2000

Hayes County Test Hole Logs

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HAYES COUNTY
Test-Hole Logs

Duane A. Eversoll

Nebraska Water Survey
Test-Hole Report No. 43

Conservation and Survey Division
Institute of Agriculture and Natural Resources
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September 2000

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Publication and price lists are furnished upon request.

September 2000

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Many others contributed to the test-hole drilling, both in the field and in the office. Jim Goeke provided geological expertise and knowledge of southwestern Nebraska and Vince Dreeszen shared cross-sections and geological data.

INTRODUCTION

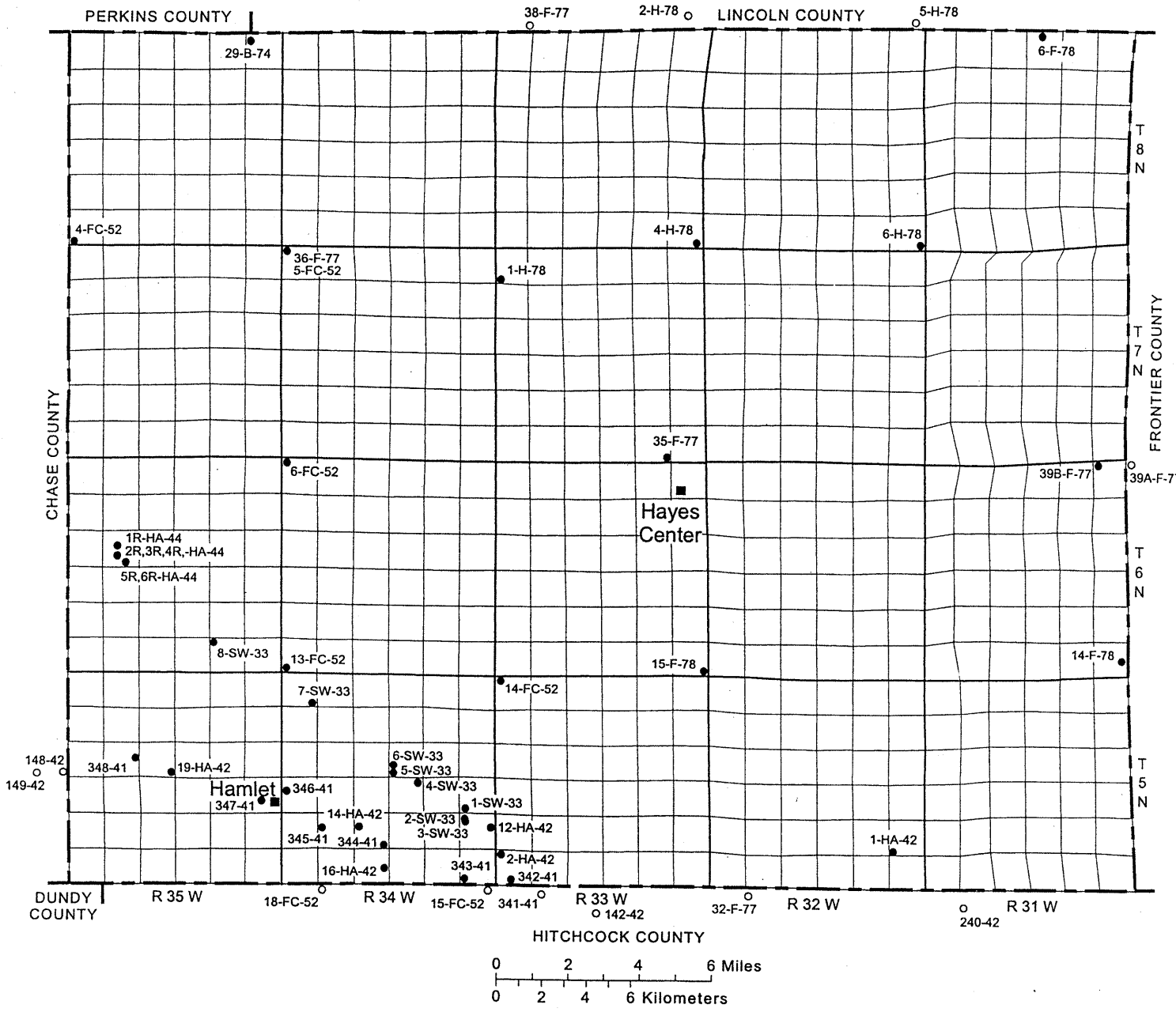
In 1930, the Conservation and Survey Division (CSD) of the University of Nebraska and the U.S. Geological Survey began a program of cooperative groundwater studies in Nebraska. Since then test drilling by use of rotary drilling equipment has been an integral part of that program. This report contains logs of all the test holes drilled in the county under the program as well as those drilled by the Conservation and Survey Division with financial assistance from other government agencies.

The map in this report (figure 1) shows the location of all test holes drilled in the county since 1933.

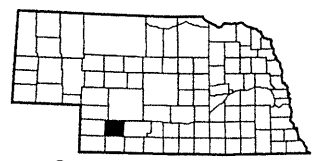
Present techniques of test hole logging and sampling include use of drilling mud suitable to drilling conditions, timing by stopwatch of the drilling of each 5-foot increment of depth, and removal of all cuttings from the test hole at intervals of 5 feet or less. During the drilling of the hole, cuttings from each interval are examined immediately; samples representing each 5-foot interval and each recognizable change in material are retained. After samples are washed, they are described lithologically and the color is evaluated by comparison with standard color charts. The samples then are dried, stored, and cataloged. All samples are processed and kept on open file in the offices of Conservation and Survey Division, 113 Nebraska Hall, University of Nebraska-Lincoln, 68588-0517.

Beginning in September 1951, some of the test holes have been logged electrically. Geophysical logs (e-logs) often can be used to determine formation boundaries more precisely than by field sampling, especially where difference in rock types from the formation to another occur at the boundary. Figure 2 is an example of a geophysical log from Hayes County (39B-F-77) with formation boundaries shown. A notation on each test hole log indicates if geophysical logs are part of the original test hole data on file in the CSD office in Lincoln.

This publication is one of a series being issued to make more readily available the record of test holes drilled since 1930. The series of publications is made on a county basis and includes, with some exceptions, logs of all test holes drilled in each of the counties. The logs have not been reviewed for conformance with editorial standards and nomenclature. In the case of Hayes County, descriptions of strata done in earlier test hole reports are included with some revised formation information in this report.



- Test hole description published in this report
- Test hole description published in other reports



County Location Map

Fig. 1. Test-hole location map of Hayes County

Figure 2. Hayes County sample geophysical log (39B-F-77)

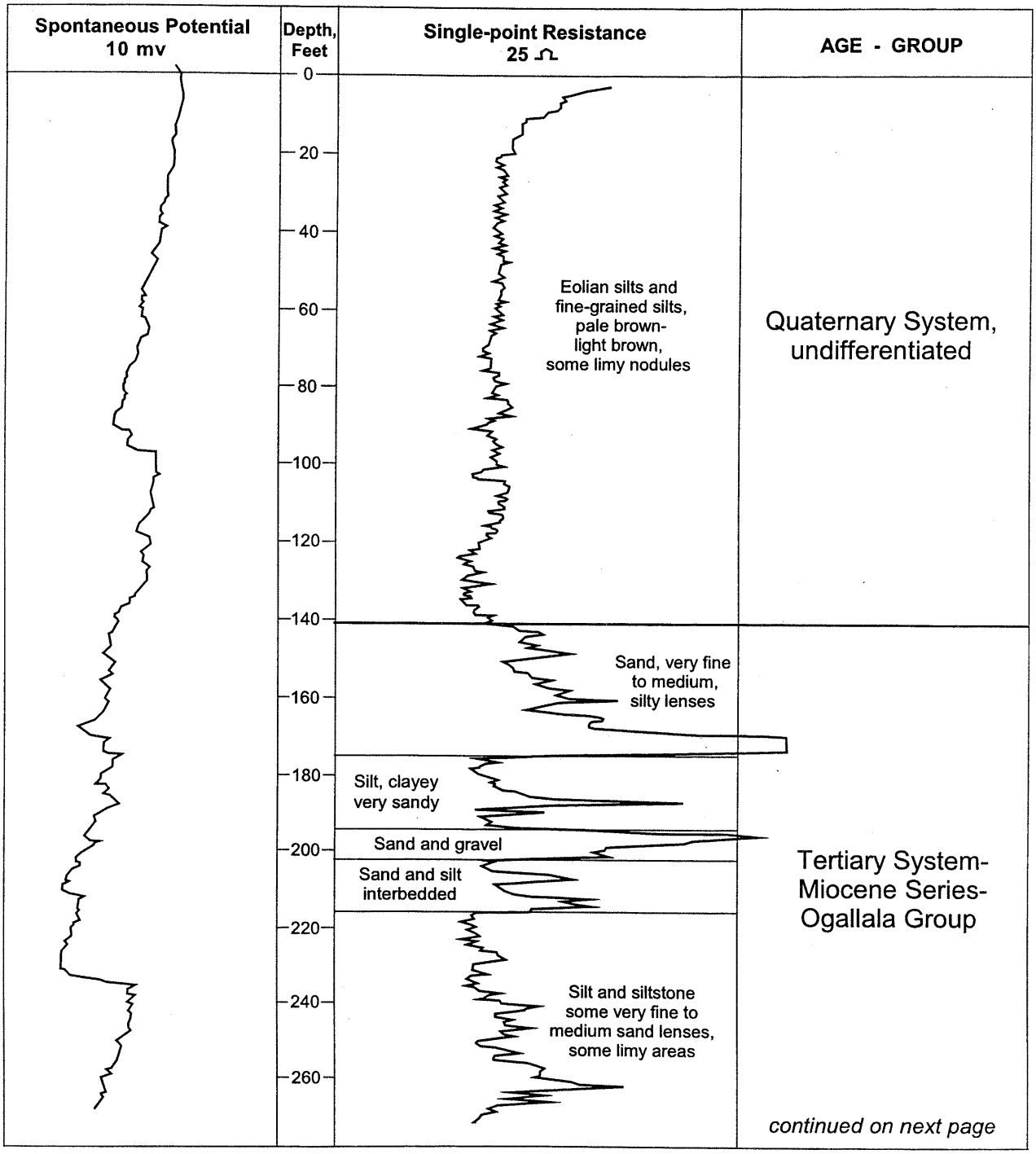
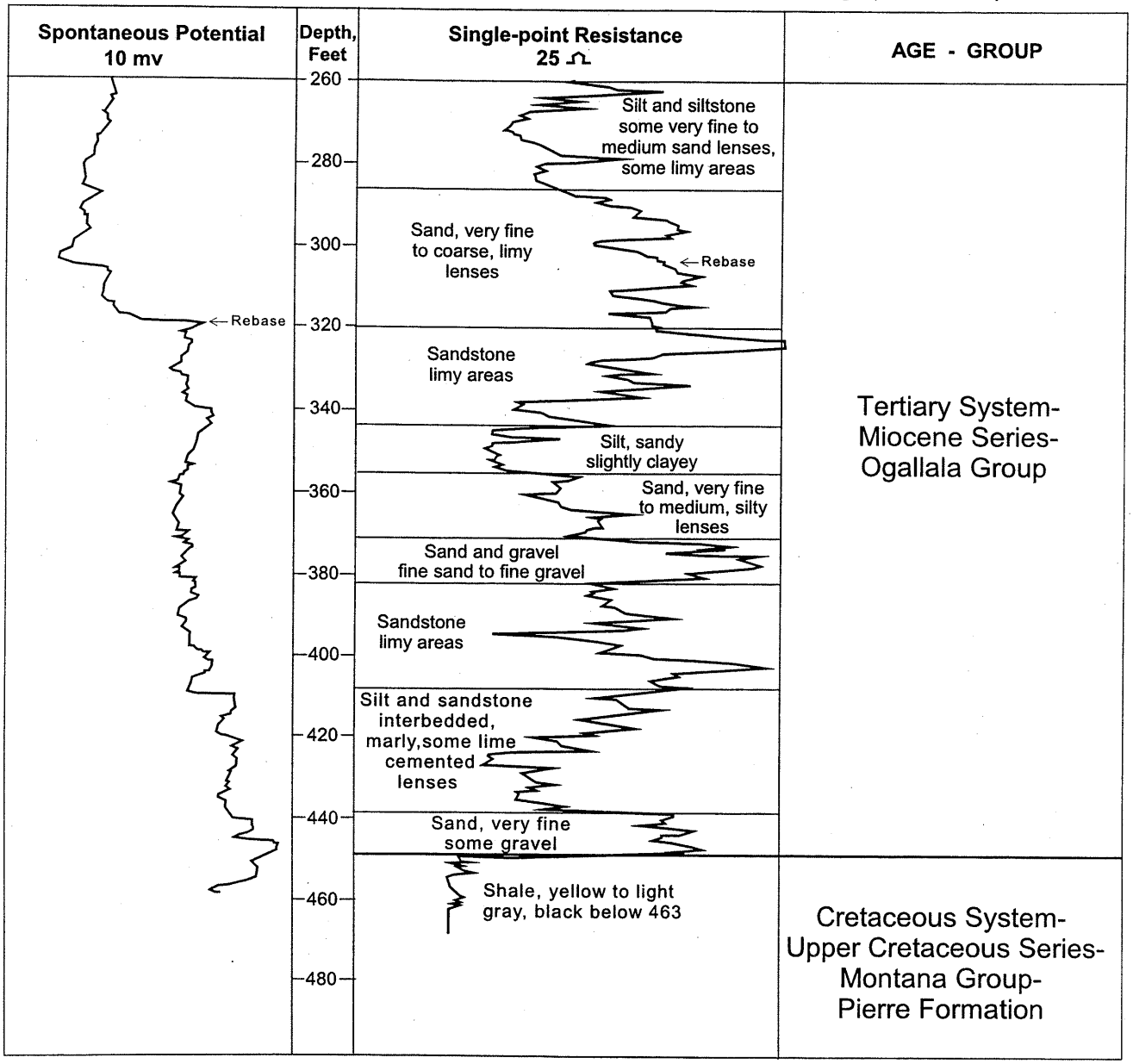


Figure 2 continued. Hayes County sample geophysical log (39B-F-77)



The method whereby the altitude of the land surface at test hole sites was determined is indicated in the heading of each log, as follows: a = altimeter, h = hand leveling, i = spirit leveling, t = estimated from topographic map.

The test hole records accurately reflect subsurface conditions only at the locations where the test holes were drilled. Interpretive data reflecting probable subsurface conditions between test holes are being compiled for publication in county reports and are available for inspection in the office of the Conservation and Survey Division.

Each test hole is identified by a number assigned in the field (for example #14-F-78), and most are also identified by a number indicating its location within the land divisions of the U.S. Bureau of Land Management's survey of Nebraska (see USGS test hole identification in figure 3). Location numbers of test holes east of the 6th principal meridian, which passes through Columbus in a north-south direction, are preceded by the capital letter A; those west of the principal meridian have no preceding letter. The first numeral indicates the township, the second the range, and the third the section. As shown in figure 3, the letters that follow the section number indicate the location of the test hole within the section, the first letter indicating the quarter section and the second letter indicating the quarter-quarter section and so on to the quarter-quarter-quarter-quarter section. The letters A, B, C, and D are applied in counterclockwise direction beginning with A in the northeast quadrant. As shown in figure 3, the letters that follow the section number indicated the location of the test hole within the section, the first letters (NE) indicating the quarter section, the second letter (NW) indicating the quarter-quarter section, the third letter (SW) indicating the quarter-quarter-quarter section, and the fourth letter (SE) indicating the quarter-quarter-quarter-quarter section. The last numeral is the serial number of the test hole within the quarter-quarter-quarter-quarter section if more than one well is present in that area.

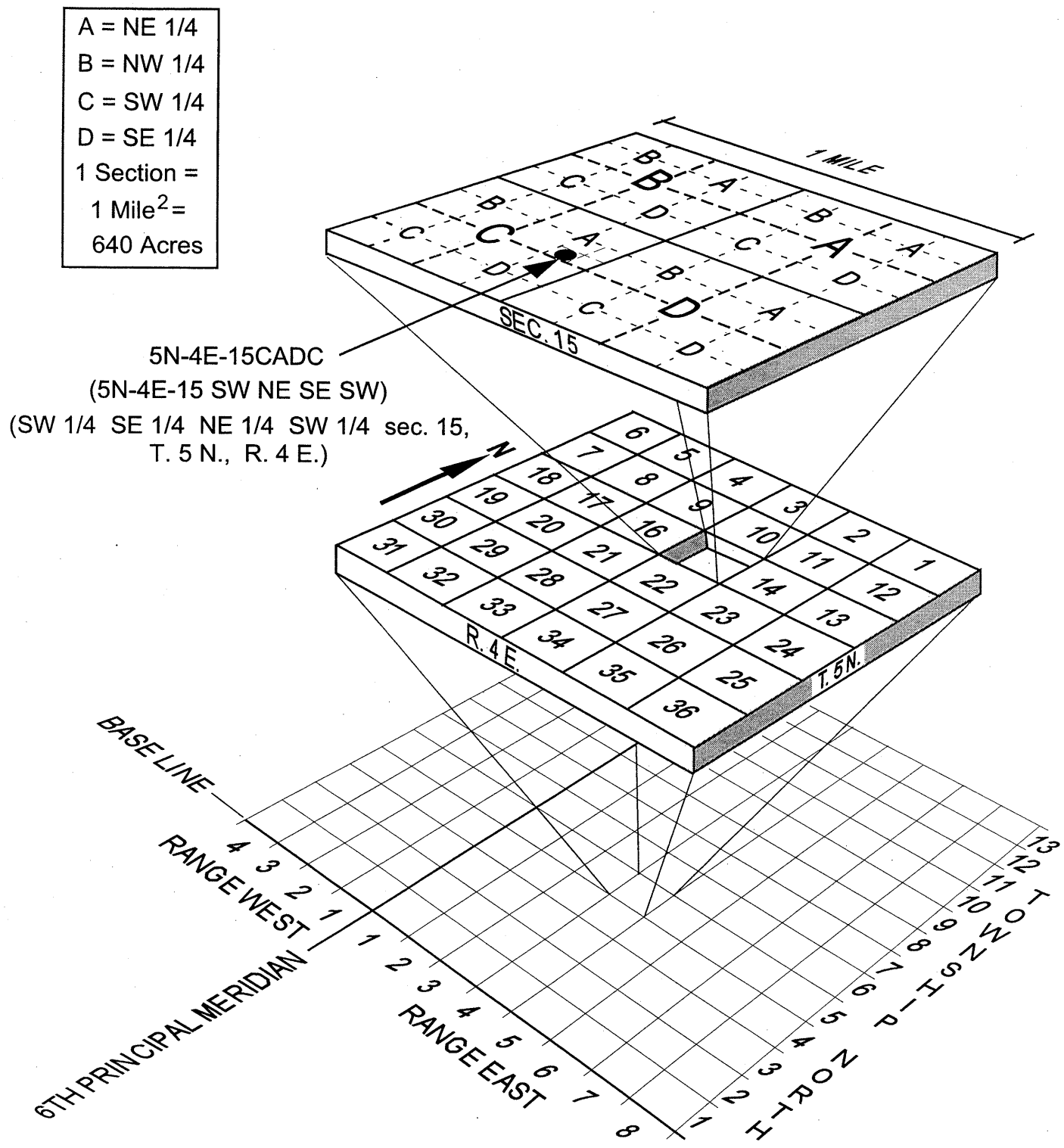


Fig. 3. System for identifying test-hole according to its location.

SELECTED REFERENCES

Some Publications that are Guides to
Earth Resources in Hayes County

Some of the published references pertinent to an understanding of the geologic and hydrologic resources of Hayes County are included below. The interested reader will find citations of other studies in these reports.

Bacon, S.R., Bruce, W.L., Franzen, D., Dodson, D.B. and Tyner, E.H. *Soil Survey of Frontier County Nebraska*, U.S. Department of Agriculture, SCS in cooperation with the Conservation and Survey Division, University of Nebraska-Lincoln, 1939 and 1978.

Cardwell, W.D.E., and Jenkins, E.D., *Ground-Water Geology and Pump Irrigation in Frenchman Creek Basin above Palisade, Nebraska* with a section on The Chemical Quality of the Water by Jochens, E.R., and Krieger, R.A., U.S. Geological Survey Water-Supply Paper 1577, 1963.

Eversoll, D.A., Dreeszen, V.H., Burchett, R.R., and Prichard, G.E., *Bedrock Map Showing the Configuration of the Bedrock Surface, McCook 1°x2° Quadrangle, Nebraska and Kansas and part of the Sterling 1°x2° Quadrangle, Nebraska and Colorado*, U.S. Geological Survey Map I-1878, 1988.

Goeke, J.W., Peckenpaugh, J.M., Cady, R.E., and Dugan, J.T., *Hydrogeology of the Twin Platte and Middle Republican Natural Resources Districts, Southwestern Nebraska*, with a section on water quality by R.A. Engberg, Nebraska Water Survey Paper No. 70, Conservation and Survey Division, University of Nebraska-Lincoln, prepared in cooperation with the U.S. Geological Survey, 1992.

Hiergesell, R.A., *Descriptive, Geologic, and Borehole Geophysical Logs for 23 Test Holes in South-Central Nebraska*, U.S. Geological Survey Open-File Report 84-073.

Keech, C.F., *Logs of Test Holes, Frenchman Creek Basin, Nebraska*, Conservation and Survey Division, University of Nebraska, Lincoln, 1957.

Selected References for Hayes County Continued

Lappala, E.G., *Quantitative Hydrogeology of the Upper Republican Natural Resources District, Southwest Nebraska*, U.S. Geological Survey Water-Resources Investigations 78-73, 1978.

Swinehart, J.B. and others, *Quaternary Geologic Map of the Platte River 4°x6° Quadrangle, United States*, U.S. Geological Survey, Map I-1420 (NK-14), 1994.

Waite, H. A., Reed, E. C., and Jones, D. S., *Ground Water in the Republican River Basin in Nebraska: Part IV, Hitchcock, Hayes, Dundy and Chase Counties, Nebraska.* Water Resources Survey, Water Supply Paper 1, Conservation and Survey Division, University of Nebraska-Lincoln.

Hayes County
Test-Hole Table of Contents

Test-holes are arranged in this publication by township, range and section.

Hayes County
Test-Hole Logs Table of Contents

Arranged by year drilled, test-hole number.

1933

1941

1942

1944

Test Hole #1-HA-42 (No e-logs)
(5N-32W-25ccbc)
Hayes County

Location: SW NW SW SW sec. 25, T. 5 N., R. 32 W., 9 ft south of center of road; 85 ft southwest of center of curve of highway.
Ground elevation: 2,716 ft (i). (Beverly 7.5 min. quadrangle).
Depth to water: 28 ft, (December 19, 1942).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Loam, sandy, dark	0.0	12.0
Clay, sandy, yellow	12.0	22.0
Clay, yellow	22.0	36.0
Sand and fine to medium gravel	36.0	46.0
Tertiary System - Miocene Series - Ogallala Group:		
Sand and fine to medium gravel; some lime	46.0	66.0
Sand and fine gravel; some clay and lime	66.0	76.0
Sand and fine to medium gravel; some lime	76.0	86.0
Sand and fine gravel; some lime	86.0	96.0
Sand and fine gravel; some clay	96.0	117.0
Sand and fine gravel; some clay or soapstone	117.0	139.0

Field number 241-42

Test Hole #14-FC-52 (No e-logs)
(5-33-6bbbb)
Hayes County

Location: NW NW NW NW sec. 6, T. 5 N., R. 33 W., drilled for U.S. Bureau of Reclamation, 1952.
Ground elevation: 3,022.0 ft. (i). (Palisade NE 7.5 min. quadrangle).
Depth to water: 205 ft (1952).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, soft, tan; contains very fine sand.....	0.0	59.3
Tertiary System - Miocene Series - Ogallala Group:		
Caliche, sandy, hard to soft, white to buff.....	59.3	72.0
Caliche, sandy, hard, buff.....	72.0	82.8
Sand, very fine, to gravel, medium; contains some well-cemented zones.....	82.8	97.7
Silt, sandy, soft, tan; contains some caliche.....	97.7	104.5
Sandstone, very fine to medium, silty; contains some siltstone.....	104.5	111.0
Caliche, silty, sandy, white.....	111.0	119.8
Sand, very fine to very coarse, silty, gravelly, loose.....	119.8	125.3
Silt, cemented in zones; contains very fine to coarse sand and some caliche.....	125.3	142.0
Silt, clayey, sandy, soft, gray.....	142.0	148.5
Silt, sandy, soft, light-brown; interbedded with thin streaks of sand and gravel.....	148.5	170.0
Caliche, silty, calcareous, hard to soft, white.....	170.0	182.0
Caliche, soft, white, and silt, sandy.....	182.0	192.0
Caliche, calcareous, hard to soft, white.....	192.0	196.3
Sand, very fine, silty, light-green, and caliche, soft, white.....	196.3	202.0
Caliche, hard, white.....	202.0	225.0
Silt, hard, gray; contains very fine to coarse sand.	225.0	232.0
Silt, hard, brown and gray; contains very fine to coarse sand.....	232.0	242.0
Silt, soft, tan to gray; contains very fine sand to very fine gravel.....	242.0	255.5
Sand, very fine, to gravel, very fine; silty; partly cemented in zones.....	255.5	274.6
Silt, sandy, soft, gray.....	274.6	282.0
Sand, very fine to coarse; contains very coarse sand and silt.....	282.0	292.0
Silt, sandy, soft, green.....	292.0	302.0
Sand, very fine to coarse, green; contains some silt and caliche.....	302.0	312.0
Silt, soft, green, and sand, very fine.....	312.0	332.0
Silt, hard, green; contains very fine sand.....	332.0	338.0
Caliche, hard, white, and silt, sandy, soft, tan....	338.0	355.0

Sand, very fine, to gravel, fine, silty, loose.....	355.0	365.6
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Clay, soft, yellow, and shale, dark-brown; contains some pale blue plastic clay.....	365.6	372.0

Test Hole #2-HA-42 (No e-logs)
(5N-33W-31bbbb)
Hayes County

Location: NW NW NW NW sec. 31, T. 5 N., R. 33 W.; 150 ft east of corner, and 9 ft south of center of road.
Ground elevation: 2,756 ft (i). (Palisade 7.5 min. quadrangle).
Depth to water: 16.7 ft, (September 24, 1942).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Loam, sandy, dark.....	0.0	4.0
Clay, sandy, yellow.....	4.0	14.0
Clay, sandy, dark.....	14.0	24.0
Tertiary System - Miocene Series - Ogallala Group:		
Gravel, fine, coarse; some lime and clay.....	24.0	34.0
Gravel, fine to coarse; some clay.....	34.0	44.0
Gravel, fine to coarse.....	44.0	54.0
Sand and fine to coarse gravel and lime.....	54.0	69.0

Field number 143-42

Test Hole #342-41 (No e-logs)
(5N-33W-31cdaa)
Hayes County

Location: NE NE SE SW sec. 31, T. 5 N., R. 33 W.; 0.2 mile north of southeast corner of quarter, on west edge of road.
Ground elevation: 2,752 ft (t). (Palisade 7.5 min. quadrangle).
Depth to water: caved at 5.8 ft, (November 8, 1941).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil, sandy, and road fill, dark brown to black.....	0.0	6.0
Sand, silty, buff.....	6.0	11.0
Clay, sandy, grayish buff.....	11.0	15.0
Silt, gray.....	15.0	20.0
Sandstone, brown; probably reworked.....	20.0	24.0
Tertiary System - Miocene Series - Ogallala Group:		
Gravel, fine to medium, some coarse, red; much brown sandstone and some lime, compact.....	24.0	48.0
Gravel, very fine to coarse, red; some brown sandstone and lime, compact.....	48.0	67.0
Gravel, fine to coarse, red; less brown sandstone and lime, not as compact.....	67.0	84.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, dark bluish gray to black, some greenish stain; compact, sticky.....	84.0	89.0

Test Hole #7-SW-33 (No e-logs)
(5N-34W-6ddba)
Hayes County

Location: NE NW SE SE sec. 6, T. 5 N., R. 34 W., 1,300 ft north and 900 ft west of southeast corner of section.
Ground elevation: 2,822 ft (a). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil; brown silty loam.....	0.0	12.0
Gravel, coarse and fine interbedded; some rounded limestone grains.....	12.0	35.0
Tertiary System - Miocene Series - Ogallala Group:		
Limestone, extremely hard, white; some coarse gravel embedded.....	35.0	44.0

Test Hole #6-SW-33 (No e-logs)
(5N-34W-15cbca)
Hayes County

Location: NE SW NW SW sec. 15, T. 5 N., R. 34 W., 800 ft northeast of southwest corner of forty.
Ground elevation: 2,786 ft (t). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Clay, very silty, gray; loosely consolidated.....	0.0	7.0
Gravel, coarse with some fine interbedded sand, some rounded limestone grains; very coarse gravel at 62 ft.....	7.0	61.0

Test Hole #5-SW-33 (No e-logs)
5N-34W-15cbcb)
Hayes County

Location: NW SW NW SW sec. 15, T. 5 N., R. 34 W., on center of west line of southwest quarter.
Ground elevation: 2,790 ft (a). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Clay, silty, gray, fairly compact.....	0.0	34.0
Gravel, coarse with some fine interbedded sand; many rounded white limestone grains.....	34.0	62.0
Tertiary System - Miocene Series - Ogallala Group:		
Limestone, hard, pure white.....	62.0	70.0

Test Hole #346-41 (No e-logs)
(5N-34W-19bccc)
Hayes County

Location: SW SW SW NW sec. 19, T. 5 N., R. 34 W.; 100 ft east of southwest corner of quarter, on north edge of road.
Ground elevation: 2,866 ft (t). (Hamlet 7.5 min. quadrangle).
Depth to water: 7.3 ft, (November 8, 1941).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Road fill and brown sandy soil	0.0	5.0
Clay, sandy, tan	5.0	14.0
Clay, sandy, grayish tan to brown	14.0	44.0
Silt, sandy, dark brown	44.0	46.0
Clay, sandy, buff-gray	46.0	48.0
Gravel, fine to medium, red; dirty, streaks of gray clay	48.0	56.0
Tertiary System - Miocene Series - Ogallala Group:		
Gravel, fine to medium, red; clean, compact, some lime	56.0	69.0
Gravel, medium, red; compact, hard streaks	69.0	79.0
Gravel, medium, red; some pebbles, hard	79.0	96.0
Silt, sandy, gray	96.0	104.0
Silt, sandy, black	104.0	109.0
Lime, sandy, hard, and medium red gravel	109.0	116.0
Clay, sandy, yellowish green	116.0	117.0
Gravel, medium, red	117.0	119.0

Test Hole #4-SW-33 (No e-logs)
(5N-34W-22aada)
Hayes County

Location: NE SE NE NE sec. 22, T. 5 N., R. 34 W., 900 ft south of the northeast corner of section.
Ground elevation: 2,779 ft (t). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Clay, silty, compact, yellow.....	0.0	12.0
Gravel, coarse and fine interbedded; many rounded limestone grains.....	12.0	73.0
Tertiary System - Miocene Series - Ogallala Group:		
Limestone, pure white; extremely hard.....	73.0	85.0

Test Hole #1-SW-33 (No e-logs)
(5N-34W-24cdbc)
Hayes County

Location: SW NW SE SW sec. 24, T. 5 N., R. 34 W., 800 ft north and 1,500 ft east of southwest corner of section.
Ground elevation: 2,780 ft (t). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil; light gray brown silty loam.....	0.0	2.0
Clay, silty, light grayish brown; loosely consolidated, uniform throughout.....	2.0	24.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay, silty, light grayish brown; some small granular, gritty, well rounded lime chips, some ash shards.....	24.0	35.0
Silt, sandy, calcareous, ashy, gray and brown; hard, tough, compact, very hard to drill, lower five ft has more lime and is a light gray.....	35.0	60.0

Test Hole #12-HA-42 (No e-logs)
(5N-34W-25adda)
Hayes County

Location: NE SE SE NE sec. 25, T. 5 N., R. 34 W.; 0.1 mile north of half section line, 125 ft southeast of northeast corner of cattle shed, 3 ft west of center of road.
Ground elevation: 2,754 ft (i). (Palisade 7.5 min. quadrangle).
Depth to water: 10.5 ft, (October 3, 1942).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Loam, sandy, dark	0.0	9.0
Gravel, fine to coarse, lime and clay	9.0	19.0
Tertiary System - Miocene Series - Ogallala Group:		
Gravel, fine to coarse and lime rock	19.0	49.0
Sand and medium gravel; some lime	49.0	59.0
Sand, gravel and lime	59.0	69.0
Gravel, fine to coarse	69.0	79.0
Sand, medium to coarse gravel and lime	79.0	89.0
Sand, medium gravel and lime	89.0	93.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, dark gray to black	93.0	98.0

Field number 144-42

Test Hole #2-SW-33 (No e-logs)
(5N-34W-25bbab)
Hayes County

Location: NW NE NW NW Sec. 25, T. 5 N., R. 34 W.; 125 ft south and 750 ft east of northwest corner of section.
Ground elevation: 2,762 ft (t). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil; light gray silty loam, loosely consolidated...	0.0	8.0
Gravel, fine, unconsolidated, well rounded; much sand.....	8.0	16.0
Clay, silty, grayish blue; tough, compact.....	16.0	18.0
Gravel, extremely coarse; some well rounded sand and limestone grains.....	18.0	58.0
Tertiary System - Miocene Series - Ogallala Group:		
Limestone, very hard, pure white; breaks up into very small angular chips.....	58.0	61.0
Clay, silty, calcareous, gray; compact, tough, consolidated.....	61.0	62.0
Gravel and sand, contains large well rounded limestone grains, coarse and fine interbedded, very slightly consolidated or extremely well packed....	62.0	84.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, hard, ochre yellow; tough, compact.....	84.0	89.0
Shale, gray; tough, hard, compact.....	89.0	101.0

Test Hole #3-SW-33 (No e-logs)
(5N-34W-25bbbd)
Hayes County

Location: SE NW NW NW sec. 25, T. 5 N., R. 34 N., 500 ft east and 500 ft south of the northwest corner of section.
Ground elevation: 2,783 ft (t). (Hamlet 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Clay, sandy, silty, light brown; loosely consolidated.....	0.0	62.0
Tertiary System - Miocene Series - Ogallala Group:		
Gravel, coarse and fine interbedded; some limestone grains, well rounded, highly compact.....	62.0	88.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, chalky, gray; tough, gummy, compact, (no samples).....	88.0	112.0

Test Hole #14-HA-42 (No e-logs)
(5N-34W-28bccc)
Hayes County

Location: SW SW SW NW sec. 28, T. 5 N., R. 34 W., 45 ft south of center of highway.
Ground elevation: 2,823 ft (i). (Palisade SW 7.5 min. quadrangle).
Depth to water: 34 ft, (October 3, 1942).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Loam, sandy, dark	0.0	3.0
Sand and clay, yellow	3.0	42.0
Sand and fine to coarse gravel; some lime and clay	42.0	52.0
Sand and fine to medium gravel; some lime	52.0	62.0
Gravel, fine to coarse; some lime	62.0	84.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay, yellow; some dark, some rootlets	84.0	94.0
Clay, sand and lime, yellow, rootlets, some gravel below 100 ft	94.0	104.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, dark yellow to light gray	104.0	112.0
Shale, dark gray, very hard	112.0	119.0

Field number 147-42

Test Hole #344-41 (No e-logs)
(5N-34W-28ddaa)
Hayes County

Location: NE NE SE SE sec. 28, T. 5 N., R. 34 W., 0.2 mile north of southeast corner of section, on west edge of road.
Ground elevation: 2,803 ft (t). (Palisade SW 7.5 min. quadrangle).
Depth to water: 7.1 ft, (November 8, 1941).

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Sand, fine, brownish buff	0.0	5.0
Sand, fine, and hard brown sandstone	5.0	10.0
Sand and gravel, fine sand to medium gravel, red; some lime	10.0	15.0
Silt, gray, and gravel and lime pebbles	15.0	22.0
Gravel, fine to medium, mostly fine, red; compact	22.0	28.0
Gravel, fine to medium, red; much fine	28.0	41.0
Gravel, fine to coarse, red; compact, reworked Ogallala	41.0	50.0
Tertiary System - Miocene Series - Ogallala Group:		
Gravel, fine, red; much brown sandstone	50.0	56.0
Gravel, fine to very coarse, red; some lime and brown sandstone pebbles	56.0	64.0
Gravel, fine to medium, red; much lime	64.0	77.0
Silt, soft, contains very fine to fine sand, blue	77.0	94.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, black; sticky	94.0	99.0

Test Hole #345-41 (No e-logs)
(5N-34W-29bcbb)
Hayes County

Location: NW NW SW NW sec. 29, T. 5 N., R. 34 W., 0.3 mile south of northwest corner of section, 300 ft north of river bridge, on east edge of road.
Ground elevation: 2,809 ft (a). (Hamlet 7.5 min. quadrangle).
Depth to water: caved at 46.5 ft, (November 8, 1941).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Sand, fine, buff	0.0	6.0
Gravel, fine to very coarse, red; large lime pebbles	6.0	17.0
Gravel, fine to coarse, red; compact, some brown sandstone and lime pebbles	17.0	23.0
Gravel, fine to coarse, red; lime pebbles, compact	23.0	29.0
Gravel, medium to very coarse, red; loose, lime and brown sandstone pebbles	29.0	50.0
Sand and fine to coarse red gravel, lime pebbles	50.0	60.0
Gravel, fine to coarse, red; small pebbles	60.0	71.0
Tertiary System - Miocene Series - Ogallala Group?:		
Sand and fine to coarse gravel, reddish brown sandstone and lime pebbles	71.0	80.0
Gravel, fine to coarse; much brown sandstone, hard, compact	80.0	84.0
Cretaceous System - Upper Cretaceous - Montana Group:		
Pierre Formation:		
Shale, gray to greenish black, compact	84.0	89.0

Test Hole #16-HA-42 (No e-logs)
(5N-34W-33dabb)
Hayes County

Location: NW NW NE SE sec. 33, T. 5 N., R. 34 W., on the east and west half section line and 1/8 mile west of east section line.
Ground elevation: 2,849 feet (i). (Palisade SW 7.5 min. quadrangle).
Depth to water: 28.8 ft, (September 29, 1942).

	Depth, in feet	
	From	To
Quaternary System. undifferentiated:		
Loam, sandy, dark	0.0	11.0
Clay, sandy, yellow	11.0	60.0
Gravel and clay	60.0	70.0
Gravel, fine to medium, and lime; some clay	70.0	86.0
Gravel and clay, hard	86.0	96.0
Gravel, fine to coarse, and lime	96.0	106.0
Sand and clay	106.0	116.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay; some sand, hard, some fine sandstone	116.0	135.0
Gravel, medium, and clay	135.0	158.0

Field number 145-42

Test Hole #343-41 (No e-logs)
(5N-34W-36ccca)
Hayes County

Location: NE SW SW SW sec. 36, T. 5 N., R. 34 W., 0.1 mile east and 0.1 mile north of southwest corner of section, in ditch, north of highway.
Ground elevation: 2,759 feet (a). (Palisade SW 7.5 min. quadrangle).
Depth to water: 17.3 ft, (November 8, 1941).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Sand, fine, compact, buff	0.0	4.0
Gravel, medium to coarse, red; slightly dirty, some very coarse gravel and lime pebbles	4.0	11.0
Gravel, fine to medium, red; dirty	11.0	17.0
Gravel, medium to coarse, red; some fine sand and very coarse gravel, compact	17.0	26.0
Gravel, coarse, red; some fine sand and lime pebbles	26.0	30.0
Sand, fine, red	30.0	32.0
Gravel, medium to coarse, red, compact	32.0	47.0
Gravel, medium to coarse, hard, red, reworked Ogallala	47.0	52.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay, silty, sandy, yellowish green	52.0	54.0
Clay, sandy, buff	54.0	65.0
Gravel, medium, green	65.0	67.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, grayish yellow	67.0	69.0

Test Hole #19-HA-42 (No e-logs)
(5N-35W-16ddca)
Hayes County

Location: NE SW SE SE sec. 16, T. 5 N., R. 35 W., about 40 ft south of center line of highway.
Ground elevation: 2,973 ft (i). (Wauneta East 7.5 min. quadrangle).
Depth to water: 8 ft, (September 29, 1942).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Clay, sandy, yellow.....	0.0	3.0
Gravel, fine to coarse, and lime; some clay.....	3.0	71.0
Sand and fine to medium gravel; some clay.....	71.0	91.0
Tertiary System - Miocene Series - Ogallala Group:		
Lime rock, hard.....	91.0	95.0
Lime rock and sand.....	95.0	99.0
Gravel, clay and lime.....	99.0	113.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, light gray, hard and compact.....	113.0	119.0

Field number 146-42

Test Hole #348-41 (No e-logs)
(5N-35W-17adba)
Hayes County

Location: NE NW SE NE sec. 17, T. 5 N., R. 35 W., 0.28 mile south of north line of section, 135 ft north of road corner, on east side of road.
Ground elevation: 2,895 ft (a). (Wauneta East 7.5 min. quadrangle).
Depth to water: 14.6 ft, (November 8, 1941).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Road fill and dark brown sandy soil.....	0.0	4.0
Clay, sandy, tan.....	4.0	13.0
Gravel, medium to coarse; much white to pink sandy lime.....	13.0	20.0
Clay, sandy, gray.....	20.0	21.0
Gravel, medium to coarse, red; compact, some lime pebbles, hard at 32 ft.....	21.0	33.0
Gravel, fine to medium, some coarse, red.....	33.0	46.0
Gravel, medium to coarse, red; some lime pebbles, some fine sand, compact.....	46.0	52.0
Gravel, medium to coarse, red; white pebbles, compact.....	52.0	63.0
Gravel, coarse, reddish green; some very coarse, hard.....	63.0	80.0
Clay, sandy, pink; some large gravel, hard streaks..	80.0	82.0
Clay, sandy, grayish pink; some medium gravel.....	82.0	85.0
Clay, sandy, greenish gray, reworked Ogallala.....	85.0	86.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay, hard, medium green, to buff sandy clay, many rootlets, contains fine to medium sandstone lenses.....	86.0	92.0
Lime, sandy, greenish white.....	92.0	96.0
Clay, sandy, medium green; compact, streaks of hard indurated green clay.....	96.0	119.0

Test Hole #347-41 (No e-logs)
(5N-35W-24cabb)
Hayes County

Location: NW NW NE SW sec. 24, T. 5 N., R. 35 W., 0.3 mile east of northwest corner of quarter, 0.2 mile west of river bridge, in ditch, on south side of highway.
Ground elevation: 2,842 ft (a). (Hamlet 7.5 min. quadrangle).
Depth to water: 14.6 ft, (November 8, 1941).

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Soil, fine, sandy	0.0	5.0
Silt, blue	5.0	13.0
Silt, gravel and old wood	13.0	16.0
Gravel, very fine to coarse; some pebbles	16.0	25.0
Tertiary System - Miocene Series - Ogallala Group:		
Sandstone, limy, light buff, whitish	25.0	34.0
Sandstone, very compact, brown	34.0	41.0
Sandstone, compact, brown	41.0	54.0
Sandstone, compact, greenish brown to brown	54.0	62.0
Clay, whitish gray	62.0	64.0
Sandstone, compact, brown	64.0	73.0
Gravel, fine, loose, reddish yellow	73.0	83.0
Gravel, fine to coarse, mostly red; clean, loose	83.0	97.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, light tan to gray to dark gray at 102 ft	97.0	104.0

Test Hole #39B-F-77 (E-logs)
(6N-31W-1bbbb)
Hayes County

Location: NW NW NW NW sec. 1, T. 6 N., R. 31 W., 71 ft south and 40 ft east of northwest section corner.
Ground elevation: 2,935 ft (t) (Camp Hayes Lake SE 7.5 min. quadrangle).
Depth to water: 202 ft, (December 14, 1977).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Sand, very fine, slightly silty	0.0	5.0
Silt, very sandy, yellowish-brown; sand is very fine; from 20 to 45 ft moderately sandy	5.0	66.0
Silt, moderately clayey, dark brown, limy areas	66.0	70.0
Silt, moderately clayey, reddish-brown, limy areas	70.0	80.0
Silt, slightly clayey, slightly sandy, pale brown; sand is very fine; some limy areas	80.0	120.0
Silt, moderately clayey, yellowish-brown	120.0	131.0
Silt, very clayey, slightly sandy, reddish-brown, moderately calcareous; sand is very fine to medium; below 135 ft limy fragments	131.0	140.0
Tertiary System - Miocene Series, Ogallala Group:		
Sand, very fine to medium, very silty with interbedded limestone and silty lenses	140.0	164.0
Sand, very fine to very coarse, little fine gravel, slightly silty to 170 ft	164.0	175.0
Silt, very clayey, very sandy, reddish-brown; sand is very fine to coarse with rare gravel in places.	175.0	194.0
Gravel, fine to coarse	194.0	200.0
Sand, very fine to very coarse, little fine gravel	200.0	202.0
Silt, very clayey, sandy, reddish-brown; sand is very fine to medium	202.0	206.0
Sand, gravelly; very fine sand to medium gravel	206.0	208.0
Silt, very clayey, sandy, brown with red tint, limy areas; sand is very fine to medium	208.0	212.0
Sand, very fine to coarse with some very coarse, trace of fine gravel	212.0	216.0
Silt, moderately clayey, moderately sandy, reddish-brown, slightly calcareous; sand is very fine to fine	216.0	232.0
Siltstone, clayey, slightly sandy, reddish-brown, slightly calcareous; sand is very fine; below 240 ft limy	232.0	250.0
Sand, very fine to medium with some coarse and little very coarse, very silty, below 260 ft lime and finer grained	250.0	265.0
Sand, very fine to very coarse with little fine gravel, slightly silty	265.0	268.0

Silt, very sandy, slightly clayey, reddish-brown, slightly calcareous; sand is very fine to medium..	268.0	275.0
Sand, very fine to medium, some coarse, very silty, many limy areas.....	275.0	286.0
Sand, very fine to coarse, slightly silty, interbedded limy lenses.....	286.0	320.0
Sandstone, very fine to coarse, very silty, in places lime cemented.....	320.0	344.0
Silt, moderately sandy, slightly clayey, reddish-brown, slightly calcareous; sand is very fine to medium.....	344.0	355.0
Sand, very fine to medium, some coarse, moderately silty.....	355.0	371.0
Sand, gravelly; very fine sand to fine gravel.....	371.0	382.0
Sandstone, very fine to medium, some coarse, slightly silty, limy areas; from 393 to 395 ft some siltstone.....	382.0	400.0
Sandstone, very fine to coarse with some very coarse, lime cemented.....	400.0	408.0
Silt, very sandy, marly, light gray; sand is very fine to medium.....	408.0	418.0
Sandstone, very fine to very coarse, silty, lime cemented; in places finer textured.....	418.0	439.0
Sand, gravelly; very fine to fine gravel, trace of medium to coarse gravel, some lithic gravels...	439.0	449.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clay, yellow, some light gray.....	449.0	463.0
Shale, clay, black.....	463.0	480.0

Test Hole #14-F-78 (e-log)
(6N-31W-36dadc)
Hayes County

Location: SW SE NE SE sec 36, T. 6 N., R. 31 W., 604 ft west of east center line, 24 ft from center of dirt road.
Ground elevation: 2,780 ft (t). (Burger Canyon East 7.5 min. quadrangle).
Depth to water: 145 ft, (August 20, 1978).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, sandy and slightly clayey, dark brown, sand is very fine to fine.....	0.0	4.0
Silt, slightly clayey, sandy, very pale brown, sand is very fine, moderately calcareous.....	4.0	18.0
Silt, moderately clayey, slightly sandy, dark brown, slightly calcareous, paleosol.....	18.0	21.0
Silt, clayey and sandy, pinkish white, sand is very fine to medium, calcareous, limy areas.....	21.0	48.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt, moderately clayey and very sandy, pink, sand is fine to medium coarse, calcareous.....	48.0	62.0
Sand, very fine to medium, slightly silty.....	62.0	67.0
Silt, clayey and slightly sandy, white to pink, sand is very fine to fine, calcareous.....	67.0	79.0
Sand, fine to medium, trace of coarse sand.....	79.0	82.0
Silt, moderately clayey, slightly sandy, pinkish white, sand is very fine to fine, limy 91 to 99 ft.....	82.0	99.0
Silt, slightly clayey and sandy, pale olive to 106 ft, then pinkish-white, sand is very fine, several very limy layers, some siliceous rootlets below 120 ft.....	99.0	129.0
Sandstone, very fine to medium grained, light gray, partly silty and limy, pinkish white below 138 ft.	129.0	145.0
Silt, moderately clayey, sandy, pinkish-white, sand is very fine to medium, very limy in areas.....	145.0	159.0
Sand, gravelly, fine to very coarse, some fine to very coarse gravel, mostly very coarse sand.....	159.0	173.0
Silt, slightly clayey and sandy, reddish-yellow to 180 ft then light gray, sand is fine to coarse, limy below 180 ft.....	173.0	185.0
Sand, gravelly, very fine to very coarse sand, some fine gravel.....	185.0	197.0
Sandstone, very fine to medium grained, white, silty and limy.....	197.0	202.0
Silt, clayey and slightly sandy, brownish yellow, very pale brown and limy 222 to 229 ft, calcareous.....	202.0	236.0

Sand, very fine to fine, some thin clayey silt layers	236.0	250.0
Silt, sandy and clayey, brownish yellow to 254 ft then pale brown, sand is very fine to medium, slightly calcareous	250.0	261.0
Sand, gravelly, fine to very coarse gravel, trace of fine to very coarse gravel	261.0	273.0
Silt, very sandy, slightly clayey, white, limy, sand is very fine to medium coarse	273.0	278.0
Sand, very fine to medium interbedded with pale brown sandy limy silt	278.0	293.0
Sand, very fine to medium, some thin clayey and sandy silt layers	293.0	298.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, light gray to olive yellow, some iron staining, light gray to black below 315 ft, slightly to moderately calcareous	298.0	340.0

Test Hole #15-F-78 (e-logs)
(6N-33W-36dddd)
Hayes County

Location: SE SE SE SE sec 36, T. 6 N., R. 33 W., 11½ ft west of dirt road, 8 ft north of dirt road, 13½ ft east of barbed wire fence, 18 ft southeast of old telephone pole.
Ground elevation: 2,846 ft (t). (Palisade NE 7.5 min. quadrangle).
Depth to water: 70 ft (August 21, 1978).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, very sandy, slightly clayey, dark grayish brown.....	0.0	1.0
Silt, sandy and slightly clayey, light yellowish brown, moderately calcareous, sand is very fine, few snail shells, limy below 58 ft.....	1.0	63.0
Sand and gravel, fine sand to coarse gravel.....	63.0	69.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt, slightly clayey and sandy, pinkish white to light brown, partly limy; light greenish gray with few siltstone lenses below 79 ft, calcareous.....	69.0	94.0
Silt, slightly clayey and sandy, pinkish white, very limy.....	94.0	108.0
Silt, clayey, slightly sandy, pinkish white, calcareous, light greenish gray and very clayey 114 to 119 ft.....	108.0	121.0
Silt, slightly clayey and sandy, pinkish white, limy, some siltstone, very limy below 136 ft.....	121.0	141.0
Sand, very fine to medium coarse.....	141.0	148.0
Silt, clayey, pinkish white, calcareous.....	148.0	150.0
Sandstone, very fine to medium grained, light gray, moderately calcareous, partly silty, some siliceous cementation, very sandy below 159 ft.....	150.0	163.0
Silt, clayey, slightly sandy, light gray, sand is very fine, calcareous, slightly clayey and sandy below 169 ft, some ash and siliceous fragments....	163.0	178.0
Silt, very clayey, light gray to pink, limy.....	178.0	184.0
Sand, very fine to medium, slightly silty.....	184.0	188.0
Silt, slightly clayey and sandy, pale yellow to pale olive, sand is very fine to medium, calcareous....	188.0	191.0
Sand, slightly clayey and silty, pale olive to light gray, sand is very fine to medium, limy.....	191.0	202.0
Silt, clayey and slightly sandy, pale olive, moderately calcareous.....	202.0	211.0
Sand and gravel, fine sand to very coarse gravel, sandy silt lenses at 226 and 231 ft.....	211.0	235.0
Silt, clayey, slightly sandy, light yellow brown, slightly calcareous, sand is fine to medium.....	235.0	240.0

Sand, fine to very coarse, silty, trace of fine gravel	240.0	242.0
Silt, clayey and sandy, pink, calcareous	242.0	245.0
Sand, gravelly, fine to very coarse sand, some fine gravel	245.0	250.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, pale yellow to light gray, light gray to black below 255 ft, some iron staining	250.0	287.0

Test Hole #6-FC-52 (No e-logs)
(6N-34W-6bbbb)
Hayes County

Location: NW NW NW NW sec. 6, T. 6 N., R. 34 W., drilled for U.S. Bureau of Reclamation, 1952.
Ground elevation: 3,066.4 ft (i). (Hayes Center SW 7.5 min. quadrangle).
Depth to water: 106 ft (1952).

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Soil, silty, hard, dark brown	0.0	2.7
Silt, soft, light brown	2.7	10.0
Caliche, white to buff; contains very fine to coarse sand	10.0	19.2
Silt, sandy, soft, light brown; contains some caliche	19.2	44.2
Tertiary System - Miocene Series - Ogallala Group:		
Sand, very fine, to gravel, medium, loose	44.2	56.1
Silt, clayey, soft; contains some very fine to fine sand and caliche	56.1	66.6
Sand, very fine, to gravel, coarse	66.6	67.4
Silt, hard, light brown; contains very fine to very coarse sand	67.4	81.0
Silt, sandy, hard, light brown; interbedded with streaks of caliche	81.0	90.5
Sand, very fine, to gravel, medium, loose	90.5	97.0
Silt, light brown; contains very fine to coarse sand and some caliche	97.0	111.0
Silt; contains very fine sand to fine gravel	111.0	129.5
Sand, very fine to coarse, silty	129.5	132.4
Clay, plastic, light brown, and silt, sandy, blocky, medium brown	132.4	141.0
Silt, clayey, light brown; contains very fine to very coarse sand	141.0	151.0
Sandstone, fine	151.0	153.0
Silt, clayey, light brown; contains very fine to very coarse sand	153.0	161.0
Silt, sandy, light brown; contains some caliche	161.0	165.2
Silt, clayey, sandy, plastic, medium brown	165.2	171.0
Silt, white; contains very fine to coarse sand	171.0	191.0
Silt, sandy, and sandstone, fine	191.0	206.2
Caliche, sandy, white; interbedded with thin streaks of light brown silt; contains some cemented zones	206.2	216.0
Silt, clayey, sandy, light brown	216.0	221.0
Silt, clayey, buff, and sand, very fine, to gravel, very fine, hard	221.0	241.0
Sand, very fine, to gravel, fine, silty, hard	241.0	247.0

Sand, very fine, to gravel, fine, loose.....	247.0	259.4
Silt, sandy, soft, gray.....	259.4	266.0
Sand, very fine to very coarse; interbedded with white to blue soft clay and streaks of sandstone..	266.0	270.0
Sand, very fine to very coarse, loose; contains very fine to medium gravel.....	270.0	276.7
Silt, hard, medium brown; contains very fine to medium sand.....	276.7	291.0
Silt, clayey, sandy, medium brown to white.....	291.0	298.0
Silt, sandy, hard, greenish-gray.....	298.0	300.3
Sand, very fine, to gravel, medium, loose.....	300.3	316.6
Silt, tan; contains some very fine to medium sand...	316.6	323.5
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Clay, hard, plastic, yellow-brown.....	323.5	329.5
Clay, plastic, blue-gray.....	329.5	331.0

Test Hole #13-FC-52 (No e-logs)
(6N-34W-31cccc)
Hayes County

Location: SW SW SW SW sec. 31, T. 6 N., R. 34 W., drilled for U.S. Bureau of Reclamation, 1952.
Ground elevation: 2,840.5 ft (i) (Hamlet 7.5 min. quadrangle).
Depth to water: 22 ft (1952).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil, silty, brown; contains some fine sand.....	0.0	4.0
Sand, very fine, to gravel, coarse, loose; contains some silt and nodules of caliche.....	4.0	21.0
Tertiary System - Miocene Series - Ogallala Group:		
Sand, very fine, to gravel, silty; contains some thin cemented layers and nodules of caliche.....	21.0	45.5
Caliche, hard to soft, buff; interbedded with very fine to medium sandstone.....	45.5	54.0
Sandstone, very fine to medium, gray-green; contains some caliche.....	54.0	67.0
Silt, soft, green; contains some very fine to coarse sand.....	67.0	71.0
Silt, slightly cemented, brown; contains some very fine to coarse sand.....	71.0	91.0
Silt; interbedded with very fine sand to fine gravel.....	91.0	104.0
Sand, very fine to very coarse, silty, gravelly.....	104.0	116.5
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Clay, plastic, yellow and light blue-gray.....	116.5	121.0

Test Hole #1R-HA-44 (No e-logs)
(6N-35W-17bddb)
Hayes County

Location: NW SE SE NW sec. 17, T. 6 N., R. 35 W. 2,000 ft south and 2,200 ft east of northwest corner of section.
Ground elevation: 2,997 ft (i). (Wauneta East 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Top Soil	0.0	5.0
Clay, yellow	5.0	48.0
Sand, fine	48.0	51.0
Tertiary System - Miocene Series - Ogallala Group:?		
***Estimated interval.**		
Sand and gravel	51.0	76.0

*Note: No samples available to review

Test Hole #2R-HA-44 (No e-logs)
(6N-35W-17caaa)
Hayes County

Location: NE NE NE SW sec. 17, T. 6 N., R. 35 W., northeast corner of southwest quarter.
Ground elevation: 3,010 ft (i). (Wauneta East 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Top soil	0.0	5.0
Clay, yellow	5.0	52.0
Sand, fine	52.0	55.0
Sand and gravel	55.0	73.0
Tertiary System - Miocene Series - Ogallala Group:?		
***Estimated interval.**		
Lime	73.0	97.0
Sand and gravel	97.0	122.0

*Note: No samples available to review

Test Hole #3R-HA-44 (No e-logs)
(6N-35W-17caad)
Hayes County

Location: SE NE NE SW sec. 17, T. 6 N., R. 35 W., 2,100 ft north of southeast corner of quarter.
Ground elevation: 2,988 ft (i). (Wauneta East 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Top soil	0.0	5.0
Clay, yellow	5.0	31.0
Sand and gravel	31.0	46.0
Tertiary System - Miocene Series - Ogallala Group:?		
***Estimated interval.**		
Limestone	46.0	56.0
Lime	56.0	75.0
Sand, fine	75.0	81.0
Lime	81.0	99.0
Sand, fine, and clay	99.0	111.0
Sand and gravel	111.0	115.0
Lime, soft	115.0	134.0
Sand	134.0	146.0
Lime, soft	146.0	159.0
Sand and gravel	159.0	170.0
Sand	170.0	178.0
Lime, soft	178.0	184.0
Sand and gravel	184.0	194.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:?		
***Estimated interval.**		
Shale, brown	194.0	204.0

*Note: No samples available for review

Test Hole #4R-HA-44 (No e-logs)
(6N-35W-17cadd)
Hayes County

Location: SE SE NE SW sec. 17, T. 6 N., R. 35 W., 1,600 ft north of southeast corner of quarter.
Ground elevation: 2,909 ft (i). (Wauneta East 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Top soil	0.0	6.0
Silt, sandy	6.0	9.0
Sand and gravel	9.0	21.0
Silt, black	21.0	27.0
Sand and gravel	27.0	45.0
Tertiary System - Miocene Series - Ogallala Group:?		
***Estimated interval**		
Limestone	45.0	56.0
Sand and gravel	56.0	83.0

*Note: No samples available to review

Test Hole #5R-HA-44 (No e-logs)
(6N-35W-17dcbc)
Hayes County

Location: SW NW SW SE sec. 17, T. 6., R. 35 W., 800 ft north and 2,500 ft east of southwest corner of section.
Ground elevation: 2,960 ft (t). (Wauneta East 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Top soil	0.0	4.0
Clay, brown	4.0	56.0
Silt, black	56.0	59.0
Sand, fine	59.0	65.0
Sand and gravel	65.0	83.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay, yellow	83.0	87.0
Sand and gravel	87.0	103.0
Clay, yellow	103.0	106.0
Sand and gravel	106.0	112.0
Limestone, decomposed	112.0	117.0
Clay, sandy	117.0	130.0
Sand, coarse	130.0	160.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:?		
***Estimated interval.**		
Shale, brown	160.0	185.0

*Note: No samples available for review

Test Hole #6R-HA-44 (No e-logs)
(6N-35W-17dccc)
Hayes County

Location: SW SW SW SE sec. 17, T. 6 N., R. 35 W.
Ground elevation: 2,989 ft (i). (Wauneta East 7.5 min. quadrangle).
Depth to water: not measured.

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Top soil	0.0	5.0
Clay, yellow	5.0	54.0
Sand and gravel	54.0	59.0
Tertiary System - Miocene Series - Ogallala Group:?		
***Estimated interval.**		
Lime, decomposed	59.0	120.0
Clay, yellow	120.0	132.0
Lime, decomposed	132.0	135.0
Sand, fine	135.0	140.0
Sand and gravel	140.0	160.0
Lime, decomposed	160.0	164.0
Sand and gravel	164.0	176.0
Lime, decomposed	176.0	184.0
Sand	184.0	190.0

*Note: No samples available for review

Test Hole #8-SW-33 (No e-logs)
(6N-35W-35bdab)
Hayes County

Location: NW NE SE NW sec. 35, T. 6 N., R. 35 W., 20 feet east of Stinking Water Creek bridge on south boundary line of quarter. Ground elevation, 2,868 ft (t). (Wauneta East 7.5 min. quadrangle). Depth to water: not measured.

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Clay, silty, brown; loosely consolidated.....	0.0	12.0
Clay, silty, soft, bluish gray; alkaline, gumbo.....	12.0	20.0
Sand, very fine, unconsolidated.....	20.0	41.0
Gravel, coarse and fine interbedded; many water-worn limestone grains.....	41.0	62.0

Test Hole #1-H-78 (E-logs)
(7N-33W-6cccc)
Hayes County

Location: SW SW SW SW sec 6, T. 7 N., R. 33 W., 122 ft north and 15 ft east of southwest section corner.
Ground elevation: 3,170 ft (t). (Hayes Center 7.5 min. quadrangle).
Depth to water: 221 ft (July 10, 1978).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, slightly clayey, slightly sandy, dark brown; sand is very fine to fine.....	0.0	10.0
Silt, slightly clayey, slightly sandy, yellowish-brown; sand is very fine to fine; trace of shell fragments.....	10.0	15.0
Silt, moderately sandy, slightly clayey, dark yellowish brown; sand is very fine to fine.....	15.0	20.0
Silt, slightly clayey, slightly sandy, yellow-brown, slightly calcareous; sand is very fine to fine; below 80 ft brown.....	20.0	85.0
Silt, slightly clayey, slightly sandy, yellowish brown to pale brown, slightly calcareous; sand is very fine; in places very calcareous.....	85.0	150.5
Tertiary System - Miocene Series - Ogallala Group:		
Silt, marly, moderately sandy, pinkish-white; sand is very fine to medium.....	150.5	185.0
Silt, moderately sandy, slightly clayey, reddish-brown; sand is very fine to medium.....	185.0	193.0
Sand, gravelly; very fine sand to fine gravel with a little medium gravel from 193 to 195 ft, silty....	193.0	208.5
Silt, moderately sandy, slightly clayey, pale brown; sand is very fine to fine.....	208.5	214.0
Sand, very silty, very fine to coarse, some sandstone.....	214.0	220.0
Silt, moderately sandy, slightly clayey, limy, light brown; sand is very fine to medium.....	220.0	230.0
Sand, moderately silty, very fine to very coarse, little fine gravel.....	230.0	238.0
Silt, slightly clayey, slightly sandy, light brown, moderately calcareous; sand is very fine to medium; below 246 ft trace of coarse sand.....	238.0	266.0
Sand, gravelly; very fine sand to fine gravel with some medium gravel.....	266.0	291.0
Silt, slightly clayey, slightly sandy, light brown, moderately calcareous; sand is very fine to fine; below 302 ft interbedded silty sandstone.....	291.0	312.0
Sand, gravelly; very fine sand to medium gravel.....	312.0	315.0

Silt, slightly clayey, slightly sandy, light brown, slightly calcareous; sand is very fine to fine....	315.0	324.5
Sand, slightly gravelly; very fine sand to fine gravel, trace of medium gravel.....	324.5	335.0
Silt, moderately clayey, slightly sandy, olive-gray, slightly calcareous; sand is very fine; below 342 ft light brown, some limy areas.....	335.0	352.0
Sand, very fine to coarse.....	352.0	360.0
Sand to sandstone, very fine to fine grained, some medium grained, silty, limy lenses.....	360.0	393.0
Sand, slightly gravelly; very fine sand to fine gravel; below 405 ft less gravel.....	393.0	411.0
Marl, silty, sandy, white; limy lenses; sand is very fine to fine.....	411.0	415.0
Limestone, sandy, white; sand is very fine to fine..	415.0	425.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clay, yellowish-brown, slightly calcareous; from 440 to 460 ft yellow with some black; in places trace of bentonite.....	425.0	460.0
Shale, clay, black.....	460.0	470.0

Test Hole #35-F-77 (e-logs)
(7N-33W-35dddd)
Hayes County

Location: SE SE SE SE sec 35, T. 7 N., R. 33 W., 85 ft west and 52 ft north of southeast section corner.
Ground elevation: 3,048 ft (t). (Hayes Center 7.5 min. quadrangle).
Depth to water: 196 ft (November 5, 1977).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, slightly clayey, slightly sandy, dark brown, slightly calcareous; sand is very fine.....	0.0	6.0
Silt, slightly clayey, slightly sandy, yellowish-brown, slightly calcareous; sand is very fine to fine; below 72 ft dark brown.....	6.0	77.0
Silt, slightly clayey, slightly sandy, pale brown, moderately calcareous; sand is very fine to fine..	77.0	103.0
Silt, moderately clayey, slightly sandy, reddish-brown, moderately calcareous; sand is very fine to fine; limy areas.....	103.0	120.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt, slightly clayey, moderately sandy, marly, white; sand is very fine to medium; limy areas....	120.0	135.0
Sand, very fine to coarse, silty, in places lime cemented.....	135.0	138.0
Siltstone, clayey, reddish-brown, slightly calcareous.....	138.0	144.0
Sand, very fine to very coarse, very silty.....	144.0	148.0
Sand, gravelly; very fine sand to medium gravel.....	148.0	158.0
Silt, clayey, sandy, gravelly, reddish-brown, moderately calcareous; very fine sand to medium gravel.....	158.0	164.0
Sand, gravelly; very fine sand to medium gravel.....	164.0	172.0
Silt, very sandy, slightly clayey, light gray, very calcareous; sand is very fine to coarse.....	172.0	182.0
Sand, very fine to very coarse, trace of gravel, very silty, slightly clayey.....	182.0	191.0
Sand, gravelly; very fine sand to coarse gravel; interbedded clay lenses.....	191.0	196.0
Silt, moderately clayey, slightly sandy, reddish-brown, moderately calcareous; sand is very fine to medium; limy areas; below 211 ft pinkish-gray, sand is very fine to very coarse.....	196.0	225.0
Silt, very sandy, slightly clayey, pale brown, moderately calcareous; sand is very fine to fine; below 237 ft marly, sand is very fine to medium...	225.0	244.0
Silt, clayey, very sandy, reddish-brown; sand is very fine to coarse; some siltstone and limy areas.....	244.0	256.0

Sand, very fine to very coarse, little fine gravel, moderately silty; below 261 ft limy areas.....	256.0	275.0
Siltstone, clayey, reddish-brown, slightly calcareous.....	275.0	278.0
Sand, very fine to very coarse, very silty.....	278.0	291.0
Silt, very sandy, slightly clayey, pale olive, moderately calcareous; sand is very fine to coarse; below 295 ft marly sand, some interbedded sandstone.....	291.0	320.0
Sandstone, very fine to very coarse grained, silty, lime cemented.....	320.0	330.0
Sand, very fine to very coarse, little fine gravel, silty.....	330.0	339.0
Siltstone, clayey, moderately sandy, pinkish-brown, moderately calcareous; sand is very fine to medium.....	339.0	357.0
Sandstone, very fine to medium grained, lime cemented, gray to olive-gray.....	357.0	361.0
Siltstone, clayey, grayish-brown, slightly calcareous.....	361.0	372.0
Sand, slightly gravelly; very fine sand to fine gravel.....	372.0	377.0
Silt, moderately clayey, marly, light gray, in part pinkish-gray; some siltstone.....	377.0	386.0
Sand, very fine to very coarse, slightly silty.....	386.0	390.0
Sand, gravelly; very fine sand to fine gravel.....	390.0	412.0
Sand, very fine to very coarse, little fine gravel..	412.0	420.0
Clay, pale olive, moderately calcareous.....	420.0	447.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clay, black, slightly calcareous.....	447.0	460.0

Test Hole #36-F-77 (e-logs)
(7N-34W-6bbba)
Hayes County

Location: NE NW NW NW sec 6, T. 7 N., R. 34 W., 540 ft east and 36 ft south of northwest section corner.
Ground elevation: 3,174 (t). (Hayes Center SW 7.5 min. quadrangle).
Depth to water: 160 ft, (November 7, 1977).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, very sandy, dark brown; sand is very fine.....	0.0	2.0
Sand, very fine, silty.....	2.0	15.0
Silt, slightly clayey, slightly sandy, pale brown, slightly calcareous; sand is very fine; some limy areas; from 34 to 36 ft reddish-brown; below 88 ft moderately clayey.....	15.0	108.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt, very sandy, slightly clayey, marly, pale white with some brown; sand is very fine to medium.....	108.0	116.0
Sand, very fine to medium, some coarse, very silty, limy areas.....	116.0	135.0
Sand, slightly gravelly; very fine sand to fine gravel; very silty.....	135.0	138.0
Silt, very sandy, slightly clayey, reddish-brown, moderately calcareous; sand is very fine to coarse.....	138.0	145.0
Sand, gravelly; very fine sand to fine gravel, trace of medium gravel; from 148 to 150 ft silt layer; below 155 ft very fine sand to medium gravel.....	145.0	168.0
Silt, very sandy to gravelly, brown, very calcareous; very fine sand to medium gravel; interbedded limestone seams.....	168.0	194.0
Silt, moderately sandy, slightly clayey, reddish-brown, moderately calcareous; sand is very fine to medium; some limy lenses.....	194.0	232.0
Silt, very sandy, marly; sand is very fine to medium.....	232.0	244.0
Silt, moderately sandy, slightly clayey, reddish-brown, moderately calcareous; limy areas.....	244.0	252.0
Sand, very fine to very coarse, moderately silty....	252.0	255.0
Sand, gravelly; very fine sand to fine gravel.....	255.0	264.0
Silt, moderately sandy, slightly clayey, reddish-brown, very calcareous; sand is very fine; in places limy areas and limestone lenses.....	264.0	295.5
Silt, moderately sandy, slightly clayey, olive-gray, very calcareous; sand is very fine to medium; below 305 ft pinkish-gray; some siltstone and limy areas.....	295.5	322.0

Silt, moderately sandy, slightly clayey, marly, white; sand is very fine to fine; some interbedded sandstone and limestone lenses.....	322.0	400.0
Sandstone, very fine to coarse grained, marly, interbedded limestone lenses.....	400.0	405.0
Sand, very fine to very coarse, moderately silty....	405.0	440.0
Sand, very fine to very coarse, little fine gravel..	440.0	447.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clay, yellow; below 452 ft, black.....	447.0	480.0

Test Hole #5-FC-52 (No e-log)
(7N-34W-6bbbb)
Hayes County

Location: NW NW NW NW sec 6, T. 7 N., R. 34 W., 200 ft east and 15 ft south of northwest section corner, drilled for U.S. Bureau of Reclamation, 1952.
Ground elevation: 3,152 ft (i). (Hayes Center SW 7.5 min. quadrangle)
Depth to water: 134 ft (1952).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil, silty, medium brown; contains some very fine sand	0.0	1.3
Sand, very fine to fine; contains some silt	1.3	10.0
Clay, silty, soft, light brown	10.0	21.0
Silt, light brown; contains some very fine to fine sand	21.0	73.0
Clay silty, hard, light brown	73.0	92.0
Tertiary System - Miocene Series - Ogallala Formation:		
Caliche, white; contains very fine to medium sand	92.0	109.0
Sand, very fine to medium	109.0	111.0
Sand, very fine to coarse, calcareous	111.0	116.5
Silt, sandy, and caliche	116.5	127.0
Sand, very fine, to gravel, medium, loose	127.0	158.5
Silt, clayey, hard, light brown; contains very fine to medium sand; interbedded with caliche and fine sandstone	158.5	171.0
Silt, hard, medium brown; contains very fine to coarse sand	171.0	177.0
Silt, sandy; interbedded with very fine sand to very fine gravel	177.0	188.5
Silt, clayey, sandy; interbedded with fine sandstone	188.5	191.0
Silt, clayey, sandy; interbedded with caliche and siltstone	191.0	211.0
Silt, clayey, and sandy caliche	211.0	216.0
Clay, sandy, gravelly, light green; interbedded with light brown sandy, gravelly silt	216.0	225.0
Sand, very fine, to gravel, medium	225.0	244.0
Silt, interbedded with caliche and sandstone	244.0	261.0
Silt, hard, light brown; contains very fine to coarse sand	261.0	281.0
Silt, hard, medium brown; contains very fine to medium sand	281.0	310.5
Caliche, sandy; interbedded with greenish-gray and fine white sandstone	310.5	321.0
Silt, sandy, hard, gray-green	321.0	341.0
Silt, sandy, hard, gray-green; contains cemented zones	341.0	361.0

Silt, sandy, hard, white	361.0	366.2
Sand, medium to very coarse, calcareous	366.2	371.0
Silt, sandy, hard, white	371.0	391.0
Sandstone, fine to medium, calcareous	391.0	401.0
Silt, white, and very fine to coarse sand	401.0	411.0
Sand, fine to very coarse, well-rounded grains, white to light green	411.0	416.0
Sand, very fine to very coarse, well-rounded grains, white to light green; contains some light green to pink silt and very fine to fine gravel	416.0	421.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Clay, yellow and yellow-brown shale	421.0	429.5
Clay, plastic, dark blue	429.5	431.5

Test Hole #6-F-78 (E-logs)
(8N-31W-3baba)
Hayes County

Location: NE NW NE NW sec 3, T. 8 N., R. 31 W., 150 ft west and 40 ft south of bend in gravel road 2 miles south of Ash Grove School.
Ground elevation: 3,080 ft (t). (Camp Hayes Lake NE 7.5 min. quadrangle).
Depth to water: 244 ft, (February 28, 1978).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, very sandy and slightly clayey, dark grayish brown, then dark brown, sand is very fine to fine, snail shells	0.0	8.0
Silt, moderately sandy and slightly clayey, light yellowish brown, sand is very fine, moderately calcareous, occasional snail shells, more sand below 66 ft	8.0	92.0
Silt, slightly sandy and clayey, dark brown, slightly calcareous, paleosol	92.0	96.0
Silt, slightly sandy, light yellowish brown, moderately calcareous	96.0	105.0
Silt, sandy, slightly clayey, pink, sand is very fine to fine, calcareous	105.0	112.0
Silt, sandy, slightly clayey, light yellowish brown 138 to 145 ft, several limy areas, moderately calcareous, sand is very fine	112.0	156.0
Silt, moderately clayey, slightly sandy, light brown to 168 ft, then light yellowish brown, moderately calcareous, some limy streaks	156.0	212.0
Silt, clayey, light yellowish brown, some limy concretions	212.0	240.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt, moderately clayey and sandy, very pale brown, calcareous, sand is very fine, limy zones	240.0	245.0
Silt, clayey, sandy pink to pale brown, some very fine to fine grained sandstone, moderately to very calcareous, sand is very fine to fine	245.0	272.0
Sand, gravelly, fine sand to fine gravel, much fine to medium grained sandstone, limy	272.0	285.0
Silt, clayey, pink	285.0	287.0
Sand, gravelly, fine sand to medium fine gravel	287.0	298.0
Silt, clayey and sandy, reddish yellow, sand is fine to medium, slightly calcareous	298.0	304.0
Sand, gravelly, fine sand to coarse gravel	304.0	321.0
Silt, moderately clayey, light brown, interbedded with very fine to medium grained sandstone and pale brown siltstone	321.0	380.0

Sand, fine to coarse, trace of fine gravel.....	380.0	387.0
Silt, slightly clayey, light gray to pink, some interbedded limy silts and fine to medium grained sandstones, moderately to very calcareous.....	387.0	427.0
Sandstone, very fine to fine grained, pink, some interbedded white limy silts to siltstones.....	427.0	451.0
Silt, slightly clayey, light gray to pink, several fine grained sandstone layers, slightly calcareous.....	451.0	468.0
Sand, very fine to medium.....	468.0	475.0
Sand, gravelly, fine sand to coarse gravel, mostly medium to coarse sand.....	475.0	500.0
Silt, slightly clayey and sandy, light gray, sand is very fine to medium, limy.....	500.0	506.0
Sand, gravelly, fine sand to coarse gravel, mostly medium to very coarse sand, some limy streaks.....	506.0	549.0
Sandstone, very fine to fine, some light gray to white silt and siltstone layers, limy.....	549.0	567.0
Sand, fine to coarse, some fine gravel.....	567.0	572.0
Silt, clayey, very pale brown, some siltstone.....	572.0	575.0
Sandstone, very fine to fine grained, pale brown to pink, some reworked pink siltstone and claystone fragments.....	575.0	585.0
Siltstone, sandy, light greenish gray, sand is fine to medium, some very fine to fine sandstone, slightly calcareous.....	585.0	602.0
Sand, very fine to medium.....	602.0	603.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, pale yellow to light gray below 620 ft, moderately calcareous, iron stains.....	603.0	640.0

Test Hole #6-H-78 (E-logs)
(8N-32W-36dddd)
Hayes County

Location: SE SE SE SE sec. 36, T. 8 N., R. 32 W., 50 ft west and 16 ft north of southeast section corner.
Ground elevation: 2,922 ft (t). (Camp Hayes Lake 7.5 min. quadrangle).
Depth to water: 95 ft, (July 26, 1979).

	Depth, in feet	
	From	To
Quaternary System, undifferentiated:		
Silt, sandy, dark grayish brown	0.0	0.5
Silt, very sandy, dark brown, sand is very fine to medium	0.5	5.0
Sand, silty, very fine to medium	5.0	14.0
Silt, slightly sandy, light yellowish brown, calcareous, sand is very fine	14.0	35.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt, slightly clayey, pink, some siltstone, calcareous	35.0	50.0
Silt, clayey, white, very limy	50.0	56.0
Silt, sandy, pink, sand is fine to medium, some siltstone and fine grained sandstone, calcareous	56.0	71.0
Sand and gravel, fine sand to very coarse gravel	71.0	105.0
Silt, sandy, strong brown, light gray 118 to 121 ft, sand is fine to medium, few limy areas	105.0	121.0
Sand and gravel, fine sand to medium fine gravel	121.0	127.0
Sandstone, fine to coarse, pinkish white, some siltstone, calcareous	127.0	137.0
Silt, slightly clayey and sandy, pink, sand is very fine, slightly calcareous	137.0	147.0
Sand and gravel, fine sand to medium fine gravel	147.0	154.0
Silt, sandy, pink, sand is fine to medium, calcareous	154.0	157.0
Silt, slightly clayey and sandy, pinkish white, calcareous, some siliceous cementation, very limy 169 to 171 ft, few siltstone and grained sandstone layers	157.0	217.0
Sandstone, very fine to medium grained, pinkish white to white, moderately calcareous, some siltstone layers	217.0	226.0
Silt, slightly clayey and sandy, pink, some siltstone and fine grained sandstone, calcareous	226.0	247.0
Sand, very fine to medium, some pink, very fine to medium grained sandstone	247.0	252.0
Limestone, white, some very fine grained sandstone	252.0	255.0
Sand, very fine to medium, pinkish white, partly silty and limy	255.0	262.0

Limestone, light gray, some very fine to fine grained sandstone layers	262.0	270.0
Silt, very sandy, light gray, calcareous, some fine to medium grained sandstone layers, sand is fine to medium	270.0	277.0
Sand, fine to very coarse, trace fine gravel	277.0	282.0
Silt, slightly clayey, pink to light gray, several limy layers	282.0	315.0
Sandstone, very fine to medium grained, pinkish white, moderately calcareous, some fine to medium sand	315.0	332.0
Silt, sandy, light gray to white, very calcareous, several siltstone layers, very fine to fine grained sandstone below 344 ft	332.0	354.0
Silt, brown, very slightly calcareous	354.0	362.0
Sandstone, very fine to fine grained, light gray, moderately calcareous, some siltstone layers	362.0	381.0
Silt, slightly clayey, brown, slightly calcareous	381.0	393.0
Sand, fine to coarse	393.0	407.0
Sandstone, fine to coarse, much fine to very coarse sand with trace fine gravel	407.0	412.0
Silt, clayey, light greenish gray, slightly calcareous	412.0	416.0
Sand, very fine to coarse, trace very coarse	416.0	424.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, pale yellow, olive yellow, slightly calcareous, iron stained, light gray below 429 ft.	424.0	440.0

Test Hole #4-H-78 (E-logs)
(8N-33W-36dddd)
Hayes County

Location: SE SE SE SE sec 36, T. 8 N., R. 33 W., 60 ft north and 20 ft west of dirt road corner and 70 ft north of canyon head with fence down middle of canyon bottom.
Ground elevation: 3,155 ft (t). (Hayes Center 7.5 min. quadrangle).
Depth to water: 260 ft, (estimated from Water Table Map).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Silt, slightly sandy and clayey, dark grayish brown.	0.0	3.0
Silt, sandy, brown, sand is very fine to fine, slightly calcareous.....	3.0	25.0
Silt, sandy, light yellowish brown, sand is very fine to fine, some snail shells, some iron stains.	25.0	92.0
Silt, sandy and slightly clayey, grayish brown, sand is very fine to fine, paleosol.....	92.0	97.0
Silt, sandy, light yellowish brown, sand is very fine to fine, some limy streaks and areas.....	97.0	119.0
Silt, sandy and slightly clayey, light yellowish brown, sand is very fine to fine, calcareous with some very limy areas.....	119.0	185.0
Silt, sandy and slightly clayey, reddish yellow to light yellowish brown, slightly calcareous, sand is very fine to fine, paleosol.....	185.0	192.0
Silt, sandy, light yellowish brown, sand is very fine, some limy streaks and very limy below 210 ft.....	192.0	251.0
Tertiary System - Miocene Series - Ogallala Group:		
Sandstone, very fine to medium, pinkish white to light gray, much fine to coarse sand, some interbedded sandy silt and siltstone layers.....	251.0	288.0
Sand, very fine to coarse, some pinkish white fine to medium sandstone.....	288.0	293.0
Sandstone, fine to medium, pink, much sand and gravel.....	293.0	299.0
Sand and gravel, fine sand to coarse gravel.....	299.0	302.0
Silt, sandy and slightly clayey, light gray, sand is very fine to medium, some siltstone layers, moderately calcareous.....	302.0	316.0
Sand, very fine to coarse, trace of fine gravel.....	316.0	321.0
Silt, slightly sandy, pink, some siltstone, limy....	321.0	328.0
Sandstone, very fine to medium, pinkish white, some siltstone layers and some siliceous cementation...	328.0	364.0
Sandstone, very fine to fine grained, light gray to pinkish white, some siltstone, very slightly calcareous, some siliceous cementation.....	364.0	369.0
Silt, slightly clayey, light gray, calcareous.....	369.0	374.0

Sandstone, very fine to medium grained, pinkish white, interbedded with sandy silt and siltstone layers, some siliceous rootlets, moderately calcareous, very fine to fine sand from 406 to 408 ft	374.0	412.0
Sandstone, very fine to coarse grained, white to pinkish white, limy, some fine to coarse sand layers at 415 ft, 419 to 422 ft, 436 to 439 ft and 447 to 449 ft	412.0	458.0
Silt, sandy, slightly clayey, pink to white, some siltstone and fine to medium sandstone layers, calcareous	458.0	488.0
Sand, fine to coarse, trace of fine gravel	488.0	492.0
Silt, sandy and slightly clayey, light gray to pink, some siltstone layers, calcareous	492.0	507.0
Sandstone, fine to medium grained, light gray to white, some siltstone layers, limy with some siliceous cementation, few fine to coarse sand layers	507.0	554.0
Silt, clayey, pale yellow to pale olive, some siltstone, very calcareous	554.0	566.0
Sandstone, fine to medium grained, light gray to white, some siltstone with fine to coarse sand lenses, moderately calcareous, some siliceous cementation	566.0	598.0
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, pale yellow to light gray, dark gray from 604 ft, slightly calcareous, iron stained siltstone 615 to 618 ft	598.0	620.0

Test Hole #29-B-74 (e-log)
(8N-35W-1bbaa)
Hayes County

Location: NE NE NW NW sec. 1, T. 8 N., R. 35 W., 8 ft south of north section line and 1,178 ft east of west section line.
Ground elevation: 3,392 ft (t). (Hayes Center NW 7.5 min. quadrangle).
Depth to water: 232 ft (estimated from Water Table Map).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Sand, very fine to medium, brown to 5 ft then light yellow tan	0.0	14.0
Silt, moderately clayey, some very fine sand, pale brown	14.0	15.0
Silt, slightly sandy and clayey, yellow-brown, limy whitish streaks	15.0	20.5
Silt, moderately clayey, slightly sandy, light brown with some limy areas	20.5	36.5
Sand, very fine with some fine sand, pale brown	36.5	48.0
Silt, moderately clayey, some very fine sand, pale brown to brown, limy 48 to 52, 58 to 60, 62 to 65 and 78.8 to 80 ft, very limy 95 to 100 ft and 109 to 111 ft	48.0	111.0
Sand, very fine to fine, slightly silty, light brown	111.0	116.0
Silt, sandy, very fine to fine, some slightly clayey lenses, intermittent limy areas, pale brown, limy areas whitish-brown, reddish brown between 150 and 155 ft, gray brown below 155 ft, marly lenses below 200 ft	116.0	220.0
Tertiary System - Miocene Series - Ogallala Group:		
Silt to very fine sand, limy, pinkish brown	220.0	226.0
Sand and sandstone, very fine to fine, silty lenses, sandstone cemented with lime, pinkish white	226.0	250.0
Sand, medium to very coarse, some fine gravel, some very fine to medium sandstone lenses, limy	250.0	260.0
Silt to fine sand, some coarse sand, very pale brown	260.0	272.0
Sand, fine to medium to silt and siltstone interbedded, limy areas, yellowish to reddish-brown	272.0	285.0
Sand, fine to very coarse, some medium gravel, some silty streaks, pale brown	285.0	294.0
Sand and sandstone, very fine to fine, interbedded with silt lenses between 320 and 330 ft, reddish-yellow to light brown	294.0	335.0
Sand, fine to very coarse, some medium gravel, some light brown claystone below 355 ft	335.0	360.0
Sandstone, very fine to coarse, interbedded with fine to coarse sand, light brown to reddish-brown.	360.0	386.0

Sand and gravel, fine sand to medium gravel.....	386.0	394.0
Sand, very fine to medium, slightly silty and clayey, pale brown, some silt lenses.....	394.0	432.0
Sand, very fine to coarse, slightly limy, some fine limy sandstone and silt interbeds, pale brown to white.....	432.0	450.0
Sand, very fine to coarse, limy areas, pale brown, silty lens 490 to 492 ft.....	450.0	500.0
Sand and sandstone, very fine to fine, limy areas, very pale brown to pinkish white.....	500.0	518.0
Sand, fine to coarse, some slightly silty areas, some rootlets, some very fine to fine sandstone interbeds.....	518.0	549.0
Sand, medium to coarse, silt lenses, slightly clayey, pinkish.....	549.0	573.0
Sand, very fine to very coarse, some fine to very coarse gravel, lens of whitish clay between 585 and 590 ft.....	573.0	603.5
Cretaceous System - Upper Cretaceous Series - Montana Group:		
Pierre Formation:		
Shale, clayey, light gray, yellowish 605 to 610 ft, then gray to black.....	603.5	615.0

Test Hole #4-FC-52 (No e-log)
(8N-35W-31cccc)
Hayes County

Location: SW SW SW SW sec. 31, T. 8 N., R. 35 W., drilled for U.S. Bureau of Reclamation, 1952.
Ground elevation: 3,216.6 ft (i). (Dittons Creek SE 7.5 min. quadrangle).
Depth to water: 157 ft (1952).

	Depth, in feet From	To
Quaternary System, undifferentiated:		
Soil, silty, medium brown; contains some very fine to medium sand	0.0	8.0
Silt, light brown; contains thin clayey zones	8.0	86.0
Silt, hard, orange-brown; contains streaks of white clay	86.0	103.0
Tertiary System - Miocene Series - Ogallala Group:		
Clay, silty, soft, light gray; contains thin streaks of caliche and some very fine to coarse sand	103.0	116.0
Silt, hard, light brown; contains very fine to medium sand	116.0	128.5
Sand, very fine with fine gravel, loose	128.5	129.0
Silt; contains very fine to medium sand	129.0	138.0
Sand, fine, to gravel, medium, loose	138.0	143.7
Clay, hard, light brown, and sand, very fine to coarse	143.7	149.7
Sand, fine to very coarse, loose; contains very fine to medium gravel	149.7	154.0
Clay, hard, light brown; contains very fine to coarse sand	154.0	185.0
Sand, fine, to gravel, medium, loose	185.0	200.7
Clay, silty, sandy, hard, light brown	200.7	209.5
Sandstone, fine, and clay, soft, white; contains some layers of fine to coarse sand	209.5	217.5
Clay, sandy, hard, light brown; interbedded with gray soft clay	217.5	229.5
Sand, very fine, to gravel, medium	229.5	241.0
Clay, silty, sandy, hard	241.0	261.0
Silt, clayey, sandy; contains some caliche	261.0	284.3
Sand, very fine to very coarse, slightly cemented; contains some fine to medium gravel	284.3	291.0
Sandstone, fine, buff; interbedded with soft white sandy clay and light gray silt	291.0	309.0
Silt, light gray, and sand, very fine to very coarse; contains some thin well-cemented layers	309.0	331.0
Silt, clayey, sandy, white to light brown	331.0	351.0
Silt, clayey, hard, light gray to white; contains very fine sand to very fine gravel and streaks of white clay	351.0	365.0

Cretaceous System - Upper Cretaceous Series - Miocene Group:

Pierre Formation:

Clay, hard, yellow-brown, and shale, dark brown.....	365.0	394.0
Clay, hard, blue.....	394.0	401.0