2011 Nebraska Water Monitoring Programs Report

Nebraska Department of Environmental Quality
Water Quality Division
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2011 Nebraska Water Monitoring Programs Report

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Introduction

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Acknowledgements:

The following Nebraska Department of Environmental Quality staff have contributed to this report with their photos, maps, numbers, words, and editing. Their efforts are greatly appreciated and gratefully acknowledged here: Ken Bazata, Dave Bubb, David Chambers, Ryan Chapman, Curt Christensen, Jennifer Coughlin, Mike Felix, Patrick Hartman, Dave Ihrie, Dan Inman, John Lund, Greg Michl, Dave Miesbach, Will Myers, Patrick O'Brien (NARD), Mary Schroer, Ed, Southwick, Jenny Swanson, Brad Routt, and Dave Schumacher.

Photo on the cover: Platte River, near Gothenburg NE.

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 editor of this document, Marty Link, NDEQ, at 402/471-4270 or marty.link@nebraska.gov.

NDEQ staff sampling at a livestock operation, central Nebraska.

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 good quality water and encourage or execute activities to improve poor water quality. Monitoring is done on the over 18,000 miles of flowing rivers and streams, our greater than 280,000 acres of surface water in lakes and reservoirs, and the vast storage of groundwater in Nebraska's aquifers.

This document brings together a short summary of the monitoring programs performed (or required) by the NDEQ. In many cases, recent results are highlighted in the descriptions. There are also several descriptions of successes in water quality programs and 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 sited at the end of each 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, 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.

Wheat bales, central Nebraska.

Many thanks.

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Water Quality Success Story – Carter Lake

Carter Lake (see map below) is a 315-acre oxbow lake along the Missouri River in metropolitan Omaha. The lake, which is in both Nebraska and Iowa, is located directly west of Eppley Airfield and about two miles from the Omaha downtown area. The City of Omaha's Levi Carter Park surrounds the lake on its convex side while the City of Carter Lake, Iowa lies within the concave portion of the lake. Carter Lake serves as a natural catch basin for stormwater runoff and melting snow and has a total drainage area of approximately 2,711 acres. The drainage area consists primarily of urban-residential and commercial land.

With its close proximity to a population of over 1,000,000, Carter Lake is used extensively for passive and active recreational activities including fishing, swimming, jet skiing, waterskiing and power boating. The Creighton University Rowing Team also uses the lake for practices and regattas. Access to the lake is available in Levi Carter Park and several public park access areas in the City of Carter Lake, Iowa and by residents living along the shoreline on the Iowa side.

Carter Lake, near Eppley Airfield, Omaha

Impairments

Carter Lake is on Nebraska's Section 303(d) list of impaired waters (NDEQ, 2006) for phosphorus, nitrogen, algae, and pH. As well, the State of Iowa has determined Carter Lake is impaired for excess algae and turbidity (Iowa DNR, 2004). The primary water quality issues with the lake stem from high nutrient concentrations from both external and internal loading sources. Total phosphorus levels in the lake have exceeded 300 parts per billion (ppb) while nitrogen levels were as high as 5,100 ppb.

Some examples of sources that contribute to the external load from the watershed include nutrient-rich fertilizers, runoff from streets that contain grease/oil, pet and animal waste, and processes that occur at some industrial sites. Internal pollutant loads result from resuspension of lake-bottom sediment and pollutants, decay of dead organisms such as fish and aquatic plants, and from shoreline erosion. Sediment resuspension occurs naturally in lakes due to wind and wave action, but can be increased due to other factors, such as power boating, jet skis, and bottom feeding fish (rough fish). The Nebraska Game & Parks Commission (NGPC) has characterized the fishery at Carter Lake as rough fish dominated, primarily with carp and buffalo. In addition to direct nutrient contributions through excrement, rough fish can re-suspend nutrients bound to bottom sediments. High nutrient concentrations, primarily phosphorus, are the primary cause of blue green algae blooms.

The occurrence of blue-green algae blooms led officials to begin monitoring for microcystin toxin in 2004. The first samples collected from the lake exceeded the beach posting criterion of 15 ppb. In 2005, the beach posting criterion was changed to 20 ppb microcystin. From 2005 through 2008, 10 of the 83 toxin samples collected exceeded 20 ppb, causing officials to post warnings at the beach for 21 weeks. Carter Lake has also experienced occasional problems with bacteria. High bacteria densities resulted in a Nebraska Section 303(d) listing in 2004 but the listing was removed in 2006.

Project Highlights

In 2006, the cities of Carter Lake (Iowa) and Omaha (Nebraska) joined forces with local and state agencies to begin a Community-Based Planning Process. As part of the planning process, a group of interested citizens formed the Carter Lake Environmental Assessment and Rehabilitation (CLEAR) Council. In 2008, the CLEAR Council, with assistance from local and state agency partners, completed the Carter Lake Water Quality Management Plan.

The plan outlines more than $6 million worth of possible restoration work. With a plan in place, partners initiated the Carter Lake Water Quality Project in 2008. First, the partners hired a project coordinator using CWA section 319 funds from Nebraska (years 1-2) and Iowa (years 3-4).

Partners have completed many watershed treatments using eight different funding sources from both Iowa and Nebraska. These treatments include:

- Installing grass swales and five rain gardens with a combined total area of 17,503 square feet;
- Conduct an extensive nutrient educational effort targeted at fertilizer use and pet waste management and aquatic vegetation management;
- In-lake treatments consisting of applying algaecide, alum and sodium aluminate to reduce in-lake phosphorus concentrations;

- Establishing a 100-acre no-wake zone with a 5-mile-per-hour watercraft speed limit to minimize displacement of sediments; and
- Renovating the fishery (replacing rough fish with largemouth bass, bluegill and channel catfish).

Other work that will be implemented includes adding stormwater detention cells, installing grass swales, creating wetlands, stabilizing the shoreline, dredging the lake and conducting a second alum treatment. Partners expect to completely implement the restoration efforts described by the plan in 2013.

Application of alum and sodium aluminate to Carter Lake

Results

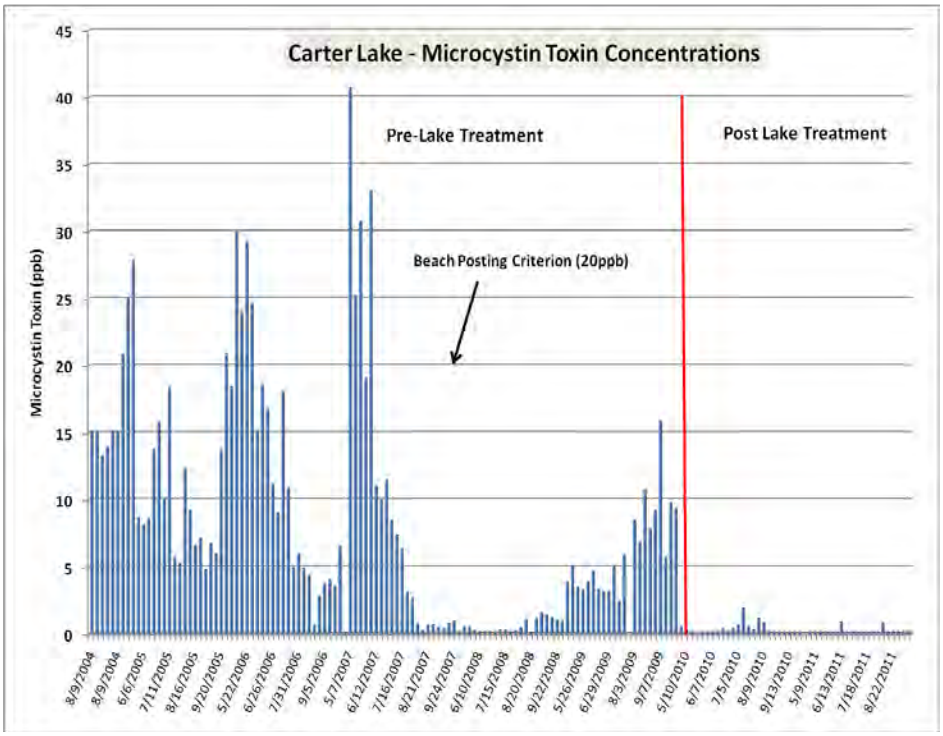
Monitoring conducted since 1990 shows that the restoration efforts have made a difference. Nutrient levels have dropped, resulting in lower algal densities and decreased levels of the microcystin toxin (see table below). The beach has not been closed by high microcystin levels since before the in-lake alum and algaecide treatment in 2010 (see graph below). On the basis of those data, NDEQ will propose to remove Carter Lake's algal toxin impairment from Nebraska's 2012 CWA section 303(d) list of impaired waters. The lake will remain on Nebraska's impaired waters list for phosphorus, nitrogen, chlorophyll A, pH, and PCBs (in fish tissue).

Carter Lake nutrients and microcystin data (1990–2011)

	1990–2009 Average levels (ppb)	2010–2011 Average levels (ppb)
Total nitrogen	2,782	1,340
Total phosphorus	185	70
Algae microcystin toxin	8.63[a]	0.31

[a] Microcystin data include the average for 2004-2009 only

Carter Lake's water clarity has improved, creating a secondary problem of aquatic vegetation overgrowth. Although the vegetation hampers water-based recreation, it has helped the newly stocked game fish flourish. In July 2011, the project team initiated vegetation harvesting in critical areas of the lake. A vegetation management plan will be developed and implemented to address future concerns.



Algae Toxin (Microcystin) Concentrations in Carter Lake, 2004 - 2011

More Information:
Contact Mary Schroer, NDEQ, at 402-471-6988 or e-mail mary.schroer@nebraska.gov .

Rain Garden at Carter Lake

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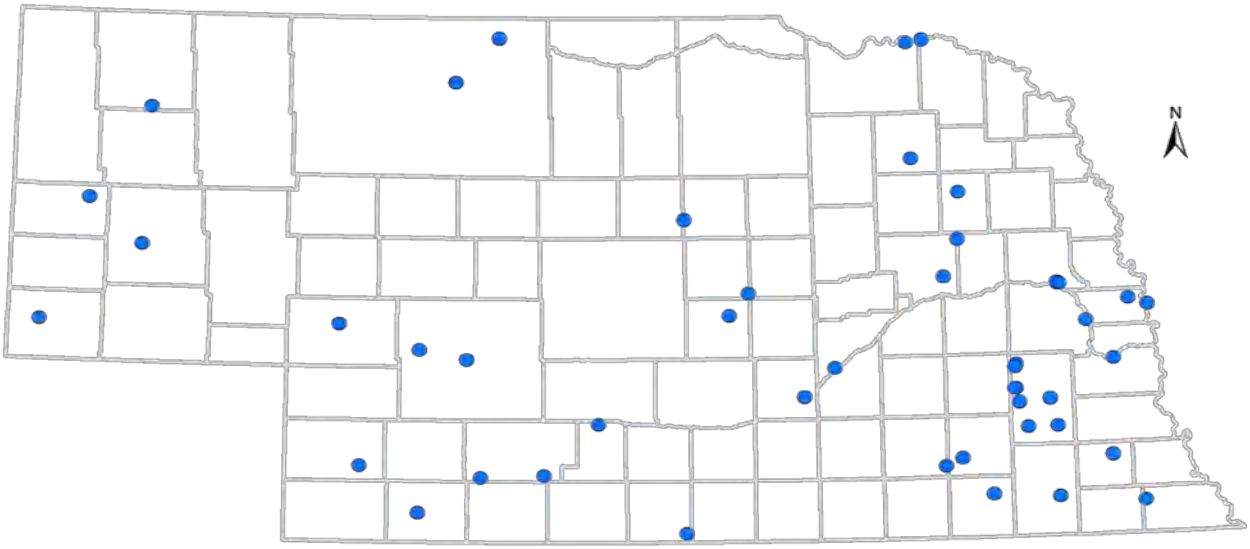
Public Beach Monitoring Program – Bacteria and Microcystin

Why Does NDEQ Monitor Public Beaches?
Water based recreation is a popular activity in Nebraska lakes including swimming, boating, jet skiing, water skiing, tubing, sailing, and etc. The Nebraska Game and Parks Commission (NGPC), Natural Resources Districts (NRDs), and other entities support water recreation by providing camping, shower, and day use facilities. NDEQ monitors current water quality at many public beaches and informs the public about the risks that may be associated with spending a day at the lake.

Blue-Green Algae Bloom at Regency Lake in Omaha, Douglas County.

When and Where is the Monitoring Conducted?
Some type of beach monitoring network has been in place in Nebraska for many years. Initially during the seventies and eighties, it was primarily conducted by the NGPC and only bacteria was assessed at a handful of lakes. The NDEQ began assisting and eventually took over the program in the nineties. After the deaths of several dogs were attributed to high levels of the microcystin toxin in 2004, toxic algae assessments were

added. In 2005, more detailed sampling and analysis procedures were established. During the recreation season, May 1 to September 30, NDEQ and its partners obtain weekly samples from publicly owned and operated lakes and swimming beaches. From 2005 through 2011, over 6,200 samples have been collected and analyzed for bacteria and toxic algae from 58 different lakes across the State. In 2011, 49 of the more heavily used public beaches at 46 lakes were included in the network. The bar graph on the next page shows the number of samples collected for each year during 2005 – 2011 and the map below shows the statewide distribution of the beaches monitored in 2011.

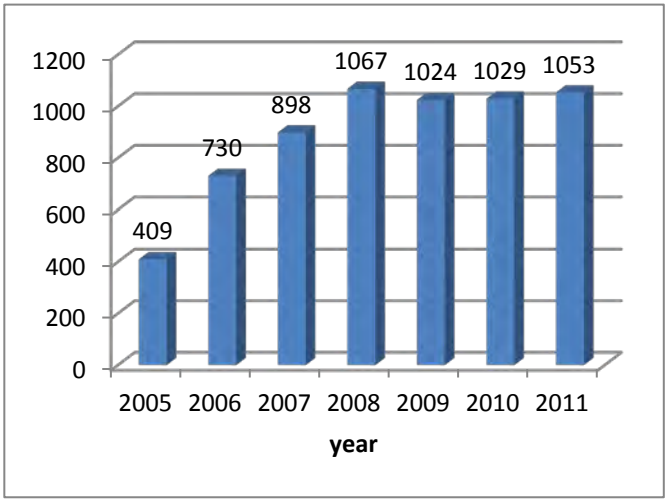


Map Showing Location of Lakes Sampled for the Beach Monitoring Program in 2011

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.

E. coli bacteria are monitored to provide an "indirect" indication of potentially harmful (pathogenic) bacteria. While all *E. coli* bacteria are not considered a threat to human health, some bacteria strains are. The larger the population of *E. coli* bacteria measured, the greater are the odds of having harmful pathogenic bacteria. Using this rationale, the value of 235 colonies of *E. coli* bacteria is established as the upper limit for supporting full body contact recreation. When people swim in or drink water with higher levels of *E. coli* bacteria, flu-like symptoms may occur.



Beach Monitoring: Number of samples taken, 2005 - 2011

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 or if swallowed, 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. The microcystin level of 20 ppb is established as the criterion for full body contact recreational activities.

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

How are the Data Used?

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

When levels of microcystin exceed 20 micrograms per liter (µg/l, or ppb, parts per billion), the NDEQ and Health and Human Services jointly issue a Health Alert. During a Health Alert at a public lake, signs are posted advising the public to use caution and avoid full body recreational activities such as swimming, wading, skiing, jet skiing, sailing and particularly avoid drinking the water. Affected swimming beaches are closed. Camping, picnics, boating, fishing and other non-contact recreational activities are allowed. The lake remains on Health Alert until levels of microcystin are measured below the 20 µg/l criterion for two consecutive weeks. If one has prolonged contact with water suspected to have high levels of the microcystin toxin, it is recommended that they shower with fresh water as soon as possible.

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

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

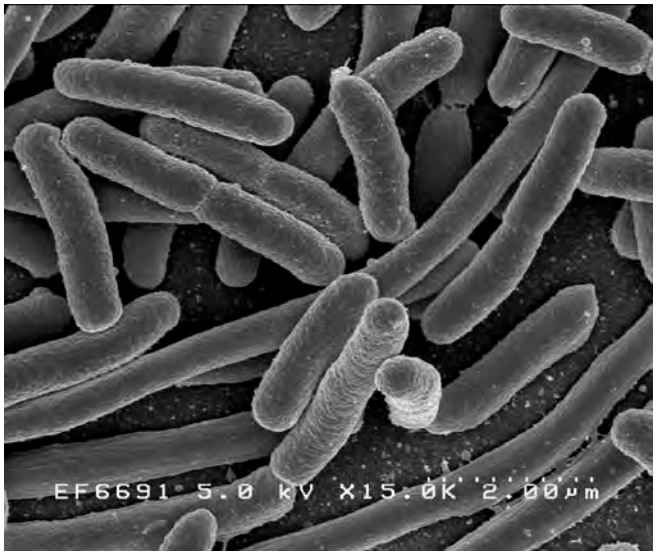
Lakes that repeatedly exceed the *E. coli* and microcystin water quality standard may be put on Nebraska's Clean Water Act 303d list of impaired waters.

2011 Results

In 2011, the Beach Monitoring program collected and analyzed approximately 1,000 samples for *E. coli* and the microcystin toxin.

Bacteria

Of the bacteria samples taken and analyzed during 2011, 56 samples (5.5%) exceeded the 235 counts/100ml of water standard.



Microscopic view of *E. coli*.

In the table below, the number of samples that exceeded 235/100 ml criterion for bacteria by month for 2005 through 2011 is shown. This table also provides the combined totals per month as well as per year. Note that most high levels occur in the early spring and summer months, in times of higher precipitation (and the associated higher run-off). Of the 56 high bacteria samples collected during 2011, 38 (67%) occurred during the months of May and June while the remaining 18 samples occurred during July through September.

Beach Samples Exceeding the 235 Col/100 ml *E. coli* Bacteria Criterion

Year	May	June	July	August	Sept.	TOTAL
2005	10	8	7	10	2	37
2006	11	14	14	9	7	55
2007	31	14	10	7	12	74
2008	21	30	19	4	15	89
2009	11	17	9	3	4	44
2010	10	27	6	4	6	53
2011	15	23	5	10	3	56
TOTAL	109	133	70	47	49	408

Toxic Algae (Microcystin)

Of the 1000 plus samples collected and analyzed for the microcystin toxin during 2011, only nine samples exceeded the 20 ppb threshold for closing a beach. This accounts for less than 1% of the total samples collected.

In 2011, five lakes were placed on alert for a total of 15 weeks for high levels of microcystin. Willow Creek Reservoir in Pierce County had three samples exceed 20 ppb, while Lone Star Lake in Fillmore County and Rockford Lake in Gage County each had two weeks of high values.

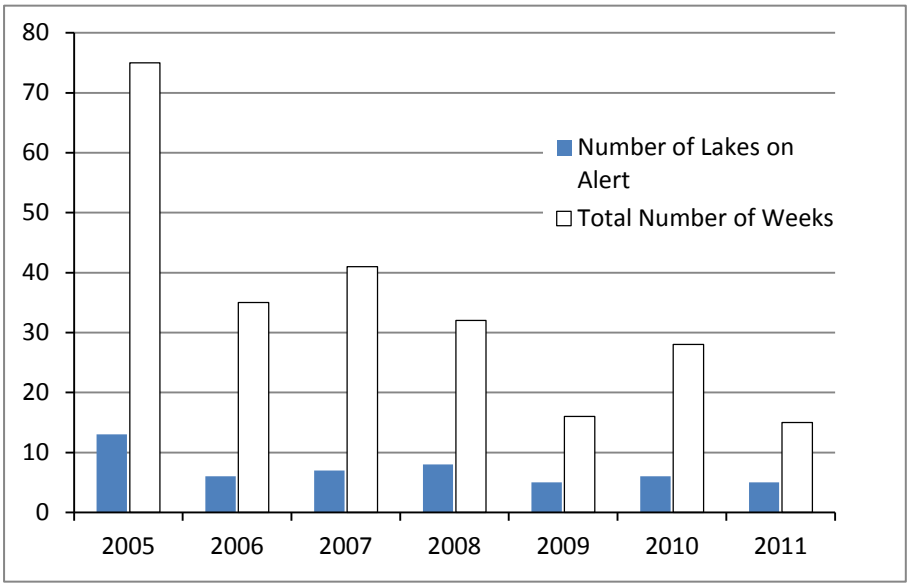
The table below shows the number of samples exceeding the microcystin 20 ppb criterion monthly for 2005 through 2011. It also shows the totals for each year as well as for each month through the years. Unlike with bacteria where high levels are more frequently observed in the springtime, blue-green algae (microcystin) impacts are usually observed later in the summer, after lake water has warmed up and algae growth is more significant.

Beach Samples Exceeding the 20 ppb Microcystin Criterion

Year	May	June	July	August	Sept.	TOTAL
2005	8	8	9	20	14	59
2006	5	5	8	8	7	33
2007	14	9	12	7	1	43
2008	0	2	4	7	13	26
2009	1	1	3	3	0	8
2010	0	1	1	8	10	20
2011	0	0	6	0	3	9
TOTAL	**28**	**26**	**43**	**53**	**48**	198

The bar graph below shows the number of lakes on health alert and the number of total combined weeks that lakes were on health alert each year from 2005 – 2011.

Number of lakes on Health Alert and the number of combined weeks that lakes were on Health Alert each year from 2005 – 2011.



Why are there problems at some lakes and not others?
Biological communities such as algae are very complex systems and are affected by many variables. The toxic algae issue gets even more complicated as some species of blue-green algae sometimes produce toxins while other times do not. Research is presently being conducted worldwide to answer this question.

Certain conditions seem to consistently have significant affects. The following conditions are often associated with blue-green algae blooms:

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

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. The least number of impacted lakes were observed in 2011. 2011 was characterized by very heavy spring rainfall and relatively full lakes.

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.

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

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.

More Information:
More information on NDEQ's Beach Monitoring Program and recreation season weekly sampling results is available at http://deq.ne.gov/ and click on "Environmental Alerts" under the "News & Announcements" section. Or contact John Lund at john.lund@nebraska.gov or at 402/471-4709.

NDEQ staff showing blue-green algae at Merritt Reservoir, Cherry County, 2011.

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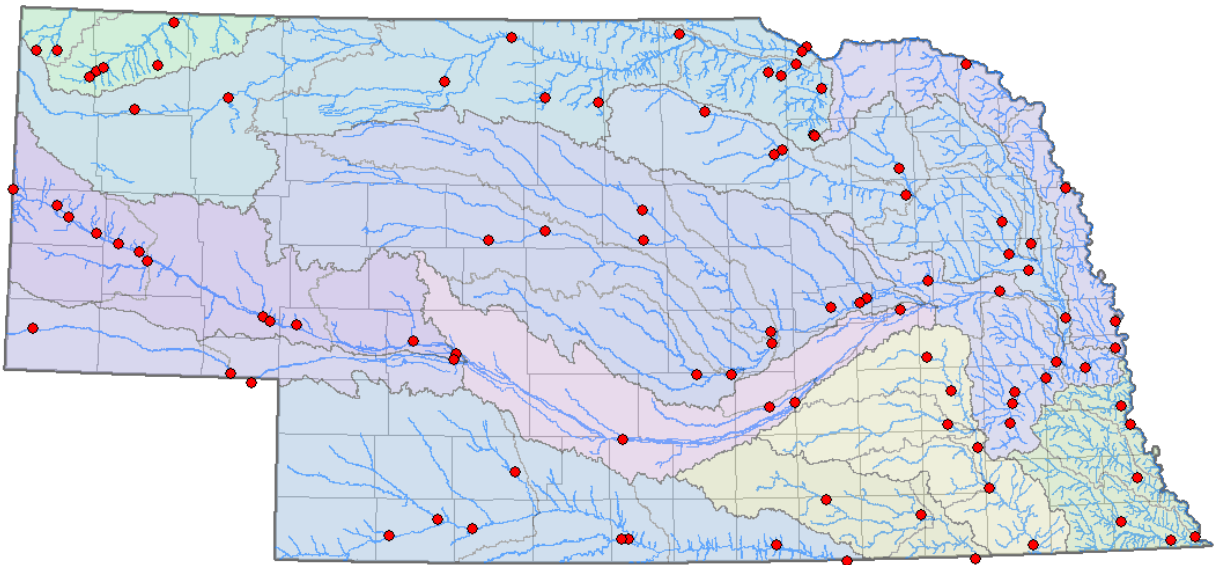
Ambient Stream Monitoring

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



Locations of NDEQ ambient monitoring sites

How were the Monitoring Sites Selected?
Nebraska's ambient stream monitoring program 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 predominate 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 integrator site. 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
- total nitrogen
- total phosphorus
- total chlorides

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

NDEQ staff monitoring Rockford Lake, Gage County

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 ~1164 water quality samples being collected annually.

Impairments and Sources

The most recent assessment of the ambient stream monitoring network found that 77 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).

The most common water quality impairment from the 2012 assessment was E. coli which violates the recreational beneficial use. E. coli samples are collected from water bodies used for recreational uses such as swimming and boating. E. coli in the lake water can cause gastrointestinal problems if swallowed. E. coli exists naturally in the environment. It gets into lakes and rivers via wildlife, human sources, and from runoff after a rainfall event. A few sources of E.coli include wildlife and livestock feces and failing septic systems.

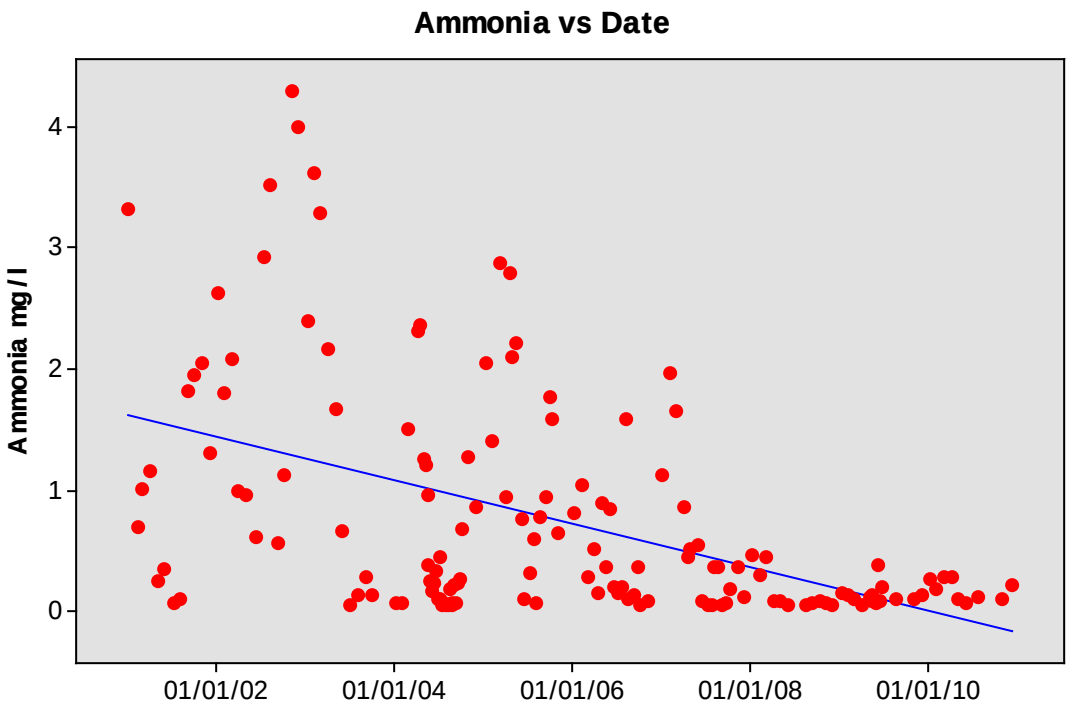
The second most common water quality impairment was selenium which violates the aquatic life beneficial use. The source of selenium in Nebraska's streams can be both natural and man-made. Naturally high concentrations of selenium occur in groundwater throughout the state and several of the selenium impaired streams are fed by groundwater with naturally high selenium concentrations. However, excess selenium can also be a result of agricultural and industrial practices, and it is important that anthropogenic sources of this pollutant are managed.

More information about all surface water impairments will be available in the 2012 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. A draft of this report should be available on NDEQ's website around February 1, 2012.

Trends

The design of the ambient monitoring program also allows the NDEQ to recognize trends in stream water quality and determine the efficacy of current pollution control strategies.

For example, Salt Creek downstream of Lincoln, was in violation of the state's ammonia water quality standard. An investigation determined that Lincoln's wastewater treatment facilities were causing the elevated ammonia concentrations and the City of Lincoln worked with NDEQ to develop an ammonia pollution control strategy. Within a few years of implementing the strategy, the ammonia concentrations in Salt Creek decreased significantly and Salt Creek now meets Nebraska's ammonia water quality standard.



Ammonia Trending in Salt Creek, near Lincoln, Lancaster County

More Information:

For more information on the quality of Nebraska's streams, the most recent *Surface Water Quality Integrated Report* and the *Annual Report to the Legislature* are available on the Department's website at http://deq.ne.gov/ . Or contact Jennifer Swanson at (402) 471- 4249 / jennifer.swanson@nebraska.gov or Patrick Hartman at (402) 471-3382 / patrick.hartman@nebraska.gov .

Platte River, near Gothenburg

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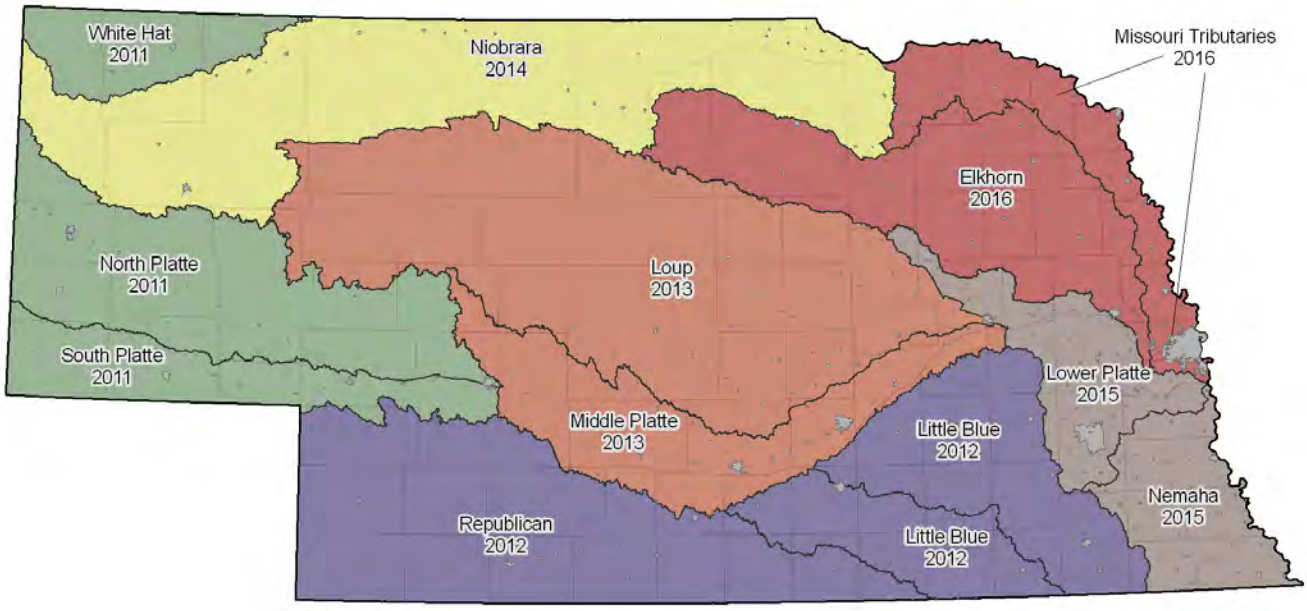
Basin Rotation Monitoring

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 20,000 miles of streams and rivers, and almost 300,000 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 on a waterbody before it makes a determination on the water quality. The basin rotation program 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 a few adjacent river basins each year, 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.



NDEQ six-year basin rotation monitoring schedule

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 between May 1 through September 30. In 2011, a total of 34 streams and 8 lakes were sampled from the North Platte, South Platte, and White-Hat basins, resulting in ~924 water quality samples being collected. The map above shows the basins and their rotation schedule.

How are the Monitoring Sites Chosen?
One of the primary objectives for the Basin Rotation Program 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, total nitrogen, total phosphorus, total chlorides, total suspended solids, turbidity, pH, temperature, conductivity, dissolved oxygen, *E. coli* bacteria, and pesticides.

Impairments and Sources
The most common impairment detected by NDEQ's basin rotation monitoring program is the bacteria *E. coli*. Potential sources of bacterial pollution are improperly functioning waste water treatment facilities, septic tanks, and lagoons, as well as urban and agricultural runoff.

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 basin rotation monitoring are combined with the ambient and other surface water monitoring programs to make up the data package used for all assessments of the status of Nebraska's waters.

Flooding in 2011 made some sampling difficult to accomplish.

More Information
For more information on the quality of Nebraska's streams, the most recent *Surface Water Quality Report* and the *Annual Report to the Legislature* are available on the Department's website at http://deq.ne.gov/.
Additional questions can be directed to Patrick Hartman (patrick.hartman@nebraska.gov) or Dave Schumacher (dave.schumacher@nebraska.gov)

Monitoring for Fish Kills and Citizen 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, a source of pollution, and/or a responsible party. Because a fish kill could result in legal action, sampling requires a relatively high level of quality data.

Fish kill at a private pond near Crete, Saline County.

What types of data are collected?
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 can define the cause of the kill, but further sampling and investigation may be needed to determine the source or reason for poor water quality conditions.

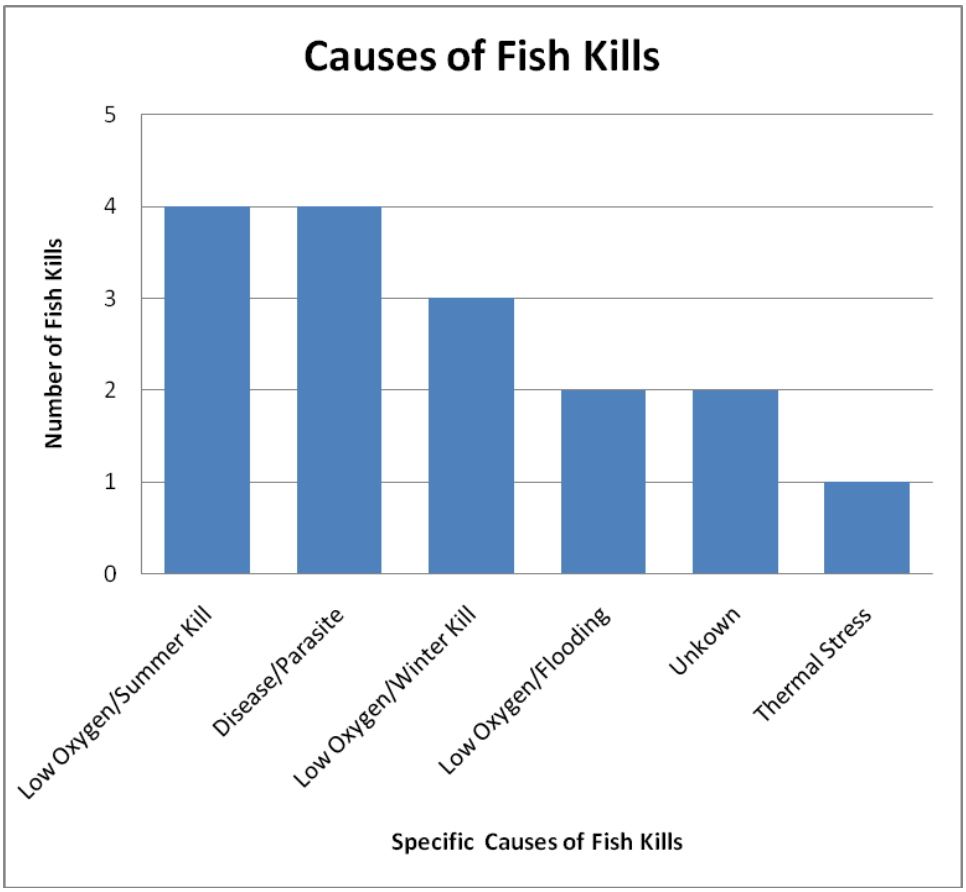
Fish Kills Reported in FY2011
From July 1, 2010 through June 30, 2011 (FY2011), a total of sixteen fish kills were reported to NDEQ. Of these, ten occurred in a lake or reservoir, four were in rivers or streams, and two were in private ponds. The cause of the fish kills is determined from

information collected from the reporting party and/or follow-up investigation and sampling. Fourteen (88%) of the reported fish kills were due to natural causes. These included nine due to low oxygen, specifically four from summer kill, three from winter kill, and three from decomposition of organic matter washed in from runoff events. Four more natural kills were attributed to disease or parasites. One fish kill was from thermal stress due to extreme temperature fluctuations. The cause of two fish kills could not be determined.

Summer fish kills 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.

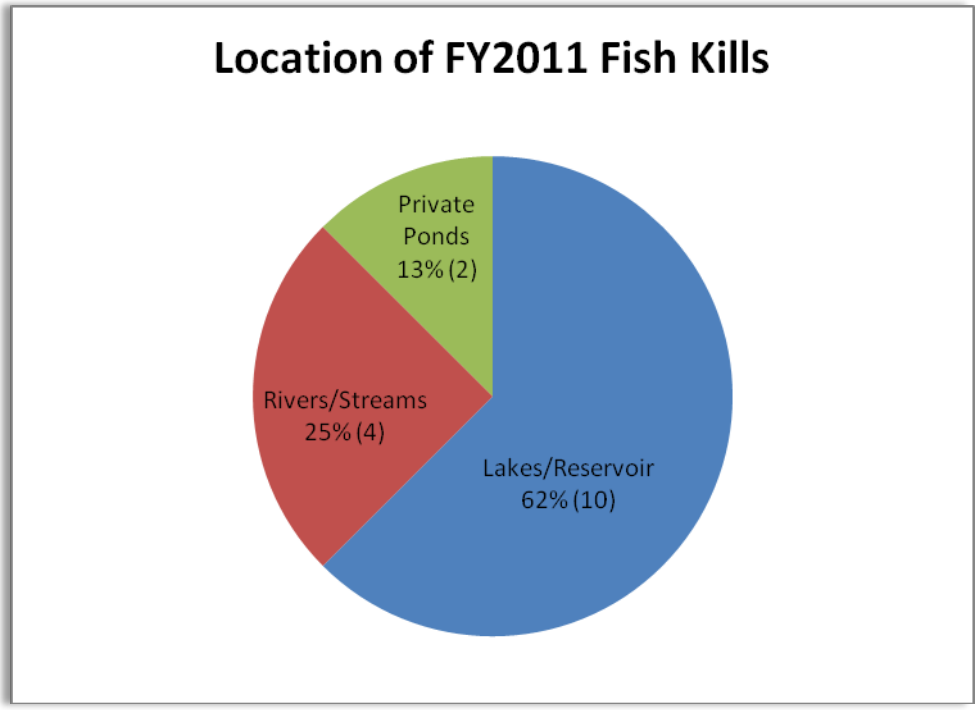
Winter fish kills are often caused by low dissolved oxygen concentrations which are the result of prolonged ice and snow cover on lakes and ponds. When lakes are frozen-over and have significant snow cover the amount of oxygen slowly decreases due to decreased photosynthetic activity, low light, and no exposure to atmospheric oxygen.

Flooding and runoff events this summer caused three fish kills. During these events new organic matter enters the water body and existing organic matter is re-suspended from bottom sediments. The suspended organic materials decompose rapidly, a process that uses oxygen, which may drop dissolved oxygen levels to a critical level.



Citizen Complaints Reported in FY2011
Between July 1, 2010 and June 30, 2011 the surface water unit received 39 notifications of concern regarding surface water issues. This compares to 21 notifications of concern for the previous year. While many of these cases were referred to other agency programs that more closely relate to the problem, the surface water unit provides assistance through investigations and/or collecting samples to help document conditions.

For More Information:
Contact Dave Bubb at 402/471-2810 or David Schumacher at 402/471-4232, or contact them via e-mail at dave.bubb@nebraska.gov and david.schumacher@nebraska.gov, respectively.



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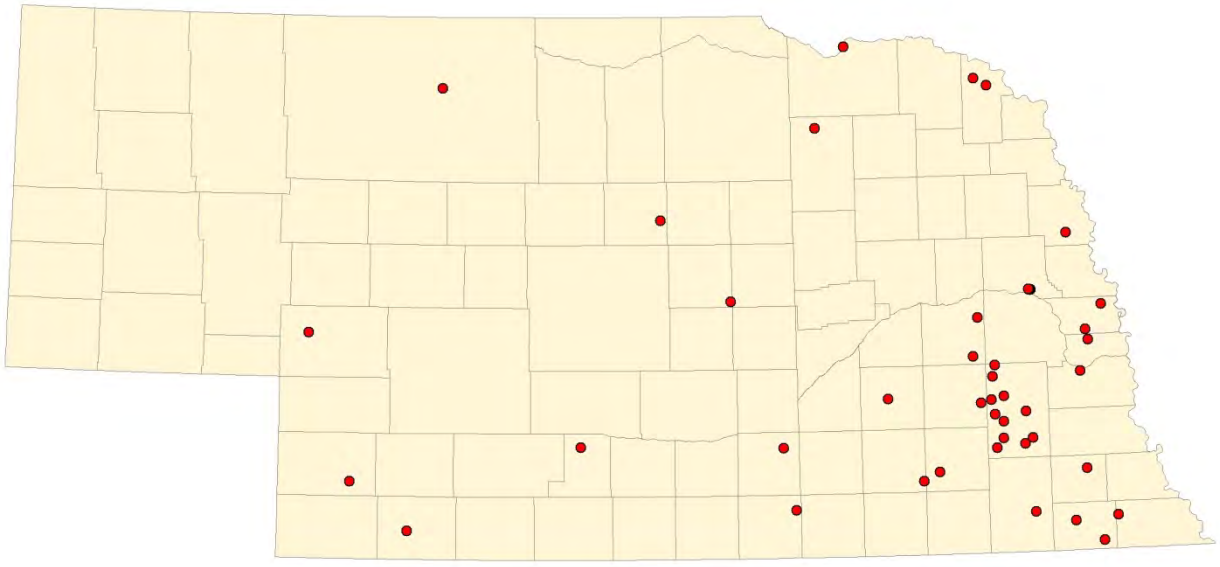
Nebraska Lake Monitoring

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 good enough for recreational activities such as swimming and water skiing, and suitable for fish and other aquatic organisms to survive and reproduce.

From May 1 to September 30, the Department and its partners obtain monthly samples 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 2011, 53 lakes were monitored for chemical and biological parameters while fish tissue monitoring was conducted at 31 lakes. Stream monitoring was conducted above eight reservoirs.



Lakes and reservoirs monitored in 2011

What is Monitored?
To determine if water quality is good enough to meet its intended uses in these lakes, samples are taken monthly for the following:

- dissolved oxygen
- temperature
- conductivity
- algae density
- water clarity
- sedimentation
- metals
- pesticides

May through September are considered to be the “growing season” of a lake or reservoir and are the months of the year when water quality tends to be the worst. Streams above reservoirs are typically monitored during and after rain events for nutrients, sediment, and pesticides.

How are the Data Used?

Collected data are compared to a Water Quality Standard or 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 good enough 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, cities, 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 Surface Water Quality Integrated Report that is prepared by NDEQ on even numbered years. This report is available on-line at http://deq.ne.gov/ .

Kingsley Dam at Lake C.W. McConaughy, Keith County.

Statewide Concerns

Nebraska Surface Water Quality Standards identifies 528 public lakes totaling 148,920 surface acres. Since 1991, the NDEQ and its partners have monitored 229 public lakes totaling 138,837 surface acres. This represents 43 percent of the total lakes and 93 percent of the total lake surface acres in the state.

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.

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.

Lake Improvement Programs

NDEQ staff collecting water samples on Swan Lake #5A, Saline County.

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.

Pesticide Trends in Lakes and Reservoirs

In 2011, the NDEQ assessed pesticide analysis results collected in all state lakes and reservoirs. The assessment was conducted using lake monitoring data collected from 1993-2008 on five of the major pesticides used in the state. This information is summarized in a report titled, “Occurrence and Trends of Pesticides in Nebraska Lakes and Reservoirs 1993-2008”. The report contains information on the trends observed in the pesticide data collectively and by each of the 13 major river basins. The report is available on-line at http://deq.ne.gov/ .

More Information

NDEQ’s Lake and Reservoir Monitoring Program is managed and conducted out of the main office in Lincoln. For more information, contact Jennifer Swanson at (402-471-4249) or at jennifer.swanson@nebraska.gov .

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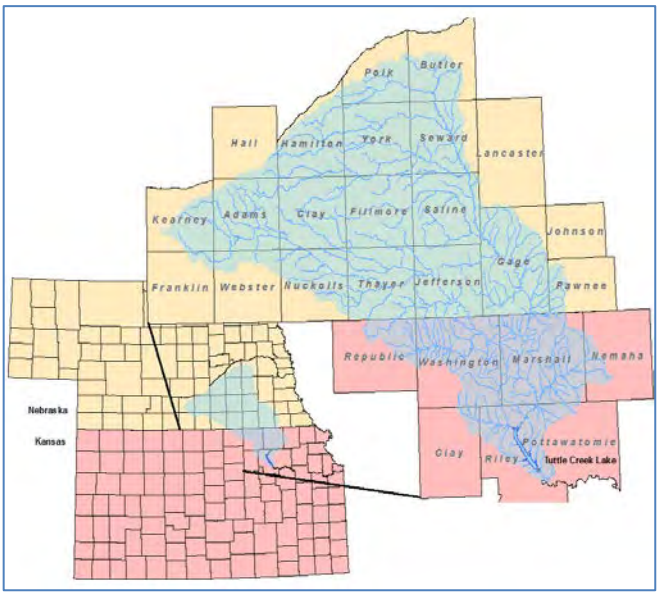
Big Blue River/Tuttle Creek Lake
Targeted Watershed Grant Monitoring

Background

The Big Blue River/Tuttle Creek Lake Interstate Targeted Watersheds Grant (TWG) Project was a collaborative effort between Nebraska and Kansas to address multi-jurisdictional water quality problems involving excessive runoff of sediment, nutrients, herbicides, and bacteria. Tuttle Creek Lake is a major source of water for the Kansas River, which supplies drinking water for the populations of Kansas City, Topeka, and Lawrence, KS. Tuttle Creek Lake is listed on the Kansas Section 303(d) list as impaired for sedimentation, eutrophication, atrazine, and alachlor. In addition to Tuttle Creek Lake, there are many other water bodies listed as impaired within the Big Blue and Little Blue River Basins in both Nebraska and Kansas.



Big Blue Watershed and Tuttle Creek Lake

Critical project area and targeted sub-watersheds

The TWG project, which began in 2006 and ended in September 2010, builds upon existing watershed partnerships by integrating funding sources from federal, state, and local programs to implement targeted conservation practices. The primary focus area of this project was Gage and Jefferson counties in Nebraska, and Marshall and Washington counties in Kansas**.** Watersheds that were specifically targeted within this area were the Big Indian Creek and Cub Creek watersheds in Nebraska, and the Horseshoe Creek watershed in Kansas. The Nebraska and Kansas teams were responsible for implementing the conservation practices in their respective states based on pre-project water quality and land use information.

Why is this monitoring being conducted?

A water quality monitoring component was included in this project to estimate reductions in pollutant loadings after conservation practice implementation was completed. Specifically, it was planned that the monitoring data would be assessed to determine if the implementation of residue management, continuous no-till farming systems, riparian buffer strips, and other conservation practices improved water quality, reduced the number of water quality criteria violations, and reduced sediment, nutrient, and herbicide loadings.

What is being monitored?

The water quality monitoring component of this project consisted of runoff and fixed-frequency water sampling at 13 stream sites. Beginning in April 2010, stream sites were sampled weekly for 26 weeks through September 30. Six runoff events were sampled at four sites during this timeframe. NDEQ collected the water quality samples with assistance from the Lower Big Blue NRD. The water samples were collected with the goal of characterizing the current water quality status at the monitoring sites during normal seasonal flow and runoff conditions. Field parameters (turbidity, temperature, conductivity, pH, oxygen, and stream flow) were measured at the time of collection. Laboratory analyses included atrazine, acetochlor, alachlor, metolachlor, total suspended solids, suspended sediment concentration, total phosphorus, and total nitrogen.

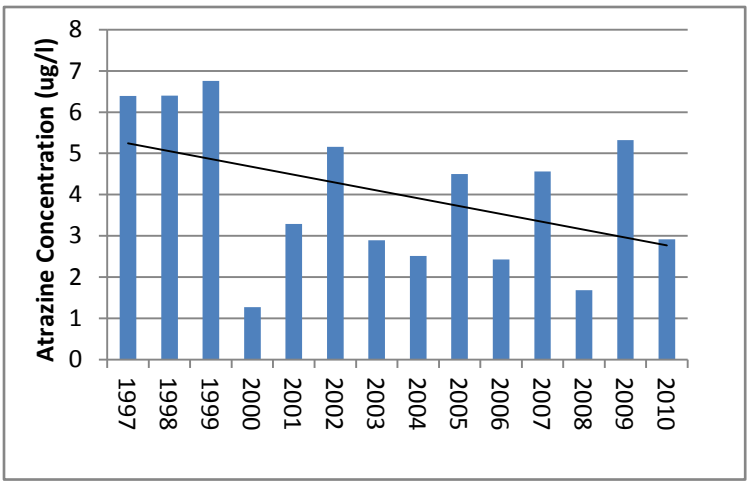
2010 TWG Monitoring Sites

NDEQ staff conducting monitoring at Horseshoe Creek near Marysville, KS.

Results of Monitoring

Many of the objectives of the project were aimed at reducing atrazine and other pollutants that enter Tuttle Creek Reservoir. Documenting these reductions was difficult due to the large size of the watershed, relatively few sampling locations, identifying pre and post project data that were comparable, and on-going implementation of best management practices.

In spite of the above identified factors that make quantification of the reductions difficult, data and information have been assessed that do indicate reductions in atrazine. It is reasonable to expect similar reductions in other pollutants given they are primarily nonpoint source in origin. Long term data and information from the Big Blue River at Barneston, NE exists and was utilized to determine if reductions in atrazine could be detected. Using data collected from 1997-2010, the following chart shows the annual mean atrazine concentrations.



Mean annual atrazine concentration in the Big Blue River at Barneston

As shown on the chart, atrazine concentrations have been observed to be decreasing over time. The specific details of the reductions cannot be quantified. However, the data collected from the Big Blue River at Barneston does represent approximately 75 percent of the watershed drainage area. These observations can be considered representative of the Tuttle Creek Lake basin. As such, these reductions should be considered in part, as a result of this project. However and more importantly, credit should be given to the collaborative effort of all the agencies and entities that have been working at reducing nonpoint source pollution.

Terrace and tile system installed in the Big Indian Creek watershed

The combination of education, installation of best management practices, and land stewardship have contributed to the observed reductions. Presently the TWG project has ended, but conservation work in the area continues and watershed partners are still actively engaged in joint water quality improvement efforts. These efforts will continue for years to come and will continue to improve water quality in the Big Blue River basin and Tuttle Creek Lake.

More Information: For more information on the Targeted Watershed Grant Project, Contact Will Myers at (402) 471-4227 or will.myers@nebraska.gov

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Fish Tissue Monitoring

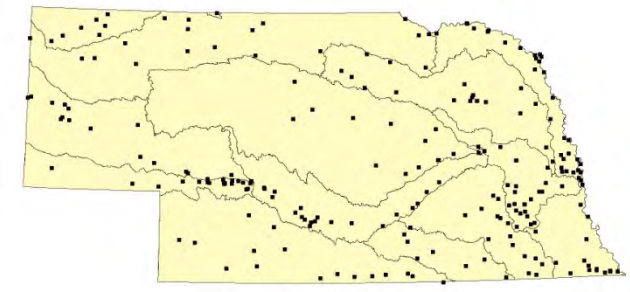
Why NDEQ Does this Monitoring

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 in 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?



Historic fish tissue monitoring locations.

Monitoring is generally conducted at locations where most fishing occurs; therefore the risk to human health is greatest. Fish species targeted for collection included those that are most frequently sought by fisherman, such as: catfish, largemouth bass, walleye, crappie, and even 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 two or three of Nebraska's 13 major river basins (see the map above for basin divisions and historic sampling locations). Fish tissue sampling activities are rotated through all 13 basins on a six-year cycle. In addition, fish samples are collected every two years at

five locations termed “trend sites.” These five trend sites have been monitored for more than 16 years in an effort to identify long-term changes in fish contaminant levels, if present.

What is Monitored?

Fish tissue samples are 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* (i.e., 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* (i.e., organic mercury – occurs naturally and is released into the environment from mining operations, fossil fuel combustion, refuse incineration, and industrial waste discharges); and
- *dieldrin* (i.e., a breakdown product of the insecticide Aldrin, generally used on corn prior to 1974).

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 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 noncarcinogencic 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 6-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 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 May 2011, the NDHHS, in cooperation with the NDEQ, the NGPC, and the NDA, has issued fish consumption advisories for 85 waterbodies: 19 stream segments and 66 lakes/reservoirs. These advisories are not bans on eating fish, rather a warning to limit the consumption of specified fish. Please refer to the table and figure below for advisory and location information.

Nebraska Fish Consumption Advisories Through 2009

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
1	Lake Hastings	Adams	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	Buffalo	Largemouth Bass	Mercury, Selenium
7	Logan Creek	Burt	Channel Catfish	PCBs, Dieldrin
8	Summit Lake	Burt	Largemouth Bass	Mercury
9	Platte River	Cass	Channel Catfish	PCBs, Mercury
10	Weeping Water City Lake	Cass	Largemouth Bass	Mercury, Selenium
11	Chalkrock Reservoir	Cedar	Largemouth Bass	Mercury, Selenium
12	Enders	Chase	White Bass	Mercury
13	Valentine Mill Pond	Cherry	Largemouth Bass	Mercury
14	Merritt Reservoir	Cherry	Walleye	Mercury
15	Cottonwood Lake	Cherry	Largemouth Bass	Mercury
16	Shell Lake	Cherry	Northern Pike	Mercury
17	Omaha Creek	Dakota	Channel Catfish	PCBs, Dieldrin, Chlordane
18	Crystal Cove Lake	Dakota	Largemouth Bass	Mercury
19	Box Butte Reservoir	Dawes	Northern Pike	Mercury
20	Chappell Interstate Lake	Deuel	Largemouth Bass	Mercury, Selenium

NOTE: The NDEQ's *Policy for Issuing Fish Consumption Advisories* uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 70 years for calculating health risks (NDEQ, 2007).

Table Continued

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
21	Dead Timber Lake	Dodge	Largemouth Bass	Mercury
22	Fremont Lake No. 1	Dodge	Largemouth Bass	Mercury
23	Johnson Lake	Dodge	Largemouth Bass	Mercury
24	Elkhorn River	Douglas	Carp	PCBs, Dieldrin
25	Zorinsky Lake	Douglas	Largemouth Bass	Mercury
26	Carter Lake	Douglas	Largemouth Bass	PCBs
27	Standing Bear Lake	Douglas	Largemouth Bass	Mercury
28	Rock Creek Lake	Dundy	Largemouth Bass	Mercury
29	Hugh Butler Lake	Frontier	Northern Pike	Mercury
30	Muddy Creek	Furnas	Channel Catfish	Mercury
31	Big Blue River	Gage	Carp	PCBs, Dieldrin
32	Wolf-Wildcat Lake	Gage	Largemouth Bass	Mercury
33	Rockford Lake	Gage	Largemouth Bass	Mercury
34	Phillips Lake	Gosper	Carp	Mercury
35	Eagle Scout Lake	Hall	Largemouth Bass	Mercury
36	Frenchman WMA Lake	Hayes	Largemouth Bass	Mercury
37	Elkhorn River	Holt	Carp	Mercury
38	North Loup SRA Lake	Howard	Largemouth Bass	Mercury, Selenium
39	Farwell South Reservoir	Howard	Largemouth Bass	Mercury
40	Cub Creek Lake	Keya Paha	Largemouth Bass	Mercury
41	Niobrara River	Knox	Carp	Mercury, Selenium
42	Salt Creek	Lancaster	Carp	PCBs, Mercury
43	Wagon Train Lake	Lancaster	Largemouth Bass	Mercury
44	Wildwood Reservoir	Lancaster	Largemouth Bass	Mercury
45	Bluestem Lake	Lancaster	Channel Catfish	Mercury
46	Stagecoach Lake	Lancaster	Largemouth Bass	Mercury
47	Merganser Lake	Lancaster	Largemouth Bass	Mercury
48	Oak Creek	Lancaster	Channel Catfish	PCBs, Mercury
49	Holmes Lake	Lancaster	Largemouth Bass	Mercury
50	North Platte River	Lincoln	Largemouth Bass	Mercury
51	Maloney Res. Outlet Canal	Lincoln	Carp	Mercury
52	Sutherland Outlet Canal	Lincoln	Carp	PCBs, Mercury
53	Interstate Lake	Lincoln	Largemouth Bass	Mercury
54	East Hershey Lake	Lincoln	Largemouth Bass	Mercury
55	Hershey Lake	Lincoln	Largemouth Bass	Mercury
56	Skyview Lake	Madison	Largemouth Bass	Mercury, Selenium
57	North Platte River	Morrill	Carp	Mercury, Selenium
58	Steinart Park Lake	Otoe	Largemouth Bass	Mercury
59	Burchard Lake	Pawnee	Largemouth Bass	Mercury
60	Mayberry WMA Lake	Pawnee	Largemouth Bass	Mercury
61	Prairie Knoll Lake	Pawnee	Largemouth Bass	Mercury

NOTE: The NDEQ's *Policy for Issuing Fish Consumption Advisories* uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 70 years for calculating health risks (NDEQ, 2007).

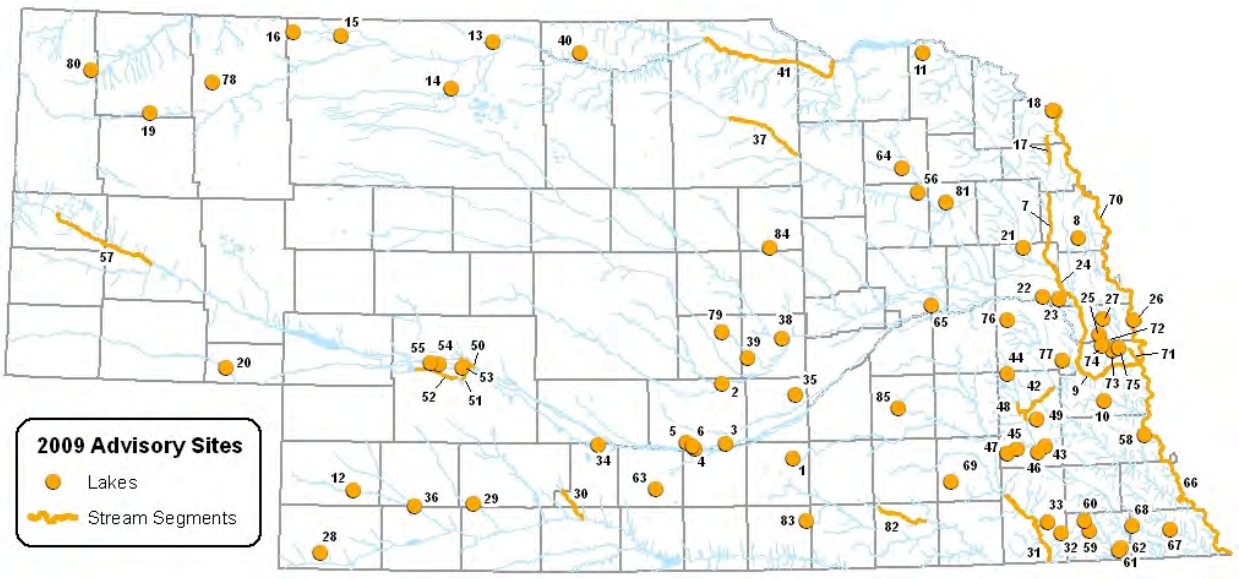
Table Continued

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
62	Iron Horse Trial Lake	Pawnee	Largemouth Bass	Mercury
63	Holdrege Park Lake	Phelps	Largemouth Bass	Mercury, Selenium
64	Willow Creek Lake	Pierce	Carp	Mercury
65	Columbus City Park Pond	Platte	Largemouth Bass	Mercury
66	Missouri River	Richardson	Channel Catfish	PCBs, Dieldrin, Chlordane
67	Verdon Lake	Richardson	Largemouth Bass	Mercury
68	Kirkman's Cove Lake	Richardson	Largemouth Bass, Carp	Mercury
69	Swan Creek 5A	Saline	Largemouth Bass	Mercury
70	Missouri River	Sarpy	Channel Catfish	PCBs, Dieldrin
71	Papillion Creek	Sarpy	Carp	PCBs, Dieldrin
72	West Papillion Creek	Sarpy	Carp	PCBs, Dieldrin
73	Walnut Creek Lake	Sarpy	Largemouth Bass	Mercury
74	Wehrspann Lake	Sarpy	Largemouth Bass	Mercury
75	Halleck Park Lake	Sarpy	Largemouth Bass	Mercury, Selenium
76	Czechland Lake	Saunders	Largemouth Bass	Mercury
77	Memphis Lake	Saunders	Largemouth Bass	Mercury
78	Walgren Lake	Sheridan	Largemouth Bass	Mercury
79	Sherman Reservoir	Sherman	Walleye	Mercury
80	Carter P. Johnson Lake	Sioux	Largemouth Bass	Mercury
81	Maskenthine Lake	Stanton	Largemouth Bass	Mercury
82	Big Sandy Creek	Thayer	Channel Catfish	Mercury
83	Liberty Cove	Webster	Largemouth Bass	Mercury
84	Pibel Lake	Wheeler	Largemouth Bass	Mercury
85	Recharge Lake	York	Largemouth Bass	Mercury

NOTE: The NDEQ's *Policy for Issuing Fish Consumption Advisories* uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 70 years for calculating health risks (NDEQ, 2007).

NDEQ staff gathering fish tissue samples, Duck Creek, Saunders County.

Location of Nebraska Fish Consumption Advisories Through 2009



For More Information Contact:
Nebraska Department of Environmental Quality: (402) 471-4264 or greg.michl@nebraska.gov ,
Nebraska Game and Parks Commission: (402) 471-5553,
Nebraska Health and Human Services System: (402) 471-8880.

For Reports and Other Information Online go to: www.ndeq.state.ne.us
The direct URL link to "Findings of the 2006 to 2008 Regional Ambient Fish Tissue Program in Nebraska":

http://deq.ne.gov/Publica.nsf/Pages/WAT155 . To find it on NDEQ's web site, click on the Publications tab, select Water Quality, find it under "Reports."

The direct URL to NDEQ's "Fish Consumption Advisories" page is:

http://deq.ne.gov/SurfaceW.nsf/Pages/FCA To find it on NDEQ's web site, click on the NDEQ News/Topics of Interest tab, then select "Fish Consumption Advisories."

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Stream Biological Monitoring Program

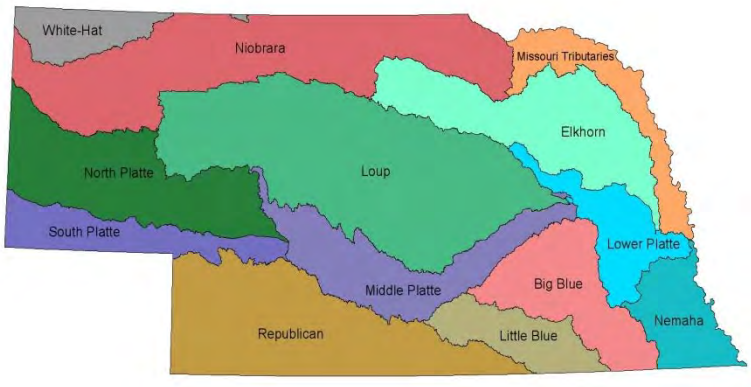
Why Biological Monitoring?

Nebraska has over 81,000 miles of streams of which approximately 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 us. 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.

Willow Creek west of Pierce, Pierce 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 bridges. 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 it's 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?" is best obtained from sample locations chosen so 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 1997-2009, the biological communities of 444 randomly selected stream sites were sampled.



Where is the Monitoring Conducted?

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

What is Monitored?

Routine chemical analyses of water samples provide water quality information for a snapshot in time and 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 on not only 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

Caddisfly larvae with case

Aquatic macroinvertebrates are small creatures that live in streams attached to rocks, vegetation, or 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.

Fish

Orangethroat darter

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 5 inches long. The Department's fish surveys have also provided information on changing abundances and ranges of fish in the state. Some species have been found to occur in many more places than previously thought, while others have shown dramatic declines over the last 30 years.

How are the Data Used?

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

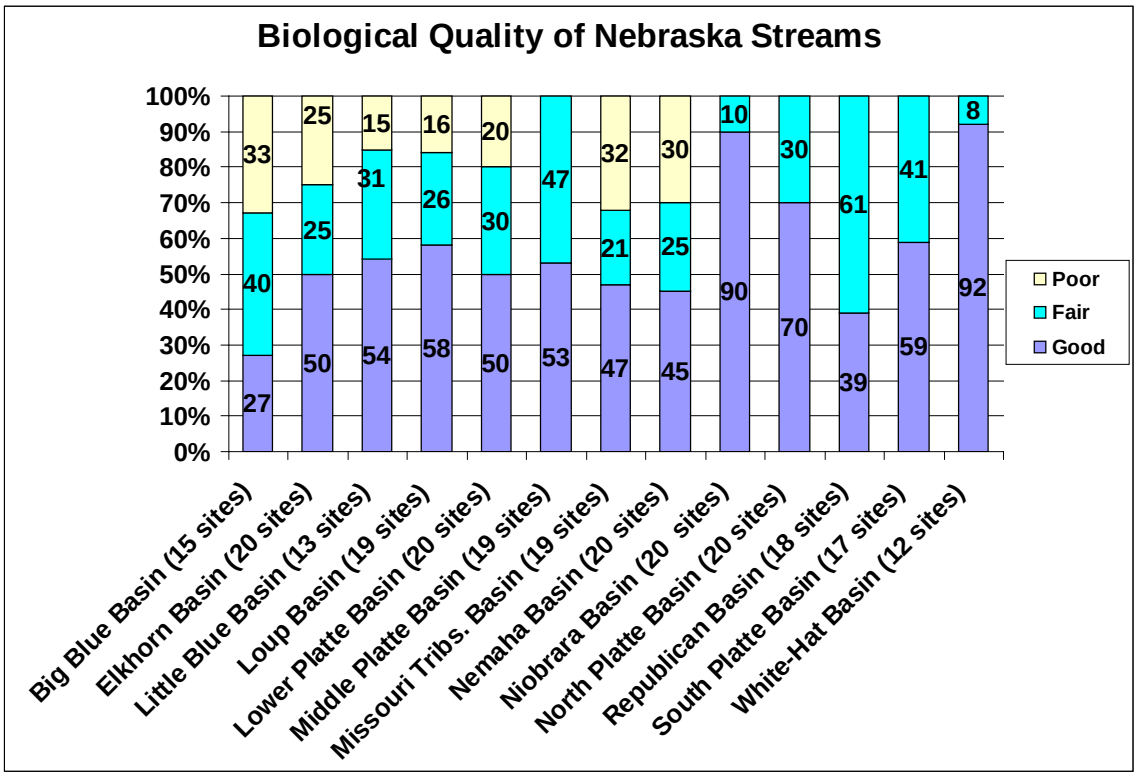
- Documenting current statewide biological conditions in Nebraska's streams to track water quality status and trends.

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

Under the federal Clean Water Act, states are required to develop programs to evaluate the physical, chemical, and biological integrity of the Nation's waters and to adopt water quality standards to restore and maintain that integrity. States must report to Congress on the condition of all waters within their boundaries every two years. The information collected by the Department's SBMP satisfies these requirements for assessing the biological integrity of Nebraska's streams.

Results

For the purposes of this report, biological data from 232 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 (2004-2008) were used to assess the water quality of streams in the Big Blue, Elkhorn, Little Blue, Loup, Lower Platte, Missouri Tributary, Nemaha, Niobrara, North Platte, and Republican Basins.



The Middle Platte, South Platte, and White-Hat Basins were assessed using two seasons of data because fewer random sites were selected in these basins. Additional findings from the next round of sampling that began in 2009 will be forth coming over the next several years and will be used to continue the assessment of the biological condition of wadeable streams in Nebraska.

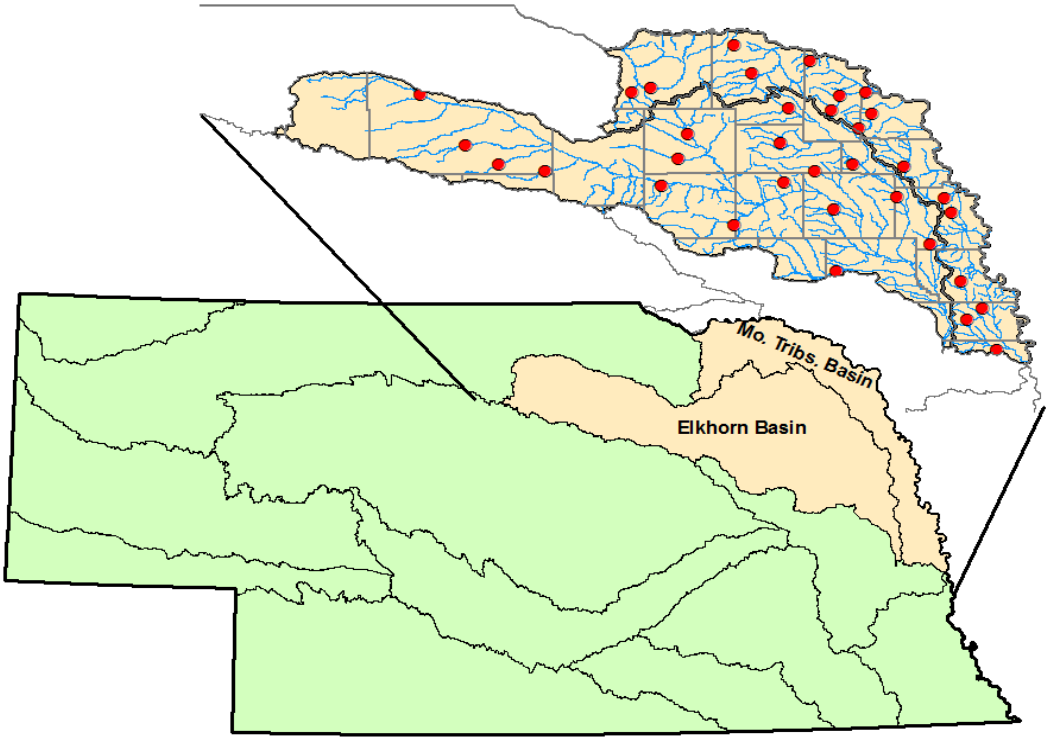
The results of the survey show the White-Hat and Niobrara Basins are in the best condition of the basins evaluated with 92% and 90% of the streams in good condition, respectively. The streams in the remaining basins are considerably lower in quality. The Big Blue Basin presents the most concerns with only 27% of the streams in good condition and 33% of streams in poor condition.

The recent Wadeable Streams Assessment done by EPA reported that increases in nutrients (e.g., nitrogen and phosphorus) and streambed sediments have the highest negative impact on biological condition. These contaminants are commonly introduced into the streams by non-point source pollution from agricultural practices such as crop production (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.

Agricultural run-off

2010 Update

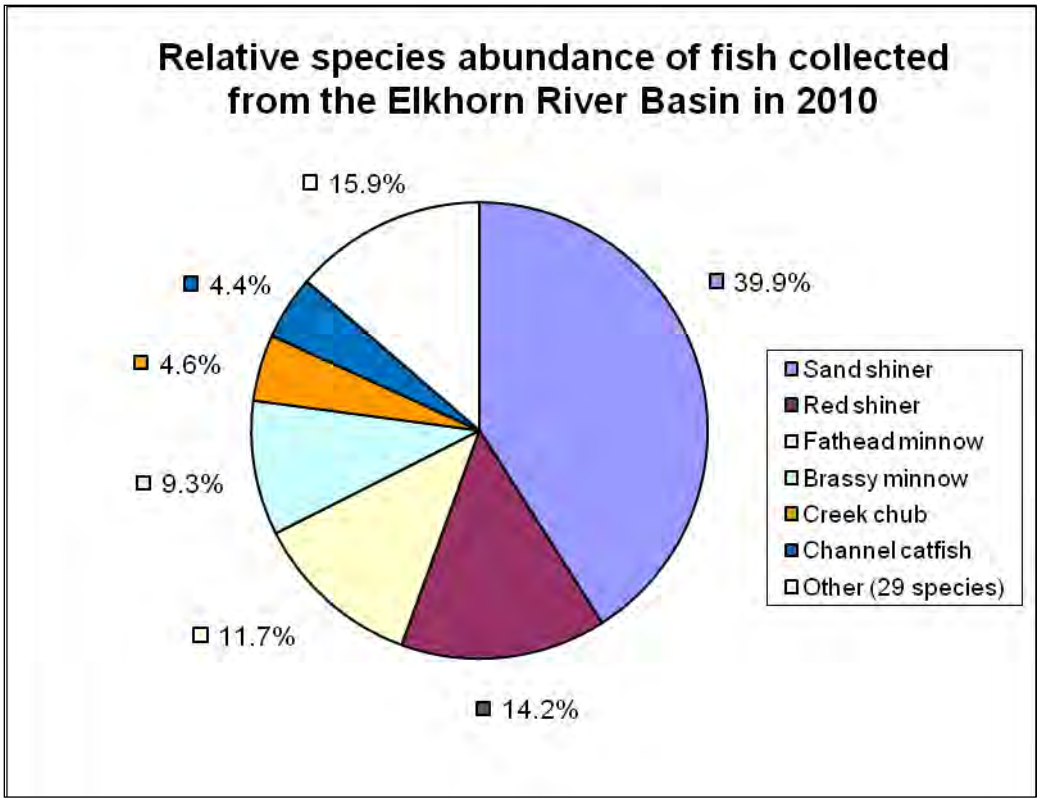
Thirty-four stream locations were sampled as part of the 2010 SBMN (see figure below).

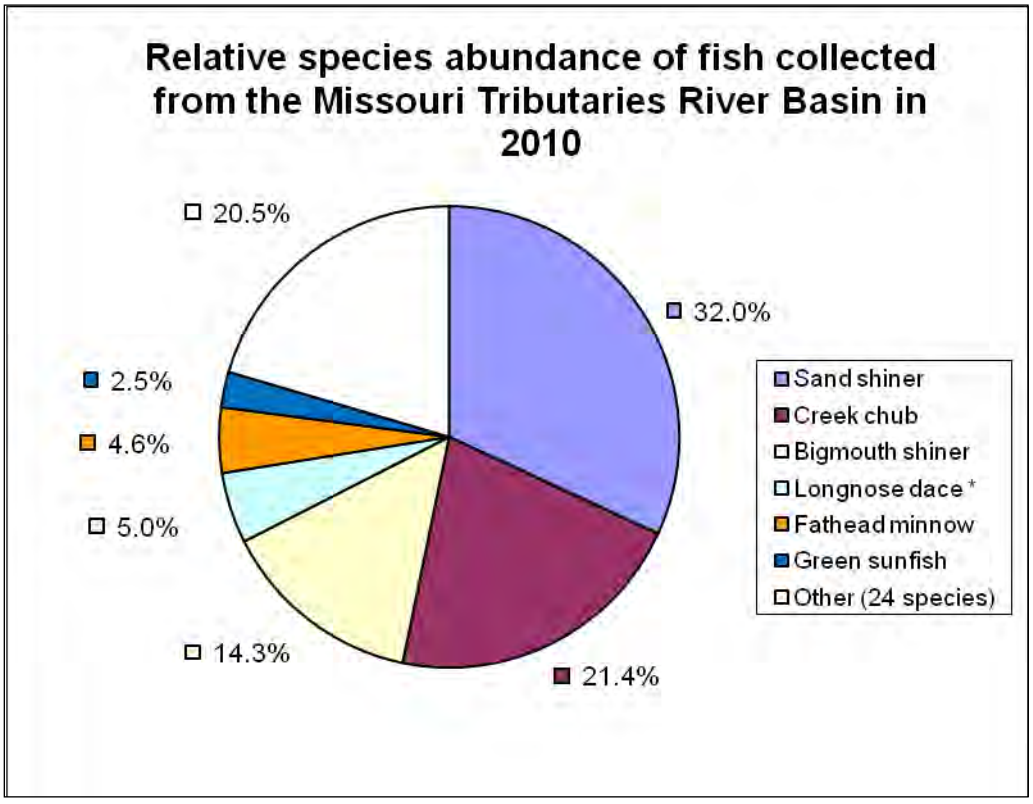


Sampling Locations in the Elkhorn and Missouri Tributaries Basins, 2010

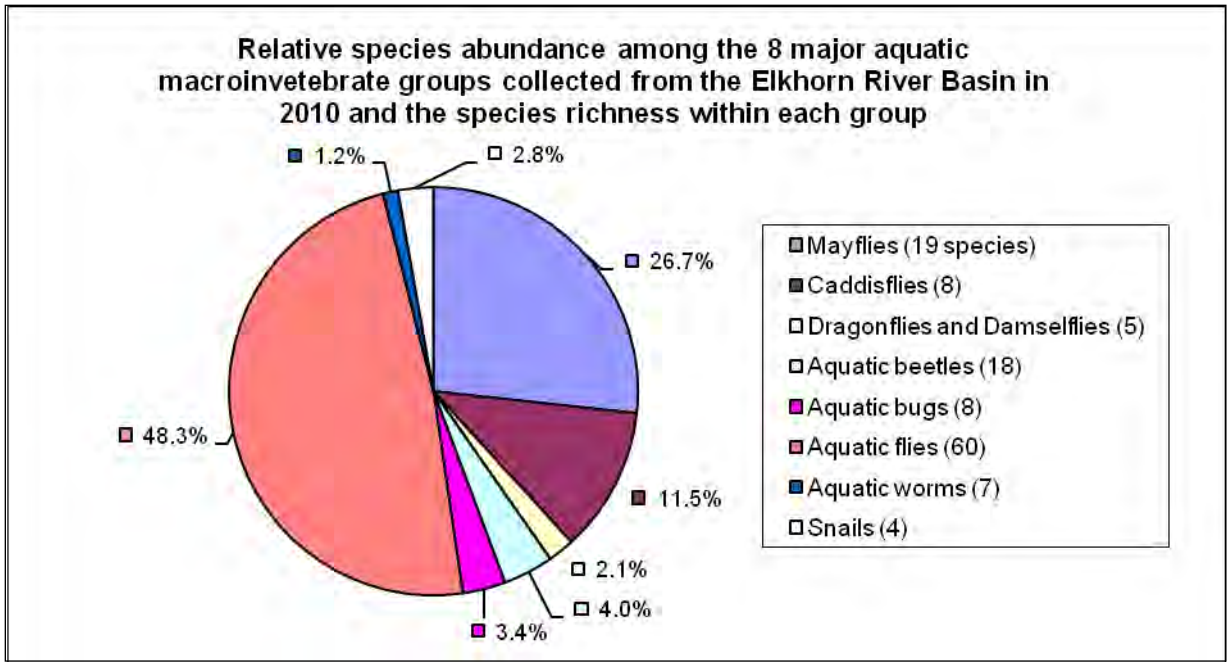
Preliminary assessments of the biological collections made in 2010 are provided in the following charts. Relative species abundance and species richness describe key elements of biodiversity which the Department uses to determine stream health. Relative species abundance refers to how common or rare a species is relative to other species in a given stream location while species richness simply refers to the number of species collected.

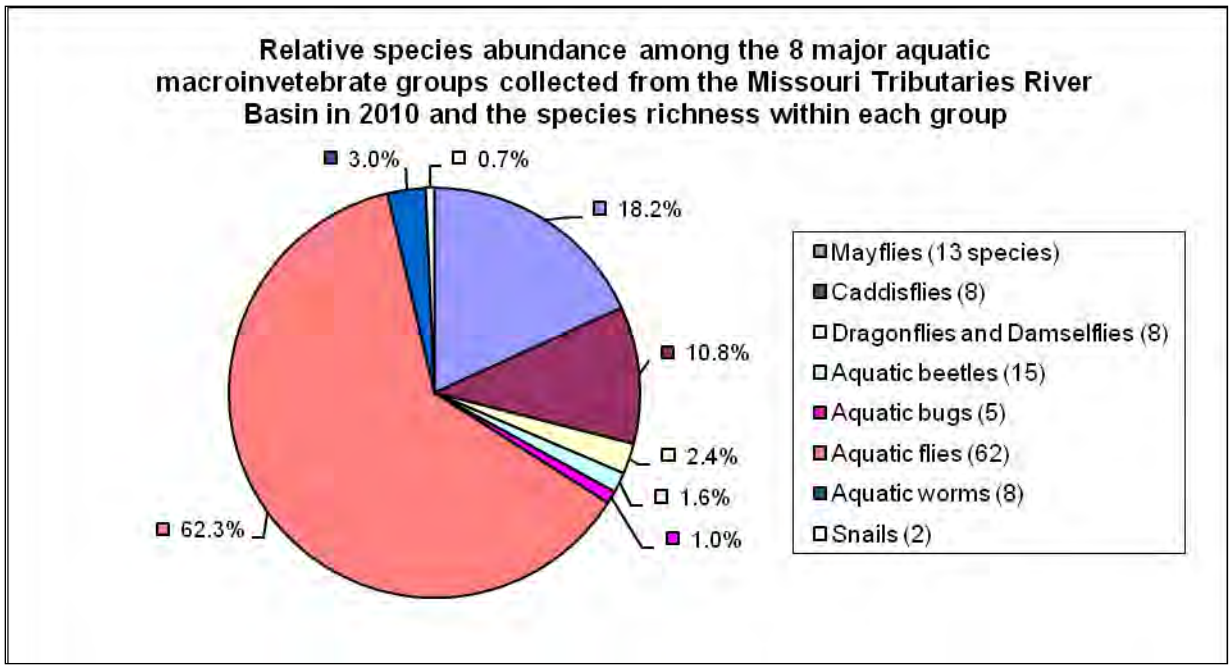
Thirty-five fish species were collected in the Elkhorn and 30 species in the Missouri Tributaries river basins throughout the 2010 sampling season with sand shiners, creek chubs, bigmouth shiners, and fathead minnows being the most abundant. The most abundant of the major macroinvertebrate taxa included the larvae life stages of the aquatic flies (e.g., midges, black flies, and mosquitoes), mayflies, and caddisflies.





*Longnose dace were collected at only 2 stream locations.


Relative species abundance among the 8 major aquatic macroinvetebrate groups collected from the Elkhorn River Basin in 2010 and the species richness within each group
1.2%
2.8%
26.7%
48.3%
11.5%
2.1%
4.0%
3.4%
Mayflies (19 species)
Caddisflies (8)
Dragonflies and Damselflies (5)
Aquatic beetles (18)
Aquatic bugs (8)
Aquatic flies (60)
Aquatic worms (7)
Snails (4)


Relative species abundance among the 8 major aquatic macroinvetebrate groups collected from the Missouri Tributaries River Basin in 2010 and the species richness within each group
3.0%
0.7%
18.2%
10.8%
2.4%
1.6%
1.0%
62.3%
Mayflies (13 species)
Caddisflies (8)
Dragonflies and Damselflies (8)
Aquatic beetles (15)
Aquatic bugs (5)
Aquatic flies (62)
Aquatic worms (8)
Snails (2)

More Information

The Department's Stream Biological Monitoring Program is conducted and managed out of the main office located in Lincoln. Contact Ken Bazata at 402/471-2192 or ken.bazata@nebraska.gov or Dave Schumacher at 402/471-4232 or david.schumacher@nebraska.gov for further data or information.

NDEQ staff seining fish on the North Platte River near Oshkosh, Garden County.

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NPDES Compliance Monitoring

Lincoln's Wastewater Treatment Facility.

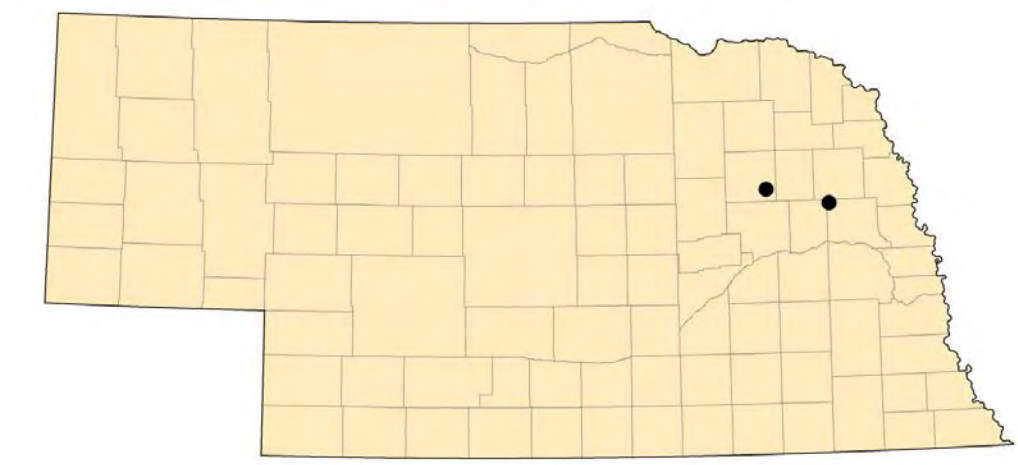
Why does NDEQ Monitor Wastewater Treatment Plant Discharges?
The federal Clean Water Act established the National Pollution Discharge Elimination System (NPDES). Under this program any person, business, or municipality must have a NPDES permit to discharge to waters of the State. The NPDES permit establishes limits on the amount of pollutants that can be discharged. In order to comply with the pollutant limits, the discharger often has to construct a wastewater treatment plant to treat their contaminants.

The NPDES program is primarily a self monitoring program. The NPDES permit, along with limiting the amount of pollutants that can be discharged, also requires the discharger to sample on a routine basis and to report the results of sampling to NDEQ quarterly.

NDEQ manages around 687 discharging NPDES permits for municipalities and industries. The permits allow for inspection by NDEQ or EPA. The NDEQ compliance monitoring program samples the wastewater treatment plant discharges to verify the accuracy of the self monitoring activities, to monitor the performance of the wastewater treatment plant, and check the accuracy of the testing laboratories.

Where is monitoring conducted?
Compliance monitoring is conducted at selected wastewater treatment plants. Wastewater treatment plants are chosen based on several criteria. EPA requires an annual inspection of all major dischargers (plants with flows greater than one million gallons per day), so some of these facilities were selected for compliance sampling at the same time as the annual inspection. Facilities with recent compliance issues may be selected for sampling**.** Facilities located on river and streams not meeting water quality standards may be selected, as well.

In 2011, compliance monitoring was conducted at two facilities; Dodge and Madison.



Locations monitored for NPDES compliance.

What was monitored and how are the data used?
Parameters are selected based on the pollutants of concern included in the facility's NPDES permit. These parameters may include carbonaceous Biochemical Oxygen Demand (cBOD), total suspended solids, pH, bacterial contaminants such as fecal coliform or E. coli, ammonia, and heavy metals. Pollutants not on the facility's NPDES permit may also be analyzed if the department suspects other pollutants may be discharged.

At both facilities selected for monitoring in 2011, the influent into the wastewater treatment plant and treated effluent discharged from the wastewater treatment plants were sampled. Sampling locations on the influent and effluent were selected based on the sampling locations included in the NPDES permit. Sampling included grab and composite sample collection.

Sampling data collected from the facilities was compared to their NPDES permit limits to verify compliance with the permit. If the data exceeded the permit, enforcement action is a possible action that can be taken by the Department. Data was also compared to the most recent four to eight quarters of self monitoring data submitted to the Department. This provides verification of the data being submitted to the Department. Data from samples that were split with the facility were used to compare the facility's lab results with the laboratory results of the Health and Human Services laboratory as a verification of the facility's lab accuracy.

More Information

For more information on compliance monitoring at NPDES facilities, contact Curt Christiansen at (402) 471-4260 or curt.christiansen@nebraska.gov.

Surface Water Sampling Summary

As discussed in the previous short reports, the NDEQ performs surface water monitoring throughout the state. This section summarizes the planned number of samples and parameters analyzed for each monitoring program. Because of the uncertainties of weather, schedules, or equipment problems, not all planned samples are taken or analyzed. 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.

NDEQ staff sampling at Rockford Lake, Gage County

AMBIENT STREAM NETWORK

Network: 97 Sites Statewide

Frequency: Once per Month (first full week), 12 Months per year

Parameters:

- **Traditional:** Total Suspended Solids (TSS), Chloride, Ammonia, Nitrate-Nitrite, Kjeldahl Nitrogen, Total Phosphorus
- **Field Measurements:** Temperature, Oxygen, pH, Conductivity, Turbidity, Discharge.
- **Pesticides:** Once per month, April – Sept; Atrazine, Acetochlor, Metolachlor
- **Quarterly Metals:** 4 Times per year (Jan., Apr., July, Oct.)
    - **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": Dissolved: Sodium, Magnesium, Calcium, Arsenic and Total Selenium

2011 Ambient Stream Sample Totals by Parameter

- **Traditional & Field** (97 Sites X 12 Events) **= 1164**
- **Pesticides:** (97 Sites X 6 Events) **= 582**
- **Metals (all metals)** (17 Sites X 4 Events) **= 68**
- **Metals (partial metals list)** (80 Sites X 4 Events) **= 320**
- **QC Samples/Year** (DEQ 14 + USACE 2 X 12 Events) **= 192**

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

BASIN ROTATION NETWORK

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 Basins
2011	North Platte, South Platte & White-Hat
2012	Big Blue, Little Blue & Republican
2013	Loup & Middle Platte
2014	Niobrara
2015	Lower Platte & Nemaha
2016	Elkhorn & Missouri Tributaries

2011 Basin Rotation Network Summary

Network: 42 Sites**:** 34 streams (including 23 shared ambient) and 8 lakes in the North and South Platte River and White and Hat River Basins.
Frequency: Weekly, May 1 – September 30 (22 weeks)
Parameters:

- **Traditional:** (Rivers/Streams only) TSS, Chloride, Ammonia, Nitrate-Nitrite, Kjeldahl Nitrogen, Total Phosphorus
- **Field Measurements:** All Rivers/Streams & Lakes) Temperature, Oxygen, pH, Conductivity, Turbidity & Discharge.
- **Pesticides:** (Rivers/Streams only) Atrazine, Metolachlor, Acetochlor
- **Bacteria:** (Rivers/Streams and Lakes) E. coli

2011 Basin Rotation Sample Totals

- Total Stream Samples (traditional, bacteria & field) = 748 Samples
- Total Lake Samples (bacteria & field measurements) = 176 Samples
- Total Bacteria Samples (Basin Rotation Only) = 924 Samples

Assistance: SPNRD

LAKE BEACH BACTERIA AND TOXIC ALGAE (Beach Monitoring)

Blue-green bacteria at Merritt Reservoir, Cherry County

Network Summary

2011 Bacteria & Toxic Algae Routine Weekly Samples

49 Sites X 22 Weeks = 1,078 Samples

Additional Toxic Algae Samples

- Routine Quality Control Samples
  - Duplicates (102) and Blanks (102)
  - Accuracy and Verification checks (26) = 230
- Special Concern Samples (Fish Kills/Complaints)
  - Pawnee Lake Groundwater Study = 75
  - Kirkman's Cove Groundwater Study = 58
  - Carter Lake NPS Study = 66
  - Helen Lake Special Concern Study = 4
  - Willow Creek Lake Microcystin Follow-up = 5
  - Merritt and Rockford Res. Post-Recreation Season Follow-up = 4
- Fish Kill/Complaint Samples = 5

2011 Total Toxic Algae Samples (Including QC + Special Samples) = 1,526

Assistance: MNNRD, NNRD, URNRD, LRNRD, LLNRD, LENRD, LPSNRD, City of Carter Lake, Nebraska Public Power District (NPPD), USACE

LAKE MONITORING

2011 Lake Monitoring Network

Deep Water Sites (53 lakes)

- **DEQ:** 35 lakes X 5 Months = 175
- **USACE:** 14 lakes X 5 Months = 70
- **NNRD:** 4 lakes X 5 Months = 20
- **QC Samples:** 10 DEQ, 10 USACE = 20

2010 Total Deep Water Samples: = 285

Frequency: Monthly from May through September

Parameters:

- **Traditional: TSS, total phosphorus, dissolved orthophosphorus, nitrate/nitrite nitrogen, kjeldahl nitrogen or total nitrogen, alkalinity.**
- **Pesticides: Atrazine, Metolachlor, Acetochlor**
- **UNL Lab: Chlorophyll-a**
- **Field Measurements: Profiles (pH, conductivity, temperature, oxygen & turbidity), water transparency**

Mid-Lake Site Profiles (33 lakes)

Frequency: Monthly from May through September

Parameters: Mid-Lake Profile (pH, conductivity, temperature, oxygen & turbidity)

2010 Mid-Lake Network Samples:

DEQ: 19 Lakes x 5 months = 95

USACE: 14 lakes x 5 months = 70

Total Mid-Lake Profiles: = 165

Run-Off Sampling

Network: 27 Inflow Sites to 18 Reservoirs (DEQ 19; USACE 8)

Frequency: Up to 6 events during significant rainfall from April - Sept

Parameters:

- **Traditional: TSS, Suspended Sediment Concentrations (SSC), total phosphorus, nitrate/nitrite nitrogen, kjeldahl nitrogen**
- **Pesticides: Atrazine, Metolachlor, Acetochlor**
- **Bacteria (E. coli): 6 Sites (Wagon Train & 2 sites at Holmes, 2 sites at Bluestem and 1 site at Swan Lake 5A)**

2011 Total Run-Off Samples

DEQ: No Run-Off Samples collected during 2011

USACE: 8 Sites X 3 Events = 21

NDEQ staff performing biological monitoring, North Fork Birdwood Creek, McPherson County.

Additional Lake Monitoring Projects (Nonpoint Source Programs)

Study/Lake	Parameter
Wagon Train Arsenic	Bi-weekly Arsenic
Lake Bathymetric Surveys	Lake Volume
UNL "Category 3" - Small Lakes Beneficial Use Assessment	Bacteria, Nutrients & Field Parameters
Carter Lake Pre-Project Evaluation Watershed/Shore Restoration, Fish Renovation, Alum Treatment,	Bacteria & Toxic Algae
Holmes Lake Biological Assessment Evaluate biological effects of project	Biological
Wagon Train Lake Run-Off Evaluation of nutrient reductions	Nutrients, sediment & pesticides
Conestoga Pre-Project - Watershed Treatment	Nutrients/Biological
Buck & Duck Creek Study	Nutrients, Bacteria & Pesticides

Assistance: USACE, NNRD, City of Carter Lake, UNL, NGPC

NDEQ staff performing water analysis.

FISH TISSUE MONITORING

2011 Fish Tissue Network

- 66 fish samples from 13 streams and 31 lakes

Assistance: NGPC, Nebraska Health & Human Services (NHHS), Nebraska Dept. of Agriculture (NDA), EPA

Northern Pike

STREAM BIOLOGICAL MONITORING PROGRAM

Network:

37 stream sites in the North and South Platte River basin and the White River-Hat Creek basin

Field measurements: Temperature, pH, oxygen, conductivity, turbidity and discharge, Fish and Aquatic Insect communities and habitat assessed

NDEQ staff collecting fish samples on the Whitetail Creek, Keith County.

FISH KILLS AND CITIZEN COMPLAINTS

Timeframe: July 1, 2010 to June 30, 2011

Fish Kill Attributed to	Number
Low dissolved oxygen levels (flooding, season change)	9
Disease or parasites	4
Unknown causes	2
Thermal stress	1
TOTAL	**16**

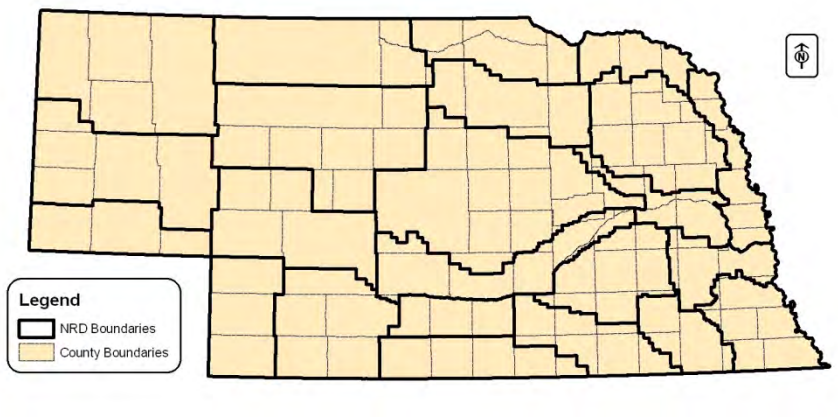
Between July 1, 2010 and June 30, 2011, the Department received 39 notifications of complaints concerning surface water issues. Many of these were referred to other agency programs that more closely related to the problem and five complaints were investigated with on-site visits by the surface water staff.

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

Fish Kill near Crete, Saline County.

Natural Resources Districts, Abbreviations And Headquarter Cities

Central Platte NRD	CPNRD	Grand Island
Lewis and Clark NRD	LCNRD	Hartington
Little Blue NRD	LBNRD	Davenport
Lower Big Blue NRD	LBBNRD	Beatrice
Lower Elkhorn NRD	LENRD	Norfolk
Lower Loup NRD	LLNRD	Ord
Lower Niobrara NRD	LNNRD	Butte
Lower Platte North NRD	LPNNRD	Wahoo
Lower Platte South NRD	LPSNRD	Lincoln
Lower Republican NRD	LRNRD	Alma
Middle Niobrara NRD	MNNRD	Valentine
Middle Republican NRD	MRNRD	Curtis
Nemaha NRD	NNRD	Tecumseh
North Platte NRD	NPNRD	Scottsbluff
Papio-Missouri River NRD	PMRNRD	Omaha
South Platte NRD	SPNRD	Sidney
Tri-Basin NRD	TBNRD	Holdrege
Twin Platte NRD	TPNRD	North Platte
Upper Big Blue NRD	UBBNRD	York
Upper Elkhorn NRD	UENRD	O'Neil
Upper Loup NRD	ULNRD	Thedford
Upper Niobrara-White NRD	UNWNRD	Chadron
Upper Republican NRD	URNRD	Imperial



More Information:
More information about the State's 23 Natural Resources Districts can be found at www.nrdnet.org. For more information about any of the specific programs summarized in this section go to the section which has more detail and use the contact information there, or contact Will Myers, NDEQ, at 402/471-4227 (will.myers@nebraska.gov).

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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.

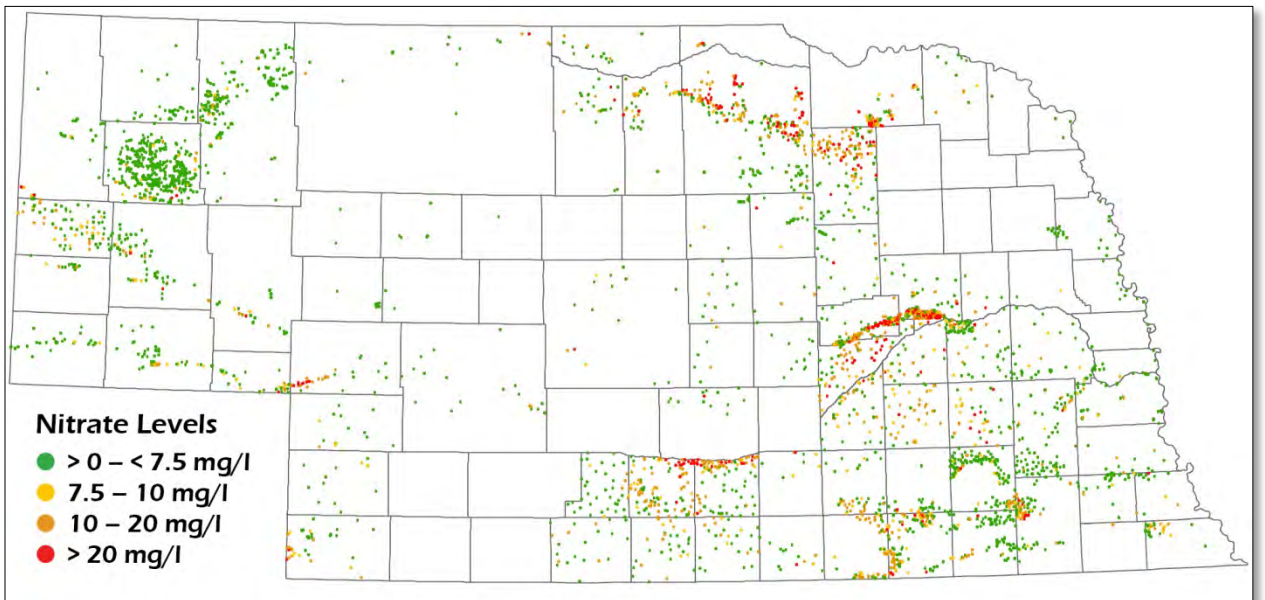
History of this Report:
Beginning in December 2001, the Department has prepared a report annually outlining the extent of ground water quality monitoring conducted primarily by Natural Resources Districts (NRDs) during the preceding calendar year. The Department uses the data submitted by the districts in conjunction with all other readily available and compatible data for the purpose of an 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 160,000 active registered wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2010, 4,079 wells were sampled. Since 1974, nearly 23,500 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 known groundwater problems.

What is Monitored?
There are over 230 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 an herbicide used for weed control in a variety of crops such as corn and sorghum.

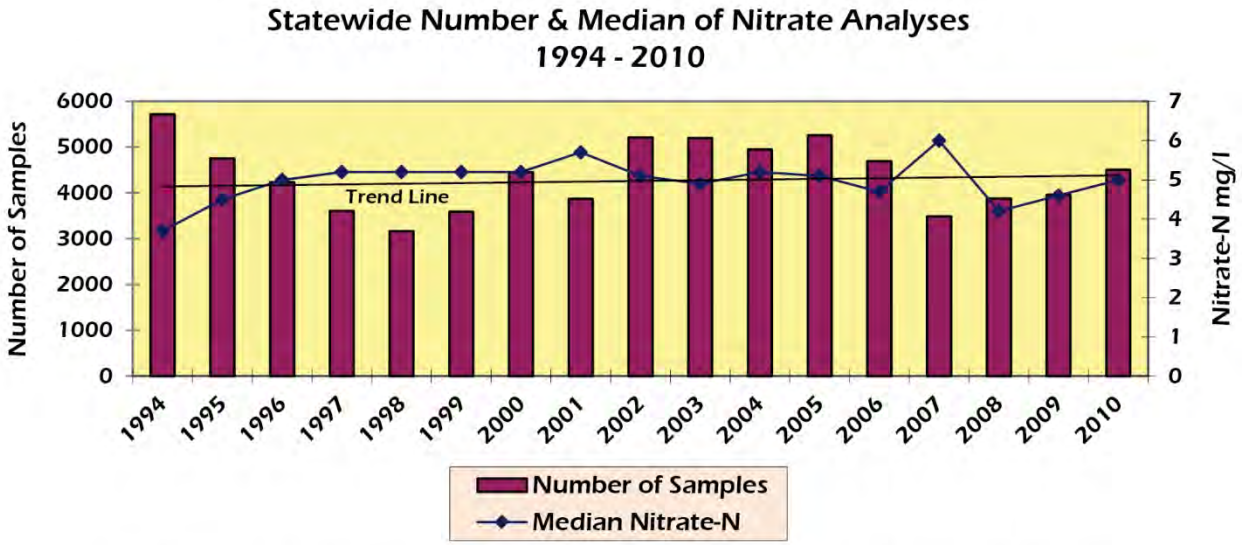
How are the Data Used?
The Department analyzes the data collected for the purpose of determining whether or not ground water quality is degrading or improving and presents the results to the Natural Resources Committee of the Legislature beginning December 1 of each year. The State's 23 NRDs use the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

Results as of 2010:
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 figure below).



Nitrate concentrations of wells sampled in 2010.
(Source: Quality-Assessed Agrichemical Database for Nebraska Groundwater, 2011)

The most representative picture of the statewide nitrate concentration is from the time period from 1994 to 2010 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 figure below).



All 74,532 analyses and median nitrate-nitrogen levels for Nebraska, 1994-2010.
(Source: Quality-Assessed Agrichemical Database for Nebraska Groundwater, 2011)

All of the results for agricultural chemicals (including nitrate) can be found on the Nebraska Department of Natural Resources (NDNR) website (http://www.dnr.ne.gov/ or http://dnrdata.dnr.ne.gov/clearinghouse/). 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:
For more information about the groundwater monitoring report, contact Dave Miesbach at the Nebraska Department of Environmental Quality, (402) 471-4982 or david.miesbach@nebraska.gov.

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Groundwater Management Area Program

What is the Groundwater Management Area Program?
The Groundwater Management Area (GWMA) Program (formerly the Special Protection Area Program) was created by the state legislature and authorized by the 1986 Nebraska Groundwater Management and Protection Act (Nebraska Revised Statutes Section 46-656.35 - 46.656.48). Title 196, *Rules and Regulations Pertaining to Special Protection Areas*, governs the GWMA Program. Under the authority of the GWMA Program and Title 196, the NDEQ performs groundwater quality studies.

What is monitored?
The GWMA Program identifies nonpoint source groundwater contamination of an area through the study of soils, geology, land use, historical water quality and well sampling results. The goal of the program is to prevent or reduce nonpoint source contamination if it is identified. The most common nonpoint source contaminant in Nebraska is nitrate. Nonpoint source groundwater contamination is associated with widespread activities such as agricultural chemical application.

Nonpoint source groundwater contamination has been correlated to commercial nitrogen fertilizer application on croplands, particularly irrigated farmland. This type of contamination has also been associated with applying fertilizer on golf courses and residential lawns, and the application of manure on cropland.

Nebraskans have a vested interest in the levels of nitrate-nitrogen in groundwater. The USEPA has set the Maximum Contaminant Level (MCL) for nitrate-nitrogen in drinking water at 10 mg/l. Ingesting drinking water that has levels of nitrate-nitrogen greater than 10 mg/l may lead to methemoglobinemia in infants less than six months in age. This condition is commonly known as blue-baby syndrome. Adults have bacteria and acidity in their digestive tracts that prohibits the conversion of nitrate into nitrite. Infants do not and the nitrite inhibits blood from carrying oxygen throughout the body.


Center pivot irrigation system.

Pesticides, including herbicides, insecticides and fungicides, are the other major nonpoint sources of groundwater contamination. Pesticides are known or suspected carcinogens and are toxic to humans and livestock. The occurrence of pesticides in Nebraska is often correlated with high levels of nitrate-nitrogen.

What is the process of a study?
A Natural Resources District typically requests the NDEQ to conduct a study on a part of or even their whole district. The NRD may have areas of elevated nitrate

concentrations in water samples they have analyzed. The NDEQ may conduct a more detailed study of the area of interest.

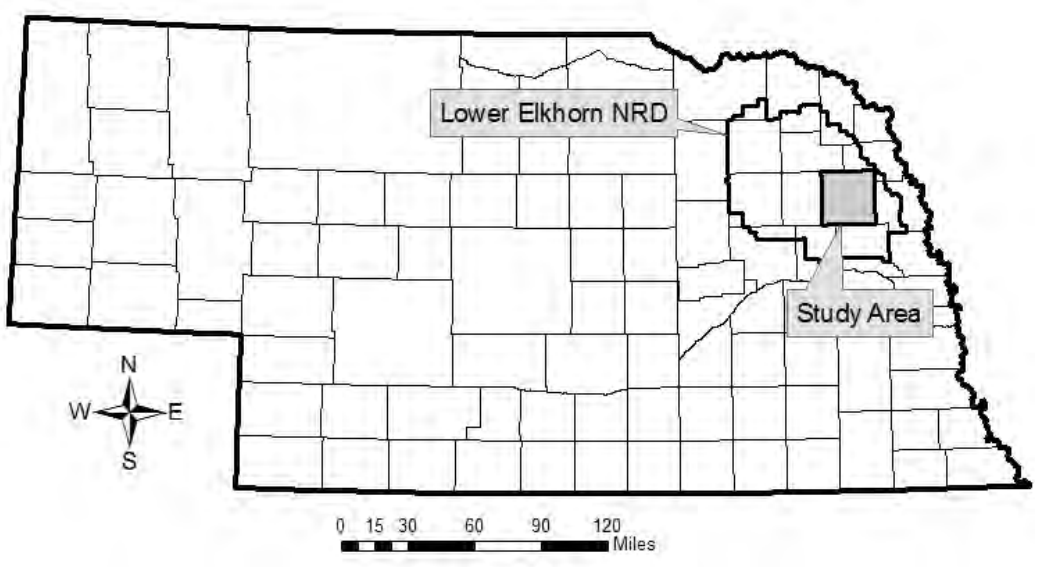
Sampling is done during the irrigation season (late June to early September). Water quality samples are collected from pre-selected irrigation wells. Irrigation wells provide water samples that best represent the regional water quality.

Analysis of the laboratory water quality results in conjunction with a review of available hydrogeologic information for the study area is done in the fall and winter after the sampling. A study report is prepared from this investigation for the Natural Resources District. The NRD typically uses this information to

1. Focus future sampling efforts,
2. Make modifications to the district's best management practices (BMPs), and
3. Place an area of the distinct into one of their Phase areas for groundwater protection.

What was the latest study area?

The Lower Elkhorn Natural Resources District requested the NDEQ conduct a GWMA study for Cuming County in 2010. Sampling was to be done in the summer of 2010. However, flooding by the Elkhorn River and the associated lowlands, and numerous large rainfall events during the sampling season, reduced the irrigation season to practically nothing, since irrigation wells are the source of groundwater being sampled. Sampling was postponed from the summer of 2010 to the summer of 2011. There were no flood or weather-related issues in 2011.



More Information:

For more information about the Groundwater Management Area Program, contact Dan Inman at (402) 471-0294, dan.inman@nebraska.gov or Dave Miesbach at (402) 471-4982, david.miesbach@nebraska.gov .

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Shallow Groundwater Nitrate Study

Why is this monitoring being conducted?
The statewide groundwater quality monitoring network results reported in the annual NDEQ Groundwater Quality Monitoring Report have shown localized areas across the state that have nitrate concentrations that measure over 20 mg/L (20 ppm). Currently, over 80% of the wells that are sampled for this statewide network are irrigation wells. Interestingly, the results of irrigation well monitoring in several of these areas also have shown nitrate concentrations that are considerably lower (<10 mg/L) when compared to other wells sampled in the same general area.

Monitoring Well Installation near Sterling, Johnson County

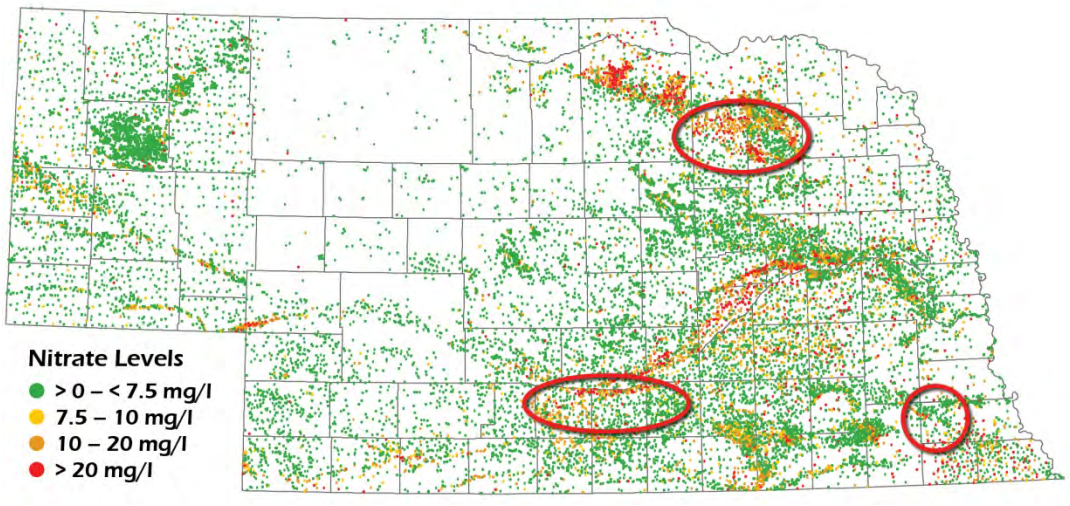
The type of well, design, and construction characteristics can influence water quality monitoring results. Thus it is suspected that nitrate concentrations are higher in the shallow groundwater in these areas, but that it is not being detected in these network irrigation wells due to well construction differences. The ability to verify the occurrence of nitrate concentrations in shallow groundwater and the vadose (unsaturated) zone allows for a more accurate assessment of potential problems that may occur in the future. This is very important to human health because domestic drinking water wells often utilize the shallow groundwater and are typically not required to be tested for nitrates or other agricultural related chemicals.

This study will assess the occurrence of agricultural related chemicals in the vadose zone sediments and shallow groundwater. This was done by installing monitoring wells adjacent to monitoring network irrigation wells that have recent low nitrate results. Both the shallow monitoring well and the deeper irrigation well will be sampled at the same time, with the same sampling procedures to minimize other variables. The vadose zone sediments will also be sampled to document any downward migration of agricultural chemicals.

When a deeper irrigation well shows low nitrate results, is the local shallow groundwater also going to be low in nitrate? Does the current network of mainly irrigation wells properly represent the condition of all groundwater in an area? The two adjacent wells will be sampled at the same time with the same methods to try to answer these questions. More precise groundwater quality information and aquifer characterization in

these areas will allow for the development of more effective monitoring strategies that will ultimately better protect domestic groundwater users.

Where is the Monitoring Being Conducted?
The three locations targeted for this study are in areas were concentrations of nitrates over 20 mg/L have been measured in other monitoring network wells. The specific monitoring sites within these areas are adjacent to monitoring network irrigation wells with low (<10 mg/L) nitrate concentrations. These areas have been further identified by NDEQ, UNL, and local NRDs as locations where more detailed water level and water quality information is needed to better characterize the aquifer.



Targeted Study Areas (red circles) with Last Recorded Nitrate Concentrations

What is being monitored?
NDEQ staff is collecting groundwater quality samples through 2012 from targeted monitoring wells installed specifically for this study. Groundwater samples are also being collected from the statewide network irrigation wells which are located adjacent to these monitoring wells. Vadose zone sediment samples were also collected to characterize the presence of agricultural contaminants above the water table. All samples collected are being analyzed for nitrogen and phosphorus species and select pesticides.

NDEQ staff collecting a vadose zone sample in Holt County

How will the data be used?
NDEQ and UNL will use the data collected in this study to provide information related to the water quality of these areas to the NRDs and the public. Specifically, the data will be used for developing groundwater monitoring

strategies, groundwater management plans, and to supplement wellhead protection plans (developed locally to protect public drinking water wells).

The NRDs will utilize these monitoring wells after study completion for both groundwater level and quality information. The water level information will be reported to the Nebraska Statewide Goundwater Level Program and the water quality information will be reported to the Quality-Assessed Agrichemical Database for Nebraska Groundwater, also known as the clearinghouse. UNL will use the drillers log and core sample information for the Nebraska Statewide Test-hole database. A project summary report will be prepared by NDEQ.

NDEQ staff measuring a test hole water level, Holt County

Current Progress

The fieldwork for this study began in summer 2011. The work in 2011 consisted of the installation of ten monitoring wells and sampling of the associated vadose zone sediments by UNL and NDEQ staff. Three to four wells were installed in each study area and permanent pressure transducers were installed at each of the three study sites. Vadose zone sampling was completed and shipped to the lab for analysis. Baseline groundwater sampling was conducted at all wells in each of the three study sites. In 2012, the wells will be sampled by NDEQ staff on approximately a monthly frequency during the active irrigation season (typically June – August). Results of this monitoring should be available for the next annual water monitoring report.

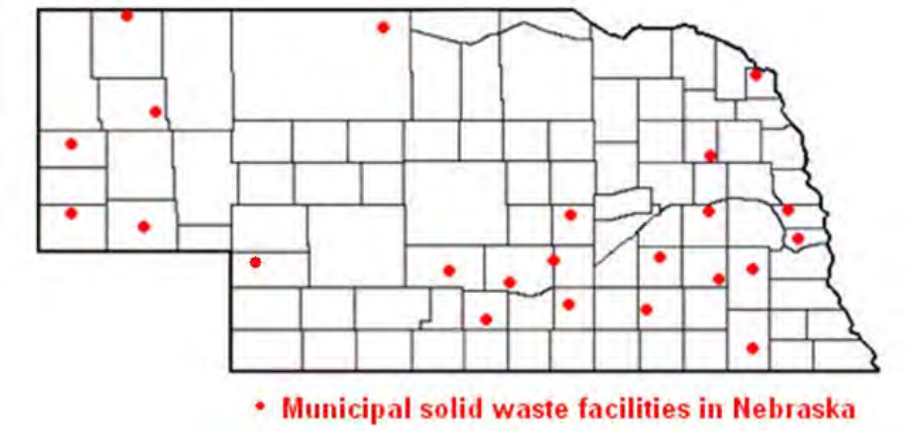
More Information:

For more information on the Shallow Groundwater Nitrate Study, Contact Will Myers at (402) 471-4227 or will.myers@nebraska.gov or Dave Miesbach at (402) 471-4982 or david.miesbach@nebraska.gov. Some of the funding for this project is from the U.S. Environmental Protection Agency's supplemental monitoring grant (2010).

Groundwater Monitoring at Municipal Solid Waste Disposal Areas

Why require monitoring at municipal landfills?
Permitted municipal solid waste disposal areas (or "municipal landfills") are designed and constructed with engineered liners. Additionally, leachate collection systems and final covers are operated to meet stringent operational criteria. Despite these construction standards, the potential exists for releases of landfill leachate to the underlying groundwater over the course of their operating and post-closure life, which could last several decades. Such leaks could cause pollution of groundwater near the landfill, and if allowed to migrate, could eventually reach and negatively impact public water supply and domestic wells, making them unsuitable for drinking. The NDEQ therefore requires all municipal landfills to regularly monitor groundwater to detect indications of possible leaks as early as possible. If detection monitoring indicates a possible leak, more extensive groundwater monitoring is required. If a leak resulting in contamination of the groundwater is identified, additional investigations and remedial measures are required.

History and Current status of program
In 1992, the State Legislature passed LB1257 which recognized the need to better manage municipal solid waste in Nebraska. It authorized the NDEQ to develop new regulations to establish a permit program for the construction and operation of municipal landfills, along with new requirements to minimize environmental and health risks. In response, NDEQ amended *Title 132 - Integrated Solid Waste Management Regulations* to provide technical criteria related to the location, design and construction, operation, groundwater monitoring, closure, post-closure care and monitoring, investigation and corrective action, and financial assurance for municipal landfills. All facilities receiving municipal solid waste on or after October 1, 1993 were required to come into compliance with Title 132. There are currently 23 operating municipal landfills that have been permitted under Title 132.



Locations of permitted municipal solid waste disposal areas in Nebraska

What is monitored and how often?
After completing background monitoring (typically quarterly sampling for two years), municipal landfills must conduct detection monitoring on a semiannual basis during the operating life of the landfill and for an additional 30 years after its closure. During each semiannual sampling event, groundwater samples are collected from monitoring wells installed around the landfills and analyzed at a laboratory. Each landfill has three options for its detection monitoring program. The majority of landfills in Nebraska follow option 2.

Drilling monitoring wells.

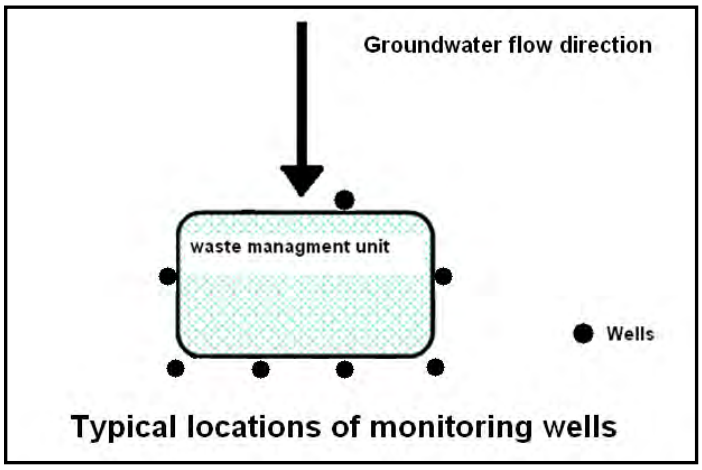
- Option 1: Sample 15 inorganic metal constituents and 47 volatile organic constituents semiannually.
- Option 2: Sample for Ammonia as Nitrogen, Chemical Oxygen Demand (COD), Chloride, Iron, Sodium, Total Dissolved Solids (TDS), Total Organic Carbon (TOC), and Total Organic Halogen (TOX) semi-annually.
- Option 3: The facility may propose an alternate monitoring frequency and/or list of parameters for the Department to review in accordance with Title 132, Chapter 7 Section 004. Less frequent sampling can be proposed by a qualified groundwater scientist or hydrogeologist based on site hydrogeologic characteristics. It is suggested that the facility consult with the Department for guidance prior to proposing an alternative frequency and/or list of parameters.

Contractors sampling monitoring wells in eastern Nebraska.

Additional data collected

- depth to water
- pH
- temperature
- specific conductivity
- turbidity
- water color and odor

Where are the wells installed?
The landfill must have monitoring wells down gradient of the landfill. These wells are to be placed at the waste management unit boundary. The number of wells needed to make sure any release will be intercepted is based on the size of the landfill and the site hydrogeology. For sites with complex hydrogeology, it may be necessary to install multiple wells at the same location, with each screened at a different depth interval. Wells are also installed in the up-gradient direction to get background data for the area.



Typical locations of monitoring wells

How are the data used?
Following each semiannual detection sampling event, the facility statistically compares the results from each compliance monitoring well against background to determine if there is a statistical indication of a possible leak. The landfills are responsible for conducting the monitoring and submitting a report to NDEQ on an annual or semiannual basis. Monitoring is conducted either by a hired environmental consulting firm or by the owner of the landfill. Sampling personnel are required to be licensed by the state in order to conduct the monitoring. NDEQ staff review the results from the groundwater sampling to determine if a statistical significant increase of a constituent has occurred. A facility that has shown a statistically significant increase in a constituent will have 90 days to set up an assessment monitoring program to look further into a potential release.

More Information:
For more information about municipal landfills and monitoring, contact Mike Felix at 402-471-2938, mike.felix@nebraska.gov or Ed Southwick at 402-471-2181, ed.southwick@nebraska.gov .

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Crow Butte Resources, Inc.
Groundwater Monitoring

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

Crow Butte Resources, Inc. uranium mine has been commercially operating in western Nebraska for twenty years. 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 1984. Part of this regulation included a local ban on drilling of 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 carbonate. 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 free up the uranium. This solution is then pumped through 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 mine 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 its restoration and stabilization goals as determined by NDEQ. Mine Units 2, 3, 4, and 5 are currently undergoing restoration activities. Mine Units 6, 7, 8, 9, and 10 are actively being mined, and Mine Unit 11 has been constructed in advance of active mining. To date, CBR has no plans to extend mining at their current facility beyond Mine Unit 11.

Groundwater Monitoring at the facility

There are two types of groundwater monitoring wells at the CBR uranium mining facility – deep (production zone) monitoring wells and shallow (Brule Formation) monitoring wells. The wells are screened through the entire deep 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 (once every two weeks) for chloride, conductivity, alkalinity (as $CaCO_3$), 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.

Monitoring well at CBR

Currently, 367 monitoring wells are actively sampled on a biweekly basis; 167 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 outside 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 of 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 the results shallow well monitoring indicate elevated levels of any of the monitored constituents, corrective action includes testing production and injection wells in the area for mechanical integrity to ensure 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 results from both the 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 2010
In 2010, approximately 9,592 groundwater monitoring well samples were collected and analyzed by the laboratory at CBR. The NDEQ randomly split 56 of those groundwater samples with CBR. The table below outlines the number of samples split during each quarter of the 2010 calendar year for both the deep and the shallow groundwater monitoring wells.

First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
Deep Wells	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells	Shallow Wells
8	6	7	7	7	7	8	6

Samples collected by NDEQ are sent to the Nebraska Public Health Environmental Laboratory for analysis. Comparisons between CBR laboratory's analyses and NDEQ's analyses for all of these samples were within a statistically reasonable margin of error.

In August of 2011, the CBR's North Trend expansion area was permitted north of Crawford. Future expansion is planned at two other satellite facilities: Three Crow, and Marsland. An application has been received for Three Crow, and a pumping test plan has been received for Marsland. These satellite facilities are expected to have similar groundwater monitoring plans and requirements as the current CBR mining operation.

More Information:
To get more information on groundwater monitoring at this facility, visit our website at http://deq.ne.gov/, or contact Jenny Coughlin, NDEQ, at (402) 471-4290 or by email at jenny.coughlin@nebraska.gov.

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Groundwater Monitoring at LUST Sites

What is the LUST program?

The Leaking Underground Storage Tank (LUST) program had its beginnings at NDEQ in the early 1980s. By the mid 1980s, both national and state legislation had been passed formally authorizing the program, and NDEQ had updated its groundwater standards (Title 118) mostly in response to the increasing number of LUST sites causing ground water contamination. In the last 30 years, there have been nearly 7,000 of these types of releases reported to NDEQ. (Approximately 10% of this total comes from other types of petroleum releases which are treated the same as LUST releases and include such things as aboveground storage tank spills, pipeline leaks, and fuel spills from transportation accidents.) For simplicity and consistency, all petroleum releases are handled by the LUST program in NDEQ's Petroleum Remediation Section and are referred to as LUST sites.

What is monitored and why is it done?

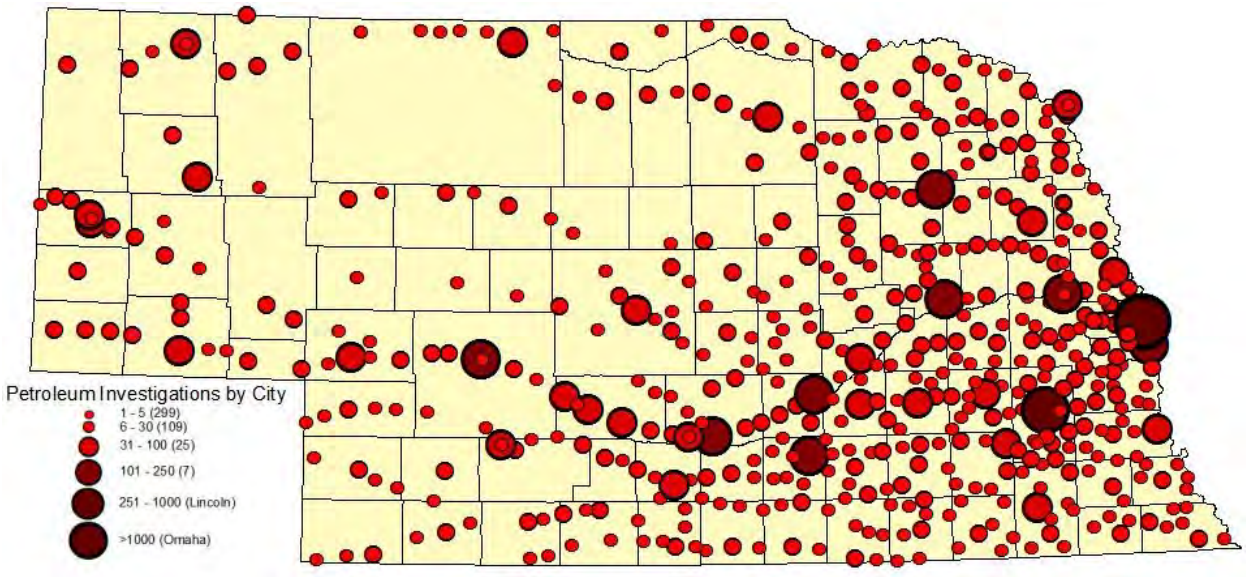
Since all LUST sites involve the release of some type of petroleum, the contaminants of concern are usually the same or similar for most releases. These contaminants have the potential to migrate through soil and groundwater and threaten public health and safety. As one might expect, petroleum such as gasoline may cause fires or explosions in subsurface structures (e.g., crawl spaces, basements, sewers). In many cases the petroleum will exist as a separate phase (sometimes called free product) in the subsurface and will appear in monitoring wells floating on the surface of the groundwater, occasionally with a thickness of up to several feet.

Contaminant	Groundwater Level of Concern (in mg/L)
Benzene	0.005
Toluene	1.0
Ethylbenzene	0.700
Xylenes	10.0
n-Hexane	4.0
MTBE	0.020
Naphthalene	0.020
Total Extractable Hydrocarbons	10.0 (as diesel) 6.666 (as waste oil)

If petroleum constituents dissolve into groundwater that is used as drinking water, health risks may occur. This table shows some of the common contaminants that may dissolve in groundwater following petroleum releases. The one that causes the most problems at LUST sites is benzene, a carcinogen. Depending on the petroleum product released, these contaminants and others may be monitored in groundwater. Other common water quality parameters (such as nitrate and chloride) are rarely examined.

Where is it monitored?

The 7,000 LUST sites are scattered around Nebraska with more being found in the eastern third of the state. Whenever NDEQ determines that a site requires investigation, monitoring wells are installed and sampling is performed to characterize the groundwater contamination. Many of the sites are former or currently operating gas stations. The following map shows the distribution of LUST sites.



Circle size represents number of LUST sites per nearest city. Number in parentheses represents number of cities falling into each category. For example, there are 299 cities with 1 to 5 LUST sites in each.

How is it monitored?

The procedures that govern LUST site monitoring are found in the regulations of Title 118 and in guidance called Risk-Based Corrective Action (RBCA) at Petroleum Release Sites: Tier 1/Tier 2 Assessments & Reports. (Both of these documents may be found on NDEQ's web site.) When an initial RBCA investigation (Tier 1) is required, three or more monitoring wells are completed to straddle the water table (although sometimes more deeply screened wells are also necessary). These wells are sampled for the petroleum contaminants discussed above, and NDEQ evaluates the contamination found using the RBCA guidance. If the contaminant levels are less than the applicable risk screening levels, the monitoring wells are properly abandoned.

Monitoring well sampling in Cedar Bluffs, NE

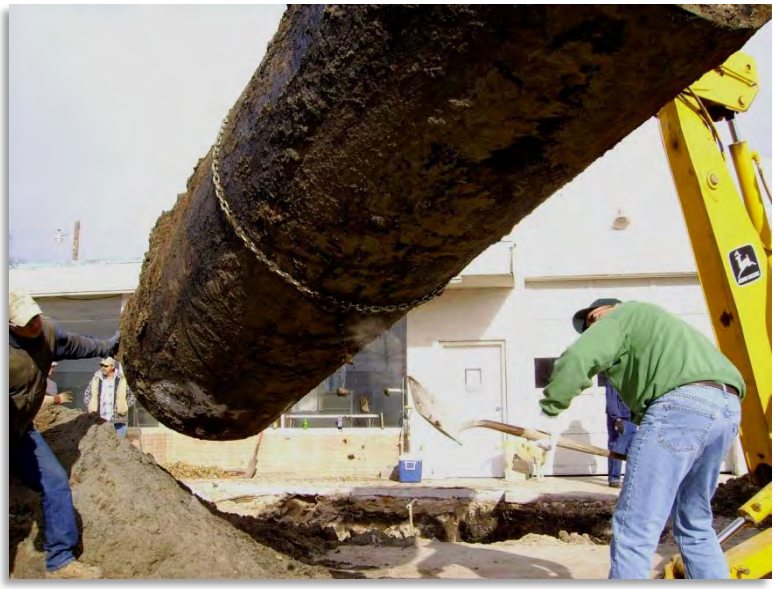
If the contaminant levels are higher than screening levels, a more detailed RBCA investigation (Tier 2) is required, which involves the installation of additional monitoring wells. NDEQ performs another evaluation this time using the contamination found

during the Tier 2 investigation. If the contaminant levels are lower than the appropriate risk target levels, the monitoring wells are properly abandoned.

The RBCA guidance contains directions for sample collection, analysis, quality assurance/quality control, reporting, and other information.

What is done with the information?
If the contaminant levels found in the Tier 2 investigation are higher than applicable risk levels, NDEQ generally requires groundwater cleanup in order to protect the public. Cleanup usually involves the installation of additional monitoring wells as well as remediation wells. These wells may remain in place many years until the cleanup is completed and are sampled periodically for petroleum contaminants. Prior to allowing a groundwater remediation system to discharge to water or air, additional monitoring is required to determine if other potentially hazardous substances are present in the groundwater. Once cleanup is complete, all wells are properly abandoned.

What are the results of the monitoring?
Over the last three decades, 5,200 of the nearly 7,000 LUST sites reported to NDEQ have been closed. This means that these LUST sites had minimal contamination, were investigated and found not to be a risk, or were cleaned up in some way to protect the public. The remaining sites are currently being investigated and cleaned up, or they wait on a prioritized list for resources to be available.



Leaking Underground Storage Tank (LUST) removal, Cambridge, Furnas County.

More Information
For more information on this topic, contact David Chambers at 402-471-4258, or david.chambers@nebraska.gov .

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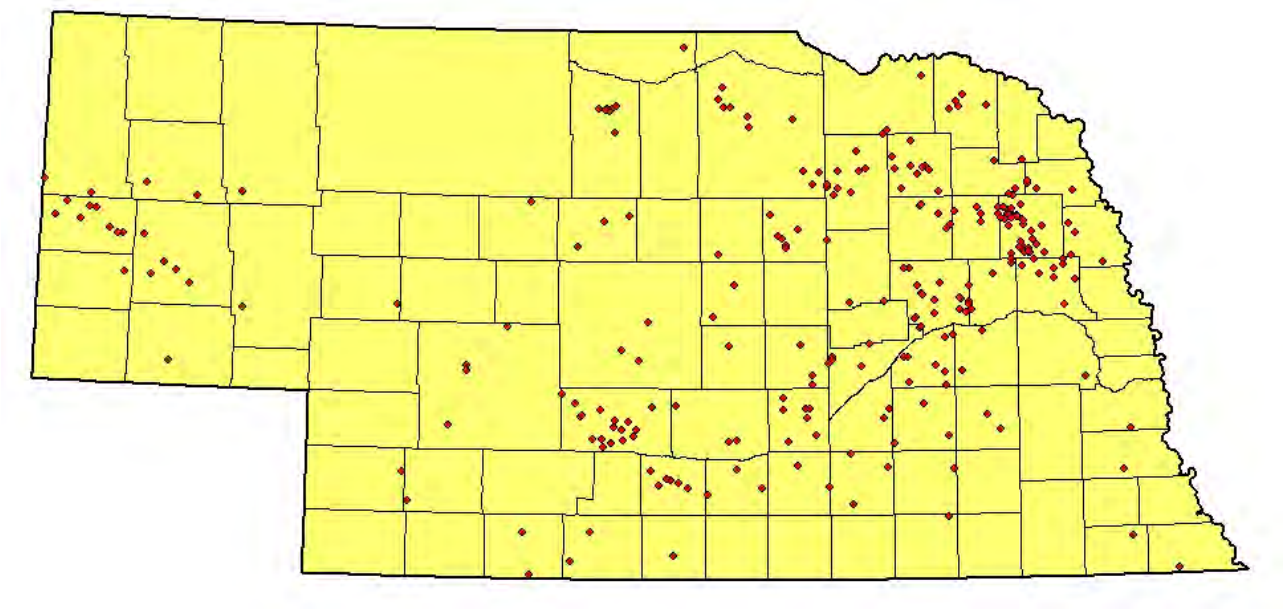
Groundwater Monitoring at Permitted Livestock Facilities

Why require monitoring at livestock facilities?
Nebraska's groundwater may be negatively impacted by leakage from holding ponds 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 in the groundwater to document any impact to groundwater quality. The contaminated groundwater may negatively impact public water supply and domestic wells. The NDEQ oversees the investigation and remedial measures conducted by the owners of the facilities if groundwater has been impacted.

History of the monitoring program
The NDEQ's Groundwater Unit began reviewing permitting plans for LWCFs in October 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 1,072 LWCFs (as of the end of October 2011), recommending monitoring at 379 of them (~35%). There are 325 approved groundwater monitoring plans and currently 260 operations at which semi-annual monitoring is conducted. Seven operations conduct annual sampling due to no change in the water quality. The map below shows the locations of the facilities where groundwater monitoring is being conducted.

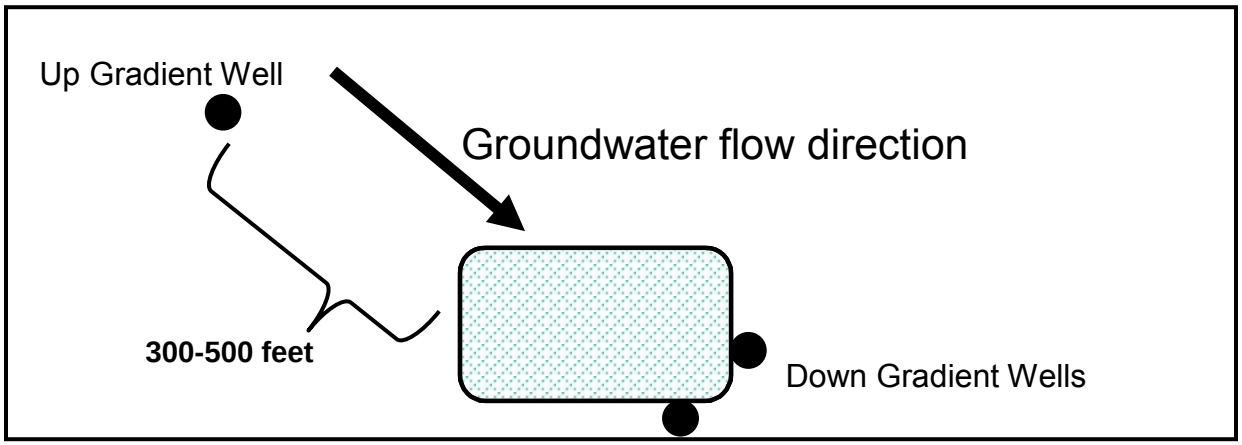


Livestock Operations with Ongoing Ground Water Monitoring

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.



Recommended Locations for Groundwater Monitoring Wells

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).

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. The down gradient wells are placed adjacent to the holding pond to more quickly identify possible impacts to groundwater. The diagram above shows a generic map of recommended locations for groundwater monitoring wells.

Feedlot in Central Nebraska.

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 20 LWCFs with more comprehensive groundwater investigations underway. To date, NDEQ is unaware of any private or public drinking water wells that have been contaminated from a livestock waste control facility.

More Information:
For more information about groundwater monitoring at livestock waste control facilities, contact Dan Inman at (402) 471-0294, dan.inman@nebraska.gov or Dave Miesbach at (402) 471-4982, david.miesbach@nebraska.gov .

Monitoring Changes in Groundwater Quality

Nebraska's Natural Resources Districts (NRDs), along with the Nebraska Department of Environmental Quality, share the responsibility for protection and management of the state's groundwater quality. This cooperation extends from monitoring, assessment and reporting, to the establishment of management areas and implementation of best management practices. To accomplish this, several thousand samples are taken each year by the 23 NRDs. In 2001, the state legislature required all ground water quality data and information to be submitted to the NDEQ with an annual report being produced to report on whether or not the groundwater quality is degrading or improving.

Statistical trend analysis is commonly used to report on improving or degrading water quality conditions. Presenting long term trend analysis for the entire state using data collected by the NRDs would not be representative for several reasons including:

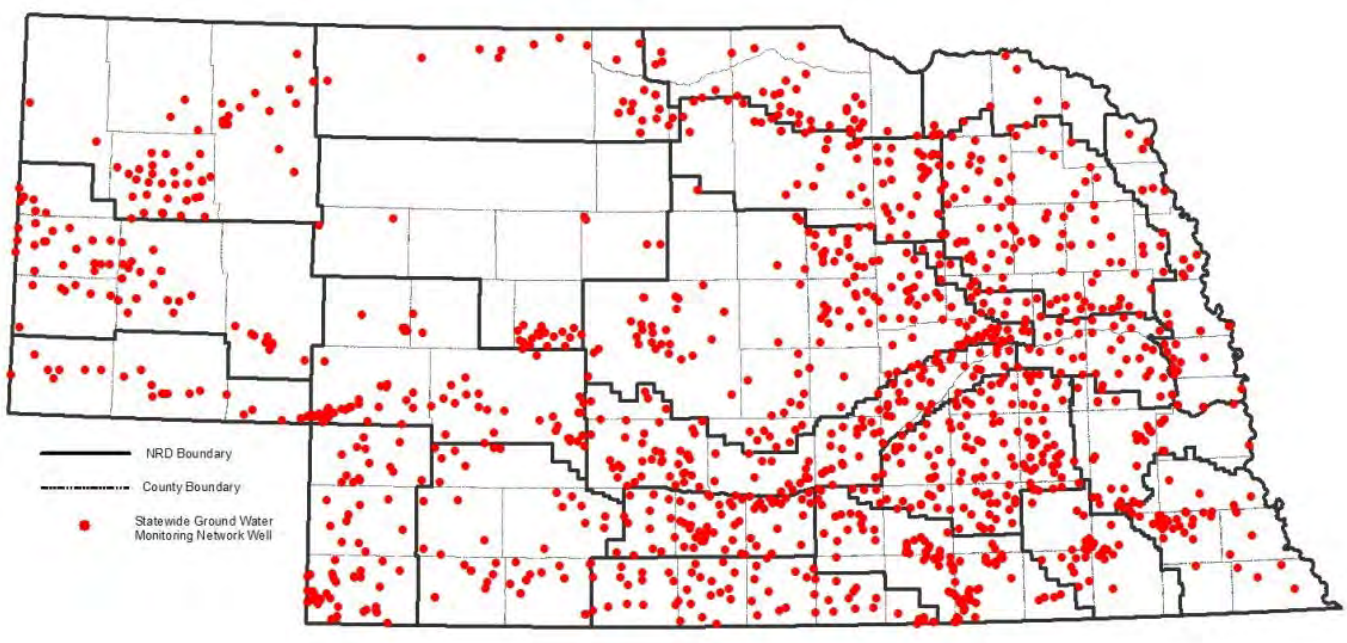
- Lack of year-to-year data for the entire state
- Small data sets that reduce confidence in the results
- Identifying wells that are representative of large areas, practices and climate.

Over time monitoring strategies have been and will continue to be modified to gather the necessary data to conduct statistical trend analysis. While efforts to produce this data are on-going, the NDEQ remains statutorily required to report on whether or not the groundwater quality is changing. To accomplish this and obtain long term data, the Statewide Groundwater Monitoring Network was established.

Water level monitoring well in Buffalo County. These wells, installed by the University of Nebraska-Lincoln, send water level measurements to Lincoln via telemetry. This type of well could be monitored for water quality as well.

Where are Groundwater Samples Collected?

According to the Nebraska Department of Natural Resources, there are over 160,000 active registered wells in the state with many more existing unregistered wells. Sampling these wells is unfeasible due to resources constraints, logistics and access issues. Each NRD annually monitors groundwater to meet the objectives established by its own Groundwater Management Plan. To allow flexibility for the NRDs while maintaining a consistent network, a target subset of wells to be monitored annually was set at 1,500 when the network was established. Over the course of the last 6 years, modifications have been made and the current network consists of 1,391 wells (see figure below). It is anticipated that future review and assessment of the selected wells will continue with the goal of having a 1,500 well network. The table on the next page presents the number and type of wells assorted by each NRD.



Location of Statewide Groundwater Monitoring Network Wells

Type of Well by Natural Resources District in the Statewide Groundwater Monitoring Network

Natural Resources District	Total Wells	Irrigation	Quality Monitor-ing	Domes-tic	Stock	Com-mercial
Central Platte	108	104		4		
Lewis and Clark	15	9	6			
Little Blue	81	81				
Lower Big Blue	30	30				
Lower Elkhorn	90	90				
Lower Loup	142	138		2	2	
Lower Niobrara	33	33				
Lower Platte North	52	52				
Lower Platte South	37	12	24			1
Lower Republican	63	54	9			
Middle Niobrara	29	10	17	1	1	
Middle Republican	46	31	15			
Nemaha	41	28	1	11	1	
North Platte	76	15	60	1		
Papio-Missouri River	45	17	26	1		1
South Platte	25	9	16			
Tri-Basin	63	63				
Twin Platte	73	63	8	2		
Upper Big Blue	136	114	18	4		
Upper Elkhorn	64	47	17			
Upper Loup	25	23		2		
Upper Niobrara-White	58	43	15			
Upper Republican	59	59				
Totals	**1391**	**1125**	**232**	**28**	**4**	**2**

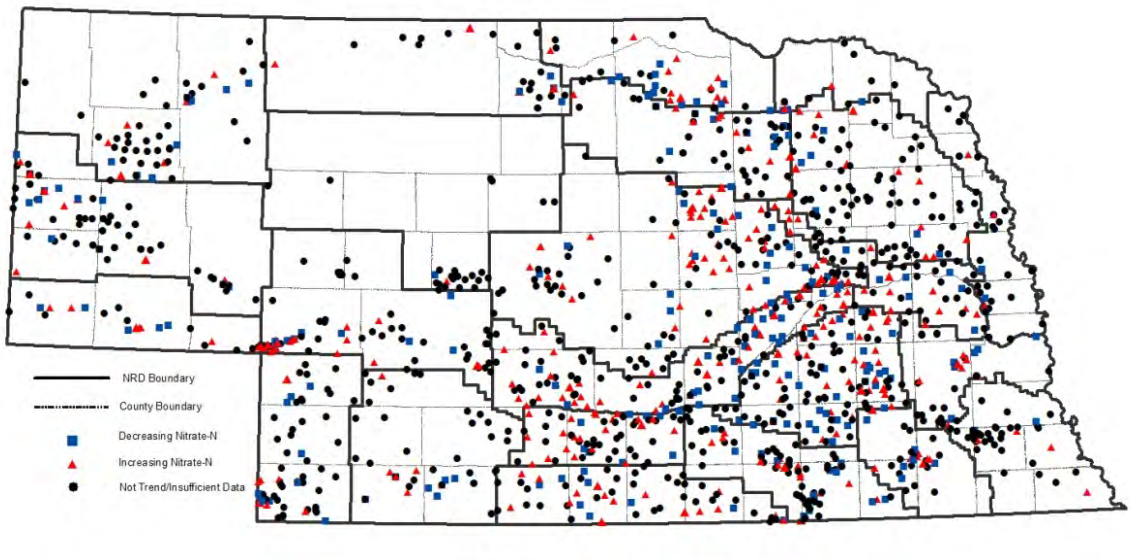
Reporting Changes

As stated, NDEQ must still report on the status of changes to groundwater quality over time. In lieu of trends, nitrates changes over the short term and long term are calculated. "Short-term change" refers to the positive or negative difference in the last two reported nitrate concentrations for an individual well. "Long-term change" refers to the positive or negative difference in the first and last concentration reported for an individual well.

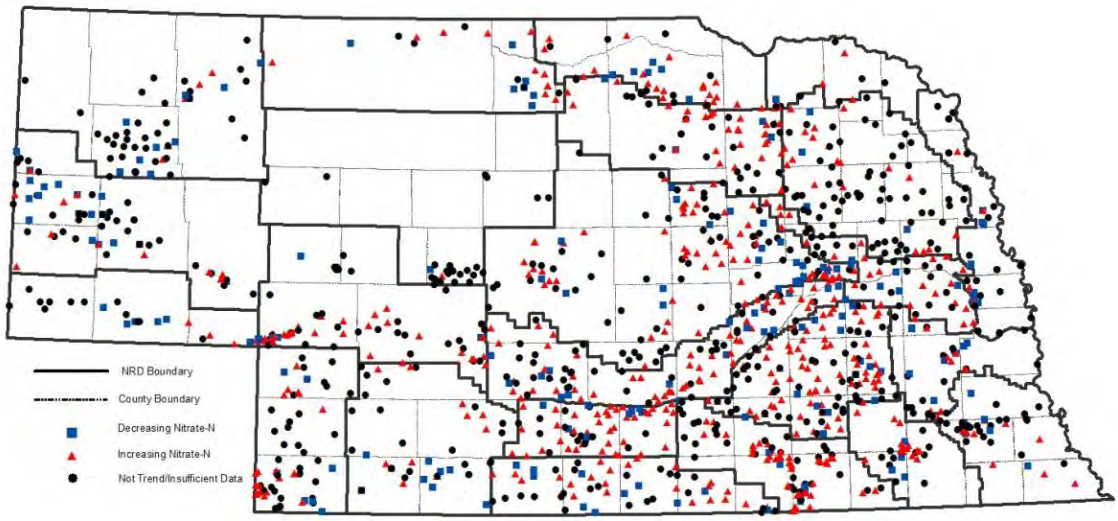
The following figures and tables show the changes in nitrate-nitrogen levels in the 1391 network wells.

Gated pipe on irrigated corn, central Nebraska.

Short-term changes in groundwater nitrate –nitrogen concentrations - 2011



Long-term changes in groundwater nitrate –nitrogen concentrations - 2011



Short-term Changes in Groundwater Nitrate-N Concentrations: 2011

Total Number of Wells Showing "Short-Term" Increases	321
Increase >1 to 5 mg/l	247
Increase >5 to 10 mg/l	47
Increase >10 mg/l	27
Total Number of Wells Showing "Short-Term" Decreases	231
Decrease >1 to 5 mg/l	162
Decrease >5 to 10 mg/l	45
Decrease >10 mg/l	24
Total Number of Wells Showing No "Short-Term" Trend	706
Total Number of Wells w/ Insufficient Data to Determine Trend	133
Total Number of Wells	1391

Short-term Changes in Groundwater Nitrate-N Concentrations: 2011

Total Number of Wells Showing "Long-Term" Increases	542
Increase >1 to 5 mg/l	355
Increase >5 to 10 mg/l	115
Increase >10 mg/l	72
Total Number of Wells Showing "Long-Term" Decreases	202
Decrease >1 to 5 mg/l	132
Decrease >5 to 10 mg/l	45
Decrease >10 mg/l	25
Total Number of Wells Showing No "Long-Term" Trend	514
Total Number of Wells w/ Insufficient Data to Determine Trend	133
Total Number of Wells	1391

It is important to keep some qualifications in mind when interpreting this information. Since each NRD has its own schedule for monitoring, individual samples may not have been taken at the same time as other samples within the same District or between Districts. Thus, at this point, each map does not necessarily represent a "snapshot" in time of nitrate levels or changes; they do, however, give a very general indication of how nitrate levels are changing over time. As time passes and the network becomes more well-established, samples will be more representative of equivalent time periods, and will be more directly comparable. It is also important to remember that aquifer systems and nitrate-nitrogen levels within them are very dynamic, complex, and variable. Although care was taken to select wells that were fairly representative of the geologic conditions present in various areas of the state, it is impossible to extrapolate conditions in a given well to a large area. Therefore, the several hundred wells in the statewide network give a general indication of how nitrate levels are changing over time across the state as a whole, but it would be inappropriate to use one or a few wells in the network to try to analyze nitrate levels in a specific part of the state.

More Information:

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