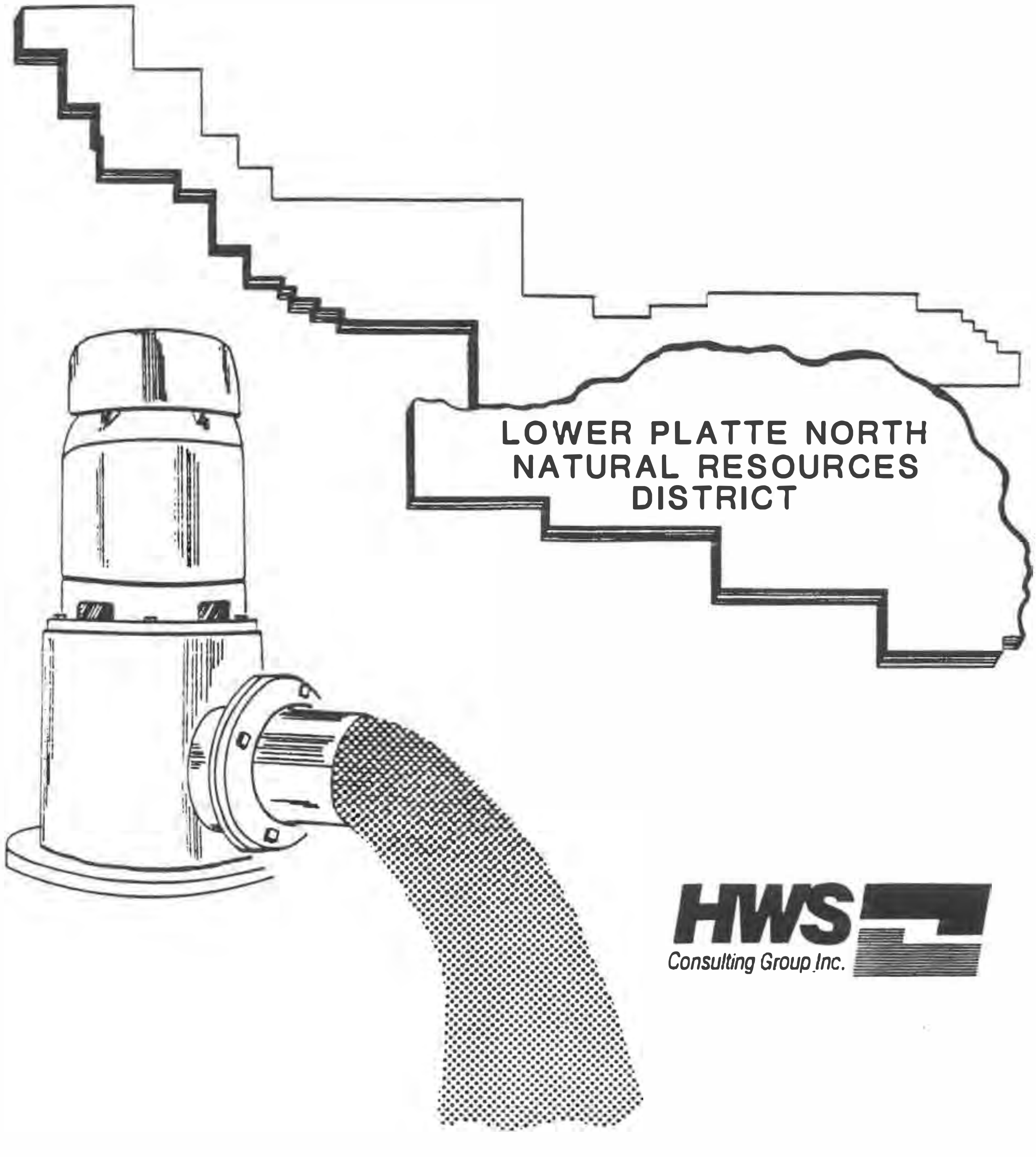
GROUNDWATER MANAGEMENT PLAN

REVISED 1995



HWS
Consulting Group Inc.

LOWER PLATTE NORTH

NATURAL RESOURCES DISTRICT

P.O. BOX 126, COMMERCIAL PARK ROAD, WAHOO, NEBRASKA 68066
PHONE (402) 443-4675 • FAX (402) 443-5339

Lower Platte North NRD Board of Directors

SUBDISTRICT	NAME
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INTRODUCTION

In 1985 the Board of Directors of the Lower Platte North Natural Resources District (hereinafter referred to as the LPN NRD) adopted a Groundwater Management Plan as a first step in formalizing their intent to manage the resource. The plan was developed to fulfill requirements set forth in Section 46-673.01 through .04 of the Nebraska Groundwater Management and Protection Act. The NRD's plan was approved by the Department of Water Resources in February 1986 (approval and agency review letters are included as Appendix B).

Prior to 1985, the LPN NRD's groundwater management initiatives were limited to a brief period of water level monitoring in the late 1970's, cost sharing on irrigation re-use pits, and cost sharing on water conservation practices. With the adoption of the 1985 plan, the LPN NRD embarked upon a new era of groundwater resource management marked by an intensive program of data collection designed to characterize the resource and establish the relationship with other water resource related aspects. In addition, the NRD developed education and demonstration programs designed to increase awareness of groundwater supplies, use, and protection. The LPN NRD staff and board embraced the responsibility for management of the District's water supply, and from 1985-1993 invested over $288,000 in programs specified in the Plan, which includes staff, analysis, and equipment.

In 1991, the Nebraska Legislature enacted Legislative Bill 51 (Section 46-673.14 of the Nebraska Groundwater Management and Protection Act)) which required the following actions by the NRD:

> "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."

This document is presented as an amendment to the 1985 LPN NRD's Groundwater Management Plan. The amendment meets the intent of LB51 and fulfills the District's need for continued understanding of the supply and quality of its groundwater resource, and sets forth a plan of protection for the future. The Board of Directors recognizes, along with the Nebraska legislature, that groundwater is a valuable resource and planned management is essential and in the public interest.

This update to the LPN NRD's Groundwater Management Plan has been developed as a progressive program management tool for present and future board members serving as a guide for the proposed direction of groundwater resource protection. Use of NRD funds to provide proper water management will be programmed through this document as an extension of the annual budgetary process. The plan provides and defines goals, objectives, policy statements, and program commitments and provides time schedules for implementation.

For reference, a glossary of groundwater related terms is included as Appendix C. A summary of the LPN NRD's groundwater related activities since 1985 is included as Table 1. In addition to the activities listed, the NRD has increased their water management staff by three staff members since 1985 as part of their commitment to support the policies outlined in the 1985 plan.

This update has been prepared by the board and staff of the Lower Platte North Natural Resources District with the assistance of The Water Policy Advisory Committees. Technical and planning assistance as well as document development was provided by HWS Consulting Group Inc.

TABLE 1

LPN NRD Summary of Groundwater-Related Activities 1985-1994

I. Regulatory

1. **Chemigation** - A program administered in response to the Chemigation Act (RRS-46-612) empowering NRD's to issue permits for application of fertilizers and pesticides through irrigation systems. The LPN NRD program started in 1987. From 1987 through 1992 a total of 309 permits were issued. A computer database was designed to assist in permit and compliance tracking.

2. **Irrigation Run-off Complaints** - NRD investigation, findings, and response actions are documented in NRD files. A total of 4 complaints were handled by the NRD during the 1985-1993 time period.

TABLE 1 - Continued

3 **Well Abandonment Program** - A program administered in response to Department of Water Resources and Department of Health regulations and Nebraska Statutes (RRS-46-602). NRD provides cost-share assistance to plug abandoned wells. An inventory of abandoned wells within the District has been completed for all counties.

4. **Special Protection Area** - In 1988 the NRD applied for and received a Special Protection Area investigation from the Department of Environmental Quality. A total of 49 irrigation wells and 60 domestic wells were sampled in the Platte Valley in Dodge County, near Fremont. Based upon sampling results, the DEQ denied the LPN NRD's request for designation of a Special Protection Area, but suggested continued monitoring of the area to ascertain quality changes.

II. Groundwater Quantity

1. **Water Level Monitoring** - A network of 68 monitor wells was established to measure water levels in the spring and fall, and has been completed each year since 1985. Eleven wells were added in 1991 in the David City area, bringing the total network to 79 wells. Starting in 1993, additional wells, district wide, are being added to the network. When completed, the network will contain approximately 120 monitoring sites.

2. **Computer Database** - The NRD developed a database to store monitor well descriptive data and water level measurements.

3. **Groundwater Model** - The NRD is developing a groundwater model for use in evaluating water level trends and forecasting future activities.

III. Groundwater Quality

1. **Sample Collection** - 1,389 groundwater samples were collected and analyzed in an analytical laboratory for selected water quality constituents from the following areas:

Date	No. of Wells Sampled	Area of Coverage
1986	155	District wide (irrigation wells)
1987	306	District wide (irrigation wells)
1988	146	District wide (irrigation wells)
1988	194	District wide resample of 1979 NURE sampling (104 domestic, 83 irrigation, and 7 stock wells)
1988	109	(Proposed) Special Protection Area - Fremont (60 domestic, 49 irrigation)
1989/ 1990	132	Platte Valley of Butler, Colfax, Saunders Counties (irrigation)

TABLE 1 - Continued

Date	No. of Wells Sampled	Area of Coverage
1990	93	Todd Valley, Saunders County (irrigation)
1990	155	Saunders County Home Well Testing (domestic)
1991	99	Shell Creek Watershed of Colfax and Platte Counties

2. **Computer Database** - Developed a computer database for storage and retrieval of collected water quality data.

III. Other

1. **Surface Water-Groundwater Interrelationships** - A program designed to investigate and map groundwater inputs to streams during the winter months was initiated in 1988. Mapping is completed for streams in Saunders, Dodge, Colfax, Butler, and Platte counties and partially completed for Boone and Madison Counties.

2. **Precipitation Monitoring** - Established a precipitation gauging network. Sites include 11 stations within or bordering the district monitored by the UNL Department of Agricultural Meteorology and Climatology and an additional 8 stations monitored by the LPN NRD. A computer database has been established to store the data.

3. Czechland Lake - LPN NRD has monitored two domestic wells downstream of Czechland Lake since 1990 for NO_3-N and bacteria. The NRD has sampled and analyzed drinking water wells of landowners in the Czechland Lake watershed and provided technical suggestions. In 1993 commenced monitoring activities of two watersheds involving Czechland Lake and Lake 6B addressing water quality in the feeder streams and the two lakes.

4. **Rural Domestic Wells** - Cooperated with Saunders County Extension Service in providing collection and analysis of water from rural domestic wells

5. **U.S.G.S. National Water Quality Study** - Participating with the study of the Lower Platte River by serving on the advisory Board and assisting with sample collection.

6. **Nebraska Ordinance Plant** - Assisted the U.S. Army Corps of Engineers and E.P.A. personnel on this study since 1987 in sample collection on and around the project site.

DESCRIPTION OF THE LOWER PLATTE NORTH NRD

Size, Population, and Industry

The Lower Platte North NRD is a composite of portions of seven counties in east central Nebraska. A distribution of associated county statistics demonstrates that the primary land mass, by County, is in Saunders County while the most financial support is generated from Dodge County. The City of Fremont is the single largest contributor of local general support resulting from the population of that city. The District comprises about 1,587 square miles and 1.03 million acres. It ranges about 110 miles from northwest to southeast and is roughly 65 miles wide north to south. The configuration resembles that of a coon skin cap with the tail lifted to the breeze (see Exhibit 1).

Estimated Population by County

County	% of County In the District	Acres In LPN NRD	Population Rural	Population Urban	Population Total	Percentage of Fiscal Input
Boone	12.9	56,473	362	--	362	2.3
Butler	44.3	165,476	2,022	3,387	5,409	11.0
Colfax	41.9	111,528	1,414	4,237	5,651	10.0
Dodge	30.2	104,245	3,100	25,215	28,315	35.7
Madison	6.3	23,086	194	770	964	1.5
Platte	38.5	169,432	2,848	723	3,571	10.5
Saunders	81.5	401,234	6,698	6,949	13,647	29.0

Twenty-eight cities, towns and villages are located in the confines of the District. Those twenty-eight communities are listed below with present estimated populations:

Fremont	23,680	Mead	513	Bruno	141
Wahoo	3,681	Platte Center	341	Colon	128
Schuyler	4,052	Lindsay	321	Leshara	118
David City	2,522	Bellwood	395	Richland	96
North Bend	1,249	Inglewood	286	Linwood	91
Ashland (Part)	219	Prague	282	Octavia	132
Newman Grove	770	Weston	299	Rogers	89
Cedar Bluffs	591	Morse Bluff	128	Memphis	117
Yutan	626	Malmo	114	Abie	106
Ithaca	133	Tarnov	61		

Information on industrial activity demonstrates a variety of industrial types present in the District.

The various types are listed below:

Alfalfa Products
Concrete Products
Dried Whey
Equipment Manufacturing
Fiberglass Manufacturing
Irrigation Equipment Manufacturing
Sand & Gravel Products
Steel Fabrication
Cheese Manufacturing
Dehydrated Hay
Egg Products Manufacturing
Feed Manufacturing
Packing Plants
Pasta Products
Soybean Manufacturing
Trailer Manufacturing

This industrial array also yields a diversity of water needs and waste treatment problems. These needs and problems may have a degrading effect on both ground and surface water quality and quantity if not properly addressed.

As would be expected in a rural agronomic society, the main industry is agriculture. The District is thus highly oriented toward agricultural activities and those events triggering changes in that industry. A review of the cropping history of the six major counties within the District demonstrates some fundamental practice changes which may result in far reaching effects on water use and water quality. Studying the acres harvested (Nebraska Agricultural Statistics Service, 1991/92) for corn, sorghum, wheat, soybeans, hay and oats during the years 1960 through 1991, it is evident there is a substantial move toward corn and soybean production. This change in crop production practices results in a decrease in the number of acres of crops providing better soil cover, such as is provided by wheat, oats, and hay. Table 2 illustrates the fluctuation in percentage of acres harvested of a composite of the six individual crops for the six counties. Madison County information was not used. As the total number of acres harvested increases, the following occurs:

1. Number of acres of permanent cover decrease.

2. The number of acres more susceptible to erosion and runoff increases.

3. The usage of fertilizer, herbicides, pesticides, etc. increases.

4. The potential for ground and surface water degradation increases.

Total Acres Harvested 1960-1990

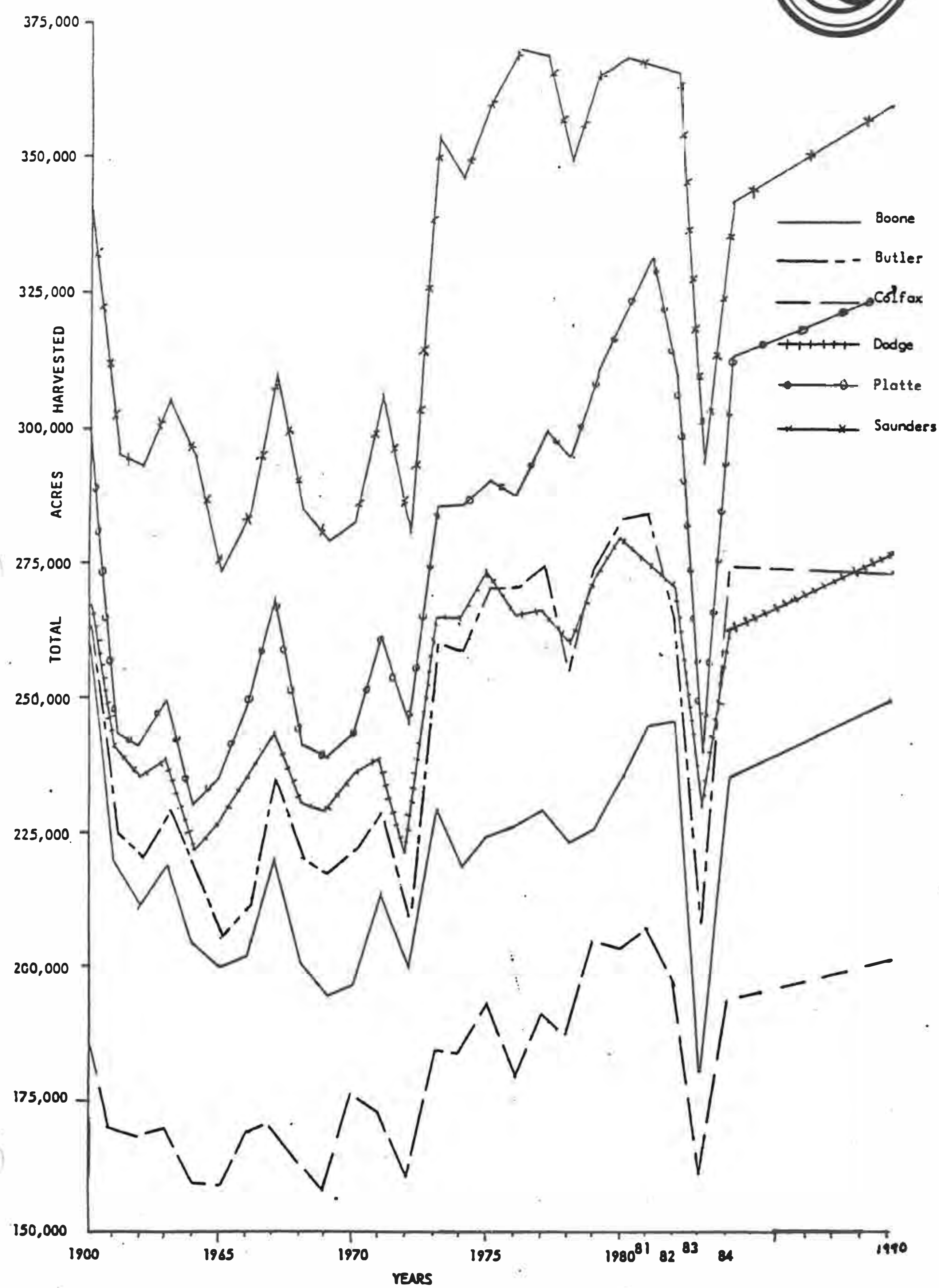

TABLE 2

According to the 1991 Nebraska agricultural statistics, the number of farms in the District have decreased significantly, resulting in an increase in the size of farming units. As the number of on-farm rural residents decrease in number, the methods of farming become more technologically oriented. Farming more ground in a shorter period of time with larger equipment leads to practice changes in the care of crops. For example, use of chemicals increases the potential for water quality degradation, if not properly applied. However, the 1991 Agricultural Statistics show a net decrease in fertilizer and pesticide usage from 1981 to 1991. For example, in 1981 fertilizer application rates for corn averaged 157 lbs/acre, in 1991 the average rate was 135 lbs/acre.

Livestock numbers tend to fluctuate with the markets and data indicates the general trend is toward a decrease in total numbers of cattle held on farms in unconfined areas. Small herds on pasture are not as prevalent as in the past and more concentrated feeding facilities may have caused or may be potential sources of future area groundwater quality problems.

The use of irrigation systems has increased dramatically. In the years leading up to 1970, the District records showed about 1,500 registered irrigation wells, but from 1970 to 1993, that number has more than doubled to 3,517. Of the total number of acres irrigated in the District, all but about five percent are irrigated with groundwater.

Drainage Systems

The Lower Platte North NRD is situated in the lower end of the Platte River basin, thus, the Platte River composes the primary flow system of the District. At a point just west of the District boundary, the Loup River and the Loup River power canal significantly augment the flow of the Platte and the effects can be seen throughout the remainder of the District. A few miles upstream from the southeast boundary of the District, the Elkhorn River joins the Platte River. These two tributaries form the major tributaries to the Platte River within the District and are also the major tributaries of the entire Platte system.

Shell Creek, along with it's principal tributary Loseke-Taylor Creek, provides drainage for the northwest portion of the District and drains approximately 460 square miles. The Shell Creek system flows in a southeasterly direction joining the Platte between Schuyler and Rogers on the north bank of the river. The remainder of the north bank drainage pattern is provided by Lost Creek and Rawhide Creek. Lost Creek parallels the Platte for approximately 15 miles then joins the Platte just east of Schuyler. Rawhide Creek and its man-made drainage systems provide flow east from Schuyler to areas northeast and southeast of Fremont where it flows into the Elkhorn River.

The Lower Platte North NRD area south of the Platte River exhibits three types of drainage patterns. First, from the Polk-Butler County line east to essentially the Butler-Saunders County line, the flow systems of the small watersheds of Bellwood, Bone, and Skull Creek carry water in a northerly direction to their confluence with the Platte. Secondly, the Clear Creek Watershed drains the eastern quadrant of Saunders County in a south southeasterly direction where it joins Wahoo Creek just above that creek's confluence with Salt Creek. Thirdly, Wahoo Creek's dendritic pattern provides drainage for about 480 square miles of Saunders County and is the single largest watershed in the District. It is composed of Cottonwood, Sand, Duck, Silver, and Wahoo Creeks. The general flow pattern is to the southeast joining Salt Creek just prior to Salt Creek's confluence with the Platte River below Ashland. With the combined flow of Clear Creek at this point, runoff can cause extremely high flows and often results in large areas of lowland flooding.

Topography

Exhibit 2 demonstrates the variability of topographic features in the District. The northwest arm of the District comprising portions of Boone, Madison, and about two-thirds of Platte County is composed of a dissected plains topography. The area is mostly hilly land with moderate to steep slopes, sharp ridge crests and some old, nearly level plains. This general pattern is a result of the force of wind and water erosion on the old, fairly level plain areas.

Some flat valley areas exist in north central Platte County typified by the topography in and around Platte Center and Tarnov. East central Platte County and western Colfax County are made up of hilly land containing moderate to steep slopes and more or less rounded ridge tops. Creek beds are incised into the landscape as a result of erosive forces, causing some rough terrain.

The Platte River Valley extends through the length of the District from Columbus to Ashland, a distance of about 125 miles. Throughout the western half of this stretch the valley width is about 5 to 7 miles wide but tapers from near Fremont to about two miles wide at Ashland. The valley side walls are composed of unconsolidated sediments and vary in topographic features from gently sloping smoothly rounded hills to steep walled somewhat narrow canyons. The valley portion is nearly flat and demonstrates a slope of about 4-6 feet per mile declining to the southeast.

Through the east central portion of Saunders County, from approximately North Bend to Ashland, is a broad fertile area, 5-8 miles wide, referred to as the Todd Valley. This area is made up of nearly level lands and includes some slight south-southeasterly stream drainage. It is situated at an elevation about 80 feet above the Platte River valley.

West and southwest Saunders County and eastern Butler County are what is known as the "hill area". It is composed of bluffs along the north edge (adjacent to the Platte River valley) and rolling hills, ridges, and steep valley slopes further south of the Platte. Maximum elevation changes in the area are up to 350 feet and slopes between drainages range 100 to 200 feet per mile.

As is evident from the foregoing information and a casual drive through the District, most of the District has undergone significant erosion. Some Dakota bedrock, particularly in western and eastern Saunders County, is located near the surface. However, most of the area is overlain by Quaternary sediment deposits that completely cover the bedrock in varying depths. The slope and near-surface material strongly influence the local topography and are a major influence upon soil type, land capability and utilization of the groundwater resource.

Soils

The types of soils overlying any particular area play key roles in the relationships of precipitation or applied surface flows to surface water runoff, groundwater recharge, and consumptive water requirements. Relationships are dependent upon the permeability of the soil, ability of the soil to hold water, and slope of the surface. All of these variables influence soil infiltration rates and result in the total amount of water contained in the soil profile. As stated, these soil aspects are very important to both the surface and groundwater hydrologic characteristics. Exhibit 3 illustrates the parent materials of the soils of the state, and Exhibit 4 illustrates soil types which formed from these parent materials.

Soils in the uplands of Butler and Saunders Counties consist primarily of clays and silty clays to silty clay loams somewhat similar to the Sharpsburg and Sharpsburg-Pawnee association. However, the recent Saunders County Soil Survey update will reclassify the soils. Primary soils in the upland areas are eroded to a point where they no longer exist, and landowners are now farming in the "B" horizon. This has tremendous implications for surface and groundwater quality. Permeability of these soils is less than 1.0 inch per hour on slopes that range from gentle to 20 percent. Recharge rates are quite low and recharge is principally limited to perched aquifers. These soils are loess type soils with some intermixed glacial till areas. The drainage pattern and flood plain configuration of Wahoo Creek is primarily composed of Kennebec soils of silty clay loam ranging from moderately to poorly drained.

The western portion of the Platte River corridor is comprised of Acadia-Platte alluvial fine sands underlain by sands and gravels. The eastern portion of the corridor is practically the same, however, depth to water in the eastern area is greater. This primary water line is bounded on the north by poorly drained Gibbon-Luton silty and clayey soils. Areas to the south and a few areas along the western end of the Platte River corridor contain silty soils that are well drained and of loess origin.

The northwest corner of the District is composed of moderately to well drained silty type soils with permeabilities ranging from 1 to 2 inches per hour above the areas adjacent to Shell Creek. Areas in northeast Platte County have permeability ranges of 1.5 to 5 inches per hour.

The general pattern of soil distribution shows that soils of loess origin are found on the uplands with alluvial soils predominant on the bottom lands. Permeabilities range from practically zero to greater than 10 inches per hour (near Columbus and southeast of Bellwood). The pattern shows that, generally, soils south of the Platte River are less permeable than those of the north side. Soil textures range from fine sands to silty clays. Soil surveys have been completed for all counties and the Saunders County Soil Survey (1959) is presently nearing completion of a substantial update.

Groundwater

The generalized map of the state depicting groundwater storage (Exhibit 5) in the principal aquifer, demonstrates the District has some areas with up to 100 feet of water in storage. However, these areas are located in the extreme northwest corner where the District overlies a portion of the southeast reaches of the Ogallala formation. The remainder of the District does not fare as well. In many areas water is stored in layered formations where stored quantities range from less than 20 feet to about 100 feet. Deeper aquifers are present in some areas.

A generalized depth to groundwater map (Exhibit 6) shows the Platte River and Todd Valley corridors with depth to water averaging around 50 feet or less. The map depicts generalized depth to water over the remainder of the District to be in excess of 50 feet.

The availability of groundwater used for competing purposes has been a contributing factor in the development of the District. The level of groundwater use and irrigation development has steadily increased over the years and somewhat parallels the state trend. Two periods of more rapid irrigation well development are evident, during the 1950's and the 1970's, presented in graphic form in Exhibit 7 and mapped on Exhibits 8A through 8G. Exhibits 8F and 8G also demonstrate that the 1980's and early 1990's also have been a period of intense well development.

The center pivot has provided the opportunity for tremendous growth in irrigation, particularly during the 1970's. Areas not previously irrigable due to topographic variations are now accessible. From 1965 to March 1993, the number of registered irrigation wells has almost tripled, to a total of 3,517 wells. This development becomes more significant when viewed in light of the pattern and intensity of well development (Exhibit 9).

The greatest concentration of wells are located adjacent to the Platte River in Butler, Colfax, and Dodge counties, and within the Todd Valley in eastern Saunders County. Both of these areas are characterized by soils and terrain suitable for irrigation, but may also be highly susceptible to water quality problems. In areas of low groundwater quantity, competition between users may become acute and is anticipated to be more so in the future.

Land Use

In 1986 the USDA Soil Conservation Service field offices conducted a Land Use Survey in an attempt to gain an accurate evaluation of current land use in Nebraska. Results of the survey in the LPN NRD are shown on Exhibit 10 and are summarized on Table 3. Land use in the LPN NRD is primarily cropland (75% of the total). Of the total land in the district, 51% is non-irrigated and 24% is irrigated, but water is primarily supplied from groundwater. Approximately 10% of the NRD is pasture or rangeland, with the remainder (15%) of the NRD split between various uses.

Environmentally Sensitive Resources

Wildlife in the LPN NRD has been influenced by the increasing urbanization of the region and changes in land use. As agriculture and other human activities disperse into areas that once were woodlands, grasslands, and marshes, the wildlife has either adapted, relocated, or has been negatively affected.

Some animals, fish, and birds that previously existed in large numbers in the District are now infrequently present or completely gone. The use of pesticides and loss of habitat has had an extremely negative impact for a variety of species. Some of the endangered or threatened species known to be or may have been in the District include: bald eagle, least tern, piping plover, peregrine falcon, swift fox, black footed ferret, river otter, pallid sturgeon, and blacknose shiner (Nebraska Game and Parks Commission). Much of this wildlife depends heavily upon habitat, food, and water supported by groundwater supplies in the District.

The grasslands, woodlands, and waters of the District support many animals, birds, insects, and aquatic life that are too extensive to mention in this short section. One endangered plant species which has been identified as possibly inhabiting the NRD is the Western Prairie fringed orchid. While this plant species has been observed to be present in Southern Dodge County, it may also be present in other areas of the NRD. The southern Dodge County site is located on an upland in a perched water table setting, which would not be considered part of the manageable groundwater reservoir (Personal Communication - Mike Fritz- Nebraska Game and Parks Commission, April 1994). The orchid could be affected by changes in groundwater levels and from groundwater activities in the plan. In this area, land use changes would be more of a threat to the orchid than changes in water quantity in the principal aquifer. As development encroaches upon remaining natural grasslands, the potential for extinction of this species increases greatly. The NRD has embarked upon a program to protect and preserve some of the valuable wetland and grassland resources within it boundaries, because it is aware of the need for such preservation for future generations. The general protection of groundwater quality and quantity is important to preservation of habitats of indigenous and threatened and endangered plant and animal species. Any NRD actions to manage the groundwater resources within District boundaries will be evaluated as it may impact these valuable resources. If adverse effects on sensitive resources are identified from changing groundwater quantity or quality, the NRD will evaluate the need for modification of its Groundwater

TABLE 3

NEBRASKA NATURAL RESOURCES COMMISSION
NATURAL RESOURCES DATA BANK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY TABLE
LAND USE DATA

LOW PLATTE NORTH NRD

PROCESSED: April 21, 1993

CATEGORY	LAND USE	ACRES	PERCENT
0	NO DATA	91765	8.20
1	NONIRRIGATED CROPLAND	576171	51.47
2	SPRINKLER IRRIGATED CROPLAND	151135	13.50
3	SURFACE IRRIGATED CROPLAND	107205	9.58
4	TAILWATER IRRIGATED CROPLAND	1920	0.17
5	FIELD BENCH IRRIGATED CROPLAND	488	0.04
6	CONTOUR BENCH IRRIGATED CROPLAND	0	0.00
7	PASTURE LAND	95775	8.56
8	SPRINKLER IRRIGATED PASTURE LAND	312	0.03
9	TAILWATER IRRIGATED PASTURE LAND	0	0.00
10	SURFACE IRRIGATED PASTURE LAND	0	0.00
11	FIELD BENCH IRRIGATED PASTURE LAND	0	0.00
12	CONTOUR BENCH IRRIGATED PASTURE LAND	0	0.00
13	RANGELAND	18334	1.64
14	FOREST LAND	15207	1.36
15	OTHER FARMLAND	23281	2.08
16	PITS AND QUARRIES	0	0.00
17	BARREN LAND	1819	0.16
18	BUILT UP LAND	18305	1.64
19	RURAL TRANSPORTATION	1311	0.12
20	WATER	16388	1.46
	TOTAL	1119416	100.00

Management plan as allowed under the Nebraska Groundwater Management and Protection Act. Modifications will include actions that they could take to reduce adverse affects. The NRD will continue to support hydrologic and hydrogeologic studies which will contribute to the foundation of knowledge needed to locate and identify orchid habitat and other water related sensitive habitats.

GEOLOGY

Geologic Sequence

The geologic bedrock maps (Exhibit 11) indicate Pennsylvanian deposits underlie the Cretaceous deposits in the extreme southeast corner of the District. Table 4 presents the geologic units in profile and lists their water bearing properties.

The oldest bedrock unit of known hydrologic importance, underlying most of Saunders, Dodge, eastern Butler, and Colfax counties, is the Dakota Sandstone. According to Ginsberg (1980), the Dakota underlying Butler County ranges in thickness from 500 to 600 feet and increases somewhat in thickness into Saunders County. Water quality is highly variable within this formation and is generally considered quite poor for domestic and agricultural use.

Bordering and overlying the Dakota on the west is a ribbon of Late Cretaceous age deposits called the Graneros Shale. Overlying the Graneros Shale is a thin layer of limestone named the Greenhorn Limestone. Neither of these layers are known to supply water to wells. These two formations have undergone significant erosion and vary in thickness throughout the area.

The youngest bedrock formation in western Butler, western Colfax, and eastern Platte counties is the Carlile Shale of Late Cretaceous age. This formation overlies the previously mentioned formation and like the Graneros Shale and Greenhorn Limestone, is not known to yield water to wells.

The Niobrara formation of Cretaceous Age forms the bedrock base under most of the portion of Platte County in the Lower Platte North NRD. Although not of significant regional hydrologic importance, water may be yielded locally to wells from fractures in the rock which have become filled with water. However, water in the Niobrara formation is generally high in total dissolved solids and may be rather poor quality.

TABLE 4

Geologic Units and Their Water-Bearing Properties
Lower Platte North Natural Resources District

System	Series	Major Stratigraphic Units	Physical Character	Water Supply
Quaternary	Holocene	Modern Soils	Locally silty, clayey, or sandy.	Transmits locally variable amounts of recharge to the groundwater reservoir.
		Recent valley-fill deposits	Stream-lain deposits of gravel, sand, silt, and clay associated with the most recent cycle of erosion and deposition along present streams.	May contribute significant amounts of water to wells.
	Pleistocene	Loess	Silt with lesser amounts of very fine sand and clay deposited as wind-blown dust.	Transmits recharge to the groundwater reservoir. May provide small quantities of water to a few shallow stock or domestic wells.
		Till	Ice-deposited silty, sandy clay with gravel and larger pebbles and boulders.	Relatively impermeable. Transmits water slowly to the groundwater reservoir. Groundwater may be perched above the till. Sand deposits within the till provide water to small-capacity wells.
		Glacial outwash and other ancient valley fill deposits.	Stream-lain deposits of gravel, sand, silt, and clay associated with ancient erosional and depositional cycles.	Contributes water to wells in generally large amounts Stream-deposited sand and gravel constitute the major reservoir in the NRD and yield water to large-capacity wells.
Tertiary	Pliocene(?)	Ancient valley-fill	Mostly unconsolidated silt. May blanket Cretaceous bedrock at base and on side slopes of paleo-valleys.	Generally too fine textured to yield water to wells.
	Miocene	Ogallala	Poorly sorted clay, silt, sand, and gravel generally un-cemented to slightly cemented.	The Ogallala constitutes a major reservoir in the western part of the NRD. Ogallal sand and gravel yield water to large-capacity wells.
Cretaceous	Upper Cretaceous	Niobrara	Chalk	May supply water to wells where fractures in the rock exist and are saturated.
		Carlile	Shale	Not known to supply water to wells.
		Greenhorn	Limestone	
		Graneros	Shale	
	Lower Cretaceous	Dakota	Sandstone and shale.	The Dakota constitutes a significant reservoir in the eastern part of the NRD. Potential yields and water quality are locally variable.

The four townships in the extreme northwest portion of the District are underlain by the Ogallala formation. The Ogallala ranges in thickness from about 10 feet in the eastern portion, to slightly more than 200 feet in thickness in the northwest tip of the District. The Ogallala does not occur in the central and eastern portions of the District.

Geologic Sections

Exhibit 12 (in pocket) demonstrates the distribution of the bedrock units across the District and illustrates the variability in the amount of overlying material. These ten cross sections demonstrate the confining layers in place and the vertical distribution of aquifer units. These will be discussed further as they pertain to the water bearing properties of the groundwater reservoir.

DESCRIPTION OF THE GROUNDWATER RESERVOIR

Definition of Terms

The following terms are defined to aid the reader in the following discussions. A larger glossary of water related terms is included in Appendix B.

Aquifer - a water bearing structure of rock or sediment capable of yielding supplies of water to wells.

Aquifer, Unconfined (Water Table) - the level below which the subsurface is saturated with water and at which the pressure head equals atmospheric pressure. A parameter associated with unconfined aquifers.

Aquifer, confined (artesian) - an aquifer in which the groundwater is isolated from the atmosphere by impermeable geologic formations and the resulting hydraulic pressure is generally greater than atmospheric pressure.

Aquifer, perched - a water bearing unit capable of yielding supplies of water to a well and containing unconfined groundwater. This unit is separated from an underlying aquifer by a less permeable unsaturated zone.

Potentiometric - Aquifer Thickness (PAT) - the distance from the potentiometric surface to the base of the principal aquifer.

Groundwater Reservoir - for any given area, the subsurface storage space between the water table and the base of the principal aquifer, includes one or more aquifers and any associated fine-grained material (usually excludes perched aquifers).

Potentiometric Surface - an "imaginary" surface representing the total head pressure in a confined aquifer that is defined by the level to which water will rise in a well.

Pressure Head - the height of a column of water which can be supported by the pressure at a given point.

Principal Aquifer - term used in describing the primary units for water supply.

Till - generally unstratified, unsorted, and unconsolidated drift consisting of intermingled clay, sand, and boulders.

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

Unsaturated Zone - porous earth materials which contain both air and water in their pore spaces.

Description of Principal Aquifer Systems

Quaternary Aquifer System

During the Pleistocene time period, three fairly distinct types of material were deposited. The youngest, near surface deposits, are the loess soils (or wind blown dusts) composed primarily of silt containing lesser amounts of very fine sands and clay. The layer deposited just prior to the loess is composed of till dredged and placed by continental glaciers. Till is normally composed of ice-deposited silty, sandy clay containing some gravel, large pebbles, and boulders. Because the till is clayey and poorly sorted, it is not generally considered an aquifer, and often serves as a confining layer.

Glacial outwashes are composed primarily of glacial stream deposits of gravel, sand, silt, and clay associated with the water melt from the ice sheets. These channels occur on top of the till, may cut into the till, or may lie under the till. Their primarily coarse-grained deposits are the principal water bearing material for much of the District. Because of the varying erosion/deposition cycles of the Quaternary, the groundwater reservoir is a complex multilayered system of aquifers separated by fine-grained silt, clay, or till layers.

Ogallala Aquifer

The Ogallala formation is made up principally of calcareous fine to medium grained sandstone, clayey or sandy silt, and lenses of coarse-grained sands and gravels. These materials are normally uncemented. However, some areas may have become slightly cemented due to calcium carbonate complexes. Silt is the predominant material throughout the formation but significant amounts of sand and gravel and sandstone allow some highly productive wells to be developed in this formation. The portion of the Ogallala in the Lower Platte North NRD is merely the eastern tip of this aquifer where most of the state's water is in storage.

Dakota Aquifer

The Dakota formation is often not classified as a principal aquifer due to the fact its geology within the NRD is not well defined and the chemical characteristics are generally undesirable. However, since it is used for a source of water where shallower aquifers do not provide an adequate water supply, it is appropriate to recognize its significance. The Dakota is composed of a thick series of interbedded sandstones and shales. The sandstone varies from very fine grained to quite coarse and may contain gravel deposits near the base. The shale is of a sandy, carbonaceous clayey material. Normally, in this area, the Dakota sandstones are penetrated and screened in combination with overlying aquifer material in order to gain sufficient saturated thickness for an irrigation well.

Due to the normal consideration of the Dakota as a secondary supply of water, it has not been included in the descriptive maps of the principal aquifer (i.e., saturated thickness and the base of the aquifer).

Geographic Distribution of Groundwater Reservoir

Exhibit 13 illustrates the underground water areas of Nebraska. From this map, it is evident that the Lower Platte North NRD is situated over four of these groundwater regions. The Platte River Valley coincides with the Platte River as it is contained within the District. The northwest portion of the District (half of Platte, Boone, and Madison counties) is located in the east central Dissected Plains. Portions of Platte, Colfax, and Dodge counties are integrated into the northeast Nebraska Glacial Drift, and Saunders and Butler counties are in the southeast Nebraska Glacial Drift region.

Exhibit 11 depicted the locations of the Dakota and Ogallala formations. Of the bedrock formations these two are the principal bedrock water bearing units in the District, with the Ogallala utilized as a principal aquifer. These two formations are located in the east-southeast and northwest parts of the District, respectively. Exhibit 14 (Dakota) and Exhibit 15 (Ogallala) show their spatial distribution and Exhibit 16 illustrates the distribution of potential water bearing Holocene and Pleistocene (Quaternary) deposits of the District, which contain the majority of the aquifer units composing the groundwater reservoir.

The geologic profiles (Exhibit 12) demonstrate the extreme variability in the areal distribution of Holocene and Pleistocene aquifers. The generalized map of the state (Exhibit 16) demonstrates that the Platte Valley, Wahoo Creek, and Shell Creek are areas of bottom land configuration containing a thin alluvial layer. Adjacent to the Shell Creek area, in western Platte County and in Boone County, are mixed dune sands and sandy table lands that provide water for irrigation and public use. The areas of western Saunders and most of Butler County are primarily composed of loess deposited on glacial drift and contain water bearing layers of varying depths.

The Todd Valley in eastern Saunders County is an area of Quaternary deposits of sands and gravels constituting a very important regional groundwater reservoir. These deposits, in combination with the Dakota, are the source of supply to nearly all of the wells in that area.

Irrigation development throughout the District provides some indication of the geographic distribution of the groundwater reservoirs. Exhibit 9 (registered wells through March 1993) clearly demonstrates irrigation has developed somewhat extensively along the Platte River corridor, from the west end of the District to the Fremont area. Development in Colfax, Platte, and Boone counties closely follows the groundwater availability patterns. Irrigation well development in Saunders County is almost exclusively limited to the Todd Valley and the Sand/Duck Creek areas adjacent to the Todd Valley.

The LPN NRD has subdivided the District into four groundwater reservoir areas based upon aquifer types, areal distribution and development. These areas are referred to as Shell Creek, Platte Valley, Uplands, and Todd Valley (Exhibit 17).

Stratigraphic Definition

The generalized geologic profiles (Exhibit 12) were developed by combining published geologic profiles and UNL Conservation and Survey Division in-house reports. These profiles have become a valuable tool in educating the staff, directors, and public about the complex, multi-layered system of groundwater settings within the District. The ten profiles yield an excellent underground look at the layered configuration of the District.

Table 4 is developed as a stratigraphic column showing depositional sequence, age, and characteristics of the various units, The table shows Holocene deposits, or recent valley fills, may contribute significant amounts of water to wells in some areas. Pleistocene loess deposits provide small quantities of water to a few shallow stock and domestic wells, while the till areas include intermingled sand deposits that may provide water for small capacity wells. The glacial outwashes and other ancient valley deposits contribute water to wells in fairly large amounts. Stream deposited sand and gravels of the Quaternary age constitute the major regional aquifers in the NRD, in terms of yielding water to large capacity wells.

The Ogallala and the overlying Quaternary in the western portion of the NRD is a major aquifer in that area. These units, although variable in depth and thickness, yield water to large capacity wells. The Niobrara formation through Platte County may supply water to wells if they are located in fractured rock. Few wells have been developed in the Niobrara because of sufficient quantities of overlying Quaternary material in most areas.

The Dakota constitutes a significant secondary aquifer in the eastern part of the NRD. The Dakota is penetrated and tapped by wells over a significantly large area in combination with overlying Quaternary deposits. Well yields and water quality from the Dakota are locally quite variable.

Groundwater Availability

The configuration of the base of principal aquifer map (Exhibit 18) does not include the highly variable Dakota formation as part of the principal aquifer, which has been excluded due to the lack of substantive information identifying its use and depth. Exhibit 18 is a modification of the Department of Environmental Quality and Conservation and Survey Division, UNL 1980 base configuration map. The update was accomplished by plotting additional data points from the drillers logs of irrigation, municipal, and monitoring wells. The contours were adjusted accordingly and represent a map of the base of the aquifer according to data available as of August 1985. This map by itself does not tell much about the groundwater reservoir, but coupled with the water table map, it helps in defining aquifer thickness.

Key variations from the 1980 Conservation and Survey Division map are in the areas from the Butler/Saunders County line west through Butler County, around the Platte Center area, and the Newman Grove and Lindsay regions. The new lines of the bedrock map indicate locations of possible bedrock valley forms in the older formations. Sands, gravels, and pebbles have filled these areas and thereby provided sufficient area for water storage.

Exhibit 19 represents the average water level surface in the principal aquifers in 1985. While the water table surface changes with time, the 1985 map is used here to generally represent regional direction of groundwater flow and elevation of the water table. The lines of equal water elevation may not constitute a continuous water level surface. Variability in mapped water levels may be explained as a result of data being obtained from wells of various depths and screened at different depth intervals, penetrating both confined and unconfined aquifers. In some areas of Butler, Dodge, and Saunders counties, water level contours may not represent actual elevations because of insufficient monitoring information and the complexity of the geology.

The water level elevation map represents the water level that will rise in a well and not necessarily the "water table". Some of the regional aquifers are "confined" (or more commonly known as "artesian") so the water levels in these wells will represent different conditions than those measured in an unconfined (water table) aquifer. The LPN NRD will periodically update this Exhibit in order to monitor changes in groundwater flow at various times of the year or over the long term.

A thickness map of saturated coarse-grained sediments of the principal aquifer (less the Dakota), noted as Exhibit 20, was developed for the plan in 1985, to more accurately define the areal distribution and thickness of saturated sand and gravel deposits. The map was constructed using data from registered irrigation well logs of sufficient detail, as well as those logs of the Conservation and Survey Division test holes. This map will be updated with new information from well logs as they become available.

A large portion of the subsurface of the District is composed of glacial till and other silts and clays not readily providing water to wells and may act as confining beds contributing to artesian head in the underlying sands. Exhibit 20 provides definition of the thickness of saturated coarse-grained material without considering the effects of artesian head or perched water levels. This map provides a basis for making conservative estimates of water in storage and well yield.

The saturated thickness map demonstrates that a sizeable portion of Saunders, Dodge, and Butler Counties are underlain by aquifers less than 50 feet thick. A large part of the remainder of the District is underlain by less than 100 feet of saturated sand. Generally, the Todd Valley area, the paleovalley just north and east of David City, areas adjacent to Tarnov, and a portion of the northwest corner of the District appear to have a significant saturated thickness and sizeable quantity of water in storage for present uses at current rates.

Water level rises and declines can be directly related to changes in saturated thickness only in an unconfined aquifer. In a confined aquifer, water level declines do not represent a reduction in saturated thickness, but rather a reduction of artesian head. Water level fluctuations cannot be directly related to percent of saturated thickness unless the hydraulic relationship has been accurately defined.

Groundwater Reservoir Yield

Transmissivity values are used to quantify the ability of an aquifer to transmit water and assist in explaining present development and future development potential of the principal aquifers. Values of transmissivity are normally expressed in terms of thousands of gallons/day/square foot. To visualize this (transmissivity) value, imagine a one square foot window in the side of an aquifer for one day with a hydraulic gradient of one. If the window were lengthened to stretch from the top of the aquifer to the bottom, and still be one foot wide, the amount of water that would flow out of this window in one day would be called the transmissivity (gallons of water yielded per square foot of formation per day). Transmissivity relates indirectly to well yield. Well yield, usually expressed in gallons per minute, is the ultimate measure of the volume of water which can be extracted from a well in an aquifer. (Design efficiency and purpose of the well often mark the ability of an aquifer to produce water). As a function of aquifer thickness and permeability, transmissivity estimates provides an indication of the productivity of an aquifer. Exhibit 21 illustrates areas adjacent to the Platte River, the Todd Valley, Central Platte County, and the upper Ogallala area of Boone County (in the District) possessing transmissivity values of more than 100,000 gallons per day, per foot of formation. The area of west central Saunders County and east central Butler County exhibit transmissivity values ranging from 1-20,000 gallons per day, per foot.

Calculation of transmissivity values requires fairly site-specific data analysis. Parameters used in transmissivity calculations are the saturated thickness and the permeability of the formation with respect to water. Detailed large scale calculations of transmissivity values have not been made for the Lower Platte North NRD. The state map, as discussed above, is sufficient to provide a general idea of transmissivity values over the District.

A more meaningful map, at least from the District's standpoint, is a map evaluating the ability to provide water to a well. Exhibit 22 depicts a general estimated well yield for the District aquifer areas, minus the Dakota. This map agrees in context with the generalized state map of transmissivity. It relates the saturated thickness and transmissivity data while providing an overview of estimated area yields assisting in developing area specific management decisions.

Water Level Changes - Predevelopment to 1991

A critical element in managing groundwater is the determination of what happens to the water levels in the groundwater reservoirs over time. In 1985, when the first LPN NRD groundwater management plan was developed, little data existed for use in analysis of water level trends. Ideally, a long period of record is desired to evaluate water level changes from predevelopment to the present which would provide long-term trends with averaging for seasonal and climatic variations. The U.S.G.S. and the Conservation and Survey Division long ago recognized this need and began a cooperative water level measurement program, in 1930, designed to observe and document water level changes throughout Nebraska. Unfortunately, the period of record in the LPN NRD does not date from 1930 and is too short to adequately determine long-term trends in water levels. However, where possible, individual comparisons have been made between 1991 water levels and estimated predevelopment water levels in the U.S.G.S. "1991 Water Level Changes report" and estimated predevelopment water levels were determined for a large portion of the NRD. Predevelopment water levels are defined as the approximate average water level at a well site, prior to human development. All available water-level data collected prior to or during the early stages of development were used to estimate predevelopment water levels.

Exhibit 23 sets forth the U.S.G.S. and Conservation and Survey Divisions approximation of net water level charge from estimated predevelopment to fall, 1991. The lower Shell Creek Reservoir and the Uplands Reservoir contain large areas where data was insufficient to determine predevelopment water levels. Monitoring wells outside the LPN NRD boundary were included on this Exhibit to provide a broader view of possible border concerns. Generally, from the few points for which predevelopment water levels are estimated within the NRD, it appears water levels have changed less than 5 feet. The only two exceptions of note are the area between Ithaca and Memphis and the one N.E. of North Bend which show declines slightly greater than five feet. The water level in a monitor well located south of David City, in the Lower Platte South NRD, is estimated to have dropped more than 40 feet since predevelopment. This well is located in an intensively developed, confined aquifer, where water level drop may reflect a drop in artesian pressure rather than dewatering of the saturated thickness. The LPN NRD's monitoring program also indicates the area near David City (north of this well) to be in a an area of decline in the past.

Water Level Changes - Base Year

In the 1985 Plan, one area of primary concern was the lack of a sufficient water level monitoring network to detect changes. In 1986, the LPN NRD began a program to fill this gap, utilizing 68 actively monitored wells for spring and fall measurement (pre and post-irrigation season). Monitor well locations are shown on Exhibit 24. Results of monitoring from the spring of 1987 through spring of 1993 are mapped on Exhibit 25, while selected hydrographs of key representative wells are presented on Exhibit 26.

As with any graph or map of data, the numbers presented must be placed in the proper perspective to be meaningful for management. The data gathered by the LPN NRD indicate a tendency toward decreasing water levels when tested against 1987 as the base year. 1987 was a relatively wet year and hydrograph data showed an elevated water table. However, 1987 is an excellent year to use as an "index" year because of the accuracy of the water level measurements from that time on. As additional water level data from the monitoring network is collected, a better picture of the long-term trend in water levels in the District aquifers will develop. The "index" year can be adjusted over time to more closely approximate a "normal" year.

The levels shown in Exhibit 25 can be placed into perspective by consideration of their relationship to the saturated thickness of the aquifer. Exhibit 20 is a map of saturated thickness of the various coarse grained aquifers of the District from the 1985 Plan and Table 5 summarizes the net water level changes as a percentage of saturated thickness.

Table 5

Net Water Level Change as a Percentage of Saturated Thickness, Selected Wells: Lower Platte North NRD Groundwater Level Data; Spring 1987 - Spring 1993

Well #	County	Aquifer	Long-Term Net Change (feet)	Estimated Saturated Thickness (ft)	Approximate % of Saturated Thickness
6	Platte	Shell Creek	-5.0	50 - 100	5 - 10
8	Platte	Shell Creek	-5.2	75 - 100	5 - 7
12	Platte	Shell Creek	-4.4	100 - 150	3 - 4
17	Platte	Shell Creek	+2.2	75 - 100	2 - 3
21	Colfax	Shell Creek	-2.5	75 - 100	2 - 3
24	Butler	Platte Valley	-6.1	75 - 100	6 - 8
25	Butler	Platte Valley	-6.7	75 - 100	6 - 9
66	Dodge	Platte Valley	-6.5	25 - 50	13 - 26
27	Butler	Uplands	-3.3	150	2
30	Butler	Uplands	-10.9	100 - 150	7 - 11
31	Butler	Uplands	-7.2	150 - 200	3 - 5
34	Saunders	Uplands	-0.4	100 - 150	<1
43	Saunders	Uplands	-2.4	75 - 100	2 - 3
48	Saunders	Uplands	-7.3	75 - 100	7 - 10
49	Butler	Uplands	-4.0	150 - 200	2 - 3
53	Butler	Uplands	-9.4	0 - 25	>38
57	Saunders	Todd Valley	-6.3	100 - 150	4 - 6

As shown in Table 5, a water level decrease in Well No. 31 (saturated aquifer thickness of 150 to 200 feet) does not carry the same implications as a 10 feet decrease in Well No. 53 (saturated aquifer thickness of 0 to 25 feet). The water level decline in the former well is less than 5 percent of aquifer saturated thickness, while in the latter just 6 miles to the north, it is over 35 percent.

Generally, District-wide water levels have declined slightly from 1987 through 1993, (less than five feet). The most significant area of decline has occurred in the David City area where water levels have declined more than 10 feet from the spring of 1987 to spring 1992. These declines are likely to be pressure head changes since this aquifer is considered to be a confined or semi-confined aquifer. Further monitoring and investigation is needed to define the relationship between the declines in water levels, changes in pressure head, and saturated thickness so as to place the declines in perspective. The LPN NRD added 11 monitoring wells in this area in 1991 to assist in gaining more pertinent information. The Shell Creek groundwater reservoir also shows some small areas of decline (<5 feet), but is difficult to characterize due to insufficient data. The LPN NRD plans to increase the number of wells monitored in this reservoir. The Platte River and Todd Valley reservoirs show only slight declines (<5 feet) from both estimated predevelopment and the 1987 "index" year. Both of these reservoirs are intensively developed and appear to be supporting this development without large-scale mining of groundwater occurring. Hydrographs of NRD monitor wells are included as Appendix C for further reference.

Groundwater Level Monitoring Network

As of June 1994 a total of 116 wells are being monitored district-wide for groundwater level changes. The Lower Platte North NRD plans to add more wells to the network in the next few years to a goal of 120 wells. Expansion into the Shell Creek Reservoir is the first priority, where multiple aquifers are known to exist. This reservoir is of concern because water levels have been declining to near the 10% level of saturated thickness.

A secondary network of 11 wells was added in the David City area in 1991. Most of these wells will be added to the primary trend monitoring network with the remainder monitored only in the spring. The aquifers in this area are semi-confined and show great fluctuation from spring to fall every year. In several areas the saturated thickness had declined close to 7% by the spring readings of 1992, which is the first trigger level for groundwater management of a confined aquifer.

The NRD's water level monitoring program is still being formulated. The first wells in the network were initiated in 1985. The NRD intends to have a trend network established for the entire district, with secondary networks established for more intensive monitoring in problem areas.

GROUNDWATER FLOW SYSTEM

Recharge

Groundwater recharge is dependant upon a variety of important parameters which include: water availability; the amount, frequency, and timing of precipitation; land slope and land use; soil infiltration rates; vertical permeability, and soil conditions.

Precipitation

Precipitation in the Lower Platte North NRD serves as the principal source of water for recharge in all but the Platte River Valley adjacent to the River. Exhibit 27 demonstrates the mean annual precipitation for the state and the Lower Platte North NRD. The average annual water requirement for maximum yield by crops varies from 25 inches for corn to 22 inches for grain sorghum and soybeans. It, therefore, appears that an abundance of moisture exists over the District, however, the timing and amount of precipitation determines crop water availability. (Exhibit 28 illustrates the timing and distribution of precipitation). Moisture needs are more critical at certain times in the crop growing cycle and if moisture is not available, crop production can and does suffer. Detailed evaluations of precipitation versus soil moisture and crop water needs are necessary components in providing a comprehensive management system.

This area of the state receives maximum precipitation in April, May, and June. The maximum water use period by crops stretches from April through September (crop dependant), with July, August, and September water requirements exceeding available average precipitation. It is apparent that at certain times there is a need for irrigation water in order to produce higher yields.

Temperature fluctuations and wind patterns are two other variables combining with precipitation to influence the amount of water moving down to the water table for recharge.

The LPN NRD recognized the need for good records of precipitation in anticipation of developing a District groundwater model. Since 1985, the NRD has supported expansion of the precipitation data collection network, and now has a network that covers the NRD and is considering adding a few new stations. The present distribution of the NRD precipitation network is mapped on Exhibit 29.

Seepage

Exhibit 30 indicates the Platte River is a losing stream from Columbus to the Salt Creek confluence. Field work by NRD staff has also indicated that the Platte River loses water to the east and north but gains from the south and west, as it flows to its confluence with the Elkhorn. From the Elkhorn River to Salt Creek, water moves underground to the west into the Lincoln municipal well fields. The slope of the water table between the Platte and Elkhorn rivers also indicates a potential loss of water by eastward seepage into the Elkhorn River aquifer. If the Elkhorn River is a gaining river in this stretch, it probably returns such gains to the Platte River at the confluence of the two rivers.

Some seepage from Lake Babcock has contributed a small amount of recharge in the area of the District adjacent to that structure. Some water logging on adjacent lands has occurred and is possibly due to an elevated water table caused by this seepage.

The LPN NRD has instituted a program of mapping seeps along streams in the NRD. These maps will be useful for water budget calculations, modeling, groundwater contamination, and identification of discharge/recharge acres. The LPN NRD has almost completed this type of mapping within the NRD.

TABLE 6

Estimated Recharge Data
Lower Platte North Natural Resources District

Soil/Topographical Region	Area Mi^2	Average Precipitation in. (ft)	Estimated Average Percent Recharged	Total Recharge AF	Total Recharge MG
1. Silty soils in valleys, developed on alluvium.	339	28 (2.33)	15	$7.6x10^4$	$2.5x10^4$
2. Silty soils on uplands, terraces or plains, developed on loess.	945	28 (2.33)	5	$7.2x10^4$	$2.4x10^4$
3. Loamy or sandy soils in valleys, terraces, or plains, developed on alluvial sands.	162	28 (2.33)	20	$4.9x10^4$	$1.6x10^4$
4. Silty, clayey, or loamy soils in uplands, developed on glacial till and loess.	35	28 (2.33)	1	$4.5x10^2$	$1.5x10^2$
5. Other	62	---	---	---	---

Land Slope

Land slope is an important recharge component as the slope determines how rapidly rainfall will run off an area or will be retained for infiltration into the groundwater reservoir. The variability of topography in the District is significant. The District encompasses six of the seven types of topography as defined by the UNL Conservation and Survey Division (Exhibit 2). In general terms, one would expect less runoff and more water available for recharge in the valleys or flat-lying areas then in areas of rolling hills. This higher recharge rate associated with sandy type soil valley areas makes them more susceptible to groundwater contamination through percolation. Reference to area and site specific slope information can be obtained from county soil surveys and topographic maps.

Soils Data

Site specific information related to particular soils and their hydrologic properties may be obtained from the soil surveys of Boone, Butler, Colfax, Dodge, Madison, Platte, and Saunders counties. Later soil surveys include tables classifying soils into four hydrologic units and illustrates runoff estimates and infiltration rates.

General soil association areas in the Lower Platte North NRD are found on Exhibit 31. A comparison of this Exhibit and Exhibit 2 provides a general overview of soils overlaying particular topographic regions. The following graphic provides an estimated percentage of average annual groundwater recharge from precipitation within topographic regions.

Topographic Region	Natural Recharge (%)
Valleys	20-30
Plains	3-5
Dissected Plains	10-15
Sandhills	25-30
Rolling Hills	1-5*
Bluffs and Escarpments	1-2

*Recharge is usually to perched aquifers.

LOWER PLATTE NORTH NRD
ESTIMATED GROUNDWATER IN STORAGE
(Does Not Contain Dakota Water - only saturated coarse sediments - no clay/silt water)

Township	Feet Average Sat. Thickness X 0.2 X	Area Mile 2	mi2 x 640 Acres =	(acre feet) Water Volume
22-6W	100	16	10,240	204,800
22-5W	125	36	23,040	576,000
21-5	75	27	17,280	259,200
21-4	50	36	23,040	230,400
20-5	75	9	5,760	86,400
20-4	50	22	14,080	140,800
20-3	50	26	16,640	166,400
19-3	100	24	15,360	307,200
19-2	125	36	23,040	576,000
19-1W	125	36	23,040	576,000
19-1E	75	36	23,040	345,600
19-2E	75	24	15,360	230,400
18-2W	75	17	10,880	163,200
18-1W	75	30	19,200	288,000
18-1E	100	30	19,200	384,000
18-2E	75	30	19,200	288,000
18-3E	75	14	8,960	134,400
17-2E	75	36	23,040	345,600
17-3E	50	36	23,040	230,400
16-1E	75	30	19,200	288,000
15-1E	100	18	11,520	230,400
15-2E	100	18	11,520	230,400
15-3E	100	36	23,040	460,800
16-2E	75	36	23,040	345,600
16-3E	25	36	23,040	115,200
17-4E	75	36	23,040	345,600
17-5E	75	36	23,040	345,600
17-6E	50	36	23,040	230,400
17-7E	50	36	23,040	230,400
17-8E	75	30	19,200	288,000
17-9E	25	13	8,320	41,600
16-4E	0	36	23,040	-
16-5E	0	36	23,040	-
16-6E	50	36	23,040	230,400
16-7E	100	36	23,040	460,800
16-8E	30	30	19,200	192,000
15-4E	100	36	23,040	460,800
15-5E	0	36	23,040	-
15-6E	0	36	23,040	-
15-7E	75	36	23,040	345,600
15-8E	100	30	19,200	384,000
15-9E	25	25	16,000	80,000
14-5E	75	18	11,520	172,800
14-6E	75	36	23,040	345,600
14-7E	50	36	23,040	230,400
14-8E	75	30	19,200	288,000
14-9E	50	36	23,040	230,400
13-8	25	30	19,200	96,000
13-9	50	35	22,400	224,000
				12,425,600 AF

Plus an estimated 530,200 for townships uncalculated 12,955,800 AF
It is estimated that the range is about 10-20 million acre feet which is approximately 1% of the state total. The above figures represent about 0.6% of the state total in storage.

TABLE 7

Table 6 provides a generalized estimate of recharge by soil types for the entire NRD. Estimates were based on measurements of acres in each soil type, multiplied by the estimated recharge times precipitation, to obtain an estimated recharge in acre-foot.

Storage

Exhibit 5 demonstrates the generalized map of groundwater in storage in the principal aquifers (does not include the Dakota aquifer) of the state. Table 7 provides an estimate of groundwater in storage by township in the Lower Platte North NRD and indicates approximately 13,000,000 acre feet of water in storage in the District. This storage figure is estimated to be low as it includes only the saturated coarse sediments and does not include the Dakota, the Quaternary fine-grained deposits, or differences in storage resulting from artesian conditions.

In developing the 1985 Groundwater Management Plan, the LPN NRD divided the District into three generalized groundwater planning and potential management areas. In attempting to determine the volume of stored water within the three areas, some estimates of portions of townships in the respective areas had to be made. (This determination is on file at the Lower Platte North NRD office.) The calculations produced the following estimated volumes in storage by area, and is estimated to be about 1% of the states total storage.

Saunders/Butler County Uplands	4,132,240 AF
Platte River Corridor	4,039,560 AF
Northwest Uplands	4,784,000 AF

The high numbers in the Saunders/Butler County area may be misleading as the preponderance of that amount is located in the Todd Valley region of Eastern Saunders County.

Exhibit 20 shows the saturated thickness of water bearing areas of the Quaternary sands and gravels and Ogallala sandstones. Unsaturated areas of the District allowing storage of significant quantity are limited. One area in northwest Saunders County, (communication with Vince Dreeszen 1985) may have slight storage potential but is assumed to be uneconomical to develop as a groundwater storage area. More detailed studies would have to be made to determine the type of storage facilities versus economic compatibility of systems and system use.

Discharge

Stream Discharge

Quantifying stream discharge will take time to develop as the present stream flow data is not of sufficient quantity or quality to make such determinations. Several streams flow year round and many more exhibit intermittent flows, however, repetitive flow records that could provide District evaluations of flow fluctuations do not presently exist. Currently (1993) the NRD measures streamflow for baseflow conditions at fourteen sites in late August and early September.

Groundwater Use

Historical Rate of Use

The primary volumetric uses of groundwater in the District has been to support irrigation, and municipal water needs. Since actual historical water use values or estimates are not available, the development of irrigation wells serves as an indicator of aquifer use. Exhibit 32 provides a look at the development through cumulative totals and annual totals of irrigation well development by county. Exhibits 7 and 8A through 8G graphically illustrates the 1950's and 1970's have been periods of rapid well installation. It also appears that the late 1980's and early 1990's may be considered a period of intense well development. Exhibit 9 depicts the distribution of irrigation wells as of 1993 and demonstrates areas of most intense irrigation.

Groundwater is the principal source of supply for public drinking water systems. All cities, towns, and villages in the District derive their supply from the groundwater reservoirs. Lincoln (located out of the District) and Fremont have extensive well fields along and adjacent to the Platte River in Saunders and Dodge Counties, respectively and Exhibit 8 shows the location of the present municipal well fields in the NRD.

Industry, rural domestic and livestock needs make up the other uses of historical significance, as well as present and projected future groundwater usage.

Present Use Estimates

Table 12 provides a profile of estimated groundwater usage 1983. This table was generated to demonstrate the magnitude and importance of the groundwater reservoir to the various present users. These figures vary with needs for water in any given year and are dependant on temperature and moisture conditions within the District. Irrigation, domestic and livestock uses were estimated using 1983 registered well data and USGS data. Public supply and self-supplied industrial water use values were obtained from the Nebraska Water Use Data Program Data Bank.

Even though the City of Lincoln is not located in the Lower Platte North NRD, a significant portion of the well field for Lincoln's public water supply is situated along the Platte River north of Ashland. It is reported that the present use rate for the city of Lincoln, out of the well field, averages 31 mgd (million gallons per day), but can be as high as 95 mgd in the summer months. This volume, added to that required by irrigation and other public and private users within the District, indicates that the quantity, as well as the quality of the groundwater of the District is extremely important for continued and or sustained development.

TABLE 12

1983 Profile of Estimated Groundwater Use
Lower Platte North NRD
(By Counties or Portions of Counties within the District)
(Values in Acre-Feet)

	Boone	Butler	Colfax	Dodge	Madison	Platte	Saunders
Irrigation							
Pivots	8,831	7,948	6,513	4,747	1,766	12,916	17,662
Gravity	2,261	49,403	57,316	58,733	1,357	27,451	35,830
Total	11,092	57,351	63,829	63,480	3,123	40,367	53,492
Public Supply	----	614	721	4,541	219	348	35,949
Self-Supplied Industry	----	----	38	2,062	----	----	106
Rural Domestic	40	230	150	150	40	280	690
Total	11,132	58,195	64,738	70,233	3,382	40,995	90,237

Dodge County - Municipal and Industry use a greater % of total use than other areas - of concern because use is from rather shallow aquifers.

Future Use Estimates

The City of Lincoln is presently developing a new well field on a Platte River Island just downstream from the southeast corner of the District. This well field is anticipated to about double the possible volume of water per day taken from the aquifer.

The Metropolitan Utilities District has purchased land along the Platte River in Saunders County across the River from the Douglas/Sarpy County line. This area is to be developed into a municipal well field, providing water to the City of Omaha and surrounding areas. Monitoring of these activities will be incorporated into the LPN NRD groundwater program.

With increases in nitrates and potential increases in chemical constituents in rural drinking water supplies, the potential for regional drinking water supplies must be explored by the District.

Other Uses

Exhibit 33 presents generalized subirrigation areas of the District. To date, the demand upon the aquifer resulting from subirrigation, evapotranspiration, sand pit development, and phreatophytic growth is not quantified. Those needs and volumes are to be computed if a complete management scheme is to be realized that provides optimal use of the resource.

Summary

Based on available data, the groundwater flow system appears to be somewhat in equilibrium with inflow approximately matching discharge. Some decline of water level has occurred district-wide since 1987. The area of most significant decline is located near David City. The period of record for water level monitoring, however, is extensive enough to determine that a portion of the decline is a result of normal climatic variation and a portion is a result of groundwater mining.

The need for groundwater in the District is destined to increase. Lincoln estimates that by the year 2005, its daily use may average 48 million gallons per day with one day peak use estimates to exceed 100 million gallons per day. Municipal uses place a relatively high economic value on the water for domestic usage. Total population served with groundwater from the District presently approaches 250,000, and with addition of a new well field near Yutan by MUD in Saunders county, that population figure will more than double and possibly triple within a decade.

Economic values associated with crop production in the District will be calculated as the base data is accumulated and distribution and cropping practices are analyzed. The three major crops grown in the district demonstrates the need of a water use range of 21 to 26 inches to provide a finished product. A gross water budget will be developed in accordance with the Lower Platte North NRD ground and surface water management strategy when water quantities and needs are better known.

AVAILABILITY OF OTHER WATER FOR ARTIFICIAL RECHARGE AND INTEGRATED MANAGEMENT

Surface Water

Flowing Water

It is inevitable that as the value of water increases and the demand for somewhat limited supplies of water increases, the greater the attention focused on the streams and rivers of the state and the NRD. Bentall, 1982, states "within the last few years, several projects entailing additional storage features and greater use of water from the river (Platte) have been proposed. These have become controversial and other new proposals are likely to become equally so, largely because their effect on the river's flow is feared by many to be detrimental to the large flocks of migrating waterfowl that stop over in the (central) valley and to the several well fields designed to induce recharge from the river. Another fear is that groundwater withdrawals, principally for irrigation, already have had a marked depletion effect on river flow and that in the future they will continue to do so in a progressively increasing rate." Those fears associated with potential loss of water are present and are often the forces that guide management decision making processes. As a result, ineffectual methods of management are often employed in an attempt to circumvent or prevent the taking of the resource.

It has been noted that the flow of this region of the Platte River is a combination of the Upper Platte, the Loup and the Elkhorn Rivers. Shell Creek and Wahoo Creek Watersheds also provide small but at times significant flows to the Platte in this reach. Several heretofore ungauged minor tributaries and groundwater inflow areas provide the remainder of the flowing water supply.

The flow entering the NRD from the upper Platte system has fluctuated from overbank flows to periods of no flow. DWR data indicates that during a 30-year record analysis, about 36 percent of the flow in the Lower Platte River has originated above the North Loup (North Bend station). At that same point, 60 percent of the flow originated in the Loup River system. DWR data indicate the remainder of the flow is from Shell Creek, unmeasured tributaries and river gains from valley groundwater contribution.

The data, for 51 years, at Ashland shows the contributions of flow are: Elkhorn River - 22 percent, Loup River - 48 percent, upper Platte River - 28 percent; tributaries and valley groundwater inflow - the remaining 2 percent. The annual and seasonal percentages of contribution vary extensively and are dependant upon the type of water year within the areas of influence. As the precipitation influences flow, the dry periods likewise influence flow and the manner of loss and gain to groundwater areas is often linked with flow volume.

Exhibit 34 (Bentall 1983), provides a graphic representation of proportional flow and instream use of the system. He further stated that the average annual depletion rate within the river is about 1,380 cubic feet per second (CFS) or about 1,000,000 acre feet per year. Bentall also points out that, if sufficient storage can be found, consumptive use totaling about 300,000 acre-feet per year could be feasible on the Platte River upstream from the Loup's mouth, if an occasional year of almost no flow at Duncan could be tolerated. He further states that the Platte River, downstream from the Loup River, could be a supply source for as much as 1,500,000 acre feet of additional development without resulting in rare no-flow years. The no flow years would be reduced if development was associated with instream flow activities. Bentalls work shows that there is a supply of water in the Platte (with the Loup) that may be used for conjunctive use schemes, artificial recharge (if feasible), irrigation development, industrial development, municipal well fields, and recreation and fish and wildlife enhancement.

DWR also concludes that, for a 50-year monitoring period, the mainstream flows have remained relatively constant. Flow changes must be assessed relative to the continual development of irrigation systems with Platte River corridor. Minor flow fluctuations are presently seen as reflecting short-term climatic changes between wet and dry conditions. It is apparent that further use of stream and river flows will need to be monitored to detect flow trend changes, no matter how subtle. It is interesting to note that work done by groups opposed to the Landmark irrigation project demonstrated a reduction in Platte River flow above Columbus due to development of center pivot irrigation along the Platte River corridor.

Flow patterns of the Platte River are very important to the municipal well field recharge. Lincoln well field personnel report that fluctuating flows are necessary to cleanse the river bed. This cleaning allows for better percolation of the river flow into the groundwater aquifer for municipal well capture and usage. Low flows also contribute to a change in the municipal drinking water quality. It is becoming extremely important to fully investigate and monitor the potential quality changes that accompany flow fluctuations.

The importance of the Loup River system to the Lower Platte area cannot be overstressed as the high quality water is and can continue to be a valuable asset. Greater concern must be addressed to the management of the system, not only by those in the Loup basin, but by those who are dependant on the quality and quantity thereof.

Contained Water

A review of the DWR dam inventory printout indicates that the amount of water stored behind dams in the Lower Platte North NRD is relatively insignificant. Storage capability at maximum acre feet of storage amounts to about 24,300 acre feet with normal storage about 4,100 acre feet. Of the maximum storage capability, two structures account for one-third of the capacity (Clear Creek 22-A and Trouble Creek). These two also account for one-fourth of the normal storage.

The potential for storing surface water in the District is excellent due to the topography in the District. The needs for stored surface water includes water quality improvement, flood control, industrial use, irrigation, recreation, and wildlife enhancement.

Water Uses

Surface water uses for irrigation have been documented by USGS and the DWR. The following information shows the surface water use by County, in the District.

County		Diversion Permits	C.F.S. Granted
Boone		1	0.94
Butler		20	33.70
Colfax		35	30.18
Dodge		7	8.32
Madison		0	0
Platte		27	19.77
Saunders		89	97.15
	TOTAL	179	191.07

Those permits are granted for a total of 17,836 acres of land.

Supplemental Sources

The NRC, Supplemental Water Supplies Policy Issue Study, 1984, defines supplemental water as additional water provided to supply that which is lacking, needed, or desired. The study further reports that, "because water is unevenly distributed in time and space, storage and transportation are the key elements in any strategy to provide supplemental water...supplemental water is considered to be water which is made available for use within a specific area by moving it from one area to another and/or storing it for use at a later time."

Supplemental sources of water are normally few in number and first supply needs are aimed at acquiring unappropriated stream flow of the Loup and Elkhorn River systems. These sources along with Platte River flow could be moved and placed in storage reservoirs for surface distribution. Economics plays an important part of any decision attempting to develop this method of supplemental supply augmentation. This method is not completely dismissed as a possibility in the Lower Platte North NRD, but its application at the present time or near future is not on the immediate planning horizon.

Some viable sources that must be determined and substantiated are: more extensive use of the Dakota Aquifer (dependent on quality and quantity monitoring), development of larger flood control structures with irrigation potential, management of moisture in the soil profile, and reduction of evapotranspiration (crop changes, irrigation scheduling, lowering water table to protect from loss by evapotranspiration). These latter methods of supplemental supplies appear most feasible in providing more usable water and saving normal supplies. More in-depth analysis must be included in developing management decisions and future supplemental supply augmentation.

GROUNDWATER QUALITY

General Conditions

The characterization of groundwater quality in the Lower Platte North NRD has become increasingly easier with the wealth of water quality samples collected during the past seven years. More than 1,300 wells have been sampled for various constituents ranging from general inorganic chemicals to radioactive isotopes, nitrates, and pesticides. Most inorganic chemicals are considered to be indicative of the natural quality of the water. As water is a solvent for many salts and some types of organic matter, it reflects the chemical constituents of the aquifer and aquifer material in the time frame it is sampled.

The background conditions of groundwater in the principal aquifer types in the Lower Platte North NRD are discussed below, in part from Engberg (1984).

The quality of water from the Quaternary deposits is generally quite variable. (Exhibit 35 shows distribution of Holocene & Pleistocene deposits). The quality is affected by recharge from precipitation, man induced changes, and from stream flow. In areas of shallow depth to water, the quality can be and frequently is strongly affected by local point source contamination (discussed in a subsequent section). The importance of maintaining good quality water in this aquifer is pointed out by Engberg, as he states over one-half of the groundwater used in Nebraska is from this system. He points out that the state mean for total dissolved solids (T.D.S.) is about 437 mg/L. Total dissolved solids is a good general indicator of water quality, reflecting in part the sodium content and degree of mineralization of the water. His information also shows that the state mean for nitrate in this system is 5.3 mg/L, which is just over half the drinking water limit of 10 mg/L. Exhibit 36 shows that the generalized T.D.S. in the Lower Platte North NRD ranges between 251-750 mg/L. Exhibit 37 demonstrates that calcium concentrations in most of Platte, Colfax, and half of Butler Counties are higher than 75 mg/L. Most of Saunders, Dodge, and the eastern half of Butler are not plotted due to the lack of sufficient data. Alkalinity, Exhibit 38, normally ranges between 101-300 mg/L except in

11/14/89

TABLE 8

Summary of EPA Health Advisories for Chemicals

This pesticide summary is offered as a quick reference to compare chemicals for which the Environmental Protection Agency has prepared Lifetime Health Advisory Levels.

Note: When details are needed, the EPA Health Advisory summary for the chemical in question should be consulted. The pen and ink changes have been made on the summaries to correct them as of November 14, 1989. The risk levels change occasionally as the EPA receives additional data about the chemical. Changes are printed in the Congressional Record or inquiries on risk level can be made to the EPA regional office in Kansas City.

LHAL - Lifetime Health Advisory Level - The level at or below which EPA data indicates the chemical presence in water can be consumed for a lifetime with no more than a one in one million chance of causing cancer and no chance of other non cancer health problems. These levels are subject to change as more data becomes available. When chemicals are considered carcinogenic an additional margin of safety is added to the LHAL.

LHAL Units - Are in either Micrograms per liter (parts per billion) or milligrams per liter (parts per million).

MCL - Maximum Contaminant Level - The maximum level of contamination in drinking water allowed by federal law when being provided for public use. Water at or below this level has not shown to produce long-term adverse health effects.

<u>Abbreviations for Water Treatment</u>

ACA - Activated Carbon Adsorption (Includes both granular & powdered)
(GACA) - Granular Activated Carbon Adsorption
(PACA) - Powdered Activated Carbon Adsorption

IE - Ion Exchange

OO - Ozone Oxidation

RA - Resin Adsorption

RO - Reverse Osmosis

UI - Ultra-violet Irradiation

Name	Common Names	Use	Lifetime Health Advisory Level (LHAL and MCL Guidelines	Hypothetical Cancer Risk When Consumed in Water at or Below Listed Level for a Lifetime [1]	Risk When Ingested Above LHAL Based on Human Data and and Animal Studies	Most Promising Way to Remove from Water
Acifluorfen	Blazer, Carbofluorfen Tackle, RH-6201	Herbicide	No designated LHAL	1 Microgram per liter One chance in one million of cancer	Damage to heart, liver, kidneys, blood, fetal development	ACA & RO
Alachlor	Lasso	Herbicide	No designated LHAL MCL = 2 Micrograms per liter	0.4 Micrograms per liter. Once chance in one million of cancer	Damage to liver, kidney, spleen and eyes	No Information available
Aldicarb & Aldicarb Sulfoxide	Temik	Pesticide	10 Micrograms per liter	Data inadequate	Inhibition of enzyme cholinesterase	ACA
Aldicarb Sulfone	Temik	Pesticide	40 Micrograms per liter	Data inadequate	Inhibition of enzyme cholinesterase	ACA
Ametryn	Ametrex, Gesapax	Herbicide	60 Micrograms per liter	Data Inadequate	Damage to liver	GACA
Atrazine	Atranex Crisazine	Herbicide	3 Micrograms per liter	Possible carcinogen	Tremors & damage to liver and heart	ACA
Baygon	Propoxur, Unden Blattanex	Insecticide	3 Micrograms per liter	Possible carcinogen	Damage to various organs and nervous system and inhibits production of enzyme, cholinesterase	GACA
Bentazon	Basagram	Herbicide	20 Micrograms per liter	Data Inadequate	Weight loss and Inflamation of prostate glands	No information available
Bromacil	Borea, Hyvar, Uragan	Herbicide	90 Micrograms per liter	Possible carcinogen	Damage to testes, liver and thyroid gland	
Butylate	Sutan, R-1910	Herbicide	350 Micrograms per liter	Data Inadequate	Damage to testes, liver, kidney & fetal devel- opment	No information available
Carbaryl	Sevin	Insecticide	700 Micrograms per liter	Data inadequate	Damage to liver and kidneys, reduced fertility, inhibition of cholinesterase	ACA, OO
Carbofuran	Furadan, Curaterr	Pesticide	40 Micrograms per liter	None	Damage to testes and uterus plus inhibited of cholinesterose.	GACA, PACA

Name	Common Names	Use	Lifetime Health Advisory Level (LHAL and MCL) Guidelines	Hypothetical Cancer Risk When Consumed in Water at or Below Listed Level for a Lifetime [1]	Risk When Ingested Above LHAL Based on Human Data and and Animal Studies	Most Promising Way to Remove from Water
Carboxin	D-735, DCMO, Vitavax	Fungicide, seed protectant and wood preservative	700 Micrograms per liter	Data inadequate	Damage to kidneys and liver	ACA and RO
Chloramben	Amiben, Vegiben	Herbicide	100 Micrograms per liter	Data inadequate	Damge to liver and fetal development	ACA, IE
Chlordane (All uses canceled in April, 1988)	Dichlorodene, Octachlor, Velsicol-1068	Insecticide	No designated LHAL. MCL = 2 Micrograms per liter	0.03 Micrograms per liter. One chance in one million.	Damage to liver and central nervous system and cancer	GACA, PACA
Chlorothalonil	Bravo, Daconil	Fungicide	1.5 Micrograms per liter	2 Micrograms per liter. One chance in one million	Kidney damage and excessive weight loss	ACA, RO
Cyanazine	Bladex	Herbicide	10 Micrograms per liter	Data inadequate	Damage to liver, blood, birth defects	ACA
Dalapon	Dowpon, Ded-weed	Herbicide	200 Micrograms per liter	Data inadequate	Changes in kidney and liver weights	ACA, IE
2,4-Dichloro-phenoxyacetic Acid	24D, Oqua-Kleen	Herbicide	70 Micrograms per liter	Data inadequate	Damage to liver and kidneys, changes in blood	ACA, RO
DBCP	Nemafune	Pesticide (for nematodes)	No designated LHAL. MCL = 0.2 Micrograms per liter	0.03 Micrograms per liter. One chance in one million	Damage to kidneys, liver and testes	Aeration, ACA
Diazinon	Spectracide, Basudin, AG-500	Insecticide	0.6 Micrograms per liter	None	Inhibition of cholinesterase	RO, GACA, OO
Dicamba	Banvel	Herbicide	200 Micrograms per liter	Data inadequate	Changes in liver and weight loss	ACA
1,2-Dichloropropane	Propylene dichloride or 1,2 DCP	Solvent	No designated LHAL. MCL = 5 Micrograms per liter	0.6 Micrograms per liter. One chance in one million	Damage to liver	GACA, Tower Aeration
1,3-Dichloropropene	DCP, Telone	Soil fumigant	No designated LHAL	0.2 Micrograms per liter. One chance in	Damage to bladder and kidneys	GACA

Name	Common Names	Use	Lifetime Health Advisory Level (LHAL and MCL) Guidelines	Hypothetical Cancer Risk When Consumed in Water at or Below Listed Level for a Lifetime [1]	Risk When Ingested Above LHAL Based on Human Data and and Animal Studies	Most Promising Way to Remove from Water
Dieldrin (Uses have been cancelled)	HEOD, Dieldrex	Pesticide for soil insects	No designated LHAL	0.002 Micrograms per liter. One chance in one million	Damage to bladder, liver and birth defects	RO, GACA, OO
Dinoseb	DNBP, Dinitro	Herbicide, dessicant, dormant fruit spray	7 Micrograms per liter	Data inadequate	Damage to liver and thyroid, reduced fertility-birth defects	ACA, IE
Diphenamid	Dymld, Enide	Herbicide	200 Micrograms per liter	Data inadequate	Damage to liver and thyroid	GACA
Disulfoton	Disyston Dithiodemeton	Insecticides	0.3 Micrograms per liter	None	Reduced organ weights, damage to eyes, genetic mut., decreased chol'ase	None known
Diuron	DCMU, Karmex	Herbicide	10 Micrograms per liter	Data inadequate	Damage to spleen, fetal development and methemoglobinemia	GACA, chlorination
Endrin (Manufacturing eliminated)	---	Insecticide	2.0 Micrograms per liter	Non carcinogenic-- (manufacturing cancelled)	Damage to liver and convulsions	ACA, RO, Coagulation filtration
Ethylene Dibromide (All pesticide uses cancelled)	EDB, Dowfume, Pestmaster	Soil fumigant	No designated LHAL MCL = 0.05 Micrograms per liter	0.0004 Micrograms per liter. One chance in one million	Damage to liver, kidneys, and testes, genetic mutations	Aeration, boiling and ACA
Ethylene Thiourea	ETU	Fungicide	No designated LHAL	0.2 Micrograms per liter. One chance in one million	Damage to thyroid, genetic mutations and birth defects	No information available
Fenamiphos	Nemacur	Nematode control	2 Micrograms per liter	Data inadequate	Chance in organ weights, reduced fetal weights, and survival, abnormal-ities in bone devel-opment, inhibition of enzyme development	No information available
Fluometuron	Cotoron, C-2059	Herbicide	90 Micrograms per liter	Data inadequate	Damage to liver, kidneys and spleen	GACA

Name	Common Names	Use	Lifetime Health Advisory Level (LHAL and MCL) Guidelines	Hypothetical Cancer Risk When Consumed in Water at or Below Listed Level for a Lifetime [1]	Risk When Ingested Above LHAL Based on Human Data and Animal Studies	Most Promising Way to Remove from Water
Heptachlor (All uses cancelled)	3-Chlorochlordene	Insecticide	No designated LHAL. MCL = 0.4 Micrograms per liter	0.008 Micrograms per liter. One chance in one million	Damage to liver and chromosomes	GACA and aeration
Hexachloro-benzene	HCB-Perchlorobenzene	Fungicide-Insecticide	No designated LHAL. MCL = 1 Microgram per liter	0.02 Micrograms per liter. One chance in one million	Damage to liver, kidneys, ovaries, skin and nervous system. Decreased fetal weight.	ACA
Hexazinone	Velpar	Herbicide	200 Micrograms per liter	Data inadequate	Damage to liver, blood and chromosomes and reduced body weight of offspring	No information available
Methomyl	Dupont 1179, Lannate or Nudrin	Insecticide	200 Micrograms per liter	Data inadequate	Damage to kidney, spleen, liver, and bone marrow	GACA
Methoxychlor	Malate	Insecticide	400 Micrograms per liter	Data inadequate	Inhibition of growth	GACA, RO
Metolachlor	Dual, Primextra	Herbicide	100 Micrograms per liter	Possible carcinogen	Damage to testes, Methemoglobinemia	GACA
Metribuzin	Lexone, Sencor	Herbicide	200 Micrograms per liter	Data inadequate	Damage to kidneys	GACA
Nitrate and Nitrite	---	Fertilizer, food preservative	Nitrate-10 Milligrams per liter Nitrite-1 Milligram per liter	Data inadequate	Methemoglobinemia in small children up to age 6 months	IE, Distillation, and RO
Oxamyl	Vydate, DPX-1410	Insecticide	200 Micrograms per liter	Does not cause cancer	Decreased weight, lower fetal survival, and inhibition of enzyme cholinesterase	ACA
Pentachloro-phenol (To be removed from registered list)	PCP	Wood preservative, herbicide, disinfectant, Mossicide, defoliant	200 Micrograms per liter	Possible carcinogen	Damage to liver and kidney, delayed fetal development	ACA

Name	Common Names	Use	Lifetime Health Advisory Level (LHAL and MCL) Guidelines	Hypothetical Cancer Risk When Consumed In Water at or Below Listed Level for a Lifetime [1]	Risk When Ingested Above LHAL Based on Human Data and and Animal Studies	Most Promising Way to Remove from Water
Picloram	Tordan	Herbicide	500 Micrograms per liter	Data inadequate	Damage to liver, thyroid, testes, and arteries	GACA
Prometon	Gesafram, Pramitol	Herbicide	100 Micrograms per liter	Data inadequate	Adverse effects on growth	GACA, RO, RA
Pronamide	Kerb, Propyzamide	Herbicide	50 Micrograms per liter	Possible carcinogen	Damage to liver	RO
Propachlor	Bexton, Ramrod	Herbicide	90 Micrograms per liter	Data inadequate	Damage to liver, kidney and blood	PACA, OO, RO
Propazine	Gesomil, Milogard, Primatol P	Herbicide	10 Micrograms per liter	Possible carcinogen	Decreased fetal weight and bone development.	No information available
Propham	IPC, Beet-Kleen	Herbicide	100 Micrograms per liter	Data inadequate	Delayed fetal development, inhibition of enzyme, cholinesterase	GACA
Simazine	Princep, Aquazine	Herbicide	1 Micrograms per liter	Possible carcinogen	Causes tremors, damage to testes, kidneys, liver, thyroid, sperm production, gene mutation	ACA
2,4,5-Trichlorophenoxyacetic (All uses cancelled by EPA)	2,4,5-T, Dacamine, Fence rider	Woody plant control	70 Micrograms per liter	Data inadequate	Damage to liver, kidney, and lungs, reduced fetal weight	ACA
2,4,5-TP (All uses cancelled by EPA)	Silvex	Herbicide	50 Micrograms per liter	Data inadquate	Adverse effect on liver and kidneys	ACA
Tebuthiuron	Graslan, Spike	Herbicide	500 Micrograms per liter	Data inadequate	Damage to pancreas, excessive weight loss	No information available

Name	Common Names	Use	Lifetime Health Advisory Level (LHAL or MCL) Guidelines	Hypothetical Cancer Risk When Consumed in Water at or Below Listed Level for a Lifetime [1]	Risk When Ingested Above LHAL Based on Human Data and and Animal Studies	Most Promising Way to Remove from Water
Terbacil	Sinbar	Herbicide	90 Micrograms per liter	Non-carcinogenic	Damage to liver, reduced fetal weight	No information available
Terbufos	Counter	Insecticide	0.9 Microgram per liter	Non-carcinogenic	Damage to eyes and stomach, disturbs fetal development and inhibits enzyme, cholinesterase	ACA, IE
Trifluralin	Treflan	Herbicide	5 Micrograms per liter	Possible carcinogen	Damage to liver and kidneys, decreased fetal weight and increased miscarriages	RO, GACA, and conventional coagulation, sedimentation, and filtration

[1] When chemicals are considered carcinogenic, an additional margin of safety is provided in setting the Lifetime Health Advisory level.

United States Environmental Protection Agency | Office of Water Washington DC 20460 | January 1989

EPA

Health Advisory Summaries

EPA has prepared the attached Health Advisory Summaries for participants in the National Pesticide Survey and is now making them available to the general public. The Survey is testing a statistically representative sample of 1,350 wells — some in every state — in order to provide a national assessment of pesticide contamination of drinking water wells.

Health advisory information has been prepared for the substances listed below because of their potential for reaching drinking water. These pesticides are among the more than 100 pesticides and breakdown products that the Survey is testing for during its two-year study of private and community water system wells. The Health Advisory Summaries describe possible health effects of these pesticides and suggest actions that may be taken by a well owner or community system operator to ensure a safe drinking water supply.

The Summaries are based on longer, more technical scientific documents called Health Advisories, which identify, for each contaminant, the level of pesticide concentration in drinking water that would not pose a health risk. These levels, based on human data or experimental animal studies, include a "margin of safety."

Appropriate Health Advisory Summaries are sent to well owners and operators when the National Pesticide Survey finds pesticides in their drinking water wells. This information is also being made available to federal, state, and local officials and to industry, farm and environmental groups for further distribution. Health Advisory levels are offered as guidance. They are subject to change as new information becomes available. Experts can advise well owners on the appropriate actions to take if pesticides are found in drinking water.

Information on how to obtain the full Health Advisories or the Summaries can be obtained by calling the EPA's Safe Drinking Water Hotline's toll-free number, Monday to Friday, 8:30 a.m.–4:30 p.m. E.S.T. The number is 1-800-426-4791 or, in Washington, D.C., 382-5533.

For more information on the Survey, write to: Director, National Pesticide Survey, Office of Drinking Water (WH-550A), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460.

LIST OF HEALTH ADVISORY SUMMARIES

Acifluorfen
Alachlor
Aldicarb &
  Aldicarb sulfone &
  Aldicarb sulfoxide
Ametryn
Atrazine
Baygon
Bentazon
Bromacil
Butylate
Carbaryl
Carbofuran
Carboxin
Chloramben
Chlordane
Chlorothalonil
Cyanazine
Dalapon
2,4-D
DBCP
Diazinon
Dicamba
1,2-Dichloropropane
1,3-Dichloropropene
Dieldrin
Dinoseb
Diphenamid
Disulfoton
Diuron
Endrin
Ethylene dibromide
Ethylene thiourea
Fenamiphos
Fluometuron
Heptachlor &
  Heptachlor epoxide
Hexachlorobenzene
Hexazinone
Methomyl
Methoxychlor
Metolachlor
Metribuzin
Nitrate/Nitrite
Oxamyl
Pentachlorophenol
Picloram
Prometon
Pronamide
Propachlor
Propazine
Propham
Simazine
2,4,5-T
2,4,5-TP (Silvex)
Tebuthiuron
Terbacil
Terbufos
Trifluralin

TABLE 9

Recommended Concentration Limits for Water Used for Livestock and Irrigation Crop Production (Freeze and Cherry 1979)

Constituent	Livestock Limits (mg/L)	Crops Limits (mg/L)
Total Dissolved Solids		
Small Animals	3000.0	
Poultry	5000.0	
Other Animals	7000.0	
Nitrate-Nitrogen	45.0	
Arsenic	0.2	0.1
Boron	5.0	0.75
Cadmium	0.05	0.01
Chromium	1.0	0.1
Fluoride	2.0	1.0
Lead	0.1	5.0
Mercury	0.01	
Selenium	0.05	0.02

TABLE 10

Water Analyses for Inorganic Chemicals
Public Supply Wells *

* From the Nebraska Health Department publication "Drinking Water Quality in Nebraska Communities, 1984."

Community	Well No.	Date Sampled	pH	TDS	Fe	Mn	F	Alk	Hard	Ca	NO_3-N	Cl	SO_4	Na
Abie	64-1	9-74	7.6	1108	0.6	0.0	0.83	312	352	99	0.6	216	201	270
Bellwood	68-1	7-76	7.8	424	0.3	0.1	0.26	264	320	96	1.2	8	97	14
	76-1	7-76	7.9	520	0.5	0.7	0.24	292	384	122	0.0	8	128	12
Bruno	36-1	9-74	7.3	358	0.0	0.0	0.32	144	264	75	4.2	22	96	13
	65-1	9-74	7.5	298	0.0	0.0	0.37	208	236	64	4.4	4	6	14
Cedar Bluffs	57-1	6-76	7.3	330	0.0	0.0	0.22	272	276	92	0.8	8	11	8
	69-1	5-74	7.4	486	0.5	0.4	0.35	276	312	96	2.2	4	60	14
Colon	61-1	4-77	7.5	370	15.0	0.2	0.42	312	280	80	0.2	0	38	25
	68-1	4-77	7.5	400	0.0	0.2	0.46	312	284	82	0.0	0	38	24
David City	47-1	1-78	7.7	428	1.1	0.4	0.27	308	328	101	0.2	2	59	12
	52-1	1-78	6.9	448	0.6	0.4	0.27	300	328	101	0.0	2	65	11
	63-1	2-76	6.9	798	2.3	1.4	0.27	372	532	165	0.0	8	245	8
	66-1	1-78	7.4	538	0.2	0.6	0.28	368	424	115	0.0	2	92	17
	72-1	1-78	7.9	352	4.5	0.6	0.24	300	320	96	0.2	0	27	7
Fremont	34-1	6-76	7.9	406	0.0	0.0	0.52	228	280	86	0.0	12	99	14
	39-1	6-76	7.6	616	0.0	0.4	0.33	212	412	120	0.6	32	215	19
	41-1	6-76	7.7	466	0.0	0.0	0.32	184	280	40	3.2	30	131	20
	53-1	6-76	8.2	672	0.0	0.1	0.32	236	444	134	1.8	20	250	15
	54-1	6-76	7.8	596	0.0	1.0	0.38	252	380	115	0.5	16	203	24
	56-1	6-76	8.1	658	0.7	0.0	0.31	212	440	139	1.6	12	290	18
	67-1	6-76	8.3	272	0.0	0.0	0.39	180	192	62	0.0	12	52	12
	70-1	6-76	8.3	392	0.0	0.3	0.34	188	250	80	0.6	16	105	17
	77-1	7-78	7.4	392	0.0	0.2	0.36	152	220	72	6.6	10	93	22
	77-2	7-78	7.5	390	0.1	0.6	0.25	172	220	70	0.6	12	101	21
	77-3	7-78	7.5	378	0.5	0.1	0.27	172	196	67	0.4	10	86	23

TABLE 10 (Continued)

Community	Well No.	Date Sampled	pH	TDS	Fe	Mn	F	Alk	Hard	Ca	NO_3-N	Cl	SO_4	Na
Lindsay	23-1	1-83	7.2	322	0.9	Nil	0.27	296	284	85	0.1	2	19	17
	75-1	1-83	7.2	384	0.1	0.1	0.25	276	316	99	3.8	22	21	16
	43-1	1-83	7.2	416	Nil	0.2	0.25	320	336	99	4.5	14	11	26
Malmo	04-1	4-76	7.3	436	0.2	0.0	0.28	256	280	80	8.2	14	40	12
Mead	58-1	5-75	7.5	428	1.0	0.5	0.52	312	296	94	0.4	2	43	16
	69-1	8-76	7.6	318	0.1	0.0	0.48	248	260	70	3.3	4	34	12
	76-1	3-78	7.8	392	1.8	0.2	0.62	276	316	88	3.0	0	59	15
Memphis	72-1	3-77	7.1	204	0.0	0.0	0.38	152	140	38	1.2	4	15	12
Morse Bluff	62-1	9-75	7.2	386	0.2	0.1	0.29	284	304	93	0.0	2	50	9
	79-1	6-79	7.3	350	0.2	0.0	0.21	288	292	93	2.1	4	51	14
Newman Grove	50-1	4-77	7.2	374	0.0	0.0	0.28	328	312	91	1.2	6	19	15
	63-1	4-77	7.2	374	0.0	0.0	0.30	300	308	94	1.4	8	23	11
North Bend	67-1	9-75	7.4	574	0.0	0.0	0.39	304	344	109	0.0	30	104	18
Platte Center	78-1	3-79	7.3	450	0.2	0.0	0.23	292	320	100	1.6	4	23	14
Prague	61-1	4-74	7.9	364	20.5	2.3	0.33	276	300	75	0.2	8	31	27
	70-1	4-74	7.4	566	10.0	4.0	0.37	344	380	106	0.0	46	57	39
Rogers	17-1	5-76	7.4	400	0.0	0.0	0.29	300	328	90	1.2	8	59	14
Schuyler	46-1	1-83	7.3	364	0.0	0.0	0.35	236	264	78	3.1	18	27	23
	60-1	1-83	7.3	390	0.0	0.0	0.37	256	288	86	5.3	12	31	22
	67-1	1-83	7.3	776	0.0	0.0	0.38	288	504	144	10.3	178	50	63
	70-1	1-83	7.3	512	0.0	0.0	0.46	304	360	99	5.3	42	41	31
	74-1	1-83	7.4	832	0.1	0.0	0.38	284	512	146	9.5	188	52	66
Wahoo	33-1	10-75	7.6	472	0.0	0.0	0.32	256	300	88	6.3	10	58	14
	38-1	6-73	8.4	408	0.0	0.0	0.30	256	260	75	9.1	8	20	32
	53-1	10-75	7.4	440	0.0	0.0	0.32	244	276	80	2.6	10	58	12
	63-1	10-75	7.5	488	0.0	0.0	0.34	272	304	88	5.4	16	62	17

TABLE 10 (Continued)

Community	Well No.	Date Sampled	pH	TDS	Fe	Mn	F	Alk	Hard	Ca	NO_3-N	Cl	SO_4	Na
Weston	30-1 58-1 (Composite)	4-76	7.4	388	0.1	0.0	0.32	252	268	80	0.8	10	40	8
Yutan	08-1 48-1 69-1 (Composite)	9-74	7-4	418	0.0	0.0	0.41	300	284	86	0.0	10	46	52

ABBREVIATIONS USED IN COLUMNS:

pH - The relative acidity of the water. A pH of 7.0 is considered neutral, less than 7 is increasingly acidic, greater than 7 is basic or alkaline.

TS - Total solids, in mg/l, water with more than 1,000 mg/l will likely contain chemicals that cause taste or odor and make water corrosive.

Fe/Mn - Iron and Manganese in mg/l, in excess cause staining of plumbing fixtures and clothes, may plug screens and pipes.

F - Fluoride in mg/l, beneficial to children's teeth at about 1 mg/l.

Alk - Total alkalinity, as mg/l calcium carbonate, ability of water to neutralize acid, caused by carbonate and bicarbonite ions.

Hard - Total hardness, as mg/l calcium carbonate, "soap wasting" property of water, the "harder" the water, the more soap required - less than 50 mg/l is considered "soft", up to about 200 mg/l not objectionable.

Ca - Calcium, mg/l, a complexing mineral.

NO_3 - Nitrate, as mg/l of NO_3-N, alters blood chemistry and restricts oxygen carrying capability of blood.

Cl - Chloride, mg/l, a complexing mineral.

SO_4 - Sulfate, as mg/l, may impart a taste to water and acts as a laxative.

Na - Sodium, mg/l, sewage waters are high in Na, may be unsafe to those on sodium-restricted diets.

central Butler County where it is normally above 300 mg/L. Sulfate concentrations, Exhibit 39, are generally between 11-100 mg/L.

Water quality of the Ogallala aquifer contains the following mean concentration levels of constituents: total dissolved solids - 422 mg/L, calcium - 56 mg/L, alkalinity - 170, sulfate - 25 mg/L. The exact concentrations of these chemicals are not known as the present data are limited, but the LPN NRD's future plans are to sample the portion of Shell Creek watershed using the Ogallala aquifer.

Dakota waters have not been sampled in quantity sufficient to yield generalizations about water quality. It is known that the quality of Dakota water is extremely variable but is nevertheless the source of drinking water for Abie and the partial source of supply for Memphis and Yutan.

As may be seen from a comparison of Tables 8 and 9, Drinking Water standards are more restrictive than are water quality standards for livestock and crops. Table 10 provides a look at sample data from public water supplies within the Lower Platte North NRD, for sample periods as indicated. The data provide a general drinking water supply chemistry for the District and a background on which the LPN NRD built its quality monitoring program.

Quality Indicators

Two primary constituents were selected to illustrate the general chemical composition of groundwater found in the District and are monitored, along with other chemicals, to assess the changes of quality. These two constituents are total dissolved solids (TDS) and iron.

Total Dissolved Solids - (T.D.S.)

Total dissolved solids (T.D.S) is a general indicator of water quality for most purposes. It reflects in part the sodium content and degree of mineralization of the water. This is important to the continued use of water for irrigation, to the aesthetic quality of the drinking water supply, and to the use of water for some industrial purposes.

Total dissolved solids (TDS) values are widely used in evaluating water quality and provide a convenient means of comparing types of waters as water containing excessive TDS may not be suitable for certain uses. The Safe Drinking Water Act has set a secondary limit of 500 mg/L (parts per million) for drinking water. Water with more than 1,000 mg/L will likely contain some chemicals that impart a taste or odor, or make the water encrusting or corrosive (NDOH 1984).

The distribution of TDS within the NRD is dependent upon several factors including the source aquifer, the depth and construction of the well, and how much the well is used. In general, higher TDS values are found in wells where the source aquifer is the Dakota Sandstone.

Exhibit 40 shows the distribution of TDS from wells within the LPN NRD. With the exception of eight wells, all wells tested were below 1,000 mg/L TDS. The probability of obtaining water with TDS values above 500 mg/L generally increases south of the Platte River in Butler and Western Saunders Counties. Although TDS values above 500 mg/L can be found throughout the LPN NRD, groundwaters in the Platte Valley near Fremont, and along Shell Creek, generally have the lowest TDS values.

Iron

Although iron is the second most abundant element in the earths outer crust, concentrations present in groundwater generally are small. Iron is an essential element for animals and plants. If present in water in excessive amounts, however, iron will cause staining of laundry and plumbing fixtures and impart a strong taste and odor to the water. Therefore, iron may be objectionable in domestic and industrial water supplies (Hem 1985). The Safe Drinking Water Act has set a secondary limit of 0.3 mg/L (parts per million) for iron. It is a useful indicator parameter for evaluating the suitability of a water supply for certain uses.

Figure 41 illustrates the distribution of iron concentrations reported within the LPN NRD. Concentrations of iron in groundwater can be affected by such factors as the composition of the formation rock, the amount of recharge available to the aquifer, chemical conditions in the aquifer, and the depth and pumping rate of the well. Corrosion of metal casing and pump parts can contribute significant iron to well water and in these cases, data are not representative of the aquifer. In general, higher iron concentrations are found in the eastern one-third of the LPN NRD, although almost all wells tested show somewhat elevated iron (above 0.2 mg/L). Groundwater from wells located in the Todd Valley and near Fremont and Wahoo appear to have a higher probability of containing elevated iron concentrations.

VULNERABILITY TO POLLUTION

The vulnerability of groundwater to spills and releases of contaminants or the application of fertilizers and pesticides is dependent upon many factors including the volume and type of the potential pollutant and the subsurface hydrogeologic features of the area. Topography, recharge, soils, the vadose zone (unsaturated soils above the water table), and depth to water are several of the physical features which will influence whether a pollutant can impact groundwater. A comparison model named DRASTIC (see Page 49) uses the parameters listed above and others to help predict the vulnerability of groundwater to surface pollution in areas larger than 100 acres. The following sections discuss in detail some of the key parameters affecting pollution potential in the NRD and concludes with results of the DRASTIC modeling done by Spalding (1990) in the Lower Platte River Basin study, the impact of land use on groundwater reservoirs, and wellhead protection.

Topography

The slope of the land determines the likelihood that a contaminant will run-off or will infiltrate to the groundwater. Level land offers the greatest potential for pollution because neither the pollutant nor precipitation run-off. Steeper slopes provide less opportunity for infiltration but more contaminants are allowed to run-off into surface water, possibly polluting groundwater from streams.

A generalized map of topography in the LPN NRD was compiled from the Spalding (1990) data files and is presented on Exhibit 42. From this exhibit it is apparent a large portion of the land mass of the NRD is flat with relatively gentle slopes, especially in the Todd Valley and Platte Valley areas. These areas would be more conducive to infiltration.

Recharge

Recharge is the principal vehicle for transporting a contaminant through the unsaturated zone to the water table. It can be of three types (1) natural recharge (which is precipitation infiltrating through the ground and percolating to the water table); (2) irrigation return flows; and (3) artificial recharge which augments precipitation. The greater the amount of recharge, the more water is available for leaching and transport of a contaminant and the greater the potential for pollution.

Recharge is one of the most difficult, if not the most difficult, hydrogeologic parameter to quantify largely due to the lack of available data describing observed recharge rates in Nebraska. Estimates are presented in various UNL theses and some limited site-specific observations have been made. In the early 1980's, CSD and other State agencies made recharge estimates for the State Water Planning Process. Spalding (1990) in the Lower Platte Valley Study incorporated some of this information and utilized other guidelines to infer this parameter for his study. Ten to fifteen percent of the mean annual precipitation was assumed to approximate recharge on flat, silty soils. Slightly higher recharge rates of 2-4 inches per year were assumed on flat loamy or sandy soils. In areas with extensive irrigation, irrigation return flows were conservatively estimated at six inches or about 30% of the irrigation water applied. Recharge was estimated at less than 2 inches in the steep glacial till uplands where the topography is more conducive to runoff than to recharge.

The lowest recharge rates occur in the silty clay loams of the uplands with slightly higher rates in the loamy and sandy Platte River Valley Plain soils. The highest recharge rates occur in areas where natural recharge on flat, silty soils is augmented by irrigation return flows. Irrigated lands where irrigation return flows may serve as potential recharge, are apparent on the land use map (Exhibit 10). A generalized map of net recharge is presented as Exhibit 43, compiled from Spalding (1990) data files. The highest recharge areas are found along the Platte River Valley, the Todd Valley, and Butler County.

Soils

Soils significantly affect the amount of recharge to an aquifer, as well as the ability of a contaminant to move vertically through the soil. Soils can serve to filter, sorb, or otherwise attenuate contaminants. "In general, the type of clay in the soil, the shrink/swell potential of the clay, and the grain size of the soil affect the soils capability to reduce the pollution potential. Generally, the less the clay shrinks and swells and the smaller the grain size, the less the pollution potential". (Spalding 1990, p. A-13). Soils are mapped and presented on Exhibit 4 and distribution of soils as they relate to pollution potential are mapped on Exhibit 43A. The soil ratings on Exhibit 43A were assigned to each soil type based on maps prepared by the Natural Resources Commission from Soil Conservation Service Maps.

Vadose Zone

The vadose zone is described as the unsaturated zone below the land surface and above the water table. The type of material in the vadose zone determines its contaminant attenuation characteristics. Biodegradation, neutralization, mechanical filtration, chemical reaction, volatilization, and dispersion are major attenuation processes occurring in the vadose zone. The vadose zone media also controls the path length and route of a contaminant and affects the time available for attenuation and the amount of material encountered. In general, the finer textured the media the lower the pollution potential.

Clay and other fine grained material in the vadose zone will significantly impede the downward migration of contaminants from the surface to the groundwater. Where the vadose zone is comprised of coarse grained sands or gravel, or where the water table is less than ten feet deep, contaminants leaching from the surface have a higher likelihood of impacting the groundwater quality.

The vadose (unsaturated) zone characteristics were compiled by Spalding (1990) and Exhibit 44 was prepared from the data files for that report. In general, shallow water tables and coarse grained vadose zone materials are more likely to occur in low lands along the Platte River and its tributaries. Thicker, fine grained vadose zone areas are more typical of upland areas throughout the NRD. Though not depicted on this Exhibit, recent soil survey activity indicates areas in the Todd Valley have sand and gravel deposits very near the surface. This can easily contribute to groundwater contamination.

Depth to Groundwater

Depth to water can be defined as the distance between the land surface and the surface of an unconfined aquifer. It determines the thickness of the geologic material through which a contaminant must move before reaching the aquifer and can affect the contact time between a contaminant and the surrounding media. As a general rule, the greater the depth to water, the longer the travel time in the unsaturated zone and the greater the opportunity for attenuation of a contaminant.

Exhibit 45 presents the relative depth to water within the NRD (compiled by Spalding 1990). Depth to water data were obtained from the U.S. Geological Survey, Conservation and Survey Division (CSD) groundwater files, test hole logs, and irrigation and municipal well registrations. In those areas where these data sources did not provide adequate information, depths to water were calculated using topographic and regional water table maps.

Depths to water range from less than 5 to greater than 100 feet in the LPN NRD. Shallow depths to water (<15 feet) occur in the Platte River Valley and its tributaries, and in the Todd Valley (<45 feet). The greater depths to water (>100 ft.) occur in the uplands of Butler and Saunders Counties.

DRASTIC

DRASTIC is a relatively new standardized methodology that predicts the pollution potential of groundwater in areas larger than 100 acres. DRASTIC is a screening tool which lends itself to mapping and facilitates comparisons of the relative potential of pollution in different areas. Because it was developed to evaluate pollution potential in relatively large areas, DRASTIC is used to provide a first approximation prior to site assessment. For example, a specific waste disposal site could not be selected with DRASTIC but areas that are hydrogeologically unsuitable could be eliminated from further consideration and more promising areas identified. Other potential uses of DRASTIC include prioritizing areas for groundwater monitoring and designating areas for groundwater protection.

DRASTIC is an acronym for the seven hydrogeologic factors evaluated to determine the potential for pollution of an aquifer. They are depth to water (D), net recharge (R), aquifer media (A), soil media (S), topography (T), impact of the vadose zone (I), and hydraulic conductivity of the aquifer (C). Each of these seven (7) factors has an associated weight factor and in calculation each data point is given a ranking. Exhibit 46 shows the DRASTIC index map generated for the NRD (from Spalding 1990). The lower the DRASTIC index number, the lower the vulnerability to pollution. The less vulnerable areas are shown in dark blue with the more vulnerable areas shown in yellow and orange. As expected, based on the DRASTIC Model, large areas of the uplands, which comprise a significant portion of the NRD, demonstrate a low pollution potential and a low vulnerability.

The Platte Valley and tributary drainage systems are clearly outlined by a higher DRASTIC index compared to the surrounding uplands. The higher potential areas are associated with low lying river valleys The potentially higher vulnerable areas are located along the Platte River, the area of Saunders County containing the Lincoln well field, the area of Dodge County containing the Fremont Well Field, and the proposed MUD well field.

Land Use

Land use above a groundwater reservoir plays an important role in the potential for non-point source pollutants impacting the groundwater. A highly vulnerable area (such as the Platte Valley reservoir) becomes an area of concern primarily because of the intensity of irrigated cropland and associated use of agrichemicals overlying it. Many of the factors used in the DRASTIC evaluation combine to make this land most desirable for irrigated land development (e.g.; flat terrain, shallow depth to water, good aquifer recharge, well drained soils, etc.).

Comparison of Exhibits 10 (Land Use), 17 (Groundwater Reservoir areas), and 46 (Groundwater Pollution Potential), reveal that the Platte Valley groundwater Reservoir is the most vulnerable and intensively cropped reservoir, thus likely requiring the greatest level of management over the long-term. Municipal well fields which currently serve large populations such as the cities of Fremont and Lincoln are located in this sensitive reservoir, with the City of Omaha also considering expansion of their well-field into this reservoir.

The Shell Creek Reservoir contains some intensive irrigated land development, primarily in areas which are slightly more prone to pollution potential than others. These areas will require closer monitoring than the remainder of the Reservoir, which is primarily dryland cropland, pasture, and rangeland.

The Todd Valley Reservoir has experienced substantial irrigated crop development in an area with medium to low vulnerability characteristics. The remainder of the area is developed primarily as dryland cropland. This reservoir, however, will also require careful monitoring as there are areas of known contamination developing.

The Upland reservoirs are the least vulnerable in the NRD to pollution. In addition these areas are also characterized by dryland farming, pasture and rangeland. These factors combine to make this reservoir less likely to suffer man-induced water quality problems. However, this reservoir is also characterized by limited supplies of groundwater, and must be managed carefully to maintain existing supplies.

Well-Head Protection

The concept of delineating well-head protection areas (i.e., land areas that contribute recharge to a well) is a modern outgrowth of the historical public health guidelines of providing adequate spacing between wells and potential sources of contamination. Nebraska regulations promulgated under the Nebraska Safe Drinking Water Act (1976) required public water supplies to provide some control over the recharge areas of their wells. Few communities, however, exercised strict control to completely guarantee the integrity of the supply. In recent years, with increasing emphasis on pollution prevention rather than cleanup, more attention has been devoted to defining well-head protection areas for drinking water wells.

The City of Lincoln has been particularly interested in defining well-head protection areas (Ayers, 1991). Development of a new M.U.D. well field near Yutan will also likely result in study and protective measures. The LPN NRD encourages communities within the NRD to investigate and adopt well-head protection as a priority and will assist on a case by case basis with support of well-head protection area delineations.

NON-POINT SOURCE POLLUTION

Non-point source pollution is generally defined as pollution arising from diffuse sources where no single point of release can be identified. While non-point source pollution can be related to weathering of minerals or soil erosion, human activities are commonly the originator for non-point source groundwater pollution. The diffuse application of fertilizers, pesticides, and herbicides in agricultural operations as well as urban areas account for large areas of land with soils containing these additives. Heavy application of chemicals, coupled with heavy precipitation or irrigation can result in these chemicals leaching to the groundwater. Overland flow resulting from runoff can also provide a means of chemical leaching to the groundwater aquifer. In Nebraska, as well as in the LPN NRD nitrate is the most common non-point source pollutant.

Nitrate/Nitrogen

Nitrates can be found in most areas in Nebraska. Sources of nitrates include breakdown of organic material in soils, human or livestock wastes, and chemical fertilizers. When exposed to nitrate levels in excess of 10 mg/L in drinking water, infants younger than about six months of age may develop methemoglobinemia or "blue-baby" syndrome. The maximum contaminant limit for nitrate under the Safe Drinking Water Act is 10 ppm as nitrate-nitrogen (NO_3-N).

Non-point source nitrate pollution refers to areas demonstrating elevated nitrate levels which are generally a result of widespread agricultural fertilizer application, either commercial or organic. Non-point source nitrates may also be associated with elevated levels of other agricultural chemicals such as atrazine.

Point source nitrate contamination is more localized and is generally associated with human or livestock waste migrating into shallow groundwater. Poorly constructed or located domestic wells often have nitrate levels exceeding the drinking water standard of 10 ppm. It may be difficult to distinguish between non-point and point source nitrate pollution in these situations unless an on-site investigation is conducted.

The general distribution of nitrate-nitrogen within the NRD (irrigation and municipal wells) is mapped on Exhibit 47. A majority of the wells with elevated nitrates are domestic or stock wells which may be the result of point source contamination (Exhibit 48). Data suggest certain areas are developing non-point source problems, including the Schuyler-Richland areas, the Platte Valley of Butler County, and the Memphis-Mead Todd Valley area.

Two public water supply systems currently have reported nitrates exceeding 10 ppm (Department of Health, 1992). Other towns in the NRD which historically had elevated levels of nitrates have been able to significantly reduce or eliminate nitrates by abandoning older wells and installing new ones, these instances are not shown on this map if the problem has been corrected.

Herbicides

In 1988 and 1989, the Lower Platte North NRD cooperated with other NRD's in the Lower Platte Valley Groundwater Quality Study (Spalding, 1990) to sample selected wells for Atrazine. The study covered three Natural Resources Districts, and a total of 54 wells were sampled for Atrazine. Of these, 33 wells were sampled in the Lower Platte North NRD, primarily concentrated in the Platte and Todd Valley groundwater reservoirs, which are identified as potentially vulnerable areas. All wells sampled in the LPN NRD were below the proposed E.P.A. maximum contaminant level of 3 ppb, with the exception of two wells south of Fremont. It was determined through further study these wells were apparently contaminated from a point source. Low concentrations (0.02 - 3.0 ppb) were detected in the areas of intensive corn production where atrazine is applied annually, which suggests contamination is non-point source. Atrazine was detected in 23 of the 30 irrigation wells sampled, with detectable concentrations ranging from 0.02 to 14.8 ppb. Breakdown products of atrazine were not looked for, yet can be present in significant concentrations and go undetected with normal analytical procedures. Present on going research indicates that Atrazine breaks down to a set of products which are more harmful then the mother component. The LPN NRD continues to test for herbicides with triazine screening as was performed in the Todd Valley in 1990 and Shell Creek in 1991.

Pesticides

Studies in Nebraska and elsewhere in the Midwest have indicated significant levels of pesticides dissolved in groundwater locally and regionally (i.e., Nebraska's Central Platte Valley). Deep percolation of contaminated recharge through permeable soils has been identified as the primary path of contaminant travel which also places shallow aquifers in jeopardy. Pesticides are commonly found in surface waters, particularly during and after spring runoff events. Pesticide contamination may also occur as a point-source problem, typically associated with contaminated soils around a mixing or wash-out area. Triazine screens have been a regular part of the NRD monitoring activities since 1990. The nature and extent of significant pesticide contamination in the NRD will be better defined in the future with additional sampling and trend analysis.

Groundwater Quality Monitoring Network

The groundwater quality monitoring program was established in 1986, with the goal of sampling selected wells across the entire NRD for the purpose of establishing baseline data. The NRD is still in the process of completing the baseline sampling. The most critical reservoirs were sampled first where problems were most likely to be present. Baseline sampling has been completed in the Platte and Todd Valley reservoirs. A total of ______ wells were sampled from 1986-1993, analyzed for Nitrate, with selected wells tested with a triazine screen.

In 1991 intensive sampling (18 wells/township) was initiated in the Shell Creek reservoir. Completion of this reservoir's baseline sampling has been delayed by wet summers and decreased use of irrigation, but is intended to be completed in 1994.

Intensive sampling of Uplands in Butler and Saunders counties will be initiated in 1995. Areas irrigated for crop production will be tested for nitrate-nitrogen with a triazine screen and nitrogen isotopes used on selected wells.

After completion of baseline sampling the strategy for future data collection is as follows: approximately 3 irrigation wells/township will be selected as fixed (trend) monitoring points; an additional 3 wells/township will be selected randomly for analysis; fixed points will be sampled every 2-3 years with a new set of random wells selected for each sampling period; wells will be tested for nitrate-nitrogen, major ions, and with triazine screens and nitrogen isotopes on selected wells. All reservoirs will not be sampled the same year. The number of wells done per year will be dependent upon budget, manpower, and weather constraints. Problem areas will also be sampled more intensively as problems appear. It is intended (once the Groundwater Management Plan is adopted) that sample analysis by the landowners (required under the Plan) for nitrate-nitrogen be incorporated into the database, reducing the need for an elaborate monitoring network.

POINT SOURCE POLLUTION

Point source pollution generally impacts the quality of the groundwater in localized areas. However, when these sites are located above potential drinking water supplies or are located adjacent to domestic or municipal wells the impact of a spill or leak can affect larger land areas and populations. Even spills that are cleaned up to health-based cleanup goals of a regulatory agency can impact drinking water supplies as human taste thresholds of many chemicals are below the health-based "action" levels (e.g., toluene, xylenes).

There are numerous manufacturing facilities and petroleum handling facilities, grain bin storage sites, and fertilizer and pesticide storage facilities within the LPN NRD. Although new regulations and generally improved product and waste handling procedures have reduced the chances of a spill or release of contaminants from these type of activities, historically, numerous spills have been documented. Exhibits 49 and 50 presents the location of these reported pollution sources within the NRD, and within the City of Fremont, respectively.

Underground Storage Tank Hydrocarbon Releases

This type of release generally involves a spill or leak from buried tanks at gasoline filling stations or industrial sites. Known as Leaking Underground Storage Tanks (LUST) they are regulated by the Nebraska Department of Environmental Quality (NDEQ) according to provisions of Nebraska Title's 118 and 126. Some LUST spills have been traced to locations no longer used as gas stations and in these cases the spills are known as "orphan tanks" and are also regulated and investigated by the NDEQ. It is not uncommon to have several LUST sites located within the same block on heavily used highways and streets.

Hazardous Waste Releases

Hazardous waste releases are defined as those sites where contaminants other than petroleum have been found in the groundwater. Such sites are often associated with manufacturing facilities or petrochemical or grain storage facilities. Hazardous waste sites are regulated in Nebraska by either the Nebraska Department of Environmental Quality (NDEQ) in provisions of the Nebraska Titles 118 and 126 or by the US Environmental Protection Agency (EPA) provisions of the Resource Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as the "Superfund."

Operation of the Nebraska Ordinance Plant (NOP) south of Mead, Nebraska has resulted in intensive groundwater contamination in that area. The sites sampling results reveal groundwater contamination by degreasers, explosives, and nitrate. The site is presently listed as a federal clean-up site by the Corps of Engineers and the Environmental Protection Agency and activity is underway in that regard.

Public Water Supply Systems With Reported VOC Contamination

The Nebraska Department of Health (NDOH) regularly tests public water supplies in the State for the presence of Volatile Organic Compounds (VOC's). These compounds are generally mobile in groundwater and include many common solvents, degreasers, paint thinners, septic tank cleaners, and grain fumigants. VOC's have been increasingly found in drinking water supplies. Public water supply systems in the NRD with VOC's in their tap water are also included on Exhibit 49. Some overlap may occur on this figure due to the fact that the water supply problem may be a result of the spill which is also mapped. NDOH responds to public water supply contamination and provides oversight relative to the quality of water delivered to the consumer. The NDEQ is notified of these results and may require groundwater investigation and take protection action.

Other Potential Sources of Pollution

Identification of potential point sources of pollution is important to protection of groundwater supplies. Ideally, all potential pollution sources should be identified on maps so siting of new wells can be accomplished considering the source area. Unfortunately, the database is limited for items such as feedlots, septic systems, and abandoned wells. At present, site specific studies are needed to inventory all potential pollution sources in a well's capture zone for long-term viability of the well.

Feedlots

Presently, there are 42 feedlot operations located within the LPN NRD as identified and regulated for State Operating Permits by the NDEQ (NDEQ files). These feedlots are mapped on Exhibit 49A. The NDEQ also estimates that this is only a small percentage of the total operations, even through all such operations are encouraged to be operating with permits under the control of NDEQ. The principal pollutants associated with feedlots are nitrogen, phosphorus, chloride, oxygen-demanding materials, and microorganisms. High levels of livestock waste pollution may also cause discoloration, odor, and taste problems in drinking water supplies. Minimization of the potential for groundwater pollution will depend heavily upon proper management of the animal waste control systems as required by NDEQ.

Landfills

Through the years the population in the NRD has disposed of their garbage in a variety of ways including burning, unauthorized "dumps", properly engineered landfills, and landfills lacking in proper siting, design, and operation techniques. Vast changes in the State solid waste regulations have brought about significant change in where garbage is handled and disposed of in the NRD. In order for a landfill to operate it must be approved by the State and be issued a permit. If a permit is not obtained the landfill must be closed. Currently, the LPN NRD does not contain a permitted landfill. The closest permitted landfill is the Kobus Landfill near David

City and other larger towns outside the NRD. The closed or inactive landfills can pose a threat to groundwater supplies if they were not properly sited. The NDEQ landfill section is in the process of determining potential problem sites.

Based on NDEQ file data, there are 13 non-permitted (closed or inactive) landfill sites in the NRD (Table 11, Exhibit 49B). While none of these sites are known contributors to groundwater pollution, the potential exists by virtue of their previous use, and should be considered when evaluating and/or investigating groundwater contamination problems.

Private Septic Systems

A conventional private septic system consists of a septic tank and laterals which serve as an absorption field. Improperly sited or constructed systems, inappropriate soils, or a high density of systems can and often does cause groundwater contamination. Liquid waste flows from household tanks to the absorption field where it is partially treated as it filters through the soil. Soil type is crucial to this process since only certain types of soils can adequately treat the effluent. A soil with large pores allows the effluent to move quickly and does not hold it long enough for sufficient treatment before it reaches the groundwater. For example, increased installation of septic systems for recreational households along the Platte River, where the water table is shallow and soils are coarse, may pose a potential pollution problem to municipal and individual water supplies. Where soils are too tight, septic systems will not drain adequately and may break down or cause nuisance conditions. Pollutants of concern from septic systems are nitrate, bacteria, viruses, and hazardous chemicals.

The location of septic systems with respect to drinking water supply wells is crucial to whether they may cause contamination problems. Many domestic wells are located in close proximity to septic systems can and do intercept contaminants. If the well is improperly constructed, the well may even serve as a conduit for pollution.

TABLE 11

Locations of Permitted and Non-permitted Waste Disposal Sites in the Lower Platte North NRD June, 1994 (Source: NDEQ unpublished file data)

County	Town	Legal Location
Butler	Abie	Sec. NW1/4, NE1/4, S-17, T-16N, R4E
Butler	Bellwood/Rising City	Sec. NW1/4, NW1/4, S-3, T15N, R1E
Butler	Bruno	Sec. SE1/4, NE1/4, S10, T15N, R4E
Butler	David City	Sec. NW1/4, NW1/4, S-24, T15N, R3E
Colfax	Schuyler	Sec. NE1/4, SE1/4, S14, T17N, R3E
Dodge	North Bend	Sec. SW1/4, SE1/4, S7, T17N, R6E
Dodge	Fremont	Sec. E1/2, SW1/4, NE1/4, S4, T17N, R9E, Sec. E1/2, NW1/4, SE1/4, S4, 17N, R9E, Sec. NE1/4, SE1/4, S4 17N, R9E, Sec. SE1/4, SE1/4, S4, 17N, R9E, Sec. NE1/4, NE1/4, S9, T17N, R9E
Madison	Newman Grove	Sec. NE1/4, NE1/4, S34, T22N, R4W
Platte	Lindsay	Sec. SW1/4, SE1/4, S34, T20N, R3W
Saunders	Ashland	Sec. NE1/4, NE1/4, S11, T12N, R9E
Saunders	Malmo	S21, 15N, R6E
Saunders	Mead	Sec. NW1/4, NW1/4, S36, T15N, R8E
Saunders	Prague	Sec. NW1/4, NW1/4, S1, T15N, R5E
Saunders	Weston	Sec. SE1/4, SW1/4, S9, T14N, R6E
Saunders	Wahoo	Sec. W1/2, SW1/4 of S2, T14N, R7E

There are presently no available statistics summarizing the number of septic systems in the LPN NRD. Towns with wastewater collection and treatment plants are less likely to have septic pollution, although municipal wastewater pipe systems may leak and contaminate groundwater.

Improperly Abandoned Wells

Abandoned water wells can serve as a conduit for groundwater pollution if they are inadequately sealed to prevent surface drainage of pollutants. The Nebraska Statutes, R.R.S. 46-602 requires proper decommissioning of groundwater wells by all landowners who have abandoned wells. The LPN NRD currently offers a cost-share program for proper well decommissioning, to assist in assuring it is properly done.

IDENTIFICATION OF PRESENT KNOWN PROBLEM AREAS WITH CONSIDERATION OF POTENTIAL PROBLEM AREAS AND INFORMATION DEFICIENCIES

Recharge Extremes

The only area of identified recharge extremes is located adjacent to the storage facility of Lake Babcock and is very limited in scope.

Some areas along and adjacent to the Platte River demonstrate high water table levels and further investigation is needed to determine natural versus man induced recharge of these areas.

Areas of localized rising water levels have been pointed out by members of the Public Advisory Committees. At present, these appear to be the result of cropland irrigation over shallow confining beds and need to be analyzed and proper management methods developed.

Groundwater Quantity

Uplands The David City Area in the Butler County uplands, has shown a marked decline in water levels in the past. It is difficult to relate this decline to saturated thickness because there is not a 1:1 comparison, due to pressure head (potentiometric pressure) consideration. The relationship between water level changes, pressure head, and saturated thickness must be determined to understand the significance of changes and what can be done to identify and alleviate problems.

Shell Creek This reservoir is difficult to characterize due to the lack of data. The monitoring network needs expansion in the northern portion of the Shell Creek groundwater reservoir. The current monitoring network indicated a declining trend in water levels in this reservoir which approximates 10% of saturated thickness in some areas. Relationship of water levels to saturated thickness must be determined for this aquifer.

Platte River Results of monitoring in this reservoir show slight declines (<5 feet) from predevelopment (U.S.G.S. data) and slightly greater declines (still less than 5 feet on average) against the index year.

Todd Valley Results of monitoring in the Todd Valley show slight declines (<5 feet) from both predevelopment and the index year. One well in upper Clear Creek shows a water level decline approaching 10% of saturated thickness.

General

1) The current monitoring network includes 116 wells. Expansion of the network in areas where few wells are presently monitored (e.g., Shell Creek) and in areas where problems may be present or will be in the near future is planned. In 1993, the NRD plans to expand the network to include 120 wells.

2) Determination of well elevations are necessary for all wells so that water table elevation maps can be constructed and regional and local changes in groundwater flow direction can be assessed.

3) Refinement of the LPN NRD groundwater computer model is needed to predict vulnerable areas to groundwater decline.

4) More information is needed on aquifer recharge rates and discharge (including water use).

5) A consistent scheme for evaluation of water level changes is needed to quantify their significance. The NRD has established an "Index" year of 1987 to reference changes. As time progresses and more data is acquired, appropriate "index" levels may be adjusted to more closely approximate "predevelopment" water levels.

6) Further coordination with other local, State, and Federal agencies collecting groundwater level data is needed. The NRD database should be a central repository for this data since the NRD is responsible for groundwater management.

Groundwater Quality

Uplands There is a general lack of irrigation well sample data in the Butler County Uplands and that is due to fewer wells being developed in this reservoir. Stock and irrigation well samples reveal some contamination is present in the township southwest of Bellwood and south of Octavia. The lack of sample analyses for this area does not allow for broad interpretation of these results. Areas where irrigation development is present are to be more intensively sampled to allow for baseline establishment in the next few years.

Shell Creek Upper: The upper Shell Creek groundwater reservoir (in Platte, Madison, and Boone Counties) is also presently characterized by limited sample analyses. A few domestic/stock wells and the Lindsay water supply well contain elevated nitrate levels. Groundwater sampling to establish baseline data is scheduled for the summer of 1994.

Lower: Generally water quality in the eastern end of the Shell Creek Reservoir appears to be quite good. Some wells appear to be approaching 8 ppm, however, no pattern is present to indicate an area-wide problem. Trend monitoring will be important in this area and is planned.

Platte River North of the Platte River, an area beginning just west of Richland to east of Schuyler contains a number of wells which are approaching or exceeding 10 ppm (MCL). The township west of Bellwood and south of the river contains numerous wells approaching or exceeding the MCL. The Rawhide Creek drainage area north and west of Fremont contains a number of wells approaching or exceeding 10 ppm.

An area east of Linwood and west and north of Octavia also contain wells which exceed 10 ppm. These areas are all located in the Platte Valley alluvium, the NRD's aquifer most vulnerable to pollution. Trend monitoring will be important in this aquifer to identify other areas which may be degrading and to monitor effects of management strategies. Trend monitoring of the aquifer system is scheduled to begin in 1994.

Todd Valley

The most significant area of nitrate contamination in the Todd Valley is present in a triangular area encompassed by the area around and adjacent to Wahoo, Mead, and stretching south to Memphis This area contains numerous wells approaching or exceeding the MCL for nitrate contamination.

Test results of shallow domestic/stock wells in the Todd Valley reveal that this aquifer contains numerous wells approaching or exceeding the MCL for nitrate. The widespread pattern, when compared to the irrigation/municipal results, supports the conclusion that the shallow portion of the Todd Valley alluvium is generally contaminated with nitrates. The results of irrigation and municipal well sampling, generally developed deeper into the aquifer, reveal that generally north and west of Mead, groundwater nitrate pollution is not apparent. Some wells along Sand Creek and near Silver Creek seem to be developing as problem areas.

General

1) Point source pollution from volatile organic compounds (VOC's) and other hazardous wastes within the NRD is present in or near several towns and cities and these pollution sources are (or may be) threatening drinking water supplies. The NDEQ is responsible for oversight of clean up activities which can be costly and very time consuming. Substantial clean up operations are underway at numerous sites in Fremont, Wahoo, and near Mead. Other areas are also in the process of clean up. The impact of such point sources on drinking water supplies is generally unknown until it occurs and impacts a water supply well.

2) More information is needed regarding the size of public water supply well-head protection areas in the NRD, along with a detailed inventory of possible point sources within those areas.

3) Non-point source pollution of streams from agricultural runoff may be impacting groundwater supplies. Further identification of the surface water and groundwater relationships will be needed to determine the connection between the two and allow for appropriate response.

4) Expansion of the NRD's water quality monitoring network will be needed to adequately cover the NRD and to monitor changes. Sampling networks should especially be intensified in problem areas identified above as is currently being done in the Richland-Schuyler areas. Trend and random monitoring will be conducted every 2-3 years in the most vulnerable aquifers (Platte and Todd Valley) and at least 3-5 years in others (Shell Creek and the Uplands).

5) Stronger coordination and data sharing with local, State, and Federal agencies is needed to develop a comprehensive picture of water quality concerns in the NRD. The NRD should obtain at a minimum the following data as they are collected by the agency:

Pollution Spills - NDEQ

Public Water Supply Sample Results - NDOH
and Regulatory Notices

Results of Special Investigations - USGS, C&SD

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THE PLAN FOR GROUNDWATER MANAGEMENT IN THE LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT

Section A
Framework for Groundwater Management

The Lower Platte North NRD prepared a Master Plan for resources management in the late 1980's, which serves as a parent document to the 1994 updated Groundwater Management Plan. The Master Plan is the foundation from which individual resource planning occurs, and guides the allocation of financial and manpower resources. The Water Quality, Supply, and Pollution Abatement goal and subsequent objectives to support the goal which are present in the Master Plan follows:

GOAL

ASSURE ADEQUATE QUANTITY AND QUALITY OF STREAM FLOW, GROUNDWATER, AND SURFACE RESERVOIRS WITHIN THE DISTRICT FOR BENEFICIAL USES AS PRESCRIBED BY LAW.

OBJECTIVE 1

Insure that all chemigation users are properly trained and comply with state rules and regulations so as to reduce the occurrence of groundwater contamination through the application of pesticides and fertilizers.

OBJECTIVE 2

Actively pursue the proper use of chemigation criteria and assure that all who chemigate have permits to do so.

OBJECTIVE 3

Develop and maintain rural landowner and community reporting stations for well monitoring, water usage, and rainfall statistics.

OBJECTIVE 4

Insure proper local management of ground and surface water resources through cooperation with local community governments, agencies and private firms, which may involve development of Special Protection Areas and groundwater management and control areas.

OBJECTIVE 5

Comply with the District's Groundwater Management Plan as well as state standards and regulations in order to meet proper conservation requirements.

OBJECTIVE 6

Assist federal and state agencies in the protection of ground and surface waters from non-point and point sources of pollutants.

OBJECTIVE 7

Maintain groundwater quality and quantity monitoring programs.

OBJECTIVE 8

Encourage and develop programs to assist users in reducing irrigation water needs through best management practices.

OBJECTIVE 9

Develop instream flow requirements that will assist in providing a stable development climate within the District.

OBJECTIVE 10

Develop best management alternatives for chemical use in areas where susceptibility to groundwater pollution is high.

OBJECTIVE 11

Cooperate with state and federal agencies to provide adequate methods of testing groundwater for pollutants.

OBJECTIVE 12

Assist in the development of rural water districts with other applicable entities as required.

OBJECTIVE 13

Develop criteria and data for wellhead protection standards to allow District urban areas to participate in this program.

The goals, objectives, policies, and programs set forth in this Groundwater Management Plan Update were developed in support of the LPN NRD Master Plan, and provide further detail regarding ways to accomplish the intent of the Master Plan. It is the intent of the Lower Platte North NRD to wisely and proactively manage the groundwater resources within the District, while maintaining local control over management and use.

Since the NRD's first Groundwater Management Plan was adopted in 1985, many significant changes have occurred regarding regulatory requirements, responsibilities, and options for groundwater management. The Nebraska Legislature, through the Nebraska Groundwater Management Act and its amendments has offered NRDs the opportunity to manage groundwater at the local level if they choose to accept such responsibility. The Act however, also provides options for intervention at the State level should the NRDs require assistance. To recognize a problem or potential problem and do nothing to prevent or alleviate it is no longer a viable option. An NRD must have a plan of action ready to retain total local control and resource protection.

A summary of "Identified Present Known Problem Areas With Consideration of Potential Problem Areas and Information Deficiencies" has been presented in this plan. It is evident from information presented in the plan that there are several areas of concern which warrant extensive action to meet the goals of both the Master Plan and the Groundwater Management Plan's adopted goals and objectives for resource management.

In the area of groundwater quality, the most significant area of concern is the increase of nitrate concentrations. In the uplands of Saunders and Butler Counties, the data base may not allow for a broad interpretation of the areal distribution. In the Shell Creek reservoir, elevated nitrate levels may not be present but a more comprehensive and definitive monitoring network is needed. Areas along the Platte River do exhibit elevated levels of nitrate contamination. This finding is consistent with the DRASTIC vulnerability index, which suggests this reservoir is highly vulnerable to pollution. The Todd Valley reservoir is also showing areas where nitrates are becoming higher. A report by Roy Spalding and Mary Exner indicated areas along the Platte River in Butler, Platte, Colfax, and Dodge Counties, the Todd Valley and Shell Creek exhibit an overall nitrate increase about 1 part per million per year from 1978/79 to 1988/89. Along with the higher nitrate concentrations is the potential problem of pesticide contamination. Surface runoff from the agricultural areas in the District are known to carry extremely high levels of pesticides, particularly during spring rainfall events.

As the State moves to recognize the interrelationship of surface and groundwater laws, an area needing extensive analysis is that of the physical surface/groundwater relationship. Some areas of the District demonstrate a potential for significant deterioration of a groundwater aquifer caused by surface water problems. Deep soil samples in the District also point out very high levels of nitrates in the soil profile just below the root zone moving into the groundwater aquifer.

The rate of development of irrigation wells in the District illustrates densely developed aquifers in many areas, which could result in overdraft. This trend is evident in a report from the Nebraska Department of Water Resources showing a steady increase in the number of new well registrations per year. Recharge rates and abilities to recover from overdraft of the aquifer and declines due to climatic changes must be understood for the entire District. Management of the physical system must reflect the ability of the system to respond to natural changes. Water level monitoring must be increased to provide a more comprehensive assessment of the systems responses to stress situations.

The Lower Platte North NRD recognizes the need for comprehensive, practical, and effective systems of groundwater management, combining both non-regulatory and regulatory approaches. Non-regulatory options such as data collection, public education, encouragement of voluntary use of best management practices, demonstration programs, and others have been used by the NRD as primary management tools prior to development of this plan. The District intends to expand its management scheme to include regulatory options available to the NRD under the Nebraska Groundwater Management Act. Regulatory tools authorized under this Act include:

1) Allocating the total permissible withdrawal of groundwater;

2) Rotation of use of groundwater;

3) Well-spacing requirements pursuant to Section 46-673.12;

4) Requiring the use of flow meters on wells;

5) Best management practices;

6) Requiring the analysis of water or deep soils for fertilizer and chemical content;

7) Educational programs designed to protect water quality; or

8) Moratorium on new well drilling (Control Area only).

(*Source*: Laws 1982, LB375, 11; Laws 1986, LB894, 30; Laws 1991, LB 51,4.)

In order for the NRD to legally utilize the tools outlined above, a Groundwater Management Area must be established with definable boundaries. The LPN NRD intends to establish the entire NRD as a Groundwater Management Area, allowing for utilization of the regulatory tools (listed above) as appropriate for overall management and for problem (subarea) management. Details are provided in Sections B and C of this Plan.

PLAN FOR GROUNDWATER MANAGEMENT IN THE LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT

Section B
Goals, Objectives, and Policies

In 1985, the Lower Platte North Natural Resources District developed, in accordance with the Groundwater Management and Protection Act of 1975, a Groundwater Management Plan. At that writing, little water quality or water quantity data existed in the NRD. The Plan, as a result of the lack of information, set forth a vigorous course of action which included sixty-four (64) actions designed to provide the District a dataset upon which proper management decisions could be based. Since 1985, the District has placed into action or has completed, 85% of those action items. The remaining 12 are actions which relied upon the database in order to be implemented, and are incorporated into this Groundwater Management Plan.

Goals established in 1985 also reflected the lack of a sufficient database and were adopted in order to assist in the building of such a dataset. With passage of LB 51, the District was in a position to analyze the considerable water information gathered since 1985. The analysis revealed a distinct set of needs for program realignment. The following goals, objectives, and policies or program components will serve to guide the District over the next several years.

GOAL #1 : Groundwater Reservoir Life

TO PROVIDE A SUSTAINED GROUNDWATER SUPPLY OF QUALITY WATER ADEQUATE TO SUPPORT REASONABLE AND BENEFICIAL USES, AND MAINTAIN LONG-TERM QUALITY YIELDS.

OBJECTIVE

Designate the entire Lower Platte North Natural Resources District as a Groundwater Management Area, consistent with Nebraska State Statutes 46-673.01 - 46-673.06.

Policy - Within two years of the date of approval of the Groundwater Management Plan by the Director of Water Resources, the Lower Platte North Natural Resources District shall establish a District-wide Groundwater Management Area.

Policy - A phased approach to water quality management based upon a Maximum Contaminant Levels (MCL) and Lifetime Health Advisory Levels (LHAL) trigger scheme, and water-level management with triggers based on water level declines with appropriate management actions, will be implemented (triggers and controls are set forth in Section C of this Plan).

Policy - Prior to establishing the Groundwater Management Area, the NRD will perform the necessary analysis to delineate subarea management boundaries for specific problem area management.

Policy - Establish and implement a Groundwater Management Area education program, to include proper fertilizer and pesticide application, irrigation scheduling and water use efficiency, urban fertilizer and pesticide use, water quality and chemical health risks, agricultural reporting needs, crop water efficiency, pump plant efficiency, adopted groundwater management triggers, and other groundwater issues as applicable.

Policy - Implement an education program to inform the public regarding the need for developing the LPN NRD as a Groundwater Management Area, with special emphasis on the adopted Management Schemes (outlined in Section C of this document).

Policy - Expand the NRD newsletter to include more information on groundwater activities.

Policy - Develop a network of demonstration farms, by aquifer, to exhibit water use efficiency benefits and solicit cooperation for voluntary metering and reporting to the NRD.

Policy - Increase the awareness of effective long-term conservation and utilization of the groundwater aquifer.

Policy - Coordinate education and information program with NDEQ, NNRC, NDOH, NDWR, and applicable local and federal agencies, to include the above items and other items such as proper well locations, number of wells per area, and new well construction.

GOAL #2: Management Systems Development

PROVIDE A SYSTEM OF GROUNDWATER MANAGEMENT TO SUPPORT THE GROUNDWATER RESERVOIR LIFE GOAL, BASED UPON AN ADEQUATE TECHNICAL FOUNDATION AND PUBLIC AWARENESS OF GROUNDWATER ISSUES.

OBJECTIVE

Provide technically accurate and updated water quantity data upon which to base management decisions.

Policy - Update the saturated thickness map by recording and mapping thickness from all new registered well logs and other new sources of information, to assist in further delineation of groundwater aquifers.

Policy - Update water level contour maps that coincide with groundwater data received from monitoring. Contour maps will be used to monitor changes in direction of groundwater flow and saturated thickness.

Policy - Enhance data collection in confined aquifers by monitoring at least 5% of the total registered wells in each confined aquifer. Use the data to evaluate predevelopment pressure head levels and changes from predevelopment to the present.

Policy - Develop a methodology to statistically analyze water level fluctuations, evaluate the significance of the changes, and relate to the management scheme developed for the GMA.

Policy - Increase the number of observation/monitoring wells in District groundwater reservoirs to provide greater coverage for early problem area detection. The actual number of wells and locations will be based upon the intensity of development of the aquifer and the dependence on the aquifer water supply for various uses. Ultimately the NRD's system will include at least 120 wells.

Policy - Support and perform studies to aid in groundwater model development to predict the amount of water which may be withdrawn from each groundwater aquifer to support the Groundwater Reservoir Life Goal.

Policy - Continue coordination of data collection, storage and analysis with other local, state and federal agencies and groups.

OBJECTIVE

Provide the most technically accurate and updated water quality data upon which to base management decisions.

Policy - Adjust the density of the groundwater quality monitoring network for each aquifer, providing data adequate to evaluate long-term trends and identify present and potential problem areas. The number of wells to be monitored is dependent on the percent of irrigated acres and the number of wells needed to irrigate those acres in each groundwater reservoir to establish and reaffirm baseline conditions.

Policy - Perform trend and random monitoring every 2 years in the most vulnerable areas and problem areas, and every 4 years in less vulnerable areas and areas not presently exhibiting water quality problems.

Policy - Continue coordination of data collection, storage and analysis with other local, state and federal agencies and groups relating to pollution spills (Nebraska Department of Environmental Quality - NDEQ), public water supplies and regulatory notices (NDOH), and results of special investigations (Conservation and Survey Division - C&SD, Department of Water Resources - DWR, NDEQ, Nebraska Department of Health - NDOH, U.S. Geological Survey - USGS, Environmental Protection Agency - EPA, Corps of Engineers - COE, etc.).

Policy - Continue to perform and/or support isolated water quality investigations in NRD aquifers as conditions dictate and the need arises.

Policy - Support nitrogen isotope studies where necessary to determine the source of a nitrate problem and its areal extent for problem boundary definition.

Policy - Support deep soil sampling in areas where suspected over-application of commercial fertilizer and/or animal manure has occurred.

Policy - Perform triazine screen testing of selected wells within the most vulnerable areas of each groundwater reservoir.

Policy - Perform studies to assess needs, benefits, costs, etc. when requested, for possible development of regional or rural drinking water supply systems.

Policy - Develop a program to assist in monitoring rural drinking water wells in cooperation with other agencies.

Policy - Coordinate the NRD's groundwater programs with the Nebraska Department of Agriculture in support of the State of Nebraska's Federal Insecticide, Fungicide, Rodenticide Act and farm management plans.

OBJECTIVE

Further develop and enhance the NRD's computer database management system to provide continual support for program advancements.

Policy - Increase the hardware capabilities of the NRD for data storage, retrieval and analysis, and interfacing with other program needs. Adapt the systems components to be compatible with local, state and federal systems.

Policy - Identify software needs to support: trend analysis; predict impacts of management decisions; and provide mapping capabilities. Acquire software to complement the NRD's hardware.

Policy - Refine the LPN NRD groundwater computer model to provide adequate prediction of vulnerable areas of decline.

Policy - Establish a QA/QC program for data entry to eliminate database errors.

Policy - Utilize the hardware and software capabilities to produce required periodic reports in a standard and meaningful format.

OBJECTIVE

To develop a coordinated NRD program to assist in implementation of the State of Nebraska's wellhead protection program. The NRD program will be targeted toward assisting the District's communities and supportive of the District's efforts in managing ground and surface water.

Policy - Further develop the information needs and assist in the continuance and upgrading of the present LPN NRD well decommissioning program.

Policy - The District will assist any community in the NRD with proper development of a Wellhead Protection Program.

Policy - The District will be the central repository for District water supply contamination information as received from the NDOH and NDEQ.

Policy - Make NRD database information on pollution and water quality readily available to all District communities for use in planning for Wellhead Protection.

Policy - If a Wellhead Protection Area is established due to non-point source pollution, the District may set boundary areas that are less than 9 square miles in size.

Policy - The District will develop a process to locate, identify, and catalogue past, present, and potential point and non-point sources of contamination (to include present and abandoned feedlots, landfills, dumps, industrial sources, etc.), which will be utilized in all ground and surface water program analysis and management.

OBJECTIVE

To support and conduct special studies, research, and data gathering activities that will assist the District in its understanding and management of groundwater.

Policy - Perform sandpit studies when appropriate, to address the locations of such pits, their fluctuations, evaporation/transpiration, and estimated effect on the groundwater table.

Policy - Continue to evaluate the adequacy of the Districts precipitation network and expand where appropriate.

Policy - Support studies/research and refinement of the DRASTIC program to further identify and understand recharge characteristics and areas vulnerable to pollution in the District.

Policy - Support and perform percolation studies to understand the recharge potential of groundwater reservoirs, particularly those areas where known or suspected contamination occurs.

Policy - Develop a water balance model for the NRD considering the effect of phreatophytic growth on the groundwater table and wetlands.

Policy - Participate in and perform instream flow studies which identify the streams dependence upon groundwater for base flow.

Policy - Participate in studies and research to quantify and qualify the interconnection between ground and surface water.

Policy - Support geologic and hydrogeologic studies which will contribute to the foundation of knowledge needed to locate and identify areas where changes in groundwater quality/quantity may impact environmentally sensitive resources.

OBJECTIVE

To adequately support the Groundwater Management Plan through proper application of District resources.

Policy - Provide sufficient qualified personnel, funding, and equipment to fully support the groundwater management system and the needs of the program.

Policy - Annually re-evaluate and upgrade the Districts Groundwater Management Plan and the resulting Groundwater Management Area designations.

Policy - Develop background information and a methodology to address potential NRD cost share programs for meter application, assistance with collection of irrigation and drinking water samples for analysis and deep soil sampling. The NRD will only cost-share with landowners that have registered wells with the Department of Water Resources. If wells are unregistered, proper registration forms will be provided by the NRD and a 6-month period will be allowed for registration before the illegal well will be reported to the Department of Water Resources. Chemigation permits will only be issued on registered wells.

PLAN FOR GROUNDWATER MANAGEMENT IN THE LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT

Section C
Action Plan

The Lower Platte North NRD is strongly aware prevention is extremely less costly than correction of a groundwater problem after it has developed. Knowledge of this principle has required the District to develop a groundwater program emphasizing protection based on a proactive approach rather than on a reactive, corrective approach. Data gathered by the District, the USGS, NDEQ and the University of Nebraska since 1985 has indicated areas where groundwater quality nitrate conditions have deteriorated beyond those established as health standards. Other data also indicate problem areas are presently developing which need to be intercepted in order to bring about a clean up of the reservoir and to halt a continuing trend of increased pollution.

The District did not enter into this activity without developing a method to arrive at what is felt to be a consistent planning and implementation strategy aimed at protection of the resource. Within two years of the date of approval of the Groundwater Management Plan by the Director of Water Resources, the District will establish a District-wide Groundwater Management Area. The quality component of the plan is a phased approach based on a Maximum Contaminant Levels (MCL) and health-based standards trigger scheme, addressing Nitrate, pesticides, and other human non-point source contaminant levels in the system. The quantity component of the plan is developed around triggers based on water level declines with appropriate management actions for confined and unconfined aquifers.

A major component of the plan is the implementation of an education program which includes, but is not limited to: proper fertilizer application (both commercial and private), irrigation scheduling and water use efficiency, water quality and chemical health risks, agricultural reporting needs, adopted groundwater management triggers, social/economic aspects, and other issues as applicable. An essential item of the education program is the development of demonstration farms, by aquifer, exhibiting water use efficiency benefits, irrigation scheduling, crop water efficiency, and fertilizer and pesticide application. Another essential item of the education program will be development of educational materials to address proper application of fertilizers, pesticides, and other chemicals on lawns and other non-commercial applications in urban areas. Prior to establishing Phase II and III Level Groundwater Management Areas, the NRD will perform necessary analysis sufficient to delineate subarea management boundaries for specific problem areas associated with levels of concern.

Groundwater Quality Management Program

The Groundwater Quality Management Program is based on a set of contaminant level triggers designating the Phase of the program in which a particular area must be placed. Phase I nitrate triggers are set at 0 to 8 parts per million in the Groundwater reservoir and includes the entire District. Phase II triggers are from 8.01 to 10 parts per million nitrate concentration in the groundwater while Phase III trigger levels range from 10.01 parts per million or greater. "Other" human-induced non-point source contaminants, such as pesticides have phased trigger levels based upon Maximum Contaminant Levels (MCL) or Lifetime Health Advisory Levels (LHAL). Phase I triggers are set at 0 to 80% of the contaminants MCL/LHAL and includes the entire NRD. Phase II areas will be established when contaminants are present at 80-100% of the

MCL/LHAL. Phase III areas will be established when the MCL/LHAL is exceeded (>100%). Currently, no "other" contaminated areas have been identified that are approaching the upper limit of a Phase I area. As "other" contaminants approach the Phase I area limit, contaminant-specific programs and regulations will be adopted, similar to the nitrate regulations which are based upon increasing levels of management and actions.

For the purpose of implementing Phases II and III of groundwater management, the LPN NRD has established some guidelines by which a problem area is identified, and Phase II and III area boundary setting studies will be initiated. Groundwater management units will be reservoir specific. Within the same reservoir, boundary setting studies will be initiated when: water quality analytical results, within a minimum 9 square mile area are at identified trigger levels, over a minimum of 2 sampling events. The area must contain a minimum of 10 registered wells and contaminant trigger levels must be exceeded in over 50% of the wells. When registered wells are not available, other wells may be used. Initial investigation by the NRD will be to determine if the contamination is a result of point-source or non-point source pollution. If non-point source is concluded more intensive investigation for boundary setting will ensue.

If a Wellhead Protection Area should be established due to non-point source pollution, the District may set boundaries that are less than 9 square miles.

Data derived from the monitoring network established by the District, combined with special studies, monitoring studies performed by the USGS, University of Nebraska, NDEQ, County Extension programs, and others as applicable, will be used as the database on which to formulate Phase II and Phase III area boundaries.

Upon confirmation of the GWMP by the Department of Water Resources, the District will move immediately into the process of evaluating Phase boundaries by performing a series of confirmation studies aimed at boundary setting. The District will also begin the development and implementation of the education program. This program will become progressively more intense as an area shifts from one Phase to another higher Phase.

Within two-years of the acceptance of the GWMP, the District will designate the entire NRD in Phase I of the program. The reasoning for this action is in keeping with the Districts goal "to provide a sustained Groundwater supply of quality water adequate to support reasonable and beneficial uses, and maintain long-term quality yields."

PHASE I CONTROLS:

- All operators in Phase I areas within the District, who use any type of fertilizer, either commercial or organic, are required to be certified by the District every four (4) years. Certification will be consistent with the Districts chemigation program and applicable to the State FIFRA program. The education/certification program will be developed with the assistance of the Cooperative Extension personnel and others, as applicable.

- A groundwater analysis for nitrogen (nitrate nitrogen) content for irrigation, municipal, and industrial wells must be made every four years using NRD approved analysis methods, and results submitted to the NRD by December 31 of the fourth year. This analysis is deemed necessary to both assist the NRD in their monitoring program and to aid the operator in developing a knowledge of their particular groundwater nitrate level. This knowledge can readily be translated into a decrease of nitrogen usage by an operator and thus a financial incentive to properly use that nitrate in the system. A methodology for sample collection and proper analysis procedures will be a part of the education program.

- A soil analysis (3-4 feet in depth) for nitrogen (nitrate nitrogen) content for each field under control of the operator used for commercial crop production are encouraged every four years. NRD approved analysis methods should be used, and results submitted to the NRD by December 31 of the fourth year. This analysis is likewise considered necessary to aid the operator in developing a knowledge of their pending useable soil profile nitrogen and of that amount already inaccessible to the crops. A methodology for sample collection and proper analysis procedures will be a portion of the education program.

- All operators are encouraged to submit a Fertilizer Application Report to the NRD once every four years on a form provided by the District, which indicates the pounds per acre of nitrogen (commercial and organic) applied to each field under their control for the past four years. The quantity in pounds per acre of pesticides applied for each field where applied, will also be encouraged. Such reports will incorporate, if applicable, those reports required under the NRD chemigation program and such reporting requirements resulting from the implementation of the State assumption of the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA). These reports will also remain consistent with changes resulting from reauthorization of the Clean Water Act which affects such reports.

- Passage of LB-981 by the Nebraska Legislature in 1994, requires all new wells to be drilled in any management area which will pump greater than 50 gpm to have a permit prior to construction. The cost of the permit will be consistent with conditions of the law. Penalties applied under this Law will be in accordance with the law.

- Application of organic fertilizer (liquid manure, dried manure, sludge or composted organic waste) is very diversified and poses management problems relative to the size of the operation. The desire of the District is to allow farming operations to continue, yet not allow the N concentration in the groundwater to increase. Not all organic waste contains the same amount of N per unit of measurement, as such the amount/acre/year allowed to be applied in Phase I areas will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. Amount/acre/year of manure applied on each field is encouraged to be reported on the Fertilizer Application Report and submitted to the NRD once every four years.

- No fall applications of N fertilizer (commercial) will be allowed on non-sandy or fine textured soils until after November 1. Such determination of non-sandy soils or fine textured soils will also be determined and identified in the same manner as sandy soils.

- Fall and winter applications of N fertilizer (commercial) will be prohibited on sandy soils. Sandy soils will be designated utilizing the USDA Soil Conservation Service Soil Surveys for the counties in the District. Such determination will be set forth prior to designation and identified prior to confirming the GWMA Phase I program. Commercial fertilizer can be applied on sandy soils after March 1 of the crop year.

Present data indicates that some of the areas in the District may be placed in the Phase II category upon designation of the GWMA in the District. Phase II areas will be delineated via the above noted procedure of delineating boundaries. Such delineation will cause extended activities to be brought into play. Those additional requirements are:

PHASE II CONTROLS:

- A continuation of Phase I activities as they apply.

- A Groundwater analysis for nitrogen (nitrate) content for all irrigation, municipal, and industrial wells must be made annually and reported to the NRD by December 31.

- Annual soil samples in the root zone (3' to 4' in depth) on each field used for commercial crop production are required for Phase II and Phase III areas. This information will be used in conjunction with use of proper best management practices. The results of the soil samples will accompany the annual report made to the NRD by December 31.

- All operators will submit a Fertilizer Application Report to the NRD at the end of each crop year or prior to December 31 of each year. Submittal will be on a form(s) developed by the NRD. Reporting of Application of Pesticides will be encouraged on this form.

- Commercial nitrogen-fertilizer as anhydrous ammonia will be permitted on non-sandy or fine textured soils from November 1 to March 1, provided that an approved inhibitor is used and applied as recommended. After March 1 an inhibitor is not needed.

- In order to assure use of an approved inhibitor, the operator will be required to furnish certification from a dealer that an approved inhibitor was used and applied as recommended. Methodology for this activity will be developed as part of the education program.

- The District will begin a voluntary fertilizer calibration program addressing all applications and will strongly encourage operators to participate in the process. The District may, as conditions warrant, choose to develop a cost share program with operators.

- Monitoring (meters or time totalizers) of water applications will be required to allow operators to better manage fertilizer applications and control excessive nitrate leaching into the aquifer. If time totalizers are used then well output must be certified by the NRD. This activity will be phased in over a period of six (6) years.

- In Phase II and Phase III areas, amount per acre per year of organic fertilizer allowed to be applied (liquid manure, dried manure, sludge, or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. The Nebraska Cooperative Extension Service Bulletin EC 89-117 "Fertilizing Crops with Animal Manure" shall be used as guidance unless more current guidelines are available. Amount/acre/year of manure applied on each field is to be reported on the Fertilizer Application Report and submitted to the NRD by December 31 of each year. The amount and timing of application must be adjusted to the N concentration in the soil profile and groundwater content. Application is allowed to frozen soils and is to be determined on a site-by-site basis as this is a prime cause of both groundwater and surface water degradation.

- The education program will be expanded to assist the Phase II operators and other personnel in the area to realize that continued increases of nitrate and/or other non-point source contamination could cause the area to be elevated to a Phase III area.

Phase III areas are characterized by contaminant levels exceeding the MCL or LHAL in the groundwater. Present data indicates the potential to delineate areas in the District where nitrate levels are consistently in this range. Areas designated as Phase III areas are further constrained in order to more fully protect the citizens of the area and to remediate the aquifer.

PHASE III CONTROLS:

- Phase I and Phase II controls remain in effect.

- Monitoring (meters or time totalizers) of water applications to allow operators to better manage fertilizer applications and control leaching of nitrates is to be phased in over 4 years. If time totalizers are used then well output is to be certified by the NRD.

- The application of commercial nitrogen fertilizer is prohibited in the fall and winter on all soils until after March 1. Spring applications of commercial nitrogen fertilizer will require split applications (pre-plant and sidedress) or the use of an approved inhibitor applied as recommended. If a split application is used and 50 percent or more is applied as a pre-plant, the use on an approved inhibitor applied as recommended is still required.

- If 50% or more of commercial nitrogen fertilizer is applied to pre-plant then operators are required to furnish certification from the dealer that an inhibitor was used at recommended rates. Methodology for this process will be developed as part of the education program.

- Require fertilizer calibration monitors on applications >50 lbs./acre. The application of fertilizer (>50 lbs/acre) would be required to be calibrated to the results of soil and water tests and monitored for compliance. The District may choose to develop or increase a cost share program.

Groundwater Quantity Management Programs

The District is composed of both confined and unconfined aquifers. Confined aquifers being generally defined as those aquifer areas where there is a pressure such that the water tends to rise in the well casing. This rise is termed the potentiometric head. Unconfined aquifers are those which do not exhibit this characteristic. The two differing types, due to their varying characteristics, are treated differently in the designation of Levels in the management of the system.

The LPN NRD has defined subareas within the District that have similar aquifer conditions. When greater than 50% of the LPN NRD monitoring wells in a subarea has reached or exceeded the trigger level, then a control area can be established. As more information becomes available in the future, these subareas can be further defined.

LPN NRD monitoring wells are established by a cooperative agreement with the current landowners on a voluntary basis. Due to hydrologic considerations LPN NRD monitoring wells are not to be located on municipal well field property.

Unconfined Aquifers

Unconfined aquifer management subareas are to be designated within the District when conditions, indicate a 10% drop in the saturated thickness of the aquifer. Assessment of percentage drop will be calculated utilizing the spring readings of the wells over a three (3) year period assessed against the baseline 1987 well levels or a more recent index year water level adopted by the Board of Directors and revised in the Ground Water Management Plan to establish the new baseline. When this condition is noted to be developing, the District will enhance the education program which may assist in correcting the situation. If this type of action does not provide the needed results the following will occur.

LEVEL 1 CONTROLS:

- The area will be designated a Level 1 Quantity Area and operators of irrigation, municipal, and industrial well systems must attend education classes designed by the District and in agreement with applicable other agency input. Certification of all operators is required every four years.
- A permit will be required for all new wells to be drilled in the area which will pump greater than 50 gpm.
- The District will encourage well metering on irrigation, municipal, and industrial wells (meters or time totalizers). This voluntary well metering program will be established with possible incentives available to operators. Incentives may include a variety of options and will be developed prior to designation of a Level 1 area.
- Encourage an acre-inch allocation system that will be developed per commercial crops planted that are dependent on that particular aquifer.
- The District will encourage submission of the Water Use Report to the NRD prior to December 31 of the fourth year.

As conditions become more severe the District will utilize a 15 percent drop in the saturated thickness as the trigger to move into Level 2 quantity programs.

LEVEL 2 CONTROLS:

- The same requirements as in Level 1 but enhanced.
- Well meters or time totalizers will be a requirement on all irrigation, municipal, and industrial wells. If time totalizers are used then well output must be certified by the NRD.
- An acre-inch allocation per crop planted will be put into place and will be based on the aquifer and the use of the aquifer.
- The District will require annual submission of the Water Use Report to the NRD by December 31.
- Well spacing requirements will be applied in the Level 2 area pursuant to Section 46-673.12 of the State Statutes. (Well spacing will vary with % of decline in the aquifer.)
- Best management practices will be required to conserve water and will be developed prior to designation of the area as a Level 2 Area.

Confined Aquifers

The sensitivity of the confined aquifers has led the District to the decision to manage them in a different manner than the unconfined aquifers. The triggers are based on a reduction in the potentiometric-aquifer thickness. The potentiometric surface is defined as an "imaginary" surface representing the total head of groundwater in a confined aquifer that is defined by the level to which water will rise in a well. The potentiometric-aquifer thickness (PAT) is defined as the distance from the potentiometric surface to the base of the principal aquifer. The use of this procedure requires the data derived from the well drilling operation as the total aquifer thickness will need to be determined.

Three Levels have been assigned to the confined aquifer designations. Level 1A is triggered by a 7 percent drop in potentiometric-aquifer thickness. Assessment of percentage drop will be calculated utilizing the spring readings of the wells over a three (3) year period assessed against the 1987 baseline well levels or a more recent index year water level adopted by the Board of Directors and revised in the Ground Water Management Plan to establish the new baseline. This program is one of primarily education and the controls applied are:

LEVEL 1A CONTROLS:

- Operators of irrigation, municipal, and industrial well systems are required to attend education classes as designed by the District. These classes will be developed prior to any area being designated. All operators are to be certified every four years.
- Permits are required for all new wells to be drilled in the area which will pump greater than 50 gpm.

- The District will encourage well metering (meters or time totalizers) on all irrigation, municipal, and industrial wells.
- Encourage adoption of acre-inch allocations on crops planted that are dependent on the aquifer.
- The District will encourage submission of the Water Use Report to the NRD prior to December 31 of the fourth year.

Level 2A is triggered by a 10 percent drop in the potentiometric-aquifer thickness of the aquifer and the following controls are applied.

LEVEL 2A CONTROLS:

- The same controls as set forth in Level 1A apply.
- Well meters or time totalizers are required to be installed and used on all irrigation, municipal, and industrial wells. If time totalizers are used then well output must be certified by the NRD.
- The District will develop and assess acre-inch allocations per crops planted. These allocations will be developed according to data assessments, wells in the area, use of the wells, and other pertinent factors leading to the proper assessment of the available resource.
- The District will require an annual submission of the Water Use Report to the NRD prior to December 31.

The trigger for the Level 3A Area is a 15 percent drop in the potentiometric-aquifer thickness. This level signals the need for extreme measures as the aquifer is under considerable stress.

LEVEL 3A CONTROLS:

- Same conditions as applied in Level 1A and Level 2A as applicable.
- As required, the District will further adjust the acre-inch allocations. Such adjustment will be commensurate with the data developed from implementation of Level 2A area designation.
- The District will adopt a well spacing requirement pursuant to Section 46-673.12 Nebraska statues and implement such a system. Well spacing will vary with % decline in the aquifer.

AGRICULTURAL RESEARCH FACILITIES

Agricultural Research Facilities within the LPN NRD may apply to the Board of Directors for a modification of the individual requirements within the groundwater management areas, that specifically affects the land they own or operate. Such requests will be reviewed on a case-by-case basis.

APPEAL PROCESS

In implementing the LPN NRD Groundwater Management Plan, all those affected are provided with an administrative appeal process whereby they may address the Board of Directors to present their case. The incorporation and functioning of the appeals process is carried out with the same manner as other administrative appeals processes utilized by the District (i.e., sediment and erosion control program appeal process).

SUMMARY

In pursuing the goals of this Groundwater Management Plan, the District will orient its programs in support of accomplishing the goals, objectives and policies of the plan. Provisions will be incorporated in the process to allow for Areas and Levels to change over time in response to changes in either nitrate levels, chemical constituent levels, or water levels.

TABLE 1
QUALITY

AREA	DATE TO BEGIN	PHASE	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Phase I Area	0-8 ppm NO_3-N in groundwater, or <80% of MCL/LHAL of "other" man-induced, non-point source contaminants.	a) All operators using any type of fertilizer must attend the education/ certification classes established by the District to become certified, every 4 years. b) A groundwater analysis for nitrogen (NO_3-N) content for all wells pumping greater than 100 gpm and irrigating commercial crops must be made every 4 years and reported to the NRD by December 31 of the fourth year. c) A soil (3-4 ft. depth) analysis for nitrogen (NO_3-N) content on each field growing commercial crops are encouraged every 4 years and results reported to the NRD by December 31 of the fourth year. d) All operators are encouraged to submit a Fertilizer Application Report to the NRD prior to December 31 once every 4 years which indicates the pound per acre of nitrogen (commercial and organic) and quantity per acre of pesticides applied to each field on crop lands under their use for the reporting period. Such reports will incorporate, if applicable, those reports required under the NRD chemigation program and such reports resulting from implementation of the State assumption of the Federal Insecticide Fungicide, Rodenticide Act (FIFRA). e) Require permits for all new wells to be drilled which will pump greater than 50 gpm. f) Amount/acre/year of organic manure allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. g) No Fall application of N fertilizer (commercial) on non-sandy or fine textured soils until after November 1. h) Fall and Winter applications of N fertilizer (commercial) is prohibited on sandy soils. Commercial fertilizer can be applied on sandy soils after March 1.

TABLE 2
QUALITY

AREA	DATE TO BEGIN	PHASE	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Phase II Area	8.01-10 ppm NO_3-N in groundwater, or >80% but <100% of MCL/LHAL of "other" man-induced, non-point source contaminants.	a) Same as Phase I b) A groundwater analysis for Nitrogen (NO_3-N) content for all wells pumping greater than 100 gpm and irrigating commercial crops must be made annually, and reported to the NRD by December 31. c) A soil (3-4 ft. depth) analysis fo r nitrogen (NO_3-N) content o n each field growing commercial crops are required annually and results reported to the NRD by December 31. d) The Fertilizer Application Report must be submitted to the Lower Platte North NRD each crop year prior to December 31. e) Commercial Nitrogen Fertilizer will be permitted on non-sandy or fine textured soils from November 1 to March 1 provided that an approved inhibitor is used at recommended rates. After March 1 inhibitor is not needed. f) Require operators applying commercial fertilizer from November 1 to March 1 to furnish certification from dealer that an approved inhibitor was used as recommended. g) Encourage fertilizer calibration monitors on all applications and develop cost-share programs. h) Monitor (meters or time totalizers) water applications to allow operators to better manage fertilizer applications and control leaching of Nitrates. (Phase in over 6 years) i) Amount/acre/year of organic manure allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. (Use of Nebraska Cooperative Extension Service Bulletin EC-89117 is recommended.) Amount and timing of application must be adjusted to the N concentration in the soil profile and groundwater content. Application to frozen soils on a site-by-site basis. j) Expand education programs.

TABLE 3
QUALITY

AREA	DATE TO BEGIN	PHASE	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Phase III Area	greater than 10.01 ppm NO_3-N in groundwater, or >100% of MCL/LHAL of "other" man-induced, non-point source contaminants.	a) Same as Phase I and Phase II b) Monitor (meters or time totalizers) water applications to allow operators to better manage fertilizer applications and control leaching of Nitrates (Phase in over 4 years). c) Application of commercial nitrogen fertilizer is prohibited in the fall and winter on all soils until after March 1. Spring applications of commercial nitrogen fertilizer will require split applications (pre-plant and sidedress) or the use of an approved inhibitor applied as recommended. (On split application, if 50% or more is applied as a pre-plant the use of an approved inhibitor applied as recommended is still required). d) If 50% or more of commercial nitrogen fertilizer is applied at pre-plant then operators are required to furnish certification from the dealer that an inhibitor was used at recommended rates. e) Require fertilizer calibration monitors on applications of > 50 lbs. per acre.

TABLE 4
UNCONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level I	10% drop in the saturated thickness.	a) All operators of well systems that pump greater than 100 gpm must attend education classes designed by the District. All operators to be certified every 4 years. b) Permits required for all new wells to be drilled which will pump greater than 50 gpm. c) Encourage well metering program (meters or time totalizers) to be established on all wells pumping greater than 100 gpm. d) Encourage adoption of acre-inch allocations per crops planted that are dependant on the aquifer. e) Encourage submission of the Water Use Report to NRD prior to December 31 of the fourth year.

TABLE 5
UNCONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level II	15% drop in the saturated thickness.	a) Same as Level I. b) Require well meters or time totalizers to be installed on all wells pumping greater than 100 gpm. c) Require adoption of acre-inch allocations per crops planted that are dependent on the aquifer. d) Require annual submission of the Water Use Report to the NRD prior to December 31. e) Requirement of well-spacing pursuant to Section 46-673.12 - Nebraska Statutes. (Will vary with % of aquifer decline.) f) Require use of best management practices to conserve water.

TABLE 6
CONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level 1A	7% drop in potentiometric-aquifer thickness.	a) All operators of well systems that pump greater than 100 gpm must attend education classes designed by the District. All operators to be certified every 4 years. b) Permits required for all new wells to be drilled which will pump greater than 50 gpm. c) Encourage well metering program (meters or time totalizers) to be established on all wells pumping greater than 100 gpm. d) Encourage adoption of acre-inch allocations per crops planted that are dependent on the aquifer. e) Encourage submission of the Water Use Report to NRD prior to December 31 of the fourth year.

1) The potentiometric surface is defined as an "imaginary" surface representing the total head of groundwater in a confined aquifer that is defined by the level to which water will rise in a well.

2) The potentiometric-aquifer thickness (PAT) is defined as the distance from the potentiometric surface to the base of the principal aquifer.

TABLE 7
CONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level IIA	10% drop in potentiometric-aquifer thickness.	a) Same as level IA. b) Require well meters or time totalizers to be installed on all wells pumping greater than 100 gpm. c) Require adoption of acre-inch allocations per crops planted that are dependant on the aquifer. d) Require annual submission of the Water Use Report to the NRD prior to December 31.

TABLE 8
CONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level IIIA	15% drop in potentiometric-aquifer thickness.	a) Same as level IA and IIA. b) Further adjust acre-inch allocations. c) Require well-spacing pursuant to section 46-673.12 Nebraska Statutes. (Will vary with % of aquifer decline) d) Require use of best management practices to conserve water.

TABLE 9
LPNNRD's - GROUNDWATER QUALITY MANAGEMENT PROGRAM

RULES AND REGULATIONS	Phase I	Phase II	Phase III
1. Phase areas will be established on Nitrate-Nitrogen (NO_3-N) concentration found in the groundwater.	0-8 ppm	8.01-10 ppm	10.01 ppm or >
2. Phase areas can be established on other non-point source contaminants found in the groundwater or soil.	0-80% MCL/LHAL	80-100% MCL/LHAL	>100% MCL/LHAL
3. Operators using any type of fertilizer are required to become certified every 4 years.	X	X	X
4. A groundwater analysis for Nitrogen (NO_3-N) content for all wells pumping greater than 100 gpm irrigating commercial crop production must be made and reported to the NRD by December 31.	Once every 4 yrs.	Annually	Annually
5. Soil samples in the root zone (3 to 4 ft. deep) are to be taken and reported to the NRD by December 31.	Encouraged	Annually	Annually
6. Fertilizer Application Report (both commercial and organic fertilizers) to NRD prior to December 31.	Encouraged	Annually	Annually
7. Permit for all new wells to be drilled which will pump greater than 50 gpm.	X	X	X
8. Amount/acre/year of organic fertilizer allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates.	X		
9. No fall application of N fertilizer (commercial) on non-sandy soils until after November 1 .	X		
10. Fall and winter applications of commercial nitrogen fertilizer is prohibited on sandy soils. Commercial fertilizer can be applied on sandy soils after March 1.	X	X	
11. Commercial nitrogen fertilizer permitted on non-sandy soils from November 1 to March 1 provided an approved inhibitor is used at recommended rates.		X	
12. Require operators applying commercial fertilizer from November 1 to March 1 to furnish certification from dealer that an approved inhibitor was used as recommended.		X	
13. Encourage fertilizer calibration monitors on all applications and develop cost-share programs.		X	
14. Monitor water applications to allow operators to better manage fertilizer application and control leaching of Nitrogen.		phase in over 6 yr.	phase in over 4 yr.
15. Amount/acre/year of organic fertilizer allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. Amount and timing of application must be adjusted to the N concentration in the soil profile and groundwater content. Application to frozen soils on a site-by-site basis.		X	X
16. Expand Education program.		X	X
17. Application of commercial nitrogen fertilizer is prohibited in the fall and winter on all soils until after March 1. Spring applications of commercial nitrogen fertilizer will require split application (pre-plant and sidedress) or the use of an approved inhibitor applied as recommended. (On split applications, if 50% or more is applied as a pre-plant, the use of an approved inhibitor applied as recommended is still required.)			X
18. If 50% or more of commercial nitrogen fertilizer is applied at pre-plant then operators are required to furnish certification from dealer that an inhibitor was used at recommended rates.			X
19. Require fertilizer monitors on all applications greater than 50 lbs/acre.			X

TABLE 10
LOWER PLATTE NORTH NRD
GROUNDWATER QUANTITY MANAGEMENT PROGRAM

UNCONFINED AQUIFER		
Rules and Regulations	**Level I 10% drop in saturated thickness**	**Level II 15% drop in saturated thickness**
1. All operators of well systems that pump greater than 100 gpm must attend education classes and be certified every 4 years.	X	X
2. Permit required for all new wells to be drilled which will pump greater than 50 gpm.	X	X
3. Well metering program established on all wells pumping greater than 100 gpm.	Encouraged	Required
4. Adopt acre-inch allocations per crops planted dependent on aquifer.	Encouraged	Required
5. Water Use Report to NRD prior to December 31.	Encouraged	Annually
6. Require well-spacing pursuant to section 46-673.12 (will vary with % decline)		X
7. Require use of best management practices.		X

CONFINED AQUIFERS			
Rules and Regulations	**Level IA 7% drop in potentiometric-aquifer thickness**	**Level IIA 10% drop in potentiometric-aquifer thickness**	**Level IIIA 15% drop in potentiometric-aquifer thickness**
1. All operators of well systems that pump greater than 100 gpm must attend education classes and be certified every 4 years.	X	X	X
2. Permits required on all new wells to be drilled which will pump greater than 50 gpm.	X	X	X
3. Well metering program established on all wells pumping greater than 100 gpm.	Encouraged	Required	Required
4. Adopt acre-inch allocations per crops planted dependant on aquifer.	Encouraged	Required	Required
5. Water Use Report to NRD prior to December 31.	Encouraged	Annually	Annually
6. Require well spacing pursuant to Section 46-673.12. (Will vary with % decline)			X
7. Require use of best management practices.			X

PLAN FOR GROUNDWATER MANAGEMENT IN THE LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT

Section D
Public Participation

Public knowledge of the ideas and designs included in the Groundwater Management Plan is crucial to the successful implementation of the plan. Therefore, the Board of Directors felt that a series of public hearings and meetings to present and discuss the changes to the adopted Groundwater Management Plan would be beneficial. Public hearings and meetings were held at the following locations:

July 26, 1993	Public Hearing - Fremont Public Hearing - Schuyler Public Hearing - Wahoo
July 28, 1993	Public Hearing - Platte Center Public Hearing - David City
August 25, 1993	Press Conference - Wahoo
September 8, 1993	Public Meeting - Wahoo
August 29, 1994	Public Hearing - Wahoo
August 31, 1994	Public Hearing - Platte Center

During each public meeting the plan was presented by NRD staff. Public comments, questions, and concerns were recorded for consideration by the Board and possible incorporation into the Plan. Overall the meetings were very beneficial, and provided guidance to the Board of Directors and NRD staff. Appropriate comments were incorporated into the Plan.

In addition to the public meeting process, public awareness was fostered through a series of 17 news articles in local papers, 5 radio spots, and presentations at 7 area meetings during 1993 and 1994. The LPN NRD board and staff is grateful to those who took the time to participate in this process.

TABLE 1
QUALITY

AREA	DATE TO BEGIN	PHASE	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Phase I Area	0-8 ppm NO_3-N in groundwater, or <80% of MCL/LHAL of "other" man-induced, non-point source contaminants.	a) All operators using any type of fertilizer must attend the education/ certification classes established by the District to become certified, every 4 years. b) A groundwater analysis for nitrogen (NO_3-N) content for irrigation, municipal, and industrial wells must be made every 4 years and reported to the NRD by December 31 of the fourth year. c) A soil (3-4 ft. depth) analysis for nitrogen (NO_3-N) content on each field growing commercial crops are encouraged every 4 years and results reported to the NRD by December 31 of the fourth year. d) All operators are encouraged to submit a Fertilizer Application Report to the NRD prior to December 31 once every 4 years which indicates the pound per acre of nitrogen (commercial and organic) and quantity per acre of pesticides applied to each field on crop lands under their use for the reporting period. Such reports will incorporate, if applicable, those reports required under the NRD chemigation program and such reports resulting from implementation of the State assumption of the Federal Insecticide Fungicide, Rodenticide Act (FIFRA). e) Require permits for all new wells to be drilled which will pump greater than 50 gpm. f) Amount/acre/year of organic manure allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. g) No Fall application of N fertilizer (commercial) on non-sandy or fine textured soils until after November 1. h) Fall an d Winter applications of N fertilizer (commercial) is prohibited on sandy soils. Commercial fertilizer can be applied on sandy soils after March 1.

TABLE 2
QUALITY

AREA	DATE TO BEGIN	PHASE	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Phase II Area	8.01-10 ppm NO_3-N in groundwater, or >80% but <100% of MCL/LHAL of "other" man-induced, non-point source contaminants.	a) Same as Phase I b) A groundwater analysis for Nitrogen (NO_3-N) content for all irrigation. municipal, and industrial wells must be made annually, and reported to the NRD by December 31. c) A soil (3-4 ft. depth) analysis for nitrogen (NO_3-N) content on each field growing commercial crops are required annually and results reported to the NRD by December 31. d) The Fertilizer Application Report must be submitted to the Lower Platte North NRD each crop year prior to December 31. e) Commercial Nitrogen Fertilizer will be permitted on non-sandy or fine textured soils from November 1 to March 1 provided that an approved inhibitor is used at recommended rates. After March 1 inhibitor is not needed. f) Require operators applying commercial fertilizer from November 1 to March 1 to furnish certification from dealer that an approved inhibitor was used as recommended. g) Encourage fertilizer calibration monitors on all applications and develop cost-share programs. h) Monitor (meters or time totalizers) water applications to allow operators to better manage fertilizer applications and control leaching of Nitrates. (Phase in over 6 years) i) Amount/acre/year of organic manure allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. (Use of Nebraska Cooperative Extension Service Bulletin EC-89117 is recommended.) Amount and timing of application must be adjusted to the N concentration in the soil profile and groundwater content. Application to frozen soils on a site-by-site basis. j) Expand education programs.

TABLE 3
QUALITY

AREA	DATE TO BEGIN	PHASE	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Phase III Area	greater than 10.01 ppm NO_3-N in groundwater, or >100% of MCL/LHAL of "other" man-induced, non-point source contaminants.	a) Same as Phase I and Phase II b) Monitor (meters or time totalizers) water applications to allow operators to better manage fertilizer applications and control leaching of Nitrates (Phase in over 4 years). c) Application of commercial nitrogen fertilizer is prohibited in the fall and winter on all soils until after March 1. Spring applications of commercial nitrogen fertilizer will require split applications (pre-plant and sidedress) or the use of an approved inhibitor applied as recommended. (On split application, if 50% or more is applied as a pre-plant the use of an approved inhibitor applied as recommended is still required). d) If 50% or more of commercial nitrogen fertilizer is applied at pre-plant then operators are required to furnish certification from the dealer that an inhibitor was used at recommended rates. e) Require fertilizer calibration monitors on applications of > 50 lbs. per acre.

TABLE 4
UNCONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level I	10% drop in the saturated thickness.	a) Operators of irrigation, municipal, and industrial well systems must attend education classes designed by the District. All operators to be certified every 4 years. b) Permits required for all new wells to be drilled which will pump greater than 50 gpm. c) Encourage well metering (meters or time totalizers) to be established on all irrigation, municipal, and indsutrial wells. d) Encourage adoption of acre-inch allocations per crops planted that are dependant on the aquifer. e) Encourage submission of the Water Use Report to NRD prior to December 31 of the fourth year.

TABLE 5
UNCONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level II	15% drop in the saturated thickness.	a) Same as Level I. b) Require well meters or time totalizers to be installed on all irrigation, municipal, and industrial wells. c) Require adoption of acre-inch allocations per crops planted that are dependent on the aquifer. d) Require annual submission of the Water Use Report to the NRD prior to December 31. e) Requirement of well-spacing pursuant to Section 46-673.12 - Nebraska Statutes. (Will vary with % of aquifer decline.) f) Require use of best management practices to conserve water.

TABLE 6
CONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level 1A	7% drop in potentiometric-aquifer thickness.	a) Operators of irrigation, municipal, and industrial well systems must attend education classes designed by the District. All operators to be certified every 4 years. b) Permits required for all new wells to be drilled which will pump greater than 50 gpm. c) Encourage well metering (meters or time totalizers) on all irrigation, municipal, and industrial wells. d) Encourage adoption of acre-inch allocations per crops planted that are dependent on the aquifer. e) Encourage submission of the Water Use Report to NRD prior to December 31 of the fourth year.

1) The potentiometric surface is defined as an "imaginary" surface representing the total head of groundwater in a confined aquifer that is defined by the level to which water will rise in a well.

2) The potentiometric-aquifer thickness (PAT) is defined as the distance from the potentiometric surface to the base of the principal aquifer.

TABLE 7
CONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level IIA	10% drop in potentiometric-aquifer thickness.	a) Same as level IA. b) Require well meters or time totalizers to be installed on all irrigation, municipal, and industrial wells. c) Require adoption of acre-inch allocations per crops planted that are dependant on the aquifer. d) Require annual submission of the Water Use Report to the NRD prior to December 31.

TABLE 8
CONFINED AQUIFERS
QUANTITY

AREA	DATE TO BEGIN	LEVEL	TRIGGERS	CONTROLS
Lower Platte North Natural Resources District		Level IIIA	15% drop in potentiometric-aquifer thickness.	a) Same as level IA and IIA. b) Further adjust acre-inch allocations. c) Require well-spacing pursuant to section 46-673.12 Nebraska Statutes. (Will vary with % of aquifer decline) d) Require use of best management practices to conserve water.

TABLE 9
LPNNRD's - GROUNDWATER QUALITY MANAGEMENT PROGRAM

RULES AND REGULATIONS	Phase I	Phase II	Phase III
1. Phase areas will be established on Nitrate-Nitrogen (NO_3-N) concentration found in the groundwater.	0-8 ppm	8.01-10 ppm	10.01 ppm or >
2. Phase areas can be established on other non-point source contaminants found in the groundwater or soil.	0-80% MCL/LHAL	80-100% MCL/LHAL	>100% MCL/LHAL
3. Operators using any type of fertilizer are required to become certified every 4 years.	X	X	X
4. A groundwater analysis for Nitrogen (NO_3-N) content for all irrigation, municipal, and industrial wells must be made and reported to the NRD by December 31.	Once every 4 yrs.	Annually	Annually
5. Soil samples in the root zone (3 to 4 ft. deep) are to be taken and reported to the NRD by December 31.	Encouraged	Annually	Annually
6. Fertilizer Application Report (both commercial and organic fertilizers) to NRD prior to December 31.	Encouraged	Annually	Annually
7. Permit for all new wells to be drilled which will pump greater than 50 gpm.	X	X	X
8. Amount/acre/year of organic fertilizer allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates.	X		
9. No fall application of N fertilizer (commercial) on non-sandy soils until after November 1.	X		
10. Fall and winter applications of commercial nitrogen fertilizer is prohibited on sandy soils. Commercial fertilizer can be applied on sandy soils after March 1.	X	X	
11. Commercial nitrogen fertilizer permitted on non-sandy soils from November 1 to March 1 provided an approved inhibitor is used at recommended rates.		X	
12. Require operators applying commercial fertilizer from November 1 to March 1 to furnish certification from dealer that an approved inhibitor was used as recommended.		X	
13. Encourage fertilizer calibration monitors on all applications and develop cost-share programs.		X	
14. Monitor water applications to allow operators to better manage fertilizer application and control leaching of Nitrogen.		phase in over 6 yr.	phase in over 4 yr.
15. Amount/acre/year of organic fertilizer allowed (liquid manure, dried manure, sludge or composted organic waste) will be based on method of collection and storage, land application method, types of crops or cover crop, soil types, landscape features, source of manure, and previous manure application rates. Amount and timing of application must be adjusted to the N concentration in the soil profile and groundwater content. Application to frozen soils on a site-by-site basis.		X	X
16. Expand Education program.		X	X
17. Application of commercial nitrogen fertilizer is prohibited in the fall and winter on all soils until after March 1. Spring applications of commercial nitrogen fertilizer will require split application (pre-plant and sidedress) or the use of an approved inhibitor applied as recommended. (On split applications, if 50% or more is applied as a pre-plant, the use of an approved inhibitor applied as recommended is still required.)			X
18. If 50% or more of commercial nitrogen fertilizer is applied at pre-plant then operators are required to furnish certification from dealer that an inhibitor was used at recommended rates.			X
19. Require fertilizer monitors on all applications greater than 50 lbs/acre.			X

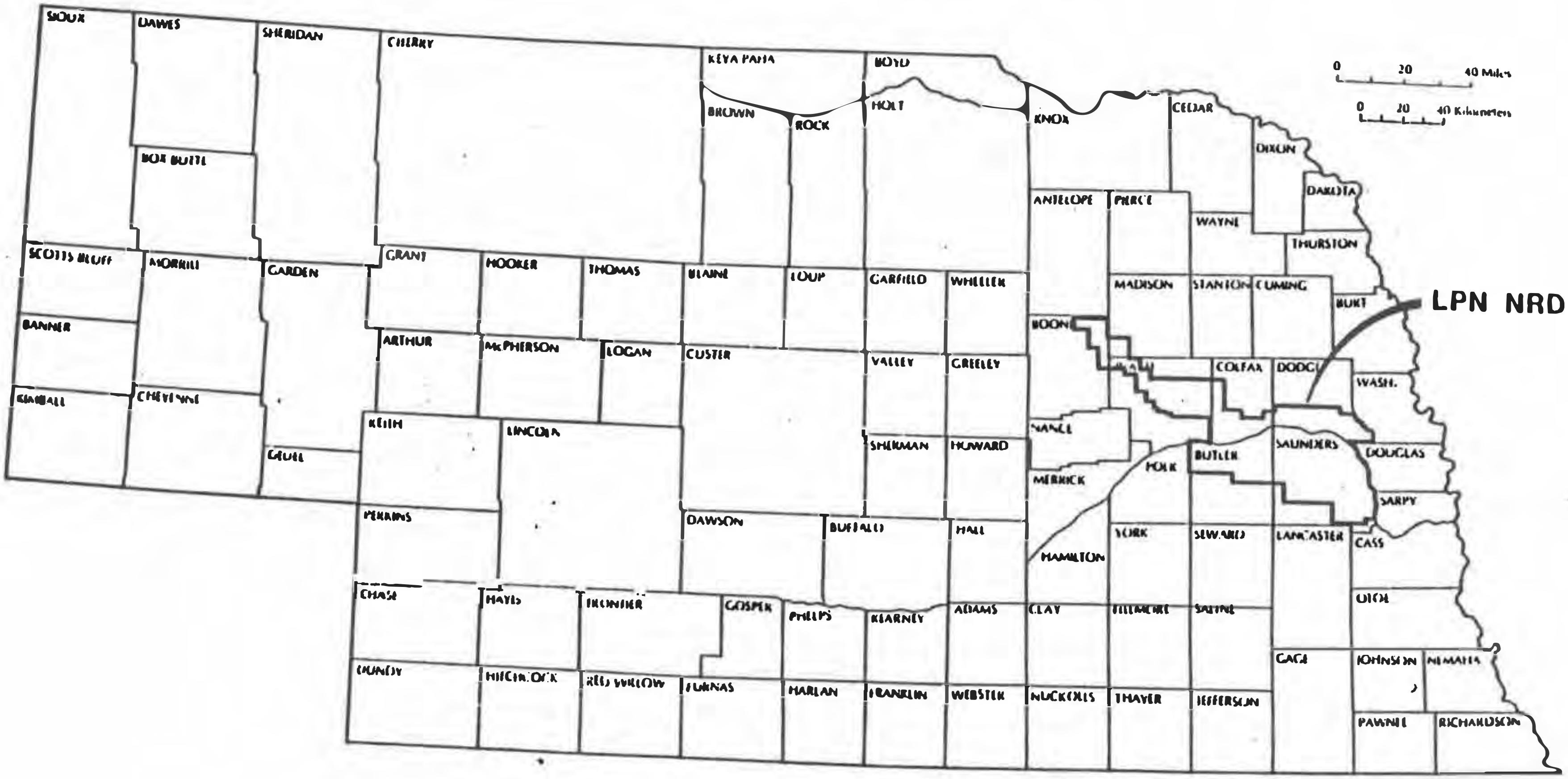
TABLE 10
LOWER PLATTE NORTH NRD
GROUNDWATER QUANTITY MANAGEMENT PROGRAM

UNCONFINED AQUIFER		
Rules and Regulations	**Level I 10% drop in saturated thickness**	**Level II 15% drop in saturated thickness**
1. Operators of irrigation, municipal, and industrial well systems must attend education classes and be certified every 4 years.	X	X
2. Permit required for all new wells to be drilled which will pump greater than 50 gpm.	X	X
3. Well metering established on irrigation, municipal, and industrial wells.	Encouraged	Required
4. Adopt acre-inch allocations per crops planted dependent on aquifer.	Encouraged	Required
5. Water Use Report to NRD prior to December 31.	Encouraged	Annually
6. Require well-spacing pursuant to section 46-673.12 (will vary with % decline)		X
7. Require use of best management practices.		X

CONFINED AQUIFERS			
Rules and Regulations	**Level IA 7% drop in potentiometric-aquifer thickness**	**Level IIA 10% drop in potentiometric-aquifer thickness**	**Level IIIA 15% drop in potentiometric-aquifer thickness**
1. Operators of irrigation, municipal, and industrial well systems must attend education classes and be certified every 4 years.	X	X	X
2. Permits required on all new wells to be drilled which will pump greater than 50 gpm.	X	X	X
3. Well metering program established on all irrigation, municipal, and industrial wells.	Encouraged	Required	Required
4. Adopt acre-inch allocations per crops planted dependant on aquifer.	Encouraged	Required	Required
5. Water Use Report to NRD prior to December 31.	Encouraged	Annually	Annually
6. Require well spacing pursuant to Section 46-673.12. (Will v ary with % decline)			X
7. Require use of best management practices.			X

APPENDIX A

EXHIBIT 1

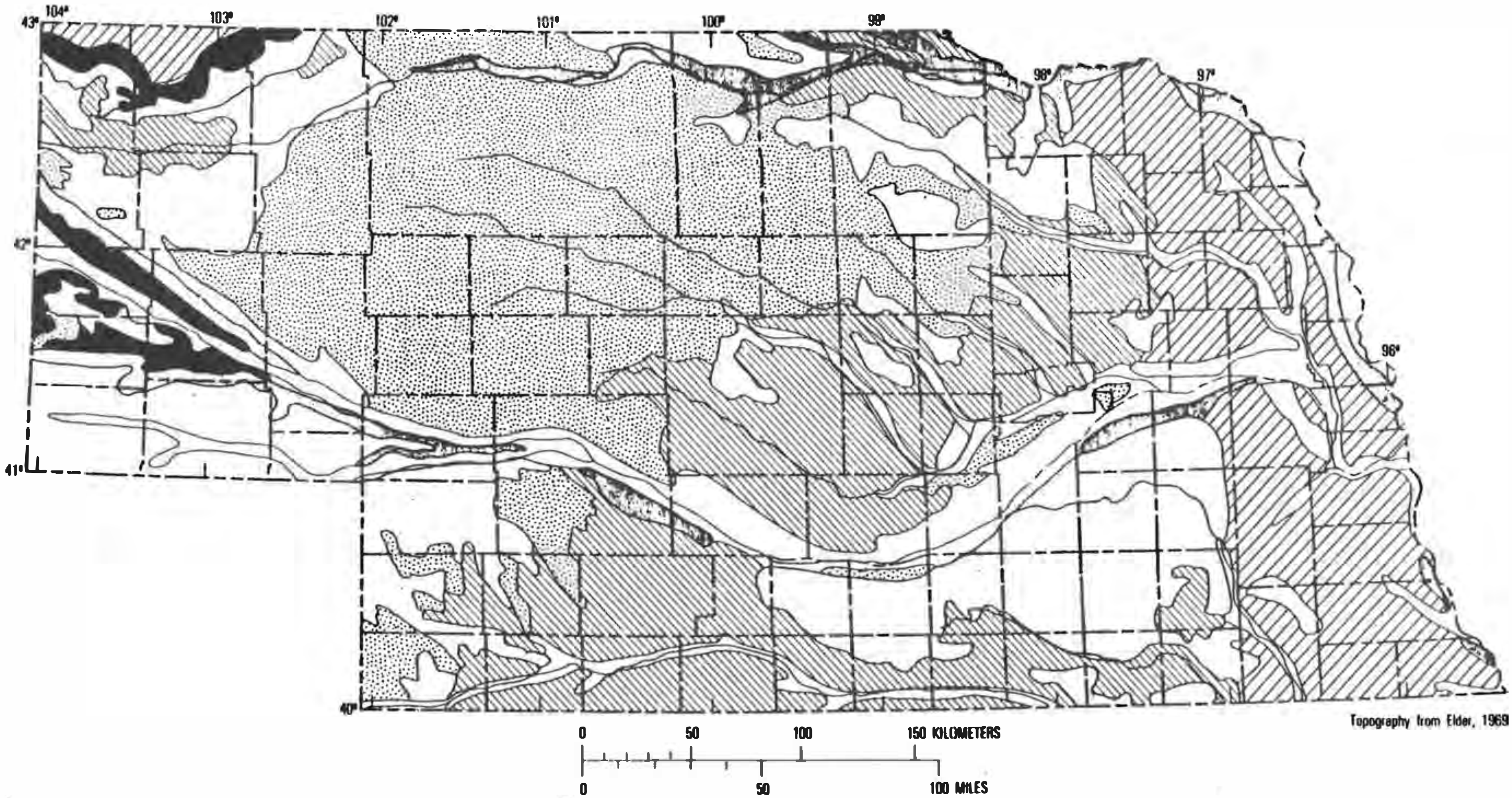


LOCATION

LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT

EXHIBIT 2

Types of topography.



EXPLANATION

- Valleys
- Plains
- Dissected plains
- Sandhills
- Rolling hills
- Bluffs and escarpments
- Valley-side slopes

Valleys—flat-lying land along the major streams. The materials of the valleys are stream-deposited silt, clay, sand, and gravel.

Plains—flat-lying land which lies above the valley. The materials of the plains are sandstone or stream-deposited silt, clay, sand, and gravel overlain by wind-deposited silt (loess).

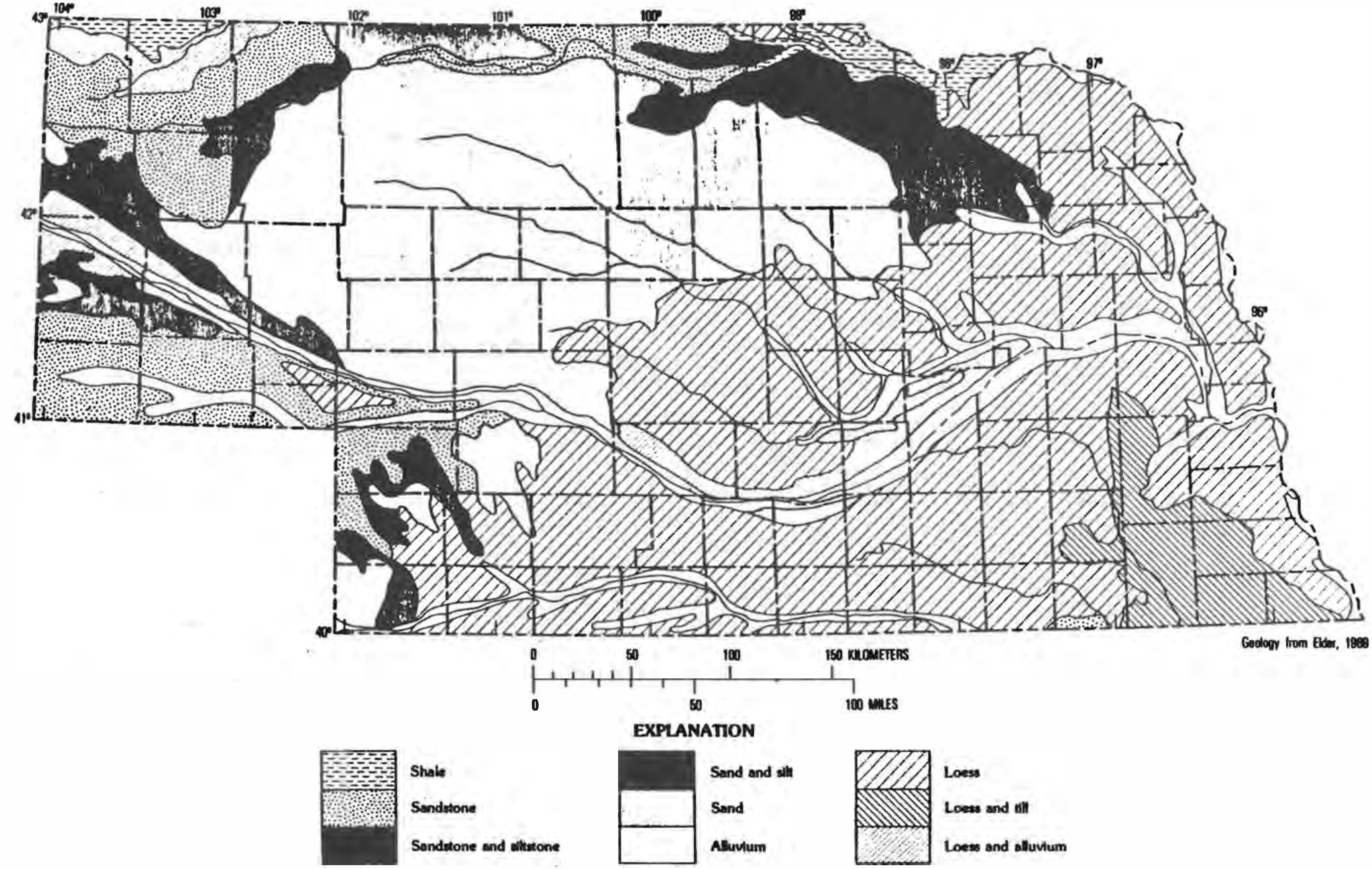
Dissected Plains—hilly land with moderate to steep slopes, sharp ridge crests, and remnants of the old, nearly level plain. The Dissected Plains are old plains eroded by water and wind.

Sand Hills—hilly land composed of low to high dunes of sand stabilized by a grass cover. The sand dunes mantle stream-deposited silt, sand and gravel, and sandstone.

Rolling Hills—hilly land with moderate to steep slopes and rounded ridge crests. In eastern Nebraska, the Rolling Hills are mostly glacial till that has been eroded and mantled by loess, while in northwestern Nebraska the hills were produced by the erosion of clay and clay-shale beds.

Bluffs and Escarpments—rugged land with very steep and irregular slopes. Bedrock materials, such as sandstone, shale, and limestone, are often exposed in these areas.

Valley-Side Slopes—moderately sloping land which occurs between the escarpments and the major stream valleys in western Nebraska. These areas are mostly siltstone bedrock covered by a few feet to a few tens of feet of sand, gravel, or silt.

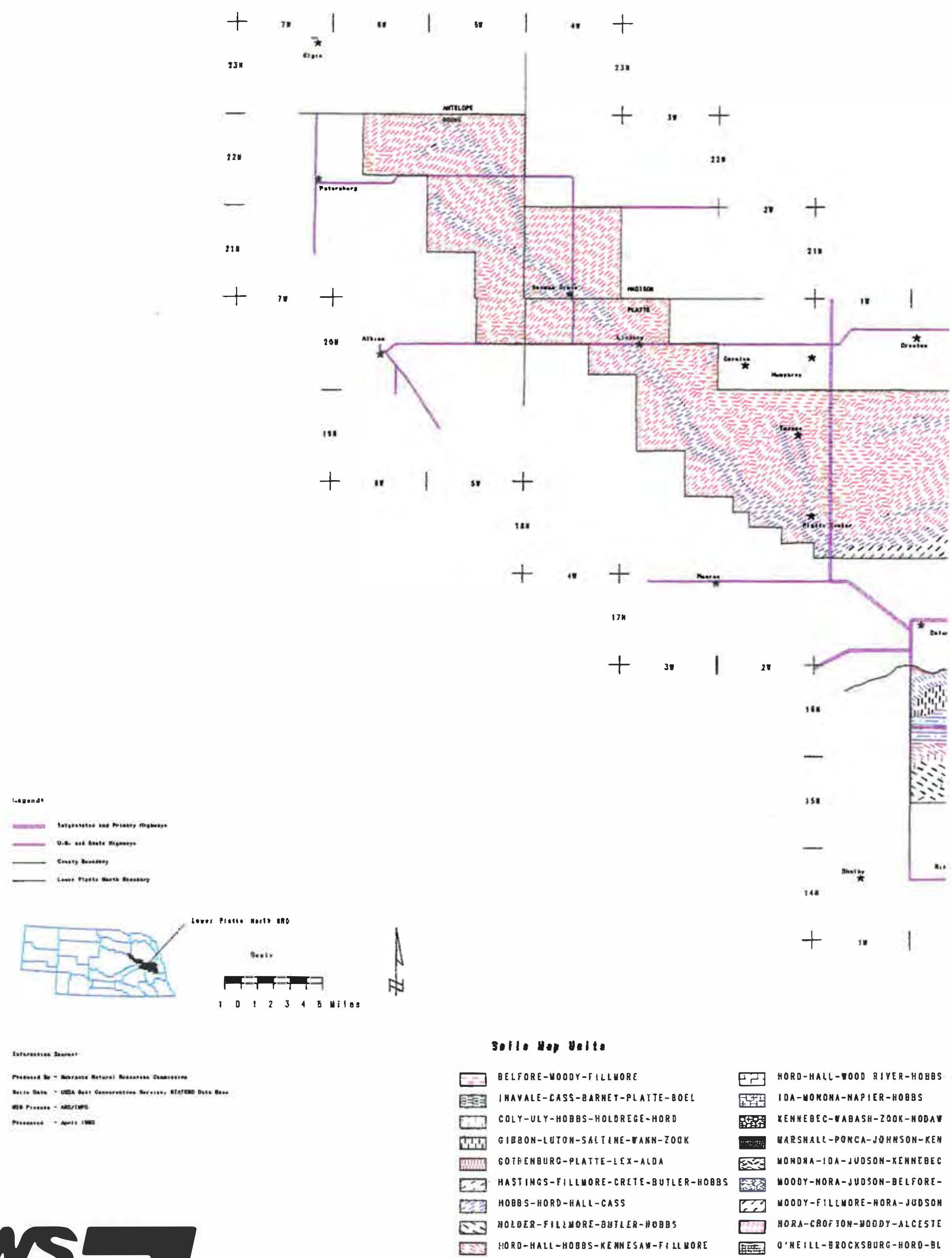


Parent materials of soils.

EXHIBIT 3

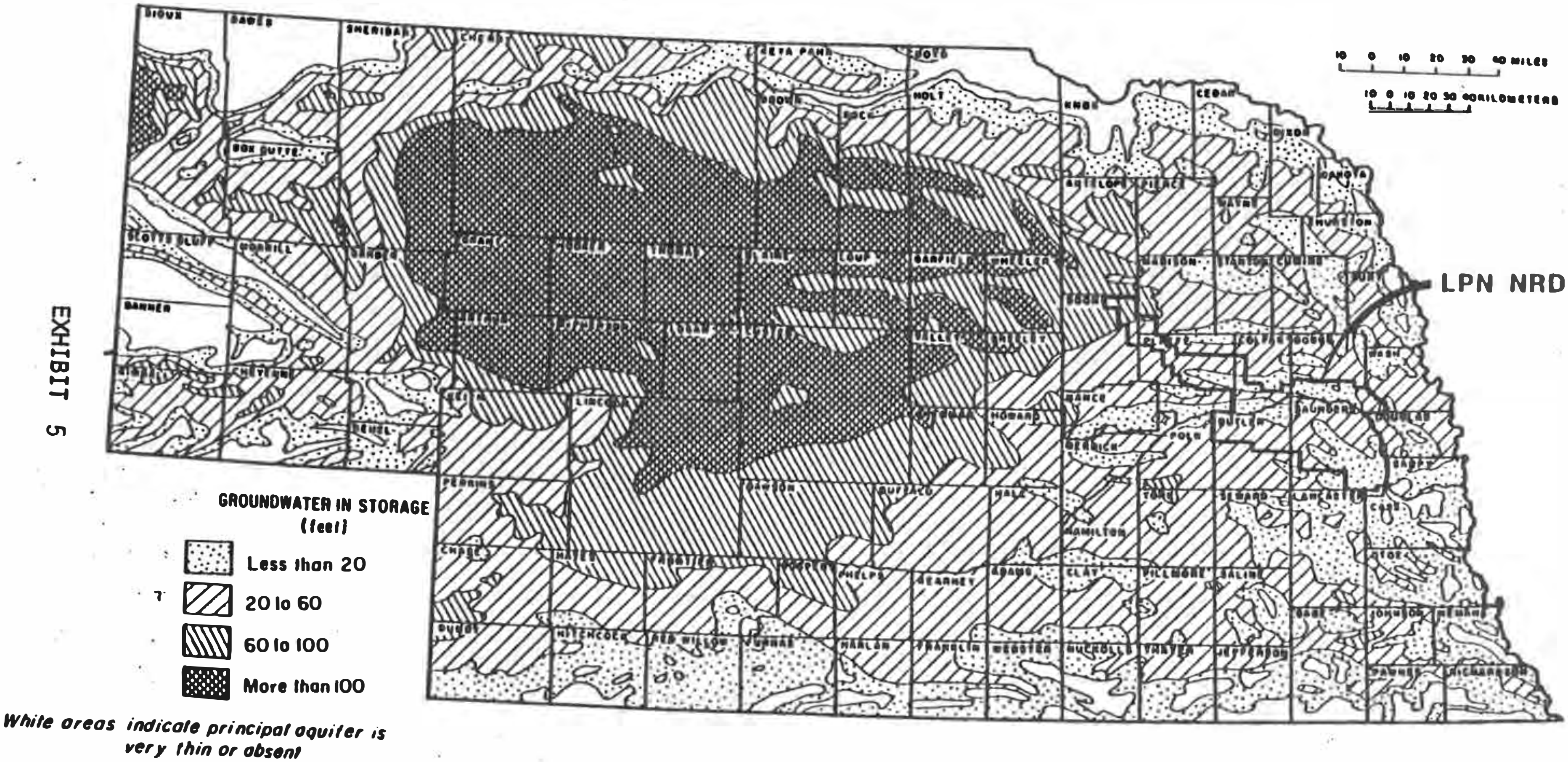
NEBRASKA NATURAL RESOURCES COMMISSION

DATA BANK



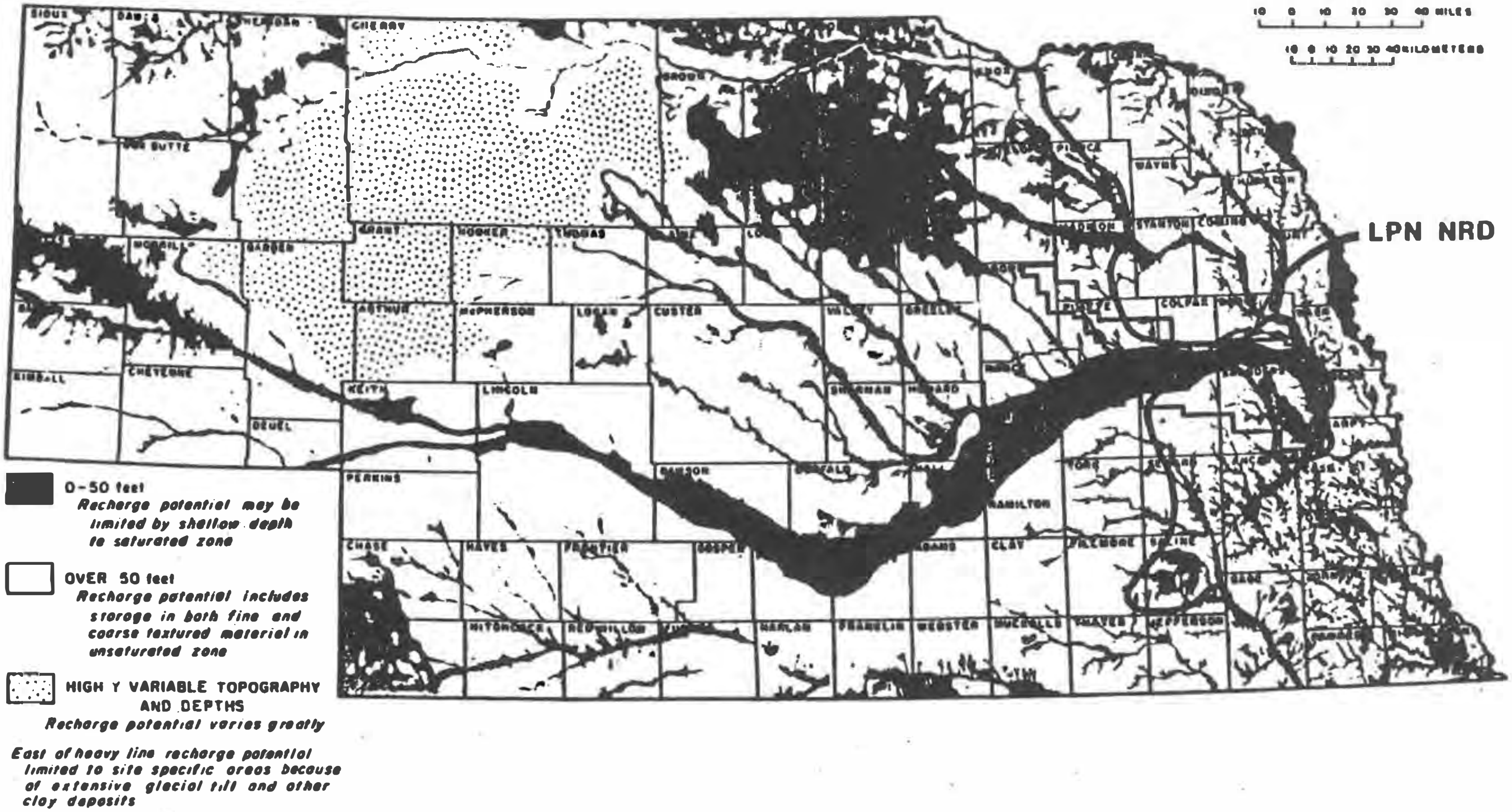
HWS Consulting Group, Inc.

EXHIBIT 5



Groundwater Storage in the Principal Aquifer. The amount of water, in feet, estimated to be contained within the principal aquifers of the state.

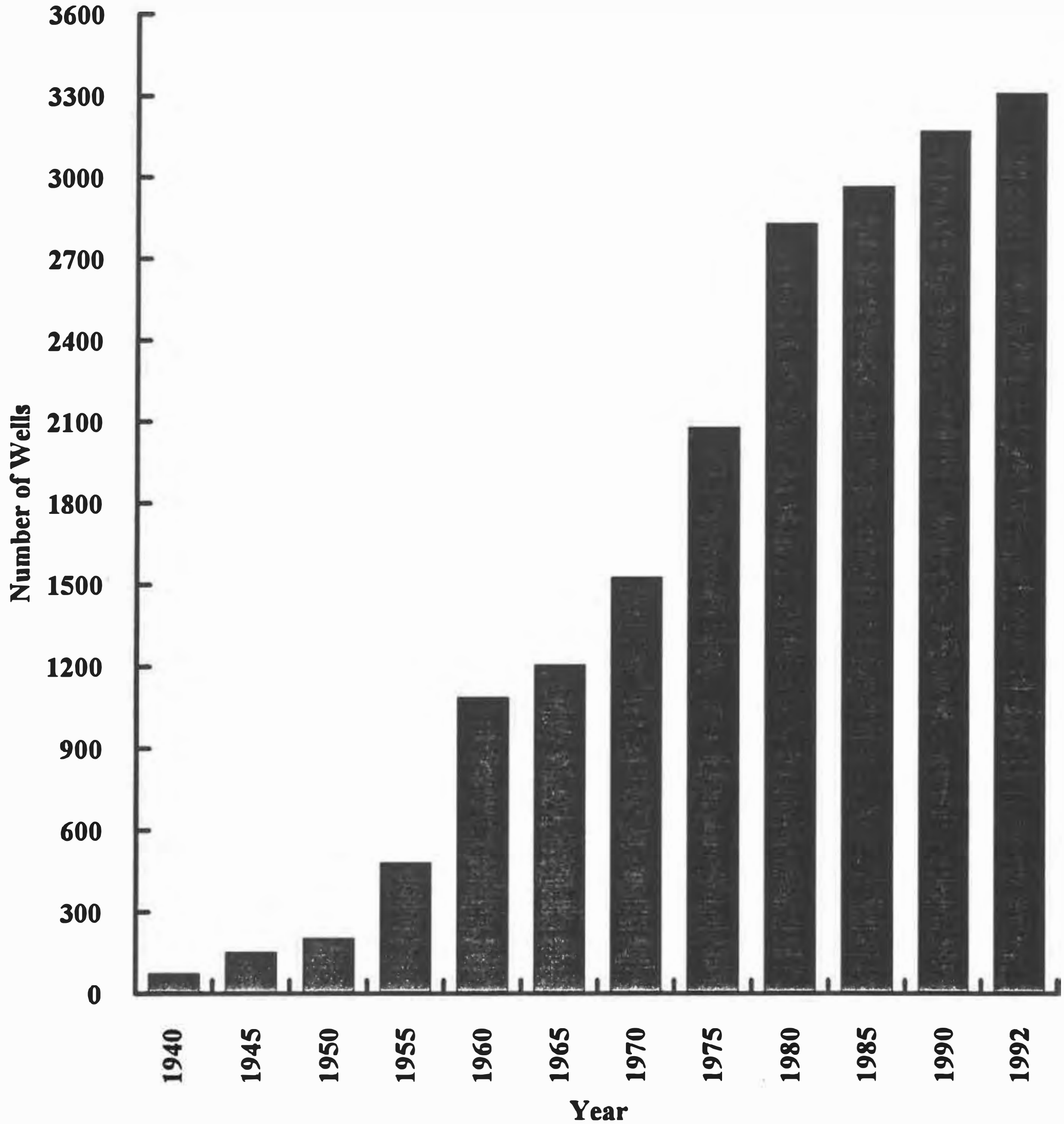
EXHIBIT 6



Generalized Depth to Water - This map was developed from a depth to water map which was produced by CSD for the NRC policy issue study on groundwater reservoir management (1982).

EXHIBIT 7

Cumulative Number of Registered Irrigation Wells
1940 - 1992
Lower Platte North NRD

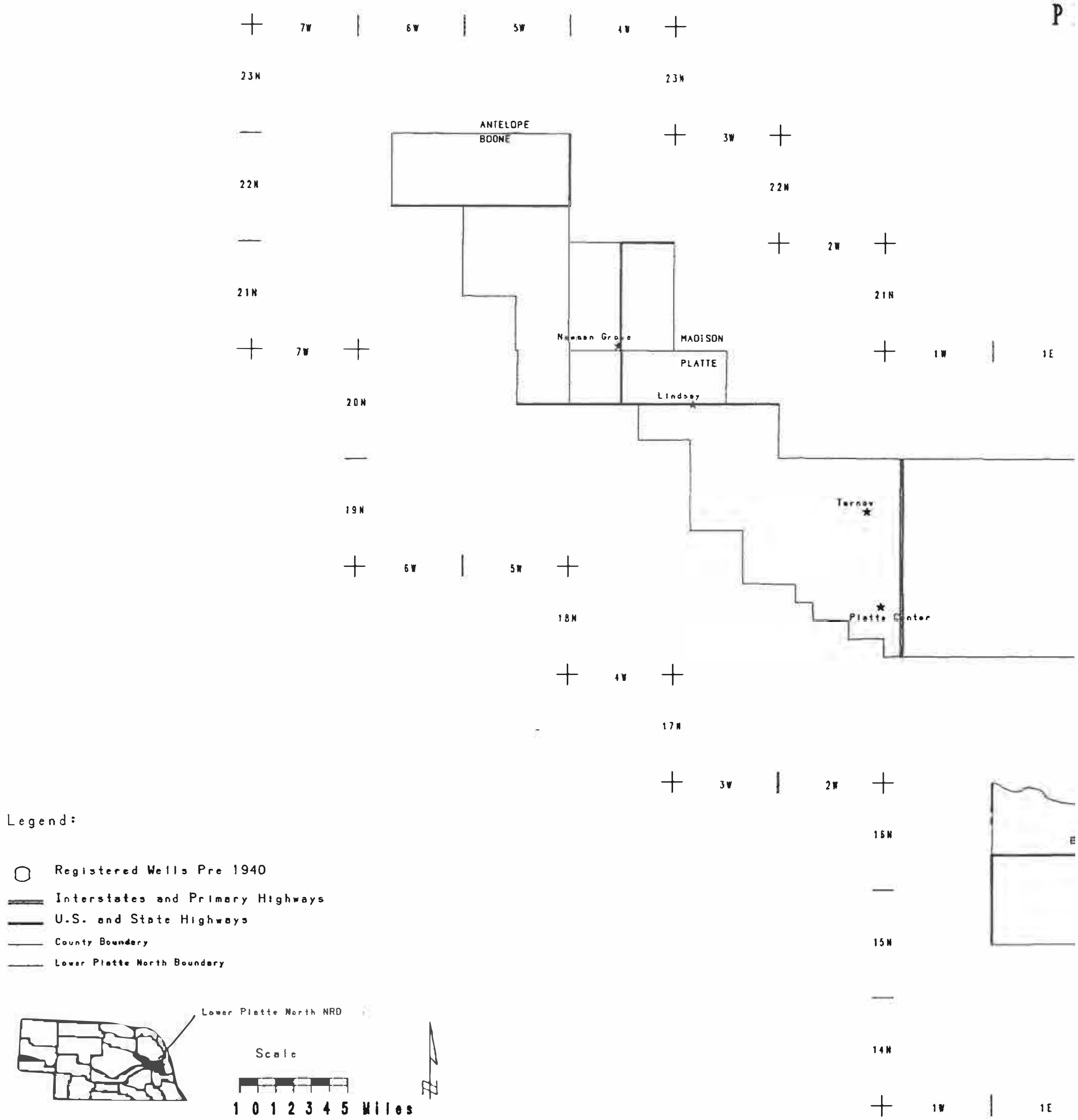


NEBRASKA NATURAL RESOURCES COMMISSION

DATA BANK

REGISTERED WELL

P



Information Source:

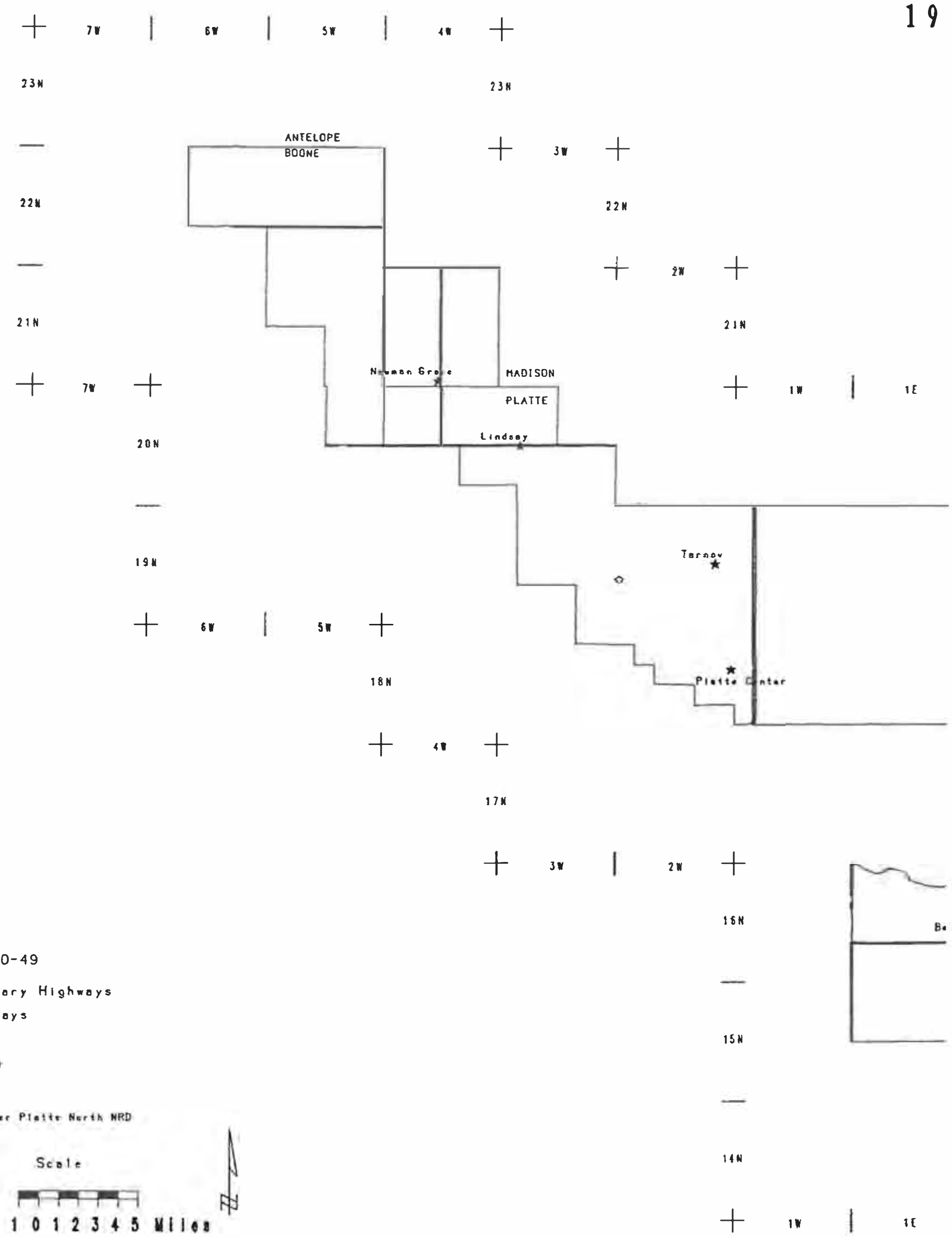
Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993
GIS Process - ARC/INFO
Processed - June, 1993

HWS Consulting Group, Inc.

NEBRASKA NATURAL RESOURCES COMMISSION

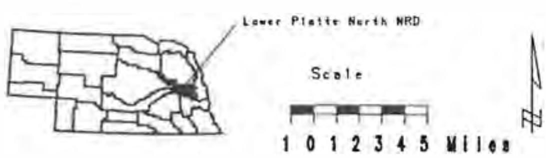
DATA BANK

REGISTERED WELL
19



Legend:

- ◇ Registered Wells 1940-49
- Interstates and Primary Highways
- U.S. and State Highways
- County Boundary
- Lower Platte North Boundary



Information Source:

Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993
GIS Process - ARC/INFO
Processed - June, 1993

HWS Consulting Group Inc.

NEBRASKA NATURAL RESOURCES COMMISSION

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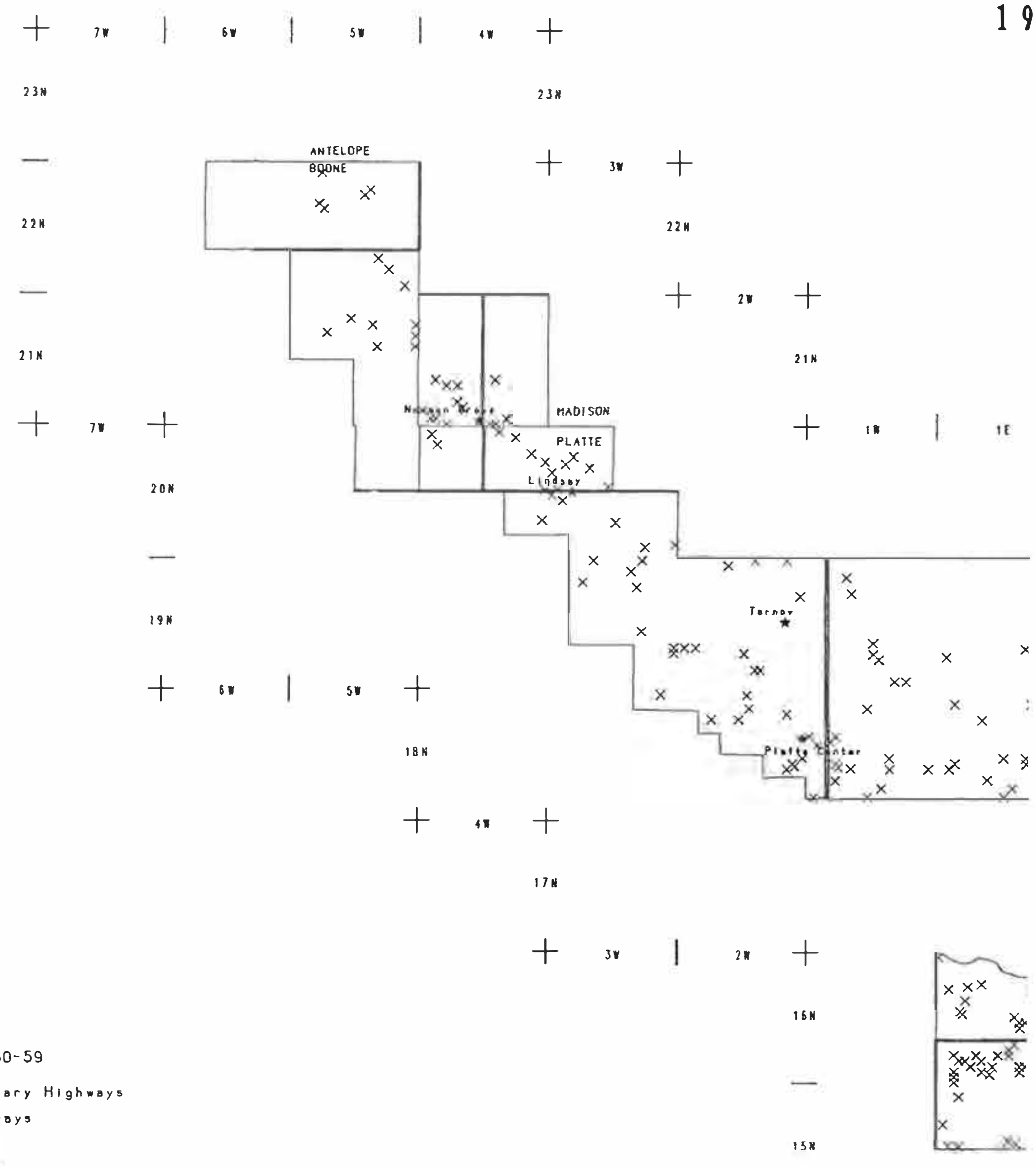
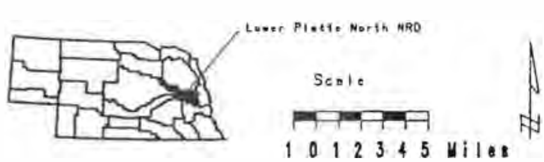


Legend:

- × Registered Wells 1950-59
- Interstates and Primary Highways
- U.S. and State Highways
- County Boundary
- Lower Platte North Boundary



Information Source:

Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993
GIS Process - ARC/INFO
Processed - June, 1993

HWS Consulting Group, Inc.

NEBRASKA NATURAL RESOURCES COMMISSION

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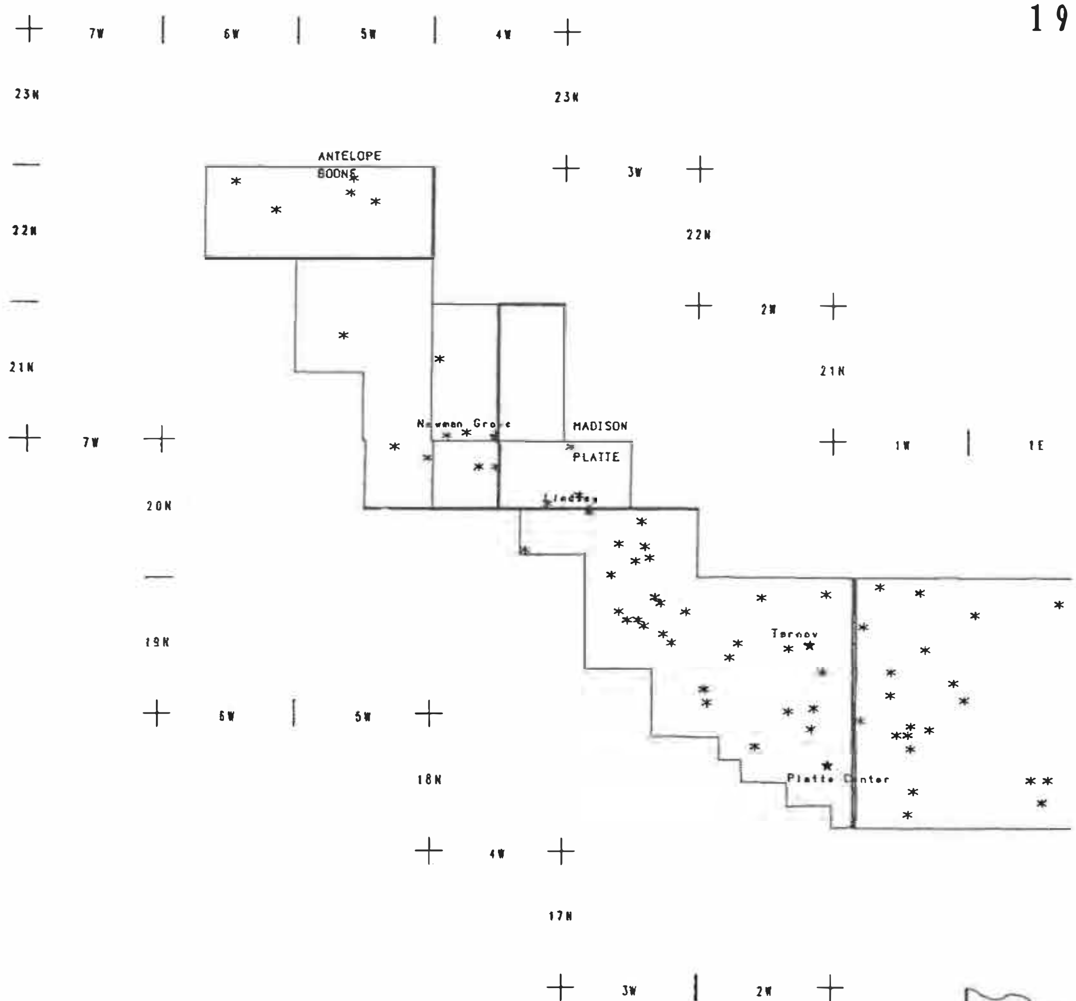
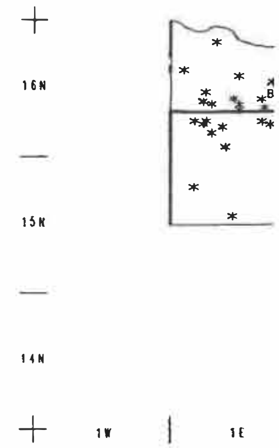
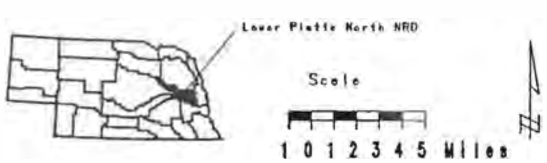




Legend:

- Registered Wells 1960-69
- Interstates and Primary Highways
- U.S. and State Highways
- County Boundary
- Lower Platte North Boundary



Information Source:

Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993
GIS Process - ARC/INFO
Processed - June, 1993

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NEBRASKA NATURAL RESOURCES COMMISSION

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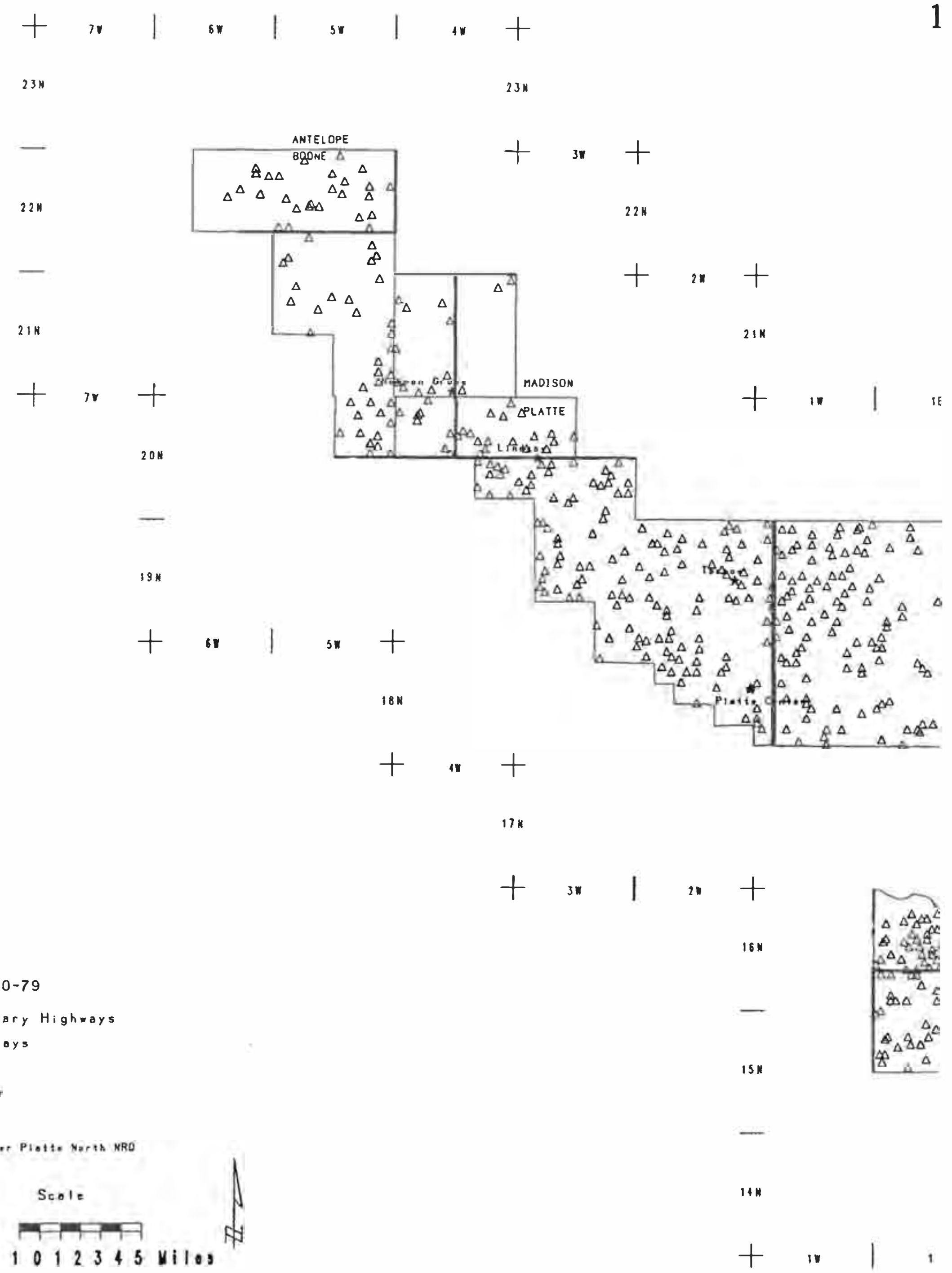


Legend:

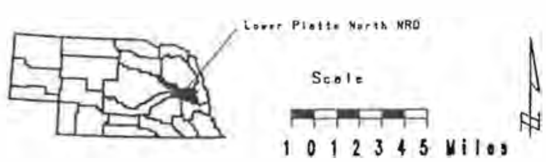
△ Registered Wells 1970-79

Interstates and Primary Highways

U.S. and State Highways

County Boundary

Lower Platte North Boundary



Information Sources

Produced By - Nebraska Natural Resources Commission

Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990

Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993

GIS Process - ARC/INFO

Processed - June, 1993

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NEBRASKA NATURAL RESOURCES COMMISSION

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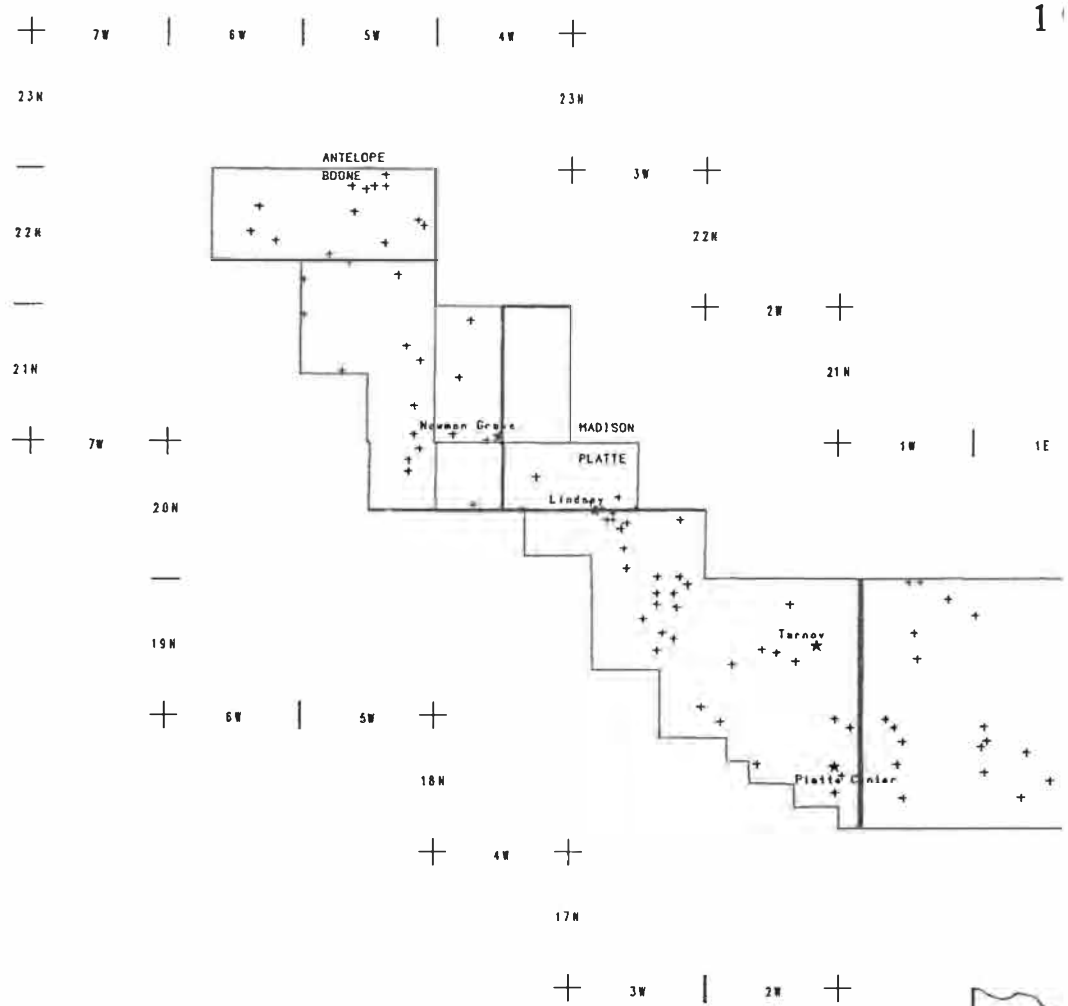
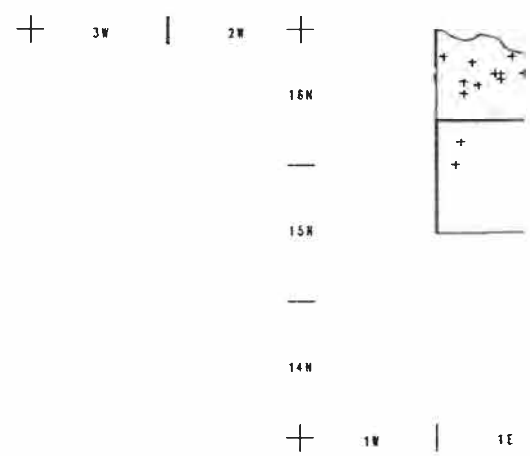




Legend:

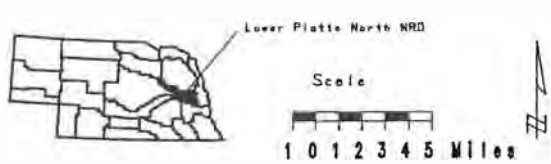
+ Registered Wells 1980-89

Interstates and Primary Highways

U.S. and State Highways

County Boundary

Lower Platte North Boundary



Information Source:

Produced By - Nebraska Natural Resources Commission

Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990

Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993

GIS Process - ARC/INFO

Processed - June, 1993

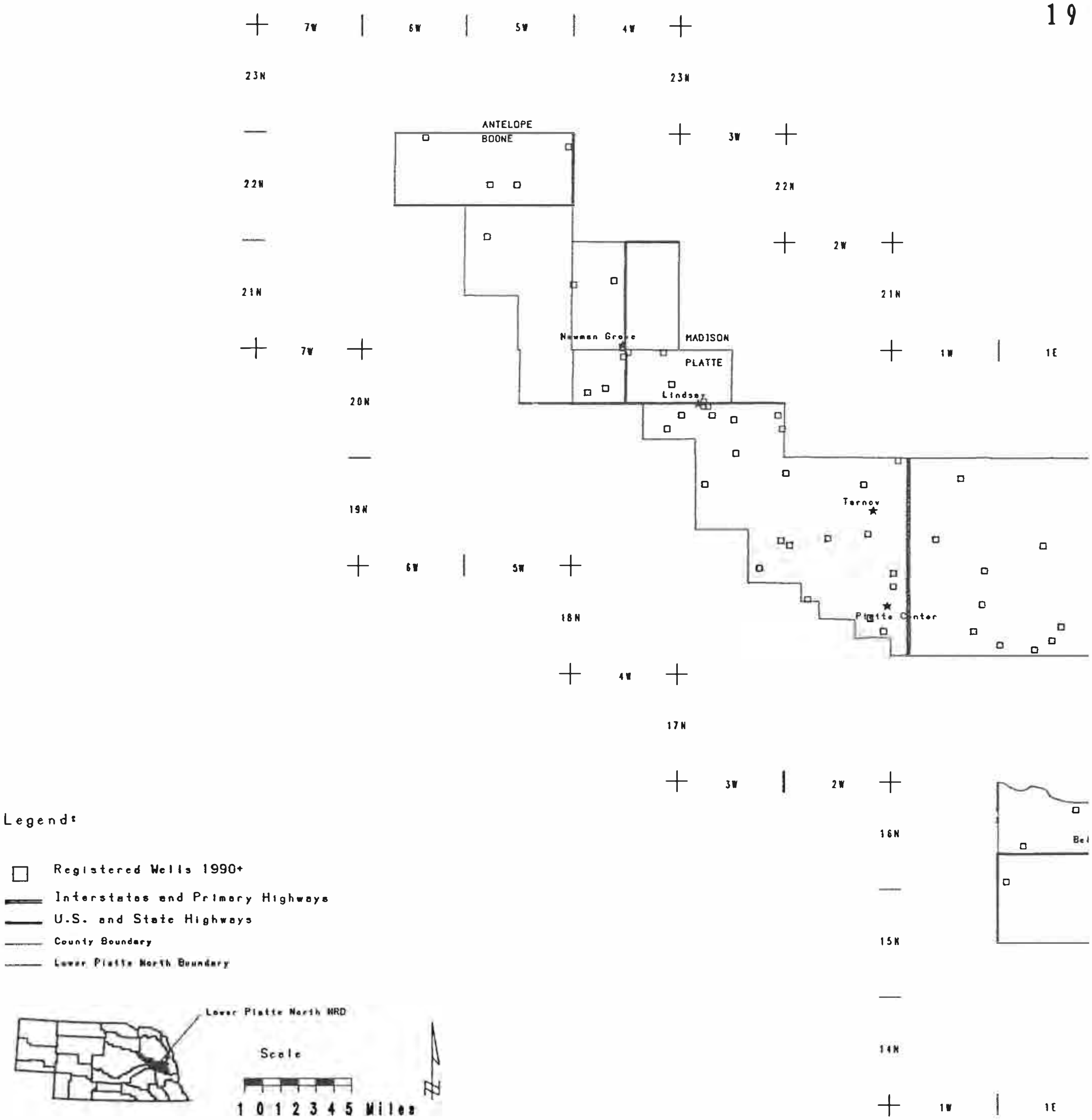
HWS Consulting Group, Inc.

NEBRASKA NATURAL RESOURCES COMMISSION

DATA BANK

REGISTERED WELL

19



Information Source:

Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Registered Wells Data - Nebraska Department of Water Resources
Updated through February 1993
GIS Process - ARC/INFO
Processed - June, 1993

HWS Consulting Group, Inc.

NEBRASKA NATURAL RESOURCES COMMISSION

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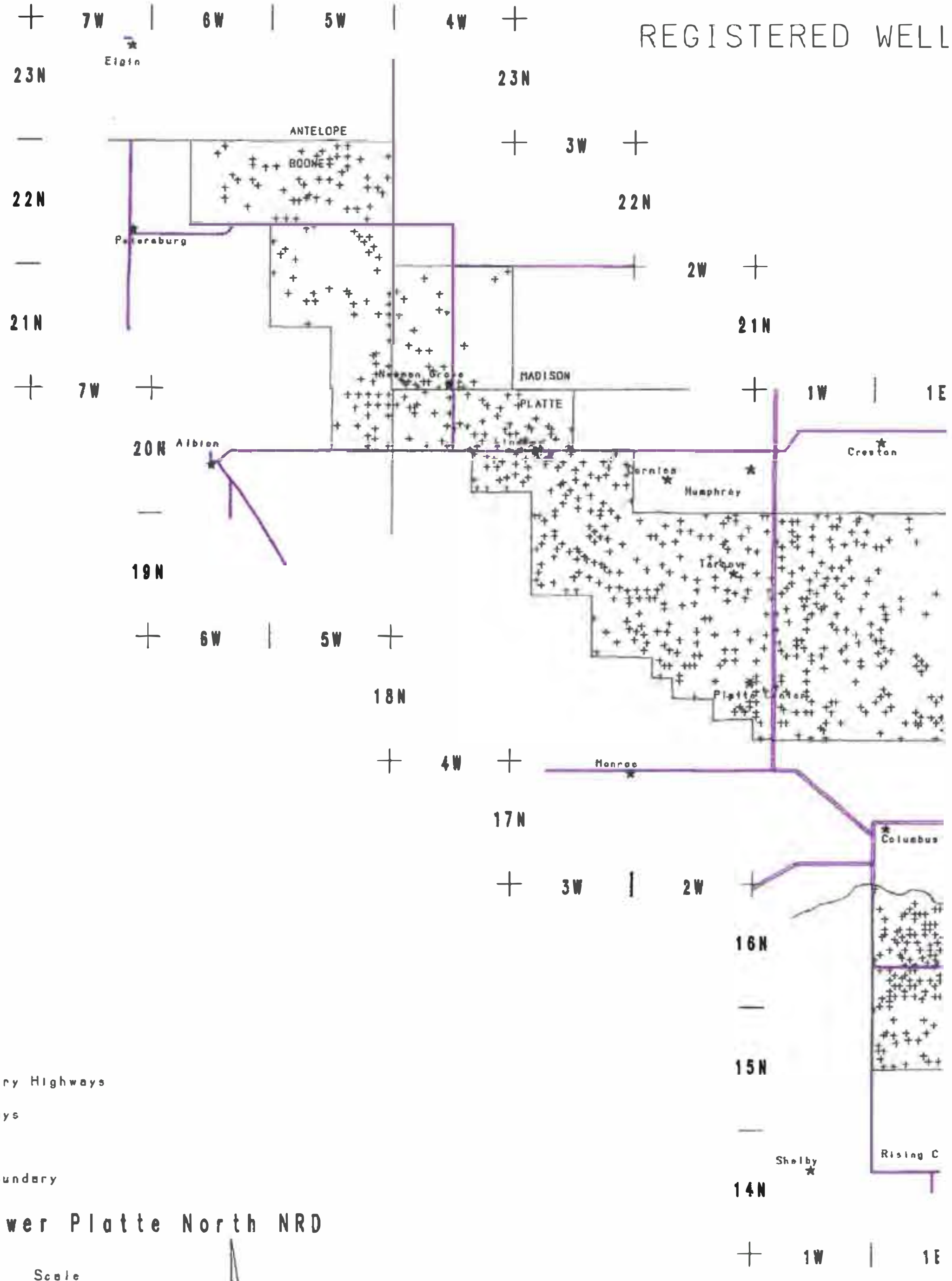
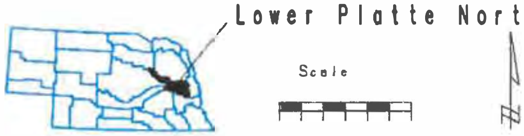
REGISTERED WELL



Legend:

- × Municipal Wells
- + Irrigation Wells
- □ Commercial Wells
- ○ Other Wells
- Interstates and Primary Highways
- U.S. and State Highways
- County Boundary
- Lower Platte North Boundary



Information Source:

Produced By - Nebraska Natural Resources Commission
Topographic Data - TIGER Files, U.S. Bureau of the Census, 1990
Registered Wells Data - Nebraska Department of Water Resources
Updated through December 1991
GIS Process - ARC/INFO
Processed - April, 1993

HWS Consulting Group, Inc.

NEBRASKA NATURAL RESOURCES COMMISSION

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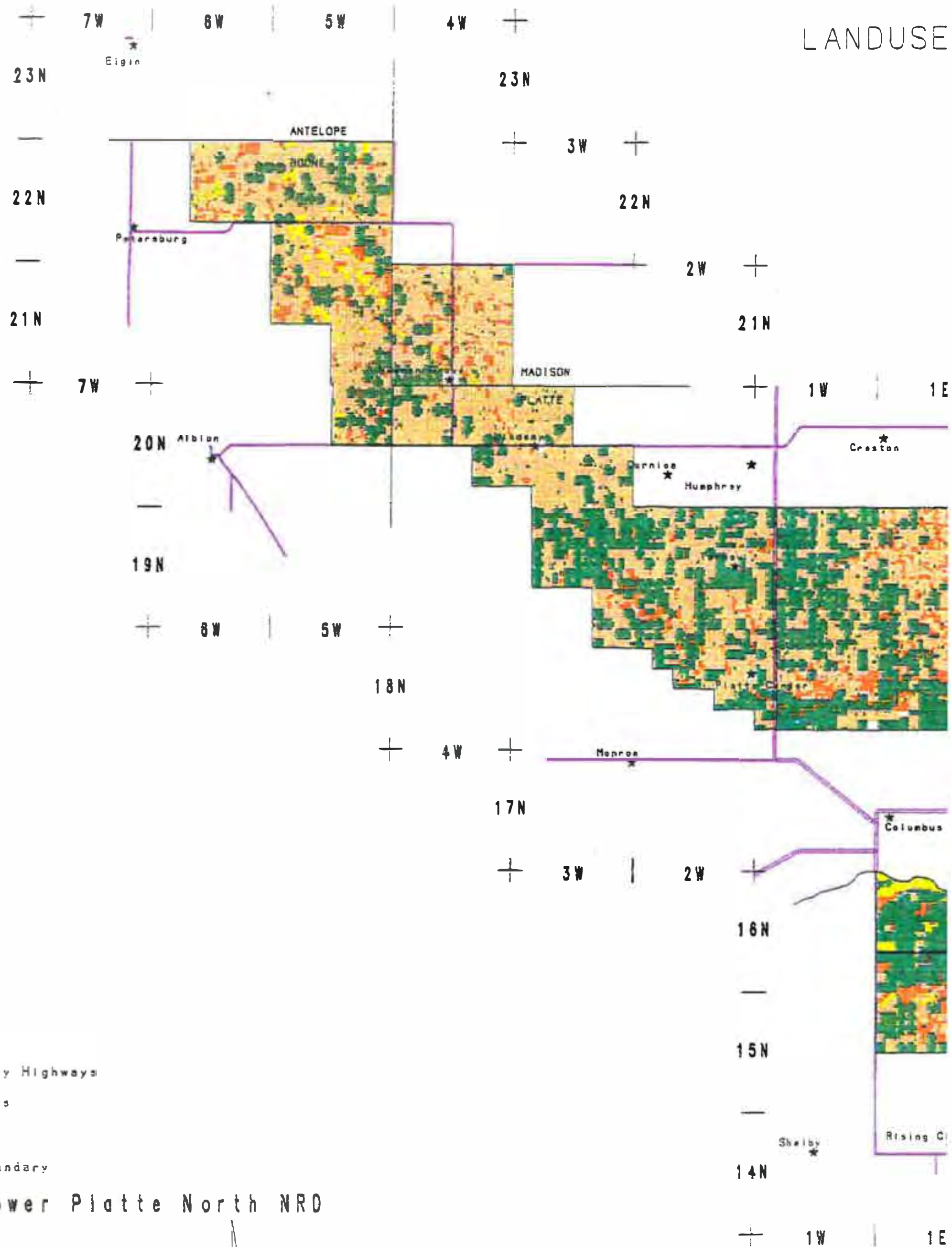
LANDUSE



Legend:

- Dry Cropland
- Irrigated Cropland
- Pasture
- Rangeland
- Forest
- Urban
- Other Rural Land
- Water
- Interstates and Primary Highways
- U.S. and State Highways
- County Boundary
- Lower Platte North Boundary

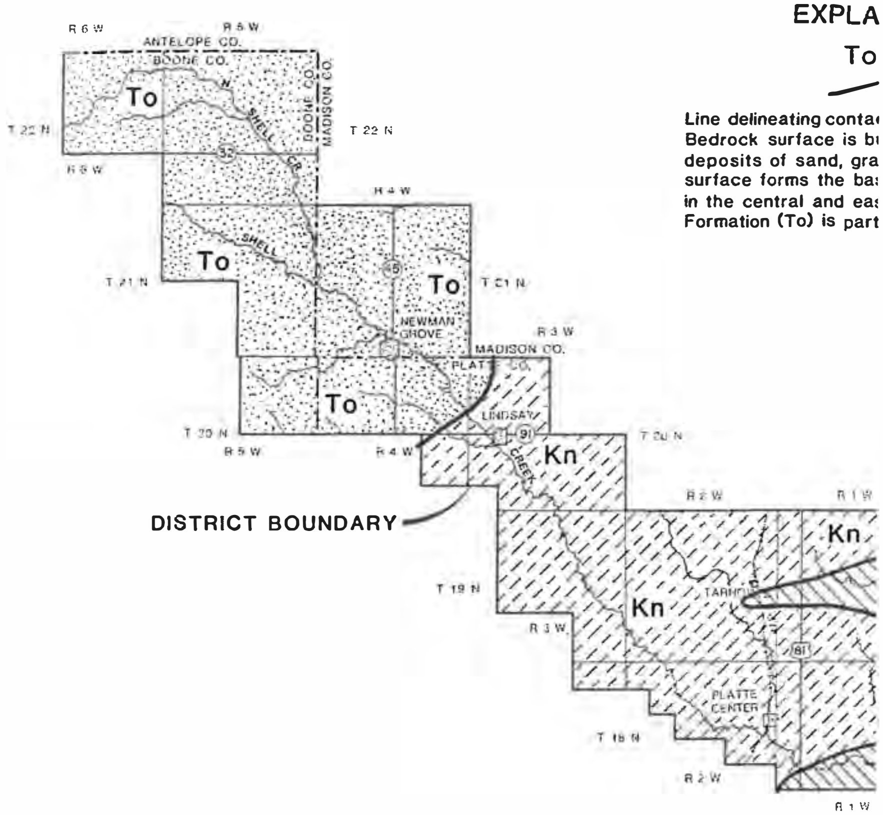
Scale

0 1 2 3 4 5 Miles

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, 1983-84
GIS Process - ARC/INFO
Processed - April, 1993

HWS Consulting Group, Inc.



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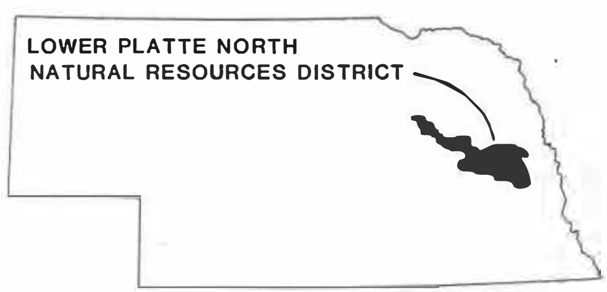
Line delineating conta
Bedrock surface is b
deposits of sand, gra
surface forms the ba
in the central and ea
Formation (To) is part



LOCATION

HWS Consulting Group Inc.

GENERALIZED GEOLOGIC PROFI

Lower Platte North Natural Resources Dist

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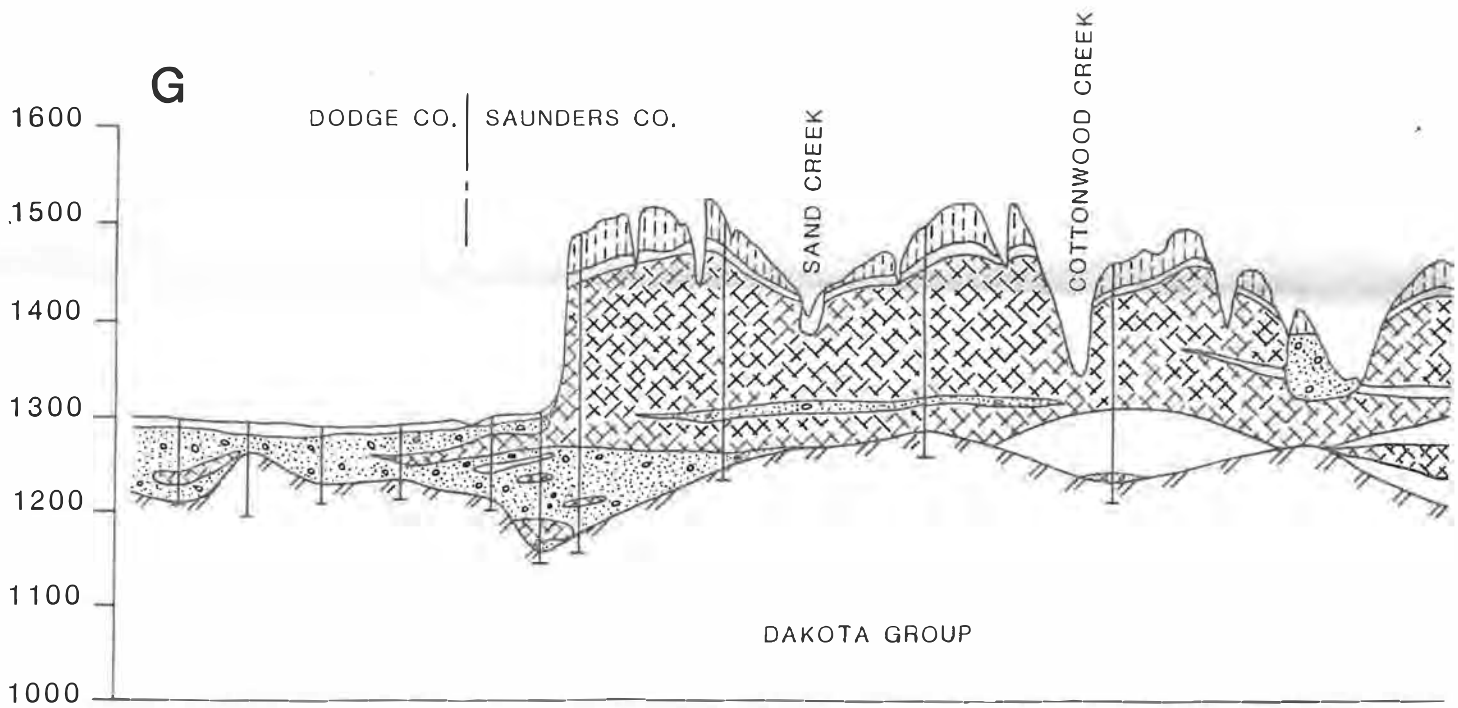
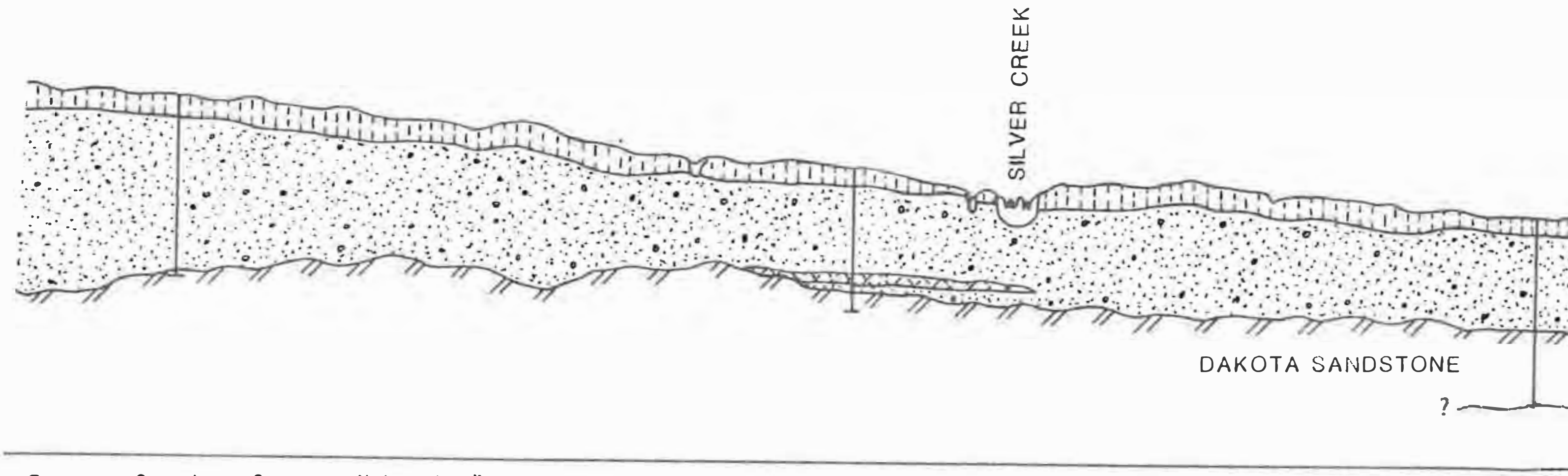
Sandstone - Ogallala

Dakota Group - Sandstone

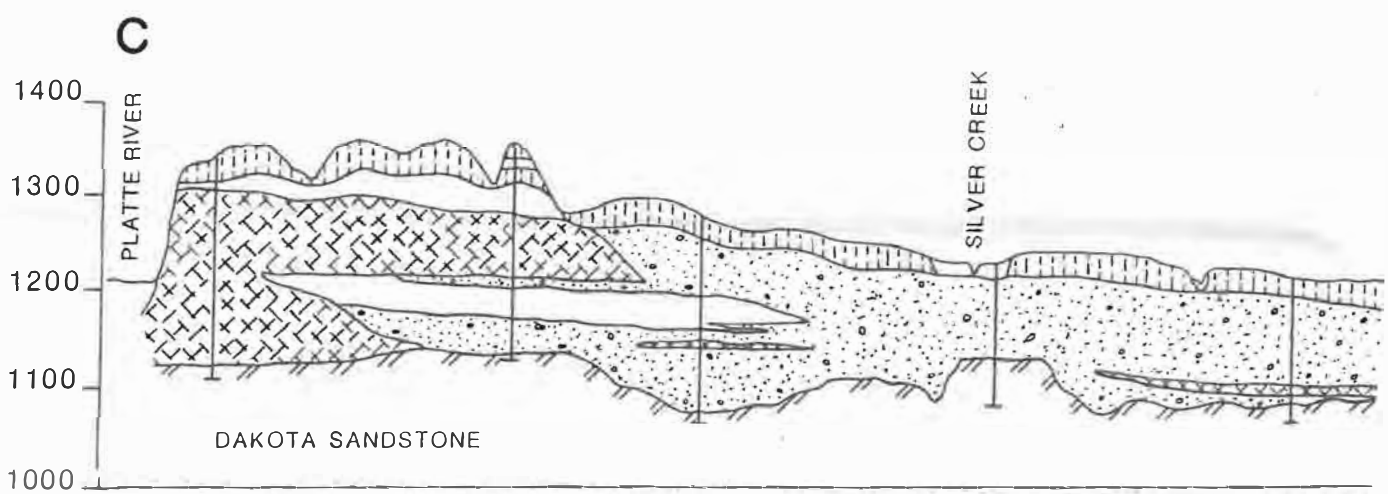
Profile Line. Dot represents location of Conse
test holes, and corresponds to th



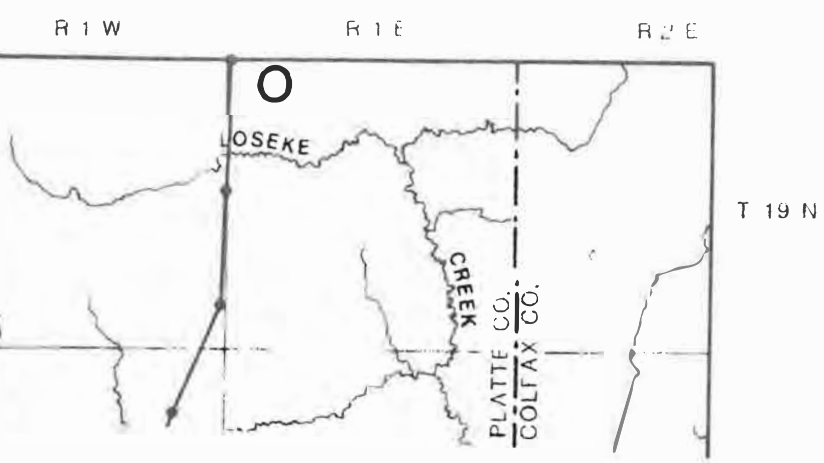
Source: Unpublished Section, Conservation and Survey Division

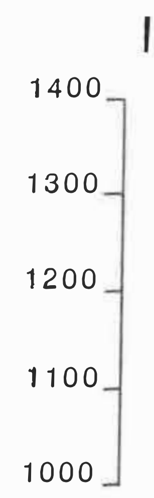


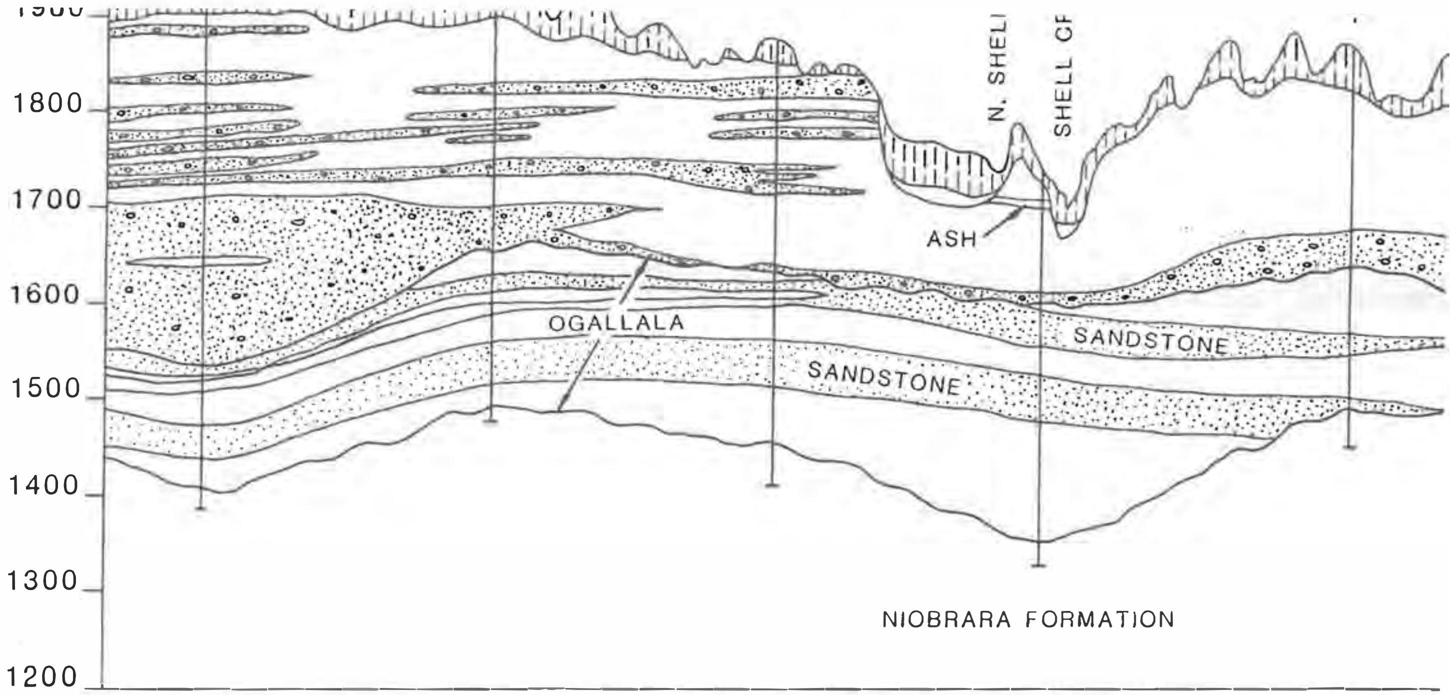
ı Eastern Saunders County, Nebraska,"
967.



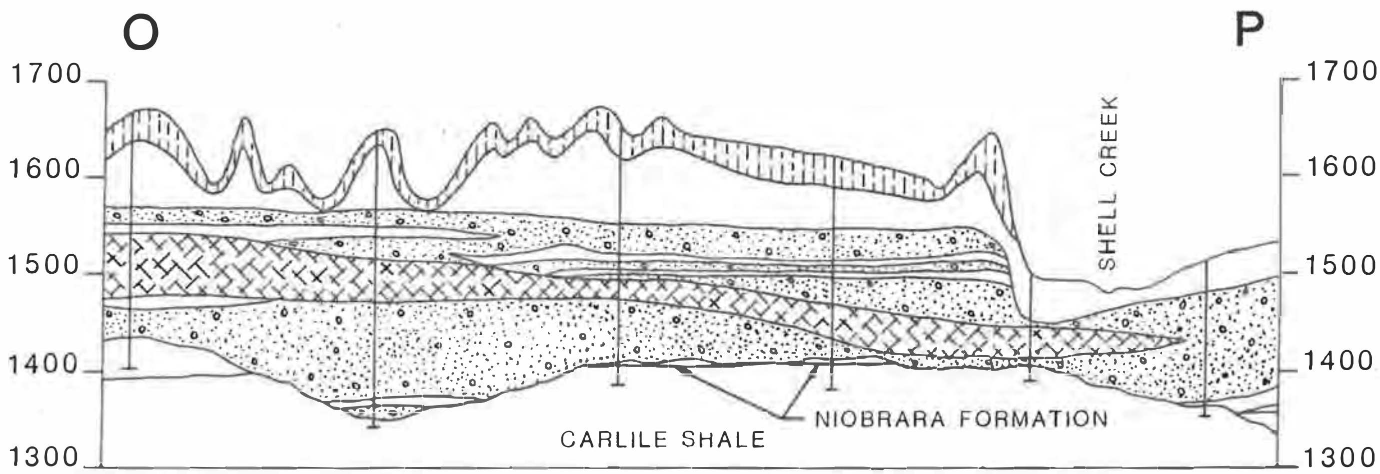
Source: "Availability of Water in Eastern Saunders County, Nebraska,"
V.L. Souders, U.S.G.S., 1967.



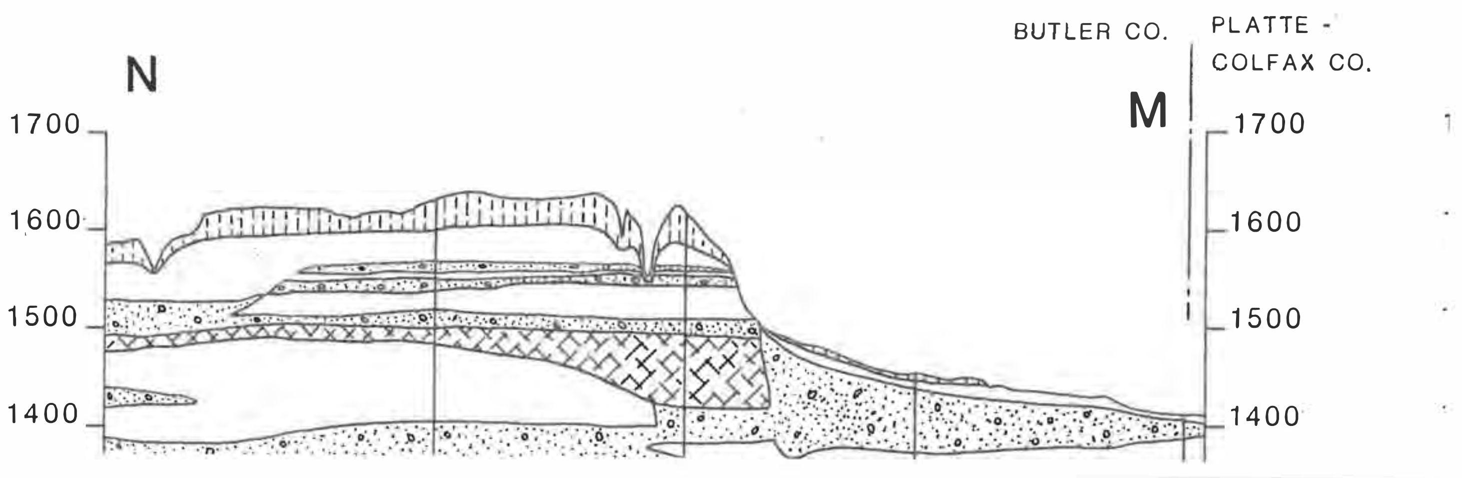


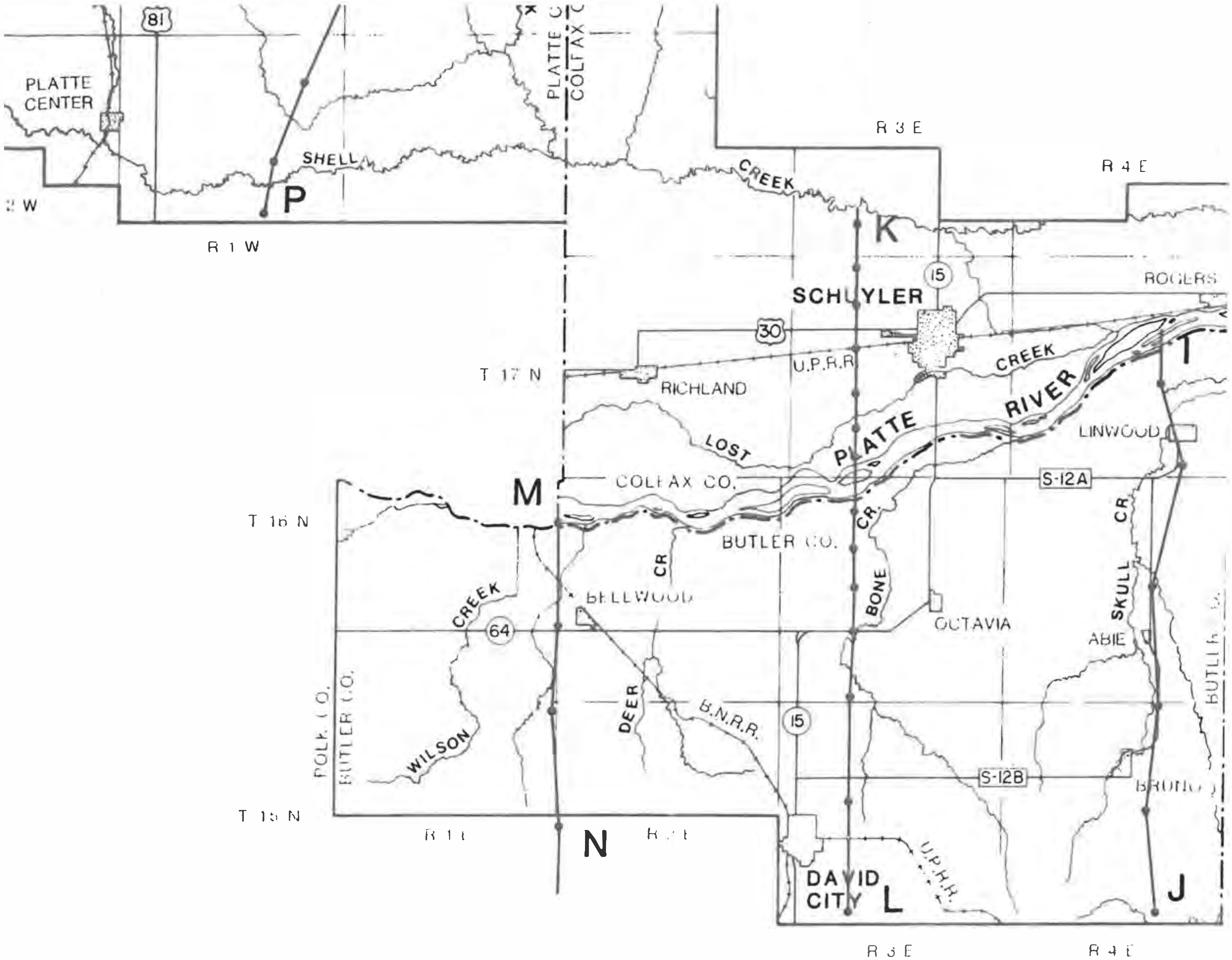


Source: "Boone County Preliminary Groundwater Study;" Conservation and Survey Division, 1959.



Source: "Platte County Preliminary Groundwater Study," Conservation and Survey Division, 1958.





81
PLATTE CENTER
PLATTE CO.
COLFAX CO.
SHELL
CREEK
P
R 1 W
R 3 E
R 4 E
K
15
SCHUYLER
ROGERS
30
U.P.R.R.
CREEK
T 17 N
RICHLAND
LOST
PLATTE
RIVER
LINWOOD
M
COLFAX CO.
S-12A
T 16 N
BUTLER CO.
CR.
CR
CR
BELLWOOD
CREEK
BONE
SKULL
64
OCTAVIA
ABIE
DEER
B.N.R.R.
15
WILSON
POLK CO.
BUTLER CO.
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DAVID CITY
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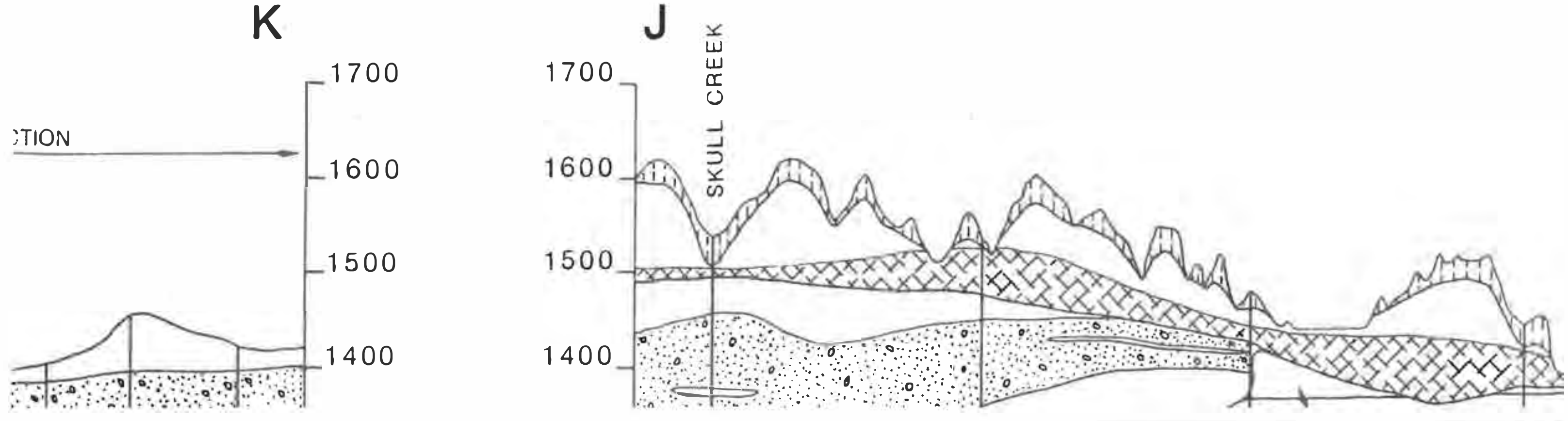

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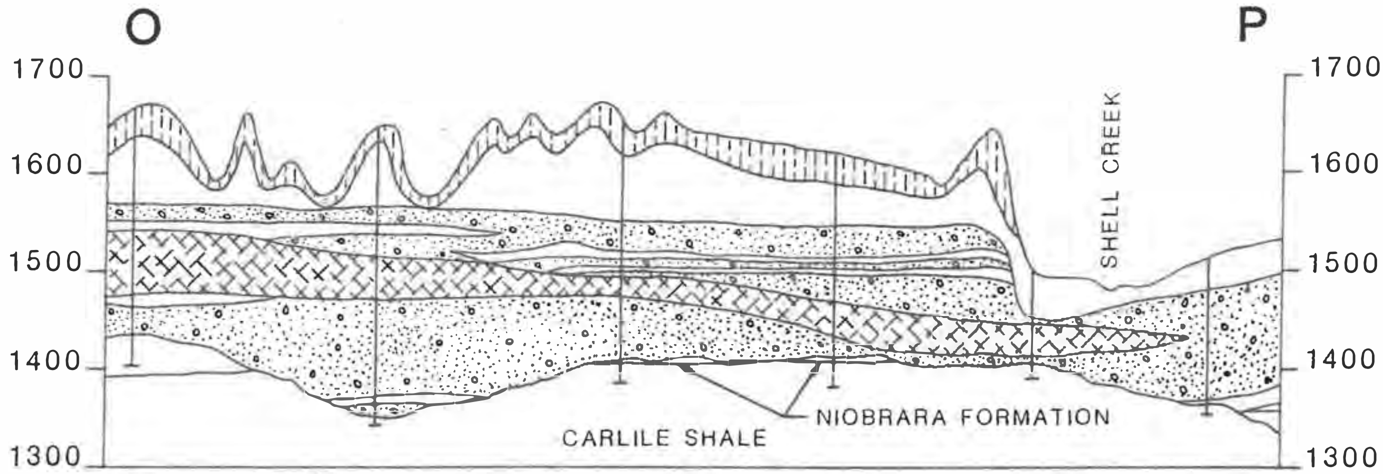
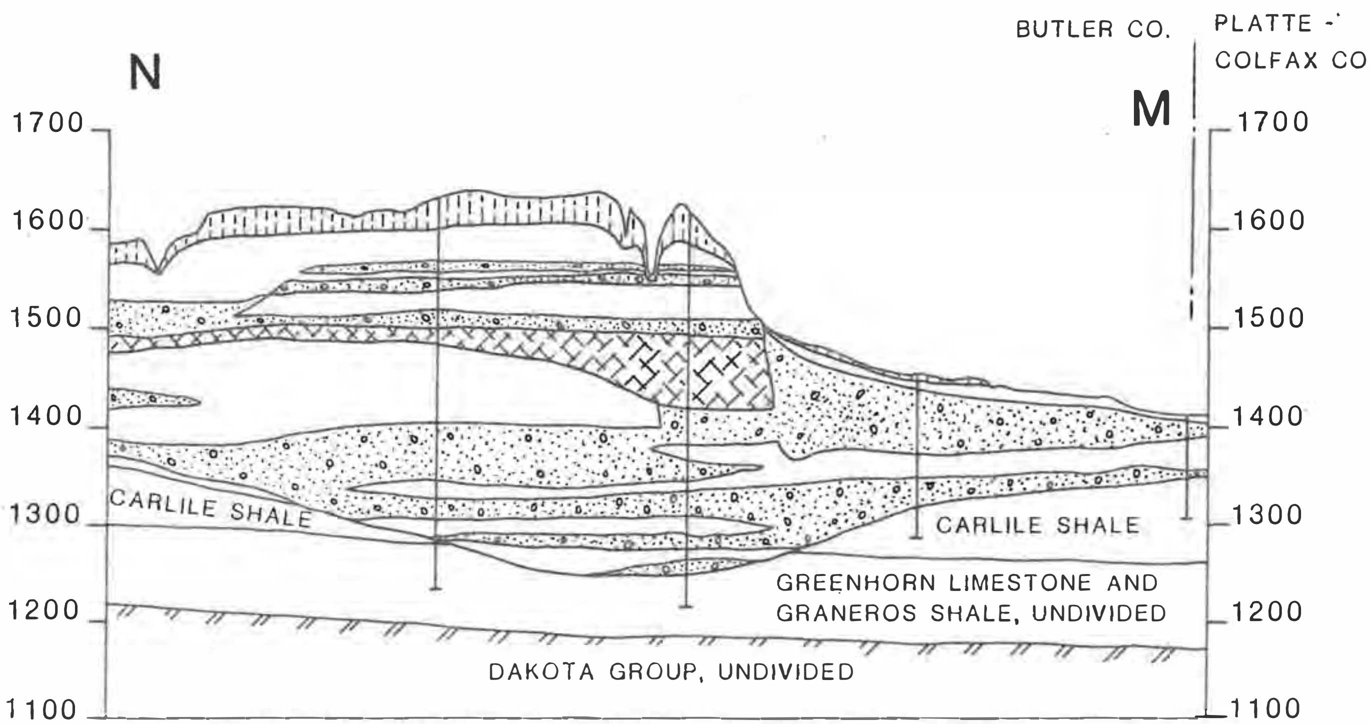
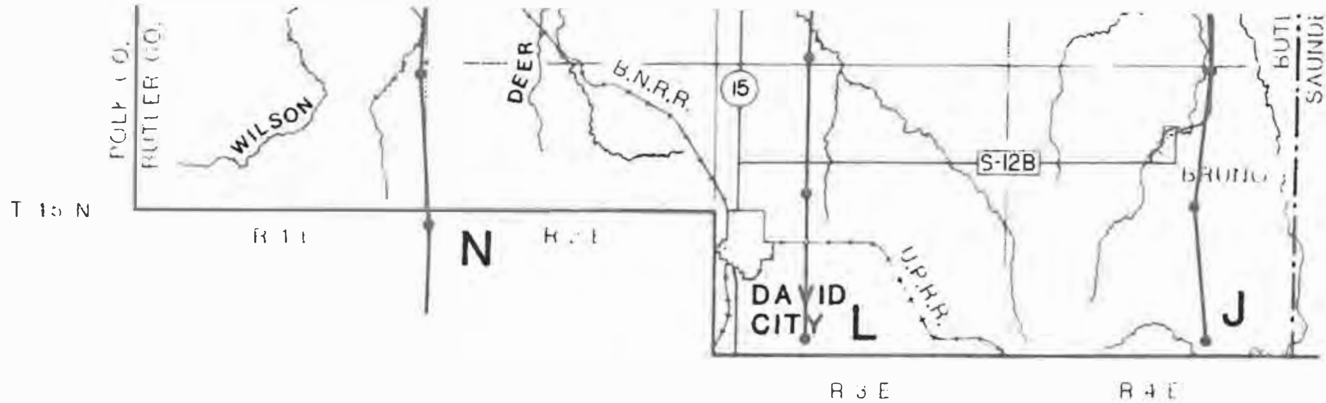
SKULL CREEK

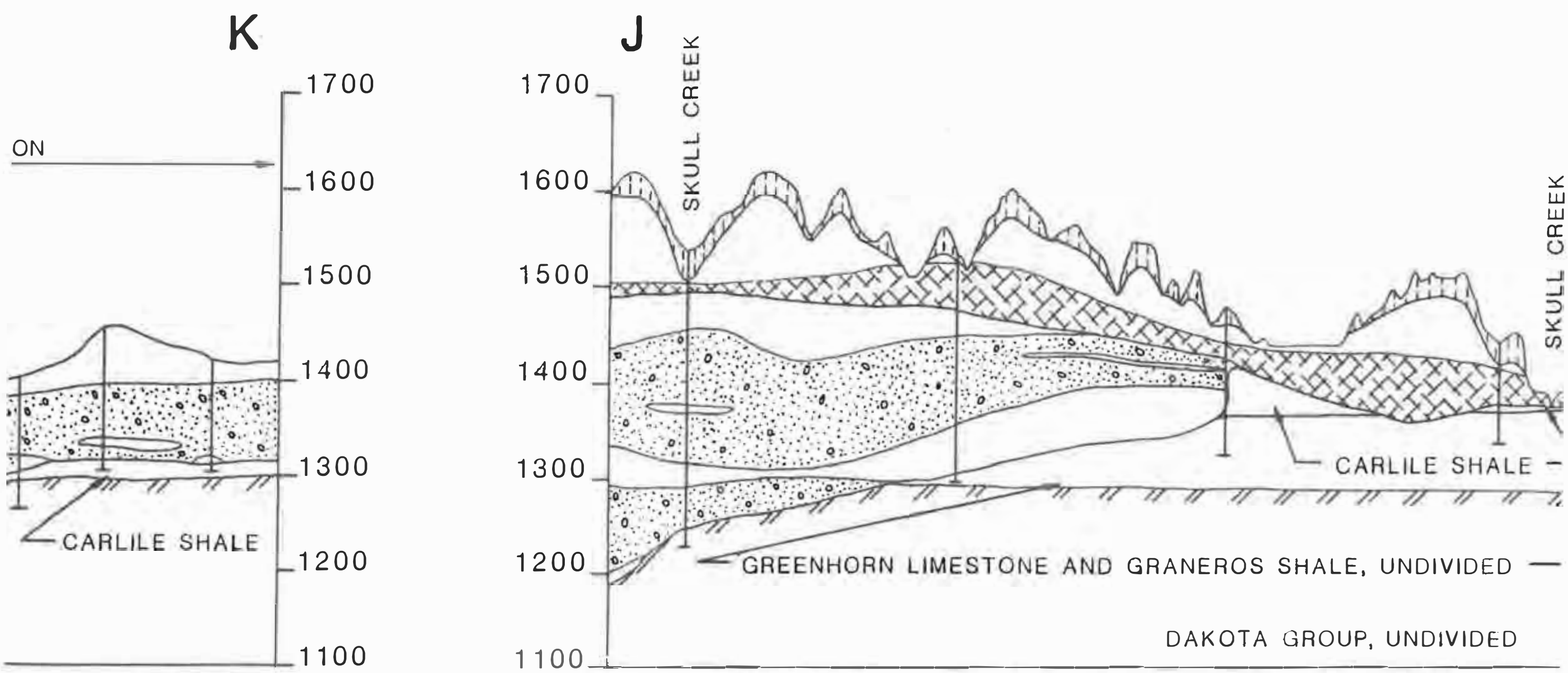


Source: "Platte County Preliminary Groundwater Study," Conservation and Survey Division, 1958.



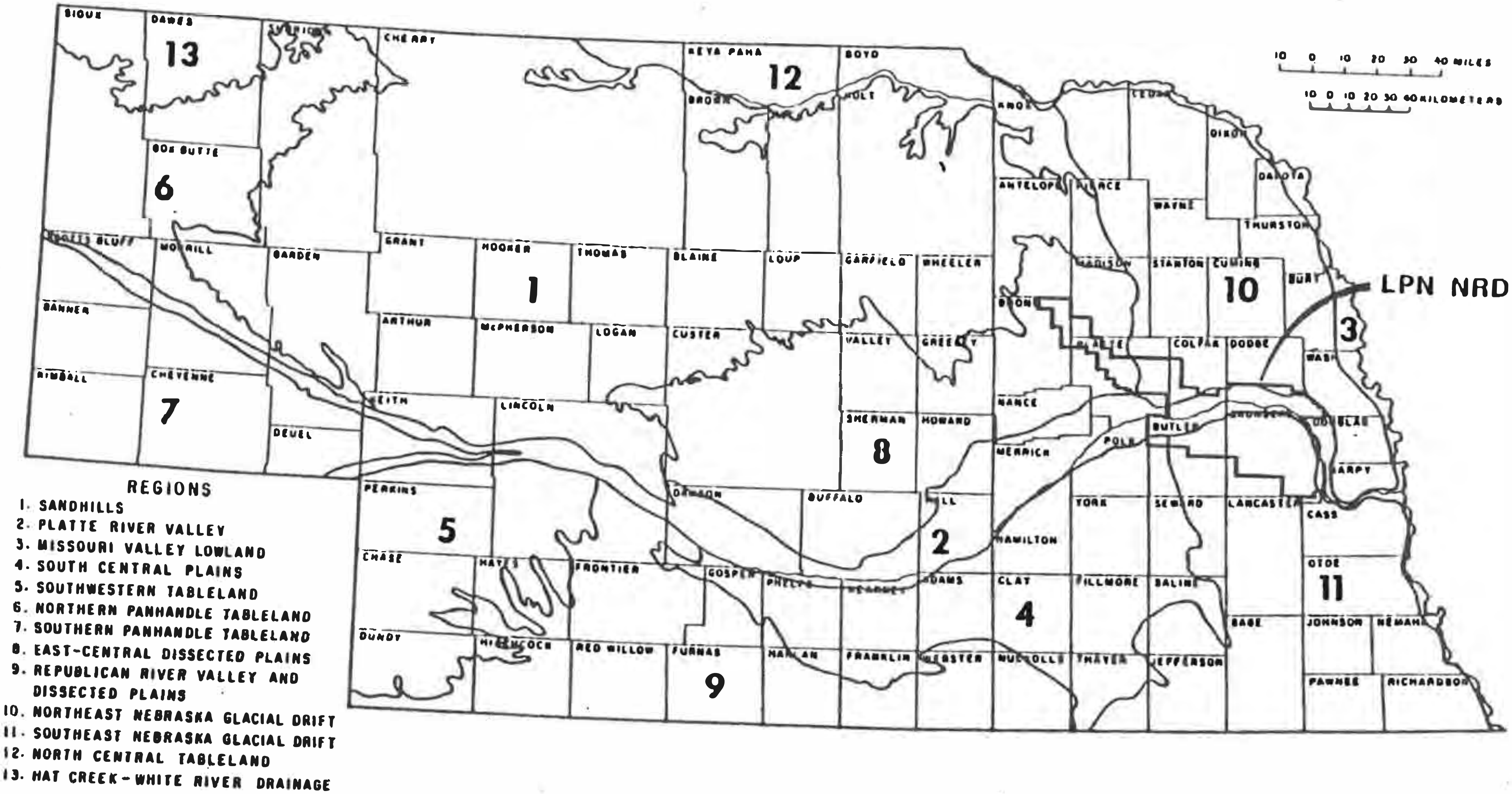
Source: "Hydrogeology of Butler County," M. Ginsberg, Conservation and Survey Division, 1983.





Source: "Hydrogeology of Butler County," M. Ginsberg, Conservation and Survey Division, 1983.

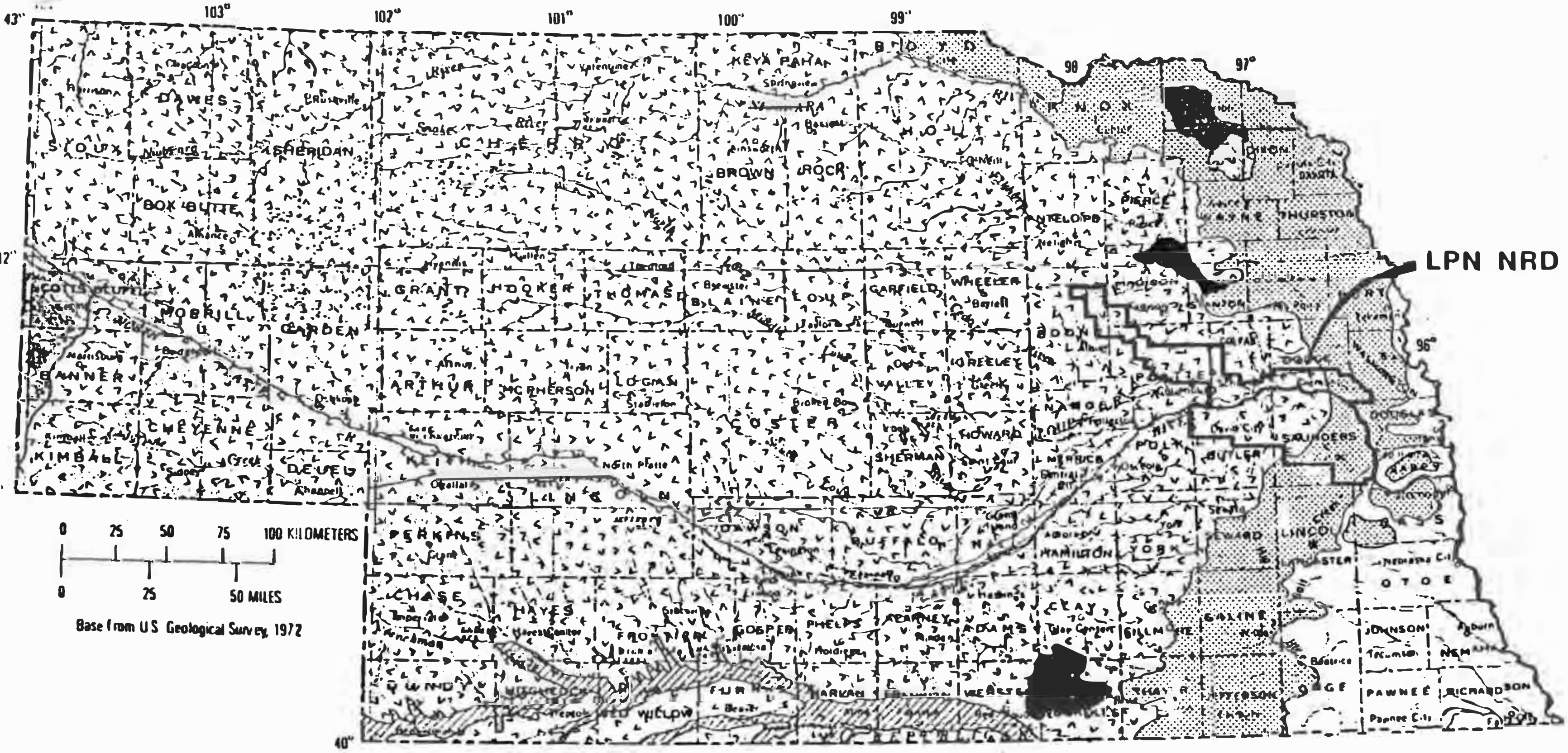
EXHIBIT 13



Underground Water Areas of Nebraska

From: Reed, 1969, "Underground Water Areas"

EXHIBIT 14



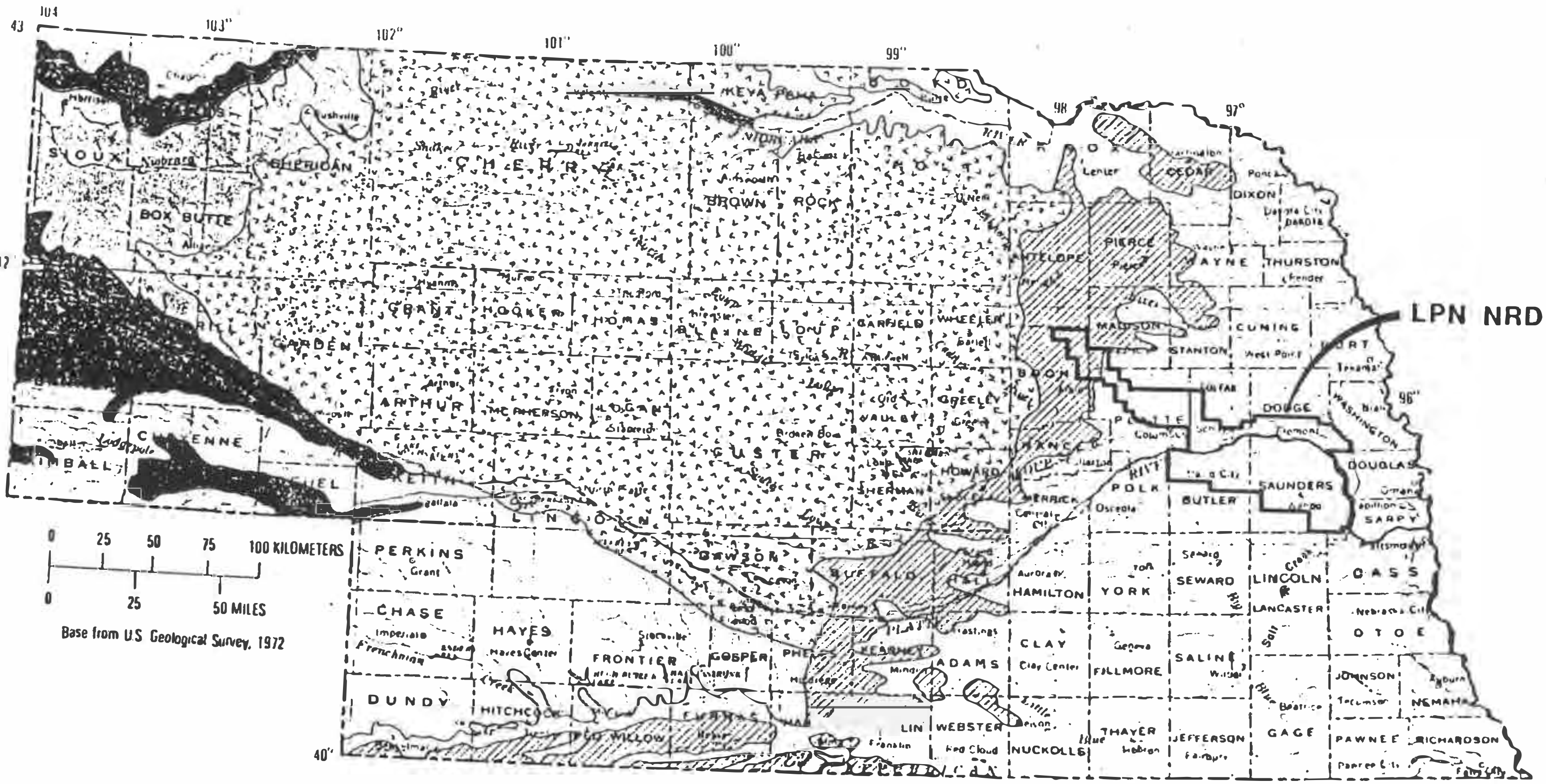
EXPLANATION

- LANCE FORMATION OR FOX HILLS SANDSTONE
- NIOBRARA FORMATION
- DAKOTA SANDSTONE
- UNDIFFERENTIATED MESOZOIC ROCKS USED FOR OCCASIONAL SMALL YIELD WELLS
- UNDIFFERENTIATED MESOZOIC ROCKS PRESENT BUT NOT NOW USED FOR WATER SUPPLIES
- MESOZOIC ROCKS ABSENT

Map showing approximate areal distribution of Mesozoic rocks and those areas currently (1982) used for water supplies.

From: Engberg, "Appraisal of Data for Groundwater Quality in Nebraska", USGS, 1984

EXHIBIT 15

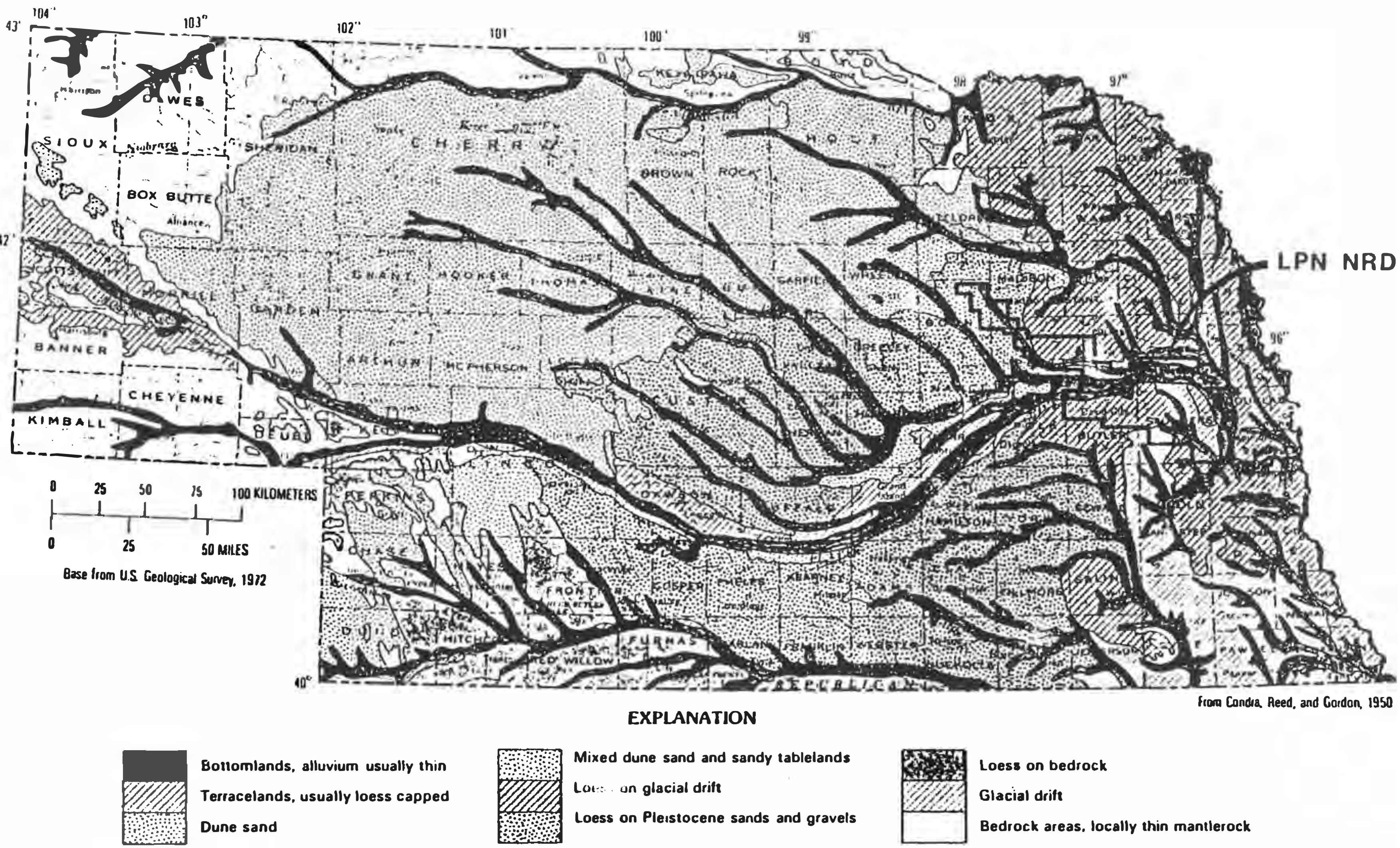


EXPLANATION

- OGALLALA FORMATION
- OGALLALA FORMATION—Wells may be finished in both the Ogallala and overlying Pleistocene deposits
- OGALLALA FORMATION—Deposits are thin and are a source of water only occasionally
- ARIKAREE GROUP
- BRULE AND CHADRON FORMATIONS OF WHITE RIVER GROUP, UNDIVIDED
- TERTIARY DEPOSITS ABSENT

Map showing approximate areal distribution of aquifers in Tertiary deposits.

EXHIBIT 16



Map showing areal distribution of Holocene and Pleistocene deposits.

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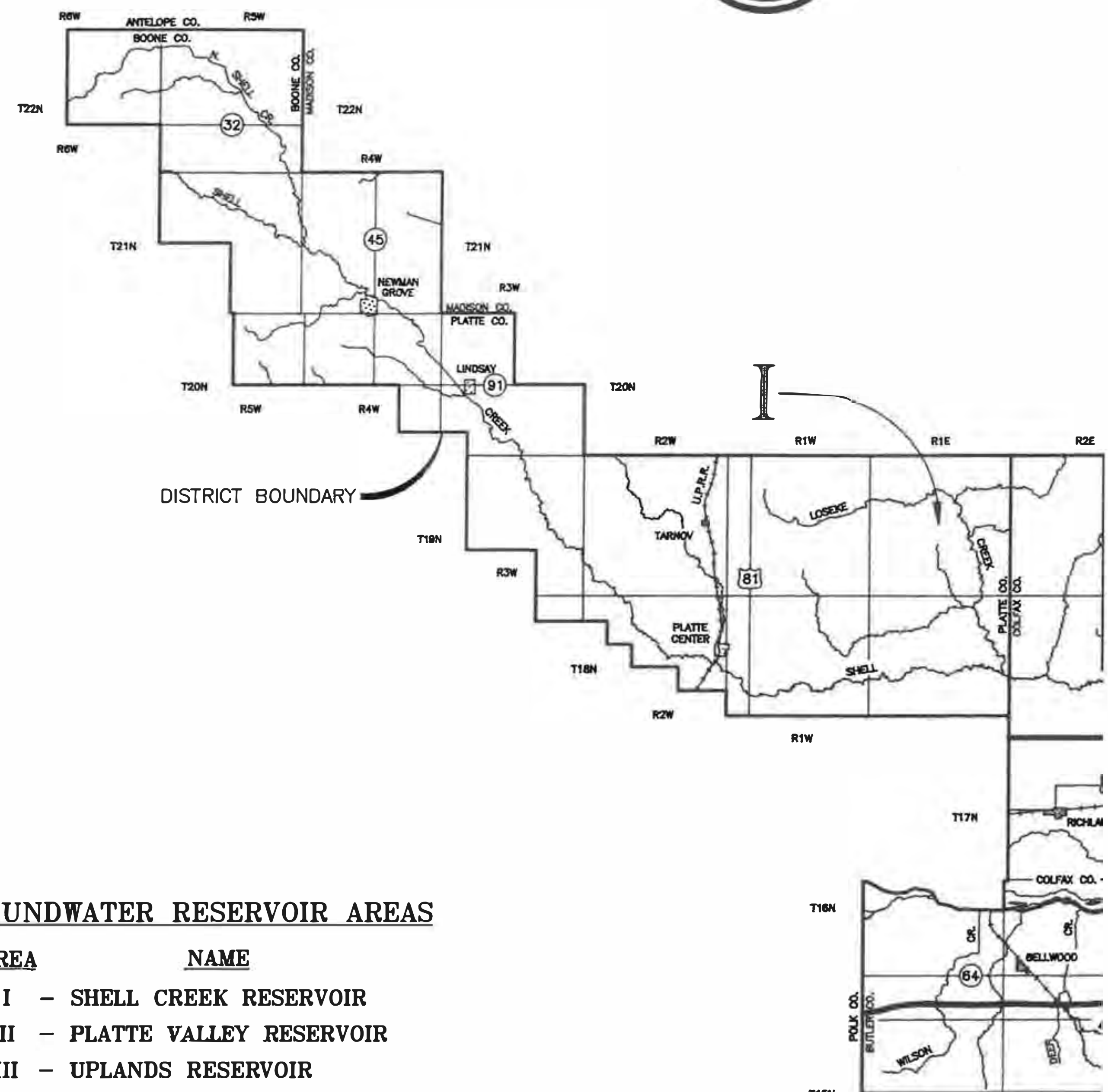
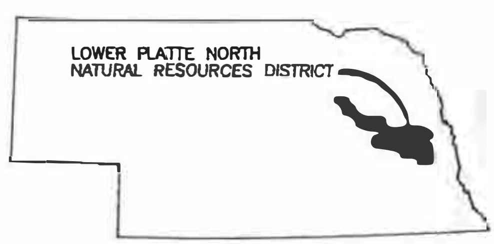
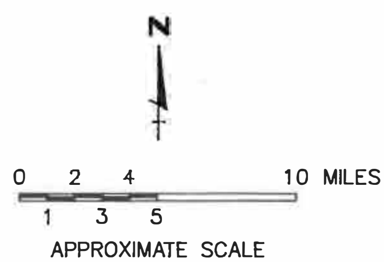


GROUNDWATER RESERVOIR AREAS

AREA		NAME
I	–	SHELL CREEK RESERVOIR
II	–	PLATTE VALLEY RESERVOIR
III	–	UPLANDS RESERVOIR
IV	–	TODD VALLEY RESERVOIR



LOCATION



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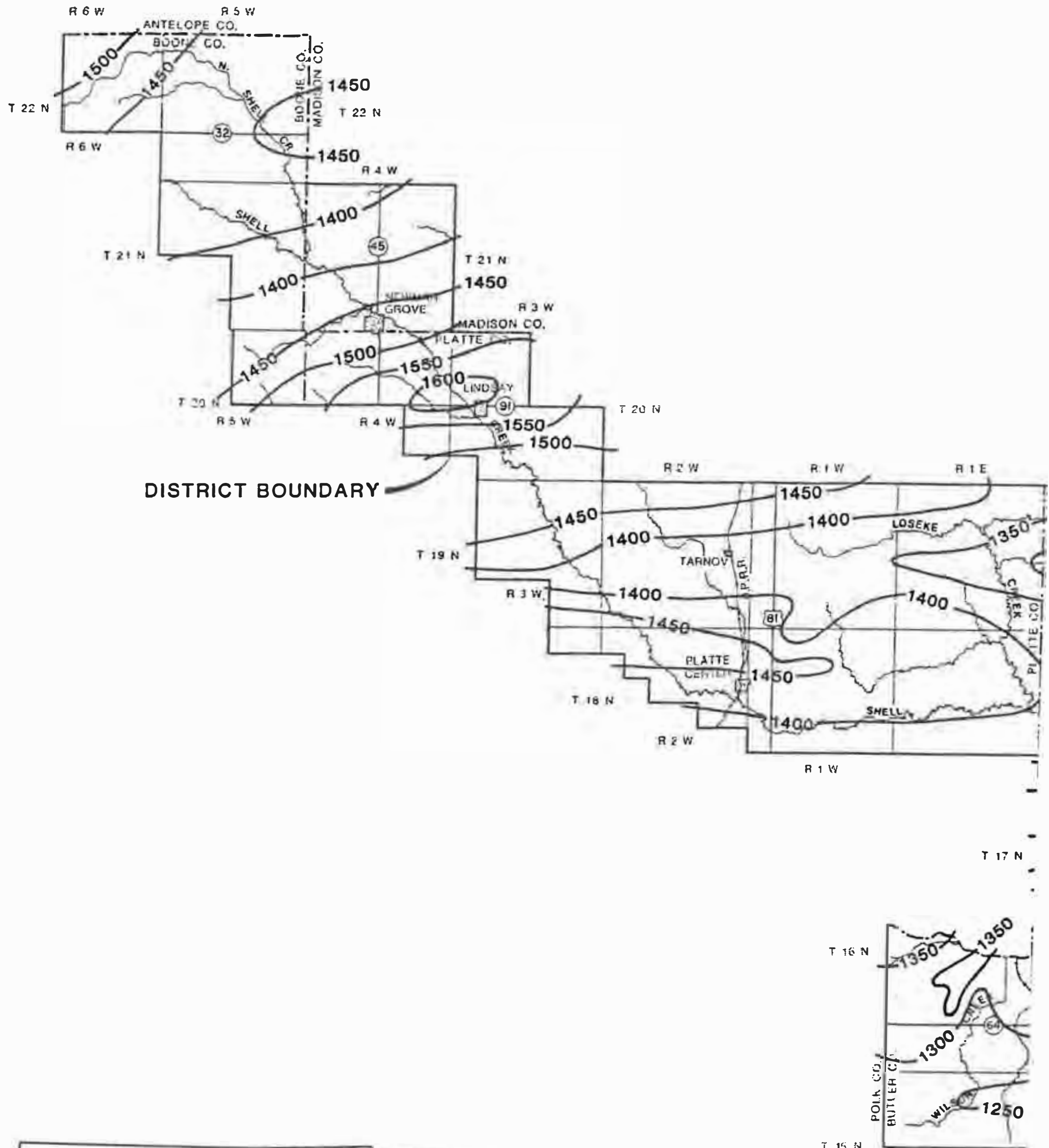

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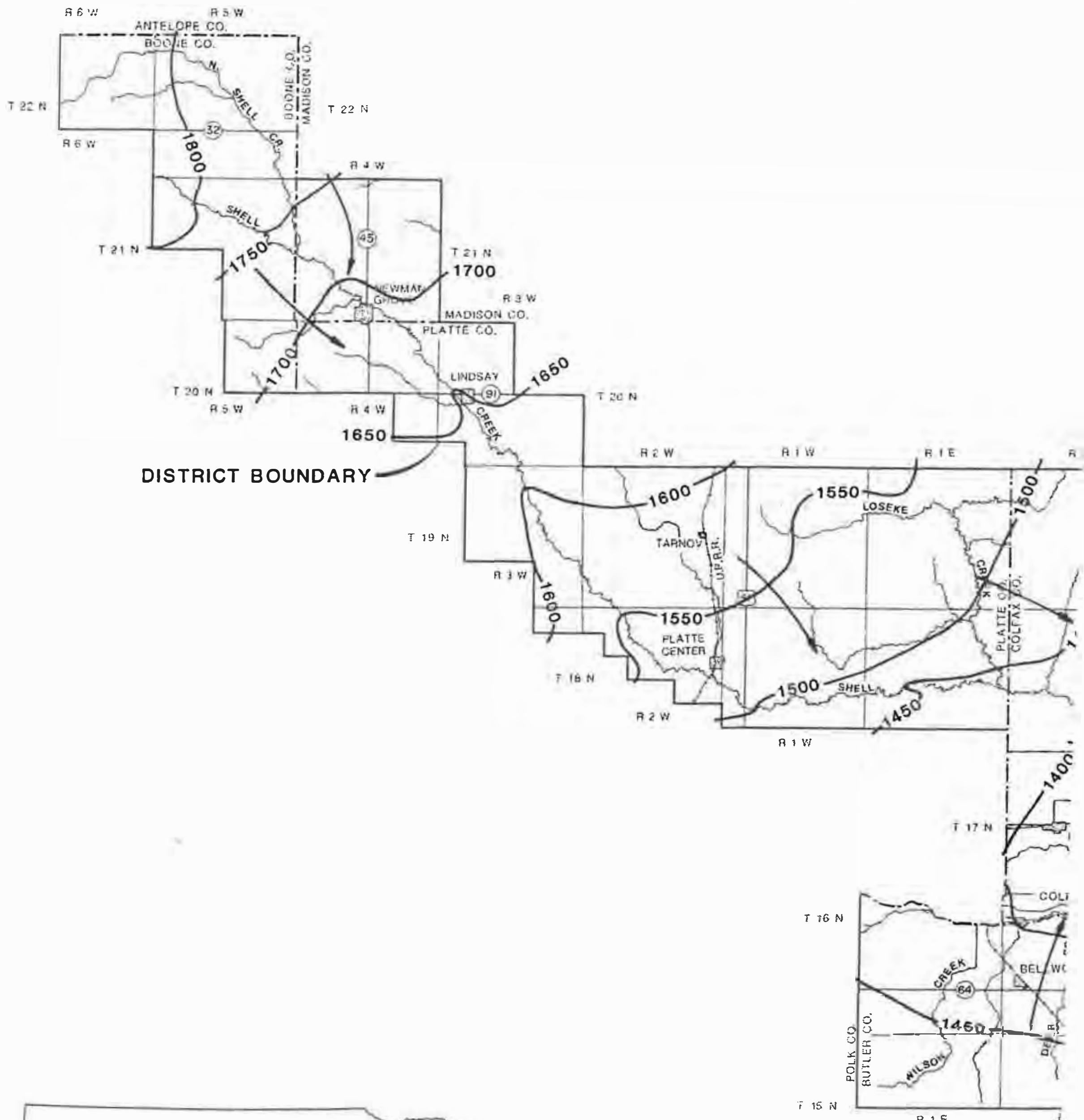

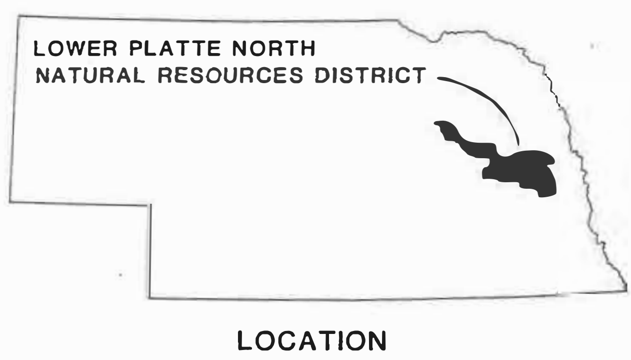

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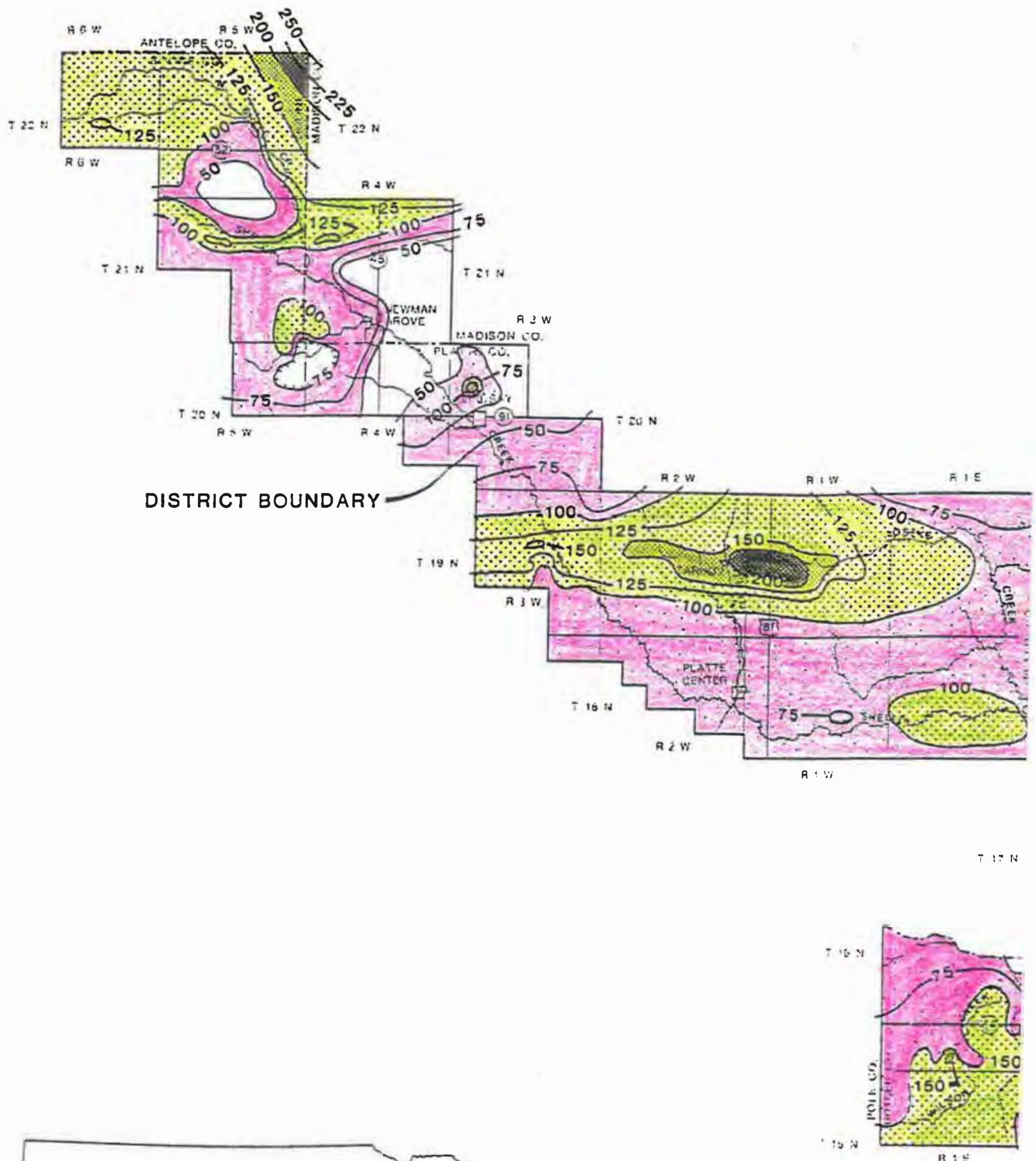

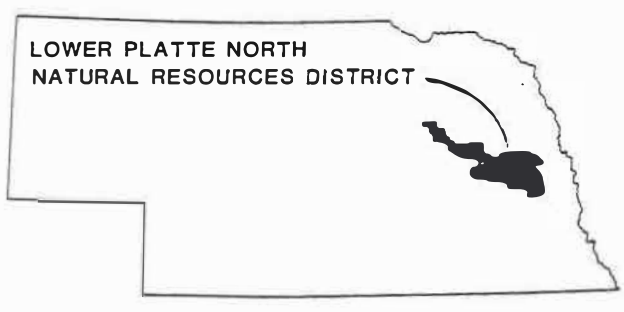

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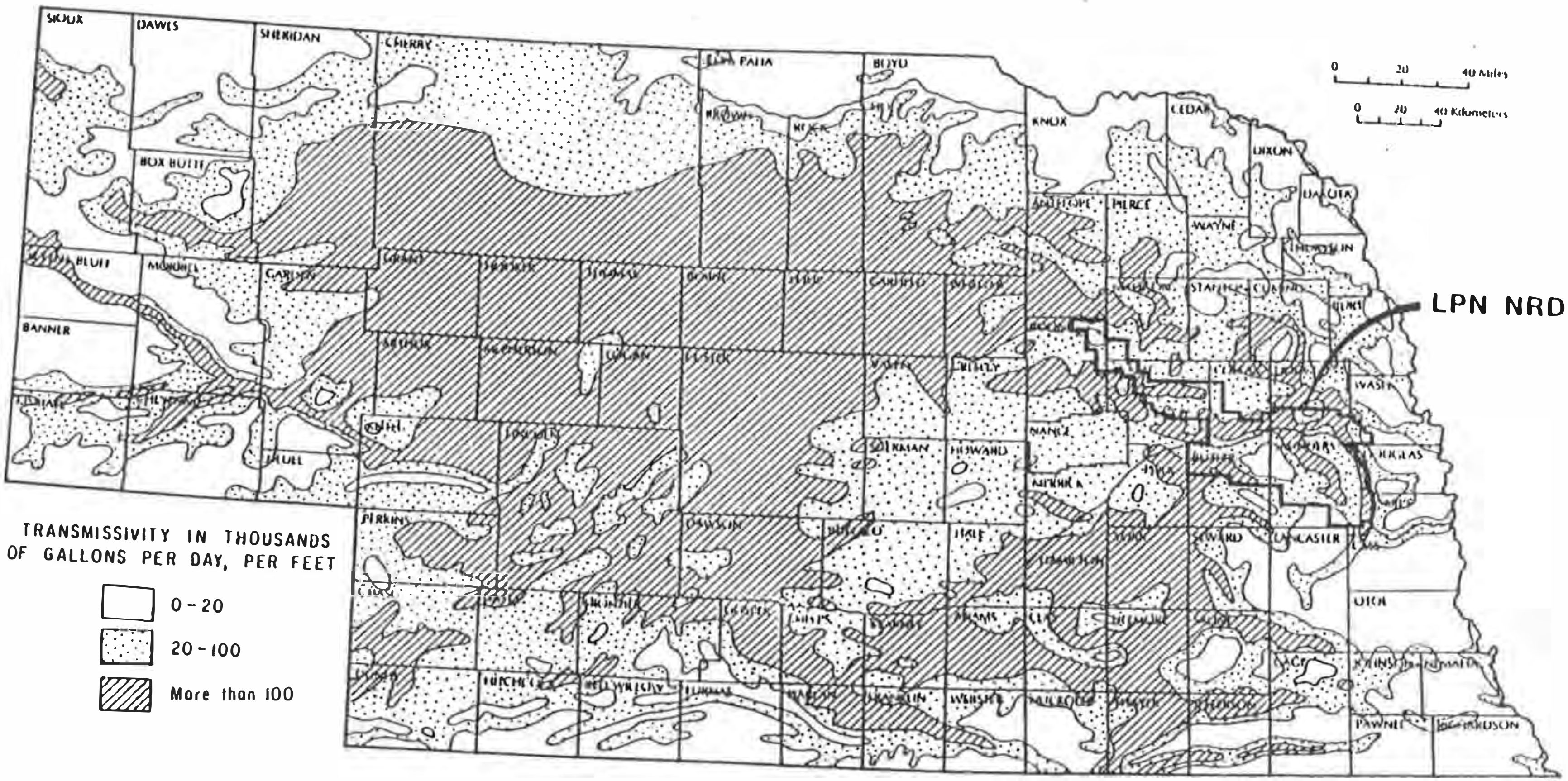
EXHIBIT 21



Transmissivity of the Principal Aquifer - A function of aquifer thickness and permeability, transmissivity estimates provide an indication of the productivity of an aquifer. Also available from CSD are transmissivity maps at a scale of 1:500,000.

From: "Policy Issue Study on Groundwater Reservoir Management", Nebraska Natural Resources Commission, 1982

LOCATION

HWS Consulting Group, Inc.

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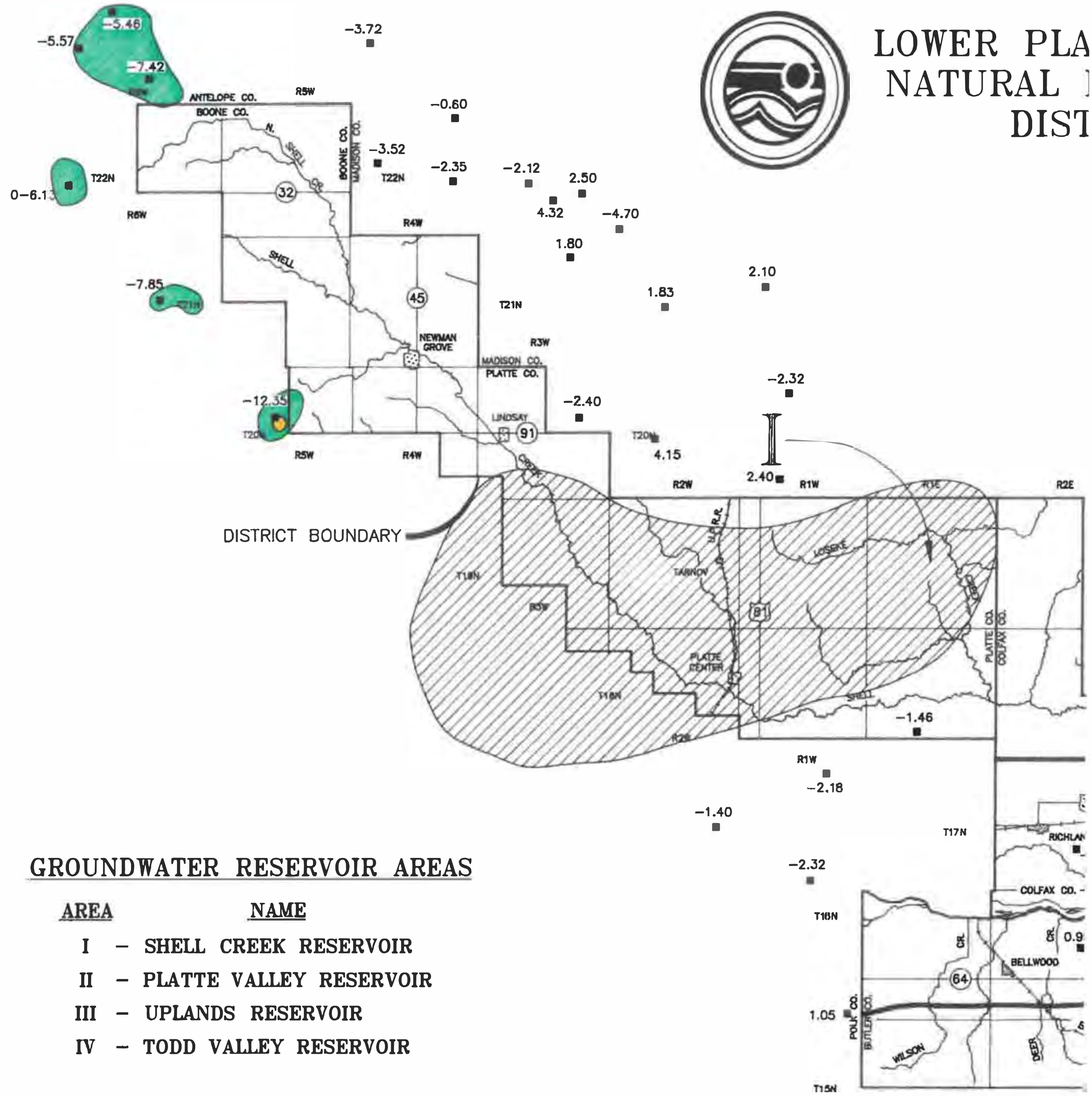
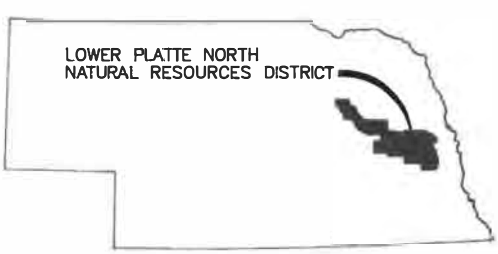
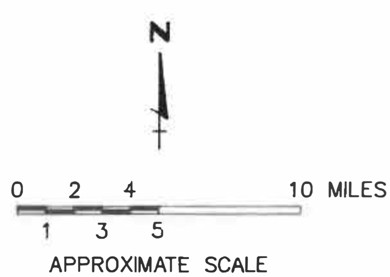


GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
III	– UPLANDS RESERVOIR
IV	– TODD VALLEY RESERVOIR



LOCATION



HWS Consulting Group Inc.

Source: U.S. Ge

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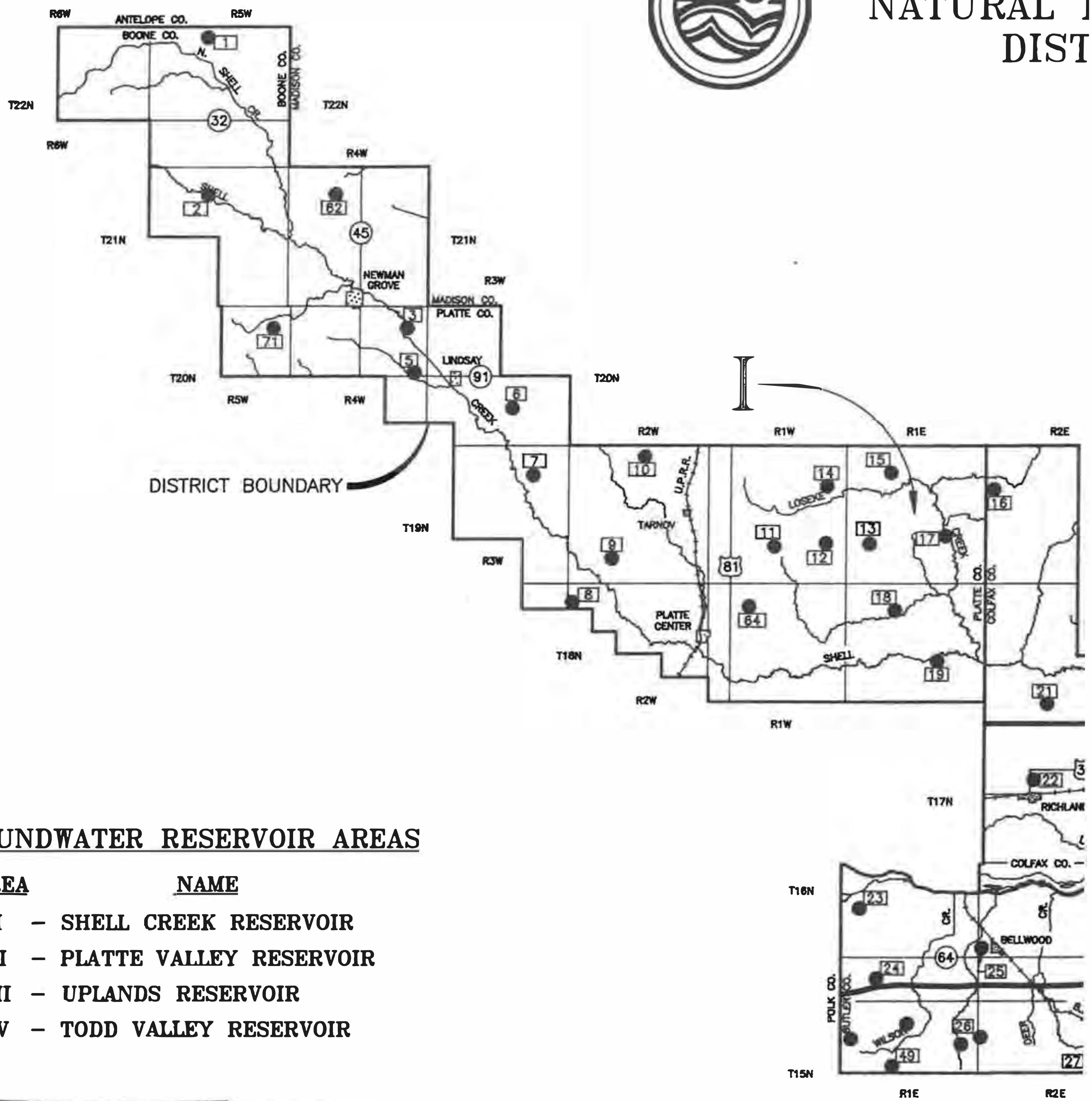
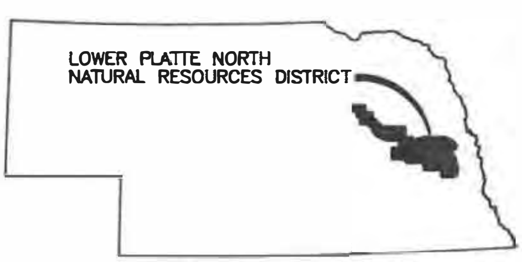
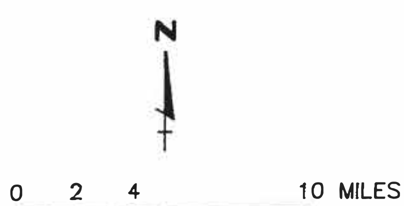


GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
III	– UPLANDS RESERVOIR
IV	– TODD VALLEY RESERVOIR



LOCATION



APPROXIMATE SCALE

Source: Lower Platte No

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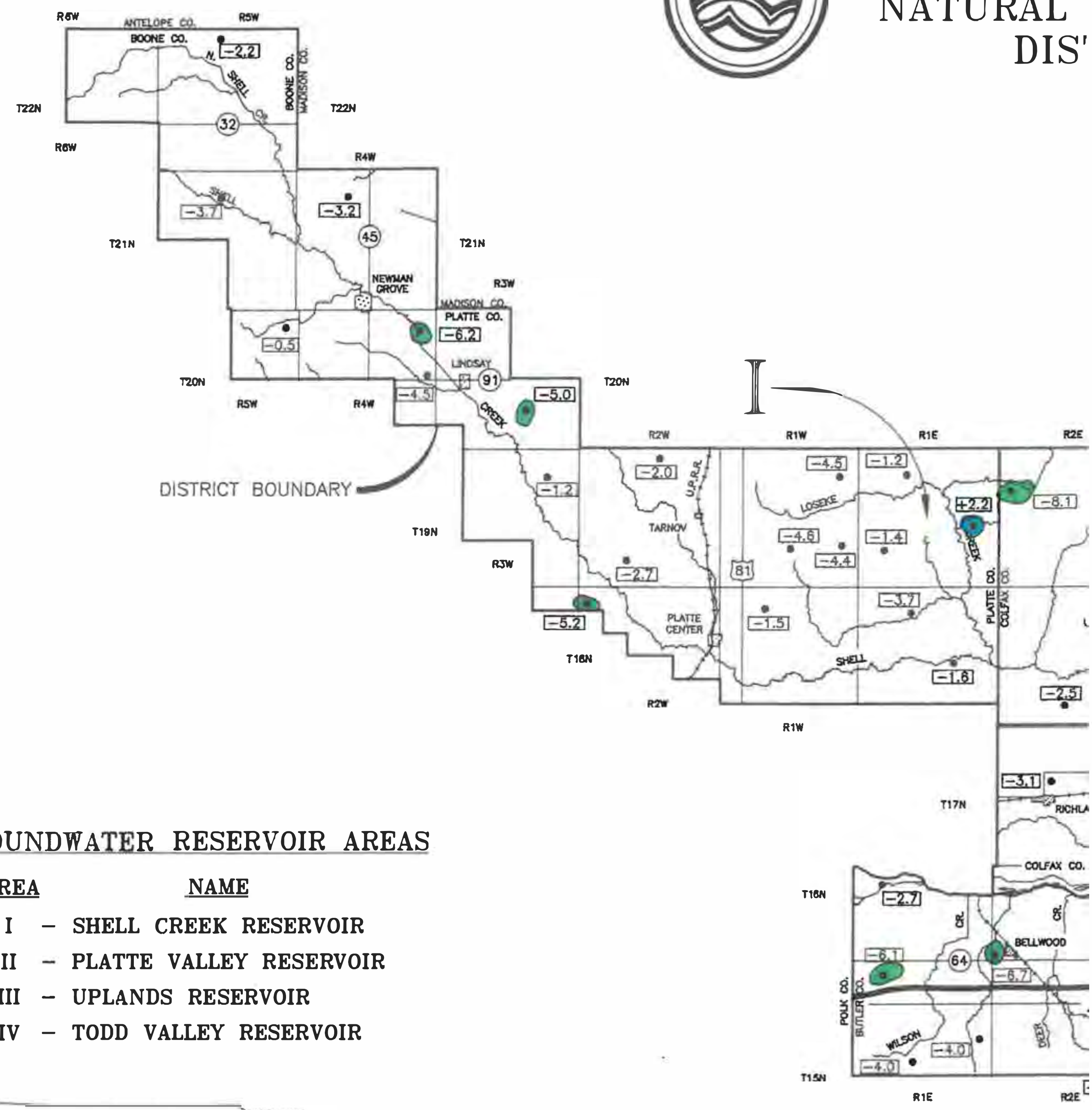
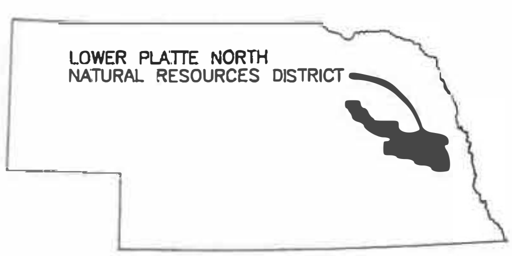
NATURAL
DIS[T]



GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
III	– UPLANDS RESERVOIR
IV	– TODD VALLEY RESERVOIR



LOCATION

N

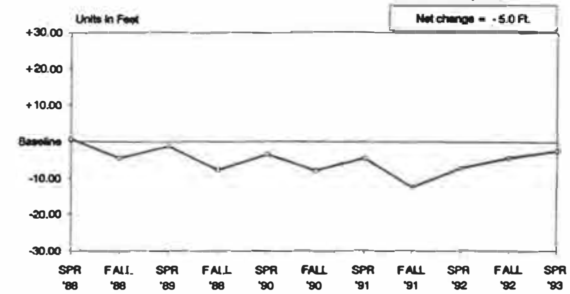
0 2 4 10 MILES
1 3 5
APPROXIMATE SCALE

Source: Lower Platte No[rth]

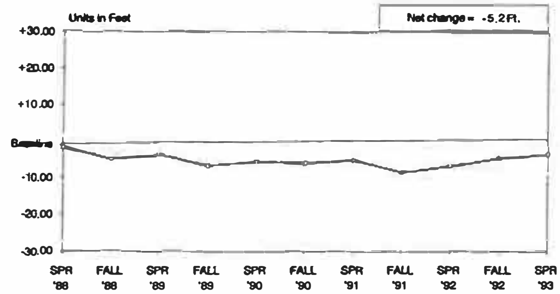
HWS Consulting Group Inc.

SHELL CREE

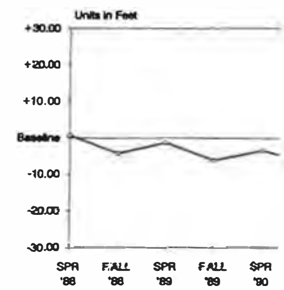
Changes in Water Levels Since 1987 (Baseline)
Well: 6 20N-3W-22DDCC Platte Co. Shell Cr. Aquifer



Changes in Water Levels Since 1987 (Baseline)
Well: 8 18N-2W-6CBAA Platte Co. Shell Cr. Aquifer

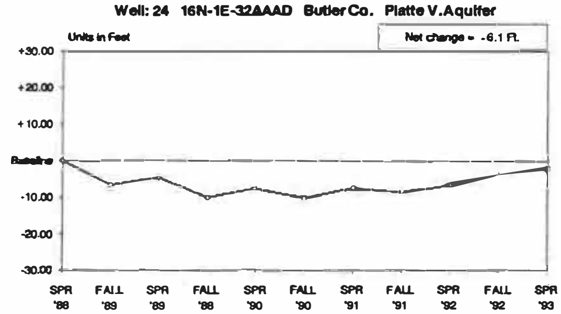


Changes in Water L
Well: 12 19N-1W-25CA

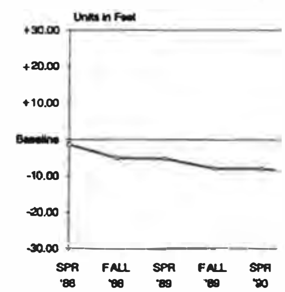


PLATTE VALL

Changes in Water Levels Since 1987 (Baseline)
Well: 24 16N-1E-32AAAD Butler Co. Platte V. Aquifer



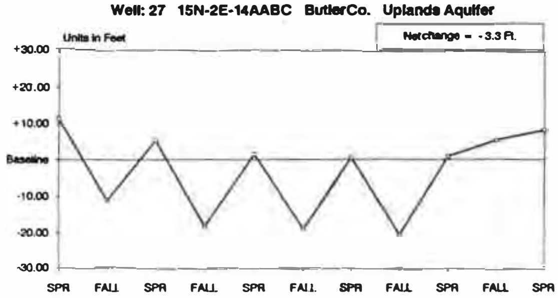
Changes in Water L
Well: 25 16N-2E-19CC



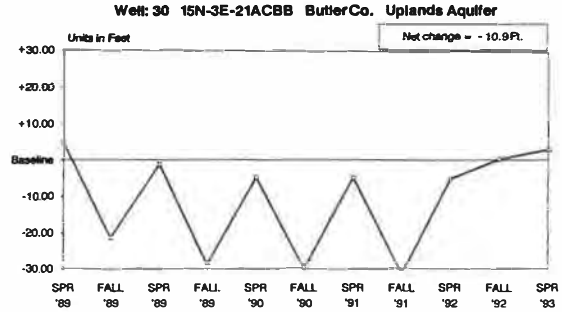
HWS Consulting Group, Inc.

UPLANDS RESERVOIR

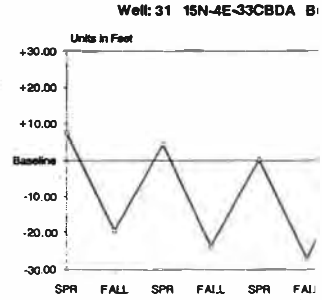
Changes in Water Levels Since 1988 (Baseline)
Well: 27 15N-2E-14AABC Butler Co. Uplands Aquifer



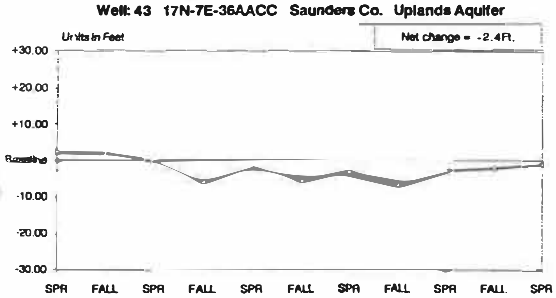
Changes in Water Levels Since 1987 (Baseline)
Well: 30 15N-3E-21ACBB Butler Co. Uplands Aquifer



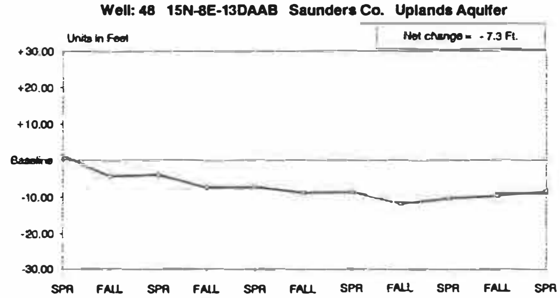
Changes in Water Levels
Well: 31 15N-4E-33CBDA B



Changes in Water Levels Since 1987 (Baseline)
Well: 43 17N-7E-36AACC Saunders Co. Uplands Aquifer



Changes in Water Levels Since 1987 (Baseline)
Well: 48 15N-8E-13DAAB Saunders Co. Uplands Aquifer



Changes in Water Levels
Well: 49 15N-1E-16DACC S

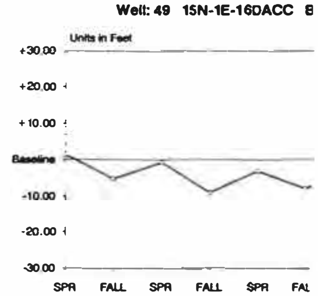
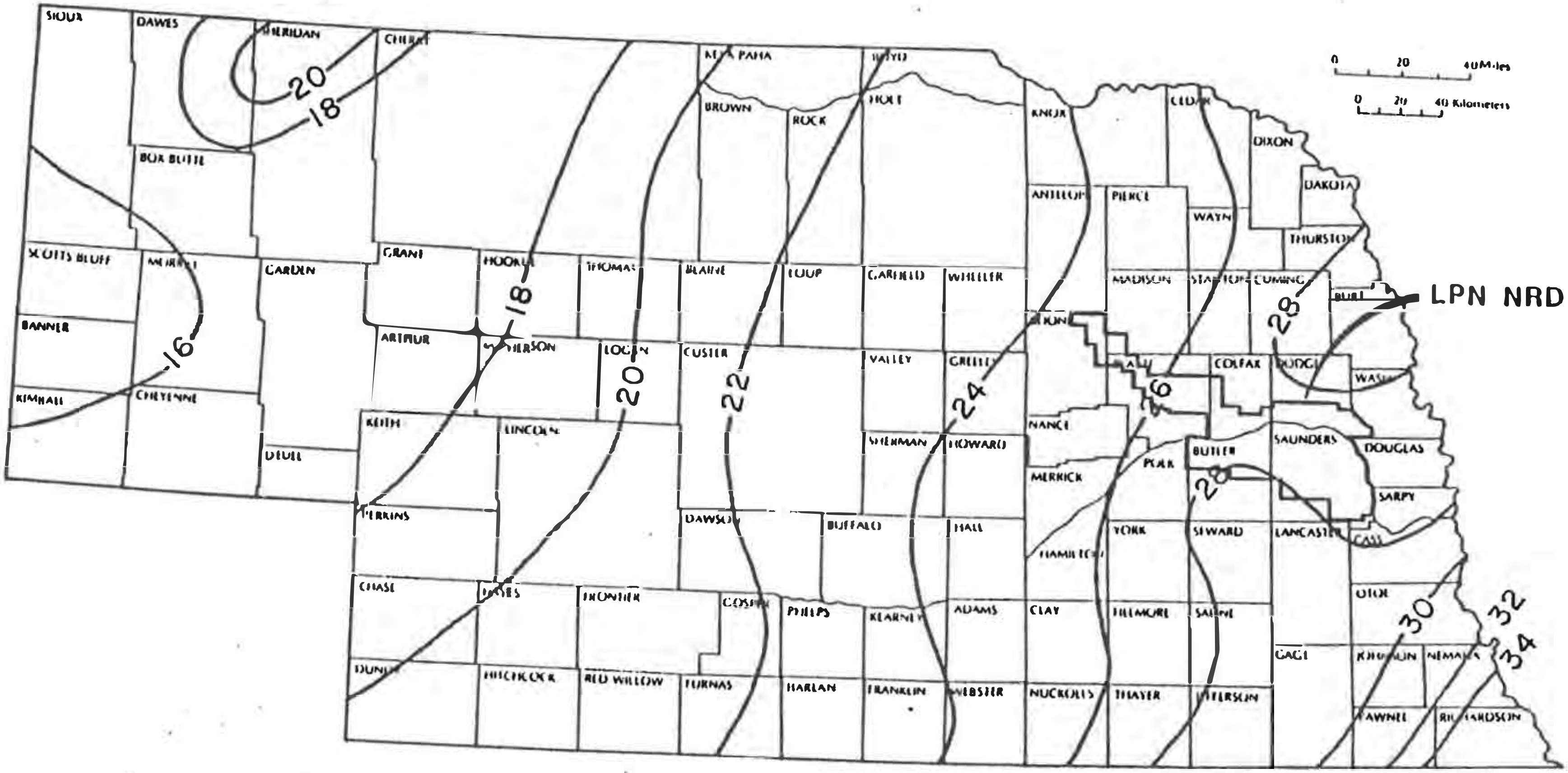
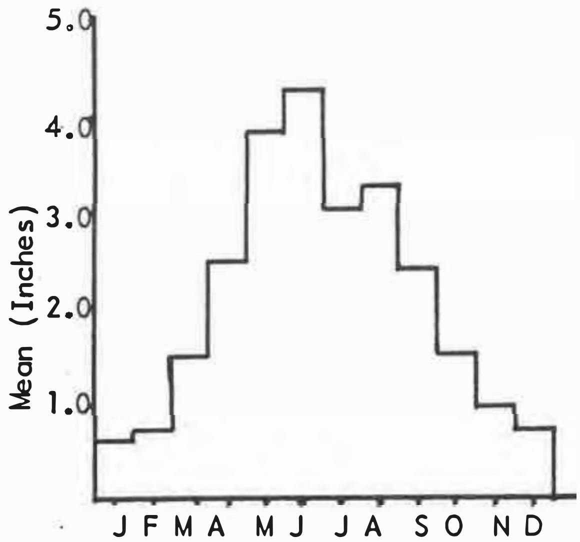


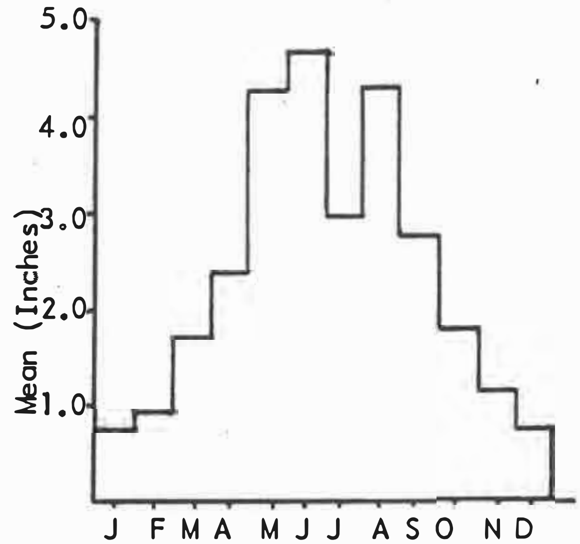
EXHIBIT 27



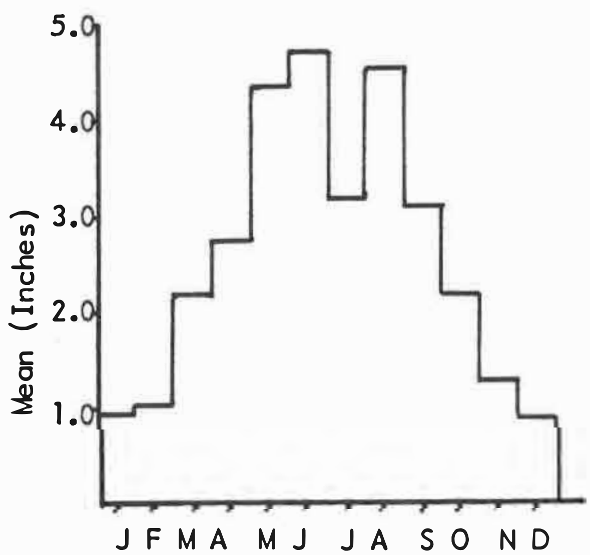
Mean Annual Precipitation (in inches) from 1900 to 1979 - This map is reproduced from "An Analysis of Nebraska's Precipitation Climatology with Emphasis on Occurrence of Dry Conditions", Agricultural Experiment Station, UN-L, Wilhite, D., 1981.



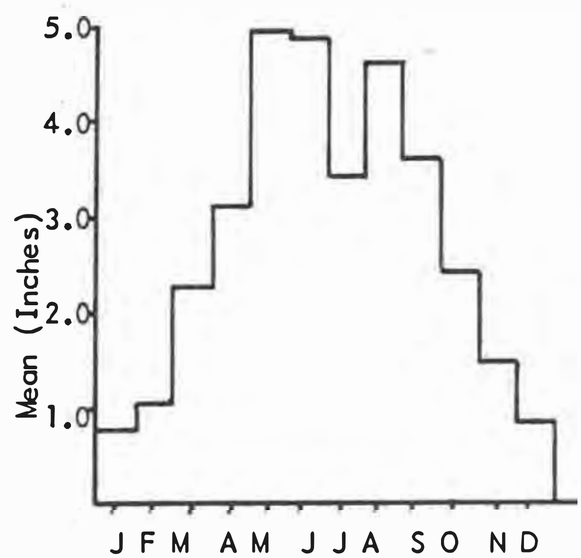
Months
Mean Annual = 25.38"
Albion
Boone County



Months
Mean Annual = 28.43"
Schuyler
Colfax County



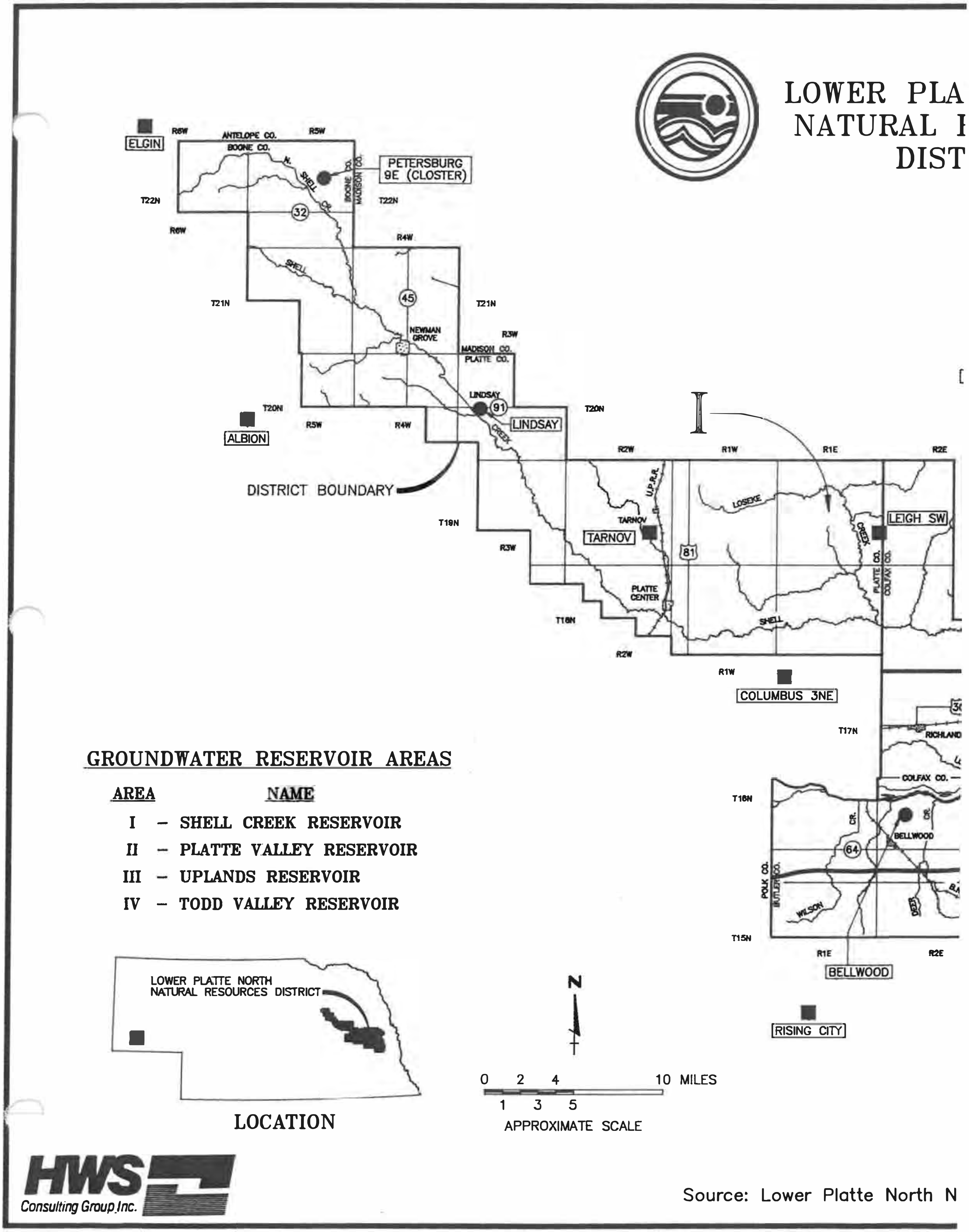
Months
Mean Annual = 30.66"
Fremont
Dodge County



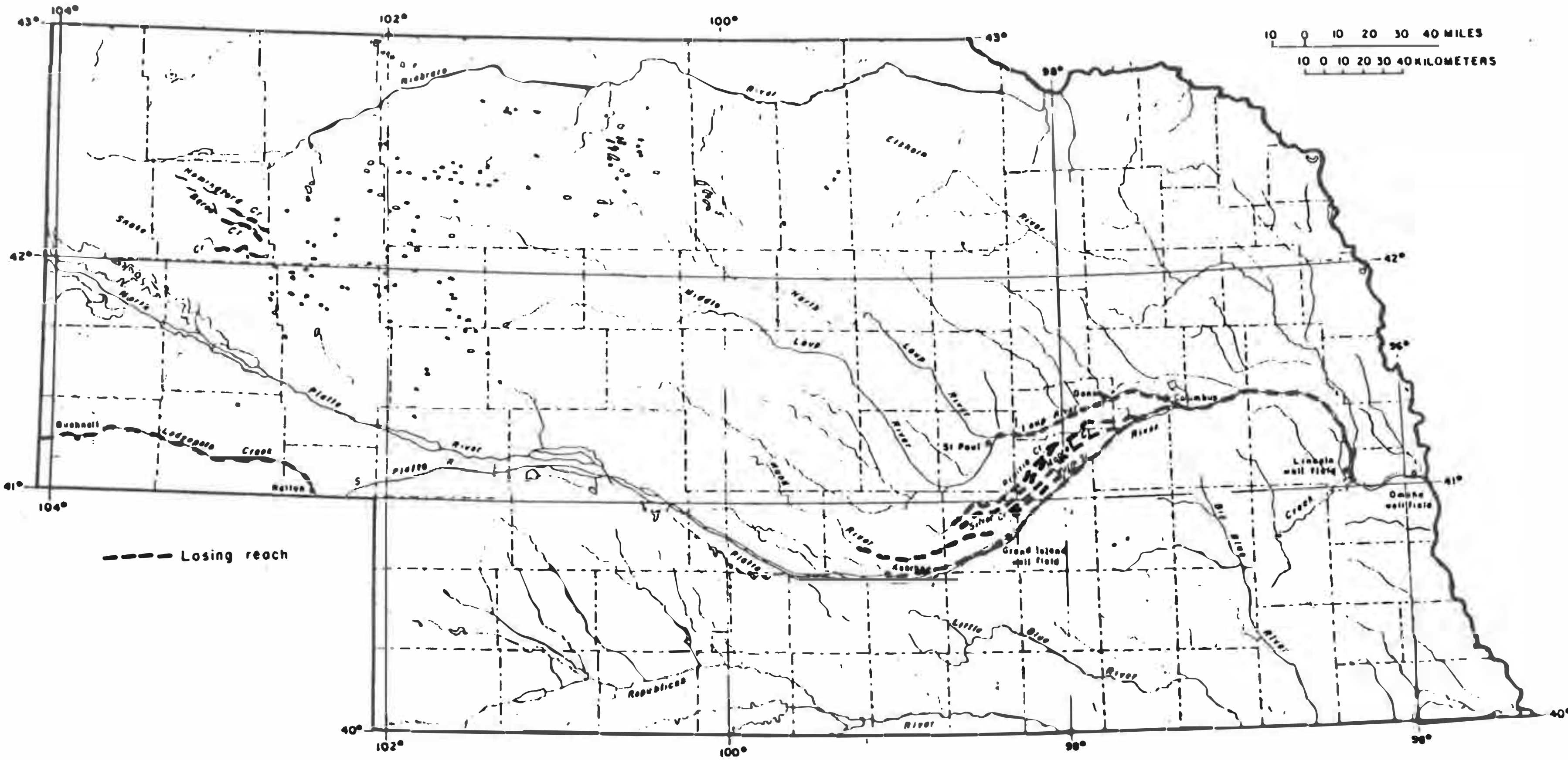
Months
Mean Annual = 33.96"
Wahoo
Saunders County

DISTRIBUTION OF AVERAGE
ANNUAL PRECIPITATION

EXHIBIT 28



LOWER PLA
NATURAL
DIST
ELGIN
R6W
ANTELOPE CO.
BOONE CO.
R5W
N. SHELL CR.
PETERSBURG 9E (CLOSTER)
BOONE CO.
MADISON CO.
T22N
32
R6W
R4W
SHELL
45
T21N
T21N
NEWMAN GROVE
R3W
MADISON CO.
PLATTE CO.
LINDSAY
91
LINDSAY
CREEK
T20N
T20N
ALBION
R5W
R4W
I
DISTRICT BOUNDARY
R2W
R1W
R1E
R2E
U.P.R.R.
LOSEKE
TARNOV
TARNOV
T19N
CREEK
LEIGH SW
81
R3W
PLATTE CO.
COLFAX CO.
PLATTE CENTER
T18N
SHELL
R2W
R1W
COLUMBUS 3NE
T17N
RICHLAND
COLFAX CO.
T16N
CR.
BELLWOOD
64
POLK CO.
BUTLER CO.
WILSON
T15N
R1E
R2E
BELLWOOD
RISING CITY
GROUNDWATER RESERVOIR AREAS
AREA
NAME
I – SHELL CREEK RESERVOIR
II – PLATTE VALLEY RESERVOIR
III – UPLANDS RESERVOIR
IV – TODD VALLEY RESERVOIR
LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT
LOCATION
N
0 2 4 10 MILES
1 3 5
APPROXIMATE SCALE
HWS Consulting Group Inc.
Source: Lower Platte North N

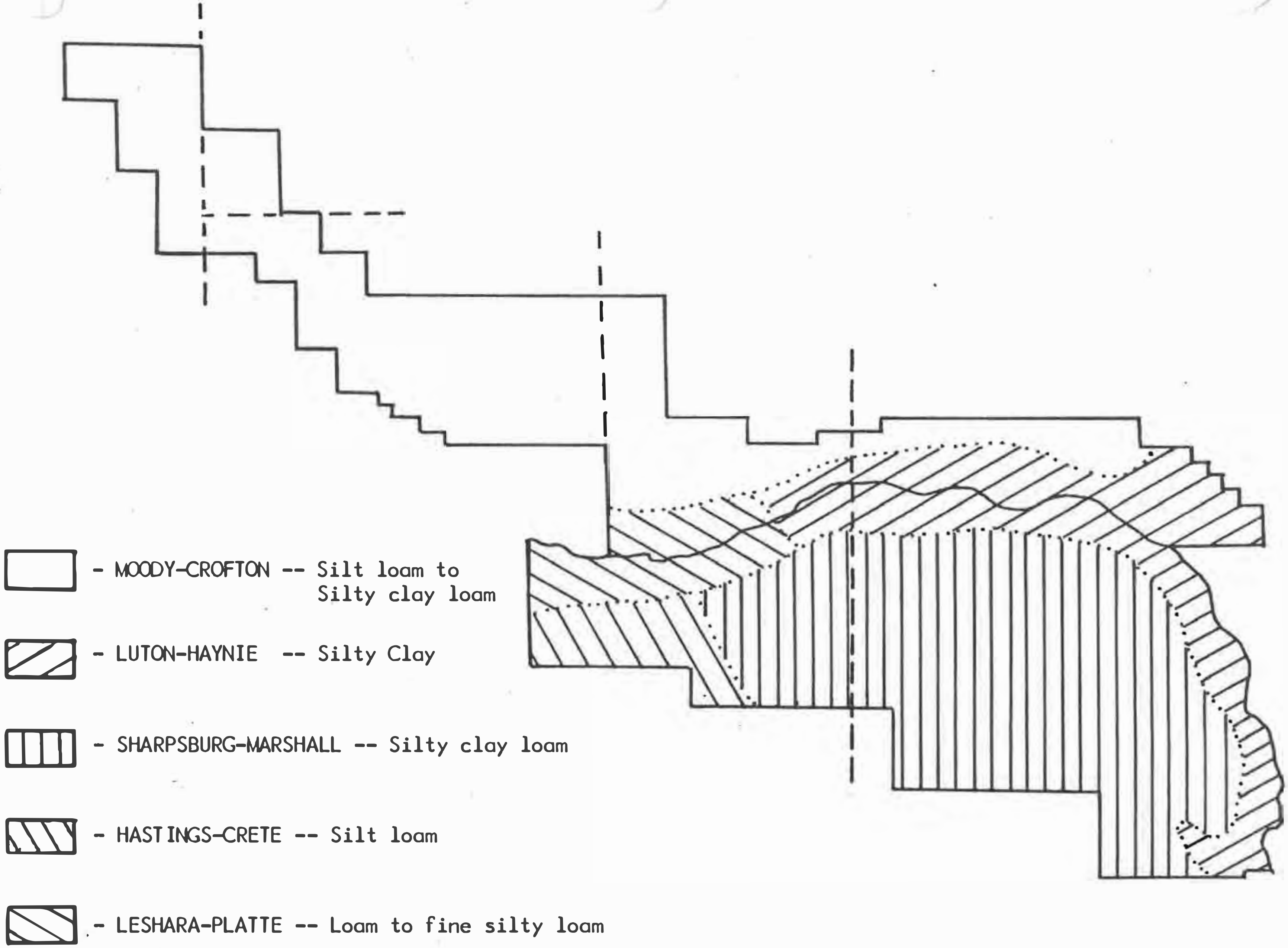


LOSING STREAMS

Source: Policy Issue Study on Supplemental Water Supplies, Nebraska Natural Resources Commission, 1984, From the Material Supplied by Conservation and Survey Division, University of Nebraska.

EXHIBIT 30

EXHIBIT 31



SOIL ASSOCIATIONS IN THE LOWER PLATTE NORTH
NATURAL RESOURCES DISTRICT

LOWER PLATTE NORTH NRD
THRU 02/93

SUMMARY OF REGISTERED WELLS BY YEAR DRILLED

CUMULATIVE TOTALS BY COUNTY — NUMBER OF REGISTERED WELLS

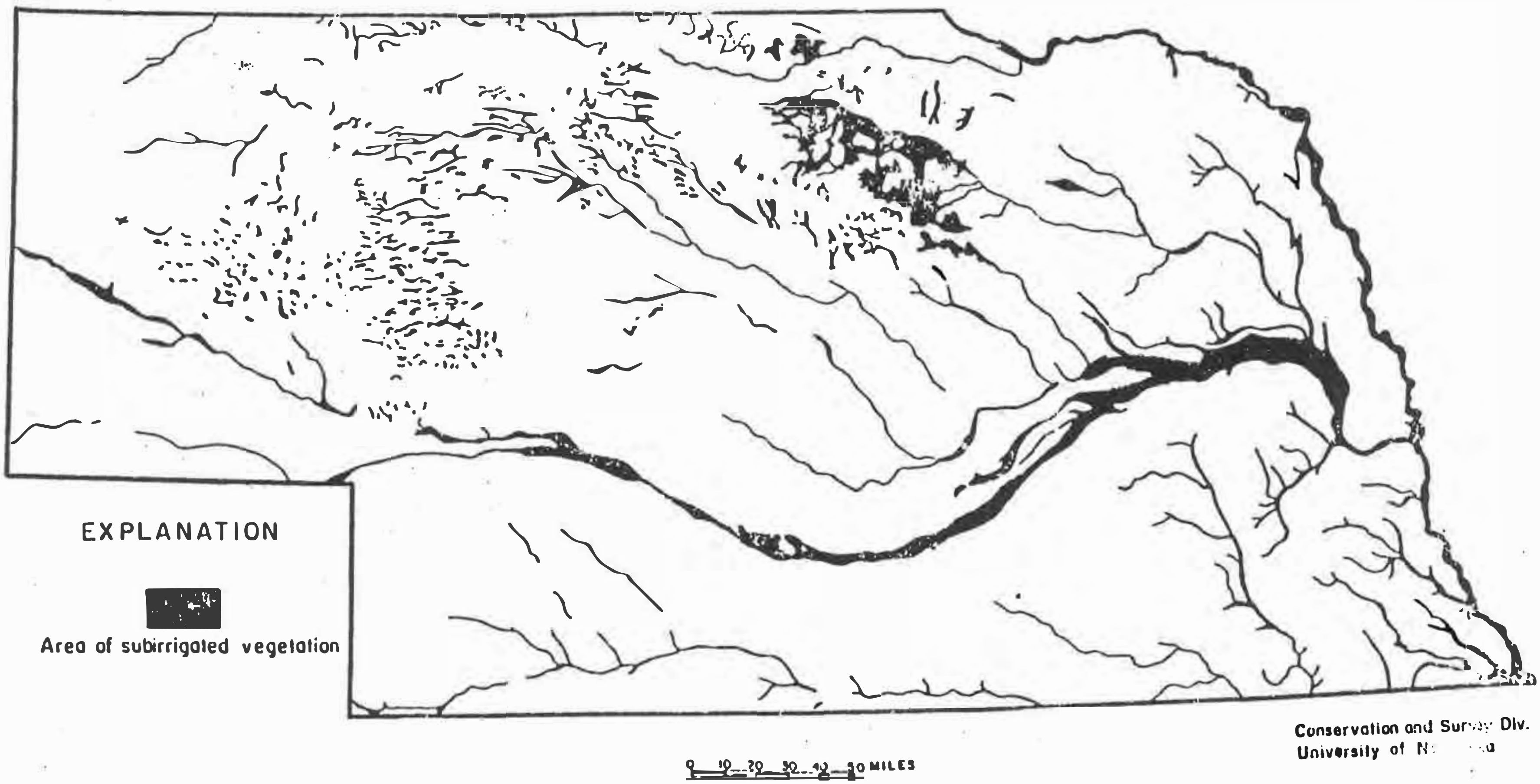
YEAR DRILLED	BOONE	BUTLR	COLFX	DODGE	MADIS	PLATT	SAUND	TOTAL
THRU 1940	0	22	27	47	0	1	3	100
1941	0	23	45	56	0	2	3	129
1942	0	25	49	60	0	3	5	142
1943	0	28	50	62	0	3	5	148
1944	0	30	53	70	0	4	6	163
1945	0	31	54	73	0	4	6	168
1946	0	34	56	77	0	4	6	177
1947	0	36	64	81	0	4	6	191
1948	0	40	69	84	0	4	6	203
1949	0	40	70	91	0	5	11	217
1950	0	42	74	96	1	5	12	230
1951	0	42	75	101	1	5	12	236
1952	0	43	78	105	1	5	12	244
1953	0	48	81	113	1	5	13	261
1954	0	73	109	140	5	10	28	365
1955	0	118	157	180	7	23	48	538
1956	11	181	228	329	12	77	90	928
1957	16	216	258	419	14	91	140	1154
1958	16	220	262	428	14	92	144	1176
1959	16	221	268	431	14	96	146	1192
1960	16	222	270	434	14	98	146	1200
1961	16	229	277	438	14	102	147	1223
1962	16	234	280	449	14	109	149	1251
1963	16	236	285	452	15	116	154	1274
1964	17	244	291	456	15	118	158	1299
1965	18	249	296	458	15	123	160	1319
1966	19	262	317	465	15	126	168	1372
1967	20	272	343	488	16	133	178	1450
1968	23	285	353	508	17	151	181	1518
1969	27	302	370	531	17	167	192	1606
1970	31	318	396	554	17	192	217	1725
1971	36	336	410	575	20	213	238	1828
1972	39	352	418	584	23	230	256	1902
1973	42	361	424	594	23	237	263	1944
1974	53	383	432	623	24	255	277	2047
1975	67	406	458	675	27	304	345	2282
1976	78	430	488	732	30	373	450	2581
1977	81	480	522	770	30	420	545	2848
1978	81	490	534	782	30	427	557	2901
1979	84	500	547	788	30	435	574	2958
1980	88	529	566	797	31	448	590	3049
1981	100	539	583	811	34	470	627	3164
1982	102	543	587	816	34	472	636	3190
1983	103	543	587	820	34	474	642	3203
1984	103	547	590	823	34	478	648	3223
1985	105	549	593	826	34	479	651	3237
1986	105	550	594	829	34	480	654	3246
1987	106	550	600	835	34	482	657	3264
1988	106	553	620	844	34	486	668	3311
1989	108	563	643	864	34	500	702	3414
1990	111	569	653	896	42	514	727	3512
1991	113	572	662	911	45	519	744	3566
1992	113	578	674	925	46	532	758	3626
02/1993	113	578	674	925	46	532	758	3626
YEAR NOT KNOWN	0	2	3	5	0	3	4	17

YEARLY TOTALS BY COUNTY — NUMBER OF REGISTERED WELLS

YEAR DRILLED	BOONE	BUTLR	COLFX	DODGE	MADIS	PLATT	SAUND	TOTAL
THRU 1940	0	22	27	47	0	1	3	100
1941	0	1	18	9	0	1	0	29
1942	0	2	4	4	0	1	2	13
1943	0	3	1	2	0	0	0	6
1944	0	2	3	8	0	1	1	15
1945	0	1	1	3	0	0	0	5
1946	0	3	2	4	0	0	0	9
1947	0	2	8	4	0	0	0	14
1948	0	4	5	3	0	0	0	12
1949	0	0	1	7	0	1	5	14
1950	0	2	4	5	1	0	1	13
1951	0	0	1	5	0	0	0	6
1952	0	1	3	4	0	0	0	8
1953	0	5	3	8	0	0	1	17
1954	0	25	28	27	4	5	15	104
1955	0	45	48	40	2	18	20	173
1956	11	63	71	149	5	49	42	390
1957	5	35	30	90	2	14	50	226
1958	0	4	4	9	0	1	4	22
1959	0	1	6	3	0	4	2	16
1960	0	1	2	3	0	2	0	8
1961	0	7	7	4	0	4	1	23
1962	0	5	3	11	0	7	2	28
1963	0	2	5	3	1	7	5	23
1964	1	3	6	4	0	2	4	25
1965	1	5	5	2	0	5	2	20
1966	1	13	21	7	0	3	8	53
1967	1	10	26	23	1	7	10	78
1968	3	13	10	20	1	18	3	68
1969	4	17	17	23	0	16	11	88
1970	4	16	26	23	0	25	25	119
1971	5	18	14	21	3	21	21	103
1972	3	16	8	9	3	17	18	74
1973	3	9	6	10	0	7	7	42
1974	11	22	8	29	1	18	14	103
1975	14	23	26	52	3	49	68	235
1976	11	24	30	57	3	69	105	299
1977	3	50	34	38	0	47	95	267
1978	0	10	12	12	0	7	12	53
1979	3	10	13	6	0	8	17	57
1980	4	29	19	9	1	13	16	91
1981	12	10	17	14	3	22	37	115
1982	2	4	4	5	0	2	9	26
1983	1	0	0	4	0	2	6	13
1984	0	4	3	3	0	4	6	20
1985	2	2	3	3	0	1	3	14
1986	0	1	1	3	0	1	3	9
1987	1	0	6	6	0	2	3	18
1988	0	3	20	9	0	4	11	47
1989	2	10	23	20	0	14	34	103
1990	3	6	10	32	8	14	25	98
1991	2	3	9	15	3	5	17	54
1992	0	6	12	14	1	13	14	60
02/1993	0	0	0	0	0	0	0	0
YEAR NOT KNOWN	0	2	3	5	0	3	4	17
TOTAL	113	580	677	930	46	535	762	3643

EXHIBIT 32

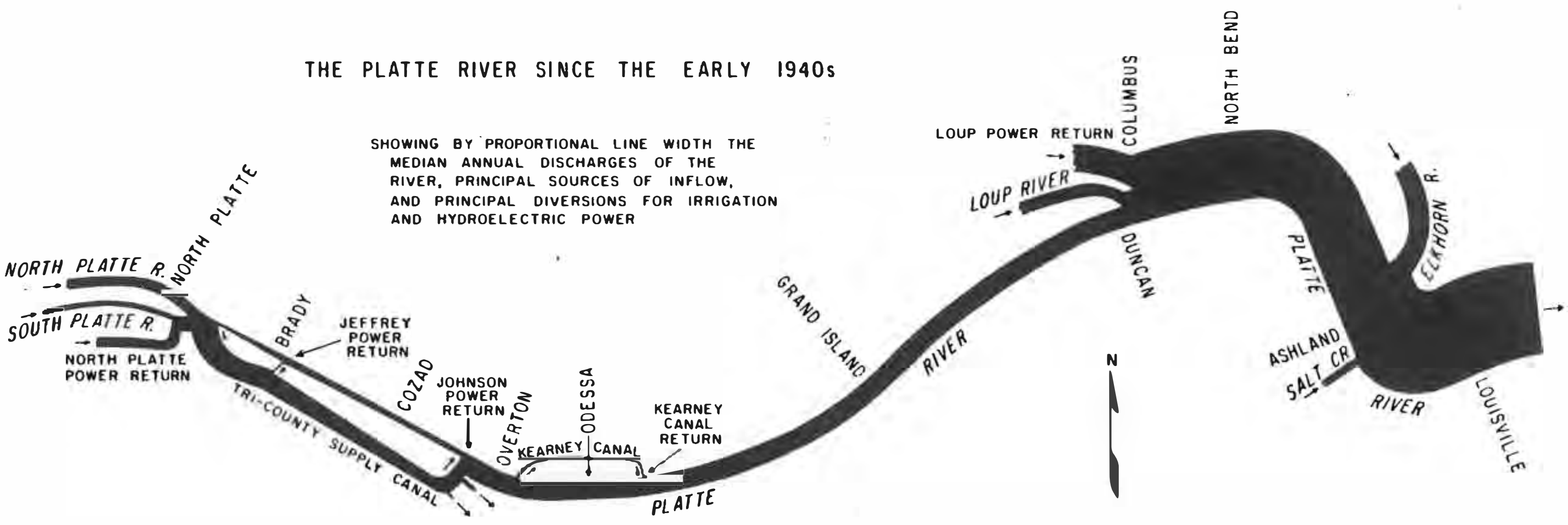
EXHIBIT 33



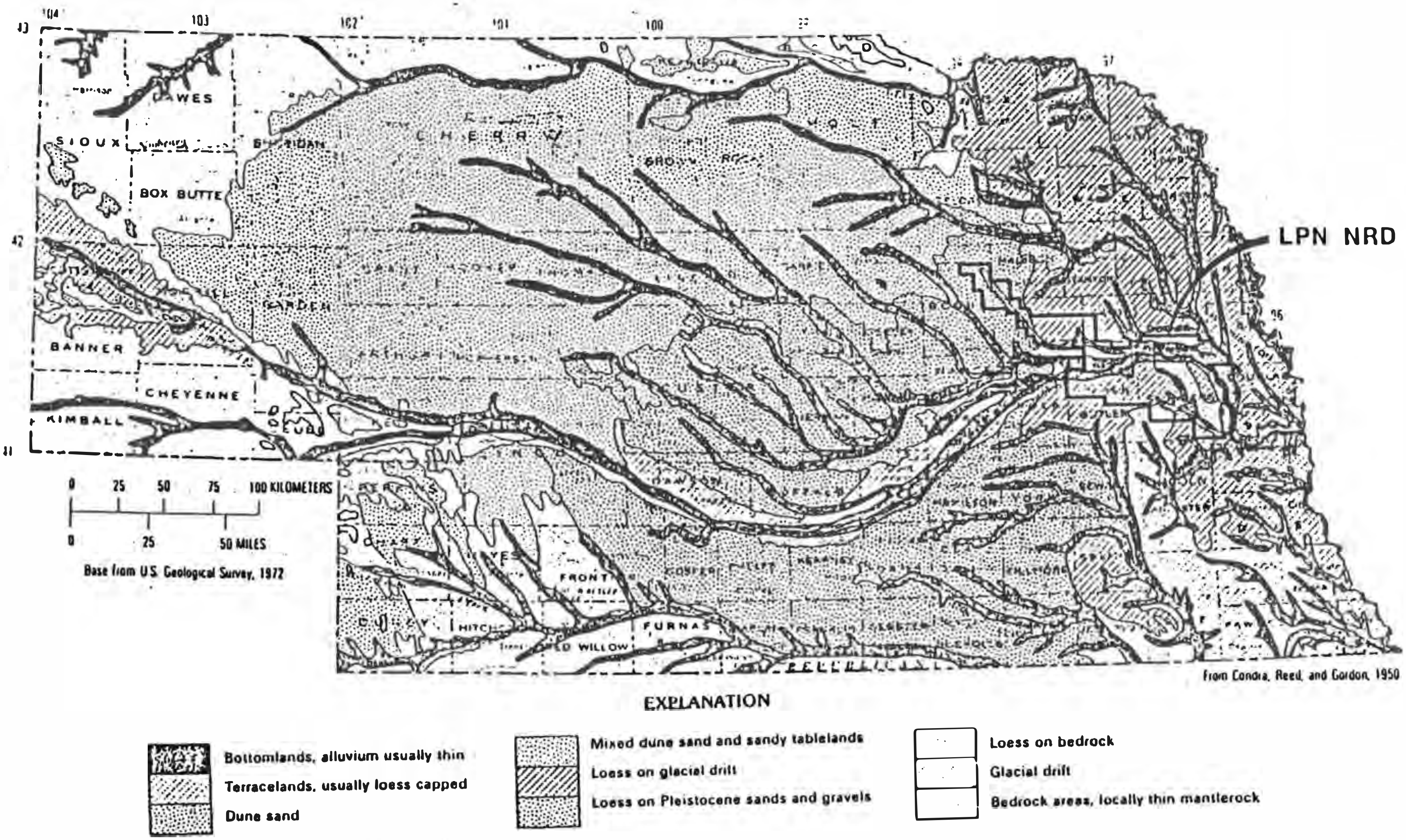
Principal Areas of Subirrigated Vegetation

Source: Shaffer, F.B., Availability and Use of Water in Nebraska, 1970. Nebraska Water Survey Paper #31, Conservation and Survey Division, University of Nebraska-Lincoln, 1972.

EXHIBIT 34



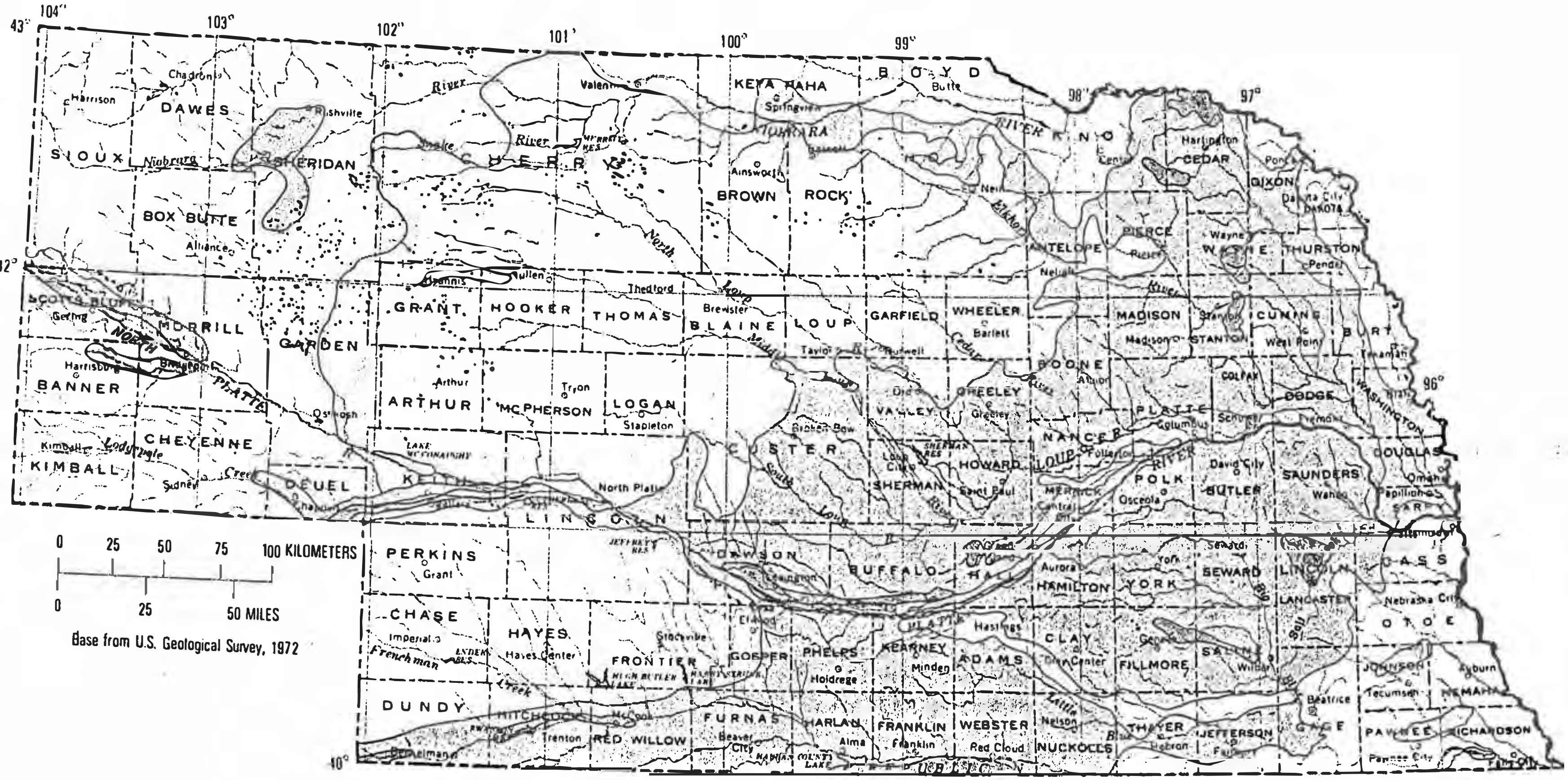
From: Bentall, "Nebraska's Platte River - A Graphic Analysis of Flows"



Map showing areal distribution of Holocene and Pleistocene deposits.

EXHIBIT 35

EXHIBIT 36



EXPLANATION

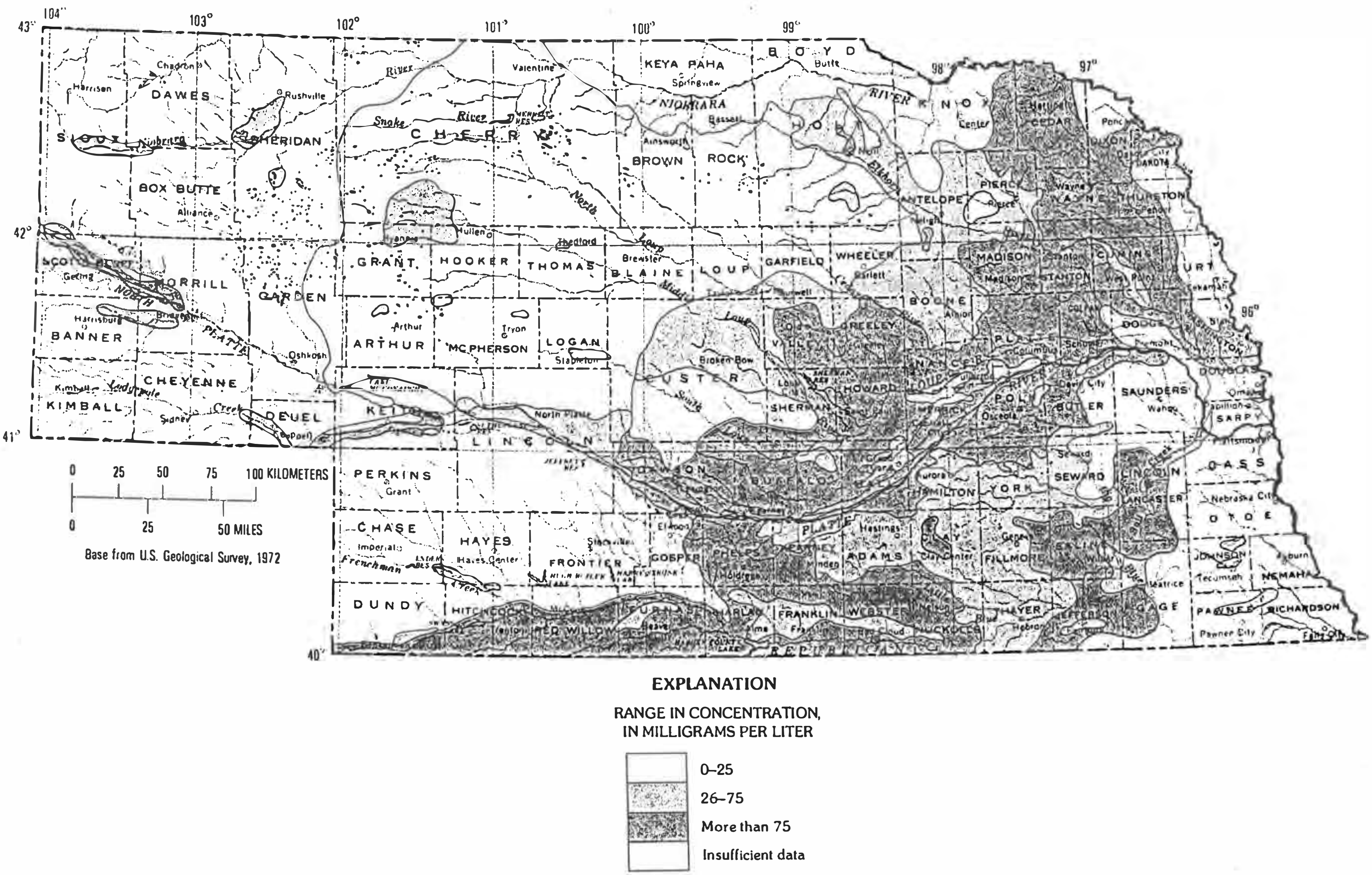
RANGE IN CONCENTRATION, IN MILLIGRAMS PER LITER

- 0–250
- 251–750
- 751–2250
- More than 2250
- Insufficient data

Map showing dissolved-solids concentrations in water from Holocene and Pleistocene aquifers.

From: Engberg, "Appraisal of Data for Groundwater Quality in Nebraska" USGS, 1984

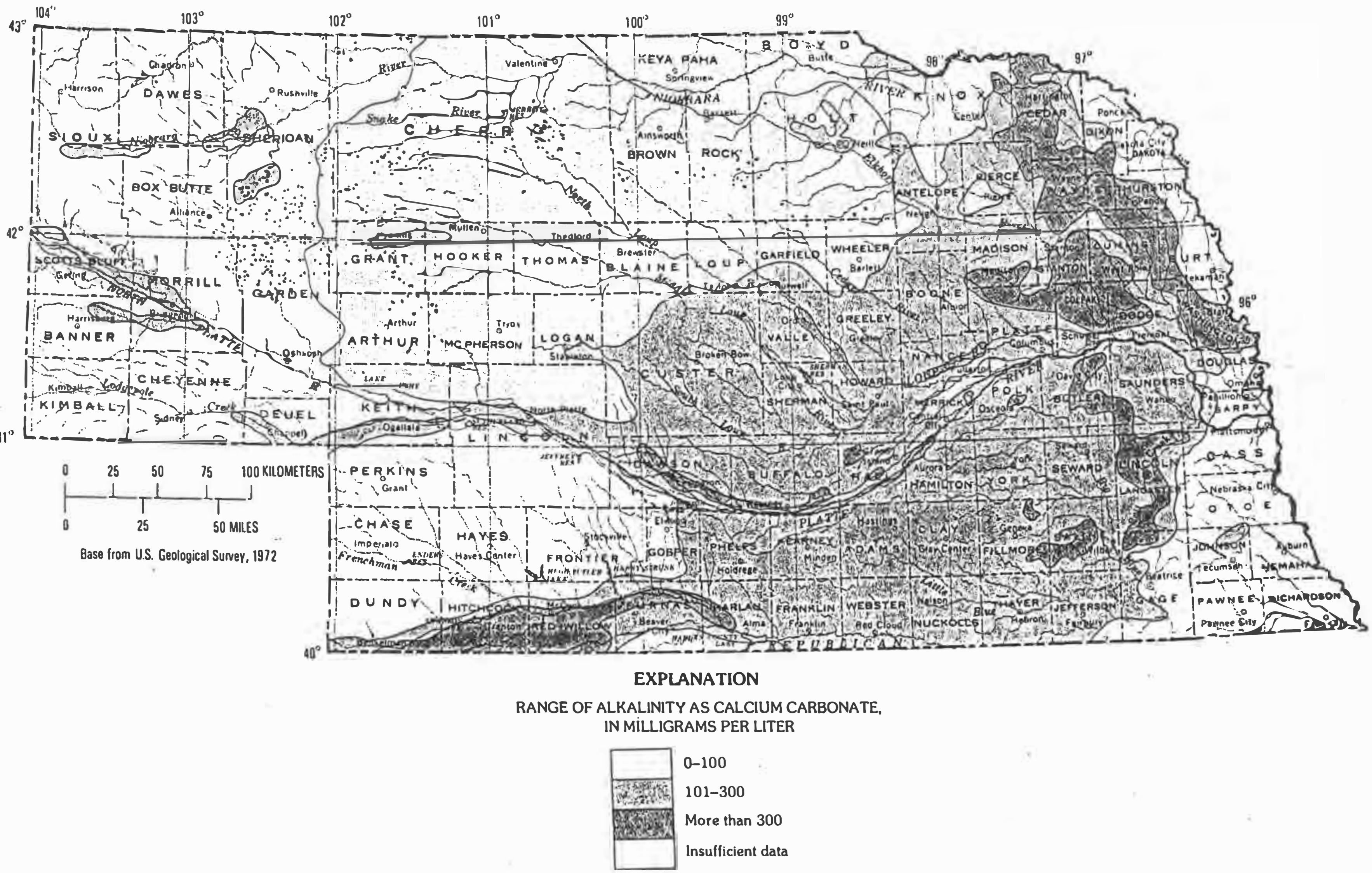
EXHIBIT 37



Map showing calcium concentrations in water from Holocene and Pleistocene aquifers.

From: Engberg, "Appraisal of Data for Groundwater Quality in Nebraska" USGS, 1984

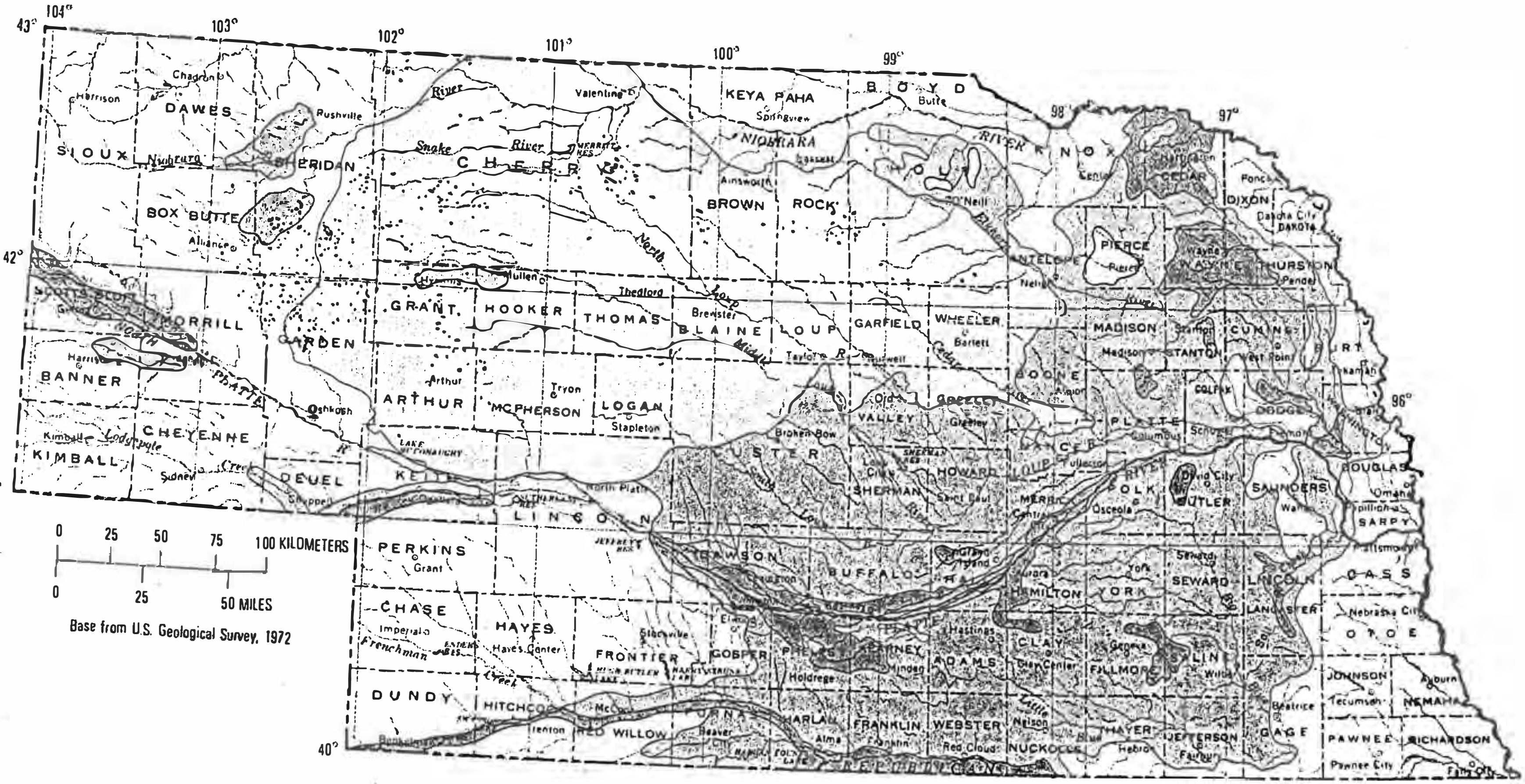
EXHIBIT 38



Map showing alkalinity of water from Holocene and Pleistocene aquifers.

From: Engberb, "Appraisal of Data for Groundwater Quality in Nebraska" USGS, 1984

EXHIBIT 39



EXPLANATION

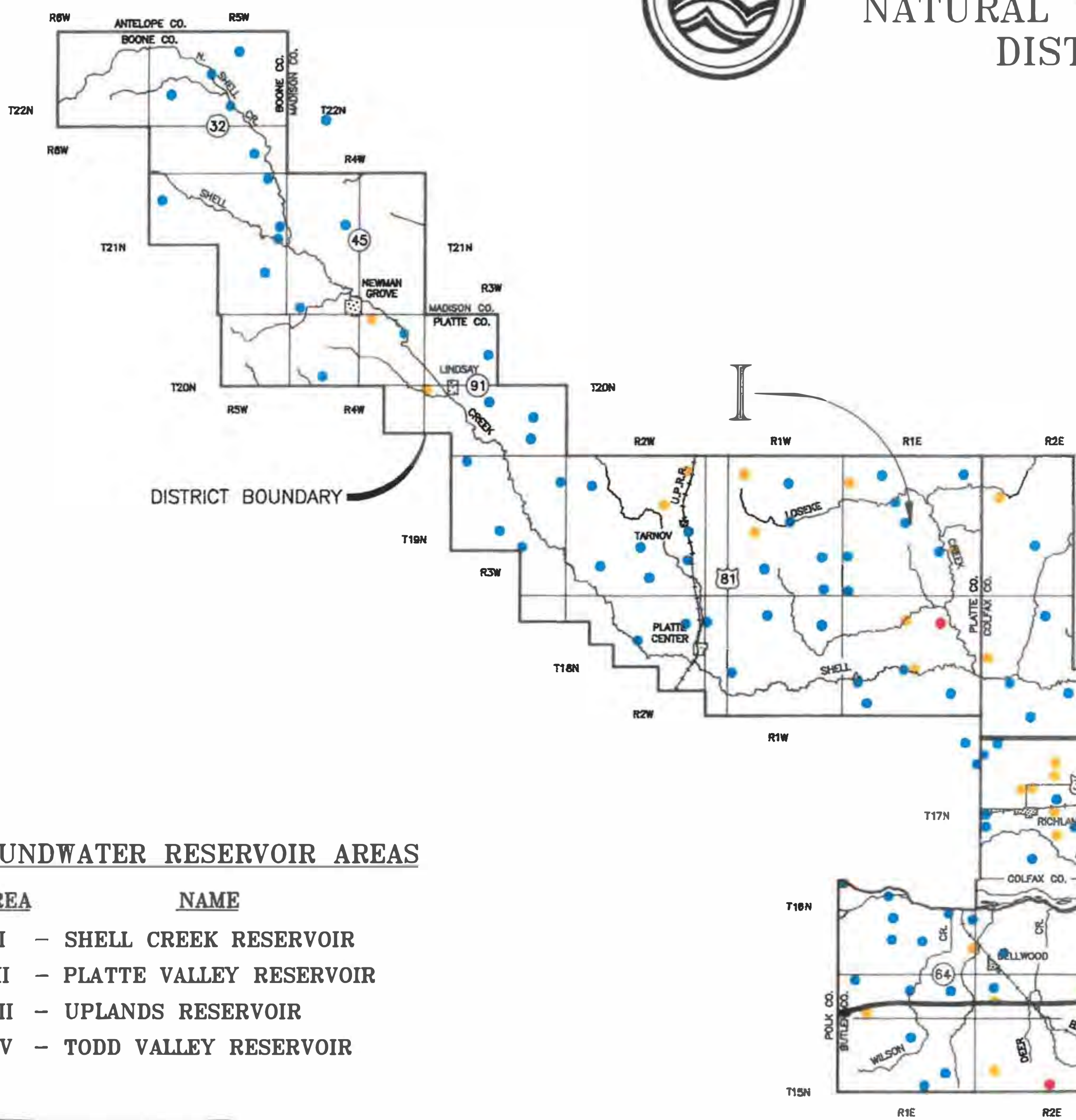
RANGE IN CONCENTRATION, IN MILLIGRAMS PER LITER

- 0–10
- 11–100
- More than 100
- Insufficient data

Map showing sulfate concentrations in water from Holocene and Pleistocene aquifers.

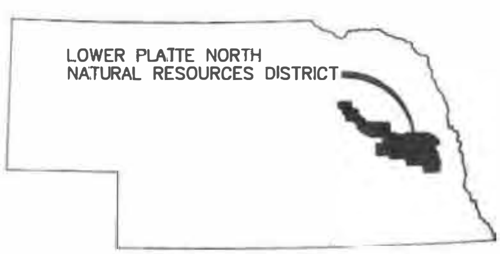
From; Engberg, "Appraisal of Data for Groundwater Quality in Nebraska" USGS, 1984

LOWER PLA'
NATURAL I
DIST



GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
III	– UPLANDS RESERVOIR
IV	– TODD VALLEY RESERVOIR



LOCATION

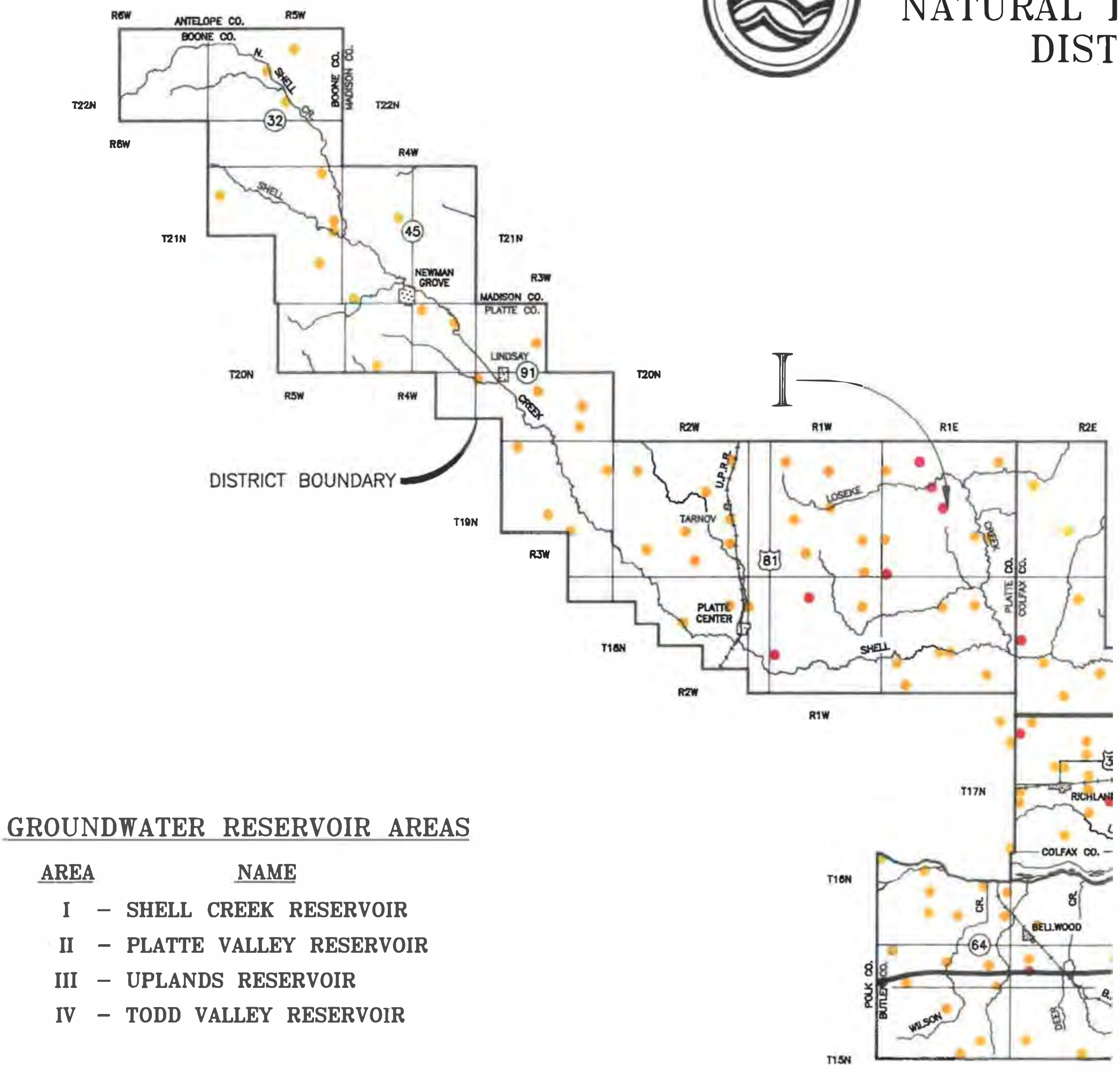
N

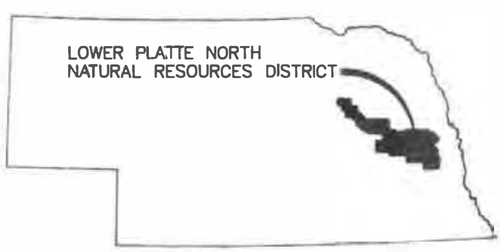
0 2 4 10 MILES
1 3 5
APPROXIMATE SCALE

Source: 1987 ·
Lower
Nebras
UN–L

HWS Consulting Group Inc.

LOWER PLA
NATURAL
DIST





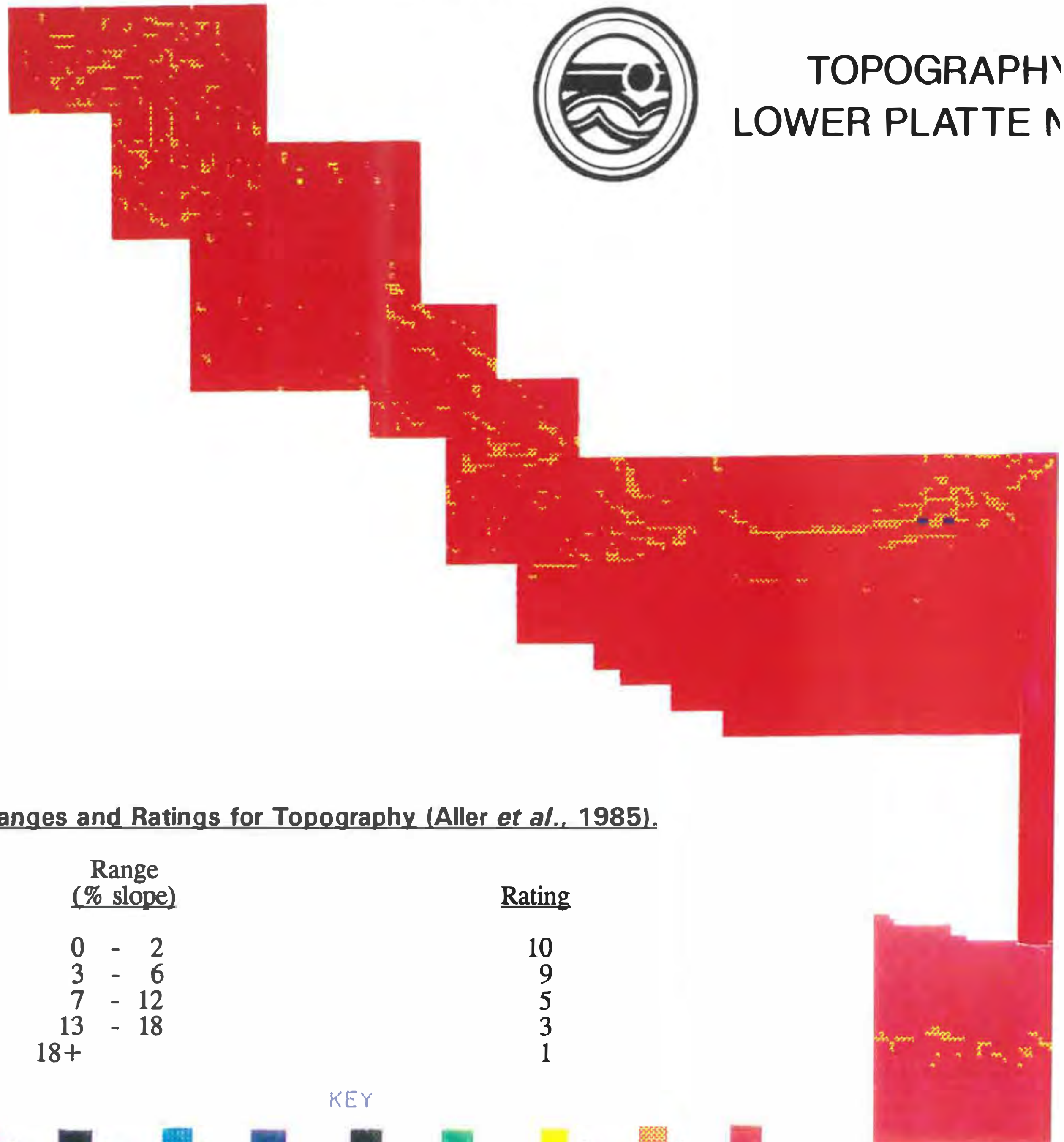
LOCATION

0 2 4 10 MILES
1 3 5
APPROXIMATE SCALE

Source: Lower Platte

HWS
Consulting Group Inc.

TOPOGRAPHY
LOWER PLATTE N



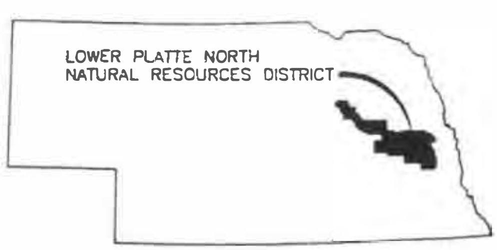
Ranges and Ratings for Topography (Aller *et al.*, 1985).

Range (% slope)	Rating
0 - 2	10
3 - 6	9
7 - 12	5
13 - 18	3
18+	1

KEY

1 2 3 4 5 6 7 8 9 10

Steep Slopes ⟷ Gentle to Flat



LOCATION

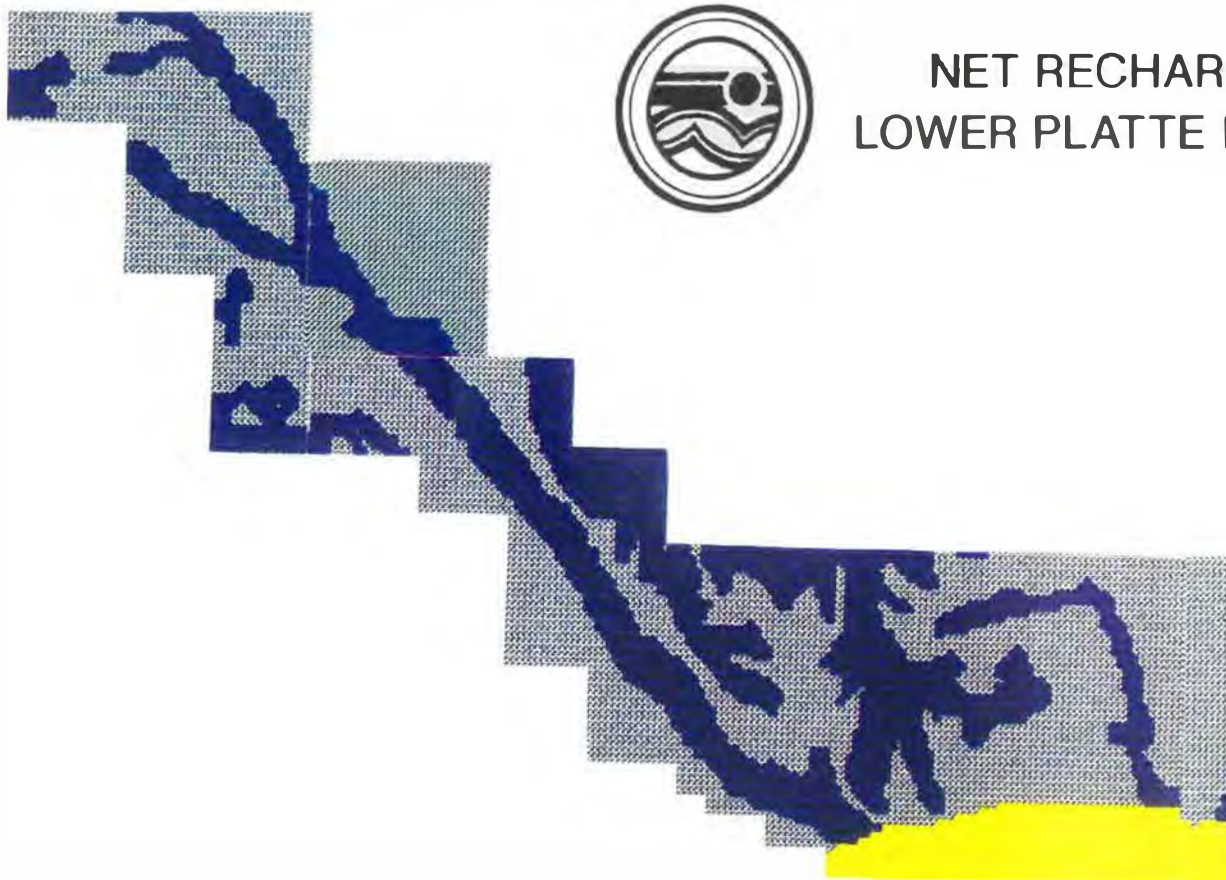
HWS Consulting Group Inc.

N

APPROXIMATE SCALE IN

0 2 4
1 3 5

NET RECHAR(
LOWER PLATTE N



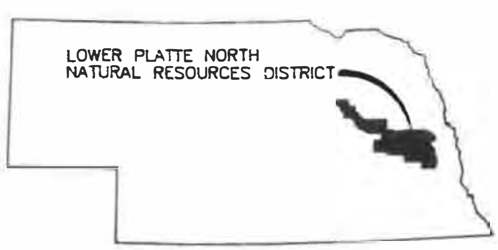
Ranges and Ratings for Net Recharge (Aller *et al.*, 1985).

Range (feet)	Rating
0 - 2	1
2 - 4	3
4 - 7	6
7 - 10	8
10+	9

KEY

1 2 3 4 5 6 7 8 9 10

Low ⟷ High



LOCATION

HWS Consulting Group Inc.

N

APPROXIMATE SCALE IN
0 2 4
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SOILS
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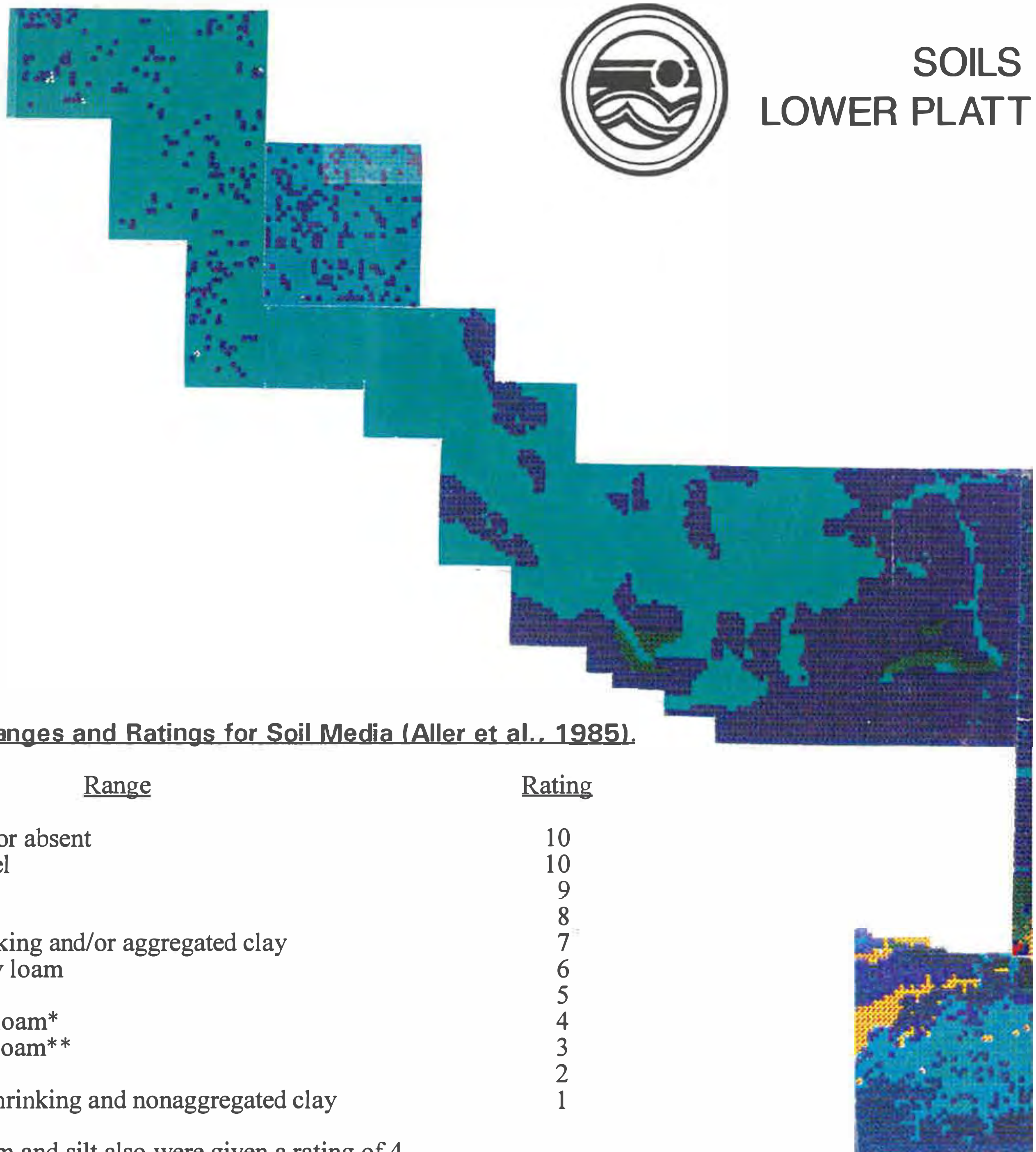


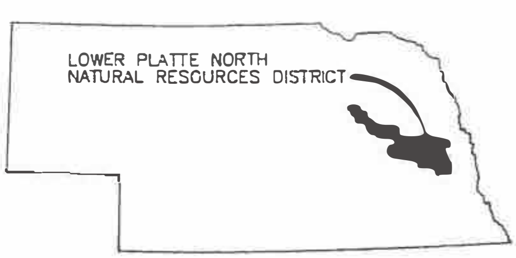
Table A-6. Ranges and Ratings for Soil Media (Aller et al., 1985).

Range	Rating
Thin or absent	10
Gravel	10
Sand	9
Peat	8
Shrinking and/or aggregated clay	7
Sandy loam	6
Loam	5
Silty loam*	4
Clay loam**	3
Muck	2
Nonshrinking and nonaggregated clay	1

*Sandy clay loam and silt also were given a rating of 4.
**Silty clay, sandy clay, and silty clay loam also were given a rating of 3.

KEY

1 2 3 4 5 6 7 8 9 10



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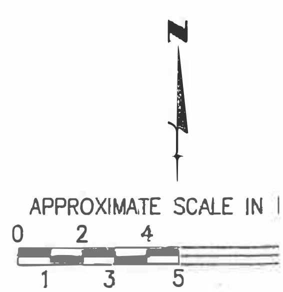

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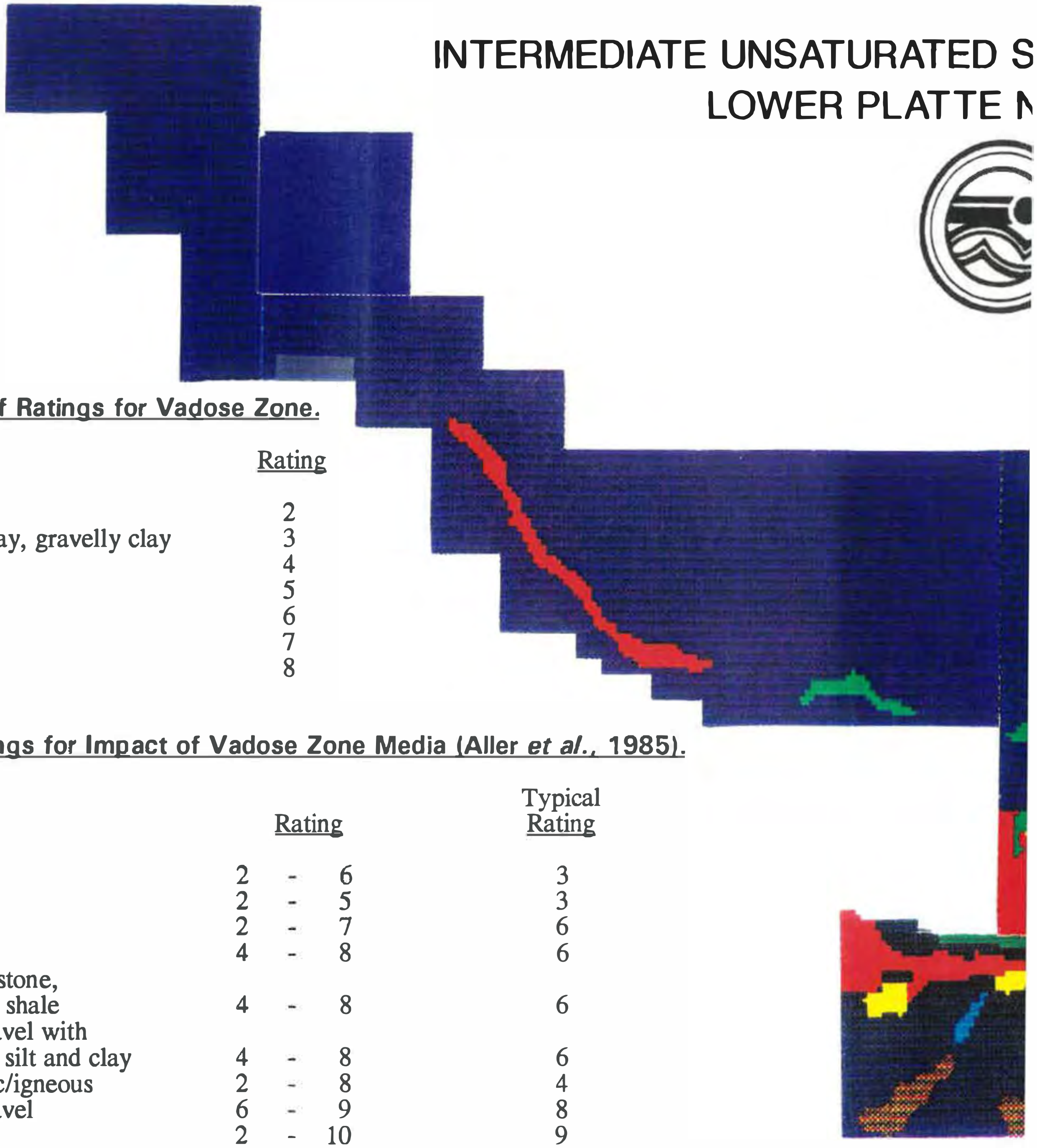


Assignment of Ratings for Vadose Zone.

Range	Rating
Clay	2
Silty clay, sandy clay, gravelly clay	3
Clayey silt	4
Silt	5
Sandy silt	6
Sand	7
Sand and gravel	8

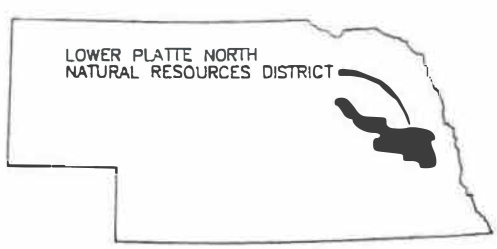
Ranges and Ratings for Impact of Vadose Zone Media (Aller *et al.*, 1985).

Range	Rating	Typical Rating
Silt/Clay	2 - 6	3
Shale	2 - 5	3
Limestone	2 - 7	6
Sandstone	4 - 8	6
Bedded limestone, sandstone, shale	4 - 8	6
Sand and gravel with significant silt and clay	4 - 8	6
Metamorphic/igneous	2 - 8	4
Sand and gravel	6 - 9	8
Basalt	2 - 10	9
Karst limestone	8 - 10	10

KEY

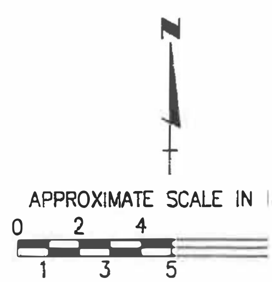
1 2 3 4 5 6 7 8 9 10

Thick ⟷ Thin



LOCATION

HWS Consulting Group Inc.



DEPTH TO WAT

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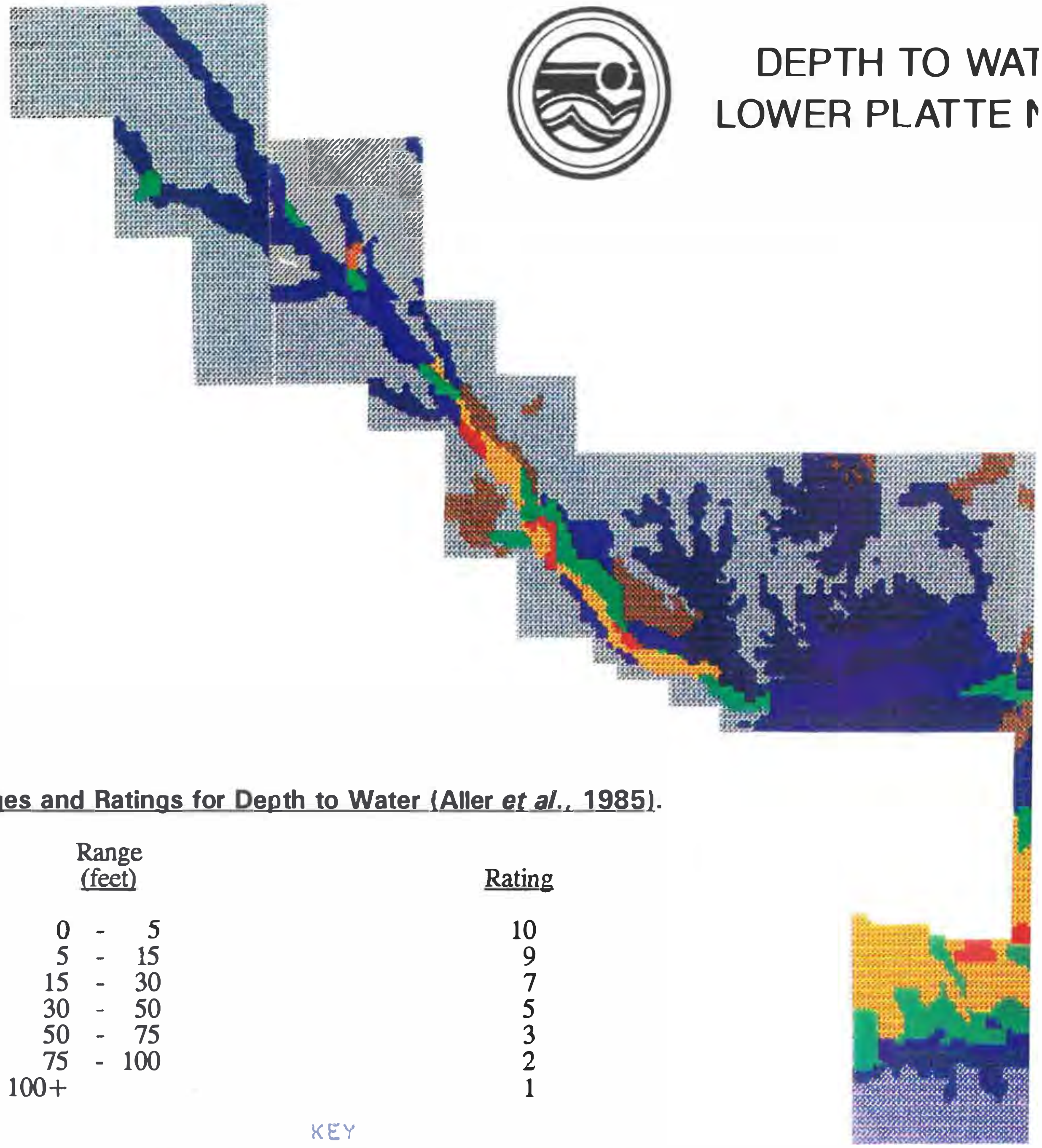
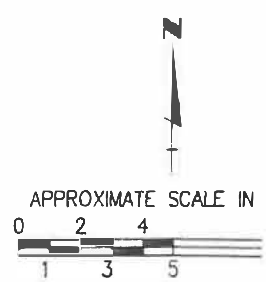
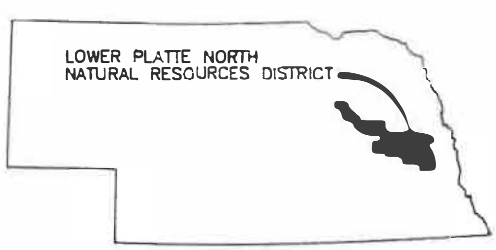


Ranges and Ratings for Depth to Water (Aller *et al.*, 1985).

Range (feet)	Rating
0 - 5	10
5 - 15	9
15 - 30	7
30 - 50	5
50 - 75	3
75 - 100	2
100+	1





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HWS Consulting Group Inc.

GROUNDWATER PO
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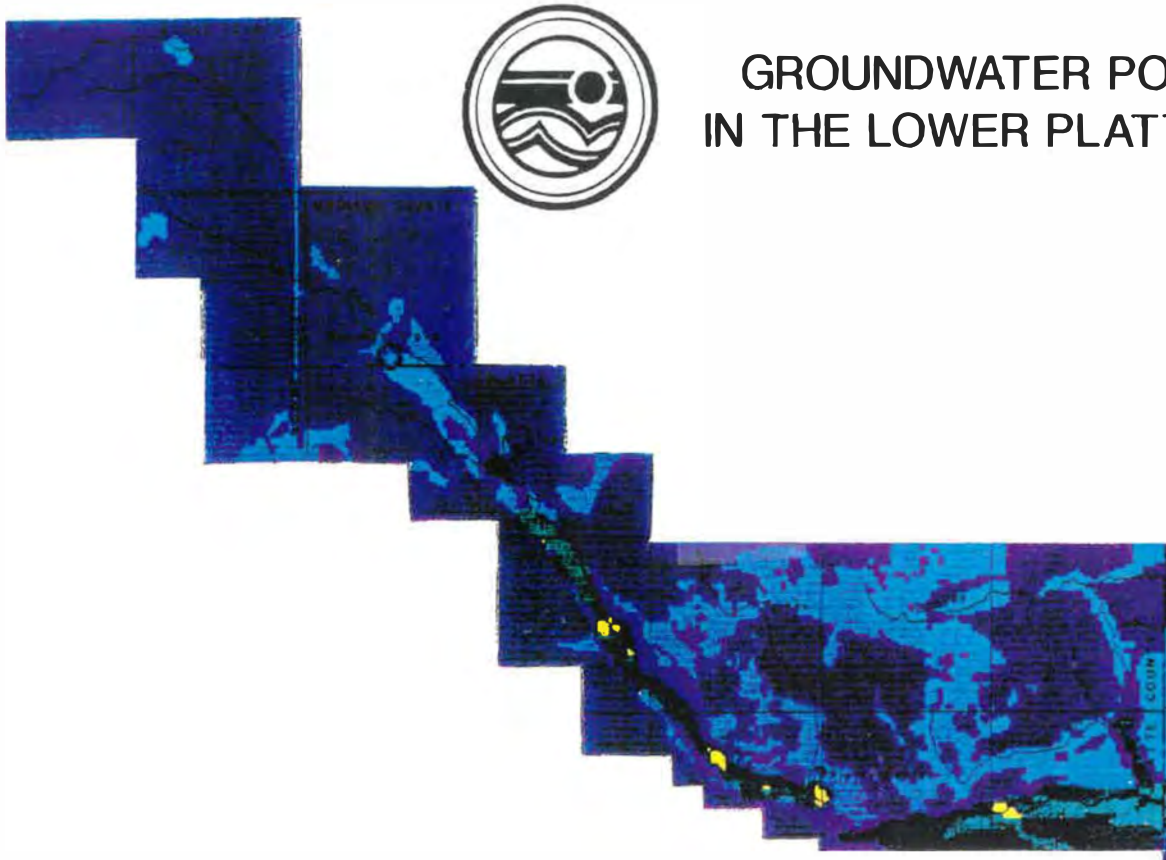
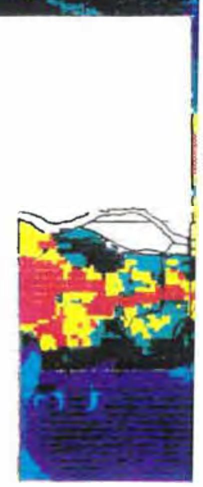
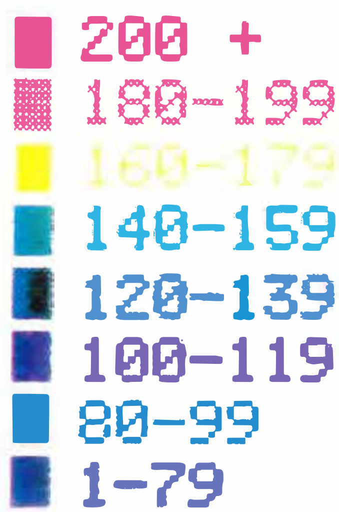




The DRASTIC Index is subdivided into eight ranges and each range is depicted by a different color. The warm colors, red, orange, and yellow, depict areas where the potential for contamination is highest. These are the areas with the highest DRASTIC Indices. The dark colors, royal blue, turquoise, and dark blue, portray areas least vulnerable to contamination and within these areas the corresponding DRASTIC Index is below 120. The greens represent the middle values between 120 and 159.



LOCATION

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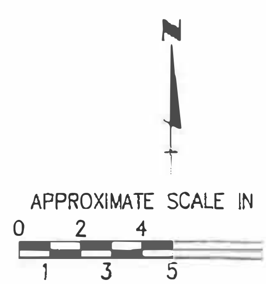
Consulting Group Inc.



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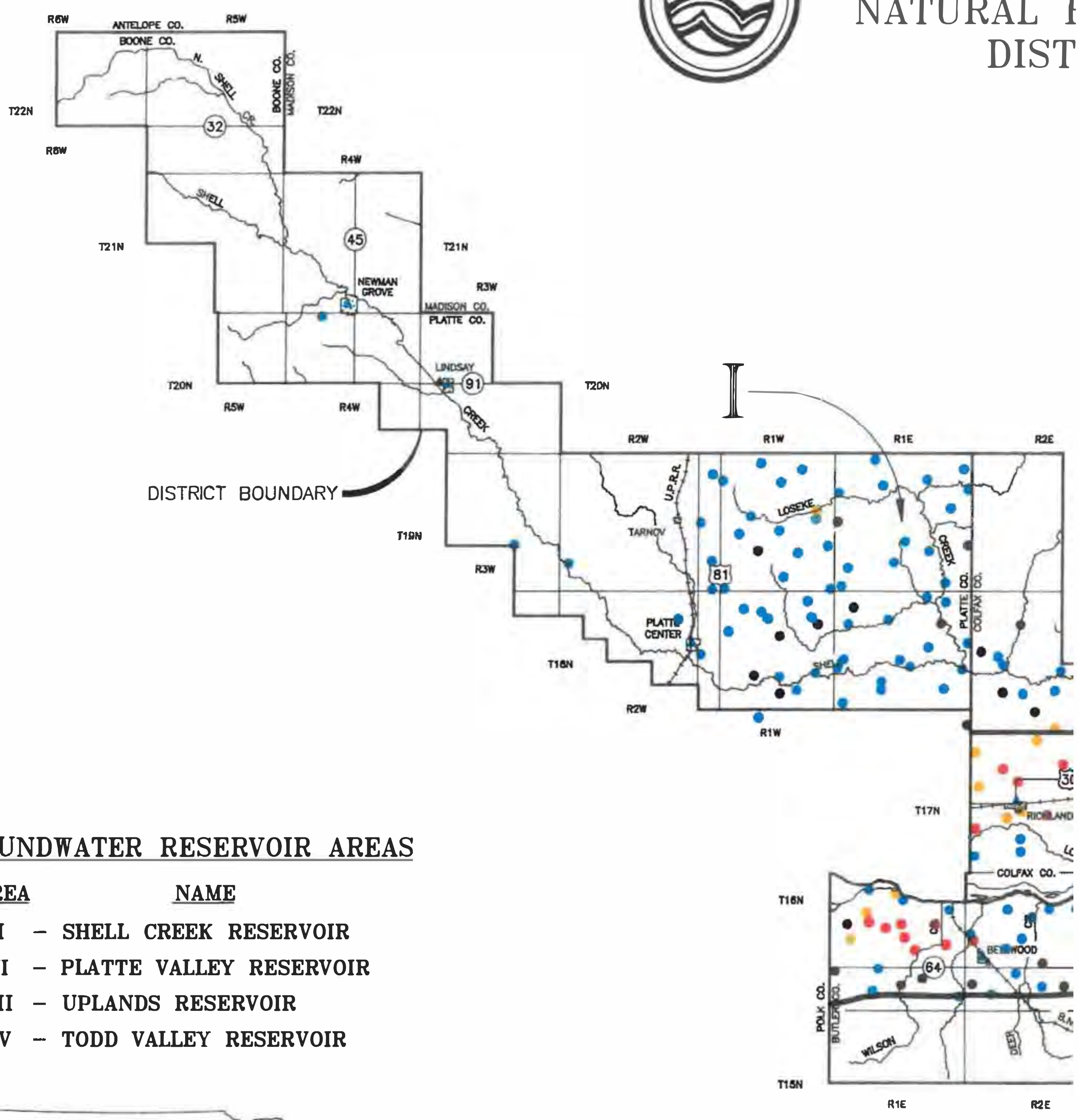
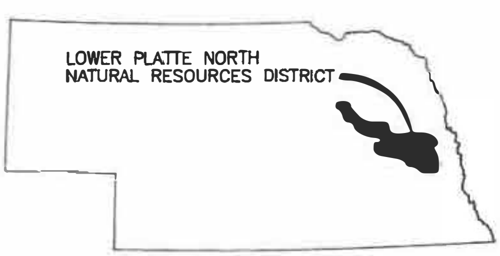
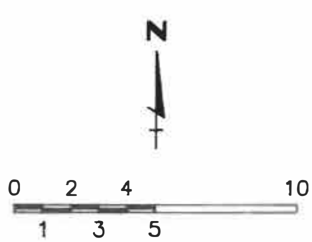


GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
III	– UPLANDS RESERVOIR
IV	– TODD VALLEY RESERVOIR



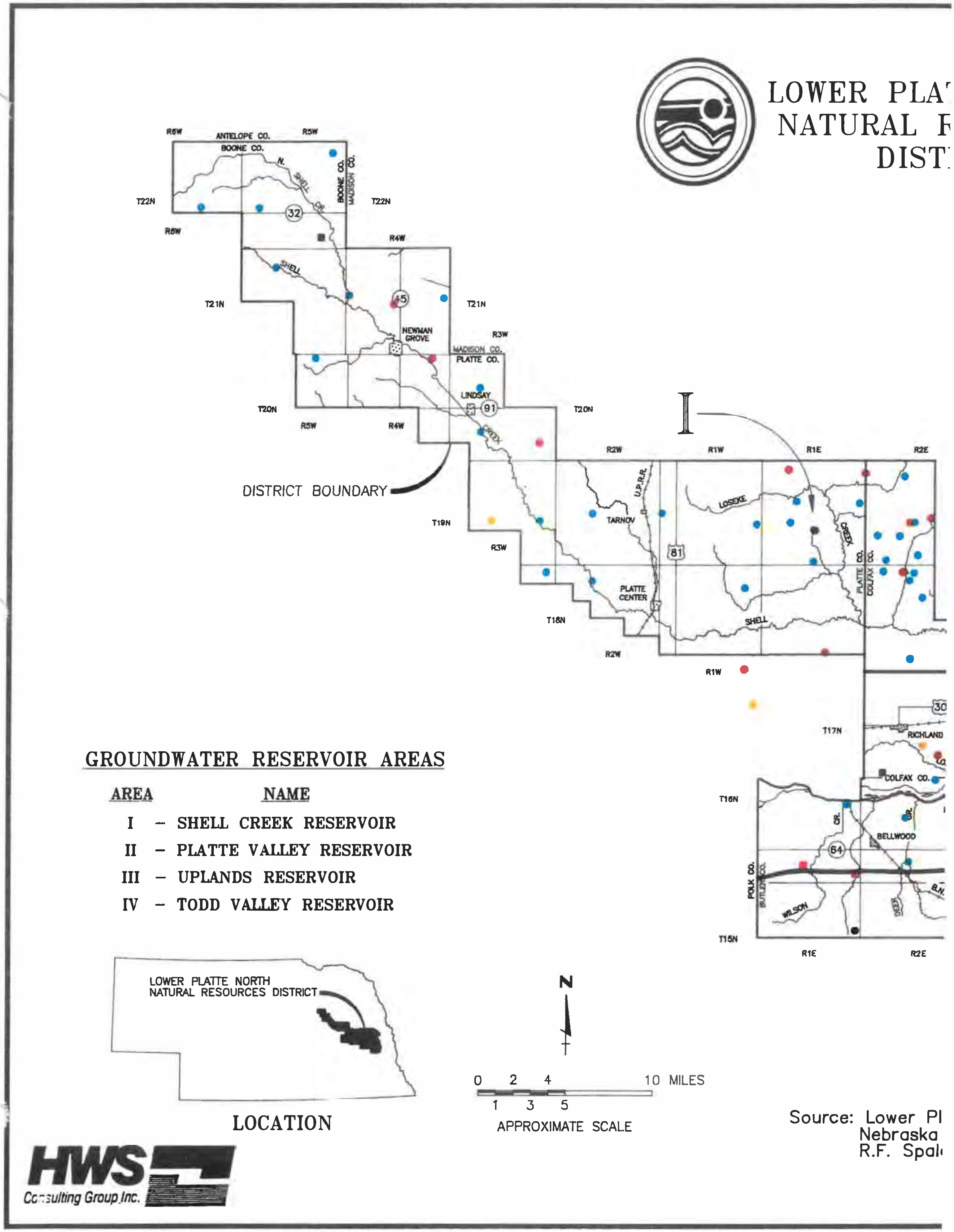
LOCATION



APPROXIMATE SCALE

Source: Lower Plat
Nebraska
R.F. Spald

HWS Consulting Group Inc.



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ANTELOPE CO.
BOONE CO.
BOONE CO.
MADISON CO.
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SHELL
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R5W
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R3W
R2W
R1W
R1E
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T20N
T19N
T18N
T17N
T16N
T15N
32
45
91
81
64
30
NEWMAN GROVE
MADISON CO.
PLATTE CO.
LINDSAY
CREEK
DISTRICT BOUNDARY
I
U.P.R.R.
TARNOV
LOSEKE
CREEK
PLATTE CO.
COLFAX CO.
PLATTE CENTER
SHELL
RICHLAND
COLFAX CO.
BELLWOOD
POLK CO.
BUTLER CO.
WILSON
DEER
B.N.
GROUNDWATER RESERVOIR AREAS
AREA NAME
I – SHELL CREEK RESERVOIR
II – PLATTE VALLEY RESERVOIR
III – UPLANDS RESERVOIR
IV – TODD VALLEY RESERVOIR
LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT
LOCATION
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0 2 4 10 MILES
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APPROXIMATE SCALE
Source: Lower Pl
Nebraska
R.F. Spal
HWS
Consulting Group Inc.

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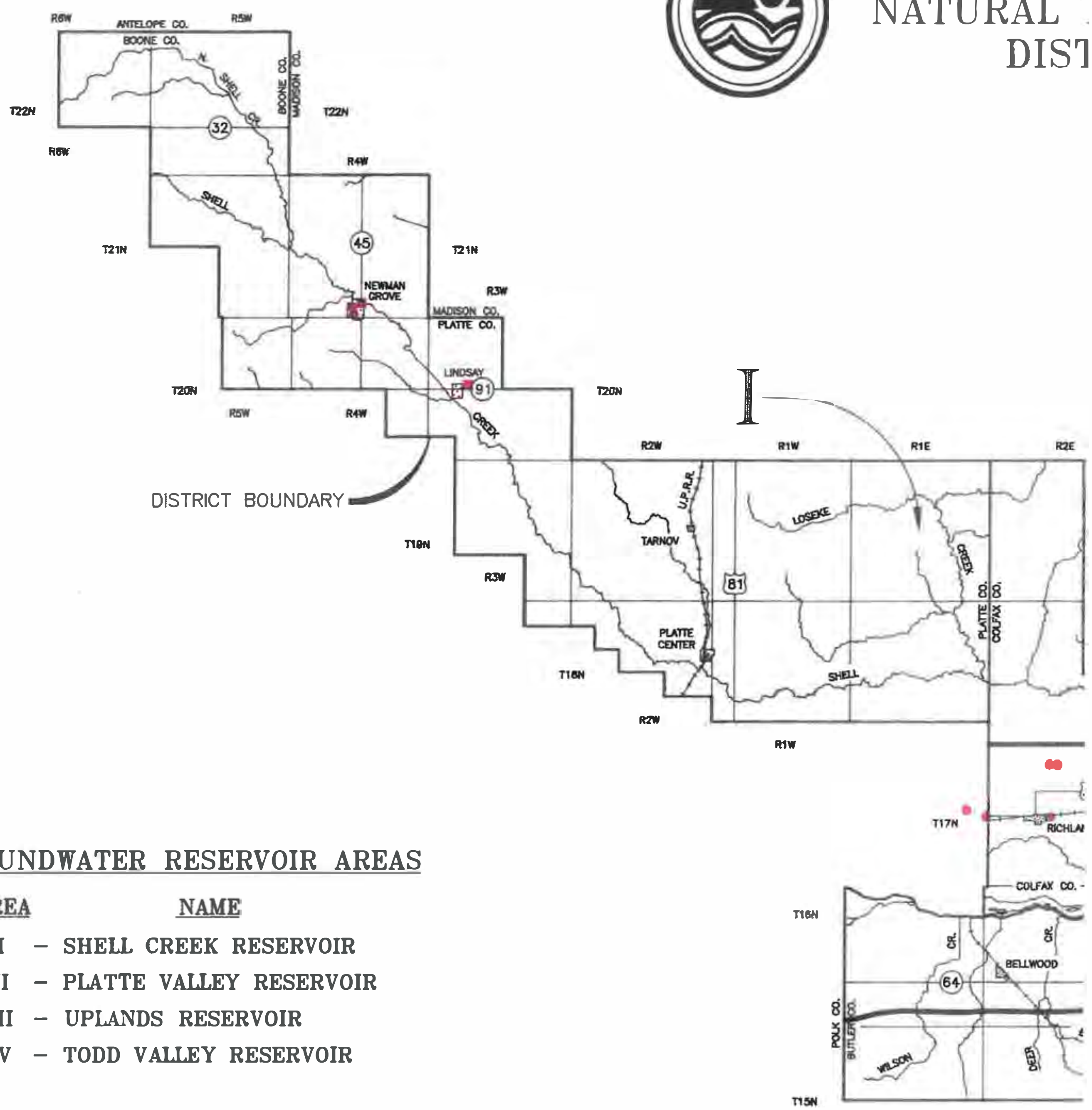
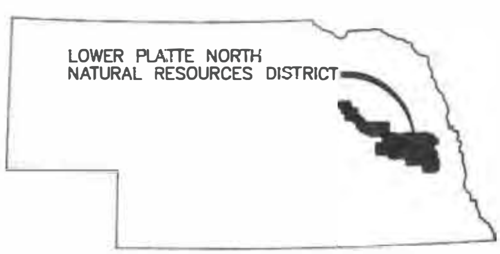


GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
III	– UPLANDS RESERVOIR
IV	– TODD VALLEY RESERVOIR



LOCATION

Source: Nebraska [
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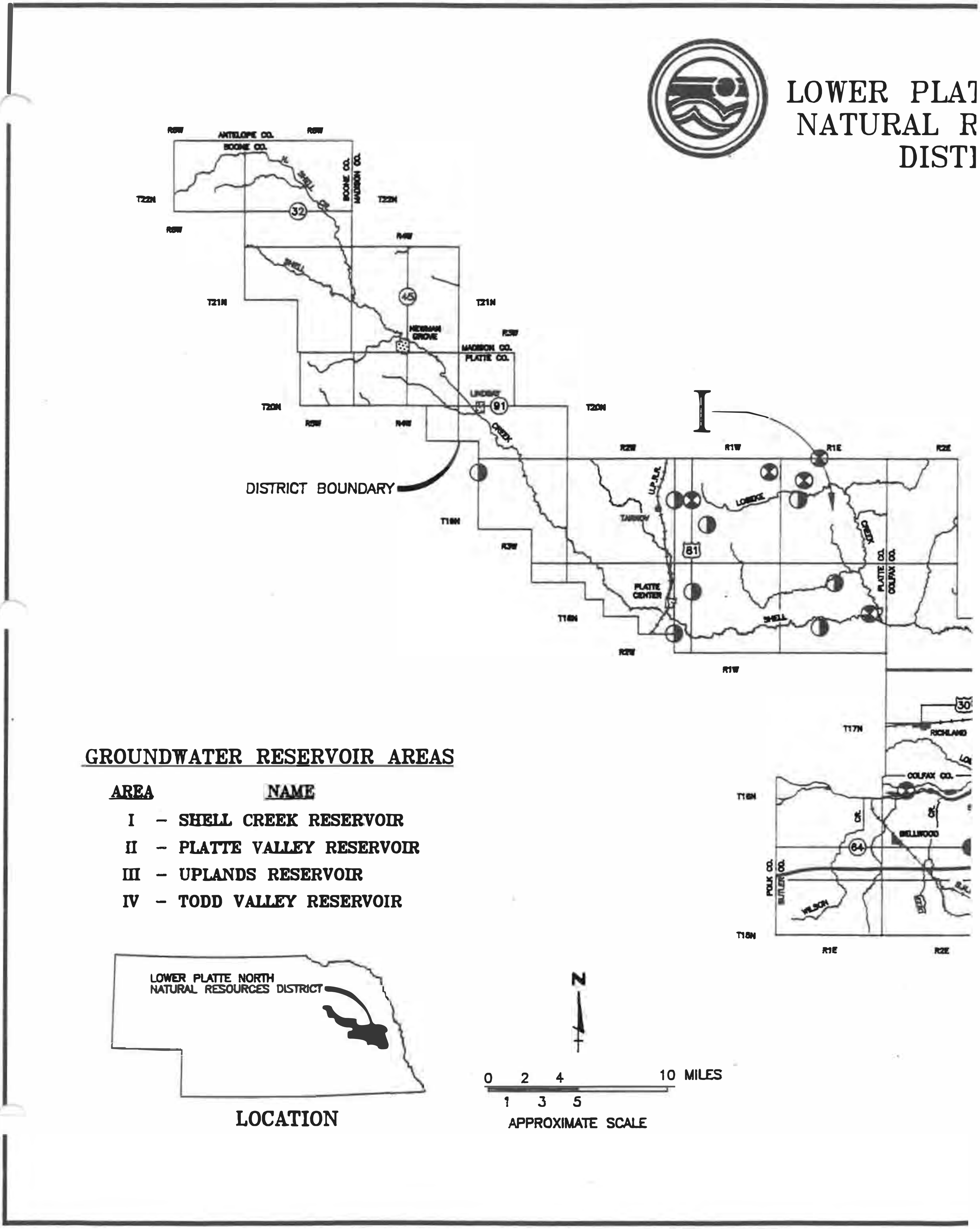
HWS Consulting Group Inc.



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DISTI
ANTELOPE CO.
BOONE CO.
MADISON CO.
SHELL CR.
NEWMAN GROVE
MADISON CO.
PLATTE CO.
LINDSAY
CREEK
DISTRICT BOUNDARY
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U.P.R.R.
PLATTE CENTER
SHELL
PLATTE CO.
COLFAX CO.
RICHLAND
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BELLWOOD
POLK CO.
BUTLER CO.
WILSON
T22N
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T16N
T15N
R5W
R4W
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R2W
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R1E
R2E
32
45
91
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GROUNDWATER RESERVOIR AREAS
AREA
NAME
I - SHELL CREEK RESERVOIR
II - PLATTE VALLEY RESERVOIR
III - UPLANDS RESERVOIR
IV - TODD VALLEY RESERVOIR
LOWER PLATTE NORTH NATURAL RESOURCES DISTRICT
LOCATION
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APPROXIMATE SCALE

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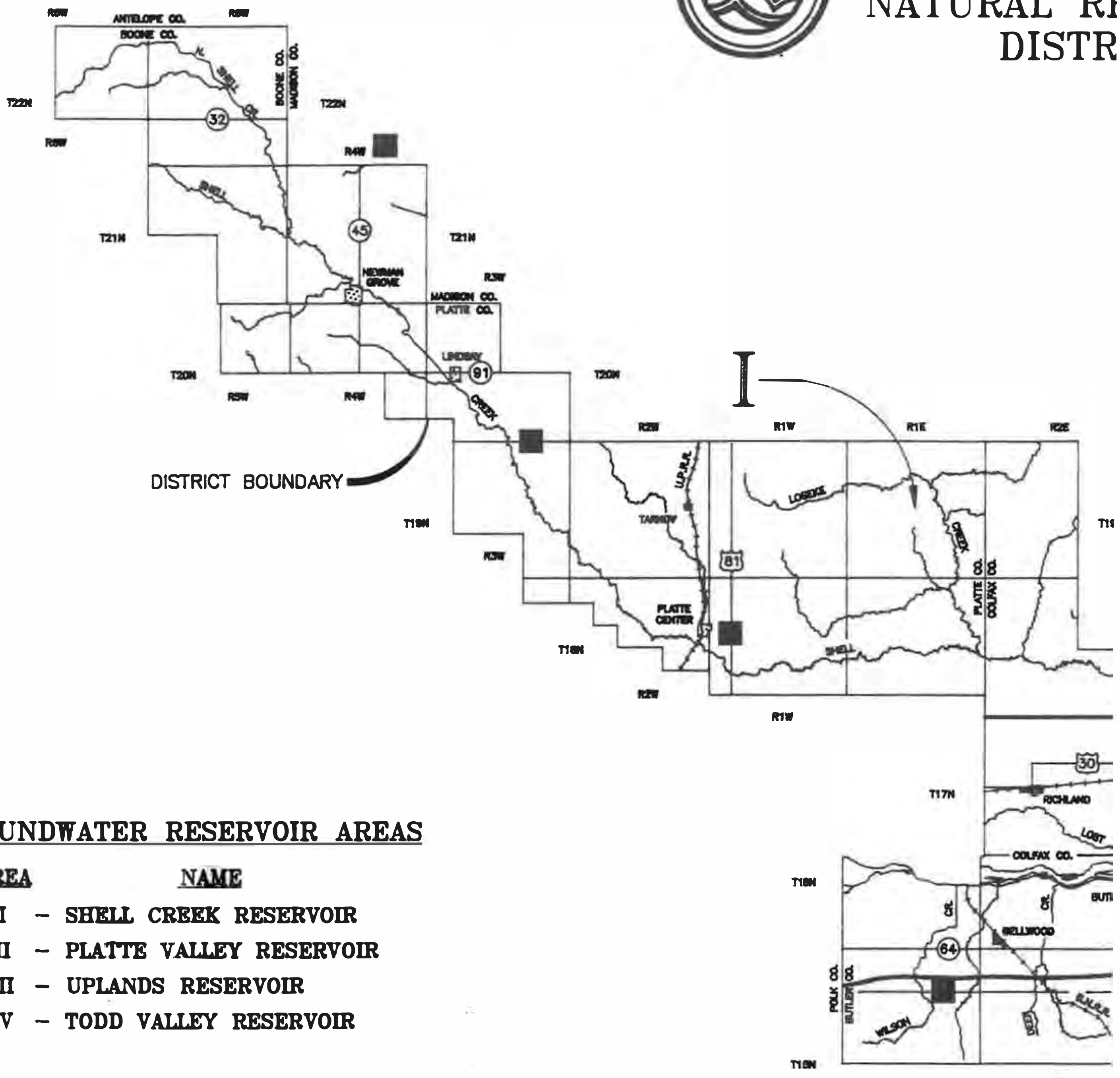
DISTR



GROUNDWATER RESERVOIR AREAS

AREA	NAME
I	– SHELL CREEK RESERVOIR
II	– PLATTE VALLEY RESERVOIR
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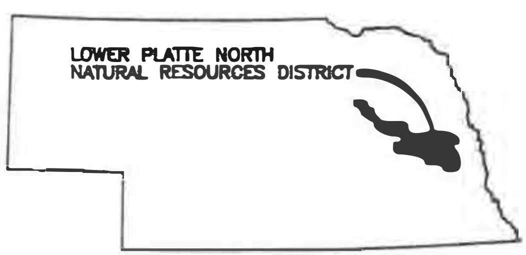
IV	– TODD VALLEY RESERVOIR



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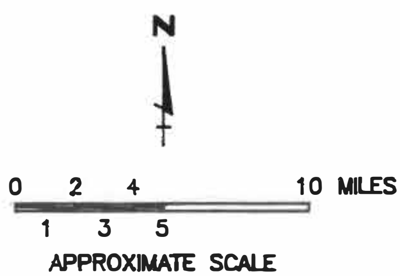

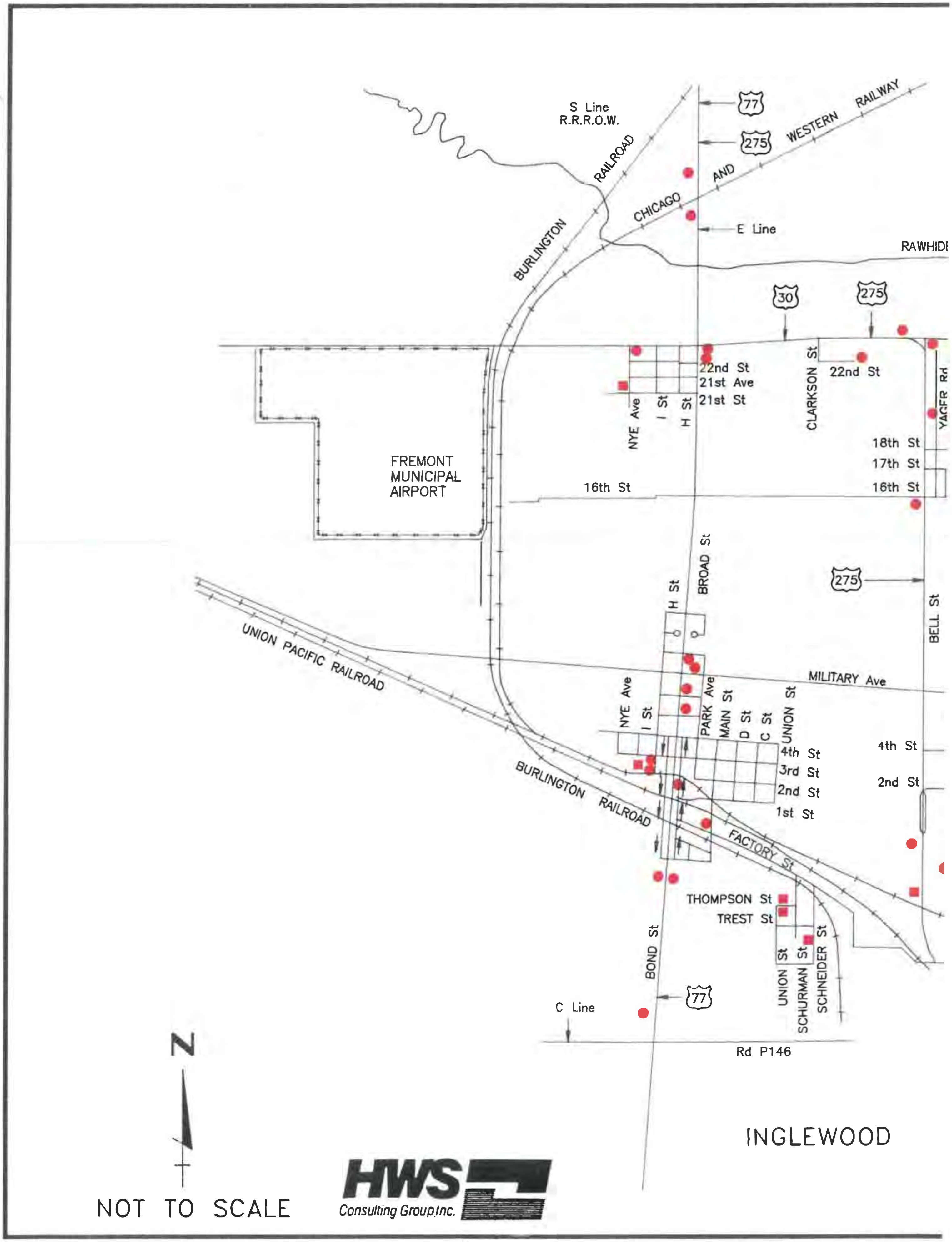
S Line R.R.R.O.W.
77
275
CHICAGO AND WESTERN RAILWAY
BURLINGTON RAILROAD
E Line
RAWHIDE
30
275
22nd St
21st Ave
21st St
NYE Ave
I St
H St
CLARKSON St
22nd St
YAGER Rd
18th St
17th St
16th St
16th St
FREMONT MUNICIPAL AIRPORT
BROAD St
H St
275
BELL St
UNION PACIFIC RAILROAD
MILITARY Ave
NYE Ave
I St
PARK Ave
MAIN St
D St
C St
UNION St
4th St
3rd St
2nd St
1st St
4th St
2nd St
BURLINGTON RAILROAD
FACTORY St
THOMPSON St
TREST St
BOND St
UNION St
SCHURMAN St
SCHNEIDER St
77
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INGLEWOOD
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NOT TO SCALE
HWS Consulting Group Inc.

APPENDIX B

STATE OF NEBRASKA

ROBERT KERREY • GOVERNOR • J. MICHAEL JESS • DIRECTOR

February 27, 1986

IN REPLY REFER TO:

Richard Sabata, Chairman
Lower Platte North NRD
P. O. Box 258
David City, Nebraska 68632

Dear Rich,

Along with four other state agencies, Lee Becker and I have reviewed your Board's Ground Water Management Plan. I am generally impressed with it and believe it should be approved. This letter is my approval.

Copies of the various agency review comments are enclosed for your reference and use. As for me, several of Dayle Williamson's comments echo my thoughts. To a degree, several items in Part VIII of the plan are vague. What significance should area residents see in relating three management planning areas to the numerous provisions narrated in Part VIII?

Your Board's plan is one of the most ambitious ones I have reviewed. You have my support and a wish for "good luck" in carrying out its provisions.

Sincerely,

DEPARTMENT OF WATER RESOURCES

J. Michael Jess
Director

JMJ:ch
Enclosures (4)
cc: Gordon Kissel
cc/enc: Jack Daniel
Vince Dreeszen
Dennis Grams
Dayle Williamson

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

DATE: February 19, 1986

TO: Lee Becker
Nebraska Department of Water Resources

FROM: Bob Kuzelka

RE: Review of the Lower Platte North NRD Groundwater Management Plan

The rationale for setting a goal time frame of the "foreseeable future" which is neither finite or infinite was a lack of "data base information." For this plan to be acceptable, the district must identify when such a time frame will be set. They do not do this. On page 119 in the items 1.3 and 1.4 they approach such a point, but do not commit themselves to setting a time frame. Aside from this major problem the policy section of the report is quite comprehensive and well thought out.

A major technical problem with this plan is the definition of what is the district's principal aquifer and whether or not the Dakota is part of it. The principal aquifer can be defined as the district wants, however it must be consistent. Well yield is not a meaningful basis for determining how much water can be taken from an aquifer. It is a site specific parameter. The Plan confuses well yield with other hydrogeologic parameters. Transmissivity and saturated thickness are more useful as regional parameters. The discussion on pages 65 and 66 under section c makes medical statements on cancer causes and comments on the correlation between nitrate levels and pesticides and herbicides without references to information sources. Such sources should be cited.

The plan divides the NRD into three potential management areas. This concept is not developed nor even referenced in the policy section of the plan.

STATE OF NEBRASKA

ROBERT KERREY • GOVERNOR • GREGG F. WRIGHT, M.D., M.Ed. • DIRECTOR

Water & Waste Water Section 402 471-2541

February 13, 1986

Mr. H. Lee Becker, P.E.
State Hydrologist
Dept. of Water Resources
P.O. Box 94676
Lincoln, NE 68509

Dear Lee:

The Groundwater Management Plan for the Lower Platte North Natural Resources District has been reviewed. The following comments are offered for your consideration:

1. Groundwater contamination resulting from manufacturing and commercial activities have adversely affected the municipal wells in Lindsay, Bruno, Morse Bluff, and Mead. Contamination sources involve acid waste disposal, petroleum waste, volatile organic chemical, and nitrate fertilizer handling. It should be recognized that similar situations could occur in any community that permits incompatible land uses to encroach on protected well locations.

2. It is our understanding that the Department of Defense plans a groundwater investigation in an area that might have been affected by storage operations south and east of Mead. It is possible the contamination from this area could influence the quality of water used by the City of Lincoln as a source of supply.

Thank you for the opportunity of commenting on this plan.

Sincerely,

Jack L. Daniel, Director
Env. Health & Hsng. Surveillance

JLD/cvw

STATE OF NEBRASKA
NATURAL RESOURCES COMMISSION
301 CENTENNIAL MALL SOUTH • P.O. BOX 94876 • LINCOLN, NEBRASKA 68509-4876 • PHONE (402)471-2081

February 13, 1986

Mr. H. Lee Becker
State Hydrologist
Department of Water Resources
P.O. Box 94676
Lincoln, Nebraska 68509-4676

Dear Lee:

We have completed our review of the Lower Platte North Groundwater Management Plan, 1985. We believe the plan ought to be approved by the Department of Water Resources. For the most part the plan is quite well done. Two particular strengths lie in the thoroughness of the information about the groundwater supply and the extent of the commitment made by the NRD for future activity. However, we do believe the plan is subject to improvement. Some suggestions are noted below.

1. The plan could address the items required by statute in a more thorough manner.

The plan makes at least some reference to each of the 15 items required by the statute, but treatment of a few of the items is minimal. Included is information regarding item (5), relating to crop water needs; item (9), as it relates to supply augmentation programs; item (10), relating to the availability of supplemental water supplies; item (11), concerning the opportunities to integrate and coordinate different water sources; and item (15), relating to the relative economic values of different groundwater uses. However, we believe the coverage provided is sufficient for approval of the plan at this point, especially considering the fact that no groundwater management or control areas are now proposed.

The manner in which the groundwater reservoir life goal is stated is confusing. The terms "perpetual" and "foreseeable future" are both used in the goal. The narrative portions of the plan suggest that the district may not have intended a goal of perpetuity and also that it intends, with additional data collection, to eventually establish a goal for a finite period of time. Since the district seems to place more importance on the "foreseeable future" part of the goal for now, the plan could conceivably be disapproved as being inconsistent with statutory requirements. Our opinion is that the manner in which the goal has been structured to include the term "perpetual" makes it statutorily sufficient, even if somewhat confusing.

2. In some instances the plan could better project future problems and better define programs or actions to deal with the problems.

The plan mentions one source of information on potential quantity problems, but rejects it as being inadequate. However, this information and other projections indicate there is a potential problem. The NRD has outlined a system for identifying problems in the future, but they do not indicate how they would deal with those problems.

The plan does not specify any criteria, or "trigger mechanisms" for consideration of management areas. It has numerous proposed programs to accomplish the goals and policies, but many of these programs are too general to show what is intended. Several work items hint at promotion of fertilizer management practices, but this topic isn't specifically addressed. There also are many other work items that say they will "develop" or "study" something. Some effort should be made to assess the cost and assign priorities to these activities, because some of the studies will be very expensive.

In spite of missing some of the key items mentioned above, the district has done a thorough job of identifying action items for the future. The implementation time schedule on pages 124 and 125 is an excellent idea in that it can produce a definite district commitment to the goals and objectives set forth. Although some of the individual action items are not sufficiently specific, the detail necessary will be added in the near future if the district maintains its stated time table.

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 E. Williamson
Director of Natural Resources

STATE OF NEBRASKA
ROBERT KERREY • GOVERNOR • DENNIS GRAMS • DIRECTOR

February 12, 1986

RECEIVED
FEB 13 1986
DEPARTMENT OF WATER RESOURCES

RECEIVED
Lower Platte North
N.R.D.

Mr. Lee Becker, State Hydrologist
Department of Water Resources
P.O. Box 94676
Lincoln, NE 68509

Dear Mr. Becker:

The Department has reviewed the Lower Platte North Natural Resources District Ground Water Management Plan and offers the following comments.

The reference "Conservation and Survey Division, 1980" listed in preparation of Figure 20 is titled in the list of references (page 126) as "General Soil Map of Fremont Area - Nebraska." Is that correct? Also, the reference "Freeze and Cherry, 1979" mentioned on page 49 needs to be added to the reference list.

The last paragraph under section C. Groundwater Quality states the need for ground water quality monitoring at the UNL experimental station at Mead because of the potential for contamination of well fields adjacent to the Platte River. However, the potential threat to wells along the Platte River is not as great as that to wells closer to or adjacent to the Field Lab. A map showing the location of the Field Lab with respect to municipal supply wells in the area would be helpful.

If you have any questions regarding these comments, please contact Gale Hutton, Water Quality Division Chief.

Sincerely,

Dennis Grams

Dennis Grams, P.E.

BR/krs

City of Lincoln County/City Building Lincoln, Nebraska 68508 Telephone (402) 471-7171 Roland A. Luedtke, Mayor

LINCOLN

DEPARTMENT OF PUBLIC WORKS DEPARTMENT OF PUBLIC UTILITIES

December 18, 1985

Mr. Raymond L. Hartung
General Manager
Lower Platte North Natural Resources District
North Hiway 15
David City, NE 68632

re: Lower Platte North NRD -
Groundwater Management Plan

Dear Mr. Hartung:

The Lincoln Water System greatly appreciates having had the opportunity to review your draft Groundwater Management Plan. The Lincoln Water System concurs with your District's foresight and desire for protecting Nebraska's groundwater by setting forth a goal in your management plan which would provide for a perpetual groundwater reservoir, addressing both quantity and quality of this natural resource.

As a significant user of groundwater within your District, the Lincoln Water System would offer the following comments, questions, and/or concerns:

1. If conditions arise necessitating the implementation of a groundwater control area, to whom would fall the responsibility of setting the limits on water use for each entity in a control area? What types of priorities will be set forth for water use within those control areas? Recommend that the "municipal water use" should have the same priority as "domestic water use".

2. We are interested in working with not only the Lower Platte North but also the Lower Platte South and Papio Districts in developing a systematic meeting process on groundwater management. A coordinated groundwater management and monitoring plan would provide us the necessary and pertinent data to assure that the existing groundwater reservoirs are being properly managed. One of the areas in which we would have an interest in working with the districts would be in setting up a monitoring well system. There are some monitoring wells in existence in our wellfields at the Ashland facility. We would be interested and willing to work with the NRD's, NRC, and USGS to:

a) establish a systematic and properly spaced series of monitoring wells within our facility and throughout the District,

b) accurately gauge groundwater levels,

c) adequately monitor the quality of the groundwater throughout the Todd Valley.

4. We are interested in several technical aspects of the monitoring program or management system such as:

a) What type of criteria will be implemented to monitor the management of the district?

b) Adequate control of chemigation is necessary. Chemical application to surrounding farm ground should be monitored. A positive assurance that these chemicals are not being fed directly back into the groundwater reservoir can be provided through the use of a "reduced pressure backflow preventor"

c) What type of production or irrigation well spacing might be recommended?

d) What regulations will be implemented to determine:

1) Proposed withdrawal allocations

2) Type of measurement in the various irrigation wells

3) Irrigation scheduling, etc. in groundwater control areas?

We will join with any municipality (such as Omaha or Fremont) or State agency that has an interest in working together for the common purpose of managing and protecting our most important natural resource in the state, water.

I thank you for the opportunity to review your plan and look forward to working with you in the future.

Sincerely,

Jerome G. Obrist
Chief Engineer of Water Works

RF/JGO/CSD323

cc: R. Erixson
B. Michaelson
R. Figard
G. DeFoil

LOWER PLATTE NORTH Natural Resources District
North Highway 15, David City, Nebraska 68632 - Phone (402) 367-3103

January 21, 1986

Mr. Jerome G. Obrist
Chief Engineer of Water Works
Department of Public Utilities
County/City Building
Lincoln, NE 68508

RE: Lower Platte North NRD
Groundwater Management Plan

Dear Mr. Obrist:

I thank you for your letter concerning the Lower Platte North NRD Groundwater Management Plan, and shall attempt to answer your questions as best I am able.

(1) Who would set limits on water use in a control area?

The Lower Platte North NRD Board of Directors would set the limits with concurrance of the State Department of Water Resources. The district would also work with all involved.

(2) What types of priorities will be set forth for water use within those control areas?

We cannot answer this until the problems are known and the alternate type measures of control or management are determined.

Your recommendation concerning municipal and domestic water use priority would be given considerable discussion.

(3) Item number 2 of your letter expressed an interest in working together to; arrange systematic meetings on groundwater management; establish a systematic and properly spaced series of monitoring wells; accurate gauging of groundwater levels; and adequately monitor the quality of the groundwater in the Todd Valley.

The systematic meeting on groundwater is a necessity. I think the Lower Platte South NRD is presently arranging such an organizational meeting.

The staff is now in the process of establishing both a groundwater level and a groundwater quality monitoring network. Most of the groundwater level wells have been sampled for the past season. This coming summer will be the beginning of the water quality network sampling.

(4) What type of criteria will be implemented to monitor the management of the district (technical aspects of the monitoring program)?

We have been working with the U.S. Geological Survey and the Department of Environmental Control to develop the most equitable system that will provide meaningful results. Exact criteria or chemical constituents have not been determined.

(5) What type of production or irrigation well spacing might be recommended? and What regulations will be implemented?

I cannot answer these questions at the present time. A problem must first be defined, it cause determined and then corrective measures will be implemented.

I hope this provides some answers to your questions and look forward to your comments on program development. It is essential that all agencies and groups work together to develop proper programs.

Sincerely,

Raymond L. Hartung,
General Manager

C: Glen Johnson, LPSNRD
Jerry Wehrspann, Papio NRD

bp

APPENDIX C

DEFINITION OF GROUND WATER - RELATED TERMS

Aquifer - a water-bearing stratum of rock or sediment capable of yielding supplies of water.

Aquifer, Confined (or Artesian) - an aquifer overlain by a low permeability layer or layers, in which pressure head will force water to rise above the aquifer in which it is contained.

Aquifer, Perched - an aquifer containing unconfined ground water separated from an underlying body of ground water by an unsaturated zone.

Aquifer, Principal - the aquifer or combination of related aquifers in a given area which is the important economic source of water to wells--has been used, perhaps inaccurately, as synonymous with ground water reservoir.

Aquifer, Secondary - any aquifer other than the principal aquifer that is not the main source of water to wells in a given area e.g. includes perched aquifers, the Chadron Formation, the Dakota Sandstone in some areas, and several Paleozoic units.

Aquifer, Unconfined (or Water Table) - an aquifer in which the upper limit is the water table rather than an impermeable layer.

Bedrock - sequences of consolidated rock which outcrop at the surface or which underlie unconsolidated earth materials.

Chemigation - the application of crop nutrients or pesticides through an irrigation system.

Ground Water - water occupying voids within the saturated zone of a geologic stratum. This saturated zone is to be distinguished from an unsaturated or aeration zone where voids are filled with water and air.

Ground Water Model - a model designed to represent a simplified version of an actual, complex ground water system; may be mathematical or physical.

Hardness - the amount of certain dissolved minerals in water. Carbonate hardness refers to the hardness caused by calcium and magnesium bicarbonate; noncarbonate hardness is caused by calcium sulfate, calcium chloride, magnesium sulfate, and magnesium chloride in water.

Head - the height of a column of water, supported by static pressure, above a standard datum (usually mean sea level).

Hydraulic Conductivity - the capacity of a porous material to transmit water under a unit hydraulic gradient through a unit area. A measure of an aquifer's ability to transmit water.

Hydrograph - a graph which illustrates a specific hydrologic parameter such as water level, discharge, or velocity as a function of time.

Irrigation Efficiency - the rate at which water enters the soil under specified conditions.

Leaching - the downward transport of dissolved minerals in a soil by percolating water.

Loess - a wind deposited silt having little or no stratification.

Non-Point Source Pollution - pollution from diffuse sources where no one point of release can be identified.

Operator - shall mean that person having the most direct control over the day to day farming operation of the land concerned.

Parts Per Million (ppm) - a measure of the concentration of dissolved material in terms of a weight ratio. Roughly equivalent to milligrams per liter (mg/L).

Percolation - the downward movement of water through soil or other earth materials.

pH - a logarithmic measure of the relative acidity of water. Below 7 is increasingly acidic, 7 is neutral, and above 7 is increasingly alkaline (basic).

Piezometric (Potentiometric) Surface - the upper level to which a water level rises in a tightly cased well.

Point Source Pollution - pollution from discrete, identifiable locations which can usually be measured directly or otherwise quantified.

Pollution - the process of contaminating air, water, and land with impurities to a level that is undesirable.

Porosity - the proportion, commonly stated as a percentage, of the total volume of a rock material that consists of pore space or voids.

Precipitation - water in the form of hail, mist, rain, sleet, or snow that falls to the earth's surface.

Pressure Head - the height of a column of water which can be supported by the pressure at a given point.

Recovery of a Pumped Well - the rise of a water level in a well towards its pre-pumping elevation, which occurs after pumping ceases.

Reservoir (Ground Water) - for any given area the subsurface storage space between the water table and the base of the principal aquifer--includes one or more aquifers and any associated fine-grained material (usually excludes any perched aquifer).

Soil - the upper layer of earth which can be cultivated and in which plants grow.

Static Water Level - the water level in a well before pumping occurs.

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

Unsaturated Zone - porous earth materials which contain both air and water in their pore spaces. Sometimes called the vadose zone.

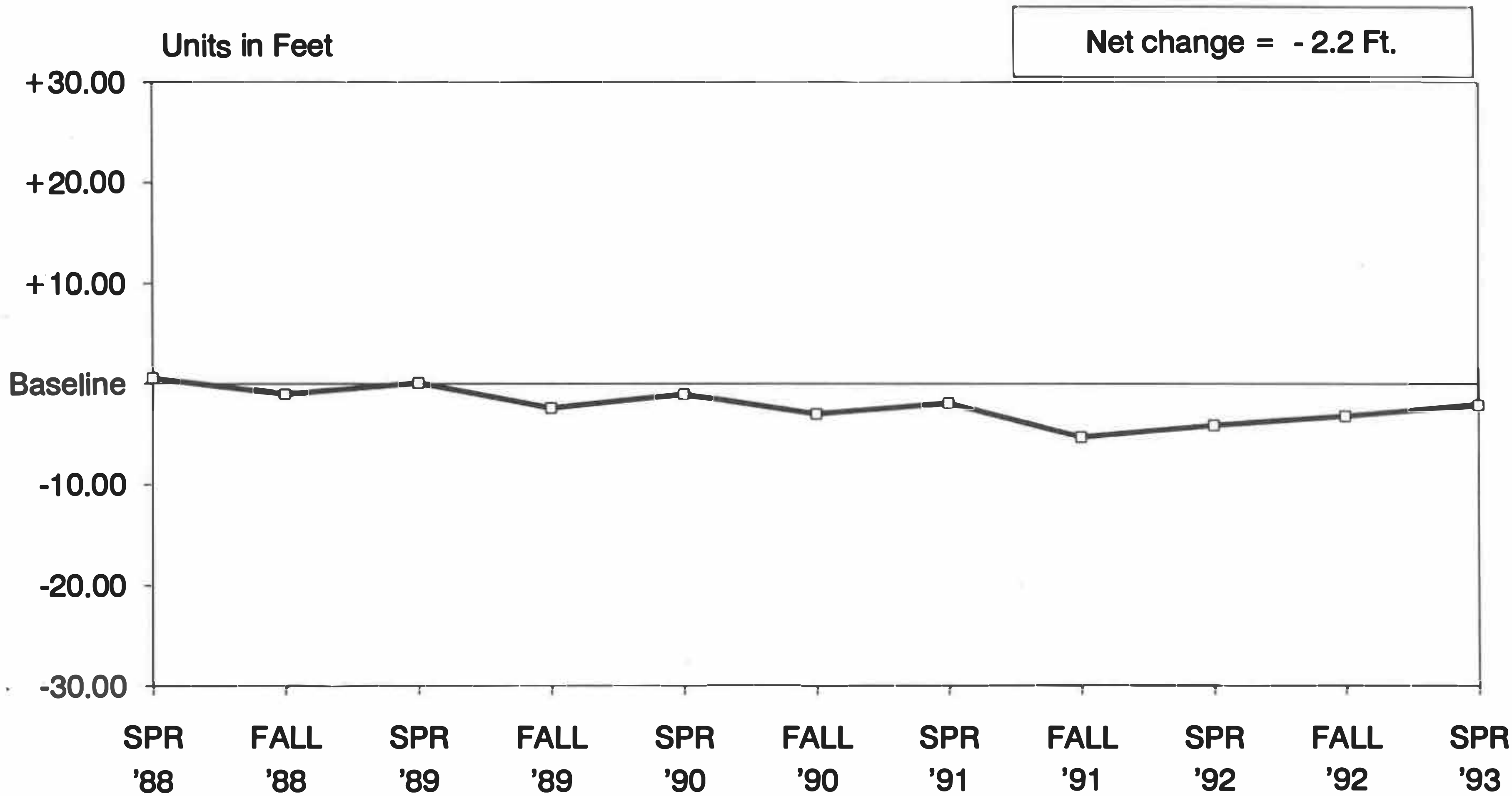
Vadoze Zone - the unsaturated zone below the land surface and above the water table.

Water Table - the level below which the subsurface is saturated with water and at which the pressure head equals atmospheric pressure. A parameter associated with unconfined aquifers.

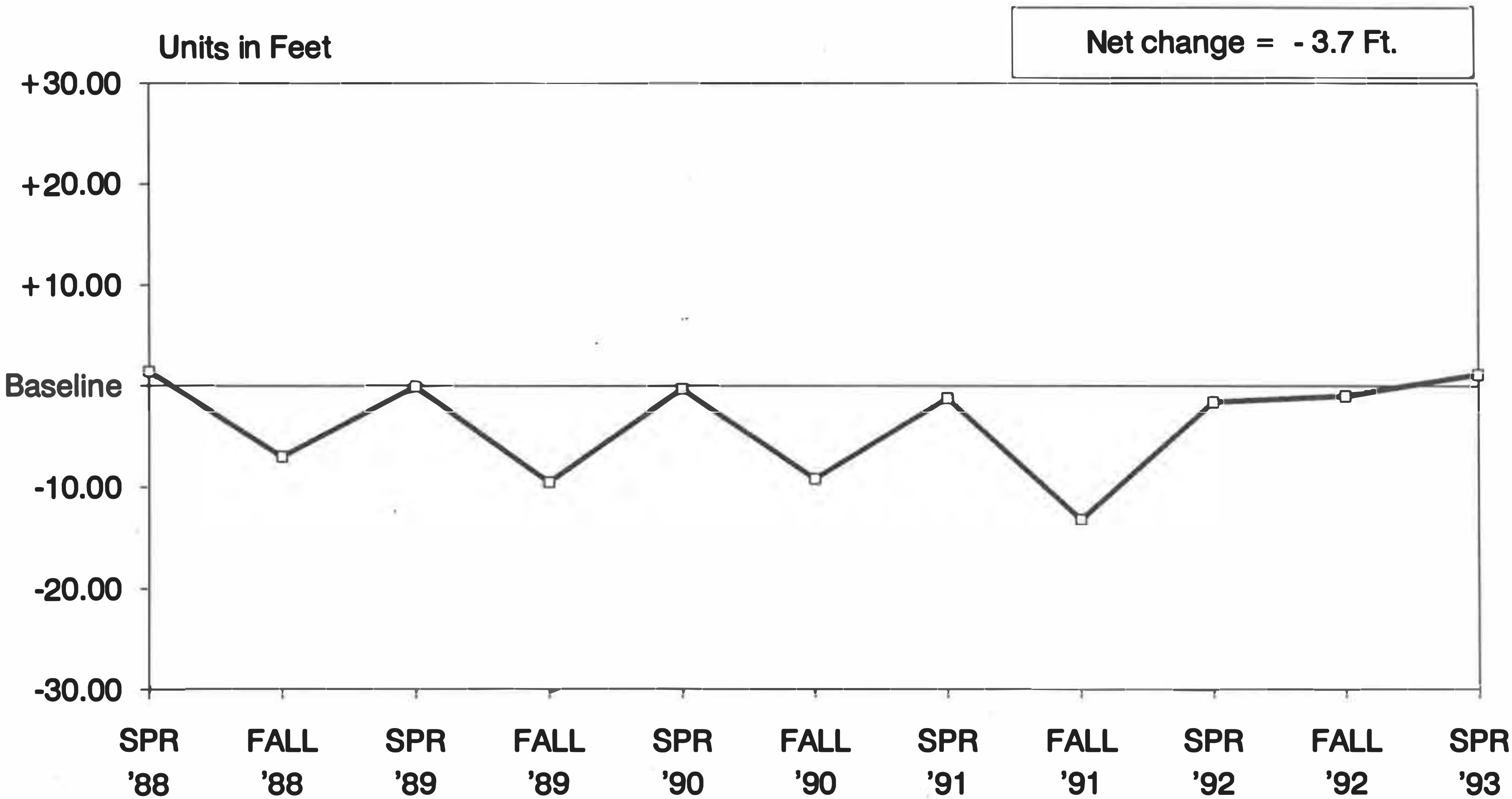
Zone of Saturation - porous earth materials, in which, all pore-spaces are filled with water.

APPENDIX D

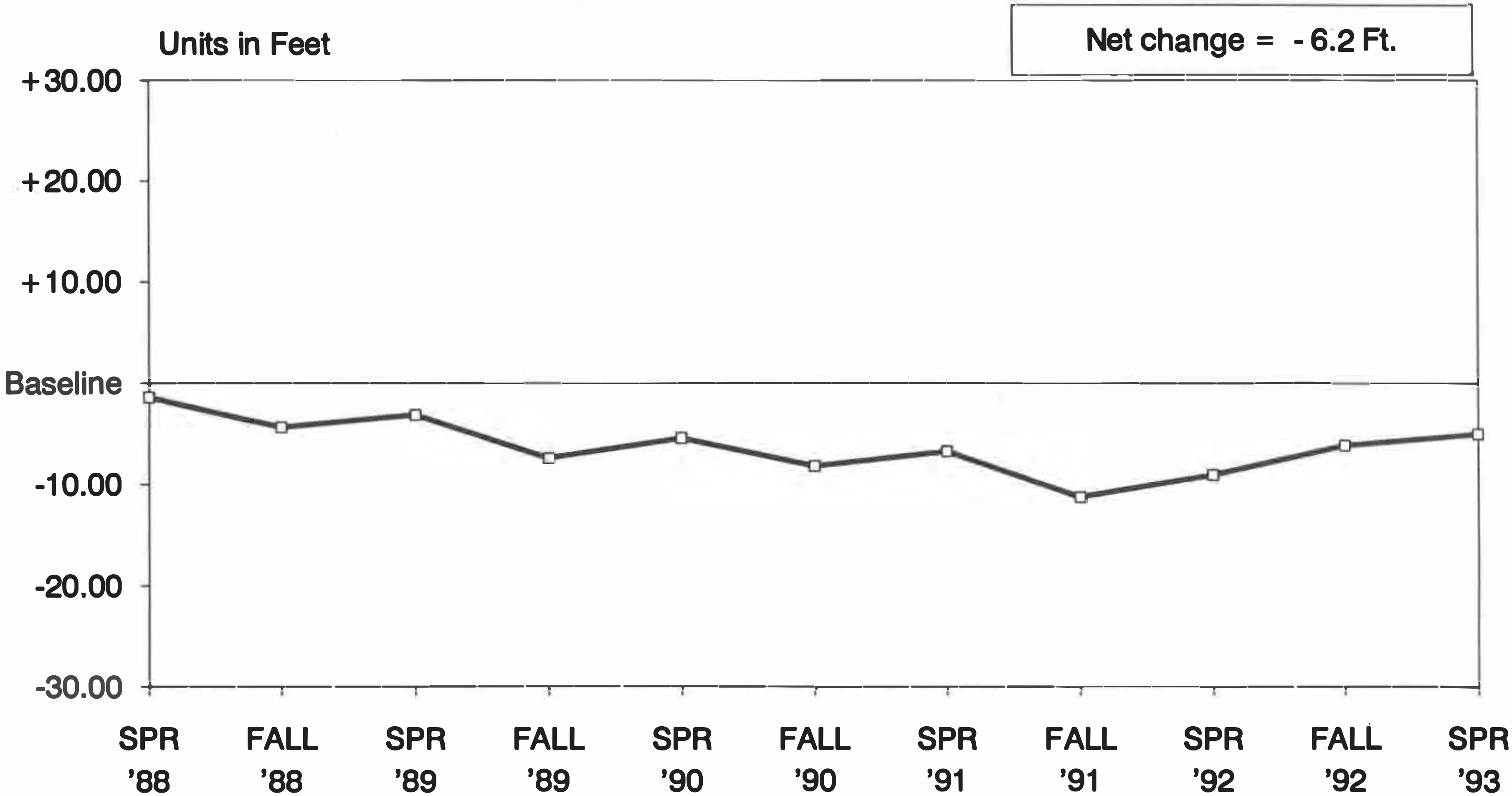
Changes in Water Levels Since 1987 (Baseline)
Well: 1   22N-5W- 4AADC   Boone Co.   Shell Cr. Aquifer



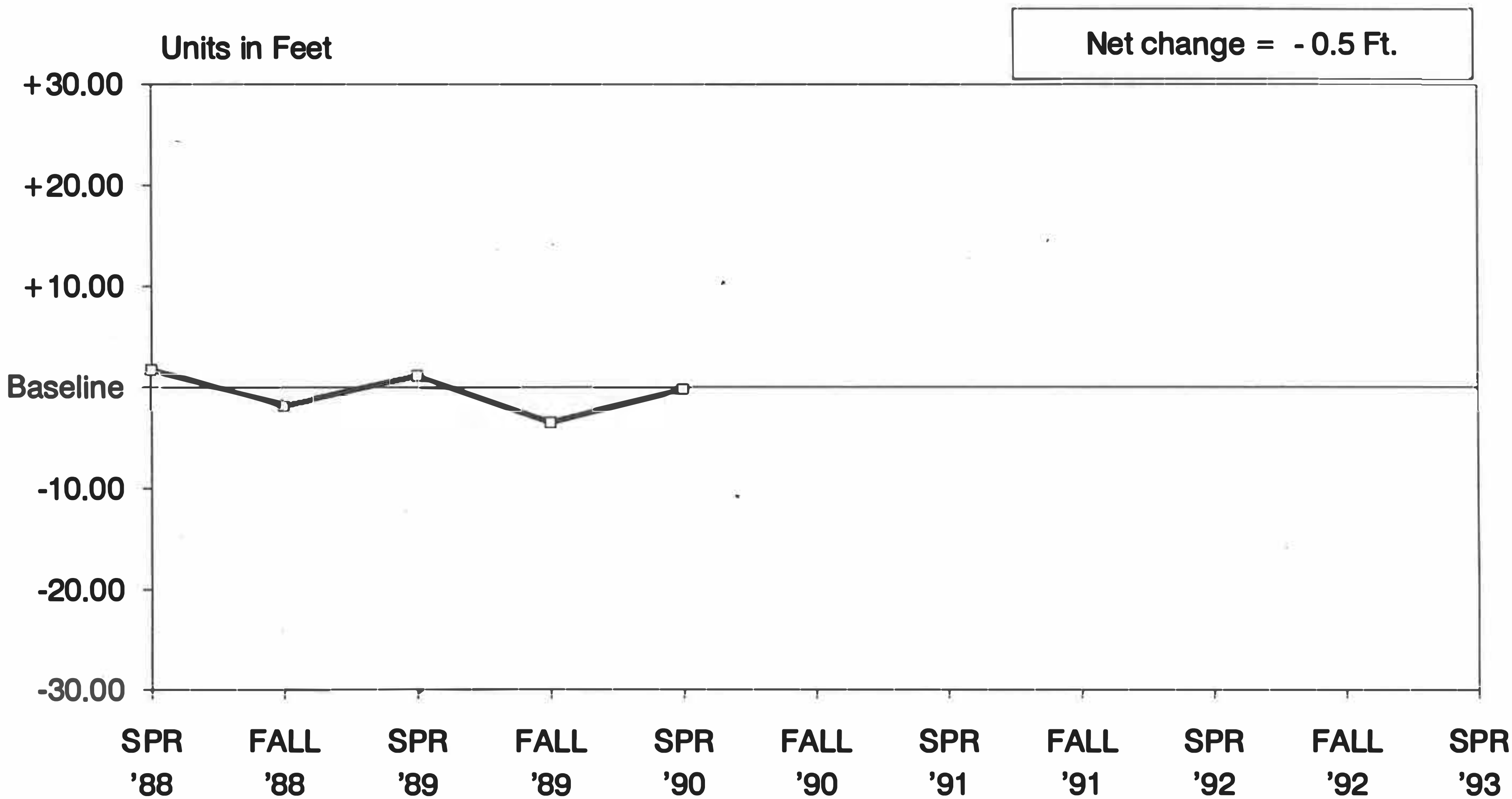
Changes in Water Levels Since 1987 (Baseline)
Well: 2 21N-5W- 9AABD Boone Co. Shell Cr. Aquifer



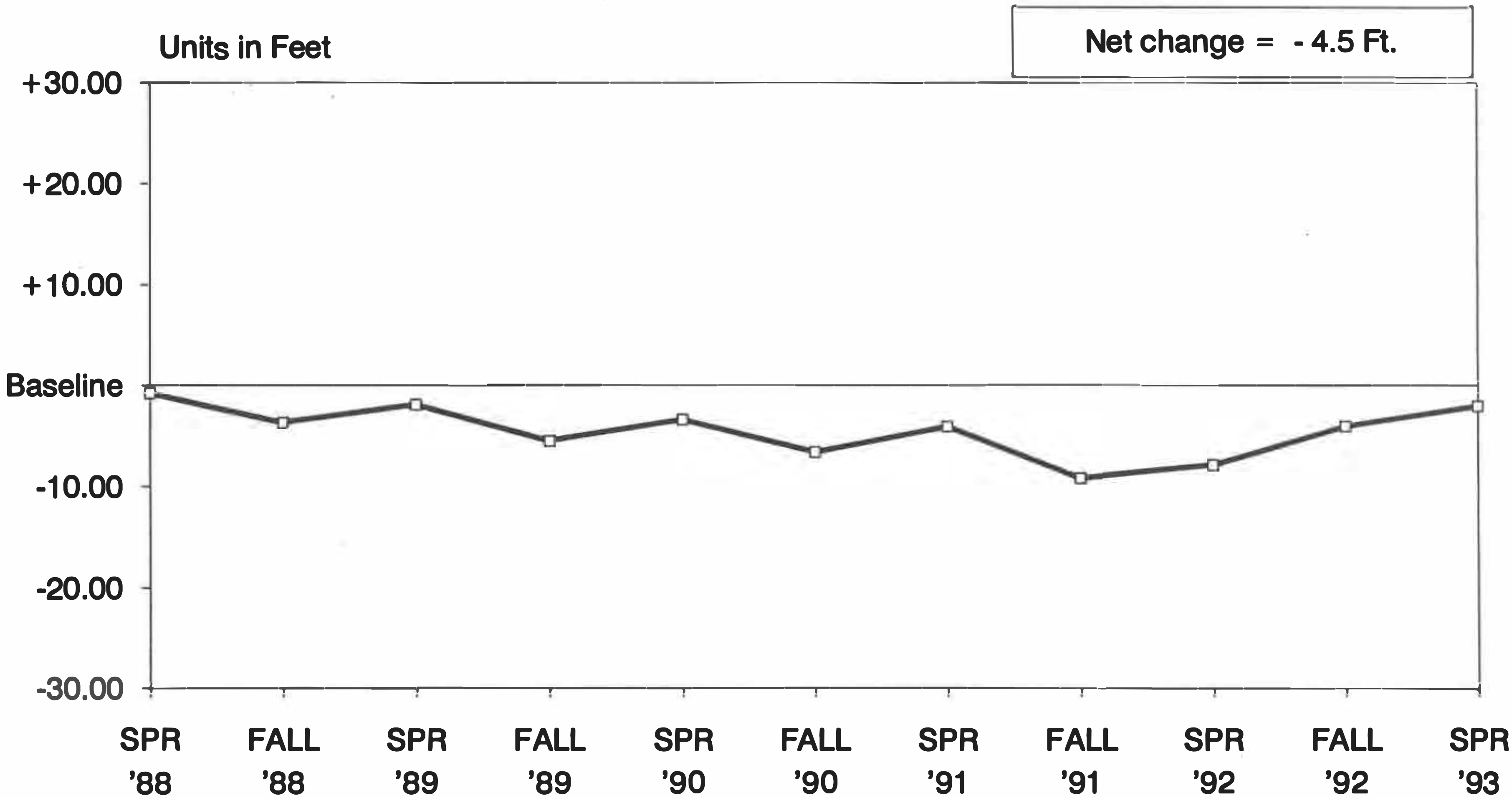
Changes in Water Levels Since 1987 (Baseline)
Well: 3 20N-4W- 1CDDA Platte Co. Shell Cr. Aquifer



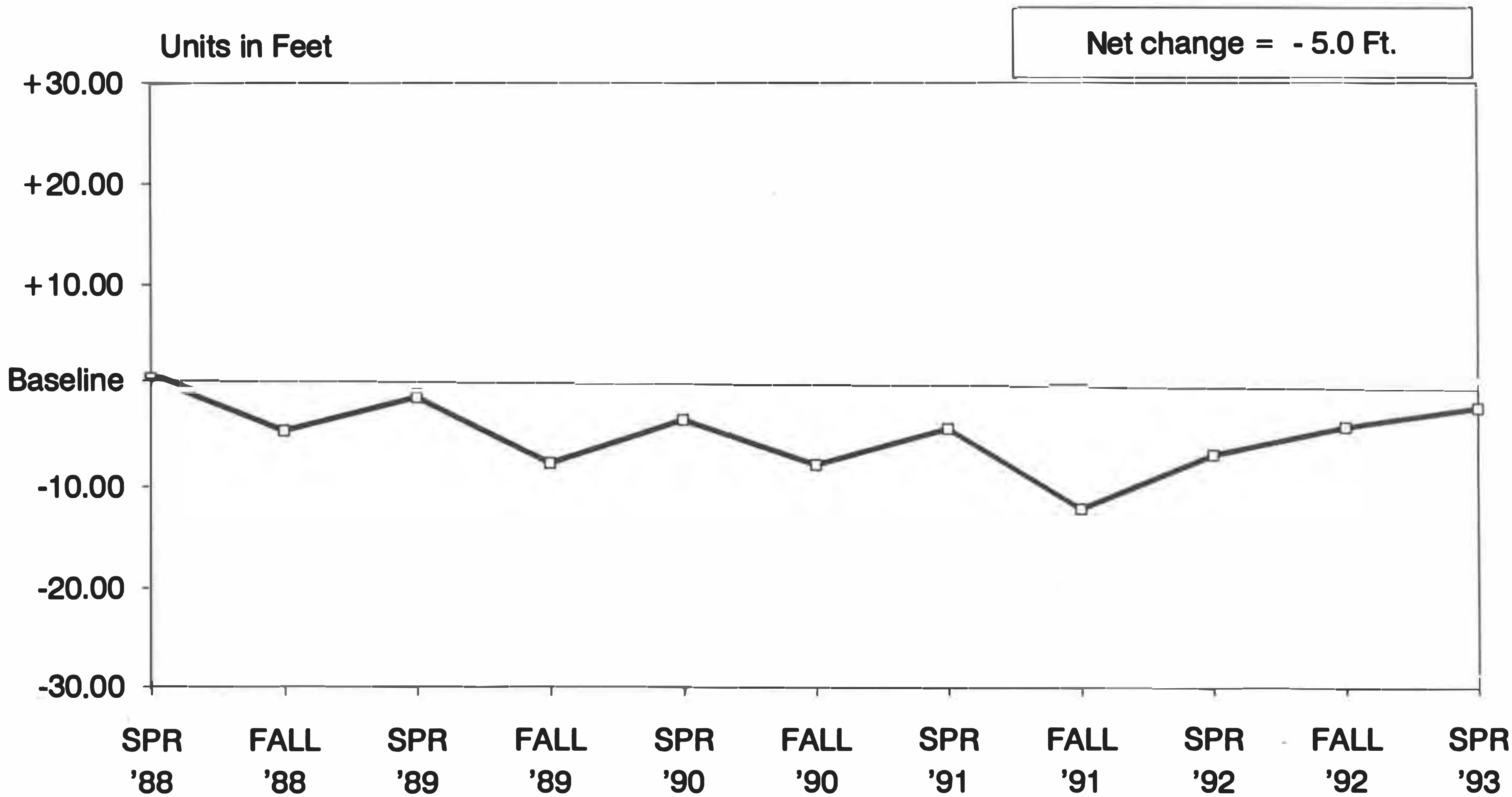
Changes in Water Levels Since 1987 (Baseline)
Well: 4   20N-5W-12ADBB   Boone Co.   Shell Cr. Aquifer

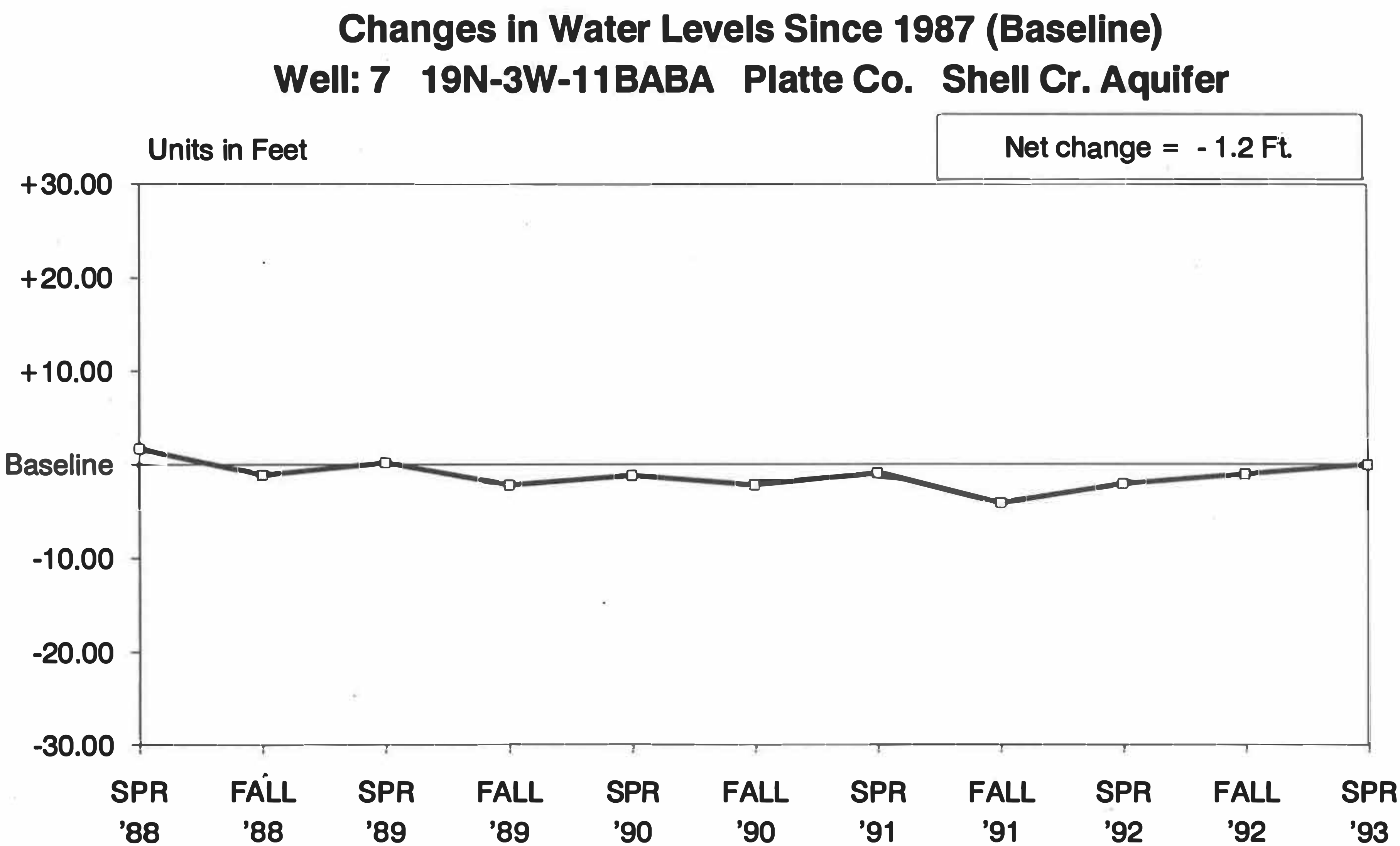


Changes in Water Levels Since 1987 (Baseline)
Well: 5 20N-4W-13DBDD Platte Co. Shell Cr. Aquifer



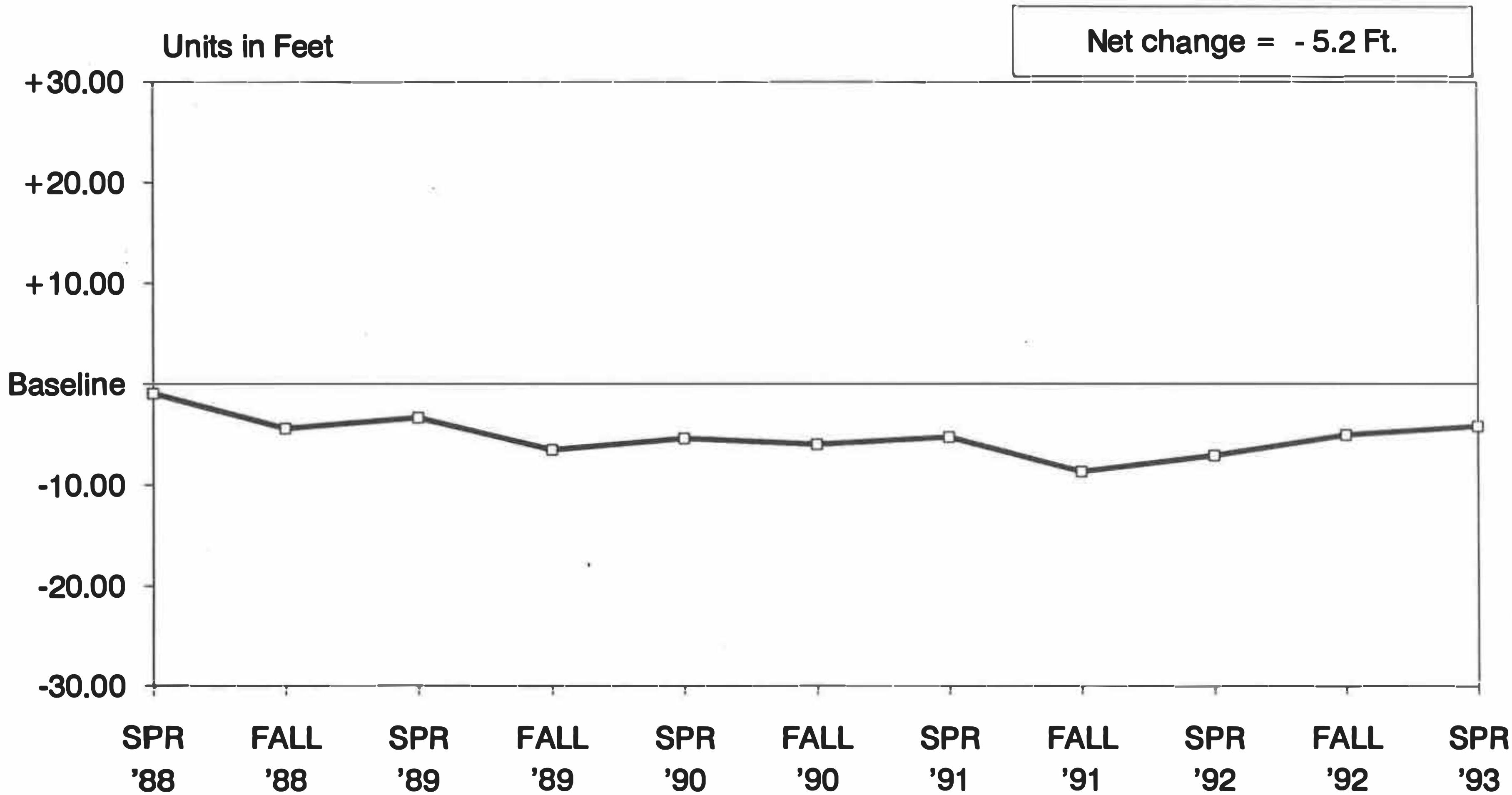
Changes in Water Levels Since 1987 (Baseline)
Well: 6   20N-3W-22DDCC   Platte Co.   Shell Cr. Aquifer



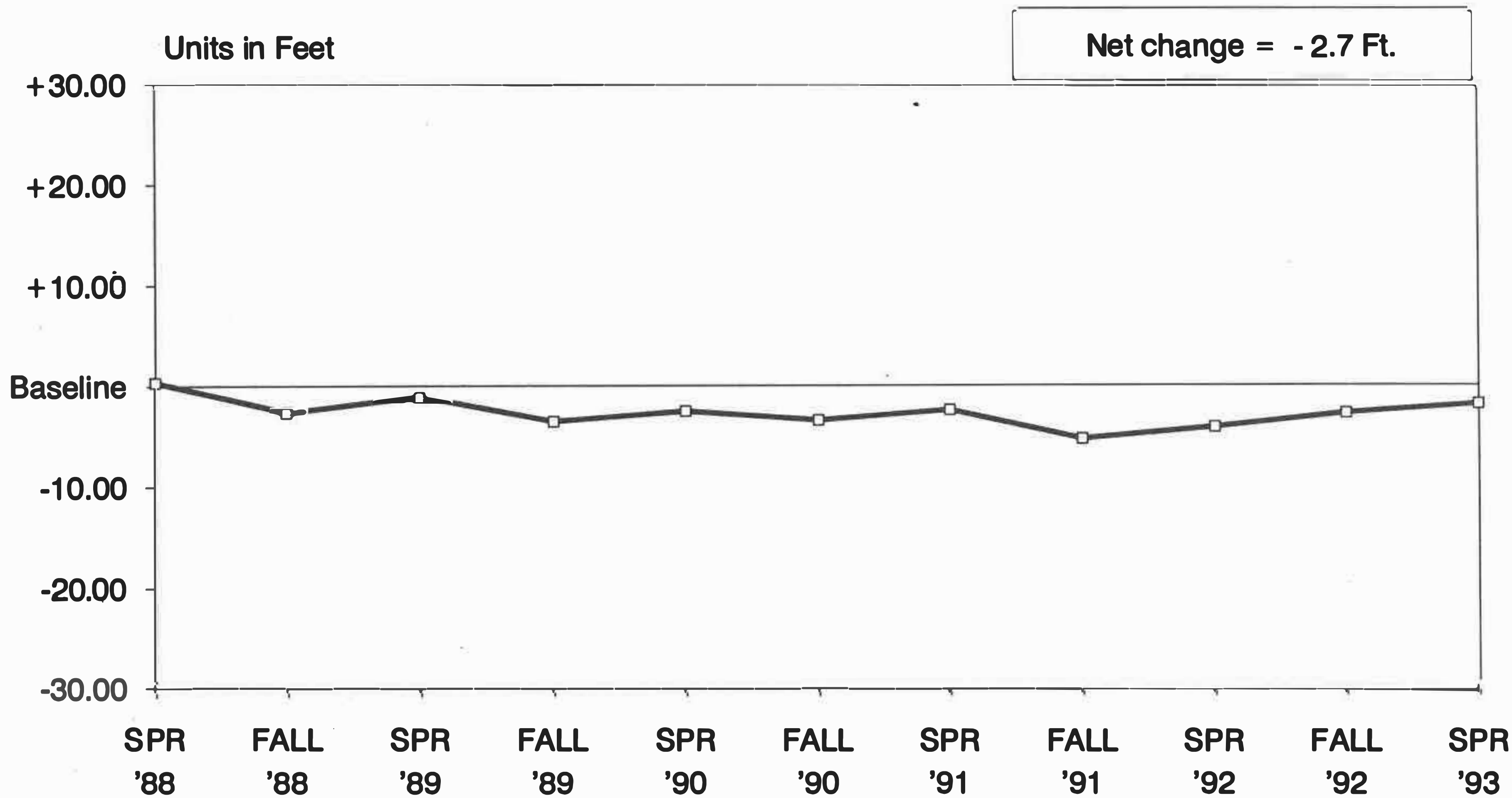


Changes in Water Levels Since 1987 (Baseline)
Well: 7 19N-3W-11BABA Platte Co. Shell Cr. Aquifer
Units in Feet
Net change = - 1.2 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

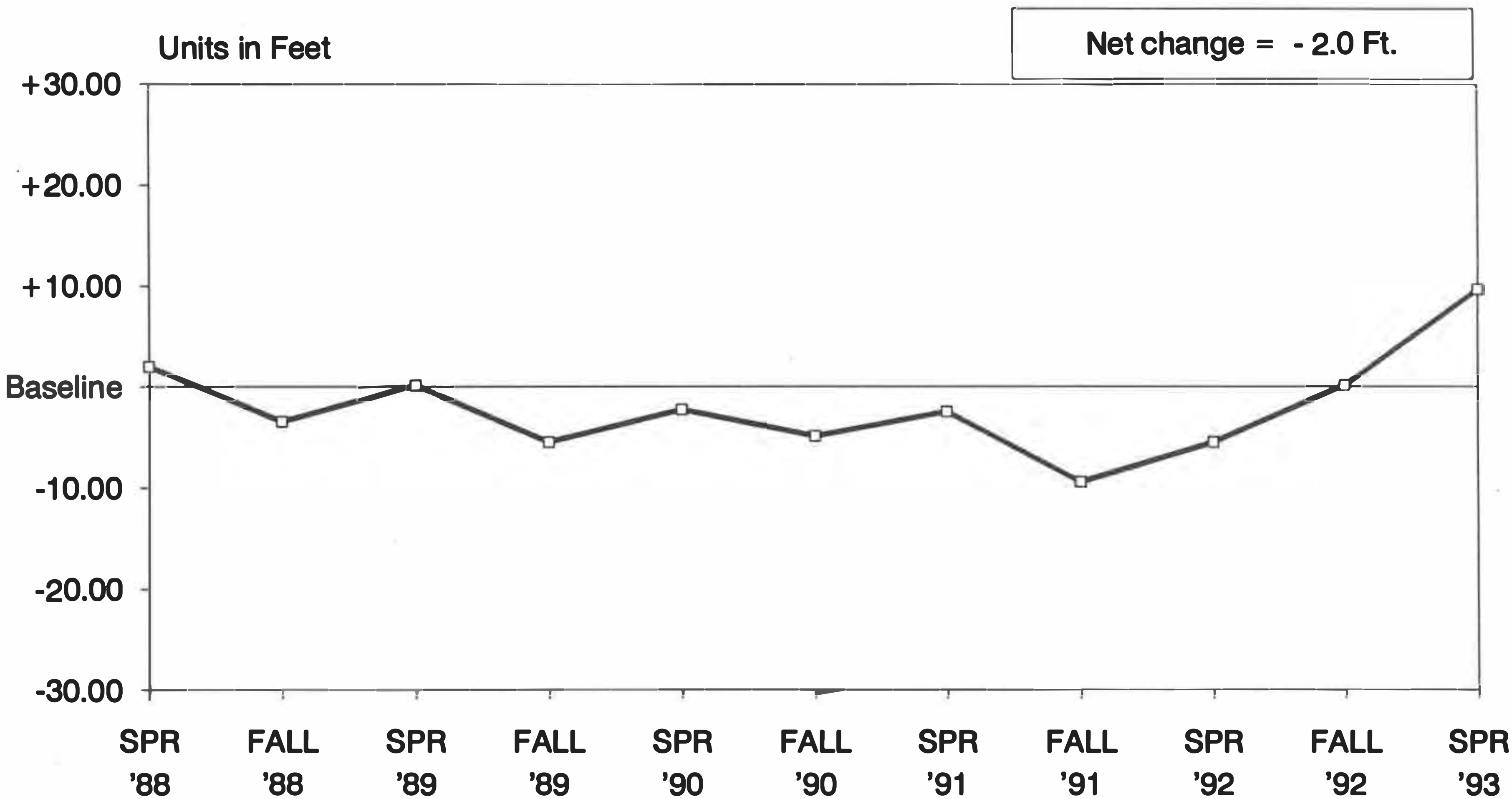
Changes in Water Levels Since 1987 (Baseline)
Well: 8 18N-2W- 6CBAA Platte Co. Shell Cr. Aquifer



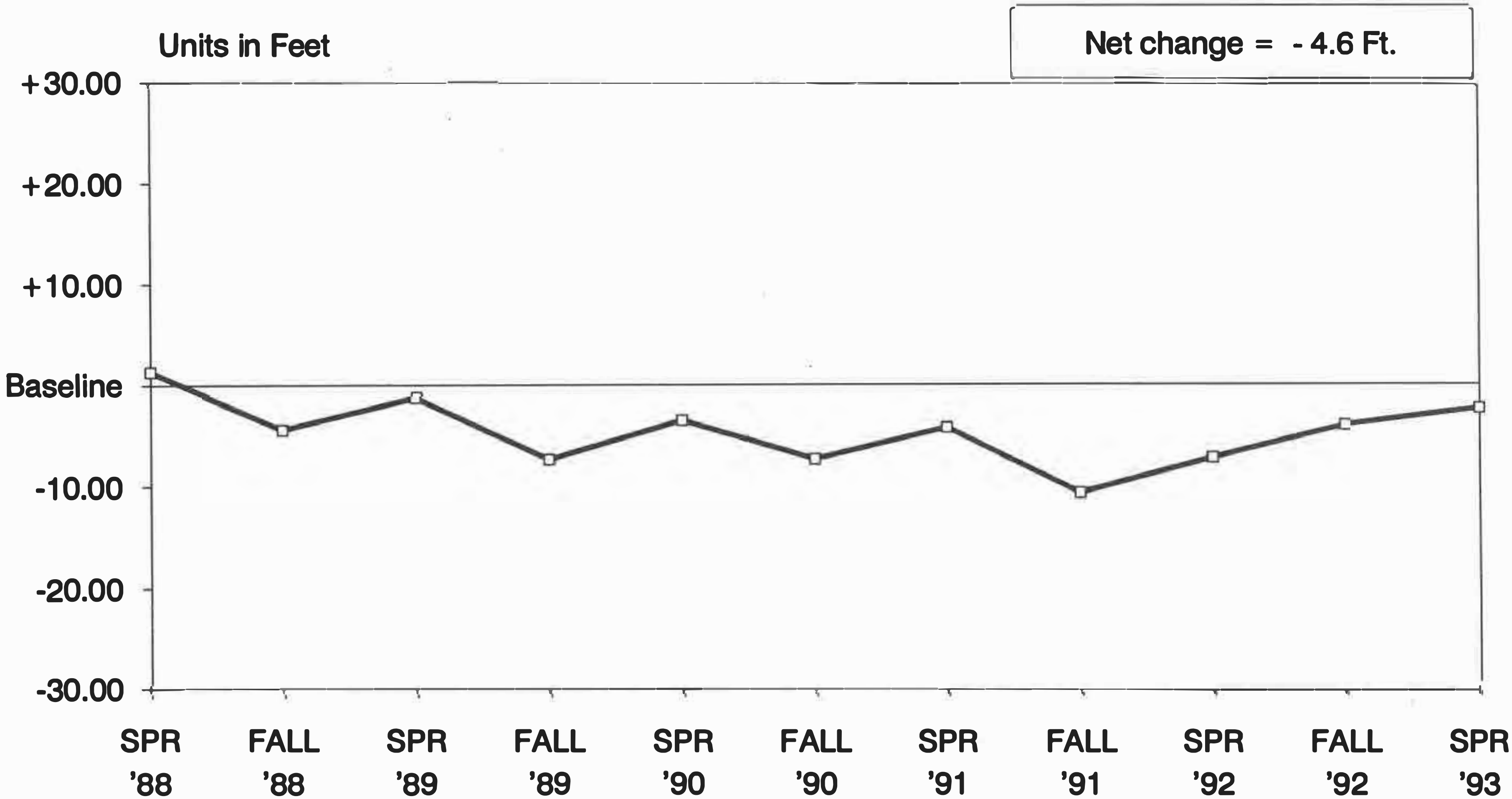
Changes in Water Levels Since 1987 (Baseline)
Well: 9 19N-2W-29DBCD Platte Co. Shell Cr. Aquifer



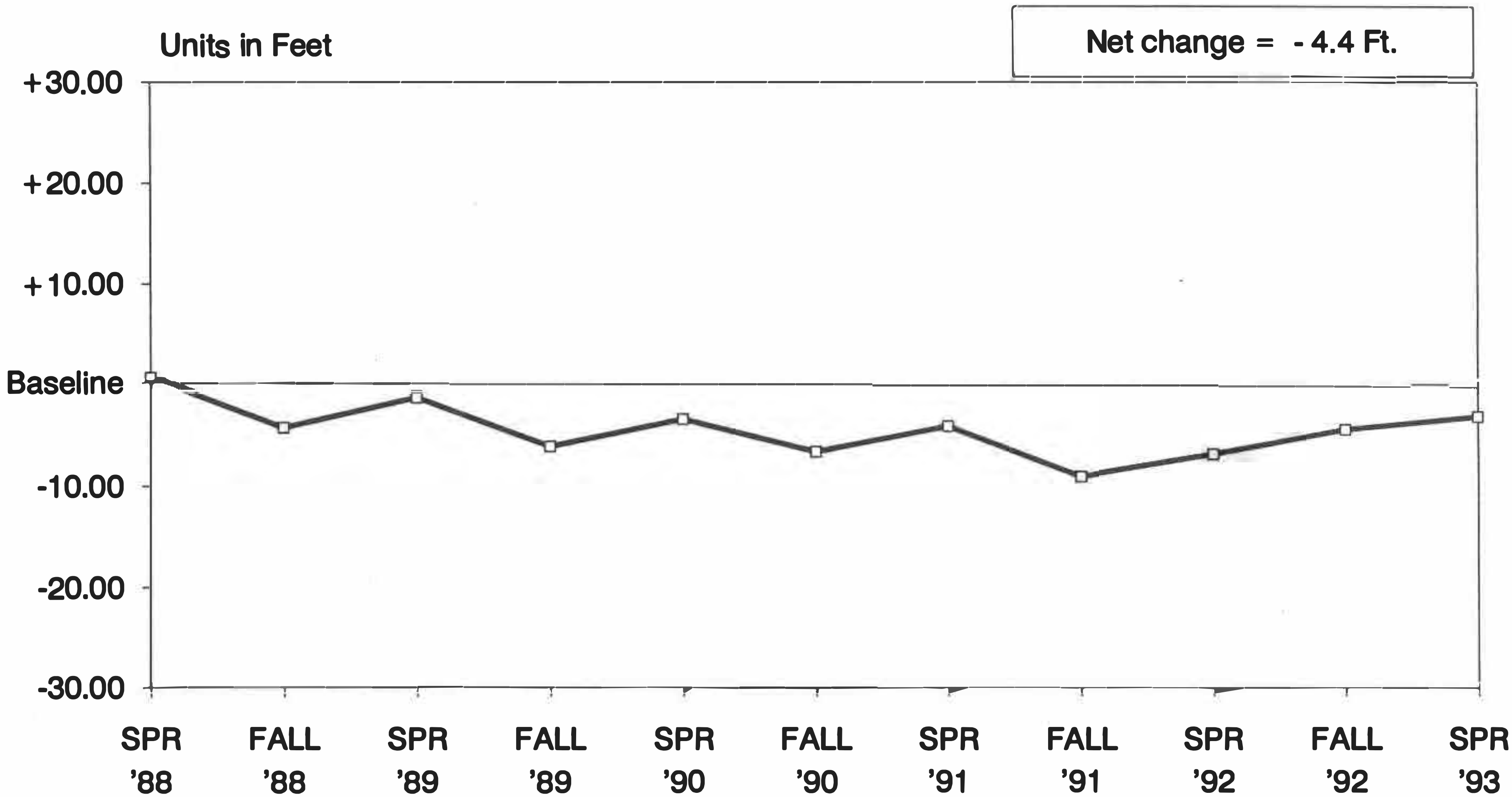
Changes in Water Levels Since 1987 (Baseline)
Well: 10 19N-2W- 3BDAA Platte Co. Shell Cr. Aquifer



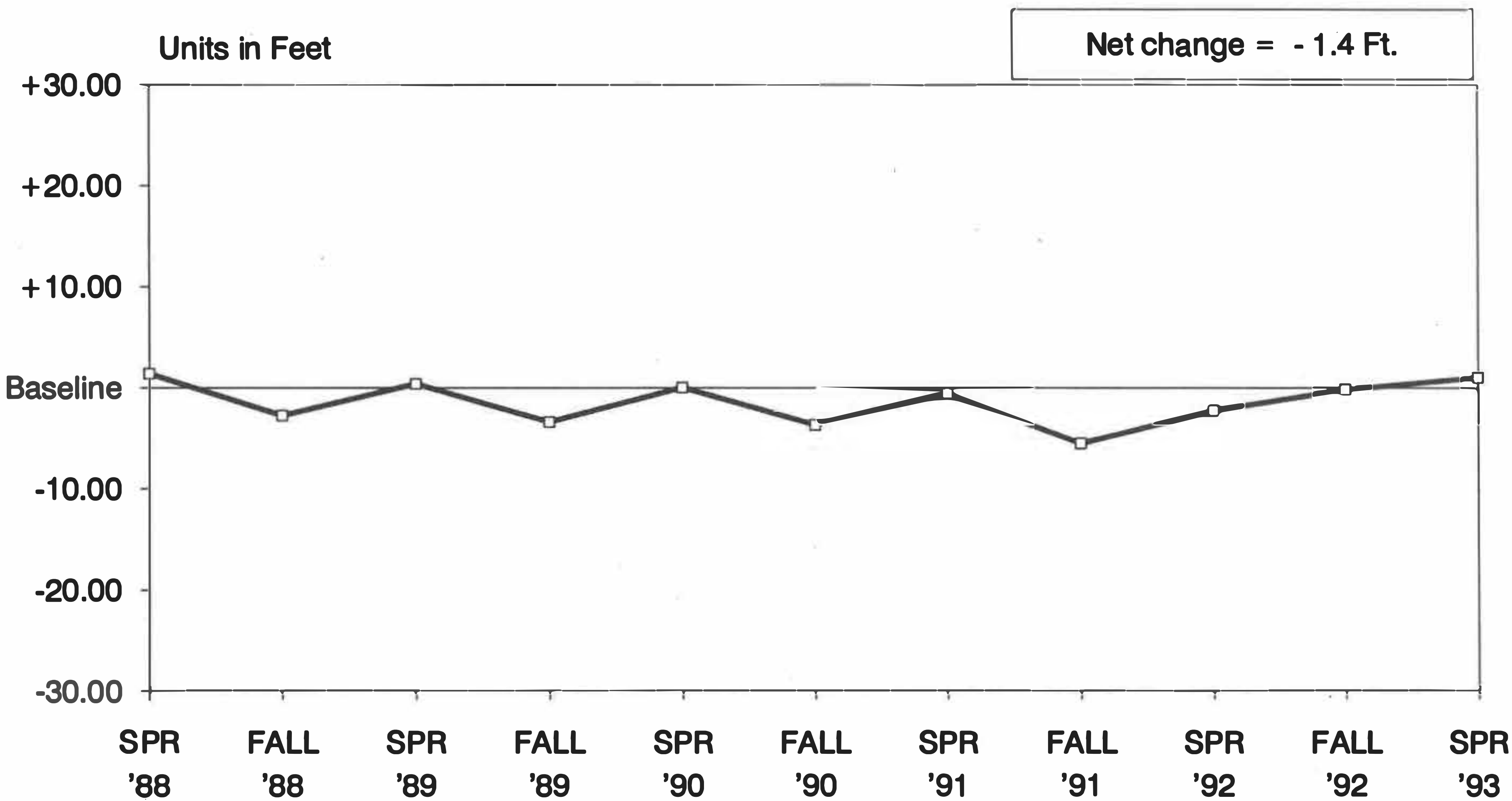
Changes in Water Levels Since 1987 (Baseline)
Well: 11   19N-1W-28ABBC   Platte Co.   Shell Cr. Aquifer



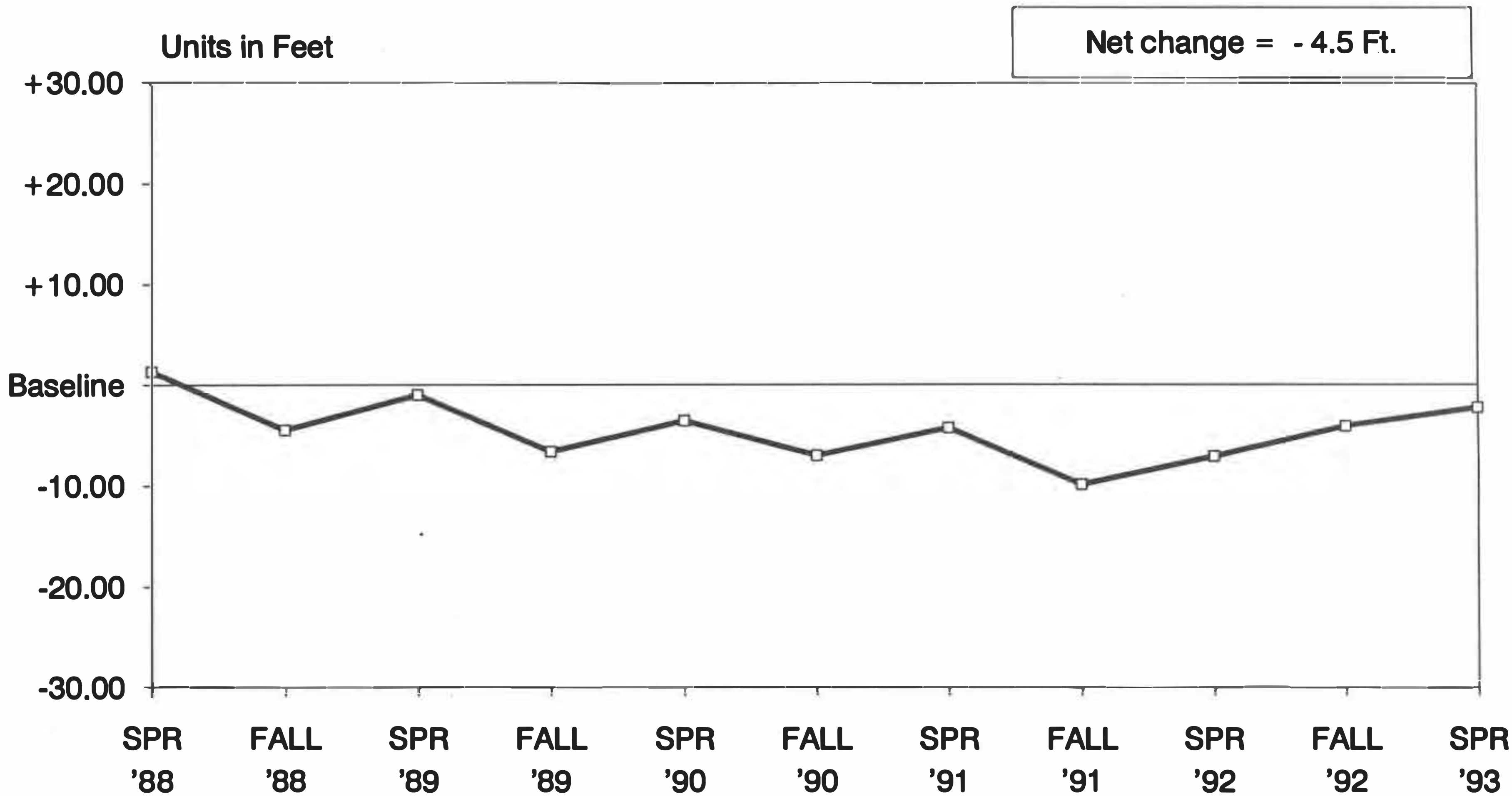
Changes in Water Levels Since 1987 (Baseline)
Well: 12   19N-1W-25CABB   Platte Co.   Shell Cr. Aquifer

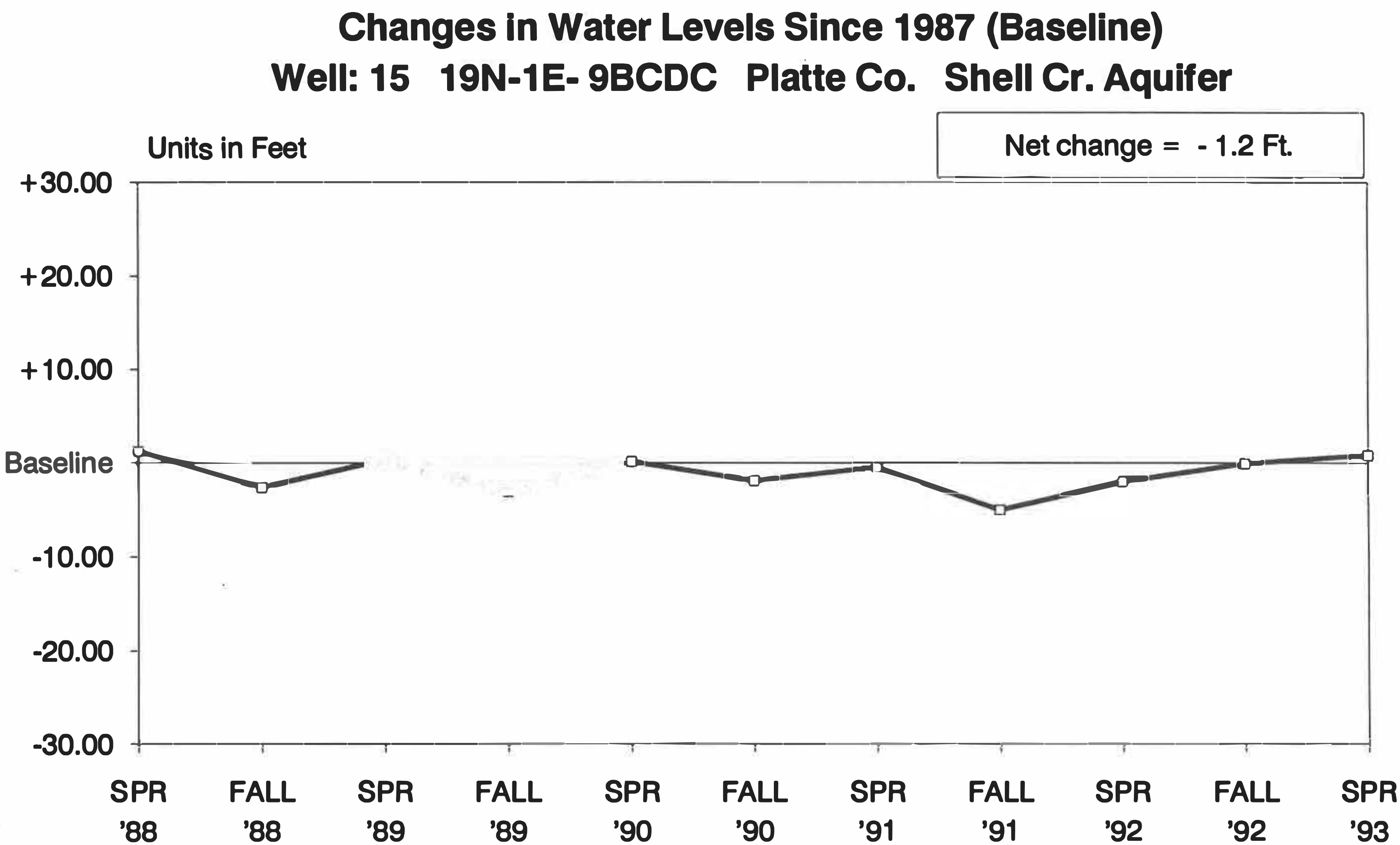


Changes in Water Levels Since 1987 (Baseline)
Well: 13 19N-1E-29CDAB Platte Co. Shell Cr. Aquifer

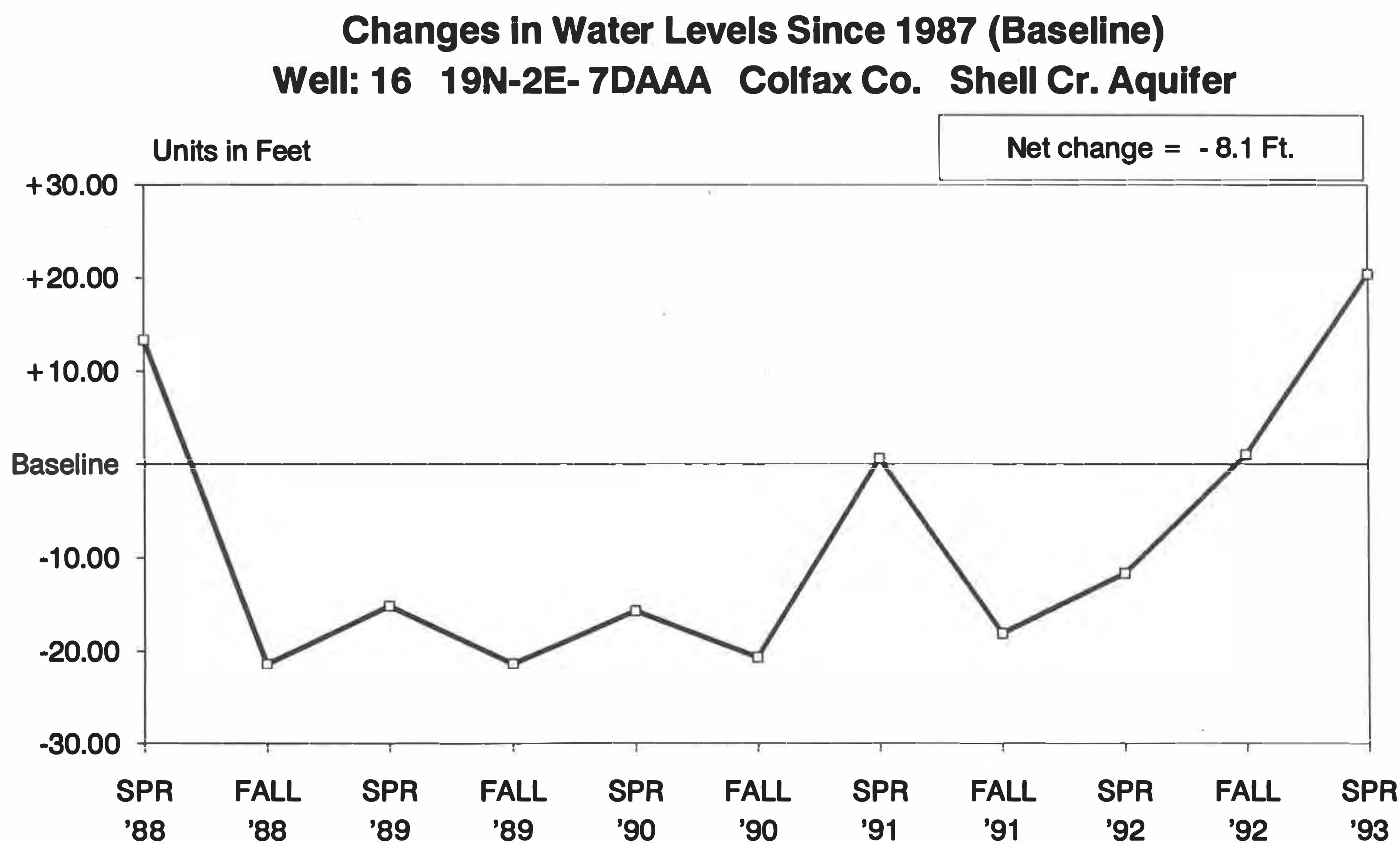


Changes in Water Levels Since 1987 (Baseline)
Well: 14 19N-1W-12CDBB Platte Co. Shell Cr. Aquifer

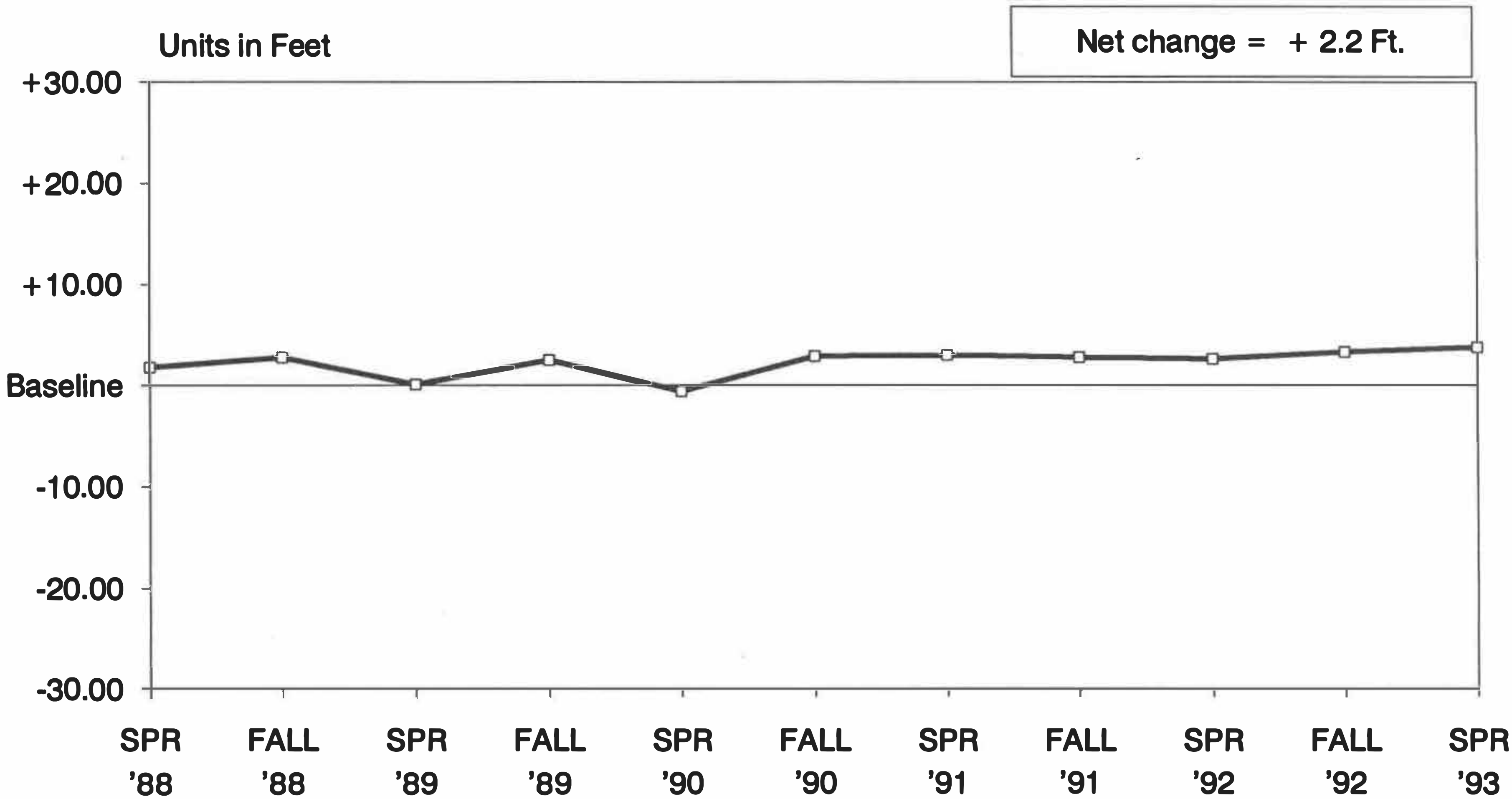




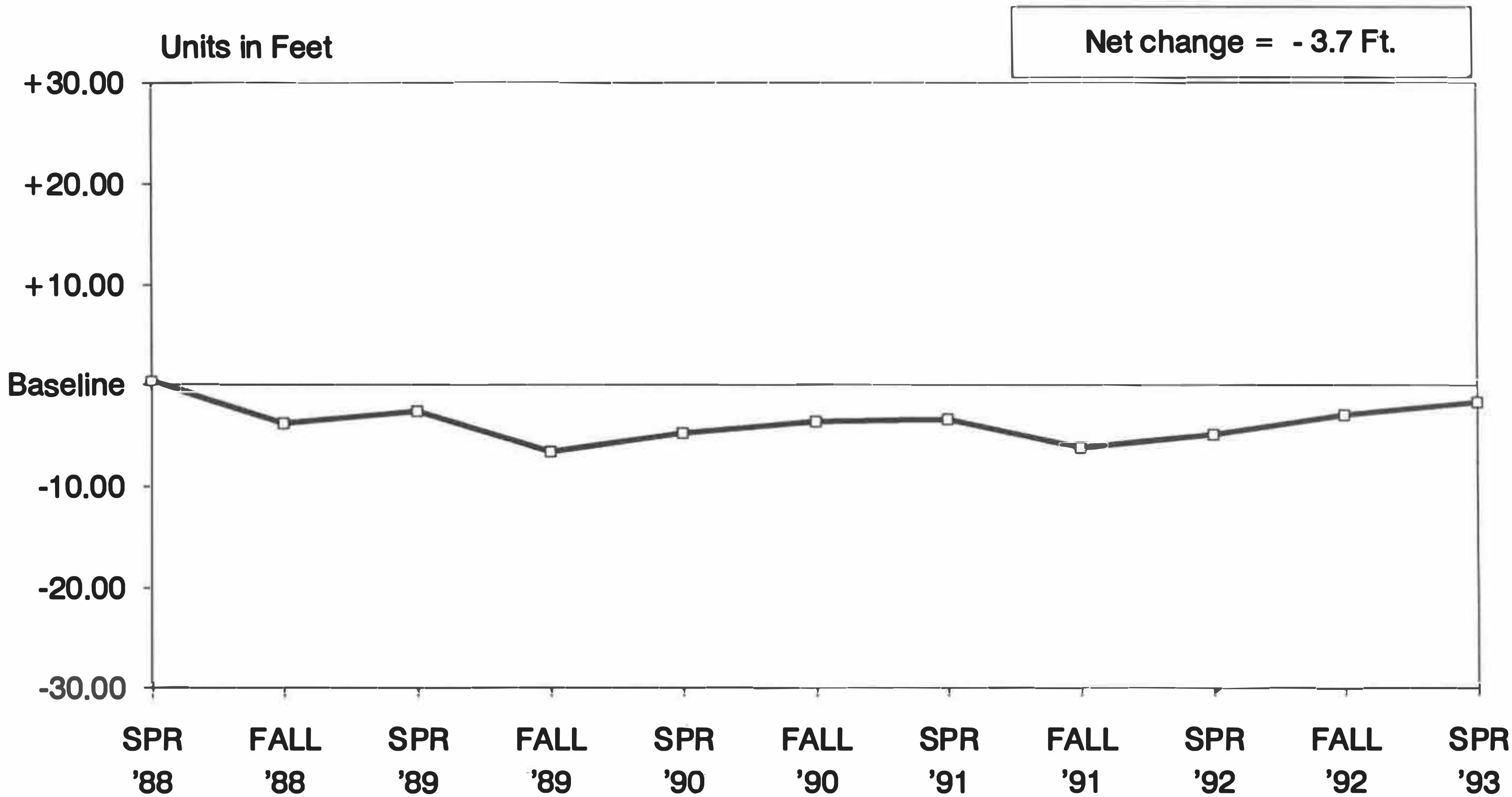
Changes in Water Levels Since 1987 (Baseline)
Well: 15 19N-1E- 9BCDC Platte Co. Shell Cr. Aquifer
Units in Feet
Net change = - 1.2 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93


Changes in Water Levels Since 1987 (Baseline)
Well: 16 19N-2E- 7DAAA Colfax Co. Shell Cr. Aquifer
Units in Feet
Net change = - 8.1 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

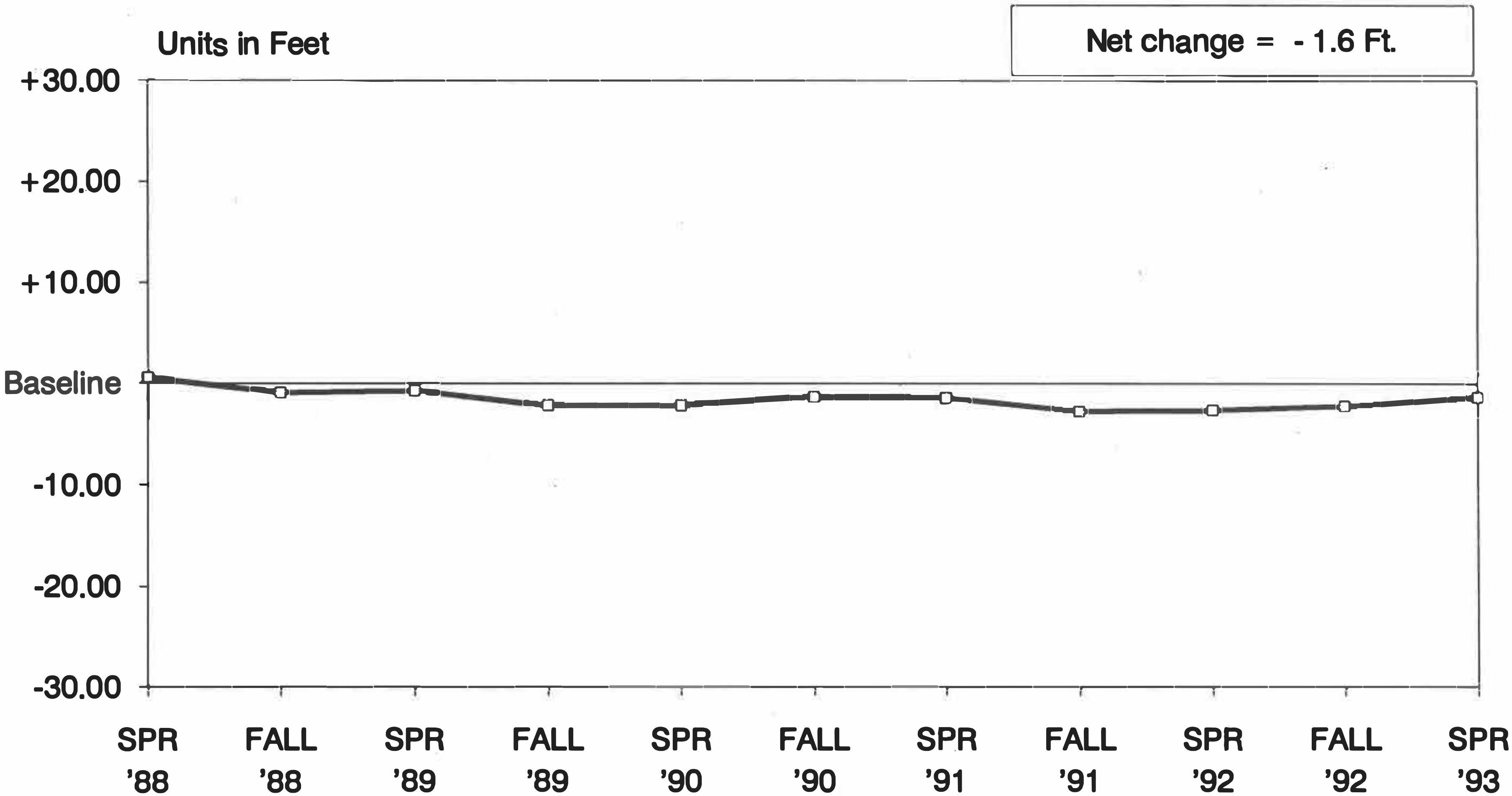
Changes in Water Levels Since 1987 (Baseline)
Well: 17 19N-1E-26DABD Platte Co. Shell Cr. Aquifer



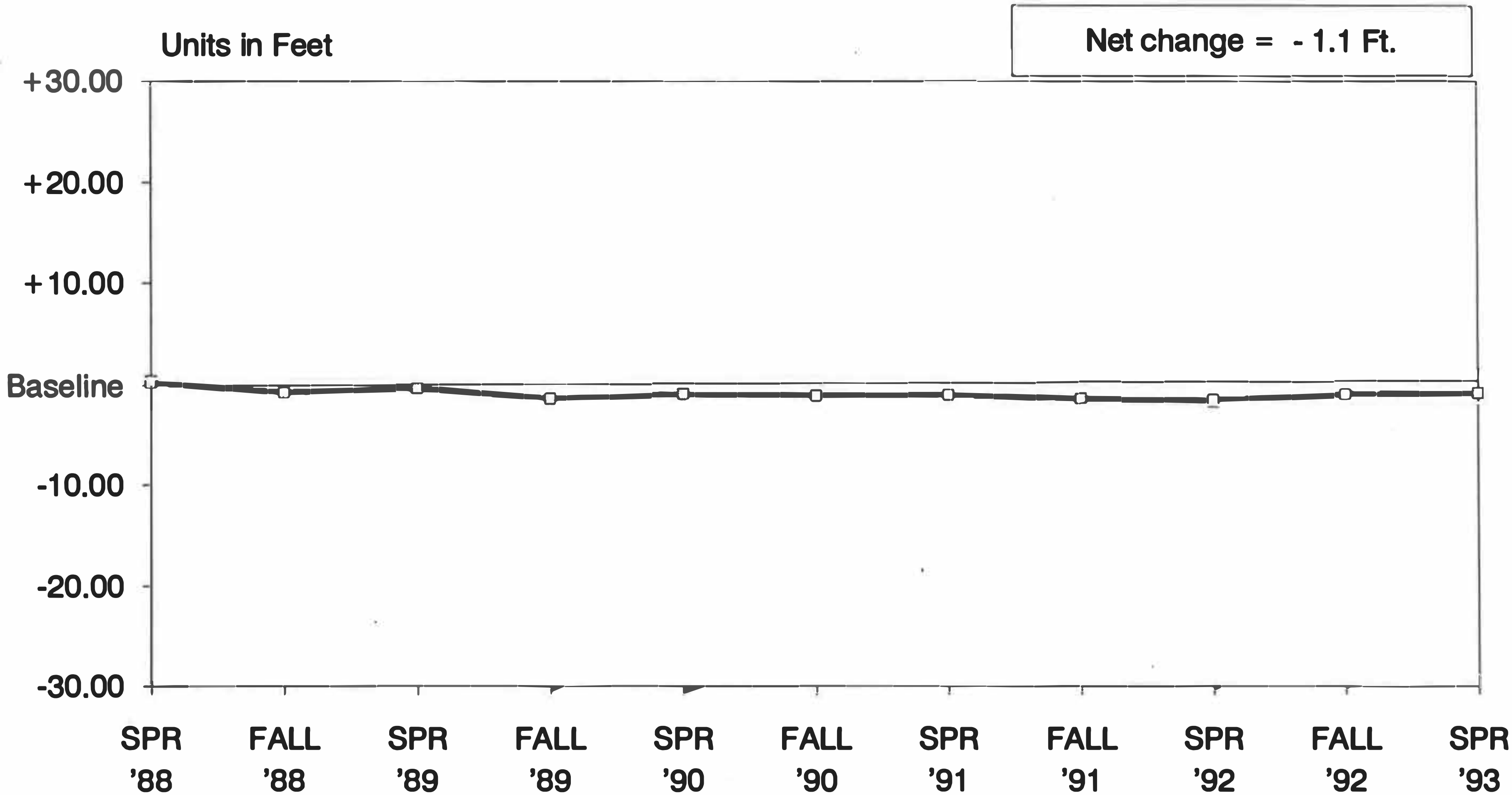
Changes in Water Levels Since 1987 (Baseline)
Well: 18 18N-1E- 9BABA Platte Co. Shell Cr. Aquifer

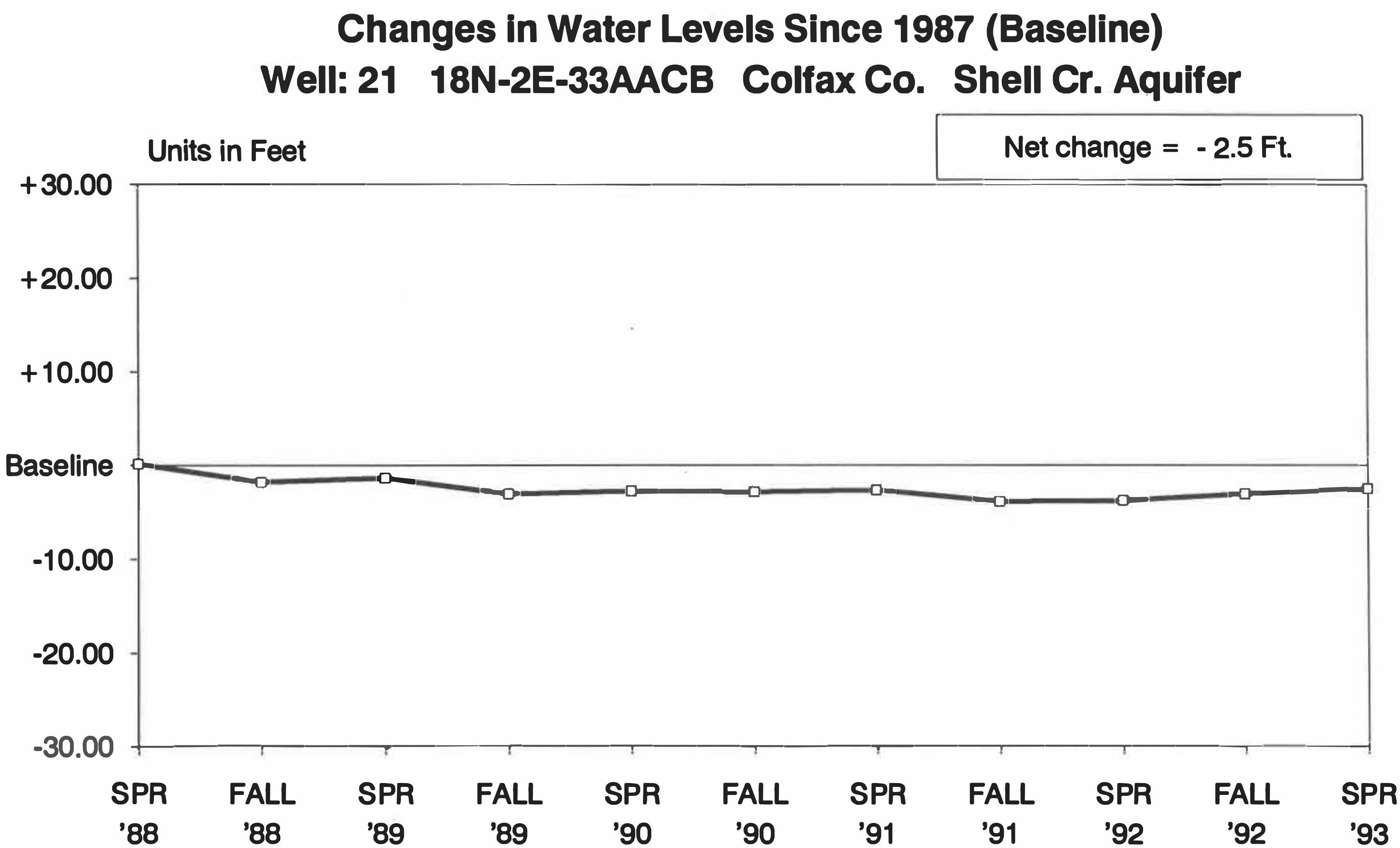


Changes in Water Levels Since 1987 (Baseline)
Well: 19 18N-1E-23BCCC Platte Co. Shell Cr. Aquifer



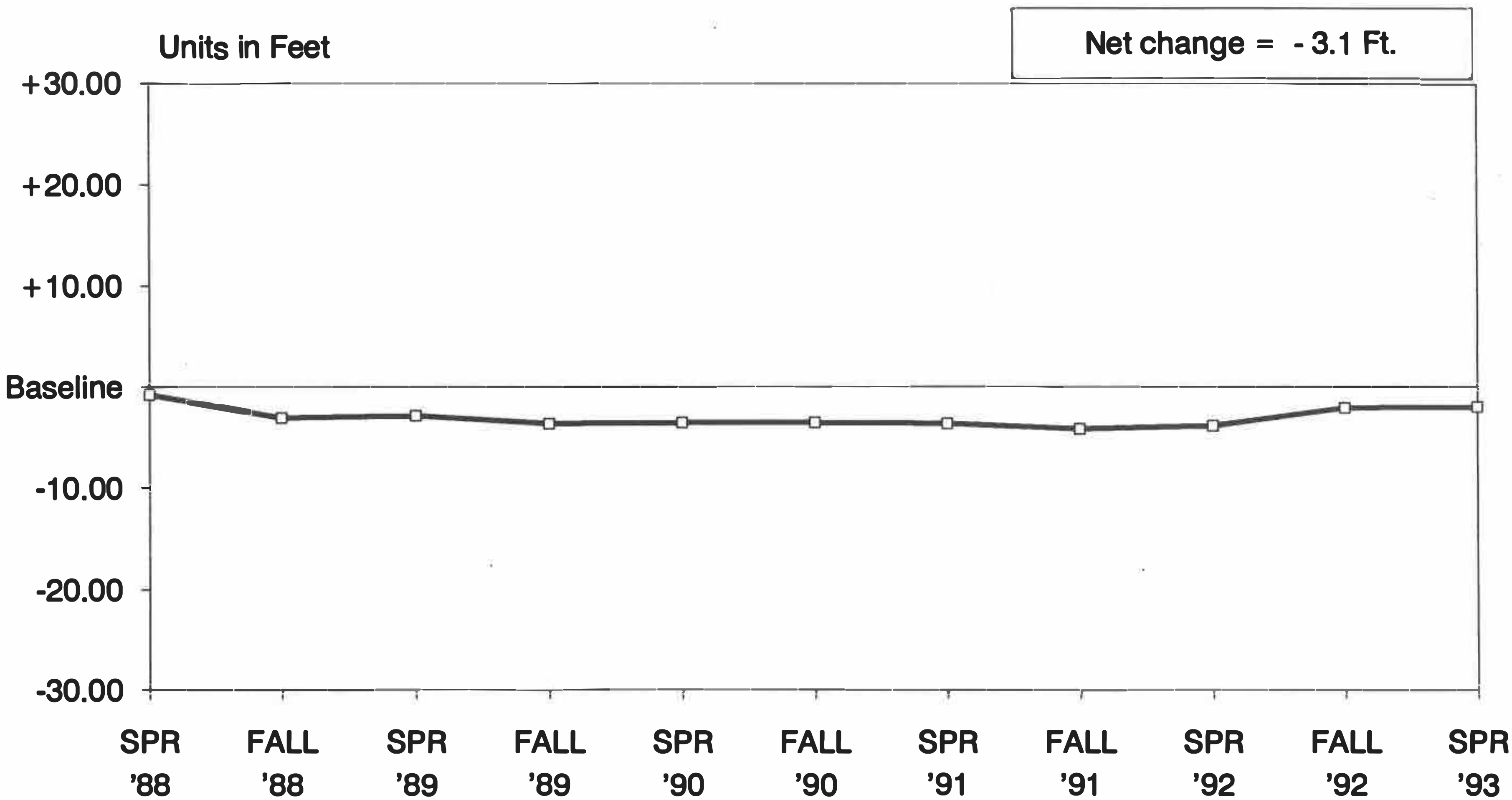
Changes in Water Levels Since 1987 (Baseline)
Well: 20 18N-2E-24CAAB Colfax Co. Shell Cr. Aquifer



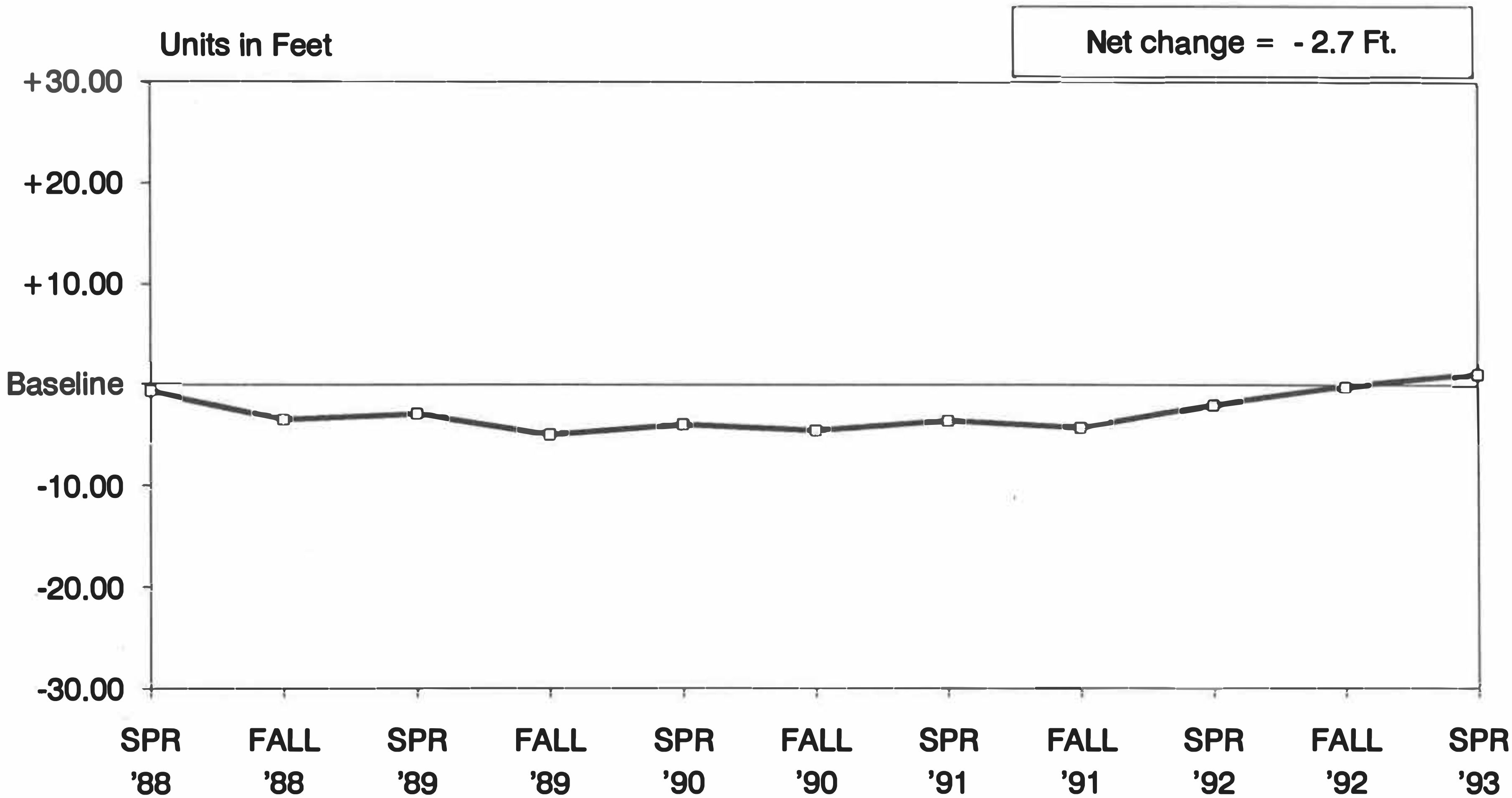


Changes in Water Levels Since 1987 (Baseline)
Well: 21 18N-2E-33AACB Colfax Co. Shell Cr. Aquifer
Units in Feet
Net change = - 2.5 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

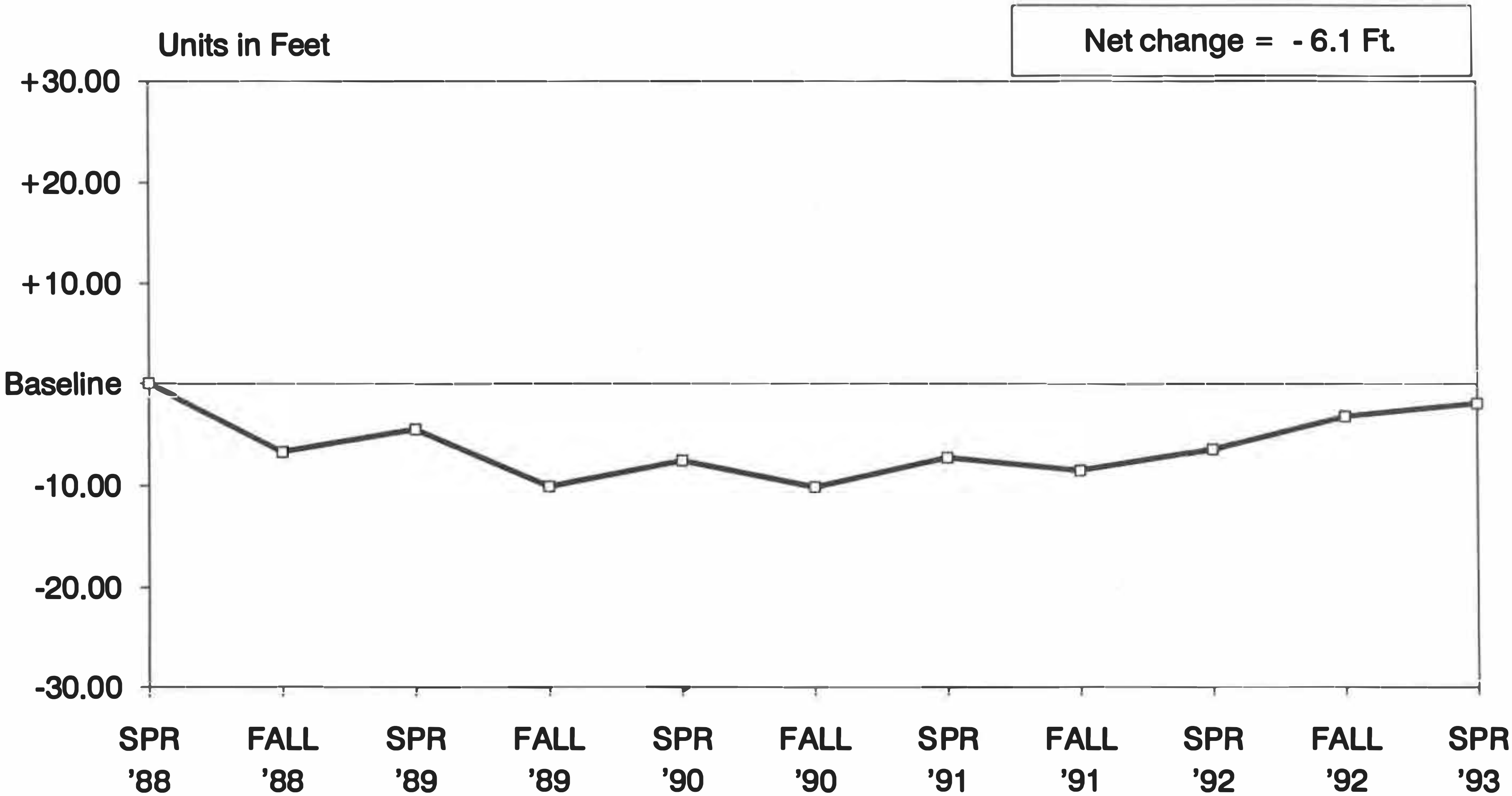
Changes in Water Levels Since 1987 (Baseline)
Well: 22   17N-2E-16BABB   Colfax Co.   Platte V. Aquifer



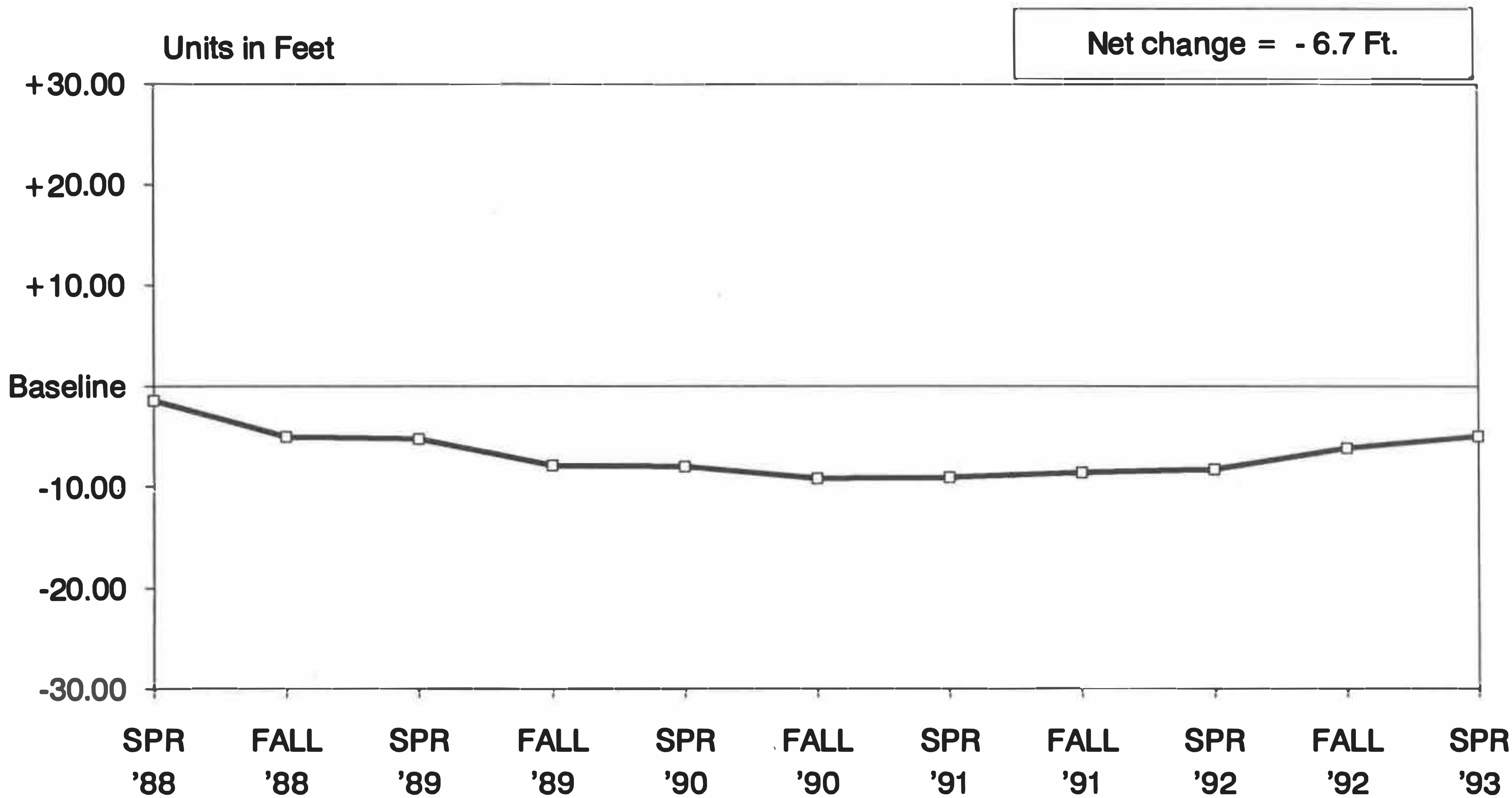
Changes in Water Levels Since 1987 (Baseline)
Well: 23   16N-1E-17CBCC   Butler Co.   Platte V. Aquifer



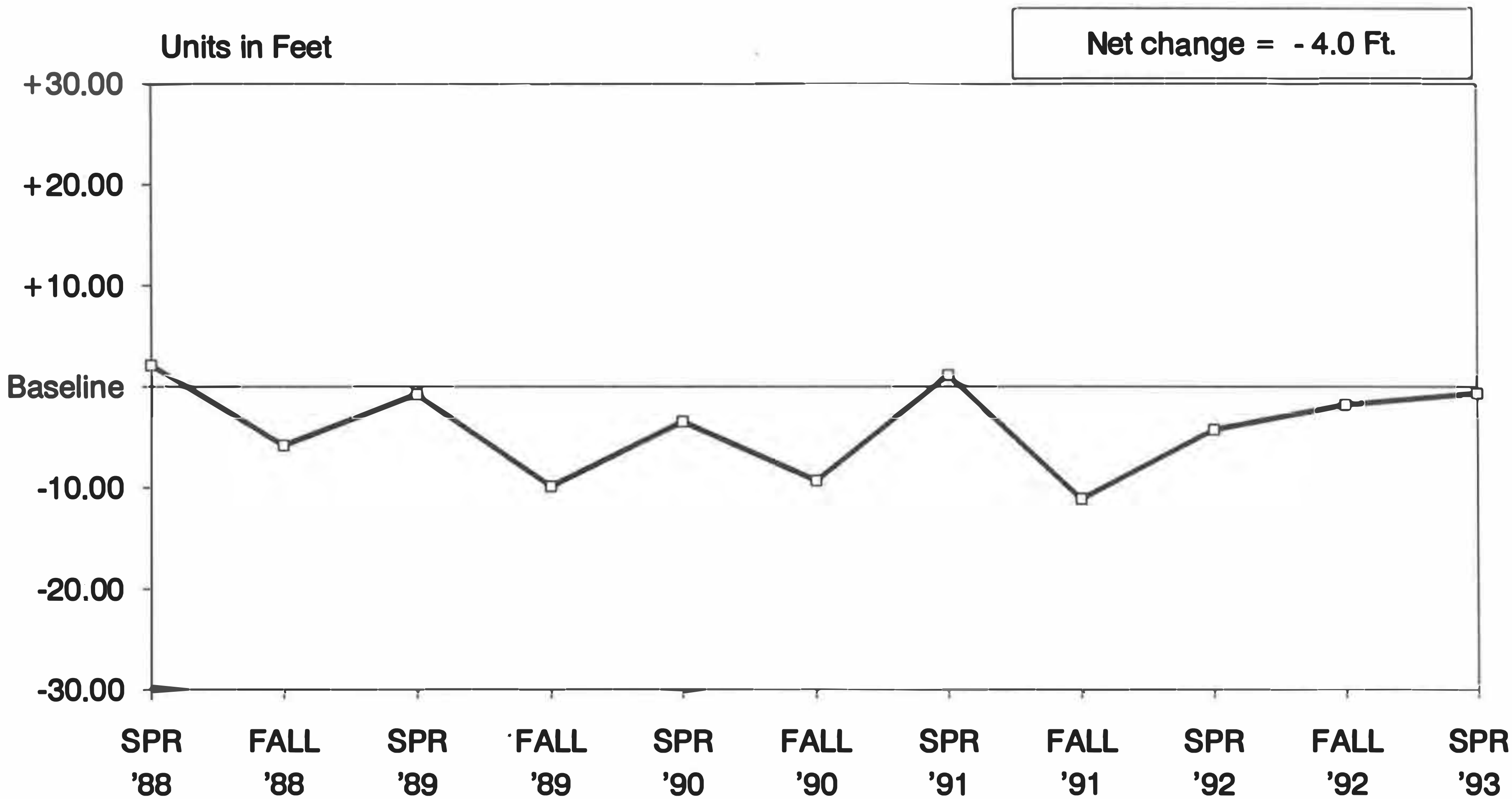
Changes in Water Levels Since 1987 (Baseline)
Well: 24 16N-1E-32AAAD Butler Co. Platte V. Aquifer



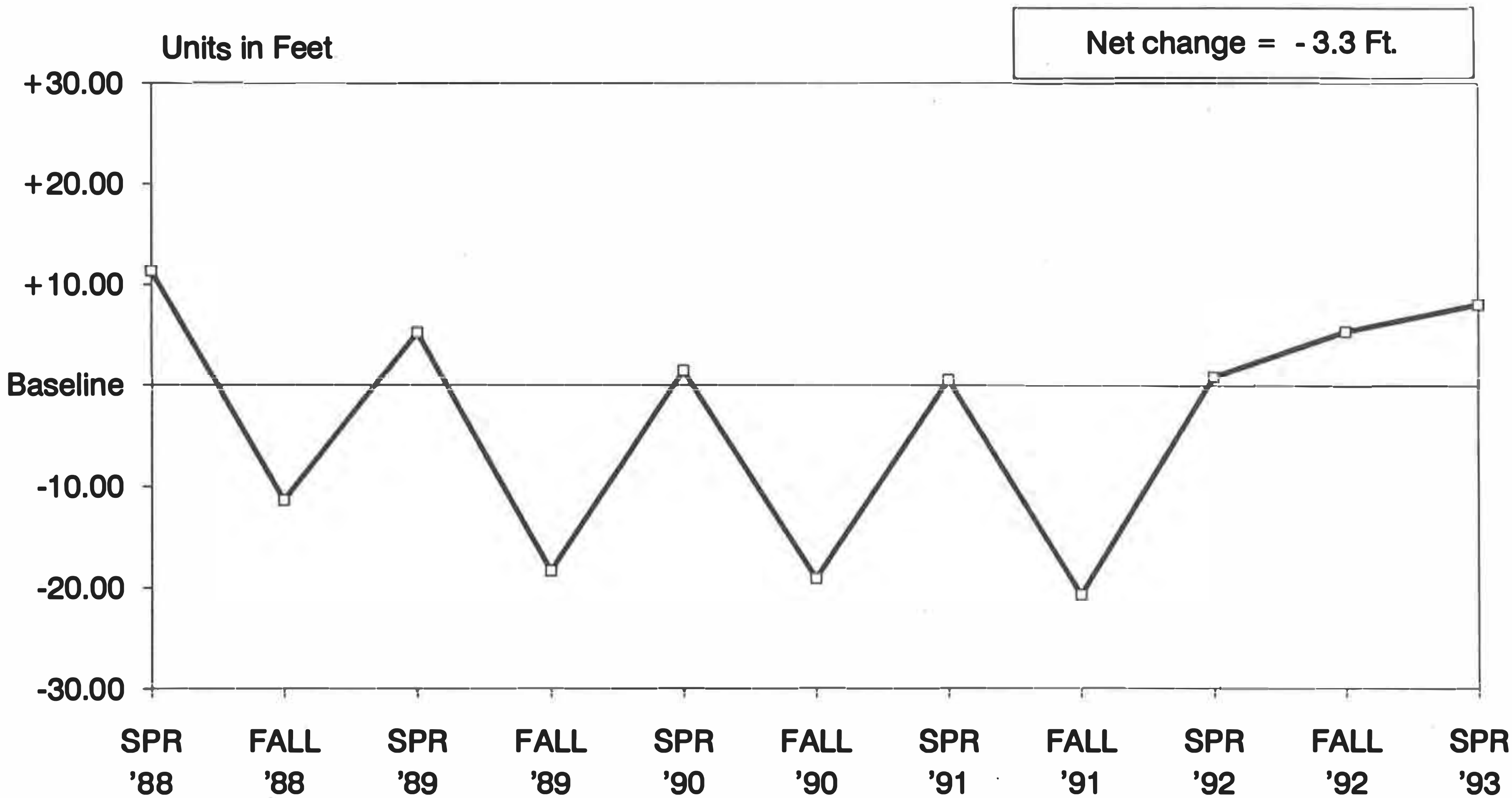
Changes in Water Levels Since 1987 (Baseline)
Well: 25 16N-2E-19CCAD Butler Co. Platte V. Aquifer



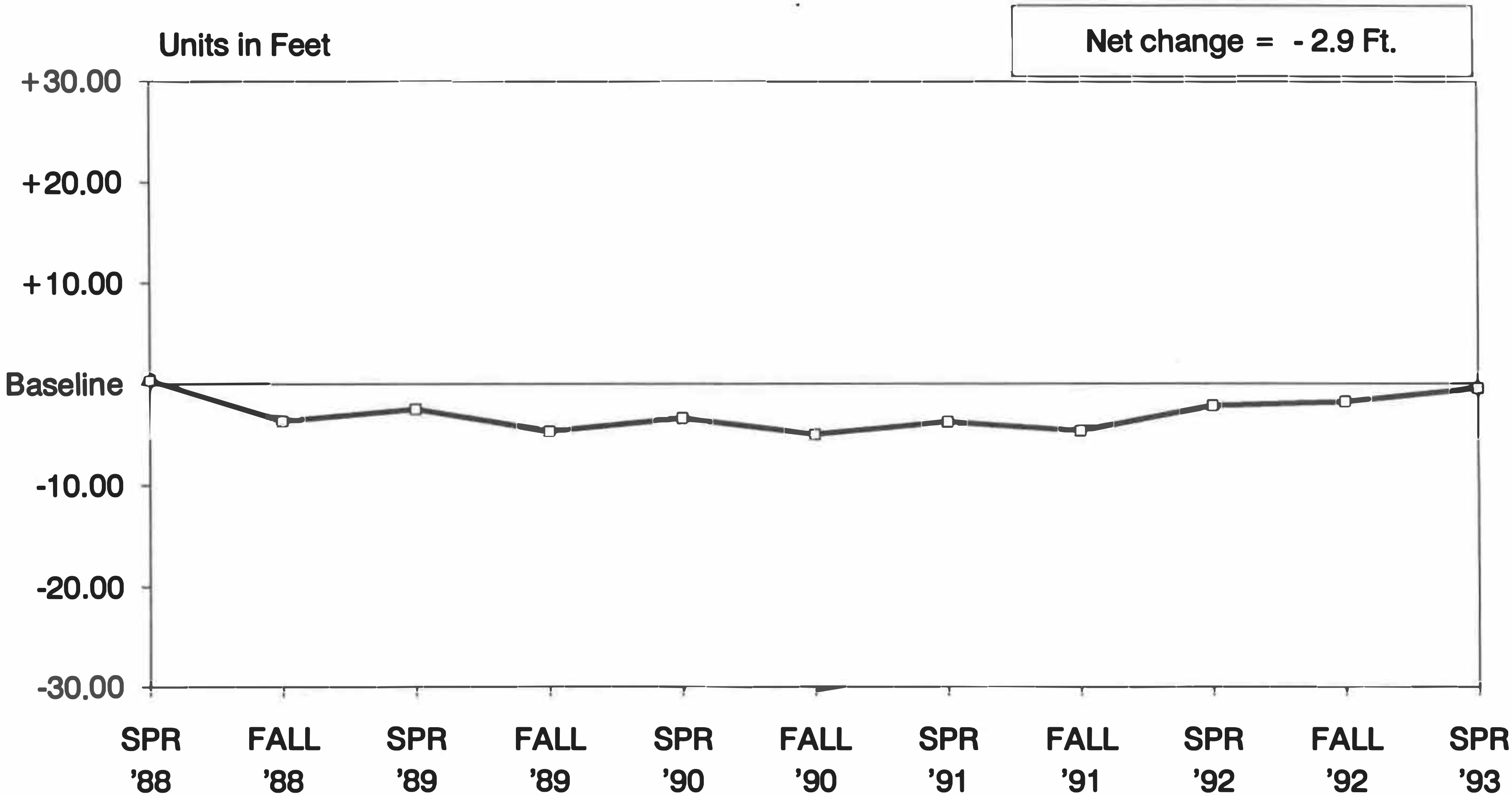
Changes in Water Levels Since 1987 (Baseline)
Well: 26 15N-1E-12CDDC Butler Co. Uplands Aquifer



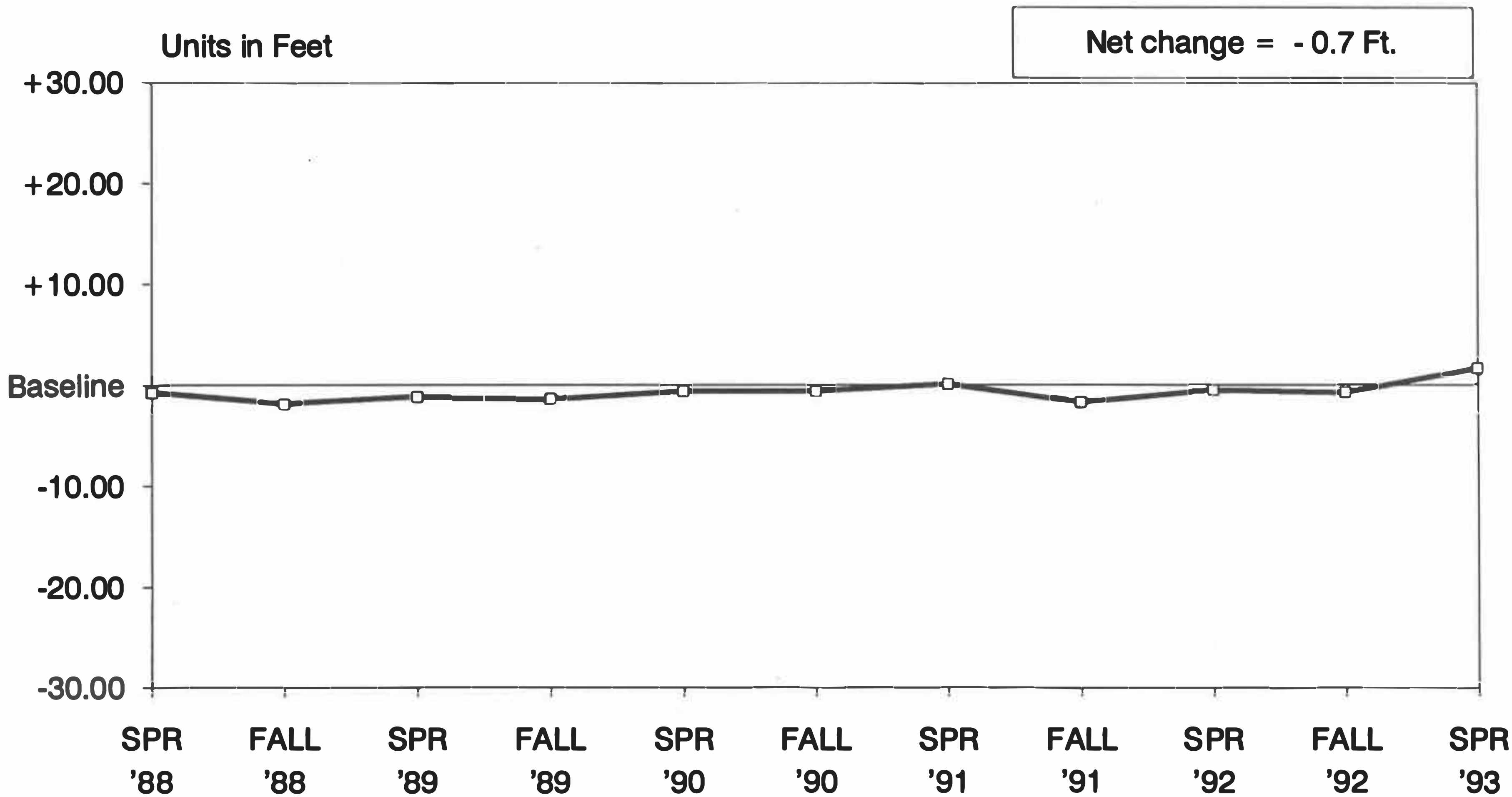
Changes in Water Levels Since 1988 (Baseline)
Well: 27 15N-2E-14AABC Butler Co. Uplands Aquifer



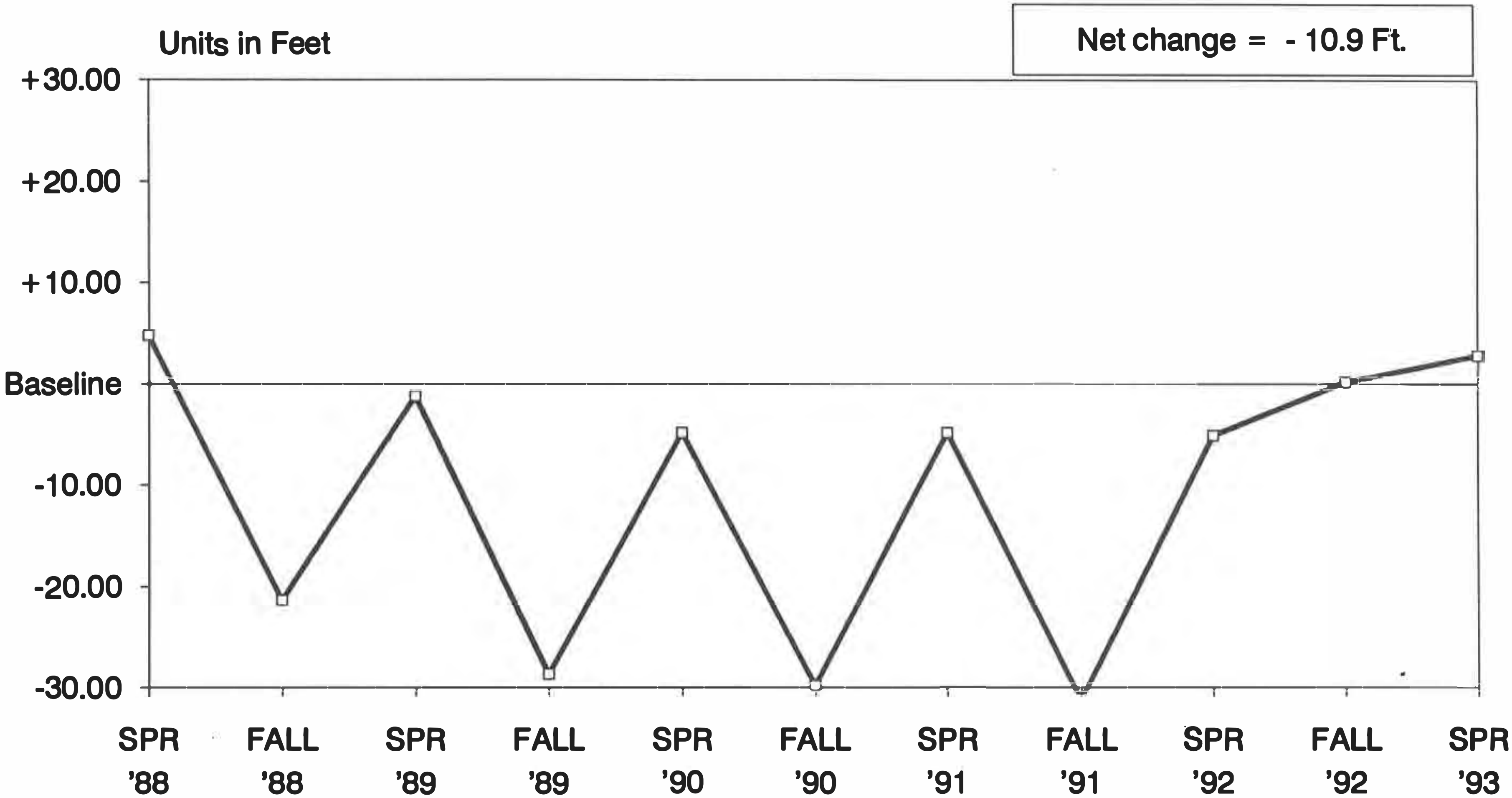
Changes in Water Levels Since 1987 (Baseline)
Well: 28 16N-3E-17DABA Butler Co. Platte V. Aquifer



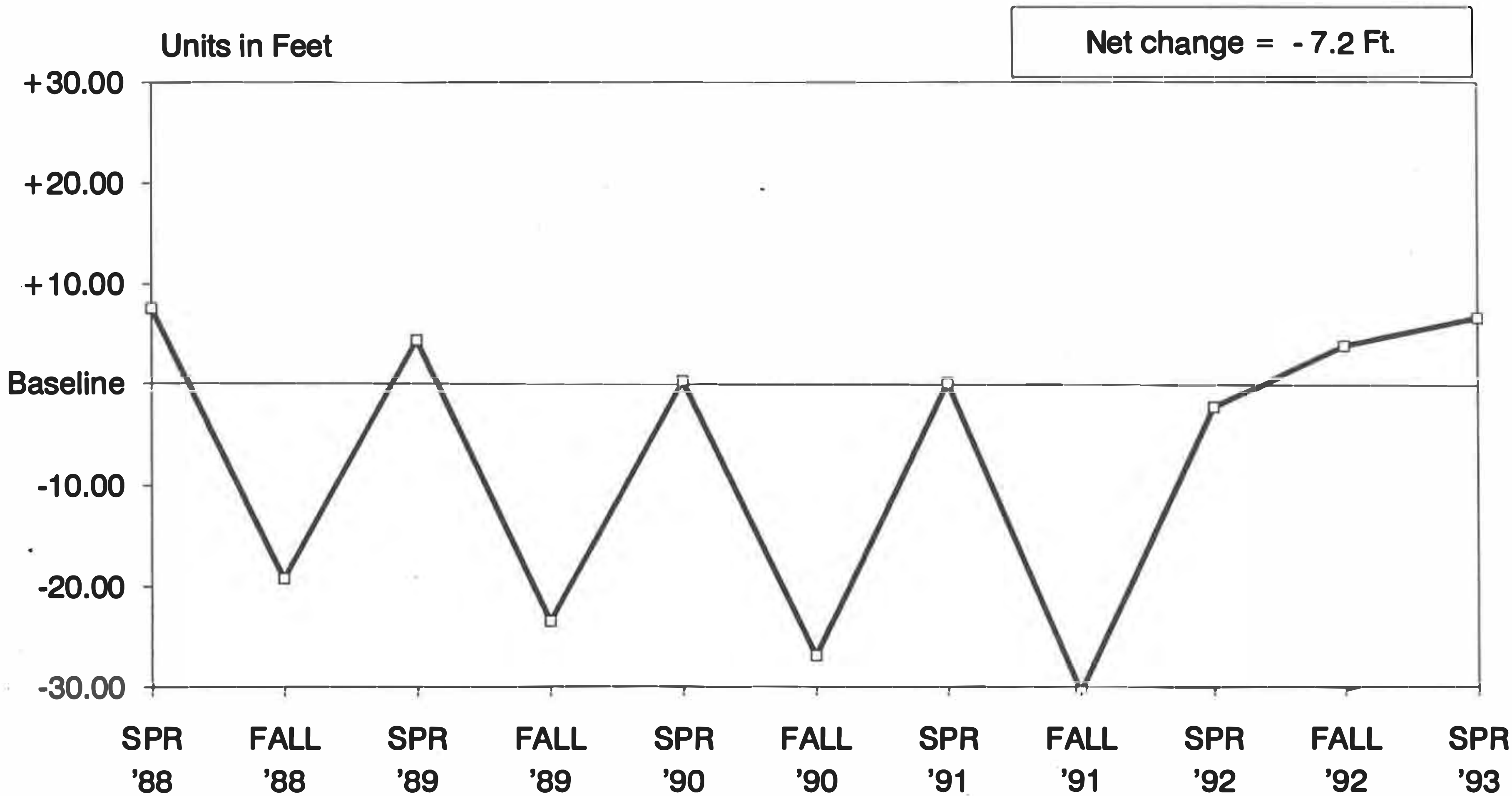
Changes in Water Levels Since 1987 (Baseline)
Well: 29 17N-3E-24CCCC Colfax Co. Platte V. Aquifer



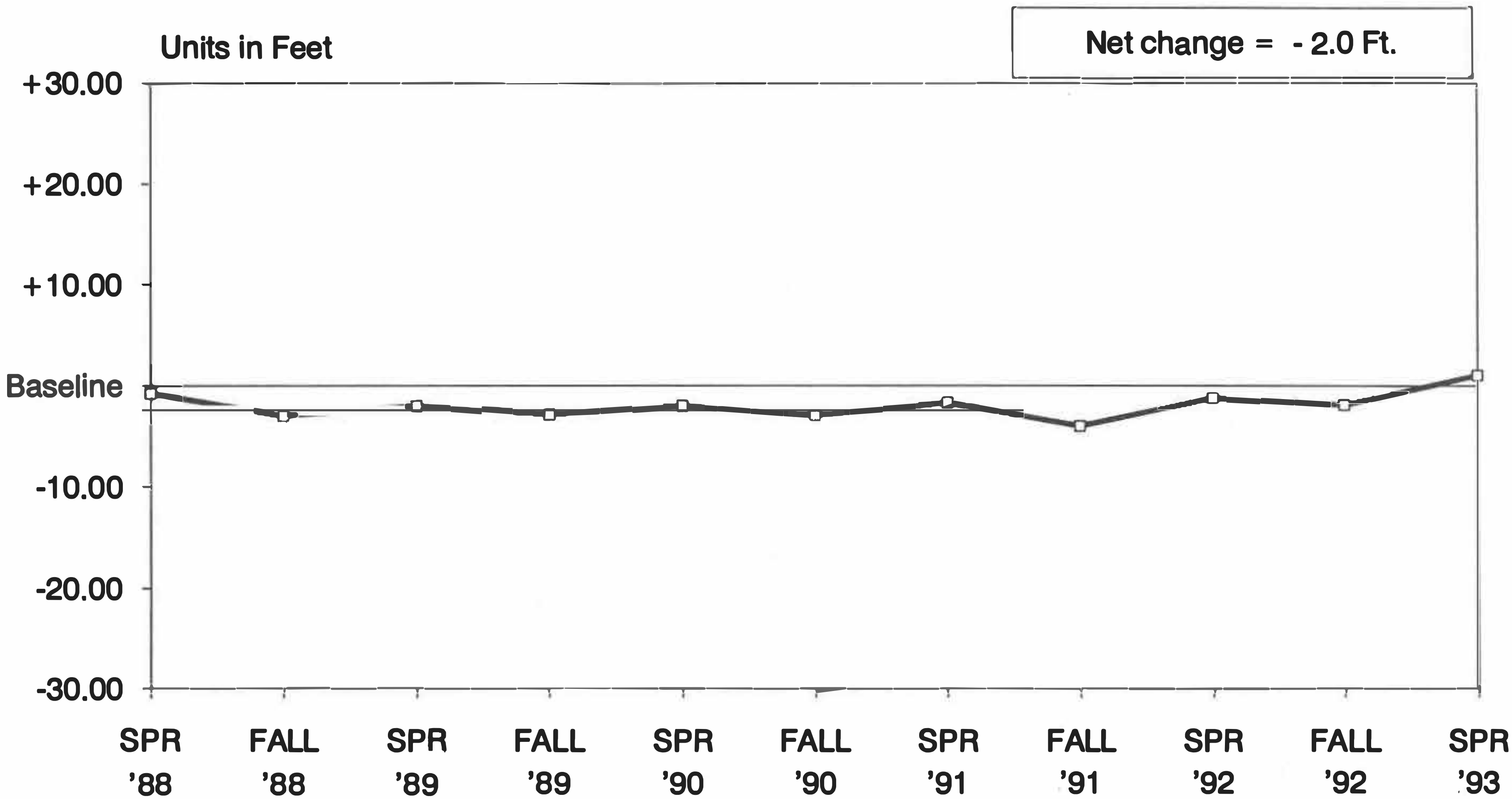
Changes in Water Levels Since 1987 (Baseline)
Well: 30   15N-3E-21ACBB   Butler Co.   Uplands Aquifer



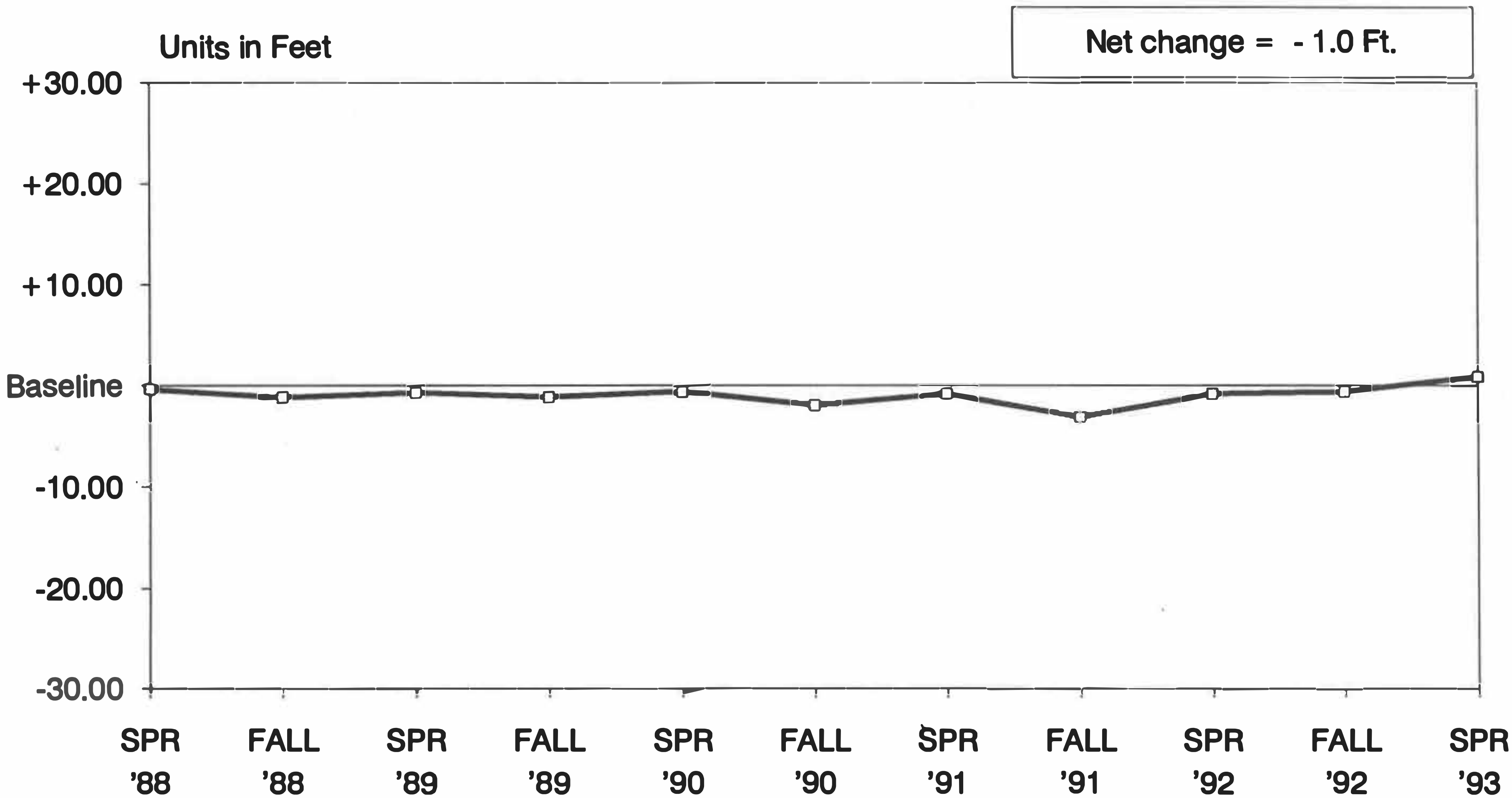
Changes in Water Levels Since 1987 (Baseline)
Well: 31 15N-4E-33CBDA Butler Co. Uplands Aquifer



Changes in Water Levels Since 1987 (Baseline)
Well: 32 17N-5E- 5CCCC Dodge Co. Platte V. Aquifer

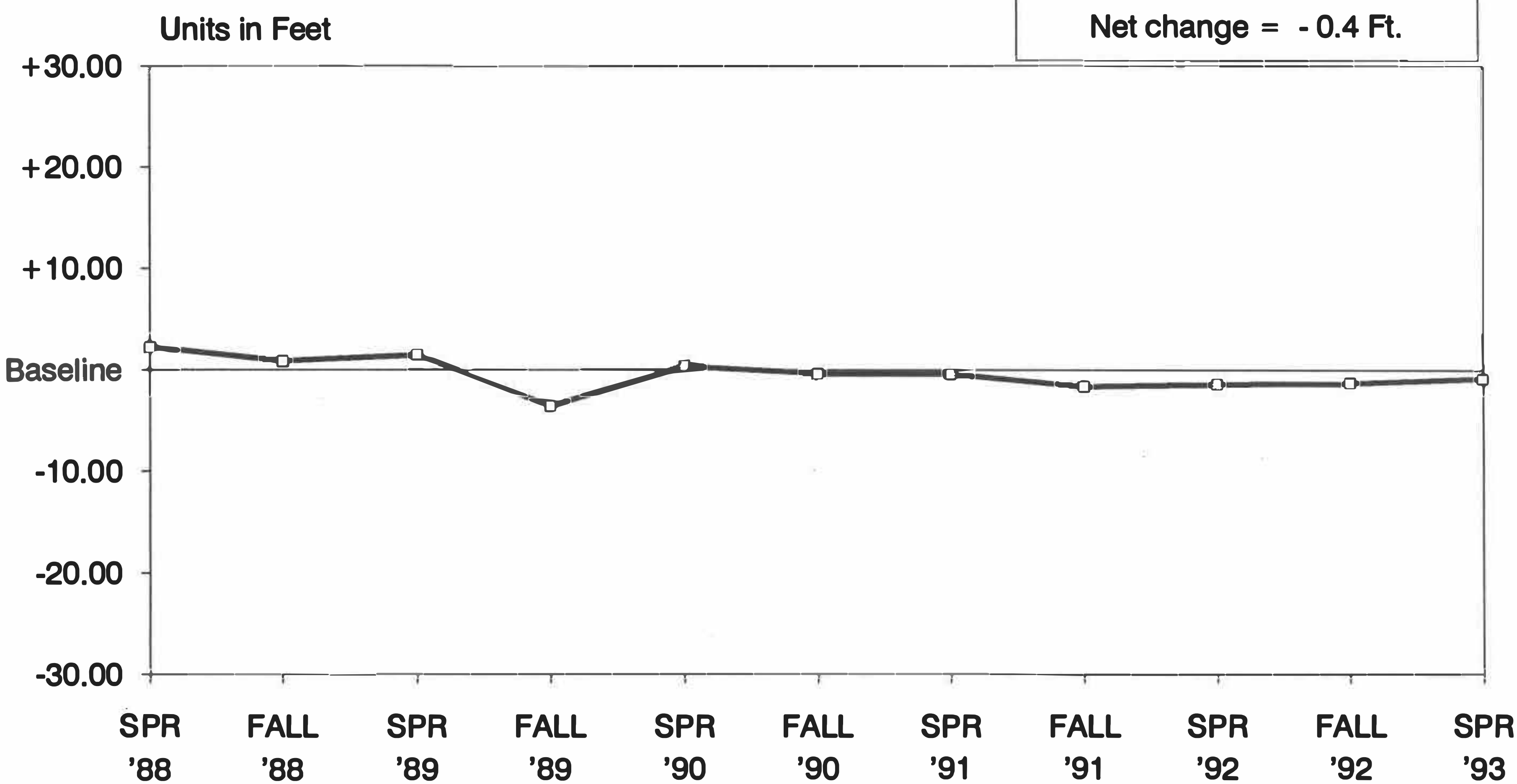


Changes in Water Levels Since 1987 (Baseline)
Well: 33   18N-5E-22DCCB   Dodge Co.   Platte V. Aquifer

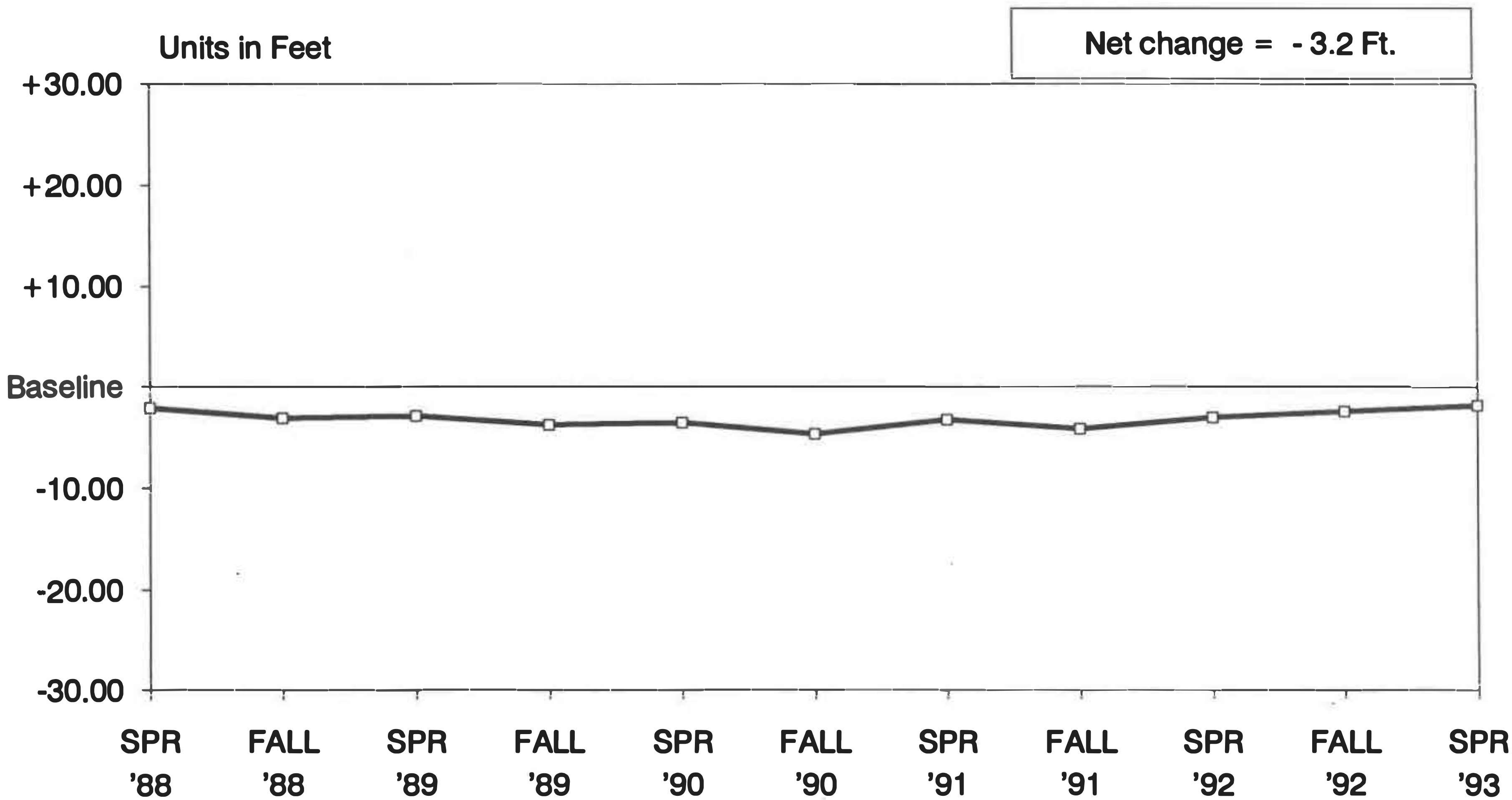


Changes in Water Levels Since 1987 (Baseline)
Well: 34 14N-6E- 6AACD Saunders Co. Uplands Aquifer

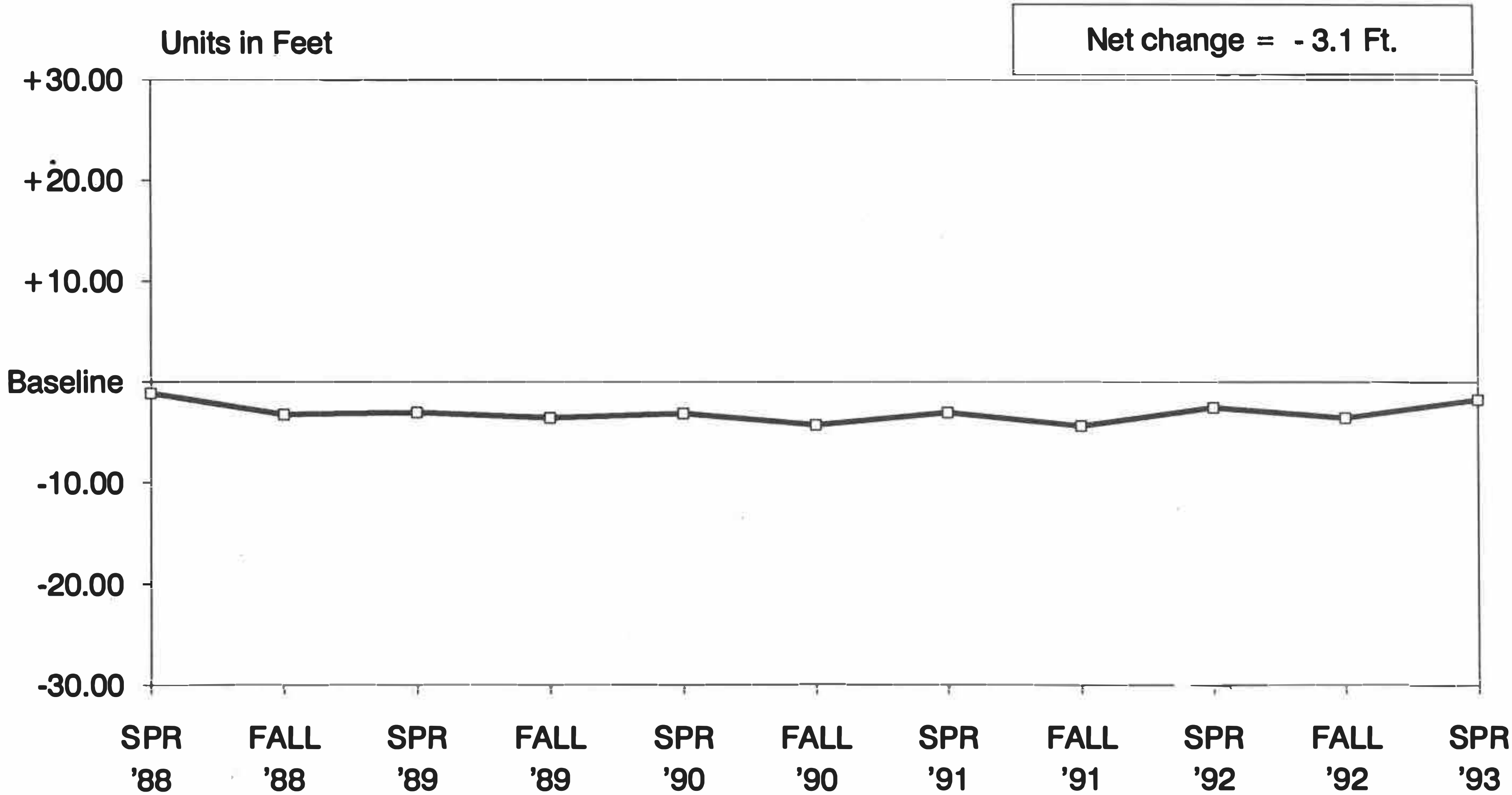
Net change = - 0.4 Ft.



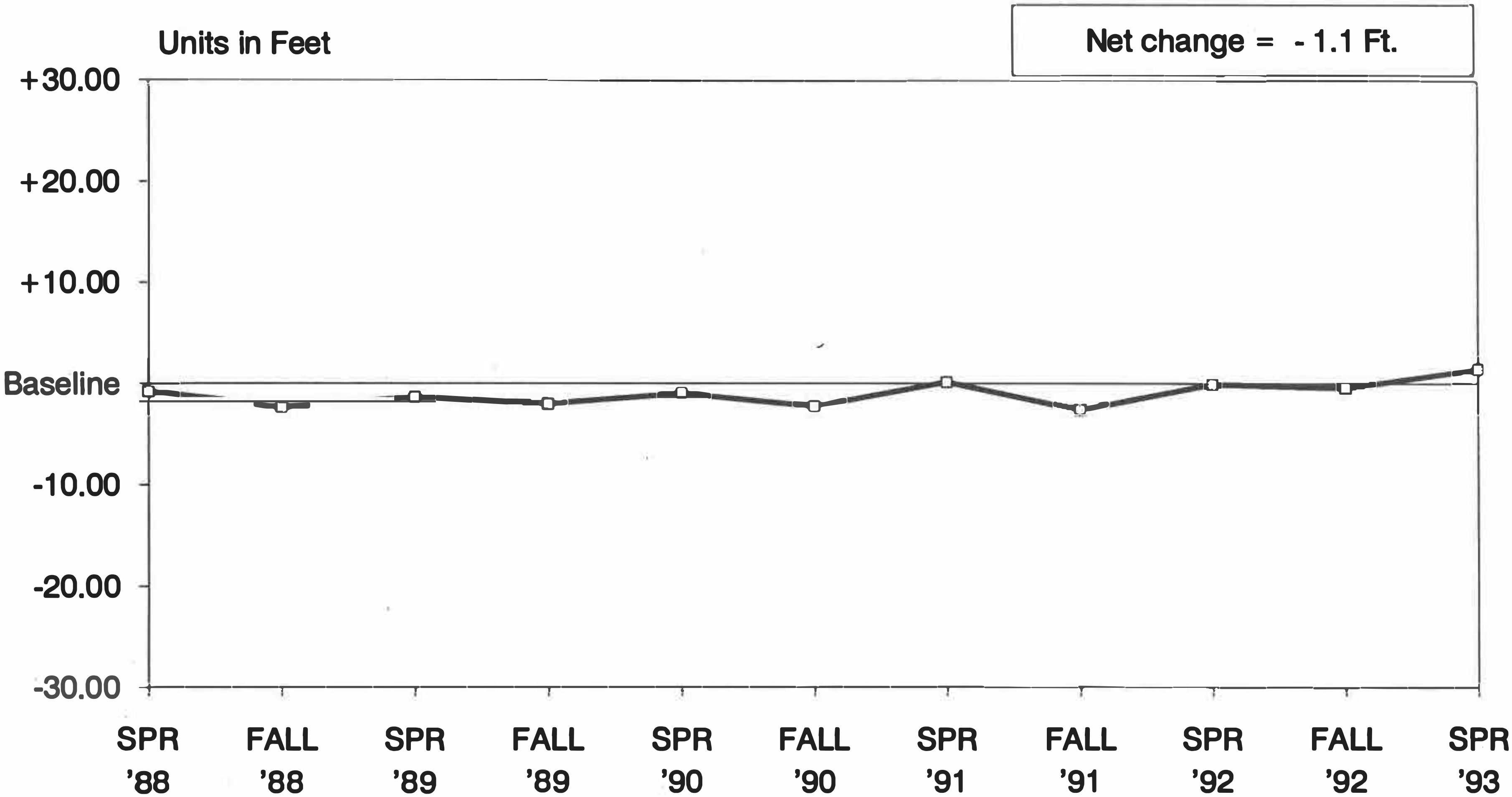
Changes in Water Levels Since 1987 (Baseline)
Well: 35 14N-6E-18DDBC Saunders Co. Uplands Aquifer



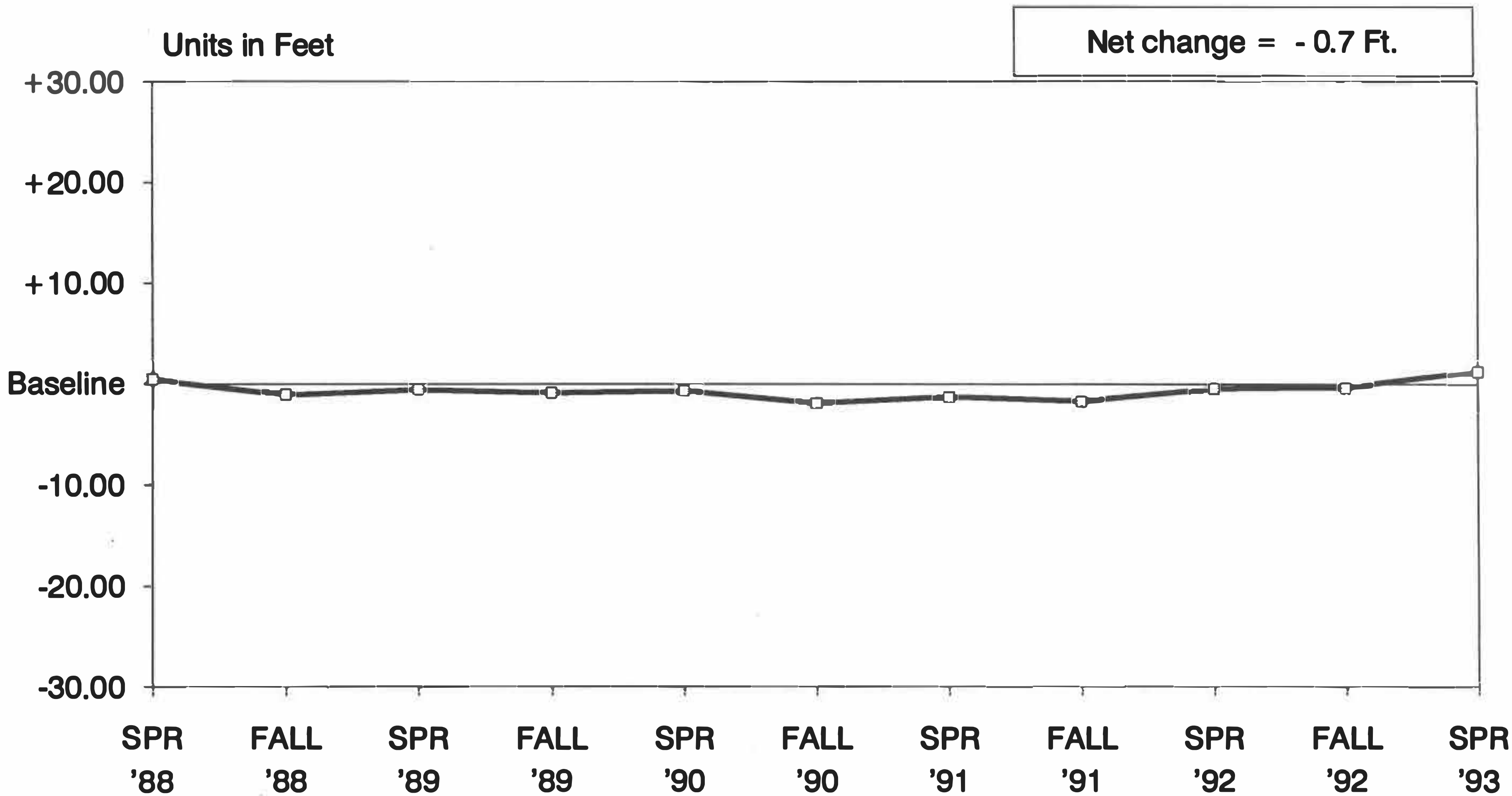
Changes in Water Levels Since 1987 (Baseline)
Well: 36 14N-7E-17BACB Saunders Co. Uplands Aquifer



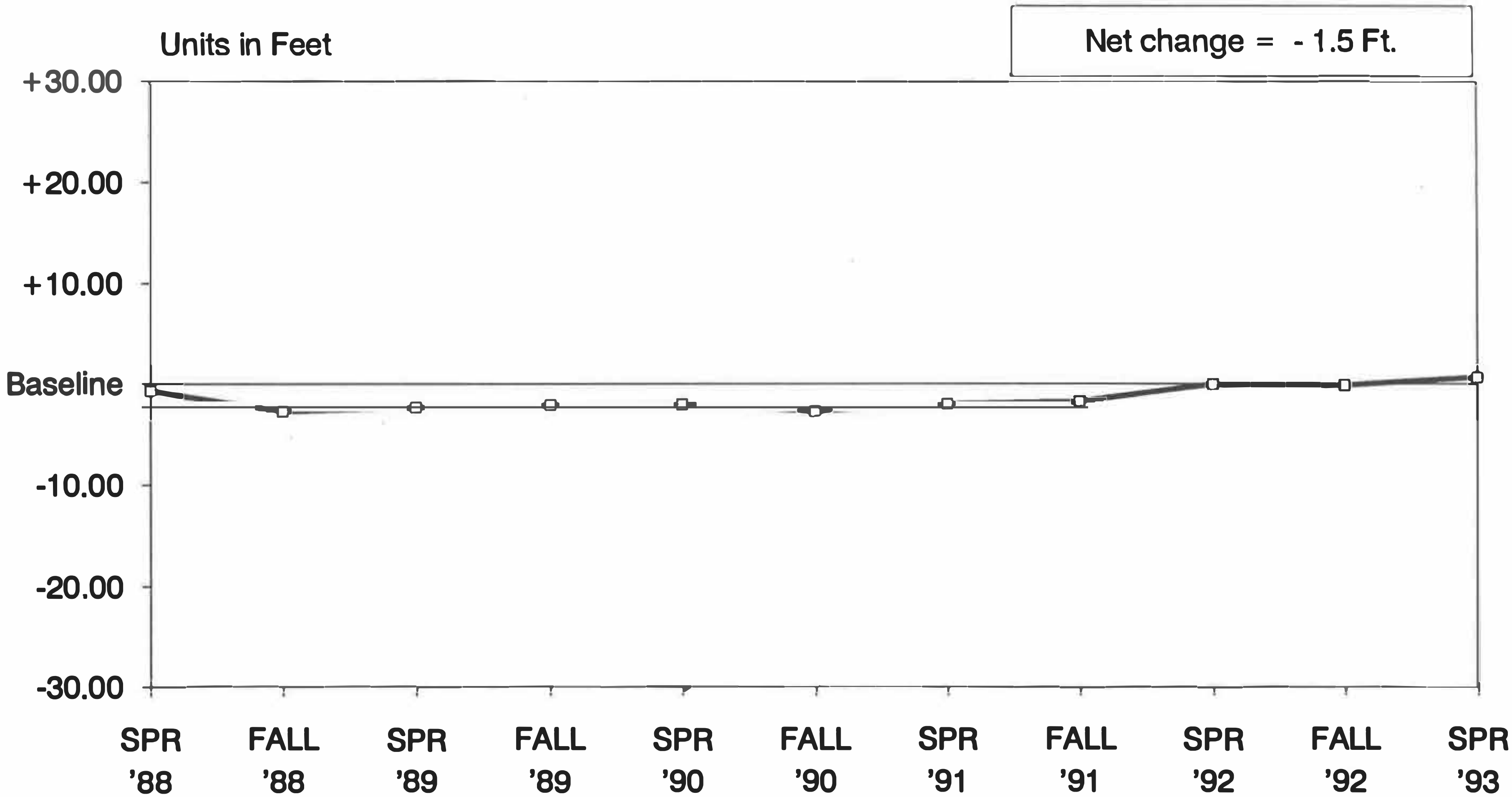
Changes in Water Levels Since 1987 (Baseline)
Well: 37 17N-6E-10BCBB Dodge Co. Platte V. Aquifer



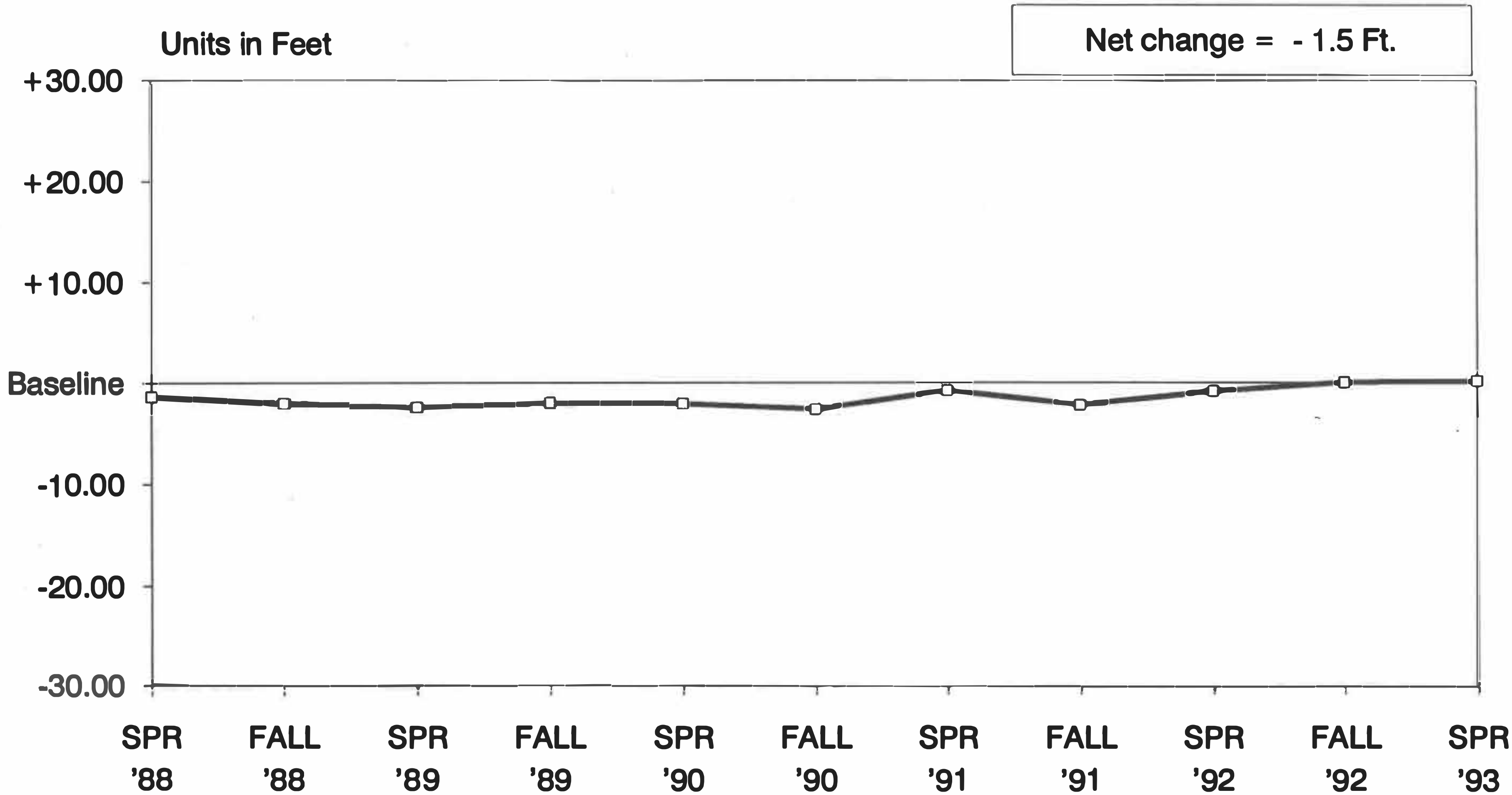
Changes in Water Levels Since 1987 (Baseline)
Well: 38 17N-5E-19CCCB Saunders Co. Platte V. Aquifer



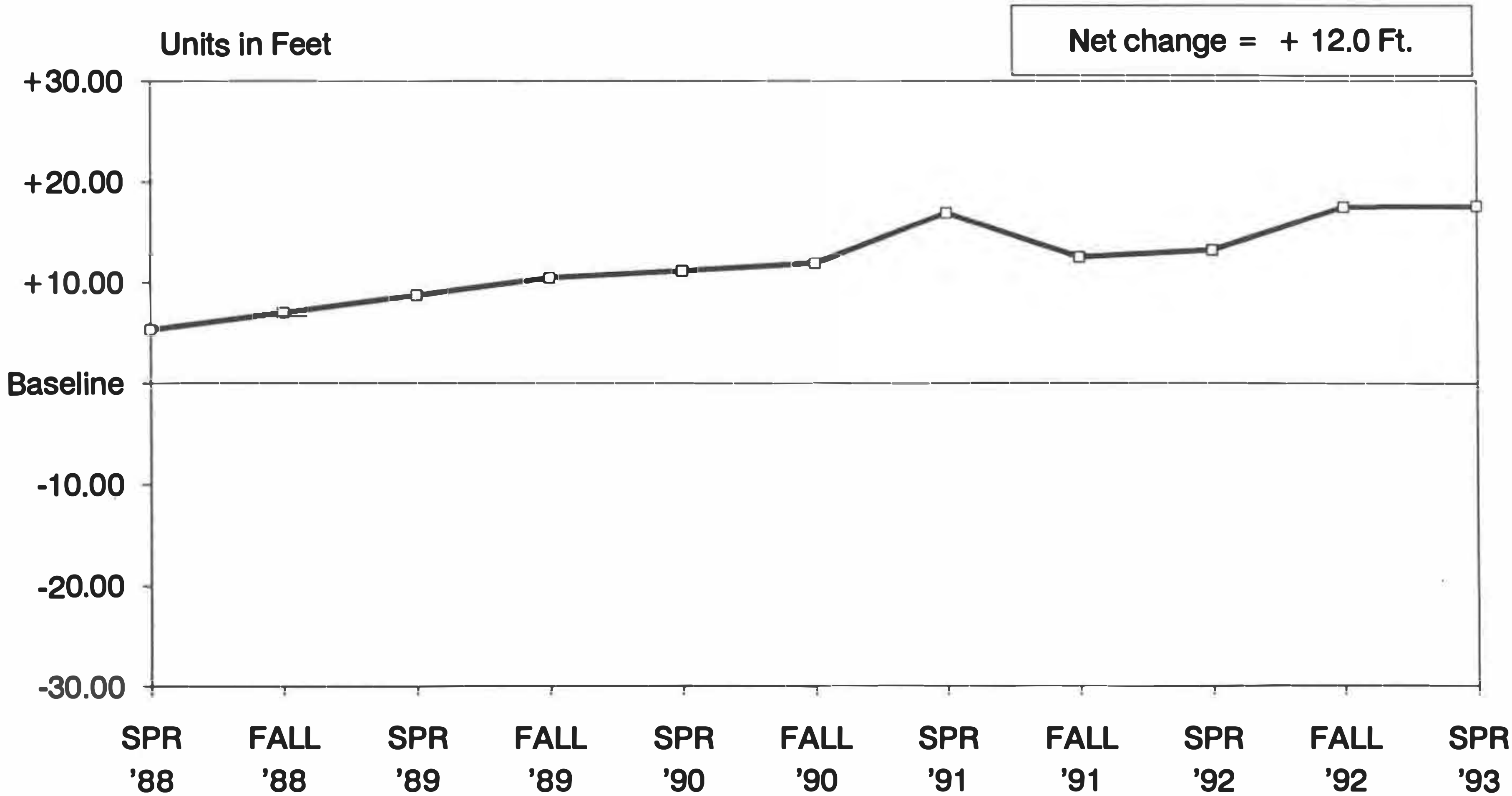
Changes in Water Levels Since 1987 (Baseline)
Well: 39 17N-8E- 8CCCC Dodge Co. Platte V. Aquifer



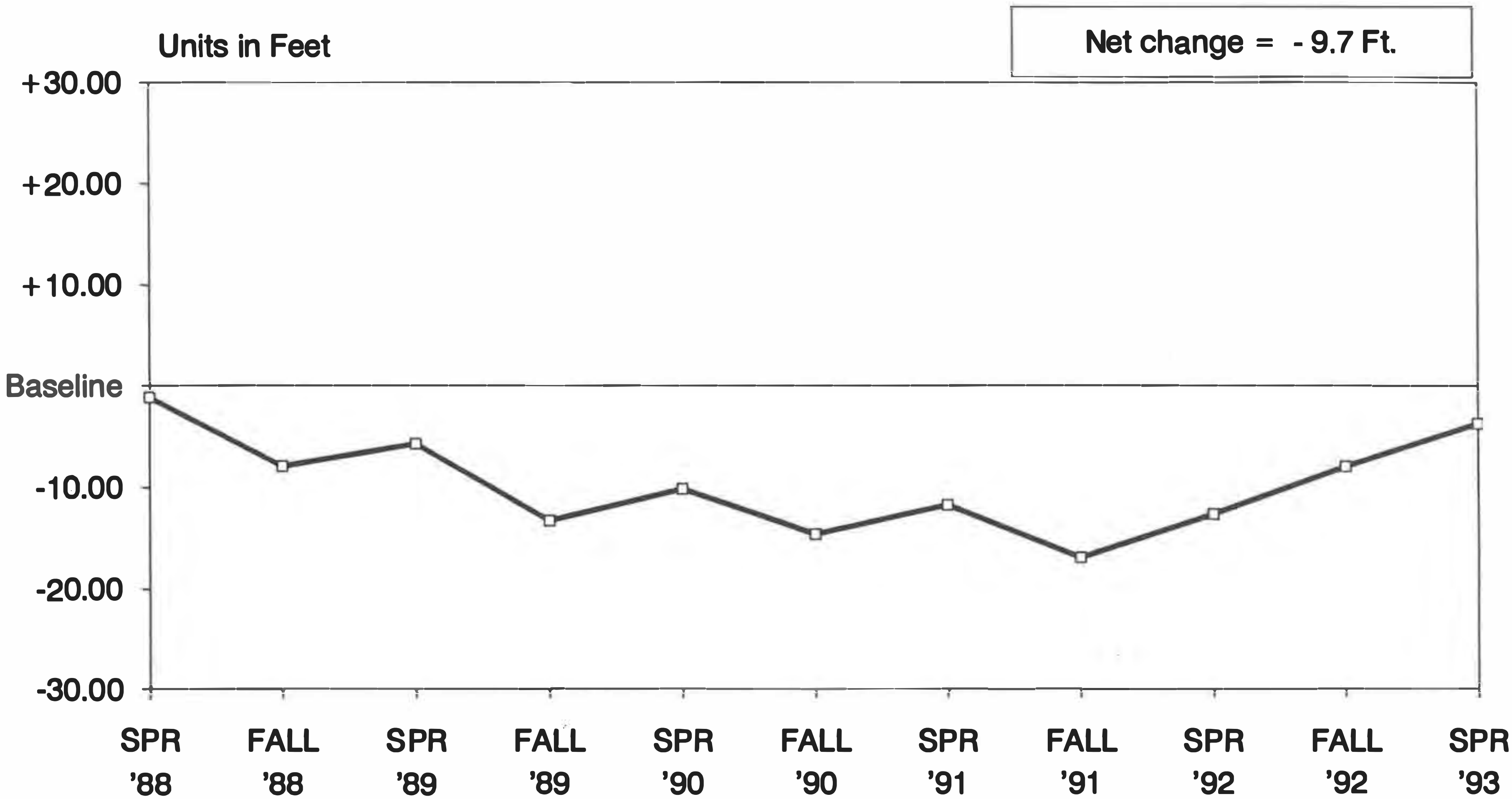
Changes in Water Levels Since 1987 (Baseline)
Well: 40 18N-8E-36CBBB Dodge Co. Platte V. Aquifer



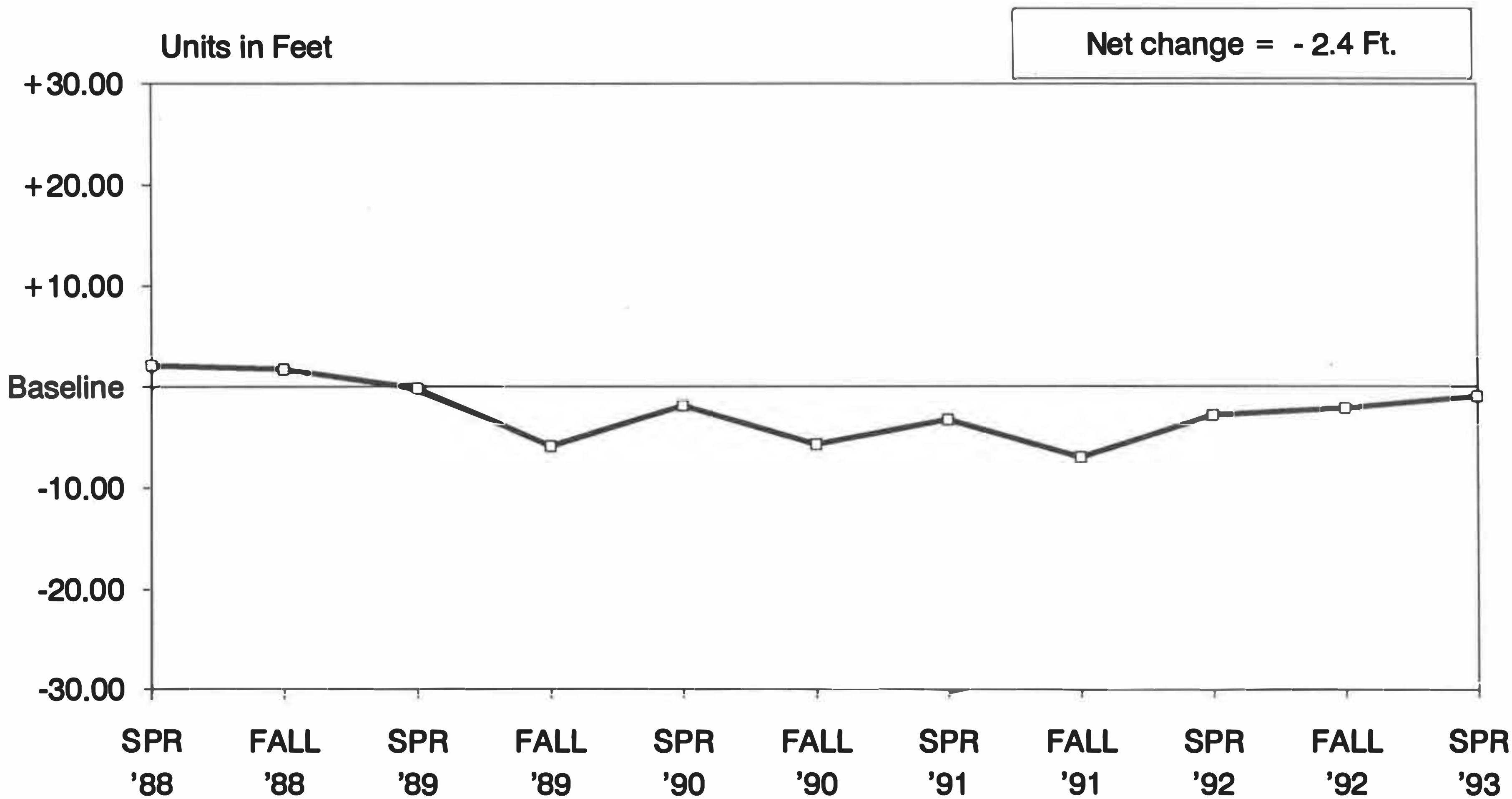
Changes in Water Levels Since 1987 (Baseline)
Well: 41 15N-5E- 9AACB Saunders Co. Uplands Aquifer



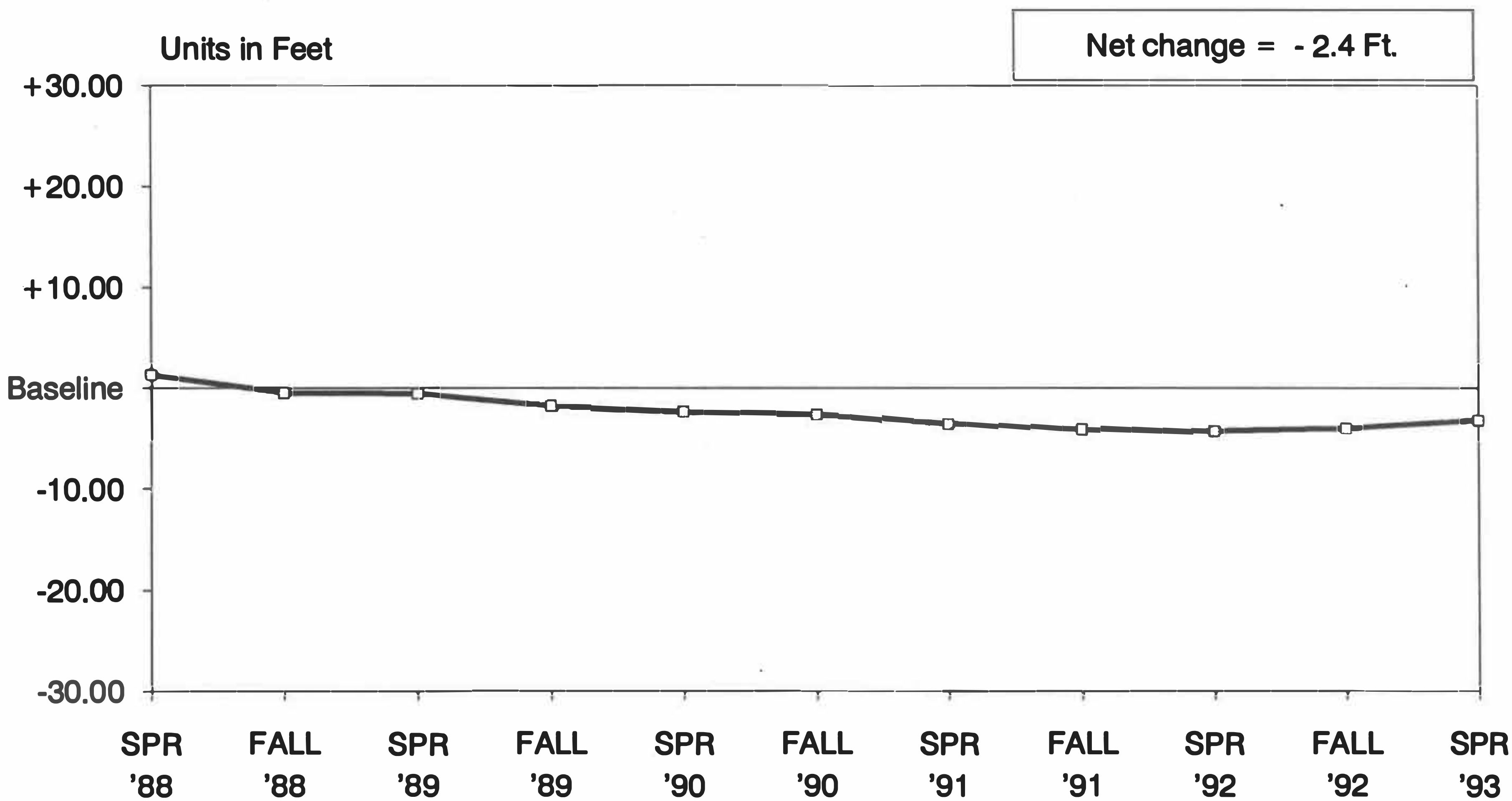
Changes in Water Levels Since 1987 (Baseline)
Well: 42 16N-6E- 7AABB Saunders Co. Uplands Aquifer



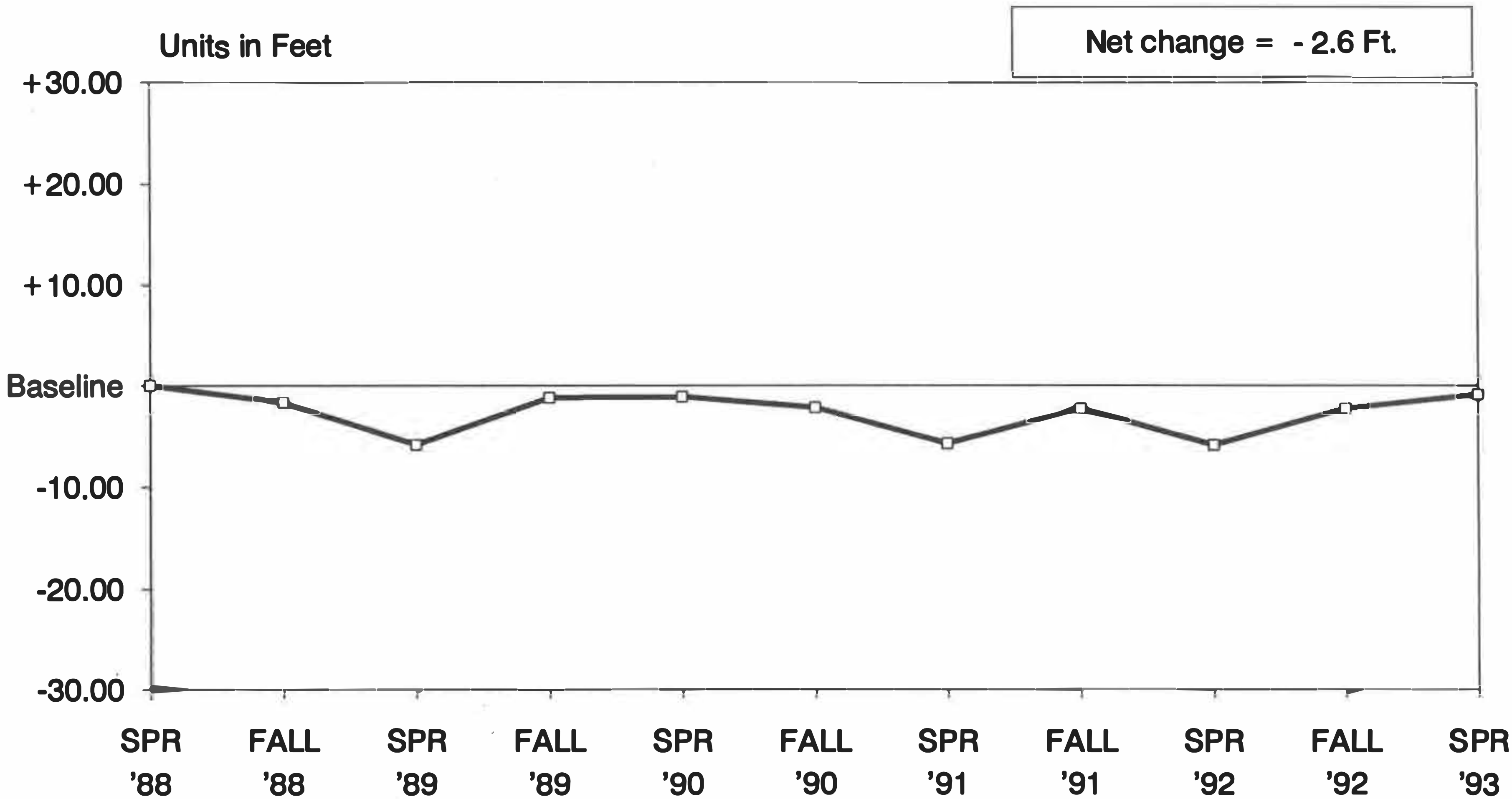
Changes in Water Levels Since 1987 (Baseline)
Well: 43 17N-7E-36AACC Saunders Co. Uplands Aquifer



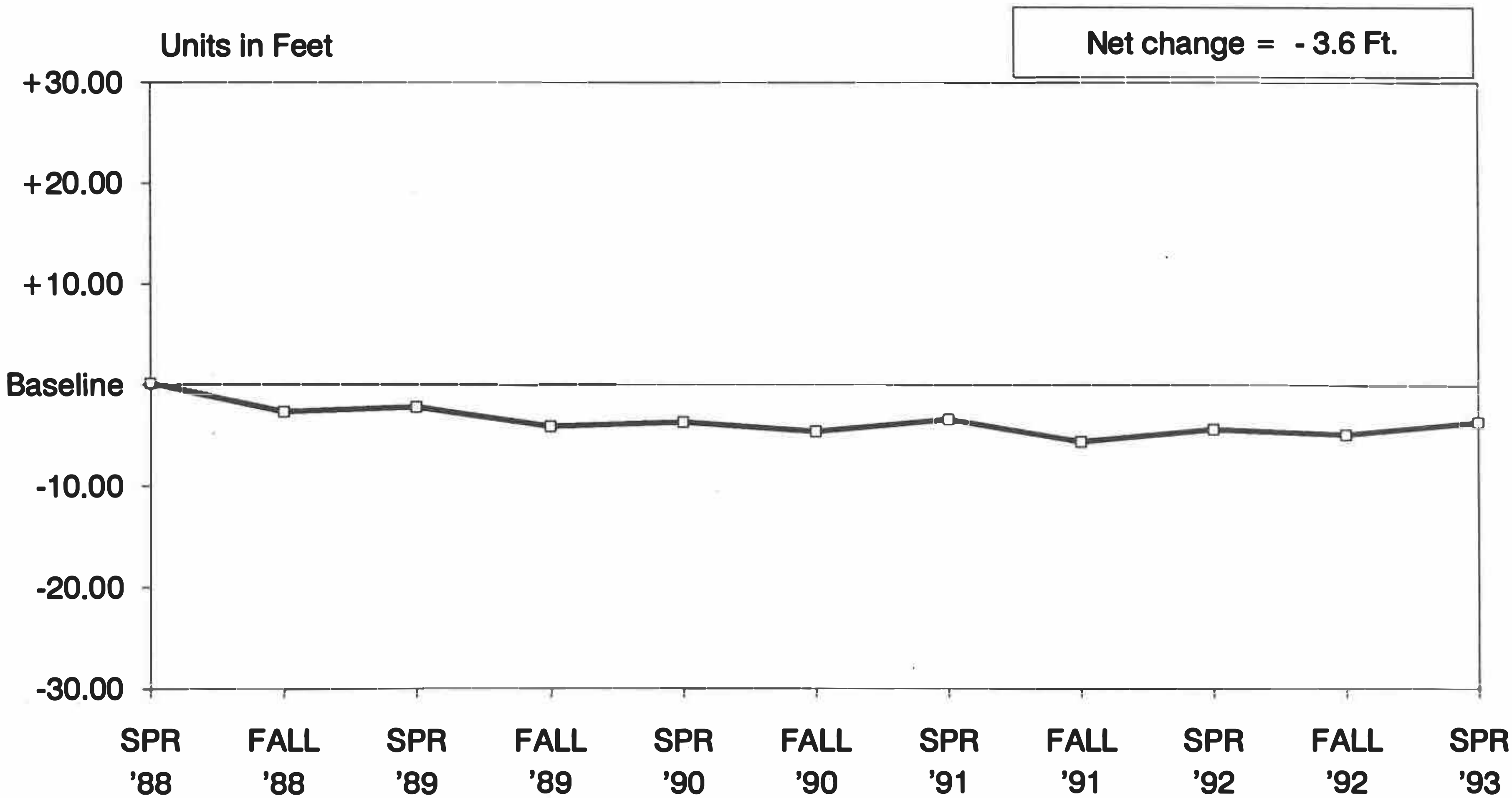
Changes in Water Levels Since 1987 (Baseline)
Well: 44 16N-8E-22CDAA Saunders Co. Uplands Aquifer



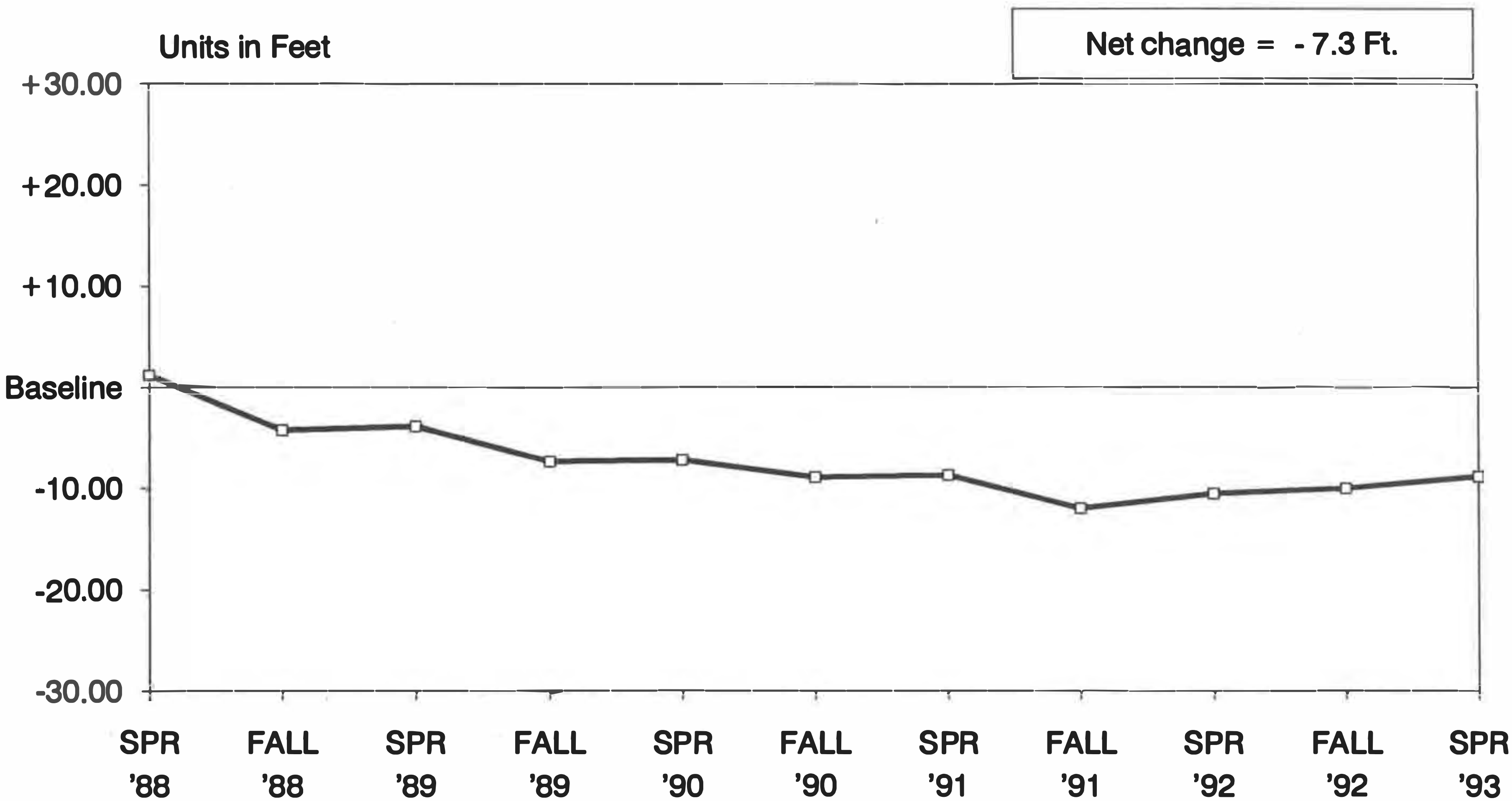
Changes in Water Levels Since 1987 (Baseline)
Well: 46 16N-9E-29CDAA Saunders Co. Uplands Aquifer

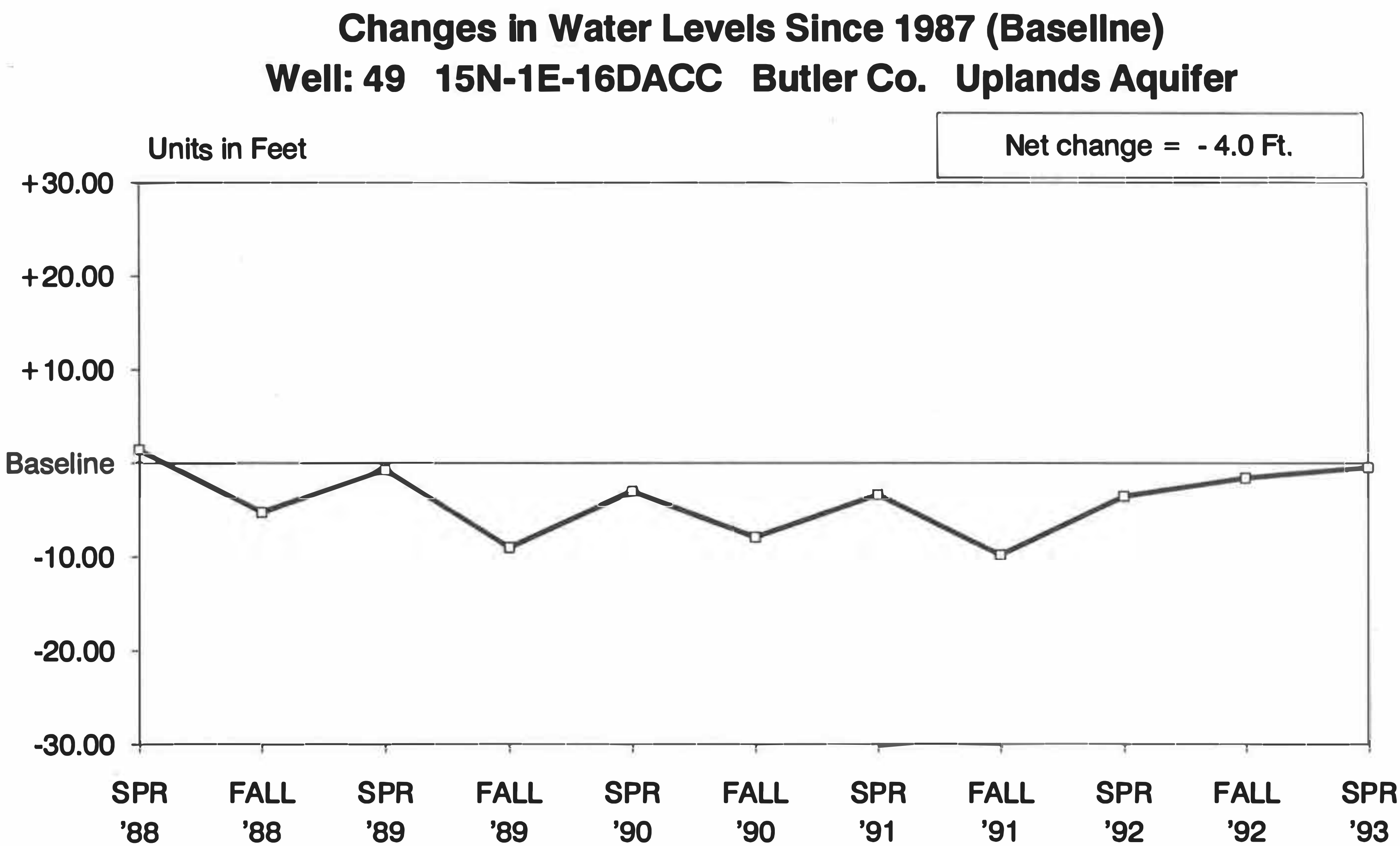


Changes in Water Levels Since 1987 (Baseline)
Well: 47 15N-9E-22CDBB Saunders Co. Uplands Aquifer

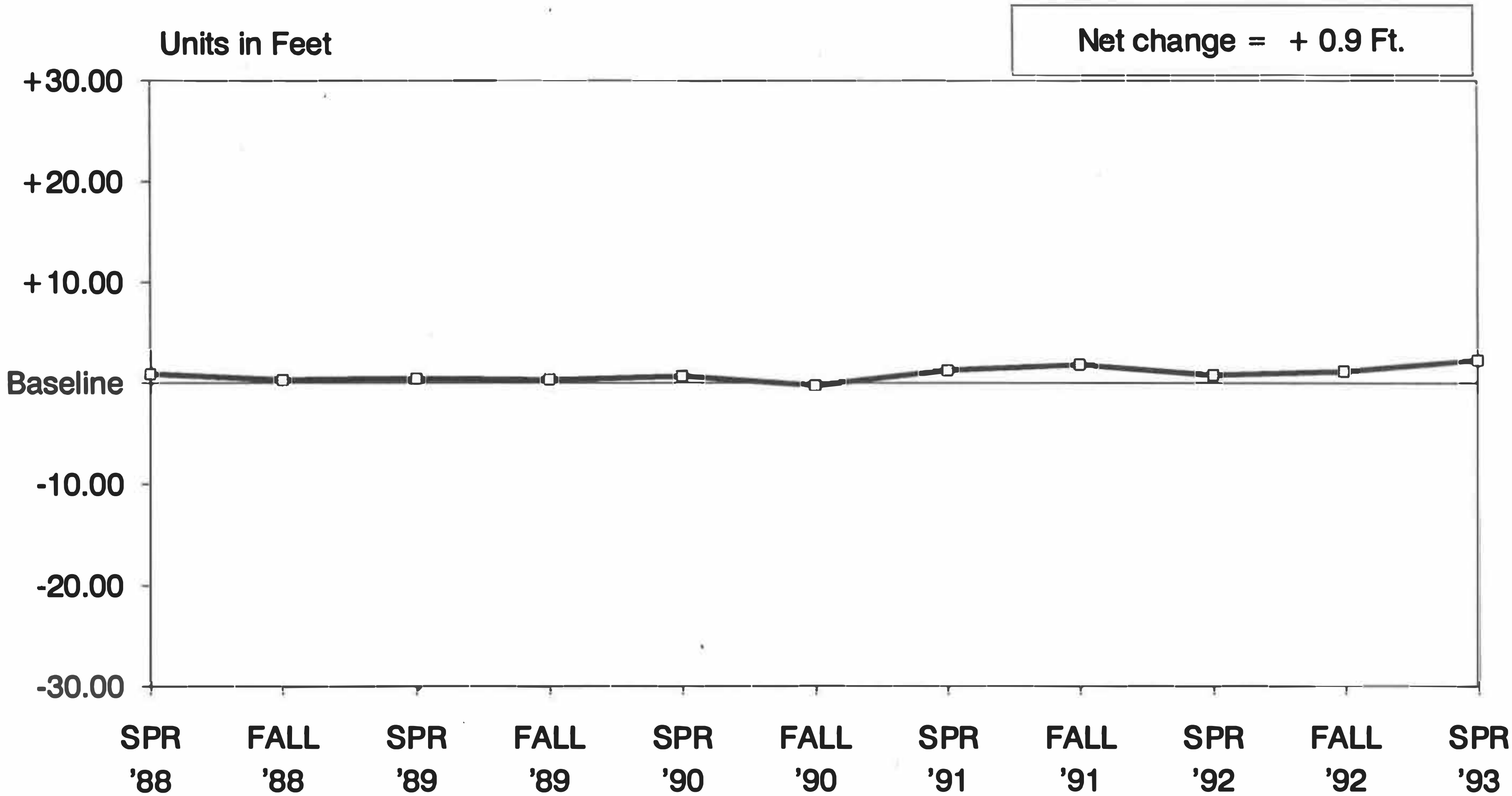


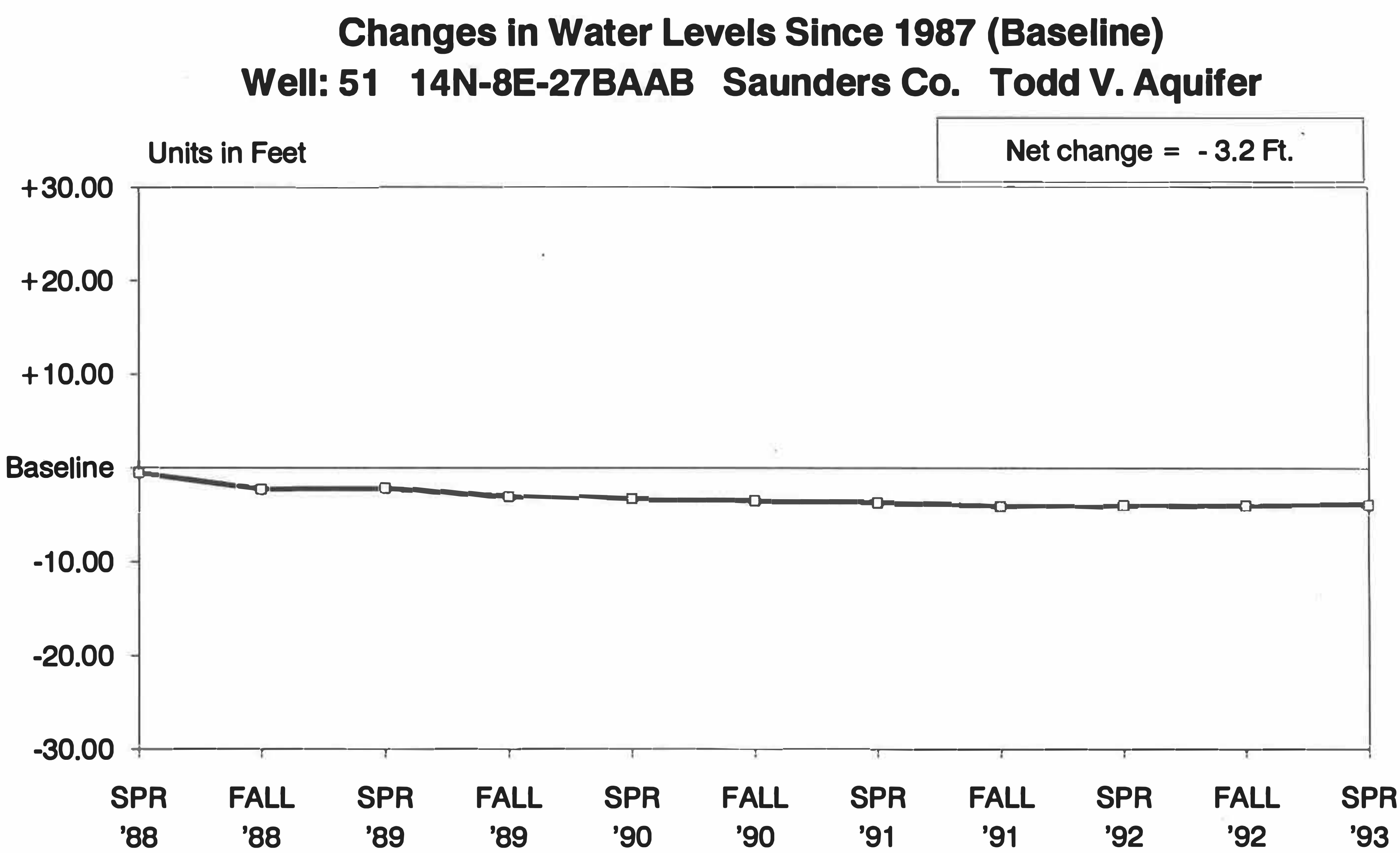
Changes in Water Levels Since 1987 (Baseline)
Well: 48 15N-8E-13DAAB Saunders Co. Uplands Aquifer



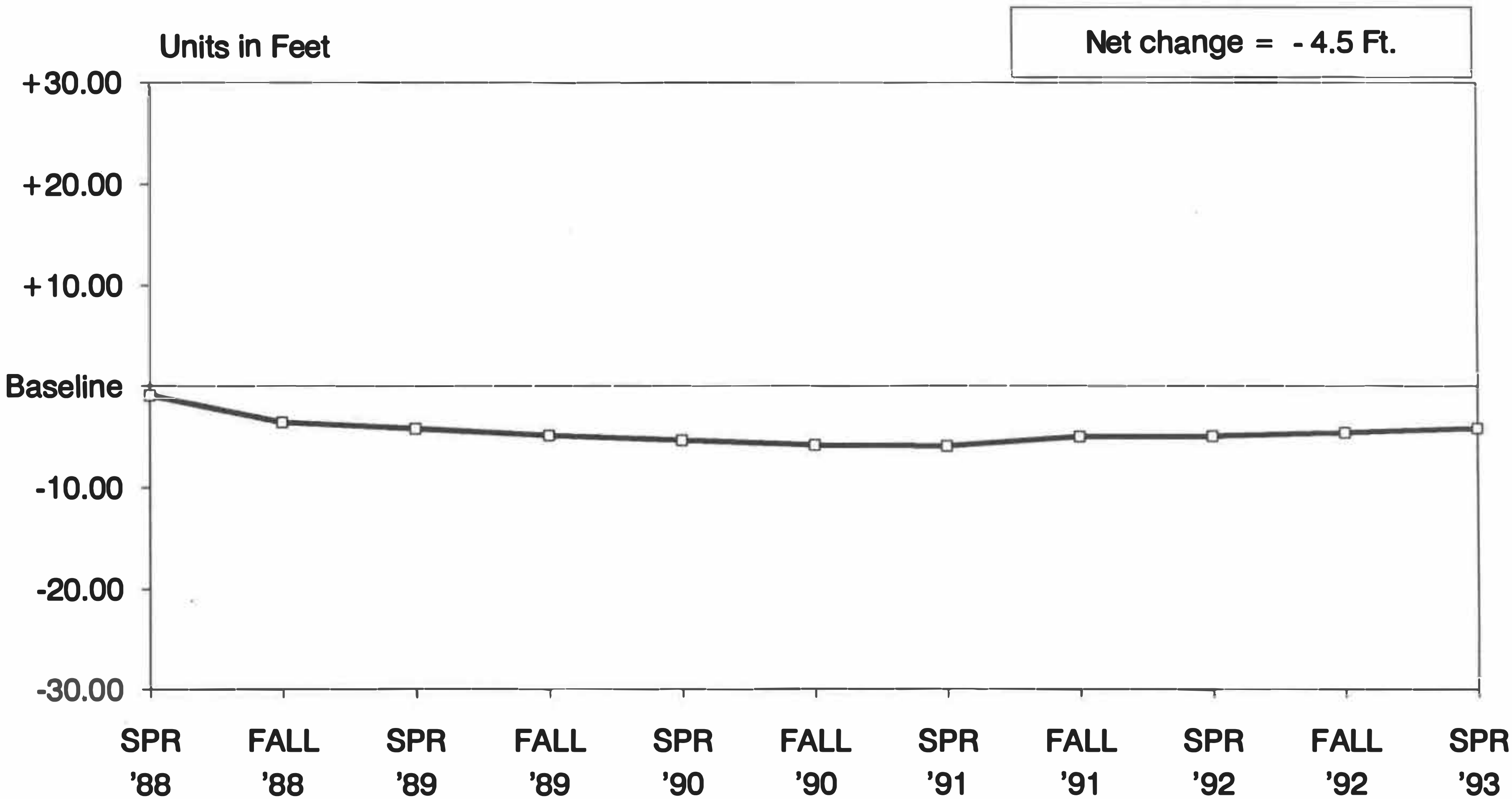

Changes in Water Levels Since 1987 (Baseline)
Well: 49 15N-1E-16DACC Butler Co. Uplands Aquifer
Units in Feet
Net change = - 4.0 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

Changes in Water Levels Since 1987 (Baseline)
Well: 50 17N-6E-21CABB Saunders Co. Platte V. Aquifer

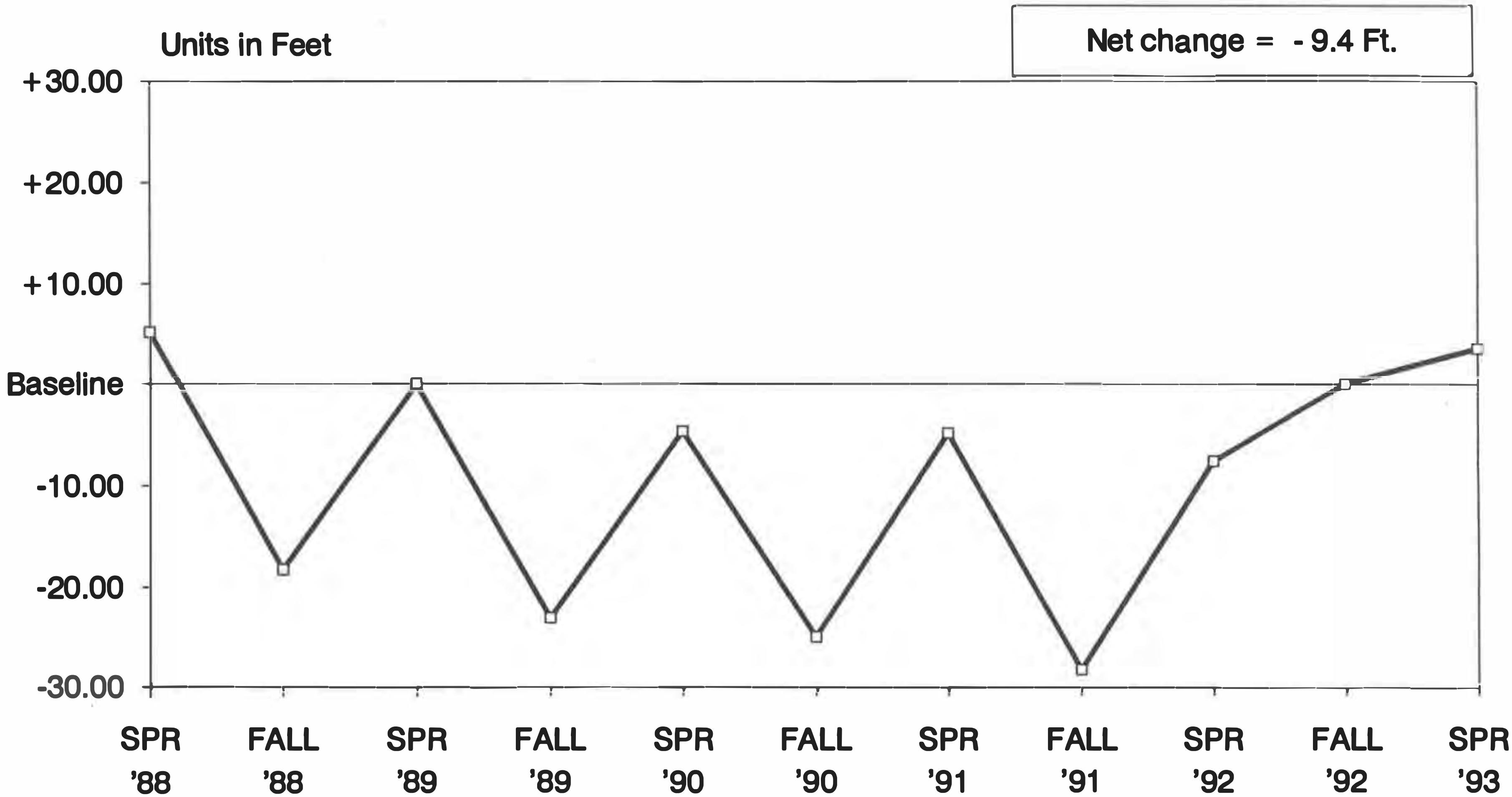



Changes in Water Levels Since 1987 (Baseline)
Well: 51 14N-8E-27BAAB Saunders Co. Todd V. Aquifer
Units in Feet
Net change = - 3.2 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

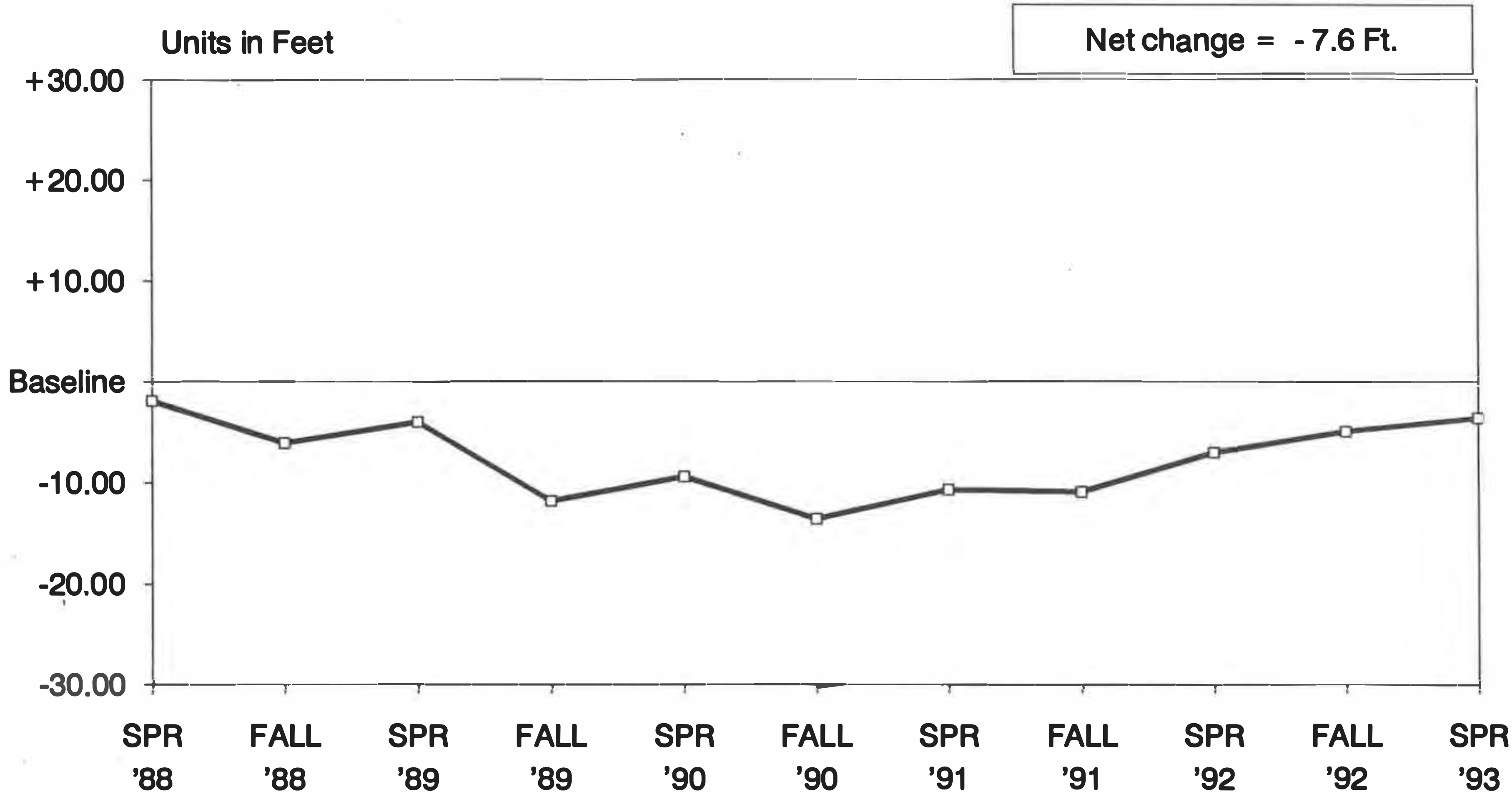
Changes in Water Levels Since 1987 (Baseline)
Well: 52 15N-7E- 3CABB Saunders Co. Todd V. Aquifer



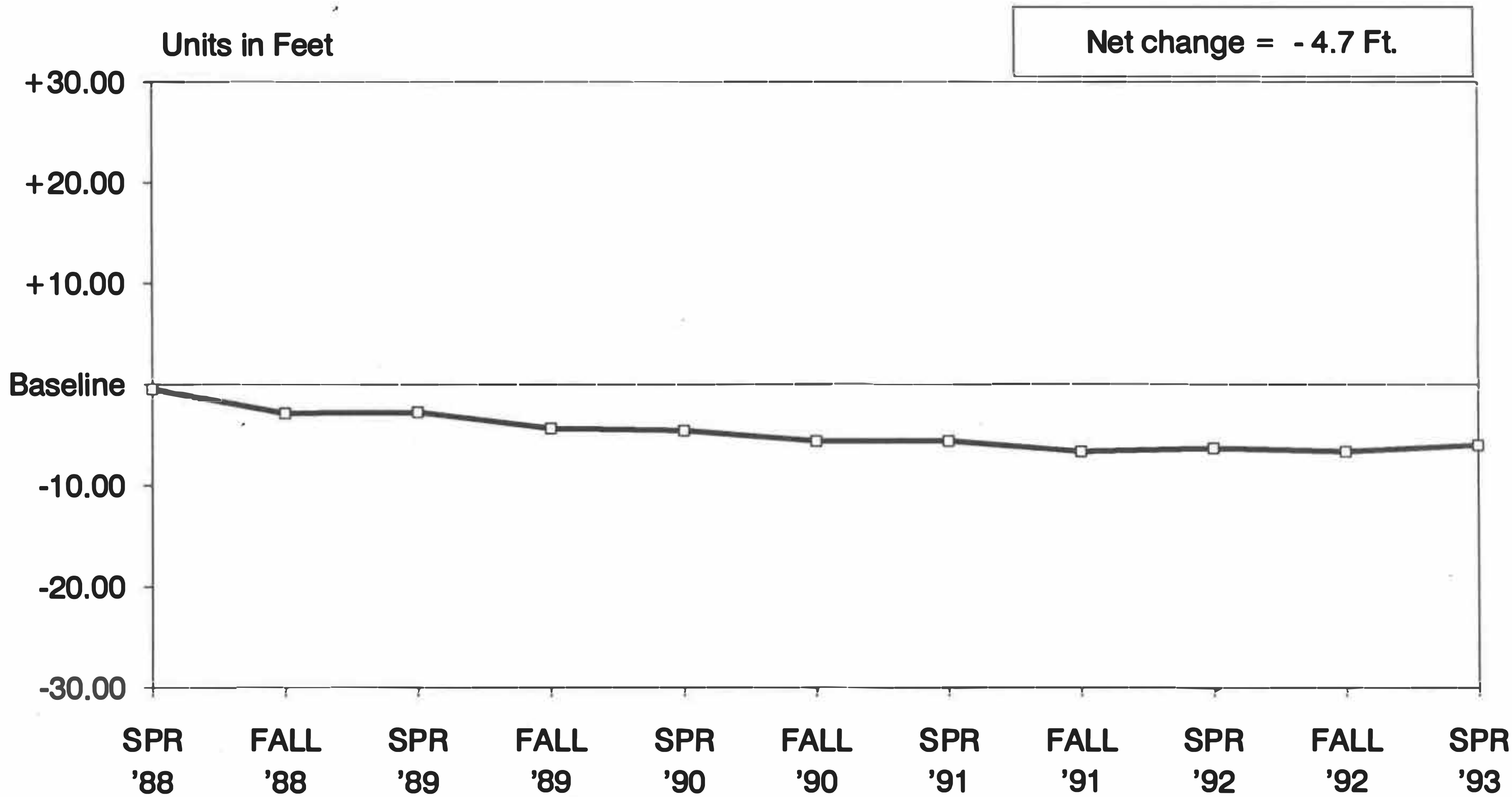
Changes in Water Levels Since 1987 (Baseline)
Well: 53 16N-4E-32DAAA Butler Co. Uplands Aquifer

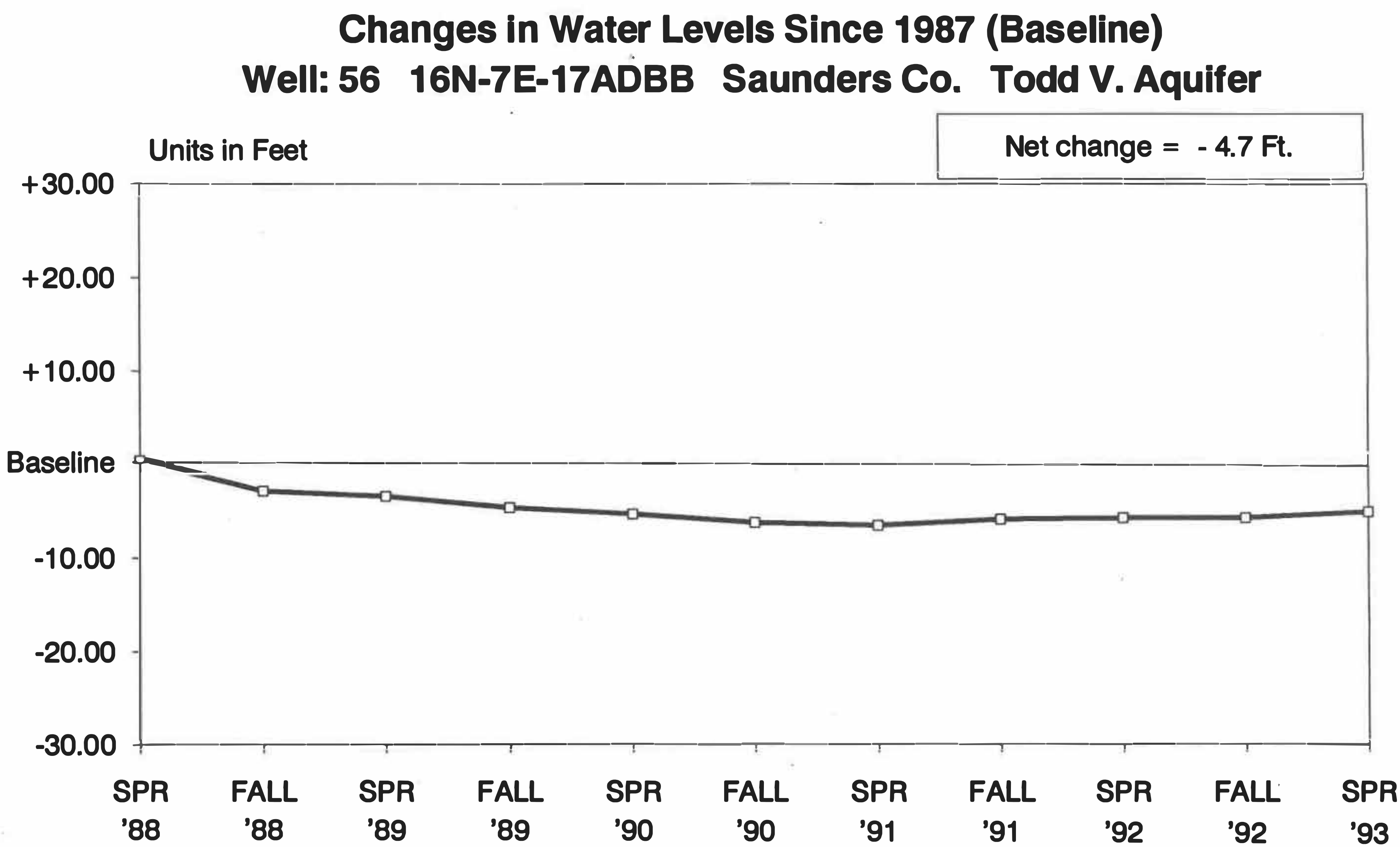


Changes in Water Levels Since 1987 (Baseline)
Well: 54 16N-6E-34CDBA Saunders Co. Uplands Aquifer

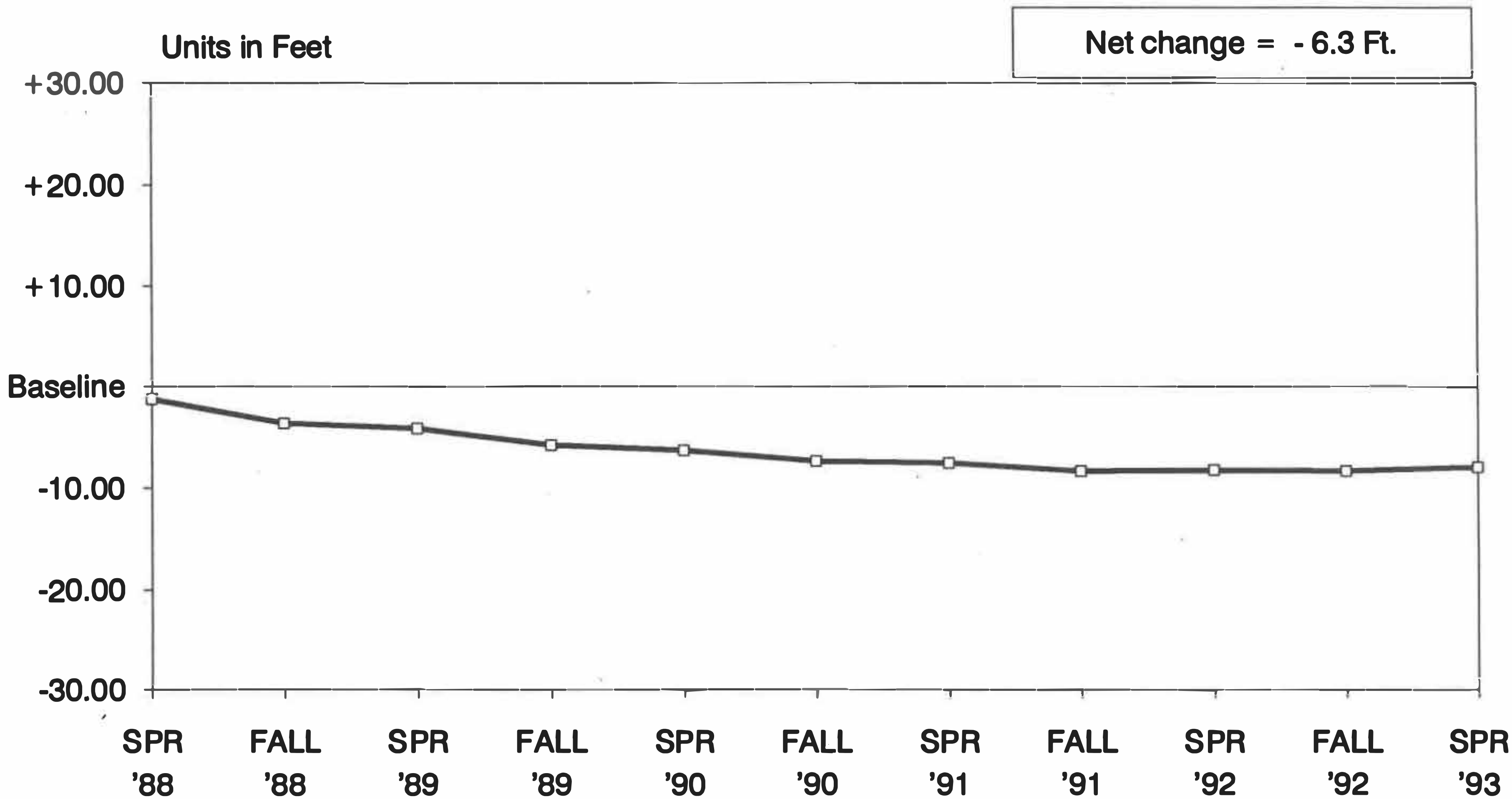


Changes in Water Levels Since 1987 (Baseline)
Well: 55   15N-9E-30CCCD   Saunders Co.   Todd V. Aquifer

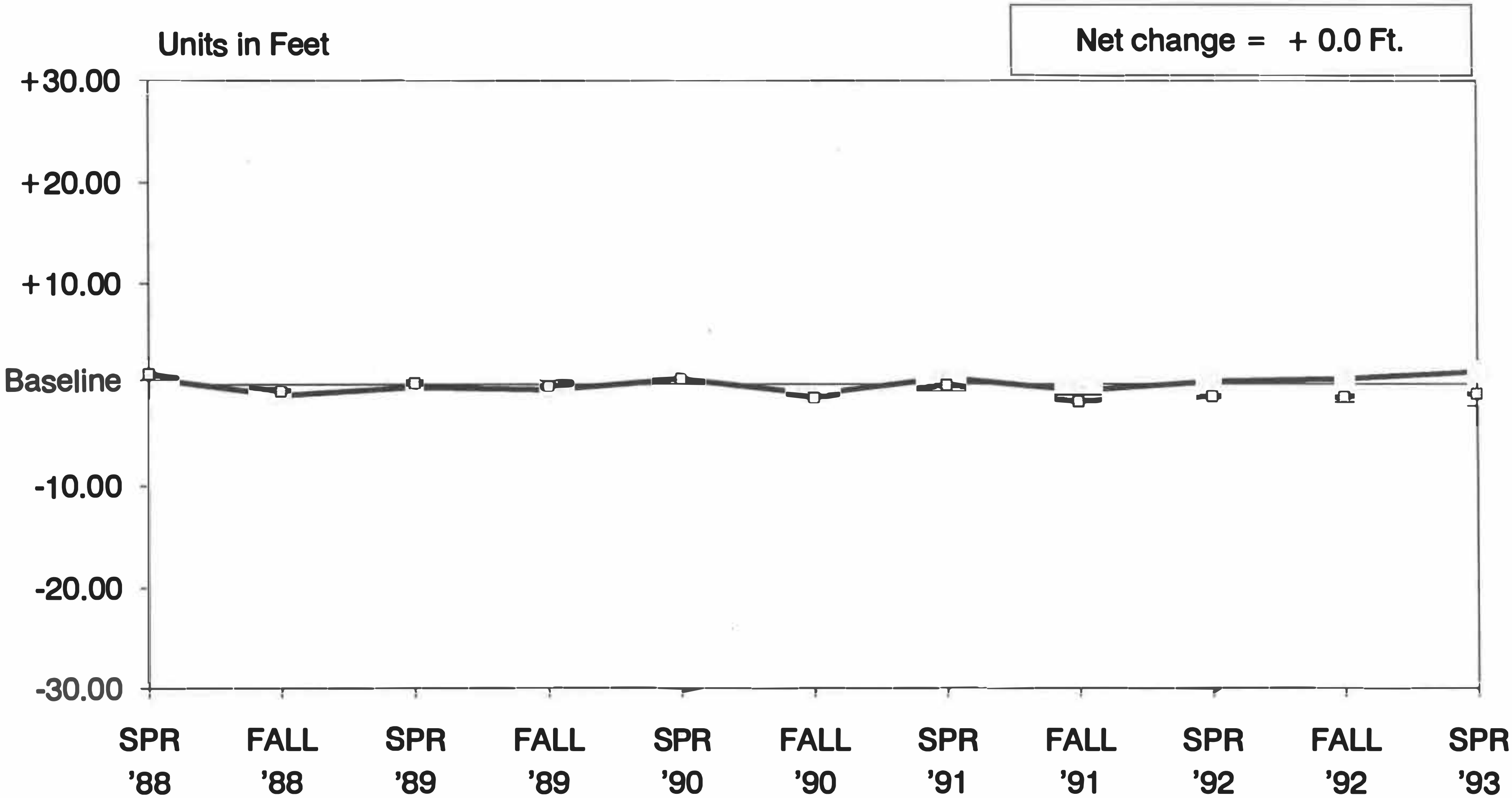



Changes in Water Levels Since 1987 (Baseline)
Well: 56 16N-7E-17ADBB Saunders Co. Todd V. Aquifer
Units in Feet
Net change = - 4.7 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

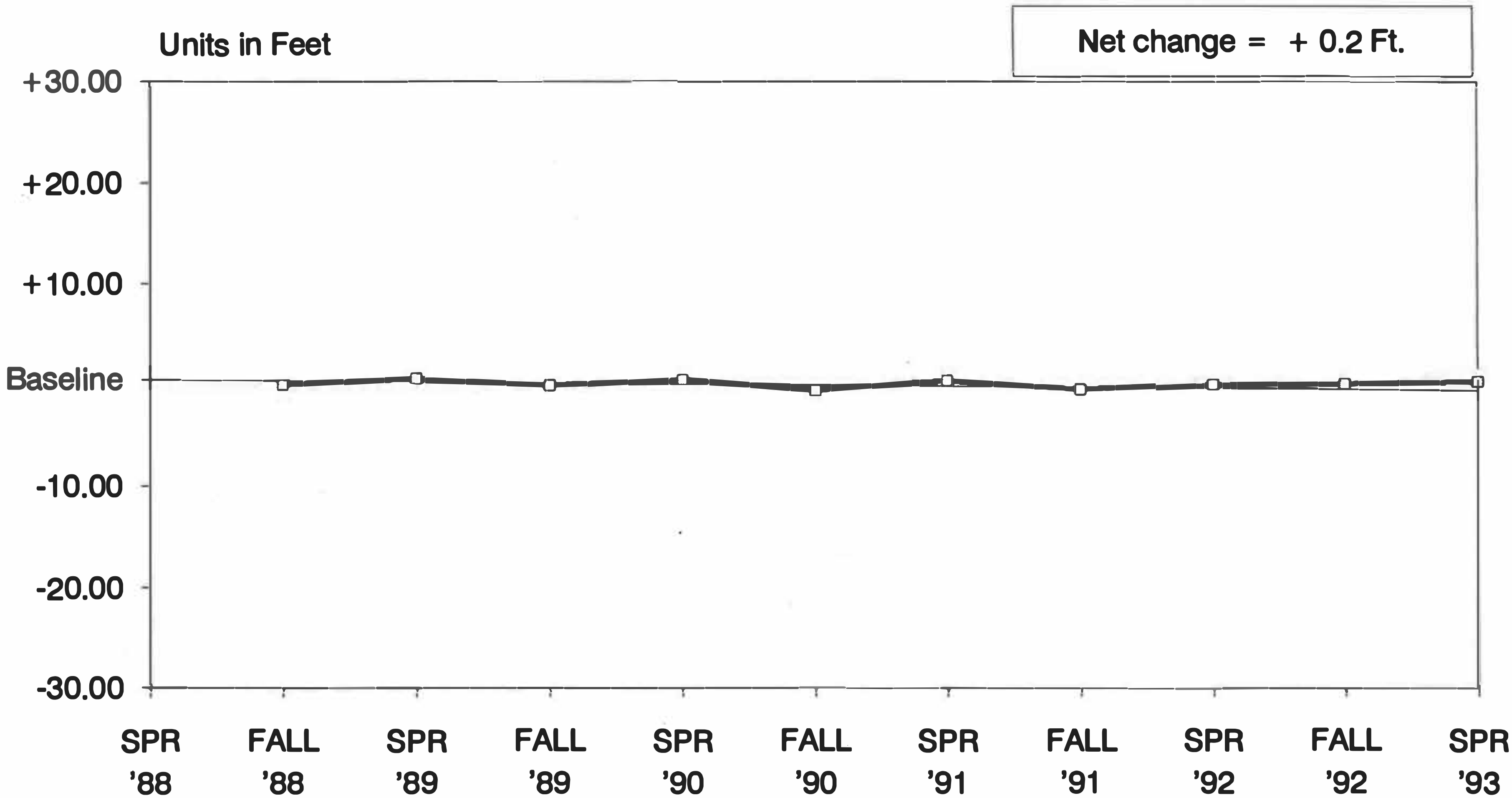
Changes in Water Levels Since 1987 (Baseline)
Well: 57 15N-7E-36DDBB Saunders Co. Todd V. Aquifer



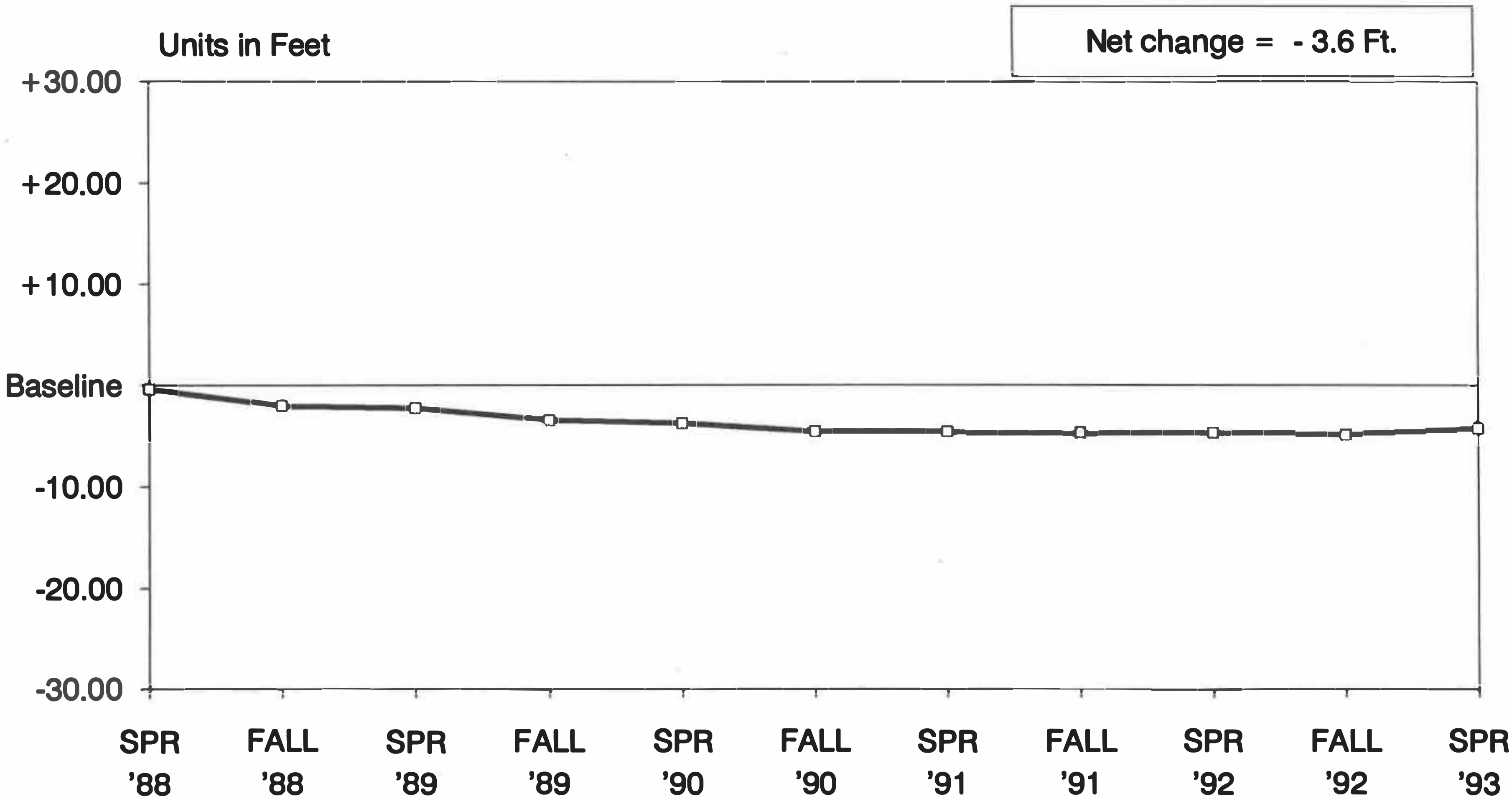
Changes in Water Levels Since 1987 (Baseline)
Well: 58 14N-9E-13AACA Saunders Co. Platte V. Aquifer



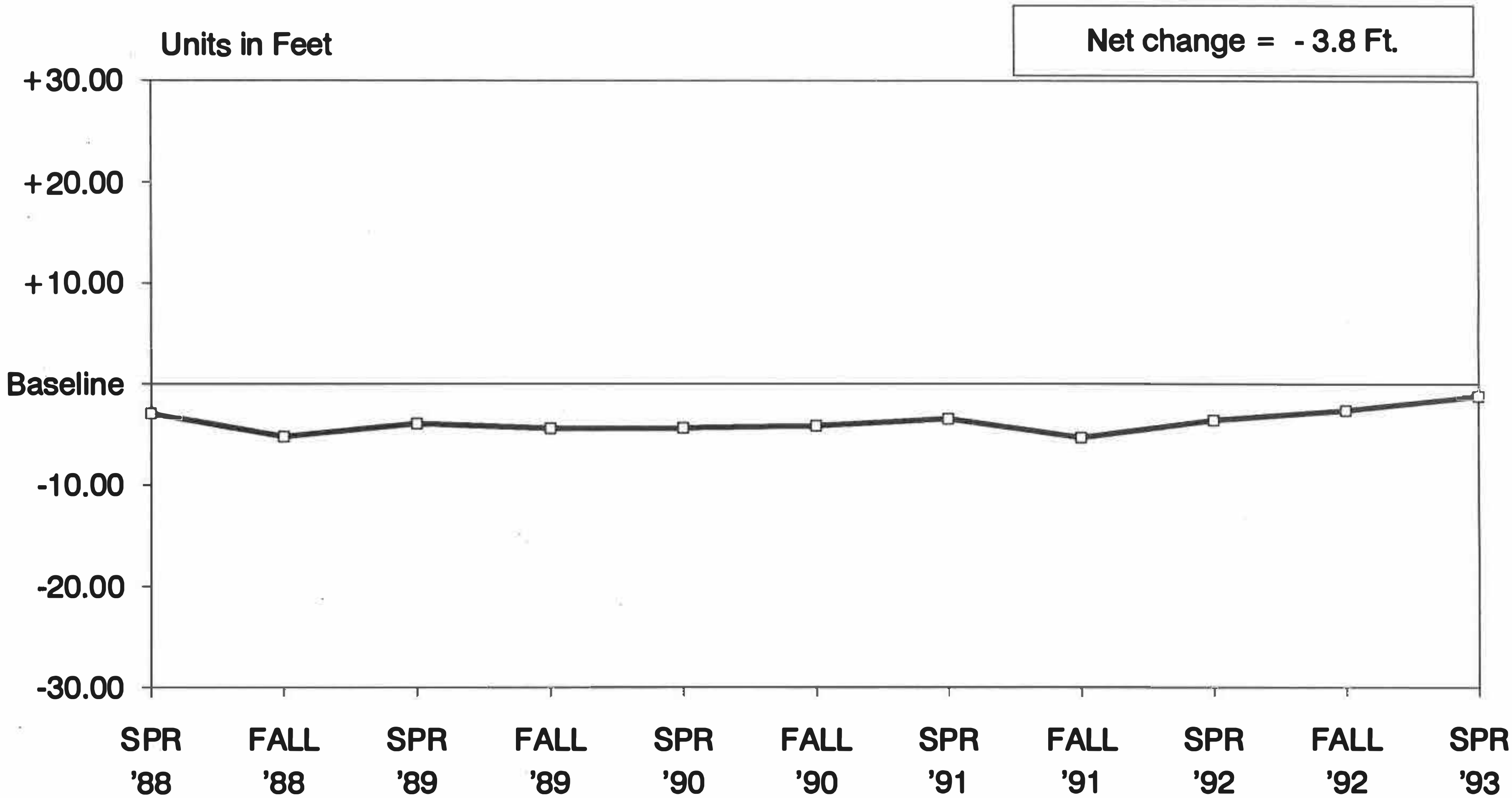
Changes in Water Levels Since 1989 (Baseline)
Well: 59 14N-9E-26CBAB Saunders Co. Platte V. Aquifer

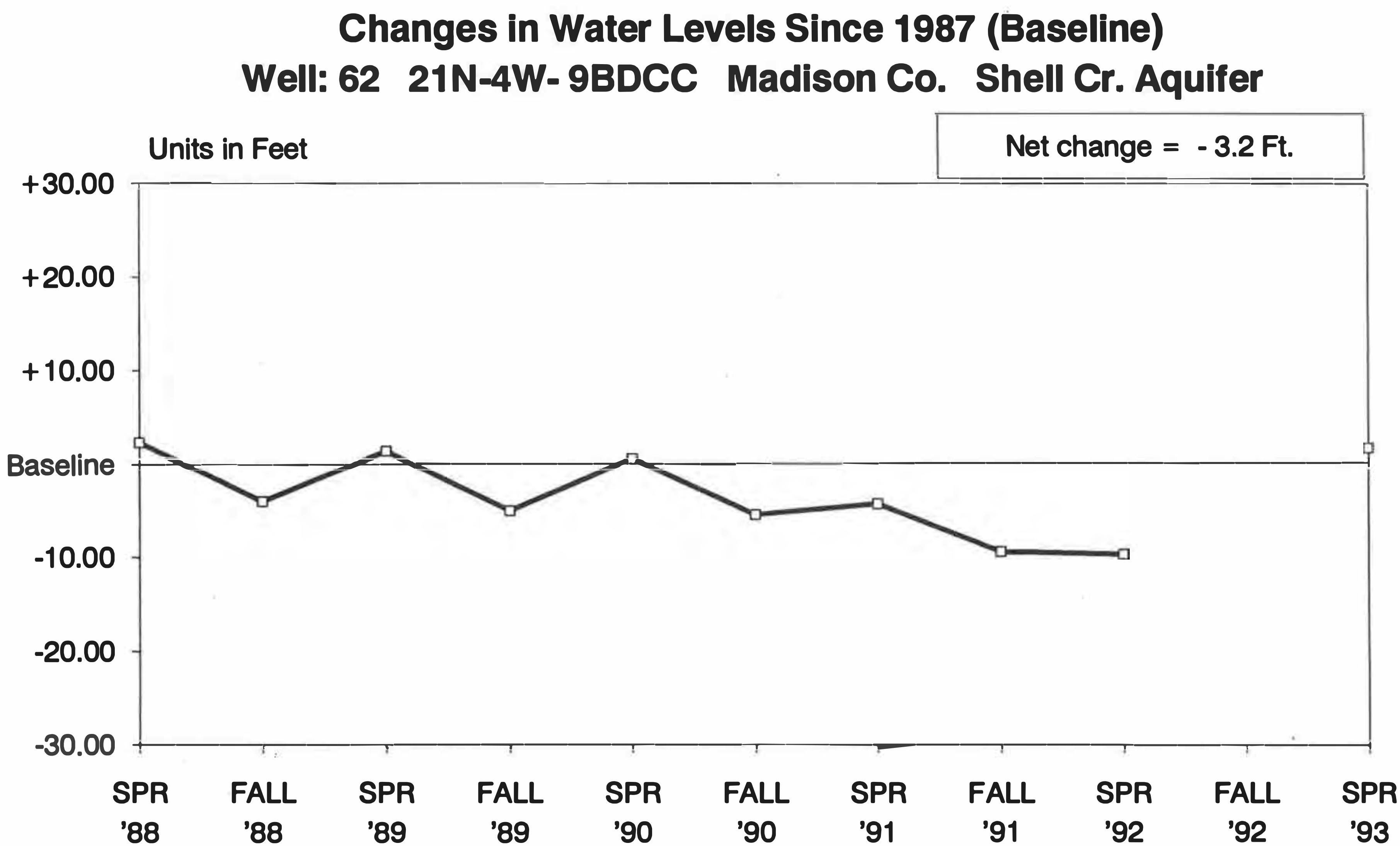


Changes in Water Levels Since 1987 (Baseline)
Well: 60   13N-9E-16BDBA   Saunders Co.   Todd V. Aquifer

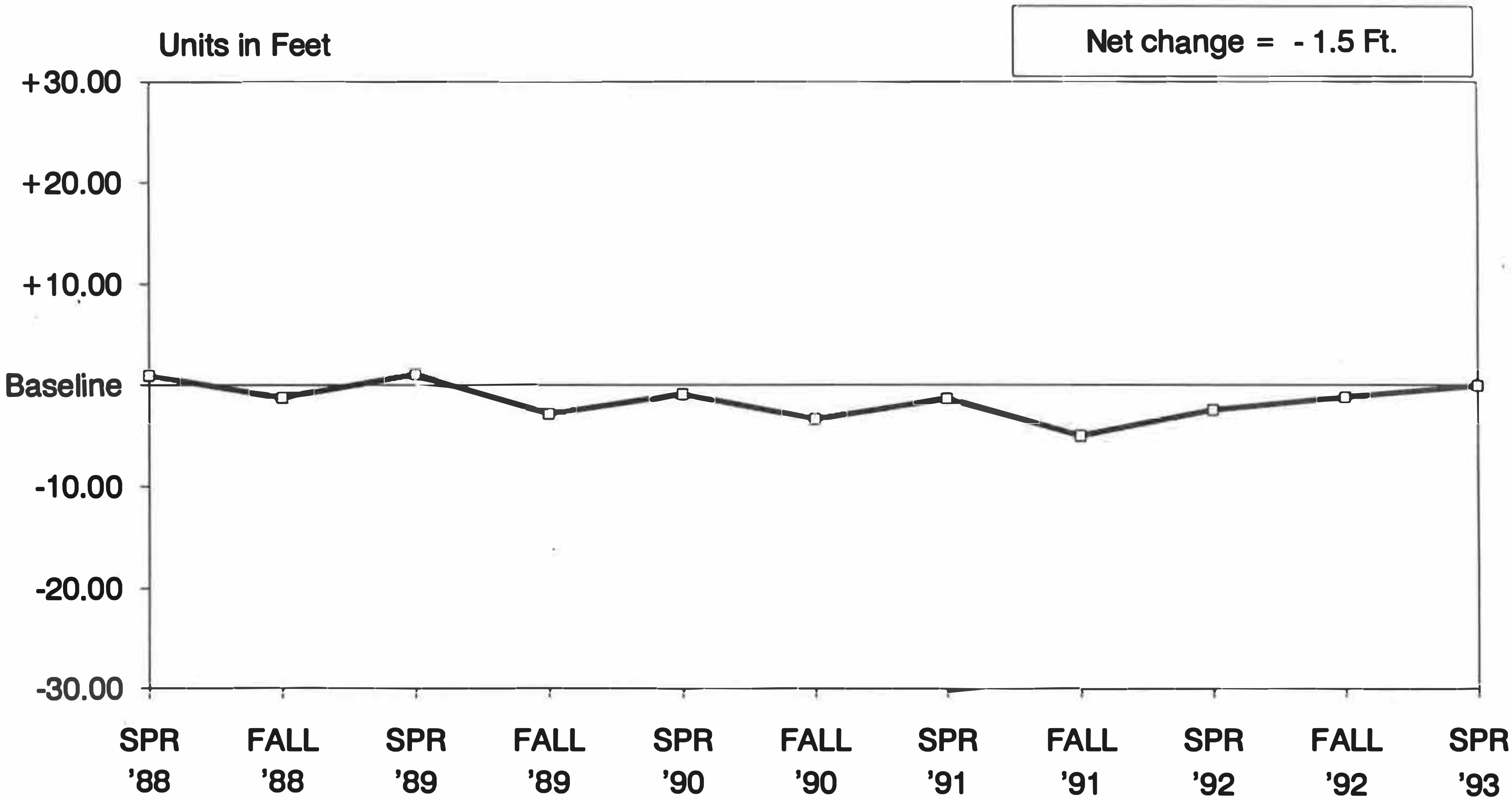


Changes in Water Levels Since 1987 (Baseline)
Well: 61 17N-3E- 9CCBB Colfax Co. Platte V. Aquifer

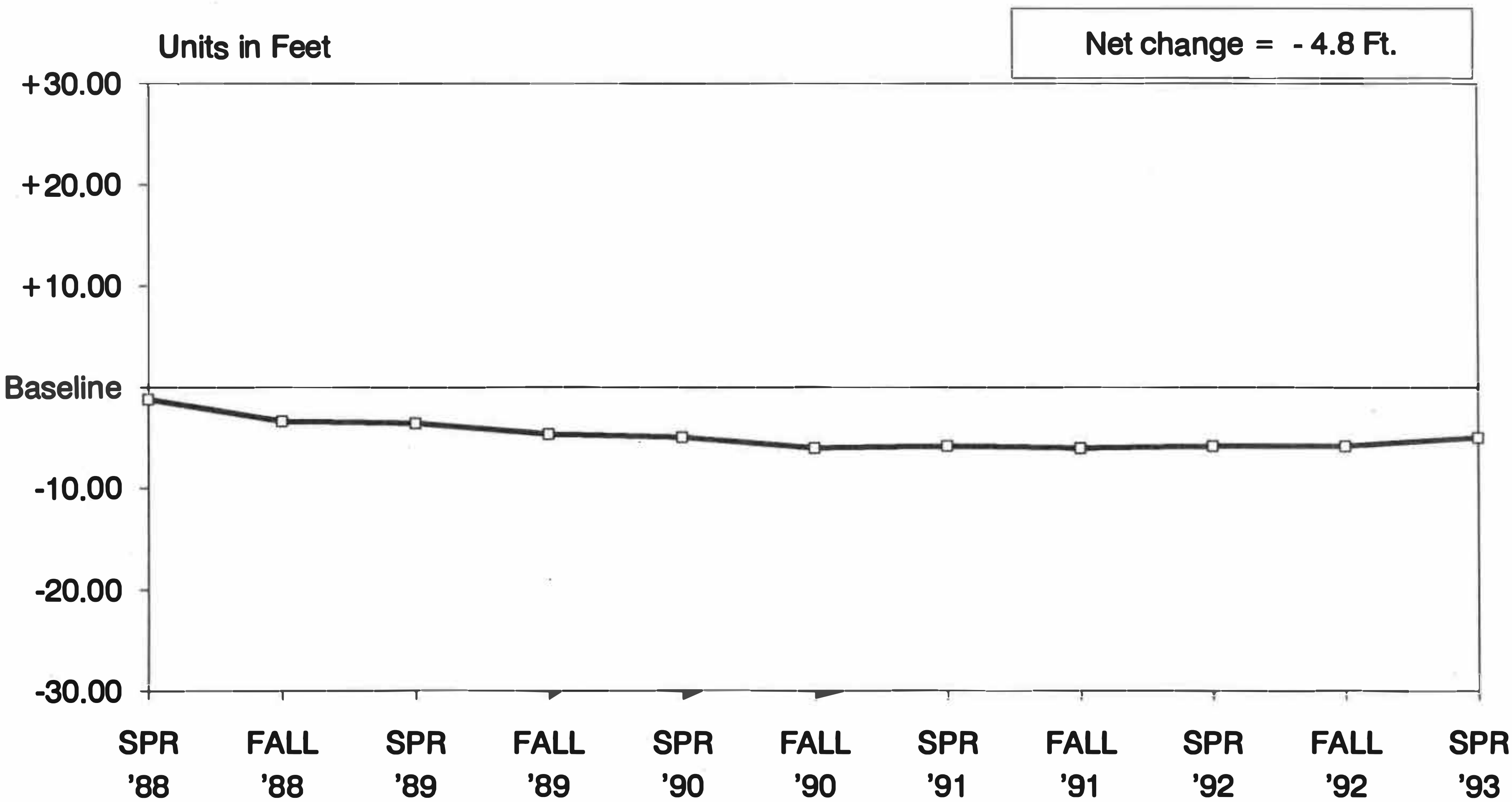



Changes in Water Levels Since 1987 (Baseline)
Well: 62 21N-4W- 9BDCC Madison Co. Shell Cr. Aquifer
Units in Feet
Net change = - 3.2 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

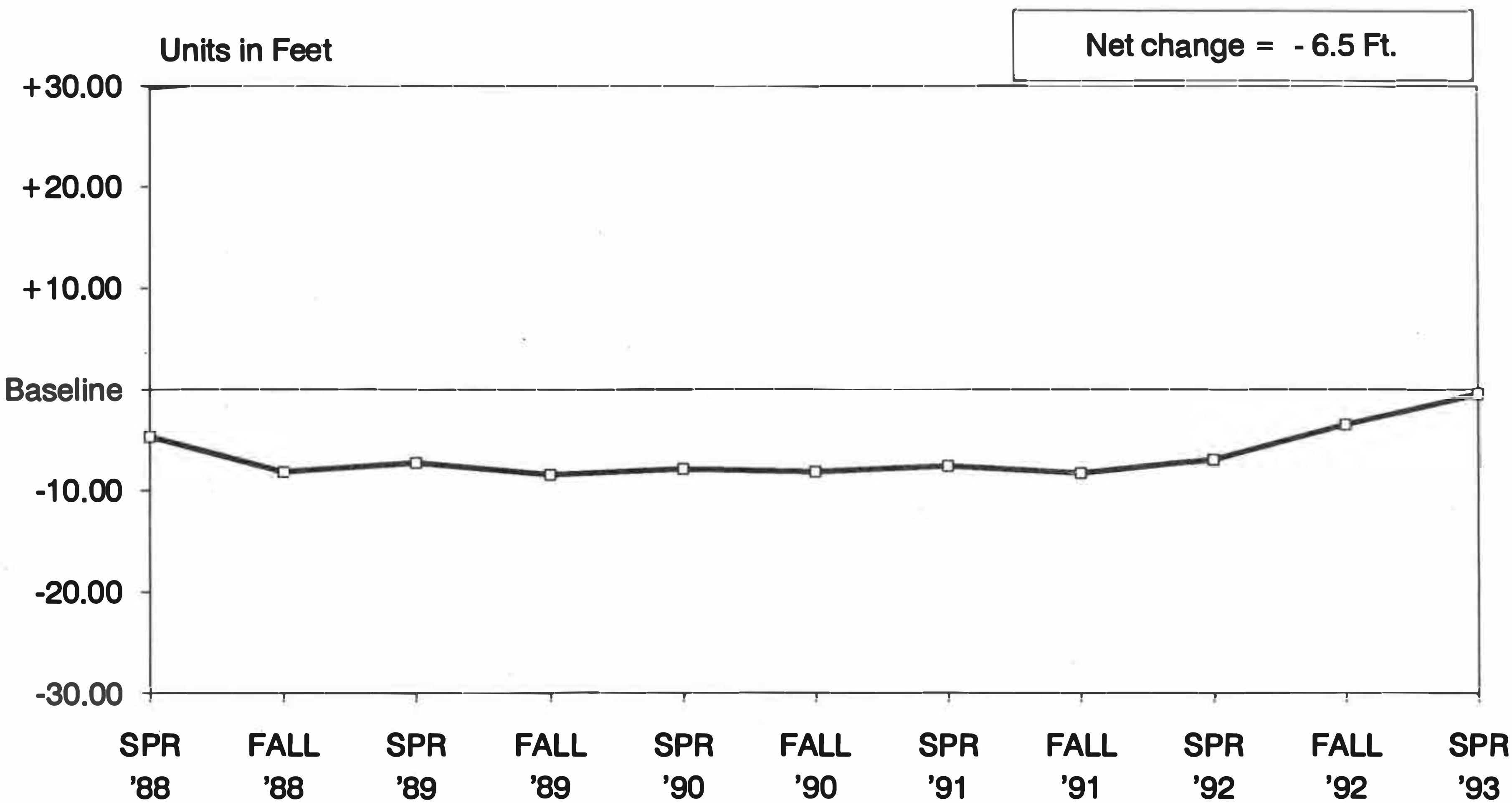
Changes in Water Levels Since 1987 (Baseline)
Well: 64 18N-1W- 5DCAA Platte Co. Shell Cr. Aquifer



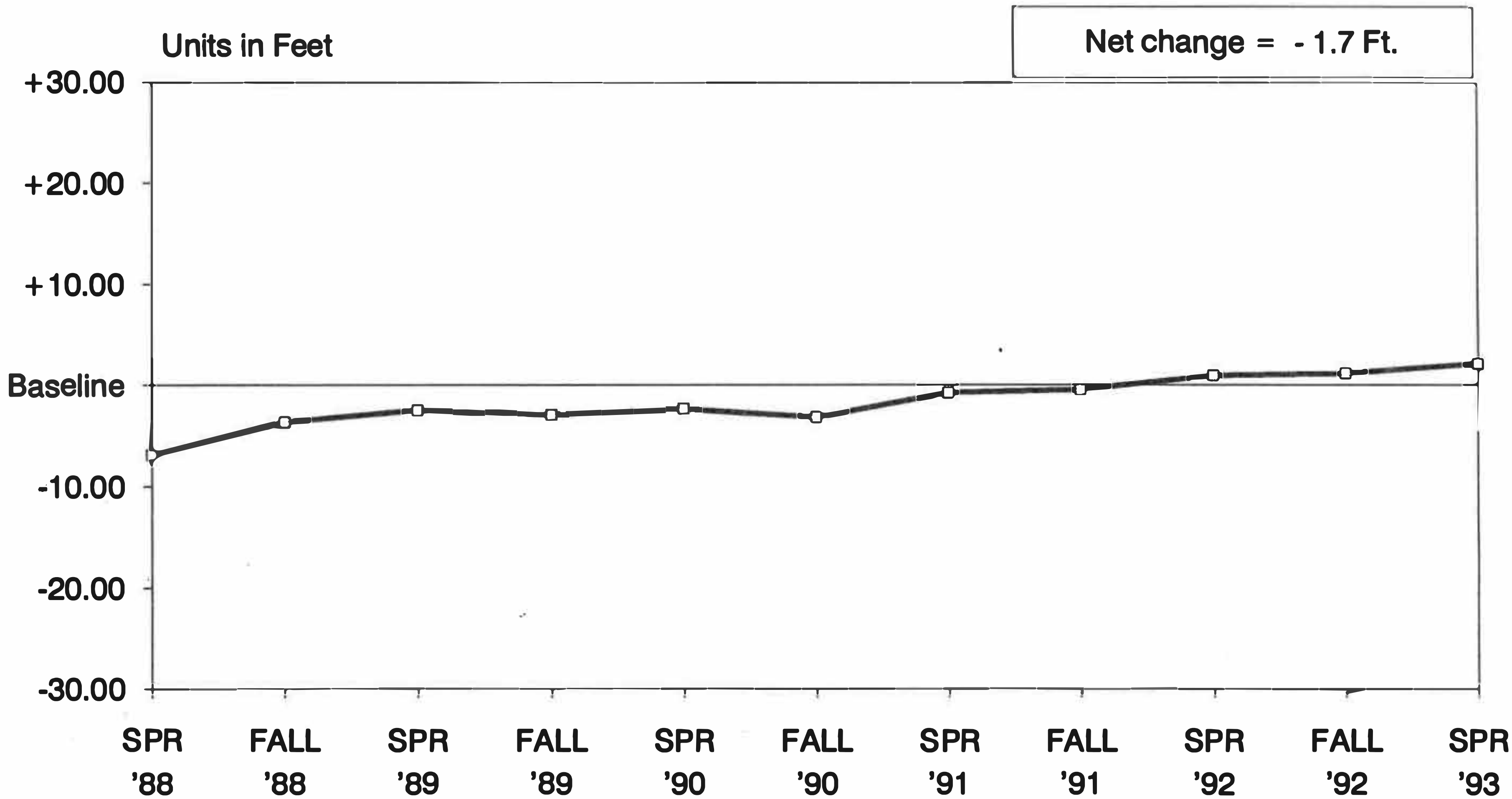
Changes in Water Levels Since 1987 (Baseline)
Well: 65 15N-6E-25BBDD Saunders Co. Uplands Aquifer



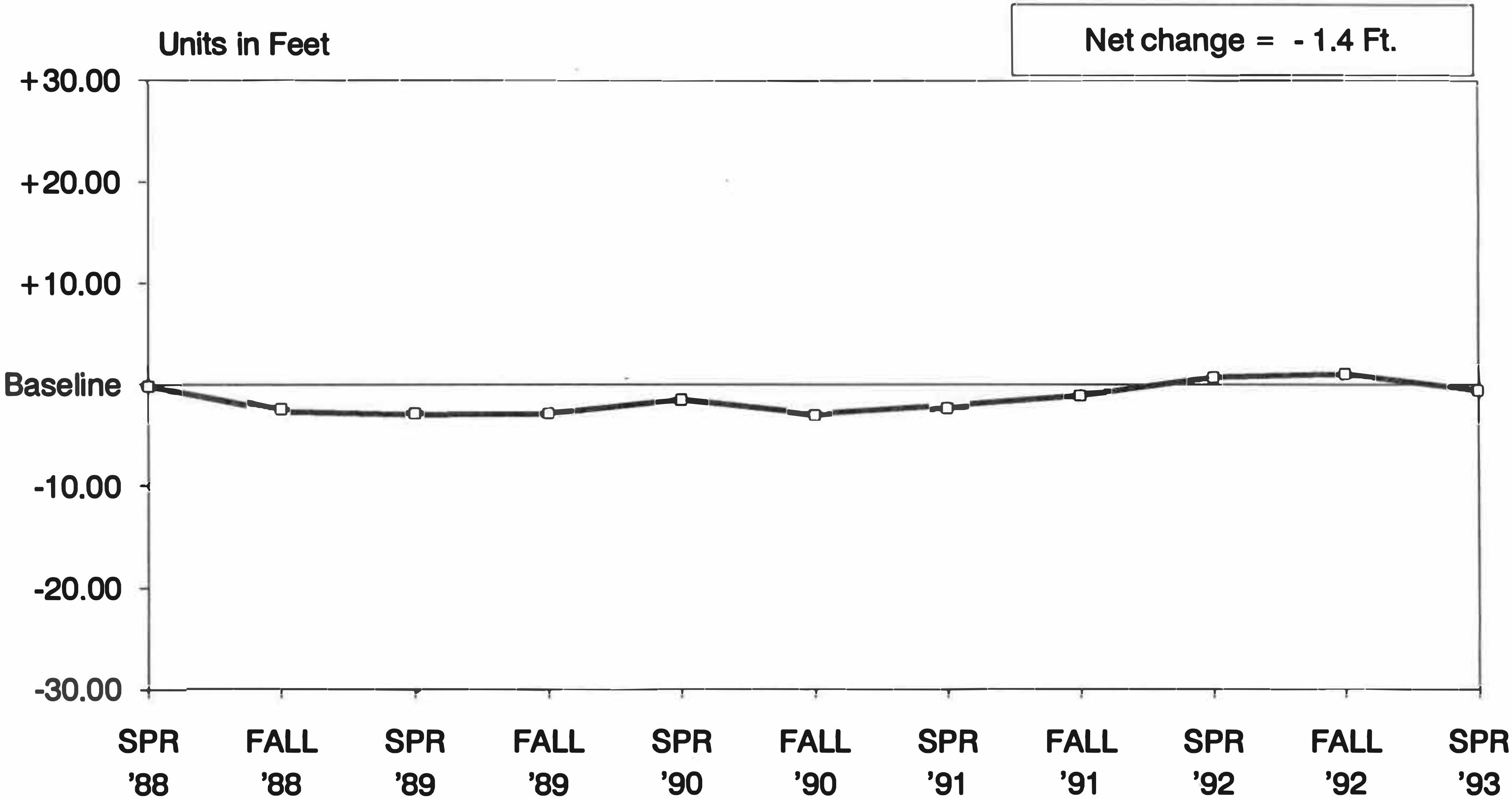
Changes in Water Levels Since 1987 (Baseline)
Well: 66 18N-6E-26CCDD Dodge Co. Platte V. Aquifer

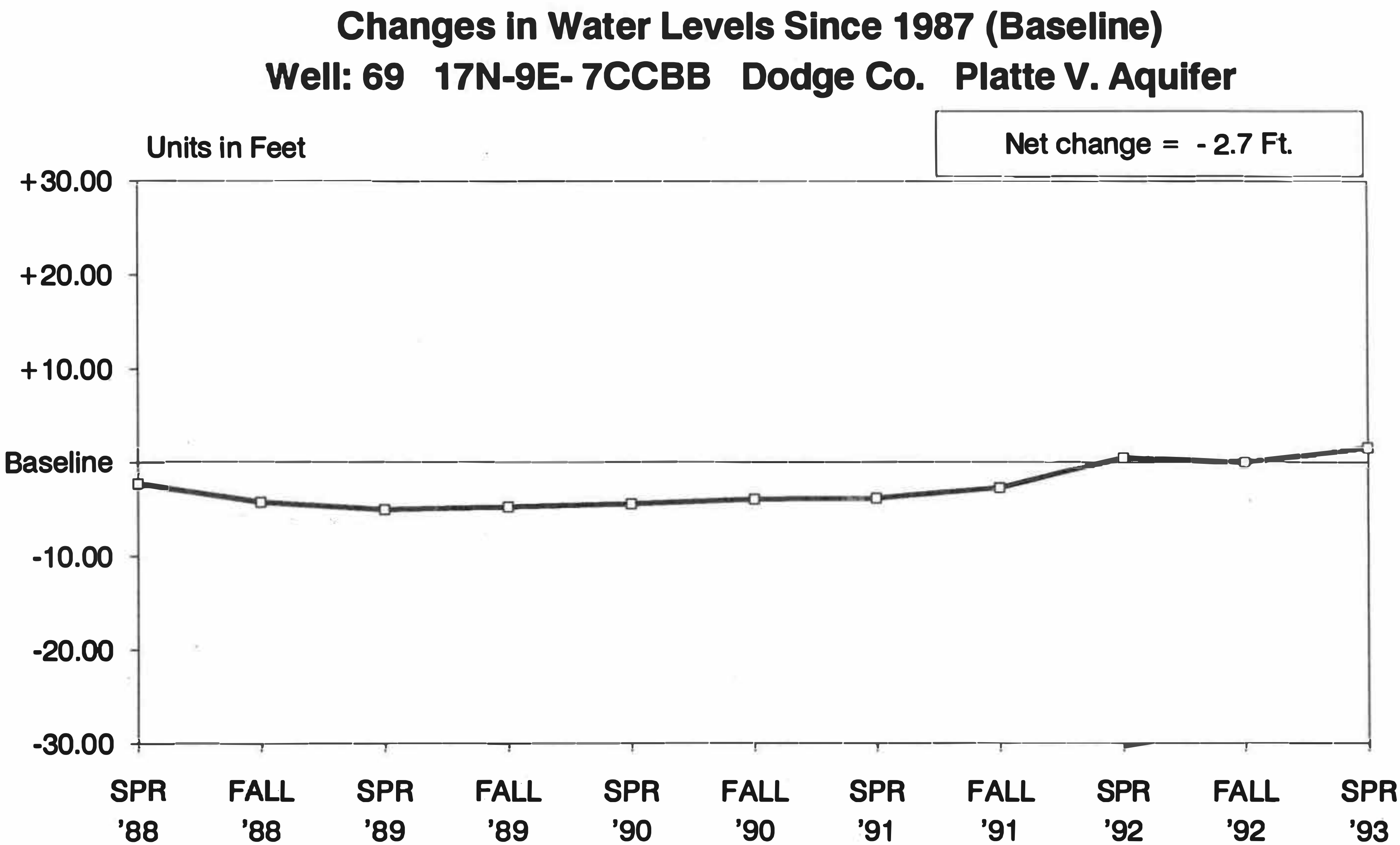


Changes in Water Levels Since 1987 (Baseline)
Well: 67 17N-8E-14CCAB Dodge Co. Platte V. Aquifer

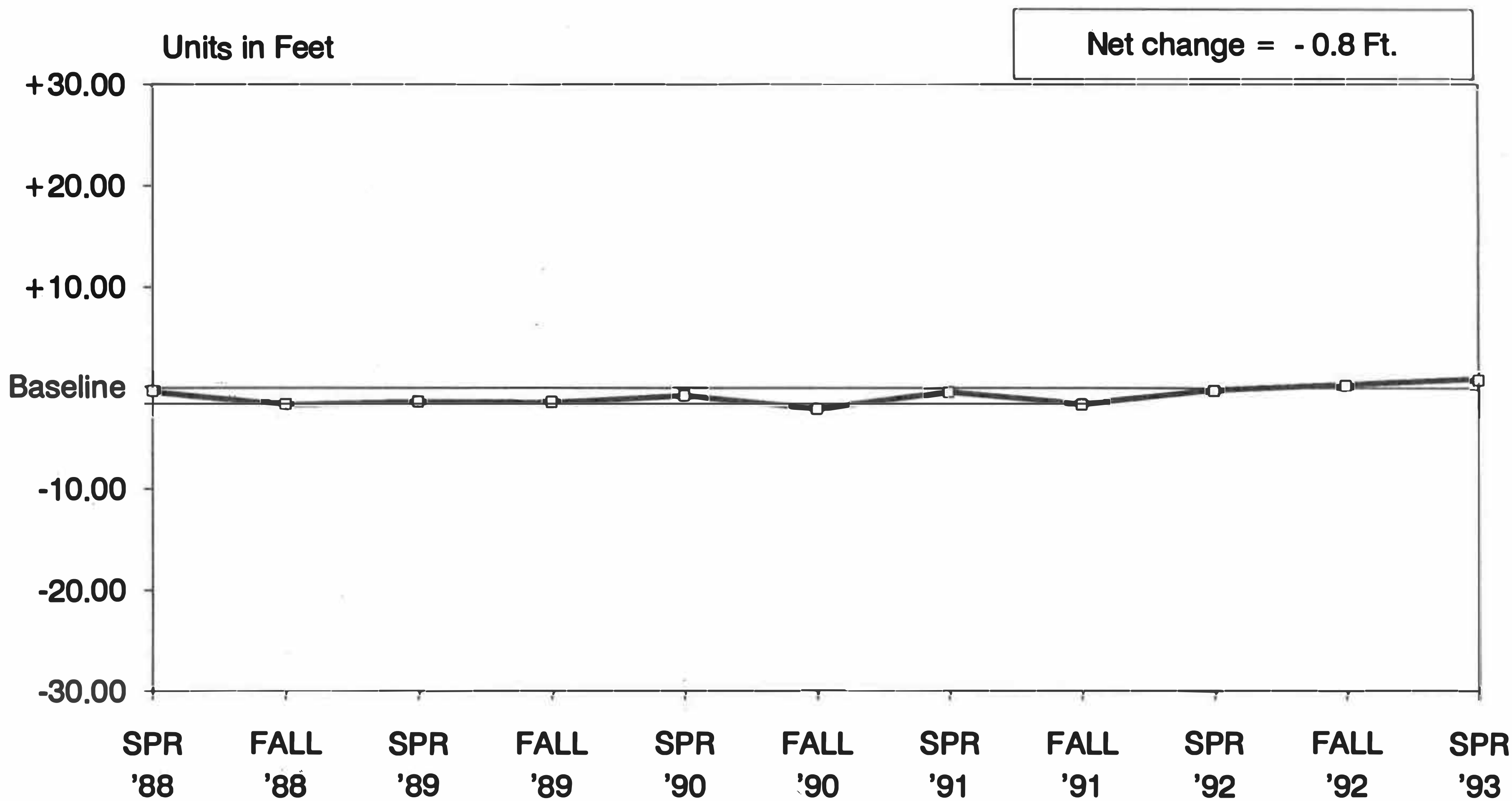


Changes in Water Levels Since 1987 (Baseline)
Well: 68 17N-9E-19DDDD Dodge Co. Platte V. Aquifer




Changes in Water Levels Since 1987 (Baseline)
Well: 69 17N-9E- 7CCBB Dodge Co. Platte V. Aquifer
Units in Feet
Net change = - 2.7 Ft.
+30.00
+20.00
+10.00
Baseline
-10.00
-20.00
-30.00
SPR '88
FALL '88
SPR '89
FALL '89
SPR '90
FALL '90
SPR '91
FALL '91
SPR '92
FALL '92
SPR '93

Changes in Water Levels Since 1987 (Baseline)
Well: 70   17N-9E-28ABCD   Dodge Co.   Platte V. Aquifer



STATE OF NEBRASKA

DEPARTMENT OF WATER RESOURCES
J. Michael Jess
Director

E. Benjamin Nelson
Governor

RECEIVED JAN 25 1995 CSD

January 24, 1995

IN REPLY REFER TO:

Don Kavan
Lower Platte North NRD
P.O. Box 126
Wahoo, Nebraska 68066

Dear Mr. Kavan,

Examination of your Board's 1994 Ground Water Management Plan has been completed. In addition to input from this agency's staff, the comments of five other agencies were reviewed. Copies of comments from the five agencies are enclosed. The deficiencies identified are significant enough to render the plan insufficient for approval.

Endangered Species

Through earlier efforts of NARD and others, we understand certain understandings and agreements for endangered species considerations were reached with Game and Parks Commission staff. Unfortunately, the Commission has identified deficiencies in your Board's language regarding threatened and endangered species. To meet the requirements of § 37-435, R.R.S., 1943, as amended, the plan must be revised to address these concerns.

Quantity

The District has developed a fairly comprehensive set of triggers and actions based on percent decline of saturated thickness. The method of setting triggers according to aquifer type is creative. However, more discussion is needed to explain what is meant by "taking into account climatic variables" and "comparable year well levels". Does the Board intend to somehow adjust the quantity triggers according to each year's climatic conditions? If so, the protocol for this adjustment must be discussed in detail.

On pages 89 and 90 are statements that the district will require volume metering for all wells with a capacity of more than 100 gallons per minute. Such a requirement does not comply with § 46-666(4) 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. This control measure must be modified or eliminated to comply with § 46-666(4).

Quality

As with the discussion of water quantity above, language on page 85 requiring nitrogen analysis on wells pumping greater than 100 gpm must be changed to comply with § 46-666(4).

While not a matter strictly requiring revision, language on page 84 should be refined to better explain the protocol for setting management phase boundaries. From exhibit 9, and Department registration records, it is evident that portions of the district would not be considered for management phase areas because they lack ten high capacity wells in a nine mile area. This scheme suggests that significant acreage would be exempt from district controls.

Also noted are inconsistencies in the number of wells included in the District's monitoring network. Page 28 shows that 116 wells are being monitored and page 65 shows 79 wells in the network. Revisions of the plan should include an accurate description of the monitoring network.

With the exception of the problems outlined above, the overall quality and style of your Board's plan is commendable.

Sincerely,

J. Michael Jess
Director

JMJ:DV
cc/enc: Randy Wood
Jack Daniel
Dayle Williamson
Perry Wigley
Ross Lock
Raymond Hartung

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

January 20, 1995

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 Platte North NRD 1994 Groundwater Management Plan

Dear Dale:

Enclosed are comments on the above referenced plan by Frank Smith and Scott Summerside of our staff.

With the changes noted, we recommend approval.

Sincerely,

Perry B. Wigley
Director

PBW/bm

January 18, 1995

TO: Perry Wigley

FROM: Scott Summerside

RE: Lower Platte North NRD Groundwater Management Plan

I have reviewed the Revised 1994 Groundwater Management Plan for the Lower Platte North Natural Resource District and I find it to be generally acceptable.

The "background chapters" regarding physical description of the NRD in terms of the geology, groundwater flow system, etc... contains some grammatical errors, a few misleading statements and minor inaccuracies. Nevertheless, I do not believe that the plan should be rejected on this basis. Chapter 11, what I view as "the actual plan", describes in detail how the NRD will monitor ground-water quantity and quality as well as what management or regulatory steps it will take when certain conditions or "trigger levels" are reached. It is my opinion that the plan shows a greater level of responsibility towards the goal of wise management of the ground-water resources; therefore, I recommend that the plan be approved.

file

STATE OF NEBRASKA

E. Benjamin Nelson
Governor

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

DEC 19 1994

RECEIVED

JAN 20 1995

DEPARTMENT OF
WATER RESOURCES

Mr. Michael Jess, Director
Nebraska Department of Water Resources
301 Centennial Mall South
Lincoln, NE 68509-4676

REFERENCE: Lower Platte North 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 Platte North Natural Resources District's (LPNNRD) ground water management plan. We referred to our previous comments of November 29, 1993 when reviewing this newly revised plan.

Many positive changes are seen in this October, 1994 version of the LPNNRD's Ground Water Management Plan. The major problems seen in the previous version have been addressed, for the most part. Minor details will, by necessity, need to be addressed by the District when they implement their planned Ground Water Management Area. We feel the plan meets the requirements of LB 51 and recommend approval.

The attached pages 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: John Miyoshi, Lower Platte North NRD

Review Comments
Lower Platte North Ground Water Management Plan

This review of Lower Platte North Natural Resources District's (LPNNRD) Ground Water Management Plan, submitted to state agencies for review in October, 1994, is based on comments made in November, 1993. Different staff reviewed the original submittal, but I will try to address the same issues as were brought up previously. I did not look at quantity issues in detail.

1) Identify levels of ground water contamination.

Lower Platte North NRD has good maps of nitrate and other constituents in ground water from sampling results, 1986 to 1993. This and the defined areas ("reservoirs") targeted for baseline sampling will be a good basis to judge ground water quality. Although some work has been done on pesticide screening and sampling, the results are not given or mapped.

The monitoring network is described as 3 irrigation wells/township as fixed wells (sampled during each sampling event) and 3 wells/township as random wells (changes from the last sampling event). Since the district is approximately 1800 square miles in area, and there are at least 50 townships (probably more, because of boundary lines), this means about 150 "fixed" wells and 150 "random" wells (my figures). These will be sampled every 2-3 years (dependent on budget and weather), not sampling all the "reservoirs" in any given year. There is not a clear indication, however, of how long it will take to cover the entire network. It is also not defined as to how sampling more intensively (p.58) will be accomplished as problems arise (nor is it defined as to what constitutes a problem).

LPNNRD mentions using the sample analysis done by landowners in the Ground Water Management Area in the monitoring network. While it is good to consider these results, I do not believe they can substitute for results from sampling done by trained NRD staff with knowledge of ground water. Central Platte and Tri-Basin staff sample hundreds of wells, despite annual submittal of water quality results from farm operators.

2) Identify sources of ground water contamination.

The LPNNRD has a good handle on land use practices which can lead to nonpoint source contamination and specific facilities and operations which are or are potentially point sources of contamination. Septic tanks and feedlots are explained, such that general public utilizing this document will get a better understanding of these potential problems.

3) Establish ground water quality goals:

The plan states the following (p.74) goal: " Assure adequate quantity and quality of stream flow, groundwater, and surface reservoirs within the district for beneficial uses as prescribed by law." Two other goals are presented that tie into and support this first one, for groundwater reservoir life: "To provide a sustained ground water supply of quality water adequate to support reasonable and beneficial uses, and maintain long-term quality yields" (p.77) and, for management systems development, "Provide a system of groundwater management to support the ground water reservoir life goal, based upon an adequate technical foundation and public awareness of groundwater issues." (p.78). These goals are supported by the objectives following each goal, and by the entire document's intent.

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.

Upon approval of this Ground Water Management Plan, the entire District will be declared a Ground Water Management Area (GWMA) within two years. A phased approach is given, with well defined boundary setting mechanisms (p.84). Nitrate, pesticides, and other human originated nonpoint source contaminants will be considered. I have only a couple of questions/comments about the boundary setting procedures. 1) How is a problem area identified? This has to do with the monitoring network and baseline information previously gathered, but in the section (section 8, p.58) describing this, it was not clear how problem areas were to be "sampled more intensively". Also, the area must have concentrations at the trigger level a minimum of two consecutive sampling events. Is a sampling event the regularly scheduled network sampling which may happen only every 2-3 years? Or will district staff come back to an area a month later and sample? 2) On page 84, second full paragraph, it is implied that Wellhead Protection Areas are established due to nonpoint source pollution. Wellhead Protection Areas are determined independently of contamination. I applaud the District's idea of allowing a smaller minimum size for trigger action when a Public Water Supply is involved.

The proposed controls for the GWMA are generally pretty good. I think as it gets closer to actual implementation of the Phase I controls, the District will need to define topics to be covered in their education program in much greater detail. I am especially pleased to see the District tackling the calibration of fertilizer application equipment. One criticism I do have is that in Phase II, organic fertilizers (manure products) must be applied taking into account the soil and water credits available, whereas commercial fertilizer does not fall under the same constraints. Commercial fertilizer has timing and soil type constraints. I feel both organic and commercial fertilizer application rates need to take into account soil and water credits, and a realistic yield goal (not mentioned in plan).

There seems to be some contradiction between Phase III controls text (p.87) and Table 9, which summarizes Phases and Control Requirements. The last diamond (♦) on page 87 states "The application of fertilizer (>50 lb/ac) would be required to be calibrated to the results of soil and water tests and monitored for compliance." Table 9, #19 states "Require fertilizer monitors on all applications greater than 50 lb/ac". Is this saying the same thing? Table 9 appears to be referring to the calibration of equipment again (as in Phase II, Table 9 #13; p.86, second to last diamond).

5) General Comments.

While there are still a few problems with this plan, I think there is enough detail and explanation of the important issues to merit approval. The monitoring network is explained, the triggering and boundary setting process is given (maybe more detail is needed on problem area definitions), and there is a pretty good explanation of the controls that are planned for the GWMA. Items that aren't clear or detailed enough will be straightened out, by necessity, by the time the GWMA is implemented. LPNNRD has done a great job presenting maps, geologic, and ground water information in this plan. I recommend its approval.

STATE OF NEBRASKA

DEPARTMENT OF HEALTH
Mark B. Horton, M.D., M.S.P.H.
Director

E. Benjamin Nelson
Governor

MEMO

To: Dale Vagts, Department of Water Resources

From: Jack L. Daniel, Department of Health JLD

Date: December 22, 1994

Subject: Lower Platte North NRD's 1994 Groundwater Management Plan

The referenced plan appears to have adequately covered groundwater quality according to our reviewer, Mr. Tom Michels; however, specific reference to the following Department of Health regulations would be appreciated.

- Wellhead encroachment regulations (Title 179 NAC 2)
- Well abandonment regulations (Title 178 NAC 12)

Thank you for the opportunity to comment.

JLD:TM:dm

301 Centennial Mall South • P.O. Box 95007
Lincoln, Nebraska 68509-5007 • Fax (402) 471-0383

Nebraska Game and Parks Commission

2200 N. 33rd St. / P.O. Box 30370 / Lincoln, NE 68508-0370 / 402-471-0641 / Fax: 402-471-5528

December 20, 1994

Dale Vagts
Ground Water Supervisor
Department of Water Resources
301 Centennial Mall South
Lincoln, Nebraska 68509

Dear Dale:

The Lower Platte North Natural Resources District's ground water management plan had been reviewed. The following changes need to be made before a "no adverse effect" opinion can be issued.

1) While the potential occurrence of prairie white fringed orchid in the District is noted in the plan, no mention is made that this species could be affected by groundwater levels.

2) A statement needs to be added that acknowledges potential impact, positive or negative, on the orchid from groundwater management activities proposed in the plan.

3) While the NRD indicates that it will evaluate the need for modification of its plan to reduce adverse effects, they need to specify that **such modifications will include actions that they could take to reduce adverse effects on the orchid by maintaining a groundwater level that will help sustain this species.**

The three changes as described above that we are recommending are consistent with the language developed by the NRD and Commission committee and outlined in a March, 1994 Commission memo to the NRD's. I have included a copy of this memo for you to include with your correspondence to the Lower Platte North.

Sincerely,

Ross A. Lock
Wildlife Diversity Program Manager
Wildlife Division

RAL/me
Enc.

Nebraska Game and Parks Commission

2200 N. 33rd St. / P.O. Box 30370 / Lincoln, NE 68503-0370 / (402) 471-0641

MEMORANDUM

TO: (one to each NRD District Manager)

FROM: WES SHEETS, ASSISTANT DIRECTOR

DATE: MARCH 2, 1994

SUBJECT: GROUND WATER MANAGEMENT PLANS AND ENDANGERED AND THREATENED SPECIES

On January 25, 1994, Ross Lock, of my staff, attended the quarterly meeting of Natural Resource District Managers. His purpose was to explain the Game and Parks Commission's position intended to resolve the differences between the NRDs and the Commission on how endangered and threatened species are to be considered in groundwater management plans. He outlined language and identified information that, if included in the groundwater management plans, would facilitate approval of the plans by the Department of Water Resources. A committee of NRD managers, chaired by Glenn Johnson, was organized at that meeting to develop refinements in the language. The committee, that included the Upper Big Blue NRD (John Turnbull), Papio-Missouri River NRD (Jerry Bowen), Middle Niobrara NRD (Bob Hilske), Lower Elkhorn NRD (Stan Staab), Lower Platte South NRD (Glenn Johnson), and Ross Lock, met on February 4. Agreement was reached on four statements that describe how endangered and threatened species should be addressed in groundwater management plans that consider groundwater quantity. The group determined that groundwater management plans should include:

1. Recognition of the existence and/or potential existence of threatened species that may be affected by groundwater levels. Include lists of species and confirmed occurrences by counties. (Game and Parks Commission has provided this information to the NRDs).

2. Recognition that general protection of groundwater quantity and quality has many benefits including protecting the habitats of threatened species listed above.

3. Recognition that any groundwater management activities proposed in the plan may have some impact (positive or negative) on threatened species listed in the plan.

4. Should specific adverse effects on threatened species listed in the plan from changing groundwater levels be identified, the NRD acknowledges the potential need to modify groundwater management plans in the future. Such modifications should include actions within control or management areas consistent with the Nebraska Groundwater Management and Protection Act that could be taken by the NRDs to reduce adverse effects on species by maintaining a groundwater level that will help sustain these species.

The Nebraska Game and Parks Commission will submit the following statement to the Department of Water Resources after reviewing groundwater management plans containing the information described above:

> Approval of the (specific NRD) 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.

The proposed content of the groundwater management plans pertaining to endangered and threatened species and our statement as to the effects of managing groundwater quantity on the species as described above have been reviewed by the Department of Water Resources and will accomodate their approval of the plans.

Regarding NRD management plans that consider only groundwater <u>quality,</u> the Commission's response to the Department of Water Resources will remain unchanged; that approval of the plans by the Department of Water Resources and subsequent management of groundwater quality by the NRDs will not adversely effect endangered or threatened species. No changes or additions to the content of the management plans considering groundwater quality are necessary.

Following the February 4 meeting, a dialogue was initiated between Glenn Johnson and Ross Lock to address the need for future discussions between the NRDs and the Commission on unresolved issues. Glenn and Ross developed language that described the intent of future discussions. After review of the language by the rest of the committee, it was agreed that the Nebraska Game and Parks Commission and the Natural Resources Districts will continue discussions to explore approaches to reducing the adverse impacts of groundwater level changes on the threatened species. The purpose of such discussions will be to develop cooperative research studies and projects that will determine cause-and-effect relationships; identify effective actions that could be taken by the NRDs and the Game and Parks Commission to reduce adverse effects to the threatened species; and develop appropriate amendments to the Nebraska Groundwater Management and Protection Act and other statutes that would facilitate the NRDs taking action to reduce adverse effects to the threatened species.

The efforts and cooperation of the NRD committee in developing this agreement are most appreciated. We will be seeking the guidance of this committee and encouraging their involvement in future discussions on the unresolved issues. We look forward to working with the committee and other NRDs. Should any of you have questions regarding the agreement or suggestions for future discussions, please contact Ross Lock (402/471-5438) or any of the NRD committee members.

RA/RL/me

cc: All Natural Resource District Managers
Gordon Kissel

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

December 1, 1994

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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 Revised 1994 Lower Platte North NRD Groundwater Management Plan. I recommend the Department of Water Resources approve the revised plan. I believe the revised plan addresses the three deficiencies identified in your Department's December 17, 1993 comment letter on the original plan. Namely: it includes further discussion of monitoring, addresses the Game and Parks Commission's concerns about the western prairie fringe orchid, and addresses more than just nitrates in its' action plan. The District has also responded to our agency's most important comment on the earlier draft by providing more detail on the boundary setting process for its action plan. Overall, this is one of the best plans we have reviewed to date.

Despite the revisions to what was in most respects already a very good plan, we continue to believe there at least one aspect in which it needs improvement. I consider the District's groundwater reservoir life goal, which is retained in the current draft, to be a weak portion of the plan. As I noted in my November 19, 1993 comment letter on the previous plan, the use of the words "sustained" and "long term" in the same sentence leaves the reader confused about what is meant. The use of the words "long term" may arguably result in some difficulty in meeting the statutory requirement that the goal be established for a finite or infinite period of time. The goal also results in a problem in the District's Groundwater Quantity Action Plan. At certain triggers that plan results in acre-inch allocations and well spacing restrictions. However, in order to set those allocations and restrictions the NRD should have a water level or specified duration of use as its' goal. The current goal doesn't lend clarity to that process.

We do have one very minor correction related to page 61 of the plan. Unless our staff is mistaken the Kobus landfill is in the Lower Platte North NRD. The NRD staff may wish to check that.

Overall, this is an excellent revision and I believe the Lower Platte North NRD is to be congratulated on a superb effort. If you have any questions, please let us know.

Sincerely,

Dayle

Dayle E. Williamson
Director of Natural Resources