

BLACK SPRINGS GENERAL IMPROVEMENT DISTRICT
WELL REHABILITATION PROJECT

Completed by:

WASHOE COUNTY DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

April 1990

BACKGROUND

The Black Springs General Improvement District (BSGID) has three wells that are used to supply water to customers. Historically, the system has experienced numerous breakdowns and failures due primarily to lack of enough knowledge about the yields and performances of these wells to properly select and install pumping equipment. Additionally, well yields appear to deteriorate over time as a result of clogging of the well screens by incrustation. As yields decrease, the pumping equipment becomes overmatched for the well yield and problems associated with excessive drawdowns begin to appear.

At least two times in the past, declining well yields required reduction in flow rates from the wells by partially closing valves. This method essentially represents an inefficient stopgap measure that resulted in at least one line break due to high pressures.

GOALS

The primary goals of this project were:

1. To identify the construction characteristics of the "Gulch Well" and the "Tank Well" by running camera logs in each.
2. To rehabilitate well productivity in the "Gulch Well" and the "Tank Well" by scrubbing, bailing and swabbing.
3. To provide accurate baseline information on well performance for the "Gulch Well" and the "Tank Well" that could be used to assess future well performance.

The well rehabilitation and pump testing was completed by Carson Pump, 1401 N. Roop St., Carson City, Nevada, 89701. The work was completed in February and March of 1990.

RESULTS

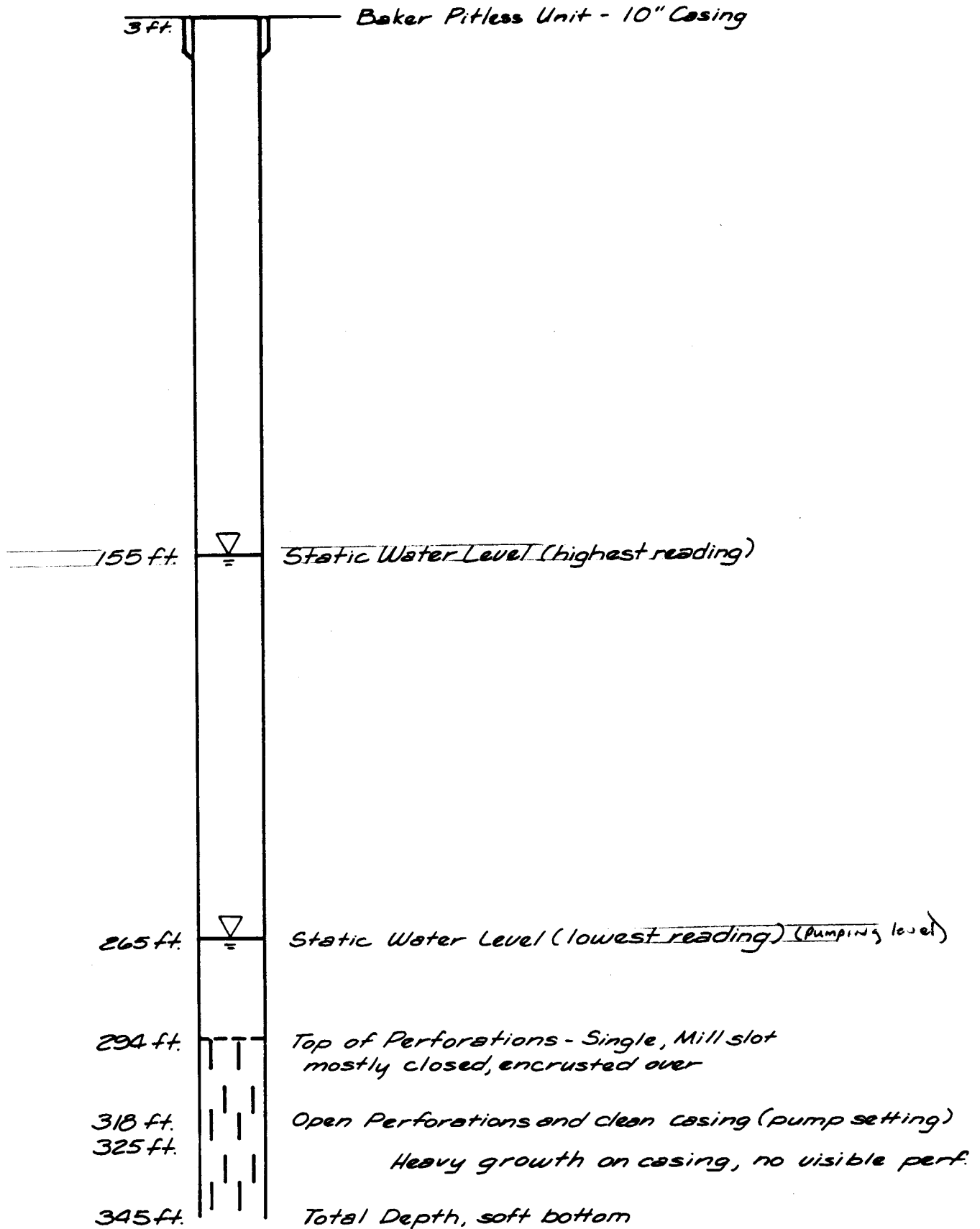
Camera Logs

Tank Well: Figure 1 is a sectional diagram detailing the findings of the camera log in the Tank Well. Generally the camera log showed the perforations were heavily encrusted except near the level of the pump intake.

Gulch Well: Figure 2 is a sectional diagram detailing the findings of the camera log in the Gulch Well. Carson Pump reported that the pitless adaptor in the Gulch Well is undersized for the well casing. The pitless is 6-inch diameter and the well casing may be either 8-inch or 10-inch diameter. The undersized pitless limits the pump size that may be installed in the well and also makes it more difficult to rehabilitate the well (a tool must be made that fits through the adaptor then expands sufficiently to scrub the casing walls during redevelopment).

BLACK SPRINGS TANK WELL VIDEO WELL SURVEY

2-12-90

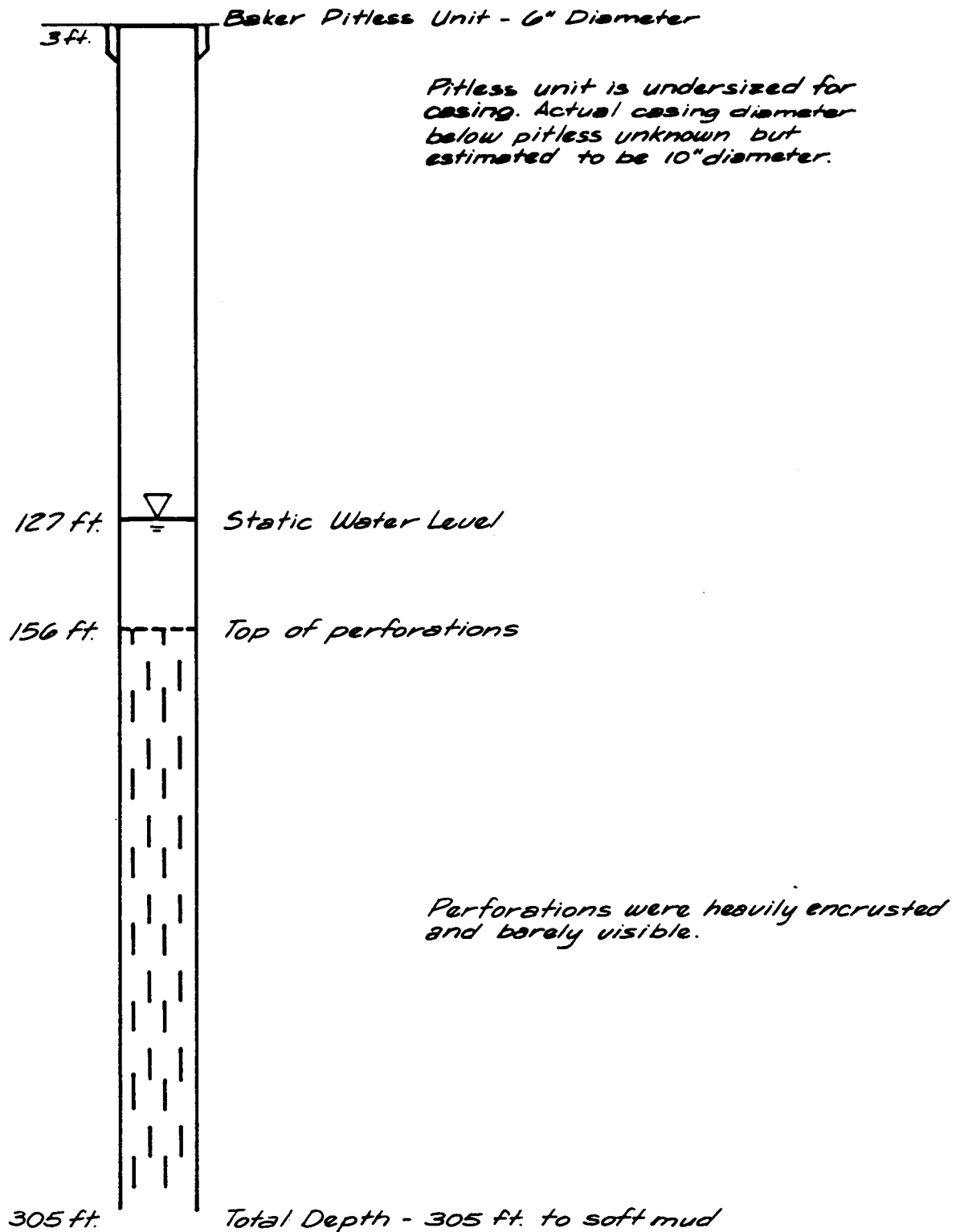


N.T.S.

FIGURE 1

BLACK SPRINGS GULCH WELL VIDEO WELL SURVEY

2-8-90



N.T.S.

FIGURE 2

The Washoe County Utility Division will retain copies of the camera logs for future reference. The original VHS video-cassettes are submitted to the Black Springs GID for their review and safekeeping.

Well Rehabilitation.

Tank Well: Based on well specific capacities collected by Washoe County, the specific capacity (gallons per minute per foot of drawdown) significantly improved as a result of well redevelopment. Specific capacities were as following:

1. Specific capacity at 100 minutes of pumping at 43 gallons per minute = 0.89 gallons per minute per ft.(May, 1986)
2. Specific capacity after unknown pumping time at 18 gallons per minute = 0.12 gallons per minute per ft.(Dec. 1989)
3. Specific capacity after 100 minutes of pumping at 31 gallons per minute = 0.96 gallons per minute per ft.(After well rehabilitation February 1990)

While the rehabilitation appears to have restored the well to 1986 performance, the well rehabilitation project provided data that indicate the Tank Well produces from a complex aquifer system. During the rehabilitation the contractor noted wide fluctuations in the static water level in the well, ranging from 155 ft. below land surface to 265 ft. below land surface. These wide fluctuations may be the result of one or more perched aquifers that contribute water to the well at various rates. The complexity of the aquifers is even more apparent considering the static water level remains at a higher elevation in the Gulch Well than in the Tank Well.

Presently, the well is equipped with a 2-hp. submersible pump which produced about 18 gallons per minute from a pumping level of 312 ft.(based on pumping levels before well rehabilitation) The pump intake is set at approximately 315 ft. With the increased specific yield, water levels should remain above the pump intake at the 18 gpm pumping rate.

Well Rehabilitation (Cont.)

Gulch Well: Washoe County does not have data on the historical performance of the Gulch Well. Because the well was unequipped at the time of this rehabilitation effort, we were unable to get a pre-rehabilitation specific capacity. However, the pump testing after well was rehabilitated provides detailed baseline performance for future reference.

Pumping Tests

Gulch Well: Data sheets, graphs and discharge data from the pumping test are included in the appendix. The specific capacity of the well after one day of pumping (1440 mins.) at 32 gallons per minute was 0.61 gallons per minute per foot of drawdown. Step tests were run at 10, 17, 23, and 29 gallons per minute for 120 minutes at each step. The step tests indicate the specific capacity of the well did not vary significantly at each step.

Tank Well: Data sheets, graphs and discharge data from the pumping test are included in the appendix. The specific capacity of the well after one day of pumping (1440 mins.) at 28 gallons per minute was 0.40 gallons per minute per foot of drawdown. Step tests were run at 12, 18, 24, and 32 gallons per minute for 120 minutes at each step. The step tests indicate the specific capacity of the well did not vary significantly at each step. The data from the 24 hour constant discharge test of the Tank Well showed water levels were still declining significantly at the end of the 24 hour pumping period. This indicates the specific capacity of the well will decrease significantly if the well is pumped continuously for long periods of time.

RECOMMENDATIONS

1. Equip the Gulch well to pump 25 gallons per minute with the pump intake set at 225 ft. Anticipated pumping levels at this rate will be about 170 ft. below ground surface. The additional submergence will provide a buffer when well performance begins to deteriorate again. Pump selection should be based on the necessary total head to pump to the tank without exceeding the 25 gpm recommended yield. Currently, we understand the water line from the Gulch Well to the tank is broken. However, based on the pumping tests, the Gulch Well is more reliable and a better producer than the Tank Well and the performance of the system would be improved if the Gulch Well were put on line again.
2. Leave the Tank Well as currently equipped, producing 18 gpm. With the improved performance the maximum anticipated pumping level at 18 gallons gpm should remain above the pump intake at 315 ft. However, as discussed earlier, the complexity of the producing aquifers and the extreme variations in static water levels in this well make the future performance of this well hard to predict.

3. Conduct performance tests on each well at least once a year, preferably near the same time of year. The performance tests may be conducted using the pumps in the wells (if the Gulch Well is equipped). Ideally, the wells should be turned off for at least 24 hours before conducting the test. The test would consist of measuring the static water level after the well has been off for 24 hours, then turning on the pump and measuring drawdowns in the well for 2 hours. The specific capacity after 2 hours could then be compared to the specific capacities determined during this well rehabilitation effort.
4. Monthly, record water levels in wells and pumping rates if pumping.

APPENDIX

1. Gulch Well-Step Drawdown data and graphs
Constant discharge data and graphs
2. Tank Well-Step Drawdown data and graphs
Constant discharge data and graphs

Black Springs Gulch well Step Test 3-28-90

46 6010

SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

K&E

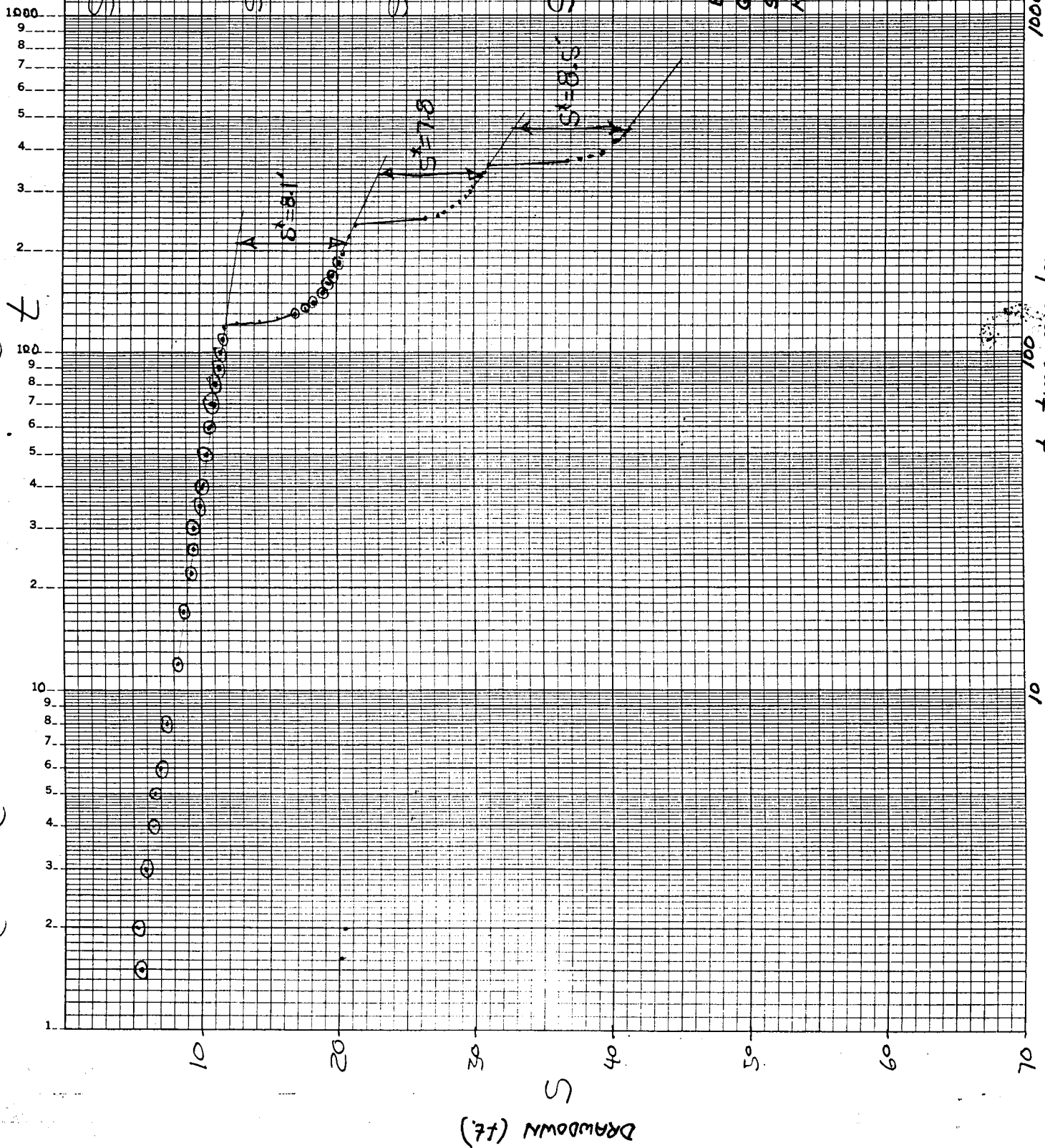
Step I $Q = 10 \text{ GPM}$
 $S_{100}/Q = 1.17 \text{ ft/GPM}$

STEP II $Q = 17 \text{ GPM}$
 $S_{100}/Q = 1.16 \text{ ft/GPM}$

Step III $Q = 23 \text{ GPM}$
 $S_{100}/Q = 1.20 \text{ ft/GPM}$

Step IV $Q = 29 \text{ GPM}$
 $S_{100}/Q = 1.24 \text{ ft/GPM}$

BLACK SPRINGS
GULCH WELL
STEP DRAWDOWN TEST
MARCH, 1990



AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date 3-28-90 Company performing test Carson Pump Measured by Pat Robertson
 Well No. Gulch Distance from pumping well @ Type of test Step Drawdown Test No. —
 Measuring equipment Orifice Pipe, drawdown meter in stilling well

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>3-28</u> Time <u>8:00</u> (h)		Static water level <u>127'</u>		How Q measured <u>2x1" or. pipe</u>		
Pump off: Date _____ Time _____ (h)		Measuring point <u>0.25' above CSG</u>		Depth of pump/air line <u>290'</u>		
Duration of aquifer test: _____		Elevation of measuring point _____		Previous pumping? Yes <u>Y</u> No _____		
Pumping _____	Recovery _____			Duration <u>180 min</u> End <u>10:30 3-27</u>		

Date	Clock time	Time since pump started		t/r	P.L. Water level measurement	Correction or Conversion	Water level	Water level change s or s'	h Discharge measurement	Rate	TEST PERFORMED BY CARSON RUMP CARSON CITY, NV
		t	t'								
3-28	8:00	0	—	—	127.9'			0	0		START STEP I
		1.5			133.5			5.6	8 1/2	10	Q = 8.02 KA √h
		2			133.1			5.2	8 1/4	10	8.02 KA = 3.68 for 2x1
		3			133.8			5.9			
		4			134.25			6.35			
		5			134.6			6.7			
		6			134.9			7.0	8 1/4	10	
		8			135.4			7.5			
		12			136.15			8.25			
		17			136.7			8.8	8 1/4	10	
		22			137.15			9.25			
		26			137.35			9.45			
		30			137.5			9.6	8 1/4	10	
		40			138.05			10.15	8	10	
		50			138.4			10.5	8	10	
	9:00	60			138.7			10.8	8	10	
		70			138.9			11.0	8	10	
		80			139.05			11.15	8	10	
		90			139.3			11.4	8	10	
		100			139.55			11.65	8	10	S/Q = 1.17 ft/GPM
		110			139.6			11.7			
	10:00	120			139.75			11.85	8	10	END STEP I / START STEP II
		122			140.25			12.85	22	17	
		123			141.65			13.25	22	17	
		124			142.45			14.35	22	17	
		126			143.65			15.25	22	17	
		128			144.25			16.35	22	17	
		130			144.9			17.0	22	17	
		135			145.25			17.85	22	17	

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date 3-28-90 Company performing test Carson Pump Measured by Pat Robertson
 Well No. Gulch Distance from pumping well @ Type of test Step Drawdown Test No. _____

Measuring equipment _____

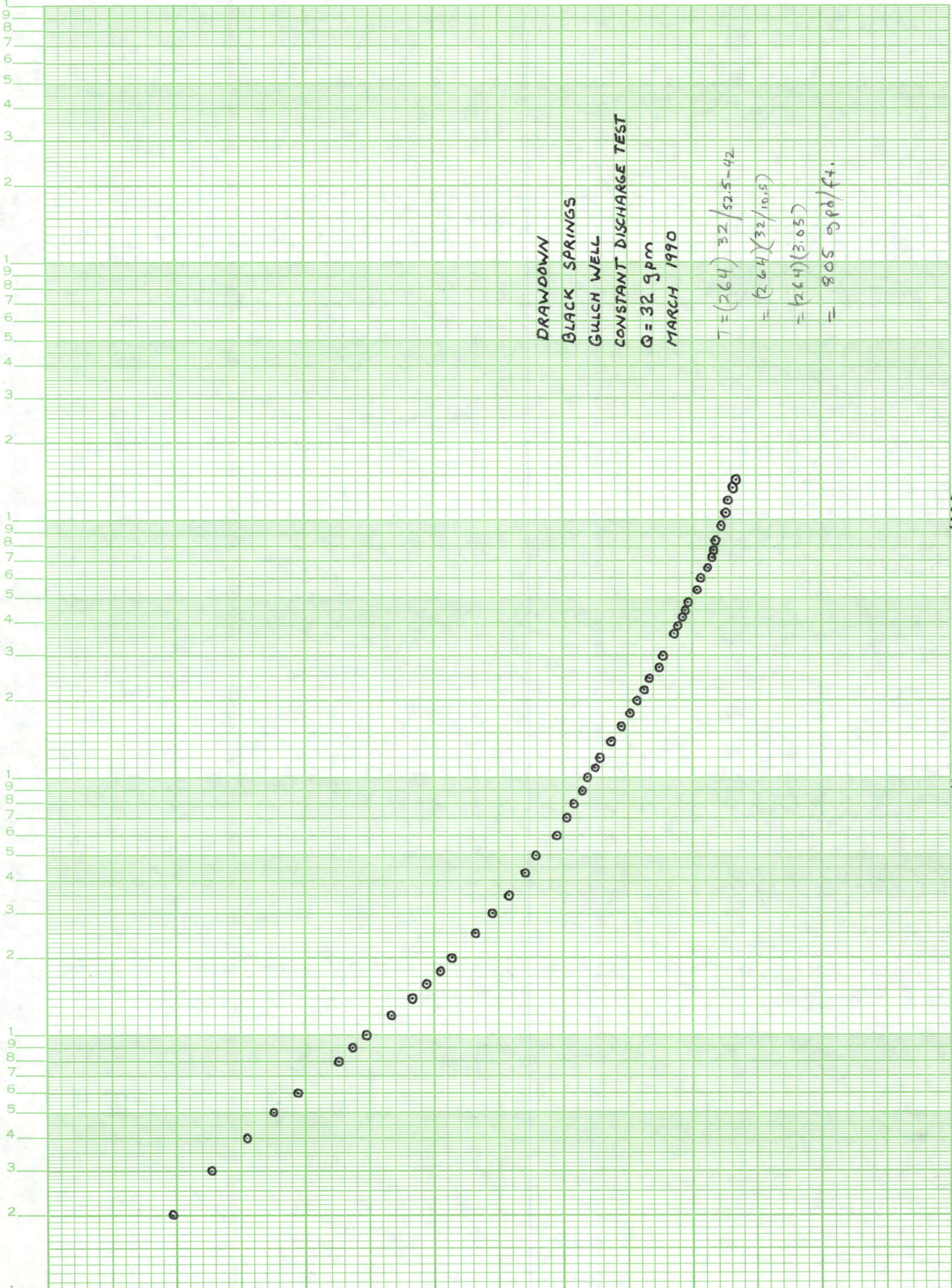
Time Data					Water Level Data					Discharge Data			Comments on factors affecting test data
Pump on: Date _____	Time _____	(%)	Pump off: Date _____	Time _____	(%)	Static water level _____	Measuring point _____	Elevation of measuring point _____	How Q measured _____	Depth of pump/air line _____	Previous pumping? Yes _____ No _____	Duration _____ End _____	
Duration of aquifer test: _____	Pumping _____	Recovery _____											
Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	P.L. Water level measurement	Correction or Conversion	Water level	S Water level change s or s'	H Discharge measurement	Q Rate			TEST PERFORMED BY CARSON PUMP CARSON CITY, NV
3-28	10:20	140	-	-	146.2	-		18 ³	22	17			
	10:30	150			146.9			19 ⁰	22	17			
	10:40	160			147 ³⁵			19 ⁴⁵	22	17			
	10:50	170			147.6			19.2	22	17			
	11:05	185			148.1			20 ²	22	17			
	11:15	195			148.3			20 ⁴	22	17			
	11:30	210			148 ⁶⁵			20 ⁷⁵	22	17			
	11:40	220			148.8			20.9	22	17			
	12:00	240			149.1			21 ²	22/40	17/23			$S_{100} = \frac{8.1 + 11.65}{17} = 1.16$
		241			150 ²			22 ²⁵	40	23			END STEP II / START STEP III
		242			151 ⁰			23 ¹	40	23			
		244			152 ³			24.4	40	23			
		246			153 ³⁵			25 ³⁵	40	23			
		250			154 ⁵			26.4	40	23			
		255			155 ¹			27 ²	40	23			
	12:20	260			155.6			27.7	40	23			
		270			156.3			28.4	40	23			
	12:40	280			156.8			28.9	40	23			
	12:50	290			157.2			29.3	40	23			
	13:00	300			157.5			29.6	40	23			
	13:10	310			157.2			29.8	40	23			
		320			158 ⁰⁵			30 ¹⁵	40	23			
		330			158 ³⁵			30 ⁴⁵	40	23			
		340			158 ⁶			30.2	40	23			
		360			158.7			31 ⁰	40/60	23/29			$S_{100} = \frac{7.8 + 19.75}{23} = 1.20$
		362			160.2			33 ⁰	60	29			END STEP III / START STEP IV
		364			162 ²⁵			34 ³⁵	60	29			
		366			163 ³⁵			35 ⁴⁵	60	29			
		370			164.2			36 ⁰	60	29			

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washington State NV
Date 3-28-90 Company performing test Corson Pump Measured by R. T. Roberts, Jr.
Well No. Gulch Distance from pumping well @ Type of test Step Drawdown Test No. _____

Measuring equipment

Time Data					Water Level Data				Discharge Data			Comments on factors affecting test data
Pump on: Date _____	Time _____ (h)	Pump off: Date _____	Time _____ (h)	Duration of aquifer test: _____	Static water level _____	Measuring point _____	Elevation of measuring point _____	How Q measured _____	Depth of pump/air line _____	Previous pumping? Yes _____ No _____	Duration _____ End _____	
Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	P.L. Water level measurement	Correction or Conversion	Water level	S Water level change s or s'	h Discharge measurement	Q Rate		TEST PERFORMED BY CARSON RUMP CARSON CITY, NV
3-28	14:15	375	-	-	165 ⁶⁵			37 ⁷⁵	60	29		Step IV - cont.
	14:20	380			166 ³			38 ⁴	60	29		
	14:30	390			167 ⁰⁵			39 ¹⁵	60	29		
	14:40	400			167 ⁴⁵			39 ⁵⁵	60	29		
	15:00	420			168 ⁴			40 ²	60	29		
	15:10	430			168 ³⁵			40 ²⁵	59 ¹	29		
	15:20	440			168 ²			40 ⁷	60	29		
	15:30	450			169 ⁰⁵			41 ¹⁵	60	29		
	15:40	460			169 ²⁵			41 ²⁵	60	29		Step IV - 8.5+27.55 = 1.24
	16:00	480			169 ⁵⁵			41 ⁶⁵	60	29		END STEP IV



100 t = time in minutes since pumping started

10

ft. = DRAWDOWN

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date 3-29-90 Company performing test Carson Pump Measured by Pat Robertson
 Well No. Gulch Distance from pumping well @ Type of test Const. Q Test No. _____
 Measuring equipment orifice pipe, drawdown meter in stilling well

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>3-29</u> Time <u>8:00</u> (h)	Static water level <u>~127'</u>	How Q measured <u>2 x 1/2 orifice pipe</u>				
Pump off: Date _____ Time _____ (h)	Measuring point <u>0.25' above csg.</u>	Depth of pump/air line <u>290'</u>				
Duration of aquifer test: _____	Elevation of measuring point _____	Previous pumping? Yes <u>X</u> No _____				
Pumping <u>24 hr.</u> Recovery _____		Duration <u>8 hr.</u> End <u>6:00 3-28</u>				

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	P.L. Water level measurement	Correction or Conversion	Water level	S Water level change s or s'	Discharge measurement	Q Rate		TEST PERFORMED BY CARSON PUMP CARSON CITY, NV
3-29	8:00	0	-	-	128 ²⁵			0	0	0		SWL
		1			134 ⁵			6 ²⁵	10	32 GPM		Q = 10.06 √h
		2			138 ⁰			9 ²⁵				
		3			141 ¹			12 ⁸⁵	10	32		
		4			143 ⁶⁵			15 ⁴⁰				
		5			145 ²⁵			17 ⁵⁰	10	32		
		6			147 ⁶			19 ³⁵				
		7			149 ⁴			21 ¹⁵	10	32		
		8			150 ⁸			22 ⁵⁵				
		9			152 ¹			23 ⁸⁵	10	32		
		10			153 ¹⁵			24 ⁹⁰				
		12			155 ⁰			26 ²⁵	10	32		
		14			156 ⁴⁵			28 ²⁰				
		16			157 ⁷			29 ⁴⁵	10	32		
		18			158 ⁷			30 ⁴⁵				
		20			159 ⁵⁵			31 ³	10	32		
		25			161 ³			33 ²⁵	9 3/4	~31.5		adjusted Q
	8:30	30			162 ⁸⁵			34 ⁶	10	32		
		35			163 ⁹⁵			35 ⁷⁰	10	32		
		43			165 ²⁵			37 ⁰	10	32		
		50			166 ¹⁵			37 ⁹	10	32		
	9:00	60			167 ⁷⁵			39 ⁵	10	32		adjusted Q
		70			168 ³⁵			40 ¹	10	32		
		80			168 ⁹⁵			40 ⁷	10	32		
	9:30	90			169 ⁶			41 ³⁵	10	32		
	9:40	100			170 ¹			41 ⁸⁵	10	32		S ₁₀₀ /Q = 1.31 +/G.F.P.
	9:50	110			170 ²			42 ⁴⁵	10	32		
	10:00	120			171 ²			42 ⁹⁵	10	32		
	10:20	140			172 ⁰			43 ²⁵	10	32		

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date 3-29-90 Company performing test Carsin Pump Measured by _____
 Well No. Gulch Distance from pumping well @ Type of test Const-Q Test No. _____

Measuring equipment _____

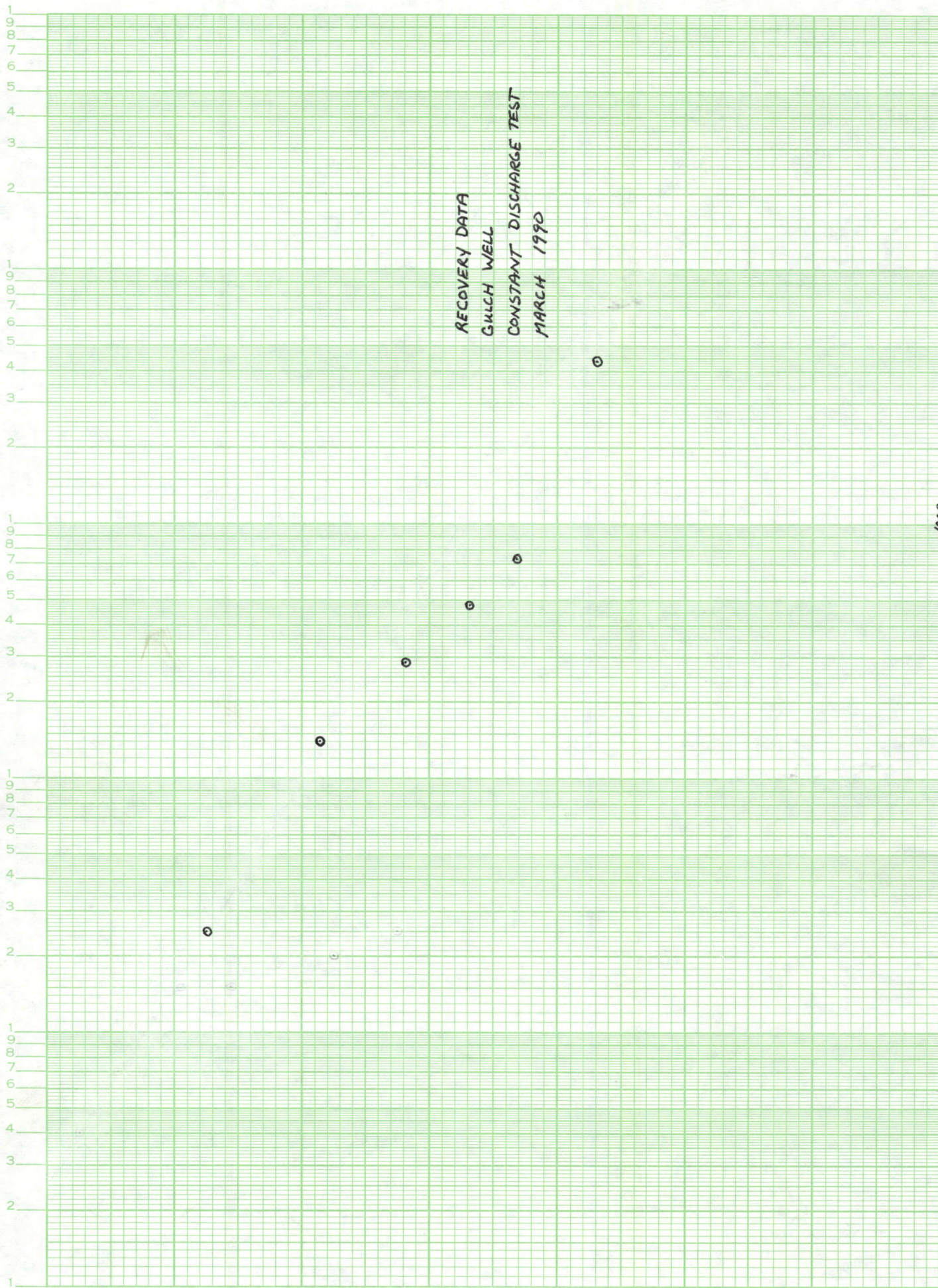
Time Data					Water Level Data				Discharge Data			Comments on factors affecting test data
Pump on: Date _____ Time _____ (t _o)					Static water level _____				How Q measured _____			
Pump off: Date _____ Time _____ (t _f)					Measuring point _____				Depth of pump/air line _____			
Duration of aquifer test: _____					Elevation of measuring point _____				Previous pumping? Yes _____ No _____			
Pumping _____ Recovery _____									Duration _____ End _____			
Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	P.L. Water level measurement	Correction or Conversion	Water level	S Water level change s or s'	H Discharge measurement	Q Rate		
	10:40	160	—	—	172.2			44.45	10	32		
	11:00	180			173.2			45.05	10	32		
	11:20	200			174.0			45.75	10	32		
	11:40	220			174.4			46.15	10	32		
	12:05	245			175.0			46.75	10	32		
	12:30	270			175.65			47.4	10	32		
	13:00	300			176.10			47.85	10	32		
	13:30	330			176.5			48.25	10	32		
	14:00	360			176.9			48.65	10	32		
	14:30	390			177.15			48.90	10	32		
	15:00	420			177.45			49.20	10	32		
	15:30	450			177.7			49.45	10	32		
	16:00	480			177.9			49.65	9 7/8			adjusted Q
	17:00	540			178.5			50.25	10	32		
	18:00	600			178.9			50.65	10	32		
	19:00	660			179.2			51.05	10	32		
	20:00	720			179.2			51.25	10	32		
	21:00	780			179.25			51.25	10	32		
	22:00	840			180.0			51.75	10	32		
	23:00	900			180.3			52.05				
	02:00	1080			180.8			52.55				
	04:00	1200			181.4			52.85				
	06:00	1320			181.3			53.05				
	08:00	1440			181.6			53.35				

RECOVERY DATA
GULCH WELL
CONSTANT DISCHARGE TEST
MARCH 1990

t/t' $t =$ time since pumping started
 $t' =$ time since pumping stopped

100

10



AQUIFER TEST DATA

Owner Bloak Springs Address _____ County _____ State _____
Date 3-23-90 Company performing test _____ Measured by _____
Well No. Gulch Distance from pumping well 0 Type of test Recovery data Test No. _____

Measuring equipment

[illegible]

BLACK SPRINGS - TANK WELL - STEP TEST - 2-21-90

46 6010

SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

K&E

10

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

5

4

3

2

1

9

8

7

6

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date 2-21-90 Company performing test Carson Pump Measured by Pat Robertson
 Well No. 1 - Tank Distance from pumping well @ Type of test Step Test No. P1/3
 Measuring equipment 2x1 & 2x1 1/2 orifice pipe

Time Data			Water Level Data			Discharge Data			Comments on factors affecting test data
Pump on: Date	<u>2-21</u>	Time <u>8:45</u> (t ₀)	Static water level	<u>204.1 *</u>		How Q measured	<u>orifice pipe</u>		
Pump off: Date		Time _____ (t ₁)	Measuring point	<u>TOP CSG</u>		Depth of pump/air line	<u>315</u>		
Duration of aquifer test:			Elevation of measuring point			Previous pumping? Yes <u>X</u> No _____			
Pumping	<u>8</u>	Recovery	<u>0</u>			Duration	<u>5</u>	End	<u>15:30 3/20</u>

											TEST PERFORMED BY	
											CARSON RUMP	
											CARSON CITY, NV	
Date	Clock time	Time since pump started	Time since pump stopped	t/t'	Water level measurement	Correction or Conversion	Water level	Water level change	Discharge measurement	Rate		
		t	t'					s or s'				
2-21	8:45	0	-	-	204.1	-		0	N/A	730 GPM	FILLING DROP PIPE	
		2			211.2			7.2	10"	12 GPM	2"x1" O.P.	
		4			211.67			7.57	10		STEP I	
		6			211.8			7.7	10			
		8			212.05			7.95	10			
		10			212.26			8.16	10			
		14			212.70			8.6	10			
	9:00	20			213.26			9.15	10	12		
		25			213.6			9.5	10			
		33			214.02			9.92	10			
		35			214.16			10.06	10			
		40			214.48			10.38	10			
		45			214.63			10.53	10			
		50			214.70			10.80	10			
	9:45	60			215.28			11.18	10	12		
		70			215.6			11.5	10	12		
	10:09	84			216.1			12.0				
	10:15	90			216.25			12.15				
	10:25	100			216.55			12.45			S/Q = 1.04 ft ³ /GPM	
	10:35	110			216.83			12.73				
	10:45	120			217.1			13.00	10/24	12/18	START STEP II	
		121			218.05			14.5	24	18 GPM		
		122			219.05			14.95				
		124			220.0			15.9				
		126			220.65			16.55				
	10:55	130			221.45			17.35				
	11:00	135			222.10			18.0				
		140			222.5			18.4				
		150			223.1			19.0				

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date 2-21-90 Company performing test Carson Pump Measured by Potter
 Well No. 1-Tank Distance from pumping well @ Type of test Step Test No. P2/B

Measuring equipment _____

Time Data					Water Level Data				Discharge Data			Comments on factors affecting test data
Pump on: Date _____	Time _____	(t ₀)	Pump off: Date _____	Time _____	(t _f)	Static water level _____	Measuring point _____	Elevation of measuring point _____	How Q measured _____	Depth of pump/air line _____	Previous pumping? Yes _____ No _____	
Duration of aquifer test: _____	Pumping _____	Recovery _____										
Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	Water level measurement	Correction or Conversion	Water level	Water level change s or s'	Discharge measurement	Rate		
2-21	11:25	160	—	—	223.2	—		19.6	24	18		TEST PERFORMED BY CARSON PUMP CARSON CITY, NV
	11:35	170			224.15			20.55	24	18		Step II cont.
	11:45	180			224.60			20.5				
	12:00	195			225.20			21.4				
	12:15	210			226.0			21.9				$S_{100}/Q = \frac{12.45 + 8.1}{18}$
	12:30	225			226.6			22.5	24	18		$= 1.14 \text{ ft/GPM}$
	12:45	240			227.1			23.0	24/42			START STEP III
	241				228.5			24.15	42	24		
	243				229.5			25.4	43	24		
	12:50	245			230.4			26.3				
	12:55	250			231.35			27.25	42	24		
	13:00	255			231.8			27.2				
	13:10	265			232.8			28.2				
	13:20	275			233.45			29.32				
	13:30	285			233.95			29.85				
	13:45	300			234.25			30.65				
	14:00	315			235.35			31.25				
	14:15	330			236.1			32.0				
	14:30	345			236.7			32.6	42	24		$S_{100}/Q = \frac{12.45 + 8.1 + 7.0}{24}$
	14:45	360			237.2				42/			$= 1.15$
	361				238.65				10"	32 GPM	2X1.5 orifice	START STEP IV
	363				240.1			36.0	10"	32		
	14:50	365			241.1			37.0	10"	32		
	14:55	370			242.1			38.0				
	15:00	375			242.7			38.8	9 3/4"	32		
	15:10	385			243.25			39.85				
	15:20	395			244.6			40.5				
	15:30	405			245.3			41.2	9 1/2"	31		
	15:40	415			245.25			41.55				

Owner Black Springs Address _____ County Washoe State NV
Date 2-21-90 Company performing test Carson Pump Measured by Pat R-
Well No. 1-Tank Distance from pumping well @ Type of test STEP Test No. P³

Time Data	Water Level Data	Discharge Data	Comments on factors affecting test data
Pump on: Date <u>2-21</u> Time <u>8:45</u> (t ₀) Pump off: Date <u>2-21</u> Time <u>16:45</u> (t ₁) Duration of aquifer test: Pumping <u>8.0</u> Recovery <u>0</u>	Static water level <u>204.1</u> * Measuring point <u>TOP CSG</u> Elevation of measuring point _____	How Q measured <u>orifice pipe</u> Depth of pump/air line <u>315</u> Previous pumping? Yes <u>X</u> No _____ Duration <u>3 hr</u> End <u>15:30</u>	

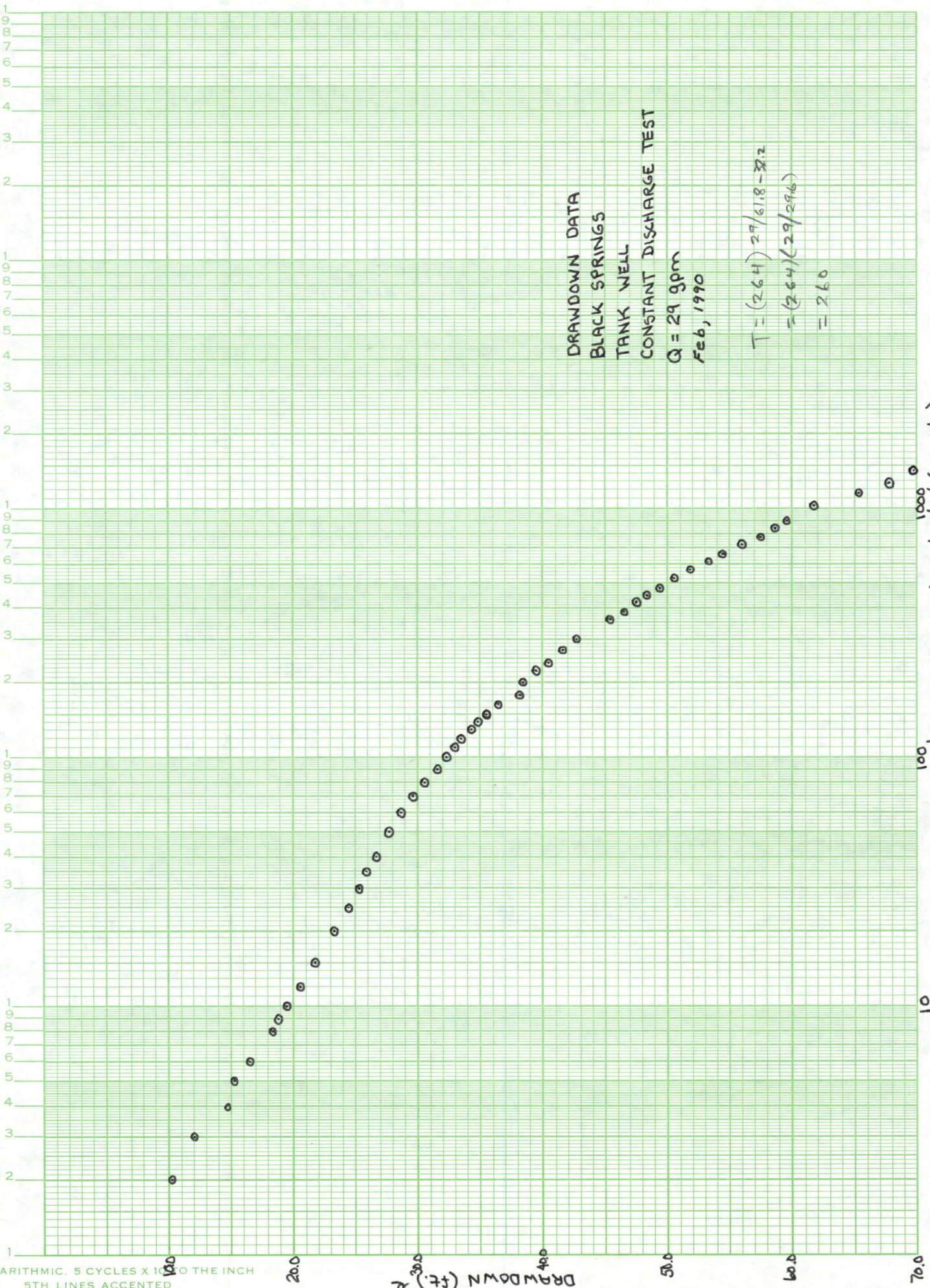
Date	Clock time	Time since pump started	Time since pump stopped	t/t'	Water level measurement	Correction or Conversion	Water level	Water level change	Discharge measurement	Rate	
		t	t'					s or s'			
	15:30	425	—	—	246 ³⁵	—		42 ³⁵	9½"	31	STEP IV CONT.
	16:05	440			247 ¹			43 ⁰	9½"	31	
	16:15	450			247 ⁶³			43 ⁵³	9½"	31	
	16:25	460			248 ⁰⁵			43 ²⁵	9½"	31	$\frac{S_{100}}{a} = \frac{12.45 + 8.1 + 7.07 + 8.1}{31}$
	16:35	470			248 ⁵			44 ⁴	9½"	31	= 1.15
	16:45	480			249			44 ⁹	9½"	31	END STEP TEST
										</	

DRAWDOWN DATA
BLACK SPRINGS
TANK WELL
CONSTANT DISCHARGE TEST
Q = 29 gpm
Feb, 1990

$$T = (264) \frac{29}{61.8 - 31.2}$$

$$= (264) \left(\frac{29}{29.6} \right)$$

$$= 260$$



t = time since pumping started (minutes)

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date Feb. 22, 1990 Company performing test Carson Pump Measured by Pat Robertson
 Well No. 1 - Tank Distance from pumping well @ Type of test Constant Rate Test No. P1/2
 Measuring equipment 2x1 1/2 orifice pipe

Time Data Pump on: Date <u>2/22</u> Time <u>9:00</u> (h) (m) Pump off: Date _____ Time _____ (h) (m) Duration of aquifer test: _____ Pumping _____ Recovery _____	Water Level Data Static water level <u>209.25</u> * Measuring point <u>TOP CSG</u> Elevation of measuring point _____	Discharge Data How Q measured <u>2x1 1/2 o.p.</u> Depth of pump/air line <u>315</u> Previous pumping? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Duration <u>8</u> End <u>2/21 16:45</u>	Comments on factors affecting test data
--	---	--	---

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	Water level measurement	Correction or Conversion	Water level	Water level change s or s'	h	Discharge measurement	Q = $8.02KA \times \sqrt{h}$ Rate	TEST PERFORMED BY CARSON PUMP CARSON CITY, NV
2/22	9:00	0			209.25							SWL * recovering
		1										(Highest SWL = 201.28'
		2			219.2			10.2	9 1/2"	31 GPM	2x1 1/2"	recorded 2-20-90)
		3			221.2			12.0		8.02KA = 10.06		
		4			223.5			14.9				
		5			224.8			15.2				
		6			226.5			16.4	9 1/2"	31		
		7			227.1			17.4				
		8			228.0			18.3				
		9			228.65			18.9	9 1/2"	31		
		10			229.20			19.5				
	9:15	12			230.20			20.5				
		15			231.5			21.8				
		20			232.95			23.2	9 1/2"	31		
		25			234.15			24.4				
		30			234.9			25.2				
		35			235.6			25.9				
		40			236.4			26.7				
		50			237.53			27.8				
	10:00	60			238.5			28.8	9 1/2"			
		70			239.4			29.7				
	10:20	80			240.25			30.5	9 3/8"	31		OPENED VALVE
		90			241.33			31.6	9 3/4"			MANO. FROZEN, THAWED
		100			241.96			32.2	9 1/2"			& reset Q to 9 1/2"
		110			242.68			33.0				S ₁₀₀ /Q = 1.04 ft/GPM
	11:00	120			243.17			33.4				
		130			244.0			34.3				
		140			244.65			34.9				
		150			245.35			35.5				

AQUIFER TEST DATA

Owner Black Springs Address _____ County Washoe State NV
 Date Feb. 22, 1990 Company performing test Carson Pump Measured by Rt R
 Well No. 1 - Tank Distance from pumping well @ Type of test Constant Rate Test No. P212

Measuring equipment _____

Time Data				Water Level Data				Discharge Data				Comments on factors affecting test data	
Pump on: Date _____ Time _____ (t ₀)				Static water level <u>209.75</u>				How Q measured _____					
Pump off: Date _____ Time _____ (t _f)				Measuring point _____				Depth of pump/air line _____					
Duration of aquifer test: _____				Elevation of measuring point _____				Previous pumping? Yes _____ No _____					
Pumping _____ Recovery _____								Duration _____ End _____					

												TEST PERFORMED BY
												CARSON PUMP
												CARSON CITY, NV
Date	Clock time	Time since pump started	Time since pump stopped	t/t'	Water level measurement	Correction or Conversion	Water level	Water level change	Discharge measurement	Rate		
		t	t'					s or s'				
2/22	11:45	165	-	-	246 ¹⁵			36 ⁴	9 ¹ / ₂ "	31		
	12:00	180			247 ⁸⁵			38 ^L	9 ³ / ₈			
	12:20	200			248 ⁰			38 ⁵	9 ³ / ₈			
	12:43	223			249 ²³			39 ⁵	9 ³ / ₈			
	13:00	240			250 ⁰			40 ³	9 ³ / ₈	31		
	13:30	270			251 ³⁵			41 ⁶	9 ¹ / ₄	31		
	14:00	300			252 ⁰⁰			42 ⁸	9 ¹ / ₄			
	14:30	330			253 ²			44 ²	9 ¹ / ₄			
	15:00	360			255 ²⁵			45 ³				
	15:30	390			256 ¹			46 ⁴	9 ¹ / ₄			
	16:00	420			257 ¹⁵			47 ⁴	9 ¹ / ₄	31		
	16:30	450			258 ¹			48 ⁴	9	30		
	17:00	480			259 ⁰⁵			49 ³				
	17:45	525			260.25			50.50				
	18:30	570			261.67			51.92				
	19:15	615			263.07			53.32	9	30		
	20:00	660			264.07			54.32				
	21:00	720			265.75			56.0	8 ³ / ₄			
	22:00	780			267.10			57.35				
	23:00	840			268.58			58.83	8 ¹ / ₂	29		
	24:00	900			269.49			59.74				
2/23	02:05	1025			272.46			62.71	8 ³ / ₈			
	04:20	1160			275.01			65.26				
	06:30	1290			277.46			67.71	8 ¹ / ₄			
2/23	09:00	1440			279 ⁰⁵			69 ²	8	28		END OF TEST

RECOVERY DATA
BLACK SPRINGS
TANK WELL
CONSTANT DISCHARGE TEST
FEB 1990

t = time since pumping started (minutes)
 t/t' t' = time since pumping stopped (minutes)

t = time since pumping started (minutes)
 t/t' t' = time since pumping stopped (minutes)

AQUIFER TEST DATA

Owner Black Spring Address _____ County _____ State _____Date 2-23-90 Company performing test Carson Pump Measured by Rat RobertsonWell No. 1 - Tank Distance from pumping well @ Type of test Residual Drawdown Test No. _____

Measuring equipment _____

Time Data				Water Level Data				Discharge Data				Comments on factors affecting test data
Pump on: Date _____	Time _____ (t ₀)			Static water level <u>209.0</u>				How Q measured _____				
Pump off: Date _____	Time _____ (t _f)			Measuring point _____				Depth of pump/air line _____				
Duration of aquifer test:				Elevation of measuring point _____				Previous pumping? Yes _____ No _____				
Pumping _____ Recovery _____								Duration _____ End _____				

Date	Clock time	Time since pump started		t/r	Water level measurement	Correction or Conversion	Water level	Water level change s or s'	Discharge measurement	Rate		TEST PERFORMED BY CARSON PUMP CARSON CITY, NV
		t	r									
2/23	9:00	1440	0	00					0	0		Pumping Stopped
			.5	2801	273.8			64L				
			1	1441	268.85			59L				
			2	721	268.35			55.6				
			3	481	268.85			54.1				
		1444	4	361	263.5			53.8				
		1445	5	289	263.0			53.3				
		1446	6	241	262.5			52.8				
		1447	7	207	262.0			52.3				
		1448	8	181	261.2			52.0				
		1449	9	161	261.0			51.5				
		1450	10	145	261.0			51.3				
		1455	15	97	259.35			49.8				
		1460	20	73	258.35			49.0				
		1470	30	49	257.55			47.8				
		1480	40	37	256.85			47.4				
		1490	50	298	256.15			46.4				
		1500	60	25	255.83			46.4				
2/23	11:00	1560	120	13	253.8			44.4				Added 2901 C1-42901 t
	13:00	1680	240	7	250.35			40.8				Pulling Test Pump
	14:10	1750	310	5.67	249.0			39.3				