

GEOHYDROLOGY FIELD TRIP
MARION COUNTY, KANSAS
November 18-19, 1983

by

Field Trip Leaders
Howard O'Connor
Pamela K. Chaffee

Kansas Geological Survey
Open-file Report 83-25

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Contents

	Page
Forward.....	3
Acknowledgments.....	3
Introduction.....	5
Road Log and Discussion of Stops.....	7
General.....	7
Day 1 of Field Trip, Stops 1 through 14.....	7
Day 2 of Field Trip, Stops 15 through 23.....	34
References.....	41

ERRATA

Please note the following corrections in the guidebook:

Pg. 20: change "Tampa" to "Ramona"

Pg. 26: change "decrease" to "increase"
change "Resturant" to "Restaurant"
change "estimated +100 gpm (+160 acre-feet/year)"
to "a measured (5/16/84) \pm 900 gpm (\pm 1450 acre-feet/year)".

Figures

Figure No.		Page
1	Geologic map of Marion County, Kansas.....	8
2	Oil and gas fields in Marion County.....	9
3	Marion County base map showing location of <u>Stops</u>	10
4	A part of the Lost Springs 7.5-minute topographic quadrangle (south-central part).....	11
5	Generalized stratigraphic section of outcropping rocks.....	13, 14
6	Water Well Record of Peterson irrigation well.....	15
7	Hydrographs of four observation wells.....	16
8	A part of the Lost Spring 7.5-minute topographic quadrangle (north-central part).....	18
9	Water Well Record of Lyle Hanschu water well.....	19
10	A part of the northwest corner of the Lost Springs 7.5-minute topographic quadrangle and the northeast corner of the Ramona 7.5-minute topographic quadrangle.....	21
11	East-west geologic section A-A' based on water well records and a test hole near Lost Springs, Kansas.....	23
12	East-west geologic section B-B' based on water well records near Lincolnville, Kansas.....	24
13	Map of northeastern Marion County showing location of geologic sections A-A' and B-B'.....	25
14	Water analysis of flowing well in NE 1/4, SE 1/4, SE 1/4 sec. 9, T19S, R4E.....	27
15	A part of the southwest corner of the Lincolnville 7.5-minute topographic quadrangle.....	28
16	Measured section of Winfield Limestone.....	30
17	Lineament map.....	31
18	A part of the northwest corner of the Goessel 7.5-minute topographic quadrangle.....	36
19	A part of the northwest corner of the Tampa 7.5-minute topographic quadrangle.....	38

Forward

This field trip represents the second annual fall field trip prepared for the Geohydrology Section of the Kansas Geological Survey. These field trips are intended to provide background geologic and hydrologic information from various areas of the State to Geohydrology staff about the diverse geology and hydrology of Kansas. The trips are also intended to present problems and ideas for discussion by all staff members.

We have invited a small number of participants from outside the Geohydrology Section who have special backgrounds in geology, hydrology, or stratigraphy of Marion County or adjacent counties to join us and to contribute their knowledge and experience to the discussion of geologic and hydrologic problems, concepts and interpretations.

Additionally, members of the Kansas Geological Survey Administration and Public Relations Section were invited in order to provide them with a better first-hand view of the geology and hydrology of Marion County and some of the results of the field and lab research, some of the hydrologic problems resolved, and some of the problems and concepts that are as yet not resolved.

Acknowledgments

Appreciation is expressed to O.S. "Nick" Fent, Consulting Geologist and owner of the Hydraulic Drilling Company of Salina, for his interest in our field studies and for agreeing to participate and share part of his many years of experience in unraveling the stratigraphy of this area and his experience with drilling, developing, and protecting the groundwater resources of the area. Nick is also a successful journalist, conservationist, and a most interesting philosopher.

Similarly, we wish to express appreciation to William "Bill" Biegler, Consulting Geologist of Salina, who for many years was the Kansas Department of Health and Environment District Geologist at Salina. Marion County was a part of Bill's district and he acquired a first-hand knowledge from more than 20 years of investigating groundwater problems reported to his office. We much appreciate Bill's willingness to share his experience and expertise with us.

We wish to thank Professor J.R. Berg, Wichita State University, and Professor Henry V. Beck, Kansas State University, for their interest in our field trip and willingness to participate in discussions of the geology and hydrology.

We also acknowledge the assistance provided by other Sections of the Kansas Geological Survey, especially Larry Hathaway and Don Whittemore who are providing assistance and guidance in our water quality studies; Don Steeples and Richard Miller for geophysical studies in the Lost Springs area; and to Dave Grisafe for identification of mineral samples collected during field studies.

Appreciation is expressed to Dave Pope, Chief Engineer, and to Dale Ten-Eyck and Dick Severt, Division of Water Resources, Kansas State Board of Agriculture, for their assistance in stream- and spring-flow measurements completed and in progress.

Last, but not least, we acknowledge the assistance of Joe Zinn, Paul Backhus, Paul Burckhart, and Paul Benda, water well drillers, who provided drill cuttings or information on water wells they have drilled, and to all of the owners of property who have graciously given permission for the field trip group to visit points of interest on their properties.

Introduction

A study, "Geohydrology of Marion County, Kansas," was initiated because of requests for information about the area's groundwater resources by several consulting engineering firms, consulting geologists, public water-supply officials and individuals in Marion County. Several communities have no public water supplies or have poor quality water supplies. Historic unregulated oil field brine disposal practices have caused pollution of some fresh-water aquifers. Some fresh-water aquifers were reported to be depleted or to have had large water level declines seemingly not related to pumpage. Marion County Commissioners have requested information on the quantity of groundwater available in the County. Several farmers have indicated interest in irrigation if adequate groundwater is available.

This study was designed to collect data necessary to evaluate the groundwater/surface water systems and the water quality and to model the systems. The study also was designed to evaluate the extent of oil field brine contamination and to verify and determine the causes of local depletion of fresh groundwater supplies.

Approximately 600 wells and springs were inventoried and wherever possible representative water samples were collected for determination of chloride and specific conductance, two indices easily and rapidly obtainable with field determinations. Thirty-seven well and spring water samples were collected for more complete water analyses. In November and December 1982, approximately 200 stream sites were evaluated for base flow and 150 water samples collected for determination of chloride and specific conductance. Estimates of stream and spring flows were made at the same time. In the fall

of 1983 the same sites are to be resampled and flow measurements are to be made at approximately 50 sites with the assistance of the Division of Water Resources.

All groundwater/surface water and water quality data are to be stored in computer data files for interpretation, analysis and preparation of graphics during the winter and spring 1983-84.

Records of 2,000 seismic shot holes and many plugging records were obtained through the cooperation of Delbert Costa and Carol Larson, Kansas Corporation Commission.

Water analyses of public water supplies and several individual water supplies were obtained from the Kansas Department of Health and Environment.

Nine rotary drilled test holes and 45 auger test holes were drilled in 1982. Fourteen observation wells were established to monitor monthly water level changes and water quality changes.

The final report will include compilation of basic geologic, hydrologic, and water quality data in maps, tables, and figures and an interpretative report describing water flow systems, water quality, and groundwater/surface water relationships.

This field trip is intended to present interesting hydrologic and geologic information obtained during the course of field investigations and to solicit discussion and interpretation of observed phenomena by all participants on the trip.

The Wellington Formation nomenclature used in this guidebook is from Byrne and others, 1959, based on studies by Ver Wiebe in 1937. The nomenclature has not yet been adopted by the Kansas Geological Survey.

Road Log and Discussion of Stops

General

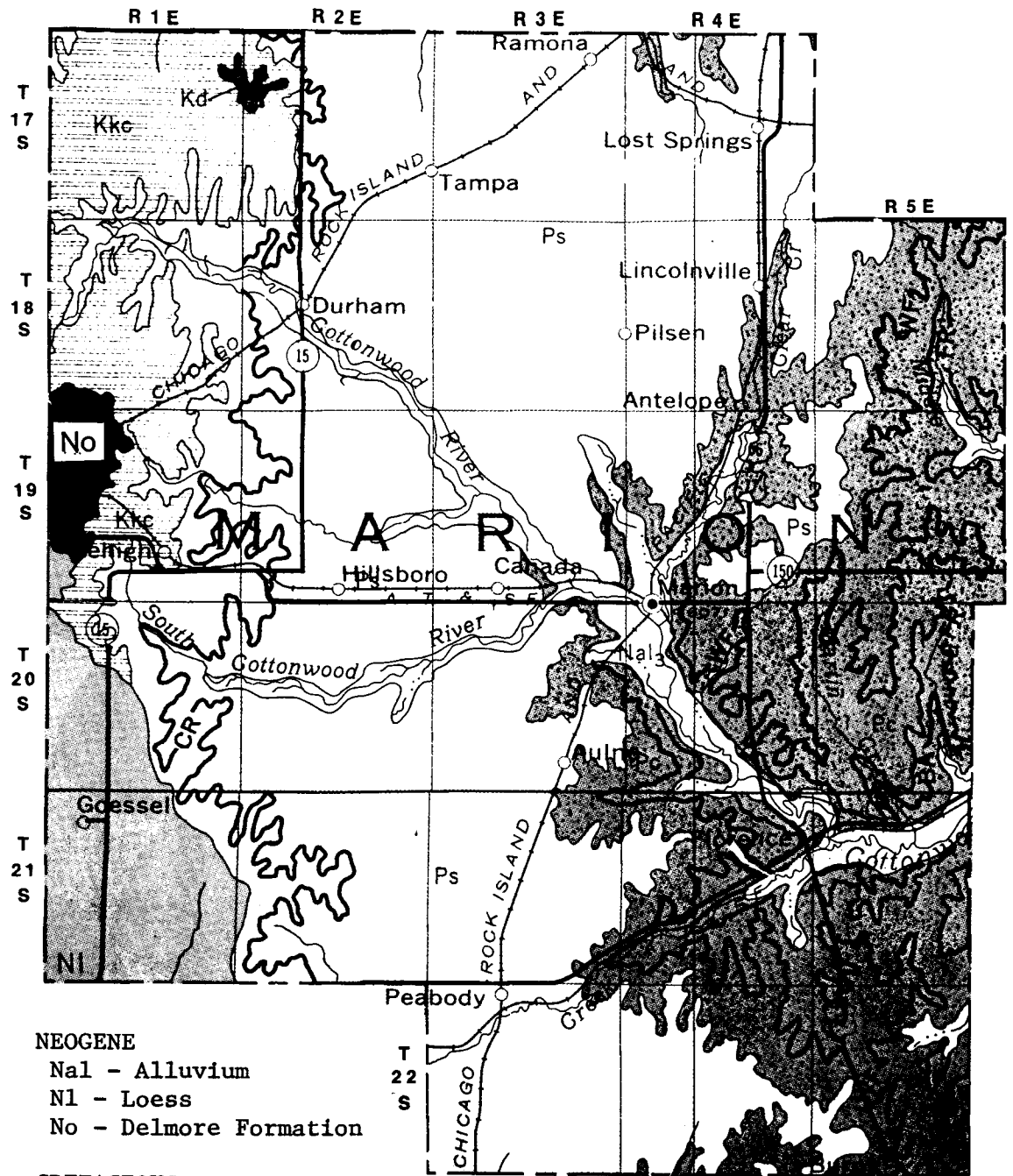
The field trip will traverse areas underlain by rocks of the Permian Chase Group and Wellington Formation, Cretaceous Kiowa and Dakota Formations, Tertiary Delmore Formation, and Pleistocene alluvium and loess deposits (Fig. 1). Both confined (or artesian) and unconfined groundwater occurs in the County.

Many of the area streams flow throughout the year because of a relatively steady discharge of groundwater to the streams (base flow). Other streams, or reaches of streams, lie above the water table and have no groundwater discharge to them. They flow intermittently following periods of intense or prolonged precipitation sufficient to cause surface runoff to the streams. Oil and gas development is extensive in the County (Fig. 2) and is important both economically and in the effect the search for and development of these resources have had on the area water resources. The Lost Springs pool, discovered in 1926, extends over the largest area.

Day 1 of Field Trip

The field trip will begin at Florence, Kansas from the Holiday Motel. We will depart from the Motel at 9:20 a.m. after unloading any gear at the Motel we don't want to carry on the vehicles during the day. Travel north on US 77 to Lincolnville, then north one additional mile, then east 2 1/2 miles to Stop 1. The locations of all the field trip stops are shown on Figure 3.

Stop 1 -- At Stop 1 (Fig. 3 and 4) NW 1/4, sec. 8, T18S, R5E, the Nolans Limestone underlies the land surface below a relatively thin thickness of soil. Sinkholes are present in the Nolans, Winfield, and Barneston Limestones (Fig. 5) in Marion County. This sinkhole is probably representative of Chase



(From M-1 Geologic Map of Kansas, 1964)

Figure 1. Geologic Map of Marion County, Kansas.

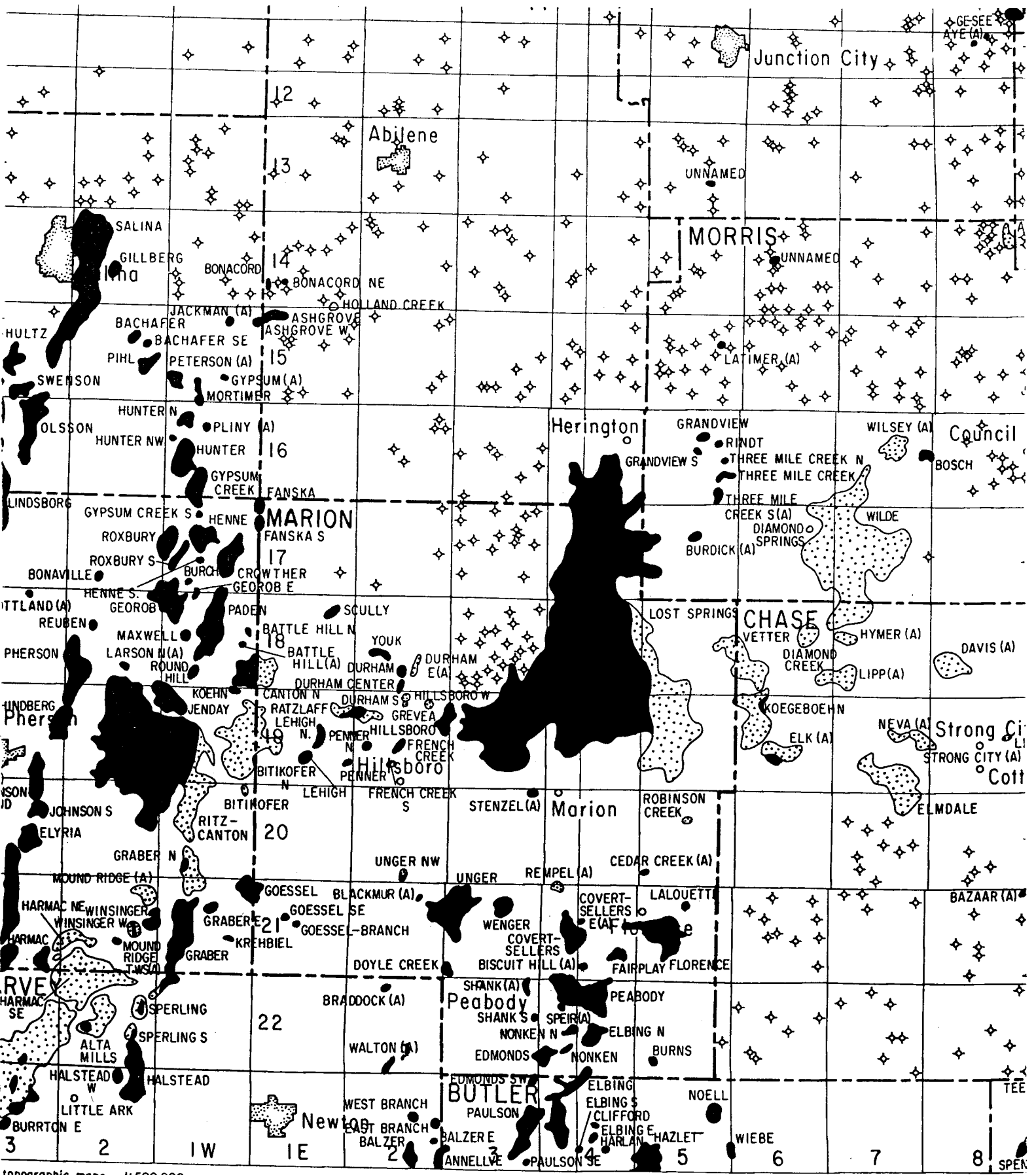


Figure 2. Oil and Gas Fields in Marion County.
(after Burchett, 1983)

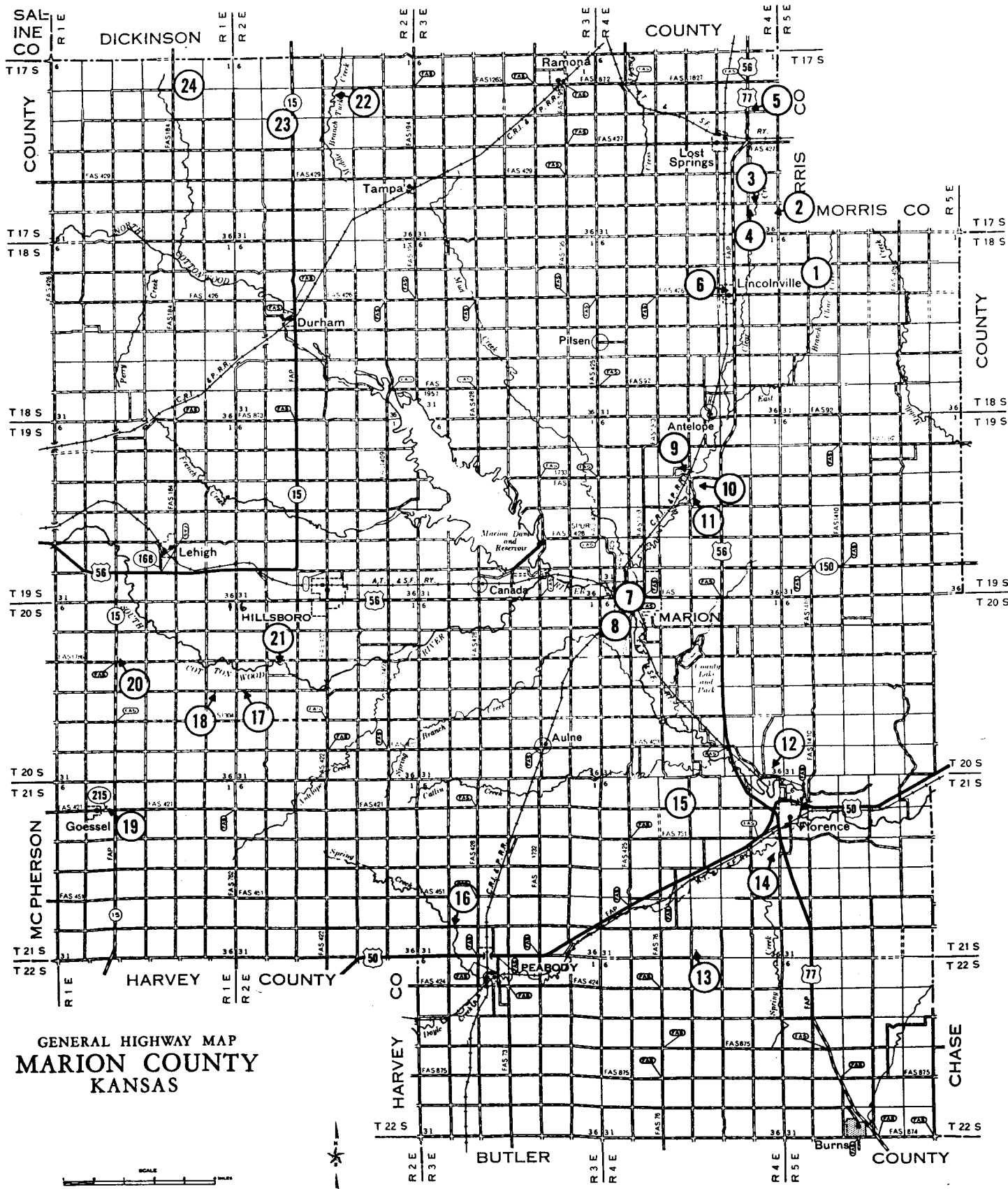


Figure 3. Marion County Base Map Showing Location of Stops.

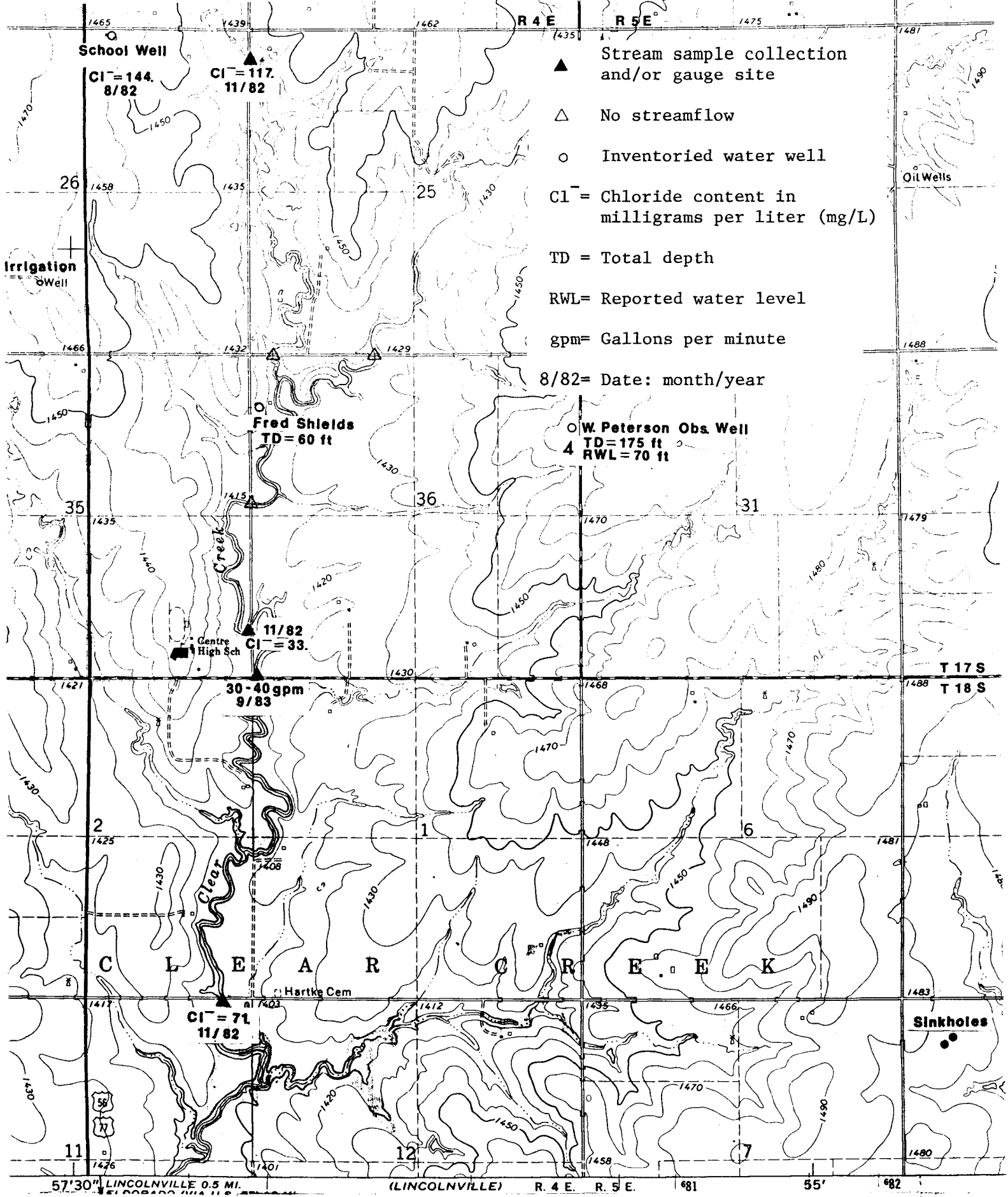


Figure 4. A Part of the Lost Springs 7.5-Minute Topographic Quadrangle (South Central Part).

Group sinkholes and about 20 acres of land drains runoff to this sinkhole. Fresh and useable groundwater is present in the Nolans, Odell, Winfield, Doyle and Barneston stratigraphic units in this area (Fig. 5).

From Stop 1 we will travel west 1 mile and north 1 3/4 miles to Stop 2.

Stop 2 -- A 175-foot deep well in NE 1/4, sec. 36, T17S, R4E (Fig. 3) drilled as an irrigation and stock well (Fig. 6) is the subject of this stop. The well penetrates two aquifers at depths of 60 and 170 feet and the bore hole hydraulically connects the two aquifers. The drillers log indicates the upper water zone was penetrated at a depth of 60 feet and the lower water zone at a depth of 170 feet. On completion of the well the driller reported a water level of 70 feet which is a combined water level resulting from the downward flow from the 60 foot zone into the lower aquifer. You will note that the resulting water level is below the depth of the upper water zone. The hydrograph (#4) in Figure 7 shows the changes in water levels which have occurred since the well was drilled. The well has never had a pump installed nor has it been pumped since construction. Water level changes are a reflection of recharge and discharge to the two aquifers and to hydraulic flow between the two aquifers penetrated by the borehole.

From Stop 2 we proceed north 1/4 mile then west 0.65 mile across Clear Creek. Note that Clear Creek does not have base flow at this point. Proceed west an additional 0.3 mile to a tributary of Clear Creek.

Stop 3 -- This brief stop to view the unnamed creek which at this point has no base flow (Fig. 4). The base flow about 2 miles upstream was measured as 35.9 gpm by the Division of Water Resources September 21, 1983. Clear Creek has no base flow 0.5 mile south of Stop 3, but has an estimated base flow of 30 to 40 gpm one mile south of Stop 3. Thus, we have a reach of this

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

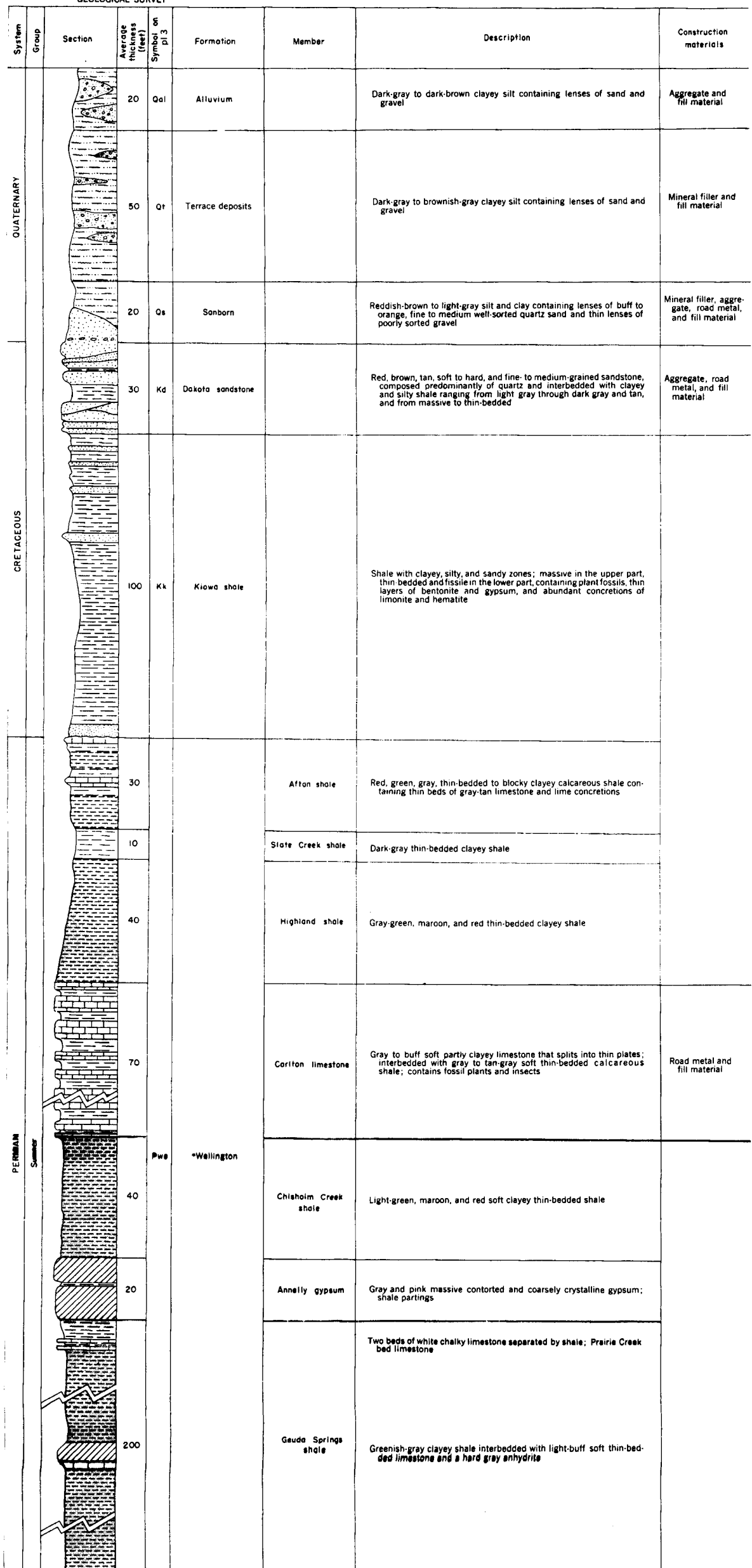


Figure 5. Generalized Stratigraphic Section of Outcropping Rocks.

System	Group	Section	Average thickness (feet)	Symbol on p. 13	Formation	Member	Description	Construction materials		
PERMIAN	Sumner		8		*Wellington	Hollenberg limestone	Tan-gray cellular coarsely crystalline limestone with dolomitic zones	Road metal and fill material		
			40	Pwe		Pearl shale	Light tan-gray to faintly varicolored thin-bedded calcareous clayey shale with limy concretions and some thin tan-gray crystalline dolomitic limestone			
	Chase		18		Nolans limestone	Herington limestone	Tan to gray fairly hard massive thick-bedded fossiliferous dolomitic limestone with geodes locally abundant	Structural stone, road metal, aggregate, and riprap		
			10			Paddock shale	Tan to gray thin-bedded to blocky calcareous shale with fossils locally abundant			
			2			Krider limestone	Tan to gray soft clayey limestone			
			30	Po	Odell shale	Gray, tan, and green blocky silty and clayey shale with thin limy zones; a red zone near the top	Fill material			
			28	Pw	Winfield limestone	Cresswell limestone	Gray to buff locally soft and dolomitic fossiliferous limestone with abundant geodes; platy and thin bedded in upper part, massive and thick bedded in lower part	Structural stone, road metal, aggregate, riprap, and fill material		
						10		Grant shale	Gray to tan silty calcareous fossiliferous shale	
						2		Stovall limestone	Hard gray massive cherty fossiliferous limestone	
			45	Pd	Doyle shale	Gage shale	Thin-bedded to massive fossiliferous shale; greenish gray to tan and calcareous in upper part, and green, maroon, and clayey in lower part	Fill material		
						10		Towanda limestone	Hard tan to gray platy to blocky limestone	Structural stone, road metal, aggregate, riprap, and fill material
						25		Holmesville shale	Greenish gray silty clayey and partly calcareous shale with a thin reddish bed and local lenses of limestone	Fill material
			39	Pb	Barneston limestone	Fort Riley limestone	Gray to tan fairly hard fossiliferous limestone with thin shale partings; thin bedded at top, massive beds in middle and near base; lower massive bed is called "rimrock"	Structural stone, road metal, aggregate, riprap, and fill material		
						2		Oketo shale	Gray calcareous fossiliferous silty shale	Fill material
			39		Florence limestone	Gray to tan thick-bedded fossiliferous limestone with many beds and nodules of chert and a thin shale parting	Structural stone, road metal, aggregate, riprap, and fill material			
			35	Pm	Matfield shale	Blue Springs shale	Banded maroon, gray, and green, massive to blocky clayey silty poorly exposed shale			
						5		Kinney limestone	Tan to gray hard massive fossiliferous limestone with few good outcrops	Fill material
						30		Wymore shale	Tan, green, and maroon, thin-bedded to blocky silty and calcareous shale	
			10	Pwr	Wreford limestone	Schroyer limestone	Gray massive limestone containing nodules and lenses of chert			

* Subdivisions of Wellington formation modified from Ver Wiebe (1937, p. 4 and 5)

STRATIGRAPHIC UNITS THAT CROP OUT IN MARION COUNTY, KANSAS,
AND THE CONSTRUCTION MATERIALS OF EACH

(from Byrne, et. al., 1959)

Figure 5. continued

LOCATION OF WATER WELL: County: Marion Fraction: NE 1/4 NE 1/4 NE 1/4 Section Number: 36 Township Number: T 17 S Range Number: R 4 E

Distance and direction from nearest town or city? 3 North and 1 1/2 E. of Lindsaville Street address of well if located within city?

WATER WELL OWNER: Willis Peterson Board of Agriculture, Division of Water Resources Application Number:

City, State, ZIP Code: Lindsaville, MO 66868

DEPTH OF COMPLETED WELL: 175 ft. Bore Hole Diameter: 8 in. to 175 ft., and _____ in. to _____

All Water to be used as:
 1 Domestic 3 Feedlot 5 Public water supply 8 Air conditioning 11 Injection well
 2 Irrigation 4 Industrial 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Observation well stock

Well's static water level: 70 ft. below land surface measured on 6 month day 80

Flow Test Data: Well water was _____ ft. after _____ hours pumping.
 Discharge Yield: _____ gpm. Well water was _____ ft. after _____ hours pumping.

TYPE OF BLANK CASING USED:
 1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile Casing Joints: Glued _____ Clamped _____
 2 PVC 4 ABS 6 Asbestos-Cement 9 Other (specify below) _____ Welded _____
 7 Fiberglass _____ Threaded _____

Blank casing dia: 6 in. to 175 ft., Dia _____ in. to _____ ft., Dia _____ in. to _____ ft., Dia _____ in. to _____ ft.

Casing height above land surface: 12 in., weight _____ lbs./ft. Wall thickness or gauge No. _____

TYPE OF SCREEN OR PERFORATION MATERIAL:
 1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 10 Asbestos-cement 11 Other (specify) _____
 2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)

Screen or Perforation Openings Are:
 1 Continuous slot 3 Mill slot 5 Gauzed wrapped 8 Saw cut 11 None (open hole)
 2 Louvered shutter 4 Key punched 6 Wire wrapped 9 Drilled holes
 7 Torch cut 10 Other (specify) _____

Screen-Perforation Dia: 6 in. to _____ ft., Dia _____ in. to _____ ft., Dia _____ in. to _____ ft., Dia _____ in. to _____ ft.

Screen-Perforated Intervals: From 135 ft. to 175 ft., From _____ ft. to _____ ft., From _____ ft. to _____ ft., From _____ ft. to _____ ft.

Gravel Pack Intervals: From 10 ft. to 175 ft., From _____ ft. to _____ ft., From _____ ft. to _____ ft., From _____ ft. to _____ ft.

GROUT MATERIAL: Neat cement 2 Cement grout 3 Bentonite 4 Other

Grouted Intervals: From 0 ft. to 10 ft., From _____ ft. to _____ ft., From _____ ft. to _____ ft., From _____ ft. to _____ ft.

What is the nearest source of possible contamination:
 1 Septic tank 4 Cess pool 7 Sewage lagoon 10 Fuel storage 14 Abandoned water well
 2 Sewer lines 5 Seepage pit 8 Feed yard 11 Fertilizer storage 15 Oil well/Gas well
 3 Lateral lines 6 Pit privy 9 Livestock pens 12 Insecticide storage 16 Other (specify below)
 13 Watertight sewer lines

Direction from well: _____ How many feet: 1 mile ? Water Well Disinfected? Yes No

Has a chemical/bacteriological sample submitted to Department? Yes No If yes, date submitted _____ month _____ day _____ year: Pump Installed? Yes No

Yes: Pump Manufacturer's name _____ Model No. _____ HP _____ Volts _____

Depth of Pump Intake _____ ft. Pumps Capacity rated at _____ gpm

Type of pump: 1 Submersible 2 Turbine 3 Jet 4 Centrifugal 5 Reciprocating 6 Other

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and completed on _____ month _____ day _____ year.

I certify this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 238

This Water Well Record was completed on _____ month _____ day _____ year under the authority of _____
 Name of _____ by (signature) William Schimpf

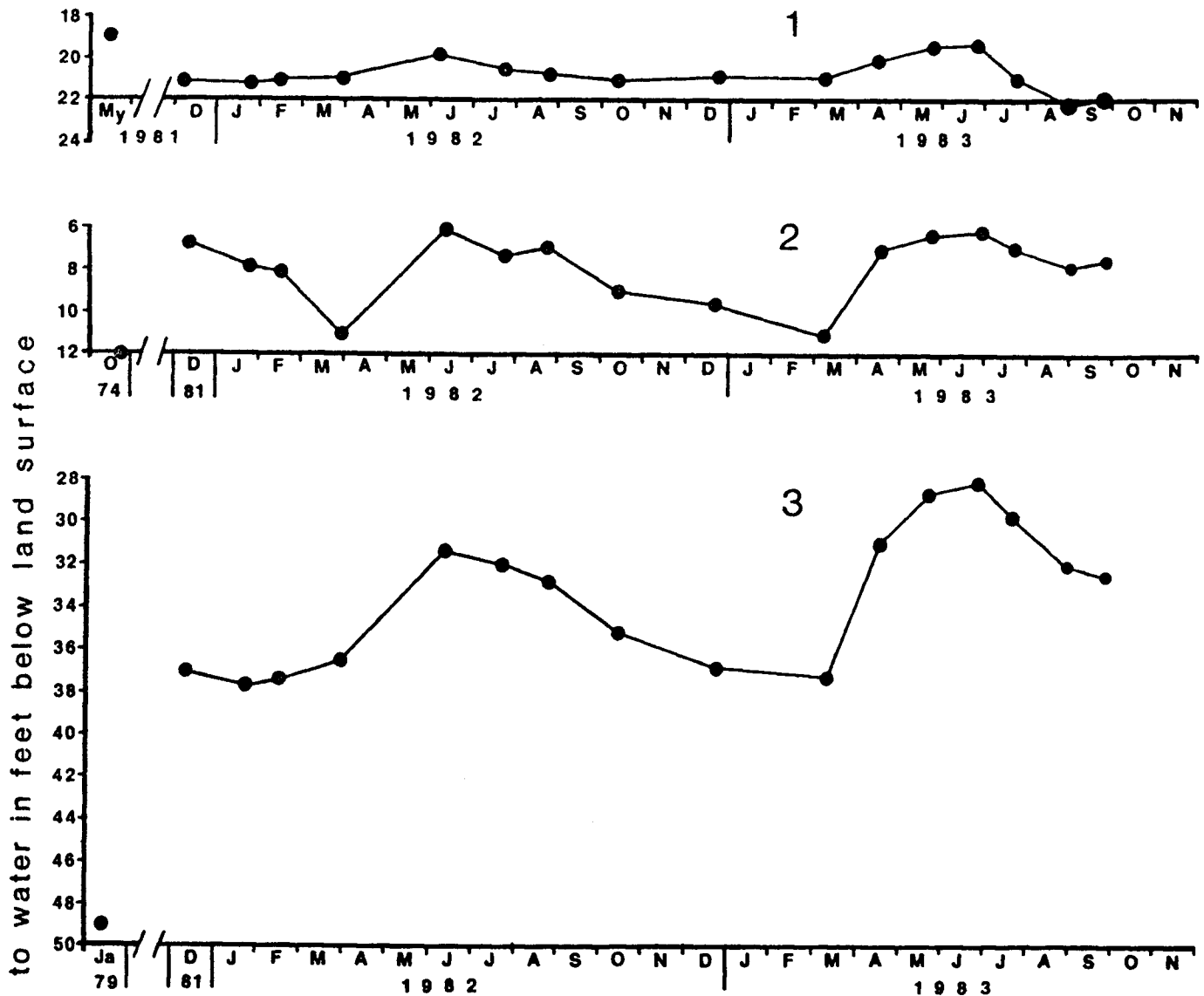
LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:	FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
	0	10	Humato			
	10	50	Stopp Stone			
	50	75	Yinse			
	75	85	Red Rock			
	85	100	Yinse			
	100	120	Red Rock			
	120	135	Yinse			
	135	150	Shale			
	150	175	Yinse			

ELEVATION: _____

Depth(s) Groundwater Encountered 1. 60 ft. 2. 170 ft.

INSTRUCTIONS: Use typewriter or ball point pen, please press firmly and copy to Kansas Department of Health and Environment, Division of Environmental Health. Obtain one for your records.

Figure 6. Water Well Record of Peterson (added) _____
 Irrigation Well. _____
 WELL OWNE _____



#1 D. Everingham obs. well
 SW $\frac{1}{4}$, SE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 6, T.21S,R. 1E

#2 V. Bartel obs. well
 SE $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 2, T. 19S, R. 1E

#3 E. Tiemeier obs. well
 SE $\frac{1}{4}$, SE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 11, T. 18S, R. 4E

#4 W. Peterson obs. well
 SE $\frac{1}{4}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 36, T. 17S, R. 4E

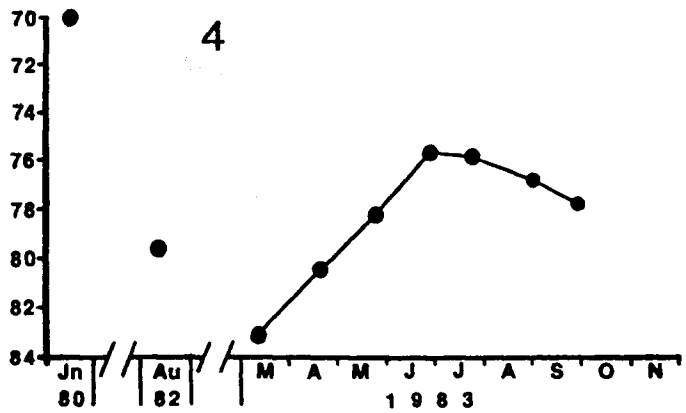


Figure 7. Hydrographs of four observation wells in Marion County, Kansas.

tributary stream 1 to 2 miles long in which there is no base flow. The stream is influent (looses water) along this reach but is a gaining stream elsewhere.

Proceed west to section corner 0.05 mile then south 0.15 mile to Stop 4.

Stop 4 -- We will view and hear groundwater flowing into a water well from a shallow aquifer and cascading downward into a deeper aquifer at this site. We have made no measurement (lack of equipment) of downward flow from the shallow zone but our estimates are that the flow is >20 gpm or >32 acre-feet/year.

Turn around and proceed 0.15 miles north to section corner then west 0.5 mile to US 77. Two wells about 100 feet apart in the farm yard SW of this intersection tap different aquifers and have static water levels that are about 30 feet lower in one well than the other. Proceed north on US 77 past the Pritz irrigation well on the west (SE SW sec. 26, T17S, R4E). The Pritz well is reported to be 130 feet deep.

We will make a brief stop along US 77 1 mile north of the intersection with the Lost Springs - Burdick road near the Lyle Hanschu water well (SW SW sec. 12, T17S, R4E) for more discussion of area hydrology. Refer to Figure 8 for locations.

Stop 5 -- Southwest corner, sec. 12, T17S, R4E. The Lyle Hanschu well was drilled in July 1976 to a depth of 93 feet (Fig. 9). The water level was reported at 65 feet after the well was pumped for 2 hours at 55 gpm. Both the driller and the field trip leaders agree that the original static water level was probably in error. Measurements at approximately monthly intervals have been made since December 1981 and at no time has the static water level been below 63.1 feet, yet during periods when the static level has been below about 62.8 to 63.1 Mr Hanschu may have trouble supplying water for his domestic and livestock use. In March of 1983 a producing oil well about 5,500 feet south

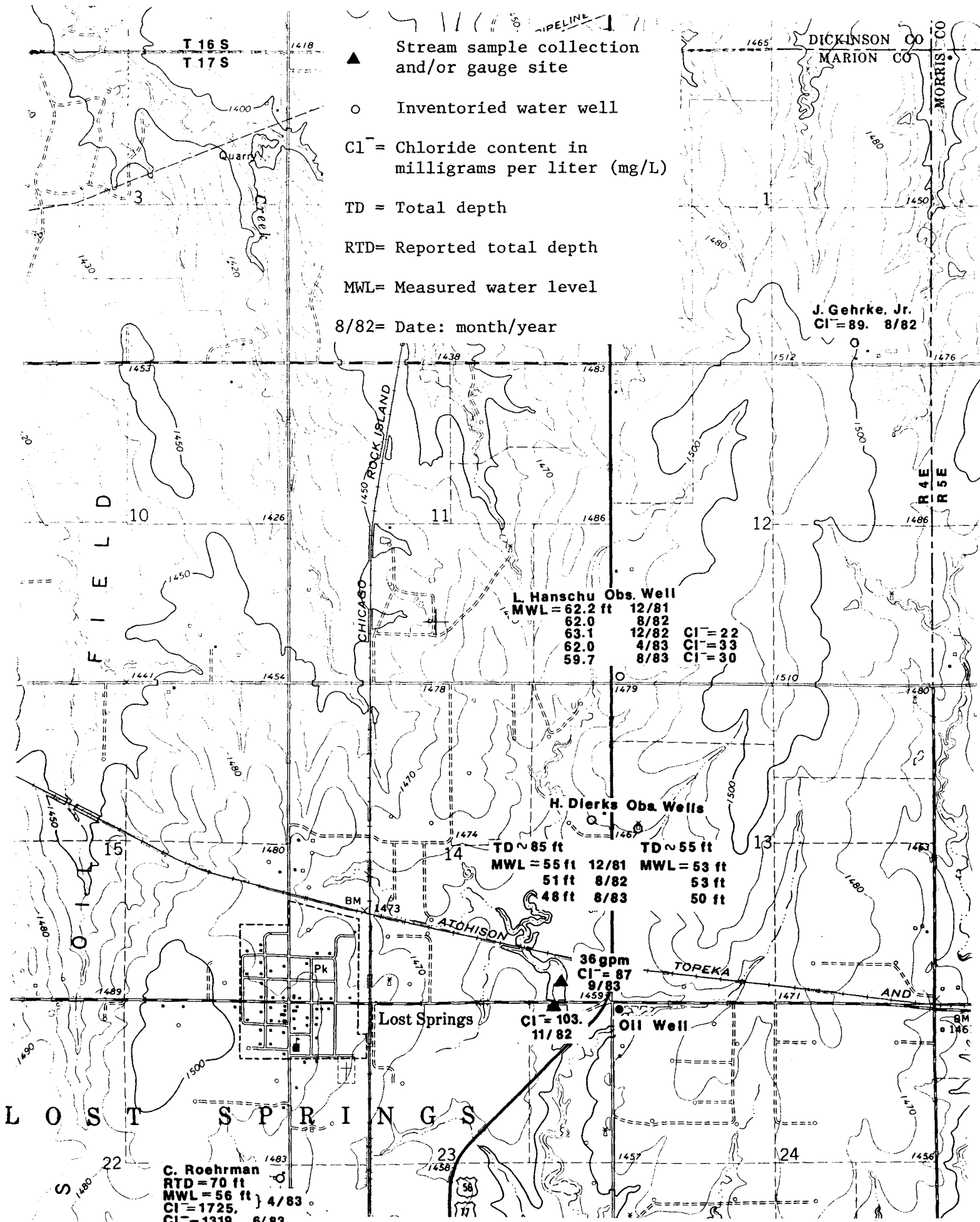


Figure 8. A Part of the Lost Springs 7.5-Minute Topographic Quadrangle (North Central Part).

USE TYPEWRITER OR BALL POINT PEN—PRESS FIRMLY, PRINT CLEARLY.

WATER WELL RECORD
KSA 82a-1201-1215

Kansas Department of Health and Environment—Division of Environment
(Water well Contractors)
Topeka, Kansas 66620

1. Location of well:		County <u>Marion</u>	Fraction <u>SW 1/4 SW 1/4 SW 1/4</u>	Section number <u>12</u>	Township number <u>T 17 S R 4</u>	Range number <u>4</u> <u>(E/N)</u>
2. Distance and direction from nearest town or city: <u>1 mile East and 1 mile North of Lost Springs</u>			3. Owner of well: <u>Warren Grentzel</u>			
Street address of well location if in city:			R.R. or street: <u>RR Lyle Hanschu</u>			
			City, state, zip code: <u>Hillsboro, Kan</u>			
4. Locate with "X" in section below:		Sketch map:		6. Bore hole dia. <u>10</u> in. Completion date <u>7-5-76</u>		
N		W		Well depth <u>93</u> ft.		
		E		7. <input checked="" type="checkbox"/> Cable tool <input type="checkbox"/> Rotary <input type="checkbox"/> Driven <input type="checkbox"/> Dug		
1 Mile		1 Mile		<input type="checkbox"/> Hollow rod <input type="checkbox"/> Jetted <input type="checkbox"/> Bored <input type="checkbox"/> Reverse rotary		
S				8. Use: <input type="checkbox"/> Domestic <input type="checkbox"/> Public supply <input type="checkbox"/> Industry		
				<input checked="" type="checkbox"/> Irrigation <input type="checkbox"/> Air conditioning <input type="checkbox"/> Stock		
				<input type="checkbox"/> Lawn <input type="checkbox"/> Oil field water <input type="checkbox"/> Other		
5. Type and color of material		From	To	9. Casing: Material <u>PVC</u> Height: <u>Above</u> or below		
<u>Topsail</u>		<u>0</u>	<u>4</u>	Threaded <input type="checkbox"/> Welded <u>glw</u> Surface <u>18</u> in.		
<u>Shale & Broken LIME - Yel</u>		<u>4</u>	<u>10</u>	RMP <input type="checkbox"/> PVC <input checked="" type="checkbox"/> Weight _____ lbs./ft.		
<u>Shale - Yel</u>		<u>10</u>	<u>25</u>	Dia. <u>8</u> in. to <u>65</u> ft. depth Wall Thickness: inches or		
<u>LIME - Yel</u>		<u>25</u>	<u>32</u>	Dia. _____ in. to _____ ft. depth gage No. <u>488</u>		
<u>Shale - Gray</u>		<u>32</u>	<u>47</u>	10. Screen: Manufacturer's name <u>Certain teed</u>		
<u>LIME - Wht</u>		<u>47</u>	<u>50</u>	Type <u>PVC</u> Dia. <u>8"</u>		
<u>Red Rock - Red</u>		<u>50</u>	<u>56</u>	Slot/gauze <u>YA</u> Length <u>28'</u>		
<u>LIME - Wht</u>		<u>56</u>	<u>58</u>	Set between <u>65</u> ft. and <u>93</u> ft.		
<u>Shale - Lite Gray</u>		<u>58</u>	<u>62</u>	_____ ft. and _____ ft.		
<u>Coevise with Broken LIME</u>		<u>62</u>	<u>72</u>	Gravel pack? <u>NO</u> Size range of material _____		
<u>Shale Lite Gray</u>		<u>72</u>	<u>74</u>	11. Static water level: _____ mo./day/yr.		
<u>LIME - Gray</u>		<u>74</u>	<u>77</u>	<u>65</u> ft. below land surface Date <u>7-5-76</u>		
<u>Shale - lite Blu</u>		<u>77</u>	<u>86</u>	12. Pumping level below land surfaces:		
<u>LIME - Gray</u>		<u>86</u>	<u>93</u>	<u>65</u> ft. after <u>2</u> hrs. pumping <u>55</u> g.p.m.		
				<u>80</u> ft. after <u>1</u> hrs. pumping <u>80</u> g.p.m.		
				Bottom of pump _____ Estimated maximum yield <u>55</u> g.p.m.		
				13. Water sample submitted: _____ mo./day/yr.		
				Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Date _____		
				14. Well head completion:		
				<input type="checkbox"/> Pitless adapter <u>18</u> inches above grade		
				15. Well grouted? <u>Yes</u>		
				With: <input type="checkbox"/> Neat cement <input type="checkbox"/> Bentonite <input checked="" type="checkbox"/> Concrete		
				Depth: From <u>0</u> ft. to <u>10</u> ft.		
				16. Nearest source of possible contamination: <u>Road</u>		
				ft. <u>150</u> Direction <u>South</u> type <u>Ditch</u>		
				Well disinfected upon completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
				17. Pump: <input checked="" type="checkbox"/> Not installed		
				Manufacturer's name _____		
				Model number _____ HP _____ Volts _____		
				Length of drop pipe _____ ft. capacity _____ g.p.m.		
				Type:		
				<input type="checkbox"/> Submersible <input type="checkbox"/> Turbine		
				<input type="checkbox"/> Jet <input type="checkbox"/> Reciprocating		
				<input type="checkbox"/> Centrifugal <input type="checkbox"/> Other		
18. Elevation:	19. Remarks:		20. Water well contractor's certification:			
Topography:			This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.			
<input type="checkbox"/> Hill			<u>Zinn Water Well Drilling 218</u> Business name License No. _____			
<input type="checkbox"/> Slope			Address <u>Lost Springs, Kan</u>			
<input checked="" type="checkbox"/> Upland			Signed <u>Joseph A. Zinn</u> Date <u>7-5-76</u>			
<input type="checkbox"/> Valley			Authorized representative			

Forward the white, blu

Figure 9. Water Well Record of Lyle Hanschu Water Well.

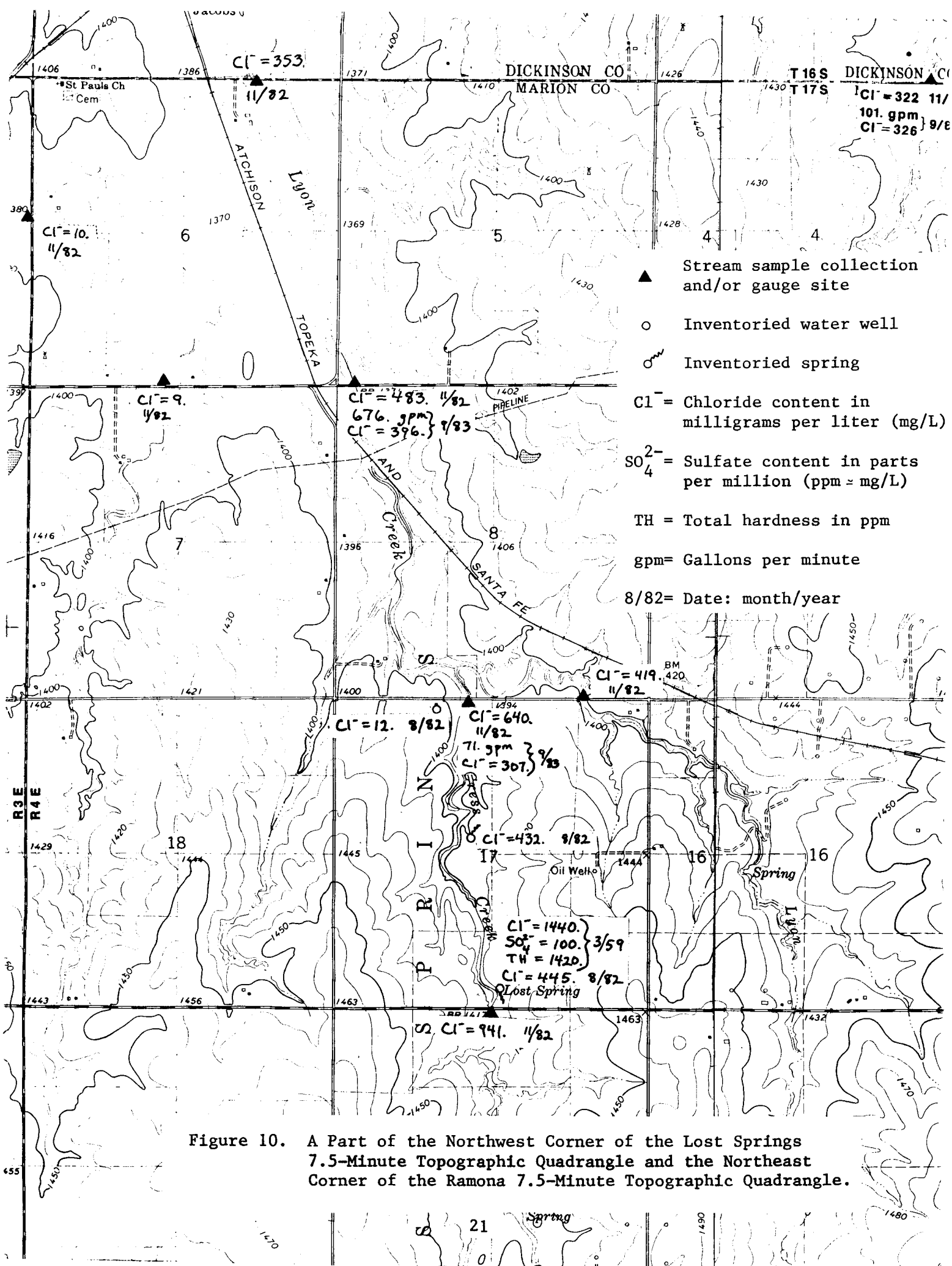
Form WWC-5

of the Hanschu well was flooded with fresh water draining into the casing through holes in the casing. Water level in the oil well was reported to be about 80 feet. Tubing was pulled, a temporary packer set, and a cement squeeze job was done to cement out the fresh water leaks. Within 2 months water levels in the Hanschu well had risen about 1 1/2 feet and have remained about 1 1/2 feet higher through September 23, 1983. Another producing oil well about 3,500 feet west of the Hanschu water well was repaired in August 1983 to prevent fresh water leaks into the well. This well was checked by Don Steeples in October using seismic equipment and apparently has no fresh water cascading through holes in the oil well casing. Mr. Hanschu has had no water quantity problems since March 1983.

The John Gehrke well, SE SE sec. 1, T17S, R4E. (Fig. 8) was drilled to a depth of 95 feet in 1960. The original static water level was reported as 30 feet. In 1976 the pump had to be replaced. The water level was reported as 45 feet. The well was inventoried, measured, and sampled in August 1982. Measured water level was 65 feet or 35 feet lower than in 1960. Yield is still about 3 gpm, the same as when originally drilled. No log is available for this well.

Proceed north on US 77 1 mile then turn west on blacktop road to Tampa for 2 miles, north 1 mile then west 0.1 mile stopping at creek (Fig. 10). The base flow of this stream draining a relatively small area was 101 gpm (163 acre-feet/year) on September 21, 1983. Chloride was 326 mg/l.

Proceed west 1.9 miles to section corner then south 0.8 mile stopping along Lyon Creek. The base flow at this site was measured by the Division of Water Resources September 21, 1983 as 676 gpm (1,100 acre-feet/year). Chloride concentration was 396 mg/l. Using Figure 10 let us look at chloride values measured in stream and spring samples along Lyon Creek and



▲ Stream sample collection and/or gauge site
 ○ Inventoried water well
 ○ Inventoried spring
 Cl⁻ = Chloride content in milligrams per liter (mg/L)
 SO₄²⁻ = Sulfate content in parts per million (ppm = mg/L)
 TH = Total hardness in ppm
 gpm = Gallons per minute
 8/82 = Date: month/year

Figure 10. A Part of the Northwest Corner of the Lost Springs 7.5-Minute Topographic Quadrangle and the Northeast Corner of the Ramona 7.5-Minute Topographic Quadrangle.

the tributaries from the east and from the west. Chlorides in streams and in groundwater west of Lyon Creek have values of 10, 9, 12 and 34 mg/l whereas those east of the main stem have chloride values in the hundreds indicating the effect of past oil field pollution from the Lost Springs pool. The chloride values from sample sites in 1983 appear to be significantly less than chloride values made at the same sites in 1982 or earlier.

Two east-west geologic sections based on water well records are shown on Figures 11 and 12 and the location of the wells is shown on Figure 13, A-A' near Lost Springs and B-B' near Lincolnville.

Continue west across railroad track and turn south for 2 miles then east 4 miles to Lost Springs and US 77. Travel south stopping briefly at Lincolnville to discuss hydrograph #3, Figure 7.

Stop 6 -- In geologic section B-B' (Figs. 12 and 13) the third well from the left is a domestic water well in Lincolnville. We have used this well as an observation well since December 1981 (#3, Fig. 7). This well shows the most seasonal change in water levels of any of our observation wells. Our explanation for the large rise in water levels each spring is as follows.

The town is underlain by the Nolans Limestone at shallow depth (Fig. 12) and this unit is partly weathered and highly permeable. It is easily recharged during the March, April, May, June period when frost leaves the ground, transpiration and evaporation are relatively low and spring rains occur. Because the town has a public sewage system the recharge to the shallow limestone is primarily good quality water not overloaded with sewage nutrients and bacteria. There are more than 100 homes within the town distributed over 80 to 100 acres. Each house discharges water from roofed and paved areas to grassed and absorbant yard areas. The effective recharge to the grassed yard areas and the underlying Nolans Limestone is probably 50 to

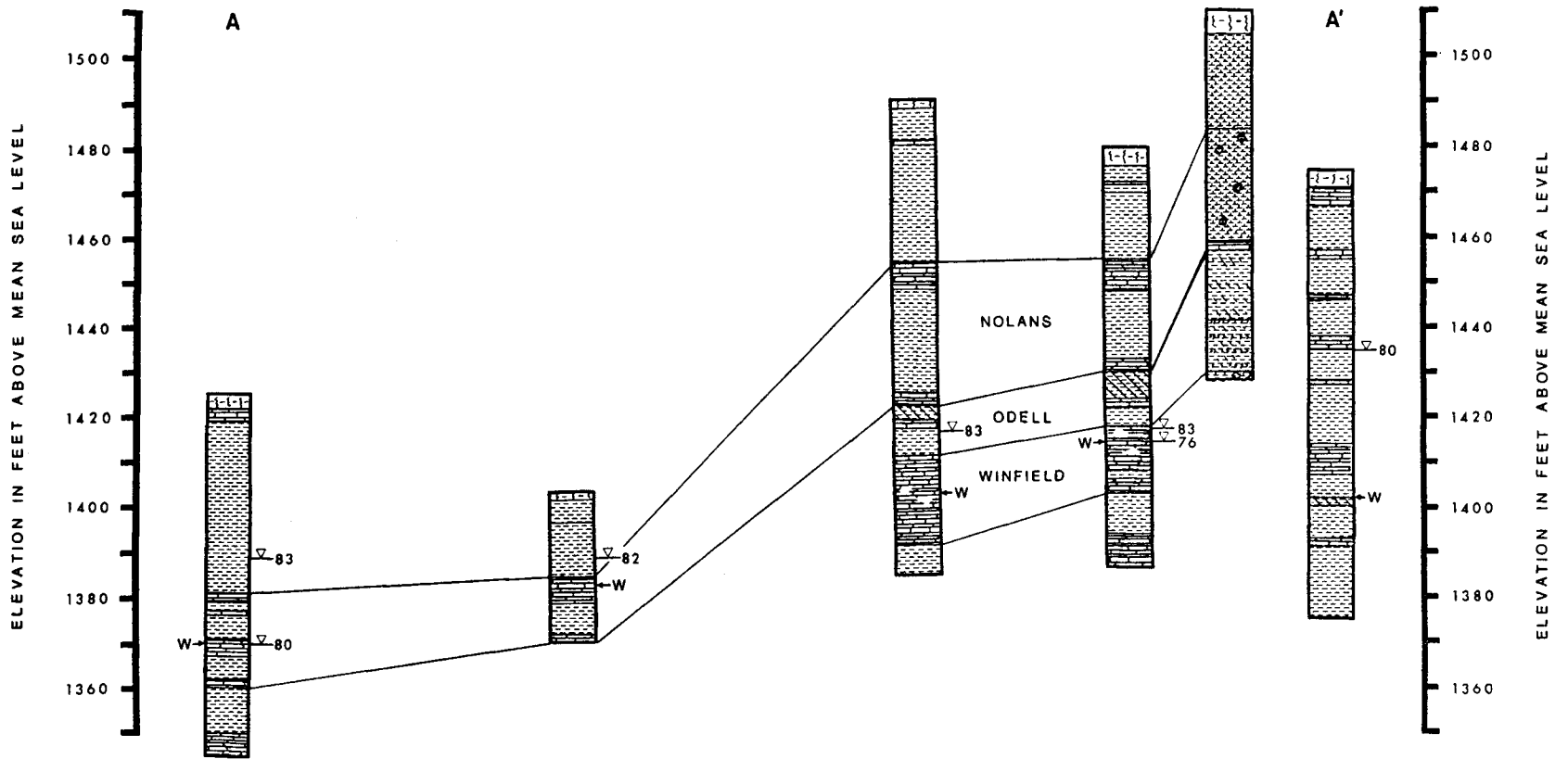


Figure 11. East - West Geologic Section A - A' Based on Water Well Records and Test Hole Near Lost Springs, Kansas.

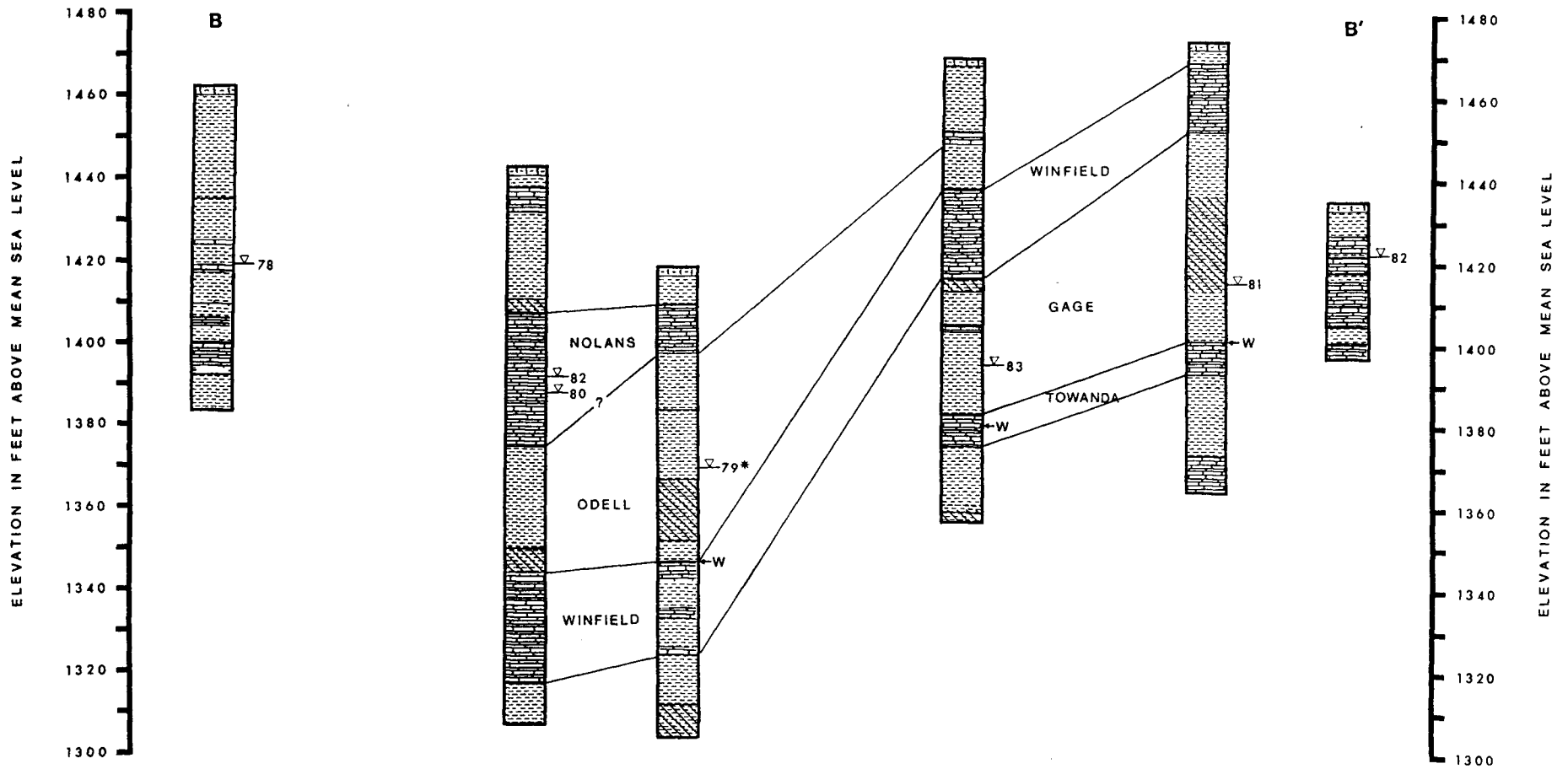


Figure 12. East - West Geologic Section B - B' based on Water Well Records near Lincolnville, Kansas.

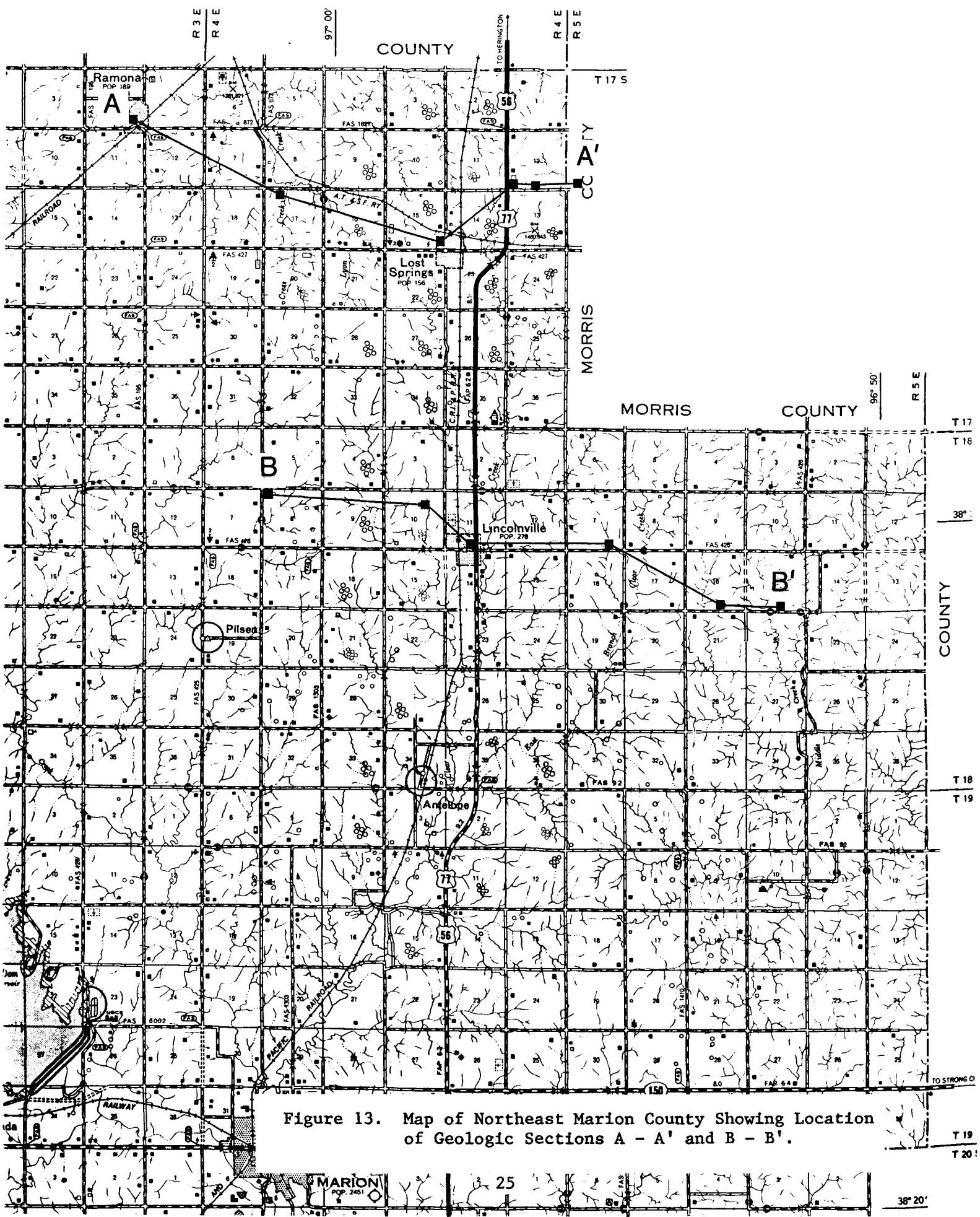


Figure 13. Map of Northeast Marion County Showing Location of Geologic Sections A - A' and B - B'.

100 percent greater than to similar pasture areas. Because of the nature of the well construction virtually 100 percent of the water wells allow downward percolation of water from the shallow Nolans Limestone down the well borehole to the underlying Winfield aquifer. The net result of the recharge to the Winfield aquifer through ± 100 boreholes connecting the Nolans to the Winfield is a water table mound below the town. This spring rise in water levels is reflected in the change in water quality also by a decrease in specific conductance, hardness and total dissolved solids.

Continue south on US 77 and US 56 staying on US 56 to Marion for lunch.

Stop 7 -- Lunch at Caryls Resturant opposite the city park or at the Owl Car Cafe in downtown Marion 2 blocks farther west.

After lunch we will continue west on US 56. Turn south 0.45 miles west of Cottonwood River bridge then south 1 mile and east 0.5 mile.

Stop 8 -- This will be a brief stop (Fig. 3) along the road to look at one facies or lithology of the Winfield Limestone. It appears to the field trip leaders that there are at least 4 facies of the Winfield Limestone in Marion County reflecting different depositional environments.

Retrace route back to US 56 then 4 miles north, 2 1/2 miles east, 0.25 mile north, then 0.4 mile east to Stop 9.

Stop 9 -- At this stop we will view a flowing well (NE 1/4, SE 1/4, SE 1/4, sec. 9, T19S, R4E) which flows an estimated +100 gpm (+160 acre-feet/year). A water analysis is given in Figure 14. The principal aquifer is believed to be the Barneston Limestone. Note the "sulfur" precipitate around the well. There is an additional series of springs in the creek about 700 feet west of the flowing well which have an estimated flow of about 500 gpm and are fresh water flows from the Winfield Limestone (Fig. 15).

KANSAS GEOLOGICAL SURVEY
Geochemistry Section

Constant Ave.
1930 ~~Avenue "A"~~, Campus West
The University of Kansas
Lawrence, Kansas 66044
913-864-1991

REPORT OF WATER ANALYSIS

OWNER AND LOCATION: Flowing Well NE 1/4, SE 1/4, SE 1/4, Sec. 9, T. 19S, R. 4E
STUDY: The Geohydrology of Marion County, Kansas DATE: August 29, 1983
COLLECTION POINT LOCATION: at well site
TYPE SAMPLE: artesian well DATE COLLECTED: June 20, 1983
SAMPLE COLLECTED BY: Pamela K. Chaffee and Christian Thueringer

Temperature of water at point of collection: 15.0 °C. = 59 °F
Specific Conductance at point of collection: 3900. micromhos at 25 °C. (77 °F)
pH at point of collection: 6.40.

Silica (SiO ₂):	<u>18.</u> mg/l*	Bicarbonate (HCO ₃):	<u>320.</u> mg/l*
Calcium (Ca):	<u>624.</u> mg/l	Carbonate (CO ₃):	_____ mg/l
Magnesium (Mg):	<u>93.</u> mg/l	<u>Sulfate</u> (SO ₄):	<u>1524.</u> mg/l
<u>Sodium</u> (Na):	<u>165.</u> mg/l	<u>Chloride</u> (Cl):	<u>361.</u> mg/l
Potassium (K):	<u>12.</u> mg/l	Fluoride (F):	<u>0.7</u> mg/l
Strontium (Sr):	<u>9.9</u> mg/l	Nitrate (NO ₃):	<u>3.4</u> mg/l
		Phosphate (PO ₄):	<u>0.1</u> mg/l

Iron (Fe): 1.15 mg/l
Manganese (Mn): 0.01 mg/l
Boron (B): 0.45 mg/l

} Trace elements determined from an acidified, unfiltered sample.

Total Hardness as CaCO₃: 1951. mg/l
Non-carbonate Hardness as CaCO₃: 1688. mg/l

Total Solids Calculated: 2968. mg/l

Sodium Adsorption Ratio (SAR): 1.63.

*Concentrations of chemical constituents reported in milligrams per liter (mg/l).

Figure 14. Water Analysis of Flowing Well in the NE 1/4, SE 1/4, SE 1/4, Sec. 9, T. 19S, R. 4E.

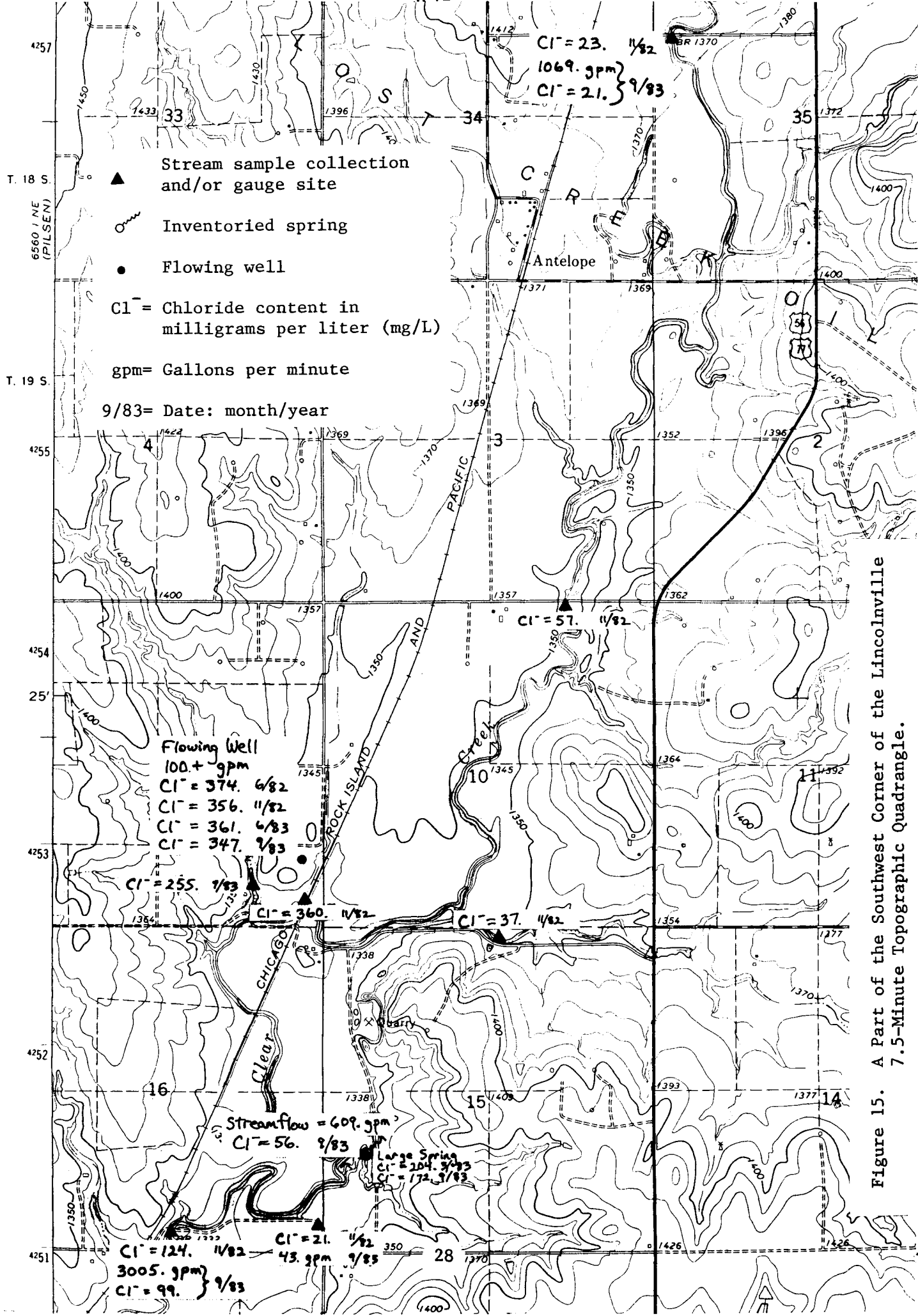


Figure 15. A Part of the Southwest Corner of the Lincolnville 7.5-Minute Topographic Quadrangle.

Return to cars, turn around and go 0.4 mile west, 0.25 mile south, then east 0.7 mile, then south on private road 0.35 mile to gate. Leave cars and walk northeast into quarry. Exposure of Nolans, Odell and Winfield.

Stop 10 -- A measured section taken from Byrne (1959) is included as Figure 16. Note the softness of the limestone, the abundant vugs, geodes, solution openings, and the siliceous material. The massive limestone weathers in the topography like shale and makes no resistant bench in this local area. The Winfield is an important aquifer.

Return to cars and proceed about 0.3 mile south on private road to stop 11, Chingawassa Springs.

Stop 11 -- Near the Center W 1/2, SW 1/4, sec. 15, T19S, R4E, Chingawassa Springs (earlier called Carters Mineral Springs) is a series of 20 to 30 springs including 3 mineral springs that emerge along a bluff. It was a popular picnic area in the 1870's (Van Meter, 1972). In 1889 a railroad was built from Marion to the springs and the quarry, a hotel built and a spa established and operated until 1893 when both the railroad and hotel went bankrupt.

At least two different water types emerge along the bluff, most of the water is fresh water emerging from the Winfield Limestone and one or more discharges are of more mineralized water containing hydrogen sulfide and similar to the water from the flowing well visited at Stop 9. The probable explanation is that both the Winfield aquifer and the Barneston aquifer discharge water along this bluff. The flow of Chingawassa Spring was measured September 22, 1983 by the Division of Water Resources as 609 gpm. McCauley (1983) shows a lineament extending parallel with much of Clear Creek valley terminating in this vicinity (Fig. 17). Stream flow measurements on Clear Creek made by the Division of Water Resources September 22, 1983 shows a

Representative section of the Stovall limestone and Grant shale members of the Winfield limestone along U. S. Highway 77 in the SW 1/4 NW 1/4 sec. 26, T. 20 S., R. 4 E.

Winfield limestone:

Cresswell limestone member (8 feet).	
Grant shale member:	<i>Feet</i>
Shale, silty, calcareous, massive, gray-green; numerous geodes; fossiliferous.....	4.0
Shale, silty and clayey; massive to poorly bedded; fossiliferous.....	5.0
Stovall limestone member:	
Limestone, hard, dense, light-gray to buff; chert nodules; fossiliferous; in two distinct beds, each about 1 ft thick.....	2.0

Total thickness of Stovall limestone and Grant shale members.....	11.0

Doyle shale.

Representative section of the Grant shale and the Cresswell limestone members of the Winfield limestone in a quarry in the SE 1/4 NW 1/4 sec. 15, T. 19 S., R. 4 E.

Winfield limestone:

Cresswell limestone member:	<i>Feet</i>
Limestone, clayey, thin-bedded to platy, light-gray; weathers lighter gray.....	1.0
Limestone, massive, soft, light-gray; contains abundant geodes; weathers slightly darker gray; fragments of shale in upper part.....	4.6
Shale, clayey, slightly calcareous, light-green; platy to thin bedded; weathers to lighter green.....	.5
Limestone, clayey, soft, tan-gray; generally massive, but thin bedded in places; weathers light buff.....	2.1
Shale, clayey, slightly calcareous, gray-green; abundant siliceous concretions; weathers light green.....	.5
Limestone, clayey, soft, massive, tan-gray; contains abundant siliceous and calcareous geodes in lower half; weathers nearly white.....	12.0
Limestone, slightly clayey, thin-bedded, light-gray; varied in thickness; weathers tan.....	.8
Limestone, medium-hard, massive, gray; contains large siliceous geodes in basal part; weathers tan gray; fossiliferous.....	4.3
Limestone, hard, massive, gray; weathers light gray and has limonite stains; contains siliceous concretions 1-8 in. thick; bottom of concretion zone is about 8 in. from bottom of bed; concretions are gray to very dark gray, and weather red brown and to lighter weight; fossils abundant in concretions.....	2.8
Grant shale member:	
Shale, limy or clayey, light-gray; breaks out in angular blocks; upper foot grades into Cresswell; weathers tan gray.....	7.0

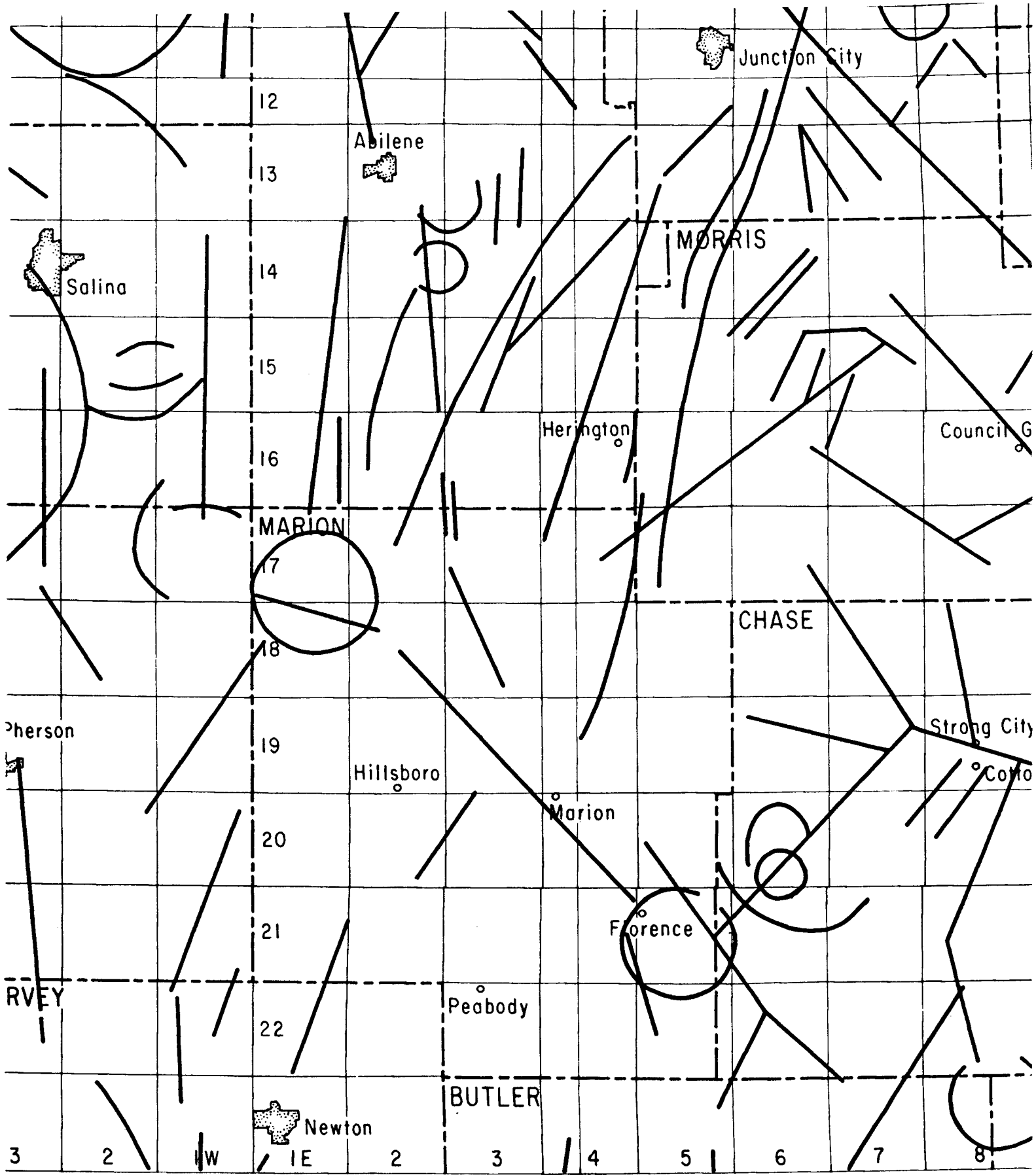
Total exposed thickness of the Grant shale and Cresswell limestone members (top eroded).....	35.5

Base covered

465868-59-3

(From Byrne, 1959)

Figure 16. Measured Section of Winfield Limestone.



topographic maps, 1:500,000

Figure 17. Lineament Map.
(after McCauley, 1983)

streamflow gain of almost 2,000 gpm between the NW 1/4, sec. 35, T18S, R4E and the bridge at the south side of sec. 16, T19S, R4E in a reach of about 4 miles (Fig. 15). The artesian well and the springs in sections 9, 10, and 15 account for most of the measured flow increase.

Return north to county road then east to US 56-77. Turn south, continue to US 50 at Florence (Fig. 3). Turn east 0.7 mile then north to Crystal Springs (near C SW NW SE sec. 36, T20S, R4E).

Stop 12 -- Crystal Spring is reported to be one of the largest springs in Marion County. Since 1920 the spring has been the principal source of public water supply. The installed pumping capacity at the spring house is 370 gpm with the excess water flowing to a nearby stream. The spring discharges near the base of a rock bluff from the Barneston Limestone.

Return to Florence and turn south 4 miles then west 4 miles, south 0.75. Park on road shoulder and walk east across pasture, cross the creek to Lee Spring.

Stop 13 -- Lee Spring appears as a circular hole in the alluvium overlying the lower part of the Winfield Limestone. The circular hole is about ±10 feet in diameter and is filled with organic plant materials. The flow from the circular hole was measured, with a V-notch weir between the spring and the creek as >115 gpm on September 22, 1983 by the Division of Water Resources. An additional 10 to 20 gpm flow emerges on the east creek bank a few feet west of the main spring. The water has a H₂S odor, chloride of 211 mg/l, and specific conductance of 3280 umhos/cm and a temperature of 58°F. Additional springs emerge from the Winfield Limestone at several places upstream from Lee Spring but have less dissolved chloride and lower specific conductance values.

Return to cars, retrace route returning to US 77. Drive north 3 miles and turn west on gravel road leading to the Leslie Allison home along Spring Creek.

Stop 14 -- Allison Spring is a tubular spring emerging from the Florence Limestone on the south bank of Spring Creek a few feet upstream from a low overflow dam. The spring at one time became quite salty owing to contamination by oil field brines in the early oil field development. The brine pollution has cleared and the water now is of good quality. A water sample collected June 23, 1983 contained 19 mg/l sulfate, 53 mg/l chloride, total dissolved solids 415 mg/l and specific conductance of 795 uhmos at 25°C. We have not measured the flow but it has been reported as more than 500 gpm. The water is piped to the house for domestic use and as a source of groundwater heat pump water.

Return to US 77 and turn north to junction of US 50 and US 77. From junction proceed northwest on US 77 for 0.15 mile then turn west on section line road for 3 miles to the Hallett quarry.

Stop 15 -- Hallett Construction Company rock quarry in the Winfield Limestone. Contrast the lithology, texture and hardness of this rock with that seen in the two Winfield quarries earlier today.

Return to Florence and the Holiday Motel. End of first day of field trip. We have dinner reservations for 6:30 p.m. at the Kingfisher Inn at Marion County Lake.

Day 2 of Field Trip

We will depart from the Holiday Motel at Florence at 8 a.m. Today's trip will be devoted more to geology whereas the first day was mainly hydrology.

Proceed west on US 50 to the west edge of Peabody, turn north on the Peabody-Canada road for 1 mile. Turn west for 0.9 mile to stop 16 east of Spring Creek (Fig. 3).

Stop 16 -- Along the ditch on the north side of the road (SW SW sec 29, T21S, R3E) the contact between Pleistocene terrace deposits and the Wellington Formation is exposed. Note the lithology of the Pleistocene gravel and the nature of the Wellington. The Wellington beds are probably part of the Geuda Springs Shale Member (Fig. 5).

Continue west 4.1 miles to Hillsboro road and turn north 7 miles, 2 west, 1 north, and 3/4 mile west (NE NW sec. 19, T20S, R2E) to a road cut exposure of the Annelly Gypsum Member of the Wellington.

Stop 17 -- Gray and white gypsum and dark gray gypsiferous shale are exposed along the south side of the road. Orange and white rock gypsum and selenite gypsum. Cemented sands and gravels of Pleistocene(?) age overlie the gypsum and shale near the top of the slope.

Return to cars and continue 1 mile west to top of hill where the Carlton Limestone has been quarried for road metal.

Stop 18 -- The Carlton Limestone consists of several beds of thin impure limestones interbedded with shale. It is separated from the Annelly Gypsum below by about 40 feet of Chisholm Creek Shale.

Return to cars and continue west about 0.3 mile, turn south 1 mile and west 3 miles to Kansas Highway 15. Turn south 3 miles to Goessel. Along K-15 we are traveling on the eastern edge of the Equus Beds, an extensive

Pleistocene clay, silt, sand, and gravel deposit containing important groundwater resources. Turn west into Goessel and stop at the Barnstormer Restaurant.

Note the many slightly raised areas in the otherwise very smooth topography. We will discuss the origin of these features at Captain Gössel's Barnstormers Restaurant Stop.

Stop 19 -- Note the many irregular shaped slightly raised (1 to 5 feet high) areas that dot the otherwise smooth topography shown on the topographic map (Fig. 18). Pleistocene deposits are generally 20 to 50 feet thick around Goessel and overlie nearly the entire thickness of Wellington.

Return to cars and travel 5 miles north on K-15, then turn right into active sand pit (SW Cor, sec. 9, T20S, R1E).

Stop 20 -- In this Pleistocene sand pit note the bedding, structures, and lithologies. This is the aquifer material at Goessel. Be careful when standing by any of the vertical faces, they may slump and bury you.

Reload into cars, return to K-15 and travel 2 miles north noting exposures of maroon, red, gray, and green shales of the upper Wellington, probably mostly Highland Shale Member. Note slump structures and tilted beds exposed along highway and creek exposures. Turn east 2 miles noting colored shales of Highland Shale Member with Pleistocene sand and gravels on hilltops. Turn south 2 miles, then 3 1/2 miles east noting Wellington exposures and Pleistocene deposits. Turn south into gravel pit.

Stop 21 -- Jost Gravel Pit (NE NW sec. 17, T20S, R2E). The sediments represented in this pit are much coarser than those seen at Stop 20 and obviously represent a fluvial environment with much stronger energies. Please be careful around the vertical faces that may cave off. Note the lithologies represented and the manganese coatings on pebble surfaces in parts of the

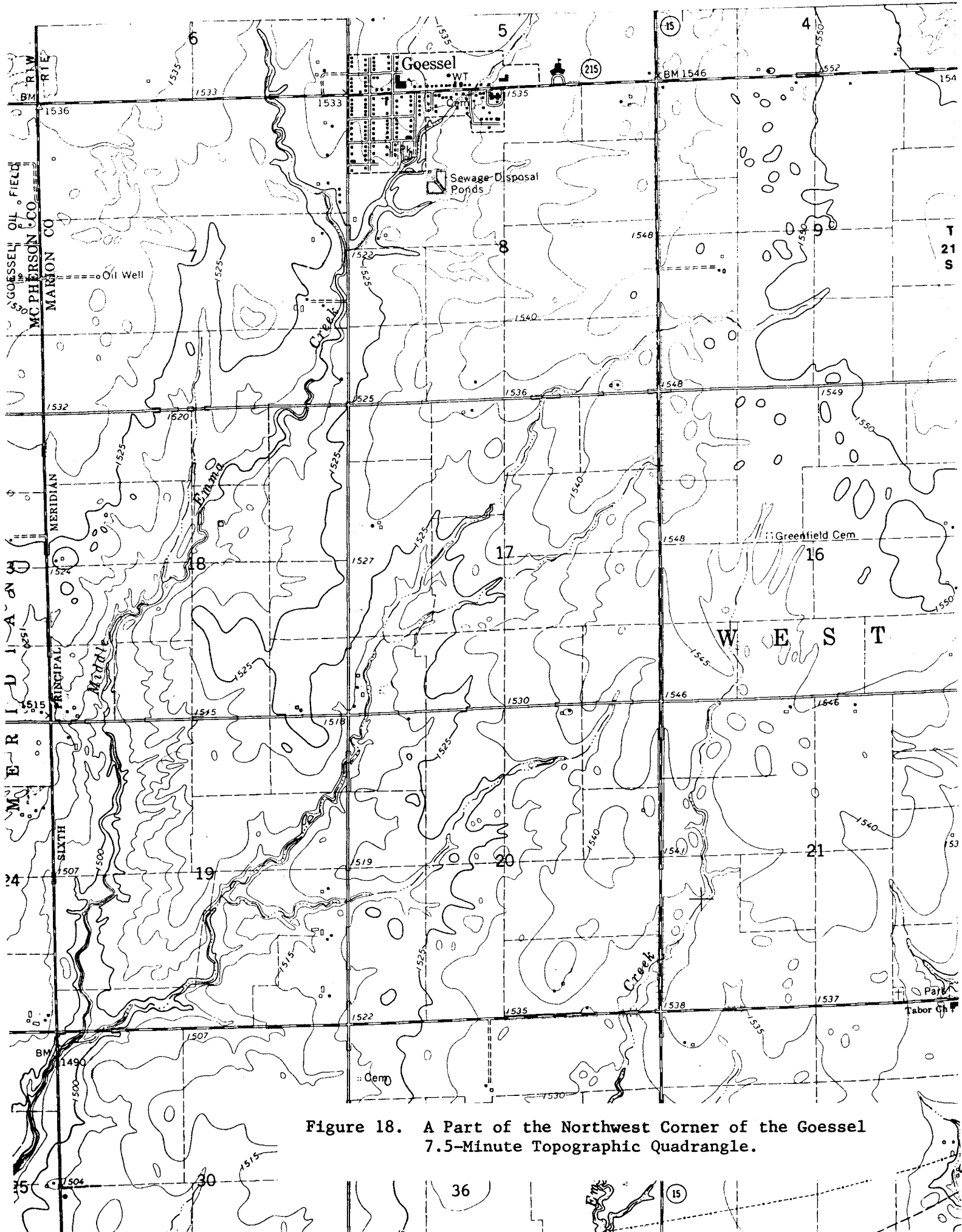


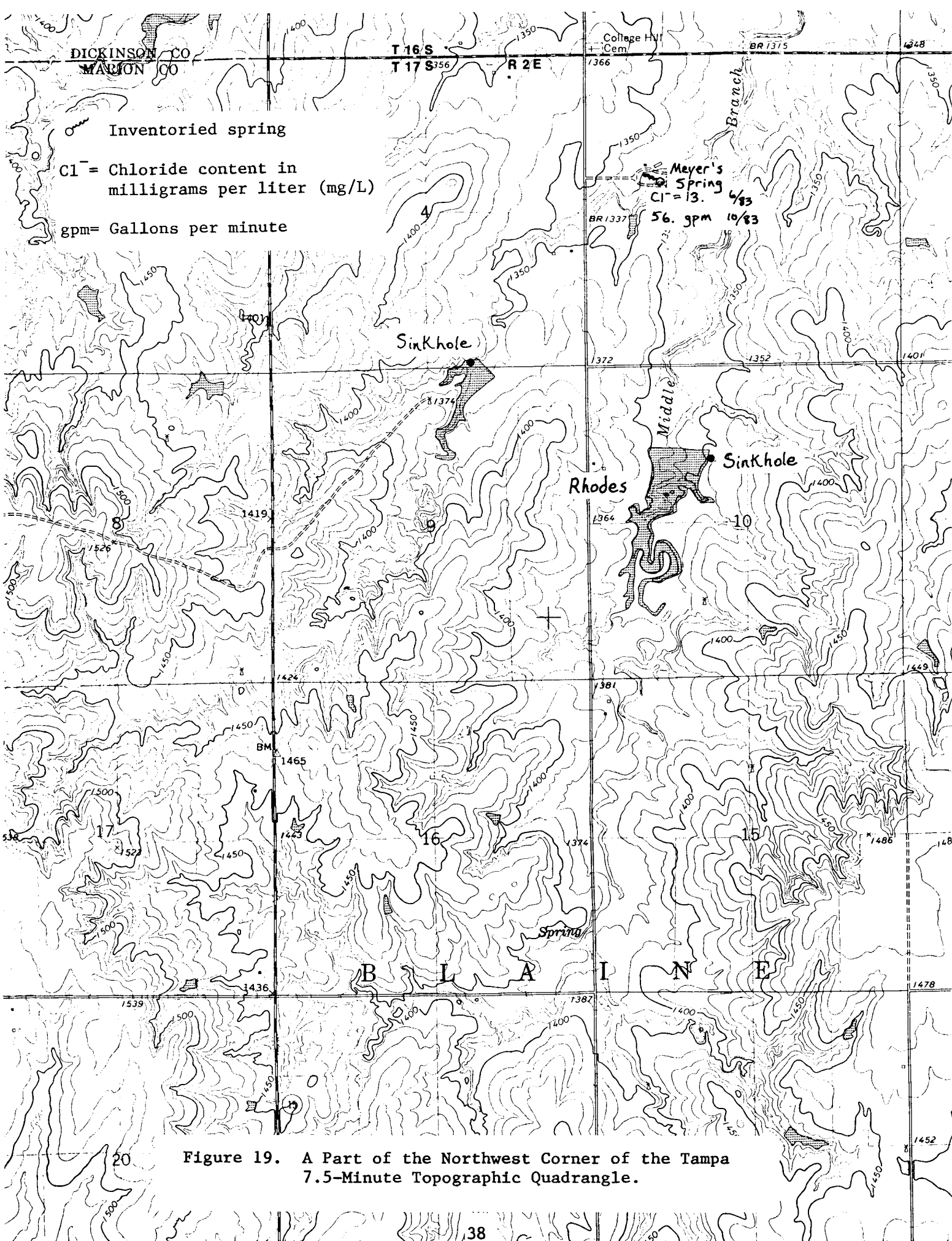
Figure 18. A Part of the Northwest Corner of the Goessel 7.5-Minute Topographic Quadrangle.

quarry exposures. Parts of the gravel deposits have very good porosity and high permeability. At the time of our last visit remains of a tusk could be seen exposed in the face of the pit. Professor S. L. Loewen, Tabor College, has collected a mammoth skull, teeth, and tusks from pits along the Cottonwood River in this area. There are irrigation wells pumping from these Pleistocene deposits about 1 1/4 miles northeast of this pit.

Move cars back to county road, turn east 1 1/2 miles, then north 2 miles to Hillsboro. At the blinker light travel east to the Iron Kettle or Pizza Hut Restaurants for lunch; both are on the south side of US 56. After lunch reassemble at the Iron Kettle, then return west to the blinker light. Turn north 1 mile, west 1 mile to Junction with K-15. Turn north 13 miles (to Tampa road), east 1 mile, then north 2 3/4 miles then turn right into Rhodes farm yard.

Stop 22 -- At this stop (Fig. 19) we will see a sink hole in gypsum developed along the east side of a watershed lake on Middle Creek. The sink hole is about 200 to 250 feet south of the dam and a few feet above the conservation pool elevation of the lake. During flood pool stages water covers the sink hole and the sink drains lake water to some point below the watershed lake. It seems probable that unless repairs are made which would include sealing the sink hole and the conduits around the east end of the dam, the hole and the solution channels in the gypsum will continue to enlarge each time they carry flood water flows with an eventual failure of the structure. The gypsum bed probably is the Annelly gypsum, but may be a gypsum bed overlying the Annelly. The bed consists of rock gypsum and earthy gypsum spotted with selenite crystals.

At this point we might note that another spring, the Meyers Spring, (56 gpm measured flow October 26, 1983 by Division of Water Resources; SE SW NW



sec. 3, T17S, R2E) is present 0.85 mile north of this watershed dam at an elevation 15 or 20 feet lower. From 1892 to 1898 the Acme Cement Plaster Company operated a commercial mine and mill on the Rhodes property quarrying a gypsum bed 6 to 10 feet thick in the area east of the spring (Grimsley and Bailey, 1899).

Another watershed lake 0.6 mile northwest has several sink holes at or near the edge of the lake, one of which was recently plugged by bulldozing dirt into the hole. It is still leaking.

Retrace route back to public road and turn south 1 3/4 miles, then west 1 mile to K-15. Turn north on K-15 about 0.7 mile stopping at gate into Rhodes Ranch pasture on west side of K-15.

Stop 23 -- At Stop 23 (Fig. 19) we will visit a series of creek bank exposures (N 1/2 NE 1/4 sec. 17, T17S, R2E) which show the Permian Wellington (Afton Shale Member?) disconformably overlain by the Cretaceous Kiowa Formation. The exposures have not yet been measured, sampled, and described in detail but there appear to be a paleosol, a conglomerate that includes abundant charcoal, silt, or siltstone beds, white amorphous clays that may be weathered volcanic ash, and very well rounded and polished igneous pebbles associated with the disconformity.

The yellowish mineral associated with the charcoal containing ferruginous conglomerate has been identified by x-ray diffraction as nearly pure Natrojarosite ($\text{Na Fe}_3 (\text{SO}_4)_2 (\text{OH})_6$) (Personal communication, Dave Grisafe, 1983).

Return to cars, turn around and travel south 0.7 mile, turn west 4 miles then north 2.25 miles. The hilltop or drainage divide is capped with Dakota Formation but is not well exposed. The gullies created by the north flowing

intermittent streams expose nearly 100 feet of Kiowa Formation. After viewing the exposure from the road, turn cars around and retrace route 0.25 mile south.

Stop 24 -- Depending on the condition of the road, we will drive east 0.35 mile or we will walk east 0.4 mile to beautiful exposures of Dakota? or Kiowa? Sandstone along a southeast trending drainage (SE SW sec 2, T17S, R1E). The yellowish brown weathered sandstone is very loosely cemented, contains considerable amount of hard, dense, iron-cemented sandstone pebbles and contains remains of plant material.

The Dakota and Kiowa Formations are the source of domestic and stock water supplies and rural water district supplies in the northwest part of Marion County.

This is the last stop of the field trip. Return to K-15 and have a safe trip home.

References

- Burchett, R.R., Paul, S.E., Deason, K.L., Netzler, B.W., and Anderson, R.R., 1983, Deep well and oil-gas field location map of the Forest City basin and adjacent regions of Iowa, Kansas, Missouri, and Nebraska: Nebraska Geological Survey, Conservation and Survey Division, 1:500,000 scale map.
- Byrne, F.E., Walters, C.P., Hill, J.L., and Riseman, L., 1959, Geology and construction-materials resources of Marion County, Kansas: U.S. Geological Survey Bulletin 1060-B, 95 p.
- Franks, P.C., 1979, Paralic to fluvial record of an Early Cretaceous marine transgression -- Longford Member, Kiowa Formation, north-central Kansas: Kansas Geological Survey Bulletin 219, 55 p.
- Frye, J.C. and Leonard, A.B., 1952, Pleistocene geology of Kansas: Kansas Geological Survey Bulletin 99, 230 p.
- Grimsley, G.P. and Bailey, E.H.S., 1899, Special report on gypsum and gypsum cement plasters: Kansas University Geological Survey Volume 5, 183 p.
- Kansas Geological Survey, 1964, Geologic map of Kansas, map M-1: Kansas Geological Survey, scale 1:500,000.
- Kulstad, R.O., Fairchild, Paul, and McGregor, Duncan, 1956, Gypsum in Kansas: Kansas Geological Survey Bulletin 113, 110 p.
- McCauley, J.R., 1983, Lineament map of the Forest City Basin and adjacent regions of Iowa, Kansas, Missouri, and Nebraska: Nebraska Geological Survey, Conservation and Survey Division, 1:500,000 scale.
- Merriam, D.F., 1963, The geologic history of Kansas: Kansas Geological Survey Bulletin 162, 317 p.
- Rydjord, John, 1972, Kansas place names: University of Oklahoma Press, Publishing Division of the University, Norman, Oklahoma, 613 p.

- Shenkel, C.W., Jr., 1955, Geology of the Lost Springs pools area, Marion and Dickinson Counties, Kansas: Kansas Geological Survey Bulletin 114, part 6, p. 168-193.
- Tasch, Paul, 1964, Periodicity in the Wellington Formation of Kansas and Oklahoma, in Symposium on cyclic sedimentation: Kansas Geological Survey Bulletin 169, v. 2, p. 481-496.
- Van Meter, Sondra, 1972, Marion County, Kansas, past and present: Marion County Historical Society, Inc., M.B. Publishing House, Hillsboro, Kansas, 344 p.
- Ver Wiebe, W.A., 1937, The Wellington Formation of central Kansas: Municipal University of Wichita, University Studies Bulletin No. 2, v. 12, no. 5, p. 3-18.

ADDENDUM

This addendum was prepared for use on a geohydrology field trip in Marion County, Kansas June 14-15, 1984. Addendum pages are lettered pages and are inserted in front of the original Kansas Geological Survey Open-File Report 83-25, "Geohydrology Field Trip, Marion County, Kansas, November 18-19, 1983."

General Statement

The Kansas Geological Survey is a research and service agency whose function, in part, is to collect, interpret, and report information on the geology, mineral resources and hydrology of the state. The results of research may be reported in Survey publications, outside publications, the media, talks or field trips.

A field trip offers opportunity to see first-hand what various aquifers look like in natural or artificial exposures within areas where the rocks are the local aquifer. Examples of solution and fracture permeability in limestone and gypsum beds can be contrasted with intergranular permeability in sand and gravel aquifers. Differences in hydraulic head between aquifers can be shown to allow upward or downward flow of ground water in boreholes, along fractures or faults or in features related to solution subsidence. Mechanisms for entry of pollutants into aquifer systems can be discussed based on direct or indirect evidence which can be shown in the field.

With the wide background of the participants on this field trip, we will have an opportunity for administrative, regulatory, research, academic and legislative staff, together with the ground-water development industry, to observe geologic and hydrologic phenomena and to discuss problems and solutions for the development and protection of our ground-water resources.

We look forward to some stimulating discussions during the course of the field trip.

Addendum Index

Figure No.

- C Information on selected springs.
- D Map showing location of areas where permits to appropriate ground water (●) or surface water (▲) have been applied for (Division of Water Resources Water Use Report, 1982 yr).
- E Water use reported for 1982 (from Division of Water Resources).
- F Hydrographs of Lyle Hanschu water well.
- G Water analyses of Lyle Hanschu well water.
- H Hydrographs of Edgar Tiemeier water well.
- I Water analysis of Edgar Tiemeier well water.
- J Hydrographs of Irvin Brunner water well.
- K Water analysis of Irvin Brunner well water.
- L Examples of seismic shot hole densities and patterns.
- M Sample seismic shot hole logs.
- Page N Field estimation of water quality in Marion County, Kansas.
- O Contours of the Sum of Dissolved Sulfate and Nitrate Concentrations (mg/L) for Specific Conductance versus Chloride Concentration of Groundwaters in Marion County, Kansas.

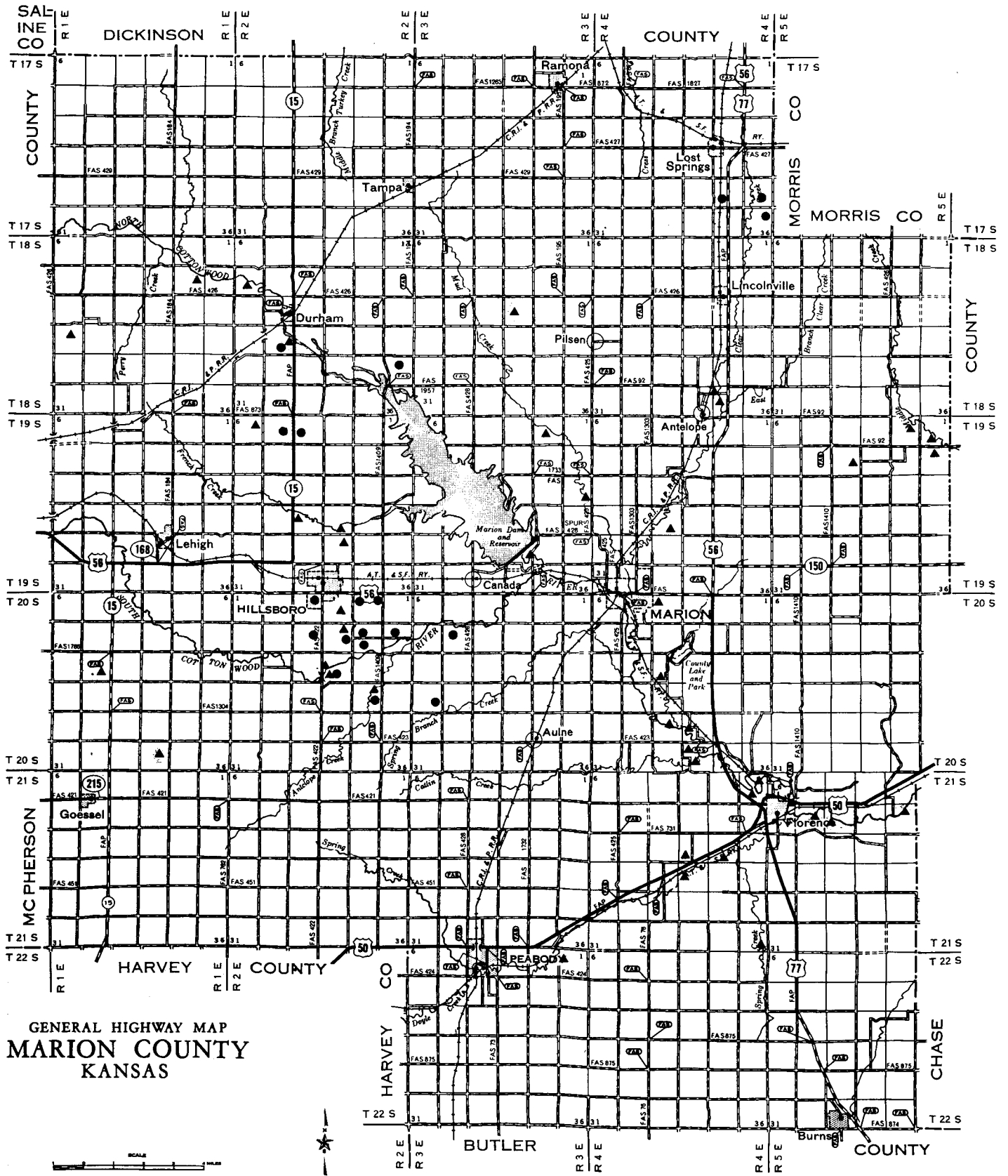
Marion County Springs

Name Location	Geologic Source	Flow Rate* gpm	Temp °F	Chloride mg/l	Sp. Cond. umhos/cm @25°C	Calc TDS mg/l
1. Allison Spring SE SW NE 13-21-4E	Florence Ls Mbr, Barneston Ls	R + 500 E + 1000 5/15/84	58 57	50 (8/17/82) 51 (5/15/84)	762 751	457
2. Chingawassa Springs SE NW SW 15-19-4E	Winfield Ls (F) Barneston Ls? (U)	M 609 9/21/83	57	51 (9/21/83) 172	1010 2075	571 1349
3. Crystal Spring SW NW SE 36-20-4E	Ft. Riley Ls Mbr, Barneston Ls	R ±700 M 4044 5/15/84	58 56.5	7 9	641 580	357
4. Elm Springs NW SW SW 4-17-1E	Kiowa Fm	E 3 or 4	44** 12/21/82	2	518	337
5. Funk Artesian Springs SE SW SW 15-20-2E	Wellington Fm M flow 52 gpm (east) 5/16/84 Cl ⁻ = 26 mg/l Sp. Cond. = 2775	E 100-200 M 74 (west) 5/16/84	57.75 58 5/15/84	35 28	2850 2770	1852
6. Lee Spring NW SW SW 34-21-4E	Barneston Ls?	M +115	58 9/22/83	222	3310	2151
7. Lost Spring SW SW SE 17-17-4E	Wellington Fm	E 5-10	58 8/4/82	1440 (1959) 436 (8/4/82)	2502	1501
8. Meyer Spring SE SW NW 3-17-2E	Annelly Mbr Wellington Fm	M 56 10/26/83	58 6/7/83	13	2450	1592
9. McCarthy Springs W 1/2 SE SE 9-19-4E	Winfield ls	E ±600	57	224	2325	1511
10. Old Coin Spring NE NE SE 14-21-4E	Barneston Ls	E ±800 2/7/84 M 2288 5/15/84	49** 2/7/84 56** 5/15/84	11 10	660 660	-----
11. Lies Farm Spring NW NW SW NE 16-22-5E	Doyle Sh	M 23 5/15/84	56	4	550	
12. Marion City Park Sp SE NW NE NW 5-20-4E	Winfield Ls	E 1/5 5/16/84				

* R = Reported, E = Estimated, M = Measured

**Temperature measured in spring discharge downstream from spring orifice and may be affected by soil and air temperature

Figure C



GENERAL HIGHWAY MAP
MARION COUNTY
KANSAS

Figure D: Map showing location of areas where permits to appropriate ground water (●) or surface water (▲) have been applied for (Division of Water Resources Water Use Report, 1982 yr).

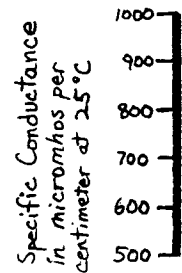
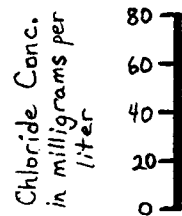
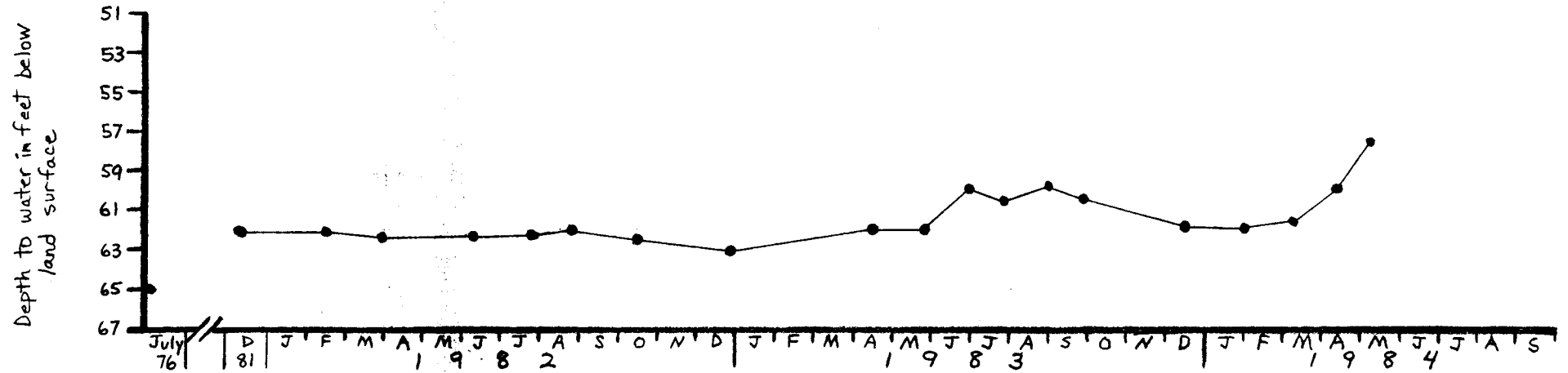
Water Use Reported for 1982*
Marion County, Kansas

	<u>Surface Water</u>		<u>Ground Water</u>	
	<u>Gallons</u>	<u>Acre-Feet</u>	<u>Gallons</u>	<u>Acre-Feet</u>
Domestic	---	---	---	---
Industrial	---	---	4,099,205	12.58
Irrigation	247,157,983	758.5	168,034,844	515.68
Municipal	85,363,186	261.97	124,318,684	381.52
Recreation	19,551,060	60.	---	---
Total	352,072,230	1,080.47	296,452,723	909.78
Total Use	648,524,953 gallons --- 1990.25 acre-feet			

*From Division of Water Resources

Figure E: Water use reported for 1982 (from Division of Water Resources).

F



Hanschu Observation Well
 Lost Springs, Kansas
 T. 17S, R. 4E, Sec. 12 cccc

Figure F: Hydrographs of Lyle Hanschu water well.

KANSAS GEOLOGICAL SURVEY
Geochemistry Section

Constant Ave.
1930 ~~Avenue "A"~~, Campus West
The University of Kansas
Lawrence, Kansas 66044
913-864-4991

REPORT OF WATER ANALYSIS

OWNER AND LOCATION: Lyle Hanschu SW¹/₄, SW¹/₄, SW¹/₄, Sec. 12, T.17S, R.4E
STUDY: The Geohydrology of Marion County, Kansas DATE: August 29, 1983
COLLECTION POINT LOCATION: frost-proof hydrant at well site
TYPE SAMPLE: water well DATE COLLECTED: June 21, 1983
SAMPLE COLLECTED BY: Pamela K. Chaffee and Christian Thueringer

Temperature of water at point of collection: 16.5 °C.
Specific Conductance at point of collection: 825 micromhos at 25 °C.
pH at point of collection: 7.10.

Silica (SiO ₂):	<u>21</u> mg/l*	Bicarbonate (HCO ₃):	<u>391</u> mg/l*
Calcium (Ca):	<u>98</u> mg/l	Carbonate (CO ₃):	<u> </u> mg/l
Magnesium (Mg):	<u>35</u> mg/l	Sulfate (SO ₄):	<u>14</u> mg/l
Sodium (Na):	<u>18</u> mg/l	Chloride (Cl):	<u>31</u> mg/l
Potassium (K):	<u>0.6</u> mg/l	Fluoride (F):	<u>0.4</u> mg/l
Strontium (Sr):	<u>0.3</u> mg/l	Nitrate (NO ₃):	<u>29</u> mg/l
		Phosphate (PO ₄):	<u>0.1</u> mg/l
Iron (Fe):	<u> </u> mg/l		
Manganese (Mn):	<u> </u> mg/l		
Boron (B):	<u> </u> mg/l		

Total Hardness as CaCO₃: 389 mg/l
Non-carbonate Hardness as CaCO₃: 68 mg/l

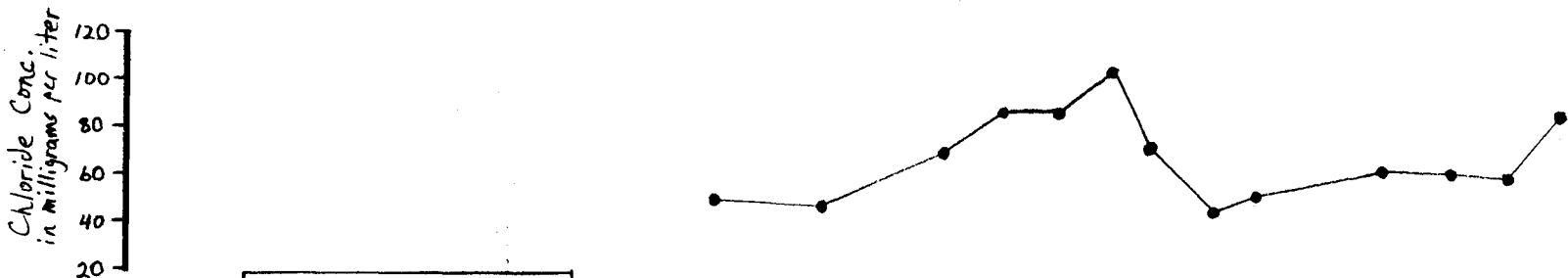
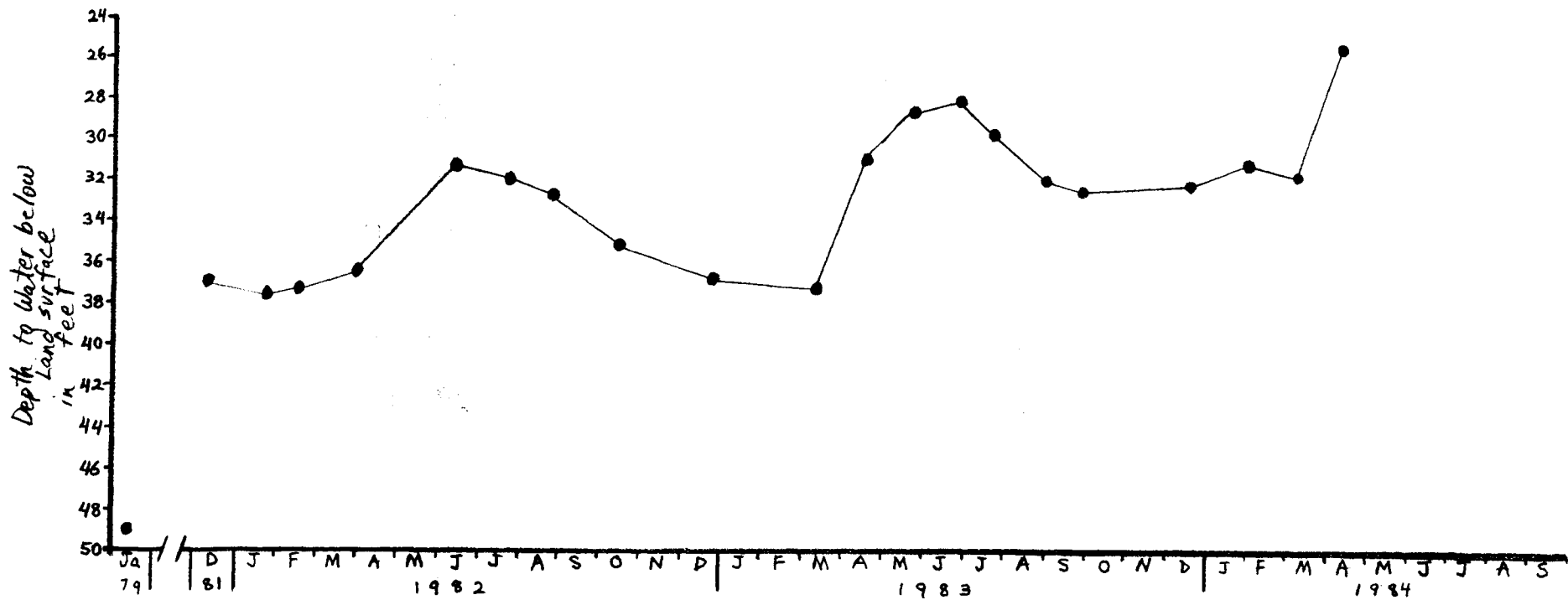
Total Solids Calculated: 440 mg/l

Sodium Adsorption Ratio (SAR): 0.40.

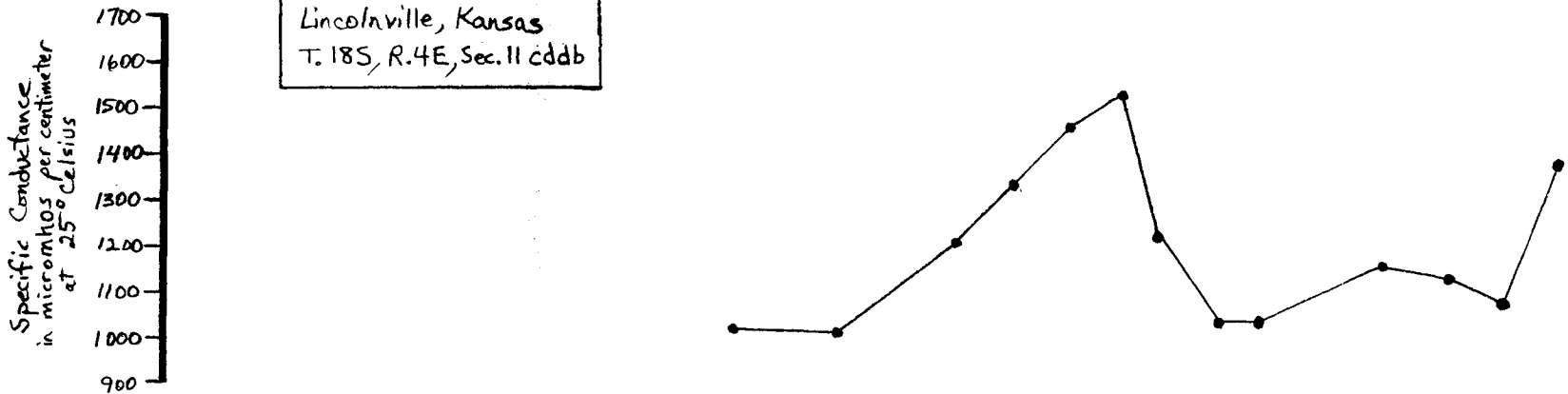
*Concentrations of chemical constituents reported in milligrams per liter (mg/l).

Figure G: Water analyses of Lyle Hanschu well water.

H
Figure H: Hydrographs of Edgar Tiemeier water well.



Tiemeier Observation Well
Lincolville, Kansas
T. 18S, R. 4E, Sec. 11 cddb



KANSAS GEOLOGICAL SURVEY
Geochemistry Section

Constant Ave.
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The University of Kansas
Lawrence, Kansas 66044
913-864-1991

REPORT OF WATER ANALYSIS

OWNER AND LOCATION: Edgar Tiemeier SE $\frac{1}{4}$, SE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 11, T. 18S, R. 4E
STUDY: The Geohydrology of Marion County, Kansas DATE: August 29, 1983
COLLECTION POINT LOCATION: faucet on west side of house
TYPE SAMPLE: water well DATE COLLECTED: June 21, 1983
SAMPLE COLLECTED BY: Pamela K. Chaffee and Christian Thueringer

Temperature of water at point of collection: 15.0 °C.
Specific Conductance at point of collection: 1540. micromhos at 25 °C.
pH at point of collection: 6.95.

Silica (SiO ₂):	<u>20.</u> mg/l*	Bicarbonate (HCO ₃):	<u>55.3.</u> mg/l*
Calcium (Ca):	<u>126.</u> mg/l	Carbonate (CO ₃):	_____ mg/l
Magnesium (Mg):	<u>61.</u> mg/l	Sulfate (SO ₄):	<u>148.</u> mg/l
Sodium (Na):	<u>126.</u> mg/l	Chloride (Cl):	<u>106.</u> mg/l
Potassium (K):	<u>3.1</u> mg/l	Fluoride (F):	<u>0.2</u> mg/l
Strontium (Sr):	<u>0.6</u> mg/l	Nitrate (NO ₃):	<u>35.</u> mg/l
		Phosphate (PO ₄):	<u>0.3</u> mg/l
Iron (Fe):	_____ mg/l		
Manganese (Mn):	_____ mg/l		
Boron (B):	_____ mg/l		

Total Hardness as CaCO₃: 566. mg/l
Non-carbonate Hardness as CaCO₃: 113. mg/l

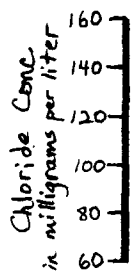
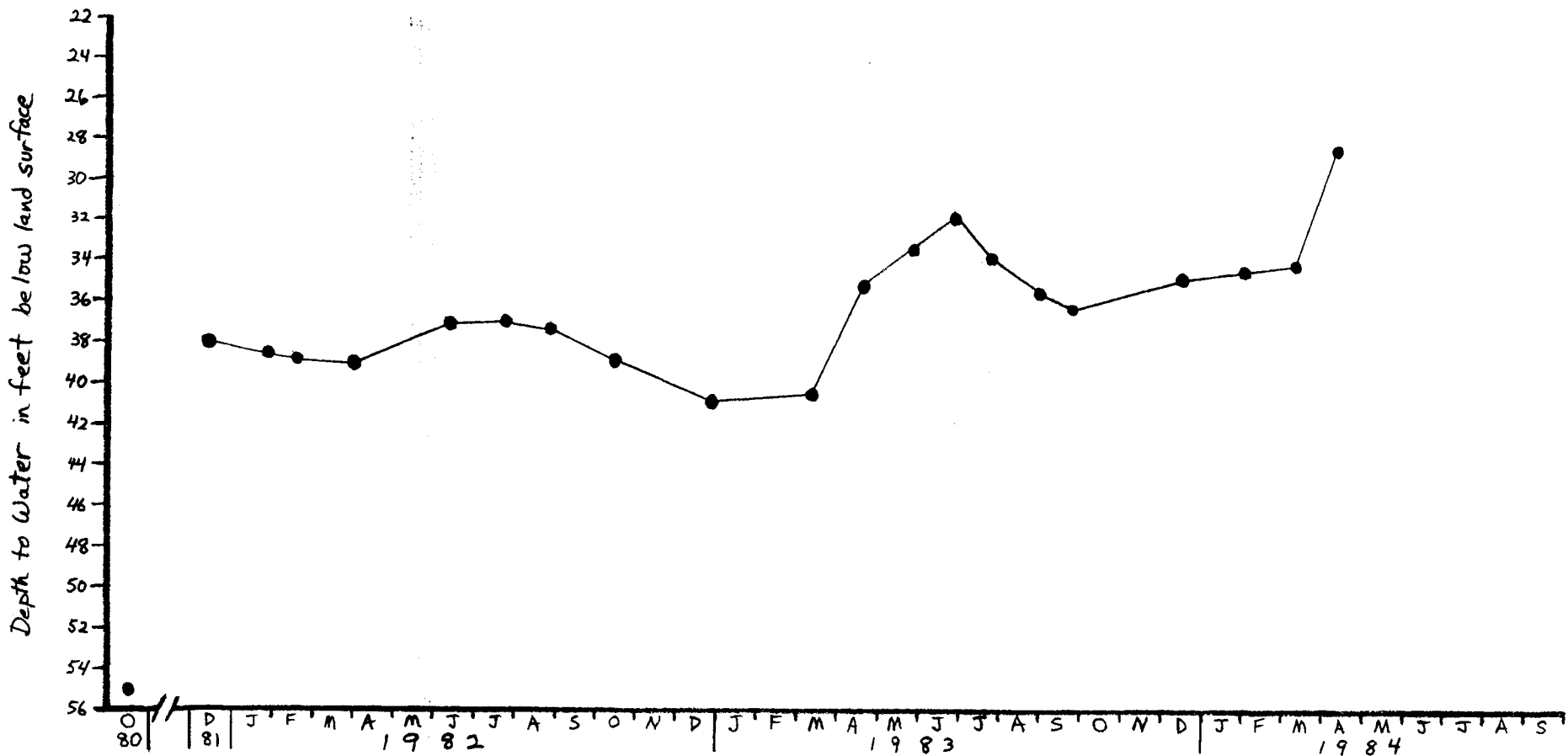
Total Solids Calculated: 898. mg/l

Sodium Adsorption Ratio (SAR): 2.30.

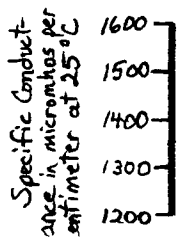
*Concentrations of chemical constituents reported in milligrams per liter (mg/l).

Figure I: Water analysis of Edgar Tiemeier well v

Figure J: Hydrographs of Irvin Brunner water well.



Brunner Observation Well
 Ramona, Kansas
 T. 17S, R. 3E, Sec. 2 ddca



KANSAS GEOLOGICAL SURVEY
Geochemistry Section

Constant Ave.
1930 ~~Avonue "A"~~ Campus West
The University of Kansas
Lawrence, Kansas 66044
913-864-1991

REPORT OF WATER ANALYSIS

OWNER AND LOCATION: Irvin Brunner SW $\frac{1}{4}$, SE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 2, T.17S, R.3E
STUDY: The Geohydrology of Marion County, Kansas DATE: August 29, 1983
COLLECTION POINT LOCATION: faucet on north side of building
TYPE SAMPLE: water well DATE COLLECTED: June 21, 1983
SAMPLE COLLECTED BY: Pamela K. Chaffee and Christian Thueringer

Temperature of water at point of collection: 17.0 °C.
Specific Conductance at point of collection: 1420. micromhos at 25 °C.
pH at point of collection: 7.20.

Silica (SiO ₂):	<u>22.</u> mg/l*	Bicarbonate (HCO ₃):	<u>399.</u> mg/l*
Calcium (Ca):	<u>134.</u> mg/l	Carbonate (CO ₃):	<u> </u> mg/l
Magnesium (Mg):	<u>51.</u> mg/l	Sulfate (SO ₄):	<u>151.</u> mg/l
Sodium (Na):	<u>70.</u> mg/l	Chloride (Cl):	<u>114.</u> mg/l
Potassium (K):	<u>1.7</u> mg/l	Fluoride (F):	<u>0.4</u> mg/l
Strontium (Sr):	<u>0.6</u> mg/l	<u>Nitrate</u> (NO ₃):	<u>51.</u> mg/l
		Phosphate (PO ₄):	<u>0.1</u> mg/l
Iron (Fe):	<u> </u> mg/l		
Manganese (Mn):	<u> </u> mg/l		
Boron (B):	<u> </u> mg/l		

Total Hardness as CaCO₃: 545. mg/l
Non-carbonate Hardness as CaCO₃: 218. mg/l

Total Solids Calculated: 792. mg/l

Sodium Adsorption Ratio (SAR): 1.30.

*Concentrations of chemical constituents reported in milligrams per liter (mg/l).

Figure K: Water analysis of Irvin Brunner well water

Township 19S, Range 2E, County MARION, State KANSAS

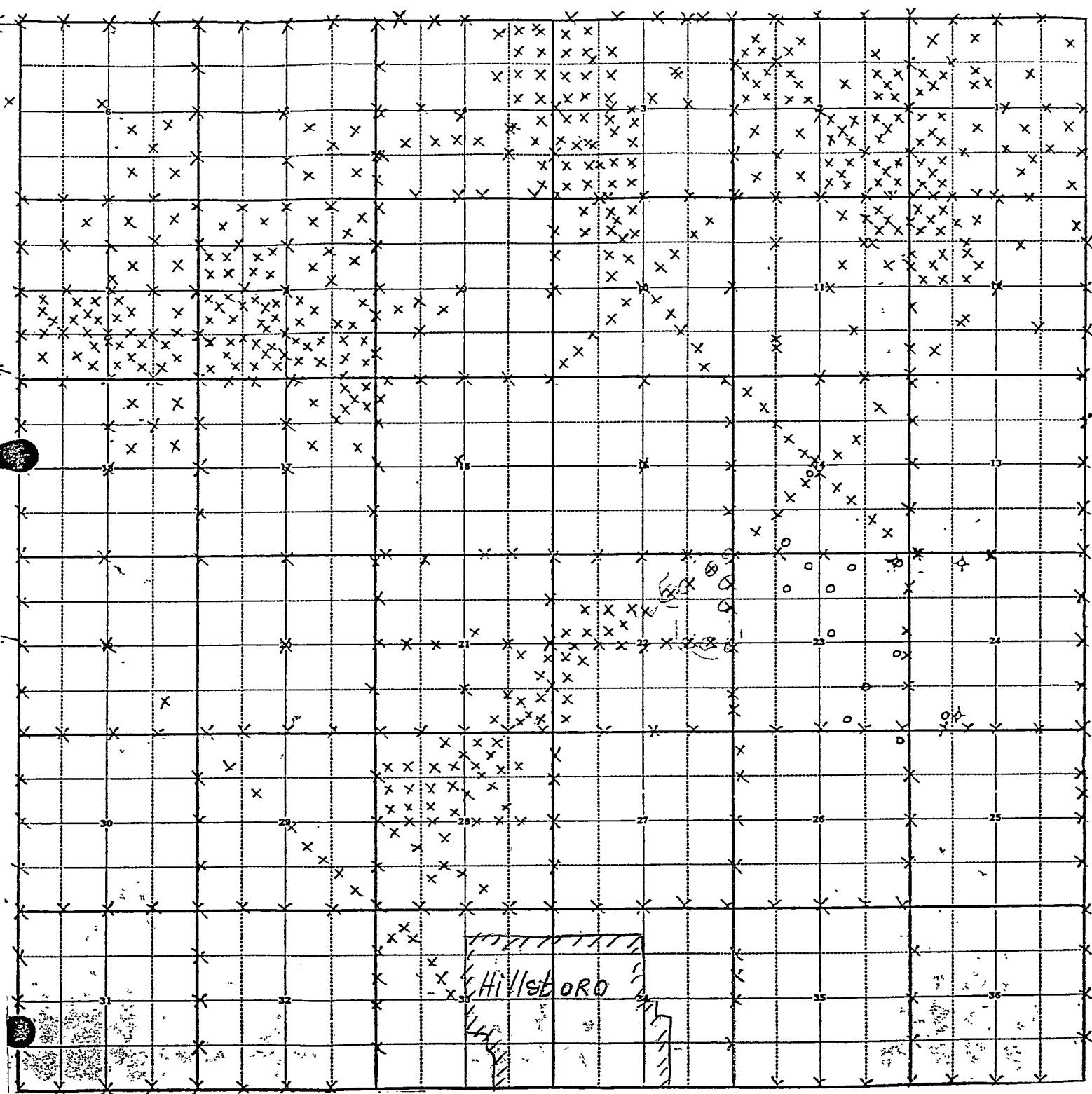


Figure L: Examples of seismic shot hole densities and patterns.

DRILLING RECORD

Hole No. 230

Party No. 1370-156 Date 6-10-53

Location MARION, Ks.

Depth of Hole 60 Feet Casing..... Ft. Size

FEET		FORMATION
FROM	TO	
0	36	@ 1/2"
36	45	Blue Shale
		limestone Strata
45	60	Blind
2 1/2	@	60' 60' Cap

REMARKS

Time Started..... A.M. P.M. Time completed..... A.M. P.M.

DRILLING RECORD

Hole No. 229

Party No. 1370-156 Date 6-10-53

Location MARION, Ks.

Depth of Hole 75 Feet Casing..... Ft. Size

FEET		FORMATION
FROM	TO	
0	62	Clay & Rock
62	75	Blind
2 1/2	@	75' 60' Cap

REMARKS

Time Started..... A.M. P.M. Time completed..... A.M. P.M.

Figure M: Sample seismic shot hole logs

Field Estimation of Water Quality in Marion County

Donald O. Whittemore, Pamela K. Chaffee, and Howard G. O'Connor

Specific conductance measurements can be used to estimate the total dissolved solids contents of water samples. The measurements are also useful for approximating the concentrations of all major dissolved constituents (calcium, magnesium, sodium, bicarbonate, sulfate, chloride, and nitrate) and values such as alkalinity and hardness, if field measurements of one or two of these constituents is also available. All aquifers in Marion County are composed of unconsolidated or consolidated sediments that nearly always contain some calcite or dolomite. In the absence of evaporite minerals or pollution, the water chemistry is generally of calcium-bicarbonate type, being controlled by carbonate mineral equilibria. If appreciable amounts of gypsum or anhydrite are present, calcium-sulfate waters are generated. Oil-field brines contaminating groundwaters produce sodium-chloride type waters, while stock and septic waste pollution increase chloride and nitrate concentrations.

To estimate total dissolved solids contents (in mg/L) for groundwaters in Marion County, multiply the specific conductance of the water (in $\mu\text{mho/cm}$ at 25°C) by 0.62 for specific conductances less than 1000, by 0.7 for conductances from 1000 to 2000, and by 0.8 for conductances greater than 2000 $\mu\text{mhos/cm}$. The approximate error is ± 15 percent in this method for groundwaters in the county.

Chloride concentrations can be measured relatively accurately in the field with a minimum of time and equipment. The sum of dissolved sulfate and nitrate concentrations can be estimated using the following graph based on the specific conductance and chloride measurements. Dissolved nitrate contents of waters can also be determined in the field. If this determination is made, the sulfate concentration of the water can be estimated by subtraction from the sulfate and nitrate sum obtained from the specific conductance versus chloride concentration graph.

Bicarbonate concentrations generally range from 300 to 450 mg/L in groundwaters in most aquifers in Marion County, but are lower (about 80 to 200 mg/L) for waters in the Kiowa Formation or in sediments associated with the Kiowa. The alkalinity of a water (expressed as mg/L CaCO_3) is 0.82 times the bicarbonate concentration. The dissolved sodium content of a water can be approximated from a plot of sodium versus chloride, while the hardness can be estimated from hardness isograms on a graph of sulfate versus chloride concentration.

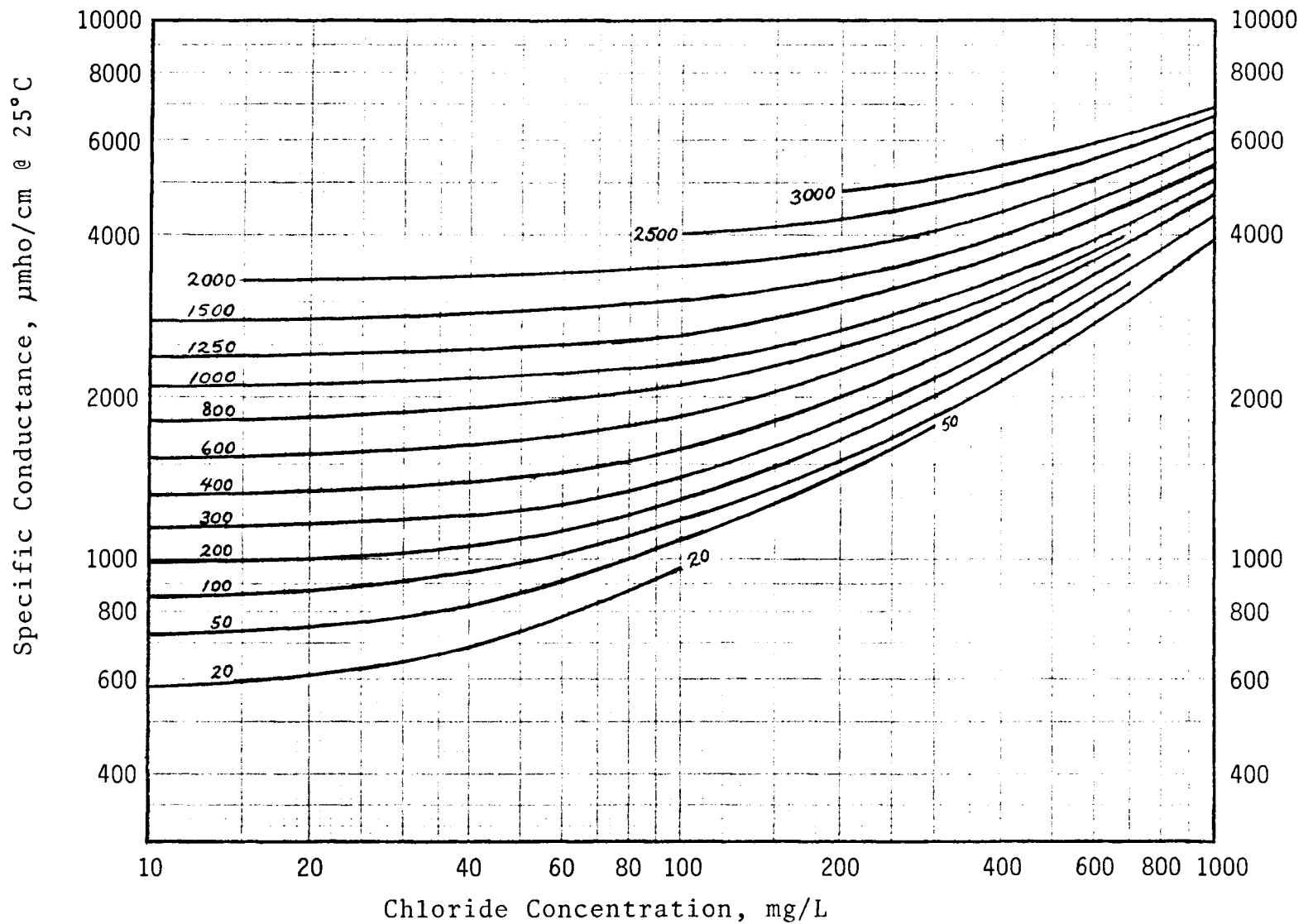


Figure 0: Contours of the Sum of Dissolved Sulfate and Nitrate Concentrations (mg/L) for Specific Conductance versus Chloride Concentration of Groundwaters in Marion County, Kansas. The graph is applicable to all groundwaters except those in the Kiowa Formation or in sediments associated with the Kiowa Formation. Add 400 to the specific conductance value of a water from Kiowa sediments for estimates using this graph. The maximum error in estimating the sulfate and nitrate sum for most groundwaters is approximately the difference between the two contour lines bracketing the specific conductance and chloride concentration for a given sample. For example, the sum of the dissolved sulfate and nitrate concentration would be about 350 ± 100 mg/L for a specific conductance of 1500 $\mu\text{mho/cm}$ and a chloride