2013

# 2013 Nebraska Water Monitoring Programs Report

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**Nebraska Department of Environmental Quality**
**Water Quality Division**
**January 2014**

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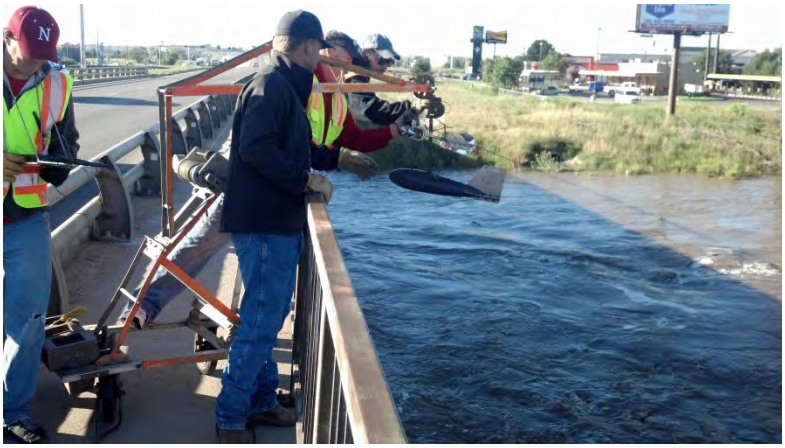


USGS staff sampling the flooding South Platte River, North Platte NE (September 2013) (photo courtesy of Kent Miller, Twin Platte NRD)

## Acknowledgements:

The following Nebraska Department of Environmental Quality staff have contributed to this report with their photos, maps, numbers, words, and editing. Their efforts are greatly appreciated and gratefully acknowledged here: Mike Archer, Ken Bazata, John Bender, Dave Bubb, Ryan Chapman, Jeremy Hammen, Dan Inman, Jon Kenning, Greg Michl, Dave Miesbach, Lindsey Phillips, Brad Routt, and Dave Schumacher.

Photo on the cover: Before (top) and during (bottom) flooding, on the South Platte River at North Platte NE. September 2013. Photo courtesy of Kent Miller, Twin Platte NRD.

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

Please direct any general questions related to this report to the editors of this document, Marty Link, NDEQ, at 402/471-4270 or marty.link@nebraska.gov or Jon Kenning, NDEQ, at 402/471-4227, jon.kenning@nebraska.gov.

NDEQ staff observing an Artesian Well, North Branch of the Middle Loup River. Cherry County, near Whitman.

# 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 16,000 miles of flowing rivers and streams, our greater than 148,000 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 many of the monitoring programs performed (or required) by the NDEQ. In many cases, recent results are highlighted in the descriptions. There are also examples of how the data that are collected are used. Individual program summaries, in some cases, include descriptions or explanations of water quality trends or observations.

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

**Partners**

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

Many thanks.

Pivot irrigation, Buffalo County.

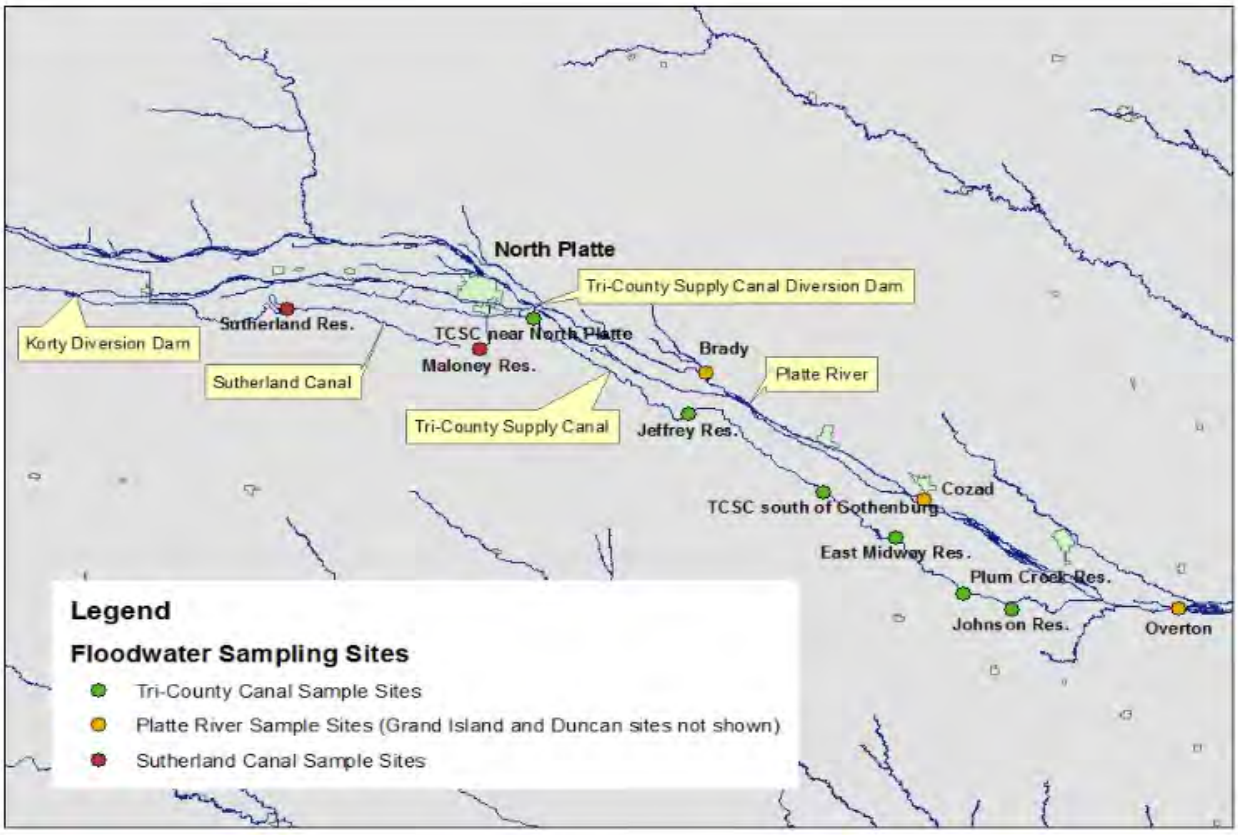
# Bacteria Monitoring of the 2013 Flood

Iron Eagle Golf Course at the South Platte River, east of North Platte. September 21, 2013. Photo courtesy of Kent Miller, Twin Platte NRD.

## Why NDEQ Did this Monitoring

Historical rains fell across the front range of the Colorado Rocky Mountains September 9-15th, 2013. The heavy rains largely fell in the South Platte River Basin and these extreme amounts of water were routed downstream through the South Platte and Platte River systems through the coming weeks. The Nebraska Department of Natural Resources, local natural resources districts, and irrigation districts in the Platte River Basin began to take steps to divert floodwaters out of the river as they moved into Nebraska from Colorado. These efforts consisted of developing agreements and coordinating the timing of the diversions of this flow in an attempt to attenuate the peak flood flows. These diversion projects were set up in a very short time frame as Nebraska braced for the large flows expected after the devastating floods in Colorado.

Due to the elevated health risk from flooded wastewater treatment and livestock facilities that could lead to a significant increase in bacteria levels, NDEQ expanded and extended its weekly sampling for bacteria. NDEQ's floodwater sampling included (see map) the Sutherland and Maloney Reservoirs on the Sutherland Canal system, six sample locations on the Tri-County Supply Canal (TCSC) system including Jeffrey, East Midway, Plum Creek and Johnson Reservoirs, and five sample sites on the Platte River located at Brady, Cozad, Overton, Grand Island, and Duncan.




**Where was the Monitoring Conducted?**

During the recreational season of May 1st to September 30st NDEQ collects and analyzes bacteria samples for both the Public Beach Monitoring and the Basin Rotation Monitoring Programs (additional information on these programs are summarized in this report). Consequently, many of the previously described floodwater sample locations were already being sampled as part of these programs. Two floodwater sampling locations were added to the existing sampling networks to obtain better coverage of the TCSC system. These sites were the TCSC near North Platte and Jeffrey Reservoir. Because the routine monitoring timeframe would be coming to an end during the peak of the floodwater surge, NDEQ decided it would be in the public's best interest to extend the sampling period at the locations that were influenced by the floodwaters until they subsided.

Korty Dam is a diversion on the South Platte River located almost six miles east of Roscoe in Keith County. This dam diverts water into the Sutherland Canal system that feeds into Sutherland Reservoir and eventually makes its way downstream to Maloney Reservoir before it is returned to the South Platte River at North Platte, NE. On average during the months of September and October this system usually diverts 147 cubic feet per second (cfs). Nebraska Public Power District (NPPD) began to divert water from the swollen South Platte River on September 19th in anticipation of the flood and continued to divert water until October 12th. According to NPPD, the average flow during that time

frame was 200 cfs. During the peak of the flood the dam was diverting 800 cfs into the canal.

The South Platte River meets up with the North Platte River at the TCSC Diversion Dam located approximately 3 miles east of North Platte. Here water is diverted into TCSC that ultimately flows into public reservoirs which include Jeffrey, Midway, East Midway, Gallagher, Plum Creek, Johnson, and Elwood reservoirs. The floodwaters first arrived at this diversion on September 20th. Central Nebraska Public Power and Irrigation District (CNPPID) normally diverts 500-600 cfs of water into the TCSC during this time of year, however 2,250 cfs of maximum allowable floodwater was diverted into the canal through October 15, 2013 while the remainder of the floodwater which peaked near 18,000 cfs continued to flow downstream in the Platte River.

**How was the data used?**

Similar to the Public Beach Monitoring program, the data received during this timeframe were posted weekly on the NDEQ web-page. This information allowed the public to become aware of the possible health risks that the floodwaters presented at specific locations. Indicator bacteria levels of *E. coli* above 235 counts of bacteria per 100 ml of water are considered a higher health risk and should be avoided if possible.

**Results**

Results of NDEQ's floodwater bacteria testing were typical of most runoff events where an initial spike in bacteria occurs followed by steadily decreasing levels over time. It did not appear that the diversion of floodwaters into the Sutherland Canal system had any impact upon the bacteria levels found at the beaches of Sutherland and Maloney Reservoirs (see table). This can likely be attributed to the proportionally small diversion of South Platte River water into Korty Canal and the mixing with North Platte River water that occurs in the Sutherland Canal further downstream.

The TCSC system posted higher bacteria values during the floodwater diversion event but did not approach the levels found in the Platte River over the same timeframe (see table). South Platte River floodwater at the TCSC diversion was mixed with the North Platte River before diverted into the canal where the water was again diluted by the water already occupying the system.

Floodwater did not significantly affect bacteria levels at Johnson Reservoir until 2 weeks after the diversion began when bacteria counts reach 548/100 ml of water on September 30, 2013. This spike in bacteria was short-lived as levels fell below the 235 count criterion by the following week.

The highest floodwater bacteria counts came from samples collected from the Platte River (see table) where a value of 3,654/100 ml water was reported on September 23rd at Overton, however, the bacteria levels at most of the Platte River sample locations fell dramatically within a week's time. In summary, although there were justified concerns of multiple direct inputs of bacteria laden wastewater from Colorado entering the Platte River system, it did not appear that this had an adverse impact on Nebraska's

waterbodies. The bacterial contamination from wastewater that entered the South Platte River appeared to be offset to a large degree by the vast amount of floodwater that came downstream with it.

**For More Information Contact:**
Lindsey Phillips at Lindsey.Phillips@nebraska.gov or (402) 471- 6988 or Dave Schumacher at David.Schumacher@nebraska.gov or (402) 471-4709.

South Platte River Bridge at Buffalo Bill Road, North Platte. September 21, 2013, 9am. Photo courtesy of Kent Miller, Twin Platte NRD.

## Sutherland and Maloney Reservoirs

| Sampling Location | Distance (miles) downstream of Korty Diversion Dam | Bacteria Results 9/19/2013 (pre-flood diversion) | Bacteria Results 9/27/2013 | Bacteria Results 10/04/2013 | Bacteria Results 10/11/2013 |
|---|---|---|---|---|---|
| Sutherland[PB] | 21 | 17 | 15 | 24 | 50 |
| Maloney[PB] | 44 | 2 | 28 | 13 | 28 |

## Tri-County Supply Canal (TCSC) System

*(Includes the reservoirs of Jeffrey, Midway, East Midway, Gallagher, Plum Creek, Johnson, and Elwood)*

| Sampling Location | Distance (miles) downstream of TCSC diversion | Bacteria Results 9/16/2013 (pre-flood diversion) | Bacteria Results 9/23/2013 | Bacteria Results 9/30/2013 | Bacteria Results 10/7/2013 |
|---|---|---|---|---|---|
| TCSC near North Platte[FW] | 1.25 | NA | 214 | 91 | 53 |
| Jeffrey Reservoir[FW] | 23 | NA | 179 | 31 | 59 |
| TCSC south of Gothenburg[BR] | 41 | 4 | 101 | 78 | 45 |
| East Midway Reservoir[BR] | 50 | 11 | 210 | 33 | 32 |
| Plum Creek Reservoir[BR] | 60 | 1 | 74 | **291** | 20 |
| Johnson Reservoir[PB] | 65 | 44 | 222 | **548** | 219 |

## Platte River

| Sampling Location | Bacteria Results 9/19/2013 (pre-flood diversion) | Bacteria Results 9/23/2013 | Bacteria Results 9/30/2013 | Bacteria Results 10/7/2013 | Bacteria Results 10/14/2013 |
|---|---|---|---|---|---|
| Brady[BR] | **687** | **2522** | 133 | 102 | NA |
| Cozad[BR] | 61 | **2417** | 78 | 73 | NA |
| Overton[BR] | dry | **3654** | 99 | NA | 42 |
| Grand Island[BR] | 24 | **727** | **488** | NA | 56 |
| Duncan[BR] | dry | dry | **2419** | NA | **387*** |

**Values in Red** indicate results > the water quality standard of 235 counts per 100 ml.

**PB – P**ublic **B**each monitoring location sampled weekly May – September 2013.

**FW –** Additional **F**lood **W**ater monitoring site.

**BR – B**asin **R**otation monitoring location sampled weekly May – September 2013.

***Note** - Although results at Duncan on Oct. 14 were above 235 counts per 100 ml, NDEQ considers these numbers to be within normal sampling levels for the Platte River, particularly since there had been considerable rain previous to sampling, which can elevate bacteria levels. The NDEQ concluded that further sampling for floodwaters' impacts was not necessary.

# Water Quality Monitoring Assistance

**Field Office Water Monitoring:**
The NDEQ field offices are responsible for assisting in water project management and water sampling within their assigned regions. Due to the vast amount of surface water throughout the state of Nebraska, it would be impossible for monitoring activities to be completed over such a large geographic region effectively without this assistance or the support provided by NDEQ's sampling partners.

Many Natural Resource Districts (NRDs) and NDEQ field offices are equipped with the appropriate supplies and equipment needed to collect and analyze water data, allowing water monitoring activities to be conducted throughout the entire state in an efficient and timely way. This assistance from the NDEQ field offices, NRDs and other entities located near the sample sites (i.e., Nebraska Public Power District, Central Public Health Department, US Army Corp of Engineers, and City of Carter Lake) is especially important considering the six-hour holding time for completing bacteria analyses. The State's 23 NRD's have received bacteria analysis equipment and training from NDEQ through a federal grant. This allows for samples collected at a prohibitive distance from Lincoln to be set up immediately for bacteria analysis, thereby meeting the holding time. The remaining sample containers are sent to the appropriate labs in Lincoln (Nebraska Health and Humans Services and NDEQ Bio-Lab). After 24-28 hours of incubation, the bacteria results are read and then sent electronically to the NDEQ Program Coordinator.


Agencies and entities that assisted in water sampling in 2013.

LLNRD staff calibrating a multi-parameter water quality meter

**Types of Water Monitoring:**

Field parameters and water sample collection – NDEQ field offices and several NRDs are equipped with portable water monitoring meters that allow them to take real-time field parameter measurements (i.e., pH, water temperature, dissolved oxygen and conductivity). Additionally, water samples are collected for routine laboratory analyses.

Bacteria – Each NDEQ field office and NRD have the appropriate supplies and equipment to analyze bacteria in regional water bodies. This allows for increased monitoring of water quality throughout Nebraska.

**How will the data be used?**

Cooperative work between the NDEQ field offices, NRDs, and other partners allow the NDEQ to monitor the state's water quality efficiently at a regional level. This data is used to compliment the Ambient Stream, Basin Rotation, and Public Beach Monitoring Programs described in previous chapters.

Water sample containers prepared by LLNRD staff used in the analysis of several routine parameters collected for NDEQ Basin Rotation, and Public Beach Monitoring Programs

**For More Information:**
For more information on the quality of Nebraska's streams, the most recent *Surface Water Quality Integrated Report* and the A*nnual Report to the Legislature* are available on the Department's website at http://DEQ.ne.gov.

For more information on where the NDEQ field offices are located, please visit the field office website at http://deq.ne.gov/NDEQProg.nsf/OnWeb/OffInfo.

Or, contact Dave Schumacher at David.Schumacher@nebraska.gov or (402) 471-4709 or Jeremy Hammen at Jeremy.Hammen@nebraska.gov (402) 471-4232.

North Fork of the Dismal River, near Mullen, Hooker County Nebraska

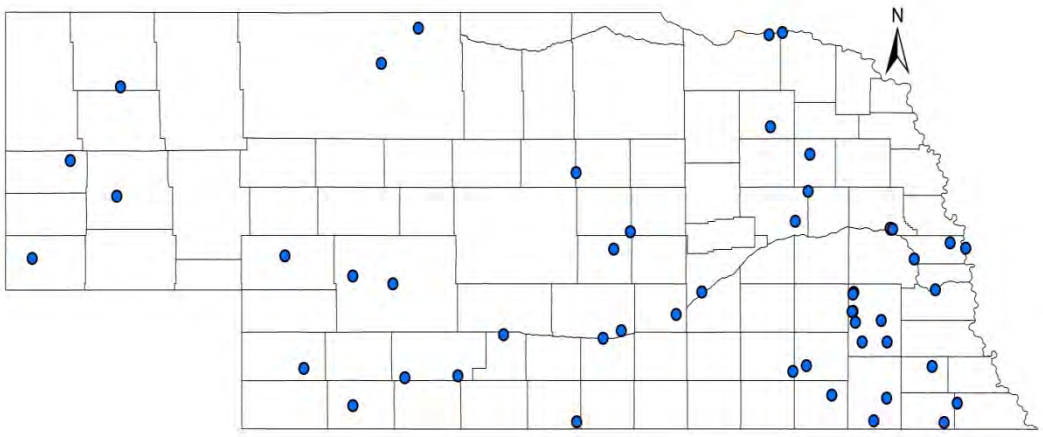
# Public Beach Monitoring Program –Bacteria and Microcystin

**Why Does NDEQ Monitor Public Beaches?**
Nebraska's lakes and reservoirs provide a multitude of opportunities for visitors to enjoy the outdoors. Visitors to these areas often times enjoy activities such as swimming, boating, skiing, jet skiing, etc. NDEQ wants to ensure that the users of these waters are informed with the most current water quality information possible.

NDEQ Personnel Sampling for Microcystin

**When and Where is the Monitoring Conducted?**
Sampling for bacteria at Nebraska's beaches has been occurring for many years. Nebraska Game and Parks Commission initiated sampling at a number of locations in the 1970s. NDEQ eventually took over the sampling program in the 1990s. In 2004 NDEQ began sampling for the toxin, microcystin; after it was determined that high levels in some Nebraska lakes attributed to the deaths of several dogs that had ingested the water. In 2005, NDEQ and its partners began a more comprehensive plan for collecting samples from publicly owned and operated lakes. Weekly sample collection of 51 sites

from 48 lakes coincides with the recreation season (May 1 to September 30). Since the inception of NDEQ's comprehensive beach monitoring program in 2005 more than 8500 samples have been analyzed for microcystin and E.Coli bacteria.

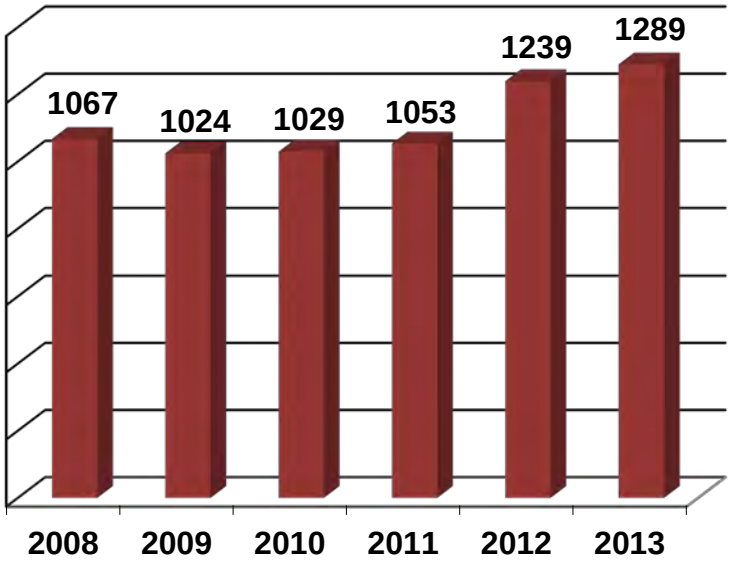



Map of Lakes Sampled for the Beach Monitoring Program in 2013

**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 ingest water with higher levels of *E. coli* bacteria, flu-like symptoms may occur.




Beach Monitoring: Number of samples taken, 2008-2013

*E. coli* bacteria are primarily associated with animal and human waste. Animal sources of *E. coli* bacteria commonly enter our waters from livestock and wildlife wastes that runoff the landscape during significant rainfall events. Human

sources of contamination can include improperly maintained septic systems and wastewater treatment facilities that discharge untreated wastewater.

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


Nebraska Lake under Health Alert. Photo provided by Ron Hines (NDEQ)

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

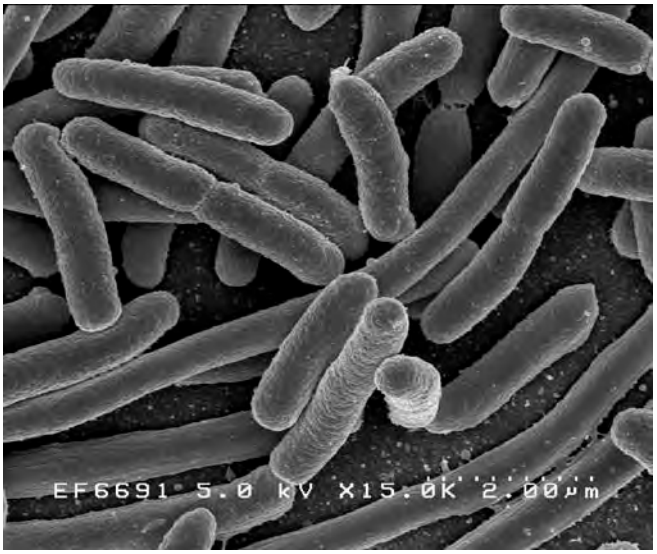
are specifically identified on the NDEQ's website weekly, in the Environmental Alerts section. Unlike with high toxic algae levels, signs are not specifically posted and beaches are not closed for high bacteria levels. This is primarily because bacteria values change quickly while microcystin levels 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 if you have been in contact with lake water.

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

**2013 Results**

In 2013, the Beach Monitoring program collected and analyzed approximately 1,300 samples for *E. coli* and the microcystin toxin.

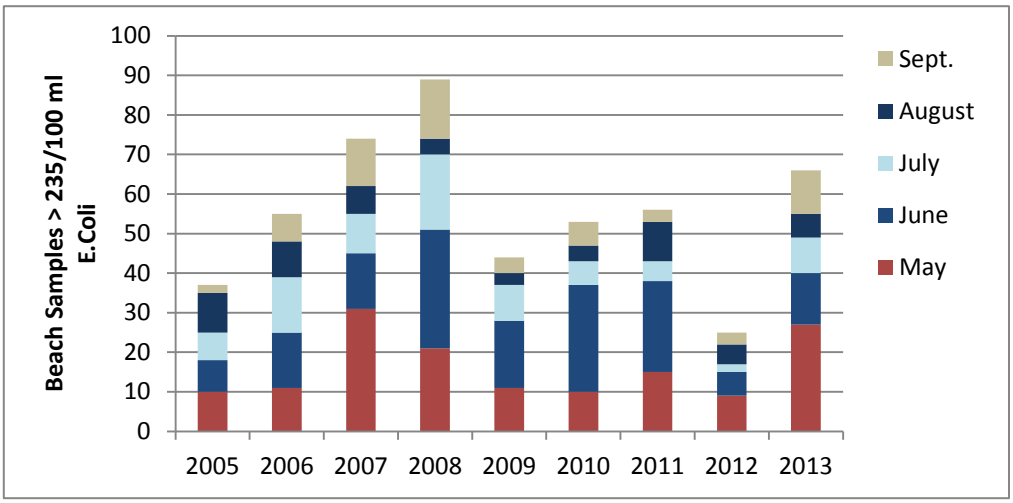



Microscopic view of *E. coli.*

**Bacteria**

Of the bacteria samples taken and analyzed during 2013, 66 samples (5.0%) exceeded the 235 counts/100ml of water standard.

In the table below, the number of samples that exceeded 235/100 ml criterion for bacteria by month for 2005 through 2013 is shown. This table also provides the combined totals per month as well as per year. Note that most high levels occur in the spring and early summer months, in times of higher precipitation (and the associated higher run-off). Extremely low amount of rainfall in 2012 led to a lower than normal number of bacteria readings that exceeded the water standard. 2013 brought with it a return to a slightly more normal amount of rainfall. In particular, the month of May experienced an increase in rainfall, when compared to 2012 and as a consequence the number of samples that exceeded the Health Alert criterion also increased. For 2013, 41% (27 of 66) of the Health Alerts issued in 2013 occurred in May.




Beach Samples Exceeding the 235 counts/100 ml E.Coli Bacteria Criterion

**Toxic Algae (Microcystin)**

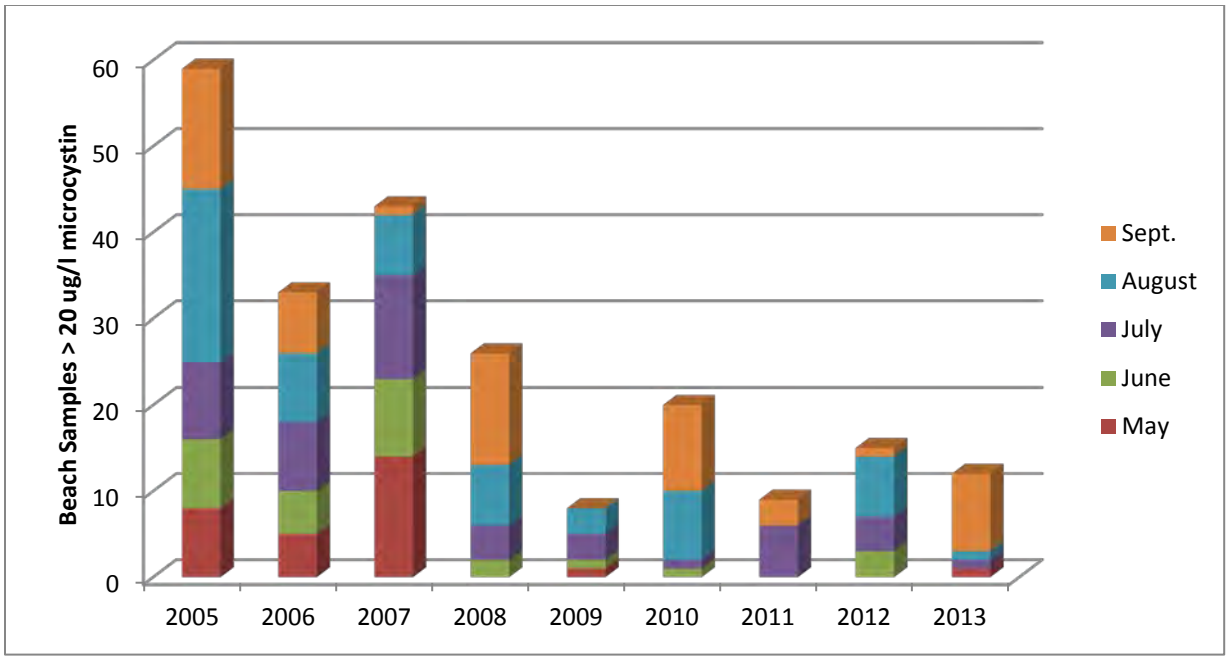
Of the approximately 1400 plus samples collected and analyzed for the microcystin toxin during 2013, only 12 samples exceeded the 20 ppb threshold for closing a beach. This accounts for less than 1.0% of the total samples collected.

In 2013, six lakes were placed on Health Alert. The table below shows the lakes that had samples exceed the 20 ppb health standard and the number of weeks they were under a Health Alert.

**Lakes with Microcystin Toxin Exceeding 20 ppb**

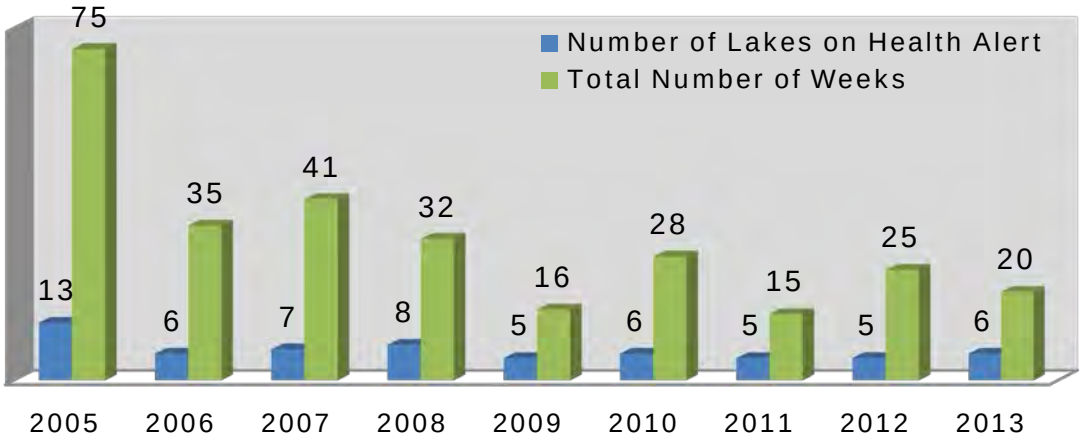
| Waterbody | County | # of Samples Exceeding 20 ppb | # of Weeks on Health Alert |
|---|---|---|---|
| Bluestem Lake @ South Beach | Lancaster | 1 | 2 |
| Kirkman's Cove at North Beach | Richardson | 2 | 4 |
| Lone Star Lake at West Beach | Fillmore | 1 | 2 |
| McConaughy Lake at Martin's Bay | Keith | 1 | 2 |
| Swan Creek Lake # 5A at South Beach | Saline | 3 | 5 |
| Willow Creek | Madison | 4 | 5 |

The following graph illustrates the number of samples exceeding the 20 ppb microcystin criterion monthly for 2005 through 2013. It also shows the totals for each year as well as for each month through the years. Unlike with bacteria where high levels are more frequently observed in the springtime, blue-green algae (microcystin) impacts are usually observed later in the summer, after lake water has warmed and algae growth is more significant.




Beach Samples Exceeding the 20 ppb Microcystin Criterion

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 – 2012.




Number of lakes on Health Alert and the number of combined weeks that lakes were on Health Alert each year from 2005 – 2013

**Why are there problems at some lakes and not others?**

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

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

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

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

Toxic algae conditions during 2005 were significantly worse when compared to the other years. 2005 was characterized by lower rainfall, higher temperatures and was toward the end of a major drought. In general, lake levels were significantly lower across the State. In contrast, 2011 was characterized by very heavy spring rainfall and relatively full lakes which led to a low number of lakes that experienced toxic algal blooms.

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

Algal Bloom in a Nebraska Reservoir. Photo by Dave Bubb (NDEQ)

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.

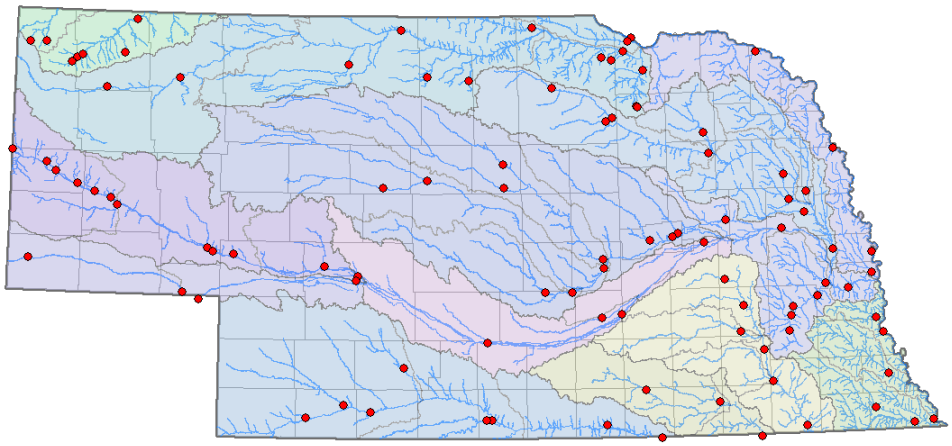
**For More Information:**
Information on NDEQ's Beach Monitoring Program and recreation season weekly sampling results is available at http://deq.ne.gov

**Contact**: Mike Archer at Mike.Archer@nebraska.gov or (402) 471-4224 Dave Schumacher at David.Schumacher@nebraska.gov or (402)471-4709

# 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 carry 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.



Locations of NDEQ ambient monitoring sites

**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 above shows the locations of the 97 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 through September. Arsenic and selenium are collected at all sites quarterly, as are a complete suite of metals at each basin integrator site.

North Loup River, northwest of Thedford, Cherry 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).

More information about all surface water impairments is available in the 2012 Integrated Report and the draft 2014 Integrated Report (available ~ February 2014). This report combines the Clean Water Act 303(d) impaired waters list with the 305(b) summary of the health of Nebraska's surface waters. This report is available on NDEQ's website at http://deq.ne.gov.

## Trends

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

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

## More Information:

For more information on the quality of Nebraska's streams, the most recent *Surface Water Quality Integrated Report* and the A*nnual Report to the Legislature* are available on the Department's website at http://deq.ne.gov.

| Atrazine Trends | | |
|---|---|---|
| Waterbody Name | Trend | P-value |
| Antelope Creek in Lincoln | Stable | 0.51 |
| Big Blue River near Barneston | Stable | 0.25 |
| Calamus River near Taylor | Stable | 0.73 |
| Cedar River near Fullerton | Stable | 0.18 |
| Chadron Creek near Chadron | Stable | 0.53 |
| Dismal River near Thedford | Stable | 0.14 |
| Elkhorn River near Norfolk | Stable | 0.13 |
| Keya Paha River near Naper | Increasing | 0.03 |
| Little Blue River near Fairbury | Stable | 0.43 |
| Little Salt Creek in Lincoln | Stable | 0.25 |
| Medicine Creek near Curtis | Stable | 0.13 |
| Middle Loup River near Dunning | Stable | 0.67 |
| Mud Creek near Ravenna | Stable | 0.63 |
| Niobrara River near Valentine | Stable | 0.09 |
| North Loup River near Taylor | Stable | 0.15 |
| North Platte River at North Platte | Decreasing | 0.01 |
| Papillion Creek at Omaha | Stable | 0.47 |
| Platte River near Duncan | Stable | 0.41 |
| Ponca Creek | Stable | 0.25 |
| Republican River at McCook | Stable | 0.54 |
| Snake River near Valentine | Stable | 0.36 |
| South Platte River at North Platte | Stable | 0.21 |
| Verdigre Creek near Verdigre | Stable | 0.50 |

Trend analysis results for the pesticide Atrazine from NDEQ's Ambient Stream Monitoring Program. A P-value less than 0.05 indicates an increasing or decreasing trend.

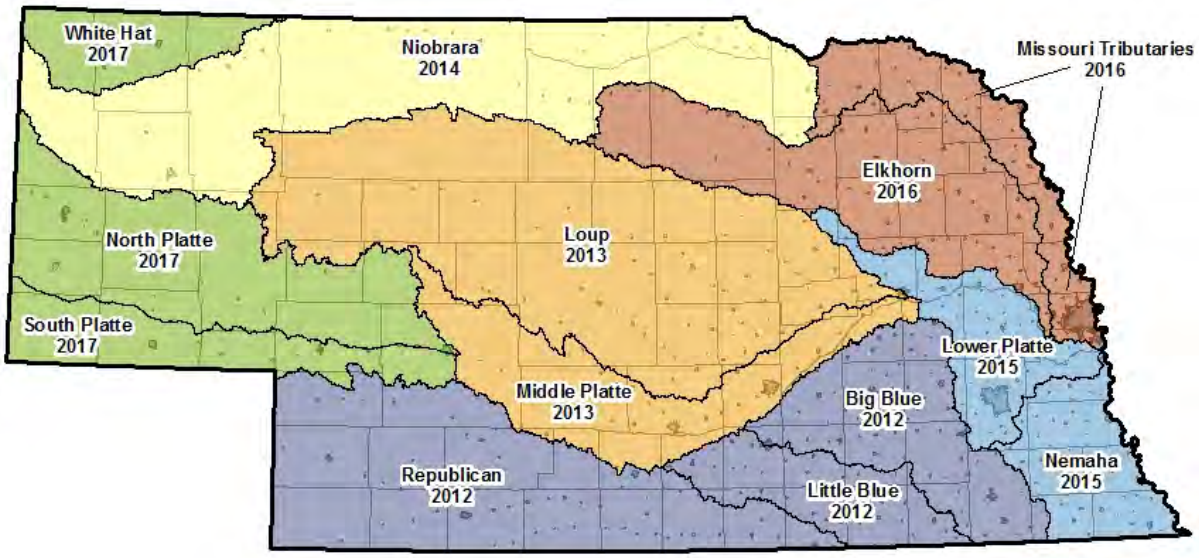
## For More Information Contact:

Dave Schumacher at david.schumacher@nebraska.gov or (402) 471-4709
Michael Archer at mike.archer@nebraska.gov or (402) 471-4224
Jeremy Hammen at jeremy.hammen@nebraska.gov or (402) 471-4232

# 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 over 16,000 miles of perennial streams and rivers, and more than 148,000 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 and September 30. In 2013, a total of 29 streams and 21 lakes were sampled in the Middle Platte and Loup River Basins. This sampling resulted in 462 lake and 638 stream 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). Accordingly, 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 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 lake water can cause gastrointestinal problems if swallowed. *E. coli* exists naturally in the environment. It often becomes elevated in lakes and rivers from runoff following a rainfall event. A few sources of *E.coli* include wildlife and livestock feces and failing septic systems.

Wood River, Wood River, NE, Hall County

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

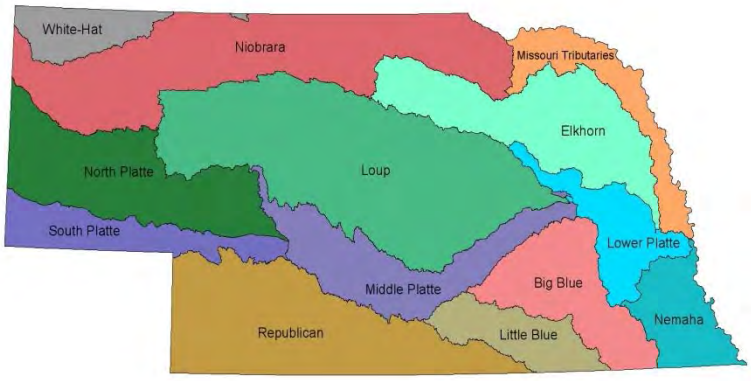
**For More Information**
For more information on the quality of Nebraska's streams, the most recent *2012 Integrated Report* is available on the Department's website at http://deq.ne.gov . Additional questions can be directed to Jeremy Hammen (jeremy.hammen@nebraska.gov), 402/471-4232 or Dave Schumacher (david.schumacher@nebraska.gov), 402/471-4709.

# Stream Biological Monitoring Program

Swan Creek, Saline County

**Why Biological Monitoring?**
Nebraska has over 81,000 miles of streams of which over 16,000 miles flow continuously. Streams in Nebraska are capable of containing a rich diversity of aquatic life including aquatic macroinvertebrates (i.e. small animals living in water that can be seen with a naked eye), fish, amphibians, and mammals. Nitrogen, phosphorus, pesticides, sediment, and other pollutants are stressors that can degrade stream conditions for aquatic life, and can be potentially harmful to people. The aim of the Stream Biological Monitoring Program (SBMP) is to provide accurate statewide assessments of the biological conditions of Nebraska's streams so that sound decisions in management, planning, and regulation can be made.

**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 its SBMP in order to address statewide and regional questions about water quality. Data to answer such questions as "How good is the water quality in Nebraska?" are best obtained such that all streams have an equal chance of being sampled. These monitoring sites are generated by a computer



program that randomly chooses sites on streams throughout Nebraska. From 1997-2011, the biological communities of 512 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 on previous page for basin divisions).

**What is Monitored?**
Routine chemical analyses of water samples provide water quality information for a snapshot in time meaning short-term pollution events may never be detected. Chemical analyses also provide no indication of the stream's physical nature or habitat. The "health" of a stream depends 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*
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 macroinvertebratessince1997 through the sampling effort associated with the SBMP. In addition, numerous new species not previously found in Nebraska have been recorded.


Burrowing mayfly nymph from Stinking Water Creek, Hayes County

*Fish*
From small coldwater trout streams to large warm rivers, Nebraska streams support about 50 species of fish. As with macroinvertebrates, fish display varying habitat requirements and water quality tolerances making them excellent indicators of stream health. The majority of Nebraska's species are small, with adults generally less than 5 inches long. The Department's fish surveys have also provided information on changing abundances and


Flathead catfish from Little Blue River, Nuckolls County

ranges of fish in the state. Some species occur in many more places than previously thought, while others have shown dramatic declines over the last 30 years.

**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.

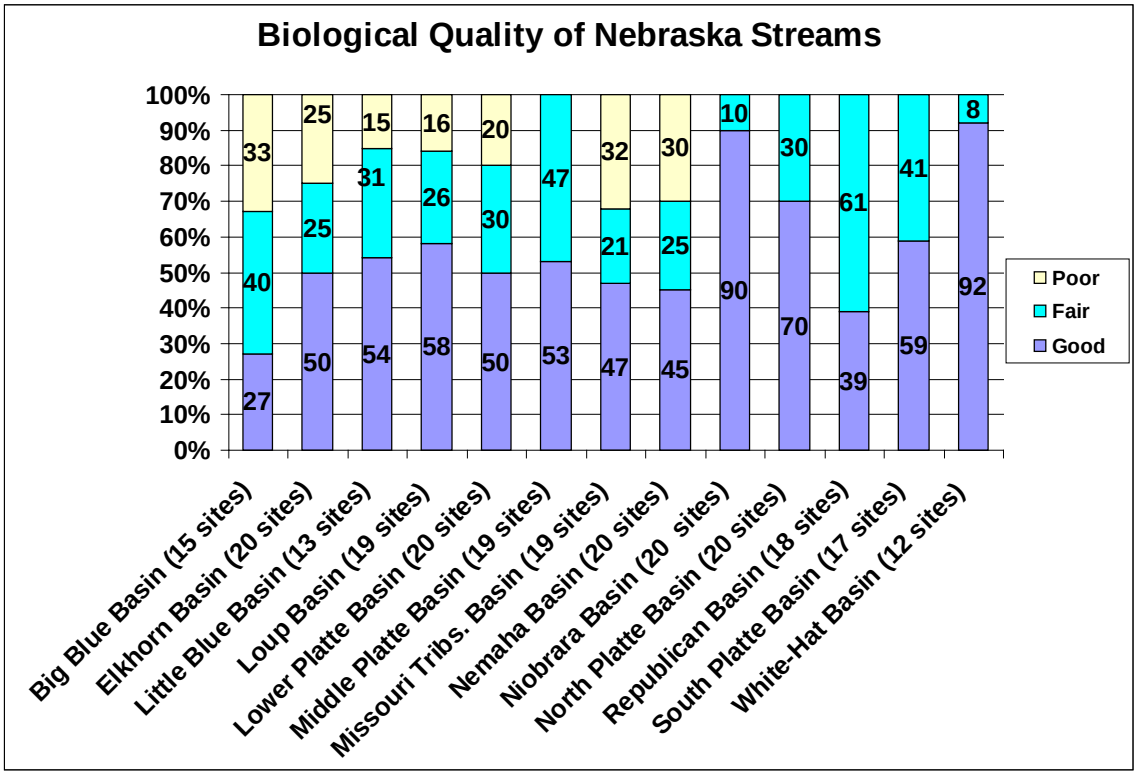
Under the federal Clean Water Act, states are required to develop programs to evaluate the physical, chemical, and biological integrity of the Nation's waters and to adopt water quality standards to restore and maintain that integrity. States must report to Congress on the condition of all waters within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

NDEQ staff seining fish from the Little Blue River, Jefferson County

**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

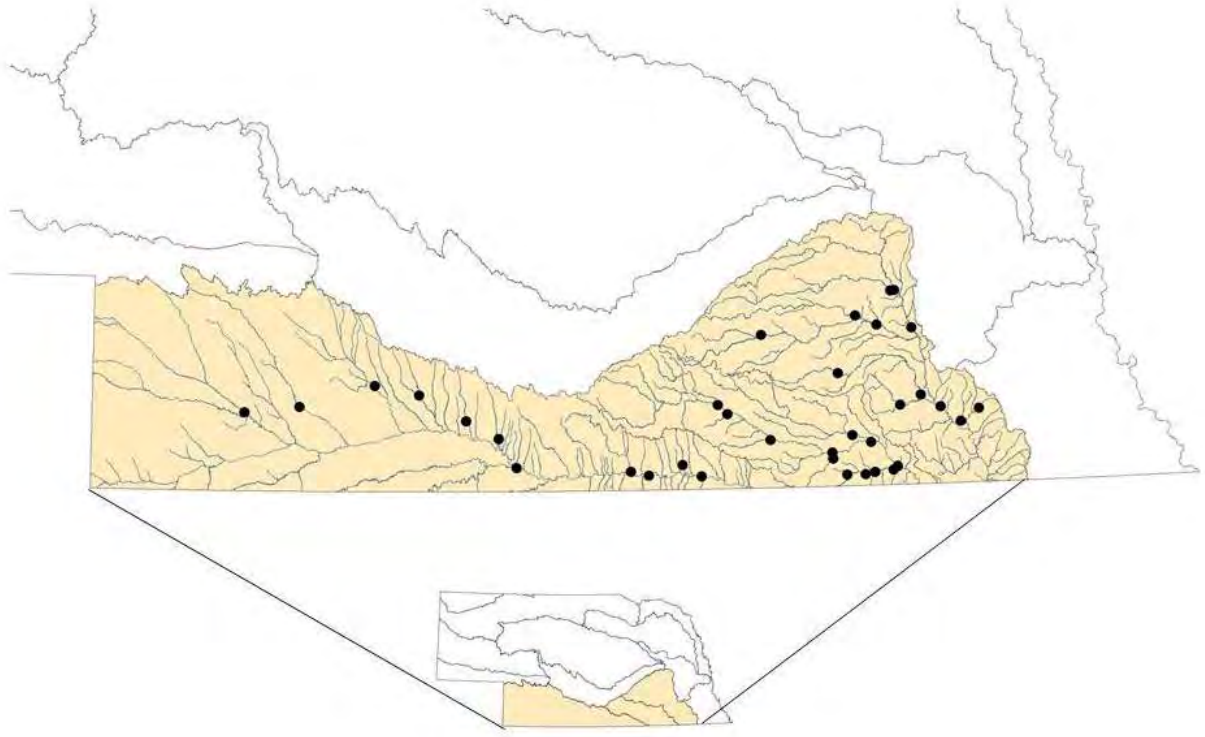
condition of the streams in Nebraska, it is important that proper management measures are implemented to reduce the impacts of these pollutants.

Agricultural run-off

NDEQ Staff sampling aquatic macroinvertebrates in Turkey Creek. Saline County

*2012 Update*

Thirty-four stream locations were sampled as part of the 2012 SBMN (see figure below).

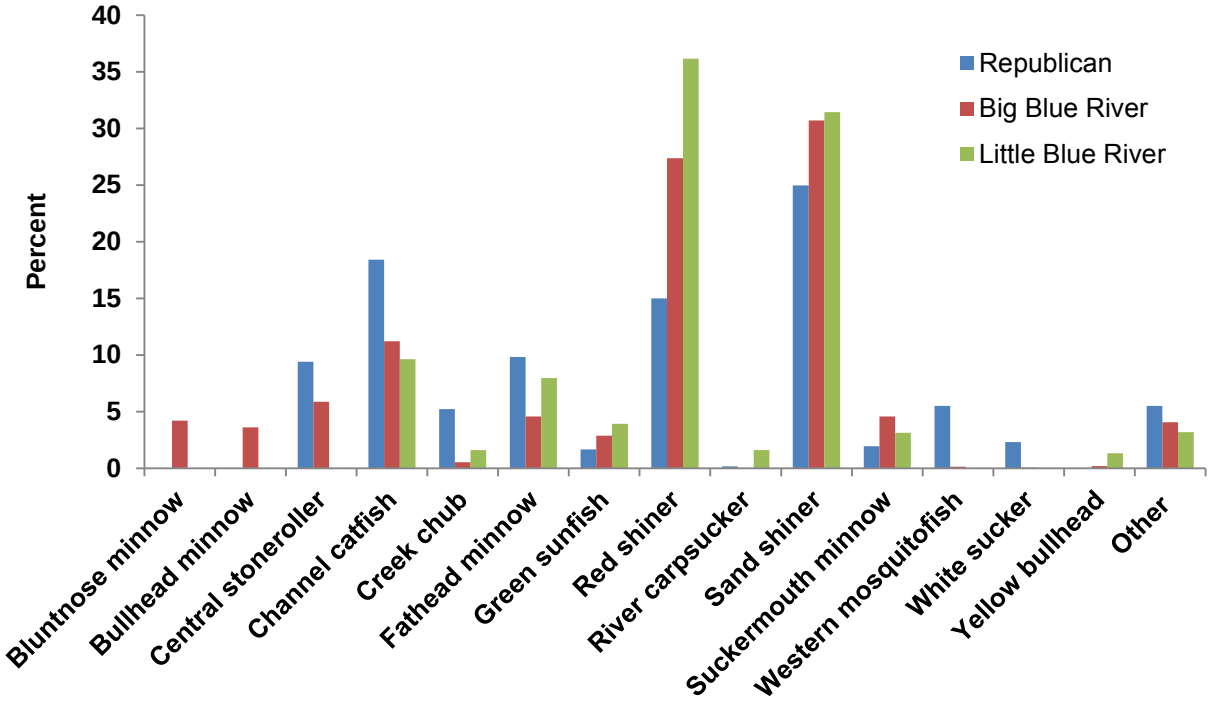


Sampling Locations in the Republican River, Little Blue River, and Big Blue River Basins, 2012

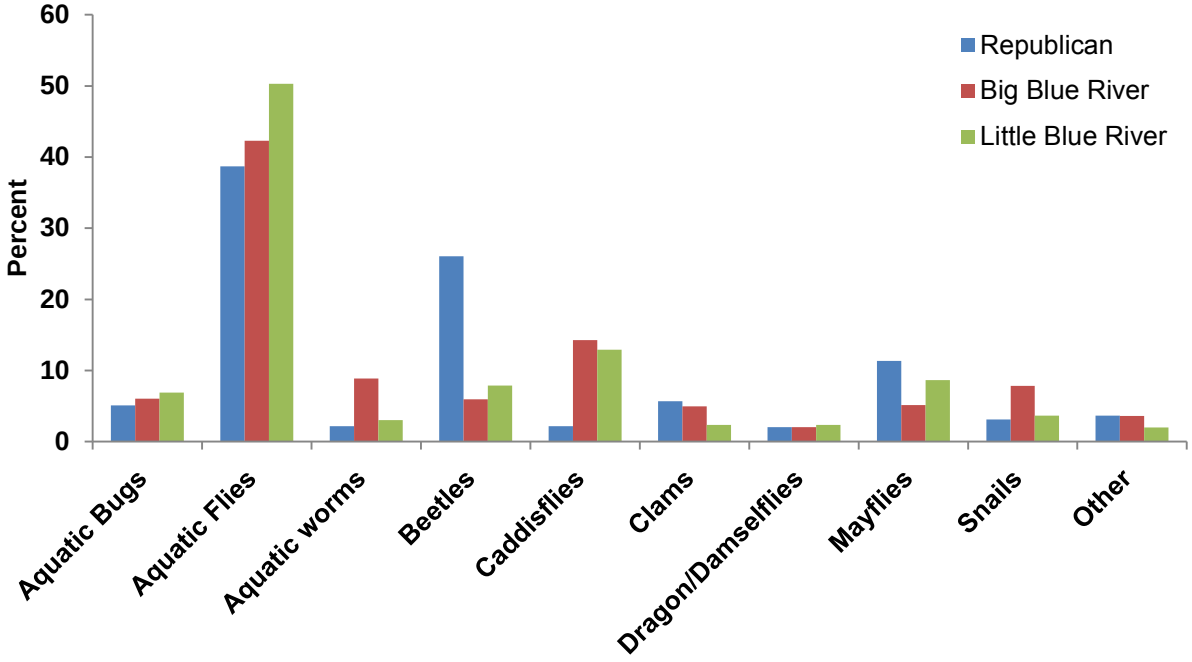
Preliminary assessments of the biological collections made in 2012 are provided in the following charts. Relative species abundance and species richness describe key elements of biodiversity which the Department uses to determine stream health. Relative species abundance refers to how common or rare a species is relative to other species in a given stream location while species richness simply refers to the number of species collected.

Twenty-seven fish species were collected in the Republican River Basin, 27 species in the Little Blue River Basin, and 18 species in the Big Blue River Basin. Sand shiner, red shiner, channel catfish, and fathead minnow were the most abundant fish species in the three basins. The most abundant of the major macroinvertebrate taxa included the larvae life stages of the midges, caddis flies, worms, and snails.

## Relative species abundance of fish collected in three river basins in 2012




## Relative species abundance of the major aquatic macroinvertabrate groups collected from three river basins in 2012



**For More Information**

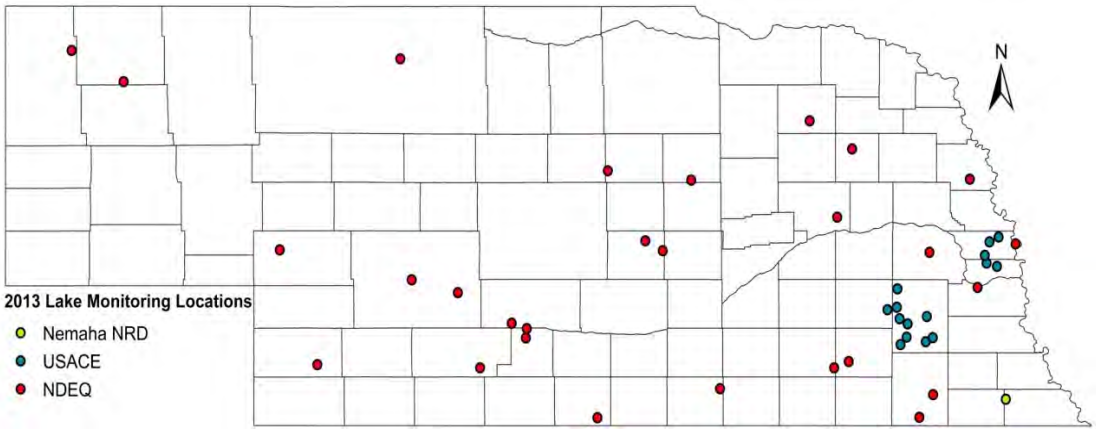
The Department's Stream Biological Monitoring Program is conducted and managed out of the main office located in Lincoln. Contact Ken Bazata at 402/471-2192 or ken.bazata@nebraska.gov or Jeremy Hammen at 402/471-4232 or jeremy.hammen@nebraska.gov for further data or information.

Little Blue River, Jefferson County, during 2012 drought conditions.

# 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 2013, 44 lakes were monitored for chemical and biological parameters while fish tissue monitoring was conducted at 54 lakes.




Lake sampling locations for 2013 (does not include fish tissue sites)

**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
- pH
- water clarity
- nutrients
- bacteria
- pesticides
- microcystin
- chlorophyll-a

May through September is 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. Some streams above reservoirs are monitored during and after rain events for nutrients, sediment, and pesticides.

**How is the Data Used?**

Lake Carter P. Johnson, Sioux County, June 2013

Collected data is 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 .

**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**

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.

Preparing to launch NDEQ's Monitoring Vessel at Gallagher Canyon Reservoir, Dawson County

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 2012, the NDEQ assessed the results of our pesticide analysis data 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 Mike Archer at (402-471-4224) or at mike.archer@nebraska.gov or Dave Bubb at (402 471-2810) or dave.bubb@nebraska.gov.

# Fish Tissue Monitoring

## Why NDEQ Does this Monitoring

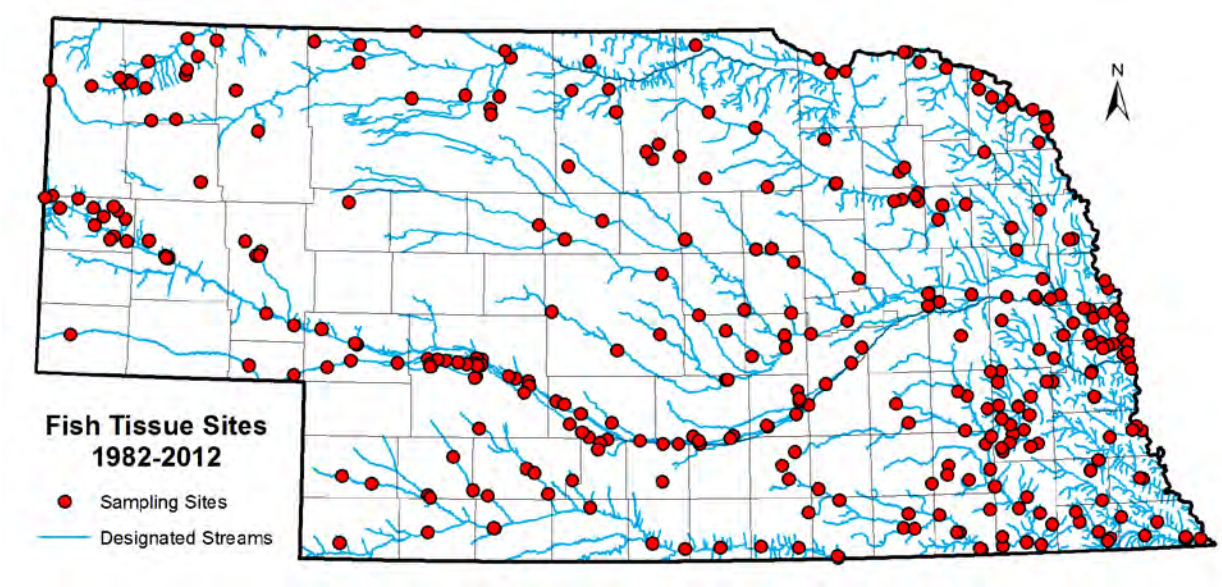
Each year fish samples are collected from numerous streams and lakes across Nebraska to determine their suitability for human consumption. This is important because certain contaminants have a tendency to bio-accumulate in fish tissue and, when eaten, can cause an increased risk for human health problems. 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?

Monitoring is generally conducted at locations where most fishing occurs; therefore the potential risk to human health is greatest. Fish species targeted for collection included those that are most frequently sought by fisherman, including: catfish, largemouth bass, walleye, crappie, and 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 below for 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).


Fish tissue preparation

**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 noncarcinogenic effects are not anticipated. If the HI equals or exceeds 1.0 then an advisory is issued.

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

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

Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with the NDEQ, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where high concentrations of contaminants may indicate a health risk for consumers. Waterbodies where sampling has revealed exceedances of health risk criteria and subsequent consumption advisories have been issued will be re-sampled following the 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 2013, the NDHHS, in cooperation with the NDEQ, the NGPC, and the NDA, has issued fish consumption advisories for 94 waterbodies: 13 stream segments and 81 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 2011

| MAP I.D. # | WATERBODY | COUNTY | FISH SPECIES | PRIMARY POLLUTANT(S) OF CONCERN |
|---|---|---|---|---|
| 1 | Lake Hastings | Adams | Common Carp | PCBs |
| 2 | Ravenna Lake | Buffalo | Largemouth Bass | Mercury |
| 3 | Bassway Strip Lake No. 5 | Buffalo | Largemouth Bass | Mercury |
| 4 | Kea Lake | Buffalo | Largemouth Bass | Mercury |
| 5 | Cottonmill Lake | Buffalo | Largemouth Bass | Mercury |
| 6 | Yanney Park Lake | Bufflalo | Largemouth Bass | Mercury, Selenium |
| 7 | Platte River | Cass | Channel Catfish | PCBs, Mercury |
| 8 | Weeping Water City Lake | Cass | Largemouth Bass | Mercury, Selenium |
| 9 | Enders | Chase | White Bass | Mercury |
| 10 | Valentine Mill Pond | Cherry | Largemouth Bass | Mercury |
| 11 | Merritt Reservoir | Cherry | Walleye | Mercury |
| 12 | Cottonwood Lake | Cherry | Largemouth Bass | Mercury |
| 13 | Shell Lake | Cherry | Northern Pike | Mercury |
| 14 | West Point City Lake | Cuming | Largemouth Bass | Mercury |
| 15 | Crystal Cove Lake | Dakota | Largemouth Bass | Mercury |
| 16 | Box Butte Reservoir | Dawes | Northern Pike | Mercury |
| 17 | Whitney Reservoir | Dawes | White Bass | Mercury |
| 18 | Grabel Pond #5 | Dawes | Largemouth Bass | Mercury, Selenium |
| 19 | Chappell Interstate Lake | Deuel | Largemouth Bass | Mercury, Selenium |
| 20 | Dead Timber Lake | Dodge | Largemouth Bass | Mercury |
| 21 | Fremont Lake No. 1 | Dodge | Largemouth Bass | Mercury |
| 22 | Johnson Lake | Dodge | Largemouth Bass | Mercury |
| 23 | Lake Bennington | Douglas | Largemouth Bass | Mercury |
| 24 | Zorinsky Lake | Douglas | Largemouth Bass | Mercury |
| 25 | Carter Lake | Douglas | Largemouth Bass | PCBs |
| 26 | Standing Bear Lake | Douglas | Largemouth Bass | Mercury |
| 27 | Rock Creek Lake | Dundy | Largemouth Bass | Mercury |
| 28 | Hugh Butler Lake | Frontier | Northern Pike | Mercury |
| 29 | Muddy Creek | Furnas | Channel Catfish | Mercury |
| 30 | Big Blue River | Gage | Common Carp | PCBs, Dieldrin |
| 31 | Wolf-Wildcat Lake | Gage | Largemouth Bass | Mercury |
| 32 | Rockford Lake | Gage | Largemouth Bass | Mercury |
| 33 | Crescent Lake | Garden | Largemouth Bass | Mercury |
| 34 | Island Lake | Garden | Largemouth Bass | Mercury |
| 35 | Smith Lake | Garden | Largemouth Bass | Mercury |
| 36 | Phillips Lake | Gosper | Common Carp | Mercury |

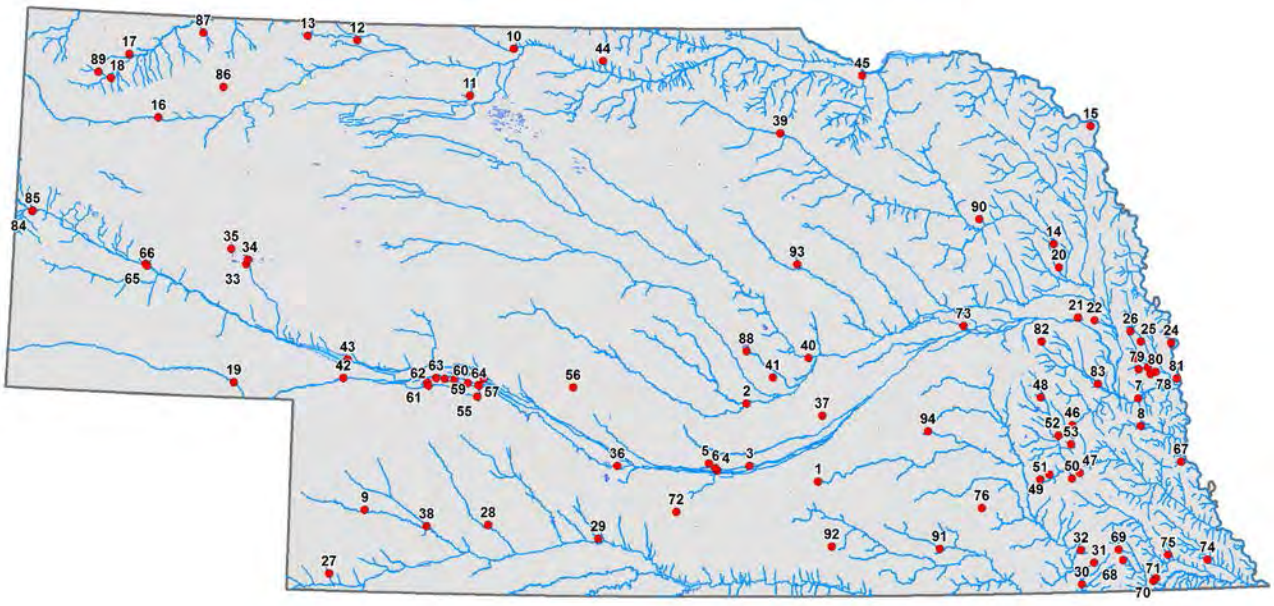
**Table Continued**

| | | | | |
|---|---|---|---|---|
| 37 | Eagle Scout Lake | Hall | Largemouth Bass | Mercury |
| 38 | Frenchman WMA Lake | Hayes | Largemouth Bass | Mercury |
| 39 | O'Neill City Lake | Holt | Largemouth Bass | Mercury |
| 40 | North Loup SRA Lake | Howard | Largemouth Bass | Mercury, Selenium |
| 41 | Farwell South Reservoir | Howard | Largemouth Bass | Mercury |
| 42 | Ogallala City Park Lake | Keith | Channel Catfish | PCBs, Chordane |
| 43 | Lake McConaughy | Keith | Walleye | Mercury, Selenium |
| 44 | Cub Creek Lake | Keya Paha | Largemouth Bass | Mercury |
| 45 | Niobrara River | Knox | Common Carp | Mercury, Selenium |
| 46 | Salt Creek | Lancaster | Common Carp | PCBs, Mercury |
| 47 | Wagon Train Lake | Lancaster | Largemouth Bass | Mercury |
| 48 | Wildwood Reservoir | Lancaster | Largemouth Bass | Mercury |
| 49 | Bluestem Lake | Lancaster | Channel Catfish | Mercury |
| 50 | Stagecoach Lake | Lancaster | Largemouth Bass | Mercury |
| 51 | Merganser Lake | Lancaster | Largemouth Bass | Mercury |
| 52 | Oak Creek | Lancaster | Channel Catfish | PCBs, Mercury |
| 53 | Holmes Lake | Lancaster | Largemouth Bass | Mercury |
| 54 | North Platte River | Lincoln | Largemouth Bass | Mercury |
| 55 | Maloney Res. Outlet Canal (above hydro) | Lincoln | Common Carp | Mercury |
| 56 | Sutherland Outlet Canal | Lincoln | Common Carp | PCBs, Mercury |
| 57 | Interstate Lake | Lincoln | Largemouth Bass | Mercury |
| 58 | East Hershey Lake | Lincoln | Largemouth Bass | Mercury |
| 59 | Hershey Lake | Lincoln | Largemouth Bass | Mercury |
| 60 | Birdwood Lake | Lincoln | Largemouth Bass | Mercury |
| 61 | Sutherland Reservoir | Lincoln | Common Carp | PCBs, Mercury |
| 62 | Sutherland Cooling Pond | Lincoln | Common Carp / Largemouth Bass | Mercury, Selenium / Mercury |
| 63 | East Sutherland Lake | Lincoln | Largemouth Bass | Mercury |
| 64 | Maloney Res. Outlet Canal (below hydro) | Lincoln | Channel Catfish / Smallmouth Bass | PCBs / Mercury |
| 65 | North Platte River | Morrill | Common Carp | Mercury, Selenium |
| 66 | Bridgeport Middle Lake | Morrill | Largemouth Bass | Mercury |
| 67 | Steinart Park Lake | Otoe | Largemouth Bass | Mercury |
| 68 | Burchard Lake | Pawnee | Largemouth Bass | Mercury |
| 69 | Mayberry WMA Lake | Pawnee | Largemouth Bass | Mercury |
| 70 | Prairie Knoll Lake | Pawnee | Largemouth Bass | Mercury |
| 71 | Iron Horse Trial Lake | Pawnee | Largemouth Bass | Mercury |
| 72 | Holdredge Park Lake | Phelps | Largemouth Bass | Mercury, Selenium |
| 73 | Columbus City Park Pond | Platte | Largemouth Bass | Mercury |
| 74 | Verdon Lake | Richardson | Largemouth Bass | Mercury |
| 75 | Kirkman's Cove Lake | Richardson | Largemouth Bass / Common Carp | Mercury |
| 76 | Swan Creek 5A | Saline | Largemouth Bass | Mercury |
| 77 | Offutt Lake | Sarpy | Channel Catfish | PCBs |
| 78 | West Papillion Creek | Sarpy | Common Carp | PCBs, Dieldrin |
| 79 | Walnut Creek Lake | Sarpy | Largemouth Bass | Mercury |
| 80 | Wehrspann Lake | Sarpy | Largemouth Bass | Mercury |
| 81 | Halleck Park Lake | Sarpy | Largemouth Bass | Mercury, Selenium |

**Table Continued**

| | | | | |
|---|---|---|---|---|
| 82 | Czechland Lake | Saunders | Largemouth Bass | Mercury |
| 83 | Memphis Lake | Saunders | Largemouth Bass | Mercury |
| 84 | Morrill Sandpit - Southwest | Scottsbluff | Largemouth Bass | Mercury |
| 85 | Morrill Sandpit - North | Scottsbluff | Largemouth Bass | Mercury, Selenium |
| 86 | Walgren Lake | Sheridan | Largemouth Bass | Mercury |
| 87 | Isham Dam Lake | Sheridan | Largemouth Bass | Mercury |
| 88 | Sherman Reservoir | Sherman | Walleye | Mercury |
| 89 | Carter P. Johnson Lake | Sioux | Largemouth Bass | Mercury |
| 90 | Maskenthine Lake | Stanton | Largemouth Bass | Mercury |
| 91 | Big Sandy Creek | Thayer | Channel Catfish | Mercury |
| 92 | Liberty Cove | Webster | Largemouth Bass | Mercury |
| 93 | Pibel Lake | Wheeler | Largemouth Bass | Mercury |
| 94 | Recharge Lake | York | Largemouth Bass | Mercury |

## Location of Nebraska Fish Consumption Advisories Through 2011



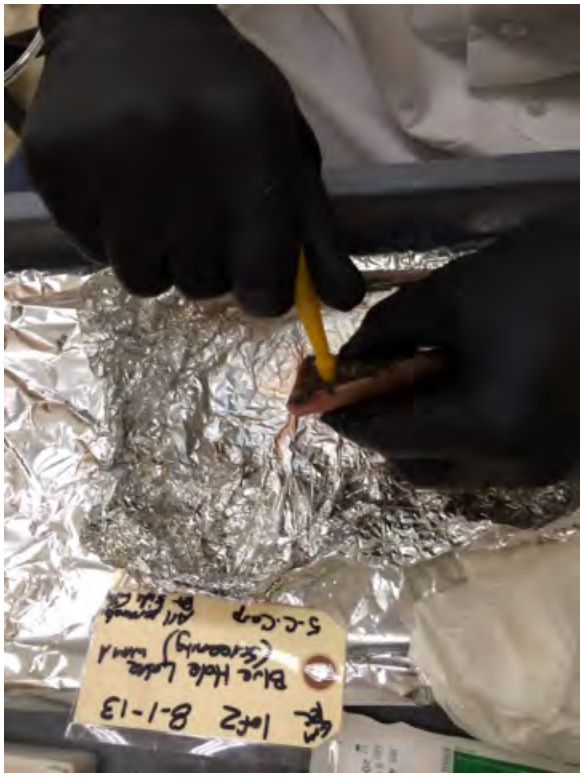
**For More Information Contact:**
Nebraska Department of Environmental Quality: (402) 471-4264
or greg.michl@nebraska.gov ,
Nebraska Game and Parks Commission: (402) 471-5553,
Nebraska Health and Human Services System: (402) 471-8880.

**For Reports and Other Information Online go to:** http://deq.ne.gov
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/NDEQProg.nsf/OnWeb/FCA To find it on NDEQ's web site, click on the NDEQ News/Topics of Interest tab, then select "Fish Consumption Advisories."



NDEQ staff doing further preparation of fish tissue, prior to delivery to the EPA lab.

# Monitoring for Fish Kills and Citizen Complaints

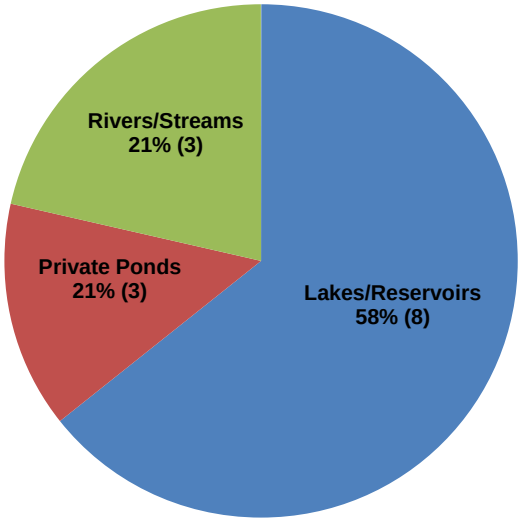
**Why do we sample after fish kills and complaints?**
The agency responds to numerous fish kills and surface water complaints annually. In many cases, the investigations surrounding a fish kill may require sampling to document the cause of the water quality problem, the magnitude and extent of the water 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 Cottontail Reservoir being investigated by NGPC personnel.
Photo courtesy of Tony Barada (NGPC)

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 cause of the fish kill.

**Fish Kills Reported**

From October 1 2012 through September 30, 2013 a total of fourteen fish kills were reported to NDEQ. Of these, eight occurred in a lake or reservoir, three were in rivers or streams, and three were in private ponds.

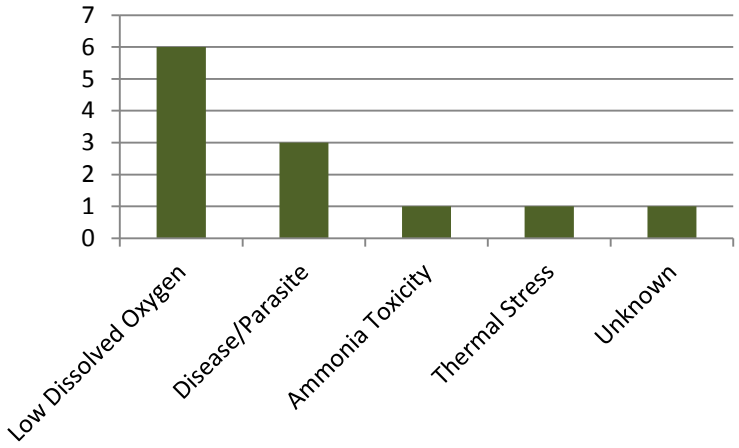



Locations of Reported Fish Kills; July 2011 –Sept 2012

The cause of the fish kills is determined from information collected from the reporting party and/or follow-up investigation and sampling. Ten (83%) of the reported fish kills were due to natural causes; these included six due to low oxygen , three from disease or parasites, and one from thermal stress. One fish kill was the result of ammonia toxicity. The ammonia release was investigated by NDEQ however the source of the ammonia release was not determined. The cause of one fish kill remains unknown.

Fish kills in the summer are typically caused by low dissolved oxygen concentrations stemming from eutrophic conditions. Eutrophication is a term that describes water quality conditions as a lake or reservoir ages. Lakes or reservoirs that are “eutrophic” tend to be shallow with high nutrient concentrations and exhibit frequent algae blooms, warmer water temperatures, and lower dissolved oxygen concentrations.

Winter fish kills are often caused by low dissolved oxygen concentrations which are the result of prolonged ice and snow cover on lakes and ponds. When lakes are frozen-over and have significant snow cover the amount of oxygen slowly decreases due to decreased photosynthetic activity, low light, and no exposure to atmospheric oxygen. 2013 saw very little winter snowfall consequently there were no reported winter fills reported.




Causes of Reported Fish Kills; July 2011 – Sept 2012.

Weather in 2013 returned to more average conditions when compared to 2012. Drought and

extended high air temperatures plagued 2012. As a result Nebraska waters experienced a number of significant fish kills that year. With a return to lower ambient temperatures and increased rainfall in 2013 the number of fish kills was greatly diminished. The Platte River did experience another fish kill due to thermal stress. Thermal stress in the Platte River was a result of low flows and high ambient temperatures. However, the number of fish affected was low when compared with 2012. This is likely due to the fact that the Platte River ecosystem had yet to fully recover from the damage sustained the previous year. Another fish kill of note in 2013 is the one that occurred at Swanton Reservoir. In contrast to the Platte River, the Swanton Reservoir fish kill was a result of flooding conditions. Extremely high inflow into the lake brought with it large amounts of sediment. This sediment clouded the water preventing light penetration and covering and killing aquatic vegetation. This combination of factors caused oxygen production to plummet and resulted in a high number dead fish.

Flooding at Swanton Reservoir in 2013 led to low dissolved oxygen levels and a subsequent fish kill. Photo provided by Lower Big Blue NRD Staff.

**Citizen Complaints**

Between October 1, 2012 and September 30, 2013 the surface water unit received 29 notifications of concern regarding surface water issues. While many of these cases were referred to other agency programs that more closely relate to the problem, the surface water unit provides assistance through investigations and/or sample collection to help document conditions.

**For More information Contact:**

Mike Archer at Mike.Archer@nebraska.gov or (402) 471-4224
Dave Bubb at Dave.Bbubb@nebraska.gov or (402) 471-2810
David Schumacher at David.Schumacher@nebraska.gov or (402) 471-4709

# Surface Water Sampling Summary

As discussed in the previous short reports, the NDEQ performs surface water monitoring throughout the state. This section summarizes the 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 collecting water samples from the South Loup River, Buffalo County

## AMBIENT STREAM MONITORING

### 2013 Ambient Stream Monitoring Summary

**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:** water temperature, dissolved oxygen, pH, conductivity, turbidity, stream discharge.
- **Pesticides:** once per month, April – September; atrazine, acetochlor, metolachlor
- **Quarterly Metals:** 4 times per year (January, April, July, October)
    - **Bottom of Basin:** all metals, 17 sites (11 NDEQ + 6 USACE) Total – selenium, mercury and; Dissolved - sodium, magnesium,

calcium, arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc

- **All other Sites** "partial metals list": Total – selenium; Dissolved: sodium, magnesium, calcium, arsenic

**2013 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** (NDEQ 14 and USACE 2 X 12 Events) = 192

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

## BASIN ROTATION MONITORING

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 |
|---|---|
| 2012 | Big Blue, Little Blue and Republican |
| 2013 | Loup and Middle Platte |
| 2014 | Niobrara |
| 2015 | Lower Platte and Nemaha |
| 2016 | Elkhorn and Missouri Tributaries |
| 2017 | North Platte, South Platte and White-Hat |

**2013 Basin Rotation Monitoring Summary**

**Network:** 50 sites**:** 29 streams (including 15 shared ambient) and 21 lakes in the Middle Platte and Loup 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:** (rivers/streams and lakes) water temperature, dissolved oxygen, pH, conductivity, turbidity, stream discharge.
- **Pesticides:** (rivers/streams only) atrazine, metolachlor, acetochlor
- **Bacteria:** (rivers/streams and lakes) *E. coli*

**2013 Basin Rotation Sample Totals**

- Total Stream Samples (traditional, bacteria and field measurements) = 638
- Total Lake Samples (bacteria and field measurements) = 462
- Total Bacteria Samples = **1,100**

**Assistance:** LLNRD and ULNRD

## PUBLIC BEACH MONITORING

**2013 Public Beach Monitoring Summary**

**Network:** 53 sites statewide
**Frequency:** weekly, May 1 - September 30 (22 weeks)
**Parameters:** bacteria, toxic algae (microcystin)

**2013 Bacteria & Toxic Algae Routine Weekly Samples**
53 Sites X 22 Weeks = 1,166

**Additional Toxic Algae Samples**

- Routine Quality Control Samples
  - o duplicates (88) and blanks (88) = 176
- Special Concern Samples
  - o Struebbing Lake (UBBNRD) = 5
  - o Carter Lake NPS Study = 66
- Fish Kill/Complaint Samples = 1

**2013 Total Toxic Algae Samples** (including QC and special samples) = **1,414**

**Assistance:** MNNRD, NNRD, URNRD, LRNRD, LLNRD, LENRD, SPNRD, City of Carter Lake, Nebraska Public Power District (NPPD), Central District Health Department (CDHD), USACE

Blue-green algae bloom at Merritt Reservoir, Cherry County

## LAKE MONITORING

NDEQ staff sampling Logan Creek, near Uehling, Dodge County Nebraska.

### 2013 Lake Monitoring Summary

**Network:** Deep Water Sites (44 lakes)

- **NDEQ:** 28 lakes X 5 months = 140
- **USACE:** 15 lakes X 5 months = 75
- **NNRD:** 1 lake X 5 Months = 5
- **QC Samples:** 10 NDEQ, 10 USACE = 20

**Total Deep Water Samples: = 240**

**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:** depth profiles (pH, conductivity, water temperature, dissolved oxygen, turbidity), water transparency

**Network**: Mid-Lake Sites (44 lakes)

- **NDEQ:** 28 Lakes x 5 months = 140
- **USACE:** 15 lakes x 5 months = 75

**Total Mid-Lake Profiles: = 215**

**Frequency:** monthly from May through September

**Parameters:** mid-lake depth profile (pH, conductivity, water temperature, dissolved oxygen, turbidity)

### Additional Lake Monitoring Projects (Nonpoint Source Programs)

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

**Assistance:** City of Carter Lake, UNL, NGPC, LENRD, LBBNRD, USGS

## FISH TISSUE MONITORING

### 2013 Fish Tissue Network

- 88 fish samples collected from 59 sites (5 rivers/streams and 54 lakes)

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

NDEQ staff preparing a fish tissue sample collected from Sutherland Canal, Lincoln County

## STREAM BIOLOGICAL MONITORING

**Network:** 35 stream sites in the Middle Platte and Loup River Basins
**Field measurements**: water temperature, pH, dissolved oxygen, conductivity, turbidity and stream discharge, fish and aquatic insect communities, and habitat assessments

NDEQ staff electrofishing Plum Creek, Nance County

## FISH KILLS AND CITIZEN COMPLAINTS

**Timeframe**: October 1, 2012 to September 30, 2013

| Fish Kills Attributed to: | Number |
|---|---|
| Low dissolved oxygen levels (flooding, plant/algae die-off) | 7 |
| Disease or parasites | 3 |
| Ammonia toxicity | 1 |
| Thermal stress (dramatic drop in water temp.) | 2 |
| Unknown causes | 1 |
| **TOTAL** | **14** |

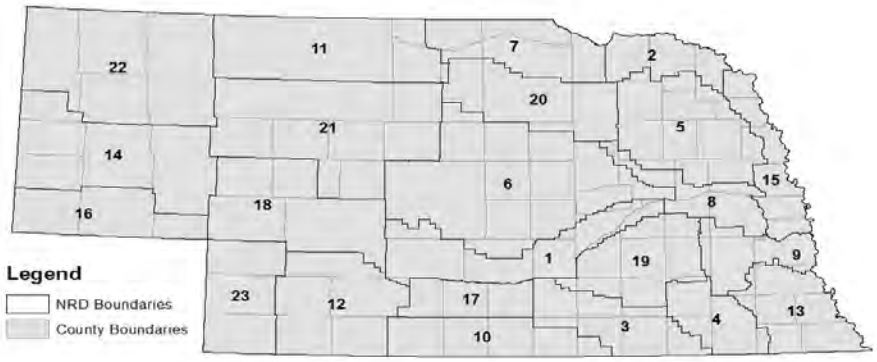
Between October 1, 2012 and September 30, 2013, the Department received 29 notifications of complaints concerning surface water issues. Many of these were referred to other agency programs that more closely related to the problem and three complaints were investigated with on-site visits by the surface water staff.

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

Fish kill at Willow Island WMA Lake, Dawson County

## Natural Resources Districts, Abbreviations and Headquarter Cities

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




**For 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 Dave Schumacher, NDEQ, at 402/471-4709 (david.schumacher@nebraska.gov).

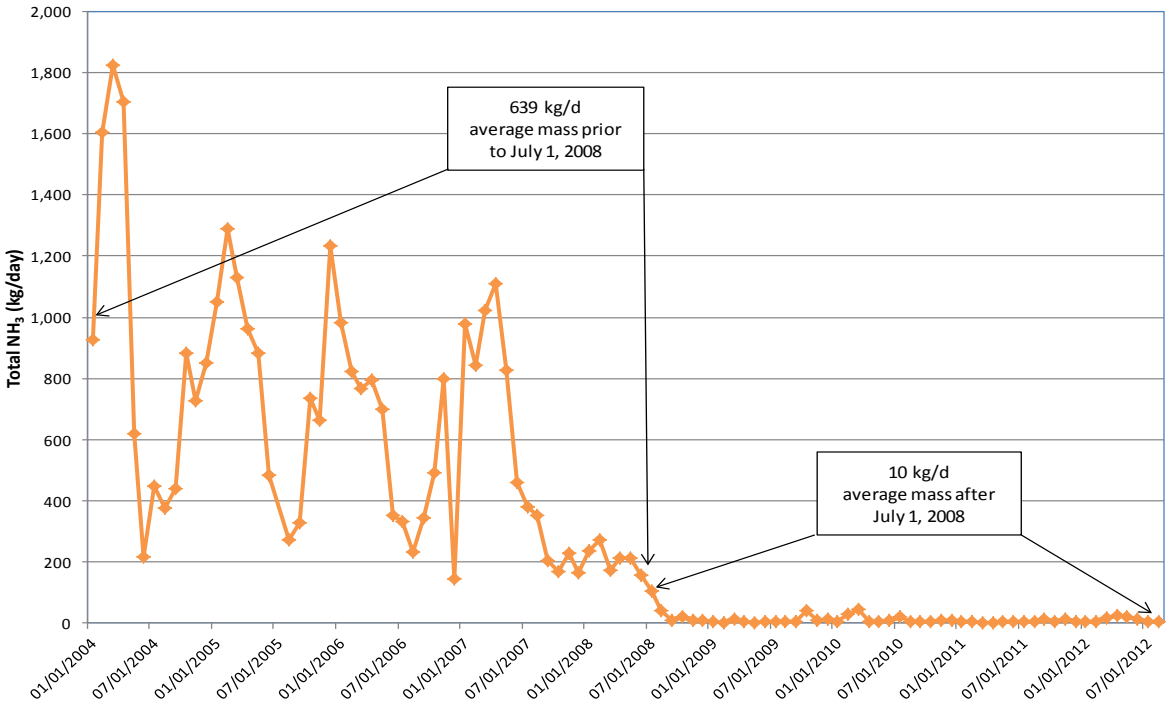
# NPDES Discharge Monitoring Reports (DMRs)

The Nebraska Department of Environmental Quality requires point sources of pollution to obtain a permit to discharge their effluent into waters of the state. Over 650 permits have been issued in Nebraska to municipal, domestic, and industrial wastewater treatment facilities as well as industrial and construction stormwater sites under the federal Clean Water Act Section 402 known as the National Pollutant Discharge Elimination System (NPDES). These permits specify allowable limits of pollution that will not cause the receiving water to exceed Surface Water Quality Standards. Permittees are required to perform self-monitoring of these limits using prescribed methods and to report the results of this monitoring to the Department in the form of Discharge Monitoring Reports or DMRs. The submitted information is stored in a national database hosted by EPA called the Integrated Compliance Information system or ICIS. The Department uses this information to verify compliance with permit conditions, to develop future discharge permits, and to relate the impacts of the discharge to receiving stream condition and ambient monitoring data.

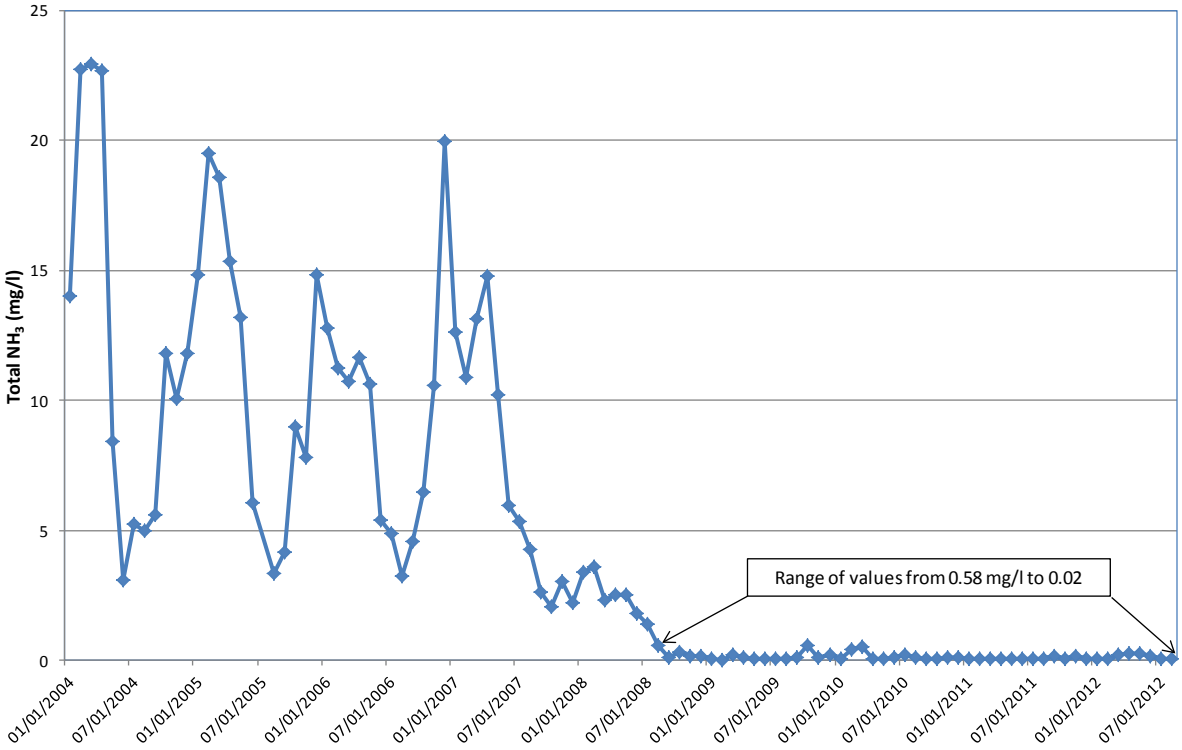
An example of how these data relate to stream condition is shown by the City of Lincoln's Theresa Street Wastewater Treatment Facility that discharges to Salt Creek. During the late 1990s and early 2000s, stream monitoring data indicated that Salt Creek was exceeding water quality criteria for ammonia ($NH_3$), which is toxic to aquatic life. The DMRs for Lincoln's facility also indicated high $NH_3$ values; hence, Lincoln's permit was modified to require $NH_3$ removal. Construction of new capabilities to accomplish $NH_3$ removal was completed and put into service in the summer of 2008.

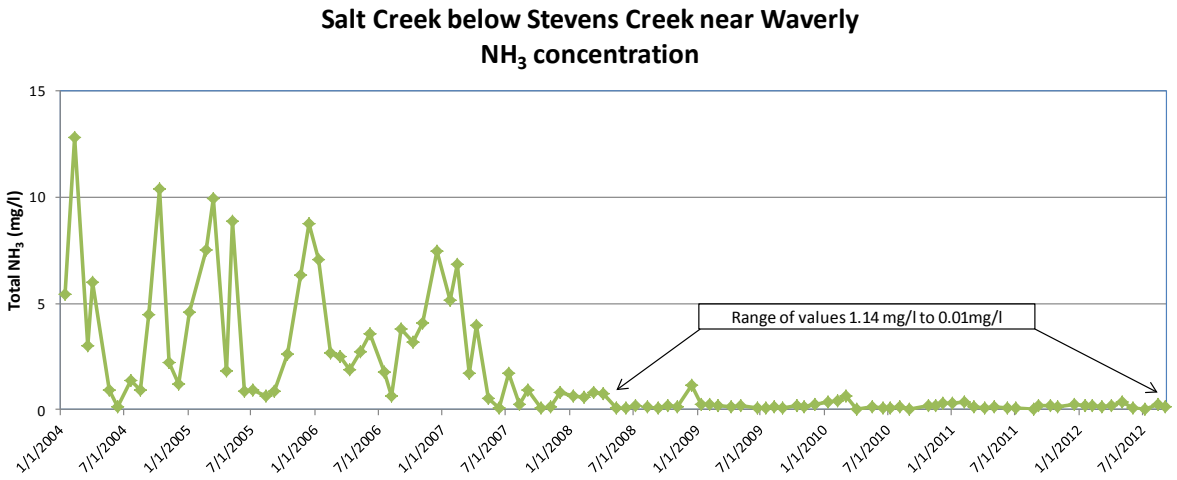
The graphs below show the impact of these improvements to Lincoln's facility.

## Lincoln Theresa St. WWTF $NH_3$ Effluent Mass Loading (monthly average)




## Lincoln Theresa St. WWTF $NH_3$ Effluent Concentration (monthly average)






Lincoln's DMR data document remarkable improvement in effluent quality for $NH_3$ in both mass loading (Kg/day) and concentration (mg/l) after completion of new activated sludge features for $NH_3$ removal. These improvements are reflected in similar improvements downstream in Salt Creek water quality.

**For More information Contact:**
RE: ICIS
Alan Aanerud at alan.aanerud@nebraska.gov or 402/471-4370

RE: Stream Monitoring
David Schumacher at david.schumacher@nebraska.gov or 402/471-4709

RE: Water Quality Standards
John Bender at john.bender@nebraska.gov or 402/471-4201

Part of Theresa Street Wastewater Treatment Facility, City of Lincoln.

# 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.

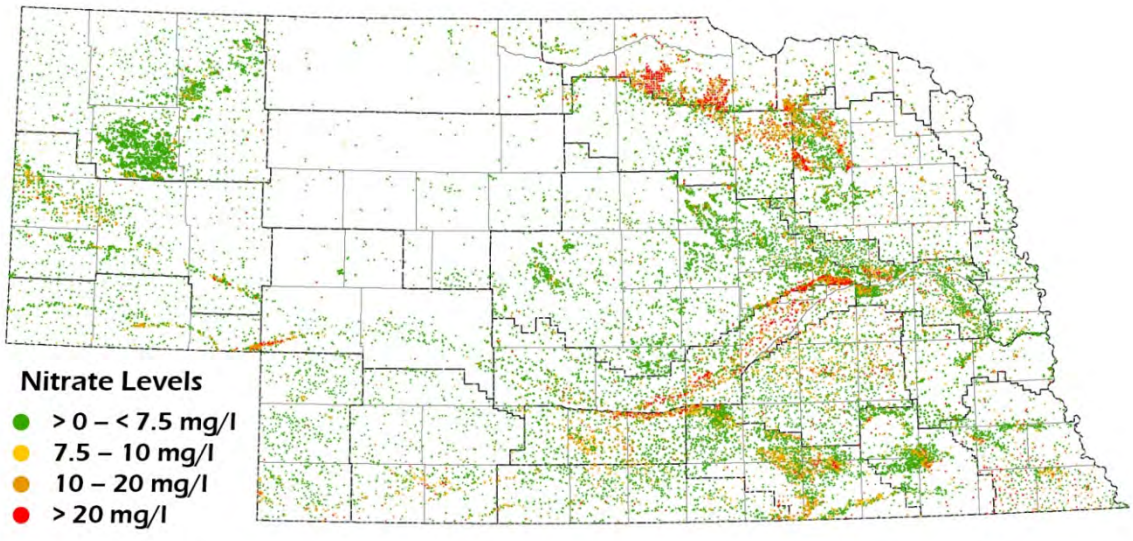
**Where is the Monitoring Conducted?**
The State of Nebraska is a large geographic area, over 77,000 square miles. There are approximately 171,000 active registered water wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2012, 4,472 wells were sampled. Since 1974, nearly 25,000 wells across the state have been sampled by state agencies,

University of Nebraska, federal agencies, and local NRDs. Monitoring is typically conducted in areas of Nebraska with known groundwater problems.

**What is Monitored?**
There are over 241 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.

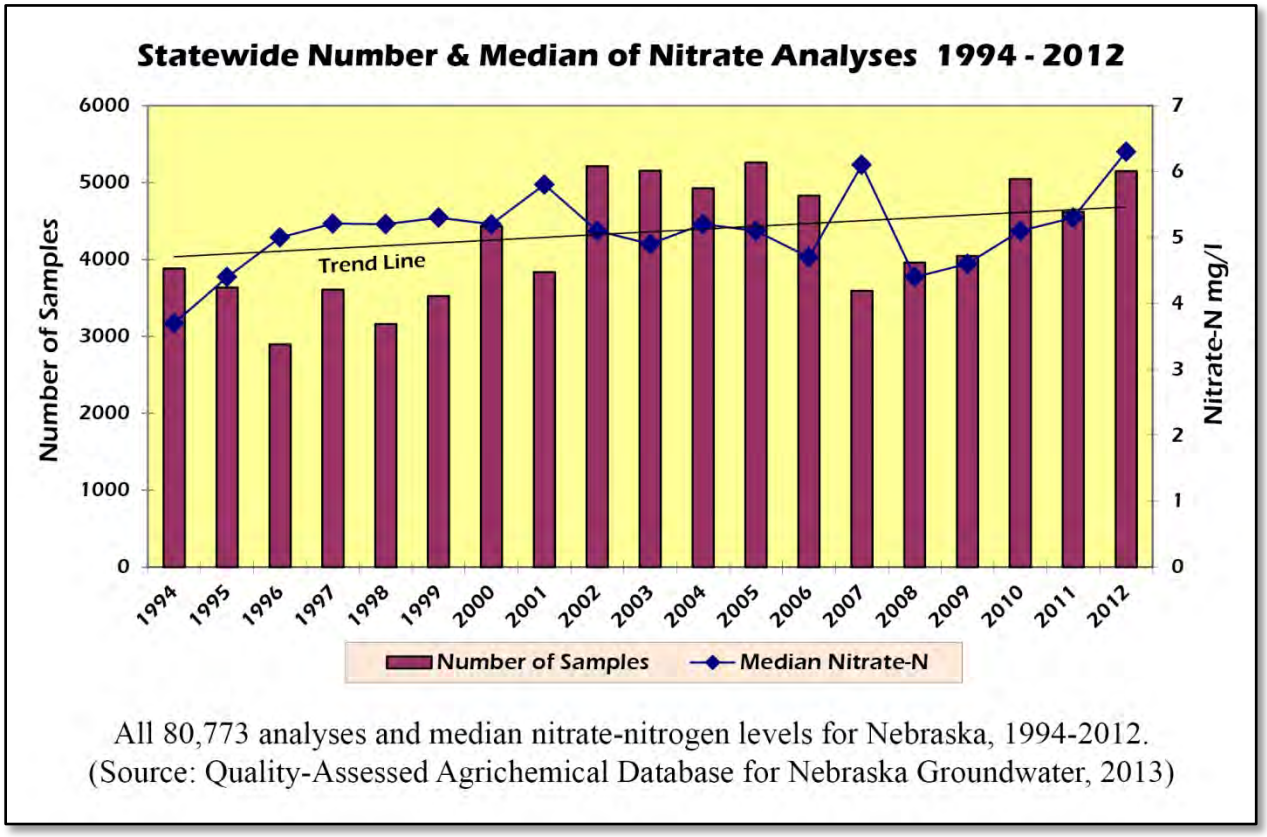
**How are the Data Used?**
The Department analyzes the data collected for the purpose of determining whether or not ground water quality is degrading or improving and presents the results to the Natural Resources Committee of the Legislature beginning December 1 of each year. The State's 23 NRDs use the data to make decisions on the management of groundwater. To date, 22 NRDs have formed Groundwater Management Areas over part or all of their districts to address groundwater quality problems.

**Results as of 2012:**
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).




Most recent recorded concentration of nitrate from 1974 - 2012.
(Source: Quality-Assessed Agrichemical Database for Nebraska Groundwater, 2013)
*Empty areas indicate no data reported, not the absence of nitrate in groundwater.*

The most representative picture of the statewide nitrate concentration is from the time period from 1994 to 2012 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 80,773 analyses and median nitrate-nitrogen levels for Nebraska, 1994-2012.
(Source: Quality-Assessed Agrichemical Database for Nebraska Groundwater, 2013)

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.

**For 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.

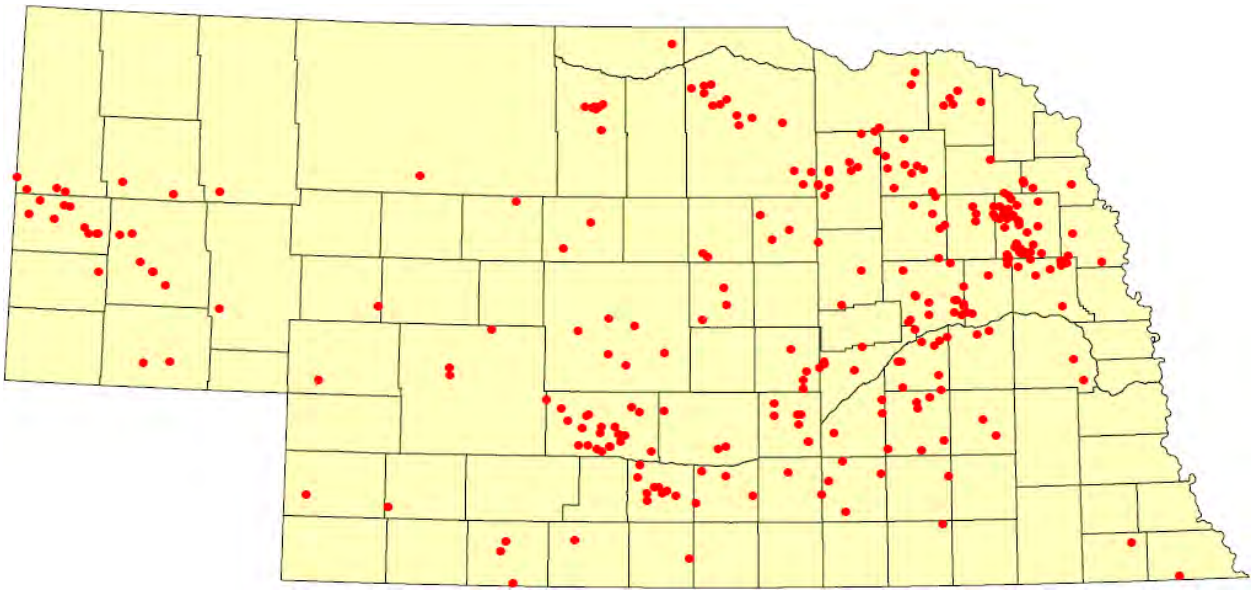
# Groundwater Monitoring at Permitted Livestock Facilities

**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 to document any impact to groundwater. 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 1,135 LWCFs (as of the beginning of November, 2013), recommending monitoring at 398 of them. Currently, there are 344 approved groundwater monitoring plans with 284 operations where semi-annual monitoring is conducted. Eight 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.

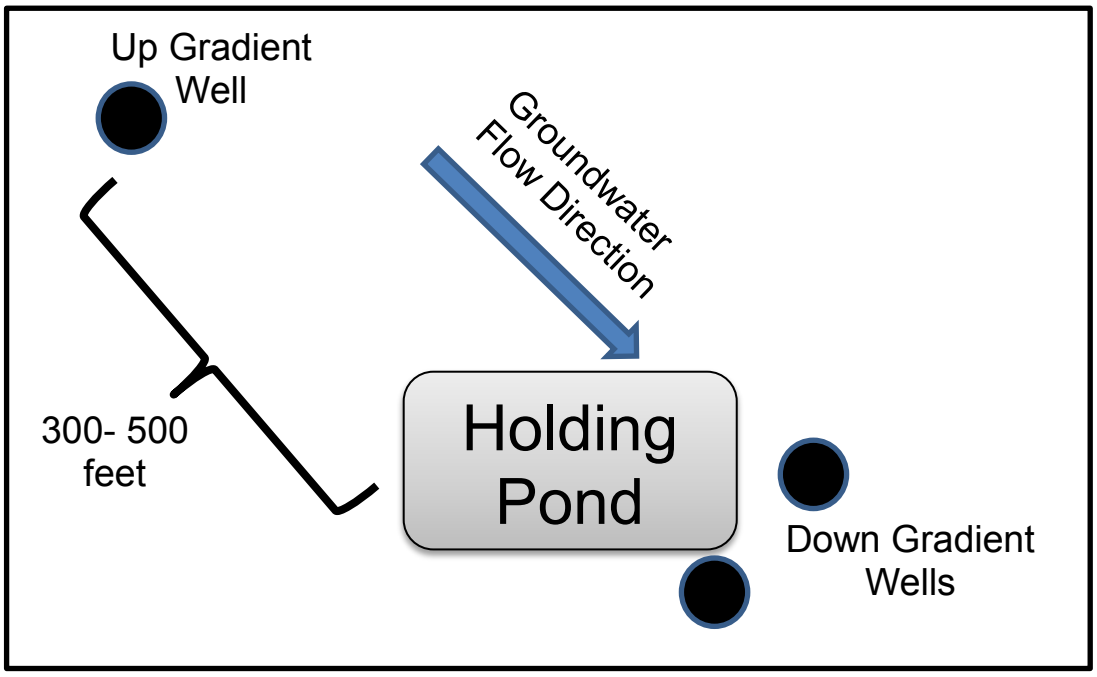


Livestock Operations with Ongoing Ground Water Monitoring

**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 to more quickly identify possible impacts to groundwater. The diagram above shows a generic map of recommended locations for groundwater monitoring wells.

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

**More Information:**
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 .

Feedlot in Western Nebraska.

# Ammonia Pipeline Release Monitoring

**Why NDEQ Does this Monitoring:**
A pipeline extending from southwestern Gage County to northeastern Burt County transports anhydrous ammonia to agricultural chemical facilities and has been in place for decades. As the pipeline ages, and in places where pipeline corrosion has been severe, ammonia releases have occurred. Pipeline repairs were followed by excavation of the most contaminated sediment and an investigation to determine if groundwater was impacted. The contaminant plumes were defined and groundwater monitoring was initiated when elevated ammonia and nitrate levels were detected in groundwater. Active remediation has not occurred at most of the releases due to the limited aerial extent of contamination.

Excavation for ammonia pipeline repair and remediation. Arrow indicates adjacent ammonia pipeline, presenting difficulties for contaminated soil removal.

**History of the Monitoring program:**
Groundwater monitoring is ongoing at nineteen sites. The oldest release site began monitoring in 2001. Release monitoring for ammonia and nitrate is conducted to help determine if the contaminant plume is attenuated in the aquifer. Ammonia can be converted to nitrate by naturally occurring bacteria, and for this reason, both of ammonia and nitrate are monitored. Ammonia does not naturally occur in groundwater

and background levels of nitrate must be understood to determine the localized impact of any pipeline release. Data from the monitoring program have been used to assess site conditions, develop site specific cleanup levels, and protect downgradient groundwater users from groundwater contamination. Monitoring is conducted on a quarterly or semi-annual basis depending on individual site conditions. Additional monitoring wells have been installed at release locations that require more detail to confirm plume conditions. Consulting firms conduct the sampling and reporting to NDEQ for the pipeline company.

**For more information contact**:
Brad Routt at brad.routt@nebraska.gov or (402) 471-3381 or Dave Miesbach at david.miesbach@nebraska.gov or (402) 471-4982.

Area where plants will not grow, due to ammonia pipeline release.