Hydro-Geologic Overview of the Little Blue NRD

An understanding of the aquifer, its characteristics, its vulnerability and its limitations help us assess the impacts of our actions on the resource, and guide our decisions to better protect the resource.

University of Nebraska Lincoln EXTENSION

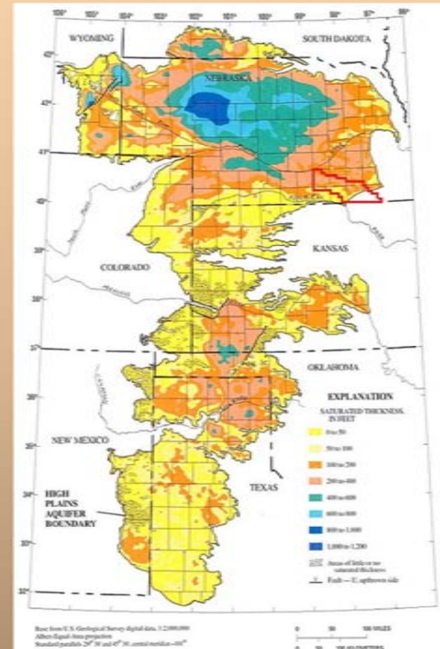
Nebraska DEQ

Irrigation & Nitrogen Management User Education/Certification Program

Understanding the aquifer, its characteristics and its vulnerability is key to understanding the water quality and quality challenges we face in Nebraska. It should also give us insights into the management strategies and practices necessary to protect this valuable resource.

High Plains Aquifer

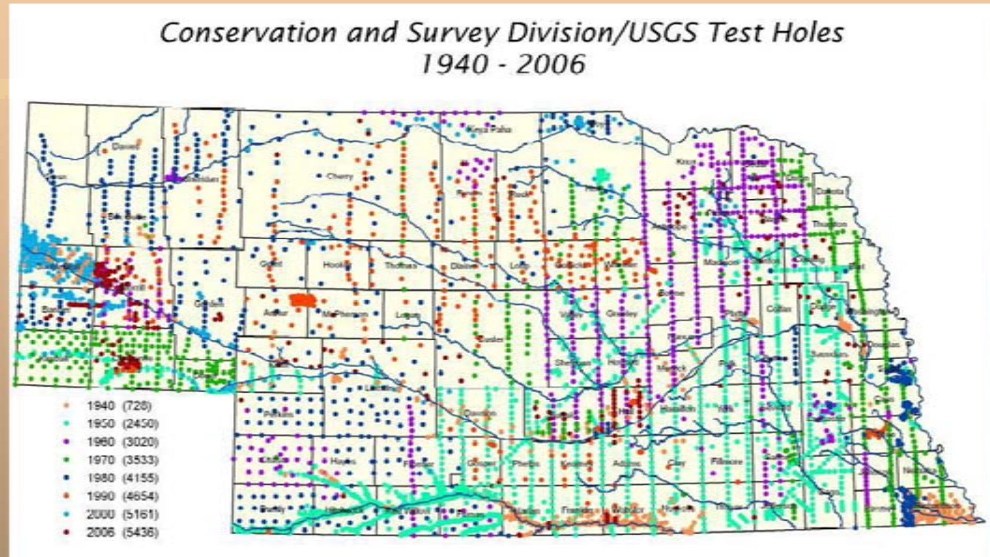
- One of worlds largest freshwater aquifers
- Covers 174,000 square miles
- Contains almost 175,000 wells
- 95, 896 wells lie in Nebraska
- 6,635 wells lie in the Little Blue NRD



Saturated thickness of the High Plains aquifer, 2000. (Modified from Weeks and Gutentag, 1981.)

First, it is important to note that Nebraska is blessed to have an abundant water supply. The High Plains Aquifer which blankets most of the State, extends through eight states, from South Dakota to Texas. Nebraska has over 36% of the land area overlying the formation, and over 64% of the water in storage. The deepest portion of the aquifer is found in the Sandhills near Hyannis. The focus of this presentation is within the boundaries of the Little Blue NRD which is highlighted on this slide, near the eastern edge of the High Plains Aquifer. But what do we know about this aquifer? Lets take a look.

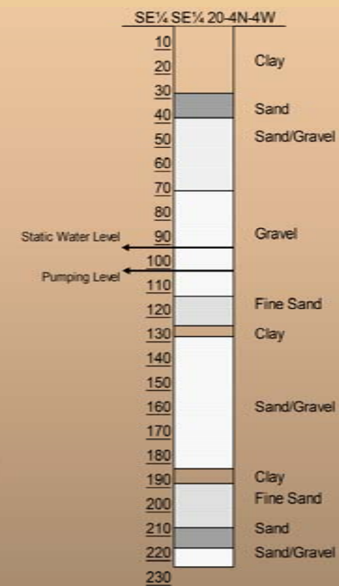
Test Hole Log Data for Nebraska



Nebraska is a leader in researching the geologic characteristics of sub-surface materials through test hole log information. Thousands of test hole logs have been completed providing very valuable and detailed profile information from the soil surface to bedrock formations below, including the presence or absence of water baring aquifers.

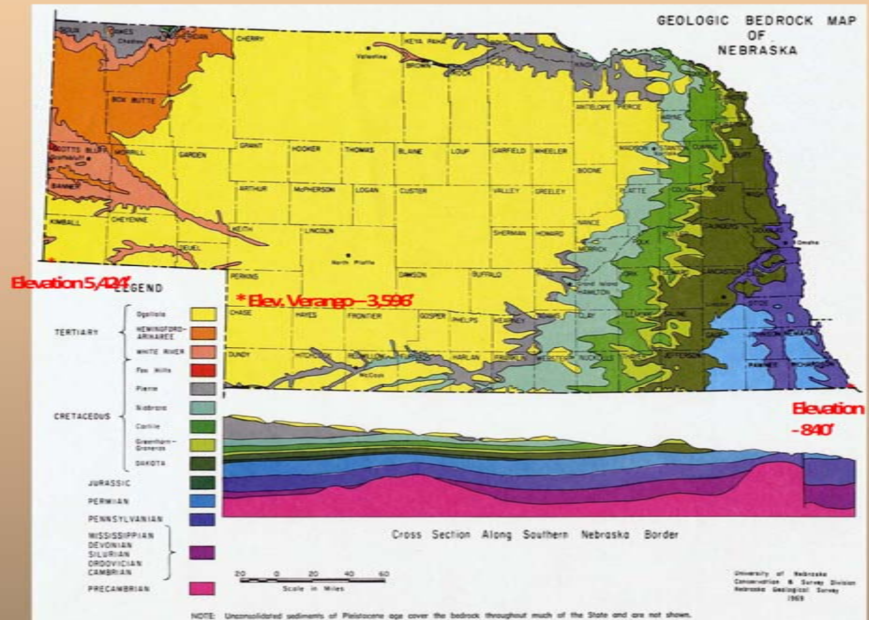
Well Logs Provide Wealth of Information

- Thickness of Topsoil
- Soils Profile Make-up
- Texture and Composition
- Water Level Information
- Saturated Thickness
- Presence of Divergent Lenses
- Bedrock Depth & Material



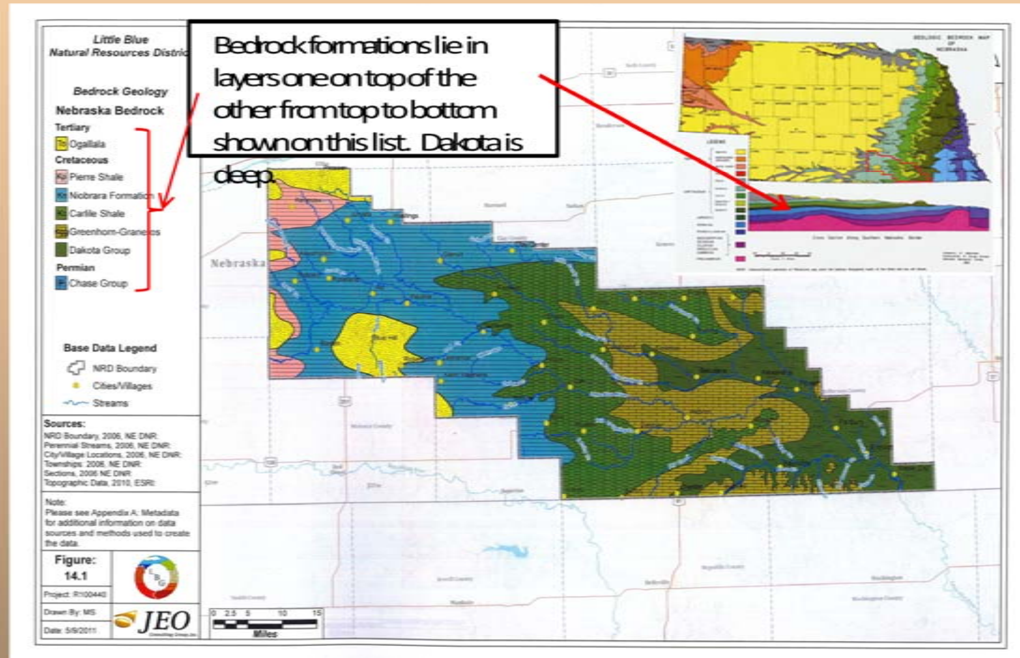
These test hole logs and well logs provide information about the thickness and makeup of soils, texture and composition of the materials, water level information and saturated thickness of the aquifer, the presence of divergent or impermeable lenses and the depth and type of bedrock that underlies the site. It is interesting to note that no two test holes or well logs are exactly identical and many have extensive variability.

Geologic Bedrock Map



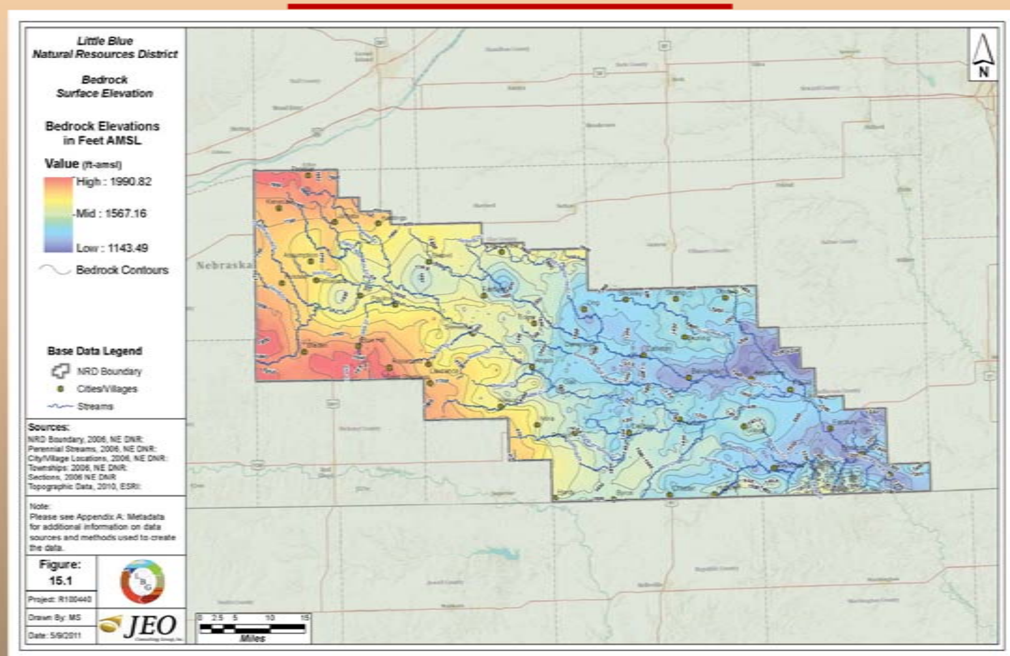
At the base of most test holes is the geologic bedrock formations. The bedrock layers of the earth are laid one on top of another like stacked plates which have had the edge sheered off as you move from west to east across Nebraska. The highest bedrock elevations are found in the western part of the State and the lowest elevations in Southeastern Nebraska.

Bedrock Geology of District

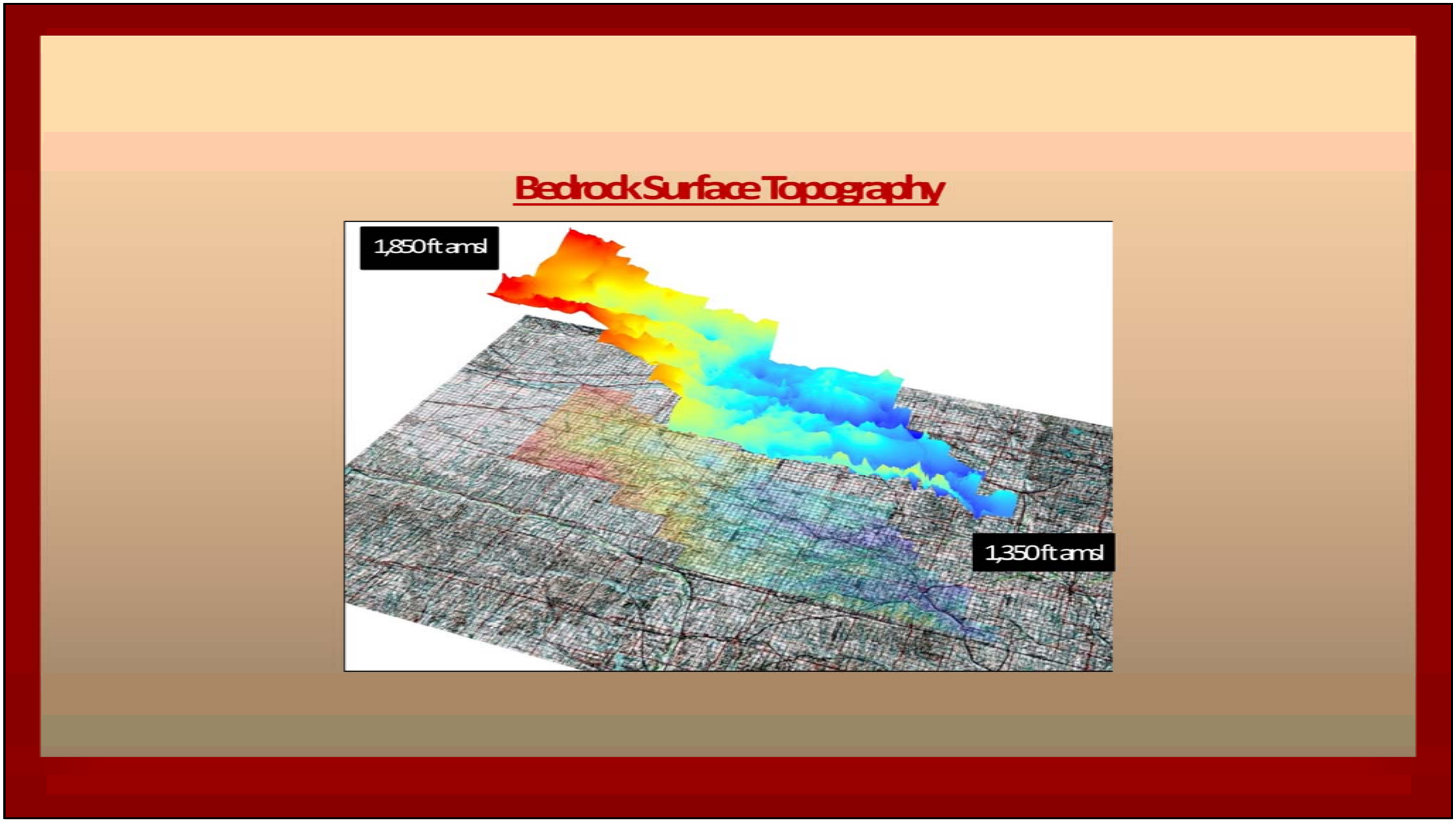


Bedrock materials vary from west to east, from the more recently deposited formations such as the Ogallala formation shown in yellow and present in small areas of Adams and Webster Counties, to the older, deeper formations, like the Dakota shown in dark green, found predominantly in Jefferson County. As you travel across the Little Blue NRD from west to east, the various geologic layers get shallower in depth until, in some areas of Jefferson County, the Dakota Formation is exposed on the land surface.

Bedrock Elevations



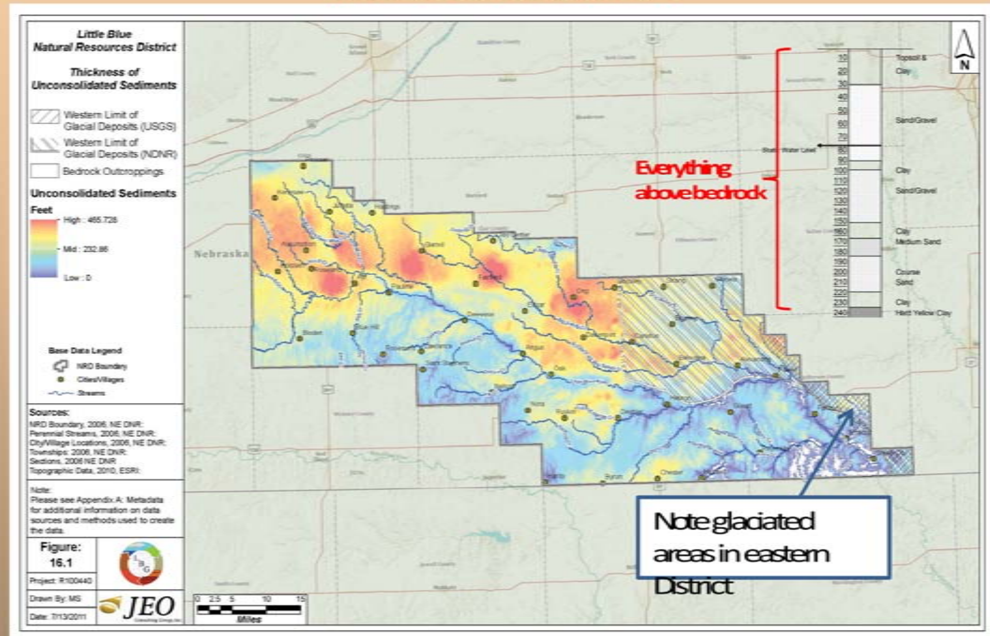
But the surface of the geologic bedrock formations are not a level plain as some might imagine. This map shows the geologic bedrock elevation contours and depicts various hills and valleys that are present across the top of the bedrock layers, much like you see contours on the land's surface.



An easier way to visualize the irregularities of the bedrock formations is to project the bedrock elevations in a three dimensional view. Note the peaks and valleys throughout the range. The peaks shown reflect some geologic high points called “bedrock highs” where the overburden may be thinner. The valleys reflect the deepest pockets where the overburden containing saturated sands and gravels are their thickest. Now lets look at the material that lies above the bedrock.

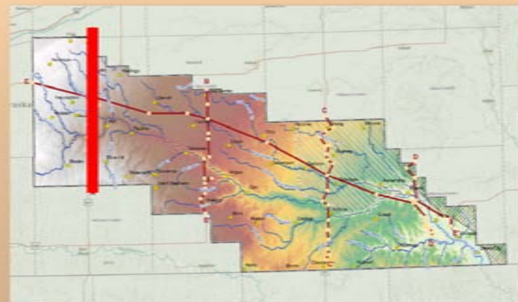
Thickness of Unconsolidated Sediments

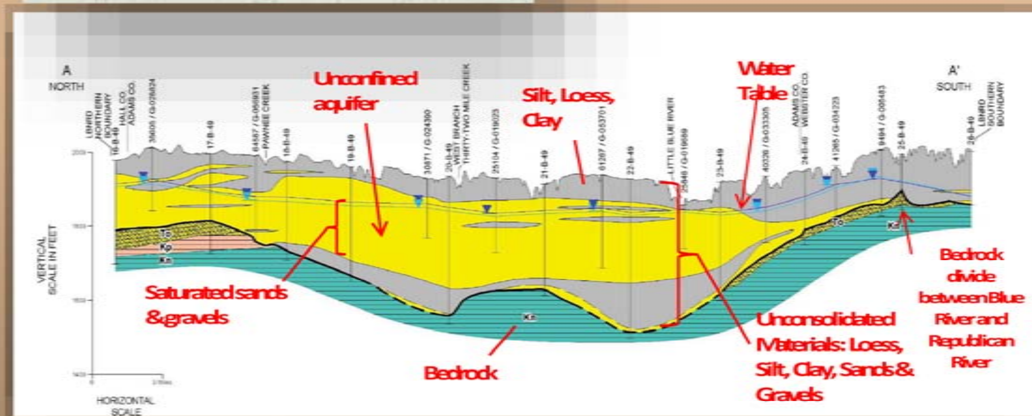
from Land Surface to Bedrock



Immediately over the bedrock formations extending to the land surface are layers of unconsolidated material which includes topsoil, clays, silts, sands and gravel. In the glaciated eastern area of District, rocks and boulders may also be present. These unconsolidated materials may be either unsaturated (those materials above the water table) or saturated (those below the water table). The areas shown in red on the map are the thickest and correspond with the deep pockets shown as valleys on the previous Bedrock Elevations Map.

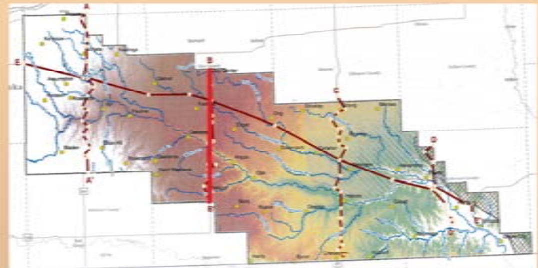
Geologic Cross Section A—A'

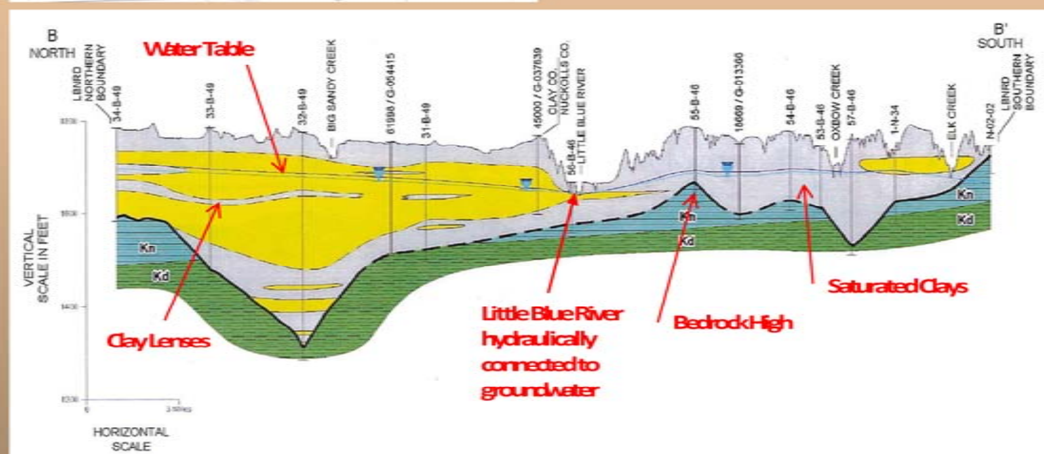




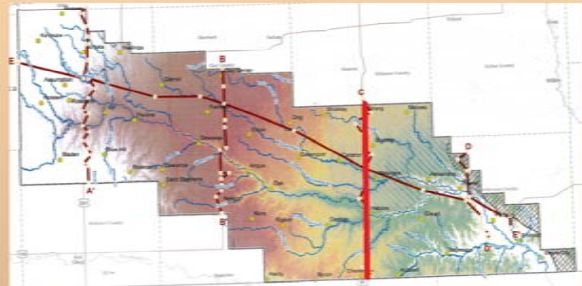
The test hole log information referred to earlier is useful in creating geologic cross-sections. By lining up numerous well logs along an axis, and connecting like materials at various elevations, we can get a picture of the unconsolidated material above the bedrock formation. This cross-section through the middle of Adams and Webster Counties shows the land surface silts and clays (grey material) that lie above the sands and gravels (yellow material) of our aquifer. The section also shows the approximate water table elevation in relation to the sands and gravels and an unconfined aquifer of saturated sands and gravels in excess of 200 feet of thickness. Also interesting to note is a bedrock high, or divide, which separates the Blue River Basin from the Republican River Basin near the right edge of the map.

Geologic Cross Section B—B'

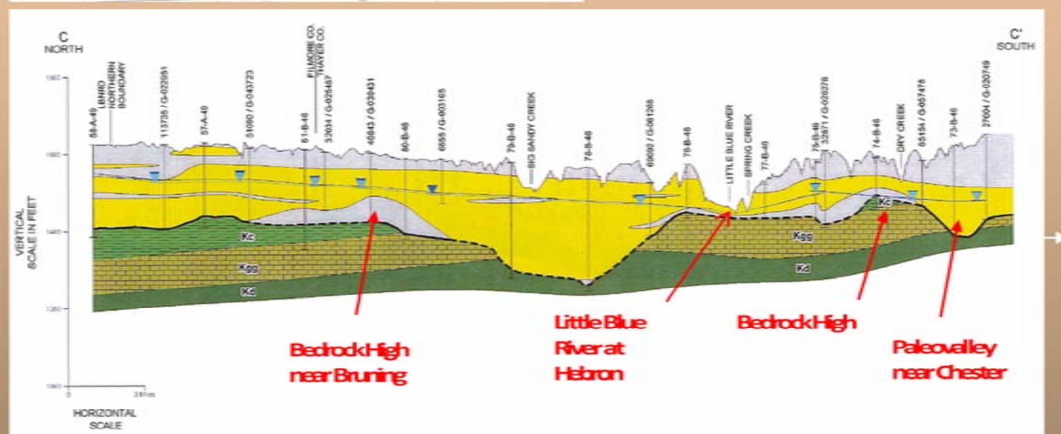




This cross-section through the center of Clay and Nuckolls Counties shows a deep sand and gravel aquifer in Clay County but quickly tapers off near the Nuckolls County Line. Although hydraulically connected to the Little Blue River, the extent of sand and gravel aquifer south of the river is thin and non-productive. The clay overburden laying south of the river, and particularly that portion south of the bedrock high are not hydraulically connected to the sand and gravel aquifer north of the river.



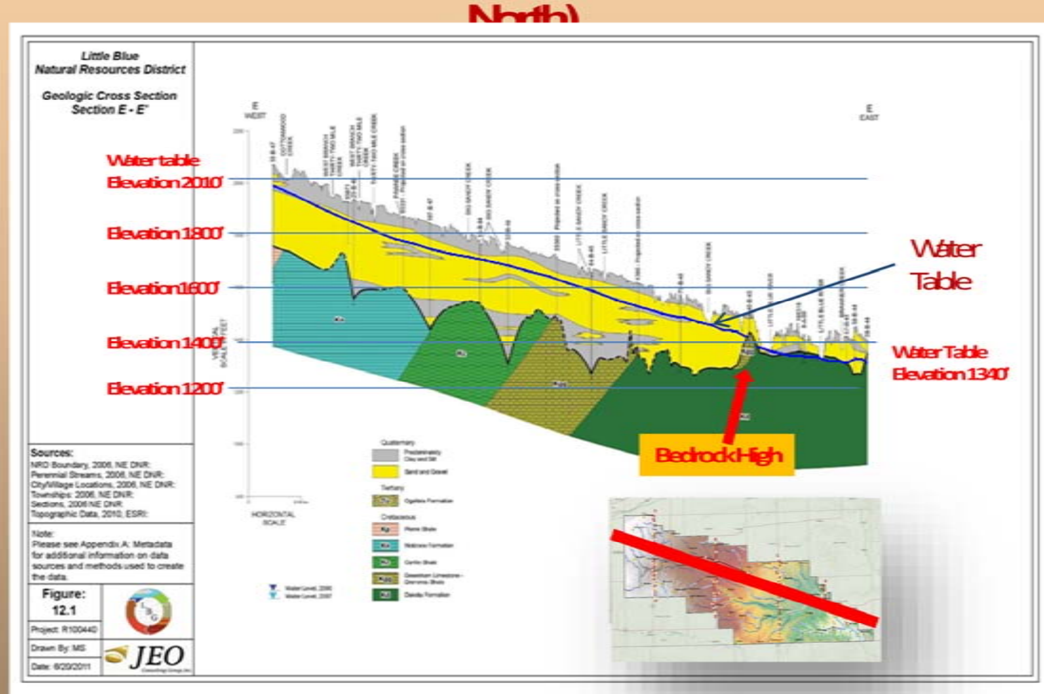
Geologic Cross Section C - C’



The cross-section through the middle of Fillmore and Thayer Counties shows an interesting bedrock high toward the left side of the map, likely made up of consolidated clay material with little specific capacity to yield groundwater. This mound lies under the Bruning area and is suspected for being a contributing factor to higher nitrates. A significant bedrock high also exists in the vicinity of the Little Blue River, and a more restrictive bedrock high exists near the Dry Creek. The later bedrock high forms a distinct divide between the regional High Plains Aquifer and the paleovalley aquifer found in southern Thayer and Jefferson Counties.

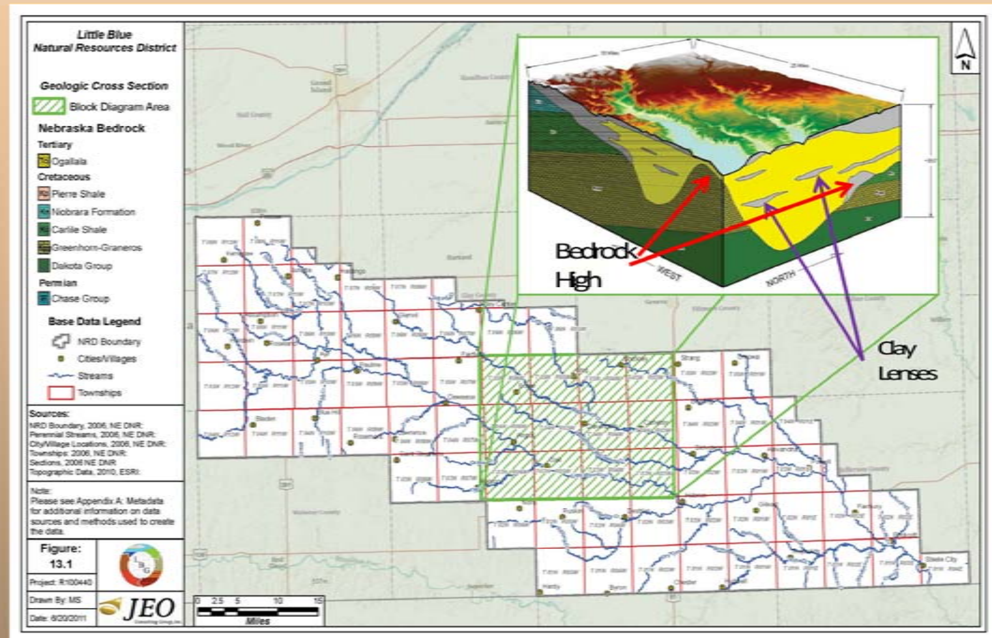
Geologic Cross-Section

Northwest to Southeast across LBNRD (Looking North)



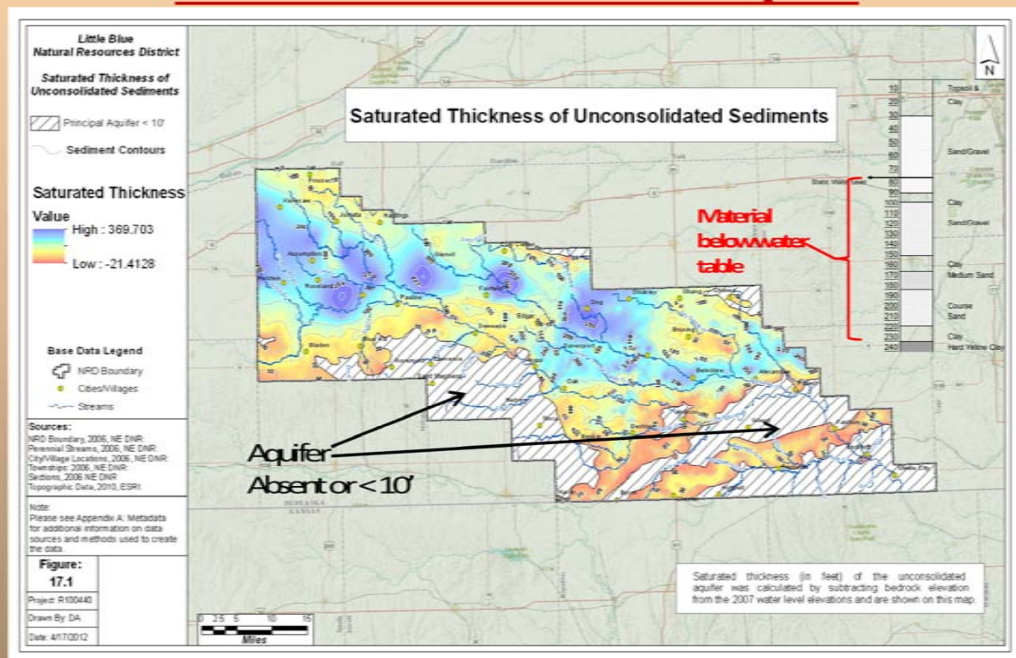
When viewing the Districts geologic cross-section from west to east across the District, it is easy to see the various bedrock formations which intersect the sand and gravel aquifer. It also gives a clear picture of the altitudinal change from west to east, with the water table on the western boundary at 2010' and that on the eastern boundary at 1340'. Naturally, groundwater flows down-gradient through the saturated materials from west to east. We'll take a look at groundwater movement shortly.

Block Diagram of Hydro-Geologic Cross-Section



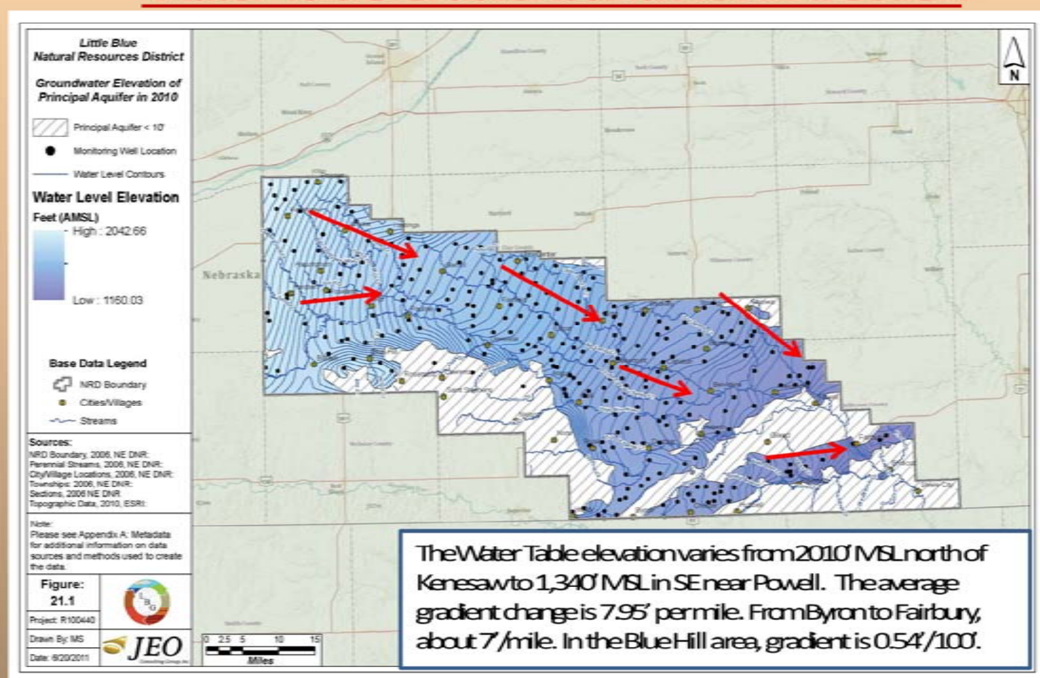
This representative geologic block was created by aligning numerous cross-sections in a parallel manner and interpolating data between those cross-sections. Note the deep aquifer paleovalleys filled with water baring materials, the bedrock highs and presence of various sized and shaped clay lenses across the section. Clay lenses, depending on the thickness and extent, can have a significant impact on groundwater drawdown during pumpage, and the movement of contaminants such as nitrates from the land surface into the water table.

Thickness of the Saturated Aquifer



This map shows the thickness of the unconsolidated sediments (silt, clay, sand, and gravel) which lie below the water table and are fully saturated. There are numerous deep pockets of water shown in deep blue which correlate to the bedrock valleys shown in the three-dimensional map of the area shown earlier. These pockets have saturated aquifer thickness which may exceed 350 feet. However, near the boundaries of the aquifer, the saturated thickness thins to just over 10 feet. About 26 % of the District has been determined to have aquifers of less than 10’ of saturated thickness of water baring material, or are void of water baring materials altogether. They are shown as the crosshatched areas of the map and are typically dryland areas.

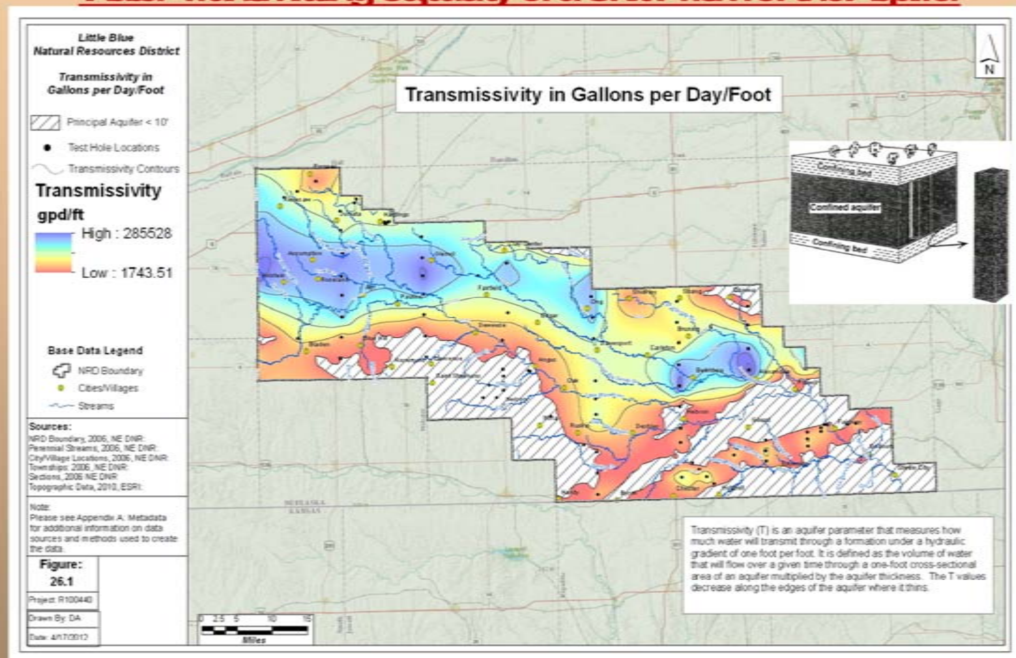
Water Table Gradient and Flow Direction



The ground water movement in the saturated sands and gravels is generally from NW to SE across the District. However, the flow direction may be altered by geologic factors, intensive pumping, or recharge. Flow patterns change slightly with each year's conditions and are reflected in annual static groundwater level readings. The natural flow movement through the saturated sands and gravels of the District is approximately 300' to 400'/ year when not influenced by water well pumping.

Transmissivity

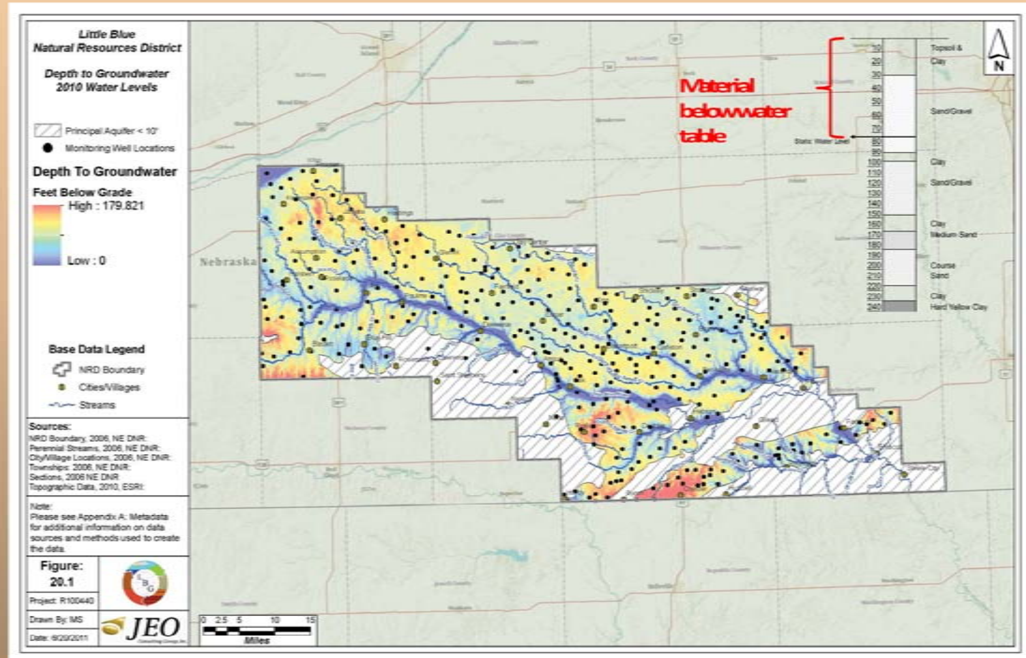
Water-Transmitting Capacity of a Unit Prism of the Aquifer



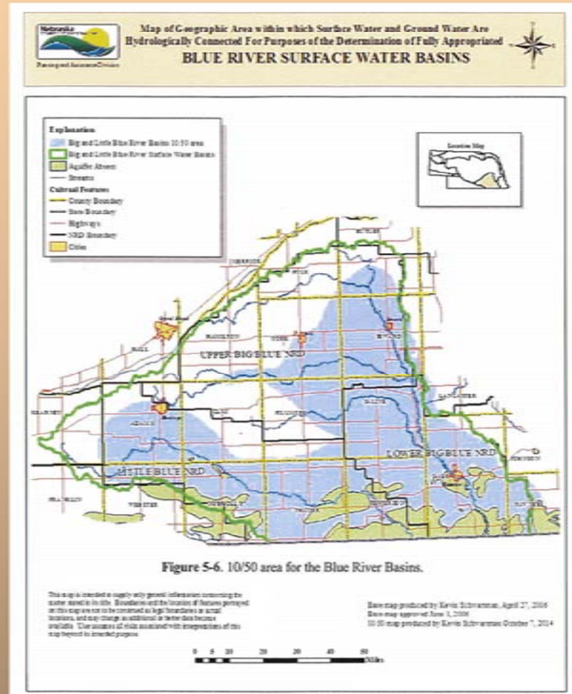
The measure of how much water will transmit through a formation under a hydraulic gradient of one foot per foot is called transmissivity. It is the volume of water that will flow over a given time through a one-foot cross-sectional area of the aquifer multiplied by the aquifer's thickness as depicted by the insert. The greatest transmissivity is present in the center of the paleovalley aquifer and lessens as you near the edges of the formation. A well with greater transmissivity generally has less drawdown during pumping because groundwater moves readily through the sands and gravels to fill the cone of depression created during pumping.

Depth to Groundwater

from Land Surface to Saturated Sands and Gravels

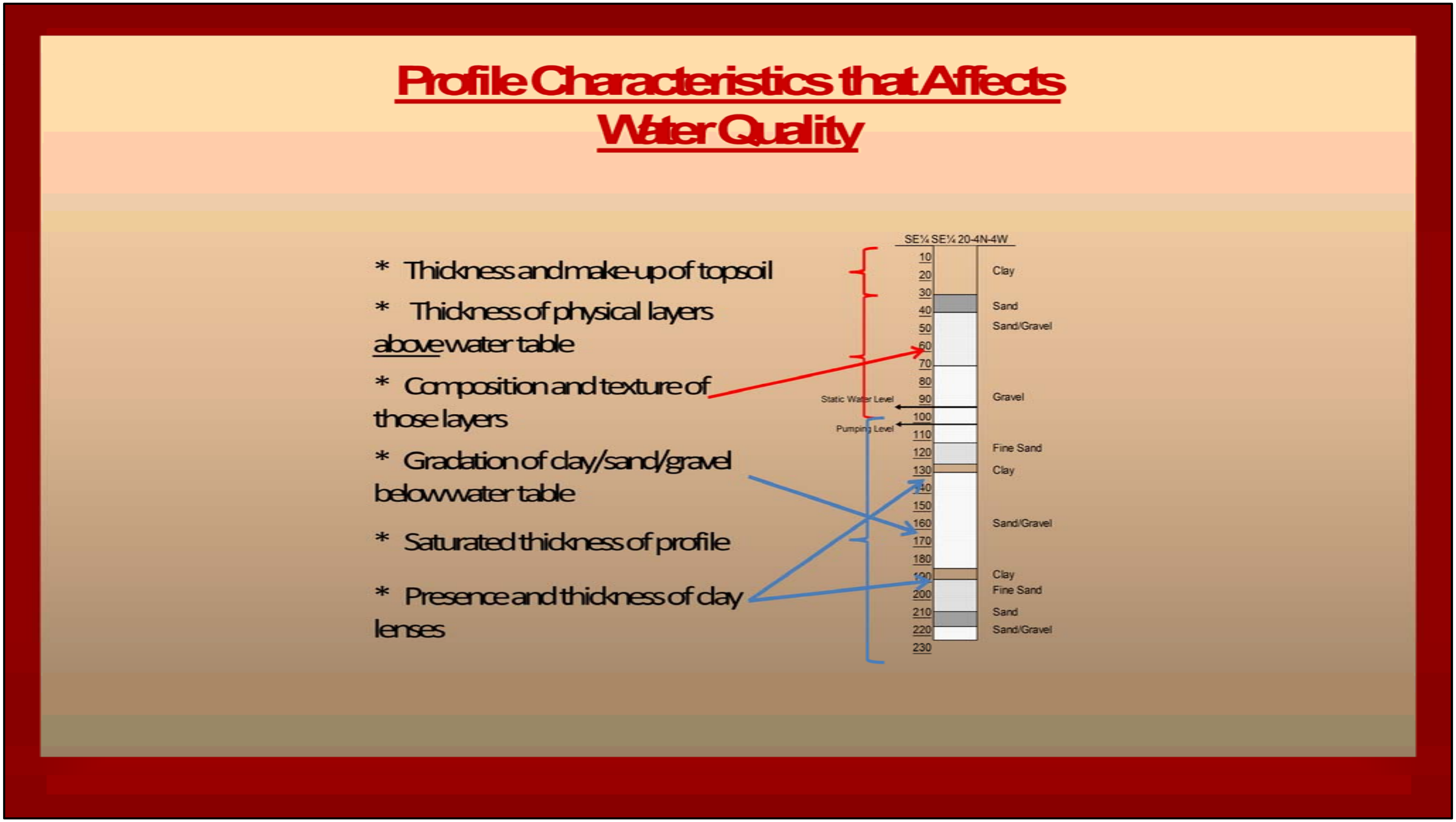


One geologic component which affects water quality from nitrates is the depth to water from the land surface. Those areas having the thickest over-burden and greatest depth to the water table provide a higher level of protection to the aquifer over time. Those areas shown in blue and bluish tints indicate the most vulnerable locations because of thinner overburden and/or higher water tables.

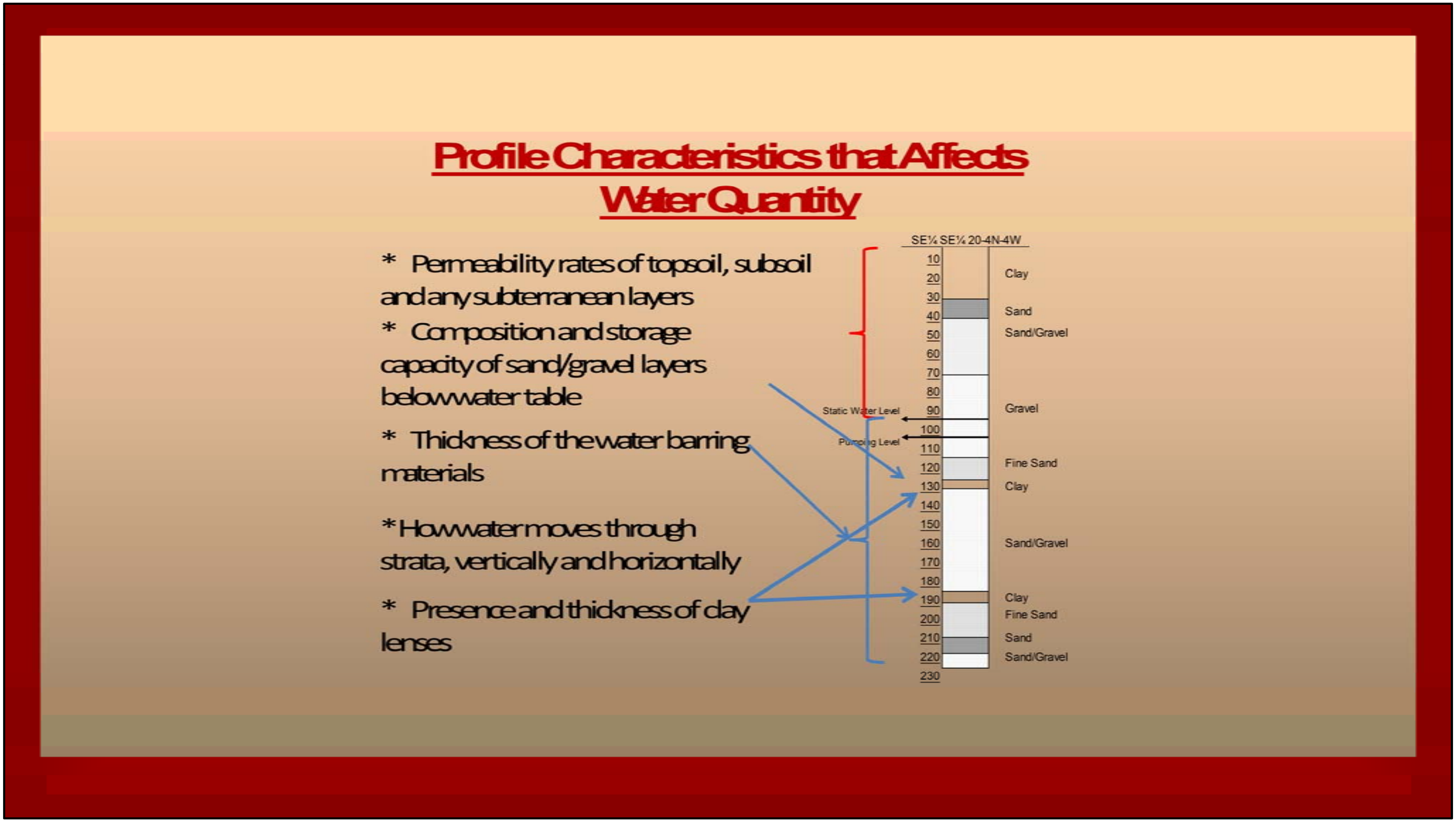


2014 DNR Fully-Appropriated Evaluation Results

Another important component of groundwater management is the assessment of areas where surface and groundwater are interconnected. This map, produced by modeling efforts of the Nebraska Department of Natural Resources and released in December, 2014, shows those portions of the Blue River Basin where, because of surface-ground water interconnectivity, stream flows would be reduced by 10% over 50 years of groundwater pumping. This interconnectivity can have impacts on both water quality and water quantity.

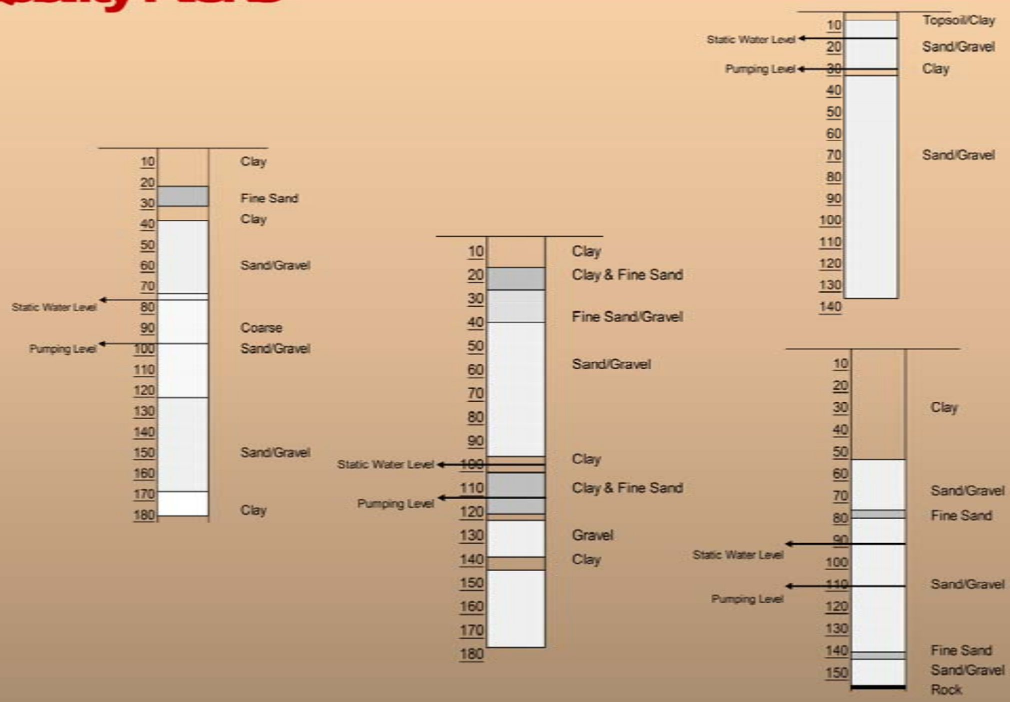


Now, we will change directions slightly as we look at how soil profile characteristics impact water quality and quantity. Water quality is affected by the thickness of various layers and physical make-up of those layers regarding permeability and percolation rates, the depth of the water table, location and types of sand and gravel that may exist in the profile, how thick the saturated material is and the presence of restrictive or limiting layers or rock or clay that may change the vertical penetration and flow pattern of water.



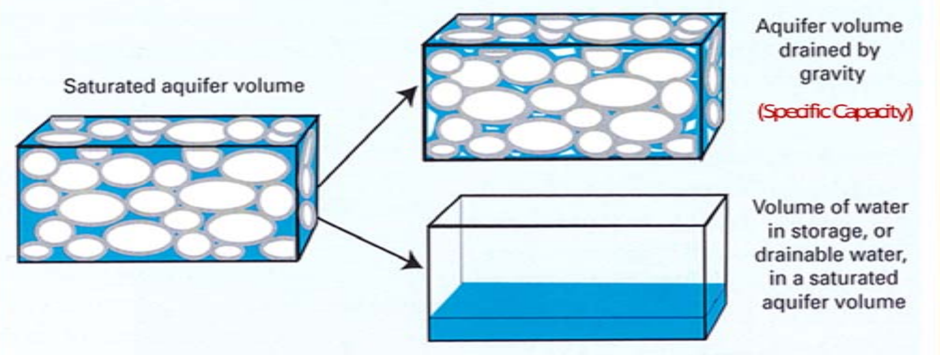
Similar characteristics affect the availability of water. Those factors include: permeability rates and composition of the soils material, thickness of water barring materials, composition of sub-water table materials and the presence of clay lenses or other restrictive features.

Well Logs Give Glimpse of Groundwater Quality Risks



As mentioned earlier, no two well profiles are the same. These actual well driller's logs show varying characteristics and help to assess the risks of groundwater contamination graphically. The more sand that exists above the water table, and the higher the water table, the quicker surface contamination could reach the groundwater below.

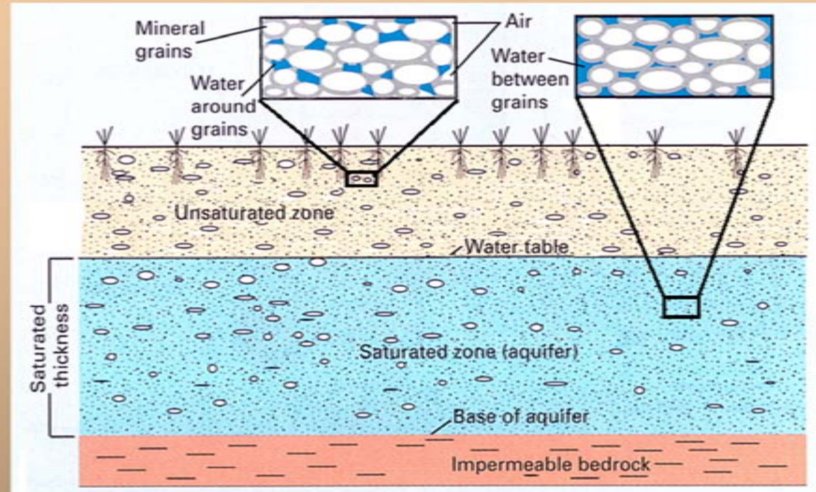
Basic Concepts of Water in Storage in the Aquifer



Schematic showing the amount of water in storage in a representative volume of the High Plains aquifer.

The soils above the water table, typically develop airspaces as water drains from them by gravity. The water which can drain naturally from the soils is referred to as the specific capacity of the soil. In a saturated condition, all the air spaces are filled with water as shown by the block at left. The amount of water which can drain from a saturated soil is dependent on the makeup and texture of the soil materials.

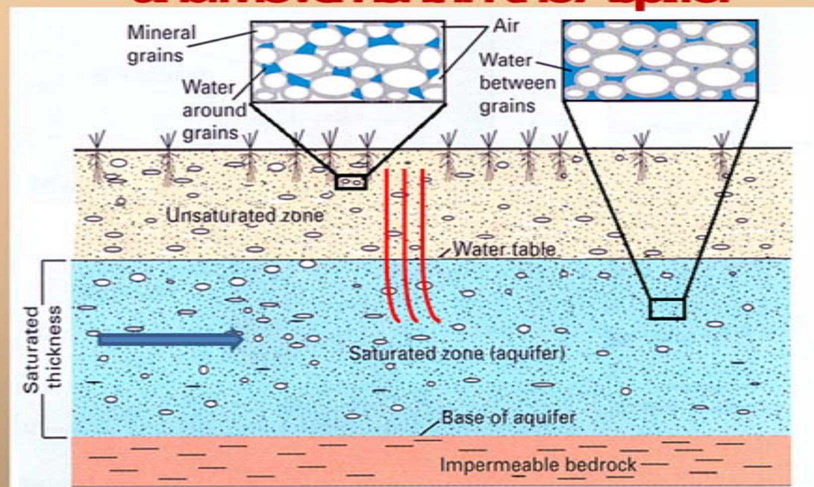
Basic Concepts of Water Storage in the Aquifer



Schematic of an unconfined aquifer showing unsaturated zone, water table, saturated zone (aquifer), base of aquifer, and under- lying impermeable bedrock.

In the environment, we typically find the unsaturated zone, above the water table, and the saturated zone, that which lies below the normal water table. Water is in constant motion, albeit very slowly, as it migrates from the land surface to the water table, and through the water table laterally from areas of higher elevation to lower elevation.

Basic Concepts of Water Percolation and Movement in the Aquifer



Schematic showing infiltration of nitrates or other contaminants leaching below the crop root zone toward groundwater. Once the contaminant reaches groundwater, it's movement is influenced by both vertical and horizontal water motions.

This slide portrays the water movement through the soil profile as it escapes below the crops root zone. (Click) Such deep percolation, if laden with nitrates or other surface contaminants, penetrates the soil profile and can reach the water table (Click) where its movement is then affected by both vertical and (Click) horizontal influences of groundwater movement. University of Nebraska research shows the deep percolation rate of nitrates with water in most silt and clay soils of the Little Blue NRD is approximately three (3’) feet per year. Movement through sandy soils is much more rapid. With the slow lateral movement of groundwater reported earlier, you can understand that most contaminants in groundwater are found fairly close to their source.

Once the soil profile has been saturated with nitrates, it takes a very long time for the soils to void of nitrates, even when the source of contamination from above is eliminated.

Summary
Factors Effecting Water Quality

- Top Soils: permeability and slope, organic matter, compaction
- Sub-Soil permeability
- Thickness of soil profile before reaching sands and gravels
- Depth to groundwater
- Effective rainfall amount
- Applications of irrigation water
  - Over irrigation drives nitrates and other contaminants down

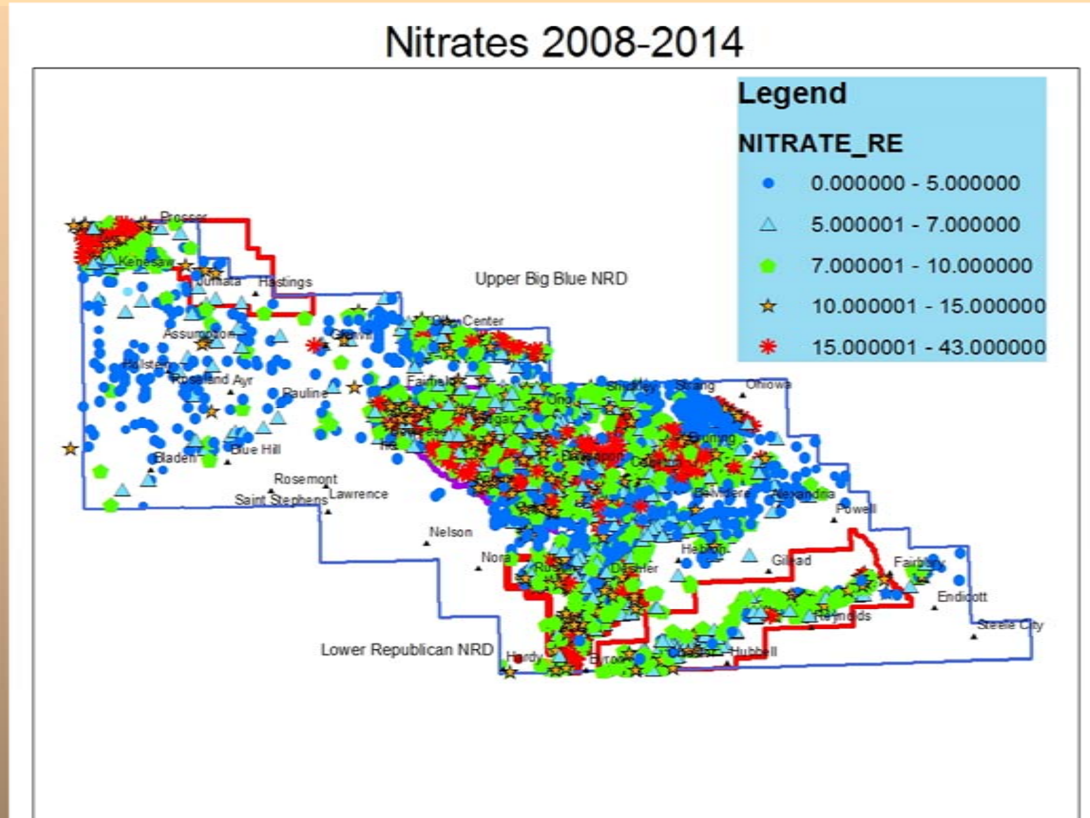
Understanding the factors that affect groundwater movement in the soil should influence our management practices on the land surface. Our goal should be apply practices which reduce the risks of contaminants leaching below the root zone and ultimately contributing to groundwater quality degradation.

Water Quality Issues of the Little Blue NRD

Now that we have a picture of the aquifer and its characteristics, let's take a look at the water quality conditions of the District and plans in place to address these challenges.

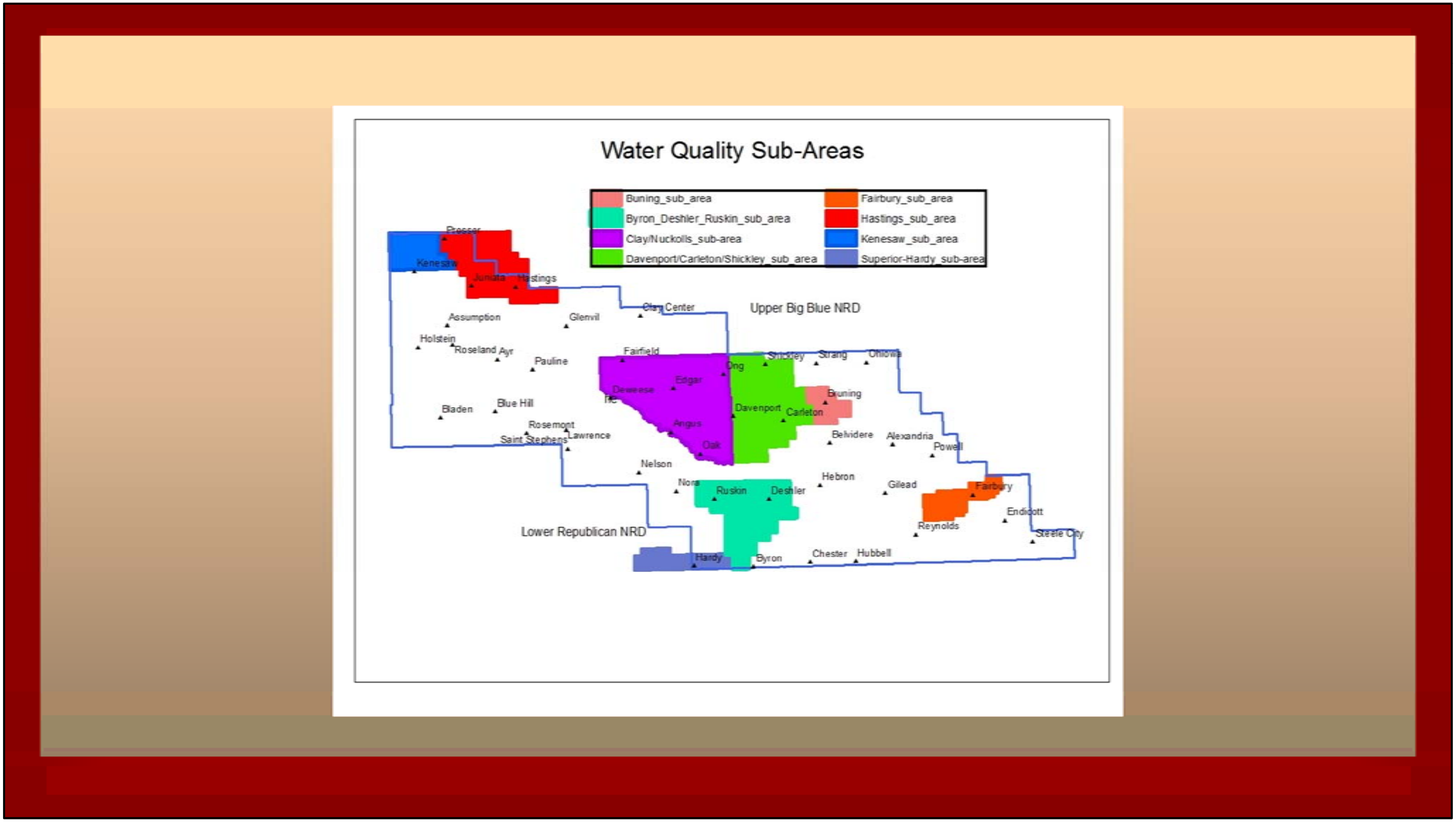
EXTENSION

No notes



Over the years, groundwater contamination, particularly from nitrates, has become a growing water quality problem. This map shows the nitrates sampling results of the Little Blue NRD over a 6 years period. The areas shown with green dots, and yellow and red stars have exceeded the groundwater quality threshold goals of 7 parts per million (PPM) established by the NRD.

LBNRD is concerned about the health of its citizens and the need to keep our groundwater clean of contaminates. As you can see nitrate can potentially cause health issues. EPA has established a maximum contaminant level of 10 parts per million for nitrates and there has been discussions that this level may still provide too much risk.



For that reason, the Little Blue NRD has established 8 water quality sub-areas where nitrate levels have exceeded the 7 ppm threshold. These areas encompass about 26 percent of the District's land area. Intensive nitrogen management actions are now required by producers in these areas.

LBNRD Water Quality Controls

- The entire LBNRD District is in a Level I Management Area.
- The LBNRD Board can establish Water Quality Sub-areas if certain contaminate thresholds are met.
- A complete set up rules are available at www.littlebluenrd.org.

The LBNRD has established a Groundwater Management Area that covers the entire NRD and includes various triggers for dealing with water quality and quantity problems. A complete set of rules is available on our web site at www. Littlebluenrd.org, but a brief summary of the water quality rules follows.

Level I - Management Requirements

- Pre-plant anhydrous ammonia applications are prohibited prior to November 1st.
- No application of liquid or dry nitrogen fertilizer between November 1 and March 1.
  - Allowed with LBNRD fertilizer permit and use of nitrogen inhibitor
  - 46-0-0 Nitrogen, 11-52-0 – Phosphorus
- Operator Certification is required District-wide every 4 years. (2018 deadline)
  - Second training can by done on-line or other similar trainings

3
2

These practices are currently in place across the NRD and apply to all lands.

Triggers for Establishment of <u>Water Quality Sub-areas</u>

- Level II
  - 70% of the MCL (Nitrate is 10 PPM)
  - 60% of the Monitored Wells
- Level III
  - 85% of the MCL
  - 60% of the Monitored Wells
- Level IV
  - 100% of the MCL
  - 60% of the Monitored Wells

To move to the next level of management, the LBNRD can establish water quality sub-areas when 60 percent of the monitored wells in an area reach 7 ppm or mg/l for nitrates. The water samples are collected from irrigation wells and if nitrates continue to rise, the NRD Board can initiate the next level of management requirements.

Level II - Management Requirements

- Establishment of "Demonstration Field"
- Soil Sampling is required on Demo Field if adding nitrogen fertilizer
- Irrigation Scheduling is required on Demo Field
- Annual report required on Demo Field
- Operator Training every 4 years

The idea of Level II management is for the producer to establish a "Demonstration Field" to do best management practices. It is hoped that the implementation of these best management practices will prompt an operator to initiate these same practices on all fields. Soil sampling has been proven to be an effective best management practice to understand the crop nutrient use and residual levels of nutrients. Sampling for residual soil nitrogen should be done before planning or applying fertilizer. Nitrate is a very mobile nutrient and levels fluctuate yearly, so sampling is necessary to determine accurate nitrogen needs of the field.

Level III - Management Requirements

- Annual Soil Sampling on all fields
- Encourage water analysis for nitrogen
- Irrigation Scheduling on all fields
- Annual Report on all fields

Level IV – Management Requirements

- No application of Nitrogen fertilizer before January 1st.
- Must follow laboratory nitrogen fertilizer recommendations, including all credits.

If groundwater nitrates levels continue to rise, higher levels of management may be needed and the level of management expectations also rise. Under Level III controls, the requirements of Level II extend to all fields. Level IV requirements are the most restrictive.

Key Nitrogen Management Strategies

- Soil testing is the simplest and most effective way to know your fertility needs.
- Apply fertilizer as close to the growing plant's needs as possible.
  - Side-dressing and chemigation are most effective uses of nitrogen fertilizer
- Calculate all possible nitrogen credits to determine fertilizer needs.
- Use crop rotations to help build soil nutrient levels

There are a number of ways to best determine fertilizer needs and prepare for next year's crop. These are just a few of the most common.

Utilizing the nitrates in the irrigation water is an often overlooked Best Management Practice. By knowing the level of nitrates in the water, a producer can calculate the credit contributed by expected irrigation water applications and reduce his nitrogen application accordingly. Because this nitrogen is applied during the critical growing period of the crop, all the nitrogen is readily available for the crop. That is why it is important to get you water tested annually to know what credit can be taken. Using this credit can help reduce fertilizer costs.

Soil Samples Provide Valuable Information About Soil Balance

- Nitrogen
- Phosphorus
- Potassium
- Sulfur
- Sodium
- Calcium
- Iron
- Magnesium
- Manganese
- Boron
- Zinc
- Copper
- Molybdenum

The NRD also encourages producers to consider an occasional complete soil sampling to determine the levels of all essential soil nutrients. A program of N-P-K fertilization, without knowledge of other soil micronutrient content, can lead to the over use of nitrogen fertilizer which simply masks the real problem, an imbalance of essential soil nutrients. Deficiencies in certain soil nutrients also lead to poorer plant health, limited yields and lost revenue.

Chemigation/Fertigation

- An effective way to spoon-feed crops.
- If you are applying chemicals or fertilizers through your irrigation system a permit is required from the LBNRD.
- Fees
  - New Permit - $60
  - Annual Renewal - $20
  - Emergency Permit - $250
- Equipment re-inspection is needed every 3 years
- Operator training is required every 4 years

Chemigation can be an effective way to spoon-feed your crop the nutrients they need during the growing season, and lower the risk of nitrate contamination of our groundwater. Be sure to obtain the necessary permit and install the proper equipment if you plan to utilize your irrigation system for chemigation or fertigation. Fertigation is the process of applying nitrogen through your irrigation system.

Reminders

- Little Blue NRD will do a nitrate water sample of your domestic or irrigation well for free.
- Staff will assist anyone in doing a more complete water analysis if needed.

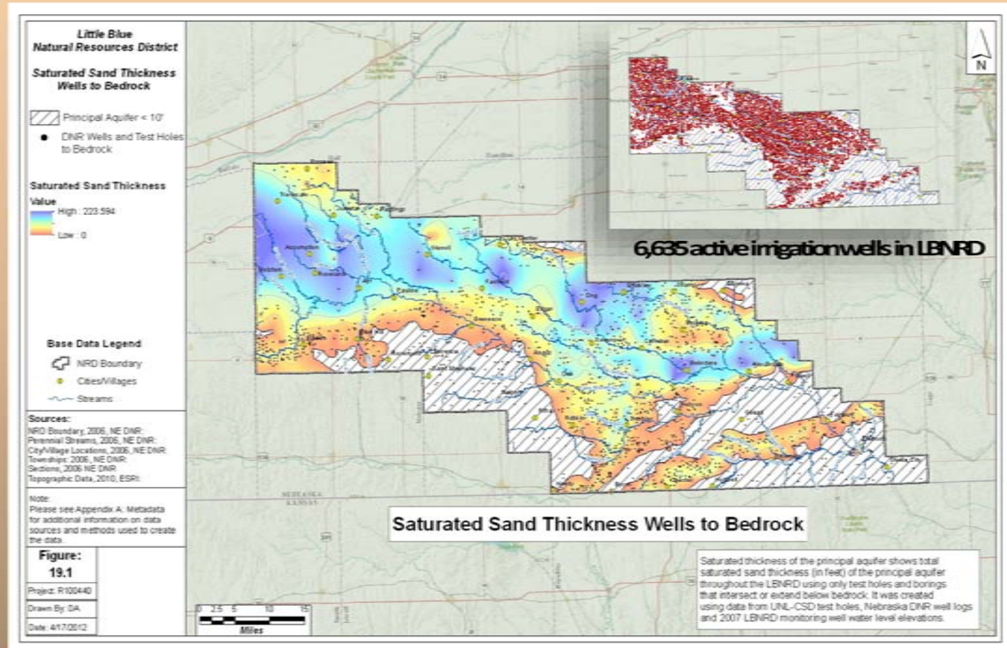
Water Quantity Issues of the Little Blue NRD

Along with water quality issues, the District faces some challenges with the intensive use of groundwater. Let's look at the water quantity conditions of the District and plans in place to address these challenges.

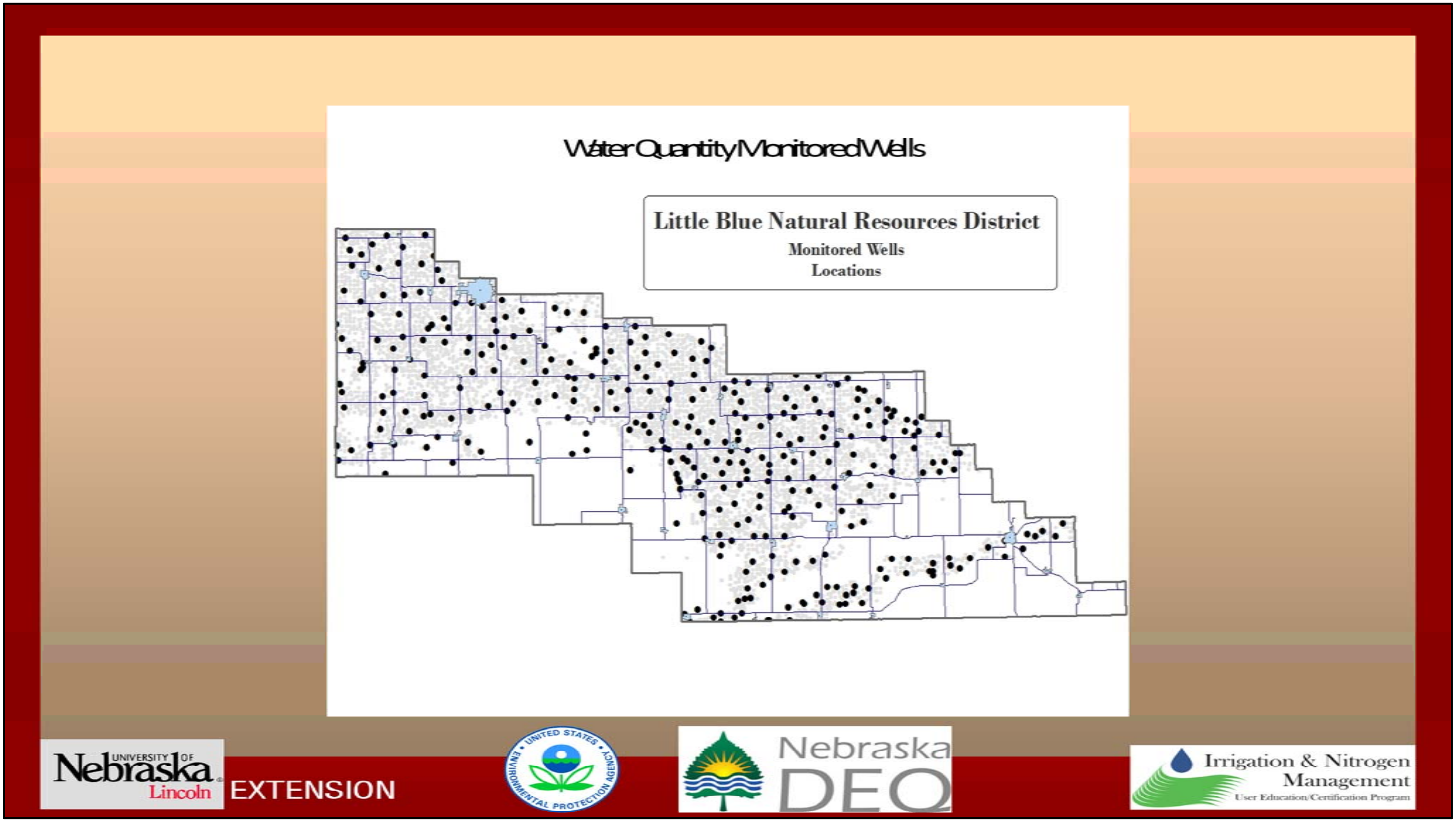
Nebraska Lincoln EXTENSION

Nebraska DEQ

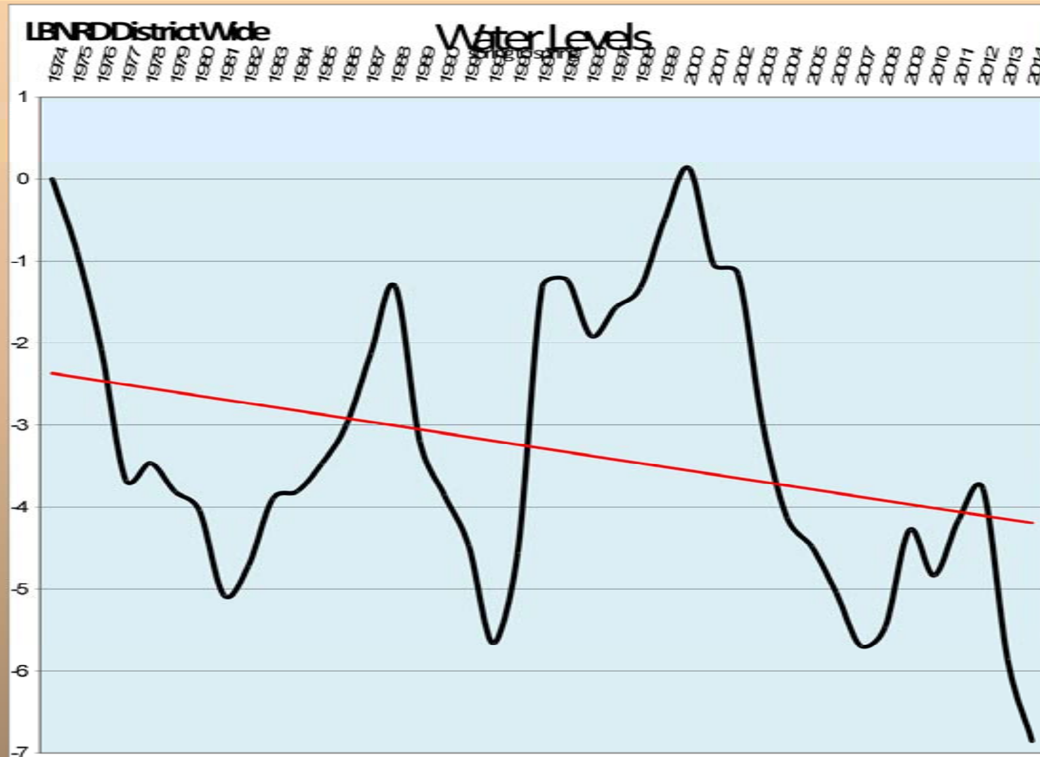
Irrigation & Nitrogen Management
User Education/Certification Program



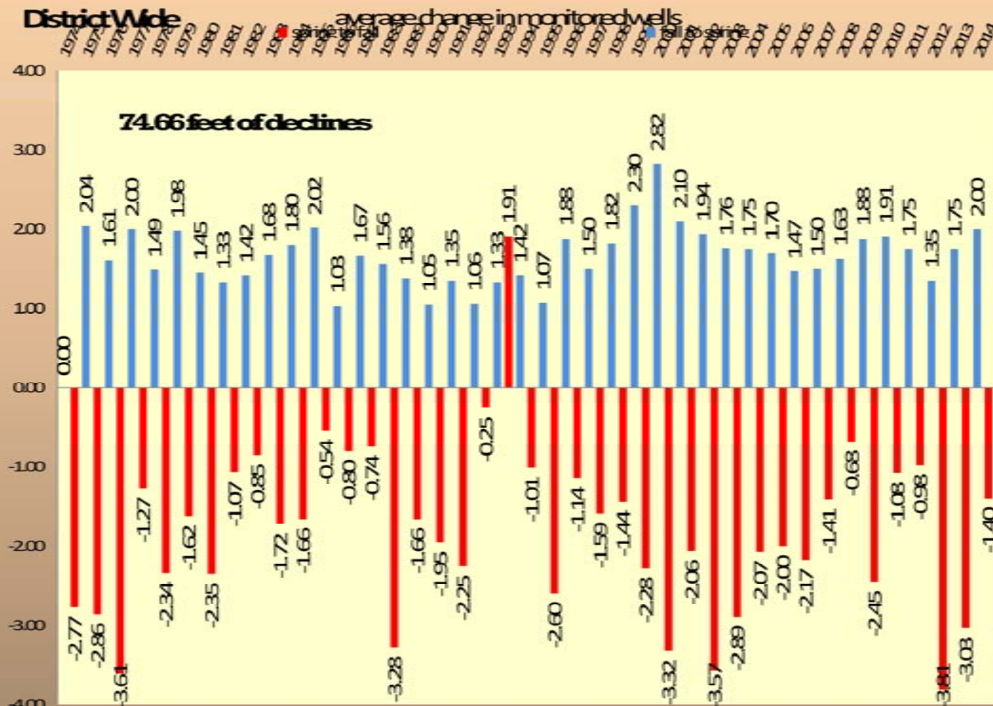
We've seen this map before in the description of the geology of the District. It shows the saturated sands and gravels that make up the groundwater aquifers of the Little Blue NRD. The presence of groundwater is also evident in the proliferation of deep irrigation wells, currently numbering 6,635, as shown in the insert at top right. In general, the deep well locations mirror the presence of a suitable aquifer for effective irrigation. Those areas where the aquifer is less than 10' or is absent do not lend themselves for productive irrigation development.



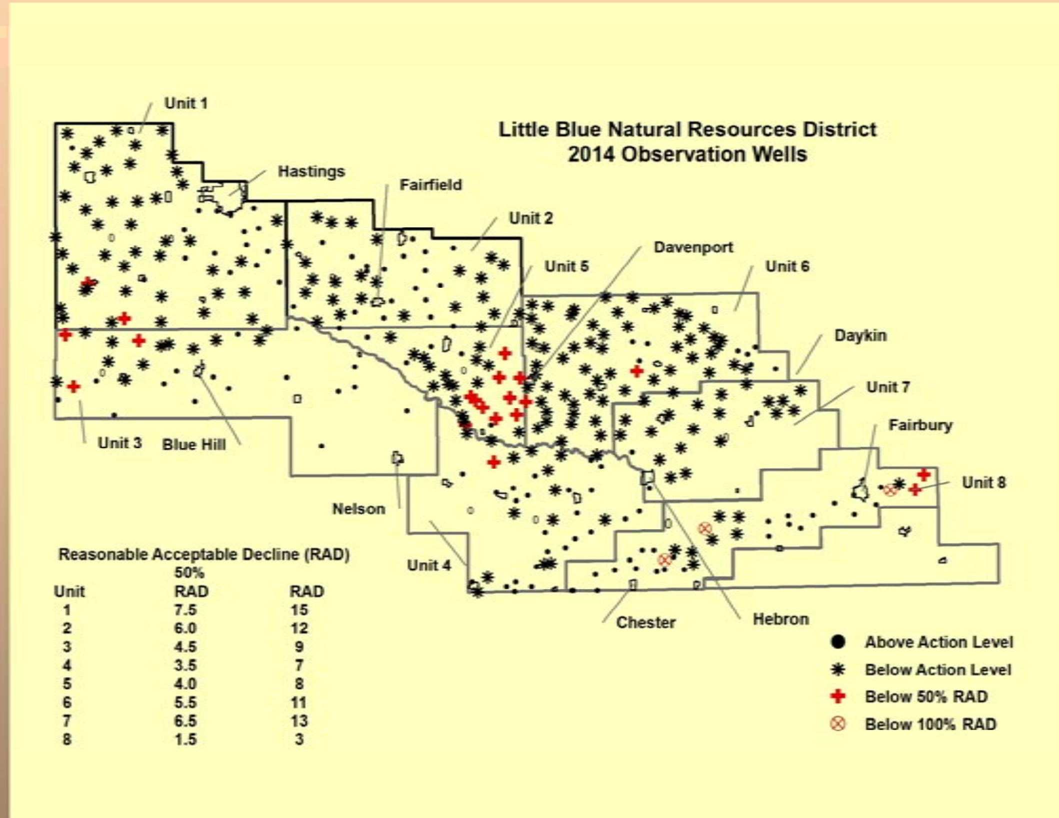
The Little Blue NRD tracks the impact of the development and groundwater uses on the aquifers through a network of 320 irrigation and other wells that are used for biannual static water measurements. These wells give us a picture of the annual fluctuations in the water table, from the impacts of seasonal pumping reflected in our fall readings, to the impacts of groundwater recharge and the ability of the groundwater table to recover through the off season.



This chart is an ongoing compilation of average spring water table readings which began in 1974. The red line shows a computer generated trend line for the 40-year period. One can see that this chart shows a little over 7’ of total aquifer decline in the 40 years of NRD static water level records

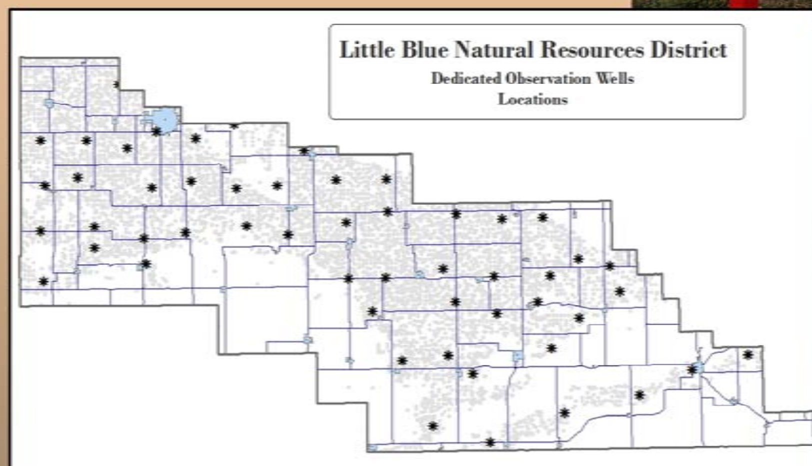


Another way of presenting the seasonal groundwater declines verses the seasonal groundwater rises is a bar chart. Declines which are typically recorded in the fall are depicted as the red bars; rises which are typically recorded after the water table has had an opportunity to recover, are depicted as the blue bars.

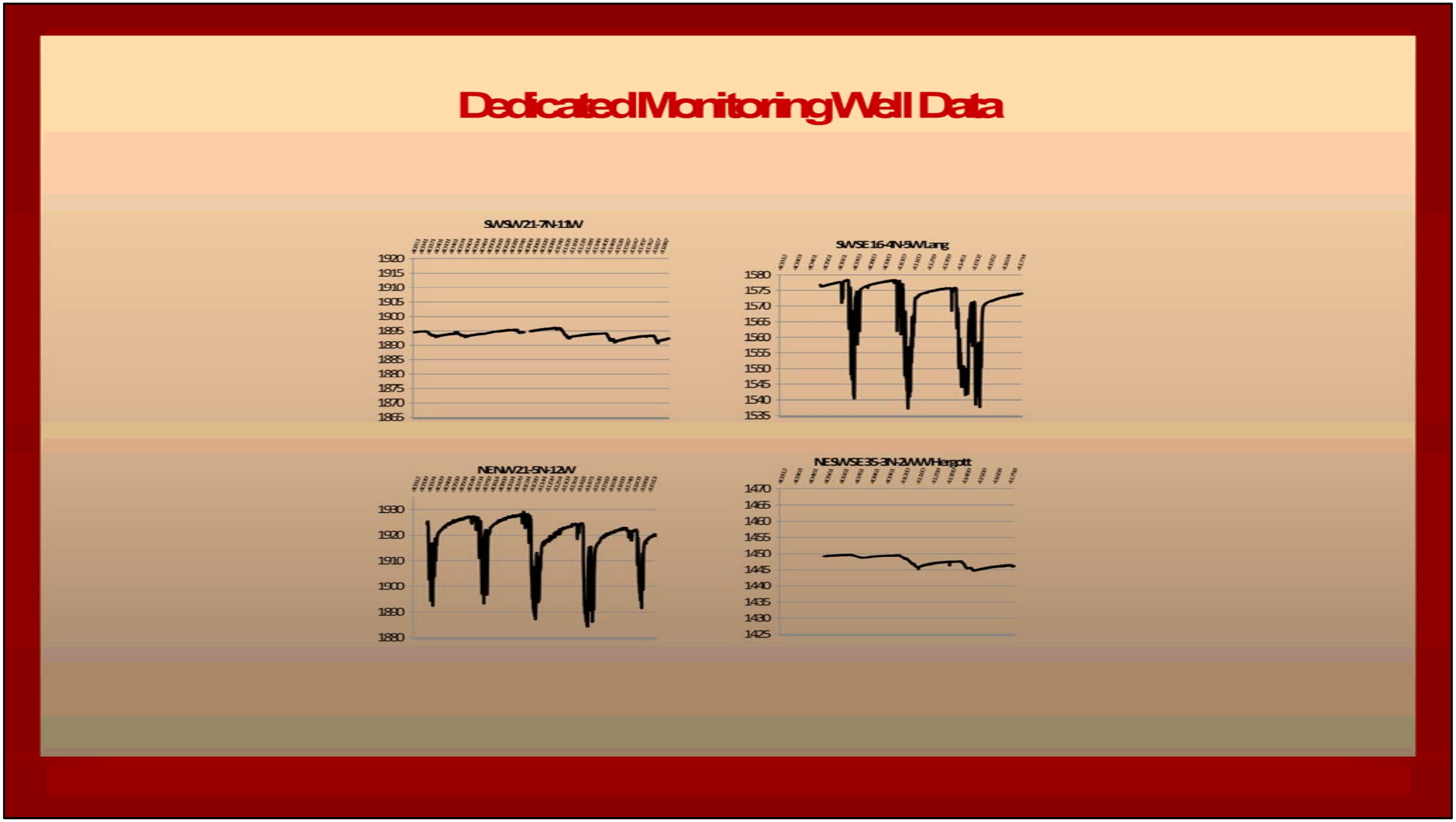


The District's Groundwater Management Plan lays out a strategy for determining if allocation is warranted based on a well's total decline over time (RAD = Reasonable Acceptable Decline) compared to the saturated thickness of the aquifer at that location. This map depicts the well locations of the District which have experienced their lowest levels of record in 2014, plus those that have fallen below 50% or 100% of their RAD. In spring 2014, 116 wells were above their Action Level, 197 were below their Action Level, and 26 were either at 50% or 100% of their Action Level.

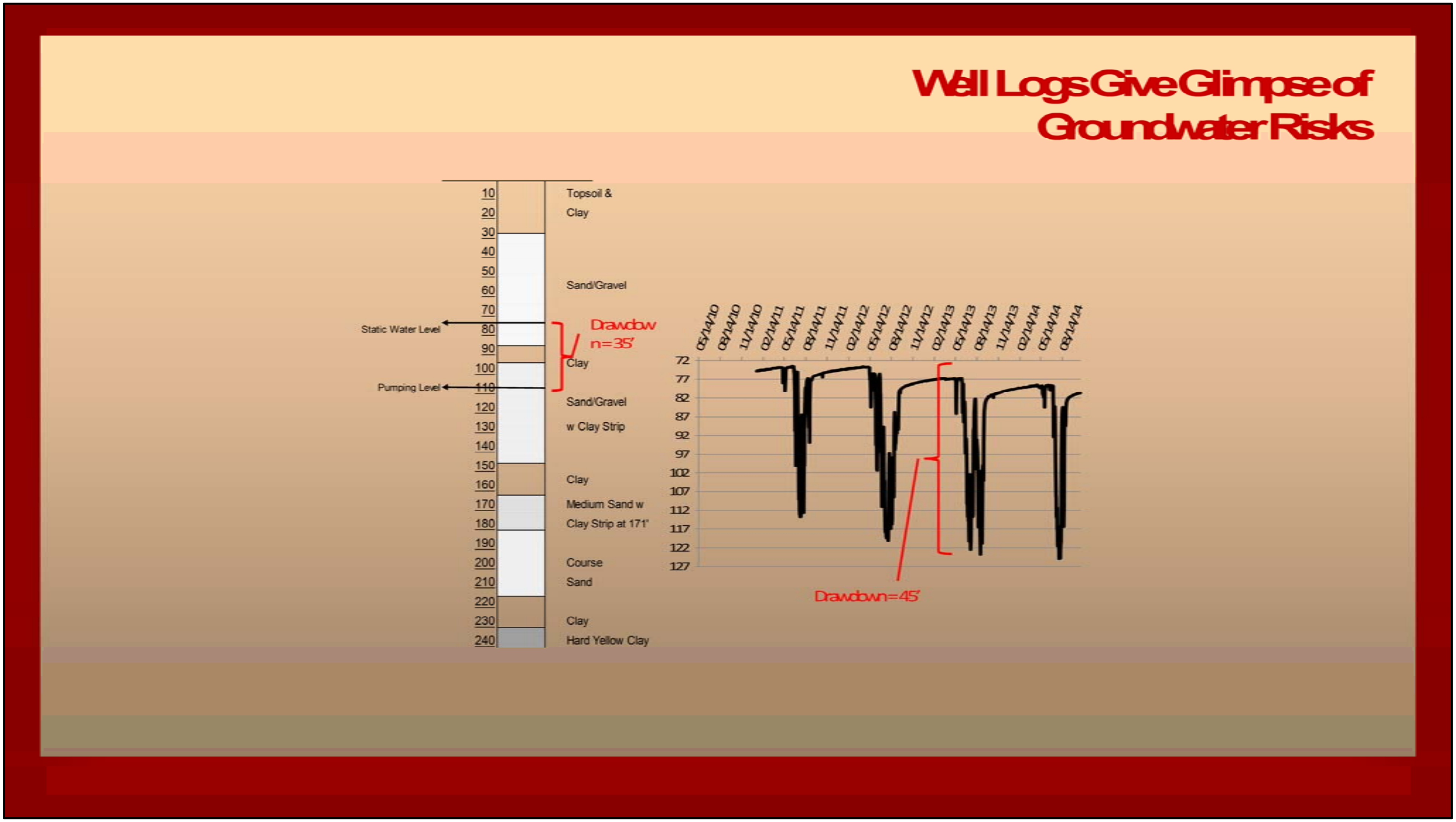
Dedicated Monitoring Well Network



The District also maintains a dedicated monitoring well network containing 50 wells, each equipped with a continuous data logger capable of providing two or more water table readings daily. This network has been invaluable in assessing the impacts of well pumping, the recovery time of each well and the role that various geologic characteristics play in water availability across the District.

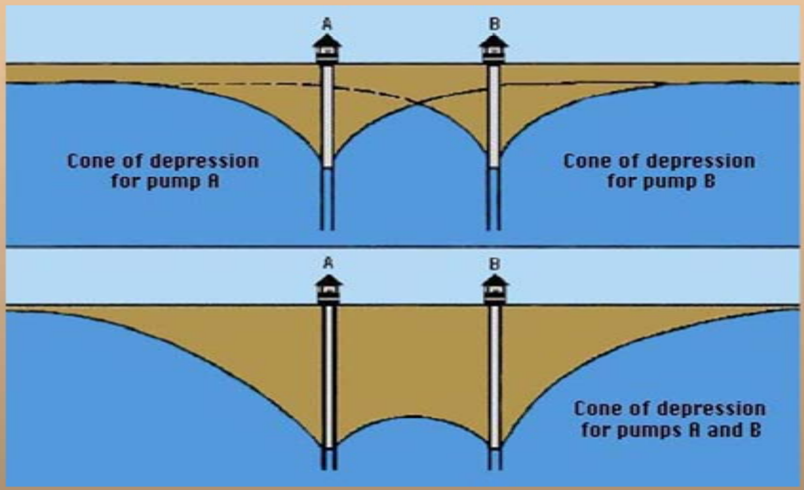


These four examples of the type of data gathered from the dedicated monitoring wells across the District. Note some areas, show little influence from seasonal pumping while others show significant drawdown during pumping. The areas of wide fluctuations present some challenges from the standpoint of pumpage season well outputs and potential conflicts between water users.

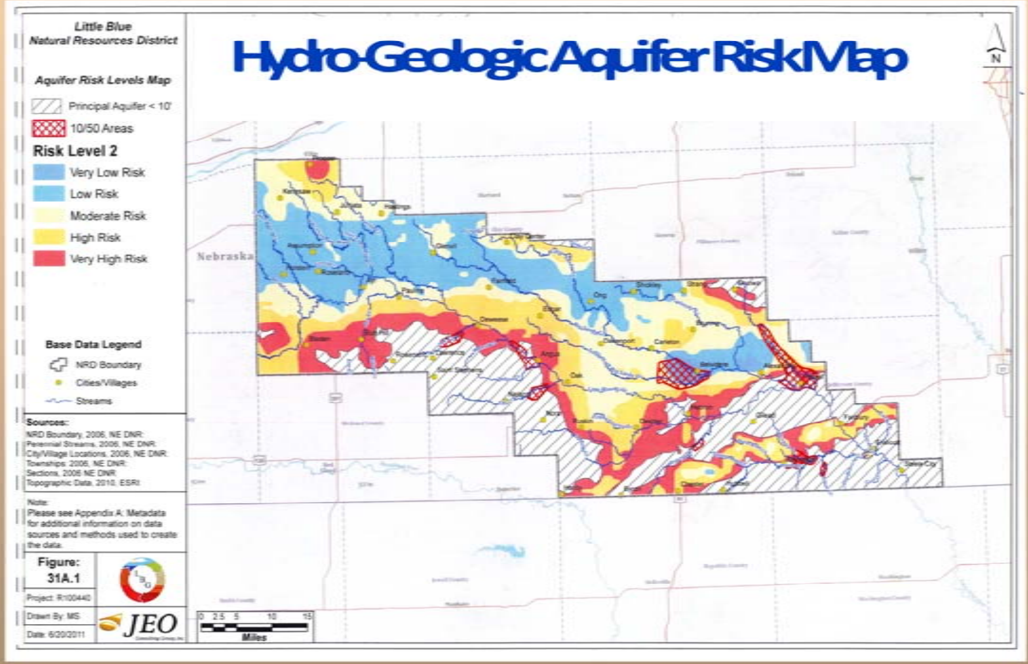


Combining some of the information we've learned from our Hydrogeologic study and monitoring well network, we can get a much clearer picture of the challenges that exist in managing our groundwater supplies. The well log on the left reveals some interesting profile facts. First, note that the drawdown in this well is nearly 35' during pumping as reported by the well driller when it was originally constructed. Some of the drawdown is due to the clay lens that exists in the profile. Also of note is that the total thickness of clay lens in this profile is about 40', all which exists below the water table. Therefore, nearly 30% of saturated profile would have a much lower capacity to deliver water to the well. The hydrograph on the right shows the actual seasonal drawdown of the well is nearly 45 feet. The well has rebounded after the irrigation season, but those levels have been slightly lower each spring.

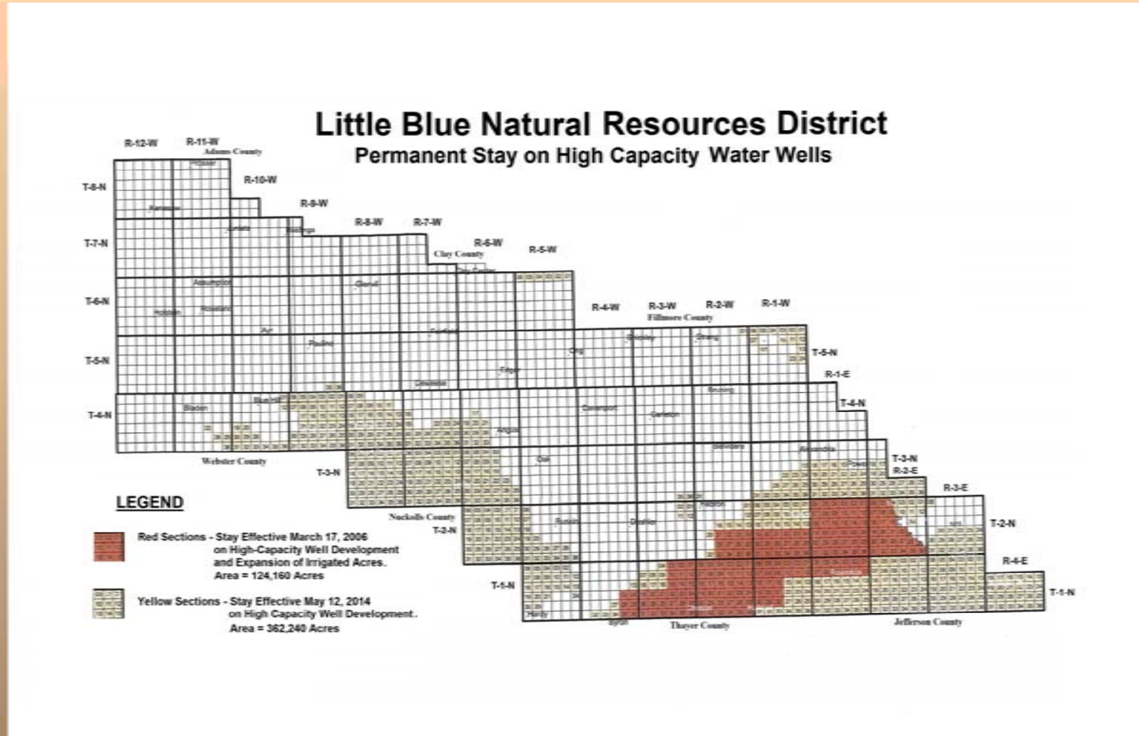
Cone of Depression and Well Interference



As our regional aquifers are being tapped more and more with high-capacity wells and the acreage being developed for irrigation continues to increase each year, the conflicts between water users, particularly in the fringe areas of the aquifer and in those areas of deep seasonal drawdown are present have prompted the NRD board to initiate additional regulations.



The Hydrogeologic Study conducted for the District identified those areas of the District where risks for groundwater development were the highest. The components that were used to develop this map included the saturated thickness of the aquifer, transmissivity and specific yield, along with values for estimated annual groundwater recharge and the impacts to the water table to the drought period of 2000 to 2007. Areas shown in the red have the highest risk for non-productive wells and conflicts between groundwater users.



Because of ongoing declines in a portion of the District and the impacts of well development in the fringe areas of the District's aquifers, the LBNRD Board also has imposed a permanent stay on the construction of new high-capacity water wells. The areas highlighted on this map are those which make up an isolated paleovalley in southern Thayer and Jefferson Counties and those areas of the District identified as having an aquifer of less than 10' of thickness.

District's Water Management Plan to Focus on Water Use Efficiency

- With high demands on our aquifer's water supply, business as usual is not an option
- NRD Board expects all landowners to evaluate their management strategies and implement practices that conserve water
- This philosophy offers the least intrusive approach and best cooperative opportunity for a long-term sustainable water resource.

Current Groundwater Rules

- Flowmeters are required on all high capacity wells. "High capacity" are wells, or series of wells, of all types that produce 50 gpm or more.
  - An exemption was given to livestock wells
- Flowmeter must be installation in the government quarter section by the date specified below.
- NE¼ of each section by December 31, 2014
- NW¼ of each section by September 30, 2015
- SW¼ of each section by June 30, 2016
- SE¼ of each section by March 31, 2017
- Annual water use reporting is required, whether a meter is installed or not.

Irrigation Wells & Acres Certification

- All irrigation wells will be identified, registered with the DNR and meters certified
- All irrigated acres must be certified by December 31, 2015
  - Assessor records used, plus FSA, aerial maps, DNR data or other information will be used

Groundwater Transfers

- All groundwater transfers off of the overlying land must be approved by the District
- Transfers are not allowed to tracts without a groundwater aquifer; or, if the groundwater aquifer is incapable of supporting irrigation on its own.
- Transfers are also limited further by allowing only the use of two wells, and not transferring water to more lands than where the well(s) are located.

Very High Risk Regulations

- Permits for lands in "Very High Risk" areas must meet an aquifer score of 80 (based on the Hydrogeologic Study criteria), or. . .
- If the aquifer score is below the minimum score, the well must "prove capacity" by pumping 300 gpm or more for a 24 hour test period.
- If the well meets the criteria above, a permit would be issued.

Spacing Requirements

- Limit of 1 well / 80 acres in "Very High Risk" areas
- High capacity wells in the "Very High Risk" areas would have to be at least 1,250' from other high capacity wells
- Wells must be placed at least 500 feet of any registered domestic well.
- Wells within 1 mile of municipal wells may have additional conditions imposed.

Operator Training

- District-wide Operator Irrigation and Fertilizer Training is required with renewals every 4 years.

In order that all operators in the District understand the current conditions of our natural resources, the rules and regulations of the Board of Directors and ways that we can work together to maintain our soil and water resources most effectively, District-wide operator training will be required beginning in 2015 for all operators, whether irrigated or dryland producers. Training will be required every four years, however on-line training is available for any operator who has previously physically attended one of the NRD's training events.

Summary Thoughts

- We began this presentation by stating that an understanding of the aquifer, its characteristics, its vulnerability and its limitations help us assess the impacts of our actions on the resource, and guide our decisions to better protect the resource.
- Our environment is complex, with many components interconnected, including our ground and surface water resources.

Summary Thoughts

- The future productivity and recognition of this area as economic stronghold is dependent on a sustainability our resources.
- We all can play a part in accomplishing that goal.
- We all have a responsibility to our children and grandchildren to make it happen.

Project Funded By

Region 7 – Environmental Protection Agency

Project Materials Developed in Conjunction With

Nebraska Association of Resources Districts
University of Nebraska Extension