1.72 Groundwater Hydrology Problem Set #3

DAVIS BASIN Due Oct. 19

The goal of this lab is to characterize and evaluate the hydrogeology of the Stanley N. Davis Basin. You have a rough map of the basin (rivers and outcrop boundaries) and some data gathered by your consulting firm. The map represents a portion of the basin which is filled with unconsolidated sediments. Impermeable granitic bedrock outcrops above the 1300 foot contour in the southwestern and northeastern parts of the map. This hot and arid region had an annual rainfall of less than six inches last year. The only continually flowing stream (perennial stream) is shown as a solid black line on the map; the dashed lines represent dry desert washes (ephemeral streams). With the data that the consultants have provided, you will characterize the aquifer(s) and map the groundwater flow pattern in the basin.

The following areas are irrigated by groundwater (refer to Appendix C for an explanation of coordinates):

5-4-24 through 5-4-36 5-5-1 through 5-5-36 5-6-7, 5-6-8, 5-6-9, 5-6-16, and 5-6-36 6-4-1 through 6-4-36 6-5-1 through 6-5-36 6-6-1 through 6-6-36

Irrigated fields and meadows are more or less uniformly distributed throughout this area. Only about one percent of the total irrigated area is actually irrigated during a particular year. All irrigation water comes from gravel-packed, large-diameter irrigation wells, which are pumped continuously through the six-month growing season and shut down for the other six months (April - Sept). You may neglect precipitation and evaporation from the map area.

THE DATA

The consultants took data from wells, test holes, bench marks, and river surface stations. There is a lot of information, so familiarize yourself with the data before starting the mapping.

Wells: Data are provided for domestic, stock, and irrigation wells. For each well you have the ground surface elevation (relative to msl) for the well, the depth of the well (depth below ground surface), and the water elevation (msl). You should make the following assumptions when analyzing the well data:

- 1) The irrigation wells are screened (i.e., open) over their entire length.
- 2) Domestic and stock wells are screened near their bottoms.
- 3) Water levels in all wells represent non-pumping conditions.

The location of all wells is marked on your map. There are a total of 23 domestic wells, 25 stock wells, and 5 irrigation wells. Look carefully at the irrigation well data before you decide to use it in constructing your hydrologic maps. The table of well data has been appended to this lab (Appendix A).

Streams: You have data from three stream gauge stations in the Davis Basin (Table 1). At these locations (also marked on your map) the flow rate in the stream (in cfs) has been measured monthly throughout the year. You also have a measurement of the average water level (msl) at each gauging station. These data should be useful in your interpretation of the groundwater regime. Remember that a stream (or portions of a stream) may be perennial or ephemeral. Use your interpretation of the stream/groundwater interaction to change the designation of the streams on the map, if necessary.

		Surface												
Station	location	Elevation (ft)	J	F	M	A	M	J	J	A	S	0	N	D
R1	4-3-18a	1,400	20	15	10	10	5	2	1	-	-	-	3	15
	5-4-16d	1,095	15	8	2	1	-	-	-	-	-	-	_	5
R3	6-6-30a	980	17	10	3	6	7	6	4	3	8	6	5	8

- indicates no stream flow in that month

Table 1: Stream Discharge (cfs)

Bench Marks: There are seven bench mark stations in the Davis Basin (Table 2). At these locations the USGS has kindly measured the ground surface elevation (relative to msl).

Station	Location	surface elevation (ft)
BM1	4-3-6b	1565
BM2	4-6-1a	1610
ВМ3	4-6-7c	1100
BM4	4-6-24a	1750
BM5	6-3-6c	1750
BM6	6-3-30d	2103
BM7	6-6-36a	985

Table 2: Bench Marks

<u>Driller's Logs of Test Holes</u>: Five test holes were bored in the Davis Basin to map the lithology of the area. For each hole, the driller has provided you with a boring log showing the type of unconsolidated deposit encountered with depth (also by elevation). The driller also measured the ground surface elevation at test hole locations. See Appendix B.

MAPPING

Your first task is to map the Davis Basin area. You will contour the ground surface elevation in the basin as well as the piezometric surface. Do not agonize over the contours! They should roughly (not precisely) show the surfaces.

- 1) Hand draw 100 foot contour lines of the ground surface elevation.
- Use the stream discharge data provided to determine which streams on the map are perennial and which are ephemeral. Alter the symbols on the map to comply with your assessment.
- 3) Map the piezometric surface of the aquifer(s) by drawing 10 foot contours. Use different colors to contour the ground surface, the water table, and any other piezometric surface(s). Remember to indicate the meaning of your color choices in the map legend.
- Label areas of natural recharge and discharge in the basin (i.e., recharge to and discharge from groundwater).
- 5) Indicate the direction of groundwater flow in the basin with arrows.

CROSS SECTION

Thus far you have examined the basin as a two-dimensional system. However, the driller's test logs provide some vertical information about the basin. Use the driller's logs information to create a geologic cross-section or fence diagram.

- 1) Draw a vertical cross-section of the basin lithology from the driller's logs.
- 2) Preserve the relative distances between adjacent holes.
- 3) Use the same symbols for each material as in the attached sample boring log.
- 4) Remember to show the trace of the cross-section on your map, and label the end points A-A'.
- Draw both the water table and any other piezometric surface(s) on your crosssection.

QUESTIONS

- 1) Describe the aquifer(s) number, distribution, thickness, lithology.
- 2) Where does the groundwater flow out of the map area?
- 3) How is the lithology of T1 different from that of the other boring logs?
- 4) Is the stream recharging or discharging the aquifers(s)?
- 5) Is the granite discharging water to the basin or is it being recharged by the basin?
- 6) Why are the water level data from the irrigation wells inconsistent with both the piezometric surface of the lower aquifer and the water table surface of the upper aquifer?
- 7) Describe the temporal nature of recharge to and discharge from the aquifer(s).
- Does the present irrigated acreage appear to suffer from a shortage of water? Support your answer.
- 9) Describe future aquifer conditions in the basin if irrigation practices continue unchanged.

Appendix A: Well Data

(from squiface) (from some level)?

Well Location			(dim datum) 1	Horn suchace y	(Troin sea level)?
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15 6-6-33a 975 (790)					980
	15	6-6-33a	975	(790)	665

Appendix B: Driller's Logs of Test Holes

				SAMPLE	
	Surface elevation (ft)	Depth of hole (ft)	7000		
TH1	1350	1200	DEPT.	7777777	T
TH2	1190	950		<i>`{/ </i>	TOP SOIL
TH3	1150	1000	10	Y	+
TH4	995	1000			1
TH5	985	800			4
	700				
TI	H1				1
0-10	top soil				ا درمی
10-150	gravel and sand				4
150-400	gravel				1
400-850	sand and fine gravel				1
850-900	sand		50		1
900-1200	gravel and sand		•		1
					SOUR
TI	I 2				3641
0-5	top soil				1
5-280	fine sand		75	1 1 2 2 2 3 4	l
280-295	clay		13	77:30	Ĭ
295-390	sand				GONEL
390-630	clay			0.0	GEOVEL AND SOND
630-950	sand and fine gravel			1-0; Q	1200 200
	-		100	~O. O.	1
TH	13			0000	Ť
0-5	top soil	,		6200	(-70.1h-
5-25	fine sand			0580	Gravel
25-150	sandy clay			33377	
150-790	clay		125	0000	
790-1000	fine sand				CLEM & SAND
TH			145	- The second of	}
0-5	top soil				FINE SOUD
5-40	sand		115	1 A. W.	111000000
40-125	clay		165		
125-130	sand				
130-650	clay				CIDIA
650-900 900-1000	fine sand		j		CLAY
900-1000	clay and sand				
TH	15		195		
0-10	top soil		140		}
10-50	sand and gravel				
50-90	clay				
90-120	fine sand				
120-690	clay				
690-800	fine sand				
	IIIO Jailu				

Appendix C: Map Locations

example: 4-3-21a

There are 12 Township designations in the basin

3	4	5	6
4-3	4-4	4-5	4-6
5-3	5-4	5-5	5-6
6-3	6-4	6-5	6-6

BASIN MAP

Each Township is divided into 36 sections

- 6	5	4	. 3	2	- 1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	4.21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

TOWNSHIP

Each section is further divided into 4 quarters

b	a s
а	d

SECTION