Water Wells

- 172,000 active registered water wells
  - 95,000 estimated not registered
- 95,000 active registered irrigation wells

Source: 2013 NE GW Quality Monitoring Report to the Legislature. NDEQ
Quality-Assessed Agrichemical Database for Nebraska Ground Water ‘Clearinghouse’

- Repository of 456,650 analyses representing 241 ag chemical compounds
- Cooperative project
  - Department of Environmental Quality ($)
  - Department of Agriculture ($)
  - Department of Natural Resources (web host)
- LB329 (Neb. Rev. Stat. §46-1304) The Department of Environmental Quality shall prepare a report outlining the extent of ground water quality monitoring conducted by natural resources districts during the preceding calendar year. The department shall analyze the data collected for the purpose of determining whether or not ground water quality is degrading or improving and shall present the results electronically to the Natural Resources Committee of the Legislature beginning December 1, 2001, and each year thereafter. The districts shall submit in a timely manner all ground water quality monitoring data collected to the department or its designee. The department shall use the data submitted by the districts in conjunction with all other readily available and compatible data for the purposes of the annual ground water quality trend analysis.
Clearinghouse
Who collects all those samples?

• States 23 Natural Resources Districts (NRDs)
• NE Dept of Health & Human Services PWS wells
• NE Dept of Environmental Quality
• NE Dept of Agriculture
• University of Nebraska
• USGS
# Quality-Assessed Agrichemical Database for Nebraska Ground Water

<table>
<thead>
<tr>
<th>REQUIREMENTS</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LEVEL 1</td>
</tr>
<tr>
<td>Well location</td>
<td></td>
</tr>
<tr>
<td>Well characteristics</td>
<td></td>
</tr>
<tr>
<td>Sampling Date</td>
<td></td>
</tr>
<tr>
<td>Sampling procedure &amp; sample preservation</td>
<td>Sample represents ground-water source (e.g., proper purging, low-flow, or passive sampling technique used). Sample container and preservation procedures follow those given in analytical method.</td>
</tr>
<tr>
<td>Analytical method</td>
<td>not a standard method approved by EPA, ASTM, or AWWA</td>
</tr>
<tr>
<td>Field QA practices</td>
<td>none</td>
</tr>
<tr>
<td>Laboratory QA practices</td>
<td>cross-checks of &gt;10% of the samples using a standard method approved by EPA, AWWA, or ASTM that confirms results. Participation in performance evaluation studies</td>
</tr>
</tbody>
</table>
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.
What's the Problem?

- 172,000 active registered water wells + ~95,000 not registered
- 98,278 analyses from 23,438 wells
- ~5,000 analyses per year
- Problem:
  - Sampling frequency

Source: 2013 NE GW Quality Monitoring Report to the Legislature. NDEQ
Annual Nitrate Analyses

- **1977**: (45 wells, 45 analyses)
- **1982**: (506 wells, 519 analyses)
- **1987**: (1324 wells, 1372 analyses)
- **1992**: (803 wells, 1049 analyses)
- **1997**: (2626 wells, 3607 analyses)
- **2002**: (4318 wells, 5213 analyses)
- **2007**: (3198 wells, 3593 analyses)
- **2012**: (4472 wells, 5147 analyses)

**Annual nitrate analyses**
(Source: Quality-Assessed Agrichemical Contaminant Database for Nebraska Groundwater)

- **Nitrate Levels**
  - < 7.5 mg/l
  - 7.5 – 10 mg/l
  - 10 – 20 mg/l
  - > 20 mg/l

Source: 2013 NE GW Quality Monitoring Report to the Legislature. NDEQ
Nitrate trends?

- Are nitrates concentrations going up or down?
- No statistical trend over time
- Deep well = lower nitrate

Source: 2013 NE GW Quality Monitoring Report to the Legislature. NDEQ
Statewide Monitoring Network

**1386 wells hand picked based on:**
- Future sampling commitment
- Geographic location
- Construction characteristics
- Futures sampling frequency
- Well type

**2005 Plan**

**Most Recent Nitrate Concentrations**

- 0 - 7.5 mg/l
- 7.5 - 10 mg/l
- 10 - 20 mg/l
- > 20 mg/l

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.

**Most Recent Nitrate Concentrations Of Network Wells**

- 0 - 7.5 mg/l
- 7.5 - 10 mg/l
- 10 - 20 mg/l
- > 20 mg/l

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

Source: 2013 NE GW Quality Monitoring Report to the Legislature. NDEQ
Still Problems?

- Eolian Sand
- Sand and Gravel
-mainly Calcareous Silt
- Pierre Shale
The Solution

• More monitoring wells in distinct aquifers
• Make sampling monitoring wells simpler
Process

Monitoring Well Location Analysis

Distance From Existing NRD Monitoring Wells

Distance From Existing WHP Areas

Distance From Existing CSD Test Holes

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

Suitability

High

Low

Principal Aquifer Absent
Final Product

- 37 Test holes logged by CSD
- Pumps in 87 current monitoring wells
- 27 new monitoring wells in 14 locations
- Pumps in 27 new wells
Community Public Water Systems

Community public water supply systems with requirements for nitrate.
(Source: DHHS, November 2013)

- 66 quarterly sampling (>5 mg/l)
- 9 on administrative order
- 12 treating

Source: 2013 NE GW Quality Monitoring Report to the Legislature, NDEQ
City of Edgar

- Population: 498
- Service connections: 229
- Irrigated cropland
- Alluvial sands & gravels of the High Plains aquifer
City of Edgar

• 2005 – Nitrate AO
• 2006 – Engineering report
• 2006 - 2009 – Community based project
• 2010 - 2011 – Treatment lagoon assessment
• 2012 - 2015 – Well rehab & aquifer separation
• 2015 - Beyond – …?
Preliminary Engineering Report

• 2006
• Options ($ in 2006 costs with 20 year O&M)
  – Water Treatment – $1.5 M
  – New Wellfield – $1.2 M
  – Clay County Regional System – $1.1 M

• No water meters
• WHP Option as a means of operating within the guidelines of a Nitrate AO
Project 1
An integrated, Community-Based Approach to Reducing Nitrate Contamination in the Wellhead Management Area for the City of Edgar

• 2006-2009
• $249,183 ($100k section 319, $150k non-federal match)
• Tasks
  – Convert gravity irrigation to pivot and adopt nutrient mgmt techniques on 240 acres
  – Implement no-till on 240 acres
  – Install buffer strips around 6 wells and a creek bed
  – Lawn soil sampling via high school students
  – Citizen lawn nitrate education program
  – Vadose zone sampling
Project 2
Wellhead Management Area Project Assessment

• 2010-2011
• $150,000
  – (Section 319, NET, City, LBNRD)
• Tasks
  – Vadose zone re-sampling
  – Update 2006 alternatives
  – Additional alternative
Project 2
Vadose Zone Re-Sampling

Edgar 40
Barnyard (~40 head)

Edgar 10
Abandoned Barnyard

Depth below land surface (ft)
Nitrate-N (µg/g)

Depth below land surface (ft)
Nitrate-N (µg/g)
Project 2
Additional Alternative

- Engineered wetlands with point source extraction wells
  - Aquifer stress test / pumping test
  - Developed a groundwater model
  - Wetlands feasibility analysis
    - Permitting requirements
    - Conceptual designs
    - Cost estimates
    - Evaluation of funding sources
Project 2
Additional Alternative

• Treatment plant (ion exchange) - $1.32 M
  – Lowest cost, know, long-term
• New wellfield - $1.55 M
  – Future NO3 levels unknown
• Regional water system - $1.63 M
  – Require cooperation, still tap the local aquifer
• Engineered wetlands feasibility study - $1.53
  – Potential savings through creation mitigation bank
  – Modeling indicated ineffectiveness of hydrologic barrier to separate ‘hot spots’
Project 3
Reducing Nitrates in Edgar’s Drinking Water

• 2012-2015
• $146,350 (section 319, NET, LBNRD, UNL)

• Tasks
  – Well Rehabilitation - Seal the annular space
  – Decommission PWS well - Explosion abandonment
  – Aquifer Study - Do nitrates float?
  – On-the-ground BMPs
    • Cover crops
Well Rehabilitation

- Beyond the grout study
Well Rehabilitation

Figure 1b Configuration of Annular Space Installations (Slot Squeezing)
Explosion Abandonment
Decommissioning the annulus
Explosion Abandonment
Decommissioning the annulus
Aquifer Study

- 2 Pumps – High NO3 water to waste & low(er) to distribution system

City of Hastings – Dual Pump Study

Submersible Pump at Depth 208.0 (2/28/11)
Submersible Pump at Depth 206.5 (3/17/11)
Submersible Pump at Depth 205.5 (4/4/11)

Nitrate MCL, 10 mg/l

NO3, mg/L

Dual Pump study

- 2 Pumps? High NO3 water to waste & low(er) to distribution system
City of Edgar

• 2005 – Nitrate
• 2006 – Engineering report
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• 2010 - 2011 – Treatment lagoon assessment
• 2012 - 2015 – Well rehab & aquifer separation
• 2015 - Beyond – …?…WHP Option…?…
Questions?

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