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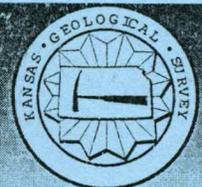
Rattlesnake Creek Conductivity Survey Stafford County, Kansas, May 1995

by

D.P. Young and J.M. Healey

Kansas Geological Survey Open-File Report 95-49c

GEOHYDROLOGY



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The Mineral Intrusion Project is a cooperative project between the Kansas Geological Survey and Big Bend Groundwater Management District No. 5, conducted with the support of the Kansas Water Office

As part of the Mineral Intrusion project, the specific conductance of surface water was measured in a five-mile stretch of Rattlesnake Creek on May 18, 1995. This conductivity survey accompanied an integrated ground conductivity survey in the Great Bend Prairie. Rattlesnake Creek flows through two of the sites surveyed for ground conductivity, the Witt site and the Seep site. Figure 1 shows locations of the surveyed areas. Results and interpretations of the ground conductivity survey are presented in reports by Rohs and Kruger (1995), Sleezer (1995), and Young (1995).

Saltwater from underlying Permian bedrock naturally intrudes into the eastern portion of the Great Bend Prairie aquifer. The saline water discharges locally to streams in the area (Whittemore, 1993). The water quality of Rattlesnake Creek is known to deteriorate about one mile east of Highway 281. This conductivity survey was conducted in an attempt to locate areas of major saltwater discharge to the stream.

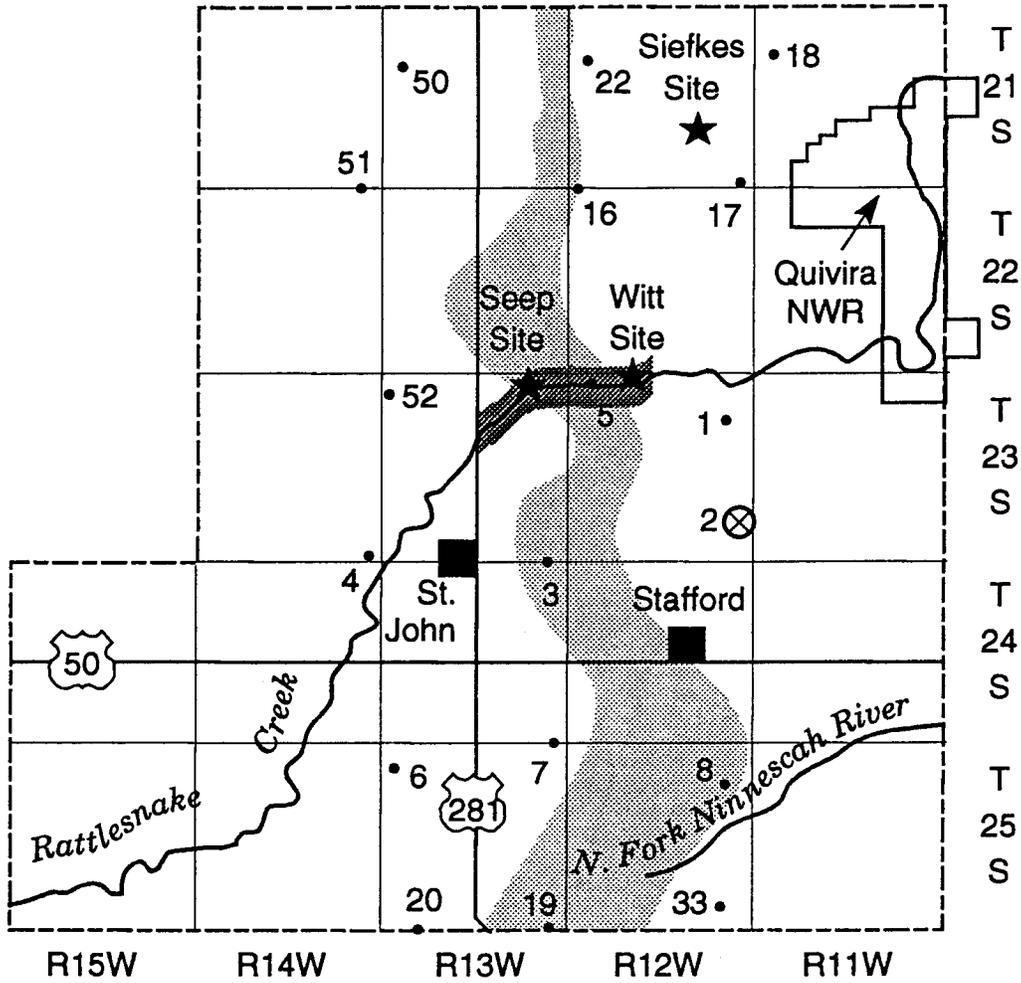
The period preceding the Rattlesnake Creek conductivity survey was marked by severe storms and major amounts of precipitation. As a result, stream levels were high and stream conductivities were reduced by dilution from freshwater runoff and seeps along the stream bank. However, along certain reaches of the creek, significant increases in specific conductance were evident, and reflected previous measurements by the Big Bend Groundwater District No. 5 (GMD5, 1992-1994 data), Bidleman (1983), and Stramel (1967).

Shown on Plate 1 are site locations and stations where specific conductance measurements were made. Approximate mile markers (corresponding to GMD5's) are circled and station numbers are underlined. Actual specific conductance values are shown on Plate 2, and are tabulated with additional description and notation in Table 1. Plates 1 and 2 are highlighted where actual or suspected saltwater intrusion occurs.

The largest increases in conductivity were observed along miles 2 and 3. Significant increases were also observed along mile 4. Little increase was observed along miles 1 and 5. In most stretches, conductivity increases were gradual. However, under drier conditions, this may not have been the case. Measurements were much lower than previous measurements because of dilution from the recent precipitation.

The most obvious abrupt rise in specific conductance was observed at a saltwater seep (labeled as "The Seep" in Plates 1 and 2), just downstream from mile marker 3 and the Seep site. Another seemingly significant increase occurred approximately 1000 ft upstream from the seep. Other potentially significant increases were observed in mile 4 at stations 2 and 5.

STAFFORD COUNTY



-  approximate subcrop area of Cedar Hills Sandstone
-  Surface EM Survey Area
-  Rattlesnake Creek Conductivity Survey Area
-  monitoring-well sites
-  plugged wells

Figure 1. Locations of conductivity survey areas and other physical features.

Except in vicinities with abrupt rises, the range of specific conductance values (0.68 to 1.60 mS/cm) corresponds to a chloride concentration range of approximately 90 to 350 mg/L (estimated from SpC vs Cl curve produced by D. O. Whittemore for the Great Bend Prairie). For comparison, a sample of Rattlesnake Creek water collected at the Witt Site on September 15, 1994 had a specific conductance of 10.2 mS/cm and a chloride concentration of 3,175 mg/L.

A water sample collected from "the seep" on August 11, 1994 had a specific conductance of 30.2 mS/cm, which is comparable to the measurement of 31.6 mS/cm in this survey, and a chloride concentration of 10,360 mg/L. A sample collected from Rattlesnake Creek just downstream from the seep on August 11, 1994 had a specific conductance of 5.76 mS/cm, which is much higher than the measurements in this survey, and a chloride concentration of 1,640 mg/L. Again, the lower stream conductivity measurements in this study are attributed to dilution from heavy precipitation.

The increase in conductivity begins (in mile 2) approximately one mile east of Highway 281, which roughly coincides with the western edge of the Permian subcrop area. The geohydrology of the area is discussed by Latta (1950), Fader and Stullken (1978), Cobb (1980), and Young (1992). In general, water quality in the Great Bend Prairie deteriorates east of Highway 281, or over the Permian subcrop. The rise in conductivity along miles 2, 3, and 4 is consistent with existing knowledge and with previous specific conductance and/or chloride measurements referenced above.

More specifically, miles 2, 3, and 4 overlie the Cedar Hills Sandstone subcrop area (Fader and Stullken, 1978, Plate 1). The Cedar Hills Sandstone is a relatively permeable Permian unit that may contribute highly mineralized water to the Great Bend Prairie aquifer where the two units are in contact.

The results of this survey suggest that the Cedar Hills Sandstone may be a significant source of saltwater to the aquifer and to Rattlesnake Creek. A few areas of potentially significant saltwater discharge to the stream have been identified. During drier and lower-flow conditions, abrupt rises would be more obvious and possibly detected more frequently.

Table 1. Specific conductance (SpC) values at each measuring station. The number before the hyphen represents the mile stretch and the number following the hyphen represents the station in that mile stretch.

Station	SpC (mS/cm)	Comments
Mile 1		
1-0	0.67	Virtually no increase in mile 1
Mile 2		
2-0	0.68	
2-1	0.68	
2-2	0.68	North bank
2-3	0.74	Small seep north bank
		Seep seems to be hotter; somewhat stagnant
	1.05	Just downstream from seep
2-4	0.85	Pool north side
2-5	1.20	Some flow out of hill (south bank); maybe stagnant
2-6	0.92	
2-7	3.0~	In cove north side
	1.2~	Middle of stream
2-8	1.08	Middle of stream
	1.09	North bank
Mile 3		
3-0	36.1	"The Seep" (north of stream)
	2.31	Creek at seep (north bank)
3-1	1.35	Creek (south bank)
	1.35	Creek (north bank)
3-2	1.34	Constant for a while
3-3	0.63	Paddled up tributary; red color
3-4	1.38	Just upstream from tributary
3-5	1.31	
3-6	0.45	Runoff from north
	1.25	North bank- creek diluted from runoff
		Probably higher in mid-stream
Mile 4		
4-1	1.33	Middle of stream
	1.46	South bank (stagnant?)
	1.27	North bank

(continued)

4-2	2.44~	Sand bar south bank
	1.5~	Sand bar north bank
	1.38	Middle; increases to 1.41 steady
4-3	1.33	Above inlet
	0.69	Inlet north bank
	1.43	Below inlet, middle of stream
4-4	1.47	At fence; steady
4-5	2.09	In inlet from south, kind of a tributary
4-6	1.51	
4-7	1.56	
4-8	1.57	
4-9	1.50	Wetland seep
	1.57	Downstream from seep
Mile 5		
5-0	1.57	Bridge
5-1	1.57	
5-2	1.64	Upstream from tributary
5-3	0.69	Tributary
	1.59	Below tributary
5-4	1.57	
5-5	1.57	Fence
5-6	1.57	
5-7	1.58	
5-8	1.59	
WITT	1.60	West EM survey line
WITT	1.60	East EM survey line

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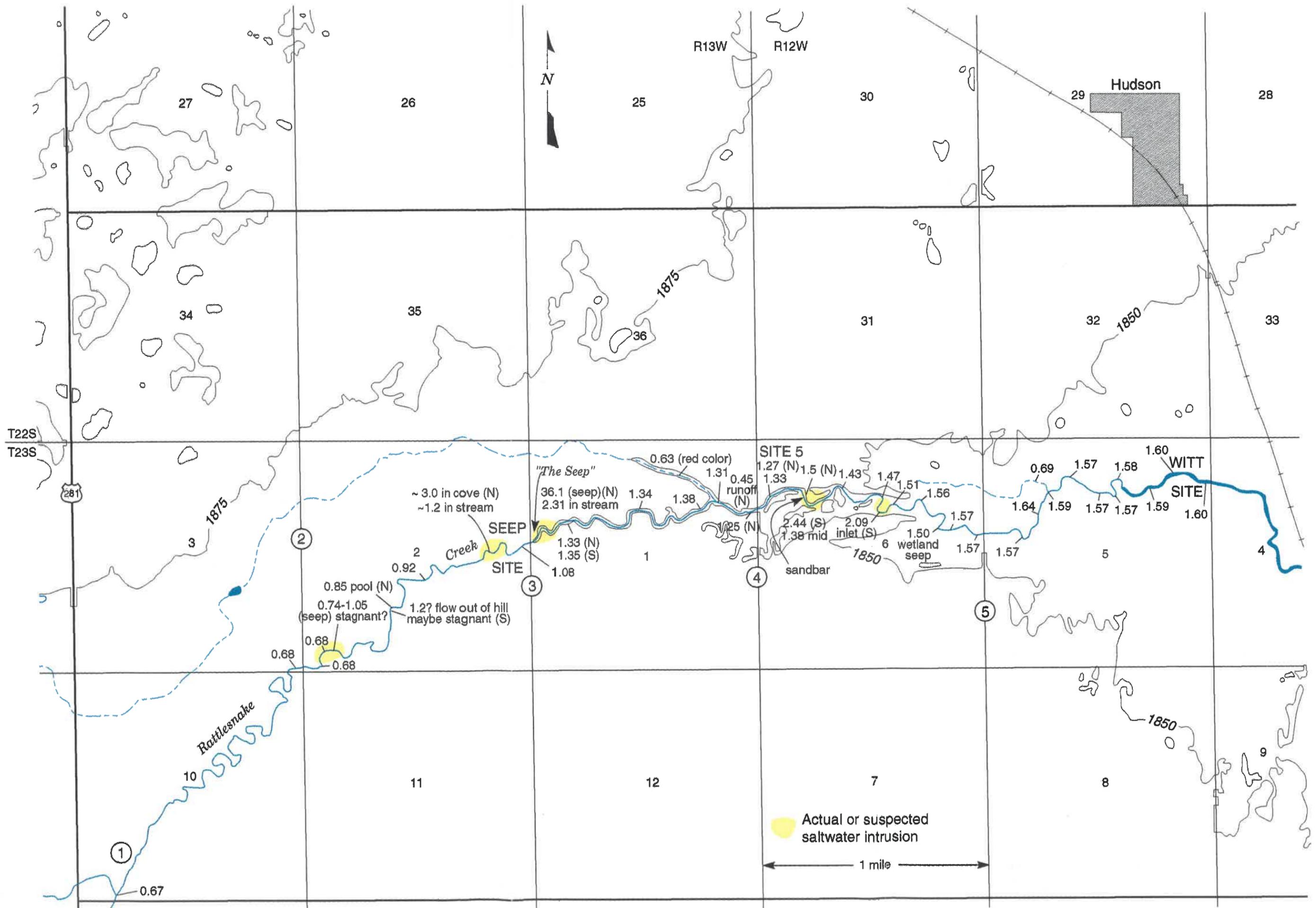


Plate 2. Rattlesnake Creek specific conductance measurements (mS/cm).

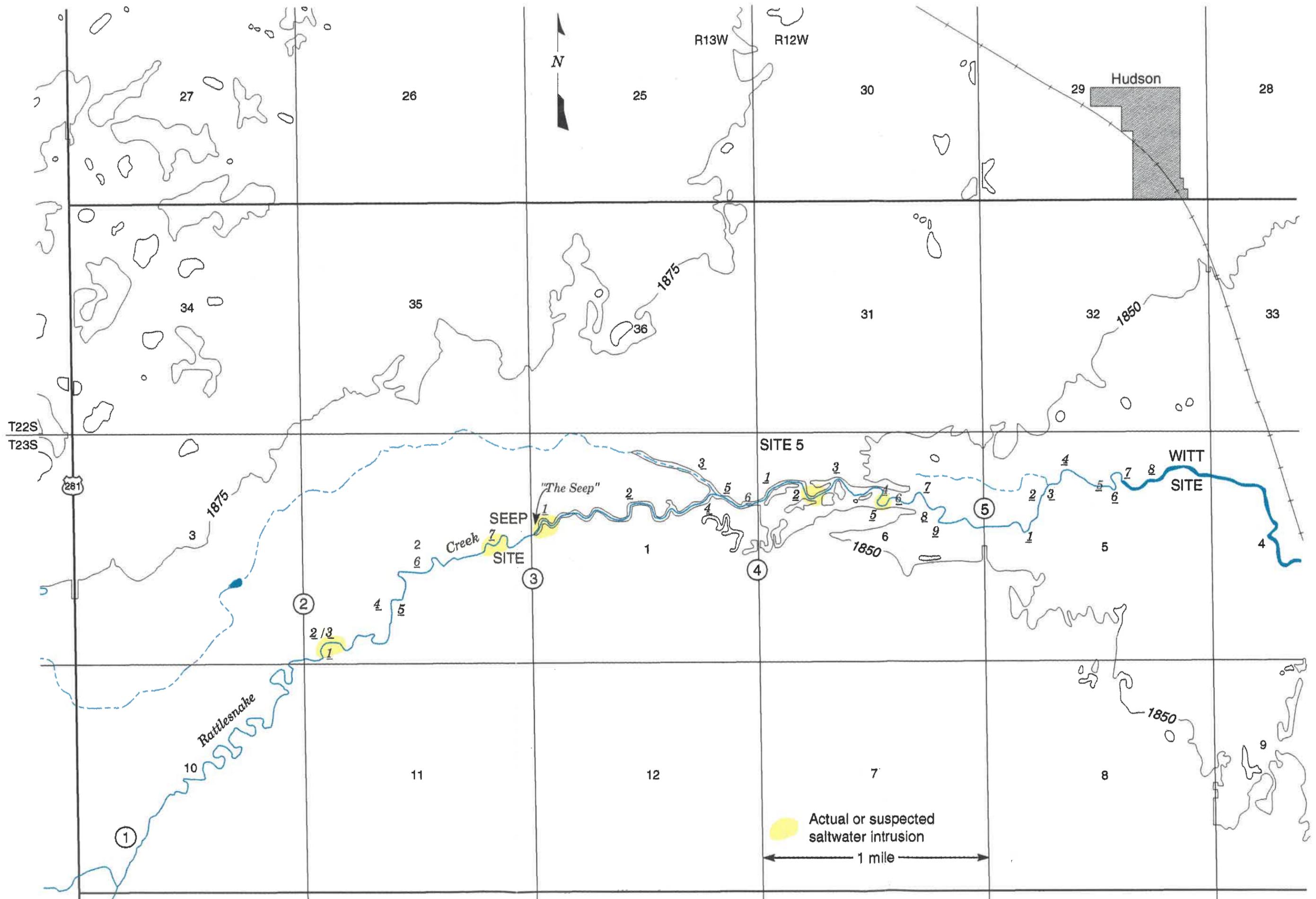


Plate 1. Rattlesnake Creek conductivity survey site locations.