Lower Elkhorn NRD Groundwater Management Plan

2018

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I. INTRODUCTION

A. *Background*

In 1984, the Nebraska legislature passed Legislative Bill 1106, which required each Natural Resources District to prepare a groundwater management plan and submit it to the Nebraska Department of Water Resources prior to January 1, 1986 (refer to Appendix 1, §46-673.01). The Lower Elkhorn NRD's original plan was accepted by the Nebraska Department of Water Resources later that year. The original plan utilized existing groundwater data to develop policies and programs for groundwater management. Much of the information applied to the entire Elkhorn River Basin, therefore, Directors of the Lower Elkhorn NRD and the Upper Elkhorn NRD authorized joint development of their original Groundwater Management Plans. Many of the exhibits and much of the text from the original plan contains information pertinent to both NRDs.

In 1990 through 1991, the groundwater quality portion of the plan was revised and improved. The plan was updated to reflect the additional water quality programs and policies that had been adopted by the district.

The legislature then required all districts to amend the groundwater quality sections of their plans with Legislative Bill 51 in 1991 (refer to Appendix 1, §46-673.14). These amendments required additional information and policies that would identify the levels and sources of groundwater contamination and would develop long term solutions to stabilize, reduce, and prevent groundwater contamination. This prompted a change in the organizational structure of the plan to a format suggested by Nebraska Department of Water Resources and Nebraska Department of Environmental Quality (refer to Appendix 1).

The groundwater management plan is used in conjunction with other Lower Elkhorn NRD plans to manage the groundwater resources of the district. Review letters of previous submittals and public comment summaries appear in Appendix 3. The plan is actually a detailed portion of the district's Master Plan. The district's Long Range Plan details the implementation of the groundwater management plan on a one and five year basis. An example of the groundwater management portion of the Long Range Plan appears in Appendix 5.

The Lower Elkhorn NRD groundwater management plan will never be complete. As more is learned about the groundwater in the district, and as the legislature addresses issues concerning groundwater and NRDs, the plan will continue to grow and improve. The plan will also be revised when unforeseen events occur and when perceptions regarding groundwater resources change.

The groundwater management plan is not intended to be a document that states specific rules and regulations that will dictate the management of the district's groundwater. The plan serves as a foundation for decision-making; it is a guide for the NRD to use in managing the groundwater resources within the district. Section VII of the plan states the NRD's policies, goals, objectives that are used to guide groundwater management. The district utilizes a proactive, education-based approach to protect groundwater resources, encouraging the voluntary use of intelligent and practical management practices by groundwater users. Section VII also outlines the regulatory actions that the district will take when groundwater quantity or quality problems arise. These actions are designed to be flexible so that the Lower Elkhorn NRD Board of Directors may adapt the actions to solve unforeseen problems when needed; and are specific enough that the public and the NRD will know when regulatory actions will be implemented. Tables I - 1 and I - 2 summarize the district's mechanisms to trigger actions for the protection of groundwater quantity and quality, respectively.

Table I - 1. Groundwater Quantity Protection Summary : Triggers and Controls

	1st Action Level (Hydrogeologic Study)	2nd Action Level (Management Area)	3rd Action Level (Control Area)
TRIGGER CRITERIA			
Groundwater elevation.	1st Action Level initiated when any well in the district monitoring program drops 15 feet below estimates of predevelopment elevations for that area for 2 years in any 3 year period. The area monitored will be a minimum of 10 square miles in size.	2nd Action Level initiated when 80% of the sites monitored in Action Level 1 drop 15 feet below estimates of predevelopment elevations for that area for 3 out of any 4 year period. The area affected must be a minimum of 10 square miles in size.	3rd Action Level initiated when 80% of the sites monitored in the management area drop 20 feet below estimates of predevelopment elevations for that area for 3 out of any 4 year period. The area affected must be a minimum of 10 square miles in size.
ACTIONS AND CONTROL MEASURES[1]			
Education and information.	M	M[2]	M[2]
Citizen advisory committee.	M	M[2]	M[2]
Intensify monitoring.	M	M[2]	M[2]
Determine control measures required.	M	D[2]	D[2]
Start the process of establishing a groundwater management area.		M	
Require volume metering of wells.		M	M
Require annual reports.		M	M
Allocate water among users.		D	D
Adopt a system of rotation.		D	D
Adopt well spacing requirements.		D	D
Require water meters.		D	D
Require 'best management practices'.		D	D
Require reduction of irrigated acres.		D	D
Begin the process of establishing a control area by requesting the NDWR to conduct a hearing.			M
Close the area to new wells.			D
Adopt other reasonable rules.			D

[1] M = Mandatory actions. D = Actions performed at the discretion of the Board.
[2] Performed as part of the 1st Action level and will be continued if further study is necessary.

Table - 1a. The Maximum Number of Years Required for the Establishment of Management and Control Areas for Groundwater Quantity Protection

Maximum time required for implementation of management and control areas

Year	The number of feet below predevelopment estimate for a single well in the district's groundwater level monitoring program (for example)	
2001	15.50	
2002	10.50	
2003	15.05	Action Level 1 is triggered, increase the number of wells monitored in the area
	Percent of wells monitored as part of Action Level 1 that are 15 or more feet below predevelopment estimates (for example)	
2004	86%	
2005	82%	
2006	65%	
2007	81%	Action Level 2 is triggered, begin management area process and continue monitoring as in Action Level 1
	Percent of wells monitored as part of Action Level 1 that are 20 or more feet below predevelopment estimates (for example)	
2008	78%	
2009	82%	
2010	84%	
2011	86%	Action Level 3 triggered, begin control area

Table 1 - 1b. The Minimum Number of Years Required for the Establishment of Management and Control Areas for Groundwater Quantity Protection

Minimum time required for implementation of management and control areas

Year	The number of feet below predevelopment estimate for a single well in the district's groundwater level monitoring program (for example)	
2001	15.50	
2002	15.05	Action Level 1 is triggered, increase the number of wells monitored in the area
	Percent of wells monitored as part of Action Level 1 that are 15 or more feet below predevelopment estimates (for example)	
2003	86%	
2004	82%	
2005	81%	Action Level 2 is triggered, begin management area process and continue monitoring as in Action Level 1
	Percent of wells monitored as part of Action Level 1 that are 20 or more feet below predevelopment estimates (for example)	
2006	82%	
2007	84%	
2008	86%	Action Level 3 triggered, begin control area

Table I - 1. Groundwater Quality Pr[illegible]tion Summary : Triggers and Controls

	1st Action Level	2nd Action Level	3rd Action Level	
TRIGGER CRITERIA				
Groundwater contamination. (Percentage of Maximum Contaminant Level)	50 Percent	75 Percent	90 Percent	
ACTIONS AND CONTROL MEASURES			SPA	Management Area
Education and information.	X	X	X	X
Voluntary best management practices	X	X	X	X
Intensify monitoring and conduct hydrogeologic study.		X*	X*	X *
Determine control measures required.		X*	X*	X *
Start the process of establishing a groundwater management area.		X		
-or- *Begin the Special Protection Area process.*		X		
Require participation in educational classes.			X	
Require 'best management practices'.			X	X
1. Irrigation scheduling.			X	X
2. Proper pesticide application.			X	X
3. Ban fall fertilizing of sandy soils.			X	X
4. Require the use of nitrogen inhibitors.				X
Require annual reports from groundwater users.			X	X
Require analysis of irrigation water.				X
Require analysis of soils.				X
Allocate water among users.				X
Adopt a system of rotation.				X
Adopt well spacing requirements.				X
Require flow meters on wells.				X
Require reduction of irrigated acres.				X

* Performed as part of the 1st Action level and will be continued if further study is necessary.

B. *Reservoir Life Goal*

An abundance of groundwater is available in most of the Lower Elkhorn NRD, however, the eastern part of the district has areas of poor quality, quantity or both. At this time the primary hazard to the groundwater reservoirs appears to be pollution or degradation of groundwater quality. The proposed groundwater reservoir life goal for the Lower Elkhorn NRD is as follows:

"PROVIDE AN ADEQUATE SUPPLY OF ACCEPTABLE QUALITY GROUNDWATER TO FOREVER FULFILL THE REASONABLE GROUNDWATER DEMANDS WITHIN THE NRD FOR DOMESTIC, MUNICIPAL, AGRICULTURAL, INDUSTRIAL, WILDLIFE AND OTHER USES DEEMED BENEFICIAL BY THE NRD BOARD."

This goal shall apply to the following groundwater reservoirs as illustrated on Exhibit 4:

1. Sandhills
2. Dissected Plains
3. Glacial Drift, including these subregions--
   a. Sandy Till Plains
   b. Alluvium
   c. Sandhills

C. *Accomplishments*

Since its original plan was drafted in 1986, the Lower Elkhorn NRD has concluded several objectives and developed many useful programs. The district groundwater quantity and quality monitoring programs have been successful in detecting groundwater problems and trends. The district has developed a rural water system that is used by over 450 households and businesses in the eastern portion of the district and is expanding to accommodate an additional 500 users. A full-time Water Resources Manager position was created in 1991 in response to the many water resources issues facing the district. The district well sealing program has helped protect groundwater quality by sealing over 300 abandoned wells in its first year (1992). The district passed motions in late-1992 and mid-1993 to begin the process of establishing a groundwater management area and to include the entire district in the area in order to remediate existing areas with nonpoint source nitrate-nitrogen contamination and to protect future problems from arising. The management area will also address other potential nonpoint source groundwater pollution.

The Lower Elkhorn NRD works with other agencies to protect groundwater resources. The district sponsors nitrogen management demonstration plots in cooperation with the University of Nebraska and participates in the Bazile Triangle Water Quality Special Project with the U.S. Department of Agriculture. Through a cooperative agreement with the U.S. Geological Survey, information was assembled to help the district evaluate groundwater vulnerability in the district (see Insert II - 1). The NRD also benefits from sharing office space with the Nebraska Department of Water Resources and the University of Nebraska Conservation and Survey Division.

I I. HYDROGEOLOGIC CHARACTERIZATION

A. *Aquifer Descriptions*

1. General Description

The Lower Elkhorn Natural Resources District comprises approximately 4,000 square miles (2,560,000 acres). The entire Elkhorn River Basin is agricultural in character. The population of the Lower Elkhorn NRD is approximately 90,700 persons, according to 1990 census figures.

The Elkhorn River rises in Rock county and flows generally east-southeast to Cuming county where it veers to a generally south-southeast direction which it follows to it confluence with the Platte River in northern Sarpy county. The river has a total valley length of approximately 335 miles. The area of the basin totals approximately 7,000 square miles or 4,480,000 acres (Exhibit 1). Surface elevation in the Elkhorn River Basin ranges from approximately 2,700 feet to approximately 1,100 feet above Mean Sea Level (Exhibit 2; Figure 5 of Insert II - 1). Principal tributaries include the South Fork (333 square miles), the North Fork (861 square miles), Maple Creek (416 square miles), Logan Creek (1,052 square miles), and Union Creek (357 square miles). The river drains all of Wayne, Stanton and Cuming counties and portions of 21 other counties.

The climate of the Elkhorn River Basin is transitional between the humid east and the semi-arid western plains. The Lower Elkhorn NRD lies mostly within a belt of moist-subhumid climate. The entire basin is generally well suited for raising livestock and growing feed and grain crops. The spring months are cool, normally with considerable rain. Summers are hot and relatively dry. Autumn is generally pleasant with occasional rains, and winters are cold with significant precipitation in the form of snow.

Average annual precipitation ranges from approximately 29 inches in the lower reaches of the Elkhorn River Basin to approximately 21 inches in the upper reaches (Exhibits Nos. 7 and 8; Appendix 3; and Insert II - 1). Normally 65 percent to 67 percent of the annual precipitation occurs during the growing season between May and September (Exhibit 9; Insert II - 1). The average number of frost free days is approximately 160 with average annual temperature being about 50 degrees Fahrenheit.

A groundwater reservoir is an aquifer or group of aquifers which can be used as a source of water. The volume of a groundwater reservoir is determined by its geographic area, the saturated thickness of the water bearing material, and the texture of the material (Exhibits 10, 12 and 13).

The Elkhorn River Basin is characterized by three geographic regions which were described by Condra and Reed and updated by E.C. Reed (Reed, 1969; Exhibits 3 and 4). For purposes of this plan, these regions have been designated as groundwater reservoirs:

The *Sandhills region* is located in the upper reaches of the basin in Rock, Holt, Wheeler, Antelope and western Pierce counties. The surface mantle of the region consists primarily of sandy, highly permeable soils which readily accept precipitation. Groundwater is plentiful in the Sandhills region and high capacity supply wells are readily obtained (Exhibit 6).

The *East Central Dissected Plains region* lies adjacent to and just east of the Sandhills region. The region comprises portions of Pierce, Madison, Platte, Boone and Antelope counties. The boundary between the Lower Elkhorn NRD and the Upper Elkhorn NRD on the east line of Antelope county essentially bisects the geographic region. The surface mantle of the region consists of loess soils of moderately low permeability which overlie Pleistocene age silt, sand and gravel. At this time groundwater supply wells of sufficient capacity for irrigation and other uses are readily obtained in the region (Exhibit 6).

The *Northeast Nebraska Glacial Drift region* comprises the remainder of the Elkhorn River Basin. The surface mantle is made of generally loessial soils which overlay glacial till. The Glacial Drift region is interspersed with *Sandhills*, *Sandy Till Plains*, and *Alluvial Subregions*. The availability of groundwater supply varies greatly in this region. Wells of sufficient capacity for irrigation exist in some areas of the region, but groundwater yield is very limited in most areas (Exhibit 6). A few wells in the region obtain water from the underlying Dakota sandstone formation. The water typically is highly mineralized and is used only where other sources of supply are not available. Existing information on suitability of the Dakota formation as a water supply source is limited at this time. A general description of these subregions follows:

The *Sandhills Subregion* is located in Stanton county and is similar to the Sandhills region described earlier. Soils have a coarse texture and are highly permeable.

The *Sandy Till Plains Subregions* are characterized by gently rolling topography with valleys in a northwesterly direction. In most areas soils are extremely sandy and permeable, but in a few places, clayey glacial till is exposed at the ground surface, and soil permeability is low. Groundwater is abundant and high capacity wells are readily obtained.

The *Alluvial Subregions* consist of areas only ¼ to two miles wide along all major streams of the Lower Elkhorn NRD. Topography is very flat, with the only local relief consisting of stream meander scars and small sand dunes several feet high. Groundwater availability and soil permeability are highly variable.

2. Physical Characteristics

An aquifer is defined as any water-bearing stratum of rock or sediment capable of yielding supplies of water. Groundwater occupies the pore spaces of aquifer materials.

Hydraulic conductivity is a measure of the speed that water moves through an aquifer. If the pore spaces in the formation are large and well connected, such as in sand and gravel, the hydraulic conductivity is large. Conversely, if the pore spaces are small and not well connected, such as in silt and clay, the hydraulic conductivity is small.

Transmissivity is the rate at which an aquifer transmits water. (Exhibit 14). Transmissivity can be estimated by multiplying the hydraulic conductivity by the saturated thickness of an aquifer system. For example, the hydraulic conductivity may be large, but if the saturated deposits are thin, the aquifer may yield relatively small quantities of water to wells. Conversely, if the hydraulic conductivity is small, but the saturated deposits are thick, the aquifer may yield relatively large quantities of water to wells.

Specific yield is the ratio of the volume of water which a subsurface material will yield by gravity to the volume of the subsurface material itself (Exhibit 15). If the specific yield and saturated thickness of a groundwater reservoir are known, the volume of groundwater in storage can be estimated (Exhibits 13, 15 and 16).

Depth to groundwater in the district ranges from a few feet to more than 200 feet below the land surface (Figure 7 of Insert II - 1). Depth to groundwater in the alluvial materials of stream flood plains is generally within 10 feet of the land surface.
Groundwater moves from higher to lower elevation at right angles to the water table contours (Exhibit 10). Generally, the direction of groundwater movement is toward the streams.

a. Groundwater Regions

1). Sandhills - In the Lower Elkhorn NRD, the western one-third of Pierce county and a small portion of northwest Madison county are in the Sandhills region (Reed, 1969; Exhibit 4). A small Sandhills subregion exists in Stanton county in the Glacial Drift region.

The principal aquifer of the Sandhills region includes the Ogallala formation of the Tertiary geologic period and the overlying sand and gravel deposits from the Quaternary period (Exhibits 4a and 5).

The surface soils of the Sandhills region are highly permeable and virtually all precipitation either percolates into the groundwater or is discharged through evapotranspiration (Exhibit 3; Figures 3 and 4 of Insert II - 1). The precipitation which percolates to the water table is discharged as groundwater seepage to streams.

General hydrogeologic characteristics of the Sandhills are indicated on Exhibits 3, 4, 4a, 5, 6, 7, 8, 9, 10, 13, 14,15, and 16.

2). <u>East Central Dissected Plains</u> - All of Madison county except the northern and eastern edges are in the East Central Dissected Plains region (Reed, 1969; Exhibit 4). The region is mantled with loess soils which have been dissected by erosion. The thickness of the loess mantle varies from over 100 feet to zero feet where stream erosion has cut through it (Exhibit 5).

The loess mantle is underlain by saturated Pleistocene deposits of sand and gravel with layers of clay and silt. The Pleistocene deposits are the principal aquifer of the region and generally exceed 100 feet in saturated thickness. In some areas the Pleistocene sands and gravels are underlain by a relatively thin layer of Ogallala formation. In other areas the Pleistocene deposits lie directly on nearly impermeable Cretaceous bedrock which is the base of the principal aquifer in the East Central Dissected Plains region.

The loess mantle is characterized by moderately slow permeability (Exhibit 3; and Figures 3 and 4 of Insert II - 1). Nearly all of the precipitation falling on the region is discharged through evapotranspiration or as surface runoff. General hydrogeologic characteristics of the Dissected Plains are indicated on Exhibits 3, 4, 4a, 5, 6, 7, 8, 9, 10, 13, 14, 15, and 16.

3). <u>Glacial Drift</u> - The Northeast Nebraska Glacial Drift region of the Elkhorn River Basin is located mostly in the Lower Elkhorn NRD (Reed, 1969; Exhibit 4). The region also covers part of the Lower Platte North NRD and nearly all of the Papio-Missouri NRD.

The Glacial Drift region formed from glacial till. It consists mostly of nonstratified silty clay mixed with pebble to boulder size rock fragments. Glacial till occurs nearly everywhere in the region but varies from a few feet to over 300 feet in thickness (Exhibit 5). Because of the heterogeneous nature of glacial till, characterizing the hydrogeologic make-up of this region is complex. The region is mantled with loess except in the Alluvial, Sandhills, and Sandy Till Plains subregions (Exhibit 4).

Lenses of sand and gravel are scattered throughout the region. There are extensive areas where material suitable for well construction is nonexistent. Where wells can be developed in such areas, they are of small capacity. In other areas sufficient sand and gravel deposits exist to provide well yields in the 700 to 1,200 gallons per minute range.

The Glacial Drift region includes a number of subregions. The subregions are identified as Alluvial, Sandy Till Plains, and Sandhills (Exhibit 4).

a). The Sandy Till Plain Subregions are characterized by gently rolling topography with valleys in a northwesterly direction. In most areas soils are extremely sandy and permeable. But in a few places clayey glacial till is exposed at the ground surface, and soil permeability is low. The Sandy Till Plain consists of two segments. One segment comprises about 65 square miles in Pierce, Madison, Stanton and Wayne counties; and the other segment includes about 30 square miles in Cuming and Dodge counties. In the northern segment the Quaternary sediments overlie the Cretaceous Niobrara chalky shale. In the southern segment they overlie the Cretaceous Dakota shaley sandstone. The Quaternary sediments include gravels (up to 100 feet thick) at the bottom, tills near the top, and several feet of wind deposited sand covering most of the land surface.

Groundwater is abundant, and although static levels are as much as 150 feet below ground surface, drawdowns are generally only a few feet in large capacity wells. The glacial tills are clayey and might be expected to retard the downward migration of agrichemicals, but high groundwater nitrate concentrations (greater than 10 milligrams per liter) have been documented in this area (Hanson, 1983; Alix, 1987; Gosselin, 1990; Appendix 4; Exhibit 17a; Reference 376).

b). The Alluvial Subregions consist of areas only ¼ to two miles wide along all major streams of the Lower Elkhorn NRD. Topography is very flat, with the only local relief consisting of stream meander scars and small sand dunes.

Soils are generally subirrigated, but vary greatly in permeability. The stream deposited sands, silts and gravels are generally 20 to 150 feet thick. Throughout most of the Lower Elkhorn NRD these materials have been deposited into glacial till, early Pleistocene gravel, and even into Cretaceous bedrock.

Groundwater availability is highly variable. Static groundwater levels are only 5 to 30 feet below ground surfaces, but drawdowns in large capacity wells may be over 100 feet. Natural water quality is poor in many places due to the abundance of buried ancient vegetation in the alluvium. In addition, the high groundwater table reduces the natural purification of recharge water, hence this region is vulnerable to groundwater pollution by agrichemicals (Reference 376).

c). The Sandhills Subregion is located just south of the Elkhorn River in Stanton county. The characteristics of the Subregion closely resemble those of the Sandhills region described previously.

The entire Glacial Drift region is underlain by Cretaceous bedrock which consists of stratified layers of Pierre shale, Niobrara chalk, Carlisle shale, Greenhorn limestone, Graneros shale and Dakota sandstone. Near the eastern boundary of the Lower Elkhorn NRD the upper layers of Cretaceous rock are nonexistent or relatively thin.

In parts of Dodge, Cuming, Colfax, Thurston and Burt counties, glacial till lies directly on the Dakota sandstone formation. The sandstone is saturated and low to medium-capacity wells have been successfully developed in the Dakota formation.

General hydrogeologic characteristics of the Glacial Drift region are in Exhibits 3, 4, 4a, 5, 6, 7, 8, 9,10, 13, 14, 15, and 16.

b. Aquifers

Aquifers in the Lower Elkhorn NRD consist of water bearing rock formations from the Quaternary, Tertiary, and Cretaceous geologic periods (Exhibits 4a and 5). The upper surface of the Cretaceous rocks is generally the base of the principal aquifer system (Exhibit 12). The principal aquifers above the Cretaceous rocks consist primarily of the Ogallala formation of the tertiary geologic period and the overlying sand and gravel deposits from the Quaternary period.

The Ogallala Formation is part of the High Plains Aquifer and consists of saturated sand and sandstone with intermixed layers of clay, silt and siltstone. It varies from nearly 400 feet in thickness in western Holt county in the Upper Elkhorn NRD to approximately 50 feet in thickness at the eastern edge of the Sandhills region in western Pierce county in the Lower Elkhorn NRD. In the Lower Elkhorn NRD the Ogallala Formation exists only in the western portion of the District (Exhibits 4a and 5).

The Quaternary deposits are part of the principal aquifer system in the Lower Elkhorn NRD. The Quaternary aquifers consist of saturated Pleistocene and Holocene sands and gravels. The aquifers exist over much of the Lower Elkhorn NRD, but the thickness varies greatly and the aquifer is virtually nonexistent in large areas of the Glacial Drift region. The sand and gravels lie above the Ogallala aquifer where it exists. In other portions of the District, the Quaternary deposits lie directly on the Cretaceous bedrock. In the Glacial Drift region, sand and gravel deposits are scattered in the glacial till.

The Cretaceous formations include the Pierre shale, Niobrara chalk, Carlisle shale, Greenhorn limestone, Graneros shale, and the Dakota sandstone. The Niobrara chalk and the Dakota sandstone formations have some potential for development as secondary aquifers.

The Niobrara chalk formation directly underlies Quaternary deposits in the vicinity of Norfolk and in both Wayne and Cedar counties (Exhibit 4a). The Dakota sandstone formation directly underlies glacial till in the eastern portion of the District.

Some existing wells in the District draw water from the Niobrara or the Dakota formations. Specific information on the formations is limited, especially for the Dakota formation. Development of the Dakota formation may be of value in areas where no overlying aquifer exists. Additional research and test drilling is needed to determine if development is feasible.

c. Groundwater Level Fluctuations

The Lower Elkhorn NRD has monitored groundwater levels (the depth to groundwater from the ground surface) in the spring and fall of each year since 1976. Fluctuations have occurred in the short term (1 to 5 years), but an overall, long term trend of either rising or declining groundwater levels has not been detected. Appendix 2 summarizes the spring groundwater level information collected by the district from 1976 through 1993, and contains graphs of the readings for each individual well. Further information for individual wells is available at the Lower Elkhorn NRD office.

d. Stream-Aquifer Relationships

The Elkhorn River is fed by groundwater seepage for nearly its full length (see Insert II - 1, page 28). There is some evidence that the river may provide some groundwater recharge between Oakdale and Meadow Grove.

The Sandhills region in the upper reaches of the basin contributes little runoff to streams, so virtually all flow in the river and its tributaries upstream from the North Fork results from groundwater seepage. The North Fork enters the Elkhorn River just east of Norfolk. Downstream from the North Fork intermittent surface runoff from the loess mantled Glacial Drift region of the basin adds significantly to the total flow in the river. Groundwater seepage to lower reaches of tributaries downstream from the North Fork does occur but is relatively small compared to surface runoff.

In 1991, a report issued from the University of Nebraska - Lincoln suggests that Willow Creek Reservoir in Pierce county is in hydraulic connection with groundwater in the area (Spalding, 1992). This report, funded by the district and the U.S. Environmental Protection Agency as part of the Clean Lakes Program, concludes that nutrient control in the lake would be difficult to accomplish with conventional watershed management techniques since the phosphorus in the lake is occurs naturally in the area groundwater.

B. *Vulnerability Description*

1. The Nebraska Department of Environmental Quality and the University of Nebraska Conservation and Survey Division produced a map depicting the relative vulnerability of groundwater to contamination. This map was generated by a model called DRASTIC, which uses 'hot' colors to show highly vulnerable drastic areas and 'cool' colors to show areas of low vulnerability. The model

assumes that the contaminant applied on the surface and is water-miscible. Figure II - 1 shows the general vulnerability of groundwater to a surface applied, water soluble contaminant. The model uses the following criteria to estimate vulnerability:

a. Depth to water.
b. Net recharge to the aquifer.
c. Aquifer media.
d. Soil media.
e. Topography.
f. Impact of the vadose zone.
g. Hydraulic conductivity of the aquifer.

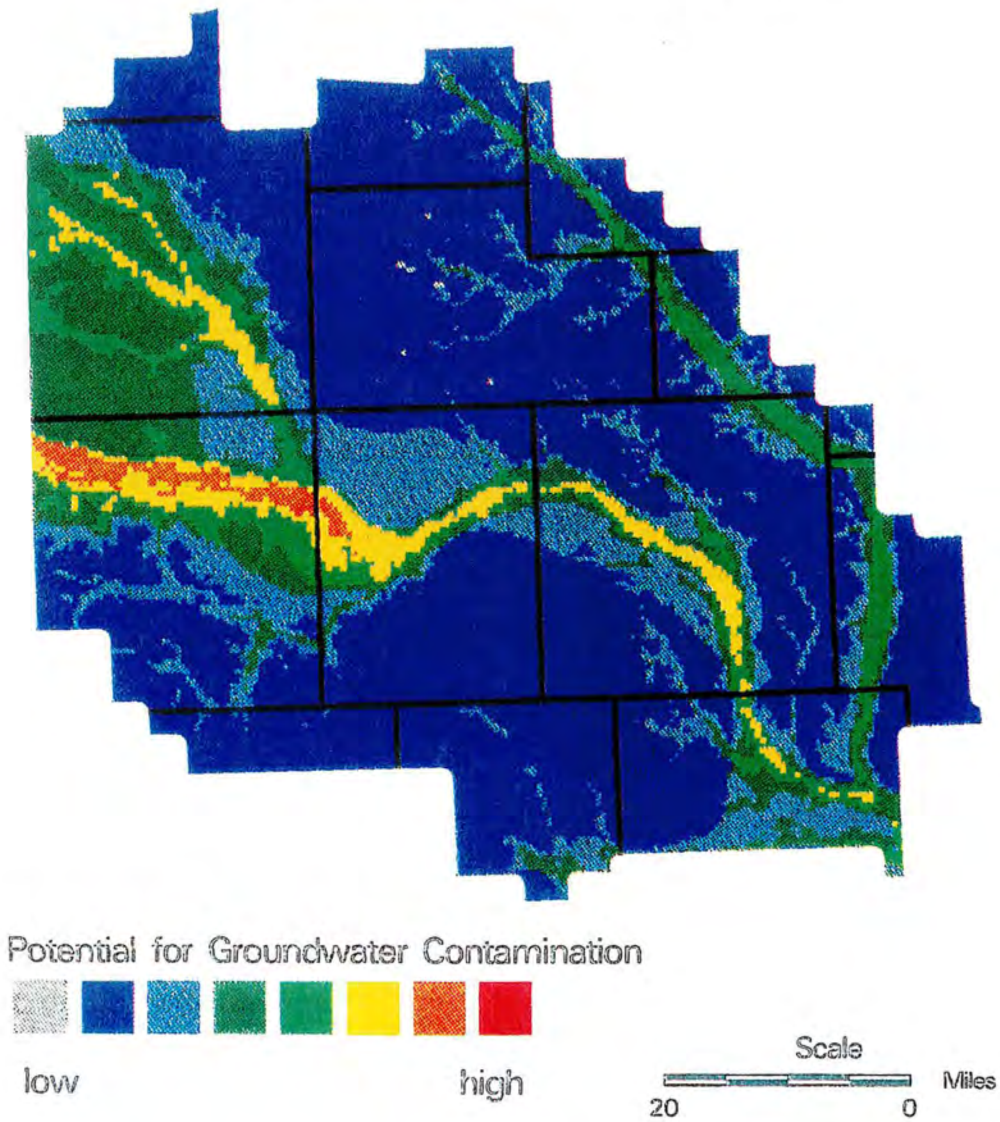
The following is a listing of the amount of land in each DRASTIC classification:

Vulnerability Classification		Area (acres)	Percent
Low	1	225	0.03
	2	376,275	58.24
	3	104,300	16.14
	4	83,625	12.94
	5	53,300	8.25
	6	21,350	3.30
	7	6,975	1.08
High	8	0	0.00

This model shows that the area west of Norfolk along the Elkhorn River is the most vulnerable area in the district (and is among the most vulnerable areas in the state). The rest of the area along the Elkhorn River, the area in Pierce county along the North Fork and the area along Logan Creek are also relatively vulnerable.

Groundwater Vulnerablity to Contamination
Using the DRASTIC Method

Lower Elkhorn Natural Resource District



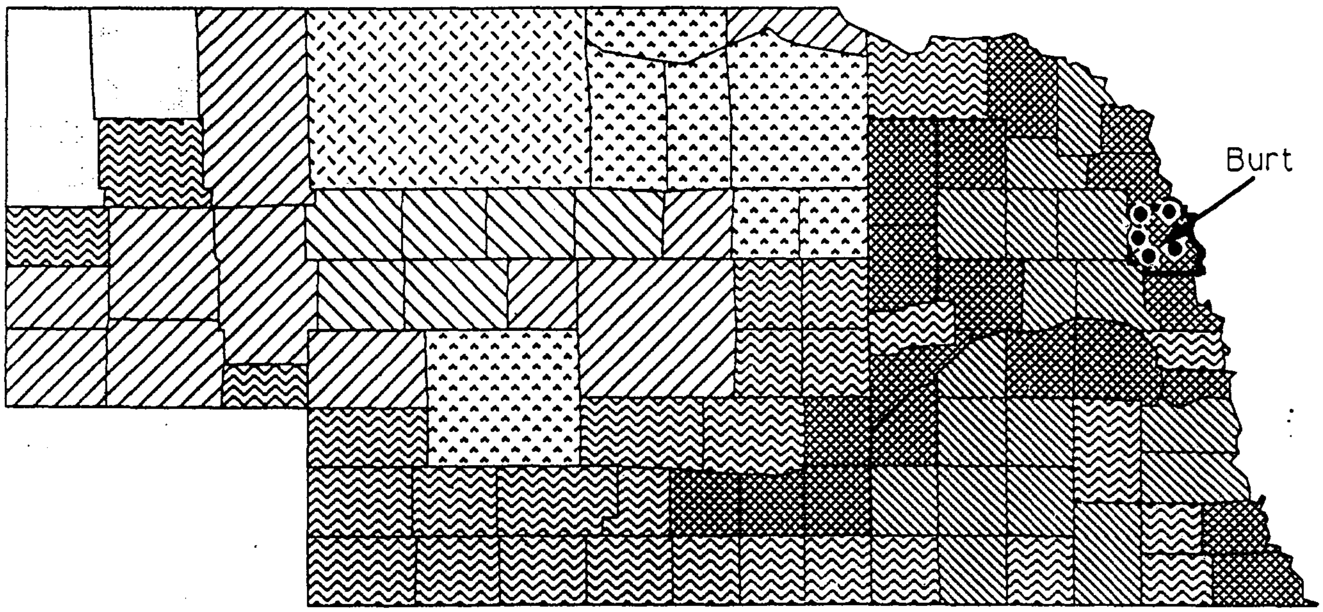
Source: CALMIT, Conservation and Survey Division Division

Figure II-1

2. The U.S. Environmental Protection Agency conducted a nation-wide survey for groundwater contaminants and in this process rated groundwater vulnerability to pesticide contamination (Figure II - 2). This was accomplished by combining the relative quantity of pesticides applied (on a county-wide basis) with the DRASTIC model. Most of the district is rated as 'high pesticide use, low vulnerability'.

   Pierce county is rated as 'high pesticide use, medium vulnerability'. This is useful information since nitrate-nitrogen contamination has been documented since the early 1980's in Pierce county, and the district can target pesticide screening for this area in the future.

National Pesticide Survey
Rural Domestic Wells
Sampled in Nebraska



Levels of Pesticide Use and Ground-Water Vulnerability

- High Pesticide Use, High Vulnerability
- High Pesticide Use, Medium Vulnerability
- High Pesticide Use, Low Vulnerability
- Medium Pesticide Use, High Vulnerability
- Medium Pesticide Use, Medium Vulnerability
- Medium Pesticide Use, Low Vulnerability
- Low Pesticide Use, High Vulnerability
- Low Pesticide Use, Medium Vulnerability
- Low Pesticide Use, Low Vulnerability
- Uncommon Pesticide Use, High Vulnerability
- Uncommon Pesticide Use, Medium Vulnerability
- Uncommon Pesticide Use, Low Vulnerability

Thirteen rural domestic water system wells were sampled in Nebraska These wells are indicated on the map by a circle, "●". Depicted wells on the map may include more than one well.

Depicted wells are based on zip codes and are not a representation of the exact well location.

Figure II - 1.

3. The Lower Elkhorn NRD entered a cooperative agreement with the U.S. Geological Survey to assemble existing information for the purpose of evaluating groundwater vulnerability. The report generated by this agreement appears in Insert II - 1.

United States Department of the Interior

GEOLOGICAL SURVEY

District Office
406 Federal Building
100 Centennial Mall North
Lincoln, NE 68508

May 21, 1993

Stan Staab
Lower Elkhorn Natural Resources District
P.O. Box 1204
Norfolk, NE 68701

Dear Mr. Staab:

Enclosed is the data summary and compilation for the Lower Elkhorn Natural Resources District, as per our cooperative agreement.

We appreciate the opportunity of working with you on this effort. If you or your staff have any questions concerning this summary, feel free to contact Dan Fitzpatrick at this office.

Sincerely,

Dan Fitzpatrick
For

Michael V. Shulters
District Chief

Enclosures

#212

DATA SUMMARY FOR THE LOWER ELKHORN NATURAL RESOURCES DISTRICT

Prepared by

U.S. Geological Survey
Nebraska District

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	by	To obtain
acre	4,047	square meter
degree Fahrenheit (F)	(F - 32)/1.8	degree Celsius (C)
foot	0.3048	meter
gallon per minute	0.06309	liter per second
inch	25.40	millimeter
inch per hour	25.40	millimeter per hour
mile	1.609	kilometer
pound	453.6	gram
square mile	2.590	square kilometer
ton	0.9072	megagram

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

VULNERABILITY DESCRIPTION

Surficial and Vadose-Zone Description

Topography

The topography within the Lower Elkhorn Natural Resources District (NRD) generally consists of rolling hills with moderate to steep slopes and rounded ridge crests. The maximum topographic relief is about 750 feet.

The topography of the NRD has been mapped on all or part of 92 U.S. Geological Survey 7.5-minute topographic quadrangles. Most mapping was done during the 1960's and was completed by 1974 (table 1). Photo-revisions of 18 of the mapped topographic quadrangles have also been published (table 2). Also, orthophotoquads of 10 quadrangles were completed in 1977.

Table 1. -- Number of topographic maps by year of publication

Number of quadrangles	Year quadrangle was published
31	1963
36	1966
6	1967
4	1968
3	1970
9	1971
3	1974

Table 2. -- Number of photo-revised topographic quadrangles by year of publication

Number of quadrangles	Year quadrangle was published
1	1975
7	1976
1	1977
1	1983
8	1985

Natural recharge areas and slopes are discussed in the next section.

Surficial Soil Description

General information

Information on soil descriptions, soil chemistry, soil physics, and soil mineralogy are available from four different sources: soil surveys published by the U.S. Department of Agriculture, Soil Conservation Service in cooperation with the University of Nebraska Conservation and Survey Division, the National Soil Survey Center-Soil Survey Laboratory research database (NSSC-SSL), a U.S. Geological Survey publication of the hydrological characteristics of Nebraska soils (Dugan, 1984), and unpublished information from the Concord Station, Department of Agronomy, Institute of Natural Resources, University of Nebraska-Lincoln.

Soil surveys.--Soil surveys are a series of county reports (U.S. Department of Agriculture, 1993). The most recent soil surveys of counties in the Lower Elkhorn NRD are listed in table 3 and are included in the reference section of this summary.

Table 3. -- List of most recent soil surveys of counties in the Lower Elkhorn Natural Resources District (U.S. Department of Agriculture, 1993)

Soil surveys	Year of publication
Soil survey of Antelope County	1978
Soil survey of Burt County	1980
Soil survey of Cedar County	1985
Soil survey of Colfax County	1982
Soil survey of Cuming County	1975
Soil survey of Dakota County	1976
Soil survey of Dixon County	1978
Soil survey of Dodge County	1979
Soil survey of Knox County	1930
Soil survey of Madison County	1984
Soil survey of Pierce County	1976
Soil survey of Platte County	1988
Soil survey of Stanton County	1982
Soil survey of Thurston County	1972
Soil survey of Wayne County	1975

The soil surveys describe many soil properties directly affecting land use and which may indirectly affect the water quality of underlying aquifers. Soil associations have a distinct pattern of soils, relief, and drainage. However, within any one association a large diversity of slopes, depth of soil profile, drainage, and other characteristics can exist. The soil associations are illustrated on general soil maps. The soil survey reports also list the soil mapping units and their properties and illustrate their geographic distribution on maps.

Each soil association is described in the soil surveys. Information contained in the surveys includes a description of the soils, their location, and a discussion of the management of the soils for specific uses. The steepness, length, and shape of the slopes; the general drainage pattern; the crops and native plants; and the kinds of bedrock also are described in the surveys.

Tables commonly included in the soil surveys summarize the following information:

1. Temperature and precipitation,
2. Freeze dates in spring and fall,
3. Growing season,
4. Acreage and proportional extent of the soils map units,
5. List of soils considered prime farm land,
6. Land capability classes and yields per acre of crops and pasture,
7. Capability classes and subclasses,
8. Water management,
9. Engineering index properties,
10. Physical and chemical properties of the soil such as depth, percent clay, moist bulk density, permeability, available water capacity, soil reaction (pH), salinity, shrink-swell potential, erosion factors, and organic matter,
11. Soil and water features such as flooding frequency, depth to water table, and risk of corrosion,
12. Engineering test data such as grain size distribution, liquid limit, plasticity index, and specific gravity, and,
13. Soil classification.

NSSC-SSL research database.--The National Soil Survey Center--Soil Survey Laboratory (NSSC-SSL) research database of the Soil Conservation Service in Lincoln, Nebraska, provides soil descriptions, and chemical, physical, and mineralogical information of the pedons in table format. Table 4 (in appendix A) lists selected laboratory characterization data elements available from the NSSC-SSL research database. Descriptions, characterization data, or mineralogy from the NSSC-SSL research database are available on the following soil series that occur in the Lower Elkhorn NRD:

Alcester, Anselmo, Aowa, Belfore, Blyburg, Bon, Burchard, Carr, Crofton, Gayville, Geary, Hastings, Hobbs, Holdrege, Hora, Lamo, Lamoure, Lawet, Leshara, Lutor, Mariaville, Maskell, Moody, Napa, Nora, Omadi, Ortello, Orwet, Paka, Redstone, Sharpsburg, Shell, Steinauer, Thurman, and Variant.

Other sources.--Dugan (1984) describes the hydrologic characteristics of the soil associations present in the Lower Elkhorn NRD. The hydrologic characteristics of these soil associations are discussed below. In addition, limited information, mainly on soil fertility, can be obtained from the Concord Station of the Department of Agronomy, University of Nebraska-Lincoln.

Soil description

Within the Lower Elkhorn NRD, 27 soil associations were identified (fig. 1). The most important soil associations in the area are the Nora-Crofton-Moody, Moody-Nora-Judson, Nora-Moody-Judson, Kennebec-Nodaway-Zook, and Thurman-Boelus-Nora Associations covering approximately 21, 20, 13, 11, and 9 percent of the surface area of the NRD, respectively (fig. 1). The Nora-Crofton-Moody Association occurs mainly in the western half of the NRD. The Moody-Nora-Judson Association occurs mainly in the eastern third of the NRD and is surrounded by the Nora-Moody-Judson Association to the west and north. The Kennebec-Nodaway-Zook Association occurs mainly along the reaches of Logan and Maple Creeks, the Elkhorn River, and their tributaries. Finally, the Thurman-Boelus-Nora Association occurs mainly along the Elkhorn River and in the northwestern part of the NRD. The Marchall-Ponca and Steinauer-Pawnee-Burchard Associations occur in very small areas in the NRD and cannot readily be seen on figure 1.

Using the soil classification of the U.S. Soil Conservation Service, the main soil order present in the Lower Elkhorn NRD is the Mollisol. Mollisols are characterized by thick surface horizons with well-developed, dark-colored (rich in organic matter) A and B horizons; high base saturation (percentage of cation-exchange capacity saturated with calcium, magnesium, sodium, and potassium); and a granular structure. Most Mollisols in the area belong to the Ustoll Suborder. This group of Mollisols occurs in areas, such as the NRD, with a warm-to-hot growing season that is intermittently dry for short periods (Dugan, 1984). Another important soil order present in the NRD is the Entisol. Soils of this order are not well developed and have thin or light-colored (low in organic matter) A horizons. The soil profile of the Entisol generally is limited to A and C horizons. These soils generally have lower base saturations. Most Entisols in the area belong to the Aquent, Fluvent, Orthent, and Psamment Suborder. The most important soil suborders present in the Lower Elkhorn NRD and their parent material are listed in table 5.

Table 5. -- Soil orders and suborders and their parent material present in the Lower Elkhorn Natural Resources District (U.S. Department of Agriculture, 1993)

Soil order	Soil suborder	Parent material
Mollisol	Ustoll	Loess, glacial till, alluvium, and eolian sand
Mollisol	Aquoll	Alluvium
Entisol	Orthent	Glacial till and loess
Entisol	Fluvent	Alluvium
Entisol	Psamment	Eolian sand
Entisol	Aquent	Alluvium

Narrative descriptions of 11 of the 73 pedons collected by the National Soil Survey Laboratory exist. Pedon descriptions include pedon name, soil survey number, location, physiography, geomorphologic position, microrelief, slope, drainage, stoniness, erosional or depositional character, parent material, classification, land use, elevation, sample date, and description of horizons. Horizon descriptions include thickness, color, texture, structure, pH, and description of horizon boundary.

Soil physical and chemical characteristics

Soil physical properties include bulk density, permeability, porosity, shrink-swell potential, slope, structure, texture, and available water capacity. These properties are listed and described by soil mapping unit in the soil surveys.

Soil chemical properties include acidity (pH); cation exchange capacity (CEC); electric conductivity; total sulphur; extractable aluminum, manganese, and iron; extractable bases of calcium, magnesium, potassium, and sodium; extractable phosphorous, surface area (SA), total nitrogen, total organic carbon, and water content.

Soil chemical and physical data exist on 41 of the 73 pedons collected by the NSSC-SSL. The data include information on (1) bulk density, (2) cation-exchange capacity (CEC), (3) electric conductivity, (4) extractable aluminum, manganese, and iron, (5) extractable bases of calcium, magnesium, potassium, and sodium, (6) extractable phosphorous, (7) pH, (8) organic carbon content, (9) total nitrogen, (10) total sulphur, and (11) water content. However, available data on most of the pedons are limited to extractable bases, organic matter content, pH, total nitrogen, and water content.

Available water capacity.--Available water capacity is the quantity of water a soil is capable of storing for use by plants and indirectly provides information on the leaching potential of dissolved contaminants in soil water. The water capacity is given in inches of water per inch of soil for each major soil layer. The factors affecting water capacity include organic matter content, soil texture, bulk density, and soil structure.

In the Lower Elkhorn NRD the available water capacity ranges from 0.07 to 0.21 inches per inch (fig. 2). Lowest available water capacity is found in soil with sandy alluvium and eolian sand as parent material. Highest available water capacities generally occur in soils with loess and silty colluvium as parent material. Areas with low available water capacity (areas shown in purple on fig. 2) generally are more vulnerable to groundwater contamination than areas with high available water capacity (areas shown in yellow on fig. 2).

Permeability.-- Soil permeability is the rate at which soil, under saturated conditions, transmits water in a vertical direction under a unit head of pressure. Soil permeability and the permeability of the remaining unsaturated zone largely governs the recharge to the zone of saturation. Areas with permeable soils generally have minimal runoff due to the rapid infiltration and percolation of precipitation. Therefore, areas with permeable soil profiles tend to be more vulnerable to groundwater contamination.

Soil permeability is affected by physical and chemical properties of the soil such as structure, porosity, and texture. Figure 3 illustrates the soil permeabilities of the 60-inch soil profile. Figure 4 illustrates the permeability of the least permeable soil horizon. The least permeable soil horizon typically is the B-horizon in well-developed soils such as Mollisols. The permeability of the least permeable soil horizon generally is smaller than the permeability of the 60-inch profile. Therefore, the permeability of the least permeable horizon may be a more accurate measure of potential for contamination.

In the Lower Elkhorn NRD, the permeability of the 60-inch profile ranges from about 0.2 inches per hour for clay soils to more than 12 inches per hour for sandy soils. The permeability of the least permeable soil horizon ranges from about 0.1 inch per hour for soils with a clayey horizon to more than 10 inches per hour for soils without a clayey horizon. Areas with low soil permeabilities (illustrated in yellow on figs. 3 and 4) generally have lower potential for contaminants to move through the soil profile than areas with high permeabilities (illustrated in purple and gray on figs. 3 and 4).

Slope.--Soil slopes are an important factor in the potential for contaminants to reach the aquifer system as they affect the time for precipitation to infiltrate the soil. The soil slope is expressed as the difference in elevation, in feet, for each 100 feet of horizontal distance and is given as a percentage. Maximum soil slopes referred to here were calculated by Dugan (1984) as averages of maximum slopes. Figure 5 illustrates the average maximum percent slope of the soil associations in the Lower Elkhorn NRD.

Generally the surface in the NRD has gentle slopes. The average maximum slopes range from 0 to more than 20 percent (fig. 5). Average maximum slopes of less than three percent occur in the bottomlands along a large number of streams and tributaries. Average maximum slopes of 3 to 10 percent occur mainly along the Elkhorn River, in the southeast corner of the NRD, and in northern Pierce and southern Knox Counties. Average maximum slopes of 10 to 20 percent are found mainly on the uplands. The average maximum slope exceeds 20 percent only where the Steinauer-Pawnee-Burchard and Monona-Ida Associations occur. These associations mainly occur along the eastern edge of the NRD.

Soil structure.--Soil structure describes arrangement of primary soil particles into compound aggregates particles. The soil structure of the soils within the NRD is described in the soil surveys for each horizon by soil series. The soil structure varies widely from a single grain, fine, and weak structure in sand (e.g., Valentine) to a blocky, moderate, and strong structure in soils with moderate to high shrink-swell capacity (e.g., Fillmore).

Porosity.--Porosity is the volume of interconnected pore space and is expressed quantitatively as a ratio of the volume of pores to the total volume. Soil porosity exists because of the packing of the grains and disturbances including shrinking and swelling, penetration of roots, and tillage. Soil porosity is not included in the soil surveys or the NSSC-SSL research database; but bulk densities are included. Soil porosity can be estimated from the bulk density by determinations.

Soil texture.--The soil texture (size group of individual soil grains) is classified as the percentage of clay, silt, and sand in the basic U.S. Department of Agriculture soil textural classes. Soil texture is an important soil characteristic as it may suggest soil mineralogy, water and nutrient holding capability of the soil, and indirectly, the potential of pollutants to leach through the soil profile. For example, the percentage of clay affects both the chemical and physical character of the soil, such as its ability to adsorb contaminants and retain moisture.

The NSSC-SSL collected 73 pedons and conducted particle size analyses on all the horizons of these pedons . The soils vary from silty and clayey soils mainly in areas with glacial till and loess as the parent material (e.g., Clarno-Nora-Betts Association), to sandy and very sandy soils with eolian sand or sandy and gravelly alluvium as parent material (e.g., Valentine-Thurman Association).

Hydrologic soil group.-- Dugan (1984) classified the soil associations and assigned them to hydrologic soil groups based on the average permeability of the 60-inch soil profile, the average maximum slope, and depth to the seasonal high water table for the purpose of explaining the hydrologic responses of Nebraska soils (table 6) (fig. 1). Dugan also used the average permeability of the least permeable soil horizon and the average available water capacity to explain some of the hydrologic responses of the soil.

Table 6. -- Numeric code for hydrologic grouping of the soil associations in the Lower Elkhorn Natural Resources District (Dugan, 1984)
[in, inches; hr, hour; %, percent]

Average permeability		Average maximum slope		Depth to seasonal water table	
Code number	Range (in/hr)	Code number	Range (%)	Code number	Feet
1	Less than 1.0	1	0 to 2.99	1	Less than 6
2	1.0 to 1.99	2	3.0 to 9.99	2	Equal or greater than 6
3	2.0 to 4.99	3	10.0 to 19.99	--	--
4	5.0 to 9.99	4	20.0 to 30	--	--
5	Greater than and equal to 10	--	--	--	--

In the soil surveys hydrologic soil groups are classified according to the intake of water when soils are thoroughly wet and receive precipitation from long-duration storms. These hydrologic soil groups are considered a measure of infiltration and runoff from precipitation. Hydrologic soil groups are classified in the soil surveys as group A soils--having high infiltration rate when thoroughly wet, group B soils--having moderate infiltration rate when thoroughly wet, group C soils--having slow infiltration rate when thoroughly wet, and group D-- soils having a very slow infiltration rate when thoroughly wet and thus a high runoff potential. Infiltration rate is the speed at which water penetrates the soil and is governed by the initial water content of the soil, the available water capacity of the soil, the permeability of the soil, the amount and type of vegetation cover, and the slope of the surface. In general, soil with eolian sand as parent material tends to have a high infiltration rate (e.g., Valentine-Thurman Association), while soils with loess or glacial till as parent material tend to have moderate to low infiltration rates (e.g., Moody-Fillmore Association). Not all soil associations listed in table 7 have been assigned to a hydrologic soil group by the U.S. Department of Agriculture.

Atterberg limits.--The Atterberg limits, liquid limit, and plasticity index indicate the plasticity of the soil. These soil characteristics are estimated in the field and listed in the soil surveys by soil mapping unit. The Atterberg limits vary widely from low values in the sandy soils to high values in the clayey soils with high shrink-swell potential in the Lower Elkhorn NRD.

Bulk density.--The bulk density is the weight of oven-dry soil per unit volume and provides information on other soil properties such as shrink-swell potential, available water capacity, and total pore space.

Oven-dry bulk densities do not vary much and are typically around 1.3 to 1.8 grams per cubic centimeter in the Lower Elkhorn NRD. Bulk densities tend to increase by compaction and with depth in the soil profile because of increasing overburden materials and decreasing disturbance.

Organic matter.--Organic matter is the plant and animal residue in the soil at various stages of decomposition. It is expressed as a percentage by weight of soil material less than 2 millimeters in diameter. Organic matter affects the available water capacity and infiltration rate.

Table 7. -- Hydrologic characteristics and parent material of the soil associations in the Lower Elkhorn Natural Resources District
[in, inches; hr, hour; %, percent, USDA, U.S. Department of Agriculture; --, not available]

Soil associations (Dugan, 1984)	Surface area (thousand acres)	Parent material	Average maximum slope (%)	Permeability of 60-inch profile (in/hr)	Permeability of least permeable horizon (in/hr)	Average available water capacity (in/in)	Hydrologic soil group (Dugan, 1984)	Hydrologic soil group (USDA classification system)
Nora-Crofton-Moody	534	Loess	18	1.28	1.26	.2	232	B
Moody-Nora-Judson	516	Loess and silty collu-vium	10	1.25	1.22	.2	222	B
Nora-Moody-Judson	326	Loess and silty collu-vium	12	1.27	1.25	.19	232	B
Kennebec-Nodaway-Zook	285	Alluvium	1	1.11	1.05	.2	211	B-D
Thurman-Boelus-Nora	240	Eolian sand	13	8.58	2.86	.14	432	A-B
Hobbs-Hord	126	Alluvium and loess	2	1.48	1.3	.2	312	B
Moody-Fillmore	75	Loess	6	1.13	1.0	.19	212	B-D
Cass-Inavale	63	Alluvium	3	8.73	2.52	.11	412	A-B
Moody-Bazile-Trent	57	Loess	5	2.76	.96	.17	322	--
Moody-Thurman	43	Loess over eolian sand	11	5.15	2.12	.15	432	A-B
Nora-Crofton-Judson	43	Loess and silty collu-vium	18	1.3	1.3	.21	232	B

Table 7. -- Hydrologic characteristics and parent material of the soil associations in the Lower Elkhorn Natural Resources District--Cont.
[in, inches; hr, hour; %, percent, USDA, U.S. Department of Agriculture; --, not available]

Soil associations (Dugan, 1984)	Surface area (thousand acres)	Parent material	Average maximum slope (%)	Permeability of 60-inch profile (in/hr)	Permeability of least permeable horizon (in/hr)	Average available water capacity (in/in)	Hydrologic soil group (Dugan, 1984)	Hydrologic soil group (USDA classification system)
Valentine-Thurman	43	Eolian sand	14	12.88	10.75	.08	532	A
Elsmere-Ipage-Loup	38	Eolian sand and alluvium	2	12.65	6.35	.09	511	A-D
Belfore-Moody	36	Loess	3	.67	.65	.19	112	B
Thurman-Hadar-Ortello	28	Eolian sand over glacial till	10	10.5	2.56	.1	532	A-B
Gibbon-Wann	28	Alluvium	2	2.94	1.2	.19	311	B
Zook-Leshara-Wann	25	Alluvium	2	1.73	.53	.16	211	B-D
Bazile-Paka-Thurman	24	Loess over eolian sand	9	6.55	1.62	.14	422	A-B
Lawet-Elsmere-Gannett	22	Alluvium and eolian sand	2	7.24	2.67	.13	411	A-D
Clarno-Nora-Betts	10	Glacial till and loess	11	1	.7	.18	232	B
Gibbon-Luton	3	Alluvium	1	1.42	.67	.18	211	B-D
Monona-Ida	2	Loess	27	1.3	1.3	.21	242	--
Hord	2	Loess	3	1.3	1.3	.21	212	B
Wymore-Pawnee	2	Alluvium	10	.24	.13	.14	122	--

Table 7. -- Hydrologic characteristics and parent material of the soil associations in the Lower Elkhorn Natural Resources District--Cont.
[in, inches; hr, hour; %, percent, USDA, U.S. Department of Agriculture; --, not available]

Soil associations (Dugan, 1984)	Surface area (thousand acres)	Parent material	Average maximum slope (%)	Permeability of 60-inch profile (in/hr)	Permeability of least permeable horizon (in/hr)	Average available water capacity (in/in)	Hydrologic soil group (Dugan, 1984)	Hydrologic soil group (USDA classification system)
Inavale-Boel-Barney	1	Sandy alluvium	2	12.71	6.03	.07	511	A-D
Marshall-Ponca	<1	Loess	13	1.31	1.31	.2	232	--
Steinauer-Pawnee-Burchard	<1	Glacial Till	26	.61	.31	.14	142	--

Organic matter varies from less than 0.5 to 8 percent in the soil mapping units in the Lower Elkhorn NRD. In general, soils have about 1 to 4 percent organic matter in the soil profile. Soils with eolian sand as parent material generally have a low percentage of organic matter (e.g., Valentine with as small as 0.5% organic matter). Soils with alluvium as parent material generally have the largest percent organic matter (e.g., Zook with up to 8% organic matter).

Salinity.--Salinity is a measure of the soluble salts in the soil at saturation and is expressed as the electrical conductivity of the saturation extract in millimhos per centimeter at 25 degrees Celsius. The salinity of the major soil mapping units is less than 2 millimhos per centimeter in the Lower Elkhorn NRD.

Shrink-swell potential.--Shrink-swell potential is the potential for a volume of soil to change with loss or gain of moisture. The volume change depends upon the type and amount of clay minerals present in the soil. Thus, the shrink-swell potential generally is dependent upon the parent material of the soil.

In the Lower Elkhorn NRD most soil series have a moderate shrink-swell potential. A soil with eolian sand as parent material generally has a low shrink-swell potential (e.g., Valentine). A soil with glacial till or clayey alluvium as parent material generally has a high shrink-swell potential (e.g., Zook and Luton).

Soil reaction.--Soil reaction is expressed as a range of pH values and is a measure of acidity or alkalinity of the soil. The pH varies from 5.1 to 9.0 and generally is slightly alkaline to acidic (6.1-8.4) in the Lower Elkhorn NRD. Zook is the most acidic soil series.

Soil mineralogy

Soil mineralogical data exist on six samples--fine-clay mineralogy of five samples and fine-sand mineralogy of one sample. Table 8 in appendix A lists the minerals which can be identified by the National Soil Survey Laboratory. Fine-clay minerals include mica, kaolinite, montmorillonite, and quartz. Fine-sand minerals include quartz, chalcedony, glass, hornblende, opaques, potassium feldspar, and plagioclase.

Natural recharge areas

Natural recharge areas mainly occur in areas with near level to moderate slopes, high to moderate soil and unsaturated zone permeabilities, and low to moderate available water capacities (e.g., Inavale-Boel-Barney Association). Based on soil information, these areas mainly occur at locations illustrated on figures 2 through 5 in red, purple, and gray.

Vadose-Zone Description

Infiltration rate

Information on the infiltration rate of the vadose zone is not available.

Unconsolidated sediment characteristics

Test hole data from 308 test holes (fig. 6) drilled since 1945, as part of a cooperative program between the USGS and the Conservation and Survey Division, generally describe the areal differences in the unsaturated sediments of the area. Sample description logs are published in booklet form, generally, by county, and can be obtained from the Conservation and Survey Division, Institute of Agricultural and Natural Resources, University of Nebraska-Lincoln.

The number of test holes by county and the number of test holes per 10,000 acres are listed in table 9. In general, 1.19 test holes per 10,000 acres exist in the NRD. The number of test holes per 10,000 acres varies from 0 in Antelope and Dakota Counties to 1.80 in Madison County.

Table 9. -- Number of test holes by county and surface area of counties in the Lower Elkhorn Natural Resources District

County	Surface area of county (in thousands of acres)	Number of test holes	Number of test holes per 10,000 acres
Antelope	1	0	0
Burt	135	18	1.33
Cedar	121	16	1.33
Colfax	158	5	.32
Cuming	368	39	1.06
Dakota	1	0	0
Dixon	82	6	.73
Dodge	236	40	1.70
Knox	55	3	.54
Madison	345	62	1.80
Pierce	368	38	1.03
Platte	74	3	.40
Stanton	276	46	1.67
Thurston	90	10	1.12
Wayne	284	22	.78
Total	2,594	308	1.19

The thickness of the unsaturated sediments varies from 0 to more than 200 feet in Stanton, western Wayne and eastern Pierce Counties, and is generally 50 to 200 feet thick. The unsaturated sediments mainly consist of Quaternary loess deposits (mainly silt) and glacial till on the uplands, and loess, sand, and gravel deposits in the valleys, including the paleovalleys. Discontinuous strata of clay exist as well. Dune-sand deposits occur in western Pierce County. Glacial till underlies the NRD except in western Pierce and Madison Counties and areas along the principal streams such as the Elkhorn River and Logan Creek (Burchett and Maroney, 1979, p.16).

Typically, the distribution of unsaturated sediments has been affected by the presence of paleovalleys and by erosion causing a complex distribution and a diverse thickness of the geological strata. Locally, the complex unsaturated-zone geology can be deciphered with the information obtained from test holes. However, test holes are absent in large areas (fig. 6) and the number of test holes per 10,000 acres is very low (table 9).

Deep-core sampling summary

Information on deep-core samples (>60 inches) in the Lower Elkhorn NRD is not available.

Depth to Groundwater

The depth to groundwater varies throughout the Lower Elkhorn NRD. Data from 238 groundwater observation wells measured during the spring of 1991 in the NRD indicate that groundwater levels ranged from less than 10 feet to more than 250 feet below the land surface. The shallowest depths to groundwater generally occur within the alluvium deposits in Pierce County, along the reach of Logan Creek from eastern Cedar County to the confluence with the Elkhorn River, and upstream of the confluence of Pebble Creek and the Elkhorn River (fig. 7). In these areas the groundwater systems probably have a direct hydraulic connection with the surface-water systems. The deepest groundwater levels in the NRD, those greater than 200 feet below the land surface, generally occur in northeastern Pierce, northwestern Wayne, and southern Knox and Cedar Counties. These areas, along with a small area in western Burt County, also have several observation wells showing spring 1991 depths to groundwater between 150 and 200 feet. Elsewhere in the NRD, depth to groundwater generally is between 50 to 100 feet below the land surface.

The vulnerability of aquifers to contamination by point source or nonpoint source contaminants is, in part, a function of the depth to groundwater. In those areas where the depth to groundwater is shallow and soils are well drained, the vulnerability of the groundwater system is probably the greatest. Therefore, the most vulnerable parts of the Lower Elkhorn NRD, with respect to the depth to groundwater, would likely be the areas along the major rivers and the least vulnerable areas would likely be in the uplands.

External Groundwater Recharge Sources

Natural Recharge

Precipitation

Normal annual precipitation within the Lower Elkhorn NRD ranges from about 24 inches in the western part of the District to approximately 28 inches in the east (fig. 8) (Steele, 1988). The normal annual precipitation is the 30-year average value of the precipitation received during 1951-80 as measured by the National Oceanic and Atmospheric Administration (NOAA). The 15 NOAA stations within the NRD for which the 30 years of precipitation data exist are: Beemer, Clarkson, Dodge, Emerson, Laurel, Lyons, Madison, Norfolk WSO AP, Osmond, Pilger, Stanton, Wakefield, Wayne, West Point, and Winside. Normal annual precipitation for each of these stations is given in the following table and the station locations are shown on figure 8 (Steele, 1988).

Table 10. --Normal annual precipitation for NOAA stations within the Lower Elkhorn Natural Resources District

NOAA stations	Normal annual precipitation (in inches)
Beemer	26.51
Clarkson	27.81
Dodge	28.30
Emerson	28.39
Laurel	24.99
Lyons	27.40
Madison	25.34
Norfolk WSO AP	23.79
Osmond	25.14
Pilger	25.32
Stanton	25.56
Wakefield	26.11
Wayne	25.62
West Point	27.91
Winside	25.83

Monthly maximum, minimum, and normal precipitation amounts for each station for the period 1951-80 are listed in table 11. These values illustrate the extremes in precipitation amounts received at each station.

Table 11. -- Monthly maximum, minimum, and normal precipitation at NOAA stations for 1951-80
[T = trace of precipitation measured]

Station name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
Beemer												
minimum	0.09	0.08	0.14	0.73	1.90	0.82	0.31	0.48	0.31	0.00	T	0.08
maximum	1.59	3.59	4.13	6.35	9.60	10.65	9.13	6.38	10.09	5.62	3.29	2.31
normal	0.65	0.98	1.58	2.46	2.98	4.11	3.26	3.47	2.50	1.92	0.91	0.69
Clarkson												
minimum	0.06	0.02	0.24	0.50	1.20	0.77	0.16	0.54	0.35	0.00	T	0.00
maximum	2.44	3.48	5.71	7.05	11.09	12.18	10.51	8.02	10.58	6.65	3.62	2.26
normal	.69	.98	1.80	2.58	4.28	4.24	3.44	3.49	2.60	1.96	0.99	0.76
Dodge												
minimum	0.07	0.06	0.12	0.41	2.31	0.99	0.40	0.32	0.32	0.00	T	0.00
maximum	1.97	3.27	4.20	7.09	9.01	12.65	9.37	9.14	10.10	5.19	2.56	2.49
normal	0.60	1.00	1.69	2.74	4.59	4.75	3.13	3.72	2.59	1.79	0.98	0.72
Emerson												
minimum	0.16	0.06	0.25	0.51	1.46	1.13	0.48	0.68	0.31	0.00	0.00	0.11
maximum	1.90	3.55	5.48	5.49	8.45	12.48	10.59	8.00	10.66	6.71	3.75	1.78
normal	0.63	1.13	2.00	2.68	4.18	4.38	3.52	3.22	2.87	1.98	1.03	0.77
Laurel												
minimum	0.02	0.04	0.02	0.41	0.71	1.46	0.67	0.54	0.46	0.00	0.02	0.05
maximum	1.52	3.39	5.64	5.15	7.78	10.74	8.04	10.51	7.07	5.02	3.29	3.27
normal	0.52	0.87	1.67	2.32	3.79	4.04	3.07	3.25	2.30	1.56	0.89	0.71
Lyons												
minimum	0.12	0.02	0.21	0.57	1.04	1.04	0.57	0.33	0.52	T	T	0.04
maximum	2.09	3.15	4.47	4.96	11.25	10.31	6.77	6.73	10.71	6.96	3.19	2.02
normal	0.57	0.94	1.73	2.62	4.38	4.41	3.07	3.47	2.77	1.92	0.90	0.62
Madison												
minimum	T	0.04	T	0.50	1.28	1.21	0.73	0.36	0.42	0.00	T	T
maximum	1.88	2.62	5.20	5.74	10.19	11.21	8.46	7.62	7.48	5.23	3.31	1.71
normal	0.49	0.82	1.55	2.48	4.06	4.56	3.25	3.11	2.15	1.50	0.76	0.61
Norfolk WSO AP												
minimum	0.10	0.06	0.06	0.23	1.38	0.86	0.33	0.53	0.30	T	0.00	0.08
maximum	1.74	3.18	5.14	4.35	8.61	12.22	8.43	5.93	6.88	4.57	3.67	1.75
normal	0.52	0.80	1.54	2.21	3.71	4.35	3.21	2.65	2.09	1.36	0.72	0.63
Osmond												
minimum	T	0.02	0.26	0.56	0.56	0.71	0.39	0.90	0.00	0.00	0.00	0.00
maximum	1.43	3.51	5.33	6.30	8.81	11.35	9.10	7.37	7.86	6.06	3.60	2.29
normal	0.51	0.95	1.66	2.59	3.75	3.93	3.31	3.11	2.27	1.37	0.97	0.72

Table 11. -- Monthly maximum, minimum, and normal precipitation at NOAA stations for 1951-80--Cont.
[T = trace of precipitation measured]

Station name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
Pilger												
minimum	0.05	0.20	0.06	0.31	1.71	1.11	0.28	0.41	0.35	T	T	0.04
maximum	2.40	3.17	3.82	4.97	10.45	11.16	10.29	6.64	7.84	4.80	3.04	2.19
normal	0.53	0.84	1.53	2.22	4.14	4.43	3.16	3.16	2.25	1.59	0.84	0.64
Stanton												
minimum	0.10	T	0.12	0.29	1.61	0.99	0.44	0.51	0.41	0.00	0.03	T
maximum	1.97	2.96	5.52	4.93	8.48	10.47	9.16	6.21	7.44	5.25	3.91	2.85
normal	0.61	0.95	1.76	2.37	4.20	4.31	3.08	2.88	2.24	1.53	0.91	.72
Wake-field												
minimum	0.05	0.09	0.15	0.49	1.59	1.08	0.36	0.49	.38	0.00	0.02	0.05
maximum	2.00	3.38	5.33	5.14	8.40	12.40	10.28	7.96	5.69	4.92	4.06	2.67
normal	0.58	0.95	1.81	2.34	3.98	4.11	3.28	3.08	2.53	1.74	0.98	0.73
Wayne												
minimum	0.05	0.08	0.08	0.33	1.34	1.09	0.47	0.38	0.33	0.00	T	0.04
maximum	1.55	3.99	5.13	4.21	9.78	11.56	8.48	6.56	8.06	4.48	4.23	2.24
normal	0.54	1.00	1.69	2.27	4.07	4.44	3.09	2.99	2.43	1.55	0.90	0.65
West Point												
minimum	0.11	0.07	0.19	0.62	1.39	0.68	0.10	0.18	0.34	0.00	T	0.02
maximum	2.63	3.91	4.18	5.25	9.33	12.72	10.19	8.20	11.08	5.92	3.78	2.81
normal	0.68	1.09	1.76	2.61	4.34	4.47	3.06	3.54	2.64	1.91	1.02	0.79
Winside												
minimum	0.15	T	0.04	0.64	0.76	0.78	0.36	0.14	0.54	0.00	T	0.06
maximum	2.69	3.04	5.24	5.13	9.28	10.65	11.69	7.08	7.36	4.65	3.32	2.46
normal	0.62	0.95	1.74	2.29	4.27	4.26	3.29	2.91	2.36	1.59	0.83	0.79

Groundwater recharge from precipitation is influenced by soil permeability, available water capacity, and soil slope. These factors influence the infiltration rates of precipitation into the soil and the volume of water that can be retained within the soil zone (Dugan, 1984). Other factors, such as the amount, duration, and intensity of precipitation, also affect recharge from precipitation.

Streams (gaining/losing)

Almost all of the streams in the Elkhorn River basin are gaining streams, which are streams whose flow is increased by the inflow of groundwater. Seepage measurements from the Elkhorn River and its tributaries in Pierce, Madison, Wayne, Stanton, Platte, Cuming, and Dodge Counties were made on September 28 and October 1-2, 1979. These measurements and observations indicate that most reaches in the streams that were measured gained flow due to groundwater seepage (appendix B in back).

Lakes, wetlands, and sandpits

Lakes within the NRD.--Lakes occurring within the Lower Elkhorn NRD generally are associated with the Elkhorn River. Most of these lakes are oxbow lakes which occupy former meanders in the River channel, but some of the lakes have resulted from or were enlarged by sand and gravel dredging. Some of these lakes have begun to fill with sediment, and marshes now occupy those lakes that are almost filled (Bentall and others, 1971). The following table lists lakes that have been located in the District using the Nebraska Surface Water Quality Standards (Nebraska Department of Environmental Quality, 1993) and U.S. Geological Survey 1:100,000 scale maps for the area. Most lakes listed below are naturally occurring, although some are impoundments which are not found in the Nebraska Department of Water Resources surface-water appropriations for storage.

Table 12. -- Location of natural lakes within the Lower Elkhorn Natural Resources District

County	Township, range, and section	Name of lake
Burt	23N 8E25	Lyons City Park Lake
Colfax	20N 2E18	Leigh Tri-County Lake
Cuming	23N 4E11	Kanes Lake
Cuming	23N 4E24	Woerderman Lake
Cuming	23N 5E30	Raabe Lake
Cuming	22N 6E21	McKirahan Lake
Cuming	22N 6E28	Horseshoe Lake
Cuming	22N 6E34	West Point City Lake
Dodge	19N 8E17	Hooper City Lake
Dodge	20N 6E12	Dead Timber Lake (State Recreational Area)
Madison	23N 1W 2	Andy's Lake
Madison	23N 1W 2	Pofahl Lake
Madison	23N 1W 1	Lehman Lake
Madison	23N 1W26	Ueckers Lake
Madison	24N 3W22	Johnson Lake
Madison	24N 3W23	Wendts Lake
Madison	24N 1W34	Ta-Ha-Zouka Park Lagoon (Norfolk)
Pierce	26N 2W26	Pierce City Lake
Stanton	23N 1E21	Johnson Lake
Stanton	23N 1E26	Loes Lake (Wood Duck Wildlife Management Area)
Stanton	23N 1E35	Pillar Lake (Wood Duck Wildlife Management Area)
Stanton	23N 1E35	Wood Duck Lake (Wildlife Management Area)
Stanton	23N 1E27	Wood Duck Pond (Wood Duck Wildlife Management Area)
Wayne	27N 3E15	Wayne Issac Walton Lake

Wetlands.--The definition of wetlands used in this text is the joint definition agreed upon by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency and is the definition used by the Nebraska Department of Environmental Quality. In this definition a "wetland" includes:

> *" Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar area."*

Wetlands are described using the Cowardin classification system. The wetland systems found in the NRD include (1) Riverine: water within a channel flowing either permanently or intermittently (rivers); (2) Lacustrine: water in a depression, generally greater than 20 acres (lakes); and (3) Palustrine: wetlands generally less than 20 acres and less than 2 meters deep (marshes).

Most wetlands occur in the Elkhorn River bottom or in the bottoms of associated tributaries. As mentioned previously, these wetlands include oxbow lakes which are located in former meanders of the river channel and the marshes created when these lakes were filled in with sediment. Generally, these marshes are classified as emergent palustrine wetlands which are temporarily or seasonally flooded. Within the NRD, wetlands isolated from the River and its tributaries rarely are found, and are often less than 5 acres in size. These wetlands commonly lie within a basin or channel excavated by man or are created by a barrier obstructing the outflow or inflow of water (impounded or diked), and are not natural wetlands. Some small isolated wetlands which appear to be natural can be found in the NRD. These generally are emergent palustrine wetlands which are temporarily or seasonally flooded, and are typically 1-5 acres in size.

Sandpits.--Twenty active sand or gravel pits are located within the NRD (Burchett and Eversoll, 1992). Pits located along the Elkhorn River valley or its tributaries are relatively large, and may contain water. Often these pits have been converted to recreational areas, wildlife areas, or housing developments. Table 13 lists the location of the sand and gravel pits which are within the NRD, the estimated acres of land disturbed, and the estimated acres reclaimed.

Table 13. -- Sand and gravel pits within the Lower Elkhorn Natural Resources District

County	Township, range, and section	Estimated acres disturbed	Estimated acres reclaimed
Burt	21N 10E21	3.60	2.20
Burt	21N 10E22	2.20	0.00
Burt	21N 10E22	7.80	6.10
Burt	21N 10E27	2.00	0.00
Burt	21N 10E27	5.10	4.00
Cuming	22N 6E28	235.00	149.00
Cuming	23N 4E 4	43.00	21.00
Madison	23N 1W 2	25.50	0.00
Madison	23N 1W 2	63.50	21.30
Madison	23N 1W 3	187.00	187.00
Madison	23N 1W 3	23.80	23.80
Madison	24N 1W29	1.00	1.00
Madison	24N 1W32	130.00	20.30
Madison	24N 3W22	41.00	0.00
Madison	24N 4W11	103.00	10.00
Madison	24N 4W12	45.00	5.00
Pierce	26N 1W18	20.00	2.00
Stanton	23N 3E 3	1.00	0.00
Stanton	23N 3E 3	75.00	16.00
Stanton	23N 3E10	41.50	0.00

Effect of lakes, wetlands, and sandpits on groundwater recharge.--There is no data available which documents the effects of the lakes, wetlands, or other surface-water bodies on groundwater recharge within the NRD. Because most of the Elkhorn River is fed by groundwater seepage, and due to the proximity of the lakes, wetlands, and sandpits to the river, it is likely that they are also sources of groundwater discharge and not groundwater recharge.

Recharge from adjacent groundwater reservoirs

Lateral movement of groundwater into the NRD helps maintain the amount of groundwater available for use in the NRD. Water-table contours can be used to determine the general direction of groundwater movement. The maximum water-table gradient, which is perpendicular to the contours, is the direction of groundwater movement toward sites of natural discharge at the land surface (Bentall and others, 1971). Most lateral groundwater movement into the Lower Elkhorn NRD is along the western boundary. Generally, the groundwater movement in the Elkhorn River basin is toward the streams, and the regional direction of groundwater movement is toward the east-southeast. This water originates primarily from the Quaternary deposits and the Ogallala Formation in the eastern portion of the Sandhills. Water also moves into the NRD along the northern district boundary. Along the southern and eastern boundaries of the NRD most of the groundwater movement is to the south and east, so there is little to no lateral movement of groundwater into the NRD.

The lateral movement of groundwater into the NRD creates some potential for groundwater contamination. Water moves into the NRD primarily along the western boundary from the Sandhills region of the State. In this region the water table is located relatively close to the surface and the sand and gravel soils are relatively permeable. If the groundwater in this region should become contaminated it is possible that the contaminated water could move into the Lower Elkhorn NRD.

Artificial Recharge

Reservoirs within the Lower Elkhorn NRD

A list of the reservoirs in the NRD, as reported by the Nebraska Department of Water Resources (NDWR) is found in table 14. Each of the reservoirs in table 14 is allocated a certain volume of water for storage. Table 14 also lists the storage allocation of each reservoir. The 43 reservoirs have a total storage allocation of approximately 10,600 acre-feet of water.

Table 14. -- Reservoirs within the Lower Elkhorn Natural Resources District

County	Stream name	Township, range, and section	Storage allocation (in acre-feet)
Burt	Bell Creek	21N 9E 2	11.92
Burt	Peterson Reservoir	21N 9E 2	0.00
Burt	Peterson Reservoir	21N 9E 2	0.00
Burt	Logan Creek, trib to	22N 8E 3	71.50
Colfax	Dry Creek, trib. to	19N 2E25	24.80
Colfax	Ternes Reservoir	19N 2E25	0.00
Colfax	Dry Creek, trib. to	19N 2E25	21.00
Cuming	Elkhorn River, trib. to	21N 6E 1	43.60
Dodge	Elkhorn River, trib. to	19N 7E 9	48.60
Dodge	Elkhorn River, trib. to	19N 8E20	5.57
Dodge	Logan Creek	19N 8E11	0.00
Dodge	Clark Creek	19N 9E 6	4.41
Dodge	Kriete Reservoir	19N 9E 6	0.00
Dodge	Kriete Reservoir	19N 9E 6	0.00
Dodge	Maple Creek, trib. to	18N 7E 6	33.30
Dodge	Trouble Creek	18N 8E29	447
Dodge	Brush Creek	18N 7E18	50.70
Dodge	Elkhorn River	17N 9E 4	.89
Madison	Elkhorn River, trib. to	24N 2W16	73.00
Madison	Elkhorn River, trib. to	23N 1W 3	432.00

Table 14. -- Reservoirs within the Lower Elkhorn Natural Resources District --Cont.

County	Stream name	Township, range, and section	Storage allocation (in acre-feet)
Madison	Elkhorn River, trib. to	24N 1W21	424.20
Madison	Elkhorn River, North Fork, trib. to	24N 1W16	26.05
Pierce	Humbug Creek, trib. to	24N 3E 9	14.90
Pierce	Willow Creek	26N 4W26	6.00
Pierce	Willow Creek	26N 3W33	10.00
Pierce	Vinson Reservoir	26N 3W33	0.00
Pierce	Willow Creek	25N 3W 3	3.00
Pierce	Willow Creek	26N 2W33	6,557.00
Stanton	Elkhorn River, trib. to	23N 1E15	29.20
Stanton	Elkhorn River	23N 1E15	23.90
Stanton	Elkhorn River, trib. to	23N 1E34	354.50
Stanton	Pleasant Run Creek, trib. to	24N 1E22	3.60
Stanton	Sand Creek	22N 1E17	99.40
Stanton	Maskenthine Creek	23N 2E18	927.50
Stanton	Elkhorn River, trib. to	22N 2E10	263.10
Stanton	Cedar Creek, trib. to	23N 3E29	9.40
Stanton	Humbug Creek, trib. to	24N 2E10	70.60
Stanton	Elkhorn River, trib. to	24N 3E26	406.00
Stanton	Maple Creek, Middle Fork, trib. to	21N 3E28	84.20
Stanton	Kucera Reservoir	21N 3E28	0.00
Wayne	Humbug Creek, trib. to	25N 2E32	21.20
Wayne	Deer Creek, trib. to	27N 1E33	13.70

Although there have been no studies analyzing the effect of reservoirs on groundwater recharge within the NRD, it is probable that the reservoirs act as sources of groundwater recharge when the altitude of the reservoir stage is greater than the altitude of the water table. If, in fact, the reservoirs act as a source of groundwater recharge, the groundwater should be considered vulnerable to contamination from the reservoirs.

Surface-water irrigation

Surface-water irrigation is common throughout the Lower Elkhorn NRD, particularly along the major streams and their tributaries. In these areas, irrigators generally install pumping devices to withdraw their permitted allocation. These withdrawals are generally for the purpose of irrigating crops such as corn; however, some withdrawals are made to provide surface-water for other purposes, such as recreation. Based upon data obtained from the NDWR (Nebraska Department of Water Resources, written commun., 1993), Dodge County has the most surface-water irrigation allotments within the Lower Elkhorn NRD (table 15). In Dodge County, most of the surface-water irrigation is concentrated along the Elkhorn River and Logan Creek. The county with the most licensed surface-water irrigators, however, is Madison County with 71. Like Dodge County, most of the surface-water irrigation systems are concentrated along the Elkhorn River. Madison County also has some surface-water irrigation systems located along Union and Taylor Creeks in the southeastern corner of the county. For the NRD as a whole, the NDWR data indicate that 351 surface-water irrigation-right permits have been issued within the Lower Elkhorn NRD. These 351 irrigators have been allocated a combined total of 499.13 cubic feet per second. Only a few surface-water diversions within the Lower Elkhorn NRD are not for irrigation.

Table 15. -- County, number of irrigators, and allocated surface-water withdrawals

County	Irrigators per county	Total allocated withdrawal (ft^3/sec)
Madison	71	61.93
Dodge	69	94.54
Pierce	49	49.40
Cuming	38	65.16
Burt	24	50.13
Stanton	24	40.72
Wayne	21	60.77
Cedar	18	23.65
Dixon	15	21.46
Colfax	12	14.33
Thurston	10	17.04
Total	351	499.13

Description of projects that provide intentional or incidental groundwater recharge

Most projects which provide intentional or incidental groundwater recharge in the Lower Elkhorn NRD are limited to the surface-water impoundment systems, which include all reservoirs. Other intentional or incidental groundwater recharge projects include industrial sites which use water for cooling and then discharge the water for irrigation of crops. This type of irrigation may provide up to 4 inches of water daily (Rich Wolzniak, Lower Elkhorn NRD, oral commun., 1993), of which some probably infiltrates to the groundwater system.

Irrigation

Groundwater Irrigation Spacing and Density

By March of 1993, registered irrigation-well data (NDWR, written commun., 1993) indicate that approximately 3,700 irrigation wells were registered in the Lower Elkhorn NRD. The number and density of irrigation wells vary greatly within the Lower Elkhorn NRD because of variations in land use, distribution of irrigable land, and availability of groundwater. Groundwater from the wells is used to irrigate an estimated 508,300 acres, or approximately 130 acres per well.

Most of the irrigation wells within the Lower Elkhorn NRD are located in areas where water-level data indicate the depth to water at less than 100 feet. About 43 percent of the 3,716 registered groundwater irrigation wells in the Lower Elkhorn NRD are located in Pierce and Madison Counties (table 16). Most of the 467 registered irrigation wells in Dodge County are located along the entire reach of Maple Creek. All other counties within the Lower Elkhorn NRD vary in number of registered irrigation wells--from Cuming County with 347 registered irrigation wells, to Antelope County with 7 registered irrigation wells. Antelope County has approximately 2 square miles of area within the Lower Elkhorn NRD, while Dakota County has approximately 1 square mile.

Table 16. -- Number of registered irrigation wells and reported number of irrigated acres in the Lower Elkhorn Natural Resources District through March of 1993

County	Number of registered irrigation wells	Irrigated acres
Pierce	911	128,764
Madison	671	94,605
Dodge	467	54,801
Cuming	347	45,335
Stanton	296	35,417
Cedar	235	35,682
Colfax	188	21,203
Wayne	187	27,928
Platte	112	18,607
Burt	92	15,490
Dixon	73	10,464
Thurston	73	10,436
Knox	57	8,647
Antelope	7	919
Dakota	0	0
Total	3,716	508,298

Water Demand and Application

Corn is the dominant crop within the Lower Elkhorn NRD. Other crops include sorghum, soybeans, and milo. The demands for irrigated water are based largely on the amount of water required by corn. The estimated consumptive irrigation requirement for corn in the NRD varies from just under 8 to 9 inches of annual consumptive irrigation to sufficiently maintain soil moisture for corn (J.T. Dugan, U.S. Geological Survey, written commun., 1993).

IDENTIFIED NEEDS AND DATA DEFICIENCIES

Surficial and Vadose-Zone Description

Topography

Some topographic maps may need updating especially in the areas where new activities or increased population have led to changes in cultural features. The adequacy of the maps should be reviewed by the NRD and requests for new map revisions will be made subsequent to this review.

Surficial Soil Description

Data accurately describing infiltration rates, soil permeabilities, and soil mineralogy are not readily available. Data describing the soil chemical and physical characteristics exist to a limited extent. The need exists to identify infiltration rates and soil permeabilities in areas with a wide variety of soil physical and chemical characteristics representative of the soil profiles in the NRD. In addition, the need exists to assess the potential for contaminants to leach through the soil profile.

The information provided in this management plan is based on existing general information about the soil associations present in the Lower Elkhorn NRD. As indicated above, within any one association a large diversity of slopes, depth of soil profile, drainage, and other characteristics can exist. Therefore, while information based on soil associations is a basis for a general evaluation of the vulnerability of the ground water based on soil profile characteristics of soil associations, the need exists to make interpretations of vulnerabilities based on soil information of soil series or soil mapping units.

Vadose-Zone Description

A lack of knowledge exists about the characteristics of the vadose zone. This large data deficiency can be addressed in several phases. First, a need exists to perform a detailed assessment of the characteristics of the unsaturated zone sediments in the NRD. Second, based on this assessment the need for additional test holes can be evaluated and addressed. Third, after an acceptable understanding of the unsaturated geology of the area is achieved, a data set of percolation rates through the unsaturated zone can be created, representative of the unsaturated zone characteristics of the Lower Elkhorn NRD. Concurrently, deep soil core samples can be collected to assess the existing contaminant concentrations in the unsaturated zone that are representative for the area based on the knowledge of unsaturated zone characteristics. Finally, the information obtained from deep core samples will enable modelling of current and future effects of contaminants on the water quality of the groundwater.

Depth to Groundwater

Although the Lower Elkhorn NRD has an extensive network of groundwater observation wells, there is a need to better define the groundwater system with respect to the types of aquifers that are being developed. Since extensive irrigation-well development has taken place over the past 10 years and will likely continue into the future, good management data within the Lower Elkhorn NRD will become more important. The type of data required to make sound management decisions regarding groundwater supply and quality will be dictated by the need to protect groundwater resources. This need is apparent when looking at the vulnerability of the aquifers within the Lower Elkhorn NRD. The shallower aquifers will likely be more vulnerable than the deeper aquifers to groundwater quality changes since recharge in the deeper aquifers may be reduced or damped in times of drought. Groundwater data collection programs of the NRD should be reviewed to ensure adequate and representative data are being collected.

External Groundwater Recharge Sources

Data are not available which document the effects of lakes, wetlands, reservoirs, and other surface-water bodies on groundwater recharge within the Lower Elkhorn NRD.

Surface-Water Irrigation

Some data regarding surface-water irrigation is available for the Lower Elkhorn NRD. These data are currently in the Nebraska Department of Water Resources database and give some of the necessary information regarding the quantity of allocated surface water withdrawals, the owners, dates of appropriative rights, etc. However, the location of the irrigation system is given only in township, range, and section, and not in any quarter section or fraction thereof. This makes it very difficult to accurately plot the surface-water irrigation sites. If these irrigation sites could be better defined, the use of Geographical Information Systems (GIS) would provide users with more accurate and reliable maps.

Irrigation (intermal recharge)

Groundwater irrigation usage in the Lower Elkhorn NRD can only be estimated by the crop index, which is the approximate amount of irrigation water that should be applied to corn. The actual usage is not currently metered since there are no requirements for metering. Metering devices would give a much better indication of the total amount of groundwater withdrawn for irrigation. Excessive irrigation tends to leach agricultural chemicals past the root zone, eventually contaminating the groundwater. The amount of water withdrawn is needed to educate groundwater irrigation users on the need for more efficient use of groundwater, and to provide natural resource managers a management tool for future decisions.

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APPENDIX A

Table 4. -- Selected laboratory characterization data elements identified in the NSSC-SSL research database

METHOD CODES	DESCRIPTION OF SELECTED LABORATORY CHARACTERIZATION DATA ELEMENTS
IDPED	FISCAL YEAR 10000 CONSECUTIVE PEDON NUMBER
PEDN	NSSL CONSECUTIVE PEDON NUMBER
CCNAME	SOIL SERIES NAME: Correlated or Field
THDEP	DEPTH, TOP OF HORIZON (CM)
BHDEP	DEPTH, BOTTOM OF HORIZON (CM)
TEXTAB	TEXTURE ABBREVIATION
V250	VOLUME % ESTIMATE, >250 mm
V25075	VOLUME % ESTIMATE,
BSCOD	BULK SAMPLE CODES
GCGT2	GRAVEL CODE >2MM
GC752	GRAVEL CODE(ALL) 75-2
GC7520	GRAVEL CODE 75-20
GC205	GRAVEL CODE 20-5
GC52	GRAVEL CODE 5-2
CLAY	TOTAL CLAY
SILT	TOTAL SILT
SAND	SAND
FCLAY	FINE CLAY
CO3CLY	CO3 CLAY
FSILT	FINE SILT
CSILT	COARSE SILT
VFSAND	VERY FINE SAND
FSAND	FINE SAND
MSAND	MEDIUM SAND
CSAND	COARSE SAND
VCSAND	VERY COARSE SAND
OC	WALKLEY-BLACK ORGANIC CARBON
N	KJELDAHL NITROGEN
P	EXTRACTABLE PHOSPHOROUS
FEDITH	DITHIONITE CITRATE EXTRACTABLE IRON

Table 4. -- Selected laboratory characterization data elements identified in the NSSC-SSL research database--Cont.

METHOD CODES	DESCRIPTION OF SELECTED LABORATORY CHARACTERIZATION DATA ELEMENTS
ALDITH	DITHIONITE CITRATE EXTRACTABLE ALUMINUM
MNDITH	DITHIONITE CITRATE EXTRACTABLE MANGANESE
CECCLY	RATIO CEC/CLAY
B15CLY	RATIO 15 BAR/CLAY
CPYP	SODIUM PYROPHOSPHATE EXTRACTABLE CARBON
FEPYP	SODIUM PYROPHOSPHATE EXTRACTABLE IRON
ALPYP	SODIUM PYROPHOSPHATE EXTRACTABLE ALUMINUM
CAX	NH4OAC EXTRACTABLE CALCIUM
MGX	NH4OAC EXTRACTABLE MAGNESIUM
NAX	NH4OAC EXTRACTABLE SODIUM
KX	NH4OAC EXTRACTABLE POTASSIUM
SUMBSE	SUM of NH4OAC EXTRACTABLE BASES
ACIDX	NH4OAC EXTRACTABLE ACIDITY at PH 8.2
ALX	KCL EXTRACTABLE ALUMINUM
SUMCAT	SUM of CATIONS
CEC7	NH4OAC CATION EXCHANGE CAPACITY(CEC)
BSESAT	NH4OAC BASE SATURATION
ALSAT	ALUMINUM SATURATION (Not Always Stored)
BSECAT	NH4OAC BASE SATURATION by SUM CATIONS
NH4BSE	BLANK
CACO3	CARBONATE, < 2mm Fraction
RESIST	RESISTIVITY in OHMS
PH1H2O	PH,1:1 SOIL-WATER SUSPENSION
CACO32	CARBONATE, 2-20mm Fraction
GYPL2,	GYPSUM < 2mm Fraction
GYPG20	GYPSUM, 2-20mm Fraction
PHSP	PH, SATURATED PASTE
PH2CC	PH, 1:2 SOIL-CACL2 SUSPENSION
CASX	CALCIUM, Saturation Extract(H2O)
MGSX	MAGNESIUM, Saturation Extract(H2O)
NASX	SODIUM, Saturation Extract(H2O)
KSX	POTASSIUM, Saturation Extract(H2O)
CO3SX	CARBONATE, Saturation Extract(H2O)
HCO3SX	BICARBONATE, Saturation Extract(H2O)

Table 4. -- Selected laboratory characterization data elements identified in the NSSC-SSL research database--Cont.

METHOD CODES	DESCRIPTION OF SELECTED LABORATORY CHARACTERIZATION DATA ELEMENTS
CLSX	CHLORIDE, Saturation Extract(H2O)
SO4SX	SULFATE, Saturation Extract(H2O)
NO3SX	NITRATE, Saturation Extract(H2O)
H2OSX	WATER CONTENT SATURATION EXTRACT(H2O)
TESALT	TOTAL ESTIMATED SALT(Use Electrical Conductivity)
ECSX	ELECTRIC CONDUCTIVITY Saturation Extract
PHNAF	PH, 1:50 SOIL-NAFL SUSPENSION
PHKCL	PH, 1:1 SOIL-KCL SUSPENSION
CEBACL	CEC, BARIUM-CHLORIDE
PSORP	PHOSPHORUS ABSORPTION
NO2CGH	NITRITE, Saturation Extract(H2O)
PEC12	PREDICTED EC 1:2 (Soil/Water by weight)
FLCGH	FLORIDE, Saturation Extract(H2O)
TKHFD	TOTAL POTASSIUM (HF Digestion)
G25	2- 5 mm Weight Percentage of <75mm
G520	5-20 mm Weight Percentage of <75mm
G2075	20-75 mm Weight Percentage of <75mm
ABGLL	ATTERBERG, LIQUID LIMIT
ABGPL	ATTERBERG, PLASTIC LIMIT
DFLD	BULK DENSITY, Field Water Content
D3	BULK DENSITY, 1/3 BAR Suction
DOD	BULK DENSITY, Oven Dry (105 C)
LEWS	LINEAR EXTENSIBILITY,Whole Soil,1/3 BAR to Oven Dry
WP10	1/10 WATER BAR, Clods, Weight Percent
WP3	1/3 WATER BAR, Clods, Weight Percent
W15AD	15 BAR WATER on AIR DRY SOIL, Weight Percent
DP3EST	BULK DENSITY 1/3 BAR Estimated
DP3RW	BULK DENSITY 1/3 BAR Rewet (Organic Soils)
LED3RW	LINEAR EXTENSIBILITY,Rewet Soil,1/3 BAR to Oven Dry
W3RW	BULK DENSITY 1/3 BAR, Rewet
D15WET	15 BAR WATER, On Field Moist Soil, Weight Percent
ADOD	RATIO, Airdry/Oven dry
ODWET	RATIO, Field Moist/Oven dry
LEFOD	LINEAR EXTENSIBILITY, Field Moist to Oven dry

Table 4. -- Selected laboratory characterization data elements identified in the NSSC-SSL research database--Cont.

METHOD CODES	DESCRIPTION OF SELECTED LABORATORY CHARACTERIZATION DATA ELEMENTS
W6L2	0.06 BAR WATER, <2mm Fraction, Weight Percent
W10L2	1/10 BAR WATER, <2mm Fraction, Weight Percent
W1CLOD	ONE BAR WATER, <2mm Fraction of Clods, Weight %
LED3L2	LINEAR EXTENSIBILITY,<2mm Fraction,1/3 BAR/Oven Dry
GRVL75	VOLUME <2mm/VOLUME<75mm at 1/3 BAR
GRVWS	VOLUME <2mm/VOLUME WHOLE SOIL at /3 BAR
EGME	SURFACE AREA, EGME
TCFRAG	COARSE FRAGMENTS (>2mm), Weight Percent Whole Soil
DG2	PARTICAL DENSITY >2mm
FWBS	FIELD WATER CONTENT of BULK SAMPLE, Weight Percent
W6CLOD	0.06 BAR WATER, <2mm Fraction of Clods, Weight %
DL2	PARTICAL DENSITY <2mm Fraction
TRMN	DOMINANT RESISTANT MINERAL, <2mm Fraction
PTRMN	PERCENT DOMINANT RESISTANT MINERALS
DWMN	DOMINANT WEATHERABLE MINERAL, <2mm Fraction
PDWMN	PERCENT DOMINANT WEATHERABLE MINERALS
XRYCLY	X-RAY Total Clay, Maximum of 5 Minerals
DTACLY	DTA Total Clays
TGACLY	TGA Total Clays
IRDCLY	INFRA-RED Total Clay
HFBCLY	HF BOMB Total Clay
BLK	BLANK

Table 8. -- List of resistant minerals identified in the NSSC-SSL research database

Resistant minerals	Resistant minerals
AE=Anatase	LU=Leucoxene
AN=Andalusite	MG=Magnetite
BA=Barite	MH=Maghemite
BE=Boehmite	OP=Opaques
BK=Brookite	OR=Other Resistant Minerals
BY=Beryl	PI=Pyrite
CD=Chalcedony(Chert, Flint, Jasper.Agate,Onyx)	PK=Perovskite
xxxx	PO=Plant Opal
CN=Corundum	PY=Pyrophyllite
CR=Cristobalite	QC=Clay-Coat Quartz
CT=Cassiterite	QG=Glass-Coat Quartz
DI=Diatoms	QI=Iron Oxide-Coat Quartz
FE=Iron Oxides(Goethite,Magnetite, Hematite)	QZ=Quartz
xxxx	RA=Resistant Aggregates
GD=Gold	RE=Resistant Minerals
GE=Goethite	RU=Rutile
GI=Gibbsite	SA=Siliceous Aggregates
GN=Garnet	SL=Sillimanite
HE=Hematite	SO=Staurolite
KH=Halloysite	SP=Sphene
KK=Kaolinite	TM=Tourmaline
KY=Kyanite	TP=Topaz
LE=Lepidocrocite	VI=Vivianite
LM=Limonite	ZR=Zircon
LT=Lithiophorite	Gy=Gypsum
AC=Actinolite	HB=Hydrobiotite
AF=Arfvedsonite	HG=Glass Coated Hornblende
AG=Antigorite	HN=Hornblende
AH=Anthophyllite	HY=Hypersthene
AL=Allophane	ID=Iddingsite
AM=Amphibole	IL=Illite (Hydromuscovite)
AO=Aragonite	JO=Jarosite
AP=Apatite	LC=Analcime
AR=Weatherable Aggregates	LO=Lepidomelane

Table 8. -- List of resistant minerals identified in the NSSC-SSL research database--Cont.

Resistant minerals	Resistant minerals
AU=Augite	LP=Lepidolite
AY=Anhydrite	MB=Mirabilite
BC=Biotite-Chlorite	MC=Montmorillonite-Chlorite
BR=Brucite	ME=Magnesite
BT=Biotite	MI=Mica
BZ=Bronzite	MM=Montmorillonite-Mica
CA=Calcite	MR=Marcasite
CB=Carbonate Aggregates	MS=Muscovite
CC=Coal	MT=Montmorillonite
CL=Chlorite	MV=Montmorillonite-Vermiculite
CM=Chlorite-Mica	MZ=Monazite
CO=Collophane	NX=Non-Crystalline
CY=Chrysotile	OG=Glass Coated Opaque
CZ=Clinozoisite	OV=Olivine
DL=Dolomite	OW=Other Weatherable Minerals
DP=Diopside	PD=Piedmontite
DU=Dumortierite	PG=Palygorskite
EN=Enstatite	PJ=Plumbojarosite
EP=Epidote	PL=Phlogopite
FA=Andesite	PR=Pyroxene
FB=Albite	PU=Pyrolusite
FC=Microcline	RB=Riebeckite(Blue Amphibole)
FD=Feldspar	RO=Rhodocrosite
FF=Foraminifera	SE=Sepiolite
FG=Glass Coated Feldspar	SG=Sphalerite
FH=Anorthoclase	SI=Siderite
FK=Potassium Feldspar	SR=Sericite
FL=Labradorite	SS=Sponge Spicule
FM=Ferromagnesium Mineral	SU=Sulphur
FN=Anorthite	TA=Talc
FP=Plagioclase Feldspar	TD=Tridymite
FO=Oligoclase	TH=Thenardite
FR=Orthoclase	TE=Tremolite
FS=Sanidine	VC=Vermiculite-Chlorite
FU=Fluorite	VH=Vermiculite-Hydrobiotite

Table 8. -- List of resistant minerals identified in the NSSC-SSL research database--Cont.

Resistant minerals	Resistant minerals
GA=Glass Aggregates	VM=Vermiculite-Mica
GC=Glass Coated Grain	VR=Vermiculite
GG=Galena	WE=Weatherable Mineral
GL=Glauconite	WV=Wavellite
GM=Glassy Materials	ZE=Zeolite
GO=Glaucophane	ZO=Zoisite
GS=Glass	OT=Other

APPENDIX B

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Appendix

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LOW-FLOW INVESTIGATIONS

PLATTE RIVER BASIN--Continued

Elkhorn River basin--Continued

Location	Observation of zero flow or measured discharge, in cubic feet per second September 28, October 1-2, 1979
Antelope Creek 4 mi southwest of Neligh in SW¼SW¼ sec. 23, T.25 N., R.7 W.	0
Antelope Creek 3 mi southwest of Neligh in NW¼SW¼ sec. 24, T.25 N., R.7 W.	.16
Hall Creek 1 mi northwest of Neligh in NE¼SE¼ sec. 18, T.25 N., R.6 W.	0
Elkhorn River at Neligh in SE¼NE¼ sec. 20, T.25 N., R.6 W.	90
Belmer Creek 1 mi east of Neligh in SW¼SW¼ sec. 15, T.25 N., R.6 W.	0
Belmer Creek at Neligh in NW¼SW¼ sec. 21, T.25 N., R.6 W.	.11
Cedar Creek 4 mi southeast of Elgin in SW¼SE¼ sec. 20, T.23 N., R.6 W.	0
Cedar Creek 5 mi east of Elgin in NW¼NW¼ sec. 11, T.23 N., R.6 W.	.73
West Cedar Creek at Elgin in NE¼NW¼ sec. 11, T.23 N., R.7 W.	0
West Cedar Creek 3 mi northeast of Elgin in SW¼NW¼ sec. 29, T.24 N., R.6 W.	0
West Cedar Creek 5 mi east of Elgin in SW¼SE¼ sec. 3, T.23 N., R.6 W.	2.8
Cedar Creek 3 mi southwest of Oakdale in SW¼SE¼ sec. 22, T.24 N., R.6 W.	8.0
Cedar Creek at Oakdale in NW¼NW¼ sec. 12, T.24 N., R.6 W.	11
Elkhorn River 2 mi east of Oakdale in SE¼NE¼ sec. 7, T.24 N., R.5 W.	121
Elm Creek 2 mi east of Oakdale in NW¼SW¼ sec. 8, T.24 N., R.5 W.	0
Trueblood Creek 4 mi northeast of Oakdale in NW¼NE¼ sec. 4, T.24 N., R.5 W.	.16
Saint Clair Creek 5 mi southeast of Oakdale in SW¼SE¼ sec. 32, T.24 N., R.5 W.	0
Saint Clair Creek 3 mi southeast of Oakdale in NW¼SW¼ sec. 9, T.24 N., R.5 W.	0
Saint Clair Creek 3 mi east of Oakdale in SE¼SW¼ sec. 16, T.24 N., R.5 W.	.02
Ives Creek 5 mi southwest of Tildon in SE¼SW¼ sec. 3, T.23 N., R.5 W.	0
Ives Creek 3 mi southwest of Tildon in NE¼NW¼ sec. 27, T.24 N., R.5 W.	.05
Ives Creek 3 mi northwest of Tildon in NW¼NE¼ sec. 15, T.24 N., R.5 W.	.09
Giles Creek 4 mi south of Tildon in NW¼NE¼ sec. 12, T.23 N., R.5 W.	0
Giles Creek 3 mi south of Tildon in SW¼SE¼ sec. 36, T.24 N., R.5 W.	Ponded
Giles Creek 2 mi south of Tildon in SW¼SE¼ sec. 25, T.24 N., R.5 W.	Ponded
Giles Creek at Tildon in NE¼SE¼ sec. 13, T.24 N., R.5 W.	.96
Elkhorn River 1 mi north of Tildon in NE¼SE¼ sec. 12, T.24 N., R.5 W.	110
Al Hopkins Creek 4 mi north of Tildon in SE¼SE¼ sec. 26, T.25 N., R.5 W.	0
Al Hopkins Creek 3 mi north of Tildon in NE¼SE¼ sec. 36, T.25 N., R.5 W.	.14
Al Hopkins Creek 2 mi north of Tildon in SE¼SE¼ sec. 1, T.24 N., R.5 W.	.26
Dry Creek 4 mi southwest of Meadow Grove in SE¼SW¼ sec. 4, T.23 N., R.4 W.	0
Dry Creek 3 mi southwest of Meadow Grove in SW¼SW¼ sec. 28, T.24 N., R.4 W.	.02
Dry Creek 2 mi west of Meadow Grove in NW¼SE¼ sec. 21, T.24 N., R.4 W.	.35
Elkhorn River 1 mi north of Meadow Grove in SE¼SE¼ sec. 14, T.24 N., R.4 W.	121
Buffalo Creek 4 mi southwest of Meadow Grove in NE¼NE¼ sec. 15, T.23 N., R.4 W.	0
ffalo Creek at Meadow Grove in SW¼SW¼ sec. 24, T.24 N., R.4 W.	2.2
er Creek 4 mi southeast of Meadow Grove in SW¼SW¼ sec. 7, T.23 N., R.3 W.	trace
Deer Creek 2 mi east of Meadow Grove in NE¼NE¼ sec. 30, T.24 N., R.3 W.	1.7
Elkhorn River 2 mi north of Battle Creek in NE¼SW¼ sec. 30, T.24 N., R.2 W.	148
Battle Creek 5 mi southwest of Battle Creek in NE¼NE¼ sec. 35, T.23 N., R.3 W.	0
Battle Creek tributary 5 mi southwest of Battle Creek in SW¼NW¼ sec. 26, T.23 N., R.3 W.	0
Battle Creek 2 mi southwest of Battle Creek in SW¼SW¼ sec. 12, T.23 N., R.3 W.	3.8
Battle Creek 1 mi north of Battle Creek in SW¼NW¼ sec. 31, T.24 N., R.2 W.	9.8
Elkhorn River tributary 3 mi west of Battle Creek in NW¼SW¼ sec. 34, T.24 N., R.2 W.	1.0
Elkhorn River tributary 5 mi southwest of Norfolk in NW¼NE¼ sec. 24, T.23 N., R.2 W.	.14
Elkhorn River tributary 3 mi southwest of Norfolk in NE¼SW¼ sec. 6, T.23 N., R.1 W.	.23
Elkhorn River tributary 5 mi southwest of Norfolk in NE¼NE¼ sec. 29, T.23 N., R.1 W.	.04
Elkhorn River tributary 3 mi southwest of Norfolk in SE¼SW¼ sec. 8, T.23 N., R.1 W.	.28
Elkhorn River tributary 2 mi southwest of Norfolk in SE¼NW¼ sec. 5, T.23 N., R.1 W.	.13
Elkhorn River at Norfolk (gage) in SW¼SW¼ sec. 34, T.24 N., R.1 W.	153
Elkhorn River 3 mi southeast of Norfolk in NW¼SW¼ sec. 6, T.23 N., R.1 E.	157
North Fork Elkhorn River basin	
East Branch North Fork Elkhorn River at Osmond in NW¼SE¼ sec. 31, T.28 N., R.2 W.	0
East Branch North Fork Elkhorn River 1 mi southwest of Osmond in SW¼SW¼ sec. 36, T.28 N., R.3 W.	.57
West Branch North Fork Elkhorn River 2 mi northwest of Osmond in SE¼SW¼ sec. 26, T.28 N., R.3 W.	0
West Branch North Fork Elkhorn River 2 mi southwest of Osmond in SE¼SW¼ sec. 35, T.28 N., R.3 W.	.03
Breslau Creek 4 mi west of Osmond in NE¼NW¼ sec. 4, T.27 N., R.3 W.	0
North Fork Elkhorn River 4 mi south of Osmond in NE¼SE¼ sec. 24, T.27 N., R.3 W.	3.6
North Fork Elkhorn River 4 mi northwest of Pierce in SW¼SE¼ sec. 5, T.26 N., R.2 W.	7.5
Dry Creek 1 mi southeast of Plainview in NE¼NW¼ sec. 10, T.27 N., R.4 W.	0
Dry Creek tributary 4 mi southwest of Plainview in SW¼NW¼ sec. 29, T.27 N., R.4 W.	0
Dry Creek tributary 3 mi southeast of Plainview in NE¼NE¼ sec. 22, T.27 N., R.4 W.	.02
Dry Creek tributary 3 mi southeast of Plainview in SW¼NW¼ sec. 14, T.27 N., R.4 W.	0
Dry Creek 3 mi northwest of Foster in SW¼SW¼ sec. 18, T.27 N., R.3 W.	.14
Dry Creek 1 mi northwest of Foster in NW¼SW¼ sec. 28, T.27 N., R.3 W.	2.5
Dry Creek 4 mi southeast of Foster in SE¼NE¼ sec. 12, T.26 N., R.3 W.	5.6
Yankton Slough 3 mi northeast of Pierce in NE¼NW¼ sec. 13, T.26 N., R.2 W.	0
Yankton Slough tributary 3 mi northeast of Pierce in NE¼NE¼ sec. 13, T.26 N., R.2 W.	0
Willow Creek at Pierce in SW¼SW¼ sec. 26, T.26 N., R.2 W.	7.4

(See "Water Resources Data for Nebraska, Water Year 1976" for low-flow information on Willow Creek.)

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PLATTE RIVER BASIN--Continued

Elkhorn River basin--Continued

Location	Observation of zero flow or measured discharge, in cubic feet per second September 28, October 1-2, 1979
North Fork Elkhorn River tributary 2 mi east of Pierce in NE¼NE¼ sec. 36, T.26 N., R.2 W.	0
North Fork Elkhorn River 3 mi southeast of Pierce (gage) in SW¼SW¼ sec. 31, T.26 N., R.1 W.	24
North Fork Elkhorn River 3 mi northwest of Hadar in NW¼SW¼ sec. 17, T.25 N., R.1 W.	30
North Fork Elkhorn River tributary 2 mi northwest of Hadar in NE¼NW¼ sec. 19, T.25 N., R.1 W.	0
Hadar Creek 2 mi southwest of Hadar in SE¼SE¼ sec. 36, T.25 N., R.2 W.	0
Hadar Creek at Hadar in SE¼SW¼ sec. 29, T.25 N., R.1 W.	.04
North Fork Elkhorn River 2 mi southeast of Hadar in SE¼NW¼ sec. 4, T.24 N., R.1 W.	49
Spring Creek 1 mi northeast of Hoskins in SW¼SW¼ sec. 23, T.25 N., R.1 E.	0
Spring Creek 1 mi southwest of Hoskins in SE¼SE¼ sec. 32, T.25 N., R.1 E.	.24
Spring Creek 5 mi southwest of Hoskins in SE¼SW¼ sec. 1, T.24 N., R.1 W.	.22
North Fork Elkhorn River at Norfolk in SE¼SE¼ sec. 26, T.24 N., R.1 W.	51
Elkhorn River tributary 8 mi southwest of Stanton in SW¼NW¼ sec. 6, T.22 N., R.1 E.	0
Elkhorn River tributary 7 mi southwest of Stanton in SW¼SW¼ sec. 32, T.23 N., R.1 E.	Ponded
Elkhorn River tributary 6 mi west of Stanton in SW¼NE¼ sec. 29, T.23 N., R.1 E.	.05
Pleasant Run 1 mi west of Stanton in NE¼NE¼ sec. 25, T.23 N., R.1 E.	0
Union Creek 7 mi southwest of Madison in NE¼NW¼ sec. 29, T.21 N., R.2 W.	0
Union Creek 7 mi southwest of Madison in NW¼NW¼ sec. 33, T.21 N., R.2 W.	.02
Union Creek tributary 9 mi southwest of Madison in NE¼SW¼ sec. 8, T.20 N., R.2 W.	0
Union Creek tributary 8 mi southwest of Madison in SW¼SW¼ sec. 33, T.21 N., R.2 W.	.01
Union Creek 4 mi southwest of Madison in SW¼SE¼ sec. 24, T.21 N., R.2 W.	.33
Pork plant runoff 3 mi southwest of Madison in SW¼NW¼ sec. 18, T.21 N., R.1 W.	.11
Union Creek tributary 3 mi southwest of Madison in SW¼SE¼ sec. 2, T.21 N., R.2 W.	0
Union Creek tributary 2 mi southwest of Madison in SE¼SE¼ sec. 12, T.21 N., R.2 W.	.10
Taylor Creek 6 mi northwest of Madison in SW¼NW¼ sec. 21, T.22 N., R.2 W.	0
Taylor Creek 4 mi northwest of Madison in NE¼NE¼ sec. 27, T.22 N., R.2 W.	2.7
Taylor Creek 2 mi northwest of Madison in SW¼NW¼ sec. 30, T.22 N., R.1 W.	6.9
North Taylor Creek 4 mi northwest of Madison in NW¼NE¼ sec. 24, T.22 N., R.2 W.	.06
Union Creek at Madison (gage) in SW¼SE¼ sec. 32, T.22 N., R.1 W.	10
Meridian Creek 1 mi northwest of Creston in NW¼SE¼ sec. 12, T.20 N., R.1 W.	0
Tracy Creek 2 mi northwest of Creston in SE¼NE¼ sec. 10, T.20 N., R.1 W.	0
Meridian Creek 2 mi north of Creston in SE¼SW¼ sec. 31, T.21 N., R.1 E.	.02
Meridian Creek tributary 3 mi northeast of Creston in SW¼SW¼ sec. 32, T.21 N., R.1 E.	0
Meridian Creek 4 mi north of Creston in NE¼NE¼ sec. 30, T.21 N., R.1 E.	.01
Meridian Creek tributary 5 mi north of Creston in NW¼NW¼ sec. 20, T.21 N., R.1 E.	0
Meridian Creek 7 mi north of Creston in SE¼SE¼ sec. 12, T.21 N., R.1 W.	.13
Union Creek 5 mi east of Madison in NE¼NW¼ sec. 6, T.21 N., R.1 E.	11
Sand Creek 5 mi northeast of Madison in SE¼NE¼ sec. 14, T.22 N., R.1 W.	0
Sand Creek 6 mi northeast of Madison in NE¼NE¼ sec. 13, T.22 N., R.1 W.	.02
Sand Creek 7 mi northeast of Madison in SW¼SW¼ sec. 16, T.22 N., R.1 E.	.13
Union Creek tributary 7 mi southwest of Stanton in NE¼NE¼ sec. 27, T.22 N., R.1 E.	0
Union Creek 6 mi southwest of Stanton in SE¼SE¼ sec. 15, T.22 N., R.1 E.	13
Union Creek 3 mi southwest of Stanton in NW¼NW¼ sec. 6, T.22 N., R.2 E.	17
Butterfly Creek 2 mi south of Stanton in SW¼SE¼ sec. 32, T.23 N., R.2 E.	0
Meskenthine Creek 3 mi southeast of Hoskins in SW¼SE¼ sec. 2, T.24 N., R.1 E.	0
Meskenthine Creek 4 mi southeast of Hoskins in SW¼SE¼ sec. 12, T.24 N., R.1 E.	0
Meskenthine Creek 5 mi north of Stanton in SE¼SW¼ sec. 34, T.24 N., R.2 E.	.04
Meskenthine Creek 3 mi north of Stanton in SE¼SE¼ sec. 6, T.23 N., R.2 E.	0
Meskenthine Creek at Stanton in SE¼SW¼ sec. 20, T.23 N., R.2 E.	0
Elkhorn River at Stanton in SE¼NE¼ sec. 29, T.23 N., R.2 E.	236
Indian Creek 3 mi north of Stanton in NW¼NE¼ sec. 8, T.23 N., R.2 E.	.04
Indian Creek at Stanton in NW¼NW¼ sec. 21, T.23 N., R.2 E.	.01
Cedar Creek 7 mi southeast of Stanton in NE¼SE¼ sec. 7, T.22 N., R.3 E.	0
Cedar Creek 7 mi southeast of Stanton in SW¼SE¼ sec. 5, T.22 N., R.3 E.	.02
Cedar Creek 4 mi east of Stanton in SE¼NE¼ sec. 24, T.23 N., R.2 E.	.02
Cedar Creek 4 mi east of Stanton in SW¼SE¼ sec. 13, T.23 N., R.2 E.	0
Payne Creek 6 mi north of Stanton in SE¼SE¼ sec. 20, T.24 N., R.2 E.	.02
Payne Creek 6 mi northeast of Stanton in SW¼SE¼ sec. 26, T.24 N., R.2 E.	.06
Payne Creek 4 mi northeast of Stanton in NW¼SE¼ sec. 12, T.23 N., R.2 E.	.04
North Branch Humbug Creek 5 mi northwest of Pilger in SE¼SE¼ sec. 7, T.24 N., R.3 E.	1.1
South Branch Humbug Creek 4 mi northwest of Pilger in NE¼NE¼ sec. 19, T.24 N., R.3 E.	.01
Humbug Creek 3 mi northwest of Pilger in SE¼NE¼ sec. 20, T.24 N., R.3 E.	1.0
Humbug Creek 1 mi west of Pilger in NE¼NE¼ sec. 4, T.23 N., R.3 E.	1.8
Elkhorn River 1 mi south of Pilger in NW¼SW¼ sec. 2, T.23 N., R.3 E.	231
Sand Creek 3 mi northeast of Pilger in SE¼NW¼ sec. 29, T.24 N., R.4 E.	Trace
Sand Creek 4 mi east of Pilger in SE¼SE¼ sec. 29, T.24 N., R.4 E.	.03
Leisy Creek 2 mi southwest of Wisner in NW¼SE¼ sec. 10, T.23 N., R.4 E.	0
Elkhorn River at Wisner in SE¼NE¼ sec. 11, T.23 N., R.4 E.	240
Rock Creek 7 mi southwest of Beemer in NW¼SW¼ sec. 2, T.22 N., R.4 E.	0
Rock Creek 6 mi southwest of Beemer in NE¼NE¼ sec. 11, T.22 N., R.4 E.	.85
Rock Creek 4 mi southwest of Beemer in NW¼NW¼ sec. 8, T.22 N., R.5 E.	2.8
Rock Creek 2 mi west of Beemer in SW¼NW¼ sec. 34, T.23 N., R.5 E.	7.8

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PLATTE RIVER BASIN--Continued

Elkhorn River basin--Continued

Location	Observation of zero flow or measured discharge, in cubic feet per second
	September 28, October 1-2, 1979
orn River 1 mi south of Beemer in SW¼NE¼ sec. 2, T.22 N., R.5 E.	251
orn River at West Point (gage) in SW¼NW¼ sec. 34, T.22 N., R.6 E.	245
er Creek 6 mi northwest of West Point in NW¼SW¼ sec. 14, T.22 N., R.5 E.	0
er Creek 5 mi northwest of West Point in NW¼NE¼ sec. 24, T.22 N., R.5 E.	.01
er Creek 3 mi northwest of West Point in NW¼NW¼ sec. 29, T.22 N., R.6 E.	.03
er Creek 2 mi west of West Point in NW¼NE¼ sec. 5, T.21 N., R.6 E.	Trace
er Creek tributary 6 mi west of West Point in SW¼NW¼ sec. 26, T.22 N., R.5 E.	0
er Creek tributary 5 mi west of West Point in NW¼NW¼ sec. 36, T.22 N., R.5 E.	Trace
er Creek tributary 3 mi southwest of West Point in SE¼NE¼ sec. 7, T.21 N., R.6 E.	.02
le Creek 11 mi west of West Point in NW¼NW¼ sec. 1, T.21 N., R.4 E.	0
le Creek 9 mi southwest of West Point in NW¼NW¼ sec. 8, T.21 N., R.5 E.	.05
h Branch Pebble Creek 8 mi west of West Point in NW¼NE¼ sec. 32, T.22 N., R.5 E.	0
h Branch Pebble Creek tributary 9 mi west of West Point in NW¼NW¼ sec. 32, T.22 N., R.5 E.	0
h Branch Pebble Creek 8 mi west of West Point in NE¼NE¼ sec. 5, T.21 N., R.5 E.	.05
le Creek 7 mi southwest of West Point in SW¼NW¼ sec. 10, T.21 N., R.5 E.	.53
h Branch Pebble Creek 8 mi southwest of West Point in SE¼SE¼ sec. 16, T.21 N., R.5 E.	0
le Creek 3 mi north of Snyder in SE¼SW¼ sec. 36, T.21 N., R.5 E.	.58
le Creek tributary 1 mi northwest of Dodge in SW¼SW¼ sec. 6, T.20 N., R.5 E.	0
le Creek tributary 1 mi east of Dodge in SW¼SW¼ sec. 9, T.20 N., R.5 E.	.03
utary to Pebble Creek tributary 4 mi south of Dodge in NE¼NW¼ sec. 5, T.19 N., R.5 E.	0
utary to Pebble Creek tributary 4 mi southwest of Snyder in NW¼SW¼ sec. 34, T.20 N., R.5 E.	0
utary to Pebble Creek tributary 3 mi southwest of Snyder in SW¼SE¼ sec. 27, T.20 N., R.5 E.	0
utary to Pebble Creek tributary 1 mi southwest of Snyder in NW¼SW¼ sec. 24, T.20 N., R.5 E.	.06
le Creek tributary at Snyder in NE¼NE¼ sec. 24, T.20 N., R.5 E.	.50
er Creek 7 mi southwest of Snyder in NW¼NW¼ sec. 7, T.19 N., R.5 E.	0
er Creek 7 mi southwest of Snyder in NW¼NW¼ sec. 16, T.19 N., R.5 E.	.03
er Creek 7 mi southwest of Snyder in NE¼NW¼ sec. 22, T.19 N., R.5 E.	.02
e Creek at Scribner (gage) in NW¼SE¼ sec. 36, T.20 N., R.6 E. (gage rating discharge)	4.8

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Di
County,
Furnas,
McCook,
April 3

Fremont
Fremont
Fremont
Fremont
Fremont
Fremont
Moran Can
Box Elder
Cottonwoo
Cottonwoo
Snell Can
Creek abo
Jeffery C

East Muddy
East Muddy
East Muddy
Muddy Cree
Republican
Hay Canyon
Republican
Camp Creek
Camp Creek
Republican
Dry Canyon
Dry Canyon
Jones Canyo
Macklin Can
Spring Cany
Meeker Cana
Republican
Elm Creek 5
Elm Creek 2
Black Canyon
Big Canyon 1
Massacre Can
Thompson Can
Frenchman Cr
Horse Canyon
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Frenchman Cr
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Bobtail Creek
Bobtail Creek
Frenchman Cree
Frenchman Cree
Rogers Canyon
Boevau Canyon
Frenchman Cree
Six-Mile Canyo

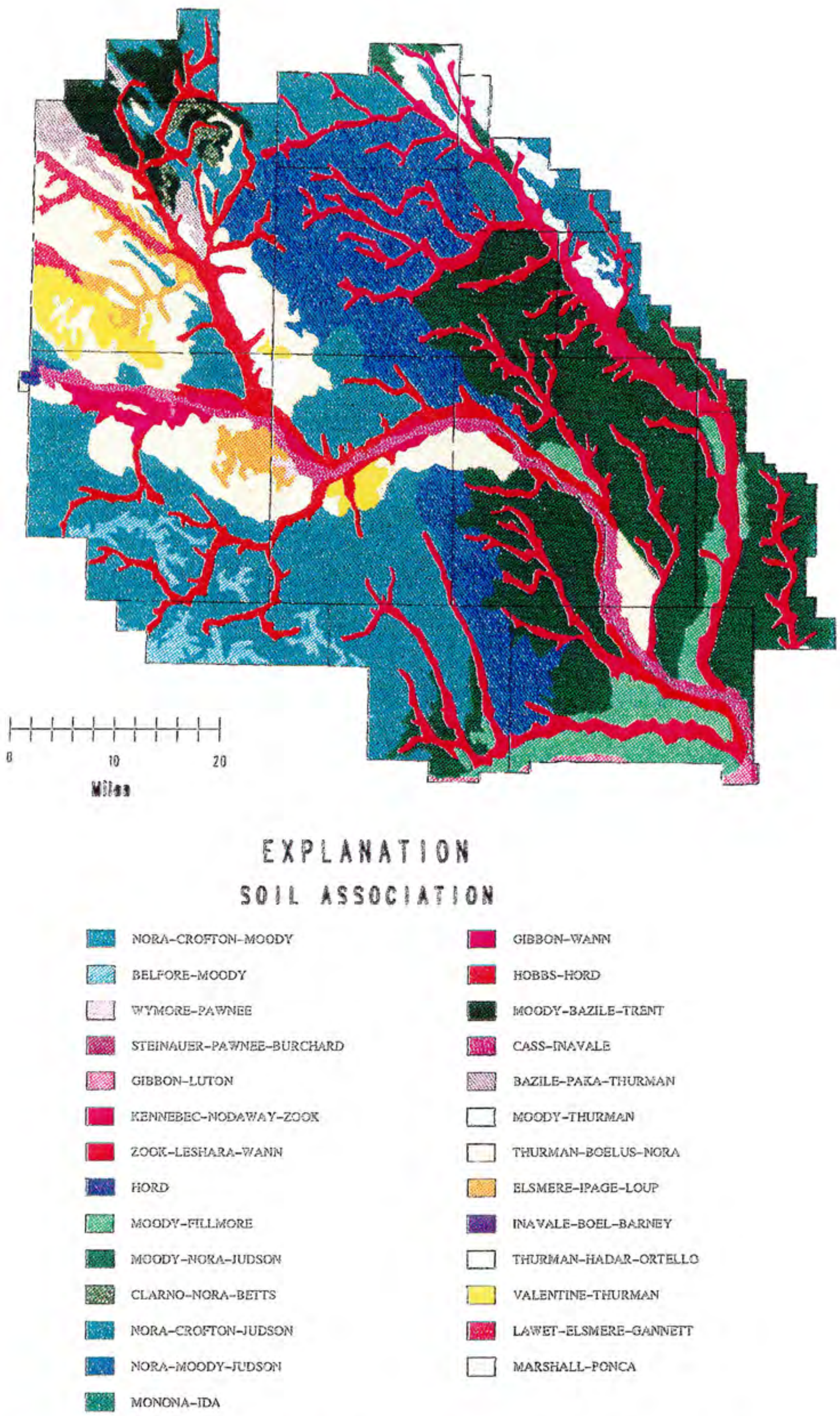


Figure 1. Location of soil associations in the Lower Elkhorn Natural Resources District (modified from U.S. Department of Agriculture, 1993).

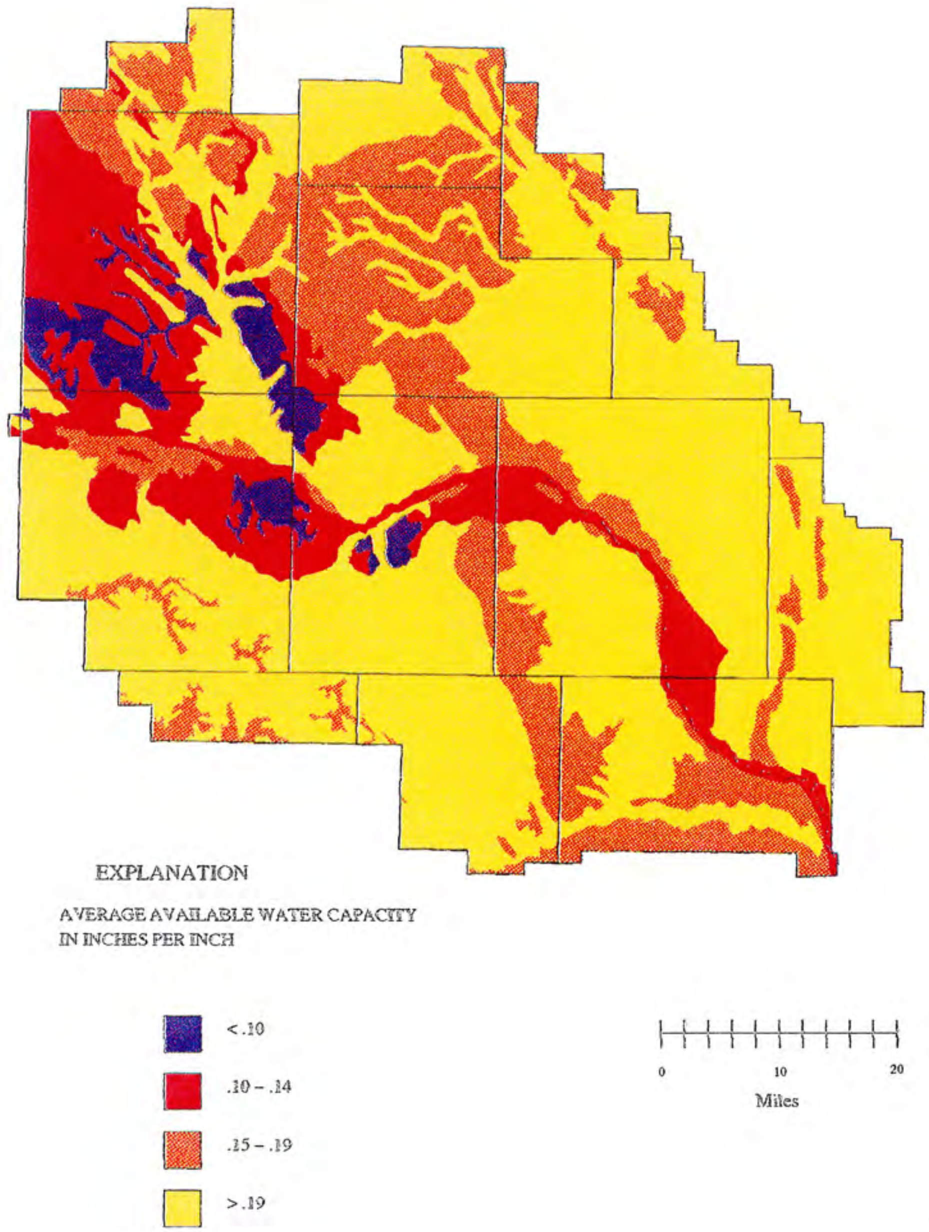


Figure 2. Average available water capacity in the Lower Elkhorn Natural Resources District (modified from Dugan, 1984).

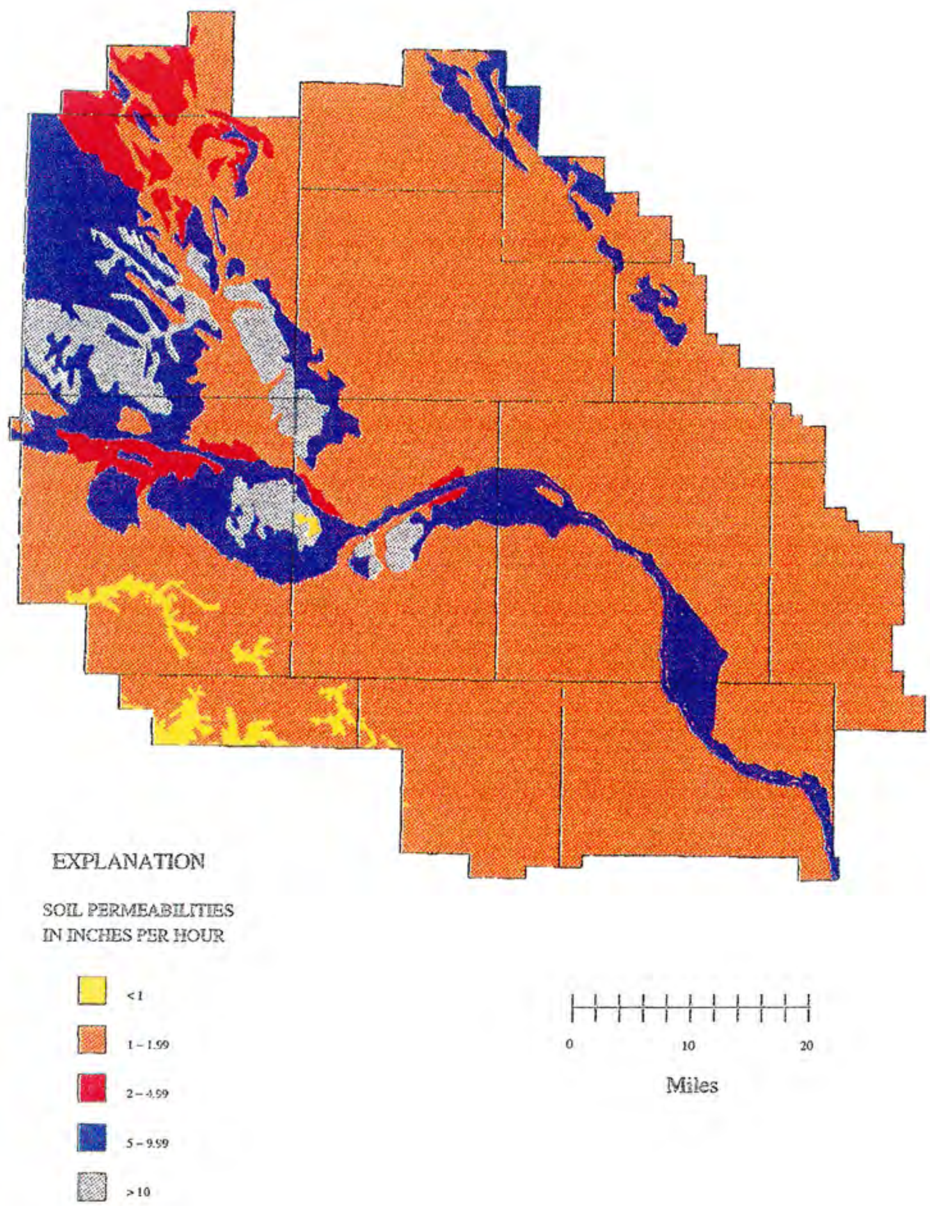


Figure 3. Soil permeabilities of the 60-inch profile in the Lower Elkhorn Natural Resources District (modified from Dugan, 1984).

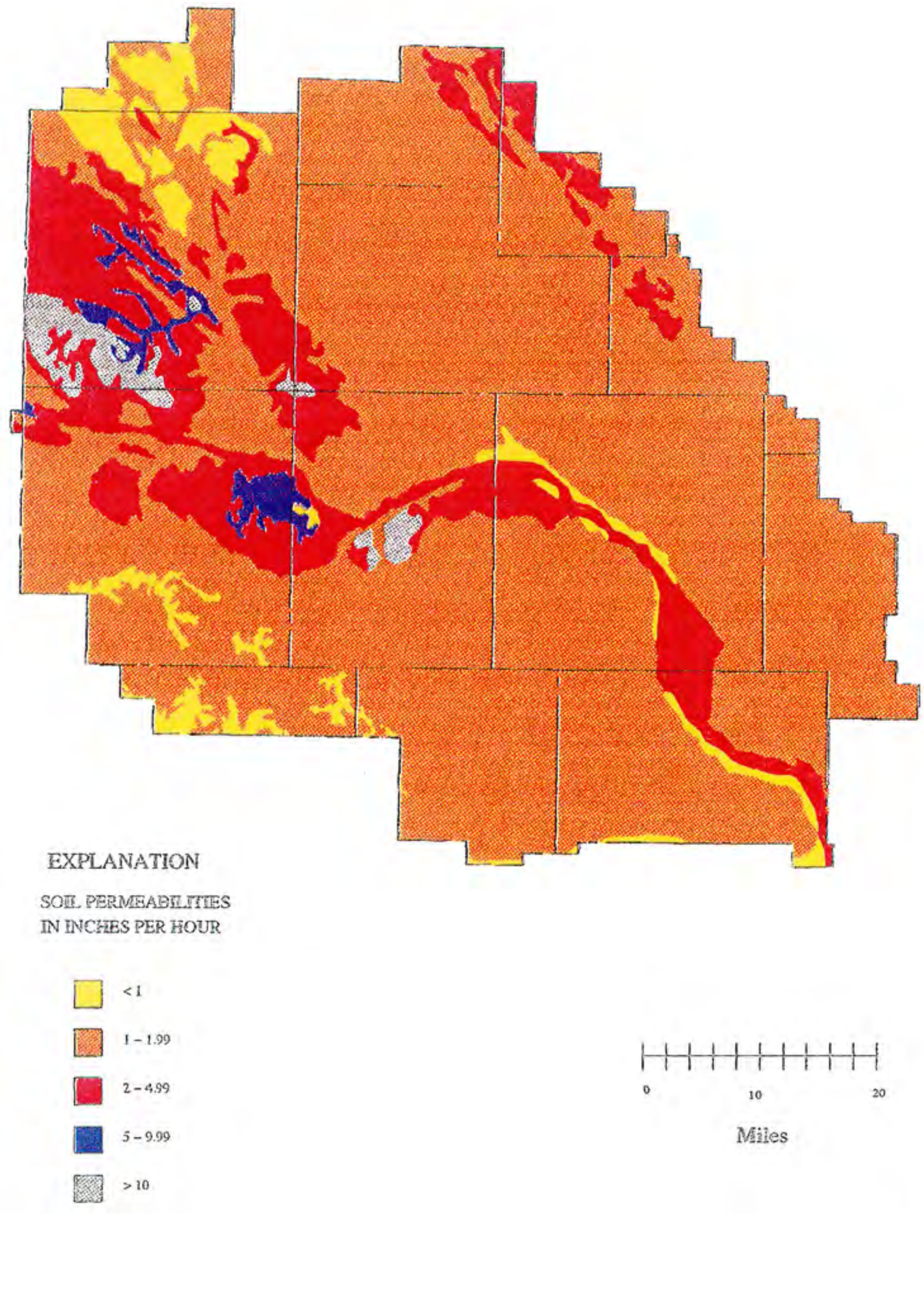


Figure 4. Soil permeabilities of the least permeable horizon in the Lower Elkhorn Natural Resources District (modified from Dugan, 1984).

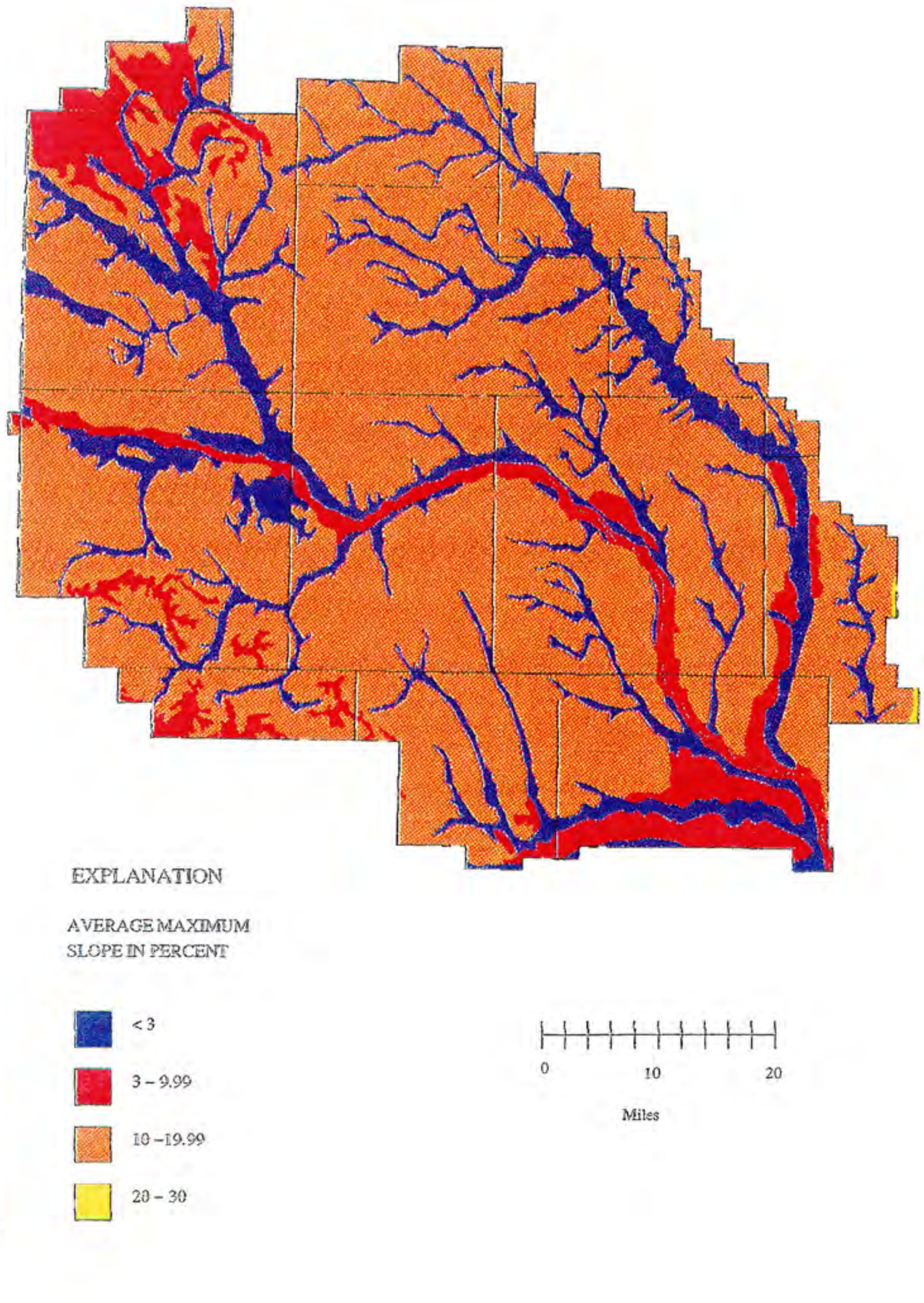


Figure 5. Average maximum percent slope in the Lower Elkhorn Natural Resources District (modified from Dugan, 1984).

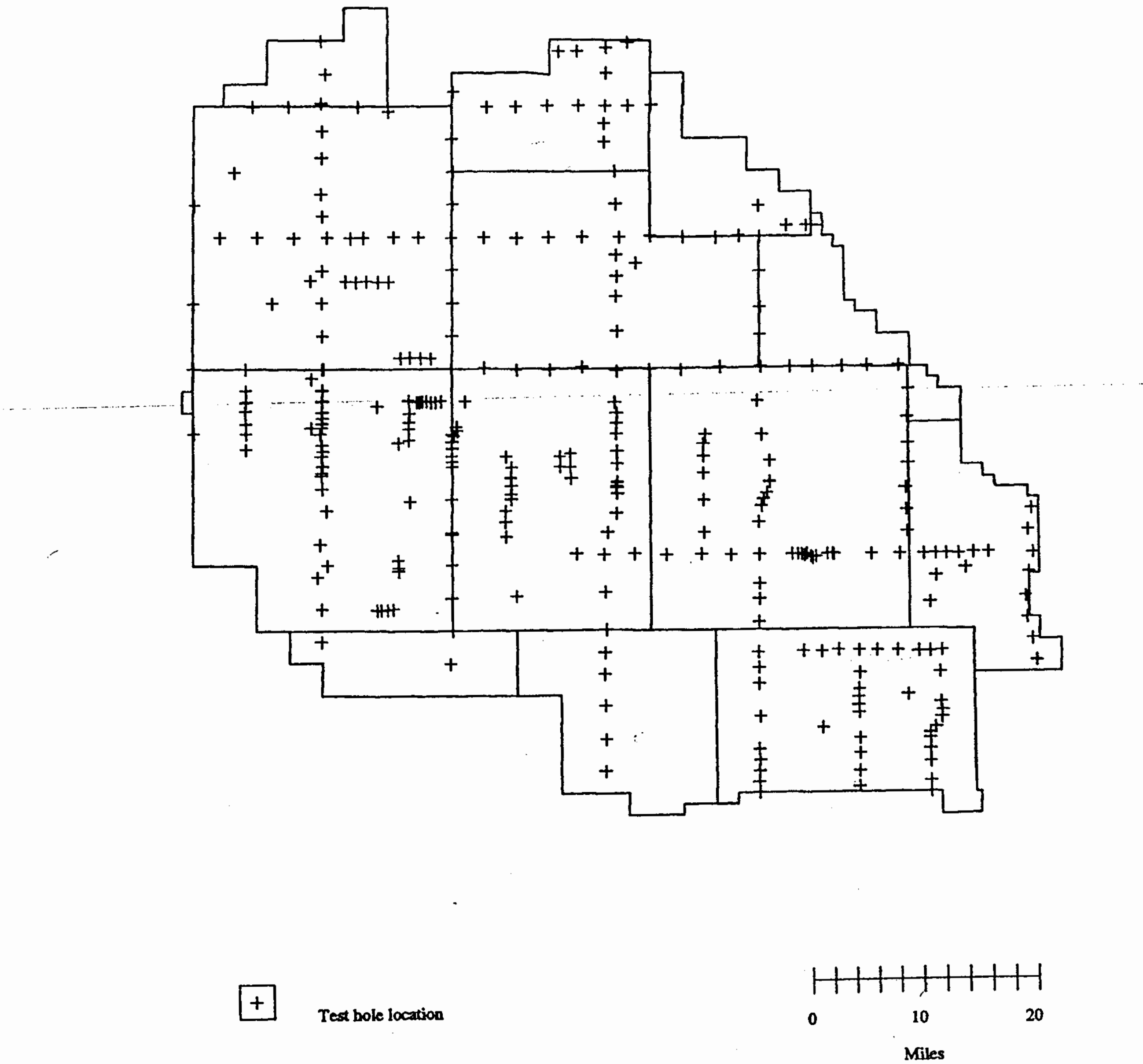


Figure 6. Location of test holes in the Lower Elkhorn Natural Resources District.

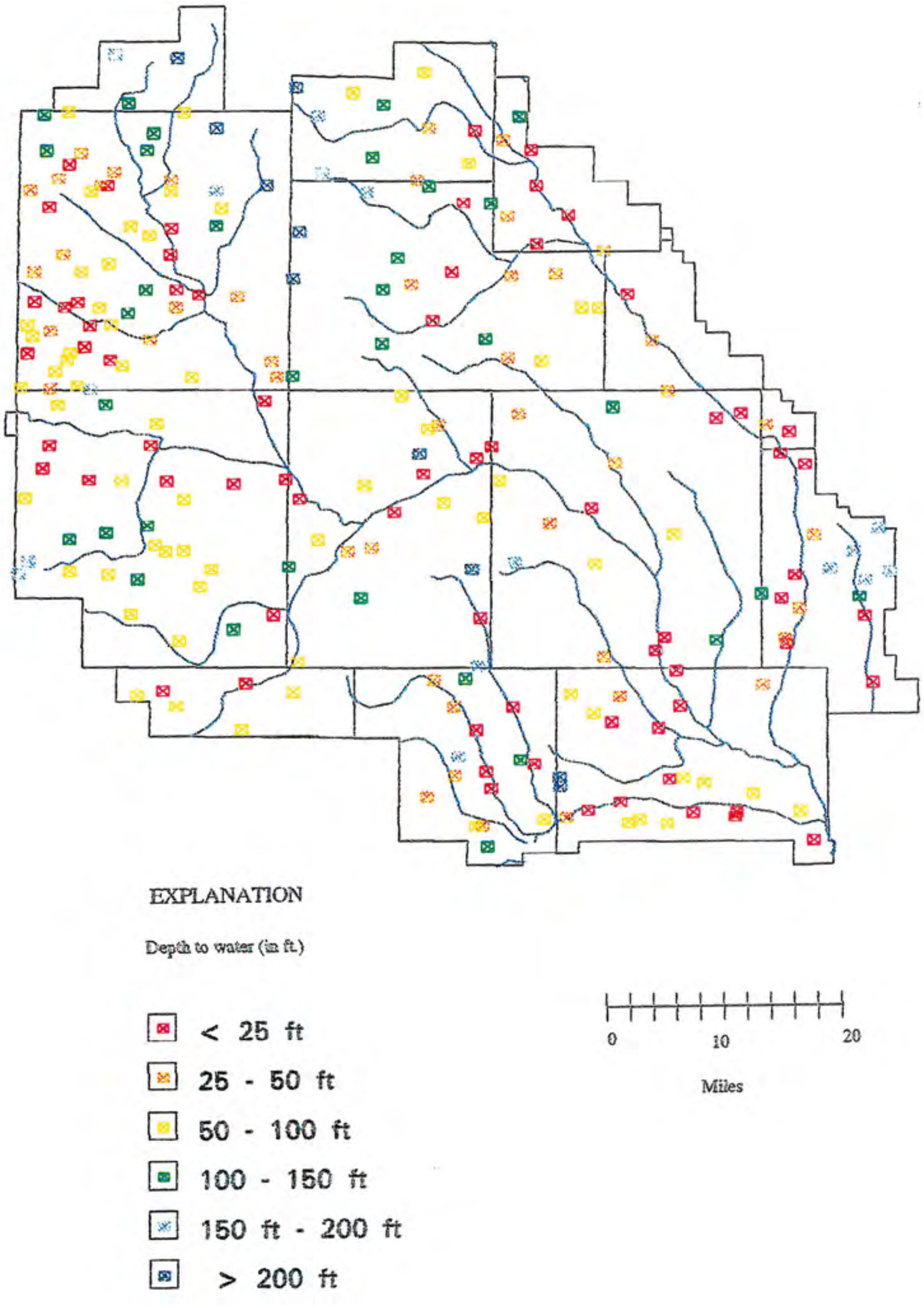


Figure 7. Location of observation wells and depth to groundwater in the spring of 1991 in the Lower Elkhorn Natural Resources District.

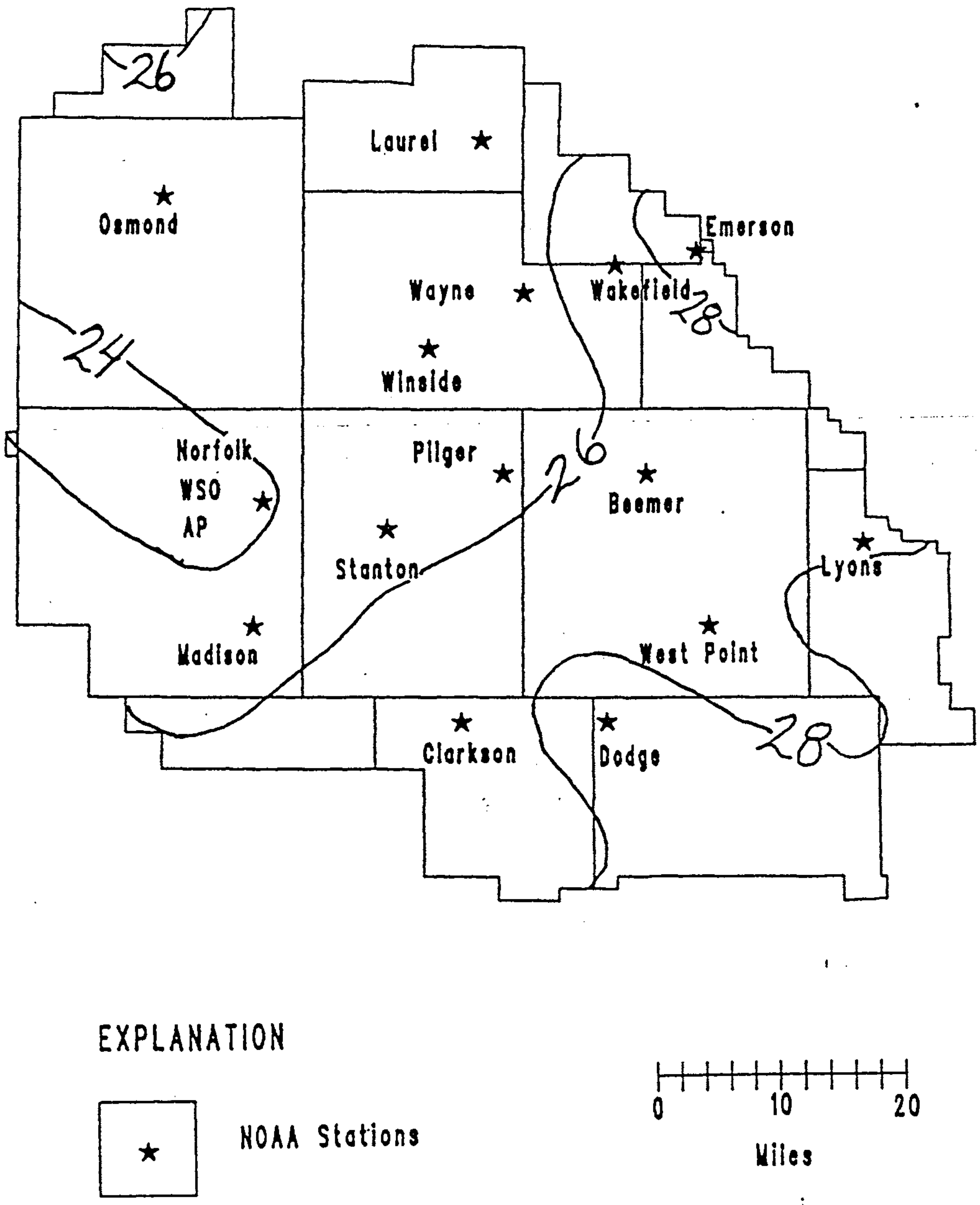


Figure 8. Annual normal (1951-1980) precipitation in the Lower Elkhorn Natural Resources District (modified from Steele, 1988).

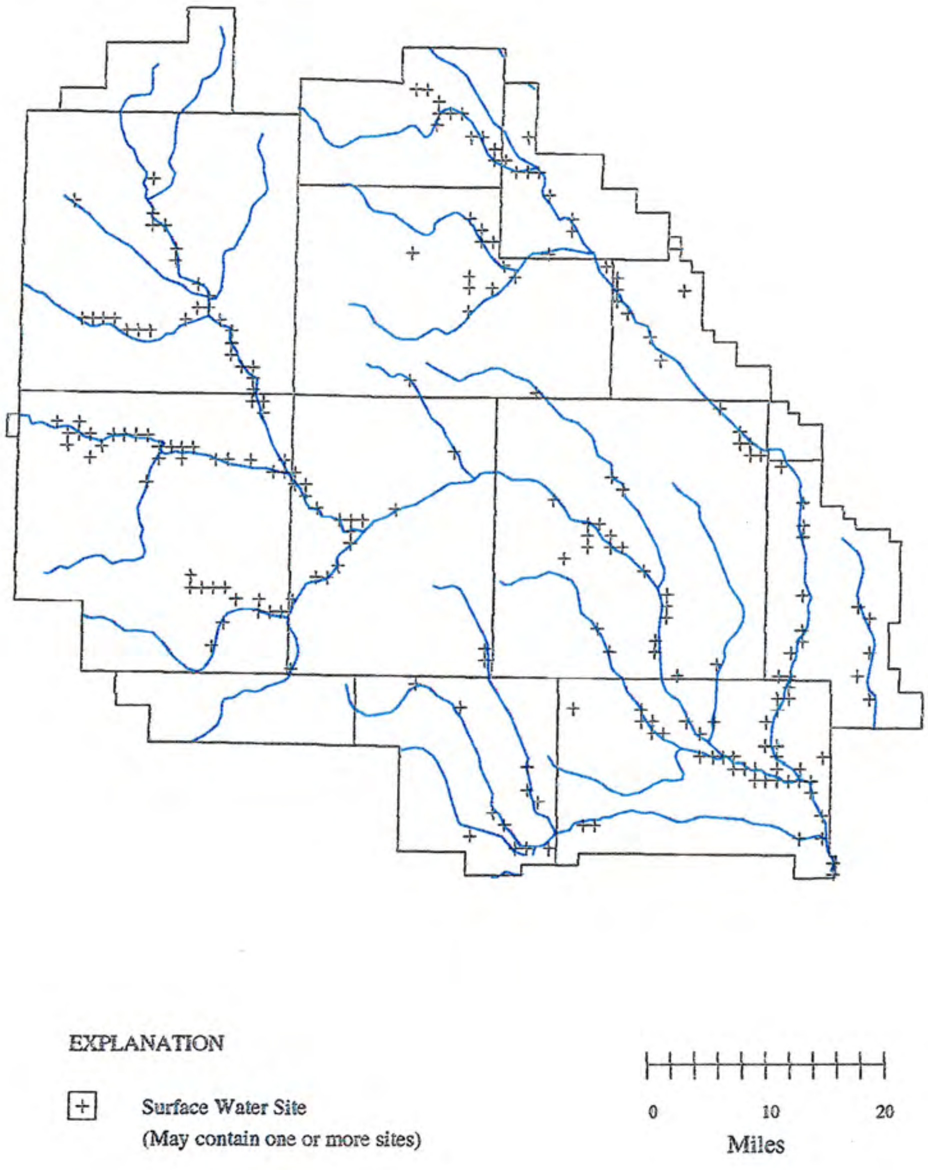


Figure 9. Location of surface-water-irrigation systems in the Lower Elkhorn Natural Resources District (Nebraska Department of Water Resources, written commun., 1993).

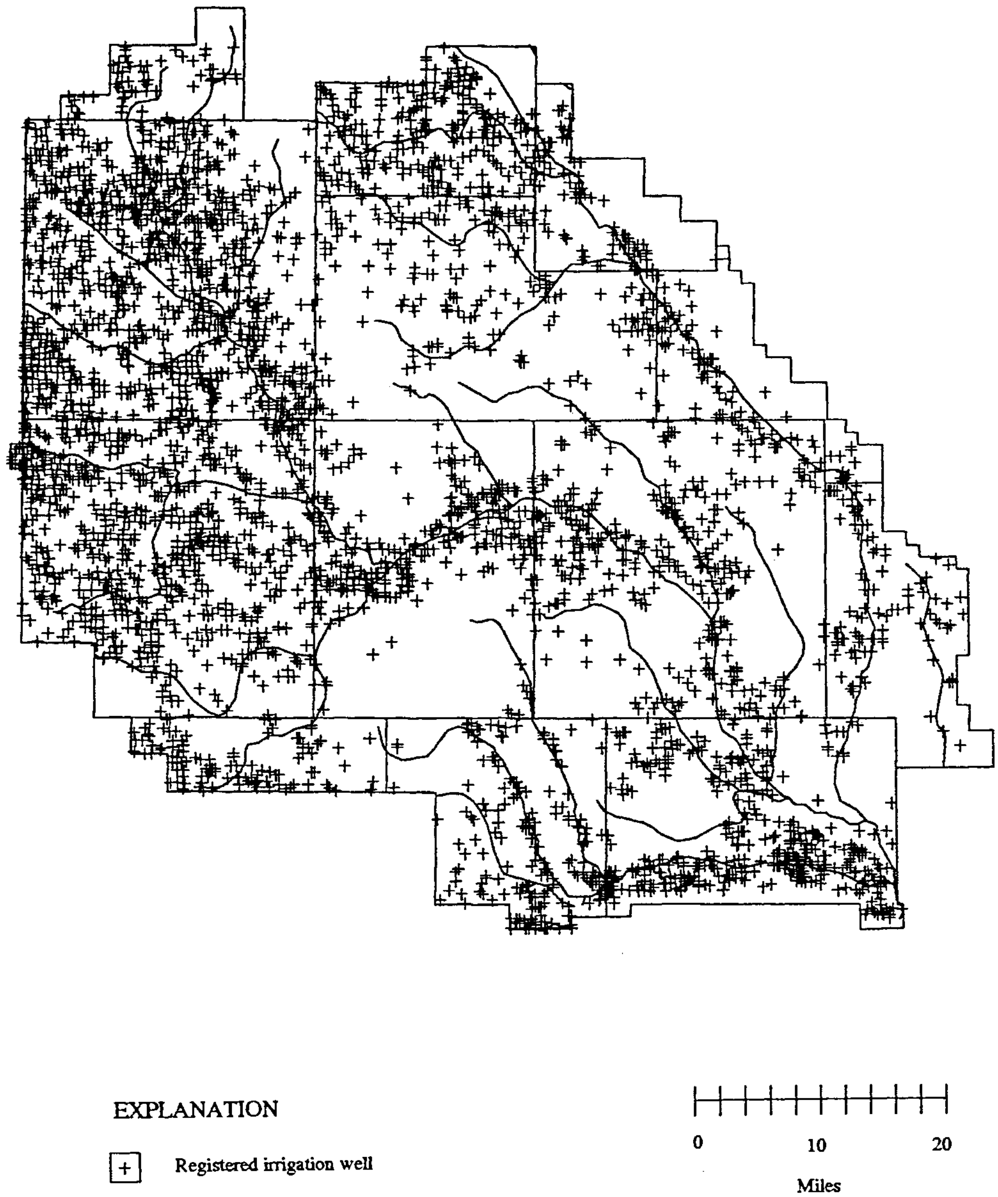


Figure 10. Location of registered irrigation wells in the Lower Elkhorn Natural Resources District - through March 1993.

C. *Identified Needs and Deficiencies*

The Lower Elkhorn NRD, like many other regions of Nebraska, has a complex hydrogeologic system. Understanding this system is necessary for effective groundwater management. For example, the district's mechanism for protecting groundwater quantity (triggering actions when groundwater levels drop to place controls on groundwater users such as industries, irrigators and municipalities) is the same for the entire district, regardless of local hydrogeologic conditions (refer to Section VII.C.6). This may be over-protecting some areas while leaving other areas under-protected, and needs to be refined so that more realistic triggers will protect different areas.

The 'Aquifer Description' section has not been updated since the original plan was developed in 1986. Although this section is usable, it is a general evaluation of the physical nature of the district's aquifers and needs to be updated. This will be an ongoing effort.

There is a large volume of hydrogeologic information that exists that needs to be compiled and interpreted for a more complete picture of the physical nature of the aquifers in the district. This information is available from sources that have not been fully utilized by the district, such as well driller's logs, site investigations by and for the U.S. Environmental Protection Agency and the Nebraska Department of Environmental Quality, and environmental audits. By gathering and interpreting existing information, the needs for new information acquisition can also be determined. This will be an ongoing effort.

The University of Nebraska Conservation and Survey Division is developing a hydrogeologic database for Pierce county using existing information. This will be a very useful tool. The district will encourage and support future efforts by the Division to eventually complete a database for the entire district.

The district has not yet compiled and interpreted all of the information collected by the various NRD programs. Groundwater level data from the Willow Creek Reservoir observation wells and the Osmond monitoring wells (these are described in Section III of the plan) need to be entered into a computer database and evaluated to understand the flow characteristics of those areas. Fall groundwater levels from the district groundwater quantity monitoring program also need to be entered into a database to

evaluate seasonal groundwater fluctuations. This data will be entered by the fall of 1994.

Understanding the complex nature of the district's hydrogeology will require extensive efforts and expertise. The NRD realizes that this will involve investing large amounts of money and manpower, and that this process will take several years to accomplish. The district will work with other governmental agencies and qualified consultants so that the proper strategy and conclusions will be used in the continuing study of the hydrogeologic characteristics of the district.

Groundwater vulnerability to quantity depletions has not been addressed. The district has a trigger that will actuate the protective processes (Section VII.C.6.) for the entire district. As mentioned earlier, this needs to be refined so that more realistic protective measures will be utilized.

Some of the information presented in the U.S. Geological Survey report will be more useful when presented on maps. This, too, will be an ongoing effort by the district.

I I I. INVENTORY OF GROUNDWATER QUANTITY AND QUALITY

A. *Groundwater Quantity*

Exhibit 16 shows estimates of the quantity of groundwater in storage for the district. This exhibit was developed from information about the porosity, geographic area, and saturated thickness of the water bearing materials in the district. Porosity and geographic area are fixed numeric values that will only change with new information or interpretation. Saturated thickness, however, can change seasonally. Saturated thickness is the difference between the elevations of the base and the top of the water bearing material, which will usually correspond to the elevations of the bedrock and the upper groundwater surface, respectively. As water is added to the system, such as precipitation, or is removed from the system, such as pumping groundwater from an irrigation well, the saturated thickness changes accordingly. These changes occur mostly at the upper groundwater surface (or the 'groundwater level'), and are determined by measuring the depth to the groundwater from the ground surface. Measuring the depth to groundwater is an indirect method of determining changes in saturated thickness, and is a general indicator of groundwater quantity.

The Lower Elkhorn NRD has monitored the depth to groundwater in selected irrigation wells throughout the district in the spring and fall of each year since 1976. The original monitoring wells selected by the Lower Elkhorn NRD staff have been evaluated by the University of Nebraska Conservation and Survey Division. Since 1976, six wells were added to represent the Dakota formation, 64 wells were dropped for quality control reasons (abandoned and cascading wells were dropped, for instance), and 18 wells were added where the need for additional data was apparent.

Exhibit 10a shows the current group of district-wide groundwater level monitoring wells and Figure 7 of Insert II - 1 shows the general depth to groundwater for these wells. The NRD will maintain this network of wells as long as possible, and when unforeseen events such as well abandonment or well alterations occur, the district will consult with the University of Nebraska Conservation and Survey Division, the U.S. Geological Survey, and other appropriate agencies to find suitable replacements.

In addition to the routinely monitored irrigation wells, the district measures groundwater levels in wells near the city of Osmond and near Willow Creek Reservoir. There are 20 monitoring wells around Osmond, Nebraska, that are measured monthly from April through October of each year. The data will be used to help Osmond develop a wellhead protection program. The Willow Creek Lake (near Pierce, Nebraska), wells are monitored as part of the maintenance program for the reservoir. Both monitoring programs are useful in documenting groundwater level fluctuations and in understanding local groundwater characteristics.

The district groundwater quantity monitoring program is described in Section VII.C.1 of this plan. Lower Elkhorn NRD personnel are certified as Monitoring Well Supervisors as required by law.

Groundwater levels are measured using the wetted-tape method (Nielsen, 1991). Land surface elevations are estimated from U.S. Geological Survey topographic quadrangles. Information for individual sites is available from the Lower Elkhorn NRD office and a summary of spring data from 1976 through 1993 appears in Appendix 2. All data are shared with the U.S. Geological Survey.

Table III - 1 summarizes the spring depth to water measurements collected by the district from 1976 through 1993. All data are in units of feet, except for the 'Location' and 'Count' columns (no units) and the 'Year' columns. The table is a summary of the information found in Appendix 2 and is organized by county. The first column lists the location of each irrigation well that the district measures routinely in the spring (Exhibit 10a shows a schematic representation of the location of each well listed in this table). The second column lists whether the well intercepts confined, unconfined or partially confined aquifers. The next four columns are basic statistical descriptions of the data for the period of record for each well. The 'Minimum' and Maximum' columns list the minimum depth (highest elevation) and maximum depth (lowest elevation) of the groundwater levels and the years that each occurred. The next column, 'Count', lists the number of years of data on record for each well. The final two columns list the predevelopment estimates that exist for each well and the maximum number of feet that the groundwater in the wells have dropped below this estimate (this is used as a 'groundwater quantity trigger', see Section VII).

Spring groundwater level measurements indicate that short term changes in groundwater quantity do occur, however, there are no large areas of long term trends for the period between 1976 and 1993.

TABLE III-1
SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY
(all measurements are in feet)

BURT COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
20N 9E 11A	P	9.35	8.60	3.31	9.32	4.74	1984	14.06	1990	17	10.00	4.06
21N 8E 02C	P	28.11	28.00	3.30	8.42	24.34	1993	32.76	1990	8		
21N 8E 22B	P	21.71	20.85	6.44	20.69	12.64	1984	33.33	1982	12		
21N 8E 22C	P	22.64	24.59	8.05	26.49	8.36	1984	34.85	1982	17	27.00	7.85
21N 9E 11B	P	3.64	3.52	1.17	4.23	1.77	1984	6.00	1977	17	4.00	2.00
22N 8E 01A	P	31.43	32.09	6.15	17.90	21.96	1987	39.86	1981	16		
22N 8E 23C	U	6.23	6.25	3.37	11.04	0.80	1984	11.84	1981	18	7.00	4.84
22N 8E 33D	P	18.88	20.97	6.22	19.12	9.43	1984	28.55	1982	18	22.00	6.55
22N 9E 10C	P	165.24	164.91	3.86	13.56	158.36	1984	171.92	1982	18	160.00	11.92
22N 9E 20B	P	159.22	160.52	5.06	15.93	152.27	1987	168.20	1981	16		
22N 9E 26B	P	148.75	149.26	3.84	13.32	141.58	1984	154.90	1982	16		
22N 9E 34D	P	113.28	111.47	3.53	11.58	107.89	1987	119.47	1990	11		
22N10E 19C	P	179.39	178.74	3.60	12.88	172.62	1987	185.50	1982	17	175.00	10.50
23N 8E 02A		13.47	13.36	3.10	10.06	7.91	1984	17.97	1990	18	15.00	2.97
23N 9E 36C	P	174.45	173.15	5.94	21.84	162.65	1979	184.49	1980	16		
24N 8E 33A	P	9.90	10.30	2.82	10.04	3.90	1984	13.94	1990	17	10.00	3.94

CEDAR COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
28N 1E 04B	U	182.14	182.24	1.19	4.02	180.04	1988	184.06	1983	18	180.00	4.06
28N 1E 33A	U	196.24	196.55	1.45	4.75	193.69	1988	198.44	1983	17	194.00	4.44
28N 2E 20C	U	135.31	136.05	2.42	7.03	130.92	1988	137.95	1982	17	134.00	3.95
28N 2E 36C	U	32.21	33.79	3.21	9.69	26.10	1984	35.79	1982	18	32.00	3.79
28N 3E 07B	U	36.96	36.85	0.75	2.86	35.36	1984	38.22	1991	18	35.00	3.22
28N 3E 11B	P	12.73	12.76	1.95	6.35	9.45	1979	15.80	1991	18	11.00	4.80
28N 3E 27A	P	58.16	59.45	2.68	6.78	53.97	1985	60.75	1982	17	57.00	3.75
29N 1E 19C	U	246.63	246.68	0.82	3.03	245.18	1988	248.21	1983	18	245.00	3.21
29N 1E 25B	P	79.85	80.75	2.43	7.38	75.62	1988	83.00	1982	17	78.00	5.00
29N 2E 13A	P	61.17	61.90	2.08	7.14	56.86	1984	64.00	1976	18	63.00	1.00
29N 2E 33B	U	112.60	113.41	2.32	6.65	108.62	1988	115.27	1982	18	112.00	3.27

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

TABLE III-1 (continued)
SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY
(all measurements are in feet)

COLFAX COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
18N 3E 11D	U	88.76	88.09	2.29	7.01	86.27	1988	93.28	1982	16		
18N 3E 12B	P	40.11	40.08	1.67	4.61	38.13	1993	42.74	1989	8		
18N 3E 24A	U	101.35	100.69	1.87	6.15	98.69	1988	104.84	1982	18	100.00	4.84
18N 4E 02D	U	56.10	55.95	5.43	17.60	47.90	1987	65.50	1982	18	55.00	10.50
19N 3E 10B	P	174.67	175.20	4.45	14.04	167.55	1987	181.59	1981	18	168.00	13.59
19N 3E 13D	P	7.11	7.17	3.92	12.41	2.29	1984	14.70	1981	16		
19N 3E 21A	U	47.33	47.67	4.64	14.46	40.66	1987	55.12	1981	16		
19N 3E 30C	P	29.12	28.63	4.49	15.64	23.46	1987	39.10	1977	18	29.00	10.10
19N 4E 09D	P	135.67	136.49	3.44	13.09	127.43	1976	140.52	1981	18	126.00	14.52
19N 4E 15A	C	3.64	3.51	0.98	2.76	2.22	1986	4.98	1989	8		
19N 4E 30B	P	7.64	7.68	3.93	12.80	3.14	1984	15.94	1981	18	7.00	8.94
20N 3E 03D	P	119.31	120.52	5.56	17.39	110.45	1984	127.84	1982	16		
20N 3E 06D	P	30.14	32.07	7.07	23.77	16.90	1984	40.67	1981	18	26.00	14.67
20N 3E 21A	P	22.65	24.55	6.31	21.27	11.87	1984	33.14	1981	18	18.00	15.14
20N 3E 35A	P	9.17	9.04	3.30	10.80	4.89	1984	15.69	1981	16		
20N 4E 02A		35.45	34.76	2.28	7.07	32.63	1987	39.70	1982	17		
20N 4E 20A	P	10.55	10.87	2.94	8.33	6.37	1984	14.70	1977	18	10.00	4.70

CUMING COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
21N 5E 26C	P	47.98	47.79	4.41	19.25	42.59	1987	61.84	1981	18	48	13.84
21N 6E 22B	U	4.62	4.51	0.60	1.66	3.93	1993	5.59	1990	8		
21N 6E 28A		3.11	3.16	0.85	2.83	1.64	1993	4.47	1981	18	4	0.47
21N 7E 20B	P	117.00	117.63	4.31	13.31	110.22	1985	123.53	1982	18	117	6.53
22N 4E 16C	U	162.92	162.45	3.02	8.78	158.45	1988	167.23	1982	18	160	7.23
22N 5E 15C	P	76.48	76.51	2.58	7.79	72.27	1984	80.06	1976	18	78	2.06
22N 6E 02B	C	53.38	54.04	2.65	8.96	47.97	1987	56.93	1981	18	53	3.93
22N 7E 36A	U	119.10	120.47	6.47	20.11	109.62	1987	129.73	1982	15		
23N 4E 07D	P	53.49	54.91	3.76	11.71	46.54	1985	58.25	1979	18	54	4.25
23N 4E 36B		35.02	34.60	2.59	7.06	31.53	1985	38.59	1982	18	36	2.59
23N 5E 02A	U	44.87	45.21	1.99	7.35	40.16	1984	47.51	1990	18	44	3.51
23N 5E 21D	P	5.53	5.90	1.83	6.76	1.26	1984	8.02	1981	18	7	1.02
23N 6W 10B		151.10	150.70	0.75	1.34	150.63	1993	151.97	1992	3		
24N 4E 09C	U	44.50	43.85	14.43	44.42	17.70	1987	62.12	1977	18	58	4.12
24N 5E 11A	U	143.67	143.74	1.44	4.61	141.59	1984	146.20	1982	17	140	6.20
24N 5E 19C	P	105.79	103.02	11.98	52.22	82.07	1993	134.29	1990	17	96	38.29
24N 7E 10D	P	16.77	18.43	3.91	13.23	8.48	1984	21.71	1981	18	17	4.71
24N 7E 17B		5.68	5.27	4.10	11.87	0.62	1984	12.49	1981	18	8	4.49

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

TABLE III-1 (continued)
SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY
(all measurements are in feet)

DIXON COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum		Maximum		Count	Predevelopment Level	
						Depth	Year	Depth	Year		Estimate	Minus Max. Depth
27N 4E 03A	U	17.77	17.28	3.87	12.33	12.04	1984	24.37	1990	17	17	7.37
27N 4E 17C	U	29.98	31.97	3.48	9.53	24.17	1993	33.70	1981	18	31	2.70
27N 4E 34A	P	22.44	23.28	2.41	7.27	18.17	1984	25.44	1976	18	23	2.44
27N 5E 18D	P	18.07	19.01	2.94	9.55	12.45	1984	22.00	1976	18	19	3.00
27N 5E 34D	P	27.49	28.95	3.65	12.62	18.95	1984	31.57	1990	17	28	3.57
28N 4E 04B	P	129.85	128.92	2.70	6.85	126.31	1988	133.16	1979	17	129	4.16
28N 4E 18A	P	37.06	37.42	1.73	6.07	33.65	1984	39.72	1991	17	38	1.72
28N 4E 22B	P	18.21	19.60	3.96	12.69	10.27	1984	22.96	1977	17	20.00	2.96

DODGE COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum		Maximum		Count	Predevelopment Level	
						Depth	Year	Depth	Year		Estimate	Minus Max. Depth
18N 5E 04A	U	22.16	21.24	2.66	8.46	18.76	1987	27.22	1992	10		
18N 5E 06D	U	30.60	30.41	4.33	13.70	23.98	1987	37.68	1982	18	28.00	9.68
18N 5E 15D	U	79.91	79.94	1.37	4.49	77.94	1985	82.43	1981	18	78.00	4.43
18N 6E 07B	U	64.86	65.07	1.30	3.20	63.32	1986	66.52	1992	8		
18N 6E 10A	U	66.46	66.65	1.15	3.07	64.87	1988	67.94	1992	8		
18N 6E 15A	U	12.69	12.85	0.82	2.53	11.52	1986	14.05	1982	18	11.00	3.05
18N 6E 17A	U	7.70	7.97	0.95	2.64	6.09	1986	8.73	1983	12		
18N 7E 03A	U	20.45	20.73	1.40	3.96	18.12	1987	22.08	1992	8		
18N 7E 06B	U	16.42	16.46	0.77	3.31	14.50	1984	17.81	1989	18	13.00	4.81
18N 8E 02A	U	72.37	72.41	1.40	3.81	70.45	1985	74.26	1977	18	72.00	2.26
18N 8E 13D	U	18.77	18.67	1.70	5.79	16.10	1984	21.89	1981	18	20.00	1.89
18N 8E 16D	U	70.69	70.63	1.99	6.28	67.22	1988	73.50	1982	18	71.00	2.50
19N 5E 19B	P	217.78	217.75	4.24	17.55	212.27	1987	229.82	1980	17	216.00	13.82
19N 5E 30B	U	242.63	242.76	3.13	8.84	238.27	1987	247.11	1990	8		
19N 5E 36A	U	9.12	9.94	3.25	10.36	3.34	1984	13.70	1981	18	9.00	4.70
19N 6E 22A	P	21.29	19.52	9.60	28.69	8.61	1987	37.30	1982	18	22.00	15.30
19N 6E 24B	C	53.34	53.20	2.42	9.83	48.37	1989	58.20	1982	12		
19N 7E 19D	U	66.17	66.05	1.53	4.43	63.79	1988	68.22	1992	8		
19N 7E 25C	U	73.42	73.52	1.73	5.21	70.98	1985	76.19	1981	16		
19N 9E 06D	C	25.60	27.34	6.66	23.03	13.95	1993	36.98	1982	12		
20N 5E 02D	P	41.19	41.90	2.49	6.45	37.13	1987	43.58	1992	8		
20N 5E 13A		47.11	47.67	2.05	7.55	42.65	1984	50.20	1990	16		
20N 5E 17B		72.92	72.95	3.87	11.74	67.16	1987	78.90	1982	18	72.00	6.90
20N 5E 22C	U	74.06	74.46	1.79	4.75	71.37	1987	76.12	1992	8		
20N 5E 26D	P	20.18	20.55	2.58	7.76	16.14	1984	23.90	1982	18	20.00	3.90
20N 6E 02A	U	8.40	8.65	1.26	3.70	6.66	1987	10.36	1981	18	8.00	2.36
20N 6E 23A	P	9.56	9.72	1.36	4.41	7.45	1984	11.86	1981	18	9.00	2.86
20N 6E 33A		2.03	1.59	2.27	7.54	-0.90	1984	6.64	1981	18	3.00	3.64
20N 8E 08B		33.46	32.85	2.54	9.03	30.41	1987	39.44	1982	12		
20N 6E 23D		4.44	4.82	1.12	2.15	3.18	1993	5.33	1992	3		

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

TABLE III-1 (continued)

SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY

(all measurements are in feet)

KNOX COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
29N 2W 08A	U	250.17	250.03	0.86	3.19	248.58	1976	251.77	1992	18	247.00	4.77
29N 2W 33C		75.40	77.08	5.61	17.89	64.82	1988	82.71	1992	18	72.00	10.71
29N 3W 04C	U	164.31	164.53	0.76	2.72	162.81	1977	165.53	1984	17	161.00	4.53
29N 3W 34A		111.02	111.31	1.90	5.88	107.71	1989	113.59	1984	18	109.00	4.59
29N 4W 35C	C	75.09	75.08	2.18	6.19	71.75	1988	77.94	1982	18	73.00	4.94

MADISON COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
21N 1W 11A	P	20.69	20.43	1.90	6.54	17.59	1984	24.13	1977	18	22.00	2.13
21N 1W 17C	U	129.86	129.79	2.09	6.03	126.73	1993	132.76	1982	17	130.00	2.76
21N 2W 21D	U	79.27	78.21	2.89	7.92	75.22	1988	83.14	1982	18	81.00	2.14
21N 3W 11B	U	55.30	53.21	4.74	13.37	48.52	1987	61.89	1982	18	58.00	3.89
22N 2W 07B	P	77.26	76.71	2.70	7.63	73.19	1988	80.82	1982	18	77.00	3.82
22N 2W 08C	U	87.87	87.06	2.50	6.46	84.63	1989	91.09	1982	18	87.00	4.09
22N 2W 09D		92.89	92.23	2.48	6.89	89.27	1988	96.16	1982	18	92.00	4.16
22N 2W 24B	P	59.75	59.14	1.63	4.86	57.36	1987	62.22	1977	18	60.00	2.22
22N 2W 26C	U	67.41	66.49	1.67	4.73	65.37	1987	70.10	1977	18	67.00	3.10
22N 3W 05A	U	107.73	107.26	3.51	9.94	102.74	1988	112.68	1982	17	110.00	2.[illegible]
22N 3W 21C		64.32	62.91	4.83	14.30	56.88	1987	71.18	1982	18	65.00	6.18
22N 3W 26A	U	125.87	128.14	4.56	11.08	119.94	1987	131.02	1982	18	127.00	4.02
22N 3W 27C		99.86	98.41	5.66	15.25	92.16	1993	107.41	1982	18	102.00	5.41
22N 4W 02D	P	120.70	120.02	3.93	11.92	114.51	1987	126.43	1982	18	123.00	3.43
22N 4W 17C	U	177.01	176.66	3.83	10.79	171.62	1988	182.41	1982	17	176.00	6.41
22N 4W 19C		151.67	151.27	2.34	7.97	148.80	1988	156.77	1983	11		
22N 4W 23D	P	101.17	100.38	5.09	14.77	93.56	1988	108.33	1982	18	102.00	6.33
23N 1W 08C	C	3.71	3.57	1.98	7.38	0.64	1984	8.02	1977	18	5.00	3.02
23N 1W 12D	U	2.71	2.65	0.77	3.42	1.25	1991	4.67	1977	18	3.00	1.67
23N 2W 08C	U	9.28	10.03	2.76	9.28	4.11	1987	13.39	1977	18	10.00	3.39
23N 2W 21A	U	78.07	77.73	3.51	10.55	72.13	1987	82.68	1982	18	80.00	2.68
23N 3W 07C		5.71	5.88	2.51	7.57	1.56	1987	9.13	1982	17	7.00	2.13
23N 3W 10C	U	66.32	66.32	1.95	6.16	62.90	1987	69.06	1977	18	66.00	3.06
23N 3W 36D	U	109.98	109.28	2.64	7.63	106.10	1988	113.73	1982	18	110.00	3.73
23N 4W 04C	U	10.65	11.26	2.64	7.61	6.28	1987	13.89	1982	18	10.00	3.89
23N 4W 19A	P	63.27	62.75	3.33	9.84	58.03	1987	67.87	1982	17	63.00	4.87
24N 1W 03D	U	16.27	16.39	1.06	3.17	14.48	1984	17.65	1977	18	10.00	7.65
24N 2W 18C	C	83.11	83.53	1.30	3.92	80.90	1984	84.82	1977	18	82.00	2.82
24N 3W 08A	U	133.09	134.04	3.32	9.05	127.63	1987	136.68	1979	18	134.00	2.68
24N 3W 25D	U	4.23	4.06	1.38	3.73	2.37	1979	6.10	1990	18	4.00	2.10
24N 4W 10A		84.33	84.82	2.10	6.04	81.08	1987	87.12	1977	17	85.00	2.12
24N 4W 28D	U	22.49	22.28	3.73	13.54	16.88	1984	30.42	1992	18	22.00	8.42

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

TABLE III-1 (continued)
SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY
(all measurements are in feet)

PIERCE COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
25N 1W 23B	C	32.45	34.39	4.15	11.19	25.68	1987	36.87	1982	18	33	3.87
25N 1W 26D	C	25.60	27.58	4.54	12.30	18.13	1987	30.43	1992	18	27	3.43
26N 1W 20C	U	40.46	41.26	2.33	6.23	36.77	1985	43.00	1979	18	40	3.00
26N 2W 05B	U	8.33	8.95	1.73	5.80	4.57	1984	10.37	1990	18	8	2.37
26N 2W 22D		4.03	4.45	1.96	5.85	0.83	1984	6.68	1991	18	4	2.68
27N 1W 03A		203.82	203.79	0.57	2.16	202.88	1989	205.04	1984	18		
27N 2W 01C	U	155.87	155.99	3.53	13.36	148.40	1989	161.76	1981	18	154	7.76
27N 2W 05C	U	87.64	88.39	2.43	7.23	83.79	1988	91.02	1982	18	86	5.02
27N 2W 13A	P	67.25	68.59	3.64	11.25	60.35	1988	71.60	1981	18	67	4.60
27N 2W 20C	U	13.71	14.46	2.19	6.58	10.54	1987	17.12	1981	18	14	3.12
27N 2W 24C	U	123.88	125.62	3.94	11.14	117.39	1988	128.53	1981	17	122	6.53
27N 3W 05A	U	10.26	10.61	2.42	7.94	6.04	1984	13.98	1991	18	9	4.98
27N 3W 05B	P	23.98	24.21	2.28	7.44	20.40	1984	27.84	1991	18	23	4.84
27N 3W 06C	C	63.38	63.44	1.71	5.15	60.72	1987	65.87	1991	18	63	2.87
27N 3W 22D	U	66.82	67.75	3.05	9.46	62.13	1984	71.59	1981	18	66	5.59
27N 3W 25D	U	48.14	48.62	2.07	7.05	43.68	1984	50.73	1990	18	47	3.73
27N 4W 06D		30.86	31.21	2.71	9.70	25.25	1984	34.95	1991	18	30	4.95
27N 4W 16B	U	10.66	10.94	2.57	8.87	5.37	1984	14.24	1991	18	10	4.24
28N 2W 12B	P	224.97	224.78	2.08	7.96	220.80	1976	228.76	1992	18	219	9.76
28N 2W 32C	U	47.79	48.17	2.89	8.05	43.70	1987	51.75	1981	18	47	4.75
28N 3W 12D	P	113.45	115.04	4.51	13.72	104.95	1988	118.67	1981	18	112	6.67
28N 3W 24B	U	133.77	134.68	3.04	9.94	127.86	1988	137.80	1981	18	132	5.80
28N 4W 05A	U	117.40	118.29	3.26	10.26	111.72	1987	121.98	1982	18	116	5.98
28N 4W 21B	U	118.69	119.64	3.08	9.58	113.28	1987	122.86	1982	18	118	4.86
28N 4W 24B	U	24.67	24.98	2.22	7.12	21.03	1987	28.15	1981	18	24	4.15
28N 4W 26B	U	22.20	22.83	2.43	7.08	18.24	1987	25.32	1982	18	21	4.32
28N 4W 34C	U	35.70	35.86	2.22	6.67	31.88	1987	38.55	1982	18	35	3.55

PLATTE COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
20N 1E 07D	U	63.71	62.64	2.42	7.53	60.44	1984	67.97	1981	18	65.00	2.97
20N 1W 09B		11.01	9.17	3.39	9.81	6.69	1993	16.50	1981	18	13.00	3.50
20N 1W 33B	U	74.27	74.18	4.15	11.54	68.27	1988	79.81	1981	18	76.00	3.81
20N 2W 08C		20.33	19.92	5.71	17.51	11.04	1987	28.55	1981	18	23.00	5.55
20N 2W 21B	U	103.46	103.67	6.80	20.43	92.24	1988	112.67	1981	18	108.00	4.67
20N 3W 14A	U	59.80	59.53	8.03	22.81	47.34	1988	70.15	1981	18	66.00	4.15

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

TABLE III-1 (continued)
SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY
(all measurements are in feet)

STANTON COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
21N 1E 31A		77.46	75.83	8.56	31.19	66.45	1983	97.64	1992	18	75.00	22.64
21N 3E 35D	P	166.63	168.50	4.85	14.81	159.16	1985	173.97	1982	15		
22N 1E 04D	P	58.08	59.72	3.56	11.43	50.99	1984	62.42	1981	16		
22N 1E 08B		31.75	33.17	3.61	10.45	25.40	1985	35.85	1982	18		
22N 1E 12C		30.97	29.75	4.51	14.80	22.93	1984	37.73	1991	18	26.00	11.73
22N 1E 19B	U	130.57	130.66	2.83	10.64	125.15	1984	135.79	1990	18	130.00	5.79
22N 2E 31C	P	146.86	146.98	1.41	3.78	145.28	1987	149.06	1992	8		
22N 3E 23B	P	233.30	233.17	2.66	7.90	229.30	1988	237.20	1982	18	232.00	5.20
23N 1E 19A	U	4.50	4.36	0.93	3.23	2.90	1984	6.13	1981	18	5.00	1.13
23N 2E 18A	P	77.97	78.78	2.37	7.36	73.76	1985	81.12	1977	17	77.00	4.12
23N 2E 27B		8.95	9.34	2.12	6.78	4.87	1984	11.65	1991	18	9.00	2.65
23N 3E 07B	U	12.14	12.60	2.03	6.36	8.20	1984	14.56	1981	18	12.00	2.56
23N 3E 20A	U	66.49	67.58	2.74	8.68	61.56	1985	70.24	1982	18	63.00	7.24
23N 3E 25C	U	99.44	99.68	3.01	8.84	94.66	1988	103.50	1982	18	98.00	5.50
24N 2E 02B	C	48.72	49.47	1.88	5.38	45.76	1988	51.14	1982	16		
24N 2E 36A	U	199.91	200.60	2.00	6.41	196.59	1987	203.00	1981	17	192.00	11.00
24N 3E 17C	P	24.22	25.44	4.05	12.14	17.32	1985	29.46	1981	18	25.00	4.46
24N 3E 19B	U	63.29	63.76	2.47	6.07	60.36	1987	66.43	1992	8		
24N 3E 25D	U	2.67	2.64	1.86	6.54	-0.24	1984	6.30	1981	18	4.00	2.30
24N 3E 35D		8.10	8.39	2.48	7.46	4.03	1984	11.49	1981	18	9.00	2.49
21N 3E 11D		12.16	12.42	2.37	8.01	7.75	1984	15.76	1977	16	11.00	4.76

THURSTON COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
24N 8E 17C	P	28.28	27.98	5.46	16.08	20.67	1987	36.75	1982	18	30.00	6.75
24N 8E 22A	P	21.53	21.74	3.23	9.77	16.08	1984	25.85	1990	17	23.00	2.85
25N 5E 02A	P	39.80	37.64	9.97	34.24	28.26	1987	62.50	1979	15		
25N 6E 09C	U	22.90	23.86	2.58	8.36	17.23	1984	25.59	1982	18	22.00	3.59
25N 6E 34C	U	46.00	45.90	2.30	7.11	42.96	1987	50.07	1982	17	45.00	5.07
26N 5E 24D	U	18.51	21.48	5.39	14.38	9.35	1984	23.73	1982	18	21.00	2.73

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

TABLE III-1 (continued)
SPRING GROUNDWATER LEVEL MEASUREMENT STATISTICAL SUMMARY
(all measurements are in feet)

WAYNE COUNTY

Location	Aquifer Type *	Mean Depth	Median Depth	Standard Deviation	Range	Minimum Depth	Minimum Year	Maximum Depth	Maximum Year	Count	Predevelopment Level Estimate	Predevelopment Level Minus Max. Depth
25N 1E 30C	U	109.92	111.45	4.78	13.24	102.00	1987	115.24	1992	18	110.00	5.24
25N 2E 09C	P	121.45	121.65	2.84	9.68	116.20	1987	125.88	1992	16		
25N 3E 12B	C	141.39	141.71	3.88	11.55	135.25	1984	146.80	1990	18	140.00	6.80
25N 4E 20B	P	40.31	39.26	4.27	11.05	35.33	1984	46.38	1990	12		
25N 4E 23B	C	48.85	47.79	3.87	10.21	44.38	1984	54.59	1990	12		
26N 1E 18B	P	203.51	203.74	1.60	4.95	200.85	1989	205.80	1981	18	201.00	4.80
26N 2E 03B	P	130.76	131.96	2.61	7.27	126.78	1987	134.05	1982	17	129.00	5.05
26N 2E 14D	U	37.64	39.29	3.23	10.58	31.91	1984	42.49	1977	17	41.00	1.49
26N 2E 21B	P	102.66	103.39	2.48	7.52	98.41	1987	105.93	1981	17	101.00	4.93
26N 3E 09C	P	13.08	12.91	2.42	9.02	9.00	1984	18.02	1990	18	12.00	6.02
26N 3E 31D	P	13.96	13.93	2.39	8.15	9.74	1983	17.89	1977	18	13.00	4.89
26N 4E 12C	P	48.21	47.68	2.57	6.79	45.11	1987	51.90	1982	18	49.00	2.90
26N 4E 17A	P	24.55	24.64	1.74	5.44	21.64	1983	27.08	1990	18	22.00	5.08
26N 5E 27C	P	52.30	54.70	6.48	18.56	42.52	1984	61.08	1982	18	55.00	6.08
26N 5E 29D	P	93.64	93.90	6.69	19.42	84.13	1984	103.55	1982	15		
27N 1E 30A	U	248.78	249.03	1.13	3.90	246.60	1979	250.50	1983	17	246.00	4.50
27N 2E 06D	P	157.32	157.74	1.80	5.61	153.99	1988	159.60	1982	18	155.00	4.60
27N 3E 06B	P	122.34	123.71	3.12	9.02	116.93	1984	125.95	1982	18	122.00	3.95
27N 3E 10C	C	8.09	8.56	2.66	7.70	3.58	1984	11.28	1991	18	8.00	3.28
27N 3E 12D	P	103.29	104.53	2.87	8.24	98.65	1987	106.89	1992	18	102.00	4.89

* C = Confined Aquifer; U = Unconfined Aquifer; P = Partially Confined Aquifer

B. *Groundwater Quality*

1. Groundwater Quality Monitoring Program

a. The district groundwater quality monitoring program is described in Section VII.C.2 of the plan. The program consists of maintaining a network of 81 irrigation wells for district-wide groundwater quality monitoring that are on a 5-year sampling cycle. Specialized monitoring is also performed to evaluate local conditions on a concentrated basis.

The district sampled the network of 81 irrigation wells over several years in the late 1980's. Nitrate-nitrogen, volatile organic compounds, and the pesticide extractable screen performed by the Nebraska Department of Health were determined to obtain a baseline of water quality data. There were no traces of pesticides detected. Volatile organic compounds were not detected either, however volatile organic compounds would not be normally be expected at these rural area sampling sites and the sample collection procedure, although it included the proper sample containers and preservatives, was not correct for volatile compounds since the samples were collected from the irrigation pump discharge. Thirteen of the 81 irrigation wells contained elevated (greater than 10 milligrams per liter) nitrate-nitrogen levels. The baseline sampling took several years to accomplish, and additional compounds were added over this period of time. A listing of the compounds tested is included in Appendix 4.

The NRD collected more samples from the areas where nitrate-nitrogen contamination was found. Exhibit 17a shows these areas. The area east of Pierce, Nebraska is the largest contaminated area.

b. Sampling Protocol

The NRD realizes the limitations of using irrigation wells as monitoring wells, and is very careful to ensure that all water quality data collected are as meaningful as possible. The district sampling protocol follows state and federal guidelines (American Public Health Association, 1992, and U.S. Environmental Protection Agency, 1983). The laboratory that will receive NRD samples must be certified by the state for the parameters performed and is always consulted for sample collection instructions. Sampling equipment and sample bottles are supplied by the lab to ensure proper bottle types, volumes and preservation techniques are used. The district requires laboratory analysis to conform to Environmental Protection Agency approved methods.

Detailed sampling requirements differ for each parameter being estimated. Irrigation wells are purged for a minimum of 4 hours prior to sample collection to ensure consistent results. The district collects one field replicate for every 10 samples collected. When replicate sample results vary more than 10%, the district will notify the lab to determine the cause and corrective actions needed. Water temperature is determined in the field with hand-held dial thermometers.

Each well that is sampled is assigned a permanent NRD identification number. Field sheets are filled out for each well that includes a detailed description of site conditions and well location.

c. Information Handling Procedures

Each sampling site is assigned a unique identification code. All results are furnished to the landowner and/or farm operator. Results are also stored electronically in a database that includes the well's owner, registration number, and location. Separate databases exist for groundwater levels, nitrate-nitrogen concentration, and chemigation permits, and the NRD is in the process of tying these together with a relational database.

2. General Groundwater Quality Studies

Groundwater quality determines its suitability for different uses. For example, water high in nitrate-nitrogen may not be suitable for drinking water but may be ideal for irrigation. Some important characteristics of groundwater include hardness, pH, conductivity, sodium, potassium, alkalinity, sulfate, chloride, fluoride, silica, boron, iron, manganese, selenium, phosphorous, dissolved solids and nitrates. Many of these are not considered hazardous and limits of concentration in drinking water have not been established by the Environmental Protection Agency. Fluoride, nitrates, and selenium have established limits and do occur naturally in Nebraska's groundwater.

Nitrate in groundwater presents a hazard because it may cause methemoglobinemia (blue baby syndrome) in infants and animals. The Environmental Protection Agency has established a limit for nitrate in drinking water of 10 milligrams per liter. There is some naturally occurring nitrate in groundwater, however, these concentrations are normally low (1 to 3 milligrams per liter). Greater concentrations indicate contamination due to human activities. Contamination occurs when nitrate is leached through the soil and into the groundwater from sources such as fertilized fields, feedlots, and septic tank drain fields. It occurs much more readily where the soil is coarse and can be compounded by irrigation. Point sources such as spills and well contamination usually cause the highest concentrations of nitrate.

In recent years public concern over nitrate contamination has increased. Nitrate in groundwater will be a subject of continuing study and monitoring so that areas with a high potential for contamination can be identified and protected. Efforts by the district, the University of Nebraska, the Nebraska Departments of Environmental Quality and of Health, the U.S. Environmental Protection Agency, and the U.S. Geological Survey have contributed to determining the locations and extent of groundwater nitrate contamination.

Exhibit 17 indicates locations in the Lower Elkhorn NRD where nitrate concentrations greater than 10 milligrams per liter have been detected in public water supplies by the Nebraska Department of Health. Appendix 4 lists nitrate-nitrogen values from the district groundwater quality monitoring program. Exhibit 17a shows areas where nitrate-nitrogen contamination (areas where nitrate-nitrogen exceeds 5 milligrams per liter) has been detected by studies that the district has been involved with.

a. Dr. Bruce Hanson conducted a baseline study of the nitrate-nitrogen content of the groundwater in Pierce county for the University of Nebraska Conservation and Survey Division (Hanson, 1983). The study was done to document groundwater nitrate-nitrogen levels in the early 1980's in Pierce county and to provide a baseline of data for future comparison. The information from this study and from subsequent studies is included in Appendix 4, and the location of irrigation wells with values greater than 5 milligrams per liter nitrate-nitrogen is presented in figure 17a. Sand-pits, irrigation wells, domestic wells, municipal wells, and a flowing field tile drain were sampled and analyzed for nitrate-nitrogen, temperature, and specific conductivity from 1980 through 1982.

   The results of the 156 samples collected at 135 sites ranged from 0.00 to 53.7 and averaged 6.4 milligrams per liter nitrate-nitrogen. Half of the 26 samples that were over 10 milligrams per liter nitrate-nitrogen occurred in a nine square-mile area east of the city of Pierce. Dr. Hanson concluded that the source of the elevated nitrate-nitrogen levels was probably under-utilized commercial fertilizer. He estimated the total amount of contamination in the county to be roughly 5,000 tons in the 1983 report.

Seventeen of the sites sampled had been previously sampled during the period from 1943 to 1979 by various state and federal agencies. Dr. Hanson concluded that nitrate-nitrogen in these wells had risen since 1970.

This information is very useful for detecting changes and trends in nitrate-nitrogen levels, since it is the earliest detailed study of nonpoint source pollution in the district. Forty-two of the sites sampled by the Division have been resampled by the district with varying results. Comparing results from this study (early 1980's) with subsequent sampling (late 1980's and early 1990's) shows that in general, low values remained low and high values remained high or increased (see Appendix 4).

b. The University of Nebraska Water Center conducted a study of nitrate contamination in domestic wells in Nebraska, and approximately 134 wells were sampled for nitrate-nitrogen analysis throughout the Lower Elkhorn NRD in 1987 and 1988 (Spalding, 1991; Appendix 4). Cedar and Cuming counties were among the five highest counties for mean nitrate-nitrogen concentrations in the state. Table III - 1 summarizes the nitrate-nitrogen and pesticide results of the study within the Lower Elkhorn NRD. It appears that much of the nitrate-nitrogen contamination reported in the study may originate from point sources. The study concluded that the dryland area of eastern Nebraska had a high frequency of nitrate and bacterial contamination in old, poorly constructed wells and that there were significant (95% level) associations between nitrate concentrations and well depth, construction, and age.

Table III - 2.

Nitrate and Pesticide Detections (from Spalding, 1991)

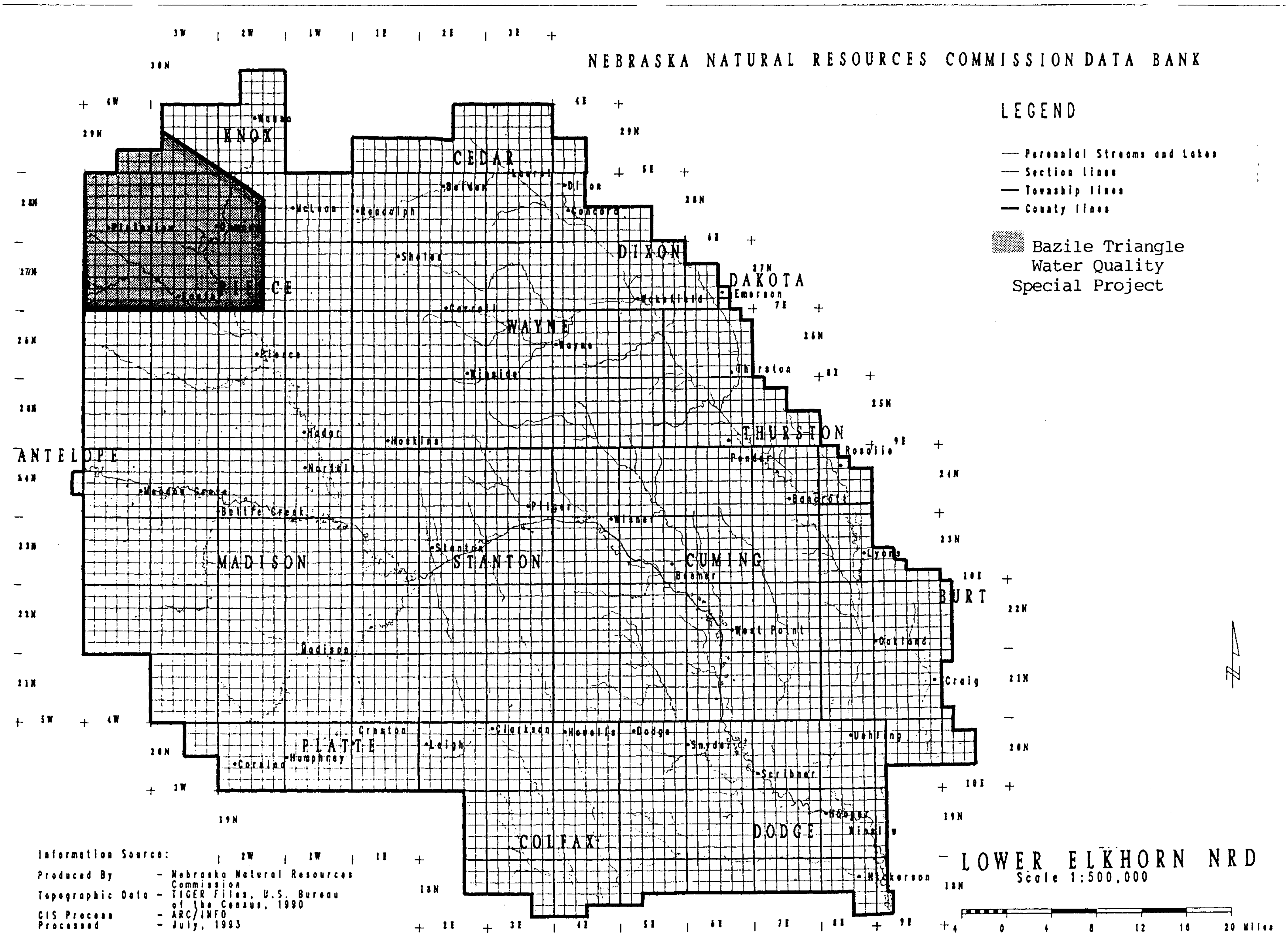
Nitrate-Nitrogen Summary

Lowest value	0.1 milligrams per Liter
Highest value	78 milligrams per Liter
Average	8.9 milligrams per Liter
Number of wells:	
Less than 5 mg/L	79
5 to 9 mg/L	17
9 to 20 mg/L	17
Greater than 20 mg/L	17

Pesticide Summary

County	Pesticide	Concentration
Cedar	Alachlor	0.95 micrograms per Liter
	Atrazine	0.01 to 0.50 micrograms per Liter
Colfax	Alachlor	20.6 micrograms per Liter
Madison	Alachlor	13 micrograms per Liter
	Chlorpyrifos	0.04 micrograms per Liter
Stanton	Atrazine	0.01 to 0.50 micrograms per Liter
Wayne	Alachlor	0.96 micrograms per Liter

c. Dr. David Gosselin conducted a study in the 1989 to determine the extent of nitrate contamination in an area of northeastern Nebraska that included a portion of the Lower Elkhorn NRD for the University of Nebraska Conservation and Survey Division (Gosselin, 1990; Figure III - 1). The area



NEBRASKA NATURAL RESOURCES COMMISSION DATA BANK
LEGEND
Perennial Streams and Lakes
Section lines
Township lines
County lines
Bazile Triangle Water Quality Special Project
KNOX
CEDAR
DIXON
DAKOTA
PIERCE
WAYNE
THURSTON
ANTELOPE
MADISON
STANTON
CUMING
BURT
PLATTE
COLFAX
DODGE
Emerson
Laurel
Belden
Dixon
Concord
McLean
Randolph
Sholes
Wakefield
Carroll
Wayne
Pierce
Winside
Thurston
Hadar
Hoskins
Pender
Rosalie
Norfolk
Meadow Grove
Battle Creek
Bancroft
Pilger
Wisner
Stanton
Lyons
Beemer
West Point
Oakland
Madison
Craig
Creston
Clarkson
Howells
Dodge
Uehling
Leigh
Snyder
Humphrey
Cornlea
Scribner
Hooper
Winslow
Nickerson
LOWER ELKHORN NRD
Scale 1:500,000
0
4
8
12
16
20 Miles
Information Source:
Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
GIS Process - ARC/INFO
Processed - July, 1993

Figure III-1

studied is called the Bazile Triangle and covers portions of the Lewis and Clark, Lower Niobrara, and Upper Elkhorn NRDs as well.

Approximately 70 percent of the 117 irrigation wells sampled in the Bazile Triangle had nitrate-nitrogen levels greater than 5 milligrams per liter and roughly one-third of these were above 10 milligrams per liter. Dr. Gosselin concluded that contamination in the Ogallala Group was from its direct hydraulic connection with overlying Plio-Pleistocene sands and gravels, and that this relationship suggests that the Ogallala may be relatively uncontaminated. Glacial till appears to inhibit the vertical movement of nitrate-nitrogen contamination, which supports the assessment of groundwater vulnerability found in Section II - B of this plan. The study also concluded that the correlation between nitrate-nitrogen and chloride values indicates that the origin of each is from fertilizer application.

d. The district supported a study of the local groundwater flow system in the Osmond, Nebraska area in the mid 1980s (Alix, 1987). The study was conducted by a University of Nebraska graduate student under the supervision of the Conservation and Survey Division. Nitrate-nitrogen contamination in Osmond's municipal wells is consistently around 10 milligrams per liter. The purpose of the study was to determine the hydraulic and chemical characteristics of the aquifer in order to help Osmond in their wellhead protection efforts. The study determined that the groundwater flow is generally towards the south and is from the west, north, and east, coinciding with the North Fork of the Elkhorn River. The study also resulted in the construction of 20 monitoring wells. The NRD measures the static water level in these wells monthly from April to October of each year, and collects samples for nitrate-nitrogen determinations in the shallow wells twice a year and once a year in the deep wells. The study concluded that Osmond should consider placing replacement wells to the north, west, or south of the city.

e. The U.S. Geological Survey conducted a study in 1991 to determine the hydrogeologic, spatial, and seasonal distribution of herbicides and nitrate in aquifers within 50 feet of the land surface (Kolpin and others, 1993). The study also collected land use information for the area surrounding each sampling site. Five sites were in the Lower Elkhorn NRD: three from public supplies in Cuming, Stanton, and Pierce counties; one domestic well in Dodge county; and one industrial well in Madison county. All five sites had detections below the Maximum Contaminant Level with the exception of a 0.54 microgram per liter detection of atrazine (Maximum Contamination Level is 0.03 micrograms per liter) at the Stanton county site.

3. Quality and Suitability of Groundwater by Region

a. Sandhills Region

Except for isolated locations where high nitrate concentrations have been reported (Exhibit 17a), the groundwater quality of the Sandhills region is generally good and is fit for most uses.

The groundwater in the region is generally low to moderate in total dissolved solids (Exhibits 4 and 18) and hardness (Exhibits 19 and 20). Calcium concentrations are also generally low to moderate, but concentration of more than 75 milligrams per liter calcium have been reported in isolated areas.

Alkalinity concentrations are generally less than 300 milligrams calcium carbonate per liter (Exhibit 21). Sulfates are generally not a problem in the Sandhills region with concentrations of around 100 milligrams per liter or less (Exhibit 22).

Recorded nitrate concentrations vary from less than 5 milligrams per liter to over 40 milligrams per liter in isolated areas. Portions of Pierce and Madison counties have been identified as areas with nitrate contamination (Exhibit 17a).

b. East Central Dissected Plains Region

Generally the water quality in this region is acceptable for all potential water uses.

The concentration of total dissolved solids in groundwater of the Dissected Plains of the Lower Elkhorn NRD is generally in the range of 250 to 750 milligrams per liter (Exhibits 4 and 18). Concentrations of calcium vary from

25 to over 75 milligrams per liter and the groundwater is moderately hard (Exhibits19 and 20). Alkalinity varies from 100 to over 300 milligrams calcium carbonate per liter (Exhibit 21). Sulfate concentrations are generally less than 100 milligrams per liter (Exhibit 22).

Nitrate contamination has occurred in some locations in the Dissected Plains, but the region is not as sensitive as the Sandhills (Exhibit 23a).

c. Glacial Drift Region

Groundwater quality in the Glacial Drift region is generally fit for most uses but concentrations of most chemical parameters are higher than in the Sandhills and Dissected Plains Regions.

The water quality in the glacial Drift of the Lower Elkhorn NRD is highly variable due to the glaciated materials that come into contact with the groundwater. Total dissolved solids are generally higher than in the Sandhills or the Dissected Plains with concentrations increasing in the lower reaches of the Elkhorn River. Total dissolved solids are generally in the range of 250 to 750 milligrams per liter, but some areas in Wayne and Stanton counties have concentrations of 750 to 2,250 milligrams per liter (Exhibits 4 and 18). Calcium generally exceeds 75 milligrams per liter, but ranges from 25 to 75 milligrams per liter in isolated areas of Pierce, Wayne, Madison, Stanton, Cuming, and Dodge counties. The groundwater is classified as hard in all areas of the Glacial Drift (Exhibits 19 and 20).

Alkalinity generally exceeds 300 milligrams calcium carbonate per liter, but ranges from 100 to 300 milligrams calcium carbonate per liter along the Elkhorn River, along the Glacial Drift western boundary, and along the northeast boundary of the NRD (Exhibit 21). Sulfate concentrations are generally less than 100 milligrams per liter. Because the groundwater can come into contact with high sulfate glacial till, some areas of high sulfate concentration do exist, especially in Wayne county (Exhibit 22).

High nitrate concentrations have been reported in some locations in the Glacial Drift region (Exhibit 17a). Because of the variability of the geology in the region, site specific research and management is necessary to prevent degradation of groundwater resources.

Alluvial Subregions are along the Elkhorn River and its major tributaries where alluvial deposits exist. Groundwater quality in the alluvial areas typically is similar to the water quality of the adjacent streams, with the exception of nitrate concentration. Organisms in the streams may lower nitrate concentrations.

Total dissolved solids concentrations range from 250 to 750 milligrams per liter (Exhibit 18). Calcium concentrations are generally 25 to 75 milligrams per liter and the water is hard (Exhibits 19 and 20).

Alkalinity ranges from 100 to 300 milligrams calcium carbonate per liter (Exhibit 21). In most areas the sulfate concentration is less than 100 milligrams per liter, but along Logan Creek in Dixon and Thurston counties sulfate concentrations exceed 100 milligrams per liter (Exhibit 22).

High nitrate concentrations have been reported at some locations in the Alluvial areas. These areas tend to be sensitive to groundwater pollution because high permeability and shallow groundwater levels are typical (Exhibit 23a). In most areas the groundwater is suitable for domestic and other anticipated uses.

Another subregion of the Glacial Till region is the Sandy Till Plains. Water quality is essentially the same as in the Sandhills region for calcium, total dissolved solids, alkalinity, sulfates, and hardness (Exhibits 18 and 22). The permeability of the soils allows water to move rapidly through them. This gives rise to the potential for high nitrate concentrations. The Sandy Till Plains of Pierce county do have an identified nitrate problem area (Hanson, 1983; Alix,1987; Gosselin, 1990; Appendix 4). Nitrate levels are highly variable in this area and where contamination is occurring, levels over 10 milligrams per liter are common (Exhibit 17a). In most areas the groundwater quality is suitable for all anticipated uses, except for areas of nitrate contamination.

d. Ogallala and Dakota Aquifers

a). The Ogallala aquifer underlies the western edge of the Lower Elkhorn NRD. Here the Ogallala formation is relatively thin and underlies Pleistocene sands and gravels. No significant data are available that are specific to the Ogallala formation in the Lower Elkhorn NRD.

b). The Dakota formation is a source of water in some eastern areas of the Lower Elkhorn NRD. Specific quality information is very limited and additional research is needed to identify the quality of groundwater in the aquifer (Exhibits 24 and 25).

C. *Identified Needs and Deficiencies*

Although the district has entered a large volume of information into a computer database (see Appendices 2 and 4), there is still an abundance of information from the district's programs that have not been entered. This includes data from the Osmond monitoring wells, the piezometers and observation wells associated with Willow Creek Reservoir, and fall groundwater level information from the district groundwater quantity monitoring program. This information will be computerized by the fall of 1995. Reference wells have not been discussed and will be included in the plan by the fall of 1994. By the fall of 1995, the groundwater level data will be organized by aquifer type (if known) which will enhance the data by grouping similar sites together.

The Nebraska Natural Resources Commission supplied the district with a large volume of information from the Nebraska Department of Health for the public water suppliers in the district. Much of this information is valuable but could not be entered into a usable form for this revision (1993) of the groundwater management plan, and will be included in the future. Some of the information is not included in this revision (1993) since it is either relatively old or it has not been fully reviewed by the Department. This information may be included at a later date after the department and the district have reviewed and evaluated the validity of the data to ensure compatibility with the information that is currently in the plan.

The Lower Elkhorn NRD is one of the many agencies that is interested in groundwater information. Studies and investigations are done by or funded by the U.S. Environmental Protection Agency, the U.S. Geological Survey, the Bureau of Indian

Affairs, the Corps of Engineers, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, the Nebraska Department of Environmental Quality, the Nebraska Department of Health, the Nebraska Natural Resources Commission, and the University of Nebraska Conservation and Survey Division. The district will continue to process the information from these agencies as it becomes available.

The Elkhorn river basin is included in separate studies of the Platte river being conducted by the U.S. Environmental Protection Agency and the U.S. Geological Survey. The U.S. Environmental Protection Agency's 'Platte Watershed Project' will assemble existing surface and groundwater data to evaluate water quality, determine future water quality information collection needs, and document the interests and data collection programs of the numerous agencies that have this type of information. The Elkhorn basin is also part of a pilot site for the U.S. Geological Survey's National Water-Quality Assessment program. The purpose of the program is to provide a consistent description of the current status and trends in water quality across the nation and insight into the major human and natural factors that control water quality in different regions. This information will be combined with the district's and included in the groundwater management plan as it becomes available.

I V. LAND USE AND CONTAMINATION SOURCE INVENTORY

Land in the Lower Elkhorn NRD is used primarily for agricultural production. Since this industry occupies such a large portion of the district, it has a major impact on the district's groundwater resources, affecting both the quantity and quality of groundwater. Although they occupy a smaller area of the district, other industries also have an impact on groundwater resources; an example being the 13 sites in the district that are listed in the U.S. Environmental Protection Agency's Superfund list. This section describes the various land uses within the district, and known and potential sources of pollution.

A. *Land Use*

1. Digitized land use data.

The Nebraska Natural Resources Commission Data Bank stores and processes land use data for the state, and has provided the following land use information for the Lower Elkhorn NRD. Figure IV - 1 shows land use for the counties within the Lower Elkhorn NRD that have digitized land use data (all except Antelope, Cedar, Dixon and Knox), and the data are also presented in Appendix 7.

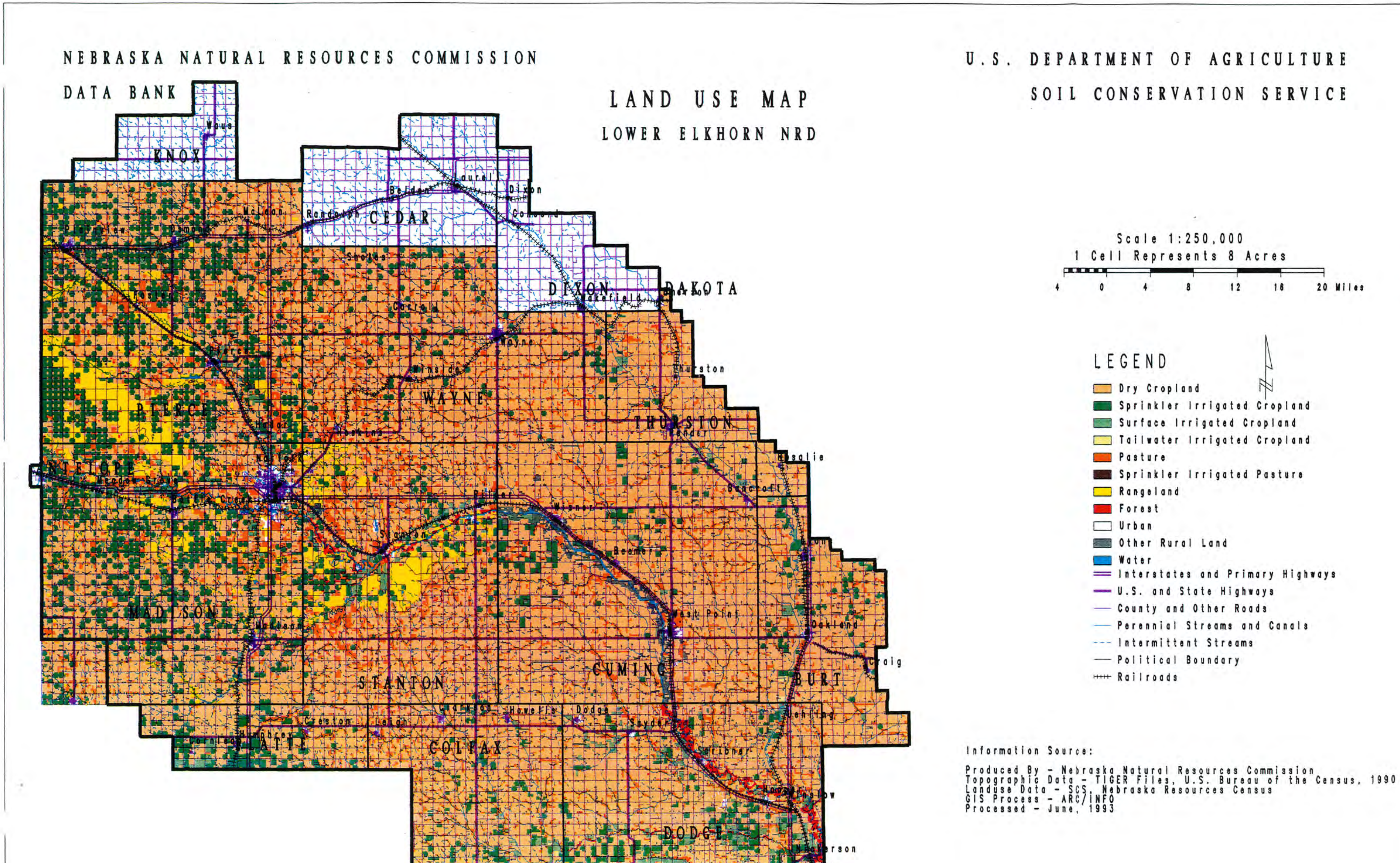
The data indicate that the district is about 70% cropland, and mostly nonirrigated cropland (about 61%). The number of acres in the district that are in pasture is roughly equal to the amount of land under sprinkler irrigation (around 9 to 10%).

Dodge county has the most land under surface irrigation (16,264 acres). Pierce county has the most sprinkler irrigation (90,471 acres). Cuming county has the most nonirrigated cropland (295,579 acres).

Irrigation well density can be found on figure 10 and surface water irrigation density is found on Figure 9 in Insert II - 1.

2. Agricultural Statistics

The Nebraska Department of Agriculture publishes annual reports containing various crop and livestock production statistics (Nebraska Department of Agriculture, 1982 through 1991). This information can supplement land use data



NEBRASKA NATURAL RESOURCES COMMISSION
DATA BANK
LAND USE MAP
LOWER ELKHORN NRD
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Scale 1:250,000
1 Cell Represents 8 Acres
4 0 4 8 12 16 20 Miles
LEGEND
Dry Cropland
Sprinkler Irrigated Cropland
Surface Irrigated Cropland
Tailwater Irrigated Cropland
Pasture
Sprinkler Irrigated Pasture
Rangeland
Forest
Urban
Other Rural Land
Water
Interstates and Primary Highways
U.S. and State Highways
County and Other Roads
Perennial Streams and Canals
Intermittent Streams
Political Boundary
Railroads
KNOX
CEDAR
DIXON
DAKOTA
PIERCE
WAYNE
THURSTON
ANTELOPE
MADISON
STANTON
CUMING
BURT
PLATTE
COLFAX
DODGE
Information Source:
Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Landuse Data - SCS, Nebraska Resources Census
GIS Process - ARC/INFO
Processed - June, 1993

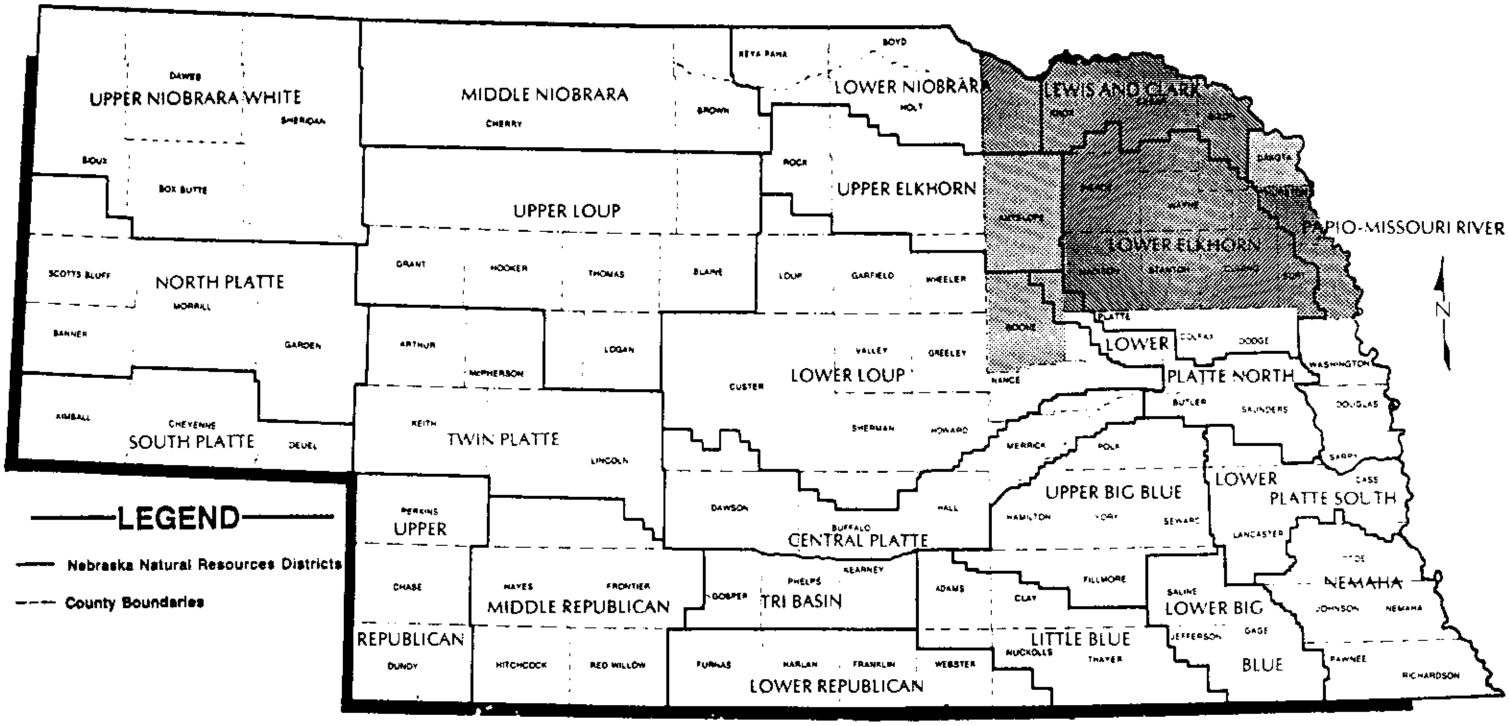
Figure IV-1

and is useful in determining the nature of agricultural production in the district. The following figures and tables summarize information from these reports, and Appendix 7 gives a more detailed summary of the various crops and livestock numbers for the northeast portion of the state.

This information is modified from the northeast region as defined by the Nebraska Department of Agriculture as shown in Figure I V - 2. The northeast region includes all of the counties that are entirely within the Lower Elkhorn NRD (Cuming, Pierce, Stanton, and Wayne), and also all of eight of the remaining 11 counties that are partially within the district (the lightly shaded area). Three counties are not included in the northeast region that are in the NRD (Colfax, Dodge, and Platte). The information presented does not represent the NRD since the geographical area of the Nebraska Department of Agriculture's northeast region does not match that of the district. The information presented is intended to reflect agricultural production trends for the general area of the state that includes the Lower Elkhorn NRD. Antelope, Boone, and Dakota county statistics are subtracted from the northeast region totals to more accurately estimate the Lower Elkhorn NRD region (the darker shaded area).

Nebraska Natural Resources District Boundaries

(NEBRASKA NATURAL RESOURCES COMMISSION)



Northeast Region as Defined by the Nebraska Department of Agriculture

Area Included in Calculations for Section I V and Appendix 7

Figure I V - 2
Comparison of the Lower Elkhorn NRD and the Nebraska Department of Agriculture's Northeast Region Boundaries

Farm numbers, irrigation statistics, and tons of commercial fertilizer sold are summarized in Table I V - 1. The number of farms declined steadily over the 10 year period from 1982 through 1991. The number of irrigated acres peaked in 1989, the same year that had the largest increase in the number of new registrations of irrigation wells. Commercial fertilizer sales were highest in 1986.

Table I V - 1. Agricultural Statistics

Year	Number of Farms	Number of Registered Irrigation Wells	Total Acres Irrigated	Commercial Fertilizer Sold (Tons)
1982	9,585	(No Data)	445,000	(No Data)
1983	9,585	(No Data)	446,000	139,830
1984	9,200	(No Data)	455,000	(No Data)
1985	8,960	(No Data)	491,000	(No Data)
1986	8,720	3,529	498,000	189,531
1987	8,720	3,536	484,000	168,319
1988	8,550	3,586	489,000	134,750
1989	8,310	3,677	501,000	129,881
1990	8,310	3,819	486,000	148,288
1991	8,185	3,869	498,000	152,769

Figure I V - 3 shows the number of acres harvested for corn, sorghum, and soybeans for the period 1982 through 1991. Corn is the primary crop in the district, averaging 66 percent of the total acres harvested of the major crops. Non-irrigated corn accounts for most of this, averaging of 45 percent of the acres harvested of the major crops, and 69 percent of the acres of corn harvested in the area. The economic benefits of applying nitrogen fertilizer to corn are well known, and the predominance of corn presents a potential for nonpoint source nitrate-nitrogen pollution of groundwater.

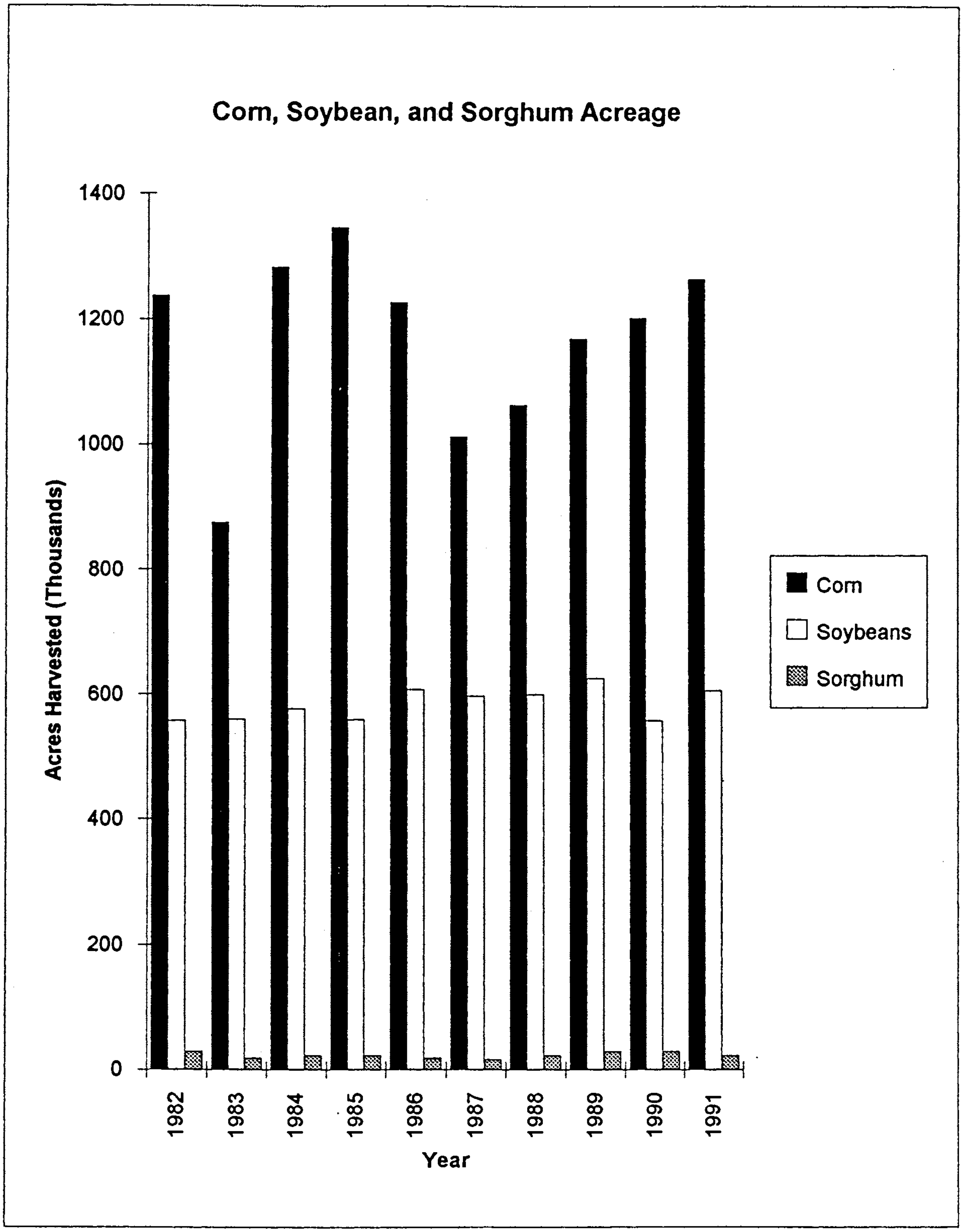


Figure I V - 3. Acres Harvested of Major Crops

Northeast Nebraska is a leader in livestock production. Figure I V - 4 shows the number of fed cattle and the number of hogs in the state and in the region. This area produces 19 percent of the state's cattle on feed and 26 percent of the state's hogs. Cuming county is the top producing county for the number of cattle on feed (with 8 percent of the cattle on feed in the state) and for the number of hogs (6 percent of the number of hogs in the state). The large number of confined animals is potential source of groundwater pollution.

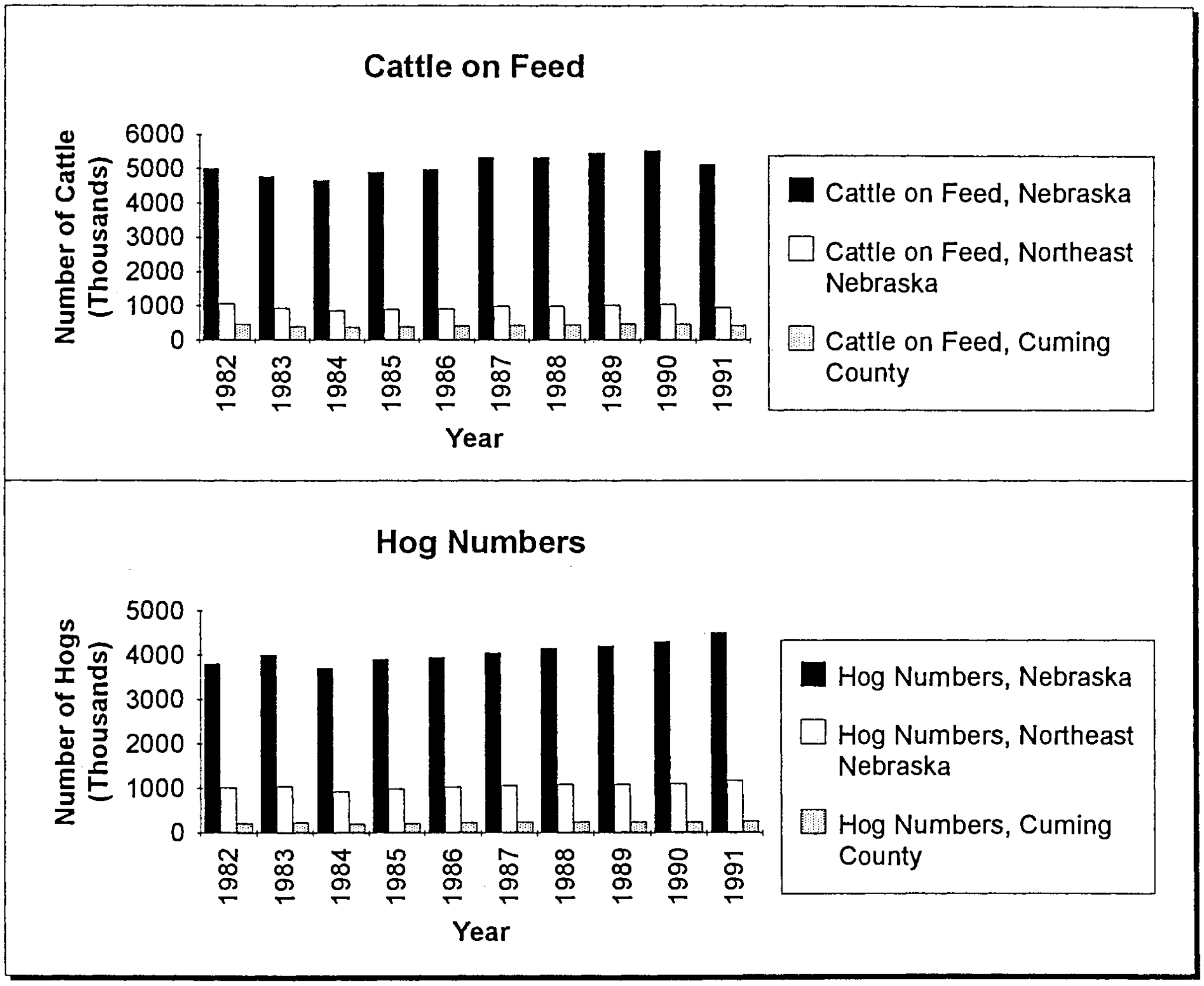


Figure I V - 4. Cattle and Hog Numbers

3. Endangered and threatened species

Endangered species are plants or animals that may become extinct throughout all or a significant portion of their range. Threatened species are plants and animals that may become 'endangered' in the foreseeable future. The groundwater management plan can have an impact on an endangered or threatened species when the species or the habitat that supports it is affected by groundwater resources. Currently in the Lower Elkhorn NRD, the habitat of one threatened species, the western prairie fringed orchid, may be impacted by changes in groundwater levels (written communication, Nebraska Game and Parks Commission, August, 1992).

The western prairie fringed orchid *(Plantanthera praeclara)* is a state and federally threatened species that is protected by state and federal statutes. Specific requirements of the orchid habitat have not been established, however, it is generally known that most sites where orchid populations exist have high soil moisture conditions and are associated with remnant native tallgrass prairies and meadows.

Historical records occurrences of the orchid have been recorded within the Lower Elkhorn NRD. Although habitat suitable for the orchid may exist in the district, our current land use data are not detailed enough to locate these areas. Insert IV - 1 describes the orchid.

The general protection of groundwater quantity and quality is beneficial in many ways, including the protection of threatened species and the habitats that these species require. Groundwater management activities that are proposed in the groundwater management plan may have some impacts, either positive or negative, on any threatened species listed in the plan (currently the western prairie fringed orchid). When specific adverse effects on these threatened species from changing groundwater levels are identified, the Lower Elkhorn NRD acknowledges the potential need to modify the groundwater management plan in the future. Such modifications will include actions within control or management areas consistent with the Nebraska Groundwater Management and Protection Act that can be taken by the district to reduce adverse effects on species by maintaining a groundwater level that will help sustain these species.

B. *Contaminant Source Inventory*

1. Nonpoint Sources.

There are numerous categories and subcategories of nonpoint source pollution, including agriculture, construction and land disposal (Nebraska Department of Environmental Quality, 1992, page 32). Each of these categories and many of the subcategories are represented in the district. The district will work with the agencies responsible for handling these problems to prevent and remediate groundwater contamination.

The occurrence and potential for the majority of the nonpoint source pollution in the Lower Elkhorn NRD originates from the primary industry in the district, agriculture. Section III of the plan describes studies that have documented agricultural nonpoint source pollution in the district. Exhibit 17a shows the areas of the district where probable nonpoint source nitrate-nitrogen contamination has been documented.

2. Point Sources

Table I V - 2 summarizes potential and known point sources of pollution for each community in the district and is based on information from the Nebraska Department of Environmental Quality. The status of communities with wellhead protection (WHP) areas delineated by the Nebraska Department of Environmental Quality are also included in the table (the city of Norfolk has hired a consultant for wellhead protection area work). The columns 'RCRIS', 'SARA Title III', and 'Hazardous Waste Inventory' are considered to be potential point sources of pollution while the items listed under columns labeled 'NPDES', 'UST', and 'CERCLIS' are pollution problems that are known to exist. The following text and tables describe each column.

The Resource Conservation and Recovery Act listing (RCRIS) is a compilation of businesses that are required to report the generation, storage or transport of hazardous *wastes* to the U.S. Environmental Protection Agency. There are 135 registrations in the district. This is a listing of potential contamination sites. Over one-third of the sites are in the Norfolk vicinity.

NEBRASKA'S

Threatened and Endangered Species

Western Prairie Fringed Orchid

NEBRASKA GAME AND PARKS COMMISSION

Western Prairie Fringed Orchid —*A threatened species*

Status

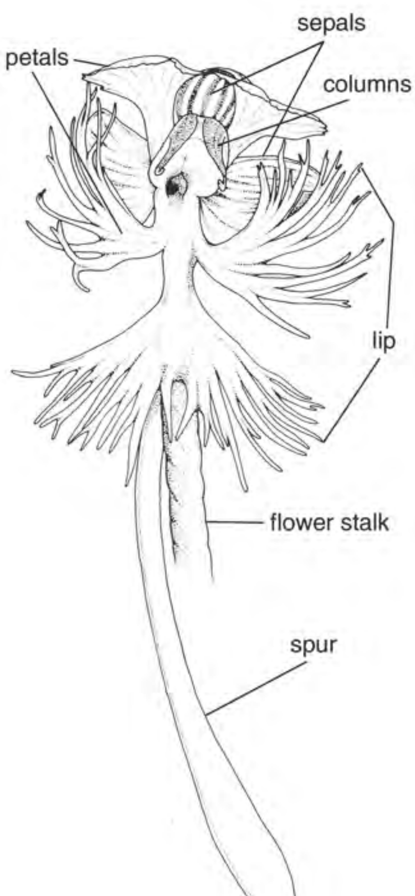
The range of the western prairie fringed orchid *(Platanthera praeclara)* extends from the Mississippi River westward to the Sandhills of Nebraska. It grows as far north as Manitoba, Canada, and as far south as Oklahoma. As its name implies, it has an eastern counterpart, the eastern prairie fringed orchid *(Platanthera leucophaea),* which occurs primarily east of the Mississippi River.

In Nebraska, the orchid grows in the eastern two-thirds of the state from the Missouri River in the east to Cherry and Keith counties in the west. It is found from Cherry to Dakota counties in the north, southward to Webster through Richardson counties.

Prior to pioneer settlement, the western prairie fringed orchid was widespread and locally common throughout its range. An 1873 record comments that the orchid was "found all over eastern Nebraska." By the late 1800s, settlement was already having a devastating impact on the species. An 1889 account from Kansas states that "once school children brought armfuls of the curious [orchid], ... now they are seldom seen." The species' decline in Nebraska was documented as early as 1898 in an account which notes that the orchid was "common in the wet valleys of the sandhills ... also in [the prairie region], where, however, it is a disappearing species." The account continues, "It was formerly abundant in the Blue River District, but is now met with but rarely and occurs only scattered and at distant stations."

Across its range, it has declined more than 60 percent in population numbers and vastly more in plant numbers. In Nebraska, the orchid has declined to less than a dozen populations with fewer than 600 plants. In 1989, as a result of these critical declines, the western prairie fringed orchid was listed as a threatened species under both the federal and Nebraska endangered species acts.

Currently, orchids are known from small populations in Lancaster County near Lincoln, eastern Seward county, Hall county near Grand Island, and from several widely scattered populations in east-central Cherry County.



Description

Although rare, flowering orchids are readily identified in the field. Flowering plants are usually comparable in height to the surrounding prairie grasses, with smooth, yellow-green foliage which blends well into the surrounding vegetation. Mature plants may grow up to 42 inches tall, but 20 to 30 inches is more common. Individual plants have a single, stout stem up to .5 inches in diameter with two to five erect leaves alternately spaced on the stem. The keeled, lanceolate-shaped leaves are somewhat thickened and have parallel veination. They are three to five inches long and .5 to 1.5 inches wide, with bases which sheath the stem. Non-flowering plants may consist of only a single basal leaf and can be very difficult to find.

The inflorescence is an elongated flowerhead, or raceme, with each individual flower borne on its own stalk from the main stem. Individual flowers are subtended by a bract which resembles a small leaf. These bracts are up to .25 inch wide and 1.5 inches long. The single raceme may be up to 10 inches in length with one to 25 flowers which begin blooming at the bottom and progress upward. Under optimum conditions, flowers may bloom for up to 10 days, and an inflorescence may be in bloom for several weeks.

While its flowers do not clearly resemble the more familiar tropical orchid species, the western prairie fringed orchid follows a pattern of flower adaption typical of all orchids. The relatively large flowers may be up to

1.25 inches wide and 1.75 inches long and are comprised of three creamy-white petals backed by three pale green sepals. The two upper, fan-shaped petals are truncated, and in combination with one of the sepals form a hood-like structure. The lower petal is modified into a broad, spreading lip which is deeply three-lobed. Each of the lobes is, in turn, deeply incised, producing a fringed appearance. The lower lip also bears a slender, curving spur that extends up to two inches from the back of the flower and holds an ample quantity of nectar. The flower produces a delicate, sweet fragrance which rivals that of any wildflower.

Life History

These specialized structures are adapted to one strategic function — insect pollination. Pollination is highly specific for only a few species of nocturnal hawkmoths of the Family *Sphingidae*. Near dusk, the orchid noticeably increases its fragrance to attract the wide-ranging moths. The white-fringed lip directs approaching moths to the spur and the plentiful supply of nectar. As the moth hovers with its long tongue extended into the spur, two specialized pollen-bearing structures, called columns, brush pollen onto the eyes of the moth. After the moth leaves, the columns rotate, exposing the stigma for pollen deposition by the next moth that visits the flower. This process ensures pollination between plants. Only those species of hawkmoths with properly spaced eyes and compatible length tongues can act as pollinators.

Orchids begin growth in early May and, with favorable conditions, flower from mid-June to late July. The peak flowering period is from the last week in June through the second week in July. If a flower is pollinated, it develops into a slender, angled capsule filled with thousands of microscopic seeds. In early fall the capsule splits, and the seeds are scattered like dust in the wind.

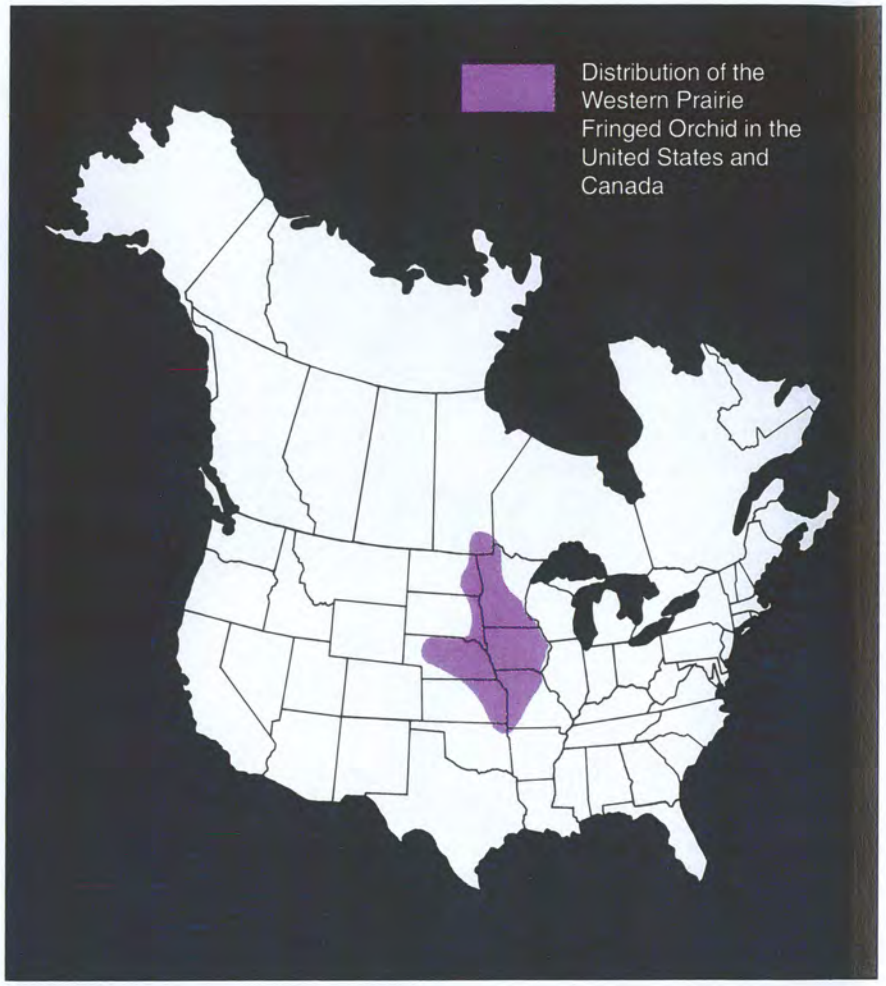
The western prairie fringed orchid is not an obligatory annual bloomer. Rather, flowering is dependant on suitable climatic conditions such as plentiful moisture and moderate temperatures for both the previous and current growing years.

The exact temperature, moisture, dormancy and light requirements for seed germination and seedling development are not known for the western prairie fringed orchid. This precludes greenhouse propagation for research or commercial use. One known aspect of the orchid's growth is its symbiotic association with micorrhizae, soil-inhabiting fungi. Orchid seeds basically contain only an embryo, and their small size is, in part, due to a lack of endosperm, a seed's stored food reserves. Thus, the seed must establish a delicately balanced relationship with specific micorrhizae. Using micorrhizae-derived nutrients, the seed is able to grow leaves and produce its own food through photosynthesis. However, the association with micorrhizae continues throughout the orchid's life. During periods of stress or unfavorable climatic conditions, this relationship allows the orchid to survive in a totally subterranean stage. Thus, orchids can go unobserved for many years until favorable conditions return and allow them to again produce above-ground growth and, with optimum conditions, to flower.

Habitat

The western prairie fringed orchid is a species of the North American tallgrass prairie community. In eastern Nebraska, the orchid occurs in mesic upland prairies in glacial drift and calcium-rich loess soils. In central and northeast Nebraska, it occurs in wet-mesic prairies and sedge meadows in alluvial soils of river floodplains. In the Sandhills of central and western Nebraska, the orchid occurs in the sandy soils of subirrigated meadows and prairie swales. While specific site types vary, all sites are typified by the tallgrass prairie habitat and a high soil moisture profile.

Populations of the western prairie fringed orchid are found primarily in high to moderate quality, unplowed prairies. Plants will colonize disturbed areas of tallgrass prairie, such as graded road ditches and soil borrow sites, but will persist only if the site reverts to prairie.



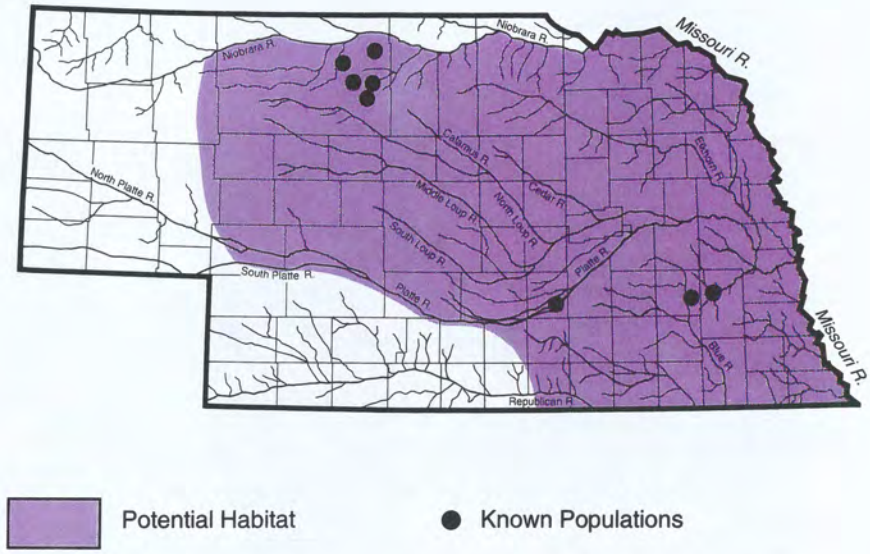
Limiting Factors

The major limiting factor for the western prairie fringed orchid is its dependency on the limited habitat of mesic to wet-mesic tallgrass prairie. It requires sites where near-surface groundwater maintains a relatively high and constant level of soil moisture. Even in mesic upland prairies, orchid sites have a higher soil moisture profile than the surrounding areas. Historically, these sub-surface sources of groundwater were relatively constant and reliable. That is no longer true.

Wetland drainage, stream channelization, ditching and irrigation from shallow aquifers pose threats to the orchid by depleting groundwater and reducing soil moisture. Reduced or interrupted stream flows also pose a threat through the drying of adjacent wet meadows.

The main cause of decline in orchid populations is the loss of habitat which has occurred over the past 100 years and is ongoing. The first major loss resulted from the settlement of the Great Plains when settlers plowed vast acreages of tallgrass prairie for conversion to cropland. A second major decline occurred when tractors replaced draft animals and "surplus" pasture and hayland was converted to cropland. The conversion to cropland is still a major threat today. Habitat is also lost to commercial development, urban expansion and road construction.

Several grassland management practices pose significant threats to the orchid. Most remaining orchid habitat is used primarily for grazing and haying. As a prairie species, the orchid evolved with grazing by native herbivores, and existing populations on grazed lands indicate



ıat it can tolerate low to ıoderate levels of grazing by omestic animals. Continuous vergrazing, however, is very etrimental, resulting in direct lant mortality, habitat degradaon due changes in species comosition and the introduction of otic species and reduced iability due to lack of seed roduction. The orchid does lerate some haying, but annual ıtting during the growing eason prevents seed production ıd results in increased plant ıortality due to stress. The net fects are an inability to produce and a decline in opulations.

Noxious weeds such as musk ıd Canada thistles and leafy urge pose multiple threats to e orchid. Invading noxious eeds threaten populations rough direct competition for ıtrients and by habitat modificaon. In addition, the orchid may e threatened by the indisiminate use of herbicides to ntrol noxious weeds.

Similarly, the uncontrolled and on-selective use of pesticides ear orchid populations poses a rious threat. The indiscriminate e of herbicides to control eedy and exotic species can sult in the inadvertent killing of chids. Large-scale application insecticides can threaten an chid population's reproductive ıpability by killing the ıwkmoths which are vital for llination. In some areas, ıwkmoth numbers are so epleted that only a very small ercentage of flowers are polıated and produce seed.

Many native orchids are high- sought after by researchers, chid growers and wildflower enthusiasts. Because most species, including the western prairie fringed orchid, cannot be domesticly propagated, the only source for plants is plundering wild populations. The loss of even one plant from small a population can seriously threaten its existence.


Western prairie fringed orchid

Management

As a threatened species, the orchid is provided protection under both the federal and the Nebraska endangered species acts. As part of its responsibility, the Nebraska Game and Parks Commission will develop a recovery plan for the orchid.

The recovery strategy for the orchid will focus on locating all extant populations, protecting them and implementing appropriate management for all populations. Protection and management will be tailored to each population and implemented through cooperative agreements, conservation easements and limited land acquisition when necessary.

Management will require staking or fencing plants to prevent them from being hayed or grazed and periodic seasonal rest to enable them to complete their growth cycle. Grazing management will prevent overgrazing and promote rotation and variable stocking rates. Practices such as prescribed burning will be used to reintroduce natural processes. Many of these management practices not only benefit the orchid, but also improve forage production and the entire prairie community.

To ensure adequate soil moisture, actions will be taken to prevent activities that would deplete groundwater near orchid populations. Protection will also require working with landowners to prevent damage to orchid populations from the improper use of pesticides and to provide technical support for the control of noxious and weedy plant species and problem insects.

The protection and recovery of the orchid will require the involvement and cooperation of many groups and individuals from federal and state government to private landowners.

Wet meadow habitat of the western prairie fringed orchid in Cherry County.

Suggested Reading

Dressler, R.L. 1981. *The Orchids: Natural History and Classification.* Harvard University Press.

North Dakota Parks and Recreation Department. 1986. *Report on the Status of **Platanthera praeclara** Sheviak and Bowles in Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota.* North Dakota Parks and Recreation Department, Number 60181-1447-84.

Sheviak, Charles J. and Marlin L. Bowles. 1986. *The Prairie Fringed Orchids: A Pollinator Isolated Pair.* Rhodora 88: 267-290.

U. S. Fish and Wildlife Service, 1993. *Recovery Plan for Western Prairie Fringed Orchid (**Platanthera praeclara,** Sheviak and Bowles).* U.S. Fish and Wildlife Service. Ft. Snelling, Twin Cities, MN.

Western Prairie Fringed Orchid is one in a series of *Nebraska's Threatened and Endangered Species* brochures published by NEBRASKAland Magazine and the Nebraska Game and Parks Commission with funds from Nebraska's Nongame Wildlife Tax Checkoff. Text by Heritage Botanist Mike Fritz. Nebraska Game and Parks Commission. Photos by Mike Fritz. Illustration by Randall Bright. July 1993.

Note: New data on the occurence and distribution of this species are being collected constantly, and some of the information in this publication may be outdated. It should be used for a general understanding of the status of this species in Nebraska and not as the sole source of locational information for any report, project, regional/local planning or environmental impact assessment. For current information on this or other threatened and endangered species, or for additional copies of this publication, contact the Wildlife Division, Nebraska Game and Parks Commission, P.O. Box 30370, Lincoln, NE 68503.

A CHECK FOR WILDLIFE

Nongame Wildlife Tax Checkoff Fund

Table I V - 2. Potential and Existing Point Source Pollution Summary							
City	WHP	RCRIS	SARA Title III	Hazardous Waste Inventory	NPDES	UST	CERCLIS
Bancroft			1		1		
Battle Creek		2	3		1	3	
Beemer		3	4		3	4	
Belden	DEQ	2	1	1			1
Carroll			1		1		
Clarkson		1	2		3	2	1
Concord	DEQ	1		1	2		1
Cornlea							
Craig			1		1	1	
Creston			2		4		
Dixon			1		1		
Dodge		2	5		2	2	
Emerson		2	5		2	4	
Foster							
Hadar			1		1	2	
Hooper		1	2		2	3	
Hoskins	DEQ		1		2		
Howells			4		2	3	1
Humphrey		2	6		1	3	3
Laurel					1		
Leigh			5		2	2	
Lyons		3	5		3	5	
Madison	DEQ	6	7	2	2	3	
McLean							
Meadow Grove			1		1	1	
Nickerson		1	1		1	1	
Norfolk		59	54	22	23	54	6
Oakland		2	9		3	2	
Osmond		3	3		1	1	
Pender		3	6	1	2	1	
Pierce		4	3		1	8	
Pilger	DEQ	3	3	1	5	2	
Plainview		2	7		1	7	
Randolf			7		1		
Rosalie					1		
Scribner	DEQ	5	2		1	2	
Sholes							
Snyder	DEQ	1	2	1	1	2	
Stanton		2	3		3	2	
Thurston			3		2		
Tilden		2	7		1	1	
Uehling		1	2		3	1	
Wakefield			5		3		
Wausa	DEQ		3		1		
Wayne		10	12	2	4	10	
Webster			1				
West Point	DEQ	9	17	4	8	8	
Winside	DEQ	1	3		1	2	
Winslow		1	3		1		
Wisner		1	5		3	9	
TOTAL		135	219	35	109	151	13

WHP - Wellhead Protection areas delineated by NDEQ; RCRIS - Resource Conservation and Recovery Act list, March 15, 1993;
SARA Title III - Community Right to Know, 1993; NPDES - National Pollutant Discharge Elimination System, March 11, 1992;
Underground Storage Tank releases, Dec. 9, 1992; CERCLIS - Superfund site list, March 20, 1992

Title III of the Superfund Amendments and Reauthorization Act (SARA) lists businesses that use, store, or release hazardous *substances.* This list helps Local Emergency Response Committees prepare for the release of any hazardous materials and informs the public about the type and location of hazardous substances in their community. The district has 219 sites registered under Title III that may be considered potential contamination sites. The majority of the sites are for fuel storage. Table I V - 3 gives more detail about the Title III sites. One-quarter of the sites are in or around Norfolk.

The National Pollutant Discharge Elimination System (NPDES) requires all discharges of point source pollutants into any waters of the state to obtain a permit from the Nebraska Department of Environmental Quality. There are 109 permits in the district, and the majority are for community wastewater treatment facilities. These are considered to be existing point source contamination sites that are conforming to the requirements of site specific permits.

There are 151 reported leaking underground storage tanks (UST) within the district. These are existing contamination sites that are regulated through the Nebraska Department of Environmental Quality. Table I V - 4 gives more detail about the sites. One-third of the sites occur in or near Norfolk. Most of the sites are gasoline spills.

The sites listed in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) have been identified by the Nebraska Department of Environmental Quality and the U.S. Environmental Protection Agency as being potentially contaminated with a hazardous substance. There are 13 sites listed in the district.

Table I V - 5 lists the agricultural facilities that are registered with the Nebraska Department of Environmental Quality. There are 110 of these facilities.

Table I V - 3. SARA Title III: Number of Businesses that Use, Store or Release Hazardous Substances					
City	Fuels	Ag-chemicals	Ag-chemicals and Fuels	Other[1]	Total per City
Bancroft			1		1
Battle Creek	1	1	1		3
Beemer	3	1			4
Belden	1				1
Carroll		1			1
Clarkson	1	1			2
Concord					0
Cornlea					0
Craig			1		1
Creston	1	1			2
Dixon	1				1
Dodge	3		1	1	5
Emerson	2	1	2		5
Foster					0
Hadar	1				1
Hooper			1	1	2
Hoskins	1				1
Howells	2	1		1	4
Humphrey	3	1	1	1	6
Laurel					0
Leigh	2	1	1	1	5
Lyons	2	1		2	5
Madison	5	1		1	7
McLean					0
Meadow Grove	1				1
Nickerson			1		1
Norfolk	27	1		26	54
Oakland	4	1	1	3	9
Osmond	2	1			3
Pender	4	2			6
Pierce	2		1		3
Pilger	1		2		3
Plainview	5	1	1		7
Randolf	4	2		1	7
Rosalie					0
Scribner	1		1		2
Sholes					0
Snyder	1		1		2
Stanton	3				3
Thurston	2	1			3
Tilden	3	4			7
Uehling		1	1		2
Wakefield	2	1	2		5
Wausa	3				3
Wayne	7	2		3	12
Webster				1	1
West Point	8	2	2	5	17
Winside	1		1	1	3
Winslow	1	1		1	3
Wisner	3	1	1		5
TOTAL	114	32	24	49	219

[1] Various compounds including industrial cleaners and solvents

Table I V - 4. Underground Storage Tank Releases								
City	Gasoline	Diesel	Gas & diesel	Fuel oil	Waste oil	Other[1]	Unclassified	Total
Bancroft								0
Battle Creek	2						1	3
Beemer	3			1				4
Belden								0
Carroll								0
Clarkson	1						1	2
Concord								0
Cornlea								0
Craig	1							1
Creston								0
Dixon								0
Dodge		2						2
Emerson		3	1					4
Foster								0
Hadar		2						2
Hooper	1		1				1	3
Hoskins								0
Howells	2	1						3
Humphrey	1	1	1					3
Laurel								0
Leigh	1						1	2
Lyons	1					a	3	5
Madison	1	1					1	3
McLean								0
Meadow Grove			1					1
Nickerson		1						1
Norfolk	20	8	2	9	2	b	12	54
Oakland			2					2
Osmond			1					1
Pender			1					1
Pierce	3	1	2				2	8
Pilger	1						1	2
Plainview	3		1	1		c	1	7
Randolf								0
Rosalie								0
Scribner	2							2
Sholes								0
Snyder	1	1						2
Stanton							2	2
Thurston								0
Tilden			1					1
Uehling	1							1
Wakefield								0
Wausa								0
Wayne	4	1	2		1		2	10
West Point	1	1	3			d	2	8
Winside		1					1	2
Winslow								0
Wisner	2	3	1		1	e,f		9
TOTAL	52	27	20	11	4	6	31	151

a. Liquid Nitrogen b. Stoddard Solvent c. Ag-chemicals d. Petroleum Solvents e. Gas and Waste Oil

f. Gas, Diesel, and Waste Oil

Table I V - 5. Nebraska Department of Environmental Quality
All Ag Facilities

Township-range-section	County	Livestock Type	Livestock Number	Controls Required
20N-9E-13B	Burt	Cattle	9,000	y
20N-9E-11A		Cattle	400	c
20N-10E-7A		Cattle	6,000	y
21N-8E-22D		Cattle	1,200	y
24N-8E-36DA		Swine	3,200	y
22N-9E-30BA		Swine	900	y
21N-8E-33AD		Swine	1,500	y
22N-9E-34AD		Swine	1,920	y
22N-8E-26C		Swine	1,600	y
29N-3E-21BC	Cedar	Swine	4,500	y
29N-1E-21CC		Swine	1,256	y
28N-2E-3CB		Swine	780	y
29N-2E-31D		Swine	700	y
29N-2E-28D		Cattle	375	y
29N-1E-36D		Swine	1,380	y
28N-3E-18B		Swine	2,500	y
20N-4E-7DB	Colfax	Cattle	650	y
20N-4E-17C		Cattle	1,500	y
20N-4E-14BA		Cattle	2,500	y
20N-3E-14BB		Swine	0	y
20N-4E-2BC		Swine	1,148	y
23N-6E-12B	Cuming	Swine	800	y
21N-7E-20BD		Cattle	85	y
21N-7E-20BD		Swine	200	y
21N-6E-1CB		Swine	1,000	y
22N-5E-9AB		Swine	3,700	y
22N-7E-19CC		Cattle	2,600	y
23N-4E-7BD		Swine	2,600	y
21N-6E-13AB		Sheep	2,500	y
21N-6E-3AA		Swine	560	y
24N-5E-32A		Swine	1,200	y
22N-6E-16DA		Swine	400	y
23N-7E-1B		Cattle	4,400	y
24N-5E-7DD		Cattle	200	y
21N-4E-4A		Swine	400	y
24N-4E-28D		Cattle	600	c
23N-5E-6A		Swine	1,400	y
23N-5E-22C		Swine	1,200	y
23N-4E-14B		Cattle	5,000	n
23N-5E-27BA		Cattle	2,500	n
21N-4E-24AD		Swine	1,650	y
21N-4E-35DC		Swine	670	y

Table I V - 5 (continued). Nebraska Department of Environmental Quality
All Ag Facilities

Township-range-section	County	Livestock Type	Livestock Number	Controls Required
27N-5E-28AD	Dixon	Poultry	——	n
28N-4E-22CD		Cattle	400	y
28N-4E-6AD		Swine	800	y
28N-5E-21AD		Swine	930	y
20N-8E-11BC	Dodge	Cattle	500	y
20N-6E-36CD		Cattle	250	c
19N-5E-2BA		Cattle	1,500	y
18N-9E-30C		Swine	600	y
20N-7E-10D		Cattle	500	y
23N-1W-5	Madison	Cattle	5,500	y
24N-1W-32		Cattle	2,500	n
22N-1W-34C		Cattle	1,400	y
24N-1W-35B		Cattle	5,000	y
24N-1W-35B		Swine	4,000	y
22N-3W-27DD		Cattle	650	n
22N-2W-9CD		Swine	64	y
24N-2W-5AD		Swine	500	y
23N-2W-9BA		Swine	512	y
24N-4W-30DB		Swine	300	n
22N-2W-34D		Swine	900	y
24N-4W-29A		Swine	699	y
23N-3W-35D		Cattle	1,000	n
23N-3W-35D		Swine	500	n
24N-2W-34CC		Cattle	2,500	n
22N-2W-28D		Swine	600	n
21N-2W-3AA		Cattle	500	n
24N-3W-25BB		Swine	140	y
21N-1W-4AA		Cattle	70	y
23N-1W-36AC		Cattle	3,000	n
27N-4W-17D	Pierce	Cattle	6,300	y
28N-4W-28DC		Swine	400	y
26N-1W-14B		Swine	2,336	y
26N-2W-15AC		Cattle	1,500	c
26N-4W-28D		Cattle	4,500	n
25N-4W-30C		Swine	1,250	y
20N-1E-32DB	Platte	Cattle	60	y
20N-1W-1D		Cattle	350	y
20N-2W-10C		Swine	528	y

Table I V - 5 (continued). Nebraska Department of Environmental Quality
All Ag Facilities

Township-range-section	County	Livestock Type	Livestock Number	Controls Required
24N-2E-26B	Stanton	Cattle	7,000	y
24N-2E-23C		Cattle	10,000	y
24N-2E-22DD		Cattle	2,000	y
24N-3E-20DA		Cattle	600	y
22N-2E-6BB		Cattle	400	y
22N-2E-6BB		Swine	200	y
24N-2E-27AA		Cattle	300	y
24N-1E-32		Cattle	15,000	y
24N-1E-18AA		Cattle	80	y
23N-3E-24CA		Swine	4,300	y
23N-2E-25		Cattle	30,000	y
21N-2E-32D		Swine	300	c
24N-3E-34CD		Swine	3,960	y
23N-2E-24C		Cattle	3,000	n
23N-2E-26A		Swine	600	y
22N-3E-33CB		Swine	600	y
22N-3E-6CD		Cattle	800	y
21N-2E-23BB		Swine	1,200	n
26N-5E-23BA	Thurston	Cattle	80	y
26N-5E-23BA		Swine	150	y
26N-5E-12A		Cattle	1,000	y
26N-6E-22AB		Swine	700	y
25N-6E-9DA		Swine	1,500	y
25N-2E-33B	Wayne	Cattle	1,000	y
26N-2E-10DD		Cattle	500	y
27N-2E-27CD		Swine	2,650	y
25N-4E-21D		Cattle	6,000	y
27N-1E-26BC		Swine	900	y
25N-5E-21C		Swine	6,000	c
26N-2E-11CB		Cattle	600	y
26N-4E-21A		Swine	420	y
26N-4E-21C		Swine	540	y

Information from a 1988 report from the Nebraska Department of Environmental Quality is summarized in Table I V - 6. A regional landfill has been proposed by the Northeast Nebraska Solid Waste Coalition that would be located in southern Stanton county. Members of the coalition include the cities of Fremont and Norfolk and several smaller towns, and several counties. As of the 1993 revision of this plan, the coalition has completed a hydrogeologic investigation of a site but has not developed the site.

Table I V - 6. Landfills Summary

City	Unlicensed dumps	Dumps closed and verified	Dumps planned for closure	Active licensed dumps: Expected life	Active licensed dumps: Active acres	Active licensed dumps: Designed acres
Bancroft	x					
Beemer	x					
Emerson	x					
Foster	x					
Norfolk				28 years	30	100
Pender	x					
Randolf		x				
Scribner	x					
Thurston	x					
Tilden	x		x			
West Point		x				
Winside	x					

Chemigation is a useful tool for distributing agricultural chemicals over a large area. This method of fertilizer and pesticide application can optimize the timing and rate of application when used properly. NRDs have permitted and inspected chemigation systems since 1987 to ensure that safety and backflow prevention equipment function correctly. Since the program started, the district has issued over 4,200 permits. Table I V - 7 summarizes the total number of permits issued in the district from 1987 through 1992.

Table I V - 7. Chemigation Permit Summary

Year	New Permits	Renewals	Total	Approvals
1987	507		507	493
1988	135	452	587	578
1989	137	540	677	673
1990	107	624	731	730
1991	158	662	820	807
1992	187	766	953	943

Not surprisingly, the highest number of permits are in the areas where the most irrigation occurs (see Figure I V - 1 and Figure 10 of Insert II - 1 for irrigation density). Permit numbers have increased throughout the district, with Pierce and Madison counties having the largest number of added permits. Table I V - 8 lists the number of permits per county from 1989 through 1992.

Table I V - 8. Distribution of Chemigation Permits

County	Number of Chemigation Permits per County per Year 1989	1990	1991	1992	Number of Registered Irrigation Wells[1]
Burt	4	5	5	5	92
Cedar	47	45	58	65	235
Colfax	10	13	14	15	188
Cuming	26	27	39	49	347
Dixon	7	8	12	12	73
Dodge	28	27	32	35	467
Knox	14	14	15	17	57
Madison	144	151	151	199	671
Pierce	304	315	354	389	911
Platte	7	9	7	10	112
Stanton	43	61	61	69	296
Thurston	2	1	2	6	73
Wayne	41	55	70	82	187

[1] March, 1993

C. *Identified Needs and Deficiencies*

The district has no information concerning residential fertilizer and pesticide use. Although this category of nonpoint source pollution is generally percieved to be a potential threat to groundwater quality, some research demonstrates that this may not be true (Cooper, 1993). The district will gather lawn and garden fertilizer and pesticide sales data from cooperating local vendors to estimate the types and quantities that are used in the area by the fall of 1998. Other data, such as actual application rates and vadose zone monitoring for lawns, gardens, golf courses, and parks will be useful but more difficult to obtain.

Data about septic tank density, abandoned wells, and land application of livestock, industrial and municipal wastes and sludge have yet to be gathered (1993 revision). This will be accomplished by the fall of 1997.

Much of this information needs to be presented on maps. The chemigation sites and point source data will be mapped by the fall of 1995. This will help the district in evaluating actual and potential groundwater contamination threats. For example, mapping the location of leaking underground storage tanks will help with wellhead protection efforts and mapping the locations of ag facilities will show feedlot density within the district.

The information will also be organized based on groundwater region, aquifer type (confined or unconfined), and/or individual aquifers. This will make the information presented more useful and will be complete by the fall of 1996.

The land use information presented in Figure IV - 1 and in Appendix 7 dates back to the mid 1980's and needs to be updated. Additional categories, such as feedlots or sandpits will be useful to include with this information. The district will work with the Nebraska Natural Resources Commission and the Soil Conservation Service to complete this task.

V. GROUNDWATER USAGE AND DEMAND

The groundwater reservoir within the Elkhorn River Basin provides water for rural domestic uses, municipal uses, livestock, crops, industries, cooling water for power generation, subirrigation of wetlands vegetation, and stream flow for fish and wildlife habitat.

A. *Rural Domestic and Livestock*

Groundwater is normally supplied for these purposes by small (5 to 20 gallon per minute) capacity wells. In Cuming and Thurston counties, rural water systems supply water through piped distribution systems. Much of the eastern portion of the district is served by the Cuming county and Logan East Rural Water Systems. The rural water systems also supply water to some small communities. Rural domestic and livestock demands do not represent a large portion of the total groundwater demand but they are very important because of health and economic concerns. If nitrate or other contamination occurs, the health of both rural residents and livestock is threatened.

B. *Municipal Groundwater Demand*

Municipal demands for groundwater include sanitation, fire protection, domestic, commercial, and industrial uses. In 1980, 65 municipal systems in the Elkhorn River Basin used 19.5 million gallons of groundwater per day or a total demand of about 22,000 acre-feet per year (Lawton and others, 1993).

The quality of groundwater for municipal purposes must meet the chemical requirements for public water supplies as prescribed by the Nebraska Department of Health. Currently, the most serious quality concern of most communities is excessive nitrate concentration in water supplies. The safe drinking water standard for nitrate is 10 milligrams per liter and is of most concern when used for infants. The annual municipal demand is small compared to the total overall demand but the quality of municipal supplies is critical for the health and economic well being of the residents of the NRD.

C. *Irrigation Groundwater Demand*

Irrigation will vary from year to year depending on the amount of rainfall received. There are approximately 3,716 irrigation wells in the Lower Elkhorn NRD. Based on crop requirements and the number of acres of each type planted in the basin, current annual groundwater irrigation requirements in the Elkhorn River Basin are approximately 500,000 acre-feet per year assuming normal precipitation occurs.

D. *Industrial Groundwater Demand*

Processing, sanitation, and use as a raw material are examples of industrial water uses. In 1980, 23 self-supplied industries in the Elkhorn River Basin used 3.42 million gallons per day or 3,830 acre-feet per year. Good water quality is critical to the success of many manufacturing processes. Poor quality water can damage manufacturing equipment and may increase production costs to a point where production is not economically feasible. Each industry must evaluate the water supply based on its specific needs.

E. *Power Generation Groundwater Demand*

In 1980, 6.4 million gallons per day or approximately 7,200 acre-feet per year was used for power generation purposes (Lawton and others, 1983). One of the major quality concerns is corrosiveness which shortens the life of power plant equipment.

F. *Subirrigation Groundwater Demand*

Subirrigation demands include groundwater which is withdrawn directly from the water table or the capillary fringe by vegetation. Subirrigation occurs in areas where the depth to the water table is quite shallow. Subirrigated areas is highly productive for grass hay and will also support trees and other vegetation.

G. *Stream Flow Groundwater Demand*

Groundwater will discharge into streams as necessary to maintain normal base flows. Most of the base stream flow in the Elkhorn River and many of its tributaries is from groundwater discharge rather than surface runoff. During periods of normal groundwater recharge, stream flow groundwater discharge is approximately 350,000 acre-feet per year.

H. *Groundwater Use Projections*

Using published projections for population, irrigation development, and industrial development, projections of increasing groundwater demands into the next decade appears in Table V - 1.

Table V - 1. Groundwater Demand Estimates and Projections

Groundwater User Category	Groundwater Demand			
	1985 Demand		Projected ** Demand for the Year 2005	
	Acre-Feet	Percent	Acre-Feet	Percent
Rural Domestic and Livestock	19,000	1.6	25,000	1.7
Municipal	22,000	1.8	26,000	1.7
Irrigation	500,000	41.6	780,000	52.2
Industrial (self-supplied)	4,000	0.3	5,300	0.4
Power Generation	7,000	0.6	7,000	0.5
Subirrigation	300,000	25.0	300,000	20.1
Stream Flow	350,000	29.1	350,000	23.4
Total Annual Groundwater Demand *	1,202,000	100.0	1,493,300	100.0

* Based Upon Normal Precipitation Occurring

** Projections based on State projections from the 1984 Policy Issue Study on Water and Energy published by the NRC (Natural Resources Commission, 1984).

Groundwater is very important economically to the Lower Elkhorn NRD. If the groundwater supply were to deteriorate substantially in either quantity or quality, competition for the remaining usable supply would increase. In some states where usable water is in short supply, allocation of water is made largely on an economic basis. In Colorado, water rights are bought and sold in a manner similar to mineral rights. Water rights do not necessarily transfer with ownership of real estate.

Fortunately, water of suitable quality is not in short supply in most areas of the Lower Elkhorn NRD. The economic value of water is not determined by the highest bidder. The economic value of groundwater could be estimated from the use which is made of it. Good quality water which is suitable for many uses has a greater economic value than poorer quality water which has limited use. Water which is usable for some purposes may have little value for other purposes. For example, water which is high in nitrates has diminished value for domestic purposes, but may be more valuable for irrigation than water with low nitrates.

Poor quality with little value in a water rich area may have high economic value in other areas where water is in short supply.

All water is important, but the economic value of water at any place or time depends on many aspects and can change rapidly depending on general economic conditions in the area where it is used. Ironically, a change in quantity or quality of water supply can also rapidly change the overall economy of an area. The economic value of water is variable, and can probably be accurately measured in dollars only if the value is determined in an open market.

I. *Identified Needs and Deficiencies*

Current and future groundwater needs for fish and wildlife and recreation are not addressed because of lack of information in these areas. Also, information on the consumption of groundwater due to its evaporation from sandpits is not available. The district will continue to search for and gather this information as it becomes available.

Many of the figures used in this section are from the original plan written in 1985 and need to be updated. Besides entering current information, this update will include an evaluation of the water use projections listed in Table V - 1 and a more detailed treatment of crop water use.

V I. CRITICAL AREAS FOR PROTECTION

A. *Groundwater Quantity Protection*

Agricultural irrigation is the largest consumer of groundwater in the Lower Elkhorn NRD (Table V - 1). Figure 10 in Insert II - 1 shows the areal density of irrigation wells in the NRD, and Figure IV - 1 shows the location of irrigated land within the district. Exhibit 10a illustrates the current (1993) network of irrigation wells that are in the monitoring program (the most monitoring sites occur where the highest density of irrigation wells are). Exhibit 6 shows potential well yield for the district. Generally, the most irrigation development has occurred where well yields exceed 200 gallons per minute.

The Lower Elkhorn NRD groundwater quantity monitoring program has revealed that long term groundwater level changes have not occurred over large areas in the district. The district will continue its monitoring efforts as outlined in Section VII C.1. Protective measures will begin when the groundwater quantity trigger is actuated (Section VII.C.6). The district will also continue efforts to increase the knowledge of hydrogeologic characteristics so that the groundwater quantity trigger will be based on local conditions rather than using one trigger for the entire district.

Currently, the district has not identified special areas for the protection of groundwater quantity. Section VII.C.1 outlines the priority areas for current and future efforts by the district for detailed groundwater elevation investigations. This represents the district's groundwater quantity prioritization in the absence of designated critical areas for groundwater quantity protection.

B. *Groundwater Quality Protection.*

Defining areas critical for groundwater quality protection requires a detailed knowledge of the hydrogeologic conditions of an area and the nature of the target contaminant. The hydrogeologic characteristics of the Lower Elkhorn NRD, like many areas of the state, are very complex. This complexity, combined with numerous potential contaminants, compounds the task of predicting the areas of the district that require the most immediate protective actions against all possible contaminants.

This section assumes that contaminants will originate at or near the ground surface and move to a groundwater recharge area, and will then move in response to the force of gravity either with water (such as precipitation or irrigation) or independently, eventually reaching groundwater. The following are the areas of the NRD that are or will be areas of critical importance for groundwater quality protection.

1. Public Water Supply Wellfields

   The majority of the population in the district obtains drinking water from public water supply wells. These wells are normally heavily used, supplying tens of thousands of gallons of water per day. The district has implemented a wellhead protection program to help public water suppliers begin and maintain a wellhead protection strategy. Appendix 6 lists the public water suppliers in the district.

2. Sensitive Areas

   Section IV describes the land use of the district. Land use is an indirect indicator of potential groundwater contaminants. The Lower Elkhorn NRD has approximately 70% of the land in row crops. Potential contaminants from the agricultural industry include fertilizers and pesticides.

   Section IV also describes existing and potential point source contamination in the district. These sources have a variety of contaminants. Petroleum-based hydrocarbons constitute the highest number of point source sites.

   Section III describes nonpoint source contamination. Groundwater quality monitoring indicates that agricultural, nonpoint source pollution, specifically nitrate-nitrogen, is the greatest threat to our groundwater reservoir life goal. There are several areas within the district that currently have nitrate-nitrogen concentrations above the MCL of 10 milligrams per liter. Section III - B and Exhibits 17 and 17a documents areas of known nonpoint source contamination.

   Section II outlines the vulnerability of the district's groundwater to contamination. Figure II - 1 shows the areas of the district that are most vulnerable to a surface applied, water-miscible contaminant. This includes the valleys of the North Fork of the Elkhorn River, the Elkhorn River and, to a lesser degree, the Logan Creek. Figures 3 and 5 of insert II - 1 show the soil permeabilities and maximum slopes within the district. Generally, creek and river valleys are the most level, and areas in Pierce county and along the Elkhorn River and the Logan Creek have the most permeable soils.

NRD actions will begin in the areas where groundwater quality triggers have been actuated. Section VII.C.7. states the triggering mechanisms and Section X describes the actions that have been taken.

V I I. GOALS, POLICIES, OBJECTIVES, AND PROGRAMS

A. *Reservoir Life Goal and Board Policies*

The reservoir life goal of the Lower Elkhorn NRD summarizes the overall mission of the NRD for groundwater management, which is to *Provide an adequate supply of acceptable quality groundwater to forever fulfill the reasonable groundwater demands within the NRD for domestic, municipal, agricultural, industrial, wildlife and other uses deemed beneficial by the NRD Board* (see page 2). This requires the management of both the quantity and quality of the groundwater resources within the district.

The Lower Elkhorn NRD reservoir life goal necessitates long term solutions to current and potential threats to the groundwater quantity and quality within the district. The policies, objectives, and programs described in this section are intended to provide these solutions in accordance with the capabilities of the NRD.

The Lower Elkhorn NRD will strive to attain its reservoir life goal through the encouragement and implementation of groundwater quantity and quality conservation practices. This will be achieved with programs aimed at public education, hydrogeologic data collection, and, when required, the regulation of activities that have an impact on groundwater.

The Lower Elkhorn NRD Board of Directors has established policies to guide the development of current and future groundwater management objectives and programs. These policies were the objectives of both the original 1986 plan and its 1991 revision.

Policies are statements that set a specific course of action towards the achievement of a goal or a series of goals. Policy statements are needed both by the NRD Board and by the management staff in order to operate in a consistent manner over a given period of time. Whereas the geographic boundaries of the Natural Resources Districts have been set, policy statements can be looked upon as defining the 'action' boundaries of the district. Policies facilitate the decisions of the Board and the management staff helping each to maintain continuity and assist in the development of clear thinking.

Policies may be either specific or very general. They can deal with the financial aspects of the NRD, they may be expressions of support for cooperation with other entities of government or they may be purely administrative in nature. The end objective of policies within the context of this document is to serve as a basis for developing specific plans and programs for groundwater management and then as a means of checking such plans and programs against policy statements.

The Board will review the Board Policies each year early in the planning process as it prepares the Long Range Plan for the upcoming year. Board Policies will be used to assist directors in selecting goals and objectives annually for the new Long Range Implementation Plan.

Establish a baseline of data and monitor trends in groundwater quality and quantity.

- Examine the existing program of groundwater quantity datum collection, make necessary modifications, and continue the program.

  Groundwater level measurements provide information to serve various purposes in groundwater reservoir management, including:

  1. Determine the amount of groundwater in storage (implications for availability for water supply).
  2. Assess water-supply changes by determining the changes in the amount of groundwater storage.
     a. Identify areas where substantial changes are taking place (economic impact).
     b. Assist state/local agencies in the formulation and administration of resource management programs.
     c. Estimate the rate and direction of groundwater movement, specific yields, base flow of streams, sources and amounts of recharge, and the location and amounts of discharge.
     d. Assess the validity of hydrogeologic interpretations and the assumptions used in developing models of groundwater systems.

  The longer the recording period, the better our potential for understanding how the system reacts to changes in precipitation or water use patterns. Currently (through 1993), the Lower Elkhorn NRD has groundwater elevation data for 190 irrigation wells since 1979, and 139 irrigation wells since 1976.

Reference wells are equipped with recording gages or are measured by steel tape monthly. Information from reference wells is valuable since it can represent different geologic and water use conditions, serve as a comparison for other observation wells, and show seasonal and long term changes. Currently there is one automatic recorder equipped reference well in the district located near Osmond.

Other Observation Wells are measured less frequently, usually in the spring and fall.

Fall measurements help to evaluate head loss problems, contributes to our understanding of the behavior of the natural hydrologic system when stressed (either due to drought or to local heavy withdrawals), and illustrates the impact on the water table of either natural discharge or discharge during pumping.

Spring measurements are made before pumping stresses occur and help to evaluate natural recharge.

The groundwater elevation monitoring program in the Lower Elkhorn NRD from 1976-1990 has consisted of monitoring the non-pumping water level (in both the spring and fall) of up to 300 irrigation wells (Exhibits 10 and 10a). This is about 10% of the irrigation wells in the district, and has given us valuable information. It has shown, based on spring water level measurements, that except for a few small, isolated areas, long-term groundwater level changes have not occurred. Groundwater levels that decline during drought years have recovered in wet years.

An immediate need is to coordinate the collection of groundwater quality and quantity datum necessary to make management decisions. By learning more about groundwater flow direction and recharge areas, on a concentrated basis, we can develop protection or management strategies to solve growing groundwater quality problems.

- Assist University of Nebraska Conservation and Survey Division in obtaining logs from wells, test holes, and other drilling so they can compile geologic data to facilitate accurate calculation of hydrologic properties.

Data collected during operations such as well installation and test hole drilling will enhance our knowledge of groundwater reservoir characteristics. This knowledge will help us manage the reservoir effectively. The NRD will actively gather boring logs for submission to the University of Nebraska Conservation and Survey Division that are either not required for submission by law or are not routinely submitted to the University of Nebraska Conservation and Survey Division. Examples of this include working with local well drillers to obtain logs for unregistered wells (coordinating with the Nebraska Department of Health and University of Nebraska Conservation and Survey Division to write the requirements for these well logs) and obtaining borehole logs from site investigations conducted by or for the Nebraska Department of Environmental Quality. The NRD can provide University of Nebraska Conservation and Survey Division the information that the NRD has and that they may not have.

- Establish and maintain a groundwater quality monitoring program.

The NRD collected samples from a district-wide network of 81 selected irrigation wells in the mid 1980's. The samples were analyzed for nitrates, pesticides, and volatile organics, to provide baseline information on the groundwater quality of the Lower Elkhorn NRD. These original 81 samples provide the public with generalized knowledge of groundwater quality, and future resampling will provide information on quality changes or trends and is also essential in maintaining our groundwater reservoir life goal.

Because of the variability of the geologic conditions, topography, and land use in the district, more complete groundwater quality information is needed. Additional samples will be taken on a concentrated basis, one area at a time. Irrigation wells in a county (or smaller area) will be selected on the basis of proper construction, distribution, and geology to give as complete a picture of hydrogeologic conditions as is practical for the area. This concentrated sampling and analysis will be continued area by area until the entire NRD is completed.

In addition to providing baseline quality data, the program provides a basis for the establishment of groundwater management or control areas, or Special Protection Areas. These areas would be managed to prevent degradation or improve the water quality in the area. Data established by the NRD will provide a basis for determining the boundaries of these areas and help eliminate the possibility of an oversized, unmanageable protection area.

The results of this monitoring will be used in education programs to inform people of existing contamination problems and why these problems exist. The results will also be used to determine the need for implementation of additional groundwater management practices.

- Ensure an adequate service for water quality testing.

  The NRD must ensure that a reliable groundwater quality testing service is available for the district groundwater quality monitoring programs and for residents of the district who sample their own wells. Data generated by this service must be accurate and consistent (and at a reasonable cost) to provide a sound basis for groundwater reservoir management.

  Appendix 6 lists the labs that are currently certified by the Nebraska Department of Health.

- Develop and maintain an NRD computer inventory of groundwater data.

- Coordinate groundwater datum collection with other agencies and share information to prevent duplication.

  Besides NRD's, the governmental agencies that collect groundwater information include: the United States Geological Survey, University of Nebraska Conservation and Survey Division, Nebraska Department of Health, the Environmental Protection Agency and the Nebraska Department of Environmental Quality. The NRD will help coordinate groundwater information collection programs within its boundaries to promote efficiency and avoid duplication of effort.

Improve groundwater conservation practices.

- Improve management of municipal, industrial, and irrigation water systems through education and research programs to conserve both quantity and quality of groundwater.

The NRD will encourage recycling of industrial wastewater, conduct seminars to inform the public of conservation practices, and encourage irrigators to use the following practices:

1. Pumping plant efficiency tests.
2. Overall system efficiency tests.
3. Irrigation scheduling using technologies such as tensiometers or moisture blocks.
4. Install necessary pollution prevention equipment.
5. Test for nitrates in groundwater and cut back fertilizer application to utilize nitrates in irrigation water.
6. Install flowmeters on irrigation wells.

Educational programs will inform urban residents of the potential hazards of fertilizer and lawn pesticide use and of stormwater runoff from streets and parking areas which might enter groundwater.

Industrial runoff should be carefully managed to provide treatment where necessary and to avoid pollutants moving downward. Surface runoff from wastewater treatment lagoons, both urban and livestock, should be controlled to avoid groundwater degradation. The NRD will work with the Nebraska Department of Environmental Quality to deal with these concerns.

- Encourage landowners to use best management practices in utilizing soil and water resources.

In those areas where groundwater levels are near the surface, it is particularly critical to minimize leaching of surface materials. The Lower Elkhorn NRD offers programs such as cost-sharing, Lands for Conservation, the Wildlife Habitat

Program and tree planting as incentives to landowners to use good conservation practices:

Structural:

1. Terracing with tile outlets or grassed waterways.
2. Grade stabilization dams.

Non-Structural:

1. Conservation Tillage.
2. Contour farming.
3. Crop rotation.
4. Establish permanent cover on marginal cropground.

These practices reduce erosion and sediment problems. They also keep sediments and agrichemicals from getting into surface water. By increasing infiltration of precipitation, these practices can reduce the amount of irrigation water needed.

- Support state and federal efforts in drought management education.

Several state and federal agencies have established the "Nebraska Drought Assessment and Response System" (DARS Task Force, 1985) which is a system to facilitate smooth operation of existing drought response programs available through various agencies.

Geological Survey Water Supply Paper 1804 "Drought of the 1950's With Special Reference to the Mid-Continent" is of great value to NRDs and other agencies concerned with drought. A flood is a specific event that can be seen and measured. A drought, on the other hand, is less an event than a situation and is difficult to describe as a course of specific events because commonly there is little measurable change from month to month. Drought occurs when the water available to plants is less than required for optimum growth and development.

Drought severity was formerly evaluated largely on the basis of damage to rural land, crops and livestock. Now, however, municipal and industrial demands for water are so heavy, that drought affects all normal activities.

Among the causes of shortage are overuse of water reserves, lack of storage and distribution facilities, improper design of distribution facilities, poor management of water supplies, and poor watershed management.

Studies of variation in runoff and recharge are essential parts of the tasks of evaluating drought effects and of devising means to alleviate those effects. The NRD must work closely with agencies concerned with drought to anticipate drought conditions, and minimize adverse impacts.

Maintain and improve groundwater quality.

• Promote the use of best management practices for agricultural and lawn chemicals.

Rural and urban dwellers alike have used chemicals without regard for the impact on groundwater. In town, lawn and garden chemical applications are poorly managed and need improvement. Studies have linked the presence of nitrates in groundwater to fertilizer applications. Pesticides are also being found in groundwater.

The best management practices for agricultural and lawn chemicals involve the most efficient use of chemicals in the production of crops or the growing of grass. This involves proper timing and rate of application. Proper application would reduce contamination from lawn, garden and agricultural chemicals on groundwater but would not eliminate contamination.

Some best management practices are:

1. Deep soil testing for identification of nutrients and pesticides in the root zone.
2. Use of nitrogen management.
3. Adherence to Extension Service suggested nutrient application rates for specific crops and locations.
4. Alternative cropping practices to reduce fertilizer and pesticide requirements.

Chemigation safety equipment is required by law on all irrigation systems through which nitrogen and other chemicals are applied. The NRD is responsible for inspecting this equipment.

Testing of soils to determine the presence of nitrates or pesticides below the root zone could identify problem areas where intensive monitoring of the groundwater or other management measures are needed.

The application of best management practices will be encouraged on a voluntary basis immediately. Where existing or potential problem areas are identified, mandatory requirements will be initiated through the use of Groundwater Control, Management, or Special Protection Areas.

Some Nebraska studies have shown that increases in the level of nitrates in groundwater can be reduced by utilizing the nitrate concentration present in the root zone and/or groundwater as a nutrient source for growing crops. Thus, the amount of nitrogen applied as fertilizer may be reduced by the amount of nitrogen that is available to the crop from the soil and/or irrigation water without adversely affecting crop yields.

Specific best management practices recommendations for any area will be based upon its topography, rainfall, soil structure and the type of crop raised. county Extension Agents can provide the information needed by farmers and city residents for proper application of chemicals.

Implementation of best management practices will require coordination of chemical suppliers, applicators, the Extension Service, Soil Conservation Service, crop consultants and the NRD to assure all necessary measures are taken.

- Communicate with Nebraska Department of Environmental Quality and other State and Federal agencies to ensure proper animal waste handling, such as lagoon design, feedlot drainage, pasture drainage, and manure application.

The Nebraska Department of Environmental Quality, the Nebraska Department of Health , and the University of Nebraska Extension Service and Conservation and Survey Division are all involved in monitoring point and nonpoint source pollution.

With Federal agencies such as Environmental Protection Agencies involved, communication and coordination are necessary. The NRD can be the communication link, not only between agencies, but between the people of the district and the agencies. A necessary part of such coordination is for representatives from each agency to work closely with the NRD on a regular basis.

- Communicate with Nebraska Department of Environmental Quality and other State and Federal agencies to investigate the source of groundwater pollution detected by the NRD monitoring programs.

  Fertilizer and pesticide parameters were monitored under the baseline data sampling program, but sources of pollution were not specifically identified. When indications of pollution are found, further investigations or studies will be required to identify the source(s) so appropriate action can be taken. The NRD will communicate with the appropriate agencies when pollution is suspected to determine the probable source(s) of the pollution and to ensure that the proper agency will respond to the problem. Special Protection Areas and Groundwater Quality Management Areas which incorporate soil and water sampling are two methods of investigating groundwater pollution.

- Communicate with Nebraska Department of Environmental Quality and other State and Federal agencies that monitor urban pollution from waste treatment lagoons, runoff and drainage, to initiate action when contamination is suspected.

  Stormwater runoff and drainage from urban areas are significant sources of pollution and will be monitored in coordination with State agencies. In areas where there is groundwater recharge potential from stormwater lagoons or drainage facilities all agencies involved will cooperate to study and implement the practices necessary to prevent pollution. In specific problem areas a sampling program using existing wells will be implemented to monitor pollution in groundwater. Where existing wells are not adequate, new monitoring wells will be properly constructed.

- Communicate with Nebraska Department of Environmental Quality and other State and Federal agencies that monitor industrial and transportation pollution.

  An extensive program of permits and monitoring for industrial and transportation pollution has been developed by the Department of Environmental Quality. The program will provide for feedback from other State and Federal Agencies involved in monitoring such activities. The NRD will assist in the identification of areas where industrial or transportation pollution exists, but any cleanup would be left to the State and Federal Agencies involved.

- Coordinate Nebraska Department of Environmental Quality and NRD programs for groundwater protection strategies.

  The NRD must maintain close coordination and association with the Department of Environmental Quality to assure that groundwater programs are not being duplicated and to maintain local control to manage groundwater resources.

- Develop a list of treatment methods available to improve drinking water quality.

  The NRD, with the assistance of State agencies, will develop a list of recognized treatment methods and tested products for rural residents to remove pollution from drinking water. Once an area has been identified as having pollution problems, this list will be helpful in determining what can be done to assure safe drinking water. This list will be maintained on the computer inventory and cross referenced to the parameters monitored in the baseline data sampling program.

- Cooperate with Nebraska Department of Environmental Quality to identify Class V injection wells, and insure that they are properly registered, constructed and monitored to prevent groundwater contamination.

  The NRD will cooperate with Nebraska Department of Environmental Quality to determine how Class V injection wells impact groundwater quality. Classs I, II, III and IV injection wells are normally associated with oil and mineral production or hazardous and radioactive waste disposal and are currently regulated by other agencies. Class V wells include agricultural drainage wells, cooling water return flow wells, groundwater recharge wells, multifamily septic systems and groundwater heat pump wells (open loop).

- Cooperate with the Soil Conservation Service and the Cooperative Extension Service to establish education, incentive and demonstration programs and projects to assist farmers in developing total nitrogen management packages.

  Research has been done and information is available on calculating available nitrogen from groundwater, the soil profile, livestock manure, and other sources. However, these concepts must be combined with realistic yield goals and presented to farmers not only on an economic basis, but also to protect water quality. It is important that farmers be able to see local demonstrations of intensive nitrogen management, and have incentives and guidance in initiating their own program. This will be a part of the solution in areas that develop high nitrates in groundwater.

- Develop a program of deep soil coring to determine nitrogen concentrations in the soil between the root zone and the water table.

  Deep soil coring of selected sites in combination with groundwater analysis can give us a more complete picture of how our current practices are affecting groundwater quality. It can also be an early warning system in areas that are not currently showing a groundwater nitrate problem. Deep sampling can also help to educate landowners of the need for nitrogen management and best management practices. The NRD will use this tool to supplement its information and education programs.

Develop integrated management and supply augmentation measures.

- Examine the feasibility of providing supplemental groundwater supplies to municipalities, industries, and rural water users where beneficial uses are impaired because of problems in groundwater quantity and/or quality.

  Municipalities not having assured adequate supplies of good water should locate and develop such supplies before allocation and development for other uses may interfere with future planning for municipal use.

  The NRD will cooperate with public water suppliers to protect their source of water from contamination through the NRD Wellhead Protection Program.

  Large municipal systems could share the source of supply from their well fields with smaller satellite communities.

• Examine the feasibility of providing supplemental stream flows for instream uses from the groundwater at beneficial times and places.

The Policy Issue Studies on Instream Flows (Nebraska Natural Resources Commission, 1982) and on Integrated Management of Surface Water and Groundwater (Nebraska Natural Resources Commission, 1986) contain alternatives regarding the use of groundwater to supplement natural flow to meet instream flow needs. Where necessary to meet an emergency situation, either new wells could be constructed or contracts negotiated with the owners of existing wells for a water supply. Legislation would be required to declare that the use of groundwater to temporarily augment natural flow is beneficial use of groundwater and to permit the transferal of groundwater off the overlying land.

Whenever multipurpose surface reservoirs are constructed, provisions could be included to release stored water for instream flow augmentation.

Cooperate with other agencies and organizations to develop and provide educational materials and programs to promote public support for and participation in management of groundwater resources.

• Develop a Summary Brochure of the NRD Groundwater Management Plan.

1. The NRD will publish a summary of the Groundwater Management Plan in the form of a brochure which can be widely distributed to the public.

2. The brochure will be reproduced in bulk quantities and made available throughout the NRD at numerous locations such as county, City, and Village Offices; banks; schools; libraries; and other appropriate agencies and organizations.

• Develop an awareness in school children of the value of groundwater.

The NRD will work with the Cooperative Extension Service to develop youth-oriented groundwater awareness programs for presentation at school assemblies, in individual classrooms, county conservation days, 4-H meetings, scout meetings, county fairs, festivals, and other activities throughout the district and State. These programs can include the demonstration of the sand-tank groundwater flow model.

The NRD will cooperate with other agencies and organizations in coordinating and assisting at special events designed to develop groundwater awareness in school children, K-12, such as the Water Riches Celebration, Water Quality Day, and the Children's Groundwater Festival.

The NRD will promote the distribution and use of publications designed to develop groundwater awareness in school children, K-12, such as Soil and Water Conservation Society and National Association of Conservation District educational booklets on groundwater resources as well as NRD and other natural resources agencies' brochures appropriate to the age group.

The programs, demonstrations, events and literature will be actively promoted by the NRD through correspondence, news releases, flyers, brochures, and the NRD newsletter.

- Expand adult citizen awareness of the value of groundwater.

The NRD will encourage the Cooperative Extension Service to develop groundwater awareness programs appropriate for presentation to adult organizations such as church groups, fraternal clubs, business societies, county fairs, and festivals. These programs could include the demonstration of the sand-tank groundwater flow model.

The NRD will present sand-tank groundwater flow model demonstrations at appropriate events such as county fairs, expos, Husker Harvest Days or upon request.

The NRD will cooperate with other agencies and organizations in coordinating or assisting at special events designed to develop groundwater awareness in adults such as twilight tours, public meetings, and other events.

Programs, demonstrations, events, meetings and literature will be actively promoted by the NRD through broadcasts, correspondence, news releases, flyers, brochures and the NRD newsletter.

Current groundwater information will be prominently presented in NRD promotions.

- Provide technical information to assist groundwater users.

Assure that farmers have access to crop water use and irrigation scheduling information.

Encourage farmers to determine fertilizer requirements based upon realistic crop yield goals and nitrate concentrations in irrigation water and in the soil.

Cooperate with the University of Nebraska Extension Service to organize and present annual continuing education seminars on nitrogen management and best management practices for farmers.

Cooperate with the Nebraska Rural Water Association and the League of Municipalities to organize and present annual continuing education seminars on best management practices for municipal and rural water system operators and users.

Inform domestic well owners of the importance and the procedures of sampling and analyzing the quality of their groundwater supply.

Provide potential well owners with educational material and information on location, depth, capacity and quality of nearby wells.

Minimize pumping conflicts.

Fluctuation of groundwater levels in high water table areas often presents potential problems. Wells for domestic use, when drilled to shallow depths, often experience water shortages during periods of lowered water tables, and domestic users will be urged to make reasonable effort to obtain a steady supply of groundwater by installing wells at a deeper depth. Wells drawing from perched water tables, often thin, and at shallow depths, have frequent shortage problems.

- Mediate pumping conflicts.

  Make technical and hydrogeology information available to conflict parties.

  Attempt to negotiate a resolution to the conflict before it reaches court.

- Establish Groundwater Control or Management Area(s) where a need is established.

- Encourage proper construction of wells having less than 100 gallons per minute capacity.

  1. Encourage and advise citizens to sample domestic and stock wells for water quality.

  2. Encourage proper clean up and abandonment of polluted wells and replacement with properly constructed wells.

Protect municipal and domestic groundwater supplies.

- Inventory existing and proposed municipal groundwater supply sites, obtain copies of Department of Health test results, and correlate with NRD monitoring information.

- Assist municipalities in the planning of new groundwater supply facilities and protection of new or existing supplies. This may include water sampling of wells and establishment of Wellhead Protection Areas and/or Groundwater Management Areas in the vicinity of municipal drinking water supplies.

- Provide assistance, such as geological and hydrological information, statutory requirements, and rules and regulations to domestic well and septic tank owners, well drillers and equipment installers.

- Plan for rural water system development, including identification of potential groundwater source locations which may be preserved by implementing Wellhead Protection Areas and/or Groundwater Management Areas.

- Coordinate with the Nebraska Department of Environmental Quality and Department of Health to inventory existing and new potential pollution point sources, such as wastewater lagoons, fuel facilities, septic systems, and landfills.

- Promote wellhead protection area planning and participation in the NRD Wellhead Protection Program.

Obtain Funding for Groundwater Management Activities.

When implementation of any of the activities described in the preceding policies requires funding, the following alternatives for funding will be considered:

- NRD tax levy authorities.

  The maximum authorized general purpose tax levy is 4.5c per $100 of actual value. Based upon 1993 taxable valuation, the maximum general purpose tax revenue generated is $1,678,617 per year.

  In groundwater management area(s) or control area(s) the NRD may levy up to an additional 1.8 cents per $100 of taxable valuation of property within the management or control area(s) for groundwater management purposes.

  In designated Special Protection Areas, the NRD may levy an additional ½ cent per $100 of taxable valuation on all property in the district to administer the Special Protection Area activities.

- Seek funding from the State of Nebraska for groundwater management purposes.

  Encourage the NARD to draft and lobby for legislation to provide, as a minimum, state matching funds for NRD administered groundwater management programs which are mandated by statute.

  Pursue cost-share funding from state agencies for data collection programs for which there is common interest.

- Seek Funding from other governmental agencies.

  Monitor federal programs for funding opportunities and submit applications for funding if appropriate.

  Pursue cost-share funding from federal agencies for data collection programs for which there is common interest.

  Consider inter-agency agreements with local governmental subdivisions for studies, information collection, and service programs for which there is common interest.

B. *Goal and Objectives*

The purpose of the Lower Elkhorn NRD groundwater management plan is to ensure that an adequate supply of acceptable quality groundwater is always available for beneficial uses, as stated by the district's reservoir life goal (see page 2). To attain this, the district will use its resources and authorities to implement the following goal and objectives to protect the district's groundwater supplies. Detailed descriptions of the objectives, programs, and actions can be found on the referenced pages.

Goal: Conserve groundwater quantity and quality
(Master Plan Goal D)

Objectives:

1. Monitor groundwater to detect changes, trends, or problems.
The following programs and actions will be used to accomplish this objective:
    a. Groundwater quantity monitoring program (Section VII.C.1.).
    b. Groundwater quality monitoring program (Section VII.C.2.).

2. Improve groundwater conservation practices through education and information dissemination.
The following programs and actions will be used to accomplish this objective:
    a. Expand adult citizen awareness of the value of groundwater.
    b. Develop an awareness in school children of the value of groundwater.
    c. Develop a summary brochure describing the Lower Elkhorn NRD groundwater management plan.

3. Assist agricultural producers in proper irrigation water and agrichemical usage.
The following programs and actions will be used to accomplish this objective:
    a. Deep soil sampling program (Section VII.C.3.).
    b. Groundwater quality monitoring program (Section VII.C.2.).
    c. Fertilizer management demonstrations (Section VII.C.8.).

4. Protect municipal and domestic groundwater supplies.

The following programs and actions will be used to accomplish this objective:

a. Well sealing program (Section VII.C.4.).
b. Plan for rural water system development.
c. Administer the Nebraska Chemigation Act (Sections IV.B. and VII.C.5.).
d. Initiate actions when groundwater elevation conditions reach groundwater quantity trigger levels (Section VII.C.6.).
e. Initiate actions when groundwater contamination reaches the groundwater quality trigger levels (Section VII.C.7.).
f. Wellhead protection program (Section VII.C.9.).
g. Mediate pumping conflicts.

5. Increase our general knowledge of the hydrogeologic characteristics of the district.

The following programs and actions will be used to accomplish this objective:

a. Vadose zone monitoring (Section VII.C.10.).
b. Groundwater quantity monitoring program (Section VII.C.1.).
c. Groundwater quality monitoring program (Section VII.C.2.).

C. *Program descriptions*

1. Groundwater quantity monitoring program.

Groundwater level monitoring consists of three phases:

a. Spring and fall district-wide monitoring. Exhibit 10a shows the irrigation wells that the district routinely monitors on a semiannual basis. Appendix 2 summarizes the groundwater level information for these wells. The purpose of this monitoring is to detect long term trends and changes in groundwater levels throughout the district. Downward changes and trends detected will actuate groundwater quantity triggers, resulting in protective actions by the NRD (Section VII.C.6.).

   Approximately 88 percent of the irrigation wells shown in Exhibit 10a have spring and fall measurements dating back 15 to 18 years. The information gathered from these wells becomes increasingly valuable with each year of data collection. The NRD will strive to continue collecting information from those wells with a significant amount of historical data. In the event that data from any well becomes invalid, such as with a collapsed well or an abandoned well, the NRD will discontinue its use as a monitoring well, and if possible, will select a suitable replacement well. The NRD will also improve the monitoring program as more is learned about the hydrogeologic system through the addition or deletion of wells from the program. The University of Nebraska Conservation and Survey Division, the United States Geological Survey, or a qualified hydrogeologist will be consulted by the district prior to dropping wells from the program or selecting replacement wells.

b. Concentrated spring and fall measurements in smaller areas such as counties, watersheds, or special interest areas. The purpose of this monitoring is to determine local aquifer characteristics to aid in management decisions. These areas will be on a rotation basis until more concentrated data are available for the entire district (where sufficient wells are present to fulfill the purpose).

The areas where concentrated groundwater level measurements are performed will be prioritized as follows:

1) Special interest areas, such as areas where groundwater quantity triggers have been actuated, potential wellhead protection areas or areas where groundwater contamination problems exist or are being investigated by the NRD;
2) Areas with the highest density of groundwater irrigation (see Insert II - 1, Figure 10);
3) Complete watersheds; and finally
4) The remaining areas on a county-wide basis.

Concentrated groundwater level measurement efforts will be done as funding and manpower allows. Currently (1993) these efforts are being applied in a groundwater quality problem area in eastern Pierce county.

c. Other specialized projects. The district monitors the groundwater level of observation wells in the Willow Creek Reservoir area to assess the impact of the reservoir on the area's groundwater. The district also measures groundwater levels in observation wells near the village of Osmond as a continuation of a study to help Osmond in their efforts in wellhead protection.

All groundwater level measurements are performed using the wetted-tape method, although other methods such as electrical probe may be utilized (Nielsen, 1991). All data are corrected to the land surface elevations and are reported to the United States Geological Survey. This information is also given to the owners of the monitored irrigation wells.

2. Groundwater quality monitoring program.

The groundwater quality monitoring program will be performed as funding and manpower allows. This program consists of two phases:

a. Routine, district-wide monitoring. In the mid-1980's, the Lower Elkhorn NRD established a district-wide network of 81 irrigation wells for a baseline evaluation of regional groundwater quality. Nitrate-nitrogen, pesticides, and volatile organic compounds were determined at that time. Additional inorganic parameters will be determined to enhance our understanding of general water quality beginning in the 1994 growing season. The district will also continue to monitor these wells (or suitable replacements, if needed) periodically to detect changes or trends in water quality as follows:

Table VII - 1
Minimum requirements for routine groundwater quality monitoring

BEGINNING IN THE 1994 GROWING SEASON	5 YEAR CYCLE
Nitrate-nitrogen	Nitrate-nitrogen
pH	pH
Temperature	Temperature
Conductivity	Conductivity
Bicarbonate Alkalinity	Chloride
Chloride	Sulfate
Phosphorus	Triazine screen/Atrazine
Sulfate	
Calcium	
Iron	
Magnesium	
Manganese	
Potassium	
Sodium	
Selenium	
Triazine screen/Atrazine	

Since detectable concentrations of atrazine have been correlated with high nitrate-nitrogen levels in groundwater, the district will determine atrazine concentrations for wells where nitrate-nitrogen contamination exists. A portable test kit will be used to screen the groundwater for nitrate-nitrogen concentrations. When nitrate-nitrogen levels are 10 milligrams per liter or higher, the district will pursue further testing to determine if atrazine also contaminates the water. If portable triazine screening equipment is available, the water will be screened for the presence of triazines, and if the triazine are not detected, there is no requirement for further testing for atrazine. If the test results in a positive detection, or if portable equipment is not available, a water sample will be collected and submitted to the laboratory for atrazine analysis.

b. Specialized monitoring. The NRD will conduct specialized groundwater quality monitoring as required for specific water quality investigations or programs:

1) Areas where groundwater quality triggers have been actuated. Exhibit 17a shows the areas where nitrate-nitrogen levels were detected by routine monitoring and exceed the NRD groundwater quality triggers. The district is investigating these areas in the following order (as of 1993):
    a) Pierce county,
    b) Central Dodge county,
    c) Northern Madison county near Norfolk,
    d) North and south of Beemer area
    e) Remaining areas;
2) Areas identified in Section VI, Identification of Critical areas for Protection, particularly along the Elkhorn river valley in Madison county;
3) Areas identified as having groundwater contamination problems through sources other than the NRD monitoring program. The district will investigate complaints to ensure that the proper agencies are contacted. This includes an area northeast of Laurel.
4) Existing or potential Wellhead Protection Areas; and
5) Other areas deemed appropriate by the Board.

All testing results are provided to the owners of the monitored wells. The protocol for collecting groundwater samples is in Section III. B. The NRD will consult with the University of Nebraska Conservation and Survey Division, the United States Geological Survey, the Nebraska Department of Environmental Quality, The Nebraska Department of Health, or a qualified consultant to design and conduct any investigations.

3. Deep soil sampling program.

The deep soil sampling program promotes proper nutrient management techniques through the collection and analysis of deep soil samples. The Lower Elkhorn NRD will cost share up to 75% of the cost of deep soil sampling (at least 36 inches deep), soil analysis, groundwater nitrate analysis, and fertilizer recommendations with landowners.

Samples are to be collected by a Lower Elkhorn NRD certified consultant or dealer (certification is acquired by attending a training session or alternative training). Each sample should represent 20 to 40 acres. Each sample will consist of at least 10 to 15 surface cores to an 8 inch depth; 6 to 8 subsurface cores 8 to 24 inches deep; and 6 to 8 deep cores 24 to 36 inches deep (up to 48 inches optional). Water samples may be collected by the landowner as long as the well has pumped for at least 4 hours continuously.

The soil is analyzed for nitrate, Bray-1 phosphorus, pH, lime requirement, excess lime, and organic matter. Irrigation water is analyzed for nitrate-nitrogen. All analyses must be done by a state certified lab. Fertilizer recommendations must be based on University of Nebraska Guidelines.

Irrigated or dryland fields that were in corn, oats, sorghum, wheat, or soybeans the previous year and will be planted to corn, sorghum, or oats are eligible.

75% of the cost of sampling and analysis up to a maximum of $40 per sample representing 20 to 40 acres is paid by the district. The district will pay up to $6.50 for water analysis. Cost share for each cooperator will be limited to three years for soil sampling. The maximum payment allowed is: $300 per cooperator the first year; $200 per cooperator the second year of participation; and $100 per cooperator the third (and final) year of participation.

Landowners with approved applications will receive cost share funds after submitting:

a. Soil and water (if applicable) analysis.
b. Bills for sampling and analysis.
c. Report from the landowner after harvest on actual nutrient applications (including manure), inches of irrigation water if applicable, and yield.

4. Well sealing program.

There are probably thousands of wells in the Lower Elkhorn Natural Resources District that are no longer used and remain as open holes. These abandoned wells are a threat to public health and safety. Besides being a potential physical hazard for people or animals to fall into, these wells are a direct means for transmitting surface borne contaminants to groundwater. The Lower Elkhorn

NRD well sealing program protects groundwater resources by offering cost share incentives for properly sealing abandoned wells. The program began in 1992, and in the first three years of the program cooperators sealed approximately 536 wells.

Two methods of administering the program have been used by the district. Both require that licensed well drillers perform the well sealing work to ensure that the work is done correctly. The methods differ in the way that the well driller is selected. Only one method is used at any one time. One method requires an applicant to submit a description of the physical characteristics of the well and an application fee to the NRD. The well descriptions are sorted by the district according to the geographic region of the district and submitted to well drillers for bidding. The NRD selects well drillers based on the bids and the work is then performed. The other method requires the applicant to select a well driller. The applicant submits a price quote from the well driller with the application form to the NRD. The well sealing work can be done after the NRD approves the application.

5. Administer the Nebraska Chemigation Act.

The district is responsible for issuing permits for chemigation. The Nebraska Chemigation Act requires each irrigation system that applies chemicals (other than water) through the system to have a chemigation permit. The Lower Elkhorn NRD is responsible for issuing these permits.

New permits cost $30 and are obtained by filling in an application form and submitting it to the NRD. The district then conducts an inspection to ensure that the necessary backflow devices and safety equipment are installed and properly functioning. The Lower Elkhorn NRD has contracted with local citizens to perform the inspections. Inspections are required for all new permits.

Each system that successfully passes the permit process may be renewed the following year. The district mails partially filled in application forms to the previous year permit holders as a service to help the renewal process. These permits must be submitted to the NRD along with the $10 application fee on or before June 1 of that year to be considered for renewal. The district performs equipment inspections for approximately 50% of the renewals each year.

6. Establish and administer a groundwater management area.

The purpose of the Lower Elkhorn NRD groundwater management plan is to ensure that an adequate supply of acceptable quality groundwater will always be available for beneficial uses, as stated by the district's reservoir life goal (see page 2). The Nebraska Groundwater Management and Protection Act gives NRDs the authority to form management areas for the protection of groundwater quantity and quality.

This portion of the groundwater management plan is intended to be the foundation for the development of rules and regulations for a groundwater management area. A description of the actions and controls for the protection of groundwater quantity begins on page 101; a description of the actions and controls for the protection of groundwater quality begins on page 105.

a. Groundwater management area background information.

1) Groundwater management and protection.

Nebraska's NRDs are authorized to form special areas to protect groundwater quantity and/or quality. Within these areas, NRDs can encourage, require, or control actions that have an impact on groundwater (Chapter 46, Reissue Revised Statutes of Nebraska).

The Lower Elkhorn Natural Resources District Board of Directors decided in 1992 to pursue a groundwater management area to deal with nitrate-nitrogen contamination in the district. The management area will also address groundwater quantity problems and nonpoint source contaminants other than nitrate-nitrogen when needed.

2) Evidence considered by the Board of Directors in establishing a groundwater management area in the Lower Elkhorn Natural Resources District.

The groundwater quality studies cited in Section III indicate that nonpoint source nitrate-nitrogen contamination exists throughout the district. The areas that are of immediate concern are in Pierce and Dodge counties. Other smaller areas of nitrate-nitrogen contamination are documented and are scattered throughout the district (refer to Exhibit 17a).

Groundwater is vulnerable to contamination in much of Pierce County, in the Logan Creek Valley, and in the Elkhorn River Valley (Drastic model, Figure II-1). The major land use in these areas is cropland (see Figure IV-1). Additionally, Stanton and Cuming counties have a very large number of confined animal feeding operations (see figure IV-4 and Table IV-5), with the manure being locally land applied. The conditions in these areas indicate the potential for nitrate-nitrogen contamination of groundwater, and the Board of Directors recognizes this possibility.

Several Public Water Supply wells in the district have nitrate-nitrogen concentrations that are near or above the Maximum Contaminant Level of 10 milligrams per Liter. While municipalities and some counties have zoning authorities that can protect Public Water Supply wells, the groundwater management tools authorized for use in groundwater management areas can enhance the protection of these wells in rural areas.

Because of documented nitrate-nitrogen contamination of groundwater in Pierce County, the Lower Elkhorn Natural Resources District Board of Directors decided in November of 1992 to begin the process of establishing a groundwater management area. Because of both documented and potential nitrate-nitrogen contamination of groundwater in other parts of the district, and to enhance Public Water Supply wellhead protection efforts in the district, the Board of Directors decided in July of 1993 to include the entire district in the groundwater management area establishment process.

Documents describing the process of establishing a management area are contained in Appendix 1. Included are letters from Jim Cook of the Nebraska Natural Resources Commission and Susan France of the Nebraska Department of Water Resources, and the Nebraska Groundwater Management and Protection Act. The process includes preparing a groundwater management plan for the area, conducting a public hearing to receive testimony on the plan, and the NRD Board making a decision whether or not to declare a management area.

When a management area is established, the district will be required to issue permits for new wells (pursuant to § 46-659). The district must also determine the total amount of groundwater to be withdrawn that is consistent with the groundwater reservoir life goal, and adopt the controls necessary to allow the beneficial use of that volume of water.

b. Groundwater management area objectives.

The Lower Elkhorn Natural Resources District groundwater management area is one of the tools that the district will use to accomplish its Reservoir Life Goal (see page 5). The objectives of the management area are to:

1) protect groundwater quantity to ensure that an adequate supply of groundwater is available for beneficial uses, and

2) prevent the levels of nonpoint source groundwater contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards.

Section 'f' beginning on page 100 explains the methods that will be used by the district to accomplish these objectives.

Formation of the groundwater management area began because of nitrate-nitrogen contamination in the district, a groundwater quality issue. The management area will also address other nonpoint source contaminants and groundwater quantity issues when needed.

c. Cooperation with other agencies.

Numerous state and federal agencies are also responsible for addressing nonpoint source pollution problems. For example, the Nebraska Department of Agriculture is responsible for regulating pesticides and may take action to prevent or remediate pesticide contamination problems.

The district will cooperate with the appropriate agency or agencies when developing and administering action plans to address nonpoint source groundwater contamination problems.

d. Geographic and stratigraphic boundaries of the groundwater management area.

The Lower Elkhorn Natural Resources District groundwater management area will include the entire district. The management area will include the following aquifers:

1) Ogallala group and overlying deposits,
2) Niobrara formation and overlying deposits,
3) Dakota group and overlying deposits,
4) All other aquifers supplying groundwater for beneficial uses.

e. Total groundwater withdrawal within the Groundwater management area.

The Lower Elkhorn NRD has adopted triggers and actions to protect groundwater quantity. Triggers are actuated when groundwater elevations drop to specified levels. When a trigger is actuated, the NRD will begin a series of actions to protect groundwater quantity supplies or to remediate existing groundwater quantity problems (see page 101). These protective actions consist of several phases, called action levels, that respond to worsening conditions with increasingly rigorous corrective measures. Each action level has its own triggering mechanism, so that changing conditions will trigger new action levels. The controls used in the action levels include various methods of restricting the amount of water that may be pumped from the groundwater reservoir. The Lower Elkhorn NRD groundwater quantity protection triggers are based on the groundwater levels that existed before widespread installation of groundwater removal methods (such as irrigation wells). These groundwater levels must be estimated and are referred to as predevelopment estimates.

The district will initiate actions when groundwater levels in an area drop 15 feet below predevelopment estimates for that area for a period of 5 to 7 years. If the controls used in the management area are not effective and groundwater levels continue to drop, more restrictive actions will be initiated when groundwater levels drop 20 feet below predevelopment estimates for 3 to 4 years after the establishment of Action Level 2.

For purposes of section 46-673.08, the Lower Elkhorn NRD will allow that amount of water to be withdrawn from the groundwater reservoir that will trigger the groundwater quantity management actions that are described beginning on page 101.

f. Groundwater management area description.

A groundwater management area can address groundwater quantity and/or groundwater quality issues. Nonpoint source nitrate-nitrogen groundwater contamination was the reason for the establishment of the management area that is described in this section. The management area, however, will also address other nonpoint source contaminants and groundwater quantity depletions in order to achieve the district's Reservoir Life Goal (see page 5).

The groundwater management area will address both groundwater quantity and quality issues, and the management area will include the entire district. The description of groundwater quantity management begins on page 101; the description of groundwater quality management begins on page 105.

There are two district-wide requirements of the groundwater management area: 1) wells designed to pump more than 50 gallons per minute must be permitted by the district prior to well construction, and 2) flow meters must be installed to measure groundwater withdrawals from each active irrigation, public water supply, commercial/ industrial and livestock well or series of wells designed to pump more than 50 gallons per minute.

Under the management area, the district will be geographically and/or stratigraphically divided into subareas. These subareas are called Action Levels for groundwater quantity management, and Phases for groundwater quality management. An area will be placed into a subarea according to the conditions in that area. For example, an area may be placed into a certain Action Level if the groundwater levels have dropped (a groundwater quantity problem), or it may be placed into a certain Phase if groundwater in the area is contaminated (a groundwater quality problem).

The district will require the use of corrective actions within subareas. Different actions will be required in different subareas according to the conditions in that subarea. Areas with groundwater level or contamination problems will have different requirements than areas without those problems. In this way, the actions that the district will require will be specific to the problem being solved. Groundwater levels and groundwater contaminant concentrations (as well as other criteria) have been established by the Board of Directors that will 'trigger' the designation of a subarea for quantity and/or quality management. A subarea's designation can be changed if conditions in that area change.

The controls required for the groundwater management area are described on the following pages.

A detailed description of the groundwater quantity portion of this groundwater management plan begins on page 101. When a problem is detected by the groundwater quantity monitoring program, Action Level 1 will be triggered and groundwater level monitoring will be intensified (more wells will be measured) in that area. If the intensified monitoring documents that a groundwater level depletion problem exists in the area, Action Level 2 will be established which will require volume monitoring of wells and the use of one or more groundwater management practices as outlined on page 103. If groundwater levels do not stabilize with these regulations, Action Level 3 will be triggered and additional groundwater management practices will be required.

A detailed description of the groundwater quality portion of this groundwater management plan begins on page 105. When groundwater contamination levels reach or exceed 50% of the Maximum Contaminant Level, that area will be subject to Phase 2 controls. When groundwater contamination levels reach or exceed 90% of the Maximum Contaminant Level, that area will be subject to Phase 3 controls. The remainder of the district will be in Phase I. The controls listed in this section are generic so that the district can most effectively address nitrate-nitrogen and other nonpoint source contaminants. The description for each phase lists the controls that the district will require. Each list of controls will be the minimum that the district will require for that phase. A list of additional controls begins on page 109 that the Board of Directors can impose in any phase to enhance the groundwater quality protection efforts in that area.

The Lower Elkhorn NRD will, if possible, coordinate with nearby NRDs to make the actions and controls adopted consistent and compatible with planned or existing management areas.

1) Groundwater quantity management; subareas, triggers, and controls.

The Lower Elkhorn NRD has established triggering mechanisms for groundwater quantity protection. These triggers are actuated when certain conditions are detected by the NRD groundwater quantity monitoring program. The triggers are intended to be protective measures that will initiate actions before serious problems occur. Once a trigger is actuated, the NRD will begin a series of actions to protect groundwater supplies or remediate existing problems.

Triggers for groundwater quantity protection consist of several phases, called action levels, that respond to worsening conditions with increasingly rigorous corrective measures. Each action level has its own triggering mechanism, so that changing conditions will trigger new action levels.

Flexibility has been built into the triggers and action levels because of the complex hydrogeology of the district. The current triggers and actions are used for the entire district, which may be too protective in some areas and may under-protect other areas. As our knowledge of the district's hydrogeology increases, the triggering mechanisms and actions will be 'fine-tuned' to improve the effectiveness of our groundwater quantity protection efforts. The Lower Elkhorn NRD will develop unique triggers and actions for different regions of the district as more local hydrogeologic information becomes available.

Action Level 1

The Lower Elkhorn NRD will initiate the following actions when, in 2 years of any 3 year period, the spring groundwater level of any well in the routine groundwater quantity monitoring program drops 15 or more feet below predevelopment estimates for groundwater levels in that area. When this trigger is actuated, the NRD will take the following actions:

a) Intensify educational efforts in the area including, but not limited to, information concerning:

   i. Groundwater conservation practices;

   ii. Potential regulatory actions of the 2nd and 3rd Action Levels (see below);

   iii. The status of the groundwater supply in the area.

b) Formation of a local citizen's advisory committee.

c) Increase the number of wells monitored in the area to determine the extent of the problem, to serve as a basis for triggering Action Level 2, and to obtain the hydrogeologic information necessary to delineate a management area. The intensified monitoring program described below applies to the entire district. The actual monitoring program for each problem area may vary according to the local hydrogeologic characteristics of the area.

i. The district will determine a rudimentary area to be monitored. The shape and size of the area may change as more information is gathered. A minimum area of 9 square miles will be monitored.

ii. The minimum number of monitoring sites will be 50% of the number of registered irrigation wells in the area that are suitable for use as groundwater level observation wells (taking into account criteria such as quality of well construction and screened intervals). The district will also consider using registered industrial, livestock, monitoring, observation, public water supply, and domestic wells that would be suitable as monitoring sites.

iii. The intensified monitoring will begin no later than the spring after the trigger was actuated for Action Level 1.

iv. If, after 5 years of the intensified monitoring, the trigger for Action Level 2 has not been actuated, the district may return to the routine groundwater level monitoring program for the area.

d) Determine the necessary control measures, rules, and regulations for Action Levels 2 and 3.

<u>Action Level 2</u>

An area will be placed into Action Level 2 when the spring groundwater levels in 80% of the wells monitored in the intensified monitoring program conducted in Action Level 1 drop 15 or more feet below predevelopment estimates for groundwater levels in those wells for 3 years out of any 4 year period of time. The area affected by this drop must be a minimum of 9 square miles in size.

The Lower Elkhorn NRD will actively seek public opinion while developing the rules and regulations for the area.

The district will require volume metering of wells used for any or all of the following categories of groundwater use: domestic, agricultural, manufacturing, commercial, or industrial. The district will also require owners of these wells to submit an annual report to the district.

Additionally, the district will choose at least one of the following authorized controls:

a) Allocate groundwater withdrawal on an acre-inch basis, specifying the total number of acre-inches of irrigation water per irrigated acre per year or an average number of acre-inches of irrigation water per irrigated acre over any reasonable period of time not to exceed five years.

b) Adopt a system of rotation of use of groundwater by utilizing a recurring series of use and nonuse of irrigation wells on an hourly, daily, weekly, or monthly basis or of irrigated acres on an annual basis.

c) Adopt well spacing requirements

d) Require the reduction of irrigated acres, where the nonuse of irrigated acres will be a uniform percentage reduction of each landowner's irrigated acres.

e) Require the use of flow meters on wells.

f) Require 'best management practices' including irrigation scheduling.

g) Require groundwater users to submit annual reports to the district.

The district will also continue the educational efforts and the groundwater level monitoring of Action Level 1.

Action Level 3

An area will be placed into Action Level 3 when the spring groundwater levels in 80% of the wells monitored in Action Level 2 drop 20 or more feet below predevelopment estimates for groundwater levels in those wells for 3 years out of any 4 year period of time. The area affected must be a minimum of 9 square miles in size.

In addition to any of the controls of Action Level 2, the district may require any of the following controls for an Action Level 3 area:

a) Require the use of tensiometers, soil moisture blocks, or other irrigation scheduling devices.

b) Require annual reports with water level measurements and quantifying the total withdrawal from wells.

c) Close the area to the issuance of any additional new well permits for a period of one year.

The district will also continue the educational efforts and the groundwater level monitoring of the first two Action Levels.

2) Groundwater quality management; subareas, triggers, and controls.

The Lower Elkhorn Natural Resources District groundwater quality portion of the management area will be divided into subareas to more effectively manage areas where different conditions exist (such as areas with high or low groundwater contamination concentrations, different soil types, or different land uses). Borders for these subareas will be determined primarily, but not exclusively, by groundwater contamination concentration. These subareas will be referred to as 'phases'. The "Additional Criteria" section on page 109 lists the other criteria that the Board of Directors will consider when delineating phases. An area may move from one phase to another (either 'up' or 'down') according to groundwater concentration and/or any of the listed additional criteria that are deemed appropriate by the Board. Borders for the subareas will follow either natural or political boundaries.

NRDs are required to address all nonpoint source contaminants in their groundwater management plans. Because of the diversity of potential nonpoint source contaminants that the management area could address, the controls listed in this section are somewhat generic. This is so that contaminants other than nitrate-nitrogen may be addressed if necessary. The controls described on the following pages will generally be most effective for land applied substances that tend to move with water, such as nitrate-nitrogen contamination that originates from fertilizer application. The generic nature of the controls allows for some flexibility in dealing with contaminants other than nitrate-nitrogen.

The following section is as detailed as possible. More detail may be added, as appropriate, when rules and regulations are developed or modified for the specific problems. For example, banning fall and winter application of fertilizer (or other source of contaminants) on coarse soils (page 109) lacks detail about the crops that may be affected (such as corn and sorghum for nitrate problems) and the definition of 'coarse soil' (this may mean a permeability greater than 2 inches per hour). These details and definitions could be added and changed with rules and regulations.

The controls listed for Phases 1, 2, and 3 on pages 106 through 108 are the minimum controls for each phase. Page 109 lists the additional controls that may be used in any of the phases if deemed appropriate by the Board.

The U.S. Environmental Protection Agency has established Maximum Contaminant Levels allowed in drinking water for many contaminants. Contaminants occurring above these levels are considered to be a health risk for people that are exposed to a specified dose of the contaminant for an extended period of time. Potential contaminants may or may not have Maximum Contaminant Levels established for them.

For those contaminants that have no Maximum Contaminant Level established, the district will cooperate with the Nebraska Department of Health to determine the health risks of the contaminant and develop trigger levels and controls for the different subareas. The district will initiate this process when the risk assessment indicates a risk of one (1) death per million of population (per U.S. Environmental Protection Agency guidelines).

For those contaminants that have an established Maximum Contaminant Level, the following criteria and controls will be used to delineate and treat subareas (the subareas will be called 'phases'):

Phase 1 - Areas that are not designated as either Phase 2 or Phase 3.

a) Persons installing new wells must obtain a permit from the NRD in accordance with § 46-659.

b) The district will encourage operators to attend educational programs sponsored by the district concerning the contaminant (such as fertilizer and irrigation water management), to perform deep soil testing for the contaminant(s), to test irrigation water for the contaminant(s) and to submit an annual report (similar to the report required in phases 2 and 3) to the district.

Phase 2 - Areas that have from 50% to 90% of the Maximum Contaminant Level for a contaminant. An area will be placed into a Phase 2 area when at least 20% of the registered wells in an area are at or above the trigger level and the contamination is the result of nonpoint source groundwater contamination. Phase 2 areas must be a minimum of 9 square miles in size.

a) Persons installing new wells must obtain a permit from the NRD in accordance with § 46-659.

b) All operators applying fertilizer or (other possible sources of contaminants that the management area is addressing) must attend educational programs sponsored by the district.

c) Soil must be tested for residual quantities of the contaminant(s) (such as nitrate-nitrogen).

d) Irrigation water must be tested for the contaminant(s) (such as nitrate-nitrogen).

e) All operators applying fertilizer or (other possible sources of contaminants that the management area is addressing) must periodically submit reports to the district that will include soil test results, irrigation water test results, and other information required by the Board of Directors.

f) Contaminants other than nitrate-nitrogen may require controls that are different than those listed above for Phase 2 areas. If these controls will not be effective in preventing or remediating groundwater contaminant(s) other than nitrate-nitrogen, the Board of Directors may choose to not use some or all of the controls listed above.

<u>Phase 3</u> - Areas with greater than 90% of the Maximum Contaminant Level for a contaminant. An area will be placed into a Phase 3 area after being in a Phase 2 area for a minimum of five years, and when 50% of the registered wells in the area are at or above the trigger level. Phase 3 areas must be a minimum of 9 square miles in size.

a) Persons installing new wells must obtain a permit from the NRD in accordance with § 46-659.

b) All operators applying fertilizer or (other possible sources of contaminants that the management area is addressing) must attend educational programs sponsored by the district.

c) Soil must be tested for residual quantities of the contaminant(s) (such as nitrate-nitrogen).

d) Irrigation water must be tested for the contaminant(s) (such as nitrate-nitrogen).

e) All operators applying fertilizer or (other possible sources of contaminants that the management area is addressing) must submit a report to the district that includes soil test results, irrigation water test results, and other information required by the Board of Directors annually.

f) All irrigation wells must have the volume output certified by the district.

g) All irrigators must employ some form of irrigation scheduling.

h) Contaminants other than nitrate-nitrogen may require controls that are different than those listed above for Phase 3 areas. If these controls will not be effective in preventing or remediating groundwater contaminant(s) other than nitrate-nitrogen, the Board of Directors may choose to not use some or all of the controls listed above.

Additional criteria - The district Board of Directors, at its discretion, may designate an area as, or include an area in, either Phase 2 or Phase 3, when the triggers are not met, under the following conditions:

a) Areas with similar soil and land use conditions as an existing Phase 2 or Phase 3 area.

b) Areas that may be vulnerable to groundwater contamination.

c) Areas that have vadose zone contamination that indicates a potential for groundwater contamination.

d) Areas that are within Public Water Supply Wellhead Protection Areas.

e) Other areas deemed necessary by the Board of Directors consistent with the Groundwater Reservoir Life Goal and the Nebraska Groundwater Management and Protection Act .

Additional Controls - Any of the following controls may be required by the Board of Directors in a Phase 1, Phase 2, or Phase 3 area if deemed necessary to fulfill the Groundwater Reservoir Life Goal:

a) All operators applying fertilizer or (other possible sources of contaminants that the management area is addressing) must attend educational programs sponsored by the district.

b) Soil must be tested for residual quantities of the contaminant(s) (such as nitrate-nitrogen).

c) Irrigation water must be tested for the contaminant(s) (such as nitrate-nitrogen).

d) Using realistic yield goals.

e) Irrigation water scheduling.

f) Meter irrigation water application volume.

g) Ban fall and/or winter fertilizer application.

h) Require the use of nitrification inhibitors.

i) Allowing nutrient credit for legume crops.

j) Performing chemical and/or physical analysis of contaminant sources being land applied (such as manure, compost, sewage sludge, and other waste products).

k) Allowing nutrient credit for manure, compost, sewage sludge, and other waste products.

l) Performing nutrient analysis of manure, compost, sewage sludge, and other waste products. Confined animal production facilities must prepare and implement a plan for the disposal of animal wastes that determines the amount of manure that will be land applied, the area of land required for that amount of manure (complying with UNL recommendations), and the location(s) of that area of land.

8. Fertilizer management demonstrations.

The district has cooperated with the University of Nebraska Cooperative Extension Service since 1986 to conduct on-farm nitrogen fertilizer management demonstrations. The demonstrations are intended to popularize and show the validity of best management practices in northeast Nebraska. The demonstrations also show how different sources of nitrogen (fertilizer and residual nitrogen from irrigation water and soil) can be efficiently used to produce a crop and protect groundwater supplies.

Test strips with the University recommended fertilizer rate, 50 pounds per acre more than the recommended rate, and 50 pounds per acre less than the recommended rate are established in a farm field. The test strips are replicated three times to increase the level of confidence in the results. The University recommendations are based on the crop's need, a realistic yield goal, and residual nitrogen from the soil and irrigation water.

In addition to nitrogen fertilizer rates, this program demonstrates proper anhydrous ammonia calibration techniques and new technologies such as chlorophyll meters.

This program has been successful in accomplishing the objective of assisting farmers in the proper use of fertilizer. The program may be improved by reaching a larger audience by allowing farmers to conduct the research themselves with guidance from the district and the Extension Service, in addition to (or rather than) having the Extension service perform the demonstrations independently.

9. Wellhead protection program.

The purpose of the Lower Elkhorn NRD wellhead protection program is to assist public water suppliers and other interested groups in establishing and managing wellhead protection areas. The program is designed to work with the Nebraska Wellhead Protection Program, and will supplement promotional and educational efforts by state and federal agencies.

Local control of planning for wellhead protection is stressed by this program. Beneficiaries of wellhead protection actions will be the primary force in planning and implementing wellhead protection areas.

a. Establishment of local planning teams. Participation in the district wellhead protection program, for all of the items following in this section except for item 'b.' below, requires a local wellhead protection planning team. to submit a written request to the district. The planning team will represent the local interests of the public water supply system for which wellhead protection is being pursued. The district will, at its option either attend meetings or review the summary of meetings held by planning teams.

b. Promote the importance of wellhead protection. The district will promote the importance of wellhead protection with educational materials and efforts. Extensive educational materials have been developed by federal and state agencies concerning wellhead protection; the district will serve as a distribution center for these.

   The NRD will, upon written request, attend wellhead protection planning team meetings, or if a planning team does not exist, the district will attend meetings held by parties interested in wellhead protection (such as city councils, village boards, or citizen groups) for the purpose of promoting the benefits of wellhead protection, and providing information about the requirements of wellhead protection planning.

c. Contaminant source inventory. The NRD will help coordinate and train personnel for contaminant source inventory work.

d. Use of existing NRD programs. The district will target existing NRD programs that are useful for wellhead protection in designated wellhead protection areas. These programs include the well sealing program, the groundwater quality monitoring program, and the groundwater quantity monitoring program.

e. General advisory capacity. The district will act in a general advisory capacity to assist wellhead protection planning teams in establishing and managing wellhead protection areas. The district will act as a liaison to agencies for the planning teams, review plans formulated by the planning teams, and supply data and information upon request.

f. The district will encourage and assist public water suppliers to obtain the Nebraska Department of Environmental Quality's wellhead protection area program delineation and mapping. The Nebraska Department of Environmental Quality has completed the mapping of some public water supply systems and has suggested the following prioritization for the remaining systems to be mapped:

Table VII - 2
DEQ Wellhead protection area delineation priorities

Already mapped	First priority	Second priority
Belden	Foster	Beemer
Concord	Hadar	Creston
Country Estates	Howells	Indian Trails Country Club
Hoskins	Osmond	Madison County SID #3
Madison	Pierce	Norfolk
Pilger	Plainview	Norfolk District Game and Parks
Scribner		Pierce Community Golf Course
Snyder		Plainview Country Club
Suburban Acres		Sherwood Medical
Wausa		Stanton County SID #1
West Point		Stanton County School #13
Winside		Weetown Bar and Grill

10. Vadose zone monitoring.

The Burt county Extension Service, the Soil Conservation Service, and the Lower Elkhorn NRD cooperated in a vadose zone sampling effort in the spring of 1993. Four sites were selected in Burt county deep sampling of soil for residual nitrate and atrazine determinations.

The district will continue to cooperate with the Soil Conservation Service, University of Nebraska's Extension Service and Conservation and Survey Division, the Nebraska Department of Environmental Quality, and the United

States Geological Survey to select suitable sites for and perform vadose zone monitoring. This program will be instrumental in determining the fate of fertilizer and pesticides in lawns and cropland, and will help to delineate the potential and extent of contamination in selected areas.

V I I I. SUPPLY AUGMENTATION AND SUPPLEMENTAL SUPPLIES

It is important that water resources be used wisely and efficiently. In areas where supplies of good water are easily obtained, water is often taken for granted and considered by many people to be inexhaustible. In recent years, loss of water supply sources due to contamination or declining water levels has increased the general public awareness that water supplies are valuable and fragile resources.

Water is the mainstay of the economy in the Lower Elkhorn NRD. Economic development requires ever increasing quantities of water. In order to meet increasing demands, additional water must be made available to those areas of existing or potential shortages. Some portions of the NRD, such as the Sandhills region have abundant groundwater reserves while other areas, such as the Glacial Drift region have only marginal supplies.

One means of making additional water available is to make the most of currently developed sources. Implementation of water conservation measures by each user classification needs to be accelerated. Practical water conservation measures need to be identified and developed. Examples of user conservation practices are:

A. Periodically check well efficiency.
B. Improve irrigation efficiency.
C. Use conservation tillage practices.
D. Require tail water reuse.
E. Measure soil moisture.
F. Measure precipitation at the field.
G. Reduce evapotranspiration.
H. Grow hybrid plants that require less water.
I. Plant shelterbelts to reduce wind.
J. Meter all water use.

Education of users regarding optimum water use and scheduling seems to be the implementation approach most likely to be successful.

Storage sites for surface water need to be identified and developed. Increased surface water development could have a twofold impact. It could reduce demands on the groundwater reservoirs and it would provide supplemental water for new development. A number of potential reservoir sites have been identified by the Soil Conservation Service, the Army Corps of Engineers, and the Bureau of Reclamation. Surface water irrigation projects were investigated by the Bureau of Reclamation in the district in the 1960's and 1970's. The projects have potential for supplemental water supply development. The water should be stored where the need occurs, and the use of groundwater basins for storage, rather than new surface storage may be feasible. The trend of long-range planning is toward conjunctive or integrated management use. This process may be characterized as using surface reservoirs for checking accounts and the groundwater basins for savings accounts.

A number of options for making better use of existing water supplies and for providing supplemental water supplies appear to be available. Additional investigation is needed to develop and evaluate the alternatives.

In the Policy Issue Study on Supplemental Water Supplies (Nebraska Natural Resources Commission, 1984) there is a recognition of a legal problem concerning groundwater transfers. Nebraska statutes explicitly authorize groundwater transfers for public water supply and industrial purposes. However, transfer authorities for agricultural purposes are unclear. The policy issue study contains a recommended alternative which would authorize, by a legislative amendment, groundwater transfer for agricultural purposes to include irrigation, recharge, and surface and underground storage.

I X. GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION

Funding and manpower required to commence and carry out all the desirable groundwater management programs will not be immediately available to the NRD. A priority ranking of groundwater management objectives and corresponding programs are necessary for orderly implementation of programs as the necessary funding and manpower become available. An ambitious but realistic schedule needs to be followed for implementation of the desired programs according to priority ranking.

Much of the planning discussed in this section is accomplished through the normal procedures used with the district's Long Range Plan. The Long Range Plan (summarized in Appendix 5) outlines the intentions of the Board for the current year and the upcoming five years. The district uses this plan to project for future funding and manpower needs.

Funding necessary for management programs can vary significantly from year to year. In order to provide for more uniform funding of the NRD groundwater management budget, establishment of a groundwater management sinking fund should be considered.

The procedure for selecting programs and timing of implementation is as follows:

A. *Review Established Groundwater Management Programs*

1. Purpose.
2. Effectiveness.
3. Cost records.
4. Need for procedural revisions.

B. *Prioritize Proposed Groundwater Management Programs*

1. Consider proposed programs for:
   a. Importance.
   b. Effectiveness.
   c. Annual operation cost.
   d. Initial implementation cost.
   e. Public acceptance.
   f. Political impact.

2. *The Rank Proposed Programs by Priority*
   The Directors are polled and programs and projects are ranked by the following categories:

   a. Urgent: Delay in implementation would be dangerous and/or costly. Justifies diversion of funding or other resources from other NRD programs.

   b. Important: Action needed to coordinate with other agencies and to acquire information needed for future critical decisions. Provide data for influencing legislation.

   c. Moderate: Potentially important for anticipating trends. Needed to support or refute warnings of undesirable conditions.

   d. Routine: Provide data for responding to inquiries and supporting studies.

C. *Annual Priority Ranking of Programs and Projects*

Directors shall annually reconsider the priority ranking and proposed activities and determine which ones will be implemented during the coming year. The Board and staff of the NRD will use a Target Agenda to ensure that policies and programs are placed on the agenda and considered at the appropriate time.

1. Describe established programs to be continued.
2. Describe top priority program(s) to be implemented.
3. Describe procedures and cost information for initiating and operating the program(s).
4. Obtain opinion of legal counsel regarding program procedures.
5. Identify applicable funding alternatives.

D. *Administer Groundwater Management Plan*

1. Operate on-going programs in the district's Long Range Plan.
2. Implement and operate new programs in the district's Long Range Plan..

An example of the results of priority ranking of the district's programs and how this process is used in the district's planning process can be found in Appendix 5 and is taken from the Long Range Plan for fiscal year 1994.

X. PLAN EVALUATION AND ASSESSMENT

The Lower Elkhorn NRD reviews the groundwater management plan annually to develop and continue groundwater management programs and policies. This annual review is an important component of the district's planning process, and also serves to evaluate the plan and objectives.

The original plan was prepared by Olsson Associates, Lincoln, Nebraska, and was a joint venture with the Upper Elkhorn NRD. The original plan was accepted by the Nebraska Department of Water Resources in 1986.

The district then revised the plan in 1990 and 1991 to improve the groundwater quality portion of the plan. One of the major changes was with the groundwater quality trigger, which was altered to treat nitrate-nitrogen contamination separately from all other contaminants. Rather than establishing a Management Area when nitrate-nitrogen contamination reached 9 milligrams per liter, this action would be initiated when nitrate-nitrogen contamination reached 10 milligrams per liter in a 10 square mile area for two years. These criteria allowed the district to be more specific in stating the triggering mechanism, and reflected the limitations in manpower faced by the district at that time. The district submitted the revised plan to the Nebraska Department of Water Resources for an informal critique of the revisions, but it mistakenly went through the formal review process and was determined to be 'not acceptable' by the department. The lack of groundwater quantity triggers and weak, non-action oriented language were the principal causes for rejection of the plan.

The district then decided to include the revisions mandated by §46-673.14 of the Nebraska Ground Water Management and Protection Act (Appendix 1) with the follow-up submittal of the plan. The district chose to follow the format recommended by the Nebraska Department of Water Resources and the Nebraska Department of Environmental Quality (Appendix 1). Most of the original text and all of the exhibits were retained, and a great deal of new material was added for the latest revision. The district added a groundwater quantity trigger, discussed provisions needed to protect endangered species, changed the groundwater quality trigger back to its original form, added groundwater policies to the plan, and altered the goals and objectives portion of the plan.

Many of the programs used by the district have been successful. The well sealing program has been particularly effective; over 300 wells were plugged during the first year of the program. The groundwater quality trigger for nitrate-nitrogen contamination used in the 1991 revision was actuated in an area of eastern Pierce county (Exhibit 17a), and the Board of Directors instructed the staff in November, 1992, to begin the process of establishing a management area.

Some of the district's programs have not been as successful. The wellhead protection program has not been utilized by the public water suppliers in the district. The district soil sampling program has not used the amount of funding authorized by the Board.

The plan has numerous deficiencies, as outlined in most sections of the plan under the heading *Identified Needs and Deficiencies.* The NRD will correct these deficiencies over time. The district will continue to improve the plan, such as adding the date of origin and the dates of revisions to each section so that the reader can know this history.

The district also needs to establish policies for measuring and evaluating the plan's objectives and programs. This will give a more clear guidance to the Directors and staff for the annual review of the plan.

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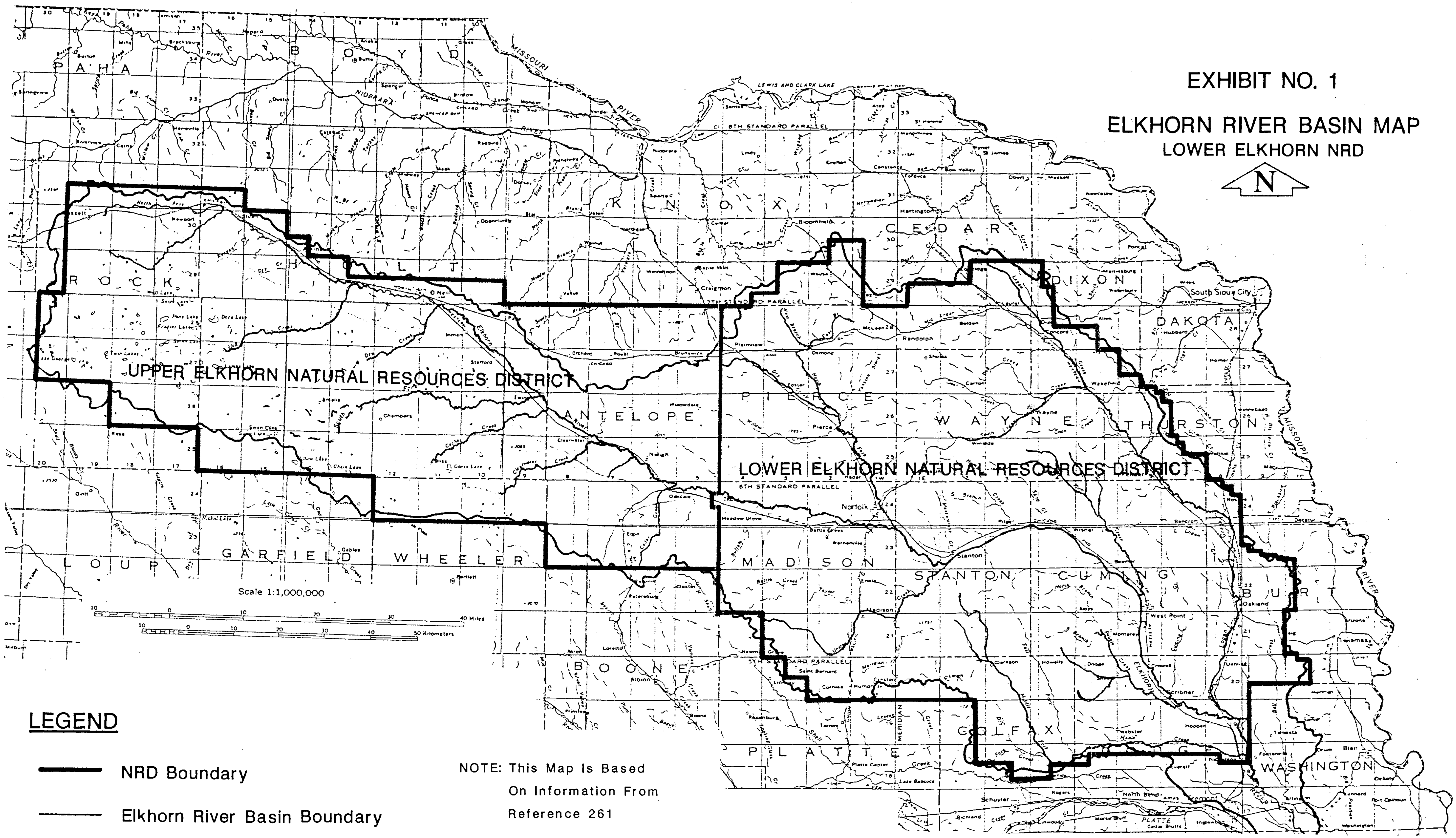
EXHIBIT NO. 1

ELKHORN RIVER BASIN MAP

LOWER ELKHORN NRD



LEGEND

NRD Boundary

Elkhorn River Basin Boundary

NOTE: This Map Is Based On Information From Reference 261

EXHIBIT 2
TOPOGRAPHIC RELIEF MAP

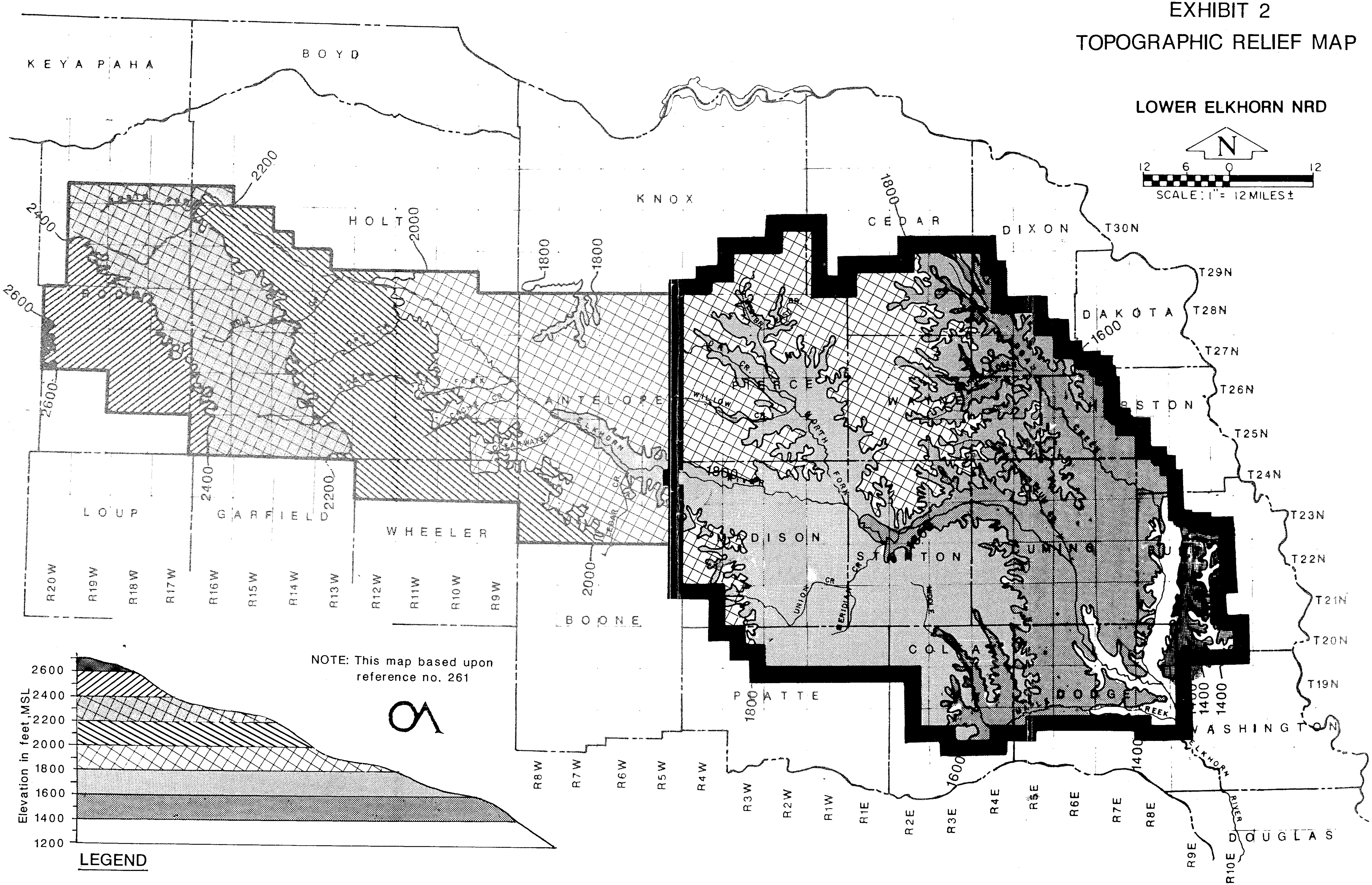
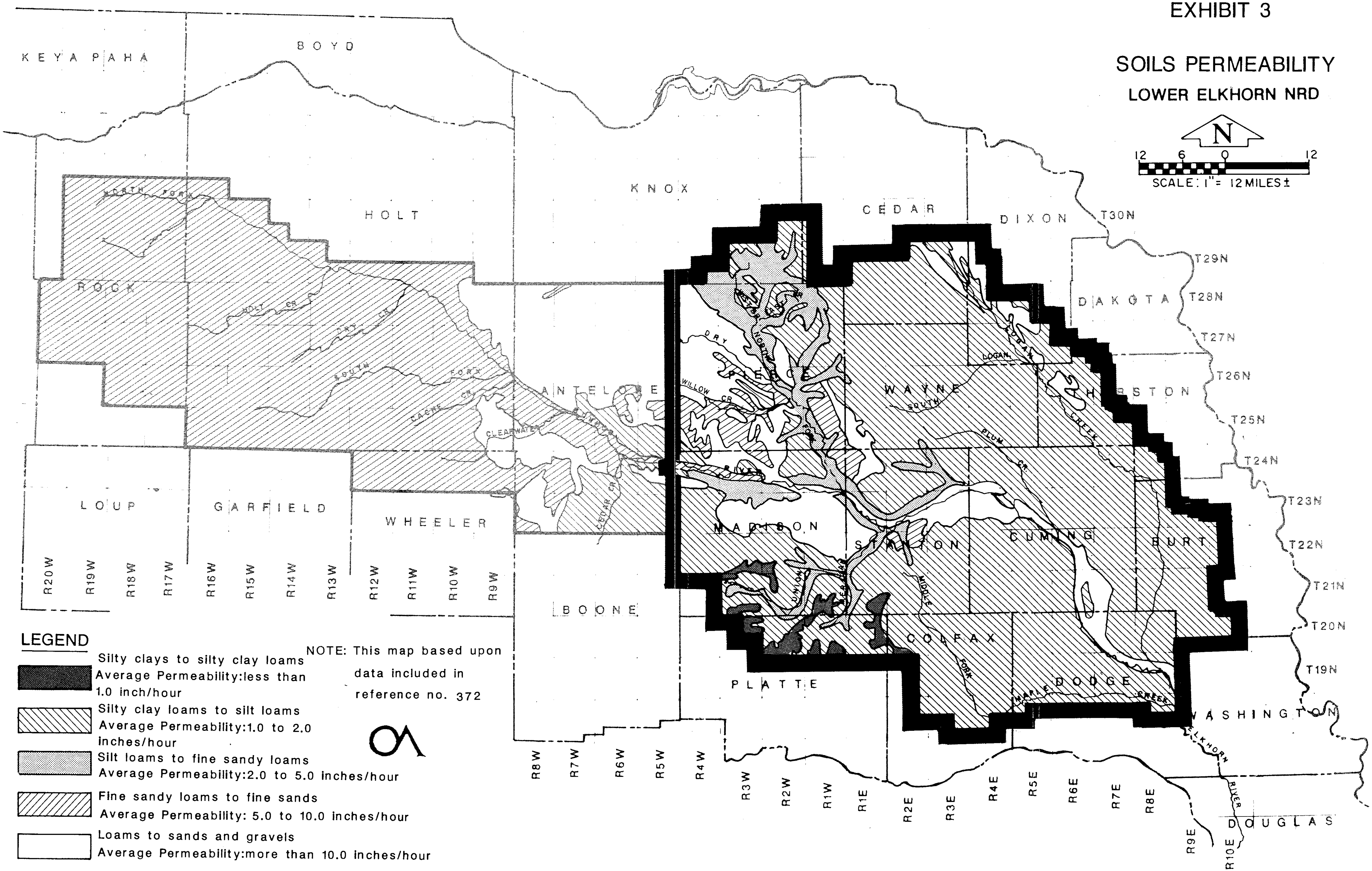


EXHIBIT 3

SOILS PERMEABILITY
LOWER ELKHORN NRD



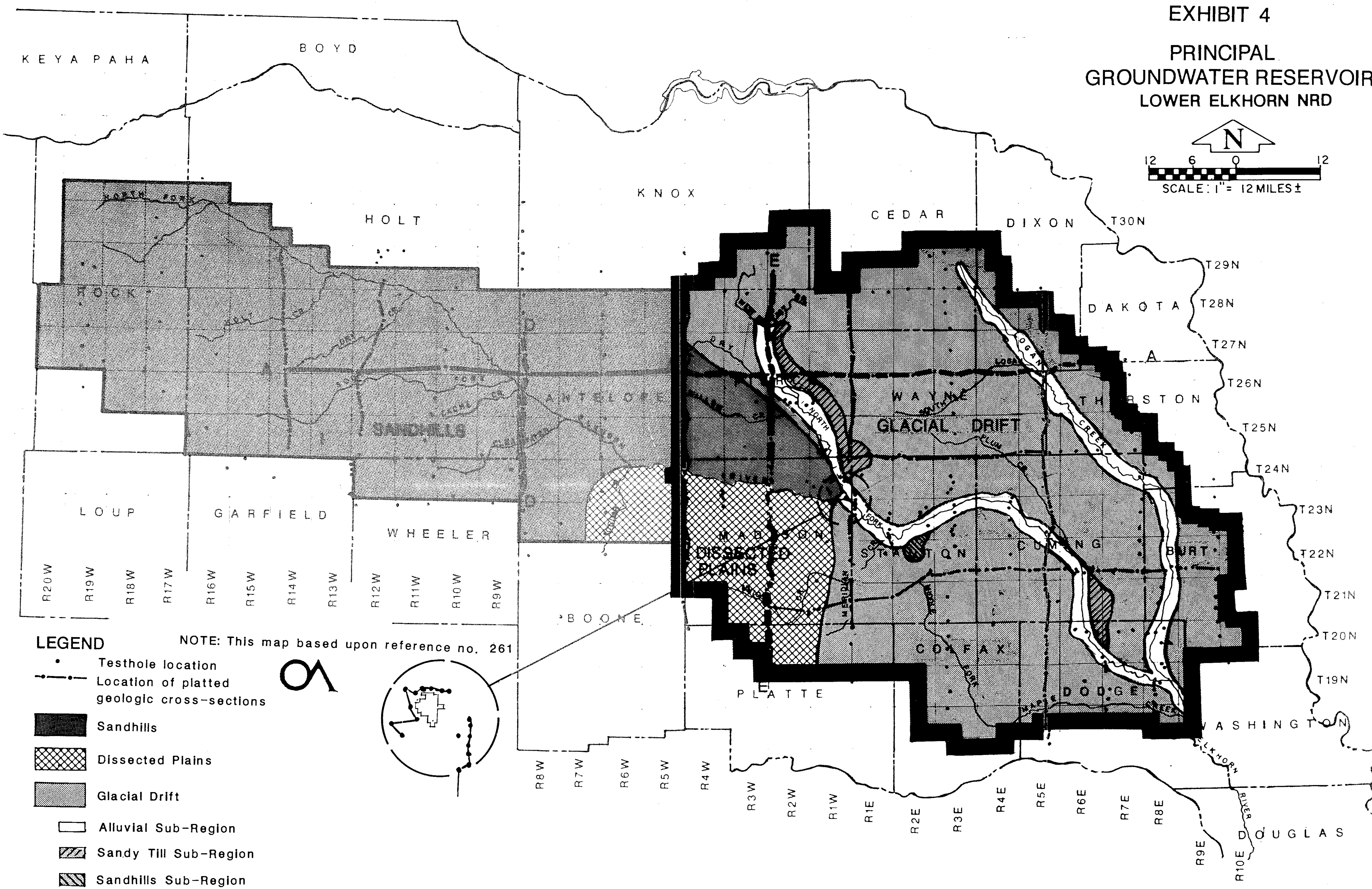
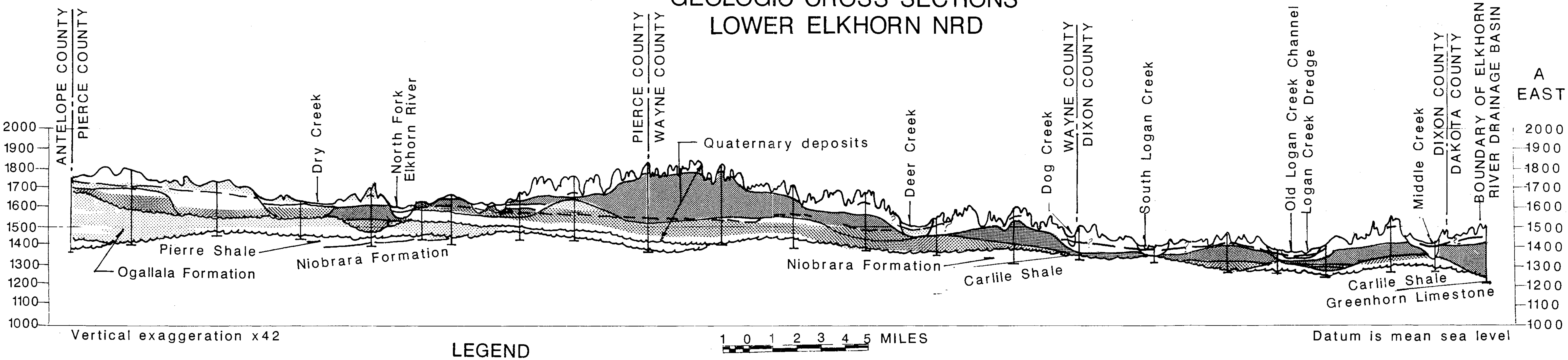


EXHIBIT 4
PRINCIPAL GROUNDWATER RESERVOIRS
LOWER ELKHORN NRD
N
12 6 0 12
SCALE: 1" = 12 MILES±
KEYA PAHA
BOYD
HOLT
KNOX
CEDAR
DIXON
DAKOTA
THURSTON
ROCK
ANTELOPE
WAYNE
LOUP
GARFIELD
WHEELER
MADISON
STANTON
CUMING
BURT
BOONE
PLATTE
COLFAX
DODGE
WASHINGTON
DOUGLAS
SANDHILLS
GLACIAL DRIFT
DISSECTED PLAINS
T30N
T29N
T28N
T27N
T26N
T25N
T24N
T23N
T22N
T21N
T20N
T19N
R20W
R19W
R18W
R17W
R16W
R15W
R14W
R13W
R12W
R11W
R10W
R9W
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
R9E
R10E
ELKHORN RIVER
LOGAN CREEK
MAPLE CREEK
NORTH FORK
MERIDIAN
LEGEND
Testhole location
Location of platted geologic cross-sections
Sandhills
Dissected Plains
Glacial Drift
Alluvial Sub-Region
Sandy Till Sub-Region
Sandhills Sub-Region
NOTE: This map based upon reference no. 261

GEOLOGIC CROSS SECTIONS
LOWER ELKHORN NRD



LEGEND

- Intermixed sand & gravel
- Sand & sandstone
- Clay, silt & siltstone
- Glacial till
- Water table
- Unconformity

NOTE: This drawing based upon data in reference no. 261

SEE EXHIBIT 4 FOR LOCATION OF CROSS-SECTIONS

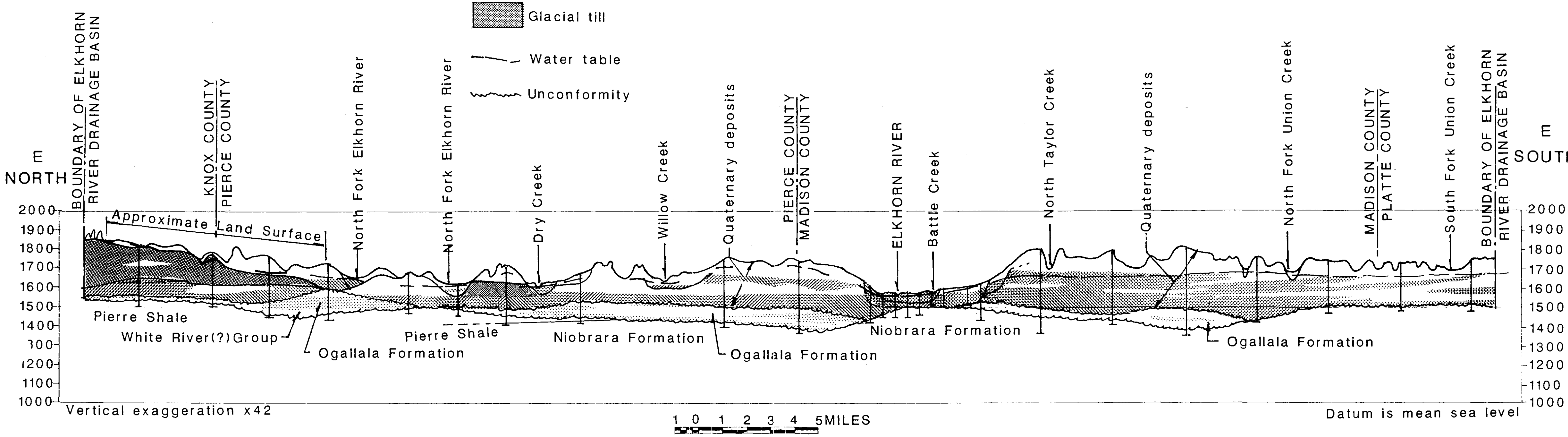
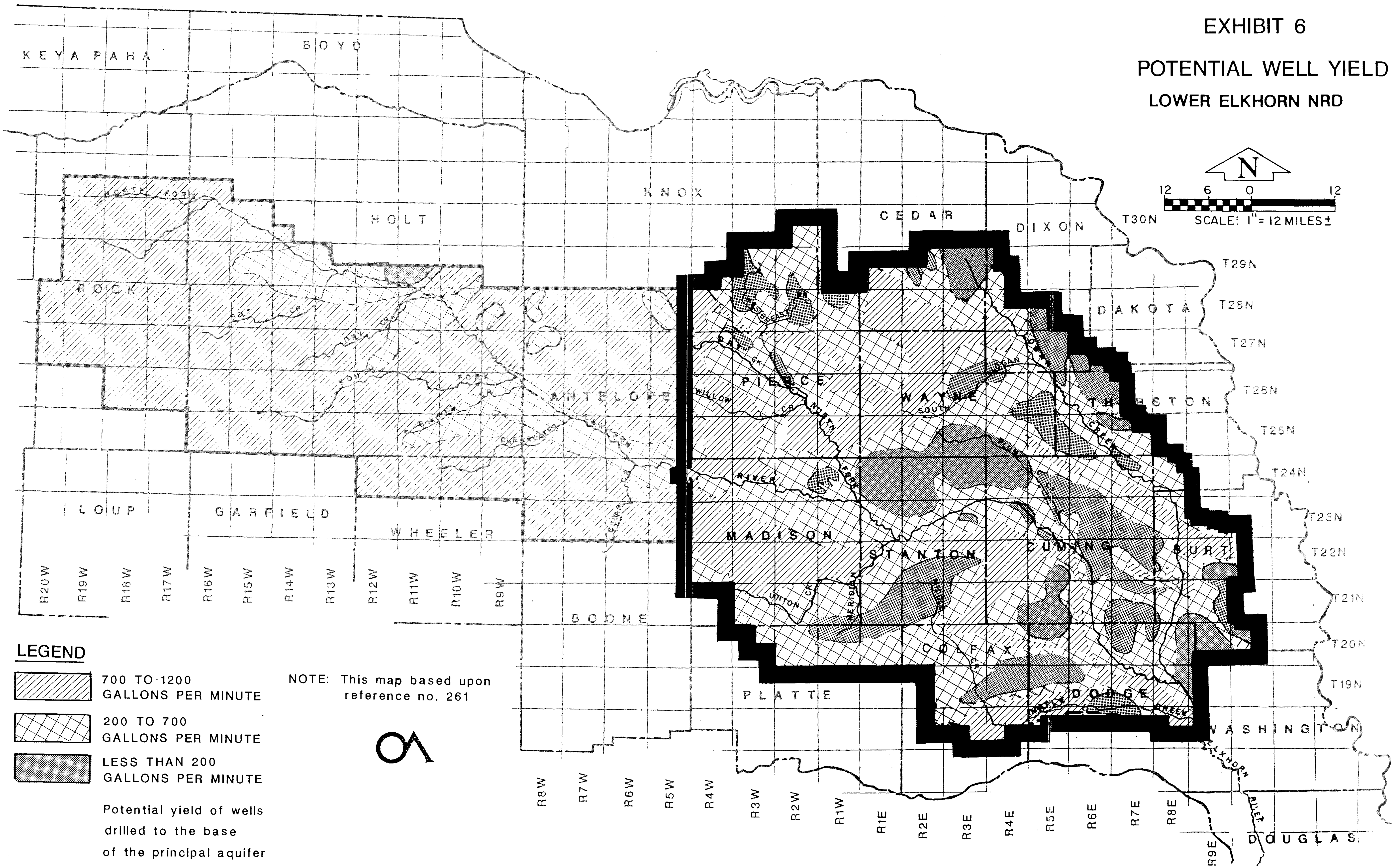


EXHIBIT 6

POTENTIAL WELL YIELD

LOWER ELKHORN NRD



LEGEND

700 TO 1200 GALLONS PER MINUTE

200 TO 700 GALLONS PER MINUTE

LESS THAN 200 GALLONS PER MINUTE

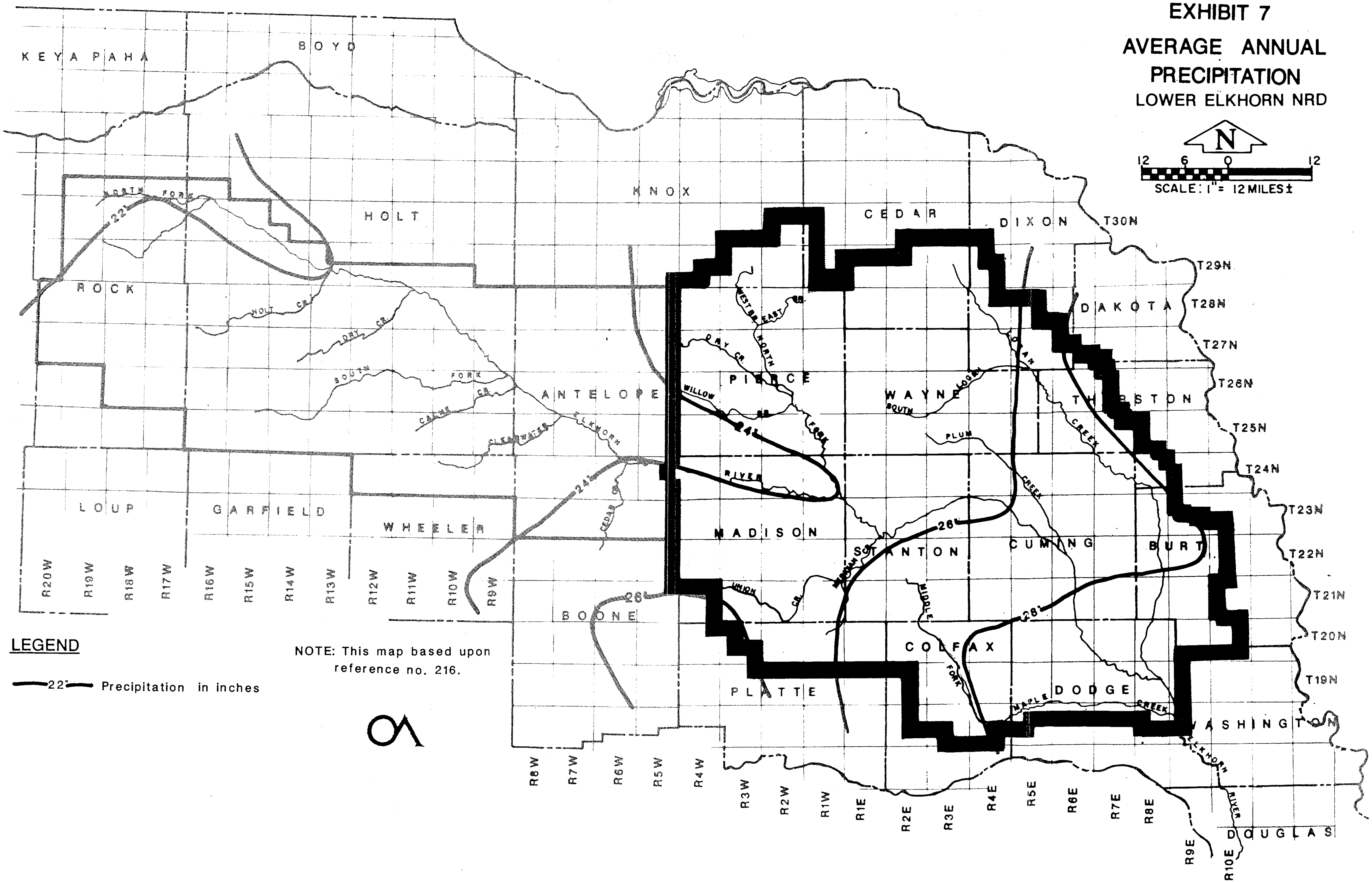
Potential yield of wells drilled to the base of the principal aquifer

NOTE: This map based upon reference no. 261

EXHIBIT 7

AVERAGE ANNUAL PRECIPITATION

LOWER ELKHORN NRD

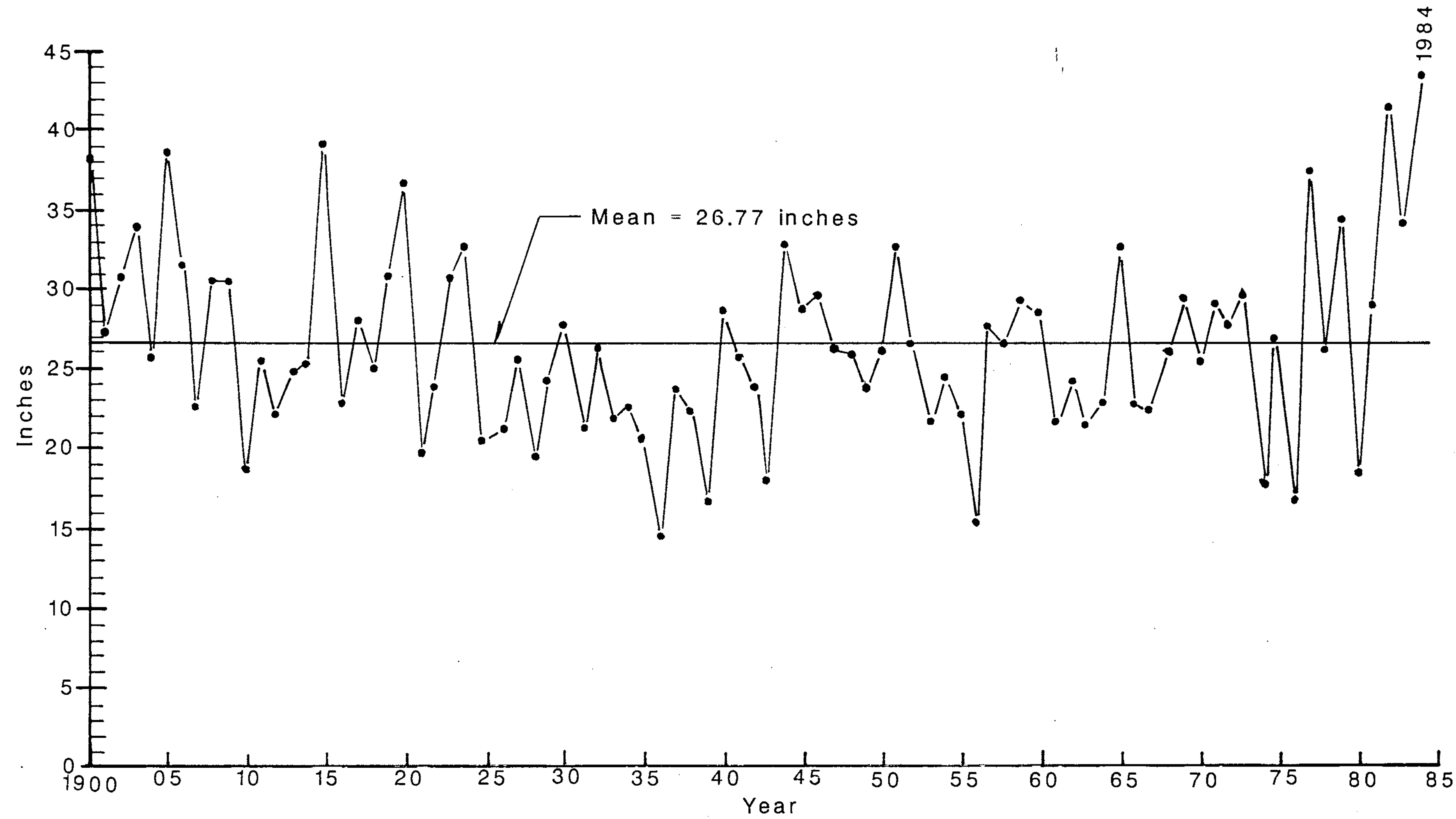


LEGEND

22" Precipitation in inches

NOTE: This map based upon reference no. 216.

EXHIBIT 8
LOWER ELKHORN NRD



NOTE: This map based upon
reference no. 216

ANNUAL PRECIPITATION
AT STANTON, NE.
(1900–1984)

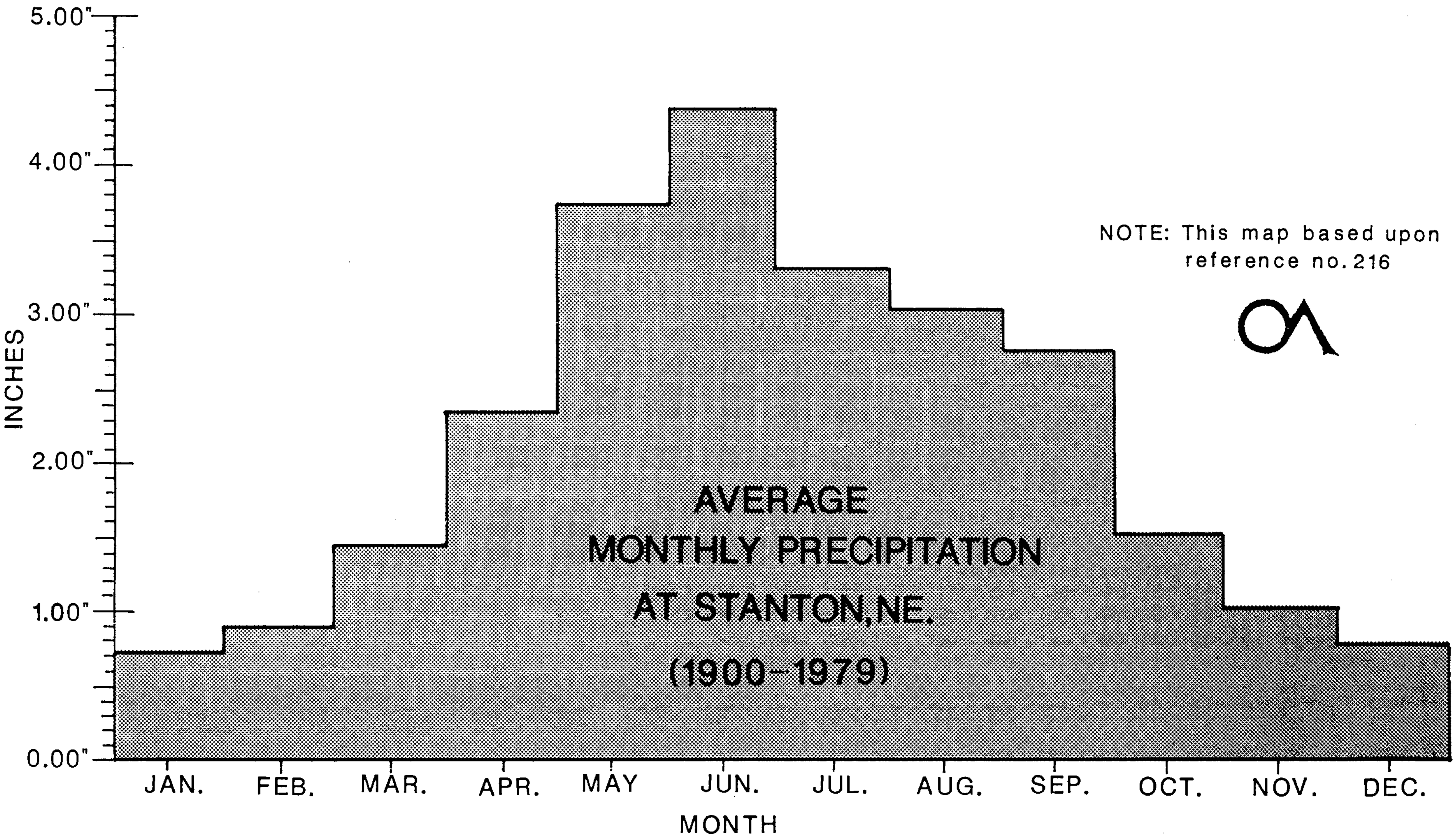


EXHIBIT 9
LOWER ELKHORN NRD

EXHIBIT 10

WATER TABLE CONFIGURATION & WATER LEVEL MONITORING WELL LOCATIONS

LOWER ELKHORN NRD

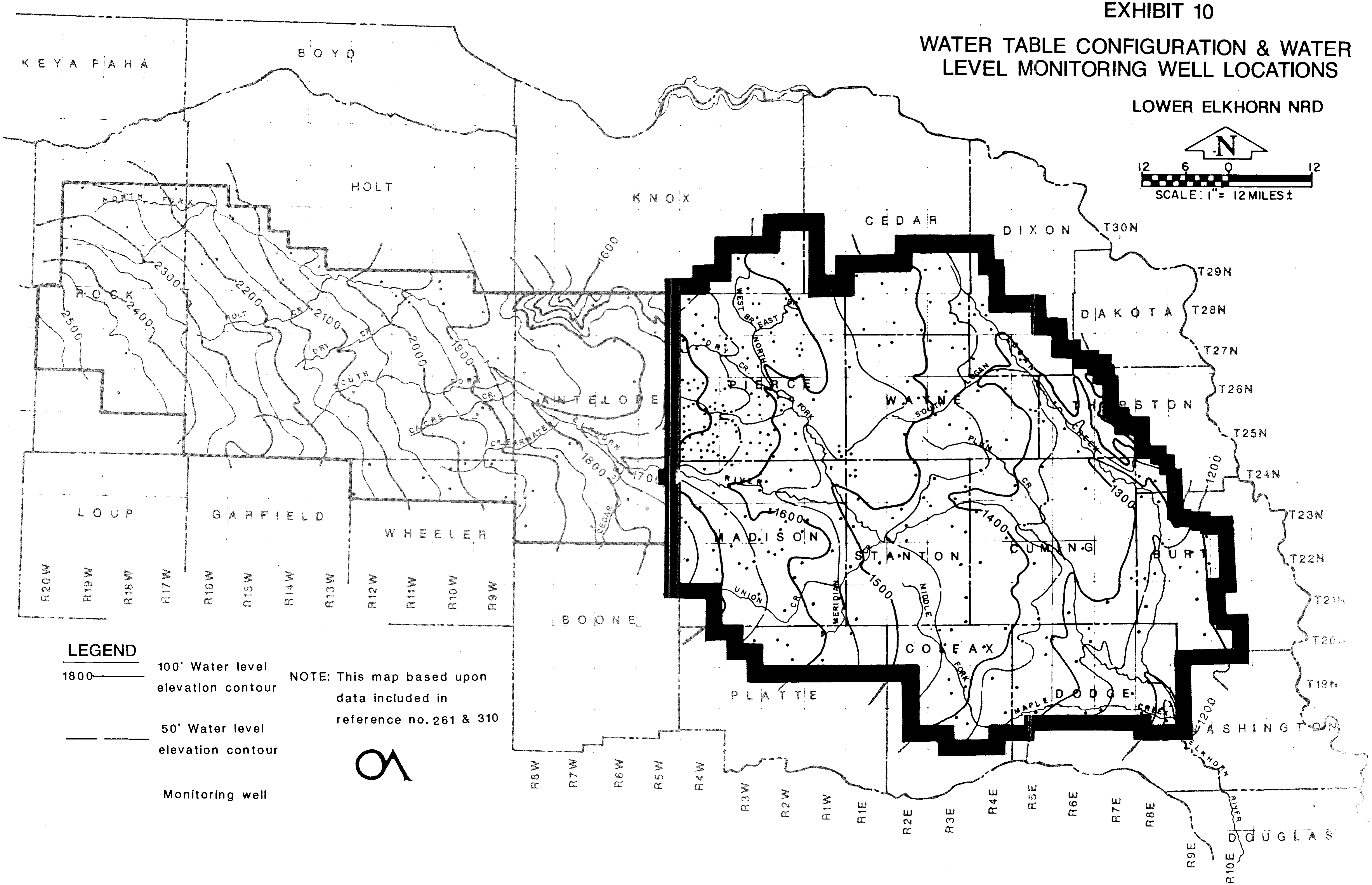


EXHIBIT 10a

LOCATION OF LOWER ELKHORN NATURAL RESOURCE DISTRICT MONITORED WELLS

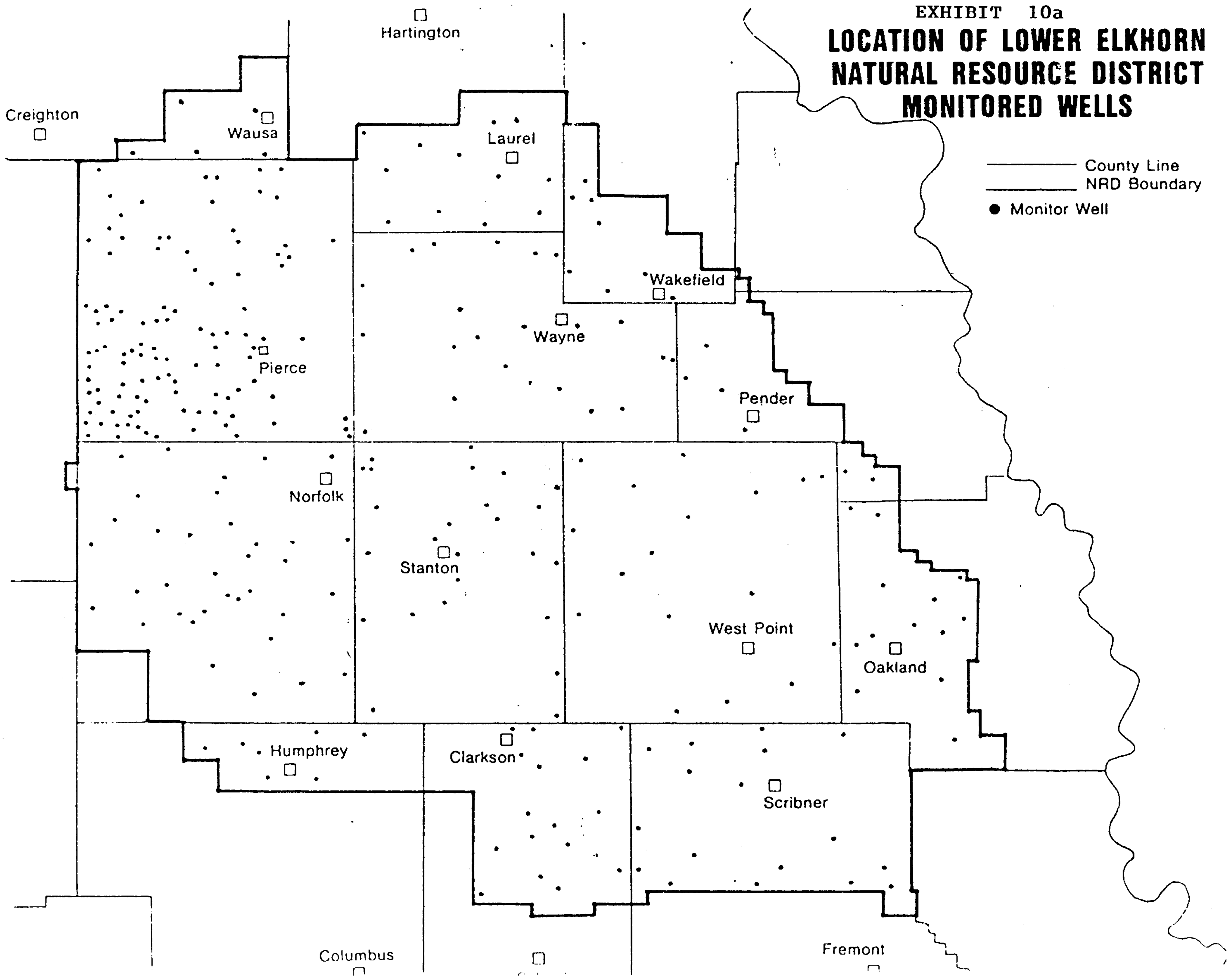
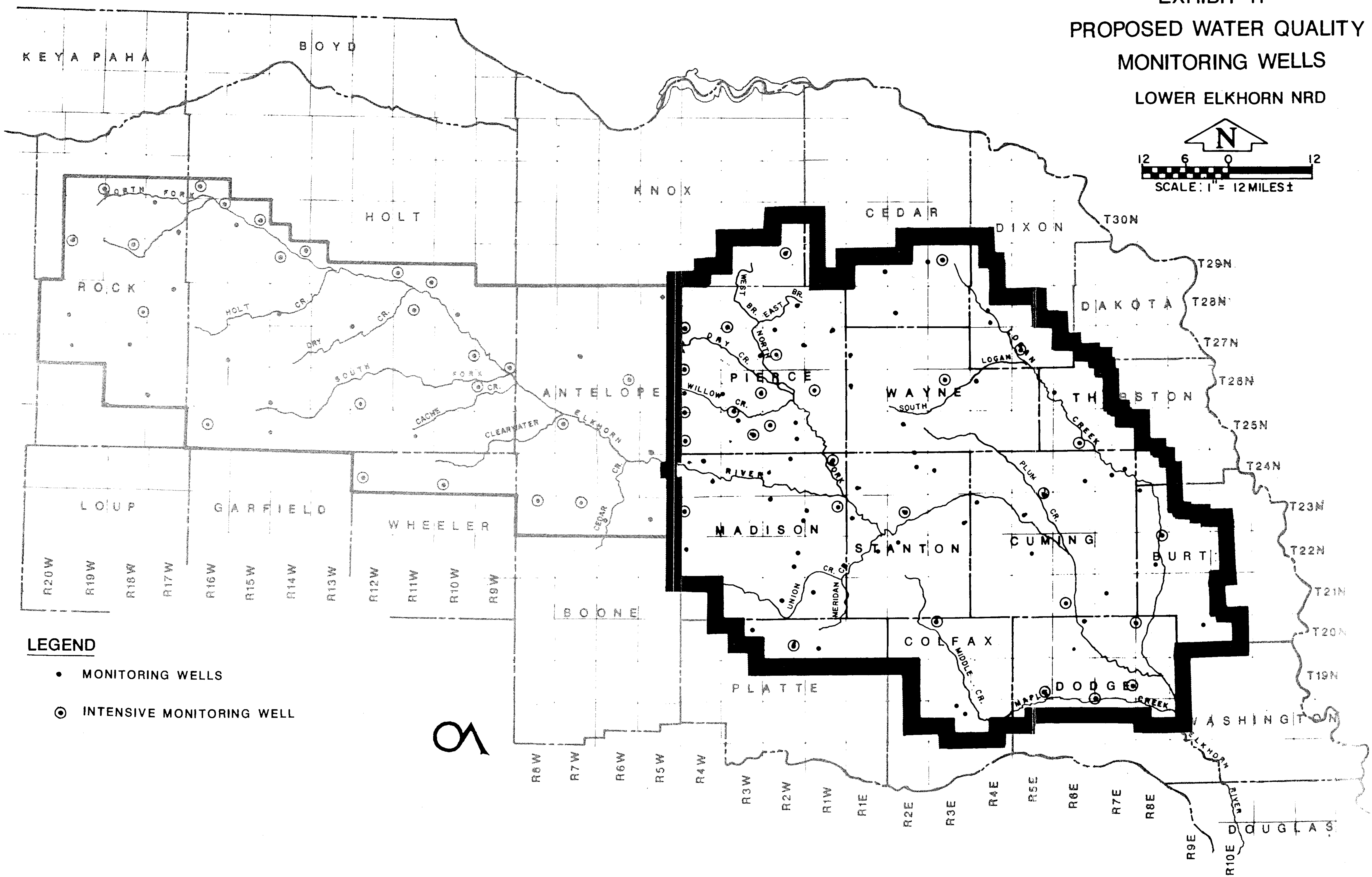


EXHIBIT 11

PROPOSED WATER QUALITY MONITORING WELLS

LOWER ELKHORN NRD



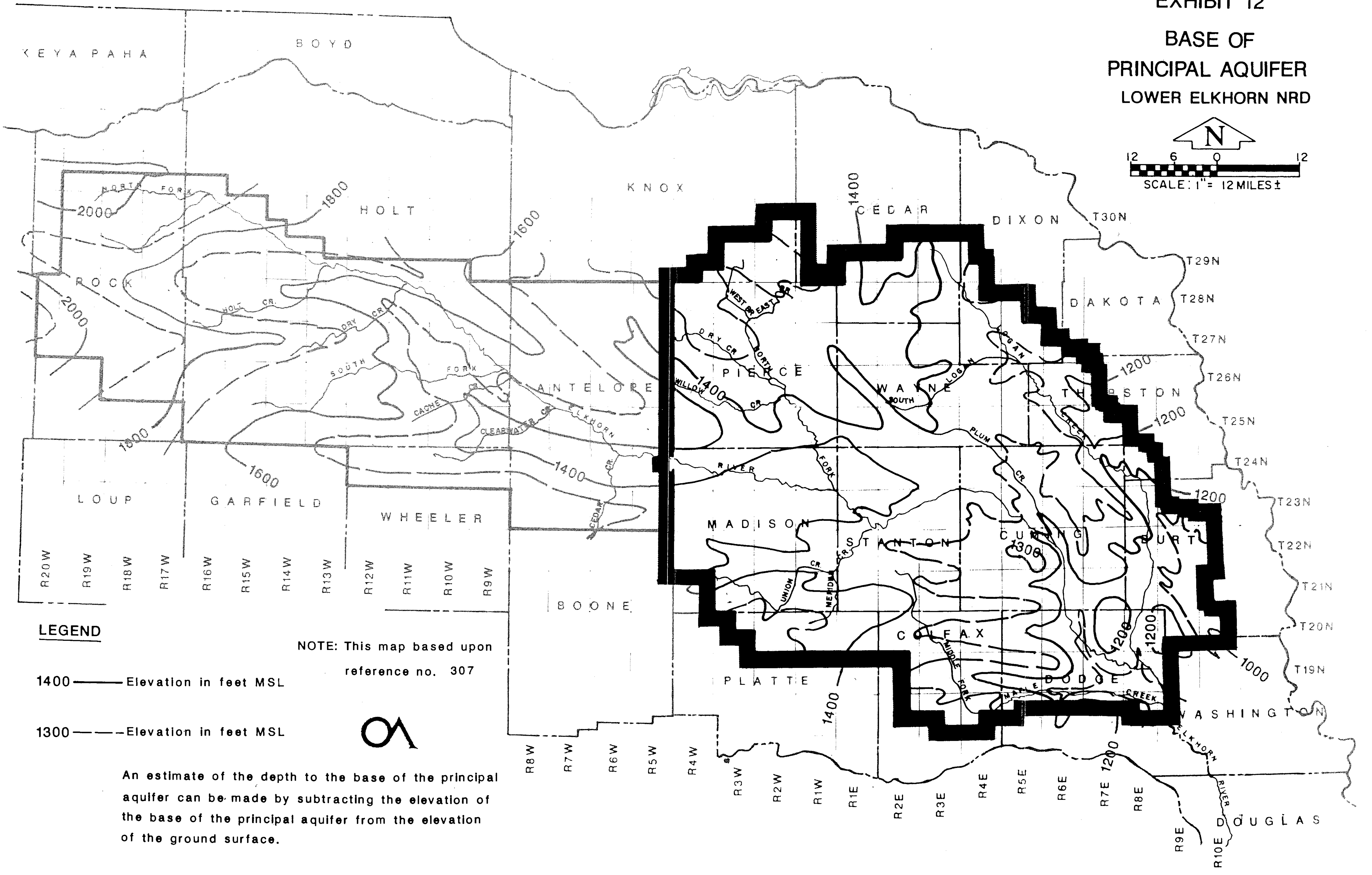
LEGEND

- • MONITORING WELLS
- ⊙ INTENSIVE MONITORING WELL

EXHIBIT 12

BASE OF PRINCIPAL AQUIFER

LOWER ELKHORN NRD



LEGEND

1400 ——— Elevation in feet MSL

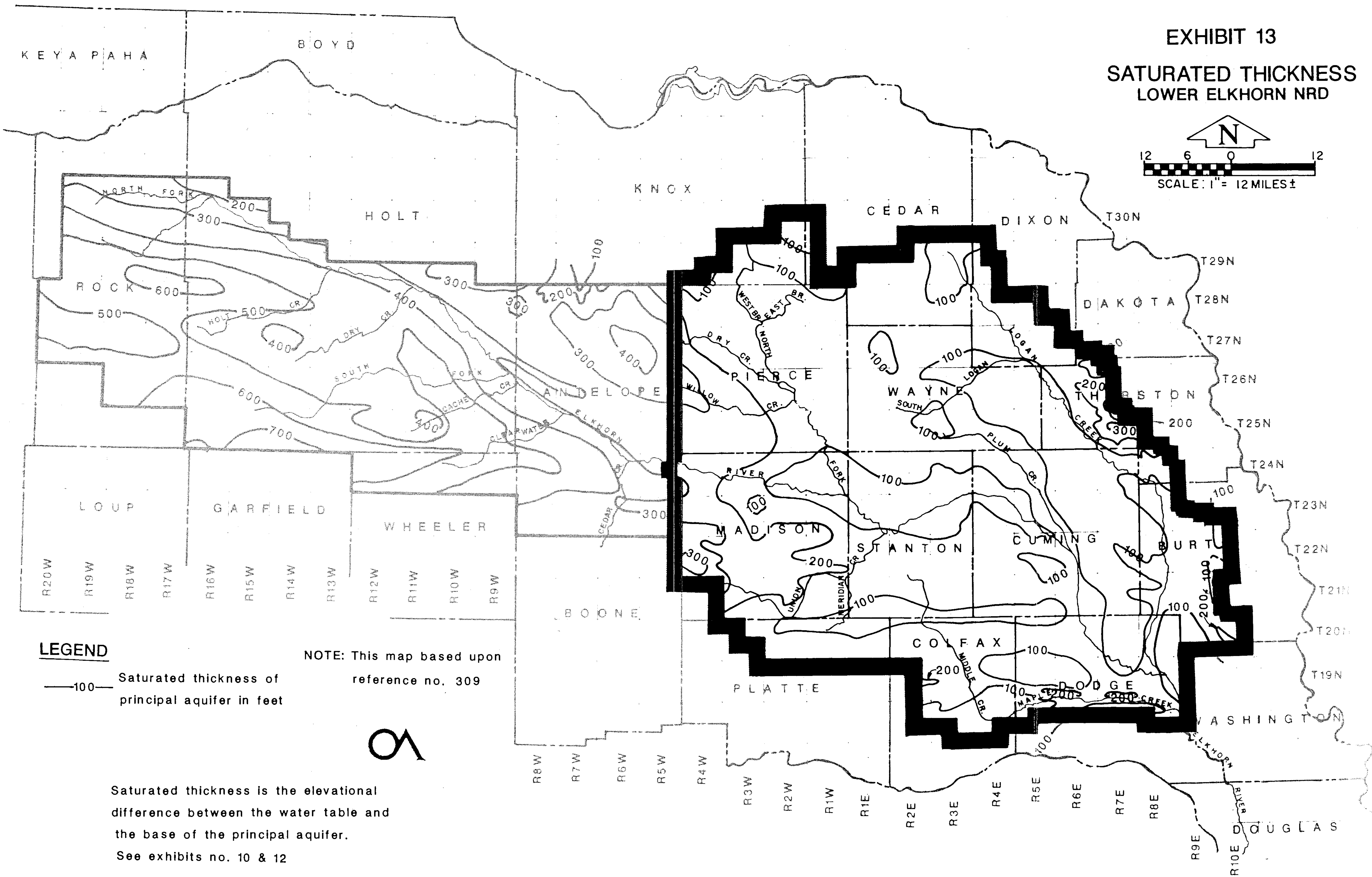
1300 — — — Elevation in feet MSL

NOTE: This map based upon reference no. 307

An estimate of the depth to the base of the principal aquifer can be made by subtracting the elevation of the base of the principal aquifer from the elevation of the ground surface.

EXHIBIT 13

SATURATED THICKNESS
LOWER ELKHORN NRD



LEGEND

—100— Saturated thickness of principal aquifer in feet

NOTE: This map based upon reference no. 309

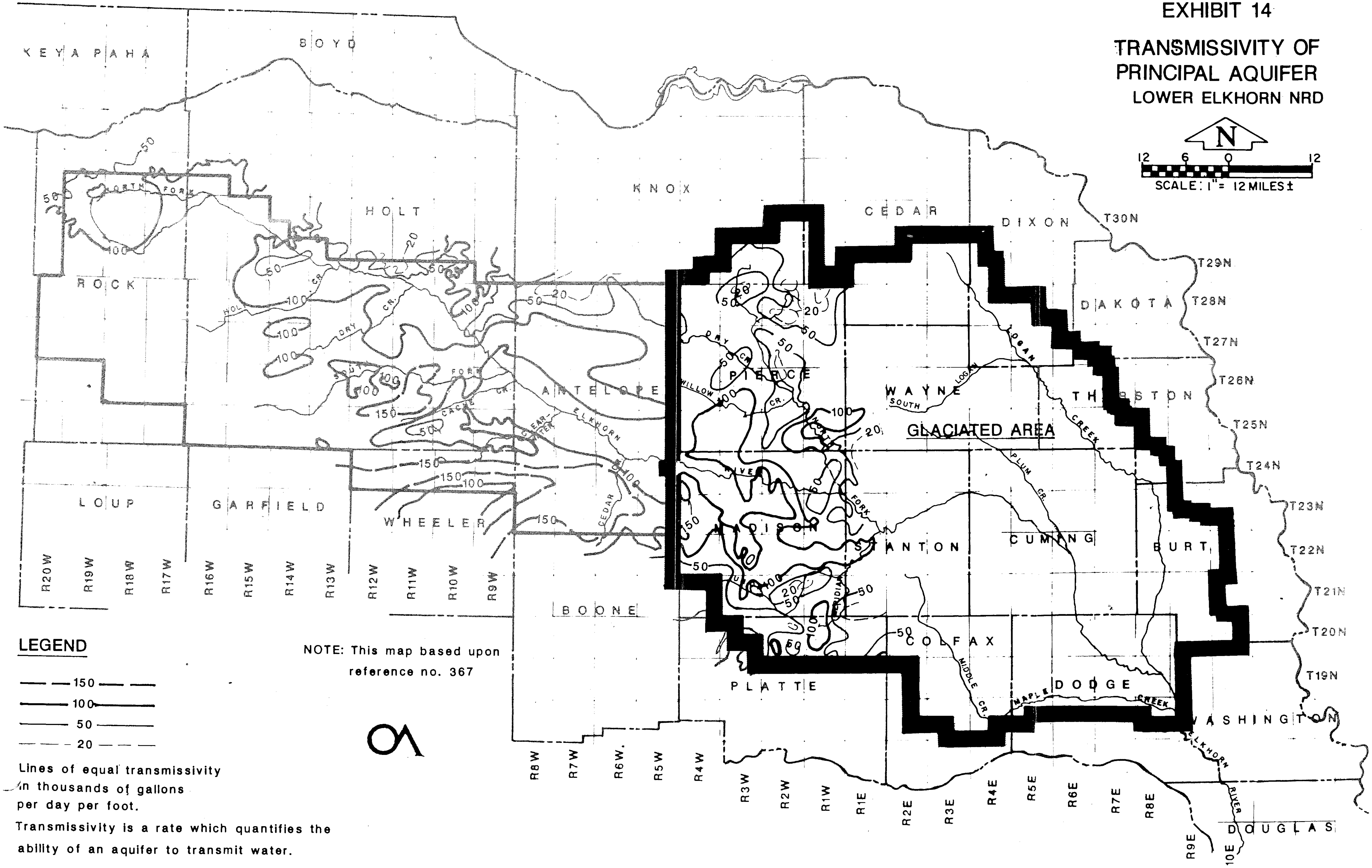
Saturated thickness is the elevational difference between the water table and the base of the principal aquifer.

See exhibits no. 10 & 12

EXHIBIT 14

TRANSMISSIVITY OF PRINCIPAL AQUIFER

LOWER ELKHORN NRD



NOTE: This map based upon reference no. 367

LEGEND

— — 150 — —
—— 100 ——
—— 50 ——
- - - 20 - - -

Lines of equal transmissivity in thousands of gallons per day per foot.

Transmissivity is a rate which quantifies the ability of an aquifer to transmit water.

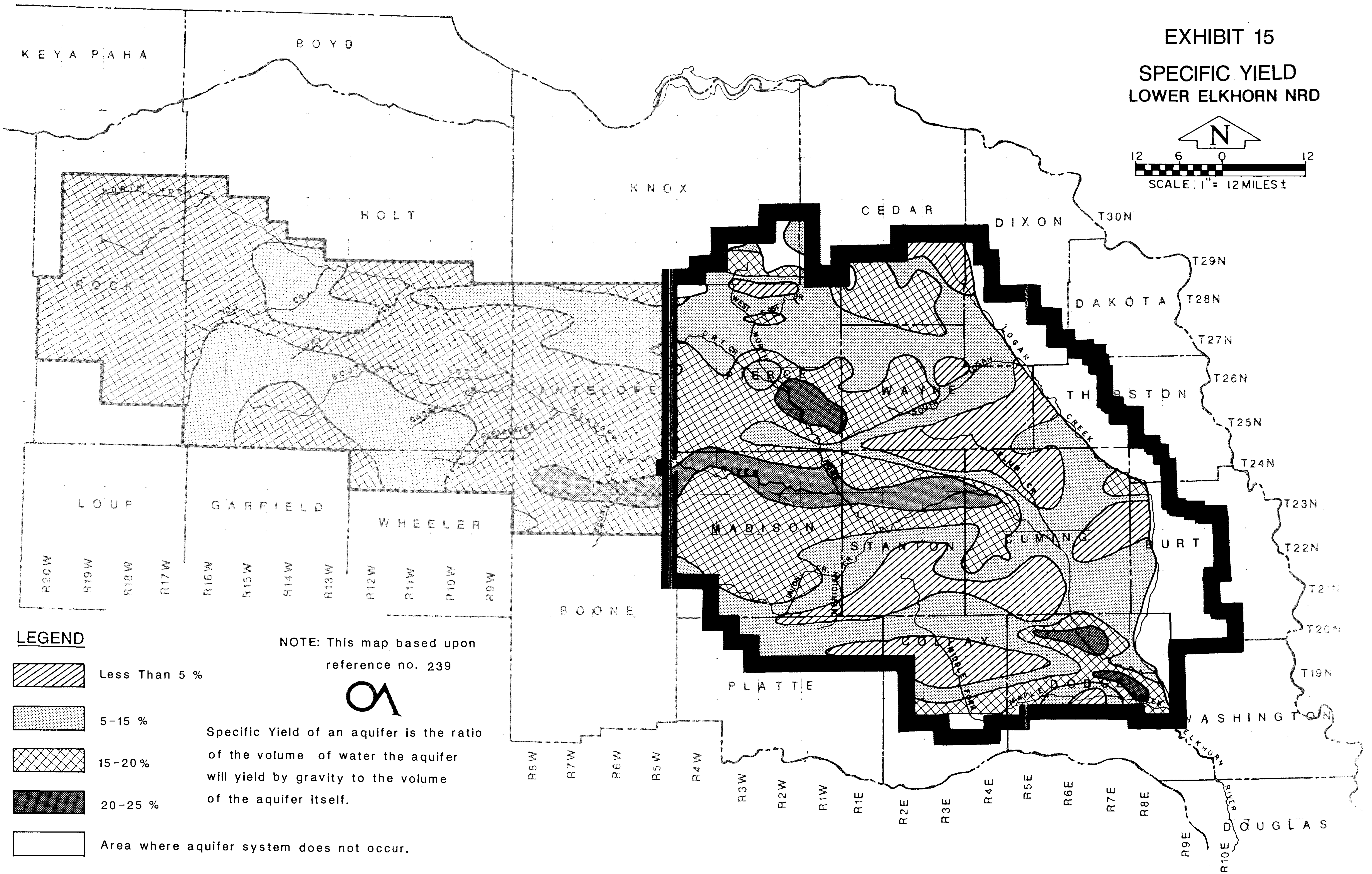


EXHIBIT 15
SPECIFIC YIELD
LOWER ELKHORN NRD
N
12 6 0 12
SCALE: 1" = 12 MILES ±
KEYA PAHA
BOYD
KNOX
HOLT
CEDAR
DIXON
DAKOTA
THURSTON
PIERCE
WAYNE
ANTELOPE
MADISON
STANTON
CUMING
BURT
COLFAX
DODGE
WASHINGTON
DOUGLAS
PLATTE
BOONE
LOUP
GARFIELD
WHEELER
T30N
T29N
T28N
T27N
T26N
T25N
T24N
T23N
T22N
T19N
R20W
R19W
R18W
R17W
R16W
R15W
R14W
R13W
R12W
R11W
R10W
R9W
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
R9E
R10E
LOGAN CREEK
ELKHORN RIVER
LEGEND
Less Than 5 %
5-15 %
15-20 %
20-25 %
Area where aquifer system does not occur.
NOTE: This map based upon reference no. 239
Specific Yield of an aquifer is the ratio of the volume of water the aquifer will yield by gravity to the volume of the aquifer itself.

EXHIBIT 16

GROUNDWATER IN STORAGE
LOWER ELKHORN NRD

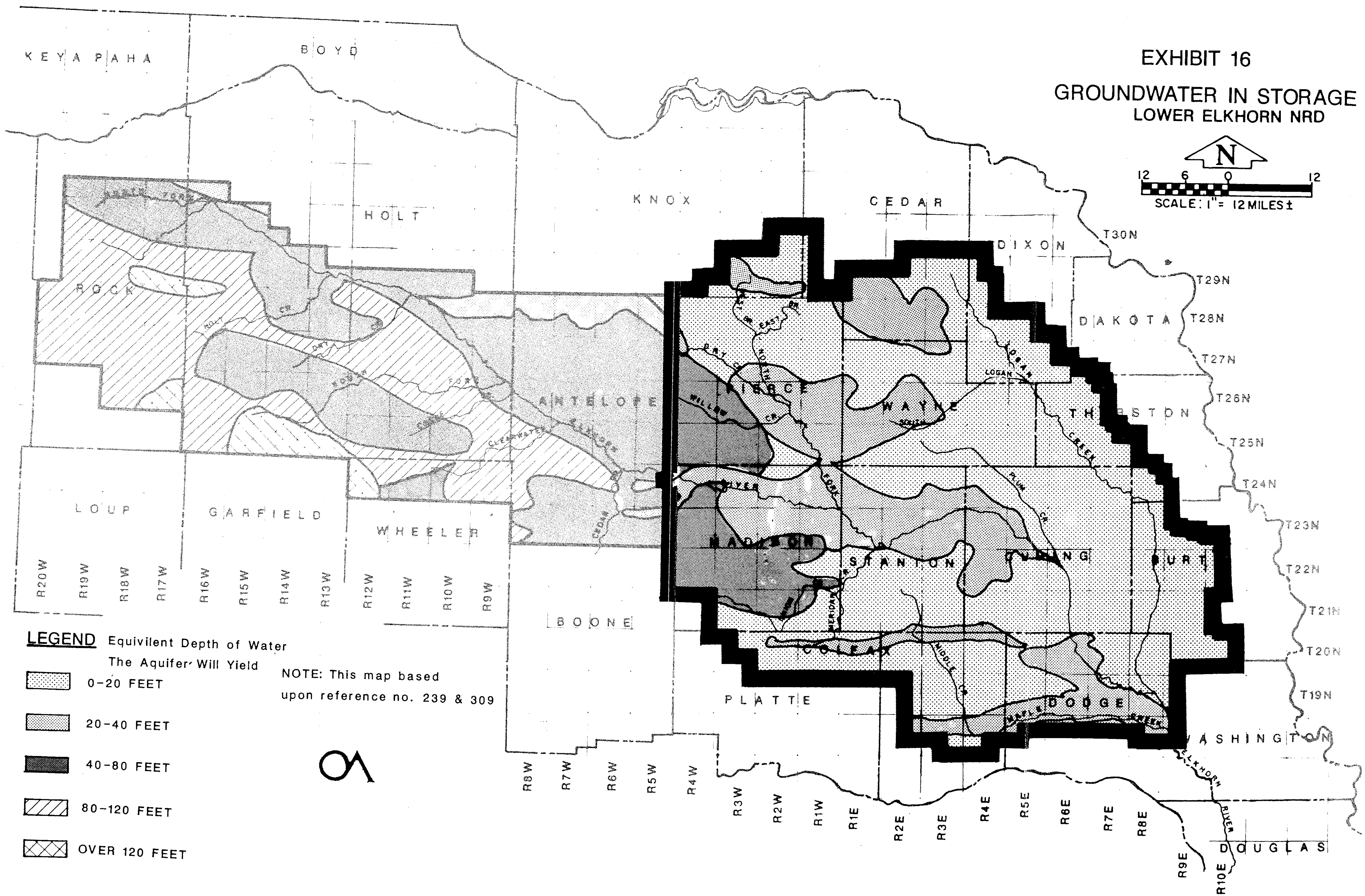
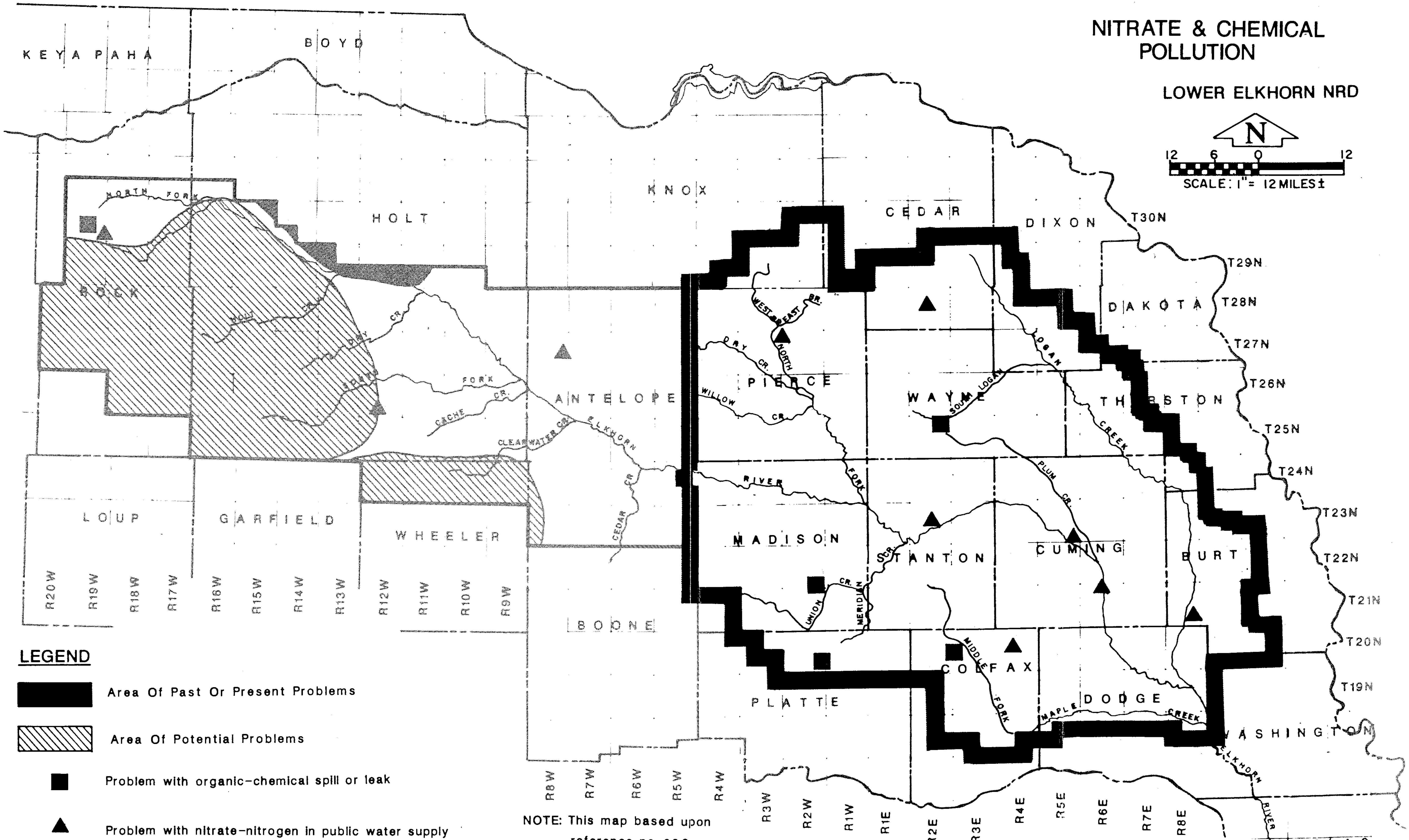


EXHIBIT 17

NITRATE & CHEMICAL POLLUTION

LOWER ELKHORN NRD



NOTE: This map based upon reference no. 292

NITRATE-NITROGEN IN IRRIGATION WELLS

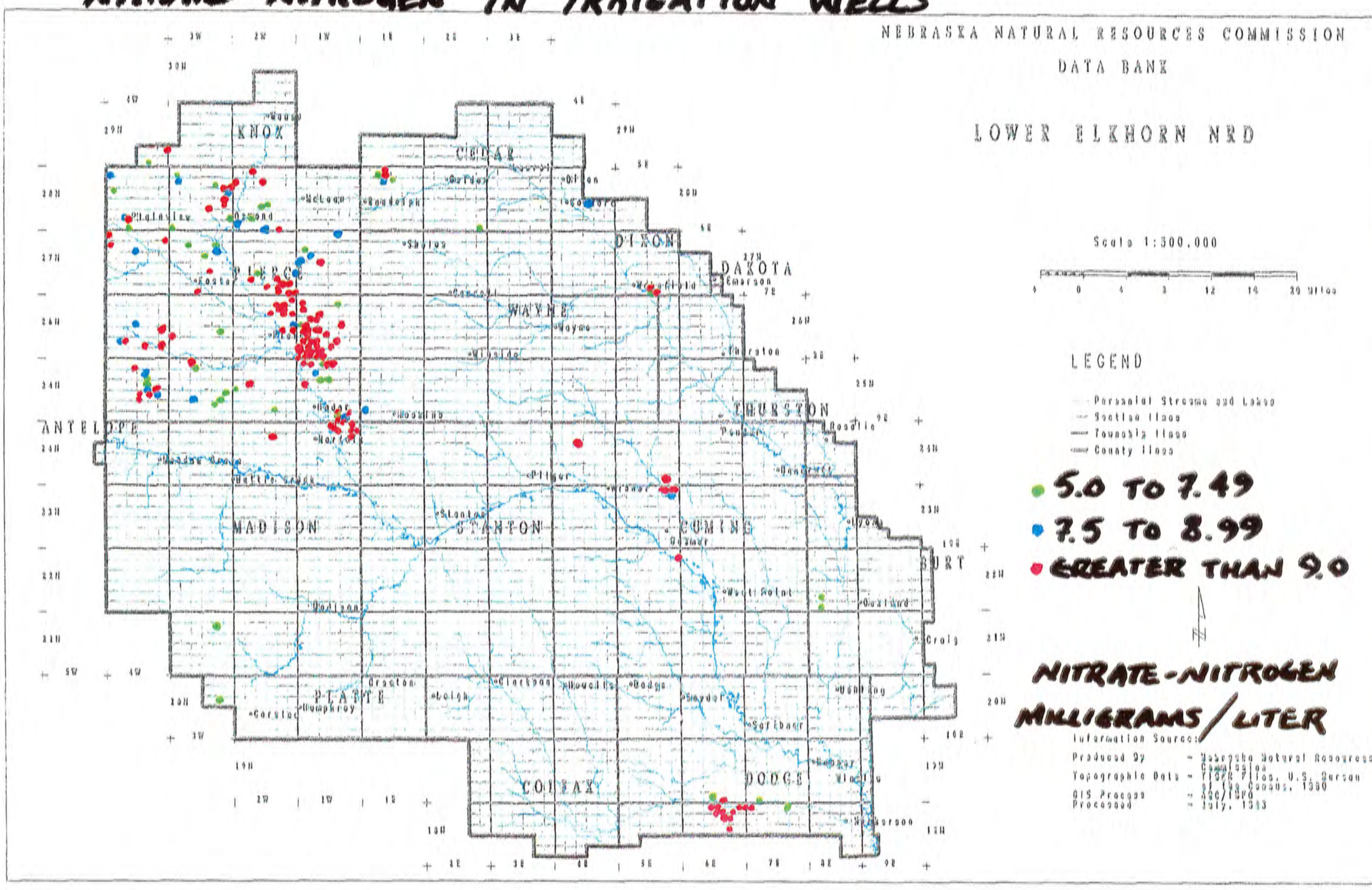


EXHIBIT 17a

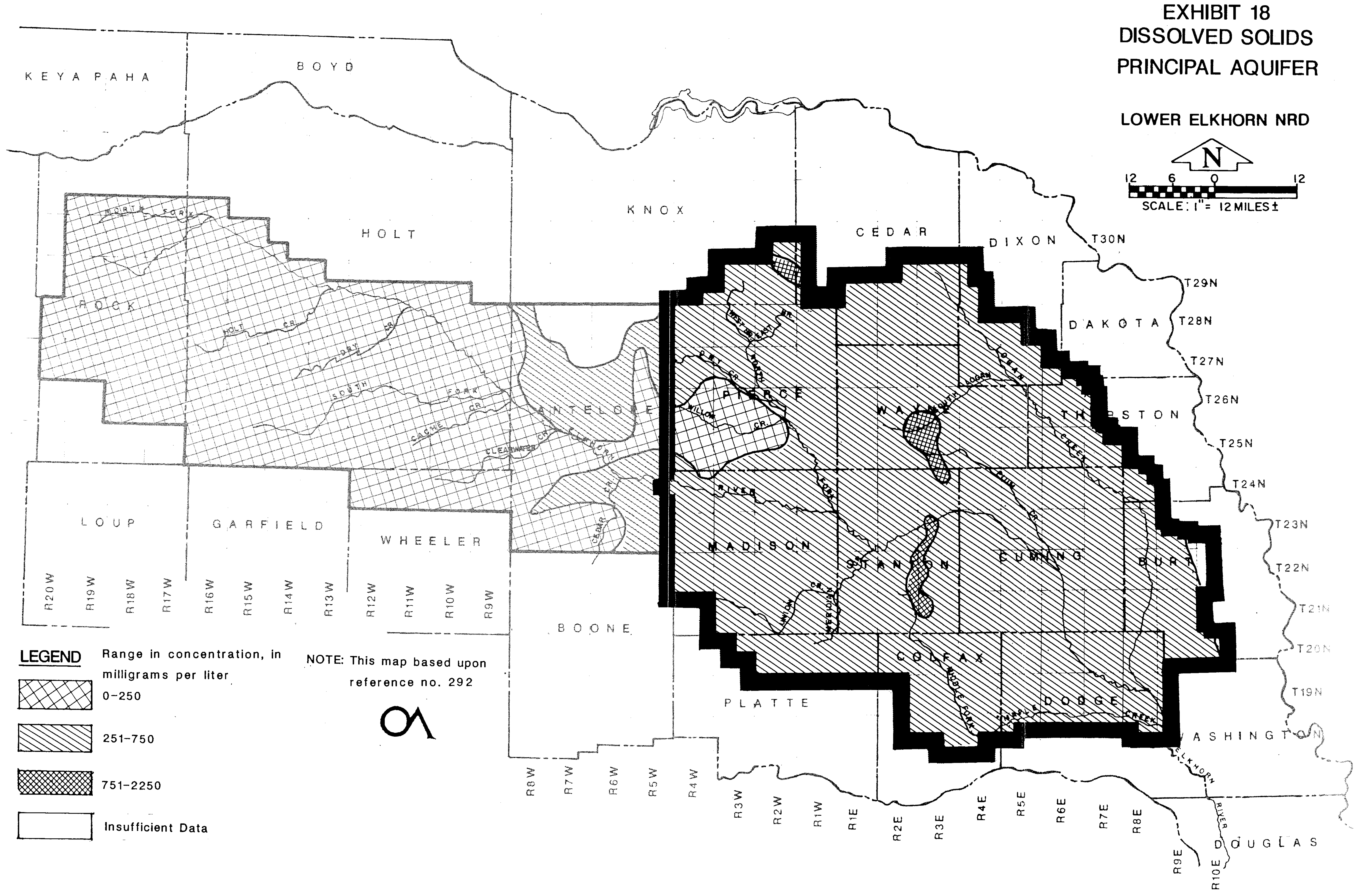


EXHIBIT 18
DISSOLVED SOLIDS
PRINCIPAL AQUIFER
LOWER ELKHORN NRD
N
12 6 0 12
SCALE: 1" = 12 MILES ±
KEYA PAHA
BOYD
HOLT
KNOX
CEDAR
DIXON
DAKOTA
ROCK
ANTELOPE
PIERCE
WAYNE
THURSTON
LOUP
GARFIELD
WHEELER
MADISON
STANTON
CUMING
BURT
BOONE
PLATTE
COLFAX
DODGE
WASHINGTON
DOUGLAS
T30N
T29N
T28N
T27N
T26N
T25N
T24N
T23N
T22N
T21N
T20N
T19N
R20W R19W R18W R17W R16W R15W R14W R13W R12W R11W R10W R9W
R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E
LEGEND
Range in concentration, in milligrams per liter
0-250
251-750
751-2250
Insufficient Data
NOTE: This map based upon reference no. 292

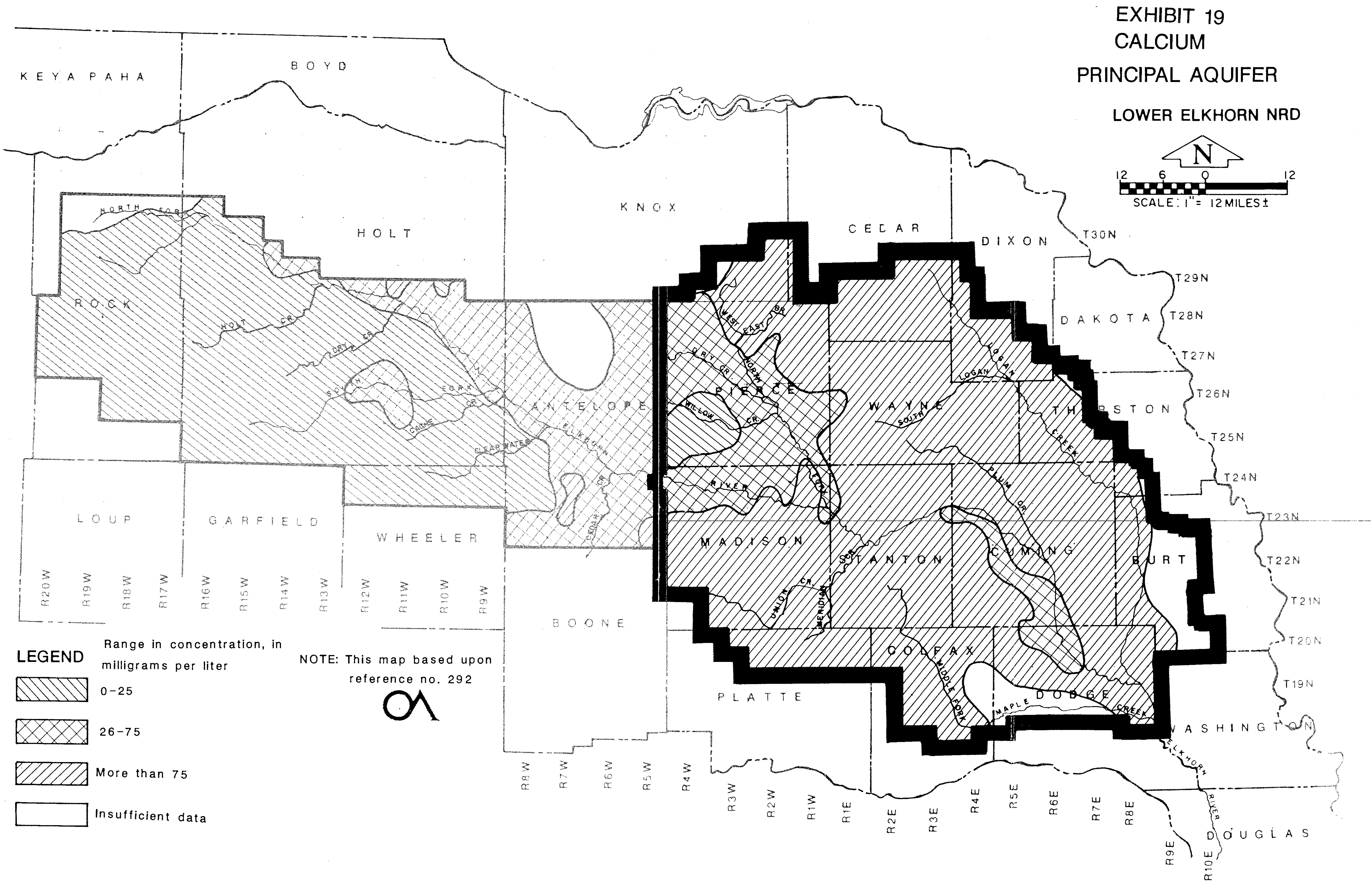


EXHIBIT 19
CALCIUM
PRINCIPAL AQUIFER
LOWER ELKHORN NRD
N
12 6 0 12
SCALE: 1" = 12 MILES ±
KEYA PAHA
BOYD
HOLT
KNOX
CEDAR
DIXON
DAKOTA
ROCK
ANTELOPE
PIERCE
WAYNE
THURSTON
LOUP
GARFIELD
WHEELER
MADISON
STANTON
CUMING
BURT
BOONE
PLATTE
COLFAX
DODGE
WASHINGTON
DOUGLAS
T30N
T29N
T28N
T27N
T26N
T25N
T24N
T23N
T22N
T21N
T20N
T19N
R20W R19W R18W R17W R16W R15W R14W R13W R12W R11W R10W R9W
R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E
NORTH FORK
HOLT CR.
DRY CR.
SOUTH FORK
CEDAR CR.
CLEAR WATER
ELKHORN
WILLOW CR.
NORTH FORK
RIVER
UNION CR.
MERIDIAN
LOGAN CR.
PLUM CR.
MIDDLE FORK
MAPLE CREEK
ELKHORN RIVER
LEGEND
Range in concentration, in milligrams per liter
0-25
26-75
More than 75
Insufficient data
NOTE: This map based upon reference no. 292

EXHIBIT 20
HARDNESS
PRINCIPAL AQUIFER
LOWER ELKHORN NRD

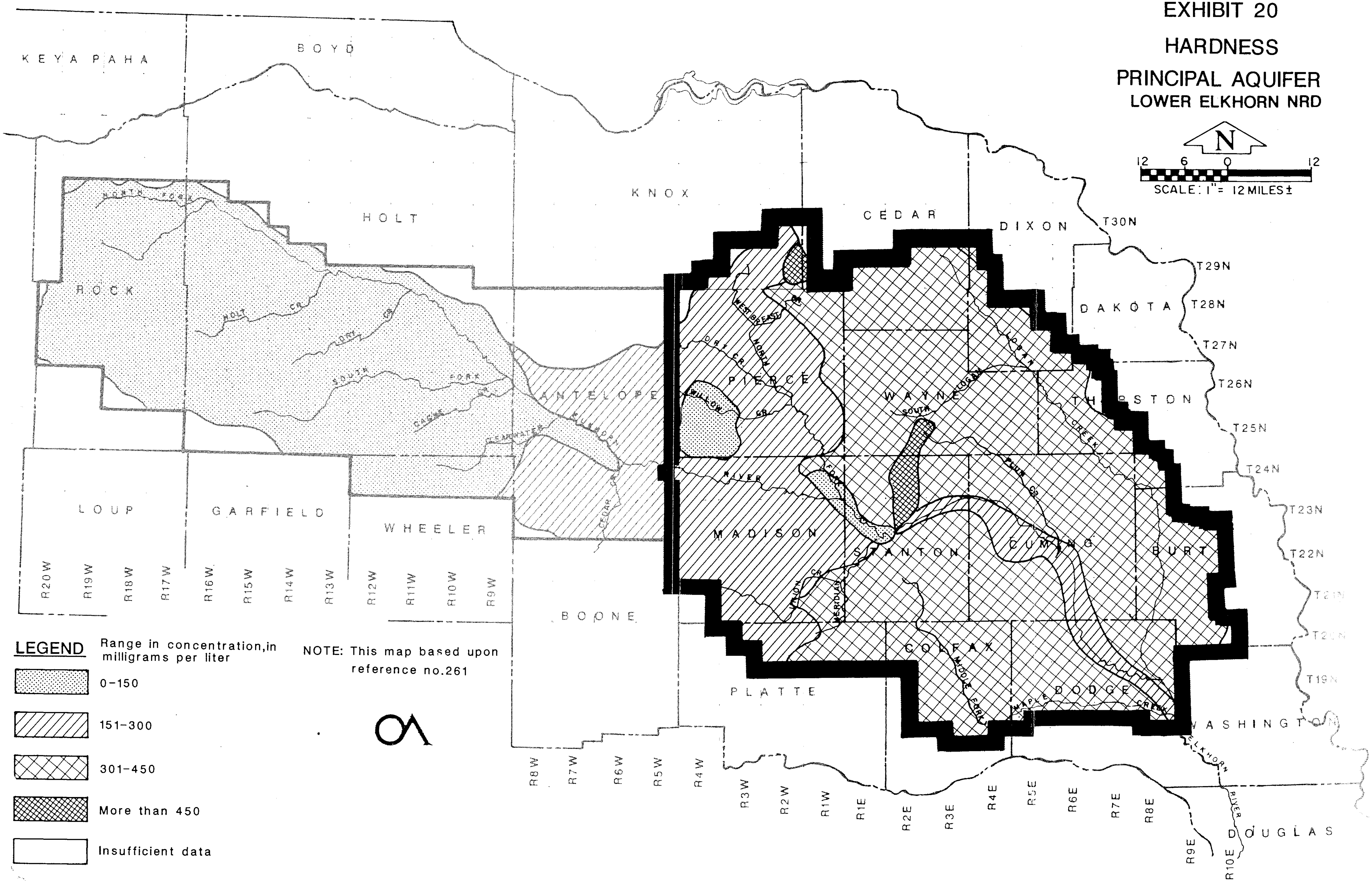


EXHIBIT 21
ALKALINITY
PRINCIPAL AQUIFER

LOWER ELKHORN NRD

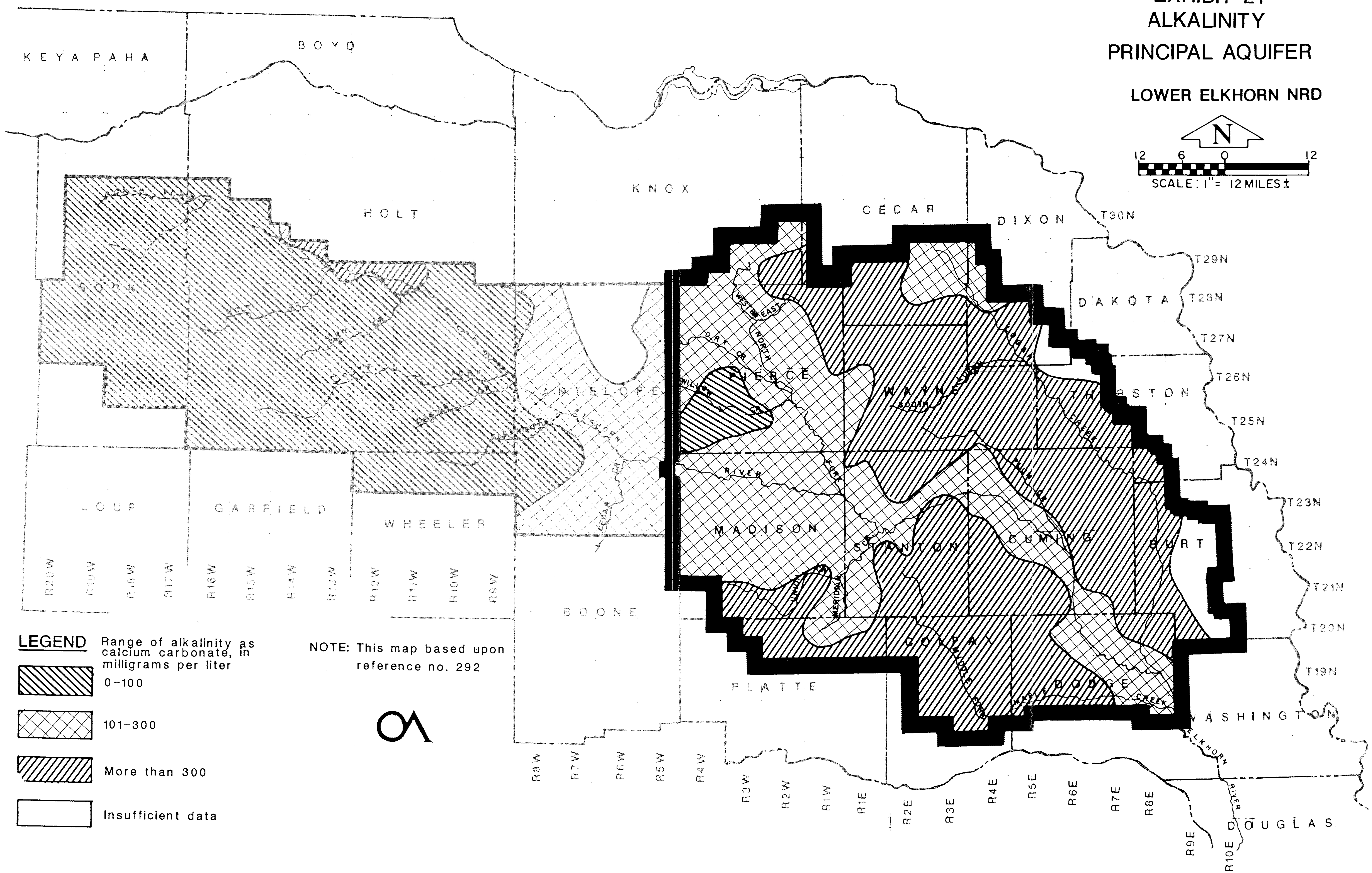


EXHIBIT 22
SULFATE
PRINCIPAL AQUIFER
LOWER ELKHORN NRD

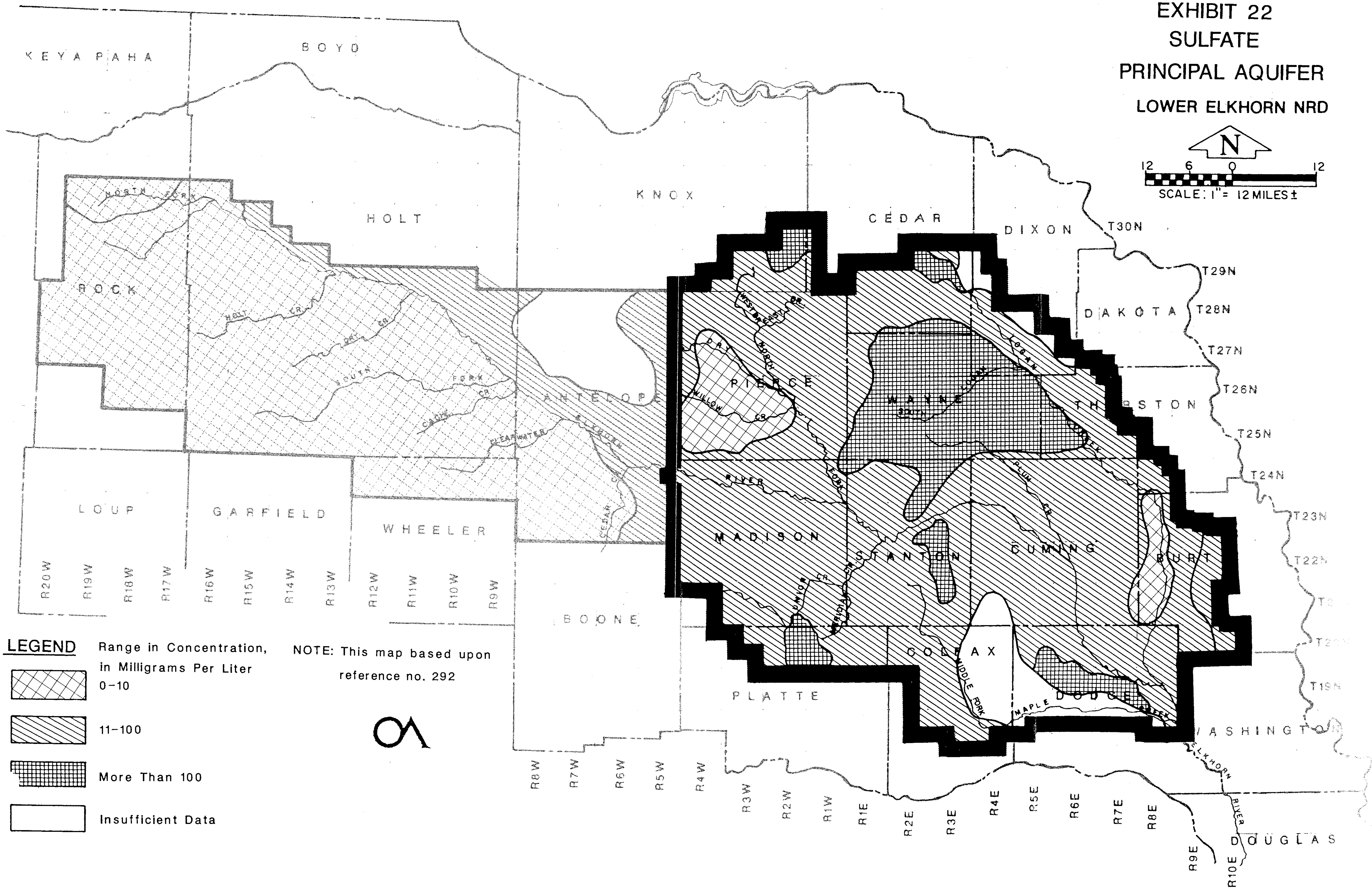


EXHIBIT 23
GROUNDWATER POLLUTION POTENTIAL MAP

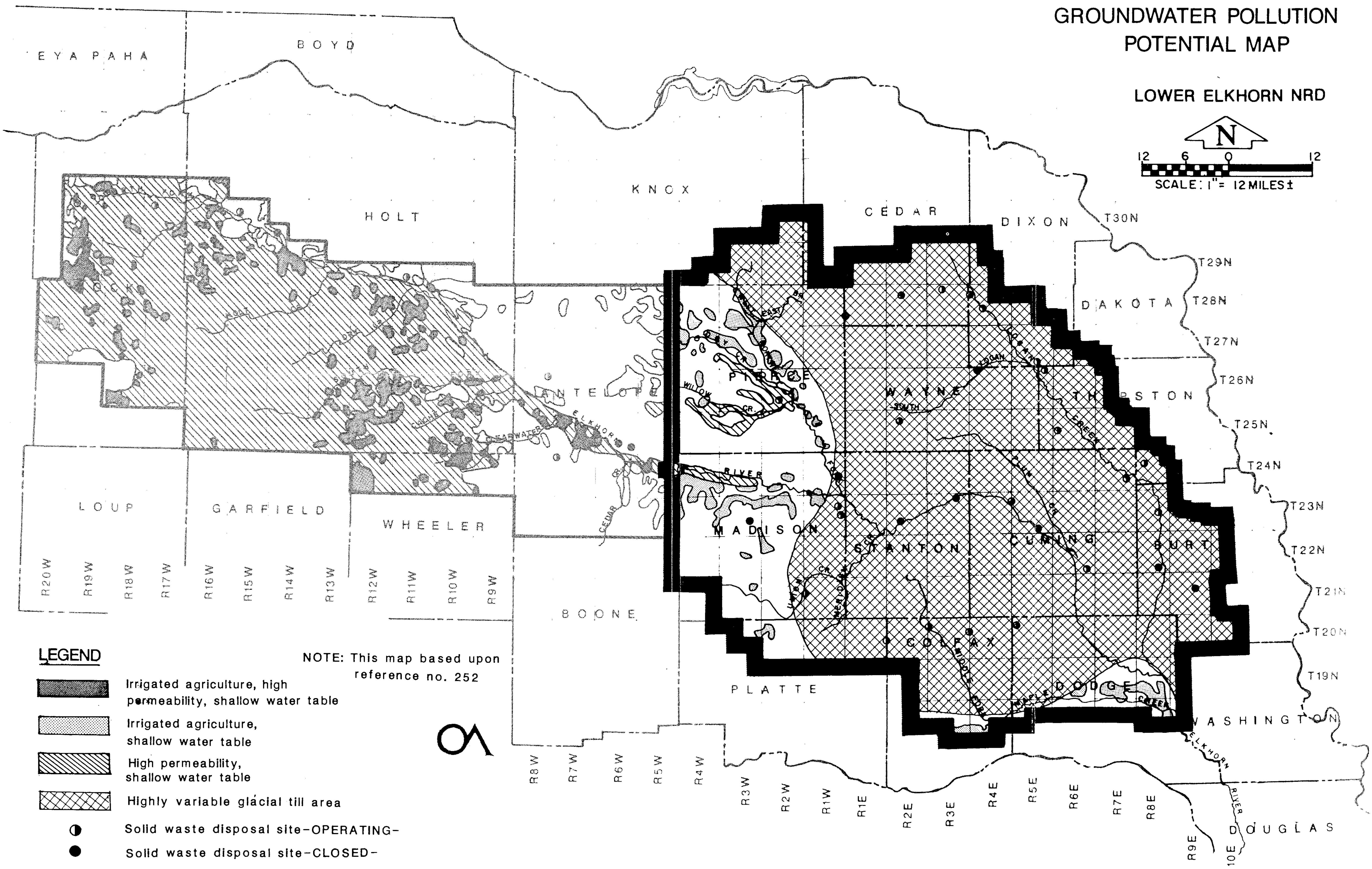


EXHIBIT 24
DISSOLVED SOLIDS
DAKOTA AQUIFER

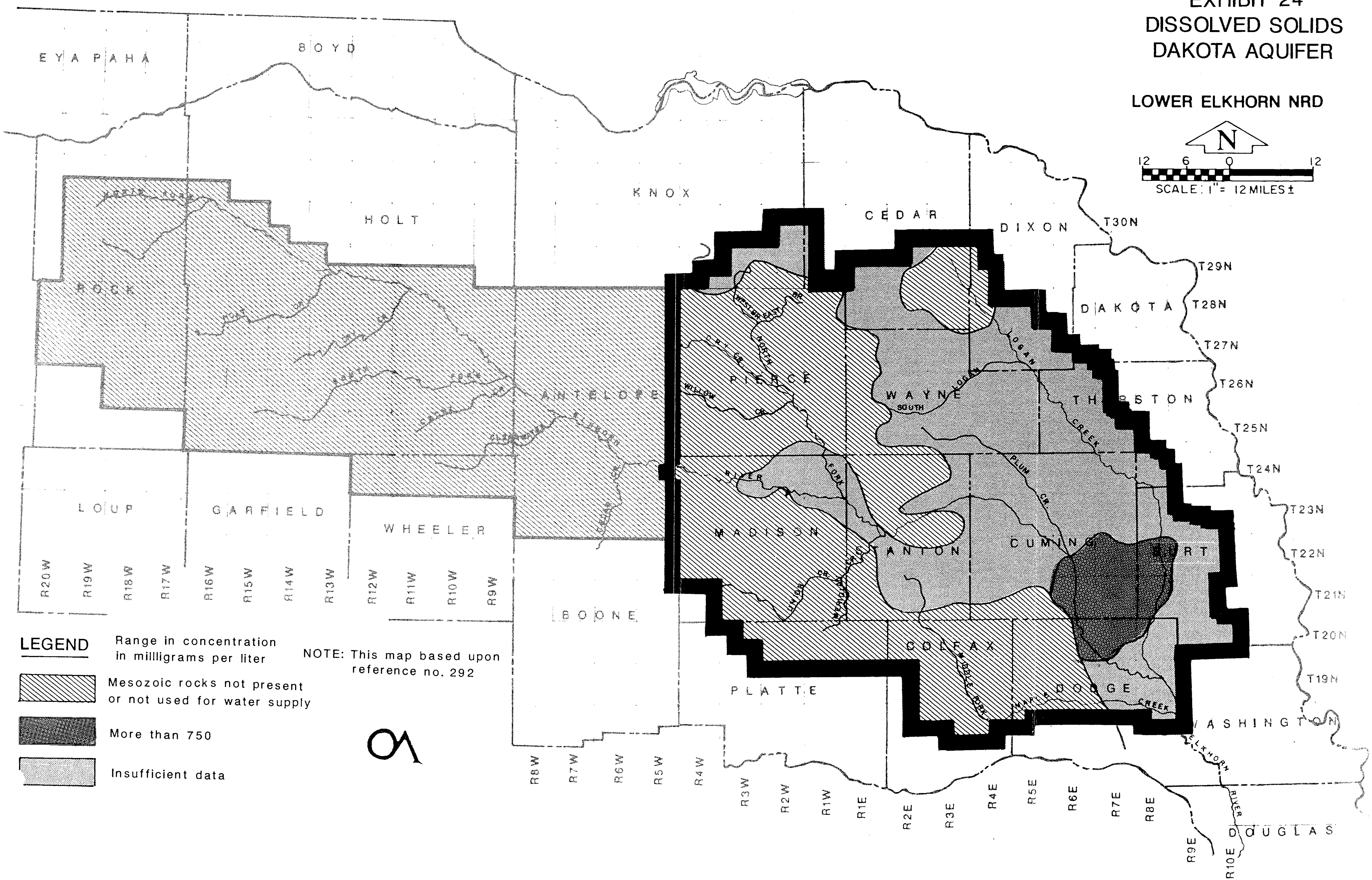
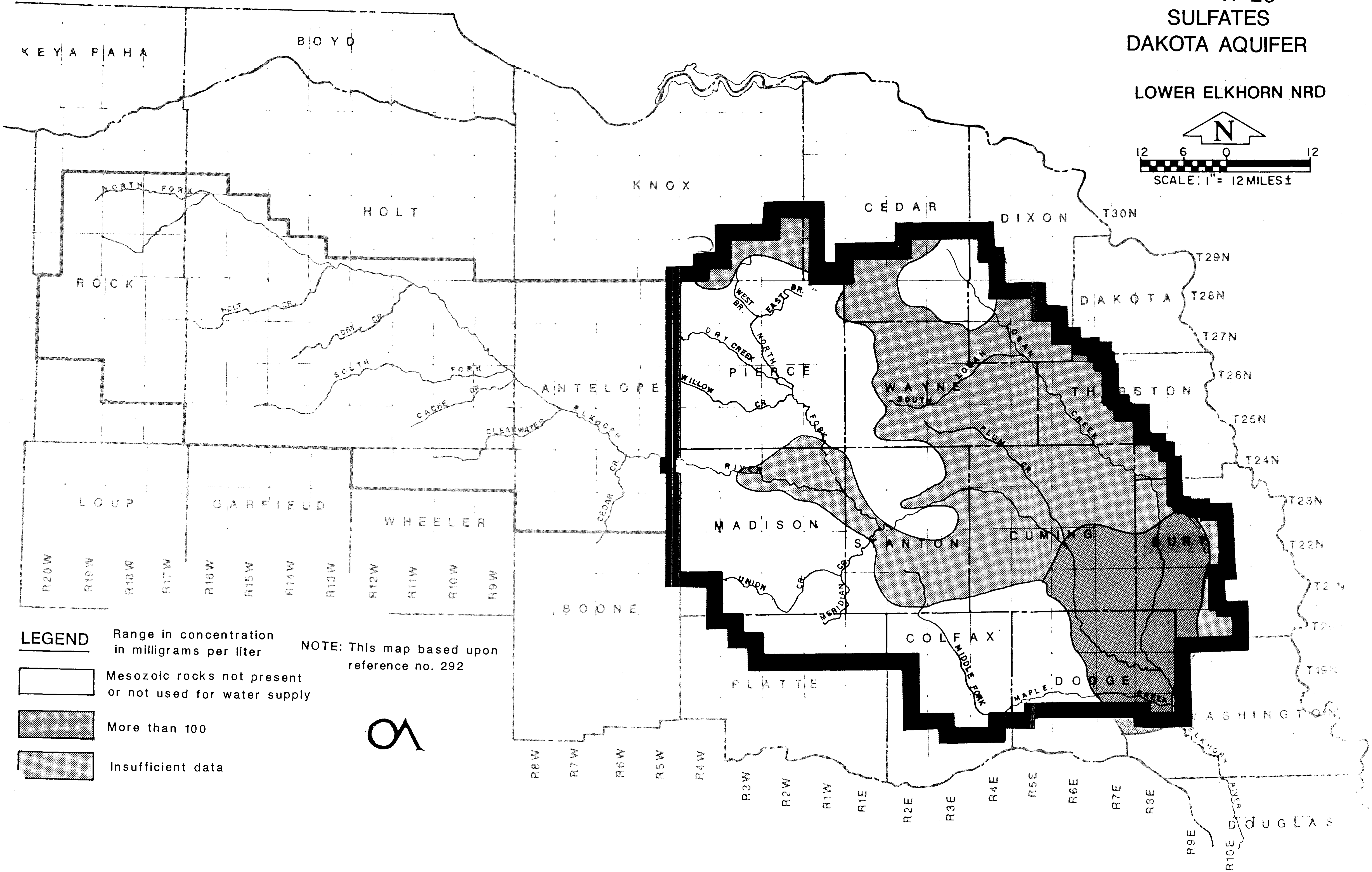


EXHIBIT 25
SULFATES
DAKOTA AQUIFER



APPENDIX 1

Ground Water Management and Protection Act

Reference Outline, Ground Water Management Plan Amendments (NDWR and NDEQ)

NNRC Description of Control, Management, and Special Protection Areas

Groundwater Management and Protection Act

Nebraska Groundwater Management and Protection Act (September, 1996)

Chapter 46. Irrigation.
Act, how cited.
46-656.01. Sections 46-656.01 to 46-656.67 shall be known and may be cited as the Nebraska Ground Water Management and Protection Act.

Chapter 46. Irrigation.
Declaration of intent and purpose.
46-656.02. The Legislature finds that ground water is one of the most valuable natural resources in the state and that an adequate supply of ground water is essential to the general welfare of the citizens of this state and to the present and future development of agriculture in the state. The Legislature recognizes its duty to define broad policy goals concerning the utilization and management of ground water and to ensure local implementation of those goals.

Every landowner shall be entitled to a reasonable and beneficial use of the ground water underlying his or her land subject to the provisions of Chapter 46, article 6, and the Nebraska Ground Water Management and Protection Act and the correlative rights of other landowners when the ground water supply is insufficient for all users. The Legislature determines that the goal shall be to extend ground water reservoir life to the greatest extent practicable consistent with beneficial use of the ground water and best management practices.

The Legislature further recognizes and declares that the management, protection, and conservation of ground water and the beneficial use thereof are essential to the economic prosperity and future well-being of the state and that the public interest demands procedures for the implementation of management practices to conserve and protect ground water supplies and to prevent the contamination or inefficient or improper use thereof. The Legislature recognizes the need to provide for orderly management systems in areas where management of ground water is necessary to achieve locally determined ground water management objectives and where available data, evidence, or other information indicates that present or potential ground water conditions, including subirrigation conditions, require the designation of areas with special regulation of development and use.

Nothing in the Nebraska Ground Water Management and Protection Act relating to the contamination of ground water is intended to limit the powers of the Department of Environmental Quality provided in Chapter 81, article 15.

Chapter 46. Irrigation.
Management area; legislative findings.
46-656.03. The Legislature also finds that:
(1) The levels of nitrate nitrogen and other contaminants in ground water in certain areas of the state are increasing;
(2) Long-term solutions should be implemented and efforts should be made to prevent the levels of ground water contaminants from becoming too high and to reduce high levels sufficiently to

eliminate health hazards;

(3) Agriculture has been very productive and should continue to be an important industry to the State of Nebraska;

(4) Natural resources districts have the legal authority to regulate certain activities and, as local entities, are the preferred regulators of activities which may contribute to ground water contamination in both urban and rural areas;

(5) The Department of Environmental Quality should be given authority to regulate sources of contamination when necessary to prevent serious deterioration of ground water quality;

(6) The powers given to districts and the Department of Environmental Quality should be used to stabilize, reduce, and prevent the increase or spread of ground water contamination; and

(7) There is a need to provide for the orderly management of ground water quality in areas where available data, evidence, and other information indicate that present or potential ground water conditions require the designation of such areas as management areas.

Chapter 46. Irrigation.
Management area; sections, how construed.

46-656.04. Nothing in sections 46-656.35 to 46-656.48 shall be construed to limit the powers of the Department of Health and Human Services Regulation and Licensure provided in the Nebraska Safe Drinking Water Act.

Chapter 46. Irrigation and Regulation of Water.
Legislative findings.

46-656.05. The Legislature further finds:

(1) The management, conservation, and beneficial use of hydrologically connected ground water and surface water are essential to the continued economic prosperity and well-being of the state, including the present and future development of agriculture in the state;

(2) Hydrologically connected ground water and surface water may need to be managed differently from unconnected ground water and surface water in order to permit equity among water users and to optimize the beneficial use of interrelated ground water and surface water supplies;

(3) Natural resources districts already have significant legal authority to regulate activities which contribute to declines in ground water levels and to nonpoint source contamination of ground water and are the preferred entities to regulate, through ground water management areas, ground water related activities which are contributing to or are, in the reasonably foreseeable future, likely to contribute to conflicts between ground water users and surface water appropriators or which may be necessary in order to resolve disputes over interstate compacts or decrees, or to carry out the provisions of other formal state contracts or agreements;

(4) The Department of Water Resources is responsible for regulation of surface water resources and local surface water project sponsors are responsible for much of the structured irrigation utilizing surface water supplies, and these entities should be responsible for regulation of surface water related activities which contribute to such conflicts or provide opportunities for such dispute resolution;

(5) The department, following review and concurrence of need by the Interrelated Water Review Committee of the Nebraska Natural Resources Commission, should also be given authority to regulate ground water related activities to mitigate or eliminate disputes over interstate compacts or decrees or difficulties in carrying out the provisions of other formal state contracts or agreements if natural resources districts do not utilize their ground water management authority in a reasonable manner to prevent or minimize such disputes or difficulties; and

(6) All involved natural resources districts, the department, and surface water project sponsors should cooperate and collaborate on the identification and implementation of management solutions to such conflicts or provide opportunities for mitigation or elimination of such disputes or difficulties.

Chapter 46. Irrigation and Regulation of Water.
Conflicts between ground and surface water use; legislative intent.

46-656.06. The Legislature recognizes that ground water use or surface water use in one natural resources district may have adverse effects on water supplies in another district or in an adjoining state. The Legislature intends and expects that each natural resources district within which water use is causing external impacts will accept responsibility for ground water management in accordance with the Nebraska Ground Water Management and Protection Act in the same manner and to the same extent as if the conflicts between ground water use and surface water use were contained within the district.

Chapter 46. Irrigation.
Terms, defined.

46-656.07. For purposes of the Nebraska Ground Water Management and Protection Act and sections 46-601 to 46-613.02 and 46-636 to 46-655, unless the context otherwise requires:

(1) Person shall mean a natural person, a partnership, a limited liability company, an association, a corporation, a municipality, an irrigation district, an agency or a political subdivision of the state, or a department, an agency, or a bureau of the United States;

(2) Ground water shall mean that water which occurs in or moves, seeps, filters, or percolates through ground under the surface of the land;

(3) Contamination or contamination of ground water shall mean nitrate nitrogen or other material which enters the ground water due to action of any person and causes degradation of the quality of ground water sufficient to make such ground water unsuitable for present or reasonably foreseeable beneficial uses;

(4) District shall mean a natural resources district operating pursuant to Chapter 2, article 32;

(5) Illegal water well shall mean (a) any water well operated or constructed without or in violation of a permit required by the act, (b) any water well not in compliance with rules and regulations adopted and promulgated pursuant to the act, (c) any water well not properly registered in accordance with sections 46-602 to 46-604, or (d) any water well not in compliance with any other applicable laws of the State of Nebraska or with rules and regulations adopted and promulgated pursuant to such laws;

(6) To commence construction of a water well shall mean the beginning of the boring, drilling, jetting, digging, or excavating of the actual water well from which ground water is to be withdrawn;

(7) Management area shall mean any area so designated by a district pursuant to section 46-656.20, by the Director of Environmental Quality pursuant to section 46-656.39, or by the Director of Water Resources pursuant to section 46-656.52. Management area shall include a control area or a special ground water quality protection area designated prior to July 19, 1996;

(8) Management plan shall mean a ground water management plan developed by a district and submitted to the Director of Water Resources for review pursuant to sections 46-656.12 to 46-656.15;

(9) Ground water reservoir life goal shall mean the finite or infinite period of time which a district establishes as its goal for maintenance of the supply and quality of water in a ground water reservoir at the time a ground water management plan is adopted;

(10) Board shall mean the board of directors of a district;

(11) Irrigated acre shall mean any acre that is certified as such pursuant to rules and regulations of the district and that is actually capable of being supplied water through irrigation works, mechanisms, or facilities existing at the time of the allocation;

(12) Acre-inch shall mean the amount of water necessary to cover an acre of land one inch deep;

(13) Subirrigation or subirrigated land shall mean the natural occurrence of a ground water table within the root zone of agricultural vegetation, not exceeding ten feet below the surface of the ground;

(14) Best management practices shall mean schedules of activities, maintenance procedures, and other management practices utilized to prevent or reduce present and future contamination of ground water which may include irrigation scheduling, proper timing of fertilizer and pesticide application, and other fertilizer and pesticide management programs;

(15) Point source shall mean any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, vessel, other floating craft, or other conveyance, over which the Department of Environmental Quality has regulatory authority and from which a substance which can cause or contribute to contamination of ground water is or may be discharged;

(16) Allocation shall mean the allotment of a specified total number of acre-inches of irrigation water per irrigated acre per year or an average number of acre-inches of irrigation water per irrigated acre over any reasonable period of time not to exceed five years;

(17) Rotation shall mean a recurring series of use and nonuse of irrigation wells on an hourly, daily, weekly, monthly, or yearly basis;

(18) Water well shall have the same meaning as in section 46-601.01; and

(19) Surface water project sponsor shall mean an irrigation district created pursuant to Chapter 46, article 1, a reclamation district created pursuant to Chapter 46, article 5, or a public power and irrigation district created pursuant to Chapter 70, article 6.

Chapter 46. Irrigation.
Natural resources district; powers; enumerated.

46-656.08. Regardless of whether or not any portion of a district has been designated as a management area, in order to administer and enforce the Nebraska Ground Water Management and Protection Act and to effectuate the policy of the state to conserve ground water resources, a district may:

(1) Adopt and promulgate rules and regulations necessary to discharge the administrative duties assigned in the act;

(2) Require such reports from ground water users as may be necessary;

(3) Require meters to be placed on any water wells for the purpose of acquiring water use data;

(4) Conduct investigations and cooperate or contract with agencies of the United States, agencies or political subdivisions of this state, public or private corporations, or any association or individual on any matter relevant to the administration of the act;

(5) Report to and consult with the Department of Environmental Quality on all matters concerning the entry of contamination or contaminating materials into ground water supplies; and

(6) Issue cease and desist orders, following ten days' notice to the person affected stating the contemplated action and in general the grounds for the action and following reasonable opportunity to be heard, to enforce any of the provisions of the act or of orders or permits issued pursuant to the act, to initiate suits to enforce the provisions of orders issued pursuant to the act, and to restrain the construction of illegal water wells or the withdrawal or use of water from illegal water wells.

Chapter 46. Irrigation.

Natural resources district; management area; rules and regulations; public hearing required; notice.

46-656.09. Before any rule or regulation is adopted pursuant to section 46-656.08, a public hearing shall be held within the district. Notice of the hearing shall be given as provided in section 46-656.19.

Chapter 46. Irrigation.

Natural resources district; cease and desist order; violation; penalty.

46-656.10. Any violation of a cease and desist order issued by a district pursuant to section 46-656.08 shall be a Class IV misdemeanor.

Chapter 46. Irrigation.

Action to control or prevent runoff of water; natural resources district; rules and regulations; power to issue cease and desist orders; notice; hearing.

46-656.11. (1) In order to conserve ground water supplies and to prevent the inefficient or improper runoff of such ground water, each person who uses ground water irrigation in the state shall take action to control or prevent the runoff of water used in such irrigation.

(2) Each district shall adopt, following public hearing, notice of which shall be given in the manner provided in section 46-656.19, rules and regulations necessary to control or prohibit surface runoff of water derived from ground water irrigation. Such rules and regulations shall

prescribe (a) standards and criteria delineating what constitutes the inefficient or improper runoff of ground water used in irrigation, (b) procedures to prevent, control, and abate such runoff, (c) measures for the construction, modification, extension, or operation of remedial measures to prevent, control, or abate runoff of ground water used in irrigation, and (d) procedures for the enforcement of this section.

(3) Each district may, upon ten days' notice to the person affected, stating the contemplated action and in general the grounds therefor, and upon reasonable opportunity to be heard, issue cease and desist orders to enforce any of the provisions of this section or rules and regulations issued pursuant to this section.

Chapter 46. Irrigation.

Ground water management plan; preparation required; contents; management area designation; when.

46-656.12. Each district shall prepare a ground water management plan based upon the best available information and submit such plan to the Director of Water Resources for review and approval.

The plan shall include, but not be limited to, the identification to the extent possible of:

(1) Ground water supplies within the district including transmissivity, saturated thickness maps, and other ground water reservoir information, if available;

(2) Local recharge characteristics and rates from any sources, if available;

(3) Average annual precipitation and the variations within the district;

(4) Crop water needs within the district;

(5) Current ground water data-collection programs;

(6) Past, present, and potential ground water use within the district;

(7) Ground water quality concerns within the district;

(8) Proposed water conservation and supply augmentation programs for the district;

(9) The availability of supplemental water supplies, including the opportunity for ground water recharge;

(10) The opportunity to integrate and coordinate the use of water from different sources of supply;

(11) Ground water management objectives, including a proposed ground water reservoir life goal for the district. For management plans adopted or revised after July 19, 1996, the ground water management objectives may include any proposed integrated management objectives for hydrologically connected ground water and surface water supplies;

(12) Existing subirrigation uses within the district;

(13) The relative economic value of different uses of ground water proposed or existing within the district; and

(14) The geographic and stratigraphic boundaries of any proposed management area.

If the expenses incurred by a district preparing a ground water management plan exceed twenty-five percent of the district's current budget, the district may make application to the Nebraska Resources Development Fund for assistance.

If a control area, management area, or special ground water quality protection area has been designated in a district prior to July 19, 1996, the area shall be designated a management area but the district shall not be required to adopt or amend its existing rules, regulations, action plan, or ground water management plan, due to that change in designation, for the geographical area of the district included in such control area, management area, or special ground water quality protection area. A district may change references from control area or special ground water quality protection area to management area without holding a public hearing. Before taking any action described in the remainder of this section, a district shall hold a public hearing within the district. Notice of the hearing shall be given as provided in section 46-656.19. If the changes made by Laws 1996, LB 108, require substantive changes to the district's rules, regulations, or plans, the district shall enact appropriate amendments to such rules, regulations, or plans. A district in which a special ground water quality protection area was designated prior to July 19, 1996, shall insure compliance with section 46-656.29. A district in which a control area, management area, or special ground water quality protection area was designated prior to July 19, 1996, may adopt any of the controls permitted by section 46-656.25.

Chapter 46. Irrigation.
Ground water management plan preparation; district; solicit and utilize information.
46-656.13. During preparation of a ground water management plan, the district shall actively solicit public comments and opinions and shall utilize and draw upon existing research, data, studies, or any other information which has been compiled by or is in the possession of state or federal agencies, natural resources districts, or any other subdivision of the state. State agencies, districts, and other subdivisions shall furnish information or data upon the request of any district preparing such a plan. A district shall not be required to initiate new studies or data-collection efforts or to develop computer models in order to prepare a plan.

Chapter 46. Irrigation.
Ground water management plan; director; review; duties.
46-656.14. The Director of Water Resources shall review any ground water management plan submitted by a district to ensure that the best available studies, data, and information, whether previously existing or newly initiated, were utilized and considered and that such plan is supported by and is a reasonable application of such information. If a management area is proposed and the primary purpose of the proposed management area is protection of water quality, the director shall consult with the Department of Environmental Quality regarding approval or denial of the management plan. The director shall consult with the Conservation and Survey Division of the University of Nebraska, the Nebraska Natural Resources Commission, and such other state or federal agencies the director shall deem necessary when reviewing plans. Within ninety days after receipt of a plan, the director shall transmit his or her specific findings, conclusions, and reasons for approval or disapproval to the district submitting the plan.

Chapter 46. Irrigation.
Ground water management plan; disapproved by director; district; duties.
46-656.15. If the Director of Water Resources disapproves a ground water management plan,

the district which submitted the plan shall, in order to establish a management area, submit to the director either the original or a revised plan with an explanation of how the original or revised plan addresses the issues raised by the director in his or her reasons for disapproval. Once a district has submitted an explanation pursuant to this section, such district may proceed to schedule a hearing pursuant to section 46-656.19.

Chapter 46. Irrigation and Regulation of Water.
Amendment of ground water management plan; contents; exception; modification.
46-656.16. Prior to January 1, 1996, each district shall amend its ground water management plan to identify to the extent possible the levels and sources of ground water contamination within the district, ground water quality goals, long-term solutions necessary to prevent the levels of ground water contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards, and practices recommended to stabilize, reduce, and prevent the occurrence, increase, or spread of ground water contamination. Notwithstanding the restrictions provided in section 46-656.22, each district may modify its plan to include (1) any agreements between the district and state or federal agencies entered into as part of the review process conducted pursuant to section 46-656.14 and (2) any conditions imposed by the Director of Water Resources during such review process. If a special ground water quality protection area has been designated in a district as of September 6, 1991, or if the study required by section 46-656.36 or 46-656.50 recommends the designation of a management area, the district shall not be required to amend its plan for the geographical area encompassed by the special protection or management area.

Chapter 46. Irrigation and Regulation of Water.
District; failure to have or amend ground water management plan; effect on funding.
46-656.17. (1) Any district which fails to comply with section 46-656.16 shall be ineligible to receive for fiscal year 1996-97 any funds appropriated pursuant to sections 77-27,136 and 77-27,137.02.
(2) Any district which fails to have an approved ground water management plan pursuant to sections 46-656.12 to 46-656.16 by January 1, 1996, shall become eligible to receive funds enumerated in subsection (1) of this section for any subsequent fiscal year if the district has an approved ground water management plan pursuant to sections 46-656.12 to 46-656.16 by the March 1 immediately preceding the start of such fiscal year.

Chapter 46. Irrigation and Regulation of Water.
District; implementation of ground water management plan; duty.
46-656.18. Each district shall, on or before January 1, 1997, begin implementation of an approved ground water management plan pursuant to sections 46-656.12 to 46-656.16 which specifically addresses ground water quality.

Chapter 46. Irrigation.
Management area; establishment; when; hearing; notice; procedure.

46-656.19. Prior to proceeding toward establishing a management area, a management plan shall have been approved by the Director of Water Resources or the district shall have completed the requirements of section 46-656.15. If necessary to determine whether a management area should be designated, the district may initiate new studies and data-collection efforts and develop computer models. In order to establish a management area, the district shall fix a time and place for a public hearing to consider the management plan information supplied by the director and to hear any other evidence. The hearing shall be located within or in reasonable proximity to the area proposed for designation as a management area.

Notice of the hearing shall be published at the expense of the district in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks, the last publication to be not less than seven days prior to the hearing. The notice shall provide a general description of the contents of the plan and of the area which will be considered for inclusion in the management area and shall provide the text of all controls proposed for adoption by the district.

All interested persons shall be allowed to appear and present testimony. The hearing shall include testimony of a representative of the Department of Water Resources and, if the primary purpose of the proposed management area is protection of water quality, of the Department of Environmental Quality and shall include the results of any studies or investigations conducted by the district.

Chapter 46. Irrigation.

Management area; designated; district; order; contents; duties; controls.

46-656.20. Within ninety days after the hearing the district shall determine whether a management area shall be designated. If the district determines that no management area shall be established, the district shall issue an order to that effect.

If the district determines that a management area shall be established, the district shall by order designate the area as a management area and adopt one or more controls authorized by section 46-656.25 to be utilized within the area in order to achieve the ground water management objectives specified in the plan. Such an order shall include a geographic and stratigraphic definition of the area. The boundaries and controls shall take into account any considerations brought forth at the hearing and administrative factors directly affecting the ability of the district to implement and carry out local ground water management.

The controls adopted shall not include controls substantially different from those set forth in the notice of the hearing. The area designated by the order shall not include any area not included in the notice of the hearing.

Chapter 46. Irrigation and Regulation of Water.

Order; publication; effective; when.

46-656.21. The district shall cause a copy of any order adopted pursuant to section 46-656.20 to be published once each week for three consecutive weeks in a local newspaper published or of general circulation in the area involved, the last publication of which shall be not less than seven days prior to the date set for the effective date of the order.

Such order shall become effective on the date specified by the district.

Chapter 46. Irrigation.
Management plan; ground water management objectives; management area; modifications; dissolution; procedure.

46-656.22. Modification of a district's ground water management plan or ground water management objectives may be accomplished utilizing the procedure established for the initial adoption of the plan. Modification of the boundaries of a district-designated management area or dissolution of such an area shall be in accordance with the procedures established in sections 46-656.19 to 46-656.21. Hearings for such modifications or for dissolution may not be initiated more often than once a year. Modification of controls also may be accomplished using the procedure in such sections.

Chapter 46. Irrigation.
Natural resources district; consult underground water storage permitholders; when.

46-656.23. A district shall, prior to adopting or amending any rules and regulations for a management area, consult with any holders of permits for intentional or incidental underground water storage and recovery issued pursuant to section 46-226.02, 46-233, 46-240, 46-241, 46-242, or 46-297.

Chapter 46. Irrigation.
Termination date April 1, 1997. Management area; boundaries encompassing existing ground water conservation district; powers and duties of natural resources district, Director of Environmental Quality, or Director of Water Resources; termination of section.

46-656.24. (1) Whenever the boundaries of a designated management area encompass either wholly or in part any existing ground water conservation district organized under sections 46-614 to 46-634, it shall be the duty of the natural resources district, the Director of Environmental Quality, or the Director of Water Resources, as the case may be, to actively consult with such ground water conservation district before adopting, amending, or repealing any control authorized by section 46-656.25 and before adopting methods, rules, and regulations for the enforcement of any adopted control.

(2) The natural resources district shall wherever possible utilize and draw upon existing research data, studies, data collection, or any other beneficial information which has been compiled by or is in the possession of ground water conservation districts, and in the interest of avoiding duplication of effort and the resultant unnecessary burden to the taxpayer, the ground water conservation district shall furnish such information or data upon the request of the district. Nothing in this section shall be interpreted to restrict the power of a ground water conservation district to collect data, undertake studies, or collect other information as prescribed in section 46-629, and such districts are hereby encouraged to actively exercise such authority.

(3) This section terminates on April 1, 1997.

Chapter 46. Irrigation.

Natural resources district; controls authorized; uniformity, exception; different water allocations authorized; restrict issuance of permits; joint exercise of authority between districts.

46-656.25. (1) A district in which a management area has been designated shall by order adopt one or more of the following controls for the management area:

(a) It may determine the permissible total withdrawal of ground water for each day, month, or year and allocate such withdrawal among the ground water users;

(b) It may adopt a system of rotation for use of ground water;

(c) It may adopt well-spacing requirements more restrictive than those found in sections 46-609 and 46-651;

(d) It may require the installation of devices for measuring ground water withdrawals from water wells;

(e) It may adopt a system which requires reduction of irrigated acres pursuant to subsection (2) of section 46-656.26;

(f) It may require the use of best management practices;

(g) It may require the analysis of water or deep soils for fertilizer and chemical content;

(h) It may provide educational requirements, including mandatory educational requirements, designed to protect water quality or to stabilize or reduce the incidence of ground water depletion, conflicts between ground water users and surface water appropriators, disputes over interstate compacts or decrees, or difficulties fulfilling the provisions of other formal state contracts or agreements;

(i) It may require water quality monitoring and reporting of results to the district for all water wells within all or part of the management area; and

(j) It may adopt and promulgate such other reasonable rules and regulations as are necessary to carry out the purpose for which a management area was designated.

(2) In adopting, amending, or repealing any control authorized by subsection (1) of this section or sections 46-656.26 and 46-656.27, the district's considerations shall include, but not be limited to, whether it reasonably appears that such action will mitigate or eliminate the condition which led to designation of the management area or will improve the administration of the area.

(3) Upon request by the district, the Director of Water Resources shall review and comment on the adoption, amendment, or repeal of any authorized control in a management area. The director may hold a public hearing to consider testimony regarding the control prior to commenting on the adoption, amendment, or repeal of the control. The director shall consult with the district and fix a time, place, and date for such hearing. In reviewing and commenting on an authorized control in a management area, the director's considerations shall include, but not be limited to, those enumerated in subsection (2) of this section.

(4) If because of varying ground water uses, varying surface water uses, different irrigation distribution systems, or varying climatic, hydrologic, geologic, or soil conditions existing within a management area the uniform application throughout such area of one or more controls would fail to carry out the intent of the Nebraska Ground Water Management and Protection Act in a reasonably effective and equitable manner, the controls adopted by the district pursuant to this section may contain different provisions for different categories of ground water use or portions

of the management area which differ from each other because of varying climatic, hydrologic, geologic, or soil conditions. Any differences in such provisions shall recognize and be directed toward such varying ground water uses or varying conditions. Except as otherwise provided in this section, the provisions of all controls for different categories of ground water use shall be uniform for all portions of the area which have substantially similar climatic, hydrologic, geologic, and soil conditions.

(5) The district may establish different water allocations for different irrigation distribution systems, on the condition that such different water allocations shall be authorized for no more than five years from the time such allocations are adopted.

(6)(a) The district may establish different provisions for different hydrologic relationships between ground water and surface water.

(b) For management areas a purpose of which is the integrated management of hydrologically connected ground water and surface water, the district may establish different provisions for water wells constructed before the designation of a management area for integrated management of hydrologically connected ground water and surface water and for water wells constructed on or after the designation date or any other later date or dates established by the district.

(c) The district shall make a replacement water well as defined in section 46-602, or as further defined in district rules and regulations, subject to the same provisions as the water well it replaces.

(7) If the district determines, following a public hearing conducted pursuant to section 46-656.19, that the impact on surface water supplies or the depletion or contamination of the ground water supply in the management area or any portion of the management area is so excessive that the public interest cannot be protected solely through implementation of reasonable controls adopted pursuant to subsection (1) of this section, it may close all or a portion of the management area to the issuance of any additional permits for a period of not more than five calendar years. The area may be further closed thereafter by a similar procedure for additional time periods of the same length. Any such area may be reopened at any time the district determines that conditions warrant new permits at which time the district shall consider all previously submitted applications for permits in the order in which they were received.

(8) Whenever a management area designated under section 46-656.39 or 46-656.52 encompasses portions of two or more districts, the responsibilities and authorities delegated in this section and sections 46-656.26 and 46-656.27 shall be exercised jointly and uniformly by agreement of the respective boards of all districts so affected. Whenever management areas designated by two or more districts adjoin each other, the districts are encouraged to exercise the responsibilities and authorities jointly and uniformly by agreement of the respective boards.

(9) For the purpose of determining whether conflicts exist between ground water users and surface water appropriators, surface water appropriators under the Nebraska Ground Water Management and Protection Act does not include holders of instream flow appropriations under sections 46-2,107 to 46-2,119.

Chapter 46. Irrigation.
Ground water allocation; limitations and conditions.

46-656.26. (1) If allocation is adopted for use of ground water for irrigation purposes in a management area, the permissible withdrawal of ground water shall be allocated equally per irrigated acre except as permitted by subsections (4) through (6) of section 46-656.25. Such allocation shall specify the total number of acre-inches that are allocated per irrigated acre per year, except that the district may allow a ground water user to average his or her allocation over any reasonable period of time not to exceed five years. A ground water user may use his or her allocation on all or any part of the irrigated acres to which the allocation applies.

(2) If annual rotation or reduction of irrigated acres is adopted for use of ground water for irrigation purposes in a management area, the nonuse of irrigated acres shall be a uniform percentage reduction of each landowner's irrigated acres within the management area or a subarea of the management area. Such uniform reduction may be adjusted for each landowner based upon crops grown on his or her land to reflect the varying consumptive requirements between crops.

Chapter 46. Irrigation.
District; review allocation, rotation, or reduction control; considerations.

46-656.27. A district may annually and shall at least once every three years review any allocation, rotation, or reduction control imposed in a management area and shall adjust allocations, rotations, or reductions to accommodate new or additional uses or otherwise reflect findings of such review, consistent with the ground water management objectives. Such review shall consider new development or additional ground water uses within the area, more accurate data or information that was not available at the time of the allocation, rotation, or reduction order, the availability of supplemental water supplies, any changes in ground water recharge, and such other factors as the district deems appropriate.

Chapter 46. Irrigation and Regulation of Water.
Joint action plan for integrated management of ground and surface water; preparation; when; procedure; factors; notice; hearing; determination; order; publication; modification; water use monitored.

46-656.28. (1) If a district on its own motion or following a request by a surface water appropriator, surface water project sponsor, ground water user, the Department of Water Resources, or another state agency has reason to believe that a management area should be designated for integrated management of hydrologically connected ground water and surface water or that controls in a management area should be adopted to include such integrated management, the district may utilize the procedures established in sections 46-656.19 to 46-656.21 or may request that the affected appropriators, the affected surface water project sponsors, and the Department of Water Resources consult with the district and that studies and a hearing be held on the preparation of a joint action plan for the integrated management of hydrologically connected ground water and surface water.

(2) If, following a request from a district and as a result of information available to the Department of Water Resources and following preliminary investigation, the Director of Water

Resources makes a preliminary determination that there is a reason to believe that the use of hydrologically connected ground water and surface water resources is contributing to or is in the reasonably foreseeable future likely to contribute to (a) conflicts between ground water users and surface water appropriators, (b) disputes over interstate compacts or decrees, or (c) difficulties fulfilling the provisions of other formal state contracts or agreements, the department shall, in cooperation with any appropriate state agency and district, conduct or coordinate any necessary studies to determine the cause of such conflicts, disputes, or difficulties and the extent of the area affected. Such studies shall be prioritized and completed within a reasonable time following such preliminary determination. The department shall issue a written report of such preliminary findings within ninety days after the completion of any such studies. The department shall consider all relevant portions of the ground water management plan developed by the district pursuant to sections 46-656.12 to 46-656.16 during the study required by this section.

(3) If the director determines from any studies conducted pursuant to subsection (2) of this section or from information otherwise available that the use of hydrologically connected ground water and surface water resources is contributing to or is in the reasonably foreseeable future likely to contribute to conflicts between ground water users and surface water appropriators, to disputes over interstate compacts or decrees, or to difficulties fulfilling the provisions of other formal state contracts or agreements and that conflicts between ground water users and surface water appropriators, disputes over interstate compacts or decrees, or difficulties fulfilling the provisions of other formal state contracts or agreements could be eliminated or reduced through the exercise of the authority granted by subsection (5) of this section, he or she shall, within thirty days after completion of the report required by subsection (2) of this section, consult with the affected surface water appropriators and district containing the area affected by such conflicts, disputes, or difficulties and fix a time and place for a public hearing to consider the report, hear any other relevant evidence, and secure testimony on whether a joint action plan should be prepared. The hearing shall be held within ninety days after completion of the report, shall be open to the public, and shall be located within or in reasonable proximity to the area considered in the report. Notice of the hearing shall be published in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks. The last publication shall be not less than seven days prior to the hearing. The notice shall provide a general description of all areas which will be considered for inclusion in the management area for which the district and director are considering in the preparation of a joint action plan.

(4) At the hearing, all interested persons shall be allowed to appear and present testimony. The Conservation and Survey Division of the University of Nebraska, the Department of Health, the Department of Environmental Quality, the Nebraska Natural Resources Commission, the affected surface water project sponsor or sponsors, and the appropriate surface water appropriators and district or districts may offer as evidence any information in their possession relevant to the purpose of the hearing. Within ninety days after the hearing or after any further studies or investigations conducted by or on behalf of the Director of Water Resources as he or she deems necessary, the district shall determine by order whether to proceed with developing a joint action plan for integrated management.

If the district determines that it should proceed and the district and the director determine that a joint action plan should be prepared, the district and the director shall develop a joint action plan to be utilized within the area in order to mitigate or eliminate conflicts between ground water users and surface water appropriators, disputes over interstate compacts or decrees, or difficulties fulfilling the provisions of other formal state contracts or agreements.

(5) The district's portion of the joint action plan developed under this section shall include one or more of the controls authorized by section 46-656.25 and shall be completed within one year after the date of the district's resolution to proceed. The portion of the joint action plan developed by the Department of Water Resources shall be completed within one year after the date of the district's resolution to proceed and shall include one or more of the following measures concerning the use of surface water:

(a) Increased monitoring and enforcement of surface water diversion rates and amounts diverted annually;

(b) The prohibition or limitation of additional surface water appropriations;

(c) Requirements for surface water appropriators to apply or utilize reasonable conservation measures or best management practices consistent with the good husbandry and other requirements of section 46-231; or

(d) Other reasonable restrictions on surface water use that are consistent with the intent of section 46-656.05 and the requirements of section 46-231.

If the department determines that surface water appropriators should be required to apply or utilize reasonable conservation measures or best management practices, the department's portion of the joint action plan shall allow the affected surface water appropriators and surface water project sponsors a reasonable amount of time, not to exceed one hundred eighty days unless extended by the department, to identify the conservation measures or best management practices to be applied or utilized and a schedule for such application and utilization.

(6) In developing their respective portions of the joint action plan authorized by subsection (5) of this section, the department and the district shall consider, but not be limited to considering, whether it reasonably appears that such action would mitigate or eliminate the condition which led to designation of the management area or the adoption of a joint action plan for the management area or will improve the administration of the management area.

(7) The district shall also determine that designation of a management area and adoption of a joint action plan would be in the public interest.

(8) Neither well registration dates nor appropriation dates shall be a factor in determining whether a management area shall be designated or a joint action plan prepared.

(9) In determining whether designating a management area or adopting a joint action plan would be in the public interest, the district shall consider (a) the impacts of the existing or projected diminution or degradation of water resources on (i) surface water appropriators, (ii) ground water users, (iii) public health and safety, (iv) social, economic, and environmental values in the affected area or areas, and (v) compliance with state laws, rules, or regulations, including, but not limited to, constitutional and statutory preferences in the use of water and interstate compacts or decrees, and (b) whether designation and implementation of a management area or adoption and implementation of a joint action plan would prevent or alleviate the impact of such

diminution or degradation of water resources.

(10) Following completion of the district's and the director's portions of the joint action plan, the district, in order to establish a management area, shall fix a time and place for a public hearing to consider the joint action plan information and to hear any other relevant evidence. The hearing shall be held within sixty days after completion of the joint action plan and shall be located within or in reasonable proximity to the area proposed for designation as a management area.

Notice of the hearing shall be published at the expense of the district in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks. The last publication shall be not less than seven days prior to the hearing. The notice shall provide a general description of the contents of the joint action plan and of the area which will be considered for inclusion in the management area and shall provide the text of all controls proposed for adoption by the district and the department.

All interested persons shall be allowed to appear and present testimony. The hearing shall include testimony of a representative of the department and shall include the results of any studies or investigations conducted by the district or the director.

(11) Within ninety days after the hearing the district shall determine by order whether a management area shall be designated.

If the district determines that a management area shall be established, the district shall by order designate the area as a management area and shall adopt the joint action plan, to include one or more controls authorized by section 46-656.25 and subsection (5) of this section to be utilized within the area in order to mitigate or eliminate the conflicts, disputes, or difficulties described in subsection (9) of this section. Such an order shall include a geographic and stratigraphic definition of the area. The boundaries and controls shall take into account any considerations brought forth at the hearing and administrative factors directly affecting the ability of the district to implement and carry out local ground water management.

The controls adopted shall not include controls substantially different from those set forth in the notice of the hearing. The area designated by the order shall not include any area not included in the notice of the hearing.

(12) The district shall cause a copy of any order adopted pursuant to subsection (11) of this section to be published once each week for three consecutive weeks in a local newspaper published or of general circulation in the area involved. The last publication shall be not less than ten days prior to the effective date of the order. The order shall become effective on the date specified by the district but not later than ninety days after the date of establishment of the management area.

(13) Modification of a district's portion of a joint action plan may be accomplished utilizing the procedure established for the initial adoption of the joint action plan. Modification of the boundaries of a district-designated management area for integrated management or dissolution of such an area shall be in accordance with the procedures established in sections 46-656.19 to 46-656.21. Hearings for such modifications or for dissolution may not be initiated more often than once a year. Modification of controls also may be accomplished using the procedure in such sections.

(14) Each district in which a joint action plan for a management area has been adopted shall, in cooperation with the surface water appropriators, any surface water project sponsors, and the department, establish a program to monitor use of hydrologically connected ground water and surface water resources in the area which is contributing to or is in the reasonably foreseeable future likely to contribute to conflicts between ground water users and surface water appropriators, to disputes over interstate compacts or decrees, or to difficulties fulfilling the provisions of other formal state contracts or agreements.

(15) For the purpose of determining whether conflicts exist between ground water users and surface water appropriators, surface water appropriators under the Nebraska Ground Water Management and Protection Act does not include holders of instream flow appropriations under sections 46-2,107 to 46-2,119.

Chapter 46. Irrigation.

Construct water well in a management area; permit required; application; form; fee; contents; late permit application; fee.

46-656.29. (1) Any person who intends to construct a water well in a management area in this state on land which he or she owns or controls shall, before commencing construction, apply with the district in which the water well will be located for a permit on forms provided by the district, except that (a) no permit shall be required for test holes or dewatering wells with an intended use of ninety days or less, (b) no permit shall be required for water wells designed and constructed to pump fifty gallons per minute or less, and (c) a district may provide by rule and regulation that a permit need not be obtained for water wells defined by the district to be replacement water wells. Forms shall be made available at each district in which a management area is located, in whole or in part, and at such other places as may be deemed appropriate. The district shall review such application and issue or deny the permit within thirty days after the application is filed.

(2) A person shall apply for a permit under this section before he or she modifies a water well for which a permit was not required under subsection (1) of this section into one for which a permit would otherwise be required under such subsection.

(3) The application shall be accompanied by a seventeen-dollar-and-fifty-cent filing fee payable to the district and shall contain (a) the name and post office address of the applicant or applicants, (b) the nature of the proposed use, (c) the intended location of the proposed water well or other means of obtaining ground water, (d) the intended size, type, and description of the proposed water well and the estimated depth, if known, (e) the estimated capacity in gallons per minute, (f) the acreage and location by legal description of the land involved if the water is to be used for irrigation, (g) a description of the proposed use if other than for irrigation purposes, (h) the registration number of the water well being replaced if applicable, and (i) such other information as the district requires.

(4) Any person who has failed or in the future fails to obtain a permit required by subsection (1) or (2) of this section shall make application for a late permit on forms provided by the district.

(5) The application for a late permit shall be accompanied by a two-hundred-fifty-dollar fee payable to the district and shall contain the same information required in subsection (3) of this section.

Chapter 46. Irrigation.
Permit; when denied; corrections allowed; fees nonrefundable.

46-656.30. An application for a permit or late permit for a water well in a management area shall be denied only if the district in which the water well is to be located finds (1) that the location or operation of the proposed water well or other work would conflict with any regulations or controls adopted by the district, (2) that the proposed use would not be a beneficial use of water for domestic, agricultural, manufacturing, or industrial purposes, or (3) in the case of a late permit only, that the applicant did not act in good faith in failing to obtain a timely permit.

If the district finds that the application is incomplete or defective, it shall return the application for correction. If the correction is not made within sixty days, the application shall be canceled. All permits shall be issued with or without conditions attached or denied not later than thirty days after receipt by the district of a complete and properly prepared application.

A permit issued shall specify all regulations and controls adopted by a district relevant to the construction or utilization of the proposed water well. No refund of any application fees shall be made regardless of whether the permit is issued, canceled, or denied. The district shall transmit one copy of each permit issued to the Director of Water Resources.

Chapter 46. Irrigation.
Issuance of permit; no right to violate rules, regulations, or controls.

46-656.31. The issuance by the district of a permit pursuant to section 46-656.30 or registration of a water well by the Director of Water Resources pursuant to section 46-602 shall not vest in any person the right to violate any district rule, regulation, or control in effect on the date of issuance of the permit or the registration of the water well or to violate any rule, regulation, or control properly adopted after such date.

Chapter 46. Irrigation.
Issuance of permit; commence construction and complete water well within one year; failure; effect.

46-656.32. When any permit is approved pursuant to section 46-656.30, the applicant shall commence construction as soon as possible after the date of approval and shall complete the construction and equip the water well prior to the date specified in the conditions of approval, which date shall be not more than one year after the date of approval, unless it is clearly demonstrated in the application that one year is an insufficient period of time for such construction. If the applicant fails to complete the project under the terms of the permit, the district may withdraw the permit.

Chapter 46. Irrigation.
Director of Water Resources; rules and regulations; Ground Water Management Fund; created; use; investment.

46-656.33. All fees paid to the Director of Water Resources in accordance with the terms of the Nebraska Ground Water Management and Protection Act shall be paid into the Ground Water Management Fund which is hereby created and which shall be administered by the director. Any money credited to the fund may be utilized by the director for payments of expenses incurred in the administration of the act. Any money in the fund available for investment shall be invested by the state investment officer pursuant to the Nebraska Capital Expansion Act and the Nebraska State Funds Investment Act.

Chapter 46. Irrigation.
Repealed. Laws 1996, LB 1114,.s. 75. (Operative date July 1, 1998.) District encompassed in a management area; tax levy; purpose; administration.
46-656.34. Each district encompassed in whole or in part by a management area shall have the power and authority to annually levy a tax not to exceed one and eight-tenths cents on each one hundred dollars annually on all of the taxable property within the district. Such levy, which shall be in addition to that authorized by section 2-3225, shall be utilized only for the costs of carrying out the Nebraska Ground Water Management and Protection Act within the district. Certification and collection of such levy shall be administered by the district and by the county or counties involved in the same manner as the levy authorized by section 2-3225.

Chapter 46. Irrigation.
Management area; reports required.
46-656.35. Each state agency and political subdivision shall promptly report to the Department of Environmental Quality any information which indicates that contamination is occurring.

Chapter 46. Irrigation.
Management area; Department of Environmental Quality; conduct study; when; report.
46-656.36. If, as a result of information provided pursuant to section 46-656.35 or studies conducted by or otherwise available to the Department of Environmental Quality and following preliminary investigation, the Director of Environmental Quality makes a preliminary determination (1) that there is reason to believe that contamination of ground water is occurring or likely to occur in an area of the state in the reasonably foreseeable future and (2) that the natural resources district or districts in which the area is located have not designated a management area or have not implemented adequate controls to prevent such contamination from occurring, the department shall, in cooperation with any appropriate state agency and district, conduct a study to determine the source or sources of the contamination and the area affected by such contamination and shall issue a written report within one year of the initiation of the study. During the study, the department shall consider the relevant water quality portions of the management plan developed by each district pursuant to 46-656.12 to 46-656.16, whether the district has designated a management area encompassing the area studied, and whether the district has adopted any controls for the area.

Chapter 46. Irrigation.
Management area; contamination; point source; Director of Environmental Quality; duties.
46-656.37. If the Director of Environmental Quality determines from the study conducted pursuant to section 46-656.36 that one or more sources of contamination are point sources, he or

she shall expeditiously use the procedures authorized in the Environmental Protection Act to stabilize or reduce the level and prevent the increase or spread of such contamination.

Chapter 46. Irrigation.
Management area; contamination; not point source; Director of Environmental Quality; duties; hearing; notice.

46-656.38. If the Director of Environmental Quality determines from the study conducted pursuant to section 46-656.36 that one or more sources of contamination are not point sources and if a management area, a purpose of which is protection of water quality, has been established which includes the affected area, the Director of Environmental Quality shall consider whether to require the district which established the management area to adopt an action plan as provided in sections 46-656.39 to 46-656.43.

If the Director of Environmental Quality determines that one or more of the sources are not point sources and if such a management area has not been established or does not include all the affected area, he or she shall, within thirty days after completion of the report required by section 46-656.36, consult with the district within whose boundaries the area affected by such contamination is located and fix a time and place for a public hearing to consider the report, hear any other evidence, and secure testimony on whether a management area should be designated or whether an existing area should be modified. The hearing shall be held within one hundred twenty days after completion of the report, shall be open to the public, and shall be located within or in reasonable proximity to the area considered in the report. Notice of the hearing shall be published in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks, the last publication to be not less than seven days prior to the hearing. The notice shall provide a general description of all areas which will be considered for inclusion in the management area.

At the hearing, all interested persons shall be allowed to appear and present testimony. The Conservation and Survey Division of the University of Nebraska, the Department of Health and Human Services Regulation and Licensure, the Department of Water Resources, the Nebraska Natural Resources Commission, and the appropriate district may offer as evidence any information in their possession which they deem relevant to the purpose of the hearing. After the hearing and after any studies or investigations conducted by or on behalf of the Director of Environmental Quality as he or she deems necessary, the director shall determine whether a management area shall be designated.

Chapter 46. Irrigation.
Management area; designation or modification of boundaries; adoption of action plan; considerations; procedures; order.

46-656.39. (1) When determining whether to designate or modify the boundaries of a management area or to require a district which has established a management area, a purpose of which is protection of water quality, to adopt an action plan for the affected area, the Director of Environmental Quality shall consider:

(a) Whether contamination of ground water has occurred or is likely to occur in the reasonably foreseeable future;

(b) Whether ground water users, including, but not limited to, domestic, municipal, industrial, and agricultural users, are experiencing or will experience within the foreseeable future substantial economic hardships as a direct result of current or reasonably anticipated activities which cause or contribute to contamination of ground water;

(c) Whether methods are available to stabilize or reduce the level of contamination;

(d) Whether, if a management area has been established which includes the affected area, the controls adopted by the district pursuant to section 46-656.25 as administered and enforced by the district are sufficient to address the ground water quality issues in the management area; and

(e) Administrative factors directly affecting the ability to implement and carry out regulatory activities.

(2) If the Director of Environmental Quality determines that no such area should be established, he or she shall issue an order declaring that no management area shall be designated.

(3) If the Director of Environmental Quality determines that a management area shall be established, that the boundaries of an existing management area shall be modified, or that the district shall be required to adopt an action plan, he or she shall consult with relevant state agencies and with the district or districts affected and determine the boundaries of the area, taking into account the effect on political subdivisions and the socioeconomic and administrative factors directly affecting the ability to implement and carry out local ground water management, control, and protection. The report by the Director of Environmental Quality shall include the specific reasons for the creation of the management area or the requirement of such an action plan and a full disclosure of the possible causes.

(4) When the boundaries of an area have been determined or modified, the Director of Environmental Quality shall issue an order designating the area as a management area, specifying the modified boundaries of the management area, or requiring such an action plan. Such an order shall include a geographic and stratigraphic definition of the area.

Chapter 46. Irrigation.
Management area; action plan; preparation by district; when; hearing; notice; publication.

46-656.40. (1) Within one hundred eighty days after the designation of a management area or the requiring of an action plan for a management area, a purpose of which is protection of water quality, the district or districts within whose boundaries the area is located shall prepare an action plan designed to stabilize or reduce the level and prevent the increase or spread of ground water contamination. Whenever a management area or the affected area of such a management area encompasses portions of two or more districts, the responsibilities and authorities delegated in this section shall be exercised jointly and uniformly by agreement of the respective boards of all districts so affected.

(2) Within thirty days after an action plan has been prepared, a public hearing on such plan shall be held by the district in reasonable proximity to the area to be affected. Notice of the hearing shall be published in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks, the last publication to be not less than seven days prior to the hearing. The notice shall provide a general description of all areas to be affected by

the proposed action plan and shall provide the text of all controls proposed for adoption by the district.
(3) Within thirty days after the hearing, the district shall adopt and submit an action plan to the department.

Chapter 46. Irrigation.
Management area; action plan; contents.
46-656.41. An action plan filed by a district pursuant to section 46-656.40 shall include the specifics of an educational program to be instituted by the district to inform persons of methods available to stabilize or reduce the level or prevent the increase or spread of ground water contamination. The action plan shall include one or more of the controls authorized by section 46-656.25.

Chapter 46. Irrigation.
Management area; adoption or amendment of action plan; considerations; procedures.
46-656.42. (1) In adopting or amending an action plan authorized by subsection (2) of this section, the district's considerations shall include, but not be limited to, whether it reasonably appears that such action will mitigate or eliminate the condition which led to designation of the management area or the requirement of an action plan for a management area or will improve the administration of the area.
(2) The Director of Environmental Quality shall approve or deny the adoption or amendment of an action plan within one hundred twenty days after the date the plan is submitted by the district. He or she may hold a public hearing to consider testimony regarding the action plan prior to the issuance of an order approving or disapproving the adoption or amendment. In approving the adoption or amendment of the plan in such an area, considerations shall include, but not be limited to, those enumerated in subsection (1) of this section.
(3) If the director denies approval of an action plan by the district, the order shall list the reason the action plan was not approved. A district may submit a revised action plan within sixty days after denial of its original action plan to the director for approval subject to section 46-656.45.

Chapter 46. Irrigation.
Management area; district publish control adopted.
46-656.43. Following approval of the action plan by the Director of Environmental Quality, the district shall cause a copy of each control adopted pursuant to section 46-656.42 to be published once each week for three consecutive weeks in a newspaper published or of general circulation in the area involved, the last publication of which shall be not less than seven days prior to the date when such control becomes effective.

Chapter 46. Irrigation.
Management area; district; duties.
46-656.44. Each district in which a management area has been designated or an action plan for

a management area has been required pursuant to section 46-656.39 shall, in cooperation with the Department of Environmental Quality, establish a program to monitor the quality of the ground water in the area and shall if appropriate provide each landowner or operator of an irrigation system with current information available with respect to fertilizer and chemical usage for the specific soil types present and cropping patterns used.

Chapter 46. Irrigation.
Management area; director specify controls; when; powers and duties; hearing.

46-656.45. (1) The power to specify controls authorized by section 46-656.25 shall vest in the Director of Environmental Quality if (a) at the end of one hundred eighty days following the designation of a management area or the requiring of an action plan for a management area pursuant to section 46-656.39, a district encompassed in whole or in part by the management area has not completed and adopted an action plan, (b) a district does not submit a revised action plan within sixty days after denial of its original action plan, or (c) the district submits a revised action plan which is not approved by the director.

(2) If the power to specify controls in such a management area is vested in the Director of Environmental Quality, he or she shall within ninety days adopt and promulgate by rule and regulation such measures as he or she deems necessary for carrying out the intent of the Nebraska Ground Water Management and Protection Act. He or she shall conduct one or more public hearings prior to the adoption of controls. Notice of any such additional hearings shall be given in the manner provided in section 46-656.40. The enforcement of controls adopted pursuant to this section shall be the responsibility of the Department of Environmental Quality.

Chapter 46. Irrigation.
Management area; controls; duration; amendment of plan.

46-656.46. The controls in the action plan approved by the Director of Environmental Quality pursuant to section 46-656.42 shall be exercised by the district for the period of time necessary to stabilize or reduce the level of contamination and prevent the increase or spread of ground water contamination. An action plan may be amended by the same method utilized in the adoption of the action plan.

Chapter 46. Irrigation.
Management area; removal of designation or requirement of action plan; modification of boundaries; when.

46-656.47. A district may petition the Director of Environmental Quality to remove the director's designation of the area as a management area or the requirement of an action plan for a management area or to modify the boundaries of a management area designated pursuant to section 46-656.39. If the director determines that the level of contamination in a management area has stabilized at or been reduced to a level which is not detrimental to beneficial uses of ground water, he or she may remove the designation or action plan requirement or modify the boundaries of the management area.

Chapter 46. Irrigation.
Management area; Environmental Quality Council; adopt rules and regulations.
46-656.48. The Environmental Quality Council shall adopt and promulgate, in accordance with the Administrative Procedure Act, such rules and regulations as are necessary to the discharge of duties under sections 46-656.35 to 46-656.47.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; applicability of sections; report; contents.
46-656.49. Until January 1, 1999, sections 46-656.50 to 46-656.60 shall apply only to river basins subject to interstate compacts involving three or more states. A report shall be prepared by the natural resources districts in such basin or basins and presented to the Natural Resources Committee of the Legislature before December 1, 1998. The report shall include, but not be limited to, a review of any activities resulting from and relating to sections 46-656.50 to 46-656.60 and recommendations for specific changes to such sections or to other sections in the Nebraska Ground Water Management and Protection Act. On and after January 1, 1999, sections 46-656.50 to 46-656.60 shall apply to the entire state.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; studies authorized; report.
46-656.50. If, as a result of information available to the Department of Water Resources or a request by a district and following preliminary investigation, the Director of Water Resources makes a preliminary determination that there is reason to believe that (1) the use of hydrologically connected ground water and surface water resources is contributing to or is in the reasonably foreseeable future likely to contribute to disputes over interstate compacts or decrees or to difficulties fulfilling the provisions of other formal state contracts or agreements and (2) the natural resources district or districts in which such use is located have not designated a management area or have not implemented adequate controls to prevent such disputes or difficulties, the department shall, in cooperation with any appropriate state agency and natural resources district, coordinate any necessary studies to determine the cause of such disputes or difficulties and the extent of the area affected. Such studies shall be prioritized and completed within a reasonable time following such preliminary determination. The department shall issue a written report of such preliminary findings within ninety days after the completion of any such studies. The department shall consider the relevant water quantity portions of the ground water management plan developed by the district pursuant to sections 46-656.12 to 46-656.16 during the study required by this section.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; action plan authorized; when; hearing; procedure; notice; order.
46-656.51. (1) If the Director of Water Resources determines from any studies conducted pursuant to section 46-656.50, or from information otherwise available, that the use of

hydrologically connected ground water and surface water resources is contributing to or is in the reasonably foreseeable future likely to contribute to disputes over interstate compacts or decrees or to difficulties fulfilling the provisions of other formal state contracts or agreements and if a management area has been established which includes the affected area, the director shall decide whether to request the district which established the management area to adopt an action plan as provided in sections 46-656.53 to 46-656.57 in addition to the controls previously adopted by the district pursuant to section 46-656.25. The district may agree to that request and begin preparing an action plan under section 46-656.53 or may inform the director that it will not prepare an action plan unless the director requires the district to do so under subsection (2) of this section and section 46-656.52.

(2) If the director determines that the use of hydrologically connected ground water and surface water resources is contributing to or is in the reasonably foreseeable future likely to contribute to disputes or difficulties described in subsection (1) of this section and that (a) a management area has not been established or (b) he or she is considering whether to require the district to prepare an action plan for all or part of an established management area, he or she shall, within thirty days after completion of the report required by section 46-656.50, consult with the district containing the area affected by such disputes or situations and fix a time and place for a public hearing to consider the report, hear any other evidence, and secure testimony on whether a management area should be designated or whether the district should be required to prepare an action plan. The hearing shall be held within ninety days after completion of the report, shall be open to the public, and shall be located within or in reasonable proximity to the area considered in the report. Notice of the hearing shall be published in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks. The last publication shall be not less than seven days prior to the hearing. The notice shall provide a general description of all areas which will be considered for inclusion in the management area for which the director is considering designation or requiring the preparation of an action plan.

At the hearing, all interested persons shall be allowed to appear and present testimony. The Conservation and Survey Division of the University of Nebraska, the Department of Health, the Department of Environmental Quality, the Nebraska Natural Resources Commission, the affected surface water project sponsor or sponsors, the appropriate surface water appropriators, and the appropriate district or districts may offer as evidence any information in their possession relevant to the purpose of the hearing. Within thirty days after the hearing or after any studies or investigations conducted by or on behalf of the Director of Water Resources as he or she deems necessary, the director shall determine by order whether a management area shall be designated or an action plan required.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; designation of management area or preparation of action plan; determination; Director of Water Resources; powers and duties.

46-656.52. (1) The Director of Water Resources may designate a management area to allow the integrated management of hydrologically connected resources or require the district to prepare an action plan under sections 46-656.53 to 46-656.60 if the Department of Water Resources determines:

(a) That the quantity of surface water resources is being substantially and adversely impacted or is likely to be substantially and adversely impacted in the foreseeable future because of the use of hydrologically connected ground water resources;

(b) That substantial and adverse impact is contributing to or is in the reasonably foreseeable future likely to contribute to disputes over an interstate compact or decree or to difficulties fulfilling the provisions of other formal state contracts or agreements;

(c) That designating a management area or requiring preparation of an action plan would mitigate or eliminate the disputes over the interstate compact or decree or the difficulties in fulfilling the provisions of other formal state contracts or agreements; and

(d) That designating a management area or requiring preparation of an action plan would be in the public interest.

(2) In determining whether designating a management area or requiring preparation of an action plan would be in the public interest, the director shall consider (a) the impacts of the existing or projected diminution or degradation of water resources on (i) surface water appropriators, (ii) ground water users, (iii) public health and safety, (iv) social, economic, and environmental values in the affected area or areas, and (v) compliance with state laws, rules, or regulations, including, but not limited to, constitutional and statutory preferences in the use of water and interstate compacts or decrees, and (b) whether designation and implementation of a management area or preparation and implementation of an action plan would mitigate or eliminate the impact of such diminution or degradation.

(3) Neither well registration dates nor appropriation dates shall be a factor in determining whether a management area shall be designated or a joint action plan prepared.

(4) If the director determines that a management area shall be established or that the district shall be required to adopt an action plan, he or she shall consult with relevant state agencies and with the district or districts affected and determine the boundaries of the area, taking into account the effect on political subdivisions and the socioeconomic and administrative factors directly affecting the ability to implement and carry out local ground water and surface water management, control, and protection. The report by the director shall include the specific reasons for the creation of the management area or the requirement of such an action plan and a full disclosure of the possible causes.

(5) When the boundaries of an area have been determined, the director shall issue an order designating the area as a management area or requiring such an action plan. Such an order shall include a geographic and stratigraphic definition of the area.

Chapter 46. Irrigation and Regulation of Water.

Disputes over interstate compacts or decrees; additional action plan required; when; hearing; notice; district; duties.

46-656.53. (1) Within one year after the designation of a management area or the requiring of an action plan for a management area, the Department of Water Resources, the surface water project sponsor or sponsors, and the district or districts within which the area is located shall, in consultation with each other, prepare an action plan designed to mitigate or eliminate the incidence of disputes over interstate compacts or decrees or of difficulties fulfilling the provisions of other formal state contracts or agreements. Whenever a management area or the affected area of such a management area encompasses portions of two or more districts, the responsibilities and authorities delegated in this section shall be exercised jointly and uniformly by agreement of the respective boards of all districts so affected.

(2) Within sixty days after an action plan has been prepared, one or more public hearings on such plan shall be held by the district and the department in reasonable proximity to the area or areas to be affected. Notice of each hearing shall be published in a newspaper published or of general circulation in the area involved at least once each week for three consecutive weeks. The last publication shall be not less than seven days prior to the hearing. The notice shall include a general description of all areas to be affected by the proposed action plan, the text of all controls proposed for adoption by the district, and the text of any surface water regulations prepared by the department.

(3) Within sixty days after the last hearing, the district shall adopt and submit its portion of the action plan to the department.

Chapter 46. Irrigation and Regulation of Water.

Disputes over interstate compacts or decrees; additional action plan; contents.

46-656.54. The district's portion of the action plan adopted under section 46-656.53 shall include one or more of the controls authorized by section 46-656.25. The portion of the action plan developed by the Department of Water Resources shall include one or more of the following measures concerning the use of surface water:

(1) Increased monitoring and enforcement of surface water diversion rates and amounts diverted annually;

(2) The prohibition or limitation of additional surface water appropriations;

(3) Requirements for surface water appropriators to apply or utilize reasonable conservation measures or best management practices consistent with the good husbandry and other requirements of section 46-231; or

(4) Other reasonable restrictions on surface water use that are consistent with the intent of section 46-656.05 and the requirements of section 46-231.

If the department determines that surface water appropriators should be required to apply or utilize reasonable conservation measures or best management practices, the department's portion of the plan shall allow the affected surface water appropriators and surface water project sponsors a reasonable amount of time, not to exceed one hundred eighty days unless extended by the department, to identify the proposed conservation measures or best management practices to be applied or utilized and a schedule for such application and utilization.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; district's portion of action plan; Director of Water Resources; approve or deny; procedure.

46-656.55. (1) In adopting or amending the respective portions of the action plan authorized by subsection (2) of this section, the Department of Water Resources and the district shall consider, but not be limited to considering, whether it reasonably appears that such action will mitigate or eliminate the condition which led to designation of the management area or the requirement of an action plan for the management area or will improve the administration of the area.

(2) The Director of Water Resources shall approve or deny the adoption or amendment of the surface water project sponsor's conservation measures and the district's portion of the action plan within ninety days after the date the plan is submitted by the district. He or she may hold a public hearing to consider testimony regarding the action plan prior to the issuance of an order approving or disapproving the adoption or amendment. In approving the adoption or amendment of the plan in such an area, considerations shall include, but not be limited to, those enumerated in subsection (1) of this section and the lawful exercise of the authority granted by the Nebraska Ground Water Management and Protection Act.

(3) If the director denies approval of the district's portion of an action plan, the order shall state the reasons for such denial. A district may, within ninety days after denial of its original action plan, submit a revised action plan to the director for approval subject to section 46-656.58.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; district's portion of action plan; publication; when.

46-656.56. Following approval of the district's portion of an action plan by the Director of Water Resources, the district shall cause a copy of each control adopted pursuant to section 46-656.55 to be published once each week for three consecutive weeks in a newspaper published or of general circulation in the area involved. The last publication shall be not less than seven days before the date such control becomes effective.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; water use monitored; when.

46-656.57. Each district in which a management area has been designated or an action plan for a management area has been required pursuant to section 46-656.52 shall, in cooperation with the surface water project sponsors and the Department of Water Resources, establish a program to monitor use of hydrologically connected ground water and surface water resources in the area which is contributing to or is in the reasonably foreseeable future likely to contribute to disputes over interstate compacts or decrees or to difficulties fulfilling the provisions of other formal state contracts or agreements.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; controls; duration; amendment authorized.
46-656.58. The controls in the district's portion of an action plan approved by the Director of Water Resources pursuant to section 46-656.55 shall be exercised by the district for the period of time necessary to reduce the use of hydrologically connected ground water and surface water resources in the area which is contributing to or is in the reasonably foreseeable future likely to contribute to disputes over interstate compacts or decrees or to difficulties fulfilling the provisions of other formal state contracts or agreements. An action plan may be amended by the same method utilized in the adoption of the action plan.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; removal of designation of management area or action plan; modification of boundaries of management area; director; powers.
46-656.59. A district may petition the Director of Water Resources to remove the designation of the area as a management area or the requirement of an action plan for a management area or to modify the boundaries of a management area designated pursuant to section 46-656.52. If the director determines that the use of hydrologically connected ground water and surface water resources in the area which is contributing to or is in the reasonably foreseeable future likely to contribute to disputes over interstate compacts or decrees or to difficulties fulfilling the provisions of other formal state contracts or agreements in a management area has stabilized at a level which is no longer detrimental to the public interest, he or she may remove the designation or action plan requirement or modify the boundaries of the management area.

Chapter 46. Irrigation and Regulation of Water.
Disputes over interstate compacts or decrees; specification of controls vested in Director of Water Resources; when; procedure.
46-656.60. (1) If (a) at the end of twelve months following the designation of a management area or the requiring of an action plan for a management area pursuant to section 46-656.52, a district encompassed in whole or in part by such a management area has not completed and adopted its portion of an action plan, (b) a district does not submit a revised action plan within ninety days after denial of its original action plan, or (c) the district submits a revised action plan which is not approved by the Director of Water Resources, the power to specify controls authorized in section 46-656.25 shall, subject to review and concurrence of need by the Interrelated Water Review Committee of the Nebraska Natural Resources Commission, vest in the Director of Water Resources.
(2) If, following a review, the committee fails to concur with the need for vesting the power to specify controls in the Director of Water Resources, the district may proceed with implementation of its portion of an action plan pursuant to sections 46-656.19 to 46-656.21.
(3) If the power to specify controls authorized in section 46-656.25 in such a management area

is vested in the director, he or she shall within ninety days adopt and promulgate by rule and regulation such authorized controls as he or she deems necessary for carrying out the intent of section 46-656.55. He or she shall conduct one or more public hearings prior to the adoption of controls. Notice of any such additional hearings shall be given in the manner provided in section 46-656.53. The enforcement of controls adopted pursuant to this section shall be the responsibility of the Department of Water Resources.

Chapter 46. Irrigation and Regulation of Water.
Interrelated Water Review Committee of the Nebraska Natural Resources Commission; created; members; powers.

46-656.61. The Interrelated Water Review Committee of the Nebraska Natural Resources Commission is created. The committee shall consist of the Governor and two commission members selected by the commission. The two commission members selected by the commission shall be selected only after a request for a decision by a district or the Department of Water Resources, and such members shall not reside or have an interest in real property in a district all or a portion of which is included in the current or proposed management area for integrated management of hydrologically connected ground water and surface water. The committee shall have the authority to determine which position will prevail when differences of opinion occur between districts and the Department of Water Resources on the questions of the need for, or adequacy of, district action plans and whether the power to specify ground water controls shall vest in the Director of Water Resources pursuant to section 46-656.60. The entity requesting a decision shall state in writing the differences of opinion and what decision the entity requests the committee to make.

Chapter 46. Irrigation and Regulation of Water.
Rules and regulations.

46-656.62. The Director of Water Resources shall adopt and promulgate, in accordance with the Administrative Procedure Act, such rules and regulations as are necessary to the discharge of duties assigned to the director or the Department of Water Resources by the Nebraska Ground Water Management and Protection Act.

Chapter 46. Irrigation.
Management area; violation; civil penalty.

46-656.63. Any person who violates any of the provisions of sections 46-656.35 to 46-656.62 for which a penalty is not otherwise provided, other than the requirements of a district, the Director of Water Resources, or the Department of Water Resources, shall be subject to a civil penalty of not more than five hundred dollars. Each day of continued violation shall constitute a separate offense.

Chapter 46. Irrigation.
Hearings; subject to review.

46-656.64. All hearings conducted pursuant to the Nebraska Ground Water Management and Protection Act shall be of record and available for review.

Chapter 46. Irrigation.
Administration of act; compliance with other laws.

46-656.65. In the administration of the Nebraska Ground Water Management and Protection Act, all actions of the Director of Environmental Quality, the Director of Water Resources, and the districts shall be consistent with the provisions of section 46-613.

Chapter 46. Irrigation.
Appeal; procedure.

46-656.66. Any person aggrieved by any order of the district, the Director of Environmental Quality, or the Director of Water Resources issued pursuant to the Nebraska Ground Water Management and Protection Act may appeal the order. The appeal shall be in accordance with the Administrative Procedure Act.

Chapter 46. Irrigation and Regulation of Water.
Interrelated Water Management Fund; created; use; investment.

46-656.67. The Interrelated Water Management Fund is created. The State Treasurer shall credit to the fund, for the purpose of conducting studies to determine the cause of current or potential conflicts between ground water users and surface water appropriators, disputes over interstate compacts or decrees, or difficulties fulfilling the provisions of other formal state contracts and agreements, such money as is specifically appropriated and such funds, fees, donations, gifts, or services or devises or bequests of real or personal property received by the Department of Water Resources from any federal, state, public, or private source, to be used by the department for the purpose of funding studies as described in this section. The department may use its budget authority to request appropriations specifically for the purpose of funding studies described in this section. The department shall allocate money from the fund for use by the department, by any state agency, board, or commission, or by any political subdivision of the state, by agreement, or by private organizations or firms as may be contracted with by the department. Any money in the fund available for investment shall be invested by the state investment officer pursuant to the Nebraska Capital Expansion Act and the Nebraska State Funds Investment Act.

Reference Outline, Ground Water Management Plan Amendments

Prepared by the Nebraska Department of Water Resources and the Nebraska Department of Environmental Quality

Reference Outline

Ground Water Management Plan Amendments

July 1992

Prepared By

Nebraska Department of Environmental Quality
and
Nebraska Department of Water Resources

printed on recycled paper

Reference Outline

Preface

In 1991, the Nebraska Legislature enacted Legislative Bill 51 which requires that "prior to July 1, 1993, each district shall amend its ground water management plan to identify to the extent possible the levels and sources of ground water contamination within the area, ground water quality goals, long-term solutions necessary to prevent the levels of ground water contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards, and practices recommended to stabilize, reduce, and prevent the occurrence, increase, or spread of ground water contamination."

It is the goal of this reference outline to provide a framework for ground water quality management that can be used by each district to: 1) evaluate existing ground water quality and inventory potential sources of ground water contamination; 2) develop a comprehensive description of the quality and vulnerability of the ground water; 3) identify the programs and practices that would be most effective in dealing with areas of existing and potential ground water contamination; and 4) evaluate the ground water monitoring program to determine the most efficient use of resources which will, in turn, enable the districts to more effectively understand and react to existing or potential ground water contamination.

The following outline provides a list of topics that would <u>ideally</u> be components of each revised ground water management plan. The outline is organized to provide a logical sequence of analysis beginning with the hydrogeologic characterization and culminating with an evaluation of the impact and effectiveness of the proposed ground water protection actions taken.

It is not the intent of this reference outline to require that each district automatically rewrite their plan to conform to the suggested format or sequence of analysis. However, the entire plan should be reviewed and evaluated to assess its ability to meet the needs of the District. Presentation of technical data can be accomplished in a number of different ways, e.g. according to watersheds, ground water reservoirs, counties, etc. Some information may already be classified according to one of the above mentioned groupings, and it would not be practical to rearrange the data according to a pre-determined grouping. Each district should determine which format will most effectively present the data. If the information to be contained in the plan is presented in an organized manner, the intent of the legislation can be fulfilled in a number of ways and in a number of different formats. The amount of revisions and the extent of reorganization will be unique to each district.

However, due to the importance being placed on protecting ground water resources, at all levels of government, and the likelihood of future related legislation and regulations, the format that is used should be easily amendable and expandable. Attached to this document is a list of format considerations developed by NDWR. Each district may want to consider maintaining their master plan copy in a three ring notebook. Format considerations should recognize the fact that the ground water management plans are growing, dynamic documents requiring periodic review and evaluation.

A very important element to this outline is the subsection category "Identified Needs and Data Deficiencies". The districts should use this subsection to identify the areas of analysis in which their data base is limited, or in which the relationships between the various components and ground water quality are not well known. This "needs assessment survey" will be one of the factors used to develop and prioritize the districts' goals, objectives, and programs.

The Nebraska Department of Environmental Quality (NDEQ), as the lead water quality agency, will assume responsibility for assisting the districts concerning the amendment of the plans. The Nebraska Department of Water Resources (NDWR) will be available for consultation concerning water quantity issues. In order to facilitate a solid relationship with the districts, NDEQ has created and filled a program specialist position specifically dedicated to providing close communications with the districts. Those districts that have concerns or questions will have the opportunity to consult the department and receive helpful and timely suggestions and comments.

The Department of Water Resources, as the approving agency, has indicated that acceptance and approval of each plan will be based on its own merits, rather than from satisfaction of a given set of requirements. The previous statutory requirements for ground water management plans continue to be pertinent.

Reference Outline

I. Introduction

The introduction should focus on describing the progress that each district has made towards implementing the objectives of the existing ground water management plan. Particular attention should be paid towards documenting the progress chronologically, including expected, as well as realized progress. Does the existing management goal reflect the needs of the District, and is it realistic? Include copies of review letters from earlier submittals, either in this section or as an attachment or appendix. Any public participation forums such as citizen advisory committees or public response meetings should be documented.

II. Hydrogeologic Characterization

The purpose of this section is to describe first the physical characteristics of aquifer(s), then describe the physical characteristics associated with vulnerability of the aquifer(s) to contamination. Much of the information asked for in this section was also required to be done for the original ground water management plans. Some districts may need only to update the information contained in the current plan, others may need a more extensive revision. Two prior publications, the Manual for Preparation of Ground Water Management Plans published in 1984, and A Manual on the Preparation of Special Ground Water Protection Area Action Plans published in 1990, both of which were prepared by the Conservation and Survey Division at the University of Nebraska-Lincoln, are excellent resources for clarification of the suggested parameters contained in this section.

A. Aquifer Description

1. Geographic/Areal Description

2. Physical Characteristics

    Description of General Geologic Setting
    Description of Surface Water/Ground Water Interaction
    Transmissivities of Separate Aquifers
    Saturated Thickness(es)
    Base and Top of Aquifer(s)
    Potentiometric Surface
        Confined/Unconfined
    Ground Water Fluctuations
    Geologic Cross-sections
    Flow Direction
    Significant Discharge Areas

B. Vulnerability Description

1. Surficial and Vadose Zone Description

a. Topography
Natural Recharge Areas
Slope

b. Surficial Soil Description
Infiltration Rate
Soil Composition and Structure
Soil Chemistry Summary

c. Vadose Zone Description
Infiltration Rate
Unconsolidated Sediment Characteristics
Deep Core Sampling Summary

d. Depth to Ground Water

2. External Ground Water Recharge Sources

a. Natural
Precipitation
Streams (gaining/losing)
Wetlands and Lakes
Recharge from adjacent ground water reservoirs

b. Artificial
Reservoirs
Surface Water Irrigation
Description of projects that provide intentional or incidental ground water recharge

3. Irrigation (Internal Recharge)

a. Spacing/density
b. Water Demand/Application Rates

C. Identified Needs and Data Deficiencies

III. Water Quality Inventory

This section should describe the district's current monitoring strategy, the results of the monitoring program, and an evaluation of the suitability of the ground water for current or potential uses. The purpose of this section is to stress the importance of accurate sampling and description of the monitoring program so that a clear interpretation of the results will lead to a better understanding of the existing water quality in the district.

Reference Outline

A. Current Water Quality Monitoring Program

1. Number, Location, and Construction Details of Sampling Points. Include Municipal Data.
2. Methodology/Protocol for Sampling
   Use of an EPA Certified Lab
   Certification of Water Well Monitoring Supervisors
3. Description of Database and QA/QC including a description of the constituents being analyzed

B. Existing Water Quality Summary

C. Suitability Characteristics

1. Potable (Domestic and/or Public)
2. Irrigation
3. Livestock
4. Industrial/Commercial

D. Identified Needs and Data Deficiencies

IV. Land Use and Contamination Source Inventory

The land use categories shown in this outline generally coincide with the categories used by the U.S.D.A. Soil Conservation Service (SCS)in their land use survey of Nebraska. The attached map shows the status of the digitized land use surveys that are being done by the SCS in cooperation with the Natural Resources Commission. However, each district may want to subdivide or generalize this information according to their own unique needs.

An important element to understanding existing and/or potential sources of ground water contamination is recognizing how land use and contamination sources interact with the physical environment. A recognition of recharge areas and other topographic and physical characteristics as defined in section II are especially critical to determining the impact that land use and the associated contamination sources may have on ground water quality.

Precipitation and irrigation water infiltration, with the potential for leaching of contaminants connected with land use practices into the ground water, is influenced to a large extent by topography. Therefore, the land use information and contamination sources inventory might best be depicted on a watershed-by-watershed basis.

A. Land Use

1. Urban
   Residential
   Parks/Golf Courses
   Commercial/Industrial
   Transportation Routes

2. Agricultural

Non-Irrigated Cropland

Surface Irrigated Cropland
Sprinkler Irrigated Cropland
Tailwater Irrigated Cropland
(Including the number of acres and primary crops grown)

Non-Irrigated Pasture

Surface Irrigated Pasture
Sprinkler Irrigated Pasture

Rangeland

Forest Land
Other Farmland (Orchards)
Barren Land

3. Other

Surface Water
Wildlife Reserves/Parks/Recreation Areas
Mining/Mineral Extraction Activities
Landfills (Open and Closed)

B. Contamination Source Inventory

1. Nonpoint Source Inventory (Known or Potential)
   - Residential Agrichemical Application
   - Erosion/Sediment Control Programs (Urban and Rural)
   - Park/Recreation Agrichemical Applications
   - Agricultural Activities (Nonpoint Sources)
     (Including Agrichemical Usage and Sales Data)

2. Point Source Inventory (Known or Potential)
   - Ammonia/Hazardous Waste Storage Facilities
   - Wellhead Protection Area Listing
   - Manufacturing/Industrial Activities (SIC code)
   - NPDES Permit Holders
   - Landfills - including extent of illegal dumping
   - Private/Municipal Water/Wastewater Treatment Facilities
   - Septic Tank Density
   - Agricultural Activities (Point Sources)
   - Abandoned Wells
   - Feedlots
   - Compost Operations
   - Land Application of Waste Sludge
   - Chemigation Permits

C. Identified Needs and Data Deficiencies

V. Water Usage and Demand

The purpose of this section is to develop a comprehensive evaluation of the amount and specific uses of ground water within the districts. Describe the availability and depletion history of the aquifer.

A. Domestic

1. Current Local/Regional Regulatory Framework and Programs
2. Current Population and Water Usage Summary

   Population Density
   Water Demand and Source(s)

3. Estimated Future Water Needs

   Population Growth
   Future Water Demand
   Future Water Source(s)
   - Availability of Alternate/Additional Sources
   - Feasibility of Acquiring Alternate Sources

B. Agricultural

1. Current Irrigation Demand

   Intensity/Density
   Demand/Metering Summary

2. Estimated Future Water Demand

   Potential Growth
   Intensity/Density
   Future Demand

C. Industrial

1. Current Demand
2. Future Demand

D. Fish and Wildlife

1. Current Needs
2. Future Needs

E. Recreation

1. Current Use
2. Future Use

F. Identified Needs and Data Deficiencies

VI. Identification of Critical Areas For Protection

This section should focus on evaluating the relationship between the various components, the physical setting, the land use(s), the associated current or potential contamination sources, and the water usage and demand, to describe the impact of current or potential ground water contamination. Particular attention should be paid to the land use(s) associated with physically vulnerable areas, and areas in which the quality of the ground water is essential to the current and/or future economic stability and physical health of the population utilizing the ground water resource.

A. Impact of Existing Land Uses on Ground Water Quality

Describe the relationship between existing land use(s) and aquifer vulnerability, focusing on critical geographic areas. Define the geographic areas as those areas in which the suitability, and/or the availability, of the ground water is being seriously impacted.

B. Potential Impact of Future Land Uses on Ground Water Quality

Evaluate the growth, or potential growth of the identified land uses and examine the possible impact on the suitability of the ground water considering both the future use(s) and the future demand. This could include such things as examining the potential for increased population density in a certain area and the resulting increase in water demand and an increased need for protection or action. Other areas of consideration may include evaluating the potential increase in irrigated acres and the potential impact on ground water quality.

C. Existing Quantity Depletion and the Resulting Impact on Ground Water Quality

Describe the geographic areas where depletion of the resource has occurred and the resulting impact, if any, on the quality of the ground water.

D. Potential Quantity Depletion and the Resulting Impact on Ground Water Quality

Evaluate the potential for depletion of the ground water due to the existing and/or potential water demand, and describe the potential impacts on ground water quality.

VII. Ground Water Quality Goals and Objectives

Two main questions arise when attempting to establish goals and objectives. The first is, what needs to be protected? Secondly, after defining the areas needing protection, how much protection is needed?

The first question is the basis of section VI of this reference outline. The second question is the subject of this section, and should be thought of in terms of the establishment of goals and objectives that are developed at the local level. Public input, either from community task forces or through other public forums, is crucial for development of meaningful goals and objectives.

In their simplest form, goals are general statements defining the scope, intention, and/or the end product of the actions taken. Objectives are subdivisions of the goals, and define the goals in more specific terms. Objectives should be measurable and include specific triggers and a timetable for implementation.

VIII. Ground Water Quality Programs and Practices

The most specific and detailed element of ground water protection plans is a description of individual programs and practices intended to address the defined goals and objectives. When considering specific programs and practices, several categories of goals and objectives exist, and the different categories require different programs and practices.

Will the actions be remedial in nature or preventive? Often, remedial actions require a substantial amount of resources in both time and money. Preventive measures may include education and information programs in the form of seminars, demonstration programs, and/or use of other medias.

Are the actions focusing on all pollution sources or a selection of priority sources? In other words what is the overall scope of the program? Due to limited financial and/or technical resources, some programs may concentrate on addressing a problem of a limited nature such as a concern with a specific community or geographic area. Other programs may concentrate on a concern that is of a more general nature that would be on a district wide scale.

Are the actions intended to be long-term programs of a sustained nature or short-term programs for specific concerns that may be resolved in a relatively short time frame? Long-term programs and strategies will require sustained resources that will necessitate long-term planning and budgeting estimates. Short-term programs may require more aggressive and intensive use of resources.

Finally, are the actions regulatory or non-regulatory in nature? Social, political, and economic influences all play a role in defining whether a regulatory or non-regulatory program will be most effective. Input from local citizens through task forces or public meetings is essential to determining the ability of regulatory/non-regulatory programs to accomplish the intended objective.

The defined programs and practices should also include a timetable for implementation and projected costs. Development and selection of alternate programs and practices that would produce the same desired effect should be evaluated from a cost standpoint and the least expensive alternative should then be selected.

IX. Plan Evaluation and Assessment

Evaluation of the ground water management plan should take into consideration the existing or potential physical, social, and economic impact of the programs and practices. How will the district know when, and if, a program is effective? What are the possible constraints or limitations, either physical, social, political, or economic, that could affect the outcome of a program? What measurements will be used to determine the effectiveness of a given program or practice? Each District should evaluate their own capabilities to determine whether additional experience or expertise is necessary to fully design, implement, and evaluate the plan.

Description of Control, Management, and Special Protection Areas

Prepared by the Nebraska Natural Resources Commission

STATE OF NEBRASKA

E. Benjamin Nelson
Governor

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MEMORANDUM

April 4, 1996

TO: Ron Bishop

FROM: Jim Cook Jim

SUBJECT: Revised Ground Water Management Areas Outline

Enclosed is a copy of the revised Groundwater Management Area outline for your distribution to the NRDs. The revisions were made in response to comments made at Monday's meeting and phone calls received since the meeting. I hope that districts find this helpful as they move towards designation of management areas and the implementation of controls in those areas.

As noted in the title, and in the last item on page 9, this outline will become largely obsolete when LB 108 becomes effective in mid-July, assuming of course that it passes. However, many districts are working their way through these processes right now and the outline details the procedures that will be in effect until that time. If LB 108 does pass, I will attempt to modify the outline before the effective date. Another meeting of the same type held on Monday, but to reflect the LB 108 changes, might be in order some time in the summer.

Thanks for taking care of distribution.

JRC:clb
Enc.

James R. Cook
Revised 4-3-96

OUTLINE
REGULATIONS, CONTROLS, AND ORDERS
IN
GROUNDWATER MANAGEMENT AREAS

(Further Revision Will Be Needed in mid July if LB 108 passes)

I. **Rules and regulations permitted <u>whether or not there is a control area or management area</u>**

A. <u>What is or can be included?</u>

1. Rules concerning improper groundwater irrigation runoff. 46-664
2. Rules permitted under section 46-663 (These all need to be in detail)
   - (a) enforcement procedures concerning violations (illegal wells, complaint process, issuance of cease and desist orders, etc.)
   - (b) other administrative rules (formal hearing procedures, etc.)
   - (c) require meters
   - (d) require reports from users
   - (e) definitions as needed for other rules

B. <u>What are the notice and hearing requirements?</u>

1. Notice must be published in newspaper(s) of general circulation in the affected area once each week for three consecutive weeks, the last time not less than seven days prior to the hearing. 46-663.01 The notice should generally describe what the rules are about (at least identify the topics), tell when and where the hearing is to be held indicate that copies of the proposed rules are available at ______________, and that all interested persons are free to testify.
2. Proposed rules must be available to the public at least 30 days in advance and the notice should note their availability. 46-663.01 (In this case, the rules themselves do not have to be published, but it would be advisable to have the first publication of the hearing notice 30 days in advance).

C. <u>How are these rules amended, repealed, etc.</u>? Use the same procedures as for the initial adoption.

II. **Rules (controls) proposed at the same time a management area is proposed for designation**

A. <u>What is or can be included?</u>

1. Details of the permit process (repeat of statutory language may be appropriate here). 46-659 to 46-662
   - (a) If the district does not want to issue permits for <u>replacement</u> wells, it must define "replacement wells" and exempt them, by rule, from the permitting requirements. 46-659
   - (b) If you decide to make all well permits effective for a shorter period of time than the one year permitted by statute, that shorter period should be established in these rules.
   - (c) If under only certain circumstances you might make the time allowed for construction of specific wells less than one year, what will serve as the basis for such shorter time should be specified in these rules.
2. Optional controls for groundwater management areas (must propose one or more) 46-673.09. **These rules need to be detailed. What must the owner/operator do or not do, when and how? (See item V.A.)**
   - (a) allocation of water (see also 46-673.10 and 46-673.11)
   - (b) rotation in use (see also 46-673.11)
   - (c) Well-spacing. If the district adopts well-spacing rules, you must also include a procedure for granting a variance (see 46-673.12). But remember that the NRD cannot grant variances from the <u>statutory</u> spacing requirements; only DWR can do that.
   - (d) reduction of irrigated areas (see also 46-673.10 and 46-673.11)
   - (e) require flow meters
   - (f) require best management practices, defined in 46-657(18) as schedules of activities, maintenance procedures, and other management practices utilized to prevent present and future contamination of ground water, including:
     - (1) irrigation scheduling
     - (2) proper timing of fertilizer and pesticide applications
     - (3) other fertilizer and pesticide management programs (but don't overlook the results of the <u>Wagoner</u> case in the Central Platte NRD).

(g) require analysis of water and deep soils for fertilizer and chemical content

(h) require educational programs to protect water quality.

3. Other regulations to include at this step:

   (a) definitions as needed for the other rules

   (b) details for phasing, if that is part of the ground water management plan

      (1) what are the criteria for each phase?

      (2) what is the process for moving from one phase to another?

      (3) what are the consequences of moving from one phase to another? (tie back in with the controls under item 2)

B. Other relevant points

1. For each management area, the NRD must specify total amount of water which may be withdrawn from the ground water reservoir (this is required whether the management area is for quantity or for quality). 46-673.08 The statute doesn't say for sure, but this probably can be done after the management area is established.

2. If the primary purpose is protection of ground water quality, the controls need to include those the NRD determines are necessary to stabilize or reduce the level, increase, or spread of ground water contamination. 46-673.08

3. The controls proposed cannot include any not set forth in the management plan. 46-673.06.

4. Allocation, rotation, and acreage reduction controls must be reviewed by the board at least once every three years. 46-673.11

5. **I strongly recommend** sending drafts of your rules and regulations to DWR and DEQ for review before your board approves the version that will be published and considered at the hearing.

C. What are the notice and hearing requirements?

1. For this initial hearing or hearings at which designation of the management area is also to be considered:

   (a) The notice is to be published once each week in a newspaper(s) of general circulation in area affected for 3 consecutive weeks, the last one being not less than 7 days prior to the hearing 46-673.05, 46-658 (also send notice to DWR and DEQ at the same time).

   (b) The notice must include:

(1) the time(s) and place(s) of the hearing(s).

(2) a general description of the contents of the plan 46-673.05

(3) a general description of the area to be considered for inclusion in the management area 46-673.05

(4) the <u>text</u> of the <u>controls</u> proposed 46-673.05

(5) that all interested persons are free to testify

(6) If you are going to allow written testimony to be presented before, during, or after the hearing, the notice should so state.

(c) The hearing(s) must be held in or in reasonable proximity to the affected area. 46-673.05

(d) Use the NRD's own informal hearing rules for the conduct of the hearing (the district must at least make a tape recording for later reference or to prepare transcript if required; if desired, a court reporter can be hired and a transcript prepared). All hearings shall be "of record" and available for review. 46-668

(e) The testimony of DWR is required. 46-673.05

(f) The testimony of DEQ is also required if the primary purpose for proposing the area is water quality. 46-673.05

(g) The results of any district studies or investigations should be introduced into the record.

(h) All interested persons must be given the opportunity to testify.

(i) The "record" of the hearing should include documents necessary to establish the basis for the decision and for an appeal. That would include the notice of the hearing, the DWR letter of plan approval, the plan itself, all written testimony offered, etc.

D. <u>How is the board's decision recorded?</u>

1. The decision is to be in the form of an <u>order</u> (46-673.06) which is to be adopted within 90 days of the hearing (46-673.06) and that order should include the following:

(a) Findings of fact and conclusions of law (there should be information in the hearing record to support each of these)

(1) Groundwater management plan was prepared, adopted and submitted to DWR

(2) Plan was approved

(3) Notice of hearing was given as required by law

(4) Hearing was held on _____________ and all present were given the opportunity to testify

(5) After the hearing, the board considered:

(i) considerations brought forth at the hearing. 46-673.06

(ii) administrative factors directly affecting the ability of the district to implement and carry out local groundwater management. 46-673.06

(iii) whether the proposed actions will mitigate or eliminate the condition which led to consideration of the management area. 46-666(2)

(iv) whether the proposed actions will encourage a high degree of water use efficiency 46-666(2)

(v) whether the proposed actions will improve administration of the area 46-666(2)

(6) (If the area is being proposed for water quality,) that the controls adopted are the actions necessary to stabilize or reduce the level, increase, or spread of ground water contamination. 46-673.08

(7) (If applicable) The district has consulted with the holder(s) of permits for intentional or incidental underground water storage (includes North Platte, Twin Platte, Central Platte, Lower Loup, Tri Basin, and Upper Loup NRDs now; could be other NRDs in the future) 46-666.01

(8) If applicable, that the district has consulted with local ground water conservation districts. 46-672. (Upper Big Blue, Little Blue, and maybe Upper Republican only and only until April 1, 1997 under current law).

(b) Conclusions and Orders

(1) That management area is (or is not) designated (stop here if decide not to designate the area)

(2) That the geographic and stratigraphic boundaries of the area are as follows: ______________________:

(3) That the total amount of water which can be withdrawn from the ground reservoir is ______ (could be either a total amount or an annual total) 46-673.08 (also see II.B.1. on page 3)

(4) That the following controls are hereby adopted (the controls can either be written here in their entirety or adopted by reference as an appendix or attachment)

2. The order, in its entirety, (that includes the rules) is to be published once each week for 3 consecutive weeks, the last no less than 10 days from the effective date. 46-673.07, 46-666(6). A copy should also be sent to DWR so they are aware of your decisions and can begin coordinating the well registration process with your permitting process.

3. The order becomes effective 90 days after it is issued, i.e. signed (no more and no less).46-673.07. Permits are required on and after that 90th day and other rules will also go into effect at the same time.

III. Additions, deletions, and amendments to rules (controls) for management area after their initial adoption in accordance with II.A.

A. What may be included in the amendments, etc. is the same as what may be in the original (see II.A.and B.). But remember that if the plan does not include the controls now proposed, the plan will have to be modified first.

B. What are the notice and hearing requirements?

1. A public meeting, not a hearing, is the first step. 46-673.13, 46-665
2. If the "proposed" rules were not developed before the "meetings" they need to be prepared before the next step.
3. One or more public hearings must also be held before additions, deletions, or amendments are adopted. 46-665
4. The text of the proposed changes must be made available at least 30 days prior to the hearing but does not have to be published in its entirety. 46-665
5. The hearing must be within or in reasonable proximity to the management area. 46-665
6. Notice of the hearing(s) is to be given by publication in a newspaper(s) of general circulation in the area at least once each week for 3 consecutive weeks, the last not less than 7 days prior to the hearing. 46-665, 46-658 (4(a))

7. Notice should be sent at the same time to Conservation and Survey, NRC, and DEQ. 46-665. The law does not require notice to DWR, but that is recommended.

8. The hearing is again on the record (see II.C.1.(i) on page 4)

C. How is the board's decision recorded?

1. The statutes are not clear on this point. It is recommended that additions, deletions (including repeals) and any amendments be accomplished by adoption of an order which includes the following:

   (a) Findings of fact and conclusions of law

      (1) Ground water management area was designated and rules were adopted by Order #_____, dated _________________.

      (2) The board held ____ public meeting(s) to determine the additions deletions, and amendments now deemed appropriate.

      (3) The board adopted proposed additions, deletions, or amendments and scheduled and published notice of _____ public hearing(s) as required by law.

      (4) ____ public hearings were held on __________ and all present were given the opportunity to testify.

      (5) After the hearing, the board considered:

         (i)

         (ii) (same as ii) to (v) in II.D.)

         (iii)

         (iv)

         (v)

      (6) If applicable, that the board consulted with all holders of permits for intentional or incidental underground water storage. 46-666.01.

      (7) If applicable that the district has consulted with local ground water conservation districts. 46-672.

   (b) Conclusions and Order

      (1) That the rules are hereby amended as follows (can either put in the revised rules or adopt them by reference as an appendix or attachment).

2. The order, in its entirety, is to be published once each week for 3 consecutive weeks, the last no less than 10 days prior to the effective date. 46-666(6) Also send a copy to DWR.
3. The statute does not specify the effective date of orders amending the controls, so it can be anytime at least 10 days after the last publication of the order.

IV. Modification of the boundaries of a management area or dissolution of the area. 46-673.13

A. For notice and hearing requirements, follow II.C, to the extent applicable.

B. For contents of the order to be entered after the hearing(s), follow II.D. to the extent applicable. This order will be effective 90 days after it is issued. 46-673.07. That means well permits would continue to be required in any territory being withdrawn from the management area until that 90th day.

V. Additional suggestions

A. Any rule which imposes a requirement on or limits the activities of owners/operators should be as specific as possible. The owner/operator should be able to read the rules and regulations and know what is required of him or her. For example, if you decide to require reporting, the rules need to specify what is to be reported, when it is due, and whether any particular format is required (such as district provided forms for that purpose). If you are imposing allocations, the rules need to specify the amount of water allocated, over what period of time, how the amount for each landowner is established (e.g. how irrigated acres are certified) and what happens as the owner/operator approaches and/or exceeds the amount allocated.

B. It is not necessary to include in the rules and regulations things that the natural resources district will do consistent with its ground water management plan but which are not "controls." While I recommend that you lay out your whole regulatory scheme as that is proposed in the plan, i.e. the phases and the regulations that go with each phase, there is no need to list other controls that might be required in the future. For the district to actually require any of those, it will have to amend its rules and regulations in accordance with item III of this outline.

C. Do not forget that any differences in controls from one part of the management area to another must be based only upon one or more of the following, as required by section 46-666(4):

1. varying ground water uses (this probably means the different types of use, such as domestic, irrigation, industrial, etc., not different quantities of use)
2. different irrigation distribution systems (limited to 5 years)
3. varying climatic, hydrologic, geologic, or soil conditions

Districts that choose to put the whole NRD in a management area need to be especially alert to these limitations.

D. The district should not adopt rules which are substantially different from those proposed for the hearing. It is much easier to delete items proposed than it is to add new items. The basic question will be "did the public have notice that the district might adopt a rule in the form being considered by the board and did it have sufficient opportunity to comment on that?"

E. I would encourage some kind of uniform format for rules which includes a lettering and numbering system. That will make later reference to specific portions of the rule easier.

F. I strongly recommend that any rules and regulations adopted under the Ground Water Management and Protection Act be reviewed by the district's own attorney before they are proposed for public hearing and that your attorney also advise you on the process to use in designating the management area and adopting controls. If you have not regularly used the services of an attorney, I strongly encourage it at this stage. Having your attorney tell you in the middle of an attempted enforcement action that you screwed up four years before doesn't leave you with many options. Getting your own counsel involved early on in the drafting and review of proposed regulations will likely save you much time, effort and money in the long run.

G. Lastly, remember if LB 108 passes, much of this outline will become obsolete in mid July.

Cook\outline.grw

January 8, 1996

TO: Natural Resources District Managers

FROM: Susan France Susan

SUBJECT: Formation of Ground Water Management Areas

Several managers have requested information on the procedure to form a management area. I have summarized the statutes concerning this procedure and enclose it with this memo in draft form. Please call if you have any suggestions or corrections.

Please remember to let this department and the Department of Environmental Quality know if you are scheduling a hearing to form a management area. We are required to give testimony and must therefore put it on our schedules.

SF:pb
cc/enc: Marty Link

c:\sharon\memos\1-8nrd.mem

FORMATION OF MANAGEMENT AREA SUMMARY
by Department of Water Resources Staff
November, 1995

DRAFT

I. GROUND WATER MANAGEMENT PLAN

District must have an approved ground water management plan, or have a plan which has been disapproved by the Director of the Department of Water Resources and the District has written a letter informing the Director how the ground water management plan addresses the issues raised by the Director as part of the disapproval. (§46-673.05)

II. BOARD INITIATES PROCESS

Only the District can form a management area. The Board must vote to initiate the ground water management area process. This can be done any time after conformance with paragraph I. (§46-673.05)

III. NOTICE OF PUBLIC HEARING

A public hearing must be held. Notice of the hearing must be published once a week for three consecutive weeks in newspapers of general circulation in the area proposed for the management area. The last publication of the notice must occur not less than seven days prior to the hearing. The notice must include the general description of the contents of the plan, a general description of the area proposed to be included in the management area and the text of the proposed controls (rules). (§46-673.05)

NOTE: The controls must be only those included in the plan, and the area must be described in the plan.

IV. PUBLIC HEARING

At the hearing, all interested persons must be allowed to appear and present testimony. The hearing must include the testimony of a DWR representative and, if the area is being formed for purposes of managing quality, the testimony of a DEQ representative. The results of studies or investigations conducted by the District must be presented at the hearing. (§46-673.05)

SUGGESTIONS: The Department of Water Resources' testimony is usually based on whether the proposed rules are in agreement with the approved ground water management plan. Therefore, if possible, consult with DWR prior to issuing the notice so that we can try to work out any problems ahead of time. Sending DWR and DEQ the notice with a reminder that their presence or testimony is required is helpful.

V. ORDER ISSUED

Within 90 days from the date of the hearing, the District must issue an order either establishing the management area or denying establishment of the area. If establishing an area, the order must include a geographic and stratigraphic definition of the area, and must adopt one or more controls (rules). (§46-673.06)

The order becomes effective 90 days after its issuance. (§46-673.07)

SUGGESTIONS: In this order, the area should be the large geographic area to be encompassed in the entire management area, not the specific phase areas which can be delineated in the accompanying rules. The order should adopt and incorporate rules that are a separate document that can later be revised. These can be referenced in the order as an attachment subject to future revisions.

If the District has a certain date that they want to begin the management area, they will need to count backwards to find out what date they should issue their order.

REMINDER: The District does not need DWR's approval to form the management area. The District must only follow the laws describing the process for formation.

VI. PUBLISH ORDER

A notice of the order must be published once a week for three consecutive weeks in a newspaper of general circulation in the area, the last publication not less than 10 days prior to the effective date of such order. While the statutes are less than clear on this point, it is recommended that the rules be published in their entirely.

VII. MODIFICATION OF MANAGEMENT AREA BOUNDARIES OR DISSOLUTION OF MANAGEMENT AREA

Either of these actions may be taken "utilizing the procedure established for the initial designation" of the area. Hearings for this purpose cannot be initiated more than once a year. (§46-673.13)

VIII. APPEALS

Any person "aggrieved" can appeal orders to state district court. Such appeals should be in accordance with Administrative Procedures Act.

IMPLEMENTING, AMENDING OR REPEALING MANAGEMENT AREA RULES
by Department of Water Resources Staff
November, 1995

I. PUBLIC HEARING

Before any rule is adopted, amended or repealed, one or more public hearings must be held in the district in proximity to the area. Text of the proposed rule must be available for the public at least 30 days before the hearing. (§46-665.02 & § 46-673.13)

The Conservation and Survey Division of the University of Nebraska, the Natural Resources Commission, and the Department of Environmental Quality are to offer as evidence any information in their possession which they deem relevant to the purposes of the hearing. (§46-673.13)

The hearing must be of record and available for review. (§46-668)

SUGGESTION: This means that the entire proceeding must be recorded and either a complete written transcript made of the proceeding, or the tape must be maintained. Send notices to Conservation and Survey Division, Natural Resources Commission and the Department of Environmental Quality with a note reminding them they are to present any relevant evidence.

II. NOTICE OF HEARING

A public notice must be published at least once each week for three consecutive weeks in such newspapers as are necessary to provide general circulation in the area. The last publication must be not less than seven days prior to hearing. The notice must include a description of area to be affected. If the notice does not include verbatim rules, the notice should include a reference that copes are available in the District's office. (§46-663.01)

III. ADOPT, AMEND OR REPEAL RULE

District must consider (but is not limited to) the following:

A. Whether it reasonably appears that such action will mitigate or eliminate the condition which led to designation of management area. (§46-666(2))

B. Whether rule will encourage a high degree of water use efficiency. (§46-666(2))

C. Whether rule will improve administration in the area. (§46-666(2))

D. Whether rules are consistent with §46-613. (§46-671)

The District needs to enter an order adopting, amending or repealing rules. The Order should include a discussion of those items listed above. (§46-666(2))

The District must consult with holders of intentional or incidental underground water storage and recovery before adopting or amending rules. (§46-666.01)

The District must consult with any existing conservation districts before adopting rules. (§46-672)

IV. PUBLISH RULES

District must publish the adopted or amended rules once a week for three consecutive weeks in the area. The last publication must be not less than 10 days prior to effective date set in order.

V. REVIEW OF RULES

District may annually review and must at least once every three years review allocations, rotation or reduction controls. (§46-673.11)

VI. APPEAL OF RULES

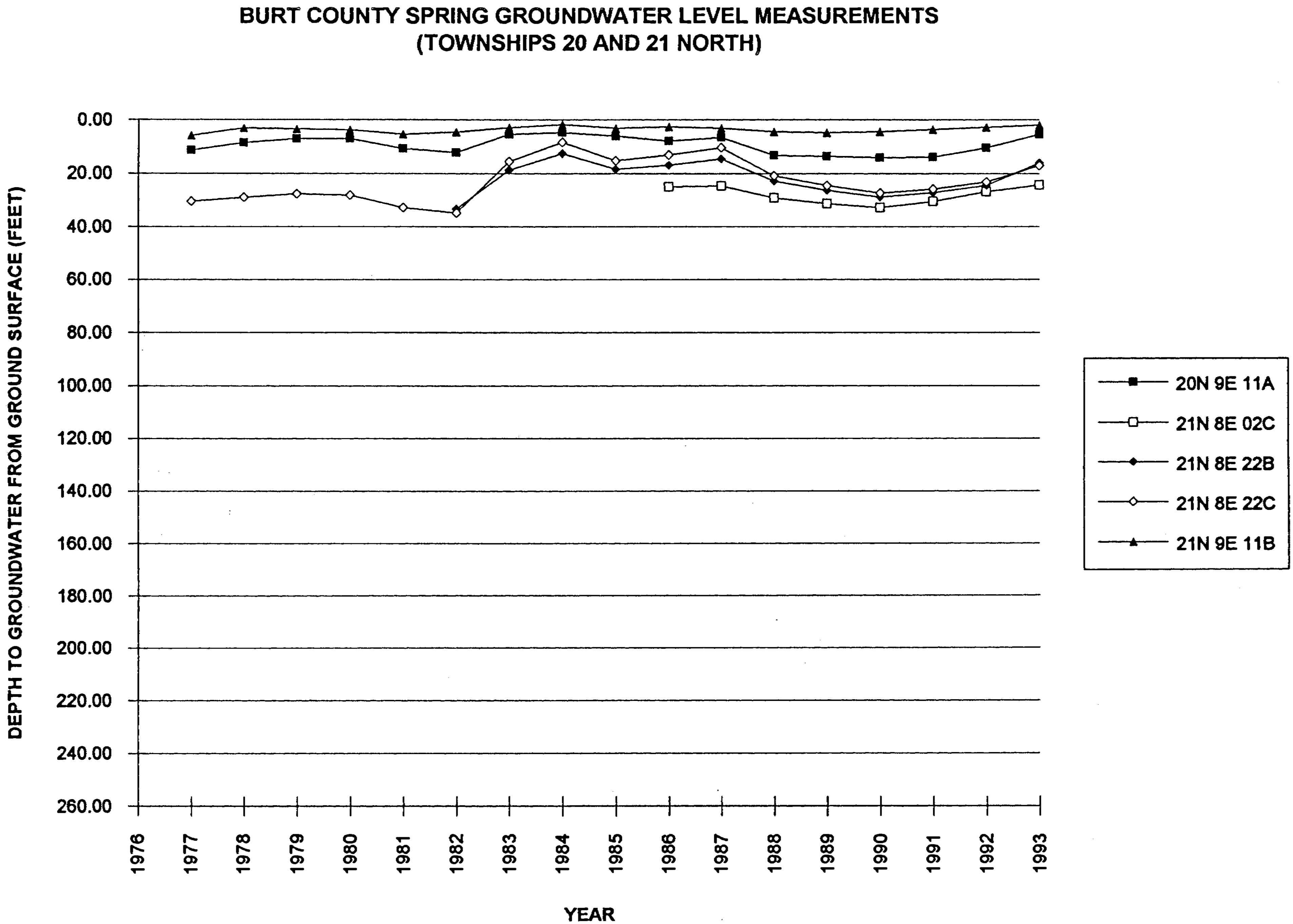
Any person "aggrieved" can appeal orders to the State District court. The appeals shall be in accordance with the Administrative Procedures Act. (§46-669)

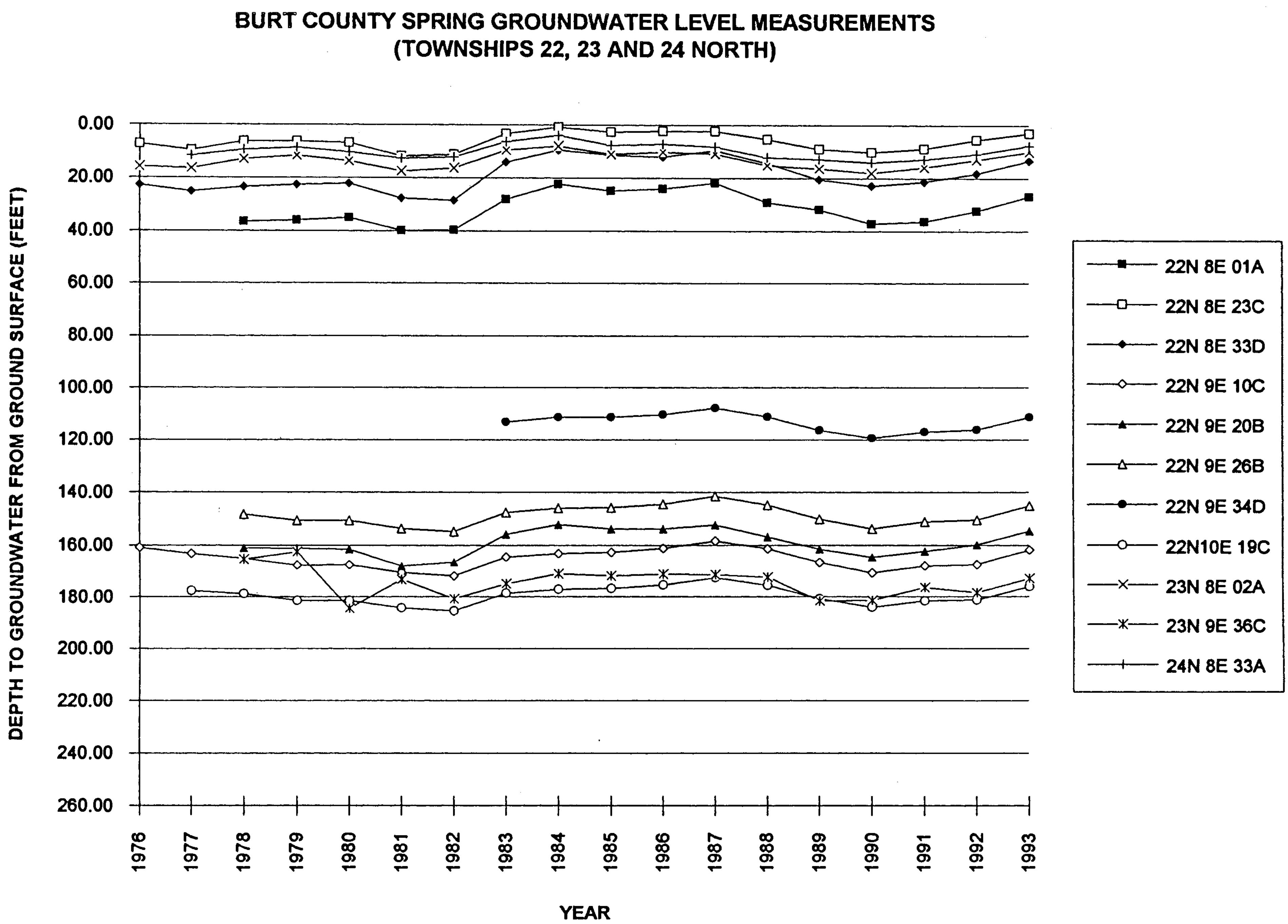
APPENDIX 2

Groundwater Level Data Summary

BURT COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS

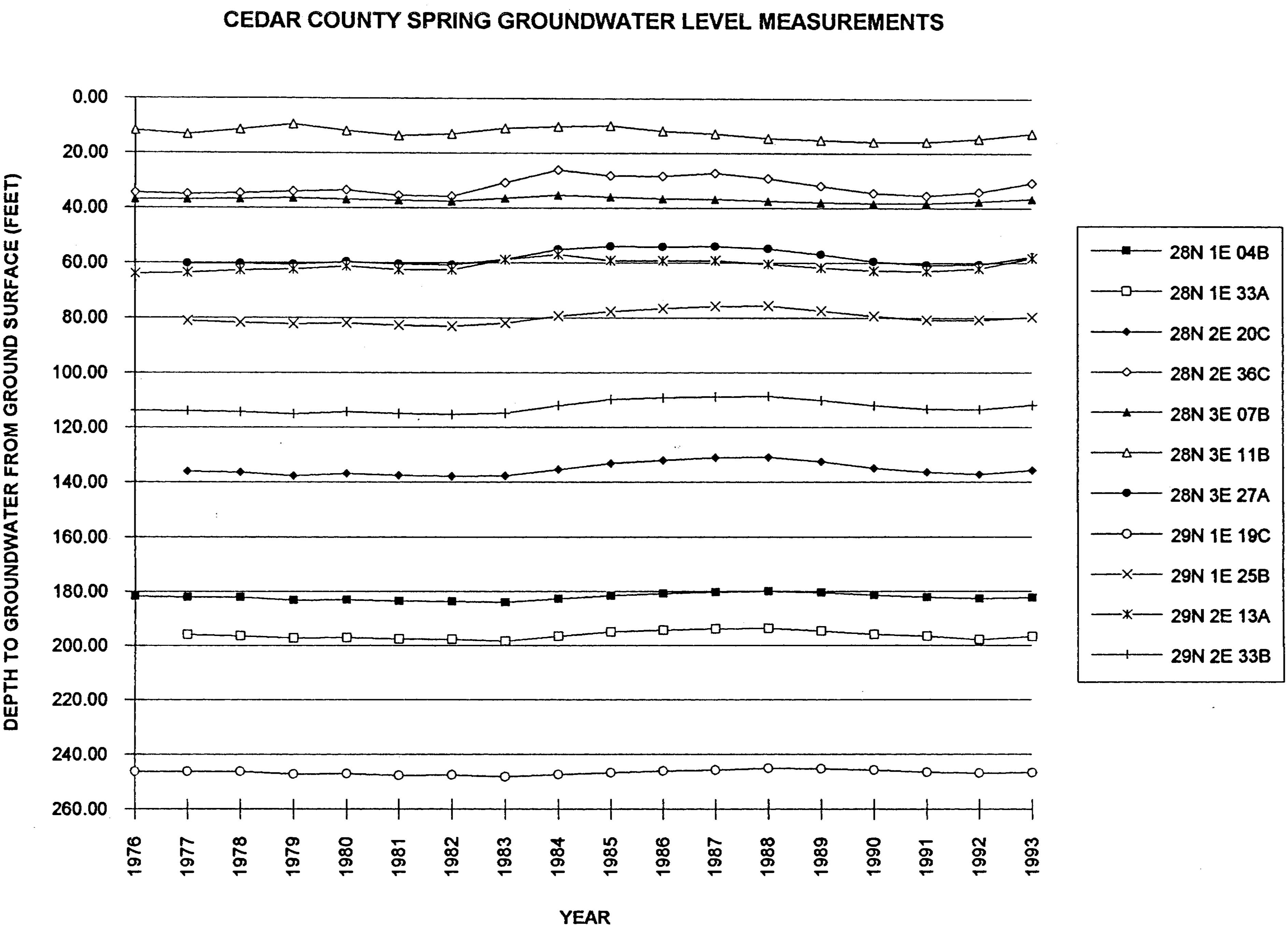
LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
20N 9E 11A		11.50	8.60	7.17	7.15	10.72	12.26	5.40	4.74	6.06	7.95	6.67	13.22	13.63	14.06	13.92	10.49	5.44
21N 8E 02C											25.07	24.71	29.18	31.36	32.76	30.61	26.82	24.34
21N 8E 22B							33.33	18.74	12.64	18.30	16.87	14.55	22.96	26.46	28.82	27.25	24.51	16.14
21N 8E 22C		30.50	29.03	27.69	28.25	32.90	34.85	15.65	8.36	15.20	13.08	10.37	20.89	24.59	27.34	25.93	23.22	17.00
21N 9E 11B		6.00	3.06	3.52	3.83	5.40	4.67	2.88	1.77	3.10	2.54	3.18	4.42	4.71	4.44	3.62	2.78	1.99
22N 8E 01A			36.67	36.08	35.15	39.86	39.68	28.10	22.44	24.87	24.10	21.96	29.23	31.85	37.27	36.44	32.33	26.81
22N 8E 23C	7.32	9.60	6.25	6.24	6.80	11.84	11.13	3.22	0.80	2.68	2.26	2.30	5.32	9.04	10.11	8.80	5.40	2.95
22N 8E 33D	22.88	25.29	23.48	22.69	22.20	27.70	28.55	13.98	9.43	11.35	12.05	9.44	14.27	20.60	22.93	21.33	18.26	13.35
22N 9E 10C	160.94	163.36	165.17	167.78	167.59	170.64	171.92	164.64	163.20	162.80	161.34	158.36	161.46	166.77	170.78	168.08	167.62	161.93
22N 9E 20B			161.15	161.18	161.67	168.20	166.62	155.90	152.27	153.97	153.88	152.39	156.84	161.59	164.82	162.39	159.88	154.73
22N 9E 26B			148.37	150.75	150.65	153.70	154.90	147.65	145.94	145.92	144.57	141.58	144.90	150.15	153.86	151.20	150.63	145.15
22N 9E 34D								113.18	111.33	111.47	110.36	107.89	111.17	116.44	119.47	117.09	116.24	111.39
22N10E 19C		177.59	178.74	181.53	181.50	184.32	185.50	178.63	177.13	176.77	175.47	172.62	175.64	180.85	184.20	181.67	181.38	176.07
23N 8E 02A	15.93	16.50	13.01	11.64	13.70	17.52	16.28	9.48	7.91	11.01	10.18	10.84	15.18	16.30	17.97	15.92	12.99	10.03
23N 9E 36C			165.44	162.65	184.49	173.27	180.93	174.92	171.08	172.02	171.23	171.49	172.55	181.69	181.54	176.44	178.48	173.02
24N 8E 33A		11.74	9.54	8.60	10.30	12.61	12.11	6.25	3.90	7.65	7.20	8.22	12.09	12.85	13.94	12.86	10.86	7.57


BURT COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 20 AND 21 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
20N 9E 11A
21N 8E 02C
21N 8E 22B
21N 8E 22C
21N 9E 11B


BURT COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 22, 23 AND 24 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
22N 8E 01A
22N 8E 23C
22N 8E 33D
22N 9E 10C
22N 9E 20B
22N 9E 26B
22N 9E 34D
22N10E 19C
23N 8E 02A
23N 9E 36C
24N 8E 33A

CEDAR COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS (FEET)

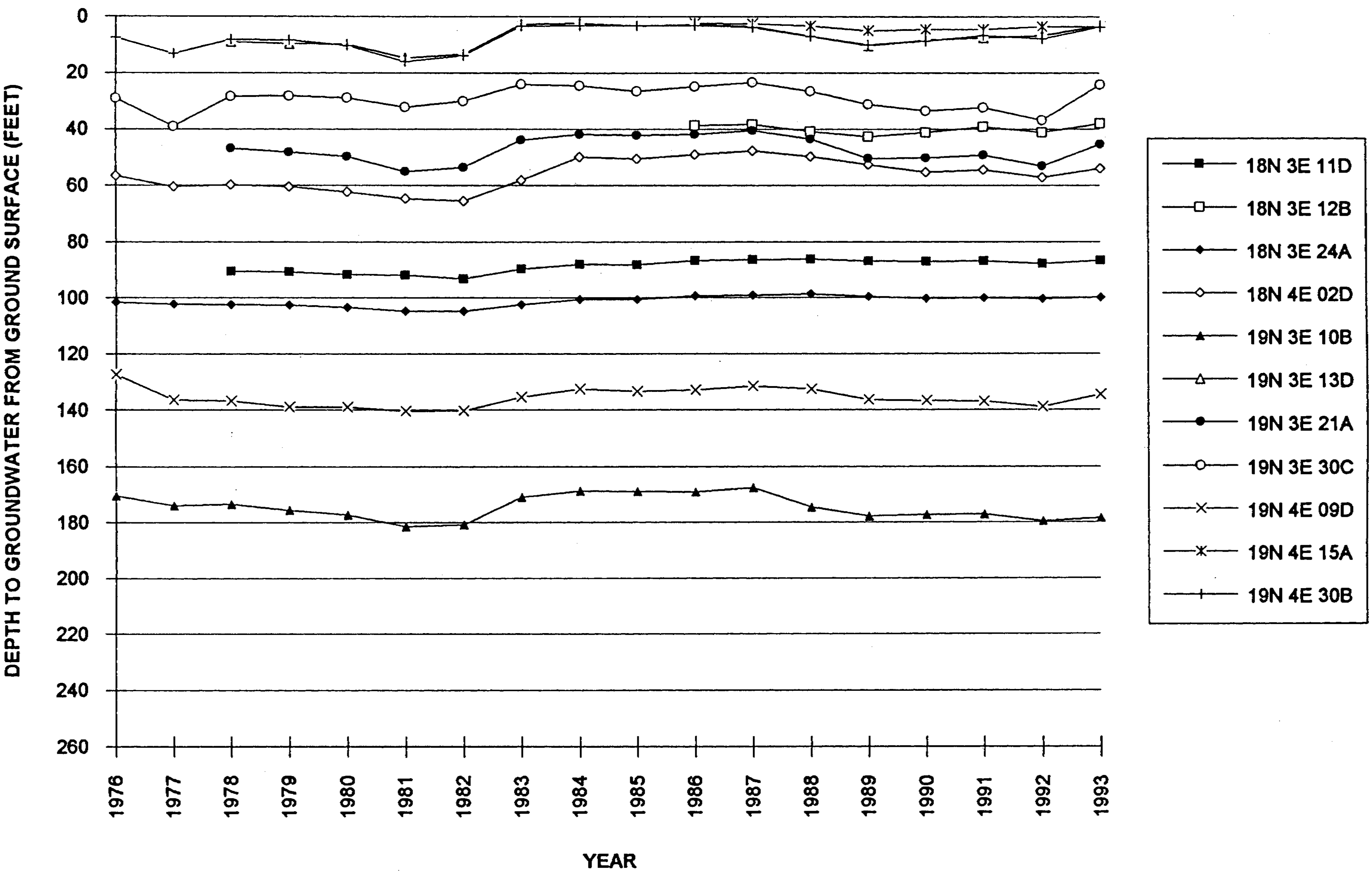
LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
28N 1E 04B	181.75	182.09	182.15	183.27	183.02	183.58	183.63	184.06	182.76	181.64	180.87	180.30	180.04	180.42	181.44	182.32	182.78	182.44
28N 1E 33A		196.00	196.39	197.30	197.06	197.59	197.73	198.44	196.55	194.92	194.43	193.91	193.69	194.72	196.04	196.56	197.92	196.82
28N 2E 20C		136.05	136.45	137.75	136.98	137.60	137.95	137.70	135.44	133.15	132.08	131.16	130.92	132.56	134.94	136.52	137.31	135.74
28N 2E 36C	34.49	35.02	34.74	34.10	33.47	35.53	35.79	30.77	26.10	28.22	28.38	27.18	29.20	31.92	34.46	35.45	34.22	30.76
28N 3E 07B	36.85	36.85	36.69	36.37	36.88	37.29	37.59	36.45	35.36	35.94	36.53	36.77	37.43	37.90	38.17	38.22	37.52	36.55
28N 3E 11B	11.67	13.17	11.40	9.45	11.96	13.74	13.13	10.87	10.28	10.00	11.98	12.85	14.54	15.12	15.71	15.80	14.72	12.67
28N 3E 27A		60.30	60.26	60.57	59.66	60.48	60.75	58.76	55.20	53.97	54.23	54.07	54.90	56.89	59.45	60.73	60.72	57.76
29N 1E 19C	246.26	246.35	246.27	247.24	247.12	247.68	247.52	248.21	247.34	246.80	246.12	245.73	245.18	245.32	245.86	246.56	246.92	246.86
29N 1E 25B		81.13	81.72	82.18	81.88	82.66	83.00	81.87	79.31	77.75	76.53	75.82	75.62	77.43	79.37	80.75	80.88	79.59
29N 2E 13A	64.00	63.65	62.79	62.40	61.20	62.62	62.59	58.92	56.86	59.24	59.19	59.22	60.47	61.75	62.84	63.04	62.05	58.28
29N 2E 33B	113.94	114.00	114.36	115.18	114.42	114.95	115.27	114.86	112.10	109.88	109.13	108.88	108.62	110.20	112.17	113.33	113.49	111.97


CEDAR COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
28N 1E 04B
28N 1E 33A
28N 2E 20C
28N 2E 36C
28N 3E 07B
28N 3E 11B
28N 3E 27A
29N 1E 19C
29N 1E 25B
29N 2E 13A
29N 2E 33B

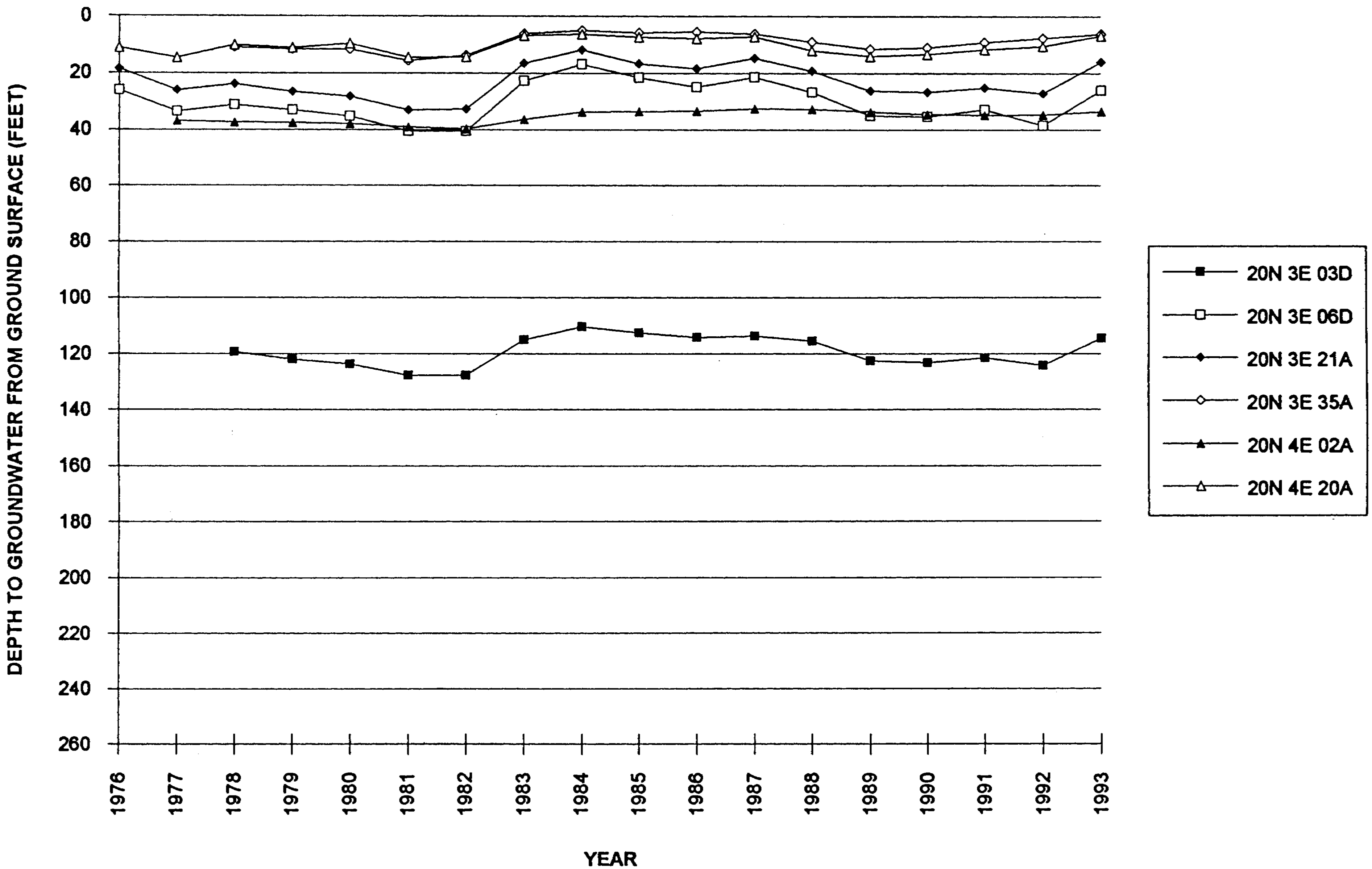
COLFAX COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
18N 3E 11D			90.58	90.73	91.80	92.05	93.28	89.87	88.19	88.22	86.85	86.42	86.27	86.94	87.22	86.97	87.98	86.72
18N 3E 12B											38.72	38.49	40.90	42.74	41.32	39.26	41.29	38.13
18N 3E 24A	101.70	102.35	102.57	102.70	103.60	104.80	104.84	102.48	100.66	100.72	99.42	99.18	98.69	99.72	100.27	100.16	100.50	99.94
18N 4E 02D	56.62	60.55	59.92	60.58	62.37	64.70	65.50	58.17	50.06	50.66	49.22	47.90	49.88	52.68	55.28	54.53	57.15	53.94
19N 3E 10B	170.45	174.05	173.54	175.70	177.24	181.59	180.93	170.98	168.87	168.98	169.13	167.55	174.70	177.73	177.32	177.08	179.64	178.55
19N 3E 13D			8.94	9.60	9.85	14.70	13.33	2.68	2.29	3.32	2.76	3.49	6.93	10.33	8.36	7.40	6.57	3.17
19N 3E 21A			47.04	48.30	49.79	55.12	53.72	43.92	42.04	42.24	42.02	40.66	43.57	50.54	50.29	49.39	53.23	45.40
19N 3E 30C	29.10	39.10	28.39	28.26	28.86	32.17	30.00	24.00	24.55	26.50	24.83	23.46	26.62	31.19	33.57	32.47	36.94	24.13
19N 4E 09D	127.43	136.49	136.81	138.96	138.93	140.52	140.35	135.46	132.58	133.52	132.93	131.61	132.58	136.49	136.73	137.06	139.04	134.64
19N 4E 15A											2.22	2.53	3.33	4.98	4.52	4.49	3.49	3.52
19N 4E 30B	7.50	13.12	8.19	8.25	10.38	15.94	13.75	3.29	3.14	3.19	3.15	3.81	7.00	10.00	8.66	6.68	7.85	3.64
20N 3E 03D			119.47	122.12	123.75	127.82	127.84	115.00	110.45	112.63	114.31	113.65	115.61	122.66	123.22	121.57	124.26	114.58
20N 3E 06D	26.10	33.54	31.24	33.00	35.20	40.67	40.59	22.79	16.90	21.47	24.91	21.44	26.68	35.06	35.35	32.90	38.60	26.09
20N 3E 21A	18.45	26.07	23.90	26.58	28.30	33.14	32.76	16.44	11.87	16.65	18.32	14.67	19.15	26.21	26.72	25.20	27.23	15.99
20N 3E 35A			10.97	11.72	11.72	15.69	13.90	6.16	4.89	5.72	5.52	6.16	8.96	11.41	11.00	9.12	7.57	6.13
20N 4E 02A		37.00	37.36	37.62	37.89	39.06	39.70	36.46	33.73	33.59	33.43	32.63	32.69	33.80	34.53	34.84	34.76	33.54
20N 4E 20A	11.19	14.70	10.23	11.22	9.65	14.52	14.35	6.80	6.37	7.35	7.81	7.19	12.06	14.07	13.30	11.62	10.55	6.88

COLFAX COUNTY GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 18 AND 19 NORTH)



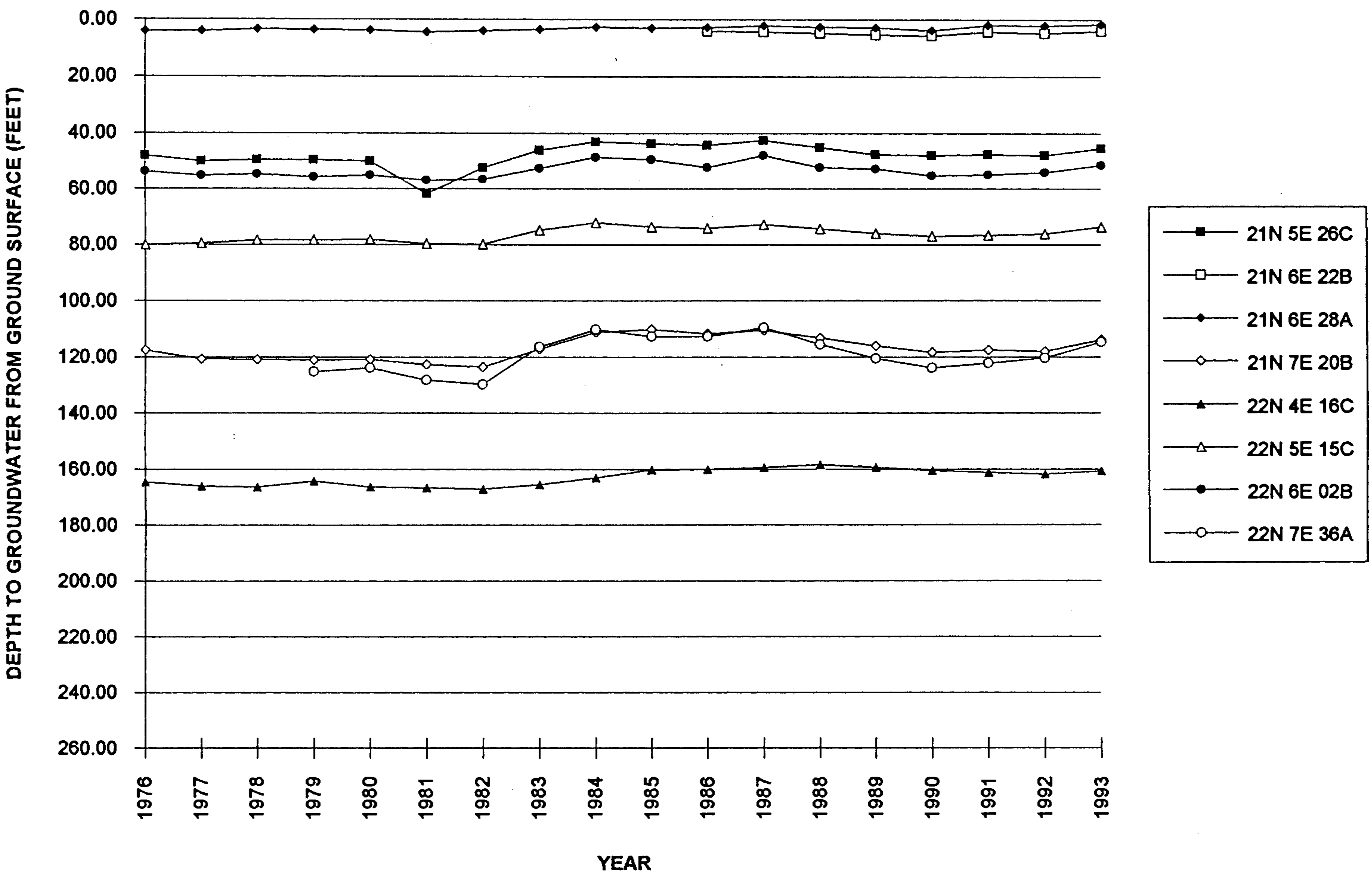
COLFAX COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 20 NORTH)

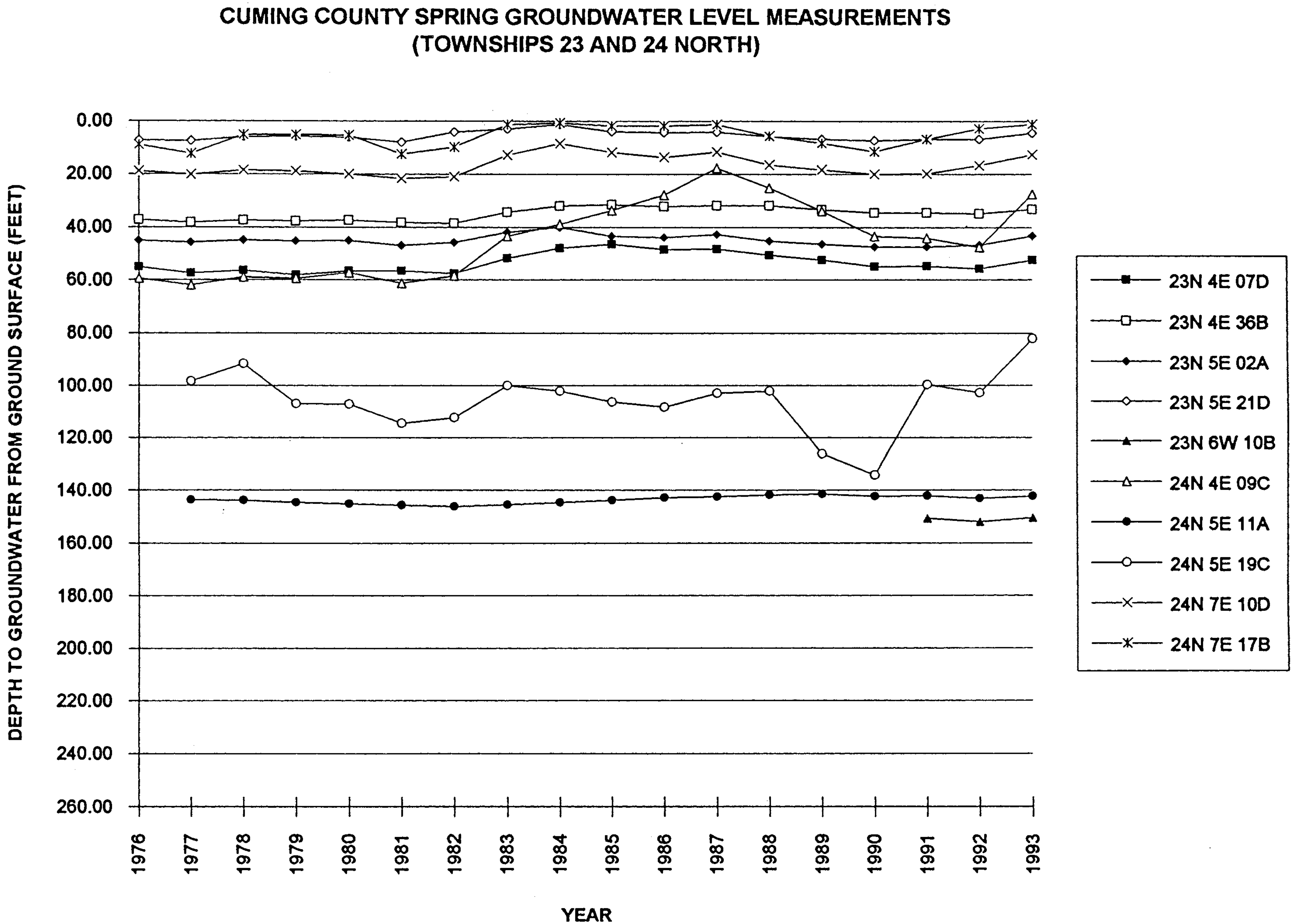


CUMING COUNTY SPRING WATER LEVEL MEASUREMENTS (FEET)

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
21N 5E 26C	48.14	50.10	49.67	49.70	50.19	61.84	52.54	46.17	43.02	43.80	44.34	42.59	45.05	47.60	47.93	47.67	47.91	45.45
21N 6E 22B											4.09	4.28	4.76	5.34	5.59	4.25	4.73	3.93
21N 6E 28A	4.06	4.20	3.45	3.60	3.82	4.47	3.90	3.45	2.58	2.86	2.72	2.07	2.64	2.74	3.71	2.00	2.13	1.64
21N 7E 20B	117.62	120.80	120.85	121.17	120.93	122.73	123.53	117.29	111.17	110.22	111.70	110.57	113.25	116.14	118.44	117.64	118.05	113.95
22N 4E 16C	164.55	166.05	166.50	164.30	166.42	166.80	167.23	165.67	163.02	160.22	160.14	159.39	158.45	159.35	160.62	161.32	161.88	160.73
22N 5E 15C	80.06	79.56	78.36	78.45	78.32	79.74	79.90	74.82	72.27	73.77	74.19	72.92	74.39	76.06	77.11	76.70	76.32	73.76
22N 6E 02B	53.85	55.28	54.75	55.85	55.14	56.93	56.67	52.61	48.58	49.55	52.32	47.97	52.37	52.84	55.35	55.01	54.22	51.47
22N 7E 36A				125.25	123.92	128.29	129.73	116.47	110.20	112.67	112.77	109.62	115.60	120.56	124.00	122.29	120.47	114.7
23N 4E 07D	55.15	57.48	56.44	58.25	56.62	56.69	57.70	51.75	48.00	46.54	48.55	48.29	50.55	52.56	54.95	54.86	55.87	52.57
23N 4E 36B	37.33	38.32	37.46	37.86	37.44	38.34	38.59	34.38	32.12	31.53	32.27	31.94	31.88	33.45	34.65	34.55	34.97	33.28
23N 5E 02A	45.20	45.76	44.88	45.27	45.19	47.04	45.75	41.87	40.16	43.38	43.86	42.74	45.22	46.40	47.51	47.44	46.73	43.31
23N 5E 21D	7.34	7.55	5.92	5.84	6.07	8.02	4.09	2.93	1.26	4.00	4.24	4.12	5.88	6.84	7.34	6.79	6.87	4.44
23N 6W 10B																150.70	151.97	150.63
24N 4E 09C	59.60	62.12	59.07	59.47	57.27	61.35	58.44	43.47	38.92	33.81	27.87	17.70	25.22	33.86	43.54	44.15	47.58	27.57
24N 5E 11A		143.74	143.80	144.66	145.14	145.72	146.20	145.45	144.74	143.80	142.92	142.50	141.85	141.59	142.39	142.27	143.2	142.41
24N 5E 19C		98.38	91.65	107.00	107.27	114.60	112.39	99.94	102.17	106.40	108.30	103.02	102.12	126.33	134.29	99.64	102.9	82.07
24N 7E 10D	18.84	20.27	18.59	18.79	20.02	21.71	21.10	12.86	8.48	11.88	13.70	11.70	16.50	18.27	20.04	19.80	16.68	12.65
24N 7E 17B	9.06	12.36	5.22	5.07	5.32	12.49	9.86	1.32	0.62	1.83	1.74	1.25	5.65	8.38	11.41	6.79	2.72	1.18

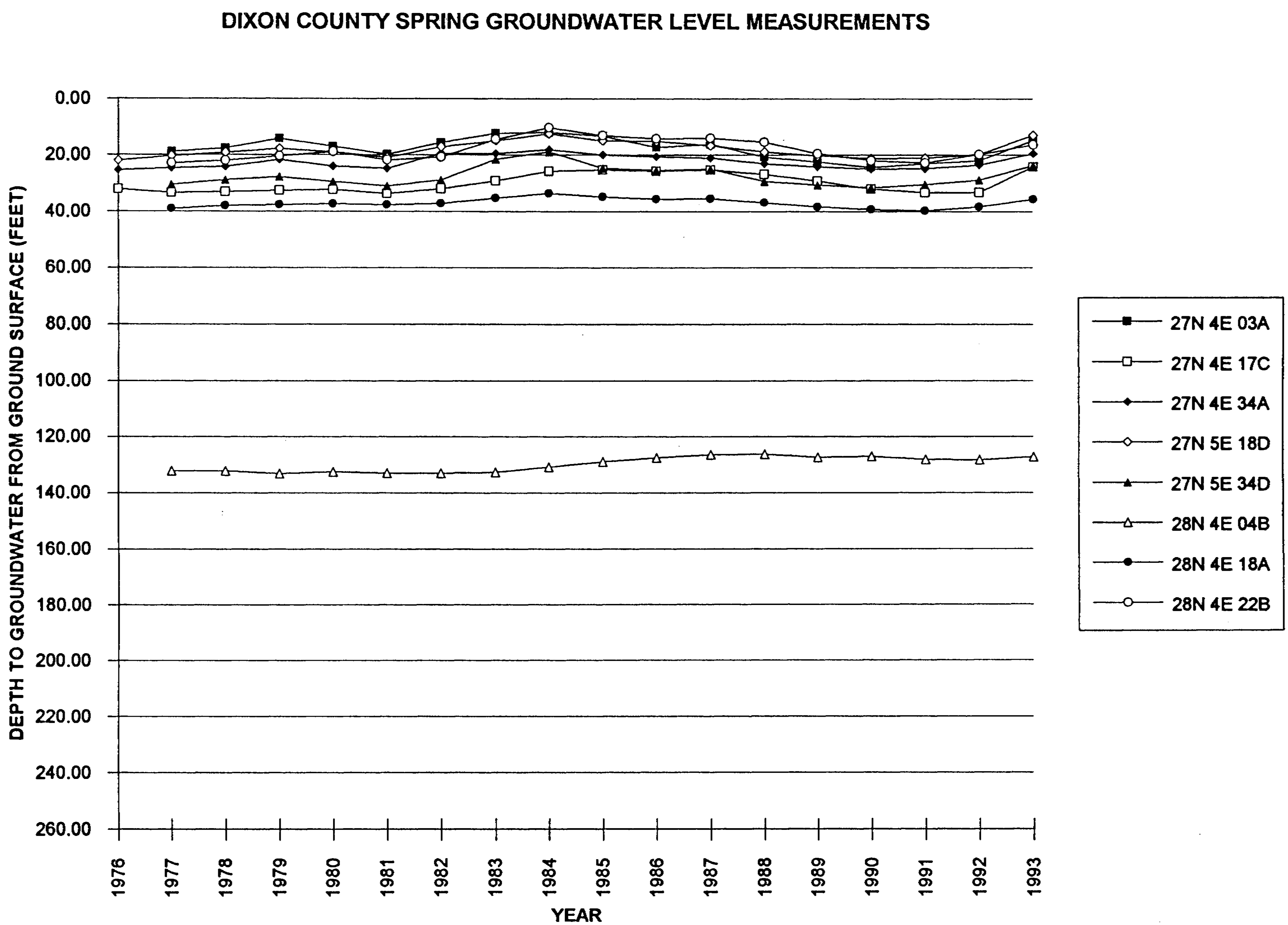
CUMING COUNTY GROUNDWATER LEVEL MEASUREMENTS (TOWNSHIPS 21 AND 22 NORTH)




CUMING COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 23 AND 24 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
23N 4E 07D
23N 4E 36B
23N 5E 02A
23N 5E 21D
23N 6W 10B
24N 4E 09C
24N 5E 11A
24N 5E 19C
24N 7E 10D
24N 7E 17B

DIXON COUNTY SPRING GROUNDWATER MEASUREMENTS (FEET)

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
27N 4E 03A		18.84	17.68	14.17	17.05	19.78	15.60	12.35	12.04	13.35	17.28	16.30	20.74	22.57	24.37	23.17	22.07	14.76
27N 4E 17C	32.20	33.50	33.10	32.58	32.30	33.70	31.97	29.19	25.80	25.32	25.85	25.25	26.91	29.20	31.96	33.35	33.27	24.17
27N 4E 34A	25.44	24.60	24.24	21.71	23.98	24.85	19.45	19.54	18.17	19.93	20.62	21.02	23.04	24.24	25.02	24.89	23.52	19.58
27N 5E 18D	22.00	20.40	19.28	17.76	19.05	20.91	17.13	14.94	12.45	15.06	15.13	16.65	18.97	20.34	21.24	21.06	19.82	12.99
27N 5E 34D		30.58	28.95	27.81	29.50	31.17	28.98	21.50	18.95	24.72	25.50	25.02	29.35	30.57	31.57	30.51	28.87	23.76
28N 4E 04B		132.23	132.33	133.16	132.60	133.05	133.10	132.72	130.84	128.92	127.63	126.40	126.31	127.40	127.10	128.27	128.29	127.17
28N 4E 18A		39.15	37.93	37.70	37.42	37.70	37.14	35.40	33.65	34.79	35.57	35.43	36.92	38.30	39.27	39.72	38.37	35.57
28N 4E 22B		22.96	22.05	20.53	18.93	21.94	20.83	14.50	10.27	13.13	14.26	14.07	15.49	19.60	22.07	22.77	19.87	16.37
27N 5E 27B							224.79	223.32	222.36	221.49	221.84	217.39	194.97	206.85	211.42	190.85	5.82	0.90


DIXON COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
1976
1977
1978
1979
1980
1981
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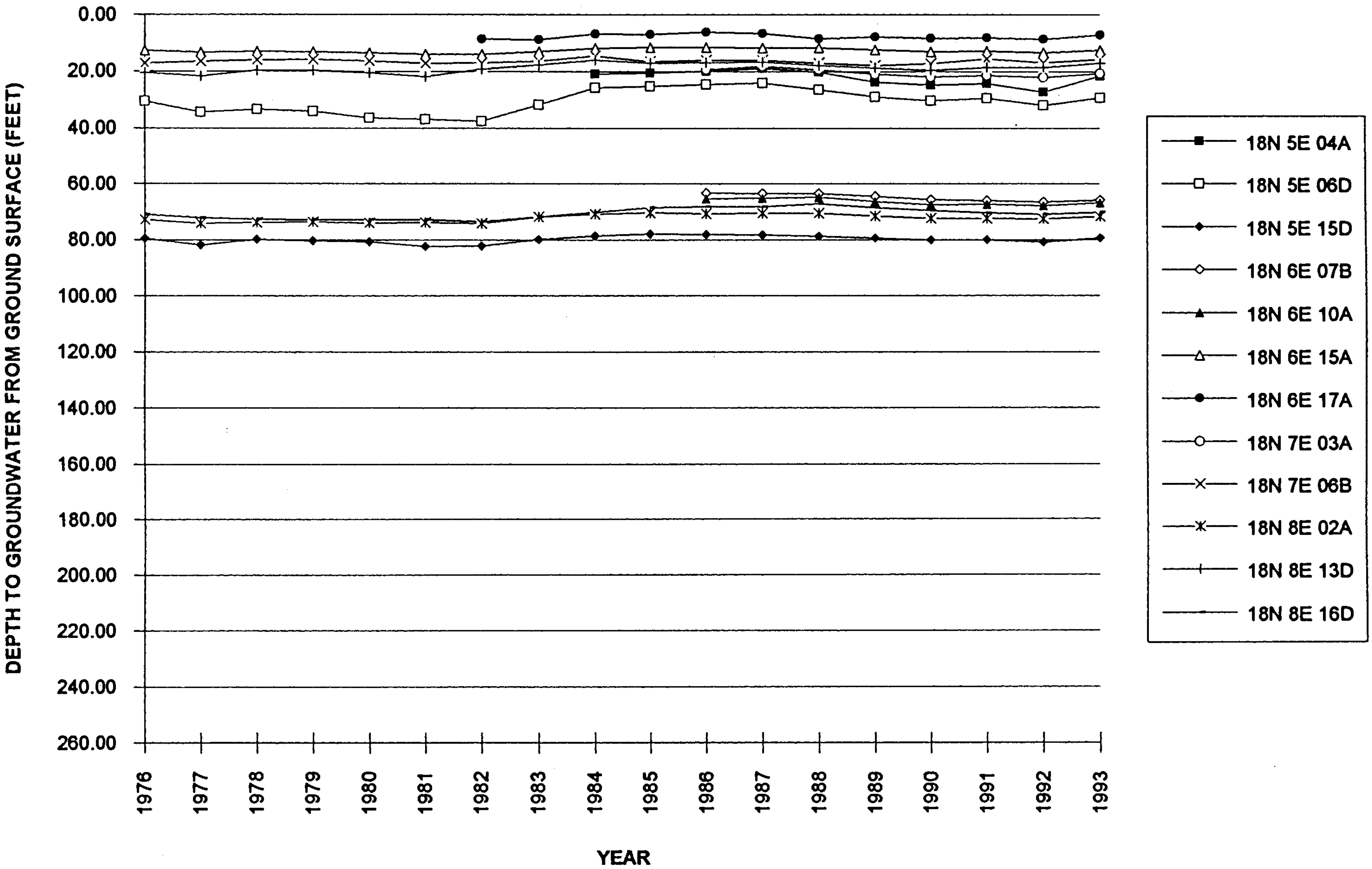
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
27N 4E 03A
27N 4E 17C
27N 4E 34A
27N 5E 18D
27N 5E 34D
28N 4E 04B
28N 4E 18A
28N 4E 22B

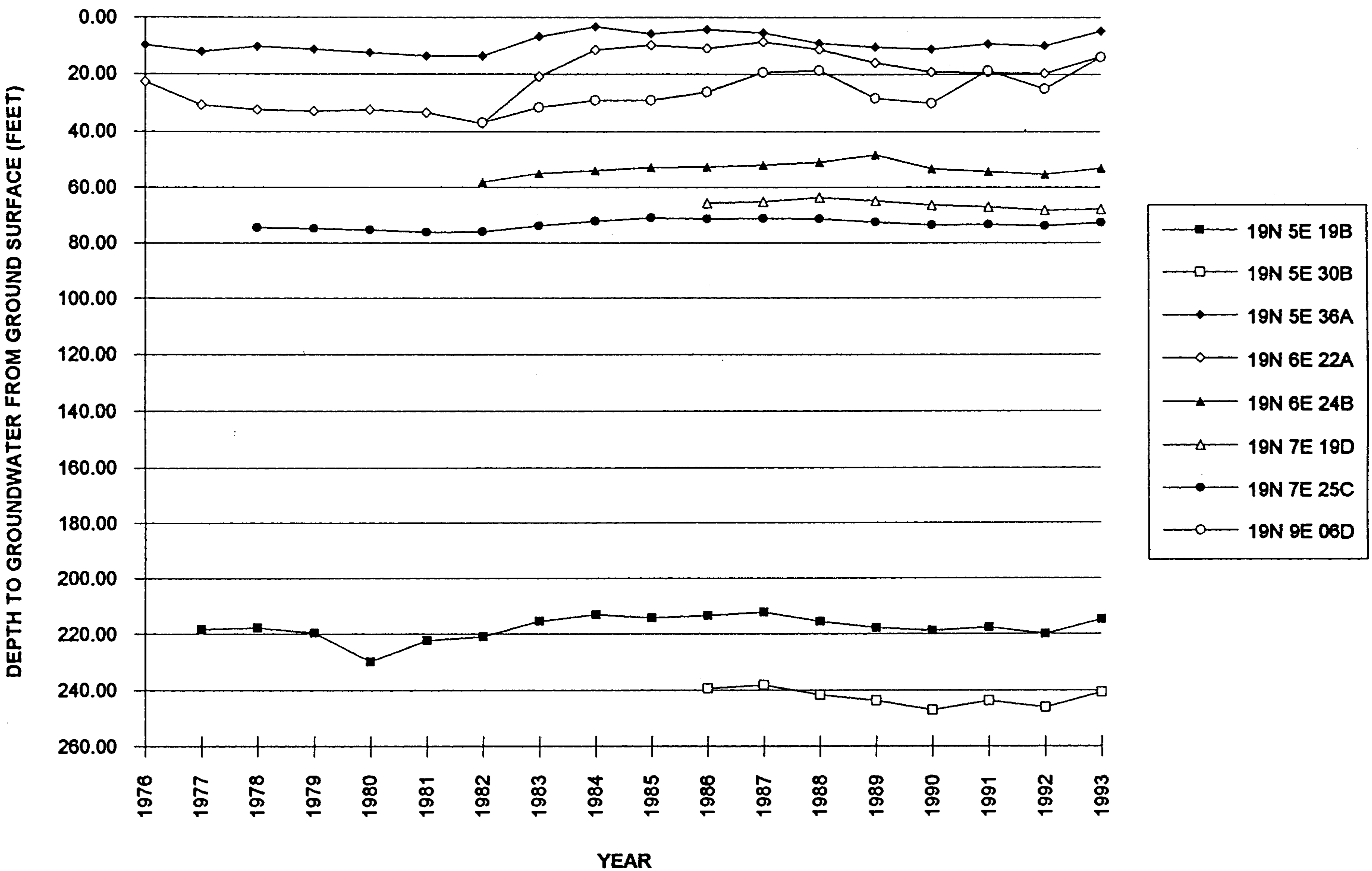
DODGE COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS (FEET)

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
18N 5E 04A									20.94	20.59	19.78	18.76	20.23	23.64	24.69	24.20	27.22	21.54
18N 5E 06D	30.63	34.36	33.46	34.00	36.48	37.00	37.68	31.68	25.78	25.29	24.52	23.98	26.38	28.83	30.18	29.47	31.87	29.28
18N 5E 15D	79.59	81.94	79.94	80.36	80.73	82.43	82.24	79.94	78.54	77.94	78.05	78.17	78.73	79.35	80.02	80.03	80.85	79.47
18N 6E 07B											63.32	63.47	63.56	64.50	65.63	65.96	66.52	65.93
18N 6E 10A											65.45	65.28	64.87	66.34	67.55	67.31	67.94	66.95
18N 6E 15A	12.60	13.34	13.02	13.11	13.46	14.02	14.05	12.96	11.79	11.54	11.52	11.64	11.64	12.29	12.90	12.79	13.26	12.44
18N 6E 17A							8.69	8.73	6.74	6.93	6.09	6.59	8.53	7.82	8.38	8.12	8.62	7.17
18N 7E 03A											19.28	18.12	19.37	20.83	21.88	21.42	22.08	20.62
18N 7E 06B	17.13	16.52	16.00	15.85	16.39	17.19	16.95	16.26	14.50	16.58	16.03	16.03	17.03	17.81	17.14	15.55	16.85	15.75
18N 8E 02A	72.96	74.26	73.85	73.75	74.00	73.96	74.16	71.93	70.96	70.45	70.64	70.53	70.52	71.59	72.37	72.45	72.56	71.75
18N 8E 13D	20.50	21.64	19.67	19.73	20.50	21.89	19.12	17.76	16.10	17.06	16.87	16.76	17.84	18.73	19.52	18.52	18.61	17.06
18N 8E 16D	71.02	72.25	72.82	72.94	72.89	72.98	73.50	71.98	70.23	68.56	68.25	68.16	67.22	68.48	69.65	70.41	70.84	70.30
19N 5E 19B		218.40	217.76	219.73	229.82	222.30	221.05	215.44	213.18	214.34	213.52	212.27	215.62	217.75	218.78	217.60	220.03	214.72
19N 5E 30B											239.40	238.27	241.76	243.80	247.11	243.76	246.15	240.80
19N 5E 36A	9.85	12.18	10.38	11.25	12.44	13.70	13.60	6.80	3.34	5.87	4.23	5.51	9.18	10.46	11.17	9.33	10.02	4.80
19N 6E 22A	22.70	30.72	32.34	32.95	32.48	33.50	37.30	20.95	11.40	9.89	11.08	8.61	11.35	16.03	19.13	19.42	19.61	13.74
19N 6E 24B							58.20	55.05	53.97	52.81	52.71	51.92	51.05	48.37	53.24	54.34	55.32	53.15
19N 7E 19D											65.68	65.28	63.79	64.94	66.42	67.10	68.22	67.92
19N 7E 25C			74.58	74.94	75.50	76.19	76.13	73.89	72.22	70.98	71.43	71.17	71.41	72.65	73.58	73.46	73.91	72.67
19N 9E 06D							36.98	31.62	29.07	29.13	26.20	19.38	18.65	28.47	30.00	18.72	25.02	13.95
20N 5E 02D											38.90	37.13	39.27	42.72	43.46	43.36	43.58	41.08
20N 5E 13A			47.85	47.48	47.96	49.24	48.96	44.48	42.65	45.18	45.44	44.99	47.00	48.80	50.20	48.43	48.38	46.68
20N 5E 17B	73.99	76.27	76.45	76.62	77.38	78.37	78.90	72.38	67.50	68.31	68.70	67.16	68.32	71.07	72.93	72.97	73.98	71.29
20N 5E 22C											72.80	71.37	72.02	74.39	75.67	75.58	76.12	74.53
20N 5E 26D	20.70	22.61	22.57	22.57	22.83	23.54	23.90	20.12	16.14	16.96	17.32	16.19	16.90	19.18	20.57	20.52	21.02	19.67
20N 6E 02A	8.76	9.75	9.21	9.33	9.70	10.36	10.18	8.71	6.69	6.68	6.75	6.66	7.15	8.24	8.82	8.36	8.59	7.34
20N 6E 23A	9.61	10.72	8.87	8.23	9.82	11.86	11.00	8.47	7.45	8.28	7.48	9.42	10.39	11.09	11.26	9.94	10.14	8.02
20N 6E 33A	3.39	5.30	1.67	0.85	3.00	6.84	6.13	0.62	-0.90	0.23	-0.63	0.05	1.66	2.69	3.45	1.52	1.20	-0.38
20N 8E 08B							39.44	34.94	31.66	31.95	31.54	30.41	31.61	33.74	35.08	34.90	34.90	31.38
20N 6E 23D																4.82	5.33	3.18

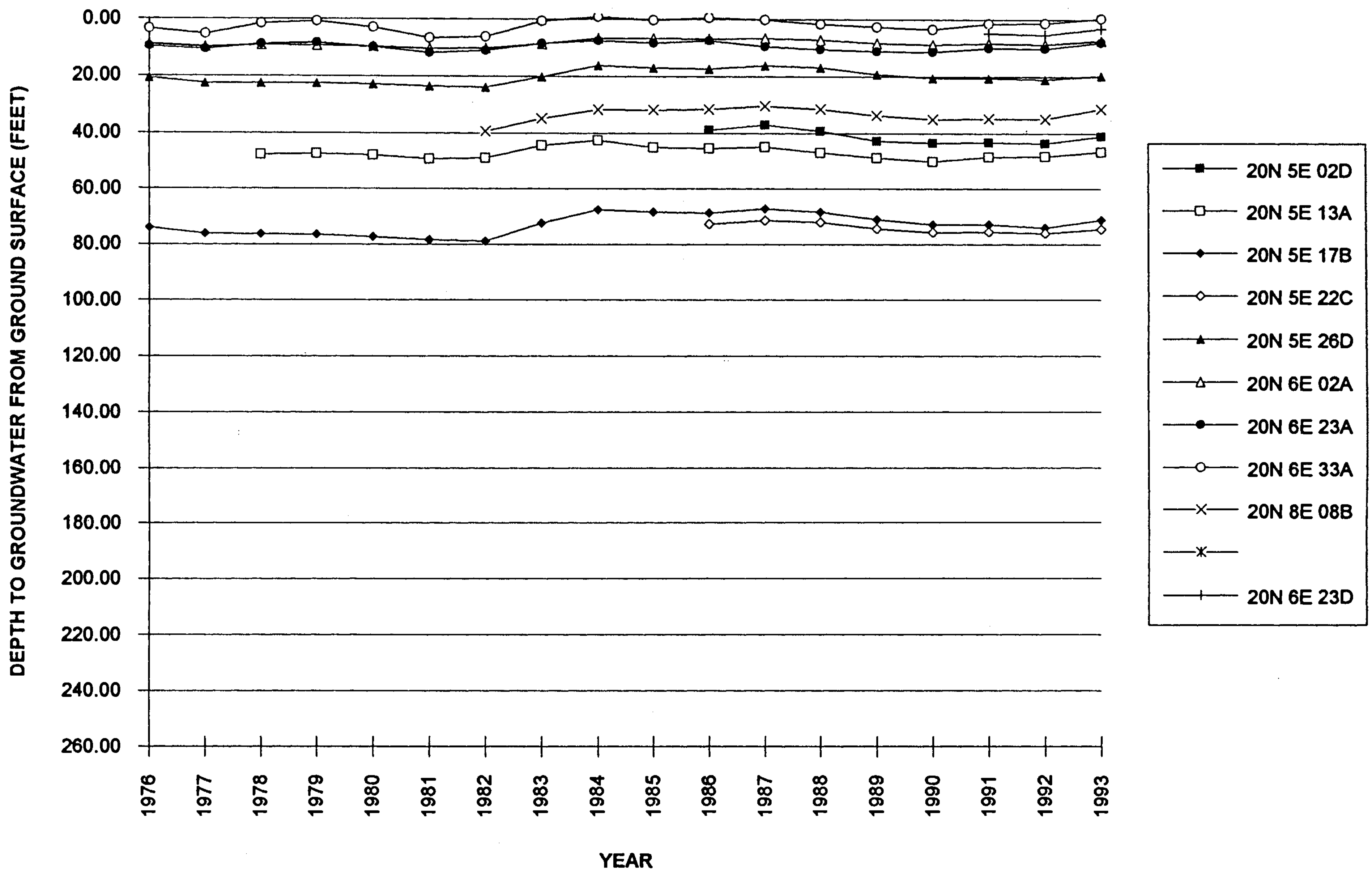
DODGE COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS (TOWNSHIP 18 NORTH)



DODGE COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 19 NORTH)

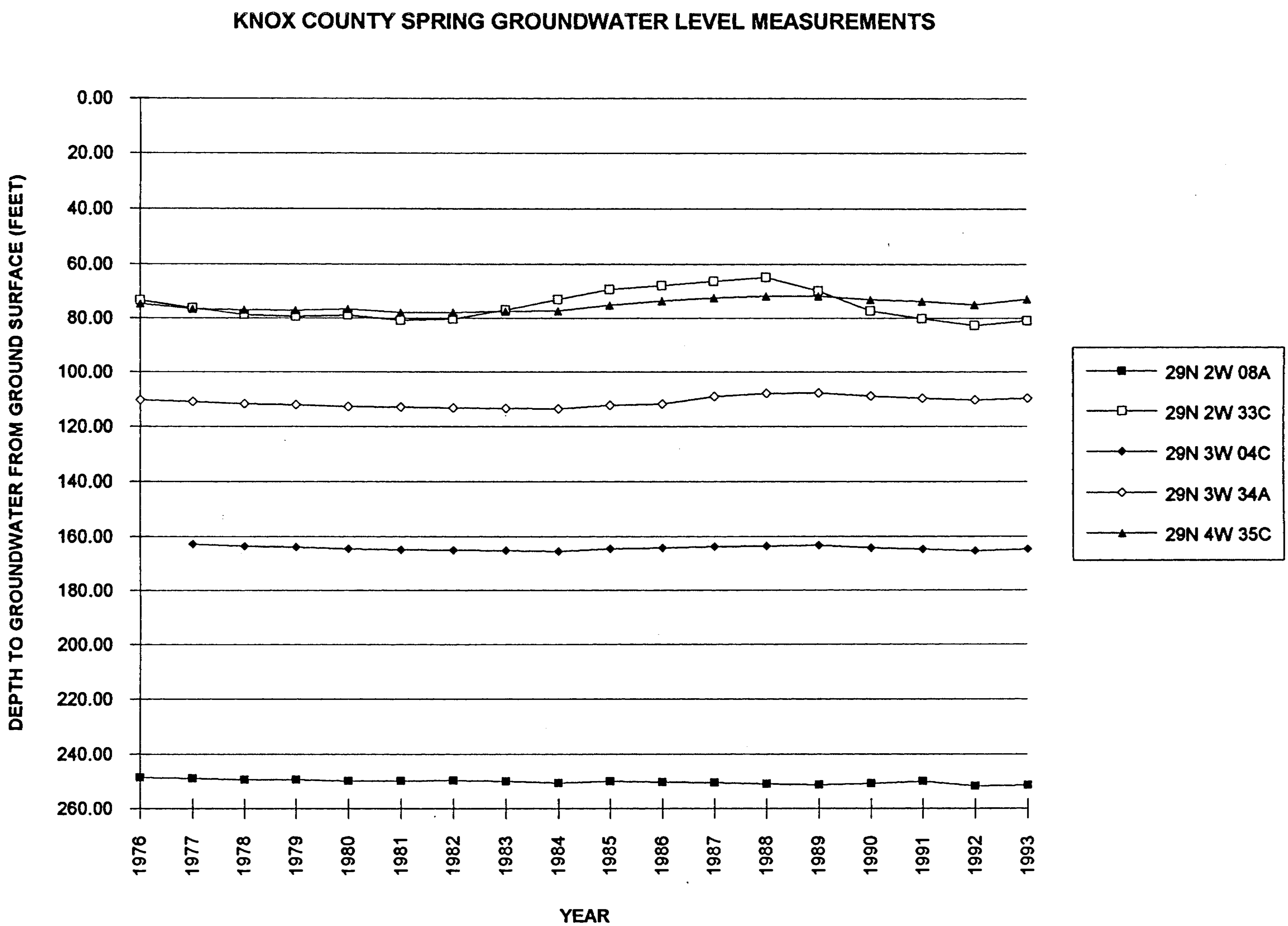


DODGE COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 20 NORTH)



KNOX COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS

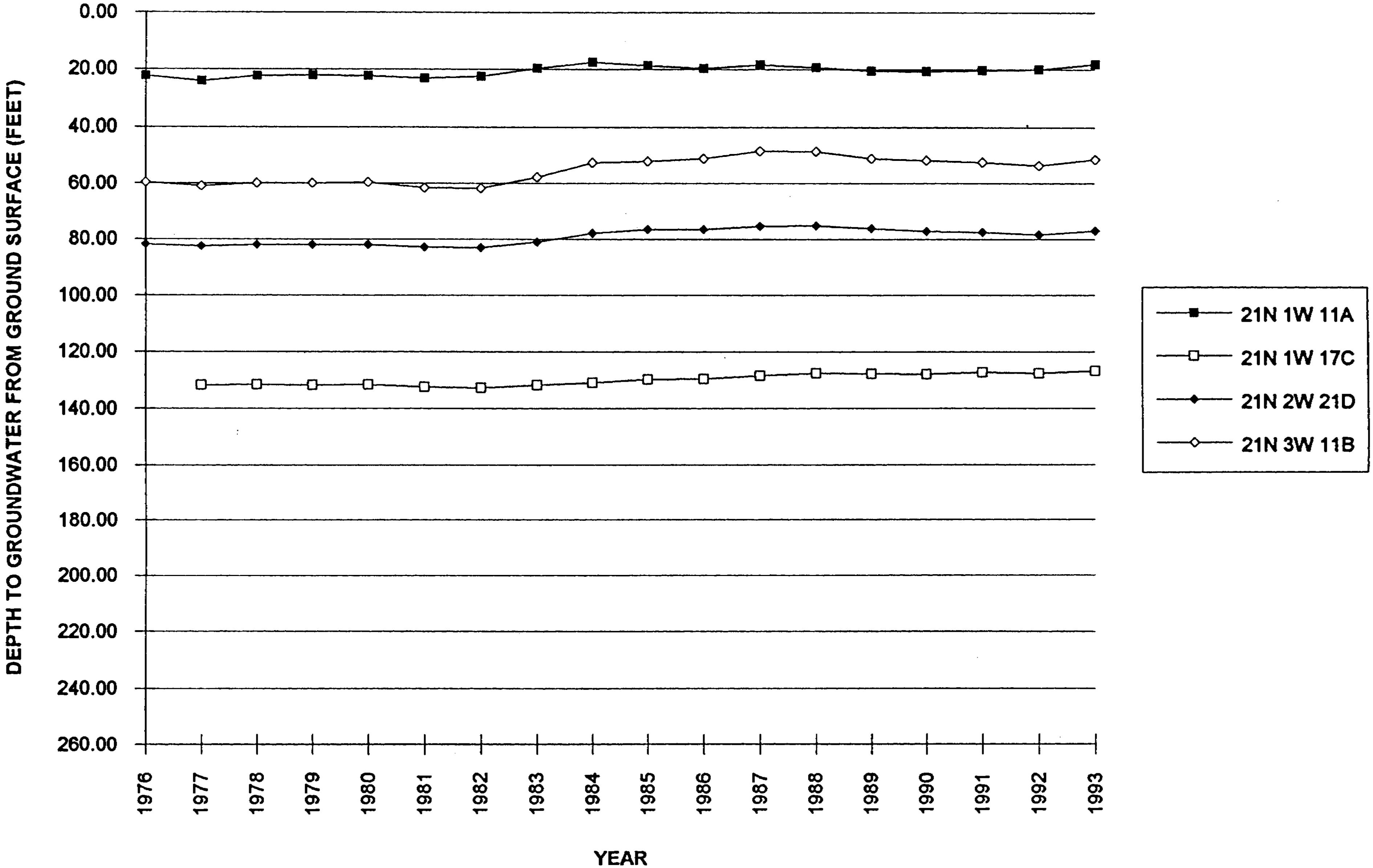
LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
29N 2W 08A	248.58	248.92	249.35	249.35	249.87	249.87	249.60	249.97	250.56	250.04	250.30	250.52	250.95	251.22	250.82	250.02	251.77	251.40
29N 2W 33C	73.43	76.35	78.73	79.40	78.88	80.86	80.35	76.94	73.04	69.36	67.83	66.36	64.82	69.86	77.22	80.15	82.71	80.96
29N 3W 04C		162.81	163.55	163.85	164.57	164.88	164.96	165.16	165.53	164.53	164.10	163.78	163.57	163.26	164.10	164.72	165.25	164.63
29N 3W 34A	110.36	110.89	111.73	112.16	112.67	112.96	113.19	113.40	113.59	112.28	111.82	109.06	107.88	107.71	108.86	109.74	110.35	109.65
29N 4W 35C	74.70	76.57	76.91	77.12	76.66	77.80	77.94	77.40	77.27	75.20	73.58	72.36	71.75	71.81	73.10	73.64	74.95	72.87

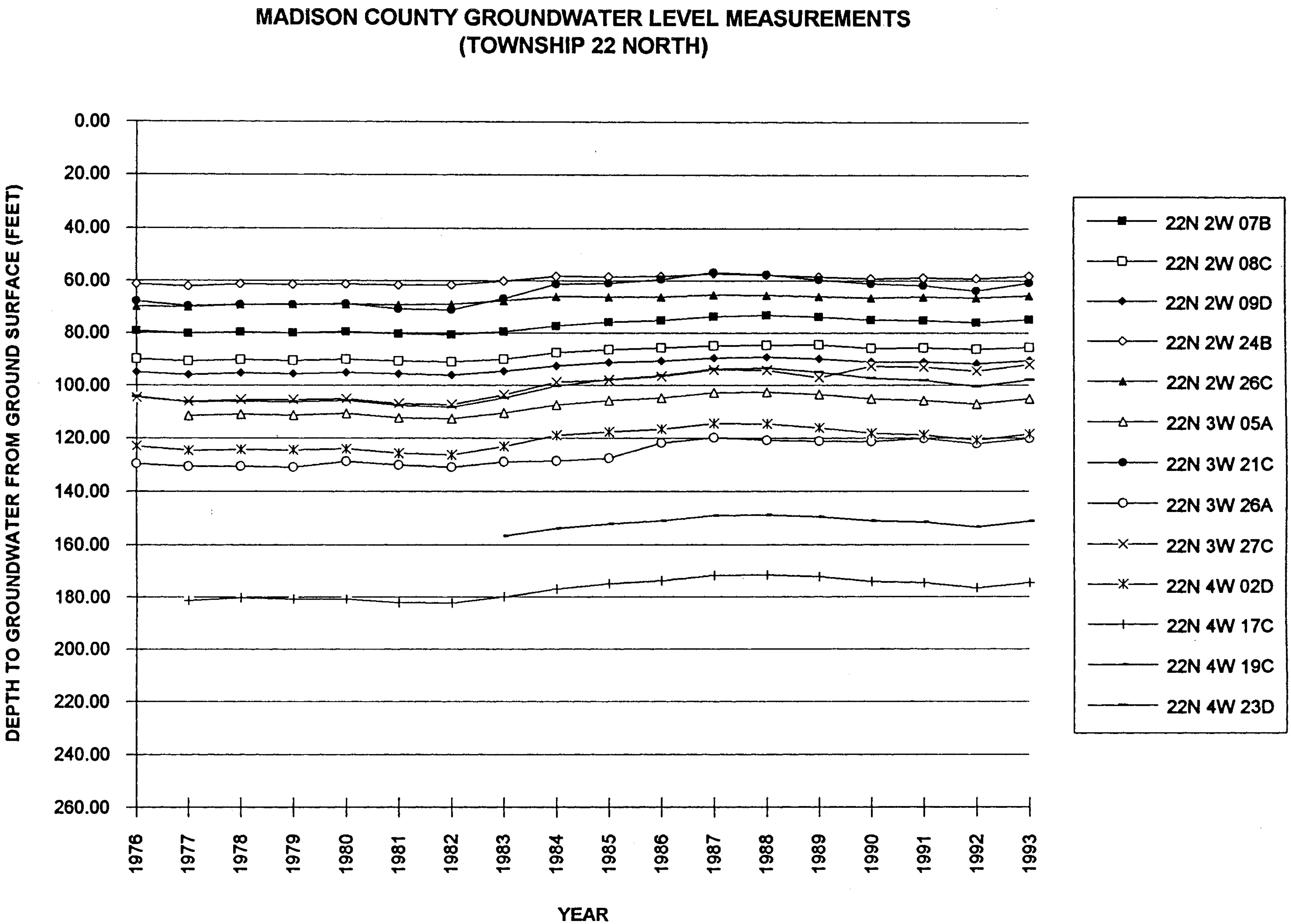

KNOX COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
YEAR
29N 2W 08A
29N 2W 33C
29N 3W 04C
29N 3W 34A
29N 4W 35C

MADISON COUNTY GROUNDWATER LEVEL MEASUREMENTS

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
21N 1W 11A	22.35	24.13	22.38	22.23	22.30	23.21	22.50	19.71	17.59	18.72	19.70	18.36	19.44	20.56	20.68	20.30	20.03	18.24
21N 1W 17C		131.73	131.70	131.83	131.59	132.49	132.76	131.82	130.89	129.79	129.58	128.38	127.57	127.73	128.04	127.36	127.69	126.73
21N 2W 21D	82.00	82.54	82.14	82.16	82.07	82.97	83.14	81.10	77.95	76.52	76.57	75.51	75.22	76.34	77.31	77.62	78.46	77.18
21N 3W 11B	59.63	60.95	59.98	60.02	59.67	61.65	61.89	57.79	52.74	52.13	51.22	48.52	48.69	51.17	51.78	52.52	53.67	51.42
22N 2W 07B	79.27	80.34	79.80	80.13	79.62	80.48	80.82	79.60	77.39	75.92	75.22	73.77	73.19	73.90	75.14	75.21	76.02	74.92
22N 2W 08C	89.96	90.85	90.31	90.60	90.06	90.80	91.09	90.05	87.68	86.43	85.81	84.90	84.81	84.63	85.98	85.77	86.30	85.57
22N 2W 09D	94.98	95.96	95.34	95.64	95.08	95.72	96.16	94.67	92.66	91.39	90.80	89.73	89.27	90.02	91.12	91.10	91.79	90.64
22N 2W 24B	61.41	62.22	61.34	61.50	61.35	61.64	61.67	60.23	58.35	58.44	58.33	57.36	57.81	58.59	59.11	58.91	59.16	58.08
22N 2W 26C	69.80	70.10	69.17	69.01	69.07	69.19	69.02	67.75	66.05	66.25	66.18	65.37	65.51	66.06	66.49	66.27	66.48	65.65
22N 3W 05A		111.50	111.13	111.43	110.76	112.35	112.68	110.57	107.50	105.92	104.92	102.86	102.74	103.48	105.23	105.80	107.26	105.20
22N 3W 21C	67.85	69.68	69.22	69.20	68.89	70.82	71.18	66.90	61.38	60.97	59.59	56.88	57.60	59.70	61.25	61.93	63.88	60.87
22N 3W 26A	129.70	130.71	130.61	130.99	128.87	130.18	131.02	129.00	128.70	127.57	121.85	119.94	120.95	121.34	121.48	120.23	122.24	120.29
22N 3W 27C	104.70	106.21	105.53	105.62	105.15	107.02	107.41	103.75	98.82	98.00	96.68	94.11	94.30	97.25	92.90	93.20	94.68	92.16
22N 4W 02D	123.07	124.74	124.44	124.65	124.16	125.84	126.43	123.27	119.09	117.75	116.72	114.51	114.80	116.25	118.32	119.00	120.94	118.64
22N 4W 17C		181.30	180.30	180.77	180.87	182.16	182.41	179.94	176.90	174.97	173.75	171.85	171.62	172.34	174.10	174.64	176.66	174.65
22N 4W 19C								156.77	153.82	152.23	151.05	148.98	148.80	149.47	151.12	151.54	153.36	151.27
22N 4W 23D	104.33	106.35	106.17	106.40	105.92	107.77	108.33	104.92	100.27	97.88	96.27	93.84	93.56	95.00	97.34	98.20	100.49	97.99
23N 1W 08C	5.18	8.02	2.72	2.92	3.53	5.69	4.90	1.75	0.64	1.81	1.78	1.48	3.60	4.96	6.42	5.04	4.16	2.16
23N 1W 12D	3.00	4.67	2.25	2.15	2.89	2.95	3.00	2.58	1.80	2.62	2.24	2.56	3.07	3.40	3.72	1.25	2.67	2.02
23N 2W 08C	11.81	13.39	11.10	11.25	10.40	12.70	12.73	8.09	5.12	6.48	6.90	4.11	6.89	8.67	10.49	10.47	9.66	6.79
23N 2W 21A	81.17	82.60	81.25	81.98	80.32	81.89	82.68	80.10	75.89	74.73	74.60	72.13	72.87	75.13	77.78	77.68	77.43	75.05
23N 3W 07C		8.54	7.95	8.25	7.59	8.82	9.13	6.60	3.70	3.18	3.10	1.56	2.11	3.20	5.34	5.88	6.94	5.15
23N 3W 10C	68.04	69.06	68.15	67.94	67.85	68.98	68.82	66.50	64.73	64.62	64.36	62.90	63.82	64.45	65.75	66.13	66.52	65.16
23N 3W 36D	111.60	113.13	112.54	112.73	112.29	113.27	113.73	111.98	109.48	108.68	108.09	106.35	106.10	106.73	108.04	108.27	109.08	107.59
23N 4W 04C	11.90	13.40	12.64	13.21	12.27	13.75	13.89	10.72	7.76	7.06	7.22	6.28	7.05	8.62	10.91	11.61	13.02	10.38
23N 4W 19A		66.28	65.82	66.61	66.08	67.47	67.87	65.80	62.75	60.63	59.63	58.03	58.09	59.08	61.68	62.59	64.72	62.54
24N 1W 03D	16.77	17.65	16.06	16.32	16.46	17.65	17.23	14.75	14.48	15.00	15.12	15.09	16.20	16.79	17.38	17.37	17.14	15.43
24N 2W 18C	83.87	84.82	83.83	83.45	83.60	84.67	84.21	81.72	80.90	81.60	81.72	80.94	82.50	83.10	84.16	84.32	84.22	82.31
24N 3W 08A	135.89	136.52	136.48	136.68	135.80	136.30	136.05	134.77	132.05	129.57	128.89	127.63	127.76	128.74	131.03	134.08	134.00	133.39
24N 3W 25D	4.17	5.90	2.64	2.37	3.96	6.05	4.15	2.79	2.69	3.44	3.29	3.27	5.59	5.79	6.10	6.09	4.86	2.96
24N 4W 10A		87.12	86.44	86.86	85.93	86.63	86.00	85.05	83.35	82.04	81.57	81.08	81.21	82.21	83.59	84.31	85.37	84.82
24N 4W 28D	23.30	25.19	23.27	23.26	22.23	24.27	27.73	19.10	16.88	17.73	18.75	17.61	20.69	22.20	22.19	22.33	30.42	27.62

MADISON COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 21 NORTH)




MADISON COUNTY GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 22 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
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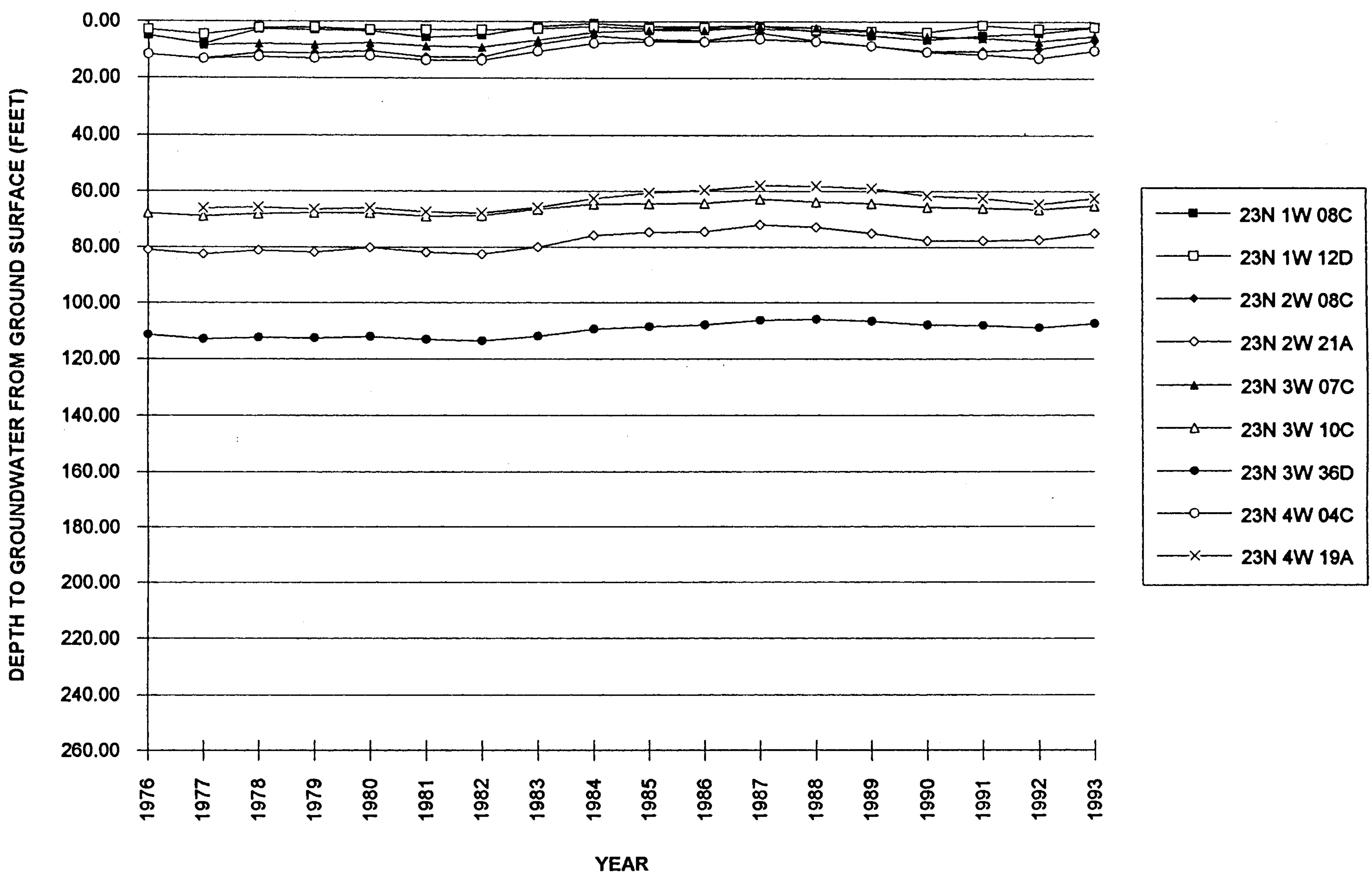
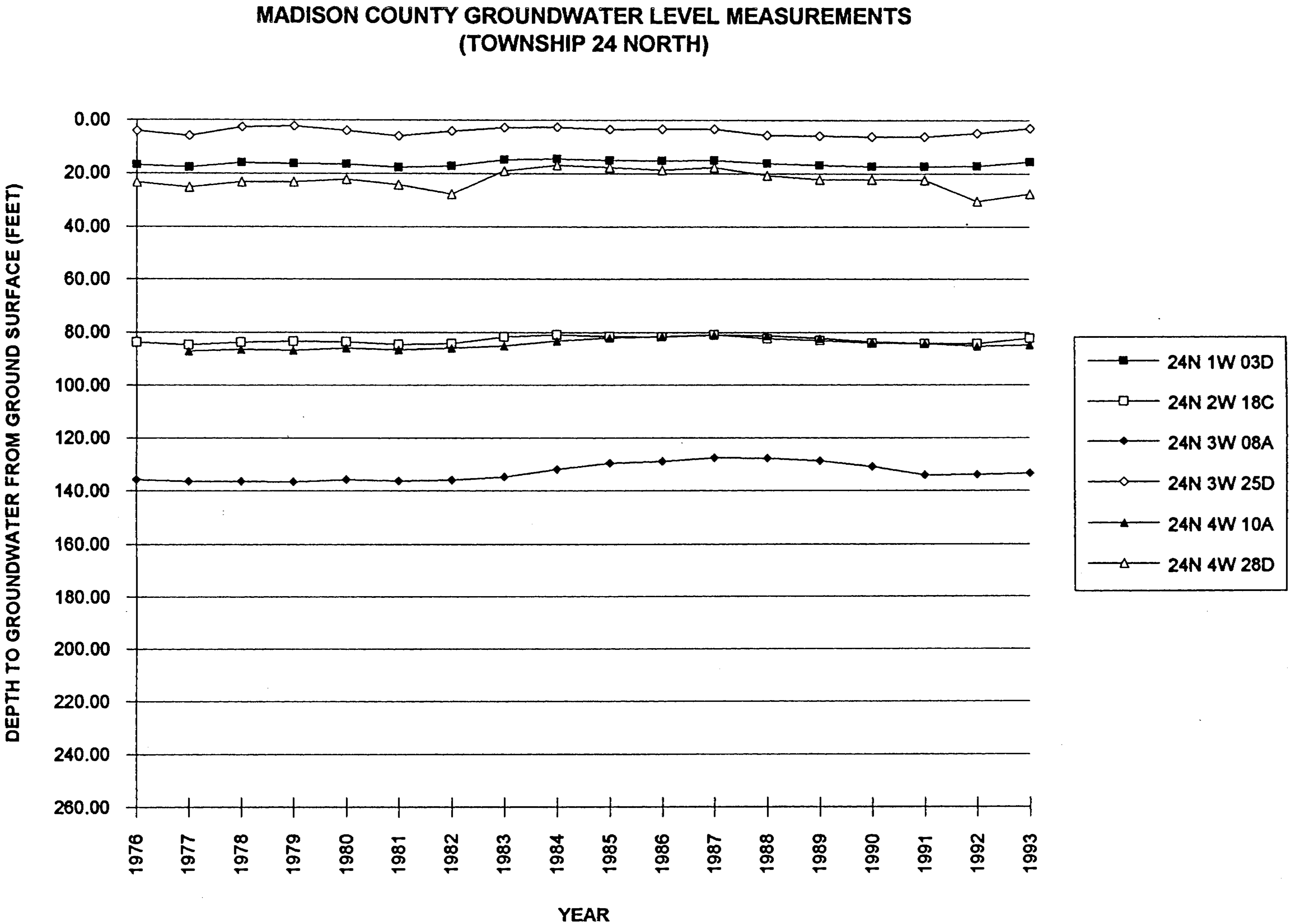
1993
YEAR
22N 2W 07B
22N 2W 08C
22N 2W 09D
22N 2W 24B
22N 2W 26C
22N 3W 05A
22N 3W 21C
22N 3W 26A
22N 3W 27C
22N 4W 02D
22N 4W 17C
22N 4W 19C
22N 4W 23D

MADISON COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 23 NORTH)




MADISON COUNTY GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 24 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
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220.00
240.00
260.00
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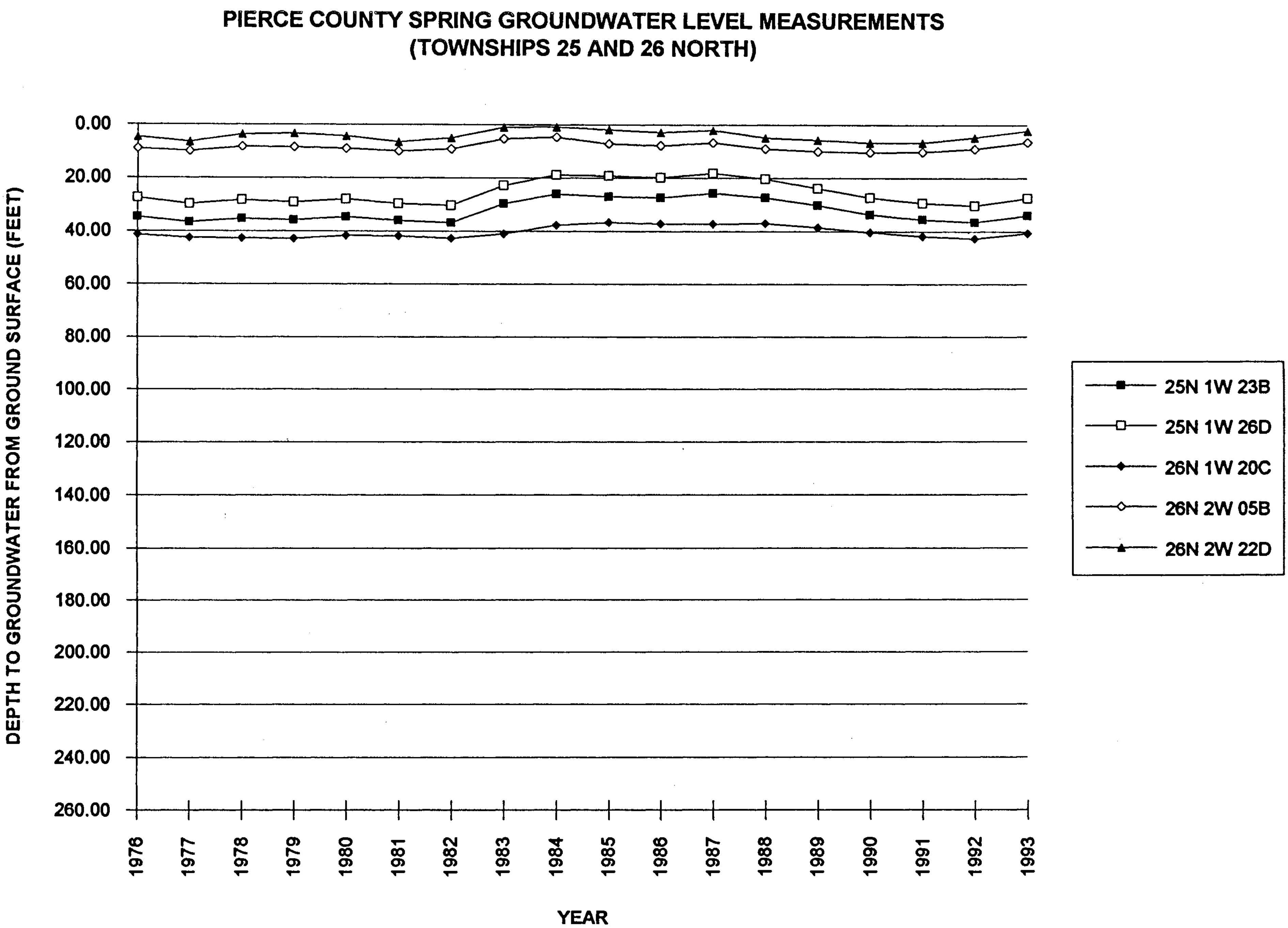
1993
YEAR
24N 1W 03D
24N 2W 18C
24N 3W 08A
24N 3W 25D
24N 4W 10A
24N 4W 28D

PIERCE COUNTY GROUNDWATER LEVELS (PAGE 2)

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
25N 1W 23B	34.67	36.70	35.37	35.96	34.82	36.02	36.87	29.77	25.99	27.12	27.45	25.68	27.33	30.28	33.71	35.62	36.58	34.10
25N 1W 26D	27.57	29.95	28.34	29.16	27.97	29.74	30.36	22.85	18.77	19.13	19.84	18.13	20.30	23.80	27.47	29.39	30.43	27.59
26N 1W 20C	41.42	42.62	42.75	43.00	41.76	42.00	42.88	41.09	37.85	36.77	37.25	37.18	37.04	38.58	40.49	41.94	42.80	40.82
26N 2W 05B	8.98	10.07	8.28	8.42	8.92	10.07	9.07	5.28	4.57	7.07	7.77	6.56	9.03	9.99	10.37	10.22	8.97	6.38
26N 2W 22D	4.60	6.39	3.63	3.38	4.33	6.50	4.95	1.02	0.83	1.82	2.75	1.89	4.75	5.65	6.67	6.68	4.56	2.12
27N 1W 03A	203.05	203.15	203.42	203.72	204.07	204.14	204.42	204.70	205.04	204.10	203.86	203.54	203.53	202.88	203.30	203.70	204.08	204.06
27N 2W 01C	155.54	156.80	159.65	158.47	159.40	161.76	158.88	158.08	156.40	155.35	154.65	151.78	149.36	148.40	153.09	155.57	157.68	154.88
27N 2W 05C	87.27	88.67	89.27	89.70	89.76	90.73	91.02	89.12	86.39	84.24	84.33	84.05	83.79	85.20	87.28	88.70	89.95	88.10
27N 2W 13A	68.15	69.03	69.39	70.54	70.83	71.60	71.02	70.65	69.05	65.20	62.97	61.53	60.35	61.30	65.30	67.38	69.06	67.12
27N 2W 20C	14.43	16.35	15.56	14.78	15.35	17.12	15.97	11.92	10.55	11.03	11.43	10.54	11.88	13.15	14.48	15.62	15.06	11.57
27N 2W 24C		126.62	126.90	127.40	127.73	128.53	128.44	125.85	122.70	118.94	118.50	117.96	117.39	120.00	123.32	125.62	126.73	123.33
27N 3W 05A	9.75	12.30	11.20	10.84	10.37	13.11	11.77	7.05	6.04	9.13	8.17	7.16	9.14	11.38	13.74	13.98	12.13	7.43
27N 3W 05B	23.50	26.62	24.93	24.57	23.94	26.52	25.53	21.33	20.40	22.29	21.81	21.08	22.37	24.47	26.89	27.84	25.95	21.68
27N 3W 06C	63.30	64.85	64.20	64.10	63.58	65.60	65.09	62.33	60.90	61.93	61.18	60.72	61.73	63.30	65.32	65.87	64.88	61.90
27N 3W 22D	67.09	69.92	68.92	68.18	68.00	71.59	69.22	62.65	62.13	63.50	64.53	62.88	64.73	67.50	69.92	70.47	68.16	63.38
27N 3W 25D	48.94	50.00	48.61	48.50	48.62	50.24	49.53	44.43	43.68	47.22	47.25	45.85	47.70	49.42	50.73	50.70	49.26	45.89
27N 4W 06D	30.98	33.50	31.83	31.44	30.46	33.05	32.87	26.68	25.25	29.73	29.05	27.33	30.38	32.27	34.57	34.95	32.66	28.54
27N 4W 16B	10.65	13.17	12.00	10.92	10.42	12.79	12.47	5.93	5.37	10.58	9.33	7.52	10.96	12.30	13.95	14.24	11.38	7.93
28N 2W 12B	220.80	222.13	223.18	223.52	223.88	224.66	223.88	224.05	224.90	225.50	225.35	224.52	224.96	226.02	227.69	228.03	228.76	227.55
28N 2W 32C	47.93	49.60	49.75	50.30	50.33	51.75	51.50	47.69	43.84	43.83	43.76	43.70	43.87	46.04	48.34	49.64	50.36	47.99
28N 3W 12D	113.15	115.24	116.69	117.21	117.25	118.67	118.06	116.55	114.29	109.05	107.17	105.91	104.95	107.79	112.22	114.84	117.42	115.66
28N 3W 24B	133.12	134.89	135.95	136.05	136.40	137.80	137.50	135.40	132.62	129.49	128.74	135.40	127.86	129.70	132.52	134.47	135.94	133.93
28N 4W 05A	117.30	119.40	119.30	120.62	119.00	121.10	121.98	119.84	116.58	113.77	113.06	111.72	111.94	113.94	117.58	119.37	120.18	116.51
28N 4W 21B	119.58	121.55	121.65	121.32	119.79	122.17	122.86	119.70	116.28	115.62	114.48	113.28	114.02	116.36	119.44	120.71	121.08	116.48
28N 4W 24B	25.45	27.18	26.67	26.75	25.09	28.15	27.77	24.74	22.88	23.20	21.80	21.03	21.44	22.99	24.87	25.75	25.68	22.60
28N 4W 26B	22.73	24.47	24.37	23.77	22.92	24.88	25.32	22.12	19.05	20.14	18.94	18.24	19.21	21.24	23.72	24.87	24.12	19.53
28N 4W 34C	35.97	37.72	37.24	36.84	35.75	38.20	38.55	35.27	32.92	33.86	32.61	31.88	33.05	35.03	37.57	38.47	37.77	33.93



PIERCE COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 25 AND 26 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
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120.00
140.00
160.00
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220.00
240.00
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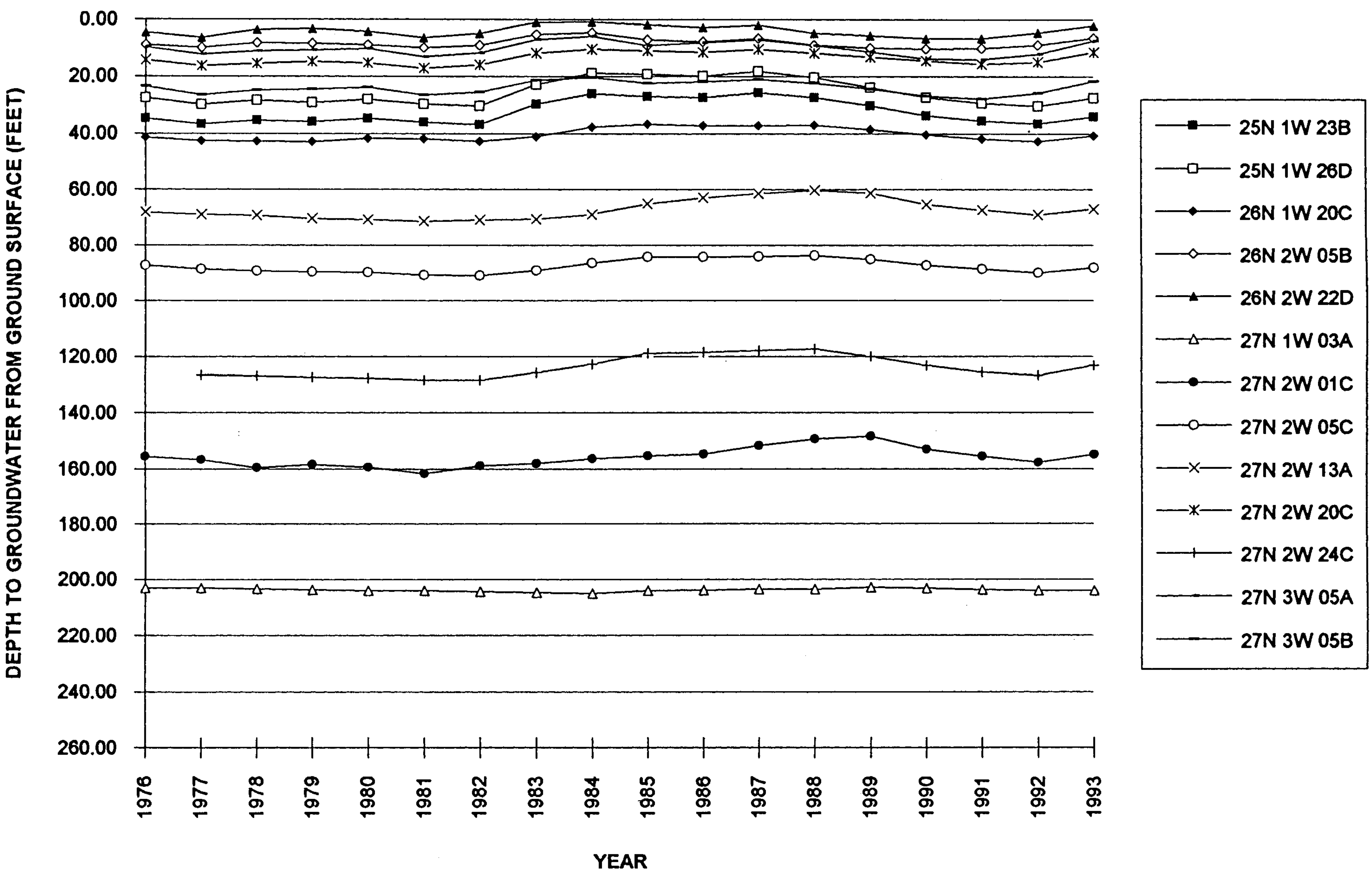
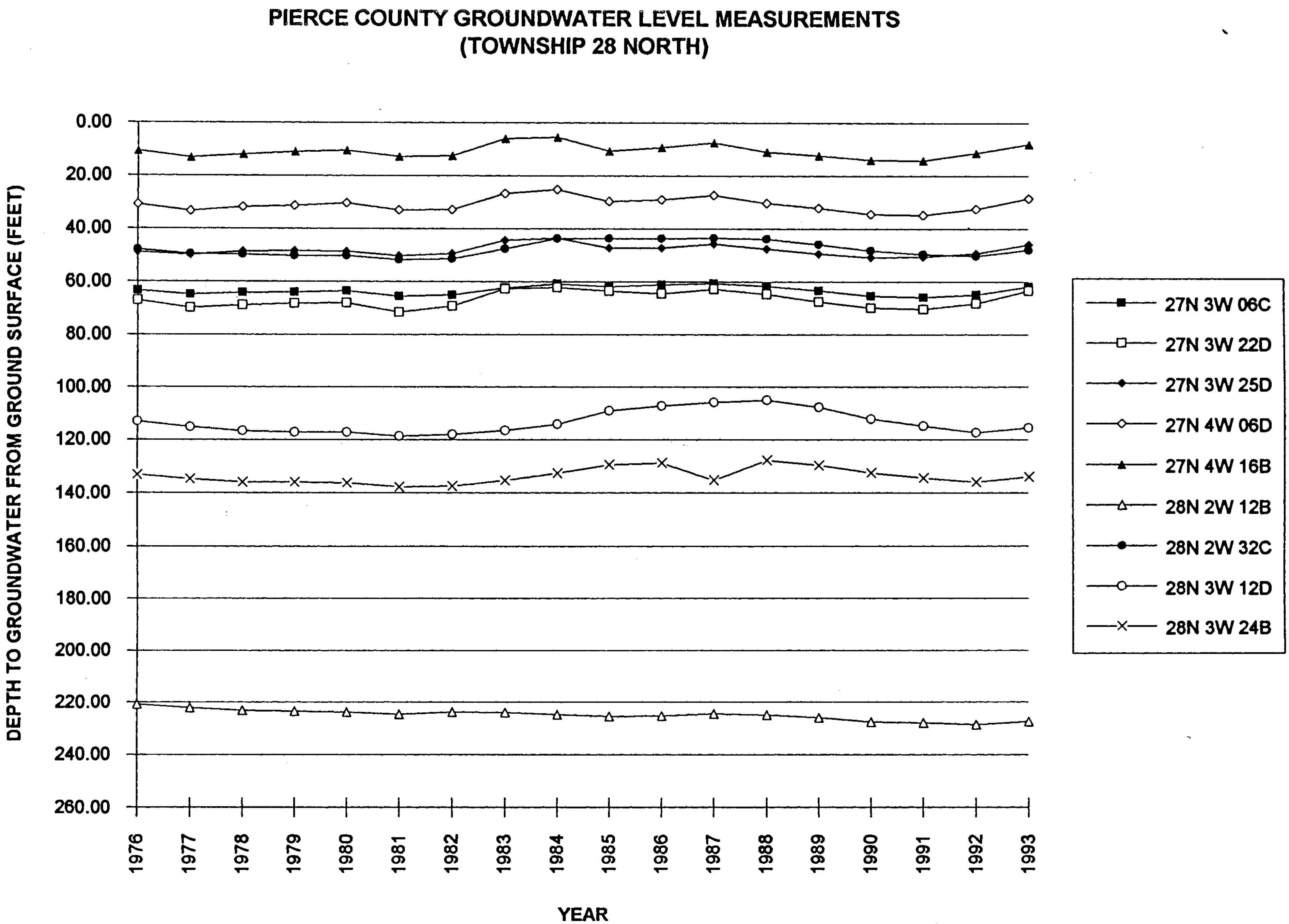
YEAR
25N 1W 23B
25N 1W 26D
26N 1W 20C
26N 2W 05B
26N 2W 22D

PIERCE COUNTY SPRING GROUNDWATER MEASUREMENTS
(TOWNSHIP 27 NORTH)





PIERCE COUNTY GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 28 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
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180.00
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220.00
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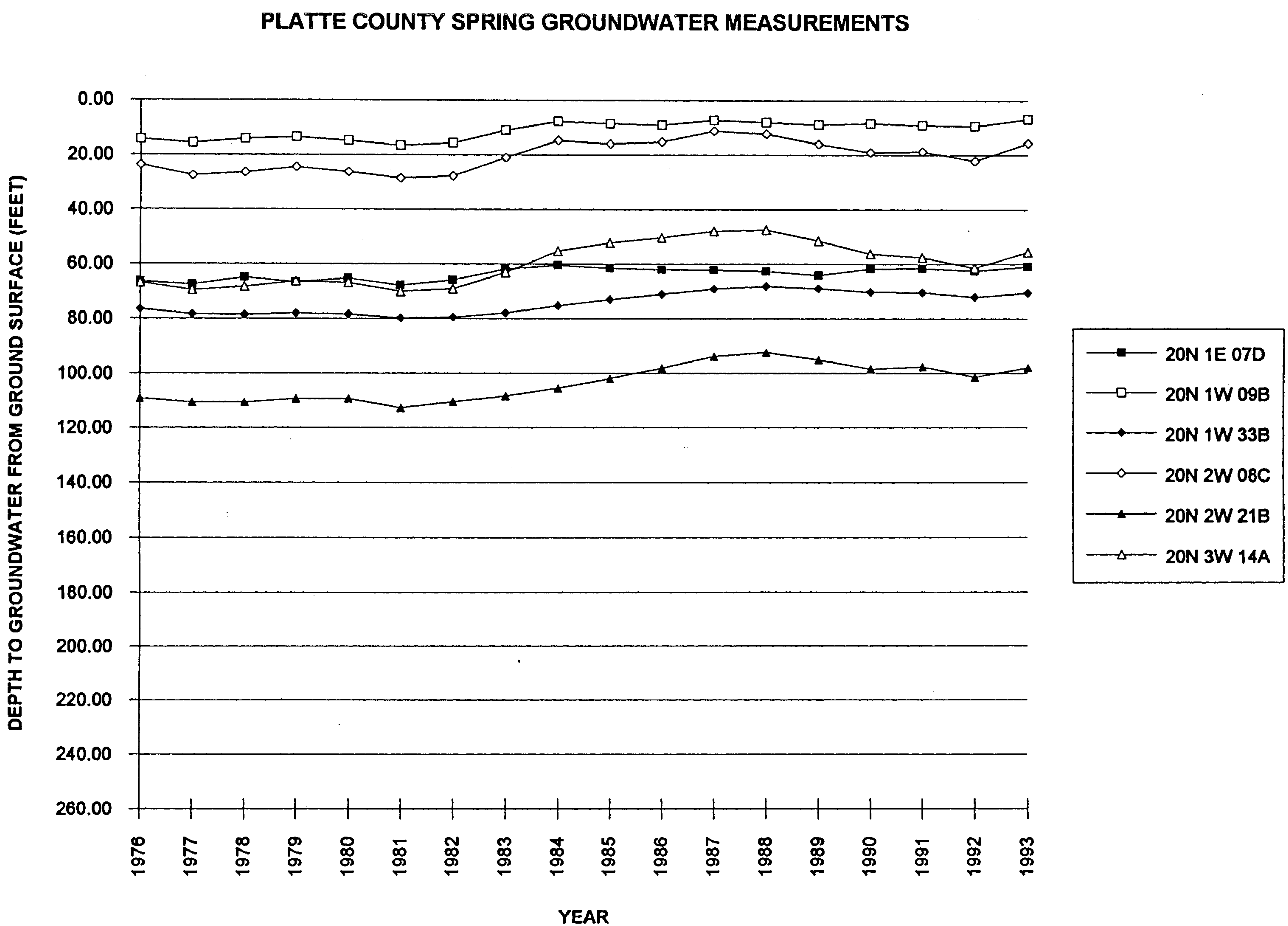
1993
YEAR
27N 3W 06C
27N 3W 22D
27N 3W 25D
27N 4W 06D
27N 4W 16B
28N 2W 12B
28N 2W 32C
28N 3W 12D
28N 3W 24B

PLATTE COUNTY GROUNDWATER LEVEL MEASUREMENTS

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
20N 1E 07D	66.38	67.50	65.04	66.73	65.26	67.97	65.90	61.98	60.44	61.57	62.06	62.20	62.65	64.25	61.74	61.59	62.62	60.95
20N 1W 09B	14.30	15.57	14.13	13.56	14.78	16.50	15.60	10.99	7.66	8.52	9.00	7.16	8.07	8.93	8.42	8.94	9.33	6.69
20N 1W 33B	76.57	78.42	78.60	78.08	78.33	79.81	79.55	77.89	75.37	72.99	71.14	69.24	68.27	69.05	70.36	70.49	72.09	70.55
20N 2W 08C	23.74	27.52	26.50	24.55	26.20	28.55	27.68	20.87	14.70	16.02	15.12	11.04	12.29	15.89	18.96	18.70	22.05	15.57
20N 2W 21B	109.17	110.62	110.58	109.32	109.34	112.67	110.50	108.39	105.48	101.86	98.12	93.76	92.24	94.98	98.46	97.53	101.36	97.85
20N 3W 14A	67.00	69.65	68.36	66.50	66.86	70.15	69.24	63.25	55.29	52.18	50.34	47.95	47.34	51.40	56.21	57.60	61.45	55.69


PLATTE COUNTY SPRING GROUNDWATER MEASUREMENTS
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
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60.00
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100.00
120.00
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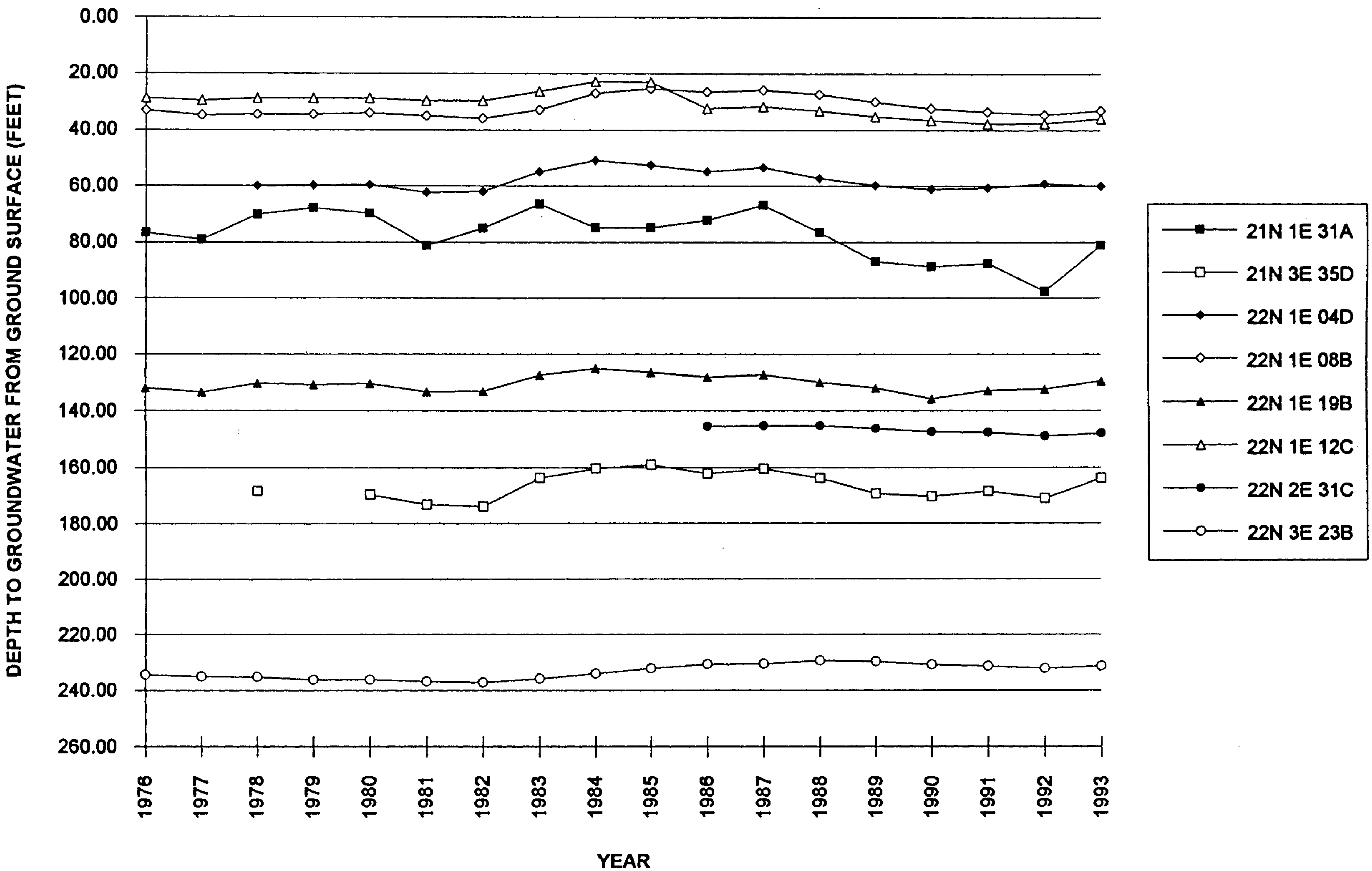
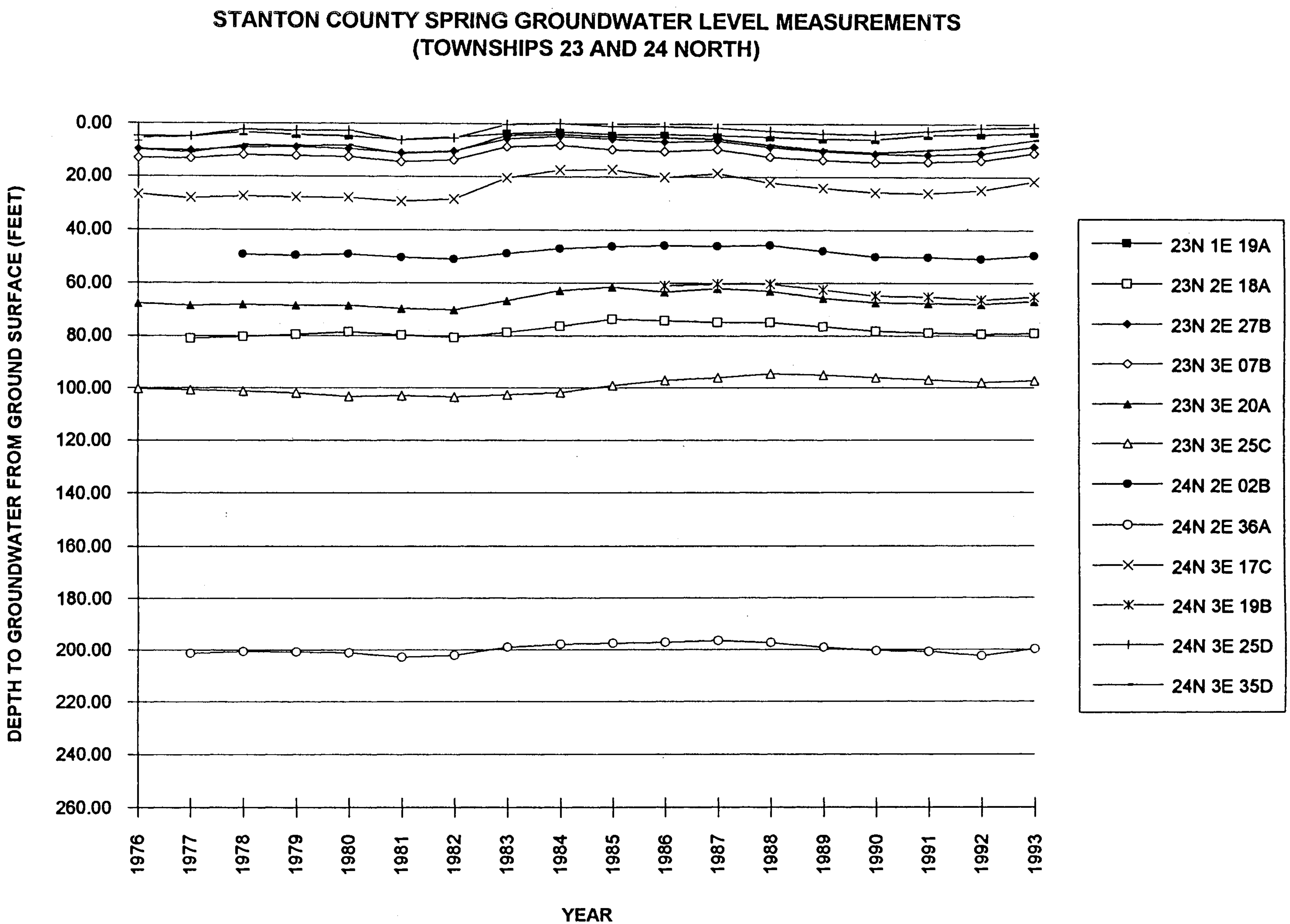
1993
YEAR
20N 1E 07D
20N 1W 09B
20N 1W 33B
20N 2W 08C
20N 2W 21B
20N 3W 14A

STANTON COUNTY GROUNDWATER LEVEL MEASUREMENTS

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
21N 1E 31A	76.76	79.12	70.28	67.85	69.80	81.20	74.99	66.45	74.87	74.88	72.19	66.89	76.66	87.03	88.84	87.64	97.64	81.10
21N 3E 35D			168.50		169.77	173.30	173.97	163.80	160.46	159.16	162.35	160.58	164.00	169.42	170.40	168.64	171.19	163.93
22N 1E 04D			60.10	59.84	59.66	62.42	62.07	55.08	50.99	52.61	54.95	53.44	57.30	59.78	61.25	60.63	59.19	59.96
22N 1E 08B	33.30	35.00	34.59	34.57	34.03	35.12	35.85	32.84	27.11	25.40	26.60	25.95	27.38	30.05	32.46	33.60	34.59	33.03
22N 1E 12C	28.82	29.80	28.97	28.87	28.82	29.65	29.70	26.30	22.93	22.98	32.47	31.72	33.30	35.19	36.63	37.73	37.64	35.89
22N 1E 19B	131.90	133.52	130.23	130.81	130.50	133.36	133.13	127.46	125.15	126.40	128.22	127.33	129.94	131.93	135.79	132.82	132.30	129.38
22N 2E 31C											145.57	145.28	145.35	146.39	147.57	147.72	149.06	147.96
22N 3E 23B	234.40	235.08	235.30	236.25	236.24	236.82	237.20	235.85	234.06	232.27	230.62	230.53	229.30	229.64	230.86	231.38	232.19	231.43
23N 1E 19A	5.46	5.12	3.27	4.33	4.76	6.13	5.18	3.72	2.90	3.95	3.97	4.38	5.01	5.65	5.76	4.18	3.96	3.30
23N 2E 18A		81.12	80.50	79.60	78.60	79.80	80.70	78.78	76.48	73.76	74.17	74.90	74.93	76.62	78.29	78.87	79.43	79.01
23N 2E 27B	9.90	10.30	9.10	9.03	9.57	11.20	10.45	5.85	4.87	5.80	6.90	6.49	8.80	10.37	11.27	11.65	11.12	8.49
23N 3E 07B	13.20	13.32	11.95	12.30	12.64	14.56	13.84	8.79	8.20	9.87	10.43	9.65	12.55	13.70	14.45	14.40	13.81	10.92
23N 3E 20A	67.80	68.52	68.25	68.60	68.50	69.77	70.24	66.65	62.79	61.56	63.33	61.98	63.09	65.62	67.39	67.76	68.10	66.83
23N 3E 25C	100.27	100.86	101.33	102.02	103.38	103.07	103.50	102.70	101.90	99.08	97.19	96.08	94.66	95.20	96.23	97.02	98.06	97.36
24N 2E 02B			49.55	49.77	49.38	50.47	51.14	49.00	47.18	46.27	46.05	46.06	45.76	47.97	50.09	50.29	50.94	49.66
24N 2E 36A		201.37	200.72	200.87	201.17	203.00	202.22	199.12	197.89	197.63	197.24	196.59	197.34	199.18	200.60	200.96	202.59	199.95
24N 3E 17C	26.90	28.20	27.62	27.93	28.00	29.46	28.56	20.45	17.56	17.32	20.19	18.74	22.14	24.23	25.83	26.16	25.05	21.64
24N 3E 19B											61.08	60.36	60.40	62.57	64.94	65.25	66.43	65.28
24N 3E 25D	4.73	5.05	2.29	2.69	2.69	6.30	5.45	0.30	-0.24	0.90	1.04	1.40	2.60	3.68	3.92	2.68	1.38	1.16
24N 3E 35D	10.00	11.20	8.32	8.46	8.30	11.49	10.60	4.40	4.03	4.92	5.26	5.55	7.99	9.79	10.86	9.85	8.75	6.04
21N 3E 11D	12.83	15.76	11.93	12.83	11.22	15.26	13.54	8.25	7.75	9.60	11.06	10.29	12.00	14.65	14.03	13.55		

STANTON COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 21 AND 22 NORTH)




STANTON COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIPS 23 AND 24 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
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120.00
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220.00
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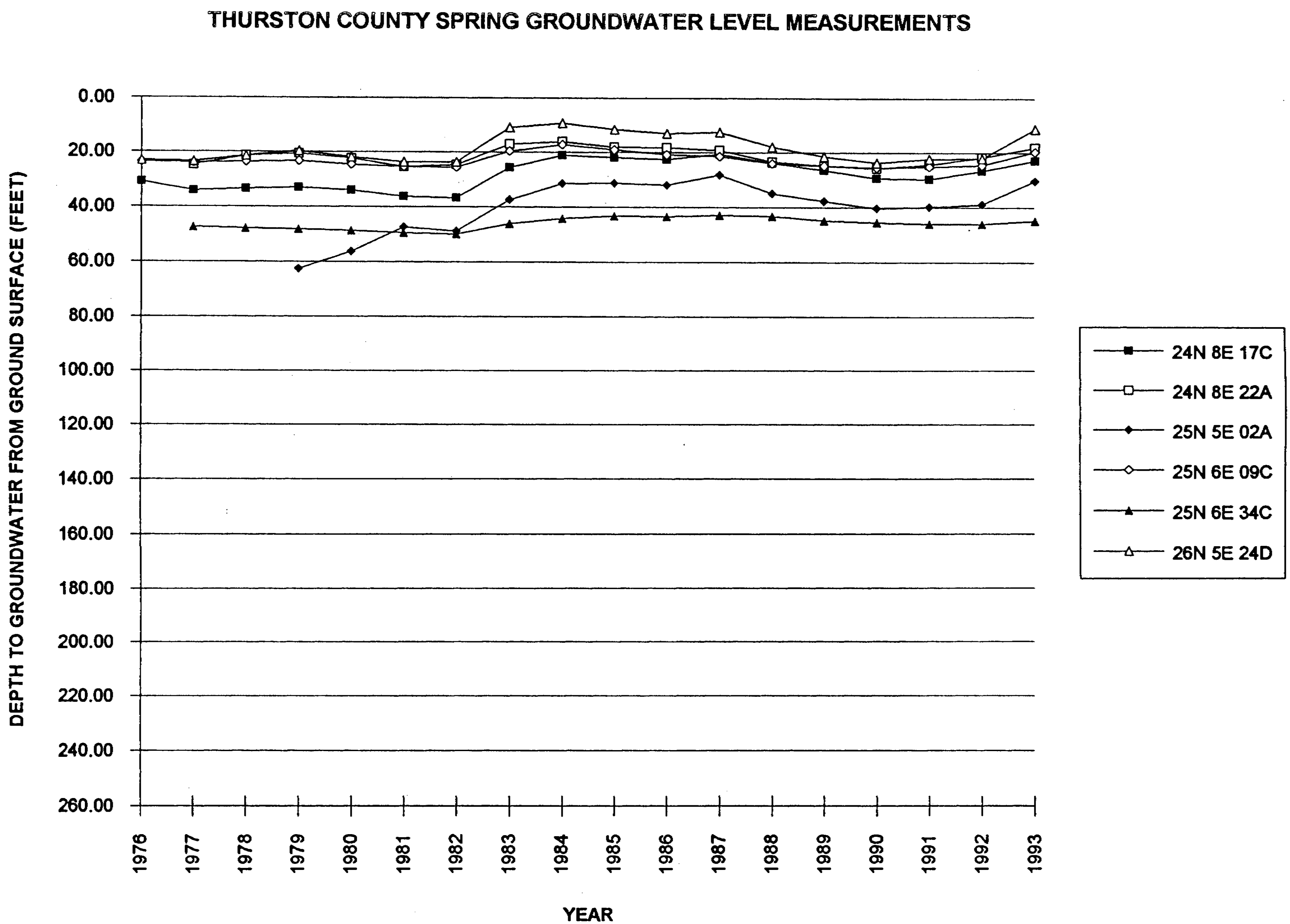
YEAR
23N 1E 19A
23N 2E 18A
23N 2E 27B
23N 3E 07B
23N 3E 20A
23N 3E 25C
24N 2E 02B
24N 2E 36A
24N 3E 17C
24N 3E 19B
24N 3E 25D
24N 3E 35D

THURSTON COUNTY GROUNDWATER LEVEL MEASUREMENTS

LOCATION	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
24N 8E 17C	30.92	34.11	33.45	33.02	34.05	36.21	36.75	25.67	21.04	21.85	22.63	20.67	23.84	26.35	29.33	29.72	26.63	22.83
24N 8E 22A		24.75	21.39	20.59	22.44	25.46	24.58	17.17	16.08	18.09	18.19	19.20	23.30	24.86	25.85	24.30	21.74	18.03
25N 5E 02A				62.50	56.28	47.38	48.82	37.37	31.42	31.19	31.84	28.26	34.94	37.64	40.39	39.80	38.83	30.32
25N 6E 09C	23.64	24.09	23.69	23.45	24.65	25.50	25.59	19.68	17.23	19.03	20.80	21.36	24.02	24.78	25.38	25.13	24.51	19.72
25N 6E 34C		47.32	47.91	48.25	48.72	49.54	50.07	46.07	44.25	43.28	43.36	42.96	43.24	44.76	45.53	45.90	45.98	44.87
26N 5E 24D	23.23	23.62	21.50	19.62	21.86	23.63	23.73	11.01	9.35	11.54	13.00	12.54	17.82	21.46	23.65	22.31	22.03	11.20


THURSTON COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
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20.00
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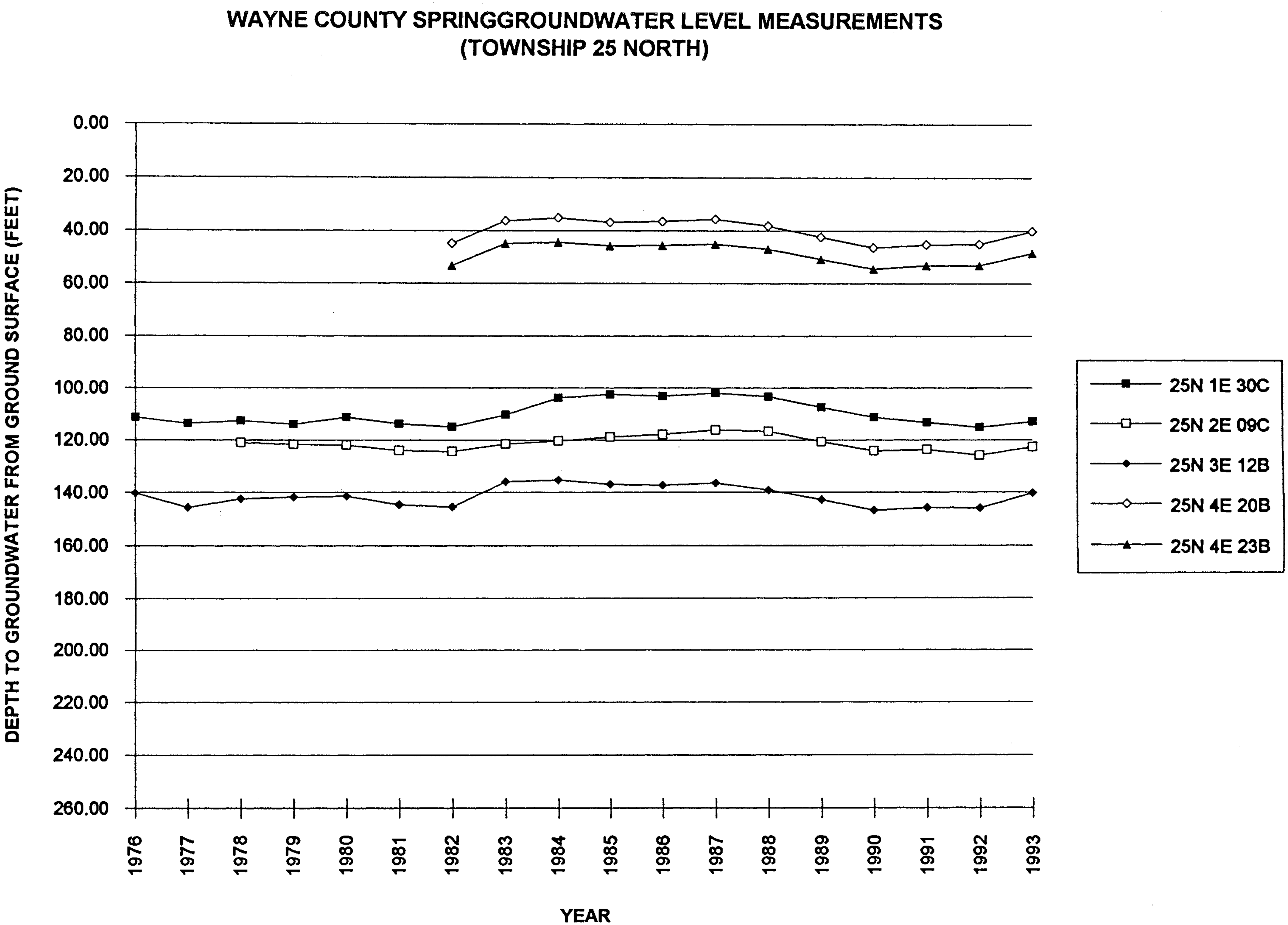
1993
YEAR
24N 8E 17C
24N 8E 22A
25N 5E 02A
25N 6E 09C
25N 6E 34C
26N 5E 24D



WAYNE COUNTY SPRINGGROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 25 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
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1976
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1984
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1986
1987
1988
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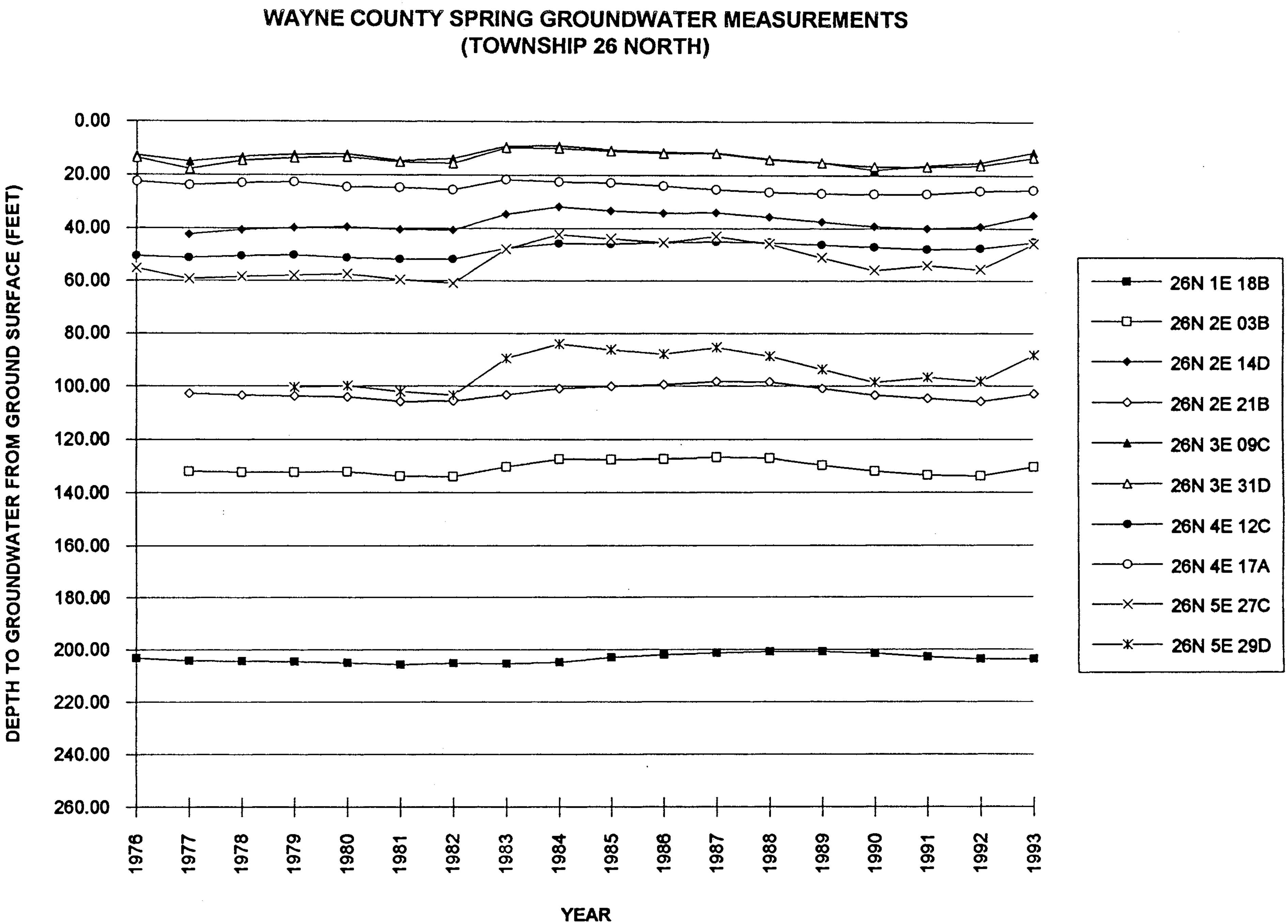
1993
YEAR
25N 1E 30C
25N 2E 09C
25N 3E 12B
25N 4E 20B
25N 4E 23B


WAYNE COUNTY SPRING GROUNDWATER MEASUREMENTS
(TOWNSHIP 26 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
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60.00
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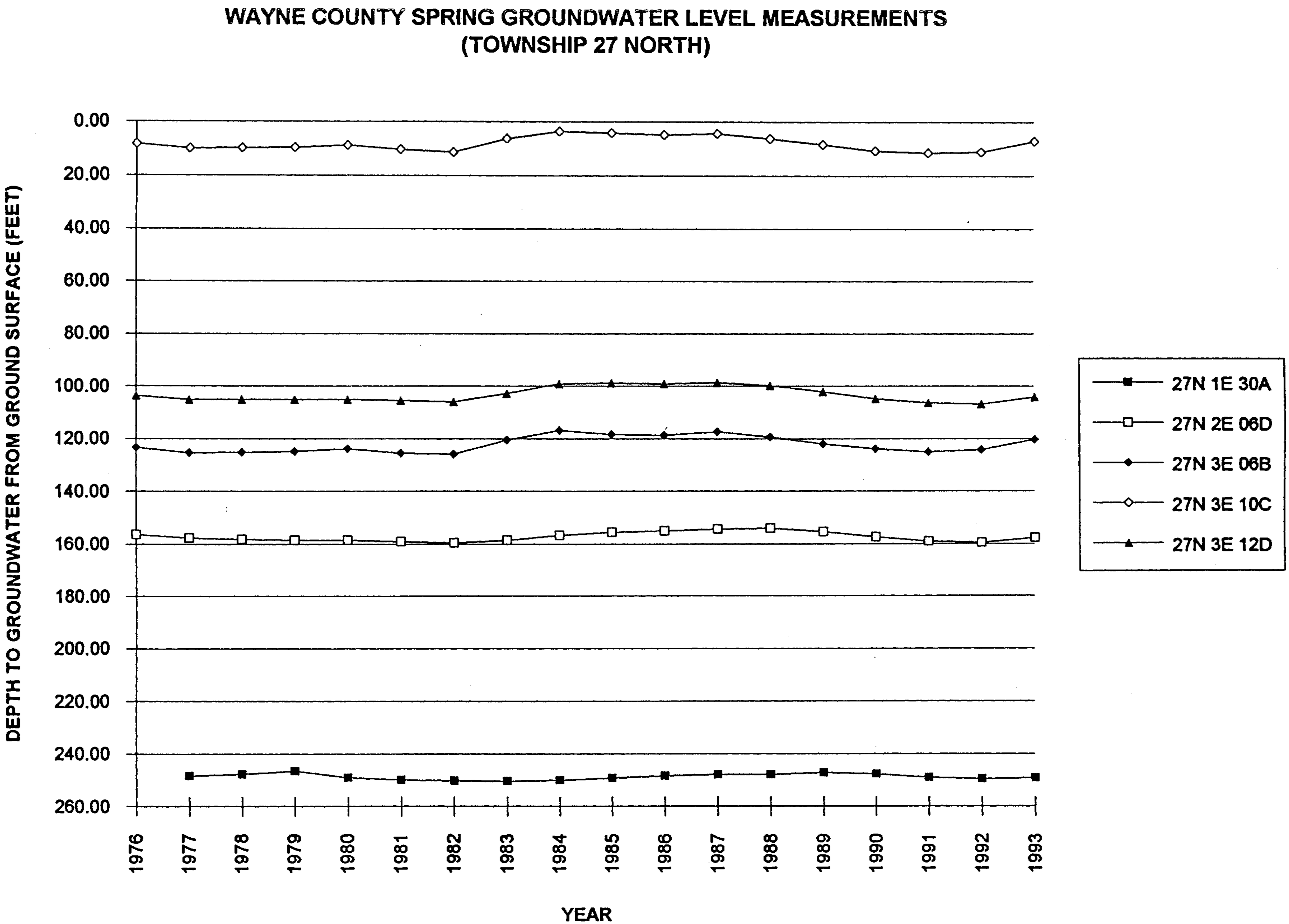
1993
YEAR
26N 1E 18B
26N 2E 03B
26N 2E 14D
26N 2E 21B
26N 3E 09C
26N 3E 31D
26N 4E 12C
26N 4E 17A
26N 5E 27C
26N 5E 29D


WAYNE COUNTY SPRING GROUNDWATER LEVEL MEASUREMENTS
(TOWNSHIP 27 NORTH)
DEPTH TO GROUNDWATER FROM GROUND SURFACE (FEET)
0.00
20.00
40.00
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1993
YEAR
27N 1E 30A
27N 2E 06D
27N 3E 06B
27N 3E 10C
27N 3E 12D

APPENDIX 3

Review Letters and Public Comment

STATE OF NEBRASKA

DEPARTMENT OF WATER RESOURCES
J. Michael Jess
Director

July 24, 1996

IN REPLY REFER TO:

E. Benjamin Nelson
Governor

Gary Loftis, Chairman
Lower Elkhorn NRD
P.O. Box 1204
700 West Benjamin Avenue
Norfolk, NE 68702

Dear Mr. Loftis:

Examination of your Board's revised Ground Water Management Plan has been completed. In addition to input from this agency's staff, the comments of five other agencies were reviewed. Overall, review agencies agreed the revised document is well written and represents an improvement to the plan. Although agencies also identified certain deficiencies, these deficiencies are not found significant and your plan is approved subject to the following understanding.

From the language on page 107, the Board's intention regarding transition from Phase 1 to Phase 2 is unclear. Since less than 20% of all registered wells are routinely monitored by the District, lacking is an explanation of how the Phase II trigger would be tripped. After conversations with District staff, I understand specific problem areas have been targeted for specialized monitoring. In fact, significant resources are already devoted to this effort for 1996. When this specialized monitoring indicates conditions are approaching Phase 2 levels, the area will be monitored more intensely to assure that 20% of registered wells are sampled. With this plan the public can be assured problem areas will not be overlooked.

If your Board does not agree with this understanding, it should consider this approval null and void. Copies of comments from each of the five review agencies are enclosed. In future revisions, the Board is urged to consider and incorporate the comments of these agencies.

Sincerely,

J. Michael Jess
Director

JMJ:DV:pb
Enclosures
cc\enc: Randy Wood
Jack Daniel
Dayle Williamson
Perry Wigley
Ross Lock
Stan Staab
Bill Birkel

RECEIVED

JUL 10 1996

DEPARTMENT OF WATER RESOURCES

STATE OF NEBRASKA

DEPARTMENT OF HEALTH
Mark B. Horton, M.D., M.S.P.H.
Director

E. Benjamin Nelson
Governor

MEMORANDUM

TO: Dale Vagts, Department of Water Resources

FROM: Jack L. Daniel, Department of Health

DATE: July 9, 1996

SUBJECT: Lower Elkhorn NRD's 1996 Ground Water Management Plan

The above referenced plan was reviewed by Mr. Tom Michels of this department and he finds no substantial reason why it is not acceptable by our standards and goals.

Thank you for the opportunity to comment on this issue.

JLD:TM:bae

301 Centennial Mall South • P.O. Box 95007 • Lincoln, Nebraska 68509-5007
FAX (402) 471-0383 • TTY 471-6421

University of Nebraska Lincoln
Institute of Agriculture and Natural Resources

Conservation and Survey Division
113 Nebraska Hall
901 North 17th Street
P.O. Box 880517
Lincoln, NE 68588-0517
(402) 472-3471

Geological and Natural Resources Surveys

July 9, 1996

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JUL 10 1996

DEPARTMENT OF
WATER RESOURCES

Dale R. Vagts
Ground Water Supervisor
Department of Water Resources
301 Centennial Mall South
4th Floor
P.O. Box 94676
Lincoln, NE 68509-4676

RE: Lower Elkhorn NRD 1996 Groundwater Management Plan

Dear Dale:

We recommend approval of the Lower Elkhorn Natural Resources District's 1996 Groundwater Management Plan. Please take into account Sue Lackey's comments.

Sincerely,

Perry B. Wigley
Director

CONSERVATION and SURVEY DIVISION
NORFOLK OFFICE

****

TO: Dr. Perry Wigley
FROM: Sue Olafsen Lackey SOL
DATE: 7/8/96
RE: Lower Elkhorn NRD 1996 Groundwater Management Plan

After reviewing the 1996, revision of the Lower Elkhorn NRD's Groundwater Management Plan, I have the following comments:

1. Page 103, last paragraph; Volume metering of domestic wells could be difficult to engineer and it seems unlikely that it would be necessary due to the low pumping rates of domestic wells. The NRD may want to define metering requirements based on pump capacity rather then the type of well.

2. Page 104, b); I believe this scheme would be difficult to administer and hard to monitor compliance.

3. Page 107, second paragraph; The NRD may want to include "areas that have concentrations of less than 50% of the MCL," for clarification.

4. Page 109, Additional Criteria; This section is a good addition to the plan.

5. Page 112, d.; The NRD may want to include deep soil sampling program. A note could be added to this section as to the designation of phases which relate to wellhead protection of public water supplies.

Nebraska Game and Parks Commission
2200 N. 33rd St / P.O. Box 30370 / Lincoln, NE 68503 / (402) 471-0641

July 9, 1996

RECEIVED
JUL 9 1996
DEPARTMENT OF
WATER RESOURCES

Dale Vagts
Department of Water Resources
301 Centennial Mall South
4th Floor
Lincoln, NE 68509

Dear Mr. Vagts:

I have reviewed the Lower Elkhorn Natural Resources District's 1996 Ground Water Management Plan. Based on this review, the Nebraska Game and Parks Commission (Commission) has determined that the proposed projects will not effect endangered or threatened species or result in destruction or modification of habitat of such species which is determined by the Commission to be critical.

If you have any questions, please contact me at (402) 471-5444.

Sincerely,

Daylan Figgs

Daylan Figgs
Endangered Species Biologist

STATE OF NEBRASKA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Randolph Woo
Directo
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186

E. Benjamin Nelson
Governor

JUN 0 5 1996

RECEIVED

JUN 6 1996

DEPARTMENT OF
WATER RESOURCES

Mr. J. Michael Jess, Director
Nebraska Department of Water Resources
P.O. Box 94676
Lincoln, NE 68509-4676

Reference: Lower Elkhorn Natural Resources District
Proposed Ground Water Management Plan revisions (May 1996)

Dear Mike:

The Nebraska Department of Environmental Quality has received the proposed revisions for LENRD's GWMP transmitted from Dale Vagts of your office on May 16, 1996. Staff from NDEQ's Ground Water Section have reviewed the ground water quality portions of the proposed revisions.

Based upon our interpretation of the Nebraska Ground Water Management and Protection Act, LENRD's revisions appear to meet the requirement of statute with regard to ground water quality. The District has laid out reasonable and clear steps for management of nonpoint source ground water concerns within its jurisdiction, and we believe these steps have a good chance at success. Therefore, NDEQ recommends approval of those portions dealing with ground water quality. In addition, we want to commend LENRD for its overall effort with regard to its GWMP. We think that it is a very clear, comprehensive, and useful document which will be an asset to the district and its citizens.

The attached material represents our specific comments and suggestions regarding LENRD's revisions. Should you require any further information, please feel free to contact Marty Link or Dick Ehrman of NDEQ's Ground Water Section at 471-0096. Thanks very much.

Sincerely,

Randolph Wood, P.E.
Director

RW:de
Enclosure
pc: Stan Staab, Lower Elkhorn NRD

Nebraska Department of Environmental Quality
Review Comments
Lower Elkhorn Natural Resources District
Proposed Ground Water Management Plan Revisions, May 1996

Page	Comment
96	Under 1) Ground water management area background information, LENRD refers to the need to address NPS contaminants other than nitrate (the plan refers to this need several other places as well). NDEQ agrees with this approach; it is probably a good idea to mention that any management of NPS pesticide problems will have to be coordinated with the Nebraska Department of Agriculture.
97	A minor point: the first line refers to the "Drastic model." The term should be DRASTIC, which is an acronym for several hydrogeologic parameters.
99	Another minor point: at the top of the page where the aquifers are listed, the terms "group" and "formation," as used in this context, are stratigraphic names and therefore should be capitalized, e.g. "Ogallala Group" or "Niobrara Formation."
100	In the third paragraph, LENRD comes up with a novel solution for the confusion between ground water quantity and quality actions by referring to quantity actions as Action Levels and quality actions as Phases. This is a good idea!
106	In the second paragraph, LENRD rightly points out that the details of requirements will depend upon the circumstances of the area for which those requirements are enacted. We suggest that instead of saying that these details "may" be added, the district commit itself and say that these details "will" be specified. NDEQ views such details as necessary for clear and defensible implementation of a GWMA.
111-114	Once again, we want to commend LENRD for their integration of Wellhead Protection activities into its GWMP. This is a very important step, and the district has done a good job in this regard.

STATE OF NEBRASKA

NATURAL RESOURCES COMMISSIO
Dayle Williams
Directo
301 Centennial Mall South
P.O. Box 94876
Lincoln, Nebraska 68509-4876
Phone (402) 471-2081
Fax (402) 471-3132

May 31, 1996

E. Benjamin Nelson
Governor

RECEIVED

MAY 31 1996

DEPARTMENT OF
WATER RESOURCES

Dale Vagts
Ground Water Supervisor
Department of Water Resources
P.O. Box 94676
Lincoln, Nebraska 68509-4876

Dear Dale:

We have reviewed the revisions to the Lower Elkhorn NRD Groundwater Management Plan which you sent us on May 16, 1996. I recommend that the Department of Water Resources approve the revisions. The district's intention of carrying out a district-wide groundwater management area is commendable and pages 96 and 97 do a good job of presenting the reasoning behind the District's decision. The actions the district proposes to take with the revisions are presented in a clear and succinct manner. I was especially pleased to see the emphasis on wellhead protection. Placing the entire District in a management area is clearly a legal option. Overall, I believe this represents an improvement over the previous version of the approved plan.

I do suggest that the District consider some minor rewording of the area designation criteria presented on page 109. By adding the words "Other areas deemed necessary" under item "e" the District may be leaving itself a little too much latitude. Landowners in an area that was designated under that criteria might feel it was unfair and it might present some legal difficulties.

There is also a minor problem with the delineation of the action level boundaries for quantity. On page 102 it appears that if a single well in the monitoring program drops 15 feet below predevelopment levels then a number of separate actions will be taken in the area. However, exactly how the area's boundaries are determined at that point is unclear.

We also note that the NRD has not updated the plan to reflect statutory changes resulting from LB 108. For example the section numbers will change and some sections, including section 46-673.08 (referenced on pages 97 and 99) have been repealed entirely. All of those changes will occur on July 19, 1996 before the NRD creates the management area.

Also the discussion on page 116 about agricultural transfers of groundwater is out of date. Such transfers are now permitted by section 46-691 of the statutes.

Sincerely,

Dayle Williamson

Dayle E. Williamson
Director of Natural Resources

LOWER ELKHORN NATURAL RESOURCES DISTRICT
CITIZENS ADVISORY SUBCOMMITTEE - "GROUNDWATER MANAGEMENT PLAN"

3 Cities & Villages:
Mr. Gary Lund, Plant Supt., Norfolk Water Control Plant, R.R. 4, Norfolk, NE 68701 371-8565
Mr. Dennis Baumert, Mayor of Scribner, 1009 Howard, Scribner, NE 68057 664-2286
Mr. Vern Schulz, Public Works Director, City of Wayne, 2201 South Main, Wayne, NE 38787 375-1300

1 Rural Water District:
Mr. David Bryngelson, R.R., Pender, NE 68047 529-3300
Farmer-Director, Cuming Co. Rural Water District

3 Irrigators:
Center Pivot Non-Chemigator:
Mr. Robert Chilcoat, Jr., R.R. 1, Stanton, NE 68779 439-2636 Farmer
Center Pivot Chemigator:
Mr. Dick Hatterman, R.R. 1, Tilden, NE 68781 368-5539 Fertilizer Manager, Tilden Fertilizer Co.
Gravity Irrigator:
Mr. Vernon Cohee, R.R., Beemer, NE 68716 528-3323 Farmer

1 Industrical User:
Mr. Bill McAllister, Environmental Engineer, Engineer Division, IBP, P.O. Box 511, Dakota City, NE 68731 494-2061 Ext. 2038

1 Irrigation Dealer:
Mr. Bob Steele, Sales Manager, Peterson & Son, Inc., Osmond, NE 68765 748-3388

1 Livestock Industry:
Mr. William Emrich, R.R. 1, Norfolk, NE 68701 371-3710 Manager-Coe Cattle Co.

1 Well Driller:
Mr. Michael Salmon, Salmon Well Co., 307 Oak, Wakefield, NE 68784 287-2236

1 Individual Domestic User (Dryland Farmer):
Mr. Louis Sindelar, R.R. 2, Howells, NE 68641 986-1324 Farmer

1 Environmental Organization Representative:
Rev. Gail Axen, Director, Nebraska Wildlife Federation, 800 6th, Stanton, NE 68779 439-2536

1 Farm Organization Representative:
Mr. Marc Brodersen, President Pierce Co. Farm Bureau, R.R. 2, Randolph, NE 68771 337-0549 Farmer

1 Farmer From Conflict Area (draw-down during pumping season):
Mr. Willmer Moseman, R.R. 1, Oakland, NE 68045 685-5027 Farmer

NOTE: LB 1106 (1984 Unicameral), Section 46-673.01 Nebraska Revised Statutes, of the Nebraska Groundwater Management and Protection Act, requires all NRD's to prepare and complete a Groundwater Management Plan by the end of calendar year 1985. The LENRD has began to compile their plan as required by law. The above subcommittee has been appointed by the LENRD to provide a broad base of input toward completing the plan for the District by November 15, 1985. Public meetings throughout the District will be held in early Fall 1985, for citizens critiquing on the draft plan, prior to finalizing the plan and distributing to the Nebraska Legislators.

MINUTES
CITIZENS ADVISORY SUBCOMMITTE-"GROUNDWATER MANAGEMENT PLAN"
LENRD - July 15, 1985

Members Present	Members Absent	Other Present.
Dick Hatterman	Vernon Cohee	Clinton Von Seggern
Lou Sindelar	Bill McAllister	Alvin Sundell
Bob Chilcoat Jr.	Michael Salmon	Ray Vogel
Bill Emrich	Rev. Gail Axen	Elden Wesely
Dennis Baumert	Marc Brodersen	Mardell Holm
Robert Steele		Wendell Newcomb
Gary Lund		Richard Seymour
Vern Schulz		Donald Kahler
David Bryngelson		Steve Oltmans
Willmer Moseman		

Steve Oltmans opened the meeting with a brief general synopsis of the first Subcommittee meeting of May 29, 1985.

Donald Kahler reviewed the LENRD Groundwater Quantity Monitoring Program and the data from said program over the passed 10 years. Discussion regarding conflicts between domestic users and irrigators during irrigation seasons because of draw-down of slow recharging aquifers which are typical in most of the LENRD.

Discussion on Groundwater Quality concerns with the following issues covered.
- Nitrate #1 concern
  David Bryngelson stated Cuming County Rural Water District which began in the middle 70's with no nitrates, is presently at 6 p.p.m. - 1985.
- Public growing more concerned about water quality due to pesticides being applied more today through irrigation systems.
- Disucssed concerns with industrial pollution and the need for better site selection of sanitary landfills.
- Discussed needs for water quality laboratory being readily available to citizens in North Central & Northeast Nebraska.
- Discussed supplemental and alternative water supplies
  Two suggestions were reviewed: Surface Reservoir Storage & Drilling into Dakota Formation.

The Subcommittee reviewed proposed <u>LENRD Groundwater Reservoir Life Goal</u>: "Provide an adequate supply of acceptable quality groundwater to forever fulfill the reasonable groundwater demands within the LENRD for domestic, municipal, agricultural, industrial, wildlife, and other users deemed beneficial by the LENRD Board."

Consensus of Subcommittee at July 15, 1985
* Quantity Conflicts: 1. LENRD should consider developing a policy and/or regulation if necessary enabling immediate solution to conflict during pumping season.
2. LENRD should adopt a formal policy requesting landowners and well drillers to drill domestic well to bottom of aquifer.
3. LENRD should consider policy and/or regulation to protect ~~domestic~~ all water needs as far as quantity and quality are concerned.

4. Continue LENRD Quantity Monitoring Program

Further discussion of water quality and quantity issues at August 1, 1985 meeting.

A request that proposed "Chemigation Act" L.B. 284 be discussed at the next meeting.

Meeting adjourned at 10:35 p.m.

Steven G. Oltmans

MINUTES
CITIZENS ADVISORY SUBCOMMITTEE-"GROUNDWATER MANAGEMENT PLAN"

Members Present	Members Absent	Others Present
Dennis Baumert	Gary Lund	Tom Anderson
David Brynegelson	Vernon Cohee	Dennis Newland
Robert Chilcoat, Jr.	Bill McAllister	Alvin Wagner
Bob Steele	William Emrich	Alvin Sundell
Mike Salmon	Marc Brodersen	Eldon Wesely
Louis Sindelar		Ray Vogel
Gail Axen		Wendell Newcomb
Willmer Moseman		Donald Kahler
Dick Hatterman		Ken Berney
Vern Schulz		Steve Oltmans

Steve Oltmans opened the meeting requesting the subcommittee to finalize their position or consensus on the wording of a "Life Goal" for the LENRD. Discussion followed on the word forever as a part of the goal. Other thoughts where using phrases in place of forever such as in the foreseeable or for as long as the demand exists.

*Discussion held on need for Groundwater Quality Monitoring Program.
- Subcommittee agreed with estimate that there is currently 10% of the rural domestic preforming as dug wells, which are quite susceptible to point source pollutants.

- Monitoring groundwater quality suggestions:
  1) Sample a number of irrigation wells (during pumping season) It was noted that these could be selected from those currently monitored by LENRD for quantity.
  2) Sample a number of domestic wells geographically distributed acposs LENRD
     a) certain number to case wells and hand dug wells
  3) Sample a certain number of industrial wells

- LENRD should initiate a cost study for such groundwater quality monitoring program.

*Discussion held on proposed Nebr. Chemigation Act (LB 284)

- All agreed that proposed act will most likely pass during 1986 unicameral

- Sumcommittee agreed with following estimates on Chemigation in LENRD today.

3500 irrigation wells in LENRD
2500 center pivot of 3500 wells
2000 chemigate of 3500 wells
500 insectigate of 3500 wells
20 herbigate of 3500 wells

*Discussion held on supplemental water needs
- Impoundment of surface water encouraged
- Consider test drilling program on limited scale to Dakota Formation.

*Other items discuss --- relating to objectives, programs, and regulations
- Municipal Water Supply needs assurance of long range protection by LENRD planning efforts and regulations
- Leakage of tanks contaminating grondwater was discussed. Questions were

raised as to whether the LENRD should be concerned with such or the responsibility of a state agency as DEC. It was pointed out that LB 217(Leaking tank bill) currently on general file will provide for permitting underground storage of 1000 gallons or more to the Dept. of Environmental Control.

Consensus of subcommittee at August 1, 1985 meeting.

1. LENRD "Life Goals" : Provide an adequate supply of acceptable quality groundwater to forever fulfill the reasonable groundwater demands within the LENRD for domestic, municipal, agricultural, industrial, wildlife, and other uses deemed beneficial by the LENRD board.

Laboratory 2. LENRD should study, develop and implement an ongoing Groundwater Quality monitoring program.

3. LENRD should ~~consider test~~ investigate the feasibility & analyze cost and make effort to ~~[illegible]~~ compile existing data drilling selectively into Dakota Formation in areas of the district where aquifers are limited as a supplemental source for future needs.

4. LENRD should develop programs and regulations if necessary to protect municipal water needs of the present and future.

Requested for next meeting agenda were:

1. Methods of financing groundwater programs
2. priorities on suggestions by citizens advisory subcommittee

Meeting adjourned at 10:35 p.m.

MINUTES

Citizens Advisory Subcommittee - "Groundwater Management Plan"
at Osmond, Nebraska

Members Present		Members Absent	Others Present
Gary Lund	Dick Hatterman	Robert Chilcoat	Clinton Von Seggern
Dennis Baumert	Bill McAllister	Vernon Cohee	Dale Lingenfelter
Vern Schulz	William Enrich	Gail Axen	Ray Vogel
Bob Steele	Michael Salmon	Marc Brodersen	Richard Seymour
David Bryngelson	Louis Sindelar		Donald Kahler
Willmer Moseman			Steve Oltmans

Meeting opened with a tour of Peterson & Son viewing commercial chemigation equipment available today to landowners and operators.

Subcommittee then reviewed a study named "Nitrate-Nitrogen Leaching Losses and Movement in the Unsaturated Zone of Sprinkler Irrigated Sands" by Gary W. Hergert, UNL.

Discussion regarding financing LENRD groundwater programs covered such items or programs as 1. Chemigation pursuant to passage of L.B. 284 (currently on Select File), 2. Developing an on going Groundwater Quality Monitoring Program. the following were discussed as possibilities:

1. General property taxing by LENRD maximum 3½¢ per $100 actual valuation
2. Property taxing by LENRD of 1.8¢ per $100 acutal vaulation
3. State matching funds with NRD's for carrying out water quality programs
4. Fees from water users
5. Combination of above possibilities

Subcommittee members requested copy of DEC's proposed Groundwater Strategy.

Meeting adjourned at 10:40 p.m.

Steven G. Oltmans

LOWER ELKHORN NATURAL RESOURCES DISTRICT
CITIZENS ADVISORY SUBCOMMITTEE - "GROUNDWATER MANAGEMENT PLAN"

Resolutions

1. LENRD "Life Goal": Provide an adequate supply of acceptable quality groundwater to forever fulfill the reasonable groundwater demands within the LENRD for domestic, municipal, agricultural, industrial, wildlife, and other uses desired beneficial by the LENRD Board.

2. LENRD should study, develop and implement an ongoing Groundwater Quality Monitoring Program.

3. LENRD should investigate the need and possibility of laboratory testing facilities for NE Nebraska with private enterprise providing such services, if at all possible.

4. LENRD should investigate the feasibility, analyze cost, and make effort to compile existing data before drilling selectively into the Dakota Formation in areas of the district where aquifers are limited as a supplemental source for future needs.

5. LENRD should develop programs and regulations if necessary to protect municipal water needs of the present and future.

6. LENRD should develop programs and regulations enabling immediate solution to conflict during irrigation pumping season.

7. LENRD should develop a formal policy requesting landowners and well drillers to drill domestic well to bottom of aquifer.

8. LENRD should develop policy and/or regulation to protect domestic water needs, as far as, quantity and quality are concerned.

9. Financing -- State Matching our cost-share NRD dollars

10. Develop an education and informational program for quality and quantity issues of water.

11. LENRD should consider a groundwater management area throughout entire district in order to finance the above stated programs and policies.

Groundwater Management Plan Advisory Committee
July 14, 1993

The Groundwater Management Plan Advisory Committee met Wednesday, July 14, 1993, to discuss the 'Goals, Policies, Objectives, and Programs' section (section VII) of the plan. The following people attended:

Susan Risinger
Farm Program Director
WJAG/KEXL Radio
Norfolk

Eileen McBride
Division Attorney
Federal Land Bank Association
Production Credit Association
Farm Credit Services
Norfolk

Ron Benson
Civil Engineer
JEO Associates
Norfolk

Jeff Boe
Farm Operator
Boe Seed Farms
Madison

Ron McKeever
Farm Manager
First Commerce Farm and Ranch Management
Norfolk

Tom Welstead
Nebraska Game and Parks Commission
Norfolk

Colleen Eikmeier
Water Superintendent
Village of Dodge

Pat Madson
Realty Officer
Omaha Indian Tribe
Macy

Sharlene Clatanoff
Manager
Cuming County RWD #1
Beemer

John Wislon
Extension Educator
Burt County

Dennis Newland
NRD Board

Don Doty
SCS, Norfolk

Ron Dierking
Farm Operator
Logan East RWS Advisory
Board, Scribner

David Kleinschmit
Tri-County Corn Growers
Wausa

The NRD staff presented copies of section VII of the plan to the group and discussed the proposed changes to the plan. This discussion included the proposed Board Policies (beginning on page 48); the proposed goal and objectives (beginning on page 67); proposed groundwater quantity trigger and actions (beginning on page75); the proposed actions that will result from the actuation of groundwater quality triggers (beginning on page 81); and the remaining groundwater management programs (beginning on page 69). The committee also discussed the treatment of endangered and threatened species.

There were numerous questions about the basic process and techniques of groundwater monitoring, and the value and hazards of using irrigation wells as observation and monitoring wells was discussed. It is apparent that the committee is interested in ensuring that data is collected and interpreted correctly.

Establishing minimum size requirements for groundwater quality management areas was discussed. The committee generally concurred that maintaining flexibility was important so that different situations could be handled appropriately (such as nitrate as opposed to atrazine contamination).

Flexibility was also stressed by the committee for dealing with endangered and threatened species. One person felt that the NRD should not commit itself in the plan to protection of endangered and threatened species. Another person called the next day and stated that the NRD should pursue the preservation of endangered and threatened species and that this is a proper function of the NRD.

The committee was also interested in wellhead protection and the district's wellhead protection program, well abandonment, current contamination problems, and the deep soil sampling program.

Groundwater Management Plan Advisory Committee
July 21, 1993

The Groundwater Management Plan Advisory Committee met on July 21, 1993, to discuss the proposed changes to the groundwater management plan. Those in attendance were:

Susan Risinger
Farm Program Director
WJAG/KEXL Radio
Norfolk

Ron Benson
Civil Engineer
JEO Associates
Norfolk

Jeff Boe
Farm Operator
Boe Seed Farms
Madison

Ron McKeever
Farm Manager
First Commerce Farm and Ranch Management
Norfolk

Tom Welstead
Nebraska Game and Parks Commission
Norfolk

Robert Warrick
Meadow Grove

Melissa Grant
Omaha Indian Tribe
Macy

John Wislon
Extension Educator
Burt County

Ron Dierking
Farm Operator
Logan East RWS Advisory
Board, Scribner

Joseph Schmit
Tri-County Corn Growers
McLean

Mike Renken
Bank of Norfolk
Norfolk

The committee again discussed section VII of the plan. NRD staff asked if the committee had any thoughts about the proposed quantity and quality triggers. Discussion followed concerning size limitations for the quality triggers. There were no recommendations from the committee about establishing a size limitation for the quality triggers.

STATE OF NEBRASKA

E. Benjamin Nelson
Governor

RECEIVED
OCT 4 1991
DEPARTMENT OF WATER RESOURCES

DEPARTMENT OF WATER RESOURCES
J. Michael Jess
Director

IN REPLY REFER TO:

October 3, 1991

Ken Berney, Assistant Director
Lower Elkhorn Natural Resources District
P.O. Box 1204
Norfolk, NE 68702-1204

Dear Mr. Berney:

Staff members of this Department, Department of Environmental Control, Natural Resources Commission, Department of Health, and Conservation and Survey Division of UNL have reviewed your proposed, updated Ground Water Management Plan.

The review found that further work is required to make your revised plan acceptable. First, in many of your objectives you are using words such as "should" or "would" rather than a word that shows commitment such as "will." A plan should be concise and a review should allow the reader to determine exactly what the NRD is going to do and when they will do it, not what they should do.

The most significant problem is found under "Ground Water Management Policies." Under quantity issues you discuss what a trigger is, but you never specify what trigger or triggers will be used. Under quality, you discuss formation of a control area, but a quality control area can only be formed when reduction in quantity is cause of degradation. You may want to address quality management areas or special protection areas.

Enclosed are the comments of the reviewers for your information.

As you are probably aware, all ground water management plans must be updated by July 1, 1993, as required by LB51 that passed this year. I suggest you include the requirements of LB51 with your next proposed revision.

Sincerely,

Michael Jess

J. Michael Jess

JMJ:SF:sb
cc: Dayle Williamson
Randy Wood
Jack Daniel
Perry Wigley

STATE OF NEBRASKA

NATURAL RESOURCES COMMISSION
Dayle Williamson
Director
301 Centennial Mall South
P.O. Box 94876
Lincoln, Nebraska 68509-4876
Phone (402) 471-2081
Fax (402) 471-3132

E. Benjamin Nelson
Governor

August 9, 1991

Susan France
Administrative Assistant
Department of Water Resources
P.O. Box 94676
Lincoln, NE 68509-4676

Dear Susan:

We have reviewed the transmitted portions of the Lower Elkhorn Natural Resources District update to their Ground Water Management Plan. That review did indicate the need for some technical revisions in the plan such as updating the references to ground water control areas and ground water management areas to more accurately reflect current law. The need for those revisions, however, should not affect the approval of the update, which is recommended.

A copy of the pages on which we have suggested technical revisions is enclosed with the original comments going to the Lower Elkhorn NRD.

Sincerely,

Dayle

Dayle E. Williamson
Director of Natural Resources

DEW:clb

Enc.

cc: Ken Berney, LENRD

STATE OF NEBRASKA

E. Benjamin Nelson
Governor

RECEIVED
AUG 2 9 1991
DEPARTMENT OF
WATER RESOURCES

DEPARTMENT OF HEALTH
Gregg F. Wright, M.D., M.Ed.
Director
301 Centennial Mall South
P.O. Box 95007
Lincoln, Nebraska 68509-5007
Fax (402) 471-0383

(402) 471-2541

August 23, 1991

Ms. Susan France
Department of Water Resources
4th Floor
301 Centennial Mall South
Lincoln, NE 68509

RE: PWS - Lower Elkhorn NRD - Ground Water Management Plan

Dear Ms. France:

Staff person, Tom Michels, reviewed the updated plan for the above-referenced project and feels there is nothing that conflicts with the State Department of Health regulations. His only comments are that we wholeheartedly support the installation and testing of backflow prevention devices for both rural and urban irrigation systems (as found in Objective 3-A Best Management Practices) and also to encourage a plan review process for all chemigation installations. The latter was not specifically stated in the plan but was covered generally with obvious intent to protect ground water and public health in Objectives 3 and 6.

The Nebraska Department of Health believes review of any well design and appurtenances is a necessity and integrity of any operation depends on a good on-site construction inspection program.

Thank you for the opportunity to comment.

Sincerely,

Jack L. Daniel

Jack L. Daniel, Director
Division of Drinking Water and
Environmental Sanitation

JLD:TM:jet

DWR memorandum

October 2, 1991

TO: Susan France

FROM: Ann Bleed *aB*

SUBJECT: Revisions to the Lower Elkhorn NRD Ground Water Management Plan

I have reviewed the proposed revisions to the ground water management plan. The program they have established for monitoring and education is most commendable. I have only a few comments on the proposed revisions.

1) The plan indicates that the NRD is planning to drop a number of monitoring wells from the monitoring program. Approximately how many wells are they proposing to drop?

2) The plan mentions that the requirements for well logs produced by well drillers will be coordinated. Who will write these requirements? I would suggest that the University of Nebraska Conservation and Survey Division be involved in the hopes that such requirements could become standard throughout the State.

3) I have made a number of other editorial changes to the text. The primary changes relate to the use of the word "could" instead of "will." In a document such as this, I feel it is important to indicate that the NRD will take certain actions, not just consider taking such actions.

4) In addition to comments on the revisions, I would like to raise another issue. In reviewing the revisions and the original plan, I could not find any indication of (1) what the life goals of the reservoirs are; (2) what water level declines would trigger action; and (3) what actions would be taken if the trigger levels are realized. Nevertheless, as I read the State statutes, such statements must be part of the management plan. I would also like to see a description of what type of mandatory controls to maintain water quantity would be instituted should trigger levels be met. The plan indicates that to date ground water levels have not demonstrated any long term declines. I have no reason to doubt that this statement is incorrect. However, should significant declines be observed, I think it prudent to have a plan for instituting mandatory conservation measures.

University of Nebraska Lincoln
Institute of Agriculture and Natural Resources

Conservation and Survey Division
113 Nebraska Hall
901 North 17th Street
Lincoln, NE 68588-0517
Telephone (402) 472-3471
Geological and Natural Resources Surveys

August 15, 1991

RECEIVED
AUG 19 1991
DEPARTMENT OF
WATER RESOURCES

Ms. Susan France
Administrative Assistant
Department of Water Resources
301 Centennial Mall South
P.O. Box 94676
Lincoln, NE 68509-4676

Dear Susan:

Perry Wigley, director of the Conservation and Survey Division, asked me to review the Lower Elkhorn Natural Resources District's Groundwater Management Plan. I used the "Handbook on the Preparation of Groundwater Management Plans" prepared by the Division in 1984 as the basis for my review.

The groundwater management objectives and programs outlined in this document are comprehensive and if they are implemented would provide a solid basis for achieving their groundwater reservoir life goal. However, they do not necessarily relate the individual sub-objectives (designated with letters) to how these will contribute to their achieving their reservoir life goal. Although the relationships are implied in many cases, I think that it is necessary to make the connection between individual objectives and the overall goal because it will help the NRD directors and staff, as well as the general public, appreciate the relative importance of the individual objectives and help the NRD prioritize their various programs and allocate their limited resources.

1)

In section IV (Groundwater Management Policies), the text indicates that the local requirement for establishing management or control areas is to give triggering mechanisms or policies to initiate such action. Although they give an example of how a triggering mechanism for water quantity problems might work, they do not give a specific triggering mechanism, actions, or a policy that the NRD will use to address water quantity issues or conflicts.

2)

The anti-degradation policy is commendable, but they need to define what a "significant change in the chemical composition or physical characteristics of the water" that will be used to initiate an investigation and what is the time frame over which the change will occur. In addition they will need to define what they will use as their baseline data for assessing changes. Defining these terms are very important because different people have different definitions. It also is not clear whether it is a requirement that a plan of action and/or recommendations be implemented and whether there will be mandatory reallocation of resources to support future action

3)

Under Pollution and the various action levels they suggest, it appears that the NRD will be doing or funding the detailed studies of the problem areas. The implication is that if hazardous wastes turn up in a drinking water supply and the source is likely to be a local manufacturing plant, the NRD will take responsibility for defining the problem area and instituting control measures and relieving the company of some of their financial obligations. I do not think this is their intent..

4)

University of
Nebraska
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Geological and Natural Resources Surveys

4) They need to define the limitations of this policy and the types of pollutants for which they will be responsible. I think the NRD is primarily concerned with potential non-point source contaminants. The Department of Environmental Control has jurisdiction over the primary pollutants given by EPA.

5) In the discussion on nitrate-nitrogen pollution, they intend to establish a groundwater management area if an area over ten square miles has an average greater than 10 ppm for two years. How many samples are going to be collected to determine the average? Does this average apply to individual wells so that every well in the area has to exceed 10 ppm or will it be some type of weighted average over the entire area? They also say they are going to "develop best management practices". I think their intent is to implement BMPs, because they are not in the business of developing them.

6) Throughout the groundwater management policies section, they refer to "further study" or "additional study" to determine the source of pollution, extent of pollution, and control measures required. They do not define who will be doing the additional study. They do not have the expertise to do the additional work so there should be an indication of who will do it.

7) In section V (Groundwater Management Plan Implementation), they outline a method for prioritizing programs, which includes assessing the effectiveness of the individual programs. However, nowhere in their plan do they outline an objective procedure or mechanism to measure a programs success.

If you require any additional comments or have any questions, please feel free to contact me at 371-6512.

Sincerely,

David C. Gosselin

David C. Gosselin
Research Hydrogeologist

cc: P. Wigley

STATE OF NEBRASKA

DEPARTMENT OF ENVIRONMENTAL CONTROL
Randolph Wood
Director
301 Centennial Mall South
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186

SEP 03 1991

E. Benjamin Nelson
Governor

RECEIVED
SEP 3 1991
DEPARTMENT OF
WATER RESOURCES

Ms. Susan France, Administrative Assistant
Nebraska Department of Water Resources
P.O. Box 94676
Lincoln, NE 68509-4676

Dear Susan:

The Department of Environmental Control's Ground Water Section has completed its review of the update to the Lower Elkhorn NRD's 1985 GroundWater Management Plan. In general, the changes made are reasonable and appropriate with respect to protection of ground water quality. However, we offer the following comments and questions in an attempt to make the plan more complete.

1) Objective 1A - Reference Wells, p. 2 (note: the original as submitted had no page numbers, therefore the numbers contained herein refer to the handwritten numbers on the attached review copy): The idea of reference wells is very good. Approximately how many will there be and where will they be located?

2) Objective 1A - Spring Measurements, p.2: Such annual or periodic measurements will also help to evaluate natural recharge. The idea of dropping some reference wells in areas of "uniform geology" is reasonable, but how many of these wells will be dropped and, perhaps more importantly, how will LENRD decide on wells to be dropped?

3) Objective 1B - Well Logs, p. 3: Sharing well log data is a very good idea, but there may be some overlap here; that is, doesn't the Conservation and Survey Division (CSD) already receive a copy of all registered well logs? Of course, if LENRD is referring only to unregistered wells, then this comment won't apply.

4) Objective 1C - Ground Water Quality Monitoring, p. 3: NDEC supports the use of irrigation wells as an integral portion of an NRD's monitoring network. However, unless there is a specific reason to suspect the presence of volatile organics in such wells, then LENRD may be wasting money on such analyses. In some cases, basic ground water quality parameters such as chloride, sulfate, bicarbonate, sodium, calcium, potassium, and magnesium may be quite helpful in characterizing overall ground water quality. - which

5) Same objective, p. 4: The idea of intensively sampling successive areas of the NRD is good, however we suggest the establishment of at least a few wells across the District which are always sampled. This will help the NRD maintain long-term data for detection of trends.

6) Objective 1D - Water Quality Testing, p. 4: If LENRD contracts with a private laboratory, it should ensure that the lab utilizes EPA - approved analytical methods.

7) Objective 2A - Ground Water Conservation, p. 6: The suggested methods for encouraging efficiency of irrigation wells are good, but they make no mention of the use of flowmeters, which are very common and relatively inexpensive.

8) Section IV, Part B - Pollution, p. 20: The use of 50%, 75%, and 90% of MCLs to trigger certain actions is acceptable, but LENRD should define how they determine these levels. For instance, will this be based on all wells sampled, only irrigation wells, only wells in a certain area, or some other method?

9) Same section, under Nitrates, p. 21: NDEC understands the use of a site-limiting factor, in this case 10 square miles. However, even this factor may be too small. That is, is LENRD really prepared to implement a management area of only 10 square miles? Also, the way in which this area will be determined needs to be defined. Again, what wells will LENRD use, when will they be sampled, etc. (see comments in above paragraph).

10) In addition to the above specific comments, NDEC has a general comment which applies to the entire document. In many places, LENRD states that they "should" perform this task or "would" do that. Use of these terms is understandable, however it is more reassuring in a plan of this sort to eliminate such terms where possible. That is, if LENRD is going to perform a certain task, simply say so (or indicate that they will attempt to do so); if not, the item probably "should" be omitted from the document.

Finally, the document contains a few typographical errors and minor mistakes. These are indicated in red on the attached review copy.

Thank you for the opportunity to review this document. Please express NDEC's regards to LENRD for making the effort to update and improve their plan. If you should have any comments or questions regarding this matter, feel free to contact Dick Ehrman of NDEC's Ground Water Section at 471-4230. Once again, thanks.

Sincerely,

Randolph Wood

Randolph Wood
Director

Attachment

Print Jim - pages 8, 17, 18, 19, and 20.

LOWER ELKHORN NATURAL RESOURCES DISTRICT

Update of 1985 Groundwater Management Plan

Janaury 24, 1991
Date approved

OBJECTIVE 3 - Maintain and improve groundwater quality.

A. Promote the best management practices (BMP) for use of agricultural and lawn chemicals.

Rural and urban dwellers alike have used chemicals without regard for the impact on groundwater. In town, lawn and garden chemical applications are poorly managed and need improvement. Studies have linked the presence of nitrates in groundwater to fertilizer applications. Pesticides are also being found in groundwater.

The BMP's for agricultural and lawn chemicals involve the most efficient use of chemicals in the production of crops or the growing of grass. This involves proper timing and rate of application. Proper application would reduce contamination from lawn, garden and agricultural chemicals ~~on~~ in groundwater but would not eliminate contamination.

Some BMP's are:

1. Deep soil testing for identification of nutrients and pesticides below the root zone.
2. Use of nitrogen management.
3. Identification of specific management areas.
4. Education of chemical users.
5. Nitrogen use studies to minimize application rates.
6. Adherence to Extension Service suggested nutrient application rates for specific crops and locations.
7. Alternative cropping practices to reduce fertilizer and pesticide requirements.
8. Installation and testing of back flow or leak prevention equipment on irrigation systems.

really BMPs

now required (chemigation safety devices)

Testing of soils to determine the presence of nitrates or pesticides below the root zone could identify problem areas where intensive monitoring of the groundwater or other management measures are needed.

Chemigation safety devices are now required by law on all irrigation systems through which nitrogen or other chemicals are appl

The application of the best management practices should be encouraged on a voluntary basis immediately. Where existing or potential problem areas are identified, mandatory requirements should be initiated.

Some Nebraska studies have shown that increases in the level of nitrates in groundwater can be reduced by taking advantage of the nitrate concentration in root zone and in the water when irrigating crops. If you reduce the amount of nitrogen applied by the amount that is there available to the crop ~~in the groundwater,~~ you can improve the quality of groundwater and save fertilizer costs without hurting crop production.

Specific BMP recommendations for any area should be based upon its topography, rainfall, soils structure and the type of crop raised. County Extension Agents can provide the information

OBJECTIVE 7 – Protect municipal and domestic groundwater supplies.

A. Inventory existing and proposed municipal groundwater supply sites, obtain copies of Department of Health test results, and correlate with NRD monitoring data.

B. Assist municipalities in planning of new groundwater supply facilities, and protection of new or existing supplies. This may include water sampling of wells and ~~declaration of a~~ *(establishment of Wellhead Protection Areas, Special Protection Areas, or)* Groundwater ~~Control~~ Management Area in the vicinity of municipal drinking water supplies.

C. Provide assistance, such as geological and hydrological data, statutory requirements, and rules and regulations to domestic well and septic tank owners, well drillers and equipment installers.

D. Plans for rural water system development, including identification of potential groundwater source locations which may be preserved by implementing a *(Wellhead Protection Area, Special Protection Area, or)* Groundwater ~~Control~~ Management Area.

E. ~~Develop and maintain an~~ *(Coordinate with the Nebraska Department of Environmental Control and Department of Health on their)* inventory of existing and new potential pollution point sources (wastewater lagoons, fuel facilities, septic systems, landfills, etc.).

OBJECTIVE 8 - Obtain Funding for Groundwater Management Activities. When implementation of any of the activities described in the preceding objectives requires funding, the following alternatives for funding could be considered:

A. NRD tax levy authorities.

1. The maximum authorized general purpose tax levy is ~~3.5c~~ *(4.5c)* per $100 of actual value. Based upon ~~1985~~ *(1990)* taxable valuation, the maximum general purpose tax revenue generated would be ~~approximately~~ ~~$1,000,000~~ *($1,427,505)* per year.

2. In groundwater management area(s) or control area(s) the NRD may levy up to an additional 1.8c per $100 of taxable valuation for groundwater management purposes.

no longer in law

~~3. An additional 0.9c (total of 2.7 exclusive of the general purpose levy) per $100 of taxable valuation may be levied on all property which lies within groundwater control area(s) which are established to control both groundwater quantity and quality.~~

(4. In designated Special Protection Areas, the NRD may levy an additional 2c per $100 of taxable valuation on all property, to study and implement the action plan.)

B. Seek funding from the State of Nebraska for groundwater management purposes.

1. Encourage NARD to draft and lobby for legislation to provide, as a minimum, state matching funds for NRD administered groundwater management programs which are mandated by statute.

2. Pursue cost-share funding from state agencies for data collection programs for which there is common interest.

C. Seek Funding from other governmental agencies.

1. Monitor federal programs for funding opportunities and submit applications for funding if appropriate.

2. Pursue cost-share funding from federal agencies for data collection programs for which there is common interest.

3. Consider inter-agency agreements with local governmental subdivisions for studies, data collection, and service programs for which there is common interest.

IV. GROUNDWATER MANAGEMENT POLICIES

1. QUANTITY

The Lower Elkhorn Natural Resources District has a variety of geologic conditions which affect the amounts of groundwater available on a local basis. Not all parts of the district have groundwater irrigation potential. The areas of extensive irrigation development have maintained stable groundwater levels.

Current laws for establishing management or control areas are very specific and provide most of the procedures necessary for the establishment of these areas. One local ~~requirement~~ option is a triggering mechanism which would automatically initiate the formation of a groundwater management or control area if specified conditions occur.

The most obvious triggering mechanism is an unacceptable decline of the groundwater level in the monitoring wells over a specified period of years. The decline can be an actual footage (example: 10 feet) or a percentage of the aquifer depth (example: 15%). For example, if a fifteen percent decline in five (5) years were established as a triggering mechanism, in an area with an aquifer of 100 feet in depth, it would require establishment of a groundwater management or control area when groundwater levels drop 15 feet in five (5) years or less.

2. QUALITY

~~The main reason for establishing a Groundwater Management or Control Area is to prevent the degradation of water quality.~~

Whenever degradation or pollution is detected, good data is necessary to make informed decisions. Considerable study must be done to define the source, extent, mechanisms, and effects of pollution and to determine the extent of a control area.

A. Degradation

Under an anti-degradation policy, any significant change in the chemical composition or physical characteristics of the water should initiate an investigation. Initial investigations should be completed within 30 days after discovery of the problem, and should address these questions:

1. Type of degradation detected.
2. Possible reasons for degradation.
3. Extent of degradation.
4. Potential impact of degradation.
5. Recommendations and plan of action.

The initial investigation should provide a basis for:

1. Further Study.
2. Establishment of Controls.
3. Best Management Practice Techniques.

B. <u>Pollution</u>

The Environmental Protection Agency has established Maximum Contaminant Levels (MCL) allowed in drinking water for many contaminants. Below these levels, the contaminants are not considered to be a significant risk for human consumption.

Where pollution is occurring, a specific set of actions can be established. However, taking correct action depends on the type of pollutant, and the source. A point source, such as a spill or the backflushing of chemicals down a well, requires quick identification of the source and decisive action to contain and clean up the problem.

If a pollution problem is considered to be from a nonpoint source, more study is necessary to determine the area affected and the probable cause so decisive action can be taken.

If pollution occurs from contaminants that EPA has established Maximum Contaminant Levels for *(except nitrates)*, the NRD must determine what percentage of the Maximum Contaminant Level is present, ~~and take corresponding action.~~ *(the area affected, and the risk to the people of the area.)*

1. At 50% of Maximum Contaminant Level - ~~Recommend increased monitoring, review the problem and i~~*(I)*nstitute voluntary use of best management practices.

2. At 75% of Maximum Contaminant Level - Do a detailed study of the problem area, define limits for establishing a control area. Issue public notices and hold informational meetings to inform people of problem areas and warn them of any risks that are present.

3. At 90% of Maximum Contaminant Level - ~~After receiving approval of regulatory agencies~~, Establish a management ~~control~~ area and require use of best management practices Review sources of problem and recommend further study to determine all control measures required.

Nitrate Nitrogen in groundwater has an established MCL of 10 ppm. However, three factors influence the Lower Elkhorn Natural Resources District Board of Directors to establish a procedure uniue for this pollutant:

1. The group of people which are at risk is a small select group (infants under six months of age and pregnant women).

2. EPA and the Nebraska Department of Health allow public water systems to continue providing drinking water which is

Review letters from first LB51 revision submittal, 1993

P.O. Box 1204
Norfolk, Nebraska
687[illegible]

STATE OF NEBRASKA

DEPARTMENT OF WATER RESOURC
J. Michael J
Direc

E. Benjamin Nelson
Governor

December 17, 1993

IN REPLY REFER TO:

Elden Wesely, Chairman
Lower Elkhorn NRD
P.O. Box 1204
700 West Benjamin Avenue
Norfolk, Nebraska 68702

Dear Mr. Wesely,

I have completed review of your Board's Ground Water Management Plan Revision. Five state agencies have offered comments identifying several deficiencies in the plan. These deficiencies are significant enough to render the plan insufficient for approval.

Copies of comments from the five agencies are enclosed. The Board should consider these comments when preparing a resubmittal of the Ground Water Management Plan.

In order for your Board's plan to be a clear, commitment to action, ground water elevation changes that will trigger second and third action levels need to be identified. Reasonable triggers should be set even though specific hydrogeologic characteristics are unclear at this time. To compensate for lack of data, the Board may want to consider triggers based on percentage of saturated thickness. Triggers and actions may be modified as more information becomes available.

Under new terms enacted by LB 131, codified into § 46-601, all water wells including domestic wells. constructed in the state must be registered. All wells in a management or control area must be permitted. Pages 99 and 101 in Section VII must be modified to reflect these changes.

301 Centennial Mall South, 4th Floor • P.O. Box 94676 • Lincoln, Nebraska 68509-4676 • Phone (402) 471-2363 • Telefax (402) 471-2900

To meet the requirements of § 37-435 the plan must address the concerns expressed by the Nebraska Game and Parks Commission regarding habitat of the western prairie fringed orchid.

All other aspects of your Board's plan are deemed satisfactory.

Sincerely,

J. Michael Jess
Director

JMJ:DV
cc/enc: Randy Wood
Jack Daniel
Dayle Williamson
Perry Wigley
Ross Lock

STATE OF NEBRASKA

DEC 14 DEPARTMENT OF ENVIRONMENTAL QUALITY
Randolph Wood
Director
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186

E. Benjamin Nelson
Governor

December 3, 1993

Mr. Michael Jess, Director
Nebraska Department of Water Resources
301 Centennial Mall South
Lincoln, NE 68509-4676

REFERENCE: Lower Elkhorn Natural Resources District Amended Ground Water Management Plan (LB51)

Dear Mike:

The Nebraska Department of Environmental Quality (NDEQ) has reviewed the Lower Elkhorn Natural Resources District's (LENRD) proposed revisions to their ground water management plan. These revisions were required under LB51 passed in the 1991 Nebraska Legislature.

NDEQ recognizes the need to be fair and consistent with our review of the plans. To accomplish this, NDEQ reviewed the plans relative to the four basic water quality components found in the legislation. Additionally, NDEQ has provided comments on the strengths and weaknesses of the amended plans as they relate to the LB 51 Reference Guide jointly developed by the reviewing agencies, UNL-Water Center, the appropriate federal agencies, and the Nebraska Association of Resources Districts.

The LB 51 legislation defines four basic water quality components that must be addressed in the amended plans. These four water quality components are as follows:

1. Identify levels of ground water contamination.
2. Identify sources of ground water contamination.
3. Establish ground water quality goals.
4. Identify long-term solutions to prevent levels of ground water contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards. Recommend practices to stabilize, reduce, and prevent ground water contamination.

The plan prepared by the LENRD is a useful working document that will aid the District, other agencies, and the public in understanding the past, present, and future direction of ground water resources management in the District. The budget and timetable priorities are considered, the present and potential sources of contamination are defined as well as possible, and good summary information on land use, soils, water quality objectives and goals is presented. We feel this plan should be approved.

The attached pages include our specific comments concerning the referenced document. If you have any questions, please contact Marty Link or Jeff Gottula of our Ground Water Section at 471-0096.

Sincerely,

Thomas R Lamkeson

for Randolph Wood, P.E.
Director

RW/mll

cc: Stan Staab, Lower Elkhorn NRD

DEQ

Lower Elkhorn Natural Resources District-Ground Water Management Plan

General comments: This plan should be accepted. Some portions of the plan could be improved but no perfect plan will ever exist. The plan presents the conditions in the district in a concise and useful manner. Objectives, goals, policies, and programs are reasonable and consistent with approved actions in similar plans. Future actions are specified in detail but with flexibility built in to allow adaptation to changing conditions. The submittal is a stand alone document. Considerable effort went into the production of this document and the Lower Elkhorn N.R.D. should be congratulated.

1. Identify levels of ground water contamination.

The plan divides the district into three major "groundwater reservoir" areas. Each area is based mainly on near-surface geology, and land form. Most of the ground water utilized in the district comes from unconsolidated Quaternary age deposits. The reservoir areas do have utility, usually in terms of similar land uses, and aquifer vulnerability. The geology and hydrology of the district is adequately described (at that scale).

Aquifer vulnerability in the district has been described in three different studies. Various factors important to ground water contamination are considered in the state-wide DRASTIC evaluation, the USEPA nation-wide pesticide survey (evaluation by counties), and a study by the USGS (contracted with the district).

Contamination has been detected in several areas in the district. Several studies have been conducted, both district-wide and in specific areas where contamination has been suspected. Nonpoint source contamination has been detected or is suspected in several listed areas within the district. The areas with nonpoint source contamination have been tested for nitrates, VOCs, and pesticides. Concern centers on detected elevated nitrate concentrations. A large area in Pierce County has nitrate-nitrogen concentrations above 9 mg/l. Other smaller areas in district also appear to have evidence of contamination.

2. Identify sources of ground water contamination.

Inventories of possible sources of point and nonpoint contamination are well presented. The plan's identified needs in this area includes mapping some information already gathered. Organizing the information to enhance other programs such as the district's Wellhead Protection Program is also planned.

3. Establish ground water quality goals.

The plan identifies goals, policies, objectives, and programs. The main goal is to "Provide an adequate supply of acceptable quality groundwater to forever fulfill the reasonable groundwater demands within the NRD for domestic, municipal, agricultural, industrial, wildlife and other uses deemed beneficial by the NRD Board.". A set of policies has been developed to guide NRD staff towards reaching the goal with consistency. Each policy is supported by one or more programs. In addition, the goal of conserving groundwater quantity and quality is defined by specific objectives. Each objective is supported by NRD programs already in place or planned. The NRD board has also begun the process of creating a Ground Water Management Area.

4. Identify long-term solutions to prevent and reduce high levels to eliminate health hazards. Recommend practices to stabilize, reduce, and prevent ground water contamination.

Several long-term programs are currently in place and the adoption of a Ground Water Management Area is being pursued. Triggers, delineation methods and regulatory actions that will be utilized have been specified. All actions are preventative in nature and are consistent with other actions approved in other Special Protection Areas or Ground Water Management Areas. Time tables are reasonable. Funding for many of the programs is considered to be important in their budgeting process.

STATE OF NEBRASKA

NATURAL RESOURCES COMMIS
Dayle Willia
Dir
301 Centennial Mall S
P.O. Box 9
Lincoln, Nebraska 68509-
Phone (402) 471-
Fax (402) 471-

E. Benjamin Nelson
Governor

November 19, 1993

RECEIVED
NOV 24 1993
DEPARTMENT OF
WATER RESOURCES

Mr. Dale R. Vagts
Ground Water Supervisor
Department of Water Resources
P.O. Box 94676
Lincoln, Nebraska 68509-4676

Dear Dale:

We have completed our review of the September 1993 revision of the Lower Elkhorn NRD Groundwater Management Plan. Although overall this is one of the best plans I have reviewed to date, it has one area of deficiency that causes me to recommend it not be approved without revisions of the type suggested in the following paragraphs. As enacted, LB 51 requires NRDs to include in their plan "long-term solutions necessary" to keep contaminant levels within health standards and "practices recommended to stabilize, reduce, and prevent the occurrence, increase or spread of ground water contamination." I do not believe the plan quite meets those requirements. This plan does contain a clear goal, reasonable objectives, a detailed work program and excellent presentation of the available data. Despite my problems with one portion of the plan I believe the District should be commended on doing what is generally an excellent job.

The deficiency that serves as my basis for recommending plan disapproval is the lack of detail on the process for initiating and creating a Special Protection Area or Groundwater Management Area. The plan acceptably uses percentage of EPA maximum contaminant levels for all contaminants as the basis for creating SPAs and Management Areas. However, there is only general information about the specific well conditions that will trigger actions and almost no information about how boundaries will be delineated. The triggers should be made more specific by stating the number or percent of wells in an area required to trigger action and the number of years of change in concentration if that is a factor. There should also be detail on the method that will be used to delineate boundaries of the management area or SPA.

The plan is also unclear as to what specific criteria would be used to decide whether to request an SPA versus creating a management area and what specific practices would be chosen from the list of actions available under each process. On page 100 the plan notes that when contamination reaches the 75% level the NRD will undertake a study that determines if it is a point or nonpoint source and if from a nonpoint source "the study will also define limits for establishing a management area, and the district will consider requesting the Nebraska Department of Environmental Quality to begin a Special Protection Area Study." Unless the District decides to request an SPA there is evidently no further action required other than continuing voluntary use of BMPs until a 90% of MCL level is reached at which point the District is committed to establish a management area and require the use of best management practices. The plan presents four practices the District could choose from. It is debateable whether a statement saying the NRD will later choose from a list of practices meets the legislation's "practices recommended" language. However, it does provide a commitment to do something other than voluntary measures. The problem is that the lack of information on the boundary setting process and specifics on the number or percent of wells in an area that trigger action make it difficult to know the circumstances under which that "something" would be done.

The remainder of the Lower Elkhorn Groundwater Management Plan is extremely well done. We do have the following suggestions for improvement.

1. The trigger for a study of a potential quantity control or management area is a 15-foot decline in the water table. There are unconfined, partially-confined, and confined aquifers in the district, so different criteria may be more appropriate for some of those aquifers. Confined aquifers, in particular, suffer no depletion of water supply simply because the water level drops even as much as 15 feet. If there is 50 feet of artesian head on the aquifer, there would not be any appreciable decrease in the amount of water in storage. Saturated thickness may be a better trigger in the case of partially-confined and confined aquifers.

2. The trigger for a quantity study (15 feet) is specific, but there are no set criteria for implementing any of the actions that are to follow. In fact, all decisions are deferred to the study and its results. It should be possible to establish policy that includes definite criteria for taking action to educate and regulate at this time, so the study can identify actions that will accomplish the goals and objectives, not determine them.

3. The plan indicates that data accurately describing in detail infiltration rates, soil permeabilities, and soil mineralogy are not readily available. Some general information on permeability is included in the plan. More detailed information on all three topics may be available in the Map Unit Interpretation Records data base at the Soil Conservation Service State Office. Raster soils data is also available from our office for most of the counties in the NRD.

The Department of Environmental Quality's DRASTIC map was used to show areas of potential vulnerability to pollution. The NRD has recognized the limitations in using general soils maps and their interpretations (and other data sets of similar detail) for identifying vulnerable areas and delineating management and control areas. With the data from SCS the NRD should have enough information available to develop a more detailed assessment of vulnerability.

In sum this is a thoroughly researched and well written plan which gives strong evidence that the district intends to address its water quality problems. However, it leaves the reader uncertain about the specific circumstances under which nonpoint source problems would be addressed and the exact nature of regulatory practices that would be used.

There is a natural conflict between the flexibility of a district to shape its response as more information becomes available and the accountability of having a plan in place that assures the state and citizens of the district that specific actions must be taken if specific evidence of contamination appears. The plans I have seen to date opt for flexibility. In my opinion this plan leans marginally too far in that direction because of its lack of a boundary setting mechanism, lack of details on its trigger, and possibly its lack of full commitment to specific actions. That leaves a loophole that could conceivably be used to avoid fully addressing the problem. Nevertheless, my recommendation for disapproval is a "close call" and the remainder of the plan is sufficiently well done that there are substantial grounds for approval.

I hope you find these comments helpful in reviewing the plan. I trust District officials also realize the importance of the plan, the fact that this is their plan and that success in meeting their groundwater reservoir life goals depends upon their ability to carry out the plan. We will be happy to meet with district officials or staff if they would like to discuss any of the above comments. If you have any questions, please let us know.

Sincerely,

Dayle Williamson

Dayle E. Williamson
Director of Natural Resources

DEW:SG:lb

****

CONSERVATION AND SURVEY DIVISION
NORFOLK OFFICE

****

TO: Perry Wigley
FROM: Sue Olafsen Lackey SOL
DATE: 11/23/93
RE: Lower Elkhorn NRD Groundwater Management Plan review

I Quantity

A When will something be done (Trigger)

1. The trigger for first level of action is related to the difference between monitored water levels and estimated predevelopment levels. Predevelopment water levels need to be estimated for all wells monitored, Table III-1.
2. Triggers for second and third levels of action will be determined by hydrogeological study in first action level.
   a. This would allow for site specific groundwater flow system aspects to be taken into consideration, even prior to completion of the plan to define systems district wide.
   b. It may not be appropriate in this plan; however, the district should consider an action plan that specifies hydrogeologic criteria that will be used to define these triggers.

B What will be done (Actions and Control Measures)

1. First action level;
   a. Education and information efforts are very good, especially ensuring knowledge of the NRD's policies and action plans.
   b. May want to include more on "visualization" of groundwater flow systems so that the general public will be better able to "digest" results of hydrogeologic studies.
   c. The citizens advisory committee is a laudable idea. It may be difficult to set up the group; however, other states have used this technique effectively in similar circumstances.
   d. Additional data collection and interpretation will assist in defining the extent and nature of the problem. However, control measures may be needed prior to the end of a five year study, especially in areas with extensive groundwater use.
2. Second and third action levels;
   a. For allocation of groundwater withdrawal to be inclusive, large volume industrial use should be considered and another allocation basis would have to be determined.
   b. The system of rotation may need to consider other commercial and industrial utilization of groundwater, as above.

C General (Does it make sense)

1. The life goal stated on page 5, seems to imply that the NRD will provide an adequate supply of water even where nature has not. If this is the case, then more information needs to be included on rural water systems, i.e. Logan East RWS. This could possibl[y] added under Section VII C or Section VIII.
2. Table I-1 is extremely helpful and concise.

II Quality

A Trigger(s)

Triggers of 50%, 75% and 90% of MCL are very definite and include multiple potential contaminants. Is there any area designation? Is this based on the NRDs monitoring program or any well that has been tested?

B Options

1. The first action level may need to consider other voluntary actions, the term "Best Management Practices" is usually related to agricultural practices only. However, this may be covered by the educational programs.
2. The second action level implies that a detailed study, public notice, and public meetings will be the only actions unless a SPA was recommended, by the NDEQ. The NRD may wish to include some requirements even if a SPA is not recommended. Requiring groundwater and agri-chemical users to submit annual reports may be an important part of the study. The study could also be more inclusive than solely determining if the contamination is point or non-point source.
3. The third action level includes controls, a through d, that have more correlation to quantity than quality. Otherwise, additional controls are encompassing.

C General

1. Shows intent to protect groundwater quality.
2. Table I-2 has a clear format.
3. Details are presented for existing water quality programs.

III Overall

I suggest that some technical clarification could be made in the hydrogeological characterization, i.e. physiographic region verses groundwater reservoir verses aquifer. This not paramount to the planning process and can be revised later.

The district has shown initiative by revising its' entire planning process. Existing strategic plans were reviewed and revised. New action plans have also been developed.

Since the NRD hired a Water Specialist, they have made many improvements to their groundwater conservation and protection programs. Additional programs have been instituted for water quality monitoring and protection. Existing programs were evaluated and modified as necessary. Public meetings have also been held in an area of elevated nitrate concentrations.

STATE OF NEBRASKA

DEPARTMENT OF HEALTH
Mark B. Horton, M.D., M.S.P.H.
Director

E. Benjamin Nels
Gover

MEMO

RECEIVED
DEC 13 1993
DEPARTMENT OF
WATER RESOURCES

To: Dale R. Vagts
Department of Water Resources

From: Jack L. Daniel JLD
Department of Health

Date: December 8, 1993

Mr. Tom Michels TM of our staff has reviewed the 1993 Groundwater Management Plan of the Lower Elkhorn Natural Resources District and finds no reason why it is not acceptable by this Division's Rules and Regulations.

Thank you for the opportunity to comment on this issue.

JLD:TM:dm

301 Centennial Mall South • P.O. Box 95007
Lincoln, Nebraska 68509-5007 • Fax (402) 471-0383

RECEIVED

DEC 7 1993

NEBRASKA GAME AND PARKS COMMISSION

MEMORANDUM

TO: Susan France, Unit Supervisor
Department of Water Resources

FROM: Mary Clausen, Heritage Zoologist
MC

DATE: December 6, 1993

RE: Review of Groundwater Management Plan for Lower Elkhorn NRD

We have reviewed the Lower Elkhorn NRD's ground water management plan for impact on endangered and threatened species. We commend the NRD for their past and future commitment to education, monitoring and management of groundwater quantity and quality. The following comments are provided regarding endangered and threatened species.

The plan states that groundwater management can have an impact on endangered or threatened species when the species or habitat that supports it is affected by groundwater resources. It also acknowledges that the western prairie fringed orchid, a state and federally threatened species, could occur within the District and could be affected by changes in groundwater levels. It is also states that although suitable habitat may exist for the orchid in the district, current land use data are not sufficient to locate these areas. The plan does provide a groundwater quantity protection summary with triggers and controls (Table I - 1 page 3). The first action level takes affect when groundwater levels drop 15 feet below estimates of predevelopment elevations for that area for 2 years in any 3 year period. Footnote number 2 on Table I -1 states that "These actions and control measures can be used for protection of Threatened and Endangered species if deemed necessary by the board".

It is our view that this plan is not sufficient to meet the needs of the orchid. We believe that the groundwater management plan must address the orchid specifically including plans to locate any extant populations through the identification and survey of potential orchid habitat, to educate landowners, to determine affects of groundwater levels on the orchid if the orchid is found within the district and options available to prevent negative affects on the orchid should the situation arise. In addition to landuse data other means are available to aid in determining potential orchid habitat such as infrared photography and aerial photography. Much of what is provided for groundwater quantity protection in the plan is applicable to protecting the orchid and its habitat. However, the 1st action level may not take affect soon enough to prevent adverse impacts on the orchid or its habitat. It is our opinion that if orchids are found within the District the NRD should have a plan to determine the appropriate 1st action level and be prepared to initiate actions to prevent adverse impacts on the orchid. Additionally, if it is determined that the orchid is being adversely affected by declining water levels, suitable actions must be taken by the NRD.

In order to assist the NRD with what the Commission would consider an adequate plan to address the needs of the western prairie fringed orchid, we have enclosed our recommendations. We recognize that this may not be the only acceptable plan to prevent adverse impacts on the orchid and would be willing to discuss other options. For further information on the western prairie fringed orchid or assistance in developing an acceptable plan to prevent adverse affects on the orchid, the NRD can contact Mike Fritz 471-5419.

Thank you for the opportunity to review this plan.

enclosure

cc: Ross Lock, Assistant Chief of Nongame
Mike Fritz, Heritage Botanist

WESTERN PRAIRIE FRINGED ORCHID
GROUNDWATER MANAGEMENT PLAN RECOMMENDATIONS

The western prairie fringed orchid (*Platanthera praeclara*) is a state and federally threatened species that is protected by state and federal statutes. Records of extant and historical populations are distributed in the eastern two-thirds of Nebraska from Cherry County to the Missouri River. The orchid is an inhabitant of native tallgrass subirrigated/wet meadows and upland mesic tallgrass prairies, however, detailed parameters of the orchid's habitat have not been established. Sites with extant orchid populations, including upland sites, characteristically exhibit high soil moisture profiles. It is known that these high soil moisture conditions can be directly linked to groundwater levels as in the case of subirrigated/wet meadows.

The western prairie fringed orchid is known to occur in several NRD districts. Due to the orchid's historical distribution and the presence of suitable habitat, a number of additional districts have the potential to support extant orchid populations. Because the western prairie fringed orchid is inextricably linked to the subirrigated/wet meadow and mesic upland native tallgrass prairie habitats, we do consider any activity that would degrade these habitats through reduction in groundwater levels to be a threat to the orchid. Efforts should be taken to detect any threat as soon as possible so appropriate protective measures can be initiated. The following steps are recommended for orchid protection related to groundwater level management.

1. Initiate educational activities on orchid identification, habitat requirements and protection needs.

2. Identify native, subirrigated/wet meadow and mesic tallgrass prairie areas that are potential orchid habitat.

3. Conduct surveys in potential orchid habitat to determine if the western prairie fringed orchid is present. This should be conducted on a systematic basis over a period of several years.

4. If no orchids are found, no action is required.

5. If orchids are found, educational efforts should be intensified, especially with landowners with orchid populations. This should emphasize the importance of maintaining tallgrass prairie habitat for the orchid and wildlife, as well as agricultural uses including grazing and hay production. Education should also include water conservation through improved irrigation methods such as proper timing, applying only the amount of water needed and the use of more efficient equipment and application techniques. Studies should be undertaken to determine the hydrologic/ hydrogeologic parameters of orchid habitats. The information obtained from the studies would be used to

specify trigger levels and protection areas. Such studies would require relatively long term research. Until such studies could be completed, the effects of a potential threat to an orchid population could be ascertained at a basic level by establishing vegetation monitoring transects in orchid habitat, where a population is present. A shift in vegetation to a dryer, more mesic plant community over a several year period would indicate an impact to the orchid. This shift could result from several factors including changes in climatic conditions. However, a correlating drop in groundwater levels, as evidenced in groundwater monitoring wells, would indicate reduced groundwater levels as a factor and signify the need to consider/initiate controls.

6. If groundwater level declines are indicated in areas of known orchid occurrence, the following controls should be instituted to protect orchid population(s):

   a. Warning Level (a groundwater level or depth that indicates that water levels are declining due to groundwater withdrawal from wells, but the level is not damaging the habitat): Information and Education campaign to inform public in the area about groundwater conservation practices and pending control measures.

   b. 1st Action Level (the groundwater level or depth where damage to the habitat begins): Purchase conservation easements that would protect the area's groundwater in order to assure the area's suitability as orchid habitat and/or establish a groundwater quantity management area
      1) permit required for new wells
      2) institute well spacing restrictions
      3) allocate among the groundwater users, the total withdrawal for each day, month or year
      4) adopt rotational use of groundwater for irrigation
      5) require volume metering of all wells

   c. Final Action Level (the groundwater level or depth that will trigger the most strict regulation; this is the lowest groundwater level that will sustain the habitat): Purchase conservation easements to assure the area's availability as wildlife habitat and/or request the Nebraska Department of Water Resources to designate a groundwater quantity control area
      1) permit required for new wells
      2) institute well spacing restrictions
      3) allocate among the groundwater users, the total withdrawal for each day, month or year
      4) adopt rotational use of groundwater for irrigation
      5) require volume metering of all wells
      6) close the area to the issuance of new well permits
      7) other reasonable rules and regulations to carry out the purpose of protecting orchid habitat

Review letters from second LB51 revision submittal,1994

STATE OF NEBRASKA

DEPARTMENT OF WATER RESOURCES
J. Michael Jess
Director

December 16, 1994

IN REPLY REFER TO:

E. Benjamin Nelson
Governor

Garry Anderson, Chairman
Lower Elkhorn NRD
P.O. Box 1204
700 West Benjamin Avenue
Norfolk, Nebraska 68702

Dear Mr. Anderson,

Evaluation of your Board's 1994 Ground Water Management Plan revision has been completed. Five state agencies have offered comments on your plan. Although agencies identified certain deficiencies in the plan, with certain conditions, these deficiencies are not found significant enough to deny approval of the plan.

Thus, your plan is approved subject to the following understandings:

1. On page 98 is a statement that the district will require volume metering and annual reports for all wells with a capacity of more than 100 gallons per minute. Such a requirement does not comply with § 46-666(4), R.R.S., 1943, as amended, which permits different management area provisions only for different categories of ground water use or different portions of the management area. Water well capacity is not listed as one of the reasons that a district may vary the provisions of management area controls. It is understood the district will comply with this distinction when drafting management area rules and regulations,

2. It is apparent from the language on page 97a that the decision whether or not to declare a quantity management area is made by the Board at the 2nd Action Level after public hearing. While this is an appropriate time in the process to formalize the decision, it is understood that the Board is committed to pursue a management area as soon as the 2nd Action Level trigger is tripped, and significant evidence would have to be introduced at the hearing for the Board to reverse this commitment.

   The same understanding applies to the discussion on page 101 regarding the commitment to declare a quality management area after the "90% of Maximum Contaminant Level" trigger is tripped.

3. Criteria for delineating study and management area boundaries should be defined in the plan. While such criteria are defined in your Board's plan for quantity management areas, the criteria are vague for quality management areas. Based on the limited language on page 100, it is my understanding that studies would be done and boundaries would be drawn if a single ground water well reaches the contaminant trigger. Considering this interpretation and data from Appendix 4, several locations across the district already merit study to "define limits for establishing a management area".

If your Board does not agree with these understandings, it should consider this approval null and void.

The Board has designed a multifaceted approach to mitigate and prevent ground water contamination. This approach includes possible declaration of a Special Protection Area at 75 percent of maximum contaminant level and establishment of a ground water management area at 90 percent of maximum contaminant level. While I find nothing in statute to prevent this strategy, I am concerned that the duplication of some provisions and controls may be awkward to administer and confusing to the public.

Also, page 96 refers to Appendix 2 for "the rationale used in determining the trigger for the 1st Action Level". While this trigger appears to be reasonable, Appendix 2 does not include the referenced text. Future revisions should include such text.

Copies of comments from each of the five review agencies are enclosed. In future revisions, the Board is urged to consider and incorporate the comments of these agencies.

Sincerely,

J. Michael Jess
Director

JMJ:DV:gs
Enclosures
cc:\enc Randy Wood
Jack Daniel
Dayle Williamson
Perry Wigley
Ross Lock
Stan Staab
Bill Birkel

University of
Nebraska
Lincoln
Institute of Agriculture and Natural Resources

Conservation and Survey Division
113 Nebraska Hall
901 North 17th Street
P.O. Box 880517
Lincoln, NE 68588-0517
(402) 472-3471

Geological and Natural Resources Surveys

December 13, 1994

RECEIVED

DEC 16 1994

DEPARTMENT OF
WATER RESOURCES

Dale R. Vagts
Ground Water supervisor
Department of Water Resources
301 Centennial Mall South
4th Floor
P.O. Box 94676
Lincoln, NE 68509-4676

RE: Lower Elkhorn NRD 1994 Groundwater Management Plan

Dear Dale:

Enclosed are comments on the above referenced plan by Sue Lackey of our staff.

With the changes noted, we recommend approval.

Sincerely,

Perry B. Wigley

Perry B. Wigley
Director

PBW/bm

****

CONSERVATION AND SURVEY DIVISION
NORFOLK OFFICE

****

TO: Perry Wigley
FROM: Sue Olafsen Lackey
DATE: 10/28/94
RE: Lower Elkhorn NRD Groundwater Management Plan review

Summarized below are the three deficiencies in the groundwater management plan submitted by the Lower Elkhorn NRD, as per the NDWR letter of December 17, 1993.

1. Groundwater elevation changes that will trigger second and third action levels need to be identified,
2. required well permits must include domestic wells (46-601), and
3. concerns of Game and Parks Commission must be addressed.

The Lower Elkhorn's revisions of September 15, 1994, clearly identifies all action level triggers and includes all wells as per 46-601.

I do not have the expertise to provide comment on the habitat of the western prairie fringed orchid. However, I know that the NRD has had numerous contacts with the Game and Parks Commission in an effort to properly address the orchid habitat issue in their groundwater management plan.

Sol

Nebraska Game and Parks Commission
2200 N. 33rd St. / P.O. Box 30370 / Lincoln, NE 68508-0370 / 402-471-0641 / Fax: 402-471-5528

November 4, 1994

RECEIVED

NOV 7 1994

DEPARTMENT OF
WATER RESOURCES

Dale Vagts
Ground Water Supervisor
Department of Water Resources
301 Centennial Mall South
P.O. Box 94676
Lincoln, Nebraska 68509-4676

Dear Dale:

The Lower Elkhorn Natural Resources District's Groundwater Management Plan has been reviewed for potential effects on endangered and threatened species.

Approval of the Lower Elkhorn NRD's groundwater management plan by the Department of Water Resources and subsequent management of groundwater quantity by the NRD will not, at this time, adversely effect endangered or threatened species or result in the modification or destruction of critical habitat. Should it be determined at some time in the future that an endangered or threatened species is being adversely effected by changes in groundwater levels, informal consultation would be reinitiated between the Department of Water Resources and the Game and Parks Commission. Consultation would address the conditions adversely effecting the species and how the groundwater management plan could be modified to include appropriate remedial actions that could be taken by the NRD. Participation of the appropriate NRD in the consultation would be necessary.

Sincerely yours,

Ross Lock

Ross A. Lock
Wildlife Diversity Program Manager

RAL/me

STATE OF NEBRASKA

E. Benjamin Nelson
Governor

NATURAL RESOURCES COMMISSION
Dayle Williamson
Director
301 Centennial Mall South
P.O. Box 94876
Lincoln, Nebraska 68509-4876
Phone (402) 471-2081
Fax (402) 471-3132

October 13, 1994

RECEIVED
OCT 14 1994
DEPARTMENT OF
WATER RESOURCES

Dale Vagts
Ground Water Supervisor
Department of Water Resources
P.O. Box 94676
Lincoln, Nebraska 68509-4676

Dear Dale:

We have completed our review of the revisions to the Lower Elkhorn Natural Resources District Groundwater Management Plan that you mailed us on September 26, 1994. I believe the revisions fully address the requirements Mike Jess set forth in his December 17, 1993 letter and that the plan should therefore be approved.

The revisions do not address the water quality related comments I provided you in my November 19, 1993 comment letter. Those comments were the basis of my recommendation for disapproval. I would have preferred that the District address those comments in its plan. However, the Department of Water Resources is the agency responsible for approving or disapproving plans and I do believe the revisions meet the requirements provided in Mike's letter. As I noted in my November 19 comment letter my recommendation for disapproval was a "close call." The plan certainly provides a clear goal, reasonable objectives, a detailed work program and an excellent presentation of data. I hope that the District will at some point consider adding further detail to the process for initiating and creating a Special Protection Area or Groundwater Management Area. I wish the District every success in implementing their plan. If you have any questions, please don't hesitate to contact me.

Sincerely,

Dayle

Dayle E. Williamson
Director of Natural Resources

DEW:SG:lb

STATE OF NEBRASKA

DEPARTMENT OF HEALTH
Mark B. Horton, M.D., M.S.P.H.
Director

RECEIVED

NOV 30 1994

DEPARTMENT OF
WATER RESOURCES

E. Benjamin Nelson
Governor

MEMO

To: Dale Vagts, Department of Water Resources

From: Jack L. Daniel, Department of Health JLD

Date: November 28, 1994

Subject: Lower Elkhorn NRD's 1994 Groundwater Management Plan

The above-referenced management plan was reviewed by Tom Michels of this department. We submit the following comments and questions:

- Is there any commitment by the District to meet a groundwater reservoir life goal?
- What specific controls does the District have to address non-point source contamination of domestic wells?
- Is there any specific commitment by the District to protect public water supply system wells against non-point contaminant encroachments or local water table drops?
- The plan does not appear to specifically commit the District to cooperating with various agencies and public water supply systems (in the district) in identifying and mitigating point source encroachments.
- A listing of regulations for which an active effort will be made by the District to cooperate with the agencies in assuring compliance would be welcomed by this department. Two NDOH regulations immediately come to mind that need the District's support:
    - Wellhead encroachments found in (Title 179 NAC 2)
    - Well abandonment found in (Title 178 NAC 12)

Thank you for the opportunity to comment.

JLD:TM:dm TM

301 Centennial Mall South • P.O. Box 95007 • Lincoln, Nebraska 68509-5007
FAX (402) 471-0383 • TTY 471-6421

STATE OF NEBRASKA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Randolph Wood
Director
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186

E. Benjamin Nelson
Governor

NOV 16 1994

RECEIVED
NOV 18 1994
DEPARTMENT OF
WATER RESOURCES

Mr. Michael Jess, Director
Nebraska Department of Water Resources
301 Centennial Mall South
Lincoln, NE 68509-4676

REFERENCE: Lower Elkhorn Natural Resources District Revised Ground Water Management Plan (second review)

Dear Mike:

The Nebraska Department of Environmental Quality (NDEQ) has reviewed the resubmittal of the Lower Elkhorn Natural Resources District's (LENRD) ground water management plan. We referred to our previous comments of December 3, 1993 when reviewing this newly revised plan. In our commentletter, we recommended approval of LENRD's plan. No ground water quality issues were addressed in the revised submittal and we believe the plan still meets the requirements of LB 51. We recommend approval.

The attached page include our specific comments concerning the referenced document. If you have any questions, please contact Marty Link of our Ground Water Section at 471-0096.

Sincerely,

Randolph Wood

Randolph Wood, P.E.
Director

RW/mll
cc: Stan Staab, Lower Elkhorn NRD

Memorandum

TO: Marty Link, Ground Water Section

FROM: Jeff Gottula, Ground Water Section

DATE: Oct. 28, 1994

RE: Revisions to the Lower Elkhorn N.R.D. Ground Water Management Plan (dated 9/24/94)

Recommendation: Approve Ground Water Management Plan with revisions.

Comments: NDEQ recommended approval of the original plan. NDWR denied approval based on the following three criteria:
1) Ground water-level triggers for the second and third action levels.
2) Language regarding the registration of all wells.
3) Specific plans for protecting the western prairie fringed orchid.

The revisions proposed (9/24/94) by the Lower Elkhorn N.R.D. attempt to address each of the problems found by NDWR. NDEQ policy regarding the review of Ground Water Management Plans is to comment only on issues of water quality. The only issue relevant to water quality in the current revision is #2. The proposed revision has corrected language in the plan to be consistent with current law.

APPENDIX 4

Groundwater Quality Data

County	Legal	Date	Source	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	
Burt	20N 9E 11AADB	6-20-88	Irrigation	L	0.1													
Burt	21N 8E 02CA	6-27-88	Irrigation	L	0.1													
Burt	21N 8E 03	8-23-89	Irrigation	L	-0.2													
Burt	21N 8E 05	8-23-89	Irrigation	L	0.7													
Burt	22N 8E 12	8-22-89	Irrigation	L	-0.2													
Burt	22N 8E 23CCBB	8-7-87	Irrigation	L	1													
Burt	22N 8E 28	8-25-89	Irrigation	L	5													
Burt	22N 8E 33	8-22-89	Irrigation	L	5.6													
Burt	22N 8E 34	8-22-89	Irrigation	L	0.6													
Burt	22N 9E 03	8-25-89	Irrigation	L	0.9													
Burt	22N 9E 09	8-22-89	Irrigation	L	-0.2													
Burt	22N 9E 19	8-24-89	Irrigation	L	-0.2													
Burt	22N 9E 21	8-22-89	Irrigation	L	0.6													
Burt	22N 9E 26	8-24-89	Irrigation	L	-0.2													
Burt	22N 9E 26BACC	6-27-88	Irrigation	L	0.1													
Burt	23N 9E 36CADD	8-7-87	Irrigation	L	0.1													
Cedar	20N 9E 11AADB	6-22-88	Irrigation	L	2													
Cedar	28N 1E 04BACC	8-19-87	Irrigation	L	10.1	6-22-88	L	9.9	8-30-91	L	16.7							
Cedar	28N 1E 04C	8-16-91	Irrigation	L	17.8													
Cedar	28N 1E 04D	8-16-91	Irrigation	L	4.2													
Cedar	28N 1E 05D	8-16-91	Irrigation	L	6.2													
Cedar	28N 1E 09B	8-16-91	Irrigation	L	7.5													
Cedar	28N 1E 10B	8-16-91	Irrigation	L	5.2													
Cedar	28N 2E 36CBDD	8-7-87	Irrigation	L	5.5													
Cedar	29N 1E 19CDBB	8-16-87	Irrigation	L	-0.1													
Cedar	29N 1E 32C	8-20-91	Irrigation	L	0.5													
Cedar	29N 1E 33B	8-21-91	Irrigation	L	0.5													
Cedar	29N 1E 33C	8-21-91	Irrigation	L	0.9													
Colfax	18N 3E 12DB	7-27-87	Irrigation	L	1.3													
Colfax	18N 4E 02DDCA	7-27-87	Irrigation	L	0.7													
Colfax	19N 3E 13DCBA	7-27-87	Irrigation	L	0.4													
Colfax	19N 3E 21AABD	7-27-87	Irrigation	L	3.4													
Colfax	19N 3E 30CDCD	7-27-87	Irrigation	L	0.2													
Colfax	19N 4E 15AA	7-27-87	Irrigation	L	-0.1													

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Nitrate values reported as milligrams per liter nitrate-nitrogen.

County	Legal	Date	Source	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	
Cuming	20N 6E 02BBDD	6-27-88	Irrigation	L	3.9													
Cuming	21N 6E 22B	6-22-88	Irrigation	L	-0.1													
Cuming	21N 7E 20BDAD	8-4-87	Irrigation	L	-0.1													
Cuming	22N 4E 16CBAD	8-4-87	Irrigation	L	0.8													
Cuming	22N 5E 15CACC	8-16-87	Irrigation	L	1													
Cuming	22N 5E 1DB	8-13-88	Irrigation	L	10.9													
Cuming	22N 7E 25	8-21-89	Irrigation	L	2.5													
Cuming	22N 7E 36	8-23-89	Irrigation	L	-0.2													
Cuming	23N 5E 02AAAA	8-4-87	Irrigation	L	26.2	6-20-88	L	29.5										
Cuming	23N 5E 1B	8-13-88	Irrigation	L	10.2													
Cuming	23N 5E 1CA	8-15-88	Irrigation	L	8.9													
Cuming	23N 5E 2BB	8-12-88	Irrigation	L	-0.1													
Cuming	23N 5E 2DD	8-12-88	Irrigation	L	0.1													
Cuming	24N 4E 09CDAB	8-1-87	Irrigation	L	13.3	7-8-88	L	15.7										
Cuming	24N 5E 11AO	8-4-87	Irrigation	L	0.8													
Cuming	24N 5E 35AA	8-15-88	Irrigation	L	12.9													
Dixon	26N 5E 33CA	8-18-88	Irrigation	L	-0.1													
Dixon	26N 5E 3A	8-18-88	Irrigation	L	1.9													
Dixon	27N 5E 34BB	8-18-88	Irrigation	L	25.6													
Dixon	27N 5E 34CC	8-18-88	Irrigation	L	6.8													
Dixon	27N 5E 34DCAD	8-7-87	Irrigation	L	36.4	6-27-88	L	36.3										
Dixon	28N 4E 22BACB	8-17-87	Irrigation	L	7.9	8-16-88	L	8										

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County	Legal	Date	Source	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	
Dodge	18N 5E 04ABDA	7-28-87	Irrigation	L	-0.1													
Dodge	18N 6E 01A	8-3-91	Irrigation	L	9.6													
Dodge	18N 6E 01B	8-22-91	Irrigation	L	10.3													
Dodge	18N 6E 02A	8-27-91	Irrigation	L	1.1													
Dodge	18N 6E 02D	8-7-91	Irrigation	L	12.9													
Dodge	18N 6E 03B	8-20-91	Irrigation	L	17.9													
Dodge	18N 6E 03C	8-5-91	Irrigation	L	18.7													
Dodge	18N 6E 03D	8-5-91	Irrigation	L	20.7													
Dodge	18N 6E 04A	8-18-91	Irrigation	L	11													
Dodge	18N 6E 07BA	7-28-87	Irrigation	L	3.8													
Dodge	18N 6E 09A	8-5-91	Irrigation	L	1													
Dodge	18N 6E 10A	7-31-87	Irrigation	L	14.52	6-21-88	L	16.4	8-5-91	L	21							
Dodge	18N 6E 10D	8-2-91	Irrigation	L	4													
Dodge	18N 6E 11B	8-7-91	Irrigation	L	19.2													
Dodge	18N 6E 12B	8-5-91	Irrigation	L	-0.1													
Dodge	18N 6E 14B	8-3-91	Irrigation	L	9.7													
Dodge	16N 7E 03AO	8-4-87	Irrigation	L	5.4													
Dodge	18N 7E 06BCBC	7-31-87	Irrigation	L	12.7	6-21-88	L	16.5										
Dodge	18N 7E 07D	8-12-91	Irrigation	L	-0.1													
Dodge	18N 7E 08B	8-14-91	Irrigation	L	-0.1													
Dodge	18N 8E 13DCAC	6-28-88	Irrigation	L	2.8													
Dodge	19N 5E 30BA	7-31-87	Irrigation	L	-0.1													
Dodge	19N 6E 33A	8-21-91	Irrigation	L	5.7													
Dodge	19N 6E 34D	8-23-91	Irrigation	L	13.4													
Dodge	19N 6E 35	8-19-91	Irrigation	L	1.8													
Dodge	19N 6E 35A	8-19-91	Irrigation	L	-0.1													
Dodge	19N 6E 36D	8-13-91	Irrigation	L	-0.1													
Dodge	19N 7E 03D	8-13-91	Irrigation	L	2													
Dodge	19N 7E 19DA	7-31-87	Irrigation	L	3.4													
Dodge	19N 7E 32C	8-3-91	Irrigation	L	6.6													
Dodge	19N 9E 06DCAC	6-28-88	Irrigation	L	0.1													
Dodge	20N 5E 02DD	7-31-87	Irrigation	L	8.5	7-14-88	L	6.9										
Dodge	20N 5E 22C	8-4-87	Irrigation	L	2.8													
Dodge	20N 6E 23D	8-16-90	Irrigation	L	1.4													
Dodge	20N 8E 08BO	8-18-87	Irrigation	L	-0.1													
Knox	29N 3W 04CDDDD	8-14-87	Irrigation	L	-0.1													
Knox	29N 3W 28B	7-27-89	Irrigation	L + C	6.95													
Knox	29N 4W 25A	7-25-89	Irrigation	L + C	12.54													
Knox	29N 4W 27A	7-25-89	Irrigation	L + C	7.42													
Knox	29N 4W 35CDCC	7-7-87	Irrigation	L	5.2	7-25-89	L + C	5.25										

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County	Legal	Date	Source	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	
Madison	21N 1W 11ACAA	7-13-87	Irrigation	L	3.2													
Madison	21N 2W 21DBBB	7-13-87	Irrigation	L	0.3													
Madison	21N 3W 11BBDD	7-13-87	Irrigation	L	7.6	7-8-88	L	5.3										
Madison	22N 1W 03CDAA	7-13-87	Irrigation	L	-0.1													
Madison	22N 3W 05AADD	7-22-87	Irrigation	L	4.7													
Madison	22N 3W 26AACC	7-20-87	Irrigation	L	3.5													
Madison	22N 4W 17CBDD	7-22-87	Irrigation	L	3.4													
Madison	23N 1W 08CCCD	7-22-87	Irrigation	L	-0.1													
Madison	23N 1W 12DBAA	7-20-87	Irrigation	L	3.7													
Madison	23N 4W 19ADBB	7-20-87	Irrigation	L	1.5													
Madison	24N 1W 01B	8-26-91	Irrigation	L	30.8													
Madison	24N 1W 02A	8-24-91	Irrigation	L	12.1													
Madison	24N 1W 02D	8-18-91	Irrigation	L	9.8													
Madison	24N 1W 02D	8-16-91	Irrigation	L	14.9													
Madison	24N 1W 03B	8-16-91	Irrigation	L	12.8													
Madison	24N 1W 03DCAD	7-31-87	Irrigation	L	13.3	6-24-88	L	13.6	8-18-91	13.4								
Madison	24N 1W 04D	8-24-91	Irrigation	L	1.1													
Madison	24N 1W 09A	8-16-91	Irrigation	L	1.2													
Madison	24N 1W 11A	8-18-91	Irrigation	L	3													
Madison	24N 1W 11B	8-13-91	Irrigation	L	14.9													
Madison	24N 2W 10ACCD	7-20-87	Irrigation	L	9.4	6-21-88	L	12.2										
Pierce	25N 2W 29BAA	7-25-80	Domestic	C	0.41													
Pierce	25N 4W 23BCD	7-25-80	Domestic	C	6													
Pierce	25N 4W 28CC	7-23-80	Domestic	C	6.6													
Pierce	26N 1W 19C	7-8-90	Domestic	L	16.4													
Pierce	26N 1W 20C	7-7-90	Domestic	L	15.1													
Pierce	27N 2W 21D	7-14-81	Domestic	C	2.7													
Pierce	28N 4W 33D	7-26-89	Domestic	L + C	6.64													
Pierce	27N 2W 05B	2-22-88	Domestic	L	11.1													
Pierce	27N 2W 06C	2-22-88	Domestic	L	9.4													
Pierce	27N 2W 10D	2-4-88	Domestic	L	24.5	3-29-88	L	29.5										
Pierce	27N 2W 18C	2-5-88	Domestic	L	11.1													
Pierce	28N 2W 16A	3-10-88	Domestic	L	-0.1													
Pierce	28N 2W 16B	3-1-88	Domestic	L	222.2	3-10-88	L	228.2	3-10-88	L	227.1							
Pierce	28N 2W 21C	2-2-88	Domestic	L	4.4													
Pierce	28N 2W 22D	3-1-88	Domestic	L	0.6													
Pierce	28N 2W 31D	3-1-88	Domestic	L	4.5													
Pierce	28N 2W 32B	2-3-88	Domestic	L	0.3													
Pierce	28N 3W 14B	2-17-88	Domestic	L	1.2													

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Pierce	28N 3W 16D	3-1-88	Domestic	L	8.6													
Pierce	28N 3W 23B	2-17-88	Domestic	L	27.5													
Pierce	28N 3W 25C	2-17-88	Domestic	L	7.4													
Pierce	28N 3W 26A	2-17-88	Domestic	L	6.3													
Pierce	28N 3W 27D	2-11-88	Domestic	L	28													
Pierce	28N 3W 33D	2-11-88	Domestic	L	-0.1													
Pierce	28N 3W 35B	2-3-88	Domestic	L	6.6													
Pierce	27N 2W 07A	2-4-88	Domestic	L	3.2													
Pierce	27N 2W 08A	2-4-88	Domestic	L	9.8													
Pierce	27N 2W 10C	2-5-88	Domestic	L	2.6													
Pierce	27N 2W 15C	2-4-88	Domestic	L	24.2													
Pierce	27N 2W 17C	2-4-88	Domestic	L	4.7													
Pierce	27N 2W 19C	2-4-88	Domestic	L	4.5													
Pierce	27N 2W 21A	2-8-88	Domestic	L	4.6													
Pierce	27N 3W 01C	2-8-88	Domestic	L	3.8													
Pierce	27N 3W 02A	2-22-88	Domestic	L	-0.1													
Pierce	27N 3W 10B	2-8-88	Domestic	L	10.3													
Pierce	27N 3W 10D	2-5-88	Domestic	L	17.3													
Pierce	27N 3W 11C	2-5-88	Domestic	L	5.3													
Pierce	27N 3W 12C	2-5-88	Domestic	L	8.1													
Pierce	27N 3W 13C	2-8-88	Domestic	L	24.5													
Pierce	27N 3W 14D	2-8-88	Domestic	L	4.8													
Pierce	27N 3W 24C	2-8-88	Domestic	L	3.5													
Pierce	28N 2W 07D	2-3-88	Domestic	L	15.7													
Pierce	28N 2W 09A	3-10-88	Domestic	L	4.9													
Pierce	28N 2W 09D	3-10-88	Domestic	L	0.9													
Pierce	28N 2W 10C	3-10-88	Domestic	L	-0.1													
Pierce	28N 2W 16B	3-10-88	Domestic	L	-0.1													
Pierce	28N 2W 16D	2-2-88	Domestic	L	0.2													
Pierce	28N 2W 17D	3-10-88	Domestic	L	36.7													
Pierce	28N 2W 18DA	2-2-88	Domestic	L	3.1													
Pierce	28N 2W 20C	2-2-88	Domestic	L	0.2													
Pierce	28N 2W 28DD	2-2-88	Domestic	L	7.9													
Pierce	28N 2W 29B	3-1-88	Domestic	L	0.1													
Pierce	28N 2W 34B	2-3-88	Domestic	L	0.7													
Pierce	28N 2W 35C	2-3-88	Domestic	L	2.3													
Pierce	28N 3W 12C	2-2-88	Domestic	L	-0.1													
Pierce	28N 3W 13C	2-2-88	Domestic	L	5.7													
Pierce	28N 3W 15D	2-11-88	Domestic	L	18.6													
Pierce	28N 3W 19B	2-2-88	Domestic	L	4.7													
Pierce	28N 3W 22D	2-17-88	Domestic	L	2.9													

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County	Legal	Date	Source	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	
Pierce	28N 3W 24D	2-2-88	Domestic	L	4.2													
Pierce	28N 3W 28D	2-11-88	Domestic	L	-0.1													
Pierce	28N 3W 34D	2-22-88	Domestic	L	0.4													
Pierce	28N 3W 36B	2-22-88	Domestic	L	12													
Pierce	28N 2W 36	9-19-80	Field Tile	C	18.1	7-16-81	C&S	9.3										
Pierce	25N 1W 01D	8-28-90	Irrigation	L	0.5													
Pierce	25N 1W 03B	8-23-90	Irrigation	L	10.1	8-22-91	L	9.5										
Pierce	25N 1W 04A	8-20-92	Irrigation	L	9													
Pierce	25N 1W 04B	8-19-92	Irrigation	L	6.5													
Pierce	25N 1W 05B	8-27-90	Irrigation	L	17.2	8-15-91	L	19.1										
Pierce	25N 1W 06A	8-27-90	Irrigation	L	9.5													
Pierce	25N 1W 06DBA	8-5-80	Irrigation	C	4.8	8-23-90	L	1.7										
Pierce	25N 1W 06DDB	7-29-80	Irrigation	C	2.3	8-27-90	L	2.2										
Pierce	25N 1W 07D	8-27-90	Irrigation	L	-0.1													
Pierce	25N 1W 08A	8-27-90	Irrigation	L	8.8	8-21-91	L	9										
Pierce	25N 1W 08C	8-27-90	Irrigation	L	3.5													
Pierce	25N 1W 08D	8-27-90	Irrigation	L	4.4													
Pierce	25N 1W 09C	8-27-90	Irrigation	L	6													
Pierce	25N 1W 09D	8-28-90	Irrigation	L	6.2	8-16-91	L	6.9										
Pierce	25N 1W 11C	8-29-90	Irrigation	L	1.4													
Pierce	25N 1W 11DDBB	8-12-80	Irrigation	C	3.1	8-29-90	L	2										
Pierce	25N 1W 12C	8-29-90	Irrigation	L	0.8													
Pierce	25N 1W 16DBD	8-8-80	Irrigation	C	2													
Pierce	25N 1W 18DDB	8-8-80	Irrigation	C	10.8	7-14-81	C	10.5										
Pierce	25N 1W 25BBD	7-17-80	Irrigation	C	0.01													
Pierce	25N 1W 29ABD	8-5-80	Irrigation	C	0.68													
Pierce	25N 1W 34A	8-24-91	Irrigation	L	17.8													
Pierce	25N 1W 34ACOBD	8-26-80	Irrigation	C	6.7													
Pierce	25N 1W 34DBD	7-17-80	Irrigation	C	14.8	7-13-81	C	14.1										
Pierce	25N 1W 34DBD	8-25-80	Irrigation	C	16.6	7-13-81	C	12										
Pierce	25N 1W 35	8-27-80	Irrigation	C	8.9													
Pierce	25N 1W 35A	8-28-91	Irrigation	L	11.1													
Pierce	25N 1W 35C	8-27-91	Irrigation	L	17.6													
Pierce	25N 1W 35C	8-27-91	Irrigation	L	17.7													
Pierce	25N 1W 35CB	8-27-80	Irrigation	C	0.02													
Pierce	25N 1W 35D	8-27-91	Irrigation	L	19.8													
Pierce	25N 1W 36BCC	7-17-80	Irrigation	C	3.9													
Pierce	25N 2W 01BDD	9-10-80	Irrigation	C	3.6													
Pierce	25N 2W 04CO	7-29-80	Irrigation	C	0.42													
Pierce	25N 2W 07CCAA	8-22-80	Irrigation	C	1.04													
Pierce	25N 2W 08CO	8-22-80	Irrigation	C	1.31													

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Pierce	25N 2W 14AO	7-29-80	Irrigation	C	0.02												
Pierce	25N 2W 16CAA	8-4-80	Irrigation	C	0.12												
Pierce	25N 2W 17BDBB	8-22-80	Irrigation	C	10.7												
Pierce	25N 2W 18CACAA	8-12-80	Irrigation	C	24	8-2-82	C	5	7-14-87	L	6.3						
Pierce	25N 2W 18CO	7-28-80	Irrigation	C	1.03												
Pierce	25N 2W 20CCA	7-17-80	Irrigation	C	2.9												
Pierce	25N 2W 27DAB	7-29-80	Irrigation	C	6.3												
Pierce	25N 2W 30BCB	7-17-80	Irrigation	C													
Pierce	25N 2W 31CAA	7-25-80	Irrigation	C	2.6												
Pierce	25N 3W 04ACD	9-20-80	Irrigation	C	4.5												
Pierce	25N 3W 04BACCC	7-28-80	Irrigation	C	10.7	8-1-82	C	4.2	7-14-87	L	7.5	7-8-88	L	5.5			
Pierce	25N 3W 04CO	8-26-80	Irrigation	C	6.7												
Pierce	25N 3W 05AACC	9-8-80	Irrigation	C	12.8												
Pierce	25N 3W 09BBD	7-29-80	Irrigation	C	3												
Pierce	25N 3W 11CO	7-29-80	Irrigation	C	2												
Pierce	25N 3W 12DBBA	7-28-80	Irrigation	C	1.38												
Pierce	25N 3W 19DO	8-28-80	Irrigation	C	2.4												
Pierce	25N 3W 21CCA	7-18-80	Irrigation	C	7.6												
Pierce	25N 3W 22CO	7-18-80	Irrigation	C	3.6												
Pierce	25N 3W 23ABOBA	8-27-80	Irrigation	C	1.9												
Pierce	25N 3W 23CBD	8-28-80	Irrigation	C	2.8												
Pierce	25N 3W 23DCB	7-18-80	Irrigation	C	10.3	8-2-82	C&S	7.1									
Pierce	25N 3W 24BAD	8-25-80	Irrigation	C	5.1												
Pierce	25N 3W 26BAOD	8-28-80	Irrigation	C	6.2												
Pierce	25N 3W 31COD	7-23-80	Irrigation	C	4.1												
Pierce	25N 3W 34CBAB	7-23-80	Irrigation	C	4.6	8-25-86	L	4.1									
Pierce	25N 4W 01ABB	7-29-80	Irrigation	C	5.7												
Pierce	25N 4W 04DCOD	7-25-80	Irrigation	C	9.1												
Pierce	25N 4W 09CO	7-28-80	Irrigation	C	4.8												
Pierce	25N 4W 10AACC	8-12-80	Irrigation	C	7.7												
Pierce	25N 4W 10DDBB	8-11-80	Irrigation	C	6.3												
Pierce	25N 4W 13AO	7-29-80	Irrigation	C	2.4												
Pierce	25N 4W 14D	8-20-91	Irrigation	L	12.8												
Pierce	25N 4W 15ABD	7-25-80	Irrigation	C	5.4												
Pierce	25N 4W 15D	8-18-91	Irrigation	L	8.5												
Pierce	25N 4W 17BO	7-25-80	Irrigation	C	4.7												
Pierce	25N 4W 22B	8-24-91	Irrigation	L	12.3												
Pierce	25N 4W 22C	8-20-91	Irrigation	L	9.2												
Pierce	25N 4W 23A	8-18-91	Irrigation	L	16.3												
Pierce	25N 4W 23BDBB	7-25-80	Irrigation	C	7.4	7-20-87	L	11.8	6-23-88	L	12.6						
Pierce	25N 4W 27BBD	7-23-80	Irrigation	C	1.99												

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Pierce	25N 4W 28CBA	7-23-80	Irrigation	C	3.1												
Pierce	25N 4W 29CCA	7-23-80	Irrigation	C	3												
Pierce	25N 4W 31CAD	7-25-80	Irrigation	C	1.59												
Pierce	25N 4W 35AO	7-28-80	Irrigation	C	4.6												
Pierce	26N 1W 03AO	8-8-80	Irrigation	C	5.4												
Pierce	26N 1W 06D	8-31-90	Irrigation	L	10	8-16-91	L	10.2									
Pierce	26N 1W 07A	8-20-90	Irrigation	L	14.9	8-21-91	L	14.1									
Pierce	26N 1W 09C	8-20-90	Irrigation	L	9.8	8-23-91	L	10.4									
Pierce	26N 1W 13D	8-30-90	Irrigation	L	2.1												
Pierce	26N 1W 14C	8-25-90	Irrigation	L	9.1	8-16-91	L	9.3									
Pierce	26N 1W 17A	8-10-90	Irrigation	L	12.5												
Pierce	26N 1W 17A	9-11-80	Irrigation	C	16.4	7-14-81	C	14.7	7-8-90	L	20.8	8-14-91	L	21.4			
Pierce	26N 1W 17B	9-8-80	Irrigation	C	10.8	8-4-82	C	10.4	8-13-90	L	13.6	8-16-91	L	12.2			
Pierce	26N 1W 18CBA	8-26-80	Irrigation	C	11.6	7-8-90	L	5.2									
Pierce	26N 1W 18D	7-8-90	Irrigation	L	10.6	8-21-91	L	10.7									
Pierce	26N 1W 19AO	8-26-80	Irrigation	C	10.8	7-14-81	C	10.9	8-15-91	L	17.7						
Pierce	26N 1W 20B	7-7-90	Irrigation	L	17.7	8-15-91	L	17.9									
Pierce	*26N 1W 20CDDC*	*8-27-80*	*Irrigation*	C	*11*	*8-4-82*	C	*13.8*	*7-16-87*	*L*	*16*	*6-24-88*	*L*	*18*	*7-24-90*	*L*	*20.8*
Pierce	*26N 1W 20CDDC*	*8-14-91*	*Irrigation*	L	*21.4*	*8-19-92*	*L*	*23.2*									
Pierce	26N 1W 21B	7-7-90	Irrigation	L	11.5	8-13-91	L	12.4									
Pierce	26N 1W 21DO	9-8-80	Irrigation	C	14.1	7-30-82	C	12	8-2-90	L	13.7	8-16-90	L	14.7	8-16-91	L	15.4
Pierce	26N 1W 27AAC	8-8-80	Irrigation	C	7	8-22-90		10.2									
Pierce	26N 1W 27D	8-21-90	Irrigation	L	10.2	8-21-91	L	11.5									
Pierce	26N 1W 29ABA	8-8-80	Irrigation	C	15.3	7-16-81	C	15.6	7-26-90	L	15.6	8-13-91	L	14.6			
Pierce	26N 1W 29B	7-24-90	Irrigation	L	10.8												
Pierce	26N 1W 29C	7-7-90	Irrigation	L	13.9												
Pierce	26N 1W 29DO	8-26-80	Irrigation	C	13.4	7-15-81	C	12	7-7-90	L	21.7	8-13-91	L	23.3			
Pierce	26N 1W 30A	7-25-90	Irrigation	L	16	8-13-91	L	15.8									
Pierce	26N 1W 30C	7-8-90	Irrigation	L	21.1	8-14-91	L	20.7									
Pierce	26N 1W 31A	10-30-80	Irrigation	C	7.79	8-17-90	L	19.6	8-13-91	L	21						
Pierce	26N 1W 31C	8-16-90	Irrigation	L	9.8												
Pierce	26N 1W 31D	8-14-90	Irrigation	L	16.5	8-15-91	L	12.7									
Pierce	26N 1W 32AO	8-8-80	Irrigation	C	11.2	7-15-81	C	10.8	8-16-90	L	16.5	8-15-91	L	18.2			
Pierce	26N 1W 32BO	10-10-80	Irrigation	C	25.18	7-14-81	C	13.5	8-16-90	L	11.2						
Pierce	26N 1W 32C	8-15-90	Irrigation	L	21.1	8-13-91	L	22.2									
Pierce	26N 1W 32DBDD	9-8-80	Irrigation	C	9.1	8-15-90	L	13.1									
Pierce	26N 1W 33B	8-17-90	Irrigation	L	9.7												
Pierce	26N 1W 33C	8-15-90	Irrigation	L	11.5	8-13-91	L	11.3									
Pierce	26N 1W 35B	8-23-90	Irrigation	L	4.4												

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County	Legal	Date	Source	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate	Date	Collector	Nitrate
Pierce	26N 1W 36C	8-21-90	Irrigation	L	0.5												
Pierce	26N 2W 01A	9-11-90	Irrigation	L	9.7												
Pierce	26N 2W 02C	9-10-90	Irrigation	L	11.5	8-16-91	L	11.7									
Pierce	26N 2W 02DBDD	8-12-80	Irrigation	C	9.3	9-6-90	L	10.5									
Pierce	26N 2W 05BBDD	8-11-80	Irrigation	C	1.55	8-20-86	L	1.9									
Pierce	26N 2W 10D	7-23-91	Irrigation	L	9.5												
Pierce	26N 2W 10D	7-23-91	Irrigation	L	12.4												
Pierce	26N 2W 11A	9-10-90	Irrigation	L	10.7												
Pierce	26N 2W 11B	7-25-91	Irrigation	L	12.9												
Pierce	26N 2W 11D	9-10-90	Irrigation	L	16.8	8-21-91	L	18.1									
Pierce	26N 2W 12D	8-23-90	Irrigation	L	12.7												
Pierce	26N 2W 12DDBB	9-20-80	Irrigation	C	13.9	8-23-90	L	16.1	8-15-91	L	17.9						
Pierce	26N 2W 13CAA	9-29-80	Irrigation	C	53.7	7-13-81	C	7.5									
Pierce	26N 2W 13D	7-8-90	Irrigation	L	9.5	8-14-91	L	8.3									
Pierce	26N 2W 15CCAC	8-11-80	Irrigation	C	1.08												
Pierce	26N 2W 23A	8-23-90	Irrigation	L	2.8												
Pierce	26N 2W 23A	8-23-90	Irrigation	L	7.9	8-14-91	L	8.2									
Pierce	26N 2W 23C	7-29-91	Irrigation	L	-0.1												
Pierce	26N 2W 23D	8-23-90	Irrigation	L	-0.1												
Pierce	26N 2W 23D	8-23-90	Irrigation	L	0.03												
Pierce	26N 2W 24A	7-9-90	Irrigation	L	8.3												
Pierce	26N 2W 25AAC	9-9-80	Irrigation	C	6	7-8-90	L	4.8	8-21-91	L	4.4						
Pierce	26N 2W 25C	8-16-90	Irrigation	L	0.3												
Pierce	26N 2W 26D	8-31-90	Irrigation	L	0.3												
Pierce	26N 2W 27ACC	8-11-80	Irrigation	C	2												
Pierce	26N 2W 29CO	8-11-80	Irrigation	C	0.2												
Pierce	26N 2W 36AA	8-20-90	Irrigation	L	2.1												
Pierce	26N 2W 36AB	8-20-90	Irrigation	L	-0.1	8-21-91	L	-0.1									
Pierce	26N 2W 36AD	8-28-90	Irrigation	L	-0.1												
Pierce	26N 3W 08AO	8-22-80	Irrigation	C	2												
Pierce	26N 3W 10CDBB	8-19-80	Irrigation	C	0.31												
Pierce	26N 3W 13BBDD	8-19-80	Irrigation	C	0.93												
Pierce	26N 3W 19CCC	8-12-80	Irrigation	C	6.5	9-4-86	L	10.8	7-8-88	L	14.8	8-24-91	L	14.7			
Pierce	26N 3W 19D	8-26-91	Irrigation	L	0.4												
Pierce	26N 3W 20DACC	9-8-80	Irrigation	C	2.5												
Pierce	26N 3W 23A	8-21-90	Irrigation	L	6.5												
Pierce	26N 3W 30B	8-18-91	Irrigation	L	6.4												
Pierce	26N 3W 33DO	8-26-80	Irrigation	C	0.06												
Pierce	26N 3W 34AO	8-27-80	Irrigation	C	0.1												
Pierce	26N 3W 34CO	8-26-80	Irrigation	C	2.2												
Pierce	26N 3W 36AAXB	8-27-80	Irrigation	C	4.8												

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Pierce	26N 4W 03AAOD	9-18-80	Irrigation	C	1.83													
Pierce	26N 4W 06BDB	9-18-80	Irrigation	C	2													
Pierce	26N 4W 08CDB	9-18-80	Irrigation	C	3.8													
Pierce	26N 4W 16DD	9-18-80	Irrigation	C	8.1													
Pierce	26N 4W 24B	8-18-91	Irrigation	L	13.1													
Pierce	26N 4W 25C	8-18-91	Irrigation	L	13.4													
Pierce	26N 4W 27DDDOA	9-16-80	Irrigation	C	9.3													
Pierce	26N 4W 29BCAA	8-19-80	Irrigation	C	8.4													
Pierce	26N 4W 29BDBB	7-7-87	Irrigation	L	10	7-8-88	L	10										
Pierce	27N 1W 03AAC	9-16-80	Irrigation	C	3.8													
Pierce	27N 1W 03AACC	9-16-80	Irrigation	C	3.8	8-20-86	L	7.3	7-8-88	L	8.3							
Pierce	27N 1W 04C	8-24-92	Irrigation	L	2.6													
Pierce	27N 1W 06A	8-20-92	Irrigation	L	0.5													
Pierce	27N 1W 07D	7-18-91	Irrigation	L	7.2													
Pierce	27N 1W 08A	8-25-92	Irrigation	L	5.2													
Pierce	27N 1W 15BAD	9-10-80	Irrigation	C	3.4													
Pierce	27N 1W 17C	7-18-91	Irrigation	L	3.6	8-19-92	L	3.5										
Pierce	27N 1W 18C	7-19-91	Irrigation	L	8.9													
Pierce	27N 1W 19B	7-17-91	Irrigation	L	7.9													
Pierce	27N 1W 20C	7-18-91	Irrigation	L	9.9	8-20-92	L	9.8										
Pierce	27N 1W 21AO	9-10-80	Irrigation	C	7	7-26-91	L	6										
Pierce	27N 1W 23BDAA	9-16-80	Irrigation	C	3.2													
Pierce	27N 1W 28D	7-18-91	Irrigation	L	1													
Pierce	27N 1W 30B	8-21-92	Irrigation	L	5.7													
Pierce	27N 1W 30B	7-18-91	Irrigation	L	11.9	8-21-92	L	11.4										
Pierce	27N 1W 31B	7-10-91	Irrigation	L	12													
Pierce	27N 1W 32BCAB	9-18-80	Irrigation	C	7.7													
Pierce	27N 2W 01BCCOC	9-19-80	Irrigation	C	9.3													
Pierce	27N 2W 02A	8-24-92	Irrigation	L	6.1													
Pierce	27N 2W 02C	8-20-92	Irrigation	L	15													
Pierce	27N 2W 03ACA	9-16-80	Irrigation	C	12.9	7-29-82	C	14.2	7-27-89	L + C	7.59							
Pierce	27N 2W 03D	10-20-80	Irrigation	C	9.66													
Pierce	27N 2W 05AABOB	9-19-80	Irrigation	C	2.8													
Pierce	27N 2W 06D	7-27-89	Irrigation	L + C	12.44													
Pierce	27N 2W 09D	7-27-89	Irrigation	L + C	4.01													
Pierce	27N 2W 10A	8-21-92	Irrigation	L	6													
Pierce	27N 2W 10B	7-29-91	Irrigation	L	5.6													
Pierce	27N 2W 10B	7-29-91	Irrigation	L	7.5													
Pierce	27N 2W 10D	7-23-91	Irrigation	L	9.5													
Pierce	27N 2W 10D	7-23-91	Irrigation	L	12.4													
Pierce	27N 2W 10D	8-24-92	Irrigation	L	12.7													

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Pierce	27N 2W 11B	8-21-92	Irrigation	L	21.8													
Pierce	27N 2W 12D	7-18-91	Irrigation	L	6.9													
Pierce	27N 2W 13A	7-19-91	Irrigation	L	9.1	8-20-92	L	8.7										
Pierce	27N 2W 15D	8-21-92	Irrigation	L	10.1													
Pierce	27N 2W 16A	8-21-92	Irrigation	L	8.1													
Pierce	27N 2W 18D	7-18-91	Irrigation	L	1.2													
Pierce	27N 2W 21CDBB	9-19-80	Irrigation	C	17.7	7-14-81	C	4.5	7-27-89	L + C	7.32							
Pierce	27N 2W 24C	7-26-91	Irrigation	L	3.7													
Pierce	27N 2W 24D	7-19-91	Irrigation	L	8													
Pierce	27N 2W 25B	7-16-91	Irrigation	L	4.8													
Pierce	27N 2W 25C	7-11-91	Irrigation	L	9.7													
Pierce	27N 2W 26B	7-16-91	Irrigation	L	17.3													
Pierce	27N 2W 26D	7-15-91	Irrigation	L	22.1													
Pierce	27N 2W 29ADAA	10-21-80	Irrigation	C	10.19	7-16-81	C	10.2	7-27-89	L + C	24.45							
Pierce	27N 2W 30BO	9-9-80	Irrigation	C	3.2	7-27-89	L + C	3.15										
Pierce	27N 2W 34B	7-27-89	Irrigation	L + C	25.1													
Pierce	27N 2W 35B	7-17-91	Irrigation	L	9.3													
Pierce	27N 2W 35C	7-23-91	Irrigation	L	12.7													
Pierce	27N 2W 36C	9-10-90	Irrigation	L	12.2													
Pierce	27N 2W 36D	8-31-90	Irrigation	L	11.8	8-15-91	L	11.9										
Pierce	27N 3W 08AO	9-16-80	Irrigation	C	7.9	7-26-89	L + C	6.5										
Pierce	27N 3W 11BBCC	9-16-80	Irrigation	C	5.6													
Pierce	27N 3W 11C	7-28-89	Irrigation	L + C	8.37													
Pierce	27N 3W 15BAAA	8-18-80	Irrigation	C	6.9													
Pierce	27N 3W 22DDBB	8-18-80	Irrigation	C	0.99	8-20-86	L	10.1	6-23-88	L	17.6	7-26-89	L + C	10.85				
Pierce	27N 3W 33DB	9-16-80	Irrigation	C	5.3													
Pierce	27N 4W 02A	10-9-80	Irrigation	C	9.12	7-26-89	L + C	3.44										
Pierce	27N 4W 03CACD	9-30-80	Irrigation	C	0.18													
Pierce	27N 4W 06B	7-25-89	Irrigation	L + C	11.45													
Pierce	27N 4W 12DCAOD	10-15-80	Irrigation	C	35.98													
Pierce	27N 4W 16D	7-26-89	Irrigation	L + C	7.71													
Pierce	27N 4W 18B	7-26-90	Irrigation	L + C	11.18													
Pierce	27N 4W 26D	10-7-80	Irrigation	C	8.15	7-26-89	L + C	2.6										
Pierce	27N 4W 32A	8-19-80	Irrigation	C	0.55	7-26-89	L + C	4.16										
Pierce	28N 1W 01AABB	10-10-80	Irrigation	C	0.79													
Pierce	28N 1W 19DABD	9-30-80	Irrigation	C	0.27													
Pierce	*28N 1W 31B*	*8-20-92*	*Irrigation*	L	*0.2*													
Pierce	28N 1W 32B	8-24-92	Irrigation	L	0.2													
Pierce	28N 1W 33BCAD	10-7-80	Irrigation	C	0.1													
Pierce	28N 2W 05AACC	9-30-80	Irrigation	C	10.9	7-16-81	C	9.9										
Pierce	28N 2W 06A	9-21-90	Irrigation	L	4.2													

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Pierce	28N 2W 07B	7-24-90	Irrigation	L	12.1												
Pierce	28N 2W 07C	7-24-90	Irrigation	L	2.1												
Pierce	28N 2W 09A	7-25-89	Irrigation	L + C	12.98												
Pierce	28N 2W 18BBDD	9-30-80	Irrigation	C	4.5	7-25-89	L + C	0.76	7-23-90	L	0.05						
Pierce	28N 2W 21DO	9-30-80	Irrigation	C	11.05	7-16-81	C	6.9									
Pierce	28N 2W 22CO	9-30-80	Irrigation	C	9.4	7-26-89	L + C	5.02									
Pierce	28N 2W 29D	7-27-89	Irrigation	L + C	5.25												
Pierce	*28N 2W 31BDB*	*8-18-80*	*Irrigation*	C	*8.3*												
Pierce	28N 2W 33D	8-25-92	Irrigation	L	8.4												
Pierce	28N 2W 34DACB	10-20-80	Irrigation	C	1.9												
Pierce	28N 2W 35C	8-24-92	Irrigation	L	11.9												
Pierce	28N 3W 01AO	10-7-80	Irrigation	C	1.09	8-21-90	L	1									
Pierce	28N 3W 01B	8-17-90	Irrigation	L	0.1												
Pierce	28N 3W 03ACAA	10-14-80	Irrigation	C	0.42												
Pierce	28N 3W 06D	8-17-90	Irrigation	L	7.1												
Pierce	28N 3W 07A	8-23-90	Irrigation	L	7.9												
Pierce	28N 3W 10A	7-25-89	Irrigation	L + C	1.71												
Pierce	28N 3W 11C	8-17-90	Irrigation	L	6.8												
Pierce	28N 3W 12B	7-27-90	Irrigation	L	3.1												
Pierce	28N 3W 12C	7-27-90	Irrigation	L	11.7												
Pierce	28N 3W 12DDBB	7-7-87	Irrigation	L	18.6	6-23-88	L	12	7-26-89	L + C	6.49	7-27-90	L	9.3			
Pierce	28N 3W 13B	7-23-90	Irrigation	L	8.4												
Pierce	28N 3W 13B	8-17-90	Irrigation	L	8.6												
Pierce	28N 3W 13C	8-17-90	Irrigation	L	12.3												
Pierce	28N 3W 18BC	7-25-89	Irrigation	L + C	-0.02												
Pierce	28N 3W 20C	7-25-89	Irrigation	L + C	1.36												
Pierce	28N 3W 22D	10-23-80	Irrigation	C	7.97	7-25-89	L + C	15.89									
Pierce	28N 3W 24B	9-11-90	Irrigation	L	14.5												
Pierce	28N 3W 25D	7-28-89	Irrigation	L + C	6.88												
Pierce	28N 3W 31C	7-24-89	Irrigation	L + C	5.79												
Pierce	28N 3W 33BAAA	8-19-80	Irrigation	C	9.4	7-26-89	L + C	1.07									
Pierce	28N 3W 35C	7-26-89	Irrigation	L + C	-0.02												
Pierce	28N 4W 02C	10-9-80	Irrigation	C	4.07												
Pierce	28N 4W 04D	7-24-89	Irrigation	L + C	2.23												
Pierce	28N 4W 06C	7-24-89	Irrigation	L + C	8.71												
Pierce	28N 4W 13BB	8-18-80	Irrigation	C	1.65												
Pierce	28N 4W 18AO	7-24-89	Irrigation	L + C	6.61												
Pierce	28N 4W 22D	7-26-89	Irrigation	L + C	4.14												
Pierce	28N 4W 24B	7-25-90	Irrigation	L + C	0.14												
Pierce	28N 4W 26DO	10-9-80	Irrigation	C													
Pierce	28N 4W 28C	7-26-89	Irrigation	L + C	12.81												

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Pierce	28N 4W 29DCB	9-30-80	Irrigation	C	7.8												
Pierce	28N 4W 33CBABC	8-19-80	Irrigation	C	5.4												
Pierce	25N 1W 05C	7-15-81	Sandpit	C	1.2												
Pierce	27N 2W 21D	7-14-81	Sandpit	C	0.3												
Pierce	27N 2W 28A	7-14-81	Sandpit	C	0.3												
Pierce	27N 2W 28D	7-15-81	Sandpit	C	0.3												
Pierce	28N 2W 31D	7-14-81	Sandpit	C	0.3												
Pierce	26N 1W 17A	7-18-81	Sandpit	C	5.4												
Pierce	26N 1W 17A	7-18-81	Sandpit	C	3.3												
Pierce	26N 1W 31D	8-15-91	Stock Well	L	24												
Platte	20N 2W 34DBBD	7-28-87	Irrigation	L	4.3												
Platte	20N 3W 14ADBB	7-22-87	Irrigation	L	6.5												
Stanton	21N 3E 35DACC	7-31-87	Irrigation	L	-0.1												
Stanton	22N 1E 04DCAB	7-14-87	Irrigation	L	0.3												
Stanton	22N 2E 31CDAA	7-28-87	Irrigation	L	0.3												
Stanton	22N 3E 23BDBB	8-4-87	Irrigation	L	0.2												
Stanton	23N 3E 25CO	7-31-87	Irrigation	L	1.1												
Stanton	24N 2E 36A	7-19-90	Irrigation	L	1.4												
Stanton	24N 3E 19BABD	8-1-87	Irrigation	L	2.4												
Stanton	24N 3E 25DAD	8-1-87	Irrigation	L	1.8												
Thurston	26N 5E 04DABD	8-10-87	Irrigation	L	1.2												
Thurston	26N 5E 2BC	8-18-88	Irrigation	L	-0.1												
Wayne	25N 1E 30CBO	8-1-87	Irrigation	L	7.8	7-15-88	L	8.7									
Wayne	25N 4E 23BDB	8-7-87	Irrigation	L	-0.1												
Wayne	26N 1E 18CAA	7-22-87	Irrigation	L	1												
Wayne	26N 5E 29DADB	8-4-87	Irrigation	L	1.1												
Wayne	27N 3E 10CACC	6-29-88	Irrigation	L	4.7												

L = Lower Elkhorn NRD; C = University of Nebraska Conservation and Survey Division
Nitrate values reported as milligrams per liter nitrate-nitrogen.

YEAR	SAMPLE IDENTIFICATION	QUARTER	SECTION	TOWNSHIP	RANGE	COUNTY	NITRATE-NITROGEN mg/L
87	3899	SW	27	21N	09E	Burt	1
87	3905	NW	13	21N	10E	Burt	16
87	3895	NW	16	23N	08E	Burt	1
87	3896	SE	22	23N	08E	Burt	39
87	3902	SW	29	23N	09E	Burt	0.1
87	3839	SW	26	28N	01E	Cedar	2
87	3840	SE	18	28N	02E	Cedar	9
87	3838	NE	21	28N	03W	Cedar	2
87	3837	SE	20	29N	03E	Cedar	58
87	3880	SE	14	18N	02E	Colfax	0.1
87	3868	SW	13	18N	03E	Colfax	6
87	3846	SW	10	19N	03E	Colfax	0.1
87	3920	NE	23	19N	04E	Colfax	0.1
87	3841	NW	28	19N	04E	Colfax	3
87	3865	SE	29	20N	03E	Colfax	12
87	3867	NE	33	20N	03E	Colfax	16
87	3866	SE	29	20N	04E	Colfax	78
87	3871	NE	24	21N	04E	Cuming	23
87	3870	NE	35	21N	04E	Cuming	1
87	3879	NE	14	21N	06E	Cuming	30
87	3890	SE	20	21N	06E	Cuming	1
87	3875	SE	31	21N	06E	Cuming	12
87	3878	NE	12	21N	07E	Cuming	24
87	3891	SW	3	22N	04E	Cuming	6.1
87	3869	SW	21	22N	04E	Cuming	4
87	3892	NE	1	22N	05E	Cuming	0.1
87	3874	NE	24	22N	05E	Cuming	0.7
87	3872	NW	34	22N	06E	Cuming	0.1
87	3876	NW	15	22N	07E	Cuming	18
87	7741	NE	21	23N	05E	Cuming	12
87	7742	NW	23	23N	07E	Cuming	1
87	3877	NE	24	23N	07E	Cuming	4
87	3881	SE	11	24N	04E	Cuming	56
87	7740	SW	21	24N	05E	Cuming	4
87	3861	SE	30	27N	05E	Dixon	0.1
87	3847	SE	19	27N	06E	Dixon	8
87	3848	SW	21	27N	06E	Dixon	43
87	3906	SE	7	18N	07E	Dodge	0.1
87	3908	SE	14	18N	07E	Dodge	0.1
87	3913	SW	19	18N	09E	Dodge	19
87	7726	NE	34	19N	05E	Dodge	0.1
87	3922	NE	6	19N	06E	Dodge	0.1
87	3921	NE	12	19N	06E	Dodge	2
87	3929	SE	9	19N	07E	Dodge	0.1
87	3919	NE	26	19N	08E	Dodge	0.1

YEAR	SAMPLE IDENTIFICATION	QUARTER	SECTION	TOWNSHIP	RANGE	COUNTY	NITRATE-NITROGEN mg/L
87	3935	NE	21	20N	05E	Dodge	3
87	7725	NW	10	20N	07E	Dodge	0.1
87	3762	NE	2	29N	02W	Knox	1.3
87	3763	SE	6	29N	02W	Knox	7.8
87	7717	SE	9	29N	03W	Knox	36
87	3759	SE	26	29N	03W	Knox	0.1
87	3758	NW	27	29N	03W	Knox	0.1
87	3772	NW	26	29N	04W	Knox	15
87	3783	NE	28	30N	02W	Knox	0.2
88	3985	SW	5	22N	01W	Madison	0.1
88	4027	NW	17	22N	02W	Madison	16
88	4214	NW	29	22N	02W	Madison	1
88	4003	SW	29	22N	02W	Madison	2
88	3979	SE	21	22N	03W	Madison	2
88	3983	NE	5	23N	01W	Madison	0.1
88	3984	SE	14	23N	01W	Madison	1
88	4215	SE	14	23N	01W	Madison	37
88	4216	NE	23	23N	01W	Madison	0.3
88	3982	SE	28	23N	01W	Madison	0.1
88	3986	SE	9	23N	02W	Madison	0.1
88	3990	NE	30	23N	03W	Madison	2
88	3993	SE	2	23N	04W	Madison	14
88	4221	SW	8	23N	04W	Madison	5.3
88	4213	SW	12	23N	04W	Madison	0.8
88	3992	NW	24	23N	04W	Madison	0.7
88	3978	SW	35	23N	04W	Madison	1
88	3998	NW	30	24N	01W	Madison	0.1
88	4217	SE	36	24N	01W	Madison	0.1
88	4218	SE	2	24N	02W	Madison	5.4
88	4219	NW	7	24N	02W	Madison	3.2
88	3989	SW	21	24N	02W	Madison	0.1
88	3997	NE	28	24N	02W	Madison	1
88	3995	SW	24	24N	03W	Madison	0.1
88	3994	NE	29	24N	03W	Madison	0.1
87	7729	SE	33	25N	01E	Pierce	0.1
87	3844	SW	15	26N	01W	Pierce	8
87	3829	NW	26	26N	01W	Pierce	6
87	3831	NE	30	26N	01W	Pierce	10
87	3830	SW	14	26N	03W	Pierce	6
87	3827	SW	21	26N	03W	Pierce	1
87	3832	NE	22	26N	03W	Pierce	0.1
87	7730	SW	29	26N	03W	Pierce	5
87	3824	NW	5	27N	01W	Pierce	0.3
87	3845	NE	9	27N	01W	Pierce	8.2
87	3825	NE	27	27N	01W	Pierce	17
87	3835	NW	35	27N	02W	Pierce	6

YEAR	SAMPLE IDENTIFICATION	QUARTER	SECTION	TOWNSHIP	RANGE	COUNTY	NITRATE-NITROGEN mg/L
87	7731	NW	27	27N	04W	Pierce	8
87	3834	NE	9	28N	02W	Pierce	4
87	7732	SE	25	28N	03W	Pierce	7
88	4183	SW	5	20N	01E	Platte	5.2
88	4002	NE	4	20N	01W	Platte	0.1
88	4022	NW	9	20N	01W	Platte	4.1
88	4000	SE	11	20N	01W	Platte	4
88	4001	NE	14	20N	01W	Platte	47
88	4031	NW	21	20N	01W	Platte	28
88	4182	NE	24	20N	01W	Platte	0.1
88	4009	SW	30	20N	01W	Platte	0.1
88	4023	NE	31	20N	01W	Platte	26
88	4030	SW	13	20N	02W	Platte	9
88	4032	SE	15	20N	02W	Platte	13
88	4184	NE	20	20N	02W	Platte	2
87	3940	NW	28	21N	01E	Stanton	0.1
87	3944	SW	24	21N	02E	Stanton	7
87	3941	NW	10	21N	03E	Stanton	11
87	3943	SW	28	21N	03E	Stanton	24
87	3924	NW	33	21N	03E	Stanton	58
87	3945	SW	35	22N	03E	Stanton	24
87	3937	SE	26	23N	02E	Stanton	0.6
87	3946	NE	33	23N	02E	Stanton	2
87	7733	NE	18	24N	01E	Stanton	4
87	3938	NW	8	24N	02E	Stanton	21
87	3862	SE	9	25N	01E	Wayne	2.7
87	3863	SE	15	25N	01E	Wayne	22
87	3864	NE	32	25N	01E	Wayne	0.1
87	3857	NW	16	25N	02E	Wayne	16
87	3855	NE	22	25N	03E	Wayne	0.1
87	7734	SW	29	25N	03E	Wayne	66
87	3854	NE	4	25N	05E	Wayne	0.4
87	3860	SE	21	26N	01E	Wayne	6
87	3850	NW	18	26N	02E	Wayne	0.1
87	3858	SE	30	26N	02E	Wayne	0.1
87	3882	SE	9	26N	04E	Wayne	0.2
87	3851	NE	35	26N	04E	Wayne	1
87	3853	SW	6	26N	05E	Wayne	0.1
87	3852	SW	27	26N	05E	Wayne	4
87	7728	NW	18	27N	03E	Wayne	2
87	3856	NW	30	27N	03E	Wayne	0.1

ILE: LELKNRD CUM-86 * STATE OF NEBRASKA VM/CMS TIMESHARING

OG NO. 156-9527 DATE COLLECTED 08-20-86 DATE RECEIVED 08-20-86
E NO. 196-9001 27N1W3AACC G17417
R I-1 among first sampled

LATILE ORGANICS DATE ANALYZED 08-28-86

INYL CHLORIDE	<MDL	1,1,1-TRICHLOROETHANE	<MDL
HLOROMETHANE	<MDL	CARBON TETRACHLORIDE	<MDL
ROMOMETHANE	<MDL	1,2-DICHLOROPROPANE	<MDL
HLOROETHANE	<MDL	TRICHLOROETHENE	<MDL
ETHYLENE CHLORIDE	<MDL	1,1,2-TRICHLOROETHANE	<MDL
HLOROFORM	<MDL	1,1,1,2-TETRACHLOROETHANE	<MDL
RANS-1,3-DICHLOROPROPENE	<MDL	TETRACHLOROETHENE	<MDL
IS-1,3-DICHLOROPROPENE	<MDL	1,1,2,2-TETRACHLOROETHANE	<MDL
ROMODICHLOROMETHANE	<MDL	CHLOROBENZENE	<MDL
IBROMOCHLOROMETHANE	<MDL	BENZENE	<MDL
ROMOFORM	<MDL	TOLUENE	<MDL
,1-DICHLOROETHENE	<MDL	ETHYLBENZENE	<MDL
,1-DICHLOROETHANE	<MDL	1,2-DIBROMOETHANE	<MDL
IS-1,2-DICHLOROETHENE	<MDL	1,3-DICHLOROBENZENE	<MDL
RANS-1,2-DICHLOROETHENE	<MDL	1,2-DICHLOROBENZENE	<MDL
,2-DICHLOROETHANE	<MDL	1,4-DICHLOROBENZENE	<MDL

COMMENTS ______________________________

RGANOCHLORINE PESTICIDES DATE ENTERED 08-26-86 DATE COMPLETED 09-02-86

LDRIN	<MDL	ENDRIN	<MDL
LPHA-BHC	<MDL	ENDRIN ALDEHYDE	<MDL
ETA-BHC	<MDL	HEPTACHLOR	<MDL
ELTA-BHC	<MDL	HEPTACHLOR EPOXIDE	<MDL
AMMA-BHC	<MDL	TOXAPHENE	<MDL
HLORDANE	<MDL		
,4'-DDD	<MDL		
,4'-DDE	<MDL		
,4'-DDT	<MDL		
IELDRIN	<MDL		
NDOSULFAN I	<MDL		
NDOSULFAN II	<MDL		
NDOSULFAN SULFATE	<MDL		

OMMENTS______________________________

MDL LESS THAN METHOD DETECTION LIMIT
NOT DETECTED.NO MDL ESTABLISHED

0 08-23-86 DATE REPORTED 10-10-86

NITROGEN/PHOSPHORUS PESTICIDES

DATE EXTRACTED 08-26-86
DATE ANALYZED 08-27-86

<MDL	CYANAZINE	<MDL
<MDL	PARATHION	<MDL
<MDL	TRIFLURALIN	<MDL
<MDL	ALACHLOR	<MDL
<MDL	CHLOROPYRIFOS	<MDL
<MDL	ATRAZINE	<MDL
<MDL	METOLACHLOR	<MDL
<MDL	DYPHONATE	<MDL
<MDL	METAPHOS	<MDL
<MDL	METRIBUZIN	<MDL
<MDL	TERBUFOS	<MDL
<MDL	CARBOFURAN	<MDL
<MDL	CARBARYL	<MDL
<MDL	PHORATE	ND*
<MDL	BUTYLATE	ND*
<MDL		

COMMENTS

ETED 09-02-86 NITRATE ANALYSIS LOG NO. 156-6765

DATE ANALYZED 08-23-86

<MDL
<MDL
<MDL

7.3 MG/L (N)

<MDL
<MDL

INFORMATION:
OCATION: ??
COLLECTED BY: SKIP KAHLER
CITY: ???

LAB #: 150-90827
DATE COLLECTED: 08-16-90
TIME COLLECTED: 99:99
DATE RECEIVED: 08-17-90
TEST COMPLETED: 08-21-90

ILE ORGANICS DETECTABLE BY EPA METHOD 502.2 TEST TYPE: 9803

L TEST RESULTS REPORTED IN PARTS PER BILLION (PPB OR UG/L)

ENZENE	LTMDL	PARA-DICHLOROBENZENE	LTMDL
INYL CHLORIDE	LTMDL	1,1-DICHLOROETHYLENE	LTMDL
,2-DICHLOROETHANE	LTMDL	1,1,1-TRICHLOROETHANE	LTMDL
RICHLOROETHYLENE	LTMDL	CARBON TETRACHLORIDE	LTMDL
ROMOBENZENE	LTMDL	1,1-DICHLOROETHANE	LTMDL
THYLBENZENE	LTMDL	1,1-DICHLOROPROPENE	LTMDL
ROMOFORM	LTMDL	1,2-DICHLOROPROPANE	LTMDL
ROMOMETHANE	LTMDL	1,3-DICHLOROPROPANE	LTMDL
HLOROBENZENE	LTMDL	1,3-DICHLOROPROPENE	LTMDL
TYRENE	LTMDL	2,2-DICHLOROPROPANE	LTMDL
HLOROETHANE	LTMDL	BROMODICHLOROMETHANE	LTMDL
HLOROFORM	LTMDL	CHLORODIBROMOMETHANE	LTMDL
HLOROMETHANE	LTMDL	1,1,2-TRICHLOROETHANE	LTMDL
)-CHLOROTOLUENE	LTMDL	1,1,1,2-TETRACHLOROETHANE	LTMDL
?-CHLOROTOLUENE	LTMDL	1,1,2,2-TETRACHLOROETHANE	LTMDL
IBROMOMETHANE	LTMDL	TETRACHLOROETHYLENE	LTMDL
M-DICHLOROBENZENE	LTMDL	1,2,3-TRICHLOROPROPANE	LTMDL
O-DICHLOROBENZENE	LTMDL	TOLUENE	LTMDL
P-XYLENE	LTMDL	TRANS-1,2-DICHLOROETHYLENE	LTMDL
O-XYLENE	LTMDL	CIS-1,2-DICHLOROETHYLENE	LTMDL
LENE	LTMDL	DICHLOROMETHANE	LTMDL
BROMOCHLOROMETHANE	LTMDL	N-PROPYLBENZENE	LTMDL
N-BUTYLBENZENE	LTMDL	SEC-BUTYLBENZENE	LTMDL
1,2,3-TRICHLOROBENZENE	LTMDL	DICHLORODIFLUOROMETHANE	LTMDL
TERT-BUTYLBENZENE	LTMDL	FLUOROTRICHLOROMETHANE	LTMDL
HEXACHLOROBUTADIENE	LTMDL	1,2,4-TRICHLOROBENZENE	LTMDL
ISOPROPYLBENZENE	LTMDL	1,2,4-TRIMETHYLBENZENE	LTMDL
P-ISOPROPYLTOLUENE	LTMDL	1,3,5-TRIMETHYLBENZENE	LTMDL
NAPHTHALENE	LTMDL		

NT NO TEST MADE FOR THIS COMPOUND
LTMDL LESS THAN METHOD DETECTION LIMIT
??? INDICATES NO INFORMATION SUPPLIED

COMMENTS:

LOWER ELKHORN NRD

ANALYST: SJB

BOX 1204
NORFOLK, NE 68701

LE0990-067 SAMPLER: SKIP KAHLER DATE SAMPLED 08-16-90

LOWER ELKHORN DATE RECEIVED 08-17-90

SOURCE: ?? LEGAL DESCRIP. QTR SE SEC 23 TN 20 RGE 6E CO 27

DESCRIP: ??

ORGANOCHLORINE PESTICIDES (EPA-608)

ORGANIC LAB. NO. 150-90815

DATE TESTED 08-31-90

	(UG/L)
ALDRIN	<MDL
ALPHA-BHC	<MDL
BETA-BHC	<MDL
DELTA-BHC	<MDL
GAMMA-BHC	<MDL
CHLORDANE	<MDL
4,4'-DDD	<MDL
4,4'-DDE	<MDL
4,4'-DDT	<MDL
DIELDRIN	<MDL
ENDOSULFAN I	<MDL
ENDOSULFAN II	<MDL
ENDOSULFAN SULFATE	<MDL
ENDRIN	<MDL
ENDRIN ALDEHYDE	<MDL
HEPTACHLOR	<MDL
HEPTACHLOR EPOXIDE	<MDL
METHOXYCHLOR	<MDL
TOXAPHENE	<MDL
PCB-1016	<MDL
PCB-1221	<MDL
PCB-1232	<MDL
PCB-1242	<MDL
PCB-1248	<MDL
PCB-1254	<MDL
PCB-1260	<MDL

NEBRASKA SCAN (EPA-507)

ORGANIC LAB. NO. 150-90814

DATE TESTED 09-04-90

	(UG/L)
ATRAZINE (ATREX)	<MDL
ALACHLOR (LASSO)	<MDL
TRIFLURALIN (TREFLAN)	<MDL
DYFONATE	<MDL
TERBUFOS (COUNTER)	<MDL
CYANAZINE (BLADEX)	<MDL
METHYLPARATHION	<MDL
ETHYLPARATHION	<MDL
DUAL	<MDL
METRIBUZIN (SENCOR)	<MDL
CHLORPYRIFOS (LORSBAN)	<MDL
BUTYLATE(SUTAN)	<MDL
CARBARYL(SEVIN)	<MDL
CARBOFURAN(FURADAN)	<MDL

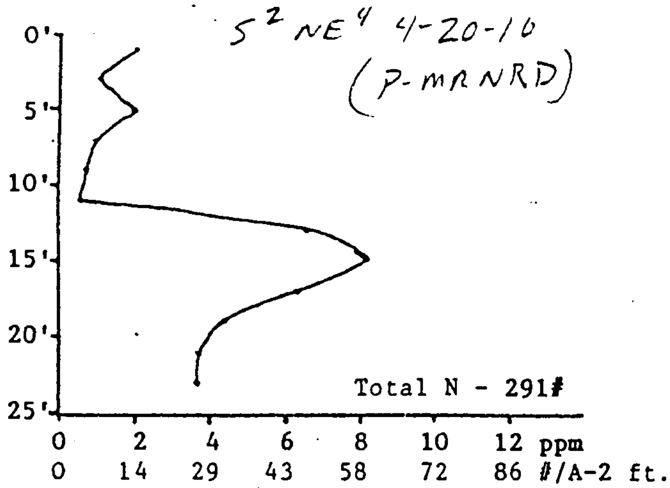
*************** EXPLANATION OF CODES ***

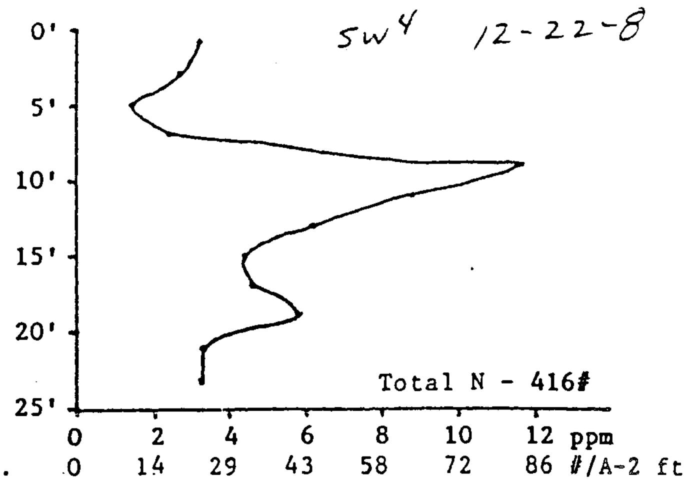
<MDL-LESS THAN METHOD DETECTION LIMIT

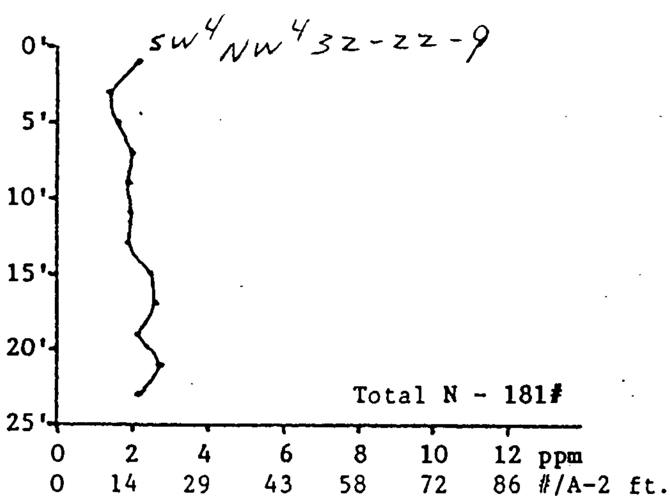
<NT -TEST NOT REQUESTED FOR THIS PARAMERER

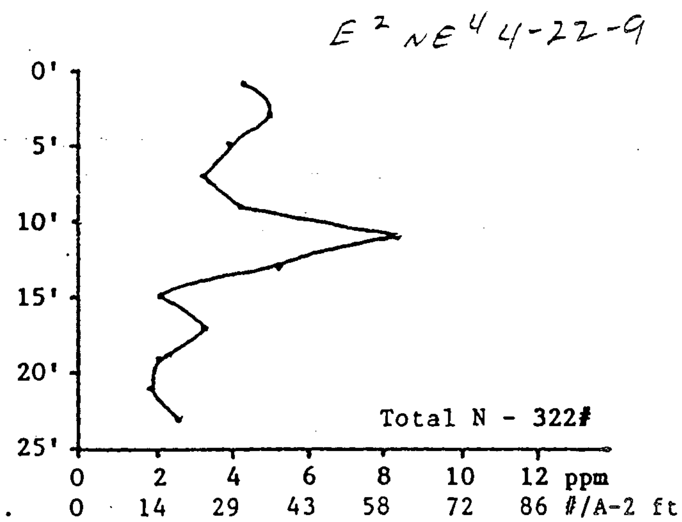
?? - NO INFORMATION GIVEN

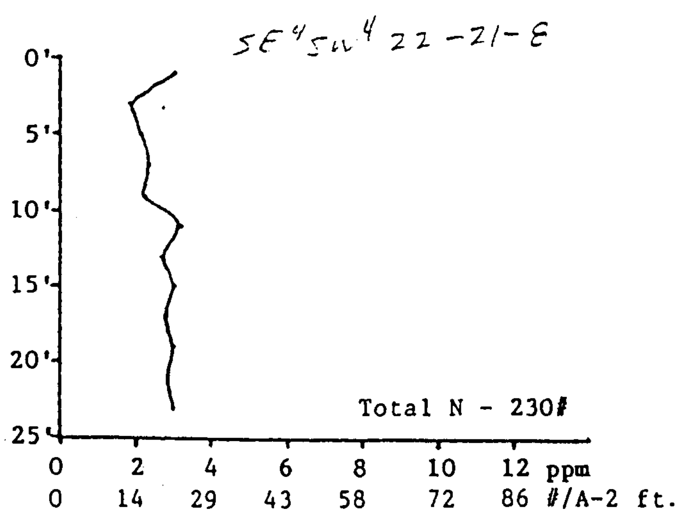
RESIDUAL NITRATE NITROGEN IN 24-FOOT SOIL PROFILES











This project measured the residual nitrogen in five Burt County fields. Soil samples were taken to a depth of 24 feet in two-foot increments and tested for residual nitrogen. The ppm of nitrate-nitrogen and estimated pounds of nitrogen per two-foot sample are shown in the graphs above. This project was conductd by the Soil Conservation Service and Cooperative Extension offices in Burt County with financial support from the Lower Elkhorn and Papio-Missouri River NRDs.

APPENDIX 5

Groundwater Management Plan Implementation

An Example from the 1993 Lower Elkhorn NRD Long Range Plan

Introduction

The Nebraska Unicameral in 1978 passed L.B. 783 (Revised Statutes of Nebraska, 1943, sections 2-3201 through 2-3261) which changed the formal planning process of natural resources districts. L.B. 783 eliminated the comprehensive "One and Six Year Plan" and established requirements for three types of planning. It outlines planning of resources development, management, utilization and conservation as one of the purposes of natural resources districts.

2-3229. "The purposes of the natural resources districts shall be to develop and execute, through the exercise of powers and authorities contained in (this act), plans, facilities, works and programs relating to:

1. erosion prevention and control,
2. prevention of damages from flood water and sediment,
3. flood prevention and control,
4. soil conservation,
5. water supply for any beneficial uses,
6. development, management, utilization, and conservation of groundwater and surface water,
7. pollution control,
8. solid waste disposal and sanitary drainage,
9. drainage improvement and channel rectification,
10. development and management of fish and wildlife habitat,
11. development and management of recreational and park facilities, and
12. forestry and range management."

2-3276. "By August 1, 1979, each natural resources district shall prepare and adopt a master plan to include but not be limited to a statement of goals and objectives for each of the purposes stated in section 2-3229. The master plan shall be reviewed and updated as often as deemed necessary by the district, but in no event less often than once each ten years."

2-3277. "Each district shall also prepare and adopt a long-range implementation plan which shall summarize planned district activities and include projections of financial, manpower, and land rights needs of the district for at least the next five years and the specific needs assessment upon which the current budget is based. Such long-range implementation plan shall be reviewed and updated annually."

2-3278. "Each district shall also prepare and adopt any individual project plans as it deems necessary to carry out projects approved by the district."

46-673.01 Groundwater management plan. Prior to January 1, 1986, each district shall prepare a groundwater management plan based upon the best available information and submit such plan to the director for review and approval.

46-673.14 Amendment of groundwater management plan. "Prior to July 1, 1993, each district shall amend its groundwater management plan to identify to the extent possible the levels and sources of groundwater contamination within the area, groundwater quality goals, long-term solutions necessary to prevent the levels of groundwater contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards, and practices recommended to stabilize, reduce, and prevent the occurrence, increase, or spread of groundwater contamination.

The Lower Elkhorn NRD Master Plan, Groundwater Management Plan and Long Range Implementation Plan include the responsibilities, policies, goals and objectives of the district based on the responsibilities assigned to the district by the legislature in section 2-3229. This Long Range Plan is **the implementation plan for all District plans.**

The "Nebraska Soil and Water Conservation Strategy" developed by the Nebraska Natural Resources Commission (NRC) is another important document that complements the Lower Elkhorn Master Plan, Groundwater Management Plan and Long Range Implementation Plan. This Strategy was developed in the mid-1980s as a cooperative effort of the Soil Conservation Service (SCS) and NRC. An Executive Committee composed of representatives from agencies with natural resources responsibilities directed the effort. This committee included the State Conservationist of SCS, a representative from the Governor's Office, the Executive Director of the Nebraska Association of Resources Districts, the Director of Cooperative Extension (UNL), the Director of Nebraska Department of Environmental Quality (DEQ), a representative from the Agricultural Conservation Program of the Agricultural Stabilization and Conservation Service (ASCS), a representative from the State Policy Research Office and the Director of Nebraska Department of Agriculture. This high degree of interaction between agencies created an identification with and a commitment to the Strategy.

The Strategy is a dynamic body of ideas, facts, agreements, and recommendations for guiding the course of future conservation activities. An update of the Strategy was published in 1990. The Action Plan is a supplement to the 1990 Update. It contains the action items identified by cooperating federal and state agencies and natural resources districts. These actions were formulated to revise, redirect or expand on activities that will fulfill the goals of the Strategy. Lower Elkhorn NRD goals and objectives are acting to meet the Strategy's goals and objective.

Information from the current Nebraska State Comprehensive Outdoor Recreation Plan (SCORP) is extremely helpful in developing a general guideline for future recreation activities for the NRD. SCORP, developed by Nebraska Game & Parks Commission, relates outdoor recreation needs of the people of the State to the resources base. Specifically, it makes recommendations for use of available federal Land and Water Conservation Fund matching grants to state and local projects.

The goal of leadership in natural resource matters can be accomplished through the cooperative preparation and review of local, state, and federal plans and programs with the overriding considerations of public welfare and the quality of living, both now and in the future. While exerting a position of leadership, the District has cooperated and worked closely with the following agencies since 1972:

City and County Governments (local)
Agricultural Research Service (state)
Natural Resources Commission (state)
Game and Parks Commission (state)
Department of Environmental Quality (state)
Department of Water Resources (state)
UNL - Conservation and Survey Division (state)
UNL - Extension Service (state)
Nebraska Forest Service (state)
Agricultural Stabilization Conservation Service - (federal)
Farmers Home Administration (federal)
U.S. Fish and Wildlife Service (federal)
Bureau of Reclamation (federal)
Corps of Engineers (federal)
U.S. Geological Survey (federal)
Soil Conservation Service (federal)
Heritage, Conservation and Recreation Service (federal)
Environmental Protection Agency (federal)

This plan was developed with close cooperation with SCS. This long range implementation plan and future plans will be developed jointly with SCS and will replace the NRD/SCS Multi-Plans that were used in the past.

The Lower Elkhorn NRD Long-Range Implementation Plan includes long range objectives and individual action items for the current fiscal year and the next five fiscal years based on the master plan responsibilities, goals and objectives.

The bulk of this plan is a breakdown of the long range objectives into specific action items, which includes the financial needs and staff time requirements for each item. Each page is first identified by the subcommittee responsible for that objective and the individual staff member responsible for carrying out the action item and then followed by the descriptions of the master plan goal, objective and action item.

The budget line item for each action item is listed under the current fiscal year "Funds" section for use during budget time. The requested dollar amount is listed along with the adopted budget figure for that item. Earlier this spring, the board members ranked each action item using the priority ranking system below. The prioritization criteria includes importance, effectiveness, annual operation cost, initial implementation cost, public acceptance and political impact.

The LENRD program objectives rankings are:

Urgent: Delay in implementation would be dangerous and/or costly. Justifies diversion of funding or other resources from other NRD programs.

Important: Action needed to reach the corresponding master plan objective. Inaction on this action item would result in a major setback in attaining the master plan objective.

Moderate: Potentially important for reaching the corresponding master plan objective.

Routine: Support services to be implemented as time permits.

Action not warranted at this time : Prioritization criteria indicates that this action item need not be accomplished at this time. However, it may gain importance in the future.

The results of the priority survey appear on the long range summary.

The following is a legend for the LENRD staff listed at the bottom of each action item sheet:

GM - General manager
AM(P) - Assistant manager, programs
AM(SP) - Assistant manager, special projects
AM(OM) - Assistant manager, operations and maintenance
WRM - Water resources manager
LERWSM - Logan East Rural Water System manager
I&E C - Information/Education coordinator
Adm. Sec. - Administrative secretary
Off. Sec. - Office secretary
Rec./Sec. - Receptionist/secretary
Main.Sup. - Maintenance superintendent
PT(field) - Part-time field technicians

The financial needs and staff time requirements are summarized by master plan goal at the end of the plan. The land rights needs are also included at the end of the implementation plan.

All NRD/USDA programs and services are available without regard to race, color, national origin, religion, sex, age, marital status or handicap.

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Lower Elkhorn NRD Board Policy

Policies are statements that set a specific course of action towards the achievement of a goal or a series of goals. Policy statements are needed both by the NRD Board and by the management staff in order to operate in a consistent manner over a given period of time. Whereas the geographic boundaries of the Natural Resources Districts have been set, policy statements can be looked upon as defining the "action" boundaries of the district. Policies facilitate the decisions of the Board and the management staff helping each to maintain continuity and assist in the development of clear thinking.

Policies may be either specific or very general. They can deal with the financial aspects of the NRD, they may be expressions of support for cooperation with other entities of government or they may be purely administrative in nature. The end objective of policies within the context of this document is to serve as a basis for developing specific plans and programs and then as a means of checking such plans and programs against policy statements.

The Board will review the Board Policies each year early in the planning process as it prepares the Long Range Implementation Plan for the upcoming year. Board Polices will be used to assist directors in selecting goals and objectives for the new Long Range Implementation Plan.

A. SOIL CONSERVATION

To attain 100 percent land treatment to control soil and wind erosion.

1. Develop and implement programs which encourage landowners to establish soil conservation practices. Modify the existing land treatment program to include participation with as many landowners as possible. This includes funding of the District's Land and Water Development Assistance Program, Wildlife Habitat Improvement Program, Small Lakes Assistance Program and the Nebraska Soil and Water Conservation Program. For further information refer to the Long Range Plan for the current fiscal year.
2. Encourage the federal and state governments to develop and fund soil conservation and water quality programs on a special project or critical area basis.
3. Encourage proper land management (Best Management Practices-BMP) and improved farming practices, such as conservation tillage, crop rotation, terracing, vegetative practices, and/or structural control, as needed, on all lands to prevent wind and water erosion of topsoil.
4. Ensure adequate permanent cover (grass and trees) on all Class VI and VII land.
5. Encourage local Soil Conservation Service personnel to develop at least one special project and/or road structure in their area each year, and to be ready should funding become available. Encourage the cooperation of county and city governments in this objective.
6. Cooperate with local units of government to implement necessary erosion control practices, as needed, on all industrial development, residential development, road construction, and other non-agricultural development sites.

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KEY TO AGENCY ABBREVIATIONS

ASCS	Agricultural Stabilization and Conservation Service
C&S	Conservation and Survey Division, UNL
Co. Bd.	County Board
Corps	U.S. Corps of Engineers
DEQ	Department of Environmental Quality
DOH	Department of Health
DOR	Department of Roads
DWR	Department of Water Resources
EPA	Environmental Protection Agency
EXT	Cooperative Extension
FWS	U.S. Fish and Wildlife Service
GPC	Game and Parks Commission
NFS	Nebraska Forest Service
NRC	Natural Resources Commission
SCS	Soil Conservation Service
USGS	U.S. Geological Survey

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Goals	Objectives	Action Items	Agency	Priority	FY '94 Start	FY '94 End	Long Range Implementation Schedule	Page
A. Conserve Soil	1. Complete 80% of remaining land treatment needs (1985 base) by 2010 and reduce soil loss on all lands to T by 2025.	A. Conservation Cost-Share program.	SCS, NRC, ASCS	Important	7/1/93	6/30/94	Ongoing	
		B. Lands for Conservation program.	SCS	Important	7/1/93	6/30/94	Ongoing	
		C. Process Erosion and Sediment Act program complaints.	SCS, NRC	Important	7/1/93	6/30/94	Ongoing	
		D. SCS/NRD Residue Management Campaign.	SCS, NEREC	Important	7/1/93	6/30/94	Ongoing	
	2. Construct or cooperate with county governments to construct 3 grade stabilization structures in place of old, dangerous bridges each year.	A. Road Structure Program.	SCS, Co. Bd., DOR	Important	7/1/93	6/30/94	Ongoing	
	3. Accelerate land treatement in specified areas to protect the land within a specified waterwshed - at least 75 percent of watershed down to T - ultimately protecting current and future LENRD water projects.	Targeted Butterfly Creek Watershed	SCS	Important/ Moderate	7/1/93	12/31/93		
	4. Utilize all land within the District for its most suitable purpose, with consideration given to conserving the resources and their continued productivity for future generations.	Provide cost-share assistance for the local cost of accomplishing a comprehensive land resource plan when federal, state, county or other sources of funds are not available to the local unit of governnment.						

Goals	Objectives	Action Items	Agency	Priority	FY '94 Start	FY '94 End	Lo ange Imple ntation Schedule	I
	5. Assist landowners and local entities of government in solving streambank erosion problems.		SCS	Routine	7/1/93	6/30/94	Ongoing	
B. Flood Control and Prevention of Damage from Flood Water and Sediment	1. Protect existing improvements from flood water.	A. Provide cost-share assistance for the local cost for the construction of Corps of Engineers flood control projects.		Moderate				
		Scribner Levee	NRC, Corps, Scribner		4/1/94	6/30/94		
		Howells Levee	Corps, NRC, Howells		4/1/94	6/30/94	1995	
		Pender Levee	SCS, Corps, Pender		4/1/94	6/30/94	1997	
	2. Utilize flood prone land for improvements not damaged by flooding.							
	3. Sponsor or cooperate on projects which include flood control benefits.	Laurel Dam	SCS, Laurel		7/1/93	6/30/94	1994	
C. Stormwater Drainage Improvements	1. To assist local units of government in correcting stormwater drainage problems.							

Goals	Objectives	Action Items	Agency	Priority	FY '94 Start	FY '94 End	Long Range Implementation Schedule	Pa
D. Conserve Groundwater Quantity and Quality	1. Monitor groundwater to detect changes, trends, or problems.	A. Groundwater Quantity Monitoring Program	USGS	Important	7/1/93	6/30/94	Ongoing	
		Osmond Observation Wells	C&S, Osmond	Moderate	7/1/93	6/30/94	Ongoing	
		B. Groundwater Quality Monitoring Program	SCS, EXT, DEQ, DOH	Important	7/1/93	6/30/94	Ongoing	
		Bazile Triangle Project	SCS, EXT, ASCS	Important	7/1/93	6/30/94	Ongoing	
	2. Improve groundwater quantity and quality conservation practices through education and information dissemination.	A. Expand adult citizen awareness of the value of groundwater: cooperate with other agencies in planning special groundwater events, programs and demonstrations; promote groundwater programs, events and publications; and demonstrate the Groundwater Flow Model.	SCS	Moderate	7/1/93	6/30/94	Ongoing	
		B. Develop an awareness in school children of the value of groundwater: cooperate with other agencies in planning special groundwater events, programs and demonstrations for school children; promote and distribute publications to help develop groundwater awareness; and promote groundwater demonstrations, literature and events.	SCS, EXT	Moderate	7/1/93	6/30/94	Ongoing	
		C. Develop a summary brochure of the NRD's Groundwater Management Plan.		Routine	10/1/93	1/31/94	1994	

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Goals	Objectives	Action Items	Agency	Priority	FY '94 Start	FY '94 End	Long Range Implementation Schedule	Page
	3. Assist agricultural producers in irrigation and agrichemical usage.	A. Deep Soil Sampling Program.	SCS, EXT	Important	7/1/93	6/30/94	Ongoing	
		B. Groundwater Quality Monitoring Program.		Important	7/1/93	6/30/94	Ongoing	
		C. LENRD/Extension Fertilizer management demonstrations.	NEREC	Moderate	7/1/93	6/30/94	Ongoing	
	4. Protect municipal and domestic groundwater supplies.	A. Well Sealing Program.	SCS	Important	7/1/93	12/1/93	Ongoing	
		B. Plan for rural water system development.		Moderate	7/1/93	6/30/94	Ongoing	
		Logan East Rural Water System Administration	LERWS, FmHA, DOH, NRWA	Important	7/1/93	6/30/94	Ongoing	
		C. Administer the Nebraska Chemigation Act Program.	DEQ	Important	7/1/93	6/30/94	Ongoing	
		D. Initiate actions when groundwater contamination reaches the groundwater quantity trigger levels.		Important/ Moderate	7/1/93	6/30/94	Ongoing	
		E. Initiate actions when groundwater contamination reaches the groundwater quality trigger levels.	SCS, EXT, USGS, C&S	Urgent/ Important	7/1/93	6/30/94	Ongoing	

OATT

R. Seymour

Equipment and Watershed Subcommittee

Goal: B. Flood Control and Prevention of Damage from Flood Water and Sediment

Objective: Sponsor or cooperate on projects which include flood control benefits.

FY 1994 Action Item: Provide cost-share assistance for the local cost for the construction of Laurel Flood Control Project.

Funds: Requested $ 72,600 /Budgeted $ ___
(Budget line item 17)

Priority - Moderate

Year	Long Range Objectives	Total Program Costs
FY '95	None	$ 0.00
FY '96	None	$ 0.00
FY '97	None	$ 0.00
FY '98	None	$0.00
FY '99	None	$0.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)		--	--	--	--	--
AM(SP)	80			--	--	--
AM(OM)						
WRM						
LERWSM						
I&E C						
Adm. Sec.	8	--	--	--	--	--
Off. Sec.						
Rec./Sec.						

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S. Kahler

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Monitor groundwater to detect changes, trends or problems.

FY 1994 Action Item: Groundwater Quantity Monitoring Program

Funds: Requested $ 0.00/
Budgeted $ __

FY 1994 Action Items	Agency
A. Continue routine measurement of 217 wells district-wide.	NRD
B. Measure wells in special interest areas - Pierce County.	NRD

Priority - Important

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 0.00
FY '96	Continue	$ 0.00
FY '97	Continue	$ 0.00
FY '98	Continue	$ 0.00
FY '99	Continue	$ 0.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)	480	480	480	480	480	480
WRM	40	40	40	40	40	40
LERWSM						
I&E C						
Adm. Sec.	16	16	16	16	16	16
Off. Sec.	8	8	8	8	8	8
Rec./Sec.						

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S. Kahler

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Monitor groundwater to detect changes, trends or problems.

FY 1994 Action Item: Osmond Observation Wells

Funds: Requested $ 0.00 /
Budgeted $__
(Budget line items 1 & 35)

Priority - Moderate

FY 1994 Action Items	Agency
A. Perform routine groundwater elevation meaurements of 20 wells in July, August, Sept., Oct., April, May & June.	NRD
B. Collect samples for nitrate-nitrogen analysis in spring (10 shallow wells and 10 deep wells.)	NRD

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$625.00
FY '96	Continue	$625.00
FY '97	Continue	$625.00
FY '98	Continue	$625.00
FY '99	Continue	$625.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)	56	56	56	56	56	56
WRM	40	40	40	40	40	40
LERWSM						
I&E C.						
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Monitor groundwater to detect changes, trends or problems.

FY 1994 Action Item: Bazile Triangle Project

Funds: Requested $0.00/
Budgeted $0

FY 1994 Action Items	Agency
A. Participate in Bazile Triangle steering committee.	NRD, SCS EXT

Priority - Important

Year	Long Range Objectives	Total Program Costs
FY '95		
FY '96		
FY '97		
FY '98		
FY '99		

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)						
WRM	8	--	--	--	--	--
LERWSM						
I&E C	8	--	--	--	--	--
Adm. Sec.						
Off. Sec.						
Rec./Sec.	5					

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Monitor groundwater to detect changes, trends or problems.

FY 1994 Action Item: Groundwater Quality Monitoring Program

Funds: Requested $ 7,500.00
Budgeted $___
(Budget line items 1 & 35)

Priority - Important

FY 1994 Action Items	Agency
A. Meet with local Food and Agricultural Councils, officials, City and Village Officials to discuss water quality problems and possible USDA action to help solve local problems. One meeting per county.	NRD, SCS
B. Assist NRD to develop and NRD/SCS Water Strategy.	NRD, SCS
C. Participate as a member of the LERND's Groundwater Management Steering Committee and provide technical assistance, if needed.	SCS
D. Provide nitrate testing services for domestic wells in the SCS field offices.	NRD
E. Provide nitrate testing for 300 producers at Expos and County Fairs.	NRD, SCS EXT
F. Perform specialized monitoring throughout the District (especially in Pierce and Dodge Counties.)	NRD
G. Prepare for routine monitoring.	NRD, SCS

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$10,500.00
FY '96	Continue	$10,500.00
FY '97	Continue	$10,500.00
FY '98	Continue	$10,500.00
FY '99	Continue	$10,500.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)	360	360	360	360	360	360
WRM	120	80	80	80	80	80
LERWSM						
I&E C						
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

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L. Gilmore

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Improve groundwater quantity and quality conservation practices through education and information dissemination.

FY 1994 Action Item: Expand adult citizen awareness of the value of groundwater: cooperate with other agencies in planning special groundwater events, programs and demonstrations; promote groundwater programs, events and publications; and demonstrate the Groundwater Flow Model.

Funds: Requested $ 500.00
Budgeted $____
(Budget line item 9)

Priority - Moderate

FY 1994 Action Items	Agency
A. Provide technical assistance to producers who operate farms in areas where known groundwater pollution occurs as directed by the District's Groundwater Management Plan.	NRD, SCS
B. Write one news release per county and broadcast 5 radio programs that deal with the need for producers to seal abandoned wells and promote deep soil testing for nitrates.	SCS
C. Write news releases, PSAs and newsletter articles on groundwater quantity and quality issues.	NRD
D. On request, serve as resource person/speaker for clubs organizations on water issues.	NRD
E. Groundwater Flow Model demonstrations.	NRD

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 500.00
FY '96	Continue	$ 500.00
FY '97	Continue	$ 550.00
FY '98	Continue	$ 625.00
FY '99	Continue	$ 675.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)						
WRM	72	72	72	72	72	72
LERWSM						
I &E C	150	150	150	150	150	150
Adm. Sec.						
Off. Sec.						
Rec./Sec.	4	4	4	4	4	4

L. Gilmore

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Improve groundwater quantity and quality conservation practices through education and information.

FY 1994 Action Item: Develop an awareness in school children of the value of groundwater: cooperate with other agencies in planning special groundwater events, programs and demonstrations; promote and distribute publications to help develop groundwater awareness; and promote groundwater demonstrations literature and events.

Funds: Requested $ 1,250.00
Budgeted $
(Budget line item 9)

Priority - Moderate

FY 1994 Action Items	Agency
A. Participate in the following activities: Wonderful World of Water (NRD-wide) and Aquafest (Wayne State College).	NRD, SCS EXT
B. Serve on Aqua Fest planning committee and help fund.	NRD
C. Help coordinate and promote Wonderful World of Water for high school students.	NRD
D. Assist with Spring Conservation Sensation. (Dodge Co.)	NRD, SCS
E. Assist with Water Riches Celebration. (Colfax & Platte Co.)	NRD
F. Groundwater Flow Model Demonstrations.	NRD
G. Participate in Children's Groundwater Festival.	NRD
H. Promote all water education programs to schools & youth organizations.	NRD

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 1,300.00
FY '96	Continue	$ 1,300.00
FY '97	Continue	$ 1,375.00
FY '98	Continue	$ 1,425.00
FY '99	Continue	$ 1,450.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)	8	8	8	8	8	8
AM(SP)						
AM(OM)						
WRM	104	104	104	100	100	100
LERWSM						
I &E C	326	326	320	320	320	320
Adm. Sec.						
Off. Sec.						
Rec./Sec.	8	8	8	8	8	8

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L. Gilmore

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Improve groundwater quantity and quality conservation practices through education and information dissemination.

FY 1994 Action Item: Develop a summary brochure of the LENRD Groundwater Management Plan.

Funds: Requested $ 100.00/Budgeted $ __
(Budget line item 9)

Priority - Routine

Year	Long Range Objectives	Total Program Costs
FY '95	Update Groundwater Management Plan brochure	$100.00
FY '96	Continue	$100.00
FY '97	Continue	$100.00
FY '98	Continue	$100.00
FY '99	Continue	$100.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)						
WRM	8	8	8	8	8	8
LERWSM						
I &E C	32	8	8	8	8	8
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

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K. Berney

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Assist agricultural producers in irrigation and agrichemical usage.

FY 1994 Action Item: Deep Soil Sampling Program

Funds: Requested $ 15,000
Budgeted $
(Budget line item 35)

Priority - Important

FY 1994 Action Items	Agency
A. Manage and promote deep soil sampling program.	NRD
B. Write one news article or radio program that deals the need for producers to use deep soil sampling.	SCS
C. Provide technical assistance to producers who operate farms in areas where known groundwater pollution occurs as directed by the District's Groundwater Management Plan.	SCS
D. Publicize the NRD's Deep Soil Sampling Program by writing news articles, conducting radio interviews and including explanations in the ASCS newsletter. (2 per county)	SCS
E. Contact local fertilizer dealers to explain details of the District's Deep Soil Sampling Program and encourage deep sampling for all customers.	SCS
F. Contact 200-300 producers District-wide by letter or contacts to encourage participation in the Deep Soil Sampling program (100 signups).	SCS
G. Promote proper fertilizer application and irrigation water management in the Bazile Triangle (Knox and Pierce counties), 4 news articles and 100 personal contacts.	SCS

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$20,000.00
FY '96	Continue	$20,000.00
FY '97	Continue	$20,000.00
FY '98	Continue	$20,000.00
FY '99	Continue	$20,000.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)	80	80	80	80	80	80
AM(SP)						
AM(OM)						
WRM						
LERWSM						
I&E C						
Adm. Sec.						
Off. Sec.	75	75	75	75	75	75
Rec./Sec.						

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Assist agricultural producers in irrigation and agrichemical usage.

FY 1994 Action Item: LENRD/Extension Nitrogen management demonstration plots.

Funds: Requested $ 7,250/
Budgeted $______
(Budget line item 35)

Priority - Moderate

FY 1994 Action Items	Agency
A. Coordinate and conduct tours of demonstration plots.	NRD, NEREC
B. Conduct short course on planning and conducting demonstrations for 10 individual producers.	NRD, NEREC
C. Summarize 6 years of demonstration data in brochure.	NRD, NEREC

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 6,850.00
FY '96	Continue	$ 6,850.00
FY '97	Continue	$ 6,850.00
FY '98	Continue	$ 7,450.00
FY '99	Continue	$ 7,450.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)	2	2	2	2	2	2
AM(SP)						
AM(OM)						
WRM	20	20	20	20	20	20
LERWSM						
I&E C	48	48	48	48	48	48
Adm. Sec.						
Off. Sec.						
Rec./Sec.	4	4	4	4	4	4

DRAFT

K. Berney

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality.

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Well Sealing Program

Funds: Requested $25,000
Budgeted $___
(Budget line item 35)

Priority - Important

FY 1994 Action Items	Agency
A. Contact 300-400 producers by letters or personal contacts to promote the Well Abandonment Program with a goal of signing up 200 participants.	SCS
B. Promote well sealing program through news releases, PSAs and a brochure.	NRD

Year	Long Range Objectives	Total Program Costs
FY '95	Continue at reduced cost-share rates	$20,000.00
FY '96	Continue	$20,000.00
FY '97	Continue	$20,000.00
FY '98	Continue	$20,000.00
FY '99	Continue	$20,000.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)	80	80	60	60	60	60
AM(SP)						
AM(OM)						
WRM	80	80	80	80	80	80
LERWSM						
I&E C	24	24	24	24	24	24
Adm. Sec.	24	24	24	24	24	24
Off. Sec.	24	24	24	24	24	24
Rec./Sec.	10	10	10	10	10	10

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Plan for rural water system development by identifying potential groundwater sources that can be preserved with protection areas.

Funds: Requested $ 0.00/Budgeted $ 0

Priority - Moderate

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 0.00
FY '96	Continue	$ 0.00
FY '97	Continue	$ 0.00
FY '98	Continue	$ 0.00
FY '99	Continue	$ 0.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM	8	8	8	8	8	8
AM(P)						
AM(SP)	8	8	8	8	8	8
AM(OM)	8	8	8	8	8	8
WRM	16	16	16	16	16	16
LERWSM						
I &E C						
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

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DRAFT

R. Seymour

Budget, Legislative and Education Subcommittee

Goal: Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Logan East Rural Water System.

Funds: Requested $ 40,000.00/
Budgeted $0
(Budget line item 17)

Priority - Important

FY 1994 Action Items	Agency
A. Plan for Phase IV expansion into Burt & Washington counties.	NRD
B. File loan and grant applications to Farmers Home Adm. for Phase IV expansion.	NRD
C. Obtain needed easements for construction.	NRD
D. Possible construction to begin for Phase IV.	NRD

Year	Long Range Objectives	Total Program Costs
FY '95	Operation and Maintenance	(Costs to be budgeted by Logan East Rural Water System.)
FY '96	Operation and Maintenance	
FY '97	Operation and Maintenance	
FY '98	Operation and Maintenance	
FY '99	Operation and Maintenance	

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM	100	100	100	100	100	100
AM(P)						
AM(SP)	520	260	260	100	100	100
AM(OM)	16	16	16	16	16	16
WRM	40	40	40	40	40	40
LERWSM	2900	2900	2900	2900	2900	2900
I&E C.	8	--	--	--	--	
Adm. Sec.	24	24	24	24	24	24
Off. Sec.	1130	1130	1130	1130	1130	1130
Rec./Sec.	20	20	20	20	20	20
PT(field)	1500	1000	--	--	--	--

8/93

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Administer the Nebraska Chemigation Act Program.

Funds: Requested $ 10,000/Budgeted $___
(Budget line item 35)

Priority - Important

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 10,000.00
FY '96	Continue	$ 10,000.00
FY '97	Continue	$ 10,000.00
FY '98	Continue	$ 10,000.00
FY '99	Continue	$ 10,000.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)						
WRM	80	80	80	80	80	80
LERWSM						
I&E C						
Adm. Sec.	320	320	320	320	320	320
Off. Sec.	5	5	5	5	5	5
Rec./Sec.	30	30	30	30	30	30

8/93

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Objectives: Initiate actions when groundwater contamination reaches the groundwater quantity trigger levels.

Funds: Requested $ 0.00/Budgeted $ ___
(Budget line item 35)

Priority - Important/Moderate

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 0.00
FY '96	Continue	$ 0.00
FY '97	Continue	$ 0.00
FY '98	Continue	$ 0.00
FY '99	Continue	$ 0.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)						
WRM	4	4	4	4	4	4
LERWSM						
I&E C.						
Adm. Sec.	2	2	2	2	2	2
Off. Sec.						
Rec./Sec.						

8/93

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Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Initiate actions when groundwater contamination reaches the groundwater quality trigger levels - Groundwater Quality Management Area.

Funds: Requested $ 20,000.00/
Budgeted $_
(Budget Line Item 35)

Priority - Urgent/Important

FY 1994 Action Items	Agency
A. Meet with farm and community groups.	NRD/SCS/EXT
B. Meet with citizen advisory committee.	NRD/SCS/EXT
C. Meet with technical advisory committee.	NRD/SCS/EXT
D. Hold 5 public meetings.	NRD/SCS/EXT
E. Determine the total amount of groundwater withdrawal.	NRD/USGS UNL C&S
F. Develop rules and regulations; controls and phases.	NRD

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 20,000.00
FY '96	Continue	$ 20,000.00
FY '97	Continue	$ 20,000.00
FY '98	Continue	$ 20,000.00
FY '99	Continue	$ 20,000.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)						
AM(SP)						
AM(OM)						
WRM	1200	1200	1200	1200	1200	1200
LERWSM						
I &E C	40	40	40	40	40	40
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

DRAFT

K. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Assist municipalities in plannning new supply facilities and protecting existing supplies and wellhead protection areas through a Wellhead Protection Program. (Including Logan East Rural Water System.)

Funds: Requested $ 20,000
/Budgeted $____
(Budget line item 35)

Priority - Important

FY 1994 Action Items	Agency
A. Meet with Logan East RWS advisory committee to formWell Head Protection planning team.	NRD
B. Meet with land owners and develop BMP programs.	NRD,SCS EXT
C. Develop Well Head Protection plan.	NRD,SCS EXT
D. Develop a brochure for and publicize NRD Well Head Protection program. (district-wide)	NRD
E. Identify towns with nitrate problems through information provided by the NE Health Dept, local FAC committees, etc.	NRD, SCS
F. Request from Conservation and Survey Division a detailed map of the recharge area of towns afflicted with groundwater pollution problems.	NRD
G. Encourage local communities and eligible landowners to enroll in the Wellhead Protection Option of the Conservation Reserve Program through personal contacts.	NRD, SCS

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 10,000.00
FY '96	Continue	$ 10,000.00
FY '97	Continue	$ 10,000.00
FY '98	Continue	$ 10,000.00
FY '99	Continue	$ 10,000.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM	8	8	8	8	8	8
AM(P)						
AM(SP)						
AM(OM)	20	20	20	20	20	20
WRM	40	40	40	16	16	16
LERWSM						
I &E C	8	8	8	8	8	8
Adm. Sec.						
Off. Sec.	32	32	32	32	32	32
Rec./Sec.	4	4	4	4	4	4

8/93

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R. Wozniak

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Protect municipal and domestic groundwater supplies.

FY 1994 Action Item: Mediate pumping conflicts.

Funds: Requested $ 0.00/ Budgeted $ 0

Priority - Routine

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 0.00
FY '96	Continue	$ 0.00
FY '97	Continue	$ 0.00
FY '98	Continue	$ 0.00
FY '99	Continue	$ 0.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM	8	8	8	8	8	8
AM(P)						
AM(SP)						
AM(OM)						
WRM	8	8	8	8	8	8
LERWSM						
I &E C						
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

8/93

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R. Wozniak

Planning and Programming Subcommittee

Goal: D. Conserve Groundwater Quantity and Quality

Objective: Increase our general knowledge of the hydrogeologic characteristics of the district.

FY 1994 Action Item: Develop a program of vadose zone monitoring to determine nitrogen concentrations in the soil between the root zone and the water table.

Funds: Requested $ 6,000
Budgeted $____
(Budget line item 35)

Priority - Important/Moderate

FY 1994 Action Items	Agency
A. Continue the vadose zone sampling done in Burt County. (5 plots)	NRD, SCS, EXT
B. Expand the use of Vadose Zone Sampling with the SCS probe truck into areas suggested by the District's Water Resources Manager.	NRD, SCS, EXT

Year	Long Range Objectives	Total Program Costs
FY '95	Continue	$ 3,000.00
FY '96	Continue	$ 3,000.00
FY '97	Continue	$ 2,000.00
FY '98	Continue	$ 2,000.00
FY '99	Continue	$ 2,000.00

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM						
AM(P)	8	8	8	8	8	8
AM(SP)						
AM(OM)						
WRM	40	40	40	40	40	40
LERWSM						
I&E C						
Adm. Sec.						
Off. Sec.						
Rec./Sec.						

R. Wozniak

Planning and Programming Subcommittee

Goal: E. Develop and Manage Surface Water

Objective: Develop surface water projects consistent with local desires for flood control, recreation, conservation irrigation, water supplies, and wildlife protection.

FY 1994 Action Item: Continue Phase II of Clean Lakes Project for Willow Creek and Maskenthine Lakes. Design and begin work on shoreline stabilization and sediment trap for Maskenthine Lake. Complete study of lake elevation stabilization at Willow Creek Lake.

Funds: Requested $200,000
Budgeted $ ______

(Budget line item 17)
(EPA grant will refund $100,000 as part of Clean Lakes Phase II agreement - line item 81)

FY 1994 Action Items	Agency
A. Provide technical assistance on land treatment needs after completion of Section 319 Clean Lakes Program Phase II for the Maskenthine and Willow Creek Lake Watersheds.	SCS
B. Assist producers to design, layout and install at least 5 livestock waste facilities in the District.	SCS

Priority - Important

Year	Long Range Objective	Total Program Cost
FY '95	Sediment trap construction and sediment removal and wetlands design at Maskenthine. Lake elevation stabilization at Willow Creek.	$196,000.00 ($ 98,000.00)
FY '96	Wetland construction at Maskenthine. Lake elevation stabilization at Willow Creek.	$135,000.00 ($ 67,500.00)
FY '97	Sediment Removal - Maskenthine.	$166,000.00 ($83,333.00)
FY '98	Sediment Removal - Maskenthine	$166,000.00 ($ 83,000.00)
FY '99	Sediment Removal - Maskenthine	$166,000.00 ($ 83,000.00)

Staff Time Requirements (Manhours)

	1994	1995	1996	1997	1998	1999
GM	16	16	16	16	16	16
AM(P)	40	40	40	40	40	40
AM(SP)						
AM(OM)						
WRM	80	80	80	80	80	80
LERWSM						
I&E C	40	16	8	8	8	8
Adm. Sec.						
Off. Sec.						
Rec./Sec.	2	2	2	2	2	2

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APPENDIX 6

List of Public Water Suppliers in the Lower Elkhorn NRD

List of Laboratories Certified By the Nebraska Department of Health (1993)

List of Public Water Suppliers in the Lower Elkhorn NRD

June 2, 1992

NEBRASKA PUBLIC WATER SYSTEMS

ALPHABETICAL BY PWS NAME

Located in the Lower Elkhorn Natural Resource District

PUBLIC WATER SYSTEM NAME	ADDRESS	CITY COUNTY	ZIP	PHONE	WATER OPERATOR NAME
BANCROFT, VILLAGE OF	REX ANDERSEN	BANCROFT Cuming (NE	68004	4026487653	
BATTLE CREEK, VILLAGE OF	WATER DEPT	BATTLE CREEK Madison (N	68715	4026752165	TODD R. BESSMER
BECKER'S STEAKHOUSE	P.O. BOX 243	NORFOLK Madison (N	68701	4023792050	DENNIS BRATETIC
BEEMER, VILLAGE OF	RT. 1 BOX 42	BEEMER Cuming (NE	68716	4025283864	RUSTY COWAN
BELDEN, VILLAGE OF	BOX 143	BELDEN Cedar (NE)	68717	4029852326	KENNETH HINTZ
CAMP CROSSED ARROWS	ROUTE 1, BOX 77	NICKERSON Dodge (NE)	68044	4025648822	RANDY VESKERNA
CAMP FONTANELLE	RESIDENT MANAGER RT. 1 BOX 28	NICKERSON Dodge (NE)	68044	4024784296	PHILIP KATT
CARROLL, VILLAGE OF	306 PEARL STREET	WAYNE Wayne (NE)	68787	4025854727	MERT MARSHALL
CENTENNIAL PARK, INC.	P.O. BOX 366	LEIGH Colfax (NE	68643	4024872721	
CHAVET'S GROCERY	HIGHWAY 20	PLAINVIEW Pierce (NE	68769		REX CHAVET
CLARKSON, CITY OF		CLARKSON Colfax (NE	68629	4028923100	DEAN A. PEKNY
COLFAX CO. DISTRICT 1-R	RT 1	CLARKSON Colfax (NE	68629	4028923789	KRIS CADA
CONCORD, VILLAGE OF	BOX 14	CONCORD Dixon (NE)	68728	4025842380	VIC CARLSON

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
COUNTRY VILLAGE SUBDIV.	1303 SHERIDAN DRIVE	NORFOLK Madison (N	68701	4023712788	MIKE KEMP
CRAIG, VILLAGE OF	RUSSELL PUFFER	CRAIG Burt (NE)	68019	4023772740	
CRESTON, VILLAGE OF	BOX 143	CRESTON Platte (NE	68631	4022850217	GEORGE BIEBORDY
CUMING CO. DISTRICT # 82		PENDER Thurston (	68047	4023852592	COUNTY SUPERINTENDENT
CUMING CO. RWD #1	% ROBERT LUNDEEN BOX 151	BEEMER Cuming (NE	68716	4025283405	CUMING CO. RWD # 1
DEAD TIMBER STATE REC AREA	ATTN - TOM HOLMES RURAL ROUTE 2, BOX 233A	SCRIBNER Dodge (NE)	68057		NE GAME AND PARKS COMMIS
DIXON, VILLAGE OF	BOX 84	DIXON Dixon (NE)	68732	4025842361	LAVERN STRIVEN
DODGE CO. DISTRICT # 19	ANN HEIDEMANN	NICKERSON Dodge (NE)	68044	4027219549	NICKERSON PUBLIC SCHOOL
DODGE CO. DISTRICT # 87	RT 2	HOOPER Dodge (NE)	68031	4027219549	RON SAGER
DODGE CO. DISTRICT # 94	ROBERT GASTON, SUPERINTENDENT ROUTE 1, BOX 104	HOOPER Dodge (NE)	68031		LOGANVIEW JR-SR HIGH SCH
DODGE, VILLAGE OF	BOX 277	DODGE Dodge (NE)	68663	4026932239	COLLEEN EIKMEIER
DUPACO OF NEBRASKA, INC.	1500 SO LOGAN	NORFOLK Madison (N	68701	4023715700	
ECONO FOODS	2125 KRENZIEN	NORFOLK Madison (N	68701		
ELKHORN ACRES GOLF CLUB	BOX 235	STANTON Stanton (N	68779	4024392191	DOUG BENGSTON

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
EMERSON, VILLAGE OF	BOX 278	EMERSON Dakota (NE	68733	4026952554	DICK MCCABE
FAIRPLAY GOLF COURSE	BOX 1111	NORFOLK Madison (N	68701	4023719877	
GOODYEAR TIRE & RUBBER CO	P.O. BOX 579	NORFOLK Madison (N	68701	4023793020	GARTH TYSON
GREEN ACRES TRAILER PARK	BOX 11	NICKERSON Dodge (NE)	68044	4027217508	VIRGINIA WELDING
HOOPER, CITY OF	P.O. BOX C	HOOPER Dodge (NE)	68031	4026543649	GEORGE K. WAGNER
HOSKINS, VILLAGE OF	BOX 35	HOSKINS Wayne (NE)	68740	4025654228	LEONARD MARTEN
HOWELLS, VILLAGE OF		HOWELLS Colfax (NE	68641	4029861666	CAROLYN KULHANEK
HOWIE'S COUNTRY RESTAURANT	RURAL ROUTE 1, BOX 76	NORFOLK Madison (N	68701	4023710777	DAVE GASSELING
HUMPHREY, CITY OF	P.O. BOX 486	HUMPHREY Platte (NE	68642	4029231701	RON BENDER
IMMANUAL LUTHERAN SCHOOL	HEAD TEACHER	HOOPER Dodge (NE)	68031	4026543663	ROBERT LEHMANN
IOWA BEEF PACKERS	LARRY MOSER ENGINEER P.O. BOX 1010	MADISON Madison (N	68748	4024543361	LARRY MOSER
IOWA BEEF PROCESSORS, INC.	SOUTH HIGHWAY 275	WEST POINT Cuming (NE	68788	4023725401	RICHARD DAVIS
JACK & JILL (OAKLAND)	1106 SADDLE CREEK ROAD	OAMAH Burt (NE)	68106	4025582736	PHIL RHODES JR.
JERRYS HILLTOP SERVICE		RANDOLPH Pierce (NE	68771	4023379912	
KARL STEFAN MEMORIAL AIRPORT	RICKI L. KROPF, AIRPORT MGR.	NORFOLK Madison (N	68701	4023717210	C/O CITY OF NORFOLK AIRP AU

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
	ROUTE 2, BOX 380				
KELLY'S COUNTRY CLUB	BOX 308	NORFOLK Madison (N	68702	4023719959	VINCE KIRBY
KLUB 81 CAFE		HUMPHREY Platte (NE	68642	4029231588	KENNETH LUBISCHER
L AND B LOUNGE	LOREN JELINEK	FOSTER Pierce (NE	68737	4023294743	
LAUREL, CITY OF	101 WEST 2ND STREET	LAUREL Cedar (NE)	68745	4022563112	Harley Reinoehl
LAZY ACRES MOBILE VILLAGE	HARRY A. HANSEN	PIERCE Pierce (NE	68767	4023294693	KENNETH HANSEN
LEIGH, VILLAGE OF	P.O. BOX 277	LEIGH Colfax (NE	68643	4024873303	RANDY HUISMAN
LOGAN EAST RURAL WATER SYSTEM	ROUTE 2, BOX 82	OAKLAND Burt (NE)	68045	4026856056	TOM BURDESS
LYONS, CITY OF	100 MAIN STREET	LYONS Burt (NE)	68038	4026872130	Dave Christensen
MACKEL TRAILER COURT	1112 SOUTH 6TH ST.	NORFOLK Madison (N	68701	4024543502	JAMES N. MACKEL
MADISON CO. DISTRICT # 20	RR 1, BOX 20	NORFOLK Madison (N	68701	4024543311	ARLO MULFORD
MADISON CO. DISTRICT # 25	RR #2	NORFOLK Madison (N	68701	4024543311	COUNTY SUPERINTENDENT
MADISON CO. DISTRICT # 3	805 GRANDVIEW RD.	NORFOLK Madison (N	68701	4023794210	CLYDE MATHER
MADISON CO. DISTRICT # 37	RR 4	NORFOLK Madison (N	68701	4024543311	THERESA GEBERS
MADISON CO. DISTRICT # 48	RURAL ROUTE 2, BOX 90A	MADISON Madison (N	68748	4024543465	JIM REEVES

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
MADISON CO. DISTRICT # 87	RURAL ROUTE 4, BOX 253	NORFOLK Madison (N	68701	4023711767	VICTORY SCHOOL
MADISON CO. DISTRICT # 96		MADISON Madison (N	68748		COUNTY SUPERINTENDENT
MADISON COUNTY SID # 3	EASTERN HTS. SUNRISE ADDITION 304 KIMBERLY WAY	NORFOLK Madison (N	68701	4023714389	EASTERN HEIGHTS SUNRISE ADDISI
MADISON PUBLIC SCHOOL DIST. #1	GENE CERNEY	MADISON Madison (N	68748		GENE CERNEY
MADISON, CITY OF	BOX 527	MADISON Madison (N	68748	4024542625	Darrell Dawson
MCLEAN, VILLAGE OF		MCLEAN Pierce (NE	68747	4023956661	JAMES BACKHAUS
MEADOW GROVE, VILLAGE OF	P.O. BOX 2	MEADOW GROVE Madison (N	68752	4026342441	RANDY LIESWALD
MERTZ LOUNGE	BOX 174	HADAR Pierce (NE	68738	4023712440	MERLIN TOELLE
MILTON G. WALDBAUM	501 N. MAIN ST.	WAKEFIELD Dixon (NE)	68784	4022872211	HUSKER PRIDE
MILTON G. WALDBAUM	SOUTH HIGHWAY 35	WAKEFIELD Dixon (NE)	68784	0000000000	BIG RED FARMS SYSTEM
NORFOLK COUNTRY CLUB	BOX 432	NORFOLK Madison (N	68701	4023713230	
NORFOLK DISTRICT NG & PC	BOX 934	NORFOLK Madison (N	68701	0000000000	CLAYTON STALLING
NORFOLK IRON & METAL CO.	P.O. BOX 1129	NORFOLK Madison (N	68702		GINA NEBUDA
NORFOLK MOBILE HOME COMMUNITY	ROUTE 4, LOT C-10	NORFOLK Madison (N	68701	4023712880	WILLIAM BRAHMSTEADT

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
NORFOLK REGIONAL CENTER	P.O. BOX 1209	NORFOLK Madison (N	68701	4023714343	
NORFOLK RENDERING WORKS	PO BOX 1144	NORFOLK Madison (N	68701	4023714822	
NORFOLK, CITY OF	CITY WATER DEPARTMENT RR 3	NORFOLK Madison (N	68701	4023717565	Dennis Smith
NUCOR STEEL	NICK JOHNSON CONTROLER PO BOX 309	NORFOLK Madison (N	68701	4023790800	
OAKLAND, CITY OF	200 S. OAKLAND AVE.	OAKLAND Burt (NE)	68045	4026855882	Dan Tanksley
OSMOND, CITY OF		OSMOND Pierce (NE	68765	4027483359	MIKE OLSON
PAPIO-MO RIVER NRD, THURSTON	MARVIN BAKER RURAL ROUTE 1	PENDER Thurston (	68047	4028465463	THURSTON COUNTY SYSTEM
PELICAN POINT SRA	P.O. BOX 53	CRAIG Burt (NE)	68019	4024685611	ROBERT ECKDAHL
PENDER, VILLAGE OF	P.O. BOX 5	PENDER Thurston (	68047	4023853232	Robert Fendrick
PIERCE CO. DISTRICT # 15		HADAR Pierce (NE	68738	4023296325	HADAR PUBLIC SCHOOL
PIERCE COMMUNITY GOLF COURSE	RR 2, BOX 126C	PIERCE Pierce (NE	68767	4023294790	JIM MAAS
PIERCE, CITY OF	114 SOUTH BROWN	PIERCE Pierce (NE	68767	4023294535	Clarence Wattier
PILGER REST AREA	P.O. BOX 1707	NORFOLK Madison (N	68701	4023714292	NE. DEPARTMENT OF ROADS
PILGER, VILLAGE OF	BOX 306	PILGER Stanton (N	68768	4023963123	KEN WIECHMAN
PLAINVIEW COUNTRY CLUB	RR 3, BOX 23A	PLAINVIEW Antelope (	68769	4025829203	LINDA PITTET

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
PLAINVIEW, CITY OF	P.O. BOX 757	PLAINVIEW Pierce (NE	68769	4025824528	Mark Anderson
PLEASANT VIEW MOBILE VILL	% MR. BOB APPLEBY MGR. ROUTE 1	NORFOLK Madison (N	68701	4023715629	ROBERT APPLEBY
RANDOLPH, CITY OF	P.O. BOX 220	RANDOLPH Cedar (NE)	68771	4023370553	LeRoy Brummels
RIVERSIDE BALLROOM	P.O. BOX 372	NORFOLK Madison (N	68702	4023719961	ELDON SMALLEY
ROMAN PACKING CO	PO BOX 702	NORFOLK Madison (N	68701	4023715990	
ROSALIE, VILLAGE OF	CITY/CLERK	ROSALIE Thurston (	68055	4028632331	SUSAN REIS
SAC COMMUNICATIONS SITE	DET 2, IACOMMW	SCRIBNER Dodge (NE)	68057	4026543325	WILLIAM FRYE
SALEM EV LUTHERAN CHURCH	ROUTE 1	NICKERSON Washington	68044	0004784227	
SCRIBNER STATE AIRFIELD	ROUTE 2, BOX 91	HOOPER Dodge (NE)	68031	0000000000	LYLE E. JOHNSON
SCRIBNER, CITY OF	P.O. BOX "D"	SCRIBNER Dodge (NE)	68057	4026643231	Gordon Evert
SHERWOOD MEDICAL	INDUSTRIES INC BOX 1169	NORFOLK Madison (N	68701	4023719010	
SHOLES, VILLAGE OF	ROUTE 1	RANDOLPH Cedar (NE)	68771	4023370348	GLEN NELSON
SLEEPY HOLLOW ACRES	P.O. BOX 173	NORFOLK Madison (N	68702	4023717615	DON MEINKE
SNYDER, VILLAGE OF		SNYDER Dodge (NE)	68664	4025682550	JACK LENNEMANN
SPORTMAN BAR		MEADOW GROVE Madison (N	68752	4026342380	

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
STANTON COUNTY SID #1	99 MARKET PLACE	NORFOLK Madison (N	68701	4023716440	ROGER FEDDERN
STANTON, CITY OF	WATER DEPARTMENT	STANTON Stanton (N	68779	4024392119	Vernon Reese
SUBURBAN ACRES SUBDIV.	1303 SHERIDAN DRIVE	NORFOLK Madison (N	68701	4023712788	MIKE KEMP
SUMMIT LAKE	P.O. BOX 53	CRAIG Burt (NE)	68019	4024685611	ROBERT ECKDAHL
TA HA ZOUKA PARK	R. R. #3 C/O DOUG NUTTLEMANN	NORFOLK Madison (N	68701	4023717565	WATER TREATMENT PLANT
THURSTON, VILLAGE OF		THURSTON Thurston (	68062	4023852710	FAYE PECK
TILDEN, VILLAGE OF	P.O. BOX 37	TILDEN Madison (N	68781	4023685515	RONALD EYMANN
TONY'S STEAK HOUSE	THOMAS MILES ROUTE 2	STANTON Stanton (N	68779	4024392893	
TRUCK HAVEN CAFE	EAST OMAHA AVE BOX 1222	NORFOLK Madison (N	68701	4023793828	GARY TULLIS
TUCKER'S TAVERN	BOX 17	NICKERSON Dodge (NE)	68044	4027271419	DANNY & JEANNIE TUCKER
UEHLING, VILLAGE OF	BOX 13	UEHLING Dodge (NE)	68063	4025672532	DON THIELFOLDT
VILLAGE INN		HADAR Madison (N	68701	0000000000	BRUCE BOLTE
WAKEFIELD, CITY OF	CITY OFFICES	WAKEFIELD Dixon (NE)	68784	4022872080	LaVerle Obermeyer
WAUSA, VILLAGE OF	P.O. BOX 216	WAUSA Knox (NE)	68786	4025862311	KENNETH F. BLOOMQUIST
WAYNE CO. DISTRICT # 51	RURAL ROUTE 1, BOX 19	WAYNE Wayne (NE)	68787	4025854796	DENNIS JENSEN

PUBLIC WATER SYSTEM NAME	ADDRESS	COUNTY	ZIP	PHONE	WATER OPERATOR NAME
WAYNE CO. DISTRICT # 57	RURAL ROUTE 2	WAYNE Wayne (NE)	68787	4023751518	KELLY HEITHOLD
WAYNE, CITY OF	CITY WATER DEPARTMENT 306 PEARL STREET	WAYNE Wayne (NE)	68787	4023751733	Vern Schulz
WEST POINT, CITY OF	444 SOUTH MAIN STREET	WEST POINT Cuming (NE	68788	4023722466	Edwin Booth
WILLOW CREEK SRA	RT 2, BOX 18	PIERCE Pierce (NE	68767	0000000000	DAN SUTHERLAND
WINSIDE, VILLAGE OF	P.O. BOX 206	WINSIDE Wayne (NE)	68790	4022864422	DENNIS VAN HOUTEN
WINSLOW, VILLAGE OF	BOX 173	WINSLOW Dodge (NE)	68072	4027215517	ARLAN PANNING
WISNER, CITY OF	UTILITIES SUPERINTENDENT	WISNER Cuming (NE	68791	4025296616	Roland Johnson
ZION LUTHERAN SCHOOL		BANCROFT Cuming (NE	68004	4026487534	
ZION ST JOHNS SCHOOL	RURAL ROUTE 1, BOX 148	WISNER Cuming (NE	68791	4025293348	PETER HEINICKE

Source: Nebraska Department of Health Division of Drinking Water and Environmental Sanitation, Monitoring and Compliance Section

List of Laboratories Certified By the Nebraska Department of Health (1993)

F$ CERT LAA * STATE OF NEBRASKA - ...

Rick - This list changes quite often. (Drop + Add)

...e following list of laboratories comprise the active file of Certified ...lities currently in the State of Nebraska.

...braska Department of Health ...ivision of Laboratories ...701 South 14th Street P.O. Box 2755 Lincoln, NE 68502 (402)471-2122 John Blosser - Director Howard Isaacs - Supr., Environmental Health Section Craig Horn, Supr. - Organic and Radiological Chemistry	Microbiology - Total Coliform Analysis by Membrane Filter Technique Fecal Coliform Confirmation Chemistry - Inorganic Fluoride, Nitrate, 8 Heavy Metals (Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag) Chemistry - Organic Herbicide, Pesticide, Volatile Organic Chemicals (Regulated and Unregulated), Trihalomethanes Chemistry - Radiological Gross Alpha/Beta, Radium 226, Radium 228 Uranium, Photon Emitters
Metropolitan Utilities District 20th and Grebe O...a, NE. 68102 (402)449-8181 Zoltan Kerekes - Laboratory Dir. James Haywood - Microbiology Steve Emary - Organics Mary Felts - Inorganics	Microbiology - Total Coliform Analysis by Membrane Filter Technique Fecal Coliform Confirmation Chemistry - Inorganic Fluoride, Nitrate, 8 Heavy Metals) (Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag) Chemistry - Organic Herbicide, Pesticide, Volatile Organic Chemicals (Regulated and Unregulated), Trihalomethanes
Metropolitan Utilities District ...0th and Hansen Lake Road Omaha, NE. 68123 (402)449-8069 Zoltan Kerekes - Laboratory Dir. Rod Jenkins - Laboratory Tech.	Microbiology - Total Coliform Analysis by Membrane Filter Technique Fecal Coliform Confirmation Chemistry - Inorganic Nitrate

Grand Island-Hall Co. Health Dept.
05 East 1st Street
Grand Island, NE. 68801
(308)381-5175

Howard Edwards - Health Dept. Dir.

Tom Dittrick - Laboratory Supervisor

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

Chemistry - Inorganic
Nitrate

Douglas Co. Health Department
1201 South 42nd Street
Omaga, NE. 68105
(402)444-7196

John Willey - Health Dept. Dir.

Lois Clausen - Laboratory Supervisor

Hong Huynh - Lab. Tech.
Michelle Westlond - Lob. Tech.

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

Chemistry - Inorganic
Nitrate

University of Nebraska-Lincoln
Manter Hall of Life Sciences
Lincoln, NE. 68588
(402)472-2766

Paul Blumm - Laboratory Supr.

Microbiology - Total Coliform Analysis
by Membrane Filtration Technique
Fecal Coliform Confirmation

Iowa Beef Producers
Production Laboratory
Box 494
Dakota City, NE. 68731
(402)494-2061

DK

Susan
Chris Welch

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

(The Nebraska State Health Laboratory
continues to conduct all required bac-
teriological analysis.)

orth Platte Water Department
Environmental Health
Box 490
h Platte, NE 69103
(308)532-2610 OR 5320

erry Deal - Laboratory Supervisor

Kevin Crosier - Lab. Tech.

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

Enviro Services, Inc.
318 S. Beltline Highway East
Rt. 2 Box 118
Scottsbluff, NE 69361
(308)632-3933

Marty McCafferty - Lab. Supervisor

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

(Certification status is currently under review.)

A & L Mid West Laboratories, Inc.
13611 "B" Street
OMAHA, NE 68144-3693
(402)334-7770

An. Boulay - Micro. Supr.
Theresa Brincks - Lab. Tech.
Shelly Mathews - Lab. Tech.

Barry Blessing - Inorganic

Sam Smith - Organic - VOC

Craig Kubitschek - Pest./Herb.

Microbiology - Total Coliform Analysis
by Membrane Filter Technique

Chemistry - Inorganic
Fluoride, Nitrate, 8 Heavy Metals
(Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag)

Chemistry - Organic
Herbicide, Pesticide, Volatile Organic Chemicals (Regulated and Unregulated), Trihalomethanes

Nebraska Testing Corporation
4123 South 67th Street
Omaha, NE 68117
(402) 331-4453

John Burnett - Lab. Director

Brian Stemmerman - Mirco.

XXXXXX

XXXXXX

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

Chemistry - Inorganic
Fluoride, Nitrate, 8 Heavy Metals
(Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag)

Servi Tech
1402 Park West Drive
Hastings, NE 68702
(402)463-3522

Lis Fredricks - Lab. Dir.

Nancy Shuler - Micro.

Roger Torske - Inorganic

Microbiology - Total Coliform Analysis
by Membrane Filter Technique
Fecal Coliform Confirmation

Chemistry - Inorganic
Fluoride, Nitrate, 8 Heavy Metals
(Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag)

Ward Laboratories
P.O. Box 788
Kearney, NE 68848
(308)234-2418

Raymond Ward - Laboratory Dir.

Microbiology - Total Coliform Analysis
by Membrane Filtration (Enrolling in
Certification process at this time)
Chemistry - Inorganic
Nitrate (Enrolling in Certification
process at this time)

Henningsen Foods, Inc.
402 N. 3rd Street
Norfolk, NE 68701
(402)371-1150

Dennis Sanders - Laboratory Supr.

LaVonne Bichelmeier - Lab. Tech.

Microbiology - Total Coliform Analysis
by Membrane Filter Technique

(Certification pertains to the facility
only. The Nebraska State Health Lab-
oratory continues to run all required
analysis.)

Olsen's Agricultural Laboratory, Inc.
P.O. Box 370
McCook, NE 69001
Mr. Bob Olsen
(308)345-3670

Microbiology - Total Coliform Analysis
by Most Probable Number Technique

Chemistry - Inorganic
Nitrate

HWS Technologies, Inc
825 J Street
Lincoln, NE

Paul Minyon

Chemistry - Inorganic
Nitrate, 8 Heavy Metals

APPENDIX 7

Land Use Data

Agricultural Statistics Data

Land Use Data

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTUR
SOIL CONSERVATION SERVIC

SUMMARY TABLE
LAND USE DATA

Lower Elkhorn NRD

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	259473	10.009
1	NONIRRIGATED CRDPLAND	1571987	60.637
2	SPRINKLER IRRIGATED CROPLAND	257393	9.929
3	SURFACE IRRIGATED CROPLAND	44045	1.699
4	TAILWATER IRRIGATED CROPLAND	608	0.023
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	228906	8.830
8	SPRINKLER IRRIGATED PASTURE LAND	641	0.025
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	93118	3.592
14	FOREST LAND	12895	0.497
15	OTHER FARMLAND	84235	3.249
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	592	0.023
18	BUILT UP LAND	26064	1.005
19	RURAL TRANSPORTATION	4079	0.157
20	WATER	8423	0.325
	TOTAL	2592459	100.00

SUMMARY TABLE
LAND USE DATA

BURT

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	12	0.009
1	NONIRRIGATED CROPLAND	112510	83.399
2	SPRINKLER IRRIGATED CROPLAND	7558	5.603
3	SURFACE IRRIGATED CROPLAND	1418	1.051
4	TAILWATER IRRIGATED CROPLAND	352	0.261
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	8248	6.114
8	SPRINKLER IRRIGATED PASTURE LAND	0	0.000
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	16	0.012
14	FOREST LAND	112	0.083
15	OTHER FARMLAND	3280	2.432
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	1383	1.025
19	RURAL TRANSPORTATION	0	0.000
20	WATER	16	0.012
	TOTAL	134906	100.00

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY TABLE
LAND USE DATA

COLFAX

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	3	0.002
1	NONIRRIGATED CROPLAND	120967	76.679
2	SPRINKLER IRRIGATED CROPLAND	11531	7.310
3	SURFACE IRRIGATED CROPLAND	3200	2.029
4	TAILWATER IRRIGATED CROPLAND	256	0.162
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	16260	10.307
8	SPRINKLER IRRIGATED PASTURE LAND	0	0.000
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	137	0.087
14	FOREST LAND	0	0.000
15	OTHER FARMLAND	4443	2.816
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	952	0.603
19	RURAL TRANSPORTATION	0	0.000
20	WATER	8	0.005
	TOTAL	157756	100.00

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY TABLE
LAND USE DATA

CUMING

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	1	0.000
1	NONIRRIGATED CROPLAND	295579	80.382
2	SPRINKLER IRRIGATED CROPLAND	13245	3.602
3	SURFACE IRRIGATED CROPLAND	2508	0.682
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	29357	7.984
8	SPRINKLER IRRIGATED PASTURE LAND	8	0.002
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	0	0.000
14	FOREST LAND	0	0.000
15	OTHER FARMLAND	22249	6.051
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	2423	0.659
19	RURAL TRANSPORTATION	0	0.000
20	WATER	2347	0.638
	TOTAL	367717	100.00

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTUR
SOIL CONSERVATION SERVIC

SUMMARY TABLE
LAND USE DATA

DAKOTA

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	0	0.014
1	NONIRRIGATED CROPLAND	551	79.871
2	SPRINKLER IRRIGATED CROPLAND	0	0.000
3	SURFACE IRRIGATED CROPLAND	0	0.000
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	34	4.959
8	SPRINKLER IRRIGATED PASTURE LAND	0	0.000
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	0	0.000
14	FOREST LAND	0	0.000
15	OTHER FARMLAND	32	4.639
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	73	10.516
19	RURAL TRANSPORTATION	0	0.000
20	WATER	0	0.000
	TOTAL	690	100.00

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY TABLE
LAND USE DATA

DODGE

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	47	0.020
1	NONIRRIGATED CROPLAND	158089	67.073
2	SPRINKLER IRRIGATED CROPLAND	22040	9.351
3	SURFACE IRRIGATED CROPLAND	17264	7.325
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	15744	6.680
8	SPRINKLER IRRIGATED PASTURE LAND	0	0.000
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	0	0.000
14	FOREST LAND	8546	3.626
15	OTHER FARMLAND	6731	2.856
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	16	0.007
18	BUILT UP LAND	1912	0.811
19	RURAL TRANSPORTATION	3634	1.542
20	WATER	1675	0.711
	TOTAL	235698	100.00

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTUR
SOIL CONSERVATION SERVIC

SUMMARY TABLE
LAND USE DATA

MADISON

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	34	0.010
1	NONIRRIGATED CROPLAND	187842	54.464
2	SPRINKLER IRRIGATED CROPLAND	65703	19.050
3	SURFACE IRRIGATED CROPLAND	6542	1.897
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	37452	10.859
8	SPRINKLER IRRIGATED PASTURE LAND	337	0.098
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	22887	6.636
14	FOREST LAND	326	0.095
15	OTHER FARMLAND	10694	3.101
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	11057	3.206
19	RURAL TRANSPORTATION	40	0.012
20	WATER	1978	0.574
	TOTAL	344892	100.00

SUMMARY TABLE
LAND USE DATA

PIERCE

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	152	0.041
1	NONIRRIGATED CRDPLAND	179962	48.905
2	SPRINKLER IRRIGATED CROPLAND	90471	24.586
3	SURFACE IRRIGATED CROPLAND	3673	0.998
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	36996	10.054
8	SPRINKLER IRRIGATED PASTURE LAND	48	0.013
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	40145	10.909
14	FOREST LAND	647	0.176
15	OTHER FARMLAND	12331	3.351
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	576	0.156
18	BUILT UP LAND	2453	0.667
19	RURAL TRANSPORTATION	209	0.057
20	WATER	318	0.087
	TOTAL	367981	100.00

ASKA NATURAL RESOURCES COMMISSION
JRAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY TABLE
LAND USE DATA

PLATTE

PROCESSED: June 14, 1993

ATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	0	0.000
1	NONIRRIGATED CRDPLAND	50377	67.726
2	SPRINKLER IRRIGATED CROPLAND	13841	18.607
3	SURFACE IRRIGATED CROPLAND	2503	3.365
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	4809	6.465
8	SPRINKLER IRRIGATED PASTURE LAND	0	0.000
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	0	0.000
14	FOREST LAND	0	0.000
15	OTHER FARMLAND	2141	2.878
16	PITS AND QUARRIES	0	0.000
	BARREN LAND	0	0.000
	BUILT UP LAND	689	0.927
19	RURAL TRANSPORTATION	0	0.000
20	WATER	24	0.033
	TOTAL	74383	100.00

SUMMARY TABLE
LAND USE DATA

STANTON

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	0	0.000
1	NONIRRIGATED CROPLAND	170458	61.804
2	SPRINKLER IRRIGATED CROPLAND	15136	5.488
3	SURFACE IRRIGATED CROPLAND	6232	2.260
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	36705	13.308
8	SPRINKLER IRRIGATED PASTURE LAND	144	0.052
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	29934	10.853
14	FOREST LAND	3264	1.183
15	OTHER FARMLAND	9312	3.376
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	2462	0.893
19	RURAL TRANSPORTATION	188	0.068
20	WATER	1969	0.714
	TOTAL	275804	100.00

SUMMARY TABLE
LAND USE DATA

THURSTON

PROCESSED: June 14, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	1	0.001
1	NONIRRIGATED CROPLAND	79513	88.711
2	SPRINKLER IRRIGATED CROPLAND	1395	1.556
3	SURFACE IRRIGATED CROPLAND	704	0.786
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	5094	5.683
8	SPRINKLER IRRIGATED PASTURE LAND	0	0.000
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	0	0.000
14	FOREST LAND	0	0.000
15	OTHER FARMLAND	2213	2.469
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	704	0.786
19	RURAL TRANSPORTATION	0	0.000
20	WATER	8	0.009
	TOTAL	89632	100.00

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY TABLE
LAND USE DATA

WAYNE

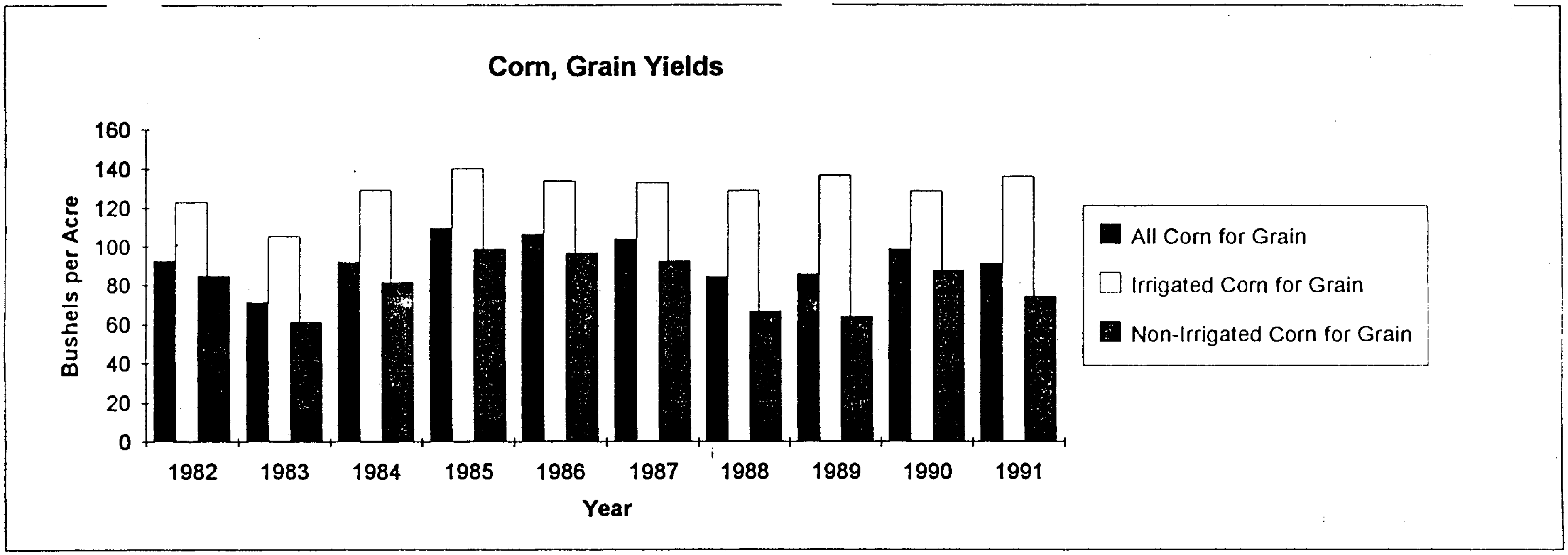
PROCESSED: June 14, 1993

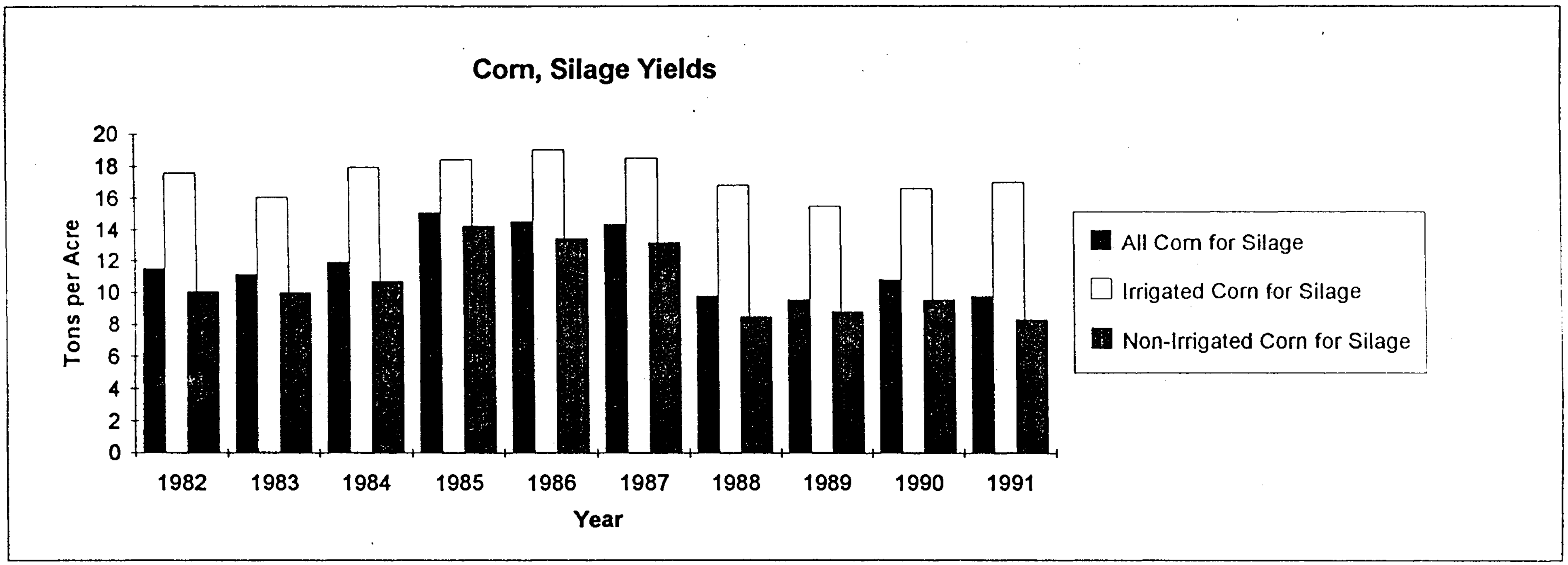
CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	0	0.000
1	NONIRRIGATED CROPLAND	216135	76.165
2	SPRINKLER IRRIGATED CROPLAND	16473	5.805
3	SURFACE IRRIGATED CROPLAND	0	0.000
4	TAILWATER IRRIGATED CROPLAND	0	0.000
5	FIELD BENCH IRRIGATED CROPLAND	0	0.000
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.000
7	PASTURE LAND	38208	13.464
8	SPRINKLER IRRIGATED PASTURE LAND	104	0.037
9	TAILWATER IRRIGATED PASTURE LAND	0	0.000
10	SURFACE IRRIGATED PASTURE LAND	0	0.000
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.000
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.000
13	RANGELAND	0	0.000
14	FOREST LAND	0	0.000
15	OTHER FARMLAND	10810	3.809
16	PITS AND QUARRIES	0	0.000
17	BARREN LAND	0	0.000
18	BUILT UP LAND	1956	0.689
19	RURAL TRANSPORTATION	8	0.003
20	WATER	80	0.028
	TOTAL	283773	100.00

Agricultural Statistics Data

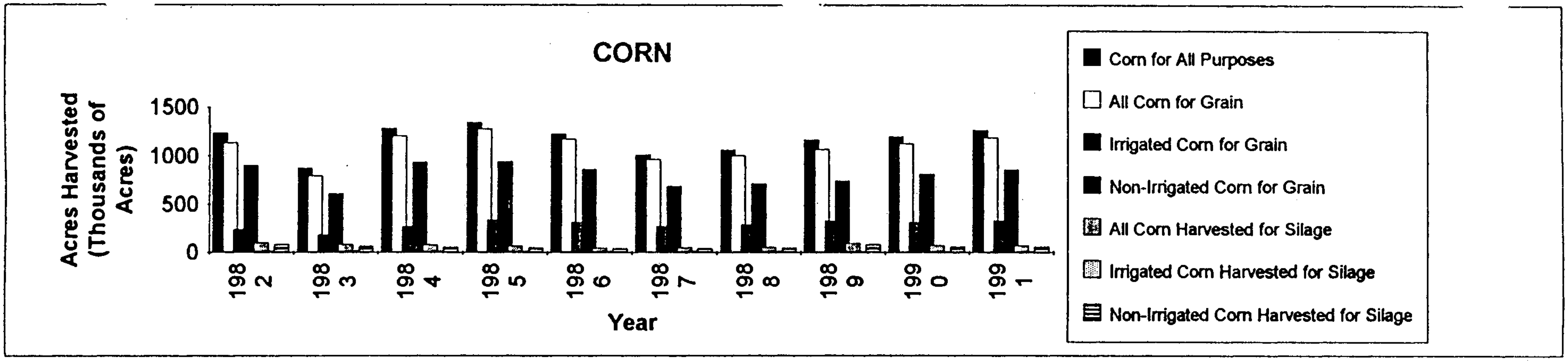
Corn Production Statistics for Northeast Nebraska (minus Antelope, Boone, and Dakota counties)
[Adapted from Nebraska Agricultural Statistics Service]

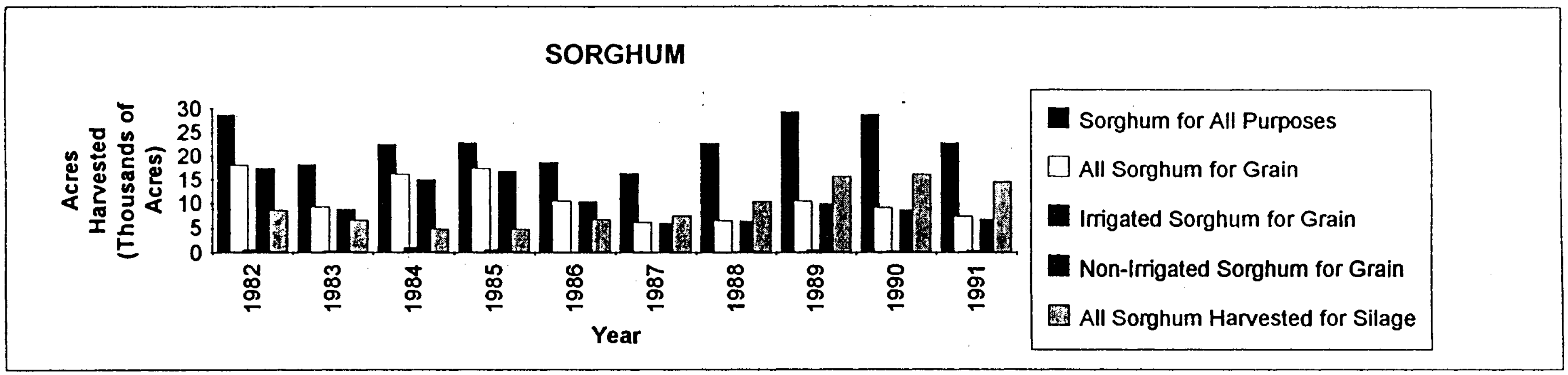
Year	Corn for All Purposes, Acres Planted (Thousand Acres)	Corn for All Purposes, Acres Harvested (Thousand Acres)	Corn for Grain, Acres Harvested (Thousand Acres)	Corn for Grain, Yield (Bushels per Acre)	Corn for Grain, Production (Thousand Bushels)	Irrigated Corn for Grain, Acres Harvested (Thousand Acres)	Irrigated Corn for Grain, Yield (Bushels per Acre)	Irrigated Corn for Grain, Production (Thousand Bushels)	Non-Irrigated Corn for Grain, Acres Harvested (Thousand Acres)	Non-Irrigated Corn for Grain, Yield (Bushels per Acre)	Non-Irrigated Corn for Grain, Production (Thousand Bushels)	All Corn Harvested for Silage, Acres Harvested (Thousand Acres)	All Corn Harvested for Silage, Yield (Tons per Acre)	All Corn Harvested for Silage, Production (Thousand Tons)	Irrigated Corn Harvested for Silage, Acres Harvested (Thousand Acres)	Irrigated Corn Harvested for Silage, Yield (Tons per Acre)	Irrigated Corn Harvested for Silage, Production (Thousand Tons)	Non-Irrigated Corn Harvested for Silage, Acres Harvested (Thousand Acre	Non-Irrigated Corn Harvested for Silage, Yield (Tons per Acre)	Non-Irrigated Corn Harvested for Silage, Production (Thousand Tons)
1982	1,252.0	1,238.2	1,135.9	93.0	105,628.7	236.7	123.0	29,120.0	899.2	85.1	76,508.7	100.6	11.5	1,158.5	19.5	17.6	343.1	81.1	10.1	815.4
1983	881.0	875.1	788.8	71.7	56,552.2	180.9	105.5	19,091.2	607.9	61.6	37,460.8	84.5	11.2	942.8	16.3	16.0	261.4	68.2	10.0	681.4
1984	1,301.0	1,283.2	1,207.2	92.6	111,753.4	272.4	129.4	35,242.0	934.8	81.8	76,511.4	76.1	11.9	907.3	15.8	17.9	283.3	58.4	10.7	624.0
1985	1,350.0	1,345.8	1,278.7	110.1	140,730.9	339.5	140.3	47,625.1	939.2	99.1	93,105.8	64.4	15.1	969.8	13.4	18.4	246.1	51.0	14.2	723.7
1986	1,233.0	1,226.3	1,174.9	107.0	125,764.6	314.3	134.1	42,141.2	860.6	97.2	83,623.4	44.9	14.5	651.1	8.9	19.0	169.1	36.0	13.4	482.0
1987	1,020.0	1,012.4	961.7	104.3	100,283.9	273.5	133.1	36,411.0	688.3	92.8	63,872.9	47.7	14.3	682.4	10.4	18.4	191.8	37.3	13.2	490.6
1988	1,068.0	1,062.2	1,003.4	84.9	85,190.7	290.2	129.2	37,506.7	713.2	66.9	47,684.0	55.1	9.8	538.5	8.8	16.8	147.5	46.3	8.4	391.0
1989	1,178.0	1,167.9	1,066.1	86.2	91,902.7	323.8	136.8	44,289.3	742.3	64.1	47,613.4	95.4	9.5	908.7	11.1	15.4	170.9	84.3	8.8	737.8
1990	1,209.0	1,201.1	1,127.2	99.2	111,771.2	313.5	128.9	40,409.4	813.7	87.7	71,361.8	72.0	10.8	776.0	13.2	16.5	218.0	58.8	9.5	558.0
1991	1,273.0	1,264.1	1,189.2	91.6	108,974.0	330.2	136.2	44,973.7	859.0	74.5	64,000.3	72.5	9.7	706.0	12.5	16.9	211.3	60.0	8.2	494.7

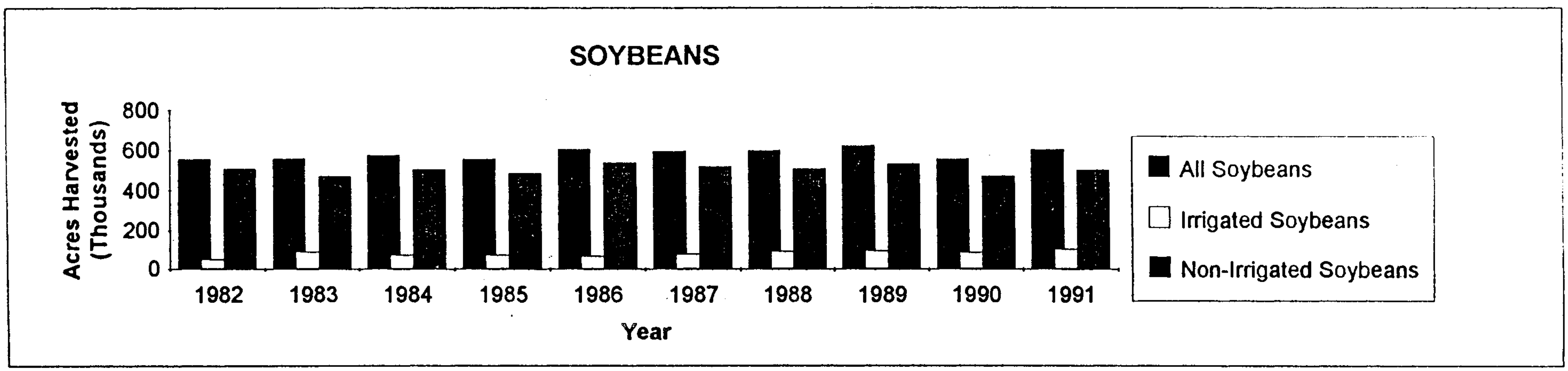

Corn, Grain Yields
Bushels per Acre
0
20
40
60
80
100
120
140
160
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
Year
All Corn for Grain
Irrigated Corn for Grain
Non-Irrigated Corn for Grain


Corn, Silage Yields
Tons per Acre
0
2
4
6
8
10
12
14
16
18
20
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
Year
All Corn for Silage
Irrigated Corn for Silage
Non-Irrigated Corn for Silage

Acres Harveste r Major Crops







APPENDIX 8

Precipitation Data

ANNUAL PRE TATION DATA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

	NORMAL	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Beemer	26.51	29.22	29.12	28.68	31.59	22.82	26.24	16.16	35.86	25.49	34.46	16.44	22.89
Clarkson	27.81	33.01	33.76	30.01	36.89	20.40	31.01	20.36	40.25	24.20	29.34	22.17	25.42
Concord		24.62	26.86	29.27	26.35	14.76	23.50	15.06	26.49	20.59	34.70	13.95	23.18
Dodge	28.30	28.19	26.79	32.01		23.79	27.72	17.96	38.35	23.67	32.86	24.17	23.56
Emerson	28.39	30.94	27.02	34.28	36.15	21.64	28.76	22.21	36.11	24.34	38.25	21.75	24.07
Luarel	24.99	23.45	29.96	26.88	27.77	16.18	24.59	14.21	30.25	20.70	38.34	18.51	26.00
Lyons	27.40	27.94	26.97	29.99	31.63	24.45	28.35	14.09	37.03	26.31	31.86	17.61	22.90
Madison	25.34	22.09	24.61	25.80	32.47	15.41	25.53	17.66	32.69	22.53	28.86	20.17	24.19
Meadow Grove		27.34	29.33	30.27	30.39	18.83	29.69	16.81	34.79	22.51	34.94	19.09	27.64
Norfolk	23.79	25.30	23.23	25.87	29.25	19.71	27.54	16.60	36.18	21.49	31.30	17.16	21.87
Osmond	25.14	21.20	26.64	31.32	30.24	16.38	24.51	14.92	30.20	23.30	29.82	14.03	25.41
Pilger	25.32	26.47	26.52	25.36	29.23	17.74	26.13	18.80	34.94	23.00	29.55	15.27	24.23
Plainview											33.23	17.79	25.85
Randolph		22.31	26.17	28.80	29.50	14.83	21.89	16.24	30.20	22.62	32.15	15.63	24.06
Stanton	25.56	25.17	28.94	27.53	29.65	17.54	27.02	16.70	37.64	26.22	34.52	18.32	29.05
Wakefield	26.11	26.34	28.61	32.70	28.95	19.23	26.18	18.66	34.42	23.37	35.01	19.24	24.01
Wayne	25.62	25.07	27.58	32.17	30.40	16.14	26.78	17.35	31.41	22.93	32.97	15.70	20.47
West Point	27.91	27.95	27.48	31.82	33.39	24.49	27.59	15.12	34.92	24.75	30.70	17.20	22.74
Winside	25.83	23.63		36.05	29.21	18.38	28.29	17.06	17.06	24.32	30.26	16.27	25.89

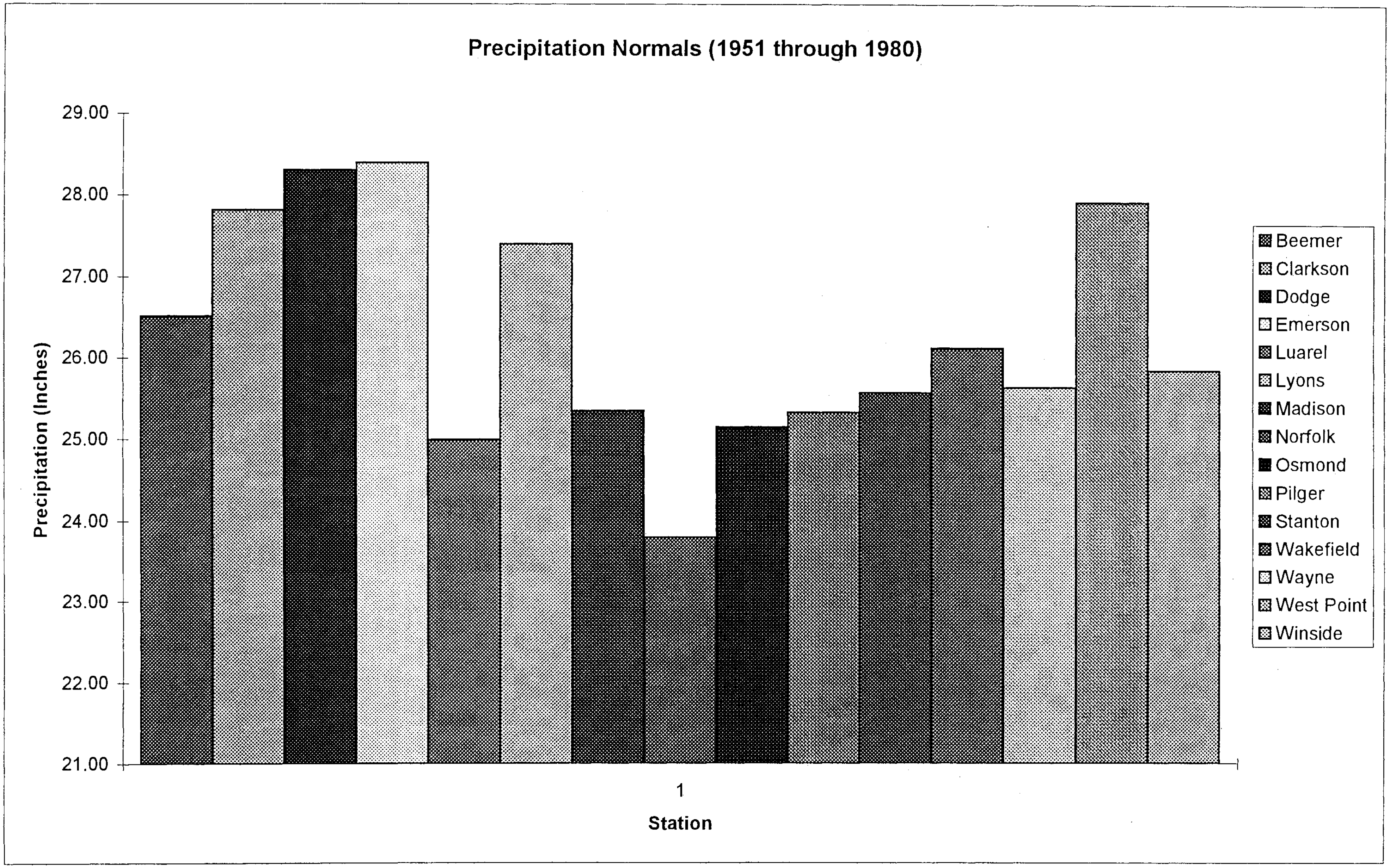
NORMAL PRECIPITATION FOR THE PERIOD 1951 THROUGH 1980

ANNUAL PRECIPITATION DATA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Beemer	41.17	27.74	38.30	23.95	34.96	28.25	22.87	19.30	30.88	30.26
Clarkson	39.42	30.07	43.31	28.68	31.22	27.85	15.76	24.37	29.30	25.68
Concord	33.26	27.42	37.78	29.44	32.77	24.79	18.31	14.94		30.22
Dodge	43.15	36.93	42.43	27.00	36.68	27.24	25.18	24.17	31.98	29.27
Emerson		36.63	43.16	27.47	32.88	26.15	24.57	18.21	34.83	24.05
Luarel	35.80	31.82	37.50	29.32	34.26	25.43	24.09	15.43	24.40	29.75
Lyons	40.84	38.30	43.94	27.01	40.50		24.78	19.56	25.98	32.52
Madison		30.50	35.85	27.33		28.88	18.62	20.49	27.08	28.07
Meadow Grove	37.58	30.81	34.15	29.64	28.72	24.09	21.14	17.22	22.38	23.16
Norfolk	31.39	28.85	33.68	25.76	30.78	28.51	24.69	16.55	26.87	29.11
Osmond	29.04		32.52	25.14	26.78	28.76	18.04		21.28	24.20
Pilger	37.07	30.15	37.00	30.82	32.80	24.91	21.22	15.51	27.08	
Plainview	37.74	33.84	33.02	30.69	31.83	30.13	25.15	16.33	23.68	31.96
Randolph	33.86	27.96	35.99	25.72	26.71	28.59	17.68	13.35	19.01	23.71
Stanton	41.97	34.05	43.92	28.61	34.35		19.71	18.59	32.24	28.17
Wakefield	40.38	32.11	40.69	26.56	35.92	25.75	21.11	16.26	28.55	29.17
Wayne	38.87	28.60	36.35		34.56	25.60	20.24		21.24	25.01
West Point	39.58	32.71	43.31	26.23	40.28	27.01	23.03	20.46	27.57	
Winside	37.02	31.85	40.47	30.84	34.83	31.53	23.75	17.85	26.46	27.34

NORMAL PRECIPITATION FOR THE PERIOD 1951 THROUGH 1980

ANNUAL PREC.PITATION DATA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



NORMAL PRECIPITATION FOR THE PERIOD 1951 THROUGH 1980