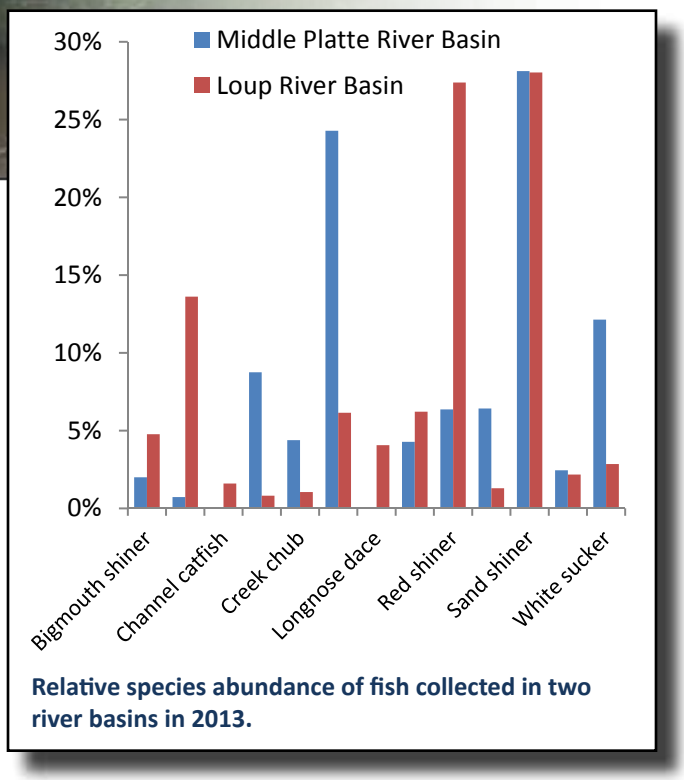
Twenty-seven fish species were collected in the Middle Platte River Basin and 39 species were collected in the Loup River Basin. Sand shiner, fathead minnow, white sucker, and creek chub were the most common fish species in the Middle Platte River Basin. Sand shiner, red shiner, brassy minnow, and fathead minnow were the most abundant fish species in the Loup

Documenting in-stream habitat, Cherry County.

River Basin. The most abundant of the major macroinvertebrate taxa included the larval life stages of the midges (aquatic flies), mayflies, and beetles in the Loup River Basin and midges (aquatic flies), snails, and aquatic bugs in the Middle Platte Basin.



Relative species abundance of macroinvertebrates collected in two river basins in 2013.



Relative species abundance of fish collected in two river basins in 2013.

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/SBMP
Ken Bazata, ken.bazata@nebraska.gov or (402) 471-2192.
Jeremy Hammen, jeremy.hammen@nebraska.gov or (402) 471-4232.

Ambient Lake Monitoring Program

Why Monitor Lakes and Reservoirs?

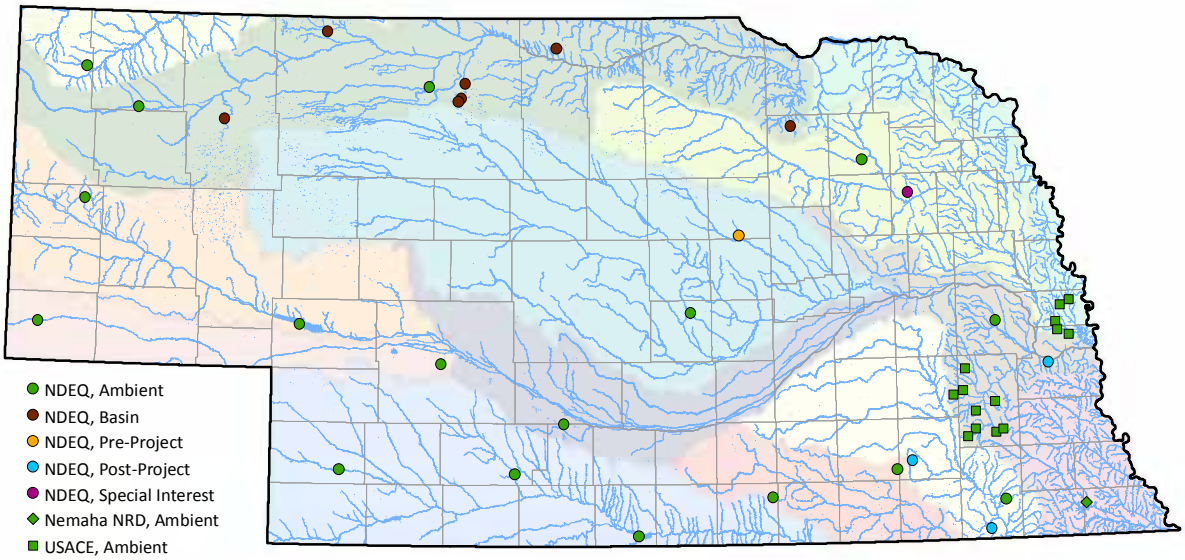
Nebraska's natural lakes and man-made reservoirs have different public usage throughout the year. NDEQ monitors these resources to determine if water quality is sufficient for recreational activities such as swimming and water skiing, and suitable for fish and other aquatic organisms to survive and reproduce.

Sample set at 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 2014, 43 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 deepwater site (deepest area) of each lake. These sites are sampled for physical/chemical parameters such as water temperature, dissolved oxygen (DO), pH, conductivity, water clarity, total suspended solids, ammonia, nitrate-nitrite nitrogen, kjeldahl nitrogen, total phosphorus, alkalinity, chloride, chlorophyll a, and select pesticides.



Lake sampling locations for 2014 (does not include fish tissue sites).

In addition, surface to bottom profiles are collected for temperature, DO, pH, and conductivity. 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.

Determine 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, Municipalities, Nebraska Game and Parks Commission, and USDA-Natural Resources Conservation Service 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/NDEQProg.nsf/OnWeb/TMDL.

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 things, 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.

Determining field parameters at Merritt Reservoir, Cherry County.

The accumulation of contaminants in the tissue of fish is a growing concern across the country. Approximately 35 percent of the lakes assessed 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 Merritt Reservoir, Cherry 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.

More Information:

Mike Archer, mike.archer@nebraska.gov or 402-471-4224.
Dave Bubb, dave.bubb@nebraska.gov or (402) 471-2810.

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-accumulate 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 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 2014, a total of 63 fish tissue samples were collected from 9 streams and 26 lakes in the Niobrara River Basin 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 State's 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.

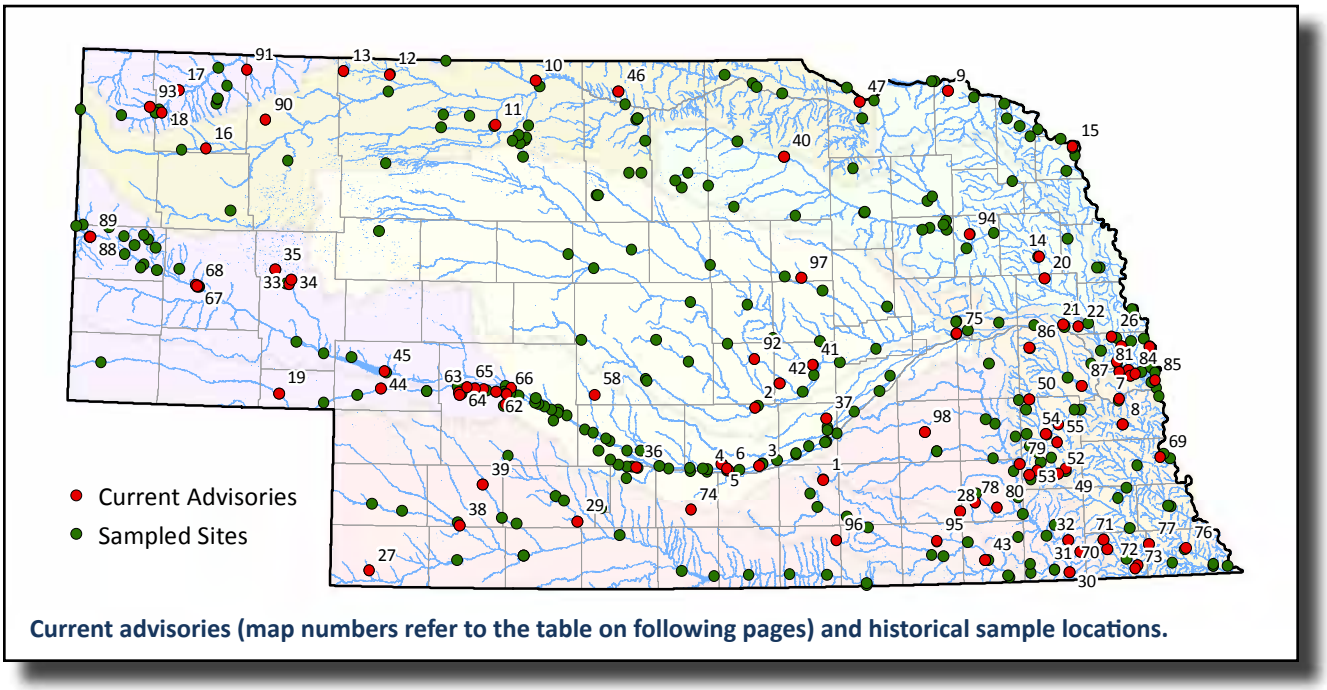
Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with the NDEQ, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where high concentrations of contaminants may indicate 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 2014, the NDHHS, in cooperation with the NDEQ, the NGPC, and the NDA, has issued fish consumption advisories for 98 waterbodies, which includes 12 designated stream segments and 85 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 2012

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
1	Lake Hastings	Adams	Common Carp	PCBs
2	Ravenna Lake	Buffalo	Largemouth Bass	Mercury
3	Bassway Strip Lake No. 5	Buffalo	Largemouth Bass	Mercury
4	Kea Lake	Buffalo	Largemouth Bass	Mercury
5	Cottonmill Lake	Buffalo	Largemouth Bass	Mercury
6	Yanney Park Lake	Bufflalo	Largemouth Bass	Mercury, Selenium
7	Platte River	Cass	Channel Catfish	PCBs, Mercury
8	Weeping Water City Lake	Cass	Largemouth Bass	Mercury, Selenium
9	Chalkrock Reservoir	Cedar	Largemouth Bass	Mercury, Selenium
10	Valentine Mill Pond	Cherry	Largemouth Bass	Mercury
11	Merritt Reservoir	Cherry	Walleye	Mercury
12	Cottonwood Lake	Cherry	Largemouth Bass	Mercury
13	Shell Lake	Cherry	Northern Pike	Mercury
14	West Point City Lake	Cuming	Largemouth Bass	Mercury
15	Crystal Cove Lake	Dakota	Largemouth Bass	Mercury
16	Box Butte Reservoir	Dawes	Northern Pike	Mercury
17	Whitney Reservoir	Dawes	White Bass	Mercury
18	Grabel Pond #5	Dawes	Largemouth Bass	Mercury, Selenium
19	Chappell Interstate Lake	Deuel	Largemouth Bass	Mercury, Selenium
20	Dead Timber Lake	Dodge	Largemouth Bass	Mercury
21	Fremont Lake No. 1	Dodge	Largemouth Bass	Mercury
22	Johnson Lake	Dodge	Largemouth Bass	Mercury
23	Zorinsky Lake	Douglas	Largemouth Bass	Mercury
24	Carter Lake	Douglas	Largemouth Bass	PCBs
25	Standing Bear Lake	Douglas	Largemouth Bass	Mercury
26	Prairie View Lake	Douglas	Largemouth Bass	Mercury
27	Rock Creek Lake	Dundy	Largemouth Bass	Mercury
28	Lone Star Reservoir	Fillmore	Largemouth Bass	Mercury
29	Medicine Creek Reservoir	Frontier	Largemouth Bass	Mercury
30	Big Blue River	Gage	Common Carp	PCBs, Dieldrin
31	Wolf-Wildcat Lake	Gage	Largemouth Bass	Mercury
32	Rockford Lake	Gage	Largemouth Bass	Mercury
33	Crescent Lake	Garden	Largemouth Bass	Mercury
34	Island Lake	Garden	Largemouth Bass	Mercury
35	Smith Lake	Garden	Largemouth Bass	Mercury
36	Phillips Lake	Gosper	Common Carp	Mercury
37	Eagle Scout Lake	Hall	Largemouth Bass	Mercury
38	Frenchman WMA Lake	Hayes	Largemouth Bass	Mercury
39	Hayes Center WMA Lake	Hayes	Largemouth Bass	Mercury
40	O'Neill City Lake	Holt	Largemouth Bass	Mercury
41	North Loup SRA Lake	Howard	Largemouth Bass	Mercury, Selenium
42	Farwell South Reservoir	Howard	Largemouth Bass	Mercury

43	Crystal Springs NW Lake	Jefferson	Channel Catfish	PCBs, Mercury
44	Ogallala City Park Lake	Keith	Channel Catfish	PCBs, Chordane
45	Lake McConaughy	Keith	Walleye	Mercury, Selenium
46	Cub Creek Lake	Keya Paha	Largemouth Bass	Mercury
47	Niobrara River	Knox	Common Carp	Mercury, Selenium
48	Salt Creek	Lancaster	Common Carp	PCBs, Mercury
49	Wagon Train Lake	Lancaster	Largemouth Bass	Mercury
50	Wildwood Reservoir	Lancaster	Largemouth Bass	Mercury
51	Bluestem Lake	Lancaster	Channel Catfish	Mercury
52	Stagecoach Lake	Lancaster	Largemouth Bass	Mercury
53	Merganser Lake	Lancaster	Largemouth Bass	Mercury
54	Oak Creek	Lancaster	Channel Catfish	PCBs, Mercury
55	Holmes Lake	Lancaster	Largemouth Bass	Mercury
56	North Platte River	Lincoln	Largemouth Bass	Mercury
57	Maloney Res. Outlet Canal (above hydro)	Lincoln	Common Carp	Mercury
58	Sutherland Outlet Canal	Lincoln	Common Carp	PCBs, Mercury
59	Interstate Lake	Lincoln	Largemouth Bass	Mercury
60	East Hershey Lake	Lincoln	Largemouth Bass	Mercury
61	Hershey Lake	Lincoln	Largemouth Bass	Mercury
62	Birdwood Lake	Lincoln	Largemouth Bass	Mercury
63	Sutherland Reservoir	Lincoln	Common Carp	PCBs, Mercury
64	Sutherland Cooling Pond	Lincoln	Common Carp / Largemouth Bass	Mercury, Selenium / Mercury
65	East Sutherland Lake	Lincoln	Largemouth Bass	Mercury
66	Maloney Res. Outlet Canal (below hydro)	Lincoln	Channel Catfish / Smallmouth Bass	PCBs / Mercury
67	North Platte River	Morrill	Common Carp / Channel Catfish	Mercury, Selenium
68	Bridgeport Middle Lake	Morrill	Largemouth Bass	Mercury
69	Steinart Park Lake	Otoe	Largemouth Bass	Mercury
70	Burchard Lake	Pawnee	Largemouth Bass	Mercury
71	Mayberry WMA Lake	Pawnee	Largemouth Bass	Mercury
72	Prairie Knoll Lake	Pawnee	Largemouth Bass	Mercury
73	Iron Horse Trial Lake	Pawnee	Largemouth Bass	Mercury
74	Holdredge Park Lake	Phelps	Largemouth Bass	Mercury, Selenium
75	Columbus City Park Pond	Platte	Largemouth Bass	Mercury
76	Verdon Lake	Richardson	Largemouth Bass	Mercury
77	Kirkman's Cove Lake	Richardson	Largemouth Bass / Common Carp	Mercury
78	Swan Creek 5A	Saline	Largemouth Bass	Mercury
79	Walnut Creek Lake #2	Saline	Largemouth Bass	Mercury
80	Swanton Lake (Swan Lake #67)	Saline	Largemouth Bass	Mercury
81	West Papillion Creek	Sarpy	Common Carp	PCBs, Dieldrin
82	Walnut Creek Lake	Sarpy	Largemouth Bass	Mercury
83	Wehrspann Lake	Sarpy	Largemouth Bass	Mercury
84	Halleck Park Lake	Sarpy	Largemouth Bass	Mercury, Selenium
85	Offutt Lake	Sarpy	Channel Catfish	PCBs
86	Czechland Lake	Saunders	Largemouth Bass	Mercury
87	Memphis Lake	Saunders	Largemouth Bass	Mercury

88	Morrill Sandpit - Southwest	Scottsbluff	Largemouth Bass	Mercury
89	Morrill Sandpit - North	Scottsbluff	Largemouth Bass	Mercury, Selenium
90	Walgren Lake	Sheridan	Largemouth Bass	Mercury
91	Isham Dam Lake	Sheridan	Largemouth Bass	Mercury
92	Sherman Reservoir	Sherman	Walleye	Mercury
93	Carter P. Johnson Lake	Sioux	Largemouth Bass	Mercury
94	Maskenthine Lake	Stanton	Largemouth Bass	Mercury
95	Big Sandy Creek	Thayer	Channel Catfish	Mercury
96	Liberty Cove	Webster	Largemouth Bass	Mercury
97	Pibel Lake	Wheeler	Largemouth Bass	Mercury
98	Recharge Lake	York	Largemouth Bass	Mercury

More Information:

http://deq.ne.gov/NDEQProg.nsf/OnWeb/FTMP
Greg Michl. NDEQ, greg.michl@nebraska.gov or (402) 471-4264.
Nebraska Game and Parks Commission, (402) 471-5553.
Nebraska Department of Health and Human Services, (402) 471-8880.

Monitoring for Fish Kills and Surface Water Complaints

Why do we sample after fish kills and complaints?

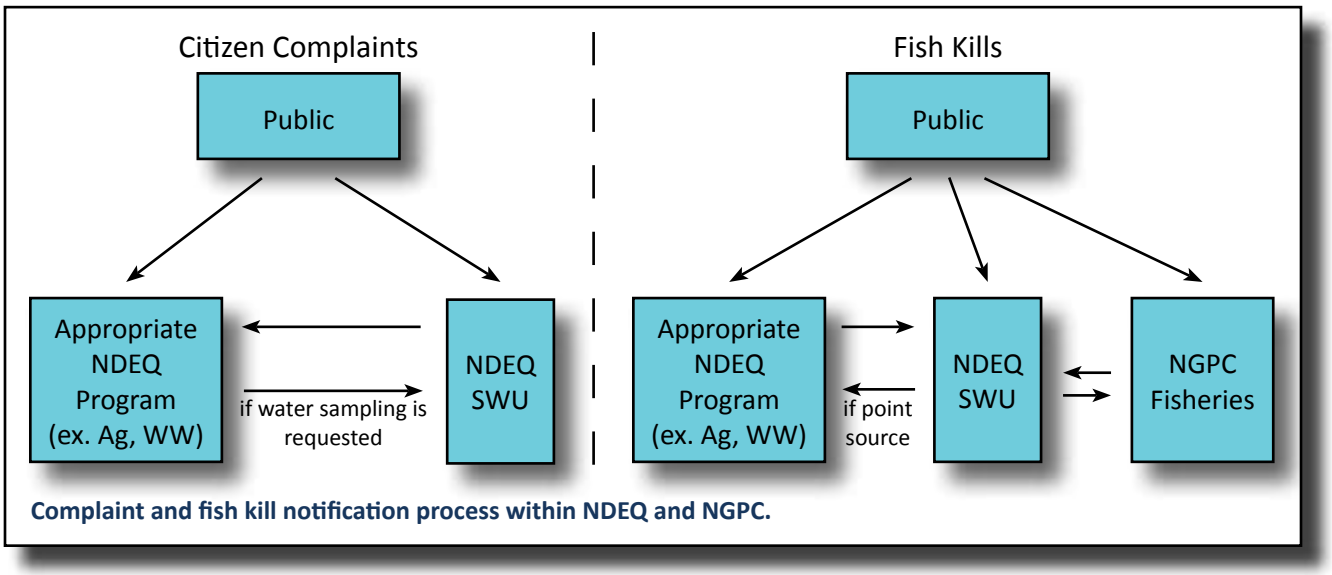
The agency responds to numerous fish kills and surface water complaints annually. In many cases, the investigations surrounding a fish kill may require sampling to document the cause of the water quality problem, the magnitude and extent of the water quality problem, the source of pollution and/or a 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.

Fish kill at Cottontail Reservoir being investigated by NGPC personnel, Lancaster County. Photo courtesy of NGPC.

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.

Fish kill at Spring Lake, Lancaster 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 will be 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, 2013 through June 30, 2014 a total of seven fish kills were reported to NDEQ. Of these, three occurred in a public lake and four were in private ponds. All of the reported fish kills were due to natural causes; these included four due to low oxygen and three from disease or parasites.

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, 2013 and June 30, 2014 the SWU received 43 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.

More information:

Mike Archer, mike.archer@nebraska.gov or (402) 471-4224.
Dave Bubb, dave.bubb@nebraska.gov or (402) 471-2810.
David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

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. 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

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:** 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.

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)
2014	Niobrara
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

Network: 41 stream sites (including 13 shared Ambient Stream sites) in the Niobrara River Basin.

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

Parameters:

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

Sample Totals - All Parameters: = 902

Assistance: MNNRD, UENRD, National Park Service (NPS: Agate Fossil Beds National Monument).

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

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), US Army Corps of Engineers (USACE).

Ambient Lake Monitoring Program

Network: Deep Water Sites (44 lakes).

NDEQ:	27 lakes	= 135
USACE:	15 lakes	= 75
NNRD:	1 lake	= 5
Total Deep-Water Samples:		= **215**

Frequency: Monthly from May through September.

Parameters:

- **Traditional:** TSS, total phosphorus, dissolved orthophosphorus, nitrate/nitrite nitrogen, kjeldahl nitrogen, alkalinity.
- **Pesticides:** atrazine, metolachlor, acetochlor.
- **Chlorophyll-a**
- **Field Measurements:** depth profiles (pH, conductivity, water temperature, DO, turbidity), water transparency.

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

Network: Mid-Lake Sites (44 lakes).

NDEQ:	27 lakes	= 135
USACE:	15 lakes	= 75
Total Mid-Lake Profiles:		= **210**

Frequency: monthly from May through September.

Parameters: mid-lake depth profile (pH, conductivity, water temperature, DO, turbidity) water transparency.

Additional Lake Monitoring Projects (Nonpoint Source Programs).

Study/Lake	Parameter
Fremont State Lakes Project Renovation Study	nutrients, biological, and fish tissue
Willow Creek Pre-Project Evaluation Study	nutrients, bacteria, and toxic algae

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

Fish Tissue Monitoring Program

Network: 63 fish samples collected from 35 sites (9 rivers/streams and 26 lakes) in the Niobrara River Basin.

Assistance: Nerbaska Game and Parks Commission (NGPC), Nebraska Dept of Health & Human Services (NHHS), Nebraska Dept of Agriculture (NDA, USEPA.

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

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

Stream Biological Monitoring Program

Network: 34 stream sites in the Niobrara River Basin.

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

Fish kill at a private pond, Saline County.

Fish Kills and Surface Water Complaints

Timeframe: July 1, 2013 to June 30, 2014

Between July 1, 2013 and June 30, 2014, the Department received 43 notifications of complaints concerning surface water issues. Many of these were referred to other agency programs that more closely related to the problem and three complaints were investigated with on-site visits by the surface water staff.

Assistance: NGPC, U.S. Fish & Wildlife (USFW), NRDs, Lincoln Lancaster County Health Department (LLCHD)

Fish Kills Attributed to:	Number
Low dissolved oxygen levels (flooding, plant/algae die-off)	4
Disease or parasites	3
TOTAL	7

More Information:

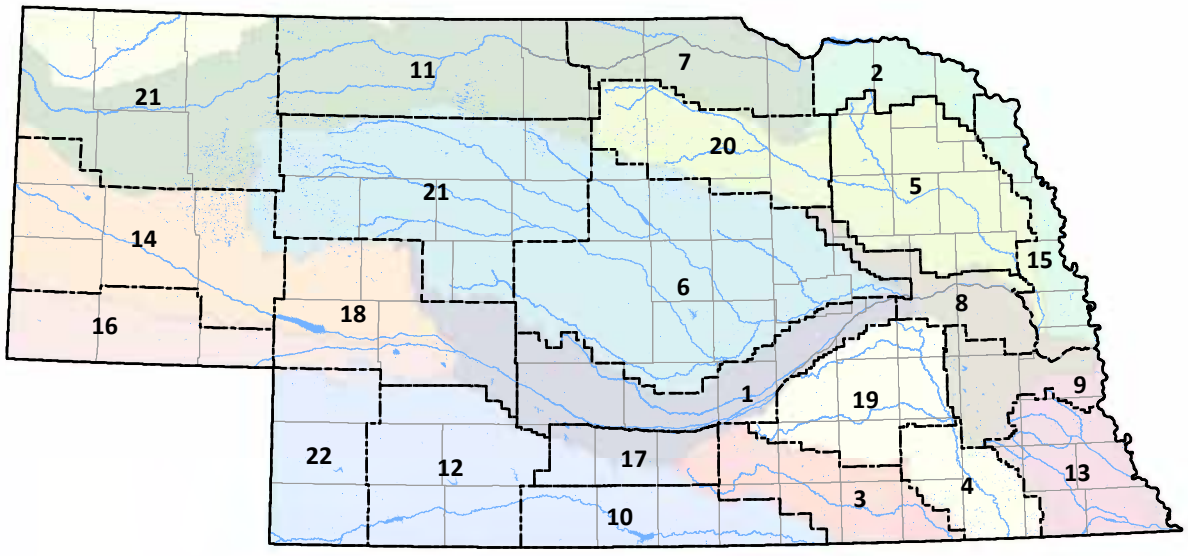
http://deq.ne.gov/NDEQProg.nsf/OnWeb/SWMA

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).

Shell Creek Fish and Macroinvertebrate Assessment 2014

By Kelli Turek, UNL Research Associate

Why NDEQ is Conducting this Monitoring

Freshwater unionid mussels in Shell Creek, Colfax County.

Shell Creek is a highly degraded tributary of the Platte River (see map on next page). Poor land use practices in the past led to extreme erosion and incision of the stream resulting at times in severe flooding and causing both ecological and economical losses to the area. In 1999, the Shell Creek Watershed Improvement Group was formed by area landowners working in conjunction with the Nebraska Department of Environmental Quality, Lower Platte North Natural Resources District, USDA Natural Resources Conservation Service, and several other partners in an effort to improve the water quality of Shell Creek and promote better management practices in the surrounding watershed. Since the development of the Shell Creek Watershed Improvement Plan in 2005, landowners have implemented best management practices (*e.g.*, converting to no-till, switching from row crops to grasses, adding buffer strips) to over 14,000 acres.

Although much has been, and continues to be, accomplished in the surrounding watershed, there are limited data on the in-stream habitat and aquatic biological community (*e.g.*, fish, freshwater mussels, and macroinvertebrates) of Shell Creek. The composition of the aquatic biological community is important because it is reflective of the in-stream physical, chemical, and biological integrity of the stream, and can provide an early indication of diminished water quality. The purpose of this assessment was to determine the current status of the fish and macroinvertebrate assemblages in Shell Creek. This will provide the baseline data necessary to document any change in the aquatic biological community following future watershed improvement projects and allow for assessment of the effectiveness of improvement projects.

Collecting water samples from Shell Creek, Colfax County.

When and Where was the Monitoring Conducted?

Fish and macroinvertebrates were sampled at 21 sites along Shell Creek in 2014 and will be sampled again in 2015. Each site was sampled once in June, once in July, and once in August-September. Sites were selected based on landowner permission, ease of access, and location along the stream (i.e., sites were spaced as evenly as possible along the stream).

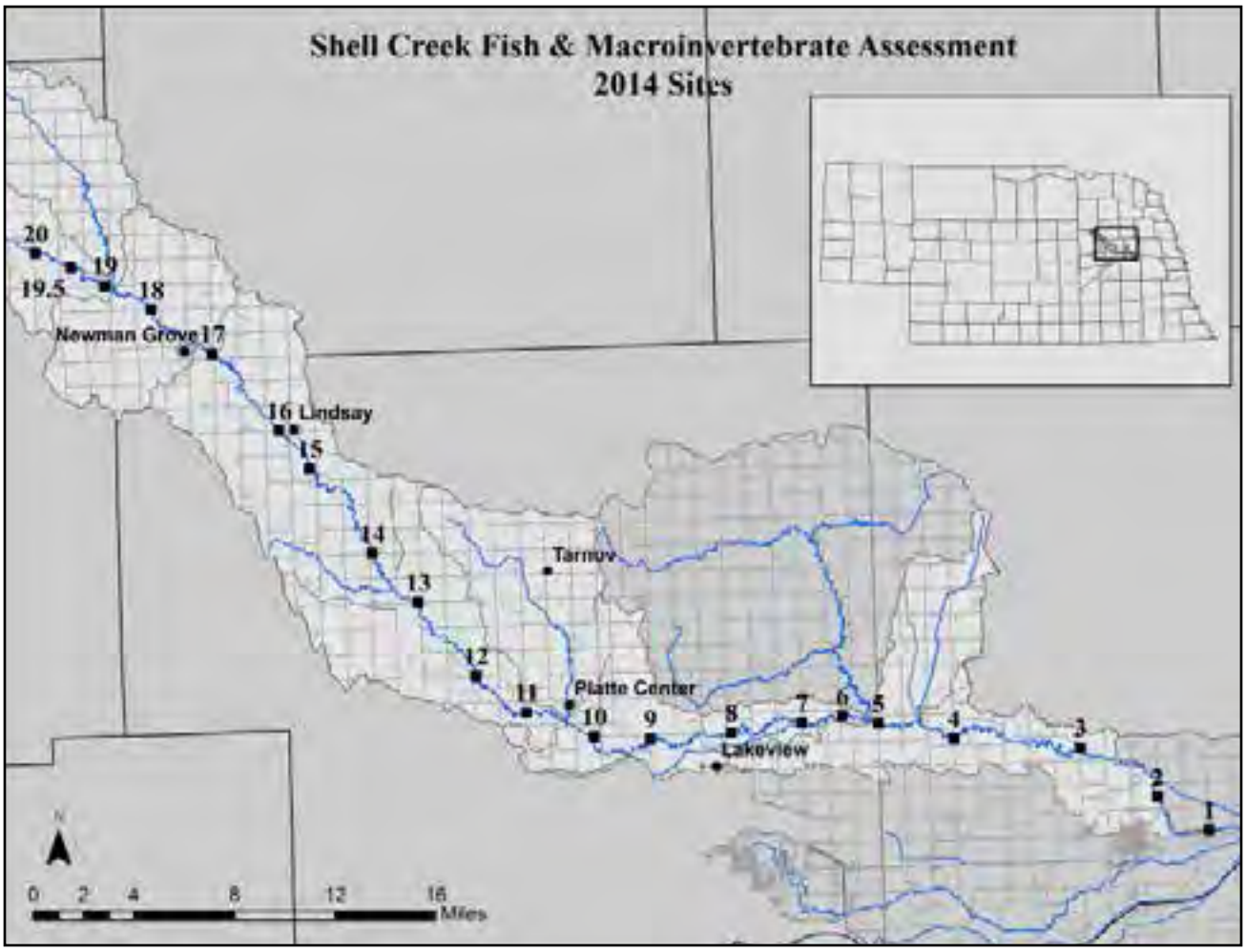
What was Monitored and How will the Data be Used?

Surveys conducted in 2014 characterized the fish and macroinvertebrate communities of Shell Creek as well as the habitat available for those organisms. By determining what species are present and how abundant those species are, NDEQ personnel can monitor the overall health of the stream. For example, decreases in the number of species sensitive to changes in water quality can be an indication of deteriorating stream health.

Additional information such as fish lengths, fish weights, and freshwater mussel ages were also collected and can provide important information used to determine the health of these organisms, as well as the overall health of the stream. Individual fish lengths and weights can be used to determine growth rates and condition of individuals and availability of food resources. Additionally, mussel ages can tell managers if mussels have reproduced recently and can provide insight into long term changes in the stream. All of the information collected in 2014 and 2015 will provide the baseline data necessary to determine if communities improve as more stream improvement projects are completed.

Results

Nearly 8,700 fish representing 25 species were collected from Shell Creek in 2014. The most abundant and widespread non-game species collected in 2014 were sand shiners, red shiners, and fathead minnows, while the most prolific game species collected in 2014 was channel catfish. Two of the species caught in 2014, bluegill and brook silverside, had not been previously recorded in



Shell Creek although they are widespread throughout the Platte Basin. Conversely, four species previously found in Shell Creek were not documented in 2014 (date found, agency): emerald shiner (1991, NDEQ), plains minnow (1972, NGPC), shorthead redhorse (1972, NGPC; 1985, DEQ),and western silvery minnow (1972, NGPC).

Six species of live freshwater mussels were documented in Shell Creek in 2014 including adults and juveniles of one state imperiled species (pimpleback). Relict shells of an additional two species were also recorded. Freshwater mussels are great indicators of the health of streams because of their sensitivity to changes in water quality and limited dispersal ability. Therefore, the baseline data collected in 2014 will allow NDEQ personnel to closely monitor changes in water quality in Shell Creek.

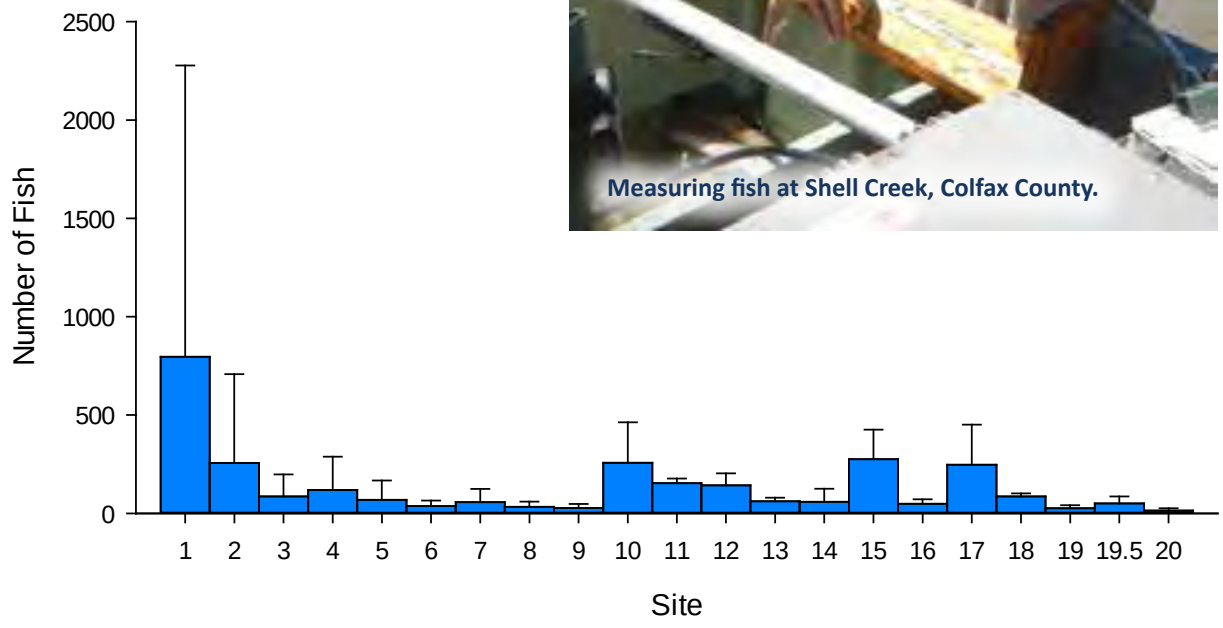
Future Work

Fish and macroinvertebrate surveys will continue in June, July, and August of 2015 to better determine the structure and variability of the aquatic biological community of Shell Creek. This will allow for better assessment of future management actions.

Measuring fish at Shell Creek, Colfax County.

Contact:

Mike Archer, Mike.Archer@nebraska.gov or (402) 471-4224.
Dave Schumacher, David.Schumacher@nebraska.gov or (402) 471-4709.
Dr. Mark Pegg, pegg2@unl.edu or (402) 472-6824.



Average number of fish collected in Shell Creek (± 95% confidence interval) at each site in 2014.

2014 Surface Water Quality Report Card

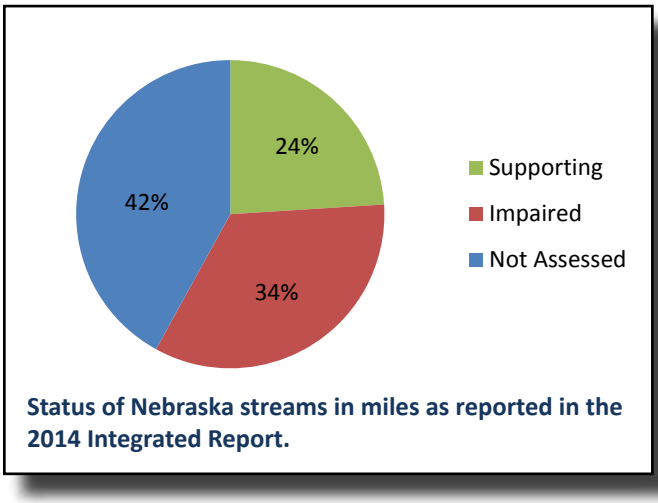
Nebraska's Assessment of Lakes and Rivers

The federal Clean Water Act (CWA) requires states to assess the water quality of their lakes and rivers to determine if they meet state and federal water quality objectives. Nebraska's water quality objectives are defined in Title 117- Nebraska Surface Water Quality Standards (NDEQ, 2012). Title 117 defines the beneficial uses that are to be supported by each of Nebraska's lakes and streams. Examples of beneficial uses for Nebraska's waterbodies include:

- Recreation (swimming, wading)
- Aquatic life (health of water insects
- Fish, and wildlife)
- Drinking water (public drinking water supply)
- Agricultural supply (livestock water supply)

Title 117 also specifies the numeric levels of pollutants such as E. coli bacteria and nitrate that can be present in a waterbody without impairing the assigned beneficial uses. When determining the water quality for a specific waterbody, NDEQ determines the assigned beneficial uses for that waterbody and assesses the water quality data against the pollutant criteria defined in Title 117.

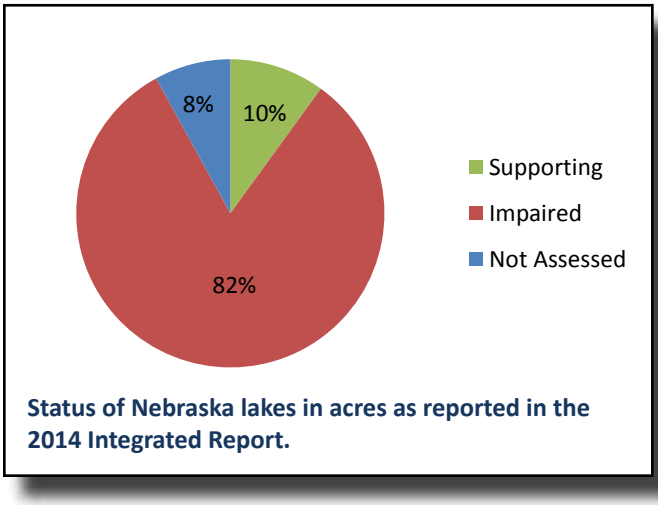
Preparing a sample for nutrient analysis at Rockford Lake, Gage County.



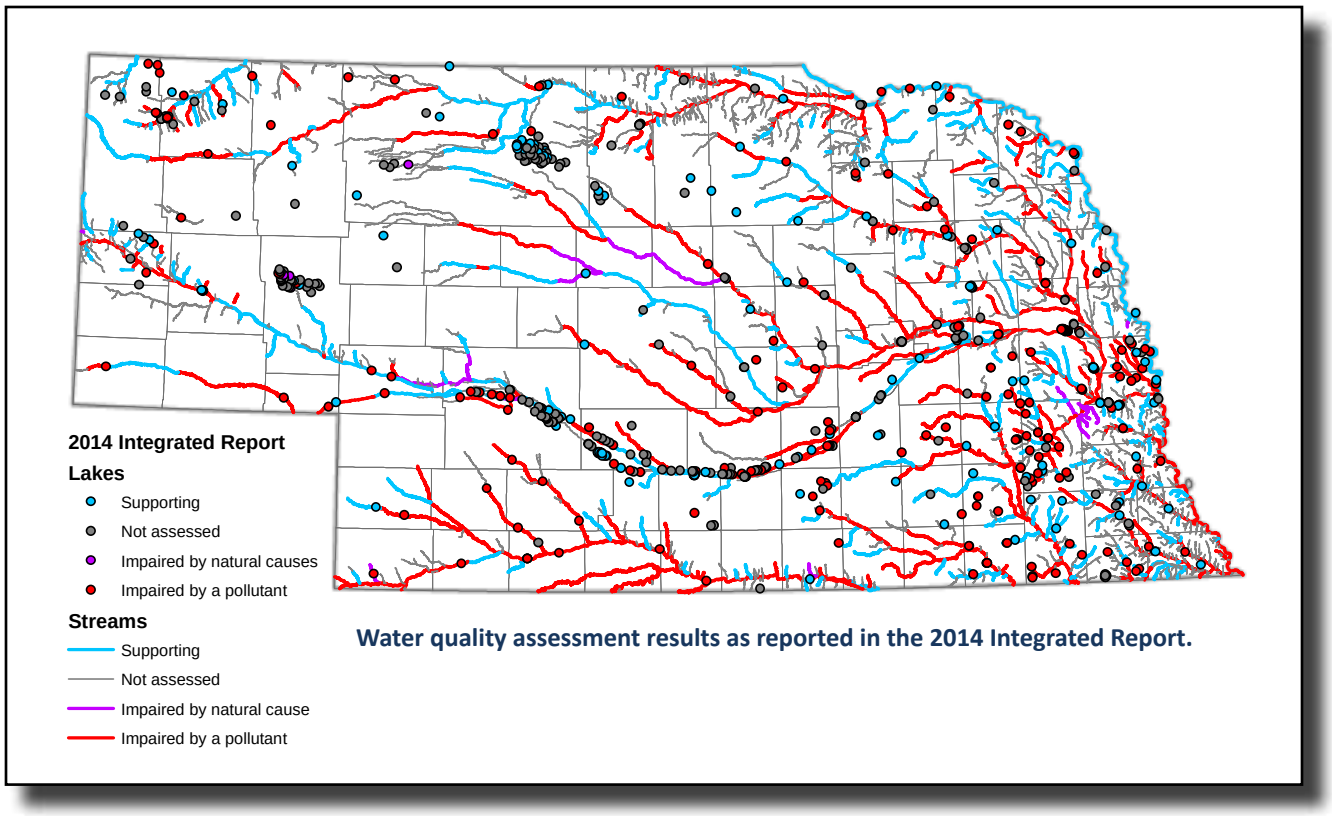
Status of Nebraska streams in miles as reported in the 2014 Integrated Report.

Reporting Water Quality Conditions

Every two years the CWA requires that states develop an "Integrated Report" (NDEQ, 2014) that summarizes the water quality condition of all surface waterbodies in the state. For this report, states evaluate all available water quality data and determine which waterbodies are or are not supporting their designated beneficial uses. Waters that do not fully support all of their assigned beneficial uses are considered "impaired" and placed on an impaired waterbodies list, the 303(d) list. Waters that support all assigned uses are considered "supporting" or good quality waters.



Status of Nebraska lakes in acres as reported in the 2014 Integrated Report.



Water quality assessment results as reported in the 2014 Integrated Report.

Summary of Nebraska's 2014 Integrated Report

Nebraska has 1,558 stream segments flowing over 16,670 miles and 528 lakes and reservoirs that cover more than 132,328 acres. For the 2014 Integrated Report, NDEQ staff conducted assessments on 522 stream segments and 289 lakes equating to more than 9,745 miles of streams and 121,578 lake acres being assessed (see map above). While numerous waterbodies still need assessment, NDEQ has made a concerted effort to focus sampling and assessments on waterbodies used more widely by the public. This has resulted in assessments on all lakes over 50 surface acres in size and all main stem rivers (see charts on previous page).

Of the 522 stream segments assessed, 269 were supporting their assigned uses, while 253 were impaired. Lake assessments found 172 of the 289 lakes assessed were impaired while 117 lakes were supporting their uses (see charts on previous page).

Common Impairments

The most common impairments for Nebraska's streams and lakes can be seen in the following charts. E. coli bacteria impaired more than three times as many streams as the next leading cause, impaired stream biology. Natural selenium, atrazine, and fish consumption advisories were also common stream impairments. The most common lake impairment was high nutrients followed closely by fish consumption advisories and elevated pH. Low dissolved oxygen and E. coli bacteria were also notable causes of lake impairments.

Summarizing the assessment information as simple percentages of impaired waterbodies does not tell the entire story, however. Because Nebraska's water quality criteria are designed to be fully protective, impairment of one beneficial use does not mean the waterbody is not supporting other beneficial uses.

Strategies to Resolve Water Quality Impairments

Once a waterbody is determined to be impaired, the CWA requires the state to develop a plan or method to reduce pollutant levels so that waterbody is able to support it's designated uses. Three types of pollution control plans are commonly implemented: Point source pollution is managed by the National Pollutant Discharge and Elimination System (NPDES) permitting program. Nonpoint source pollution is managed by the development of Total Maximum Daily Loads (TMDLs) and Watershed Management Plans. Both of these nonpoint source pollution plans involve determining the cause and sources of the water quality impairment and working with stakeholders to develop and implement on the ground pollution control strategies. Continues water quality monitoring provides the needed data to determine if the plan is working or if modifications are required.

References:

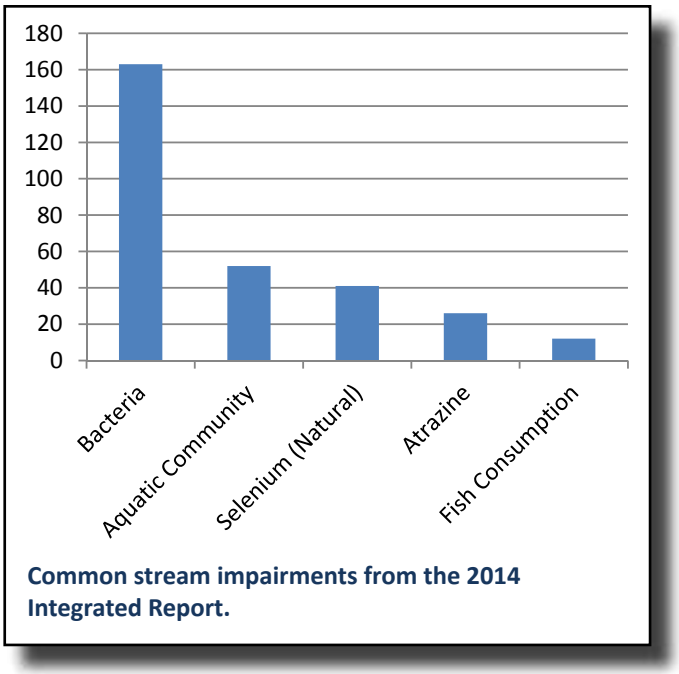
NDEQ, 2012. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

NDEQ, 2014. 2014 Water Quality Integrated Report. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

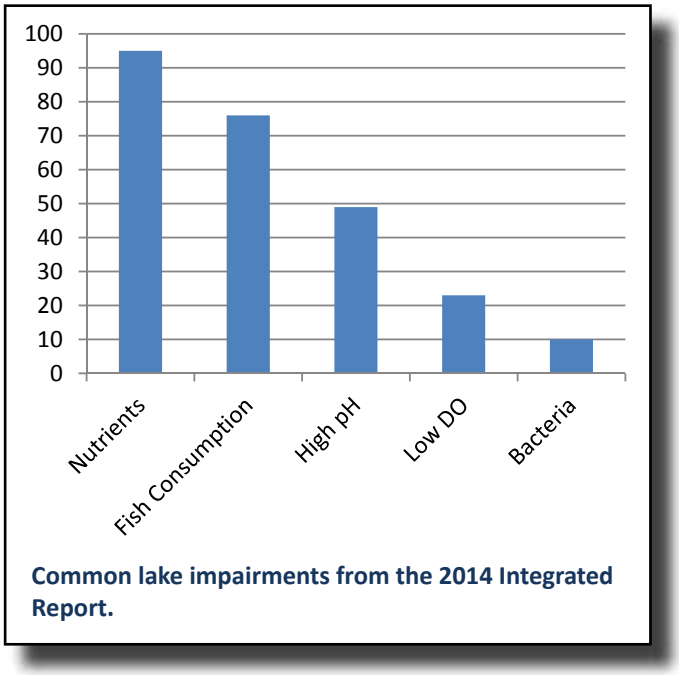
More Information:

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

Laura Johnson, laura.r.johnson@nebraska.gov or (402) 471-4249.



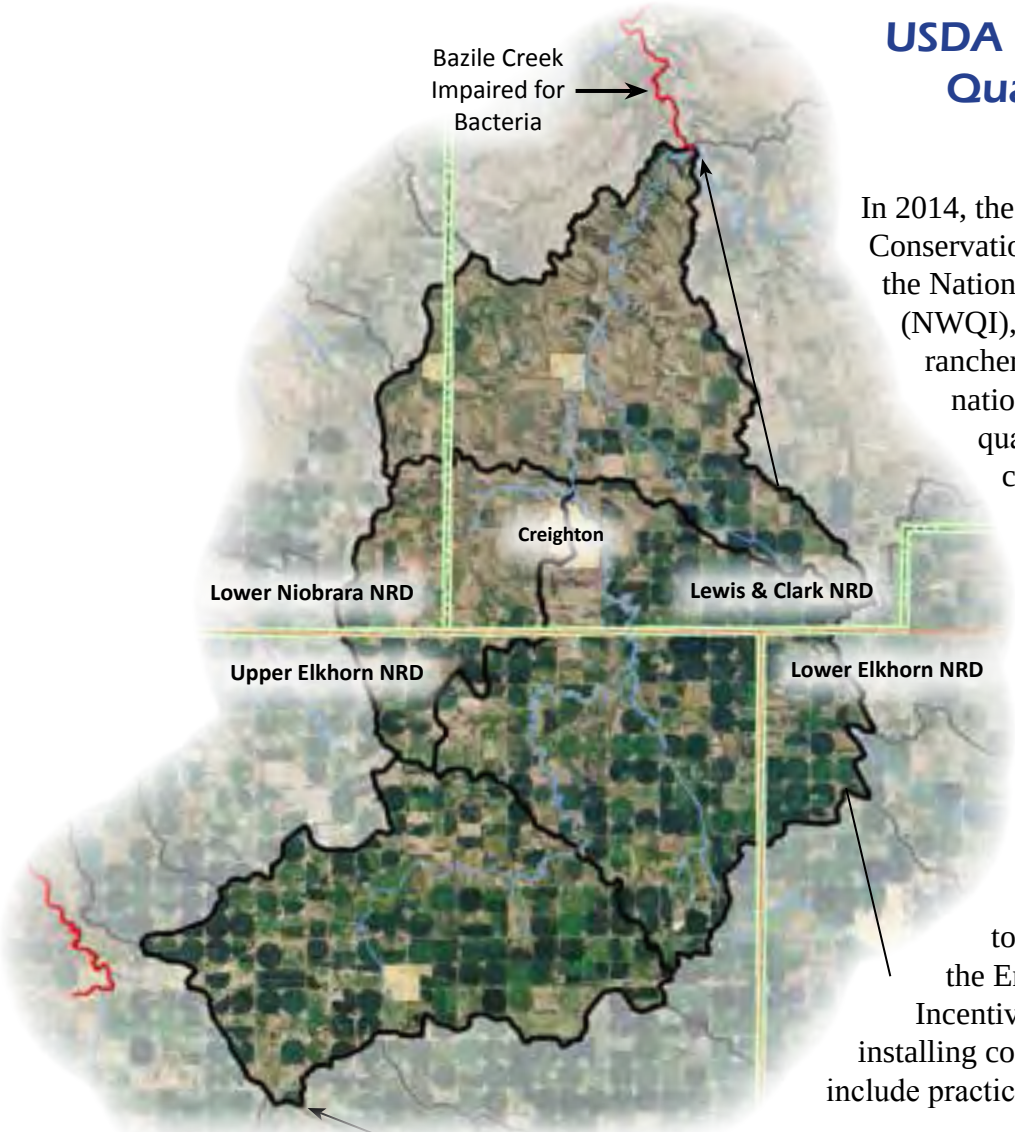
Common stream impairments from the 2014 Integrated Report.



Common lake impairments from the 2014 Integrated Report.

Sampling aquatic macroinvertebrates at Rush Creek, Sheridan County.

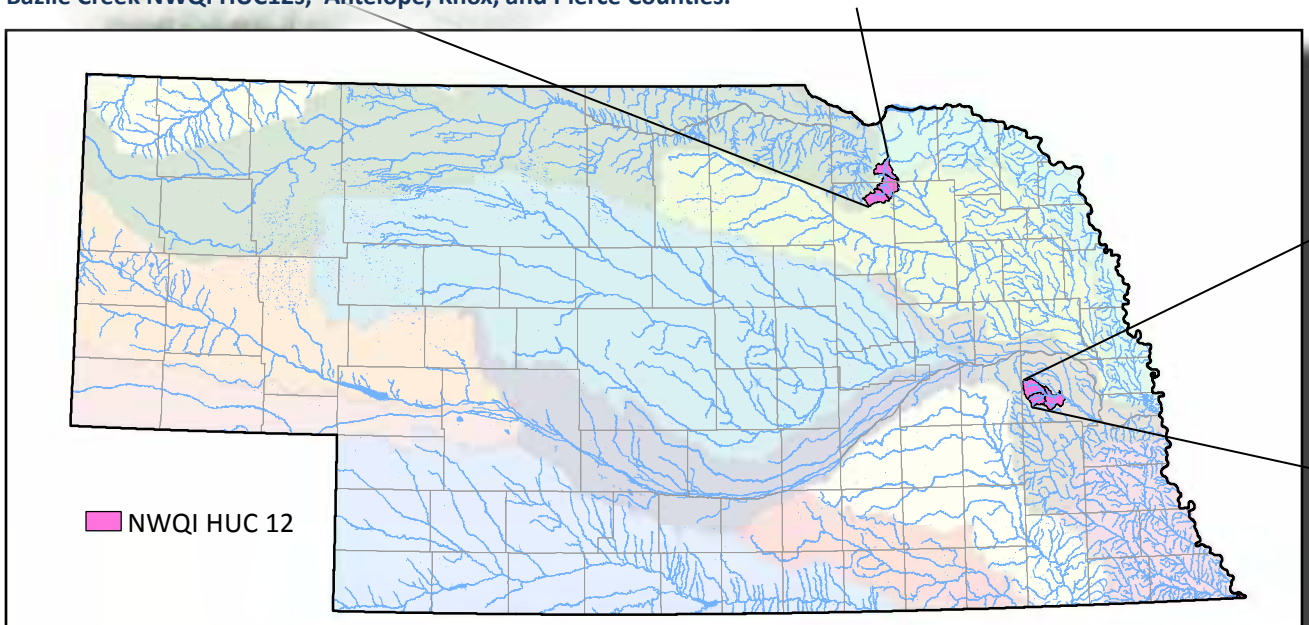
USDA National Water Quality Initiative



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

In 2014, the USDA Natural Resources Conservation Service (NRCS) through the National Water Quality Initiative (NWQI), worked with farmers and ranchers in 174 small watersheds nationwide to improve water quality where there is a critical concern. NRCS works closely with federal and state agencies to determine eligible priority watersheds where conservation practices will result in the greatest water quality improvements.

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

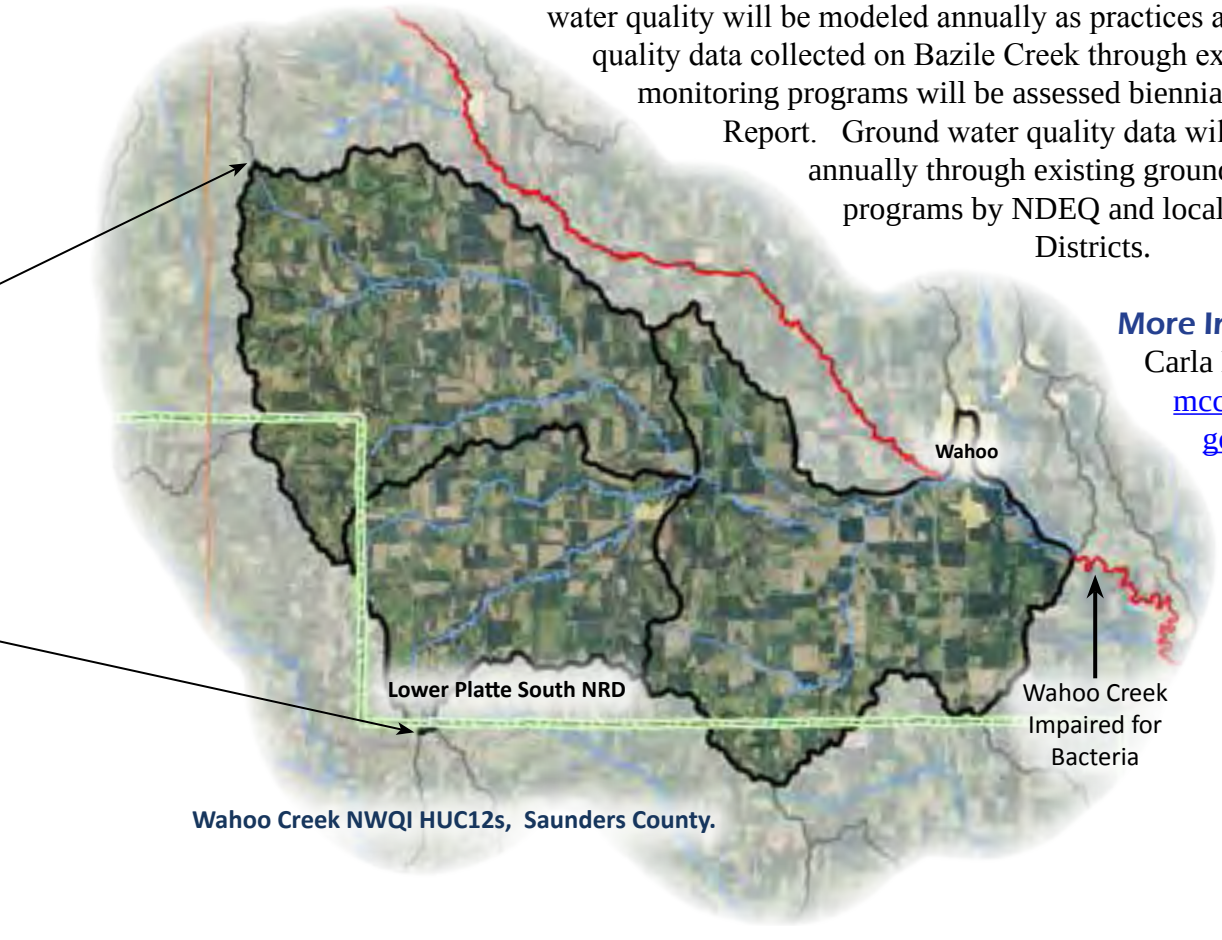


General location for the 2015 National Water Quality Initiative (NWQI) HUC 12s.

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 (map below) and Bazile Creek Water Quality Area (map left).

Wahoo Creek Watershed has been a designated NWQI area since 2014. The area consists of three Hydrologic Unit Code subwatersheds (HUC12) for a total of 70,245 acres. An additional HUC12 was added in 2015 bringing the total to 86,138 acres. 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. There is no dedicated monitoring plan for this NWQI project, but impacts to water quality will be modeled annually as practices are installed. Water quality data collected on Wahoo Creek through existing NDEQ monitoring programs will be assessed biennially for the Integrated Report. 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. It consists of three HUC12s and a total of 75,059 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 ground water. Bazile has groundwater nitrate levels ranging from 3.7 to 18.9 mg/L. 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 this NWQI project, but impacts to water quality will be modeled annually as practices are installed. Water quality data collected on Bazile Creek through existing NDEQ monitoring programs will be assessed biennially for the Integrated Report. Ground water quality data will be collected annually through existing ground water 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.