AP - 062

REPORT

11/20/2007

AP062

R. T. HICKS CONSULTANTS, LTD.
901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

November 20, 2007

Glenn Von Gonten
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
Via E-mail

RE: Samson Livestock "30" Reserve Pit, T21S, R35E, Section 30, Unit P;
NMOCD Case # Unassigned

Dear Mr. von Gonten,

We attach what we call a "Final Abatement Report". This report:

- Describes the magnitude and extent of ground water impairment at the site
- Presents data supporting the efficacy of the vadose zone remedy and
- Proposes to cease the pump-and-dispose source control strategy in favor of a long-term pump-and-use ground water remedy

We are conducting the final ground water sampling event of 2007 within the next two weeks. Dale Littlejohn will apprise NMOCD Hobbs of the exact date of sampling.

Sincerely,
R.T. Hicks Consultants, Ltd.

Randall Hicks
Principal

Copy: Hobbs NMOCD office;
Scott Rose, Samson Resources
Merchants Livestock Company

Samson Livestock "30"
Reserve Pit
Final Abatement Report
NMOCD Case # Unassigned

R. T. Hicks Consultants
November 20, 2007

Location: T-21-S, R-35-E, Sec 30, Unit P
Latitude: North 32° 26' 41.2"
Longitude: West 103° 24' 6.9"
NMOCD#: Unassigned

1 Executive Summary

The Samson Livestock "30" site, which is operated by Samson Resources Company (Samson), is located approximately 16 miles west of Eunice, New Mexico (Plate 1). The purpose of this Final Abatement Report is to:

- Define the magnitude and extent of ground water impairment at the site,
- Evaluate the efficacy of the ground water pumping (source removal) program and
- Provide a recommendation for the final Stage 2 Abatement Plan (aquifer restoration)

This report is consistent with the commitments made in the June 2006 Corrective Action Plan, September 2006 Stage 1/Stage 2 Abatement Report, and Progress reports submitted in December 2006, May 2007, and August 2007.

2 Work Elements Performed

Appendix A presents the chronology of salient events at the site followed by a brief description of characterization and corrective action activities that are summarized in this report. All lithologic and well logs are in Appendix B.

Since July 2007, site activities included:

1. Drilling the well clusters at MW-4 and MW-5
2. Re-habilitation of MW-3d to remove accumulated silt in the casing
3. Sampling of all wells

3 Conclusions

3.1 The ET Barrier is Effective

The soil boring program conducted by Ocotillo in 2005 (Plate 2 and Table 1) indicate that the brine-impacted soil is limited to the area immediately below the reserve former pit with the greatest concentrations observed below the southeast half. All of this impacted area lies below the ET Barrier.

Visual inspection of precipitation run-off from the ET barrier following a precipitation event indicate that the infiltration barrier is effective at shedding precipitation and restricting infiltration. Soil moisture monitoring demonstrates that the moisture content within the ET Barrier is very low and has declined over time. As shown in Table 1, moisture content of the gypsum blocks were uniformly 80 (an electrical resistance of about 500 ohms) for the first reading. A meter reading of 80 translates into nearly 100% saturation, which due to the fact that these instruments must be set in a saturated slurry of silica flour. Within three months of installation, readings from the upper 5-feet of the ET Barrier were 1 (about 162,000 ohms of resistance). Because the ET barrier is comprised of loam textured material, a meter reading of 1 corresponds to water content of about 8% of dry weight. At a depth of 9 feet, the meter reading of 7 translates into a water content of 15-20% of dry weight. We expect the lower portions of the ET barrier to dry more slowly than the upper portion because the upper portion of the barrier is affected by evaporation to a larger extent.

	ET Cover Monitoring Port		
Vadose Zone Measurement Date	No. 1 West 2.8-foot	No.2 Center 5-foot	No. 3 East 9-foot
4/17/07	80	81	80
5/1/07	7	15	17
5/21/07	3	10	9
7/18/07	1	1	7
8/9/07	1	1	7

3.2 The Magnitude and Extent of Ground Water Impairment Is Defined

As Plate 3 and Plate 4 show, the chloride concentration in the upper portion of the aquifer is about 25% of the chloride concentrations in the lower zone. As a result of this difference in water chemistry, the magnitude and extent of impairment in the upper ground water zone is less than the lower zone.

The results of the most recent ground water monitoring define the magnitude and extent of the dissolved chloride-impacted ground water within the deeper portion of the aquifer (Plate 3). Ground water down gradient (southeast) of the production pad and southwest of the production pad are at background concentrations with respect to chloride and TDS. Northeast of the production pad and former pit, data MW-2 permit us to conclude that ground water is not impaired within this quadrant of the site and may be at background concentrations. All ground

water impairment is restricted to the area of the former pit and the existing production pad, which we believe is an area of about 400-feet wide by 400-feet long.

3.3 Down Gradient Migration of Impaired Ground Water Is About 10 Feet/Century

Regionally, the hydraulic gradient in the area is 0.0006 to the southeast (Plate 5). At the site, the potentiometric surface slopes to the southeast with a hydraulic gradient of 0.0012 (Plate 6). Lithologic logs of the wells and water level recovery of the 4-inch wells after sampling or after long-term source removal pumping demonstrates that the hydraulic conductivity of the lower portion of the ground water zone is consistent with a fine-grained sand plus silt (about 0.06 ft/day). Recovery of wells completed in the upper portion of the aquifer suggests a slightly higher hydraulic conductivity in this zone. Nevertheless, the hydraulic conductivity of the ground water zone beneath the site is relatively low. The low hydraulic conductivity of the ground water zones combined with the nearly flat hydraulic gradient (0.0012) will cause ground water to move very slowly to the southeast. The calculated average linear velocity for chloride in the lower zone (assuming a porosity of 0.3) is about 10 feet in 100 years. If we use the regional gradient in the calculation, the rate of chloride movement in the lower zone of the aquifer is less than 5 feet per century.

3.4 Source Removal Pumping is Ineffective

Although pumping the lower portion of the aquifer is removing the chloride and TDS mass, the 2 gpm pumping rate that the aquifer can yield is providing little measurable short-term benefit (Figures 1 and 2). Moreover continued disposal of the impacted ground water as a source-removal measure is a waste of the resource.

Figure 1
Near Top of Aquifer
Cl & TDS vs Pump Volume

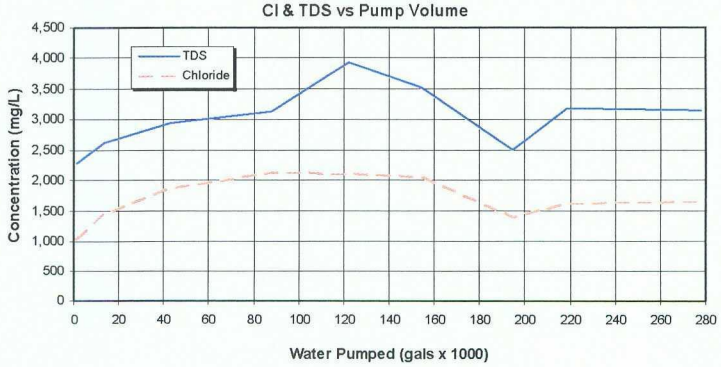
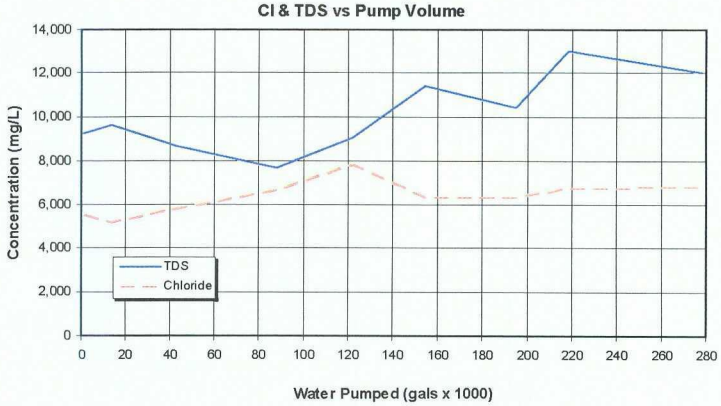


Figure 2
Near Base of Aquifer
Cl & TDS vs Pump Volume



Because ground water in the lower zone moves at a rate of about 10 feet/century, we conclude that fresh water outside of the existing 3-4 acre area of impairment is not materially

threatened. Source removal pumping to protect fresh water is not required.

3.5 A Pump and Use Remedy Provides the Highest Benefit

Because fresh water quality in the upper zone of the aquifer is satisfactory for mature cattle at all wells except MW-3s, we conclude that a long-term natural restoration strategy is sufficient to complete the mitigation process of this portion of the aquifer.

Fresh water is protected by pumping impaired ground water from MW-3d and/or MW-1d at a rate that is greater than the Darcy flux across the property. The Darcy flux is:

Q=	KA dh/dl	
Q=	0.576	ft3/day
Q=	4.3	gal/day
Q=	1573	gal/year
Where		
K=	0.06	ft/day
dh/dl	0.0012	
Thickness	20	feet
Width	400	feet

Obviously a ground water abatement strategy that withdraws and uses about 2-5 water truck loads per year (10,000 – 30,000 gallons/year) is significantly greater than the minimum withdrawal rate required to protect fresh water.

Over time, on-demand pumping will remove all of the ground water from the 20-foot thick lower ground water zone that exhibits a salinity that is unacceptable for consumption by mature cattle. Below the 400-foot wide by 400-foot long estimated zone of impairment, the total volume of water impaired above the quality required for mature cattle is:

Volume=	7,180,800.00	gallons
Where		
Thickness	20	feet
Width	400	feet
Length	400	feet
Porosity	0.3	

A strategy that uses pumped water for road maintenance/dust suppression and/or drilling fluid make-up water might use 50 truck loads per year. At this rate, beneficial use removes the 7 million gallons of impaired ground water in about 25 years. At a usage rate equal to the ground water production rate of 4 gpm (2 gpm from MW-3d and 2 gpm from MW-1d), the time

required to remove the 7 million gallons is about 3.5 years. Appendix C presents an analysis showing that the application of water with a chloride at an application rate of 0.25 kg/m^2 will not, with reasonable probability, impair ground water quality in this area. A loading rate of 0.25 kg/m^2 is equivalent to four applications of ¼ inch of water that contains 10,000 mg/L chloride.

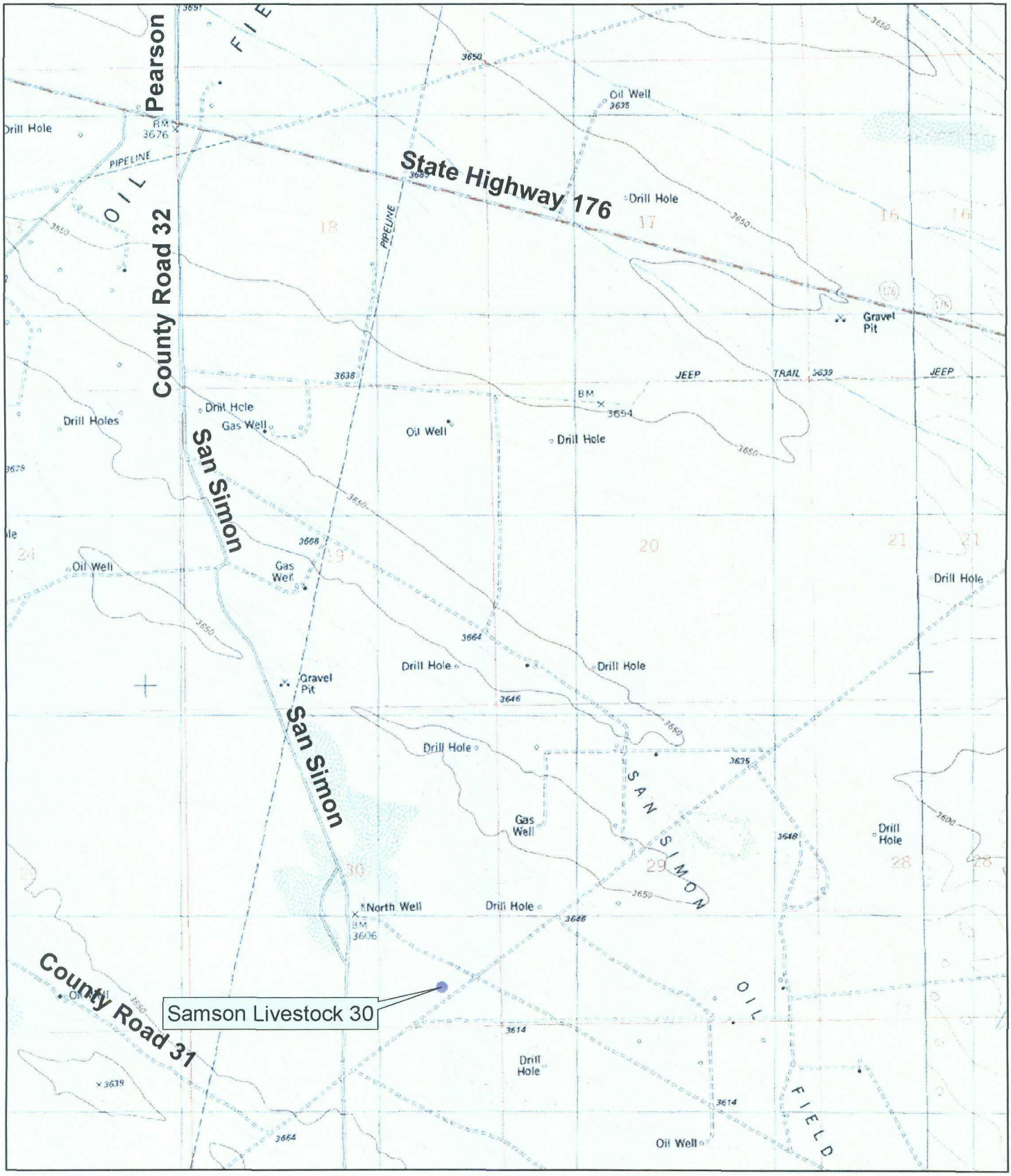
3.6 Application of Impaired Ground Water for Construction or Road Dust Suppression Will Not Impair Ground Water

Appendix C presents the evaluation that provides the support for this conclusion.

4 Recommendation

We recommend that Samson:

1. Place temporary electric pumps in MW-3d and/or MW-1d to enable the withdrawal of a total of about 4 gpm of water for beneficial use on an as-needed basis.
2. When water is needed for road or pad construction, road dust suppression or drilling fluid make-up; place a portable tank on location adjacent to MW-3d.
3. Begin pumping and store the pumped water in portable tank(s). A discharge of 4 gpm will produce sufficient water to fill one 130-barrel water truck every day.
4. Use the chloride-impacted water in lieu of fresh water for drilling fluids make-up water, road dust suppression, construction water for access roads and drilling pads. Record the volume of water used each year.
5. Collect and analyze ground water samples from all wells on a annual basis for chloride, TDS and field specific conductance
6. Cease pumping when monitoring data demonstrate that the water quality is suitable for mature stock (less than 3000 mg/L TDS) or when there is no further use for the water and provide notice to NMOCD.
7. Plug and abandon all wells when pumping for beneficial use ceases or when NMOCD approves closure of the regulatory file.
8. Monitoring of the gypsum blocks in the soil moisture ports should continue for two years to verify that the ET cover and infiltration depression is continuing to function as designed.



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Location of Samson Livestock 30 relative to Highway 176 and San Simon Rd	Plate 1
	Samson Livestock "30" Samson Investment Company	June 2006

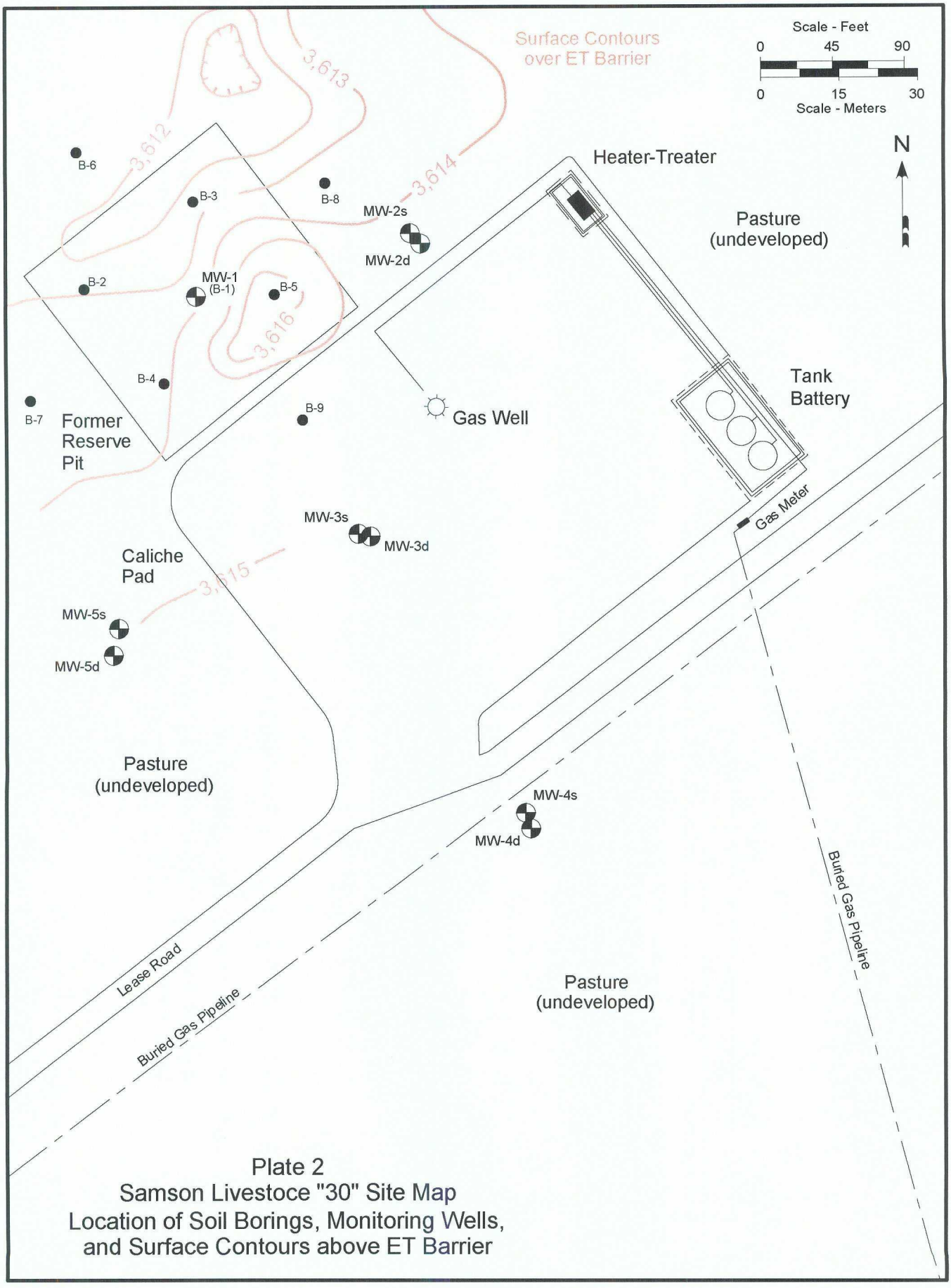


Plate 2
Samson Livestoce "30" Site Map
Location of Soil Borings, Monitoring Wells,
and Surface Contours above ET Barrier

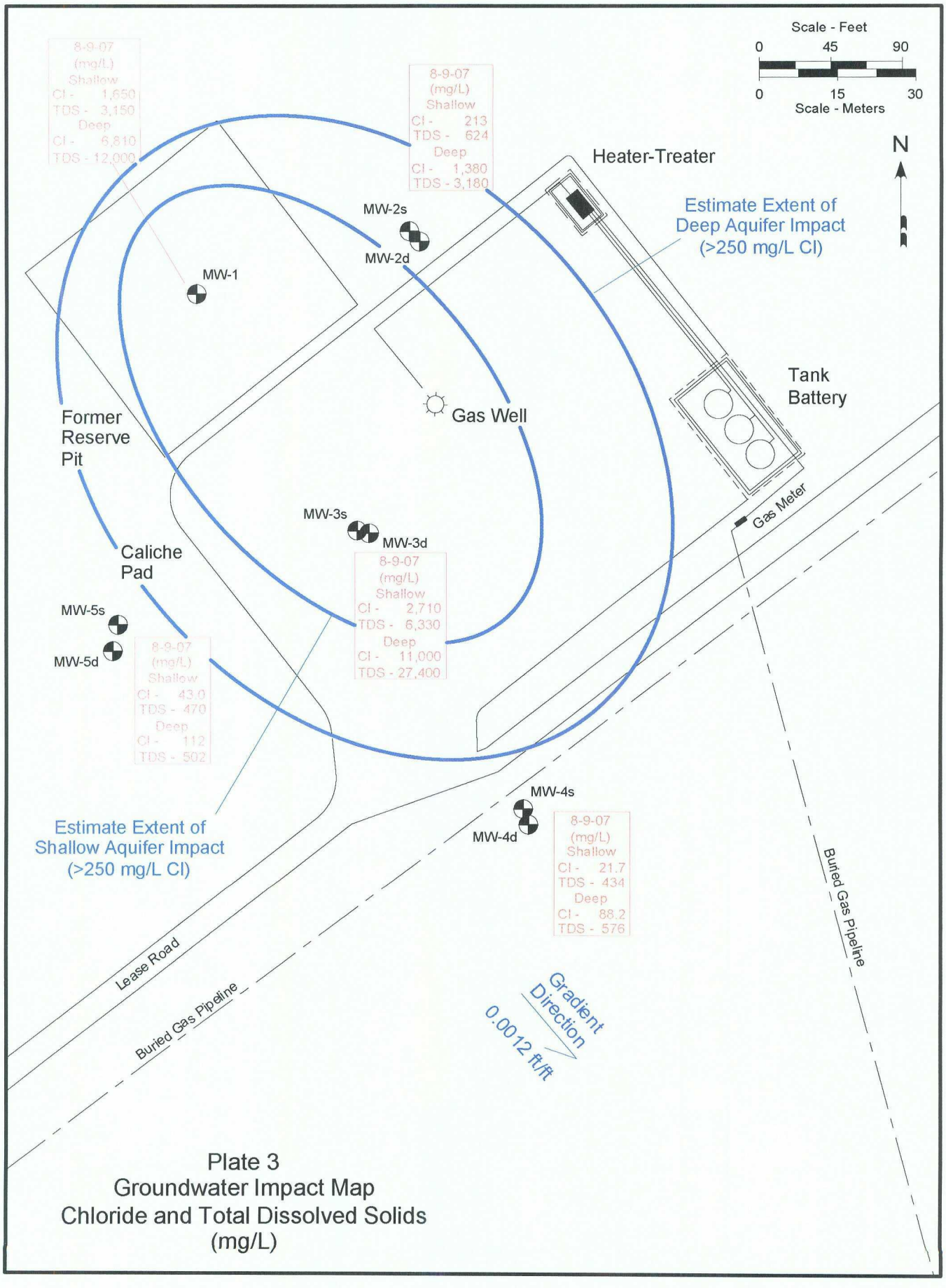
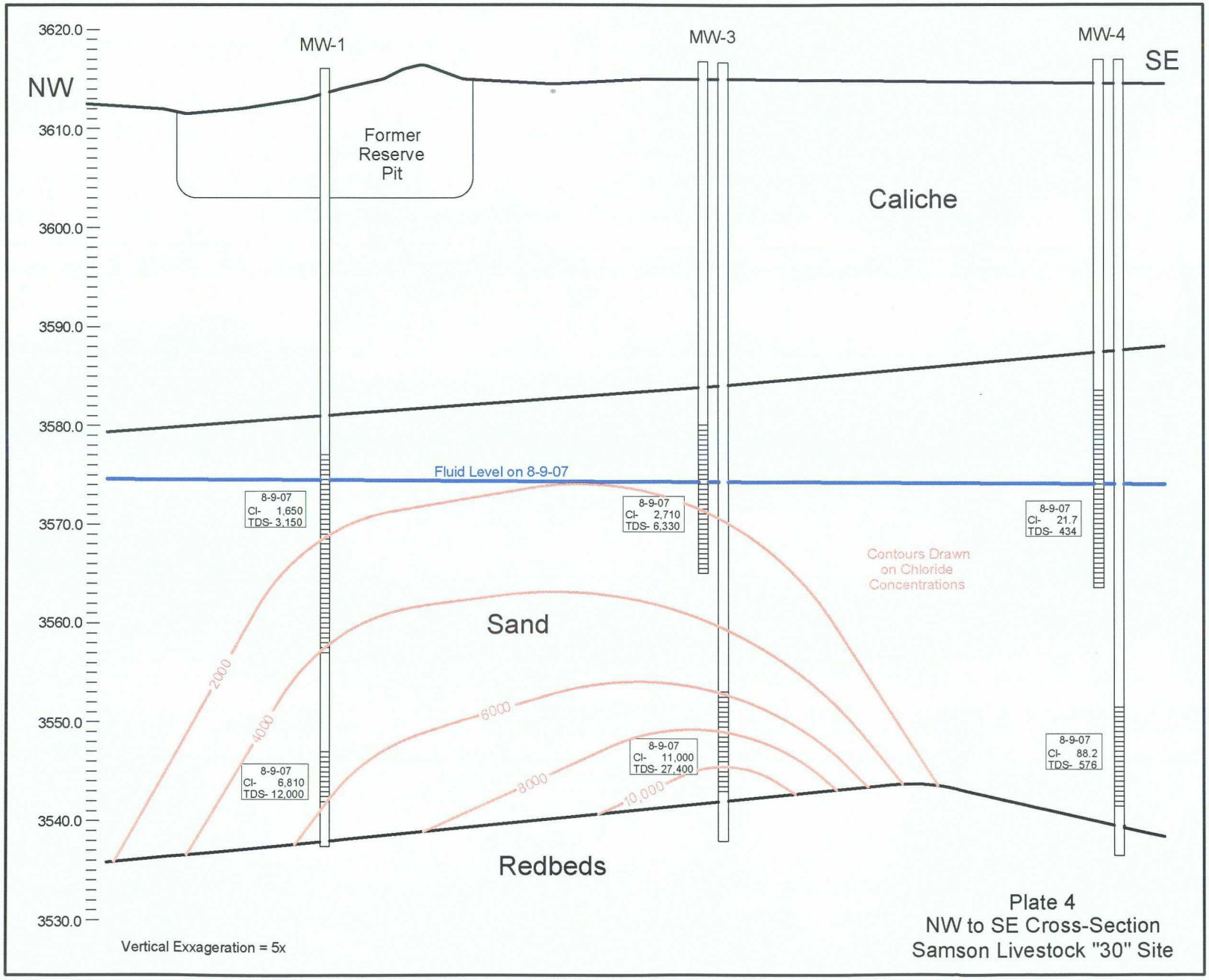
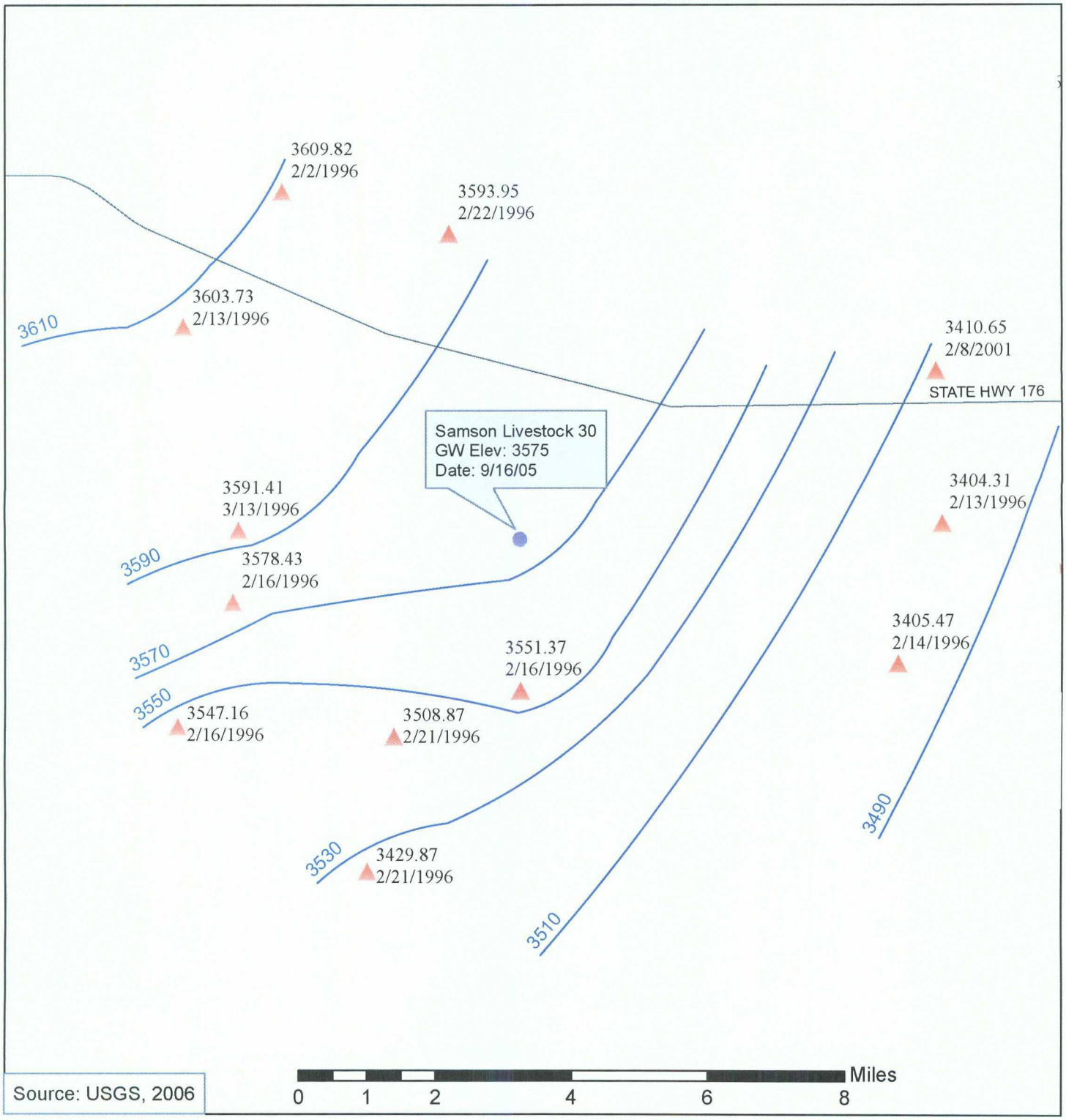


Plate 3
Groundwater Impact Map
Chloride and Total Dissolved Solids
(mg/L)


3620.0
3610.0
3600.0
3590.0
3580.0
3570.0
3560.0
3550.0
3540.0
3530.0
NW
SE
MW-1
MW-3
MW-4
Former
Reserve
Pit
Caliche
Fluid Level on 8-9-07
8-9-07
Cl- 1,650
TDS- 3,150
8-9-07
Cl- 2,710
TDS- 6,330
8-9-07
Cl- 21.7
TDS- 434
Contours Drawn
on Chloride
Concentrations
Sand
2000
4000
6000
8000
10,000
8-9-07
Cl- 6,810
TDS- 12,000
8-9-07
Cl- 11,000
TDS- 27,400
8-9-07
Cl- 88.2
TDS- 576
Redbeds
Vertical Exxageration = 5x
Plate 4
NW to SE Cross-Section
Samson Livestock "30" Site



Legend

Site — Potentiometric Surface (ft) — USGS Gauging Wells

N

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Regional Potentiometric Surface USGS gauging wells (2/1996)	Plate 5
	Samson Livestock "30" Samson Investment Company	June 2006

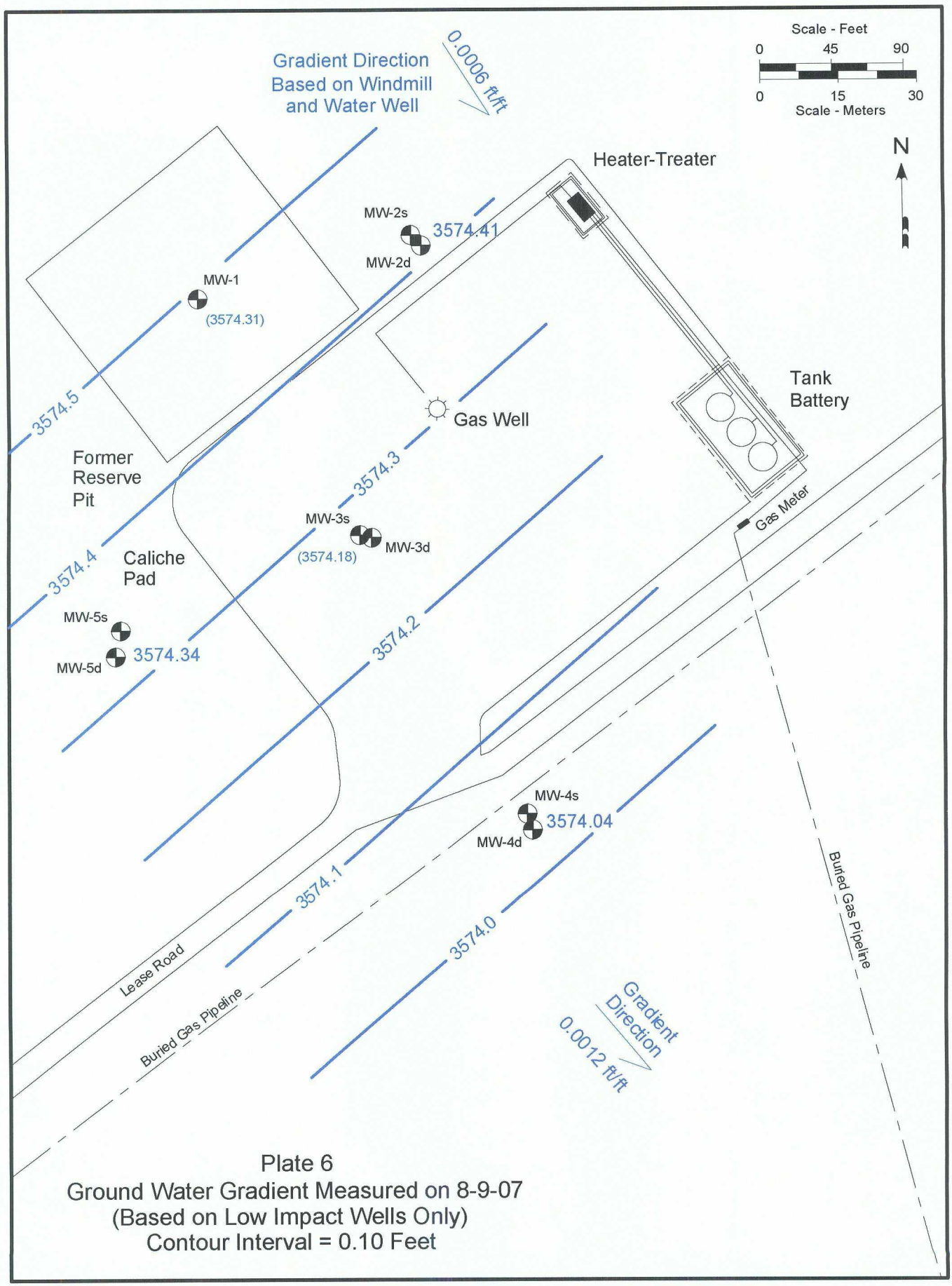


Plate 6
Ground Water Gradient Measured on 8-9-07
(Based on Low Impact Wells Only)
Contour Interval = 0.10 Feet

Table 1

RT Hicks Consultant Ltd

Table 1
Laboratory Results Summary - Excavation Soil Samples
Results in mg/kg

Sample Location	Pit Center	Pit W/4	Pit N/4	Pit S/4	Pit E/4	B-1	Applicable
Sample Depth (ft)	10	10	10	10	10	40	Reg.
Sample Date	5/11/05	5/11/05	5/11/05	5/11/05	5/11/05	9/16/05	Levels
Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	--	**0.2**
Toluene	<0.005	<0.005	<0.005	<0.005	<0.005	--	**0.347**
Ethyl Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	--	**1.01**
Total Xylenes	<0.015	<0.015	<0.015	<0.015	<0.015	--	**0.167**
GRO (C_6-C_{10})	<10.0	<10.0	<10.0	<10.0	<10.0	--	**200**
DRO (>C_{10}-C_{28})	**262**	<10.0	70.6	<10.0	**549**	--	**200**
Total Alkalinity	--	--	--	--	--	400	--
Chloride	**8,080**	**4,160**	**3920**	**5,520**	**6,880**	864	**1,000**
Carbonate	--	--	--	--	--	211	--
Bicarbonate	--	--	--	--	--	0	--
Sulfate	--	--	--	--	--	77	--
Calcium	--	--	--	--	--	64	--
Magnesium	--	--	--	--	--	12	--
Potassium	--	--	--	--	--	25	--
Sodium	--	--	--	--	--	647	--

c:\Samson\Livestock 30\Project Data

Table 1
Laboratory Results Summary - Soil Samples

Boring Well	Sample Location	Sample Date	Depth (ft)	Cl (mg/kg)
B-1 (TMW-1)	Center of Pit	9/16/05	15	**3,071**
		9/16/05	20	768
		9/16/05	25	**1,120**
		9/16/05	30	**1,312**
		9/16/05	35	**1,296**
		9/16/05	40	864
B-2	West/4 of Pit	9/22/05	15	**1,400**
		9/22/05	20	**2,431**
		9/22/05	25	**1,887**
		9/22/05	30	**1,344**
		9/22/05	35	800
		9/22/05	40	496
		9/22/05	45	592
B-3	North/4 of Pit	9/20/05	15	432
		9/20/05	20	432
		9/20/05	25	432
		9/20/05	30	688
		9/20/05	35	720
		9/20/05	40	704
		9/20/05	45	368
B-4	South/4 of Pit	9/22/05	15	**3,551**
		9/22/05	20	**5,998**
		9/22/05	25	**14,080**
		9/22/05	30	**6,718**
		9/22/05	35	**2,799**
		9/22/05	40	**1,424**
		9/22/05	45	**1,232**
B-5	East/4 of Pit	9/20/05	15	**3,007**
		9/20/05	20	**5,726**
		9/20/05	25	**3,039**
		9/20/05	30	**3,839**
		9/20/05	35	**2,031**
		9/20/05	40	**1,104**
		9/20/05	45	**1,168**
B-6	20' NW of Pit	9/19/05	15	16
		9/19/05	20	16
		9/19/05	25	32
		9/19/05	30	32
B-7	20' SW of Pit	9/19/05	15	112
		9/19/05	20	80
		9/19/05	25	32
		9/19/05	30	16

RT Hicks Consultant Ltd

Table 1
Laboratory Results Summary - Soil Samples

Boring Well	Sample Location	Sample Date	Depth (ft)	Cl (mg/kg)
B-8	20' NE of Pit	9/19/05	15	16
		9/19/05	20	128
		9/19/05	25	128
		9/19/05	30	112
B-9	20' SE of Pit	9/19/05	15	224
		9/19/05	20	64
		9/19/05	25	240
		9/19/05	30	48
NMOCD Landfarm Closure Standard				**1,000**

Bold **Text** indicate concentration exceeds Regulatory Standards

c:\Samson\Livestock 30\Project Data

Table 2

Table 2
Laboratory Results Summary - Groundwater Samples

Sample Date / Location	DTW (csg)	GW Elevation (ft)	Recv. Vol (gal)	Field Cond.	Sample Depth	Chloride (mg/L)	TDS (mg/L)
TMW-1 Casing Elev.=		**3607.11**					
9/19/05	No Data	--	--	--	Shallow	**3,999**	--
3/30/06	31.65	3575.46	30	7.49	Shallow	**2,240**	**4,520**
5/10/06	31.74	3575.37	450	7.51	Shallow	**2,580**	**3,900**
6/7/06	31.86	3575.25	830	5.93	Shallow	**2,150**	**4,080**
6/27/06	31.83	3575.28	1,230	7.70	Shallow	**2,520**	**4,160**
8/22/06	31.99	3575.12	6,830	5.52	Shallow	**1,930**	**3,720**
					Deep	**1,880**	**3,570**
MW-1 Casing Elev.=		**3616.06**					
11/6/06	41.28	3574.78	765	11.00	Deep	**5,520**	**9,240**
11/30/06	41.32	3574.74	837	6.03	Shallow	**1,030**	**2,280**
				11.19	Deep	**4,390**	**5,870**
12/12/06	43.03	3573.03	13,209	12.01	Deep	**5,210**	**9,600**
1/9/07	43.02	3573.04	42,609	4.80	Shallow	**1,870**	**2,940**
				12.25	Deep	**5,840**	**8,670**
2/20/07	43.12	3572.94	87,609	5.46	Shallow	**2,130**	**3,120**
				12.92	Deep	**6,690**	**7,680**
3/20/07	43.37	3572.69	121,881	4.94	Shallow	**2,110**	**3,930**
				11.99	Deep	**7,820**	**9,030**
4/17/07	43.44	3572.62	154,137	5.54	Shallow	**2,050**	**3,510**
				13.07	Deep	**6,350**	**11,400**
5/21/07	41.60	3574.46	194,529	3.91	Shallow	**1,400**	**2,490**
				11.88	Deep	**6,360**	**10,400**
6/13/07	41.65	3574.41	218,289	5.68	Shallow	**1,620**	**3,180**
				15.89	Deep	**6,770**	**13,000**
7/18/07	41.64	3574.42	253,929	--	--	--	--
8/9/07	41.75	3574.31	277,689	5.60	Shallow	**1,650**	**3,150**
				14.62	Deep	**6,810**	**12,000**
MW-2s Casing Elev.=		**3616.29**					
6/13/07	41.83	3574.46	113	1.27	Shallow	**348**	**1,260**
7/18/07	41.83	3574.46	--	--	--	--	--
8/9/07	41.89	3574.40	119	0.93	Shallow	**213**	**624**
MW-2d Casing Elev.=		**3615.92**					
6/13/07	41.44	3574.48	320	4.59	Deep	**1,460**	**3,810**
7/18/07	41.46	3574.46	--	--	--	--	--
8/9/07	41.50	3574.42	405	3.63		**1,380**	**3,180**
MW-3s Casing Elev.=		**3616.80**					
6/13/07	42.57	3574.23	148	8.77	Shallow	**4,480**	**10,600**
7/18/07	42.58	3574.22	--	--	--	--	--
8/9/07	42.62	3574.18	201	7.67	Shallow	**2,710**	**6,330**
MW-3d Casing Elev.=		**3616.70**					
6/13/07	42.55	3574.15	97	16.65	Deep	**6,670**	**24,100**
7/18/07	42.53	3574.17	--	--	--	--	--
8/9/07	42.62	3574.08	242	>20.00	Deep	**11,000**	**27,400**
MW-4s Casing Elev.=		**3616.89**					
8/9/07	42.85	3574.04	18	0.72	Shallow	**21.7**	**434**

RT Hicks Consultant Ltd

Table 2
Laboratory Results Summary - Groundwater Samples

Sample Date / Location	DTW (csg)	GW Elevation (ft)	Recv. Vol (gal)	Field Cond.	Sample Depth	Chloride (mg/L)	TDS (mg/L)
MW-4d Casing Elev.=		**0.00**					
8/9/07	0.00	0.00	12	0.92	Deep	**88.2**	**576**
MW-5s Casing Elev.=		**3616.43**					
8/9/07	42.10	3574.33	22	0.69	Shallow	**43.0**	**470**
MW-5d Casing Elev.=		**3616.19**					
8/9/07	41.85	3574.34	96	0.80	Deep	**112**	**502**
N. Windmill Csg. Elev.=		**3609.13**					
3/30/06	--	--	NA	--	--	**33.6**	**644**
6/27/06	34.25	3574.88	--	--	--	--	--
6/13/07	33.65	3575.48	NA	0.89	Unkn	**62.8**	**500**
Water Well Csg. Elev.=		**3615.58**					
6/27/06	40.40	3575.18	--	--	--	--	--
6/13/07	40.73	3574.85	--	--	--	--	--
NMWQCC Standards						**250**	**1,000**

c:\Samson\Livestock 30\Project Data

Appendix A

Appendix A
Chronology of Events

09-30-02: Following the installation of the reserve pit, drilling of the Livestock "30" State No. 1 gas well commenced. The well lies within the Grama Ridge Morrow East Field.

04/05/04: After the completion of the gas well, while the reserve pit was drying out in preparation for closure, a significant precipitation event flooded the reserve pit and damaged the liner. Rainwater probably flushed the chloride from the cuttings, flowed through the liner tears and caused the impact to the underlying soil and ground water.

05-11-05: Samson contracted for the removal of the cuttings and some underlying material to a centralized facility. Soil samples collected in the excavation indicated that the material underlying the pit contained chloride concentrations and diesel-range organics but there is no evidence that regulated hydrocarbons were present in soil.

09-16-05: Ocotillo Environmental installed nine hollow-stem auger holes within and surrounding the reserve pit. The data showed elevated chloride concentrations (>1,000 mg/kg) in at several locations from the base of the excavation to the water table (approximately 40 feet below ground surface.

09-19-05: A sample from a temporary monitoring well (TMW-1) in the center of the pit showed elevated chloride concentrations.

Undated: A report by Ocotillo included recommendations to over-excavate the reserve pit to a depth of 30-feet, install a 20-mil plastic liner, backfill the pit with clean soil, and install monitoring wells surrounding the area to delineate the chloride impact to ground water.

03-15-06: Samson contracted with RT Hicks Consultants, Ltd to re-evaluate the reserve pit site and determine the feasibility of an alternate remedy for closure.

03-30-06: TMW-1 was purged of 30 gallons of water using a disposable bailer prior to sampling to determine the concentrations of chloride and total dissolved solids. The results indicated that the chloride concentration at TMW-1 had decreased significantly from the sample recovered on 9-19-05 but remained above WQCC Standards. A water sample recovered from the windmill-equipped water well located 1,800 feet to the northwest of the site established background water quality for the area.

05-10-06: The first of three additional ground water samples was recovered from TMW-1 over a 2-month period. In each case the well was purged of approximately 400 gallons prior to sampling. Chloride concentrations from each sample were generally consistent with the sample recovered on March 30, 2006.

06-12-06: Hicks Consultants submitted a Corrective Action Plan (CAP) for the proposed pit closure at the Livestock "30" site to Mr. Glenn Von Gonten, with the NMOCD in Santa Fe. The CAP presented a design for an evapotranspiration (ET) cover and recommended installation of the barrier over the reserve pit area to control the migration of additional chloride into the ground water. The CAP proposed a "point-of-use" ground water remedy.

07-12-06: A solar-powered pump installed in the 2-inch monitoring well (TMW-1) withdrew water at a rate of 1-2 gpm in order to determine if more aggressive water recovery would significantly decrease the chloride concentration in the ground water below the pit. Water discharged to the produced water tank.

08-30-06: In a meeting with Mr. Glenn Von Gotten and David Sanchez at the NMOCD offices in Santa Fe, Hicks Consultants and Samson presented the June 12, 2006 CAP and results of the ground water purging/sampling feasibility test. The result of the meeting was a commitment to submit a Stage 1/Stage 2 Abatement Plan and to proceed with construction of the ET Infiltration Barrier in advance of NMOCD approval of the Abatement Plan.

09-22-06: Hicks Consultants submitted a Stage 1/Stage 2 Abatement Plan to the NMOCD. The plan made minor changes to the CAP and to the planned closure of the reserve pit. The plan included a proposal to abate the chloride-impacted ground water through a point-of-use water withdrawal program.

09-28-06: Hicks Consultants supervised closure of the former reserve pit according to the plan provided to the NMOCD on September 22, 2006.

10-23-06: Closure of the former reserve pit was complete and the final surface topography was shaped and mapped.

10-30-06: Hicks Consultants supervised the installation of a 4-inch monitoring/recovery well (MW-1) at the location of the former 2-inch temporary monitoring well (TMW-1). MW-1 included screened intervals at the vadose zone/ground water interface and at the base of the aquifer, above the lower confining Triassic red shale formation. In addition, three vadose zone moisture monitoring ports were installed into the backfilled pit material.

11-30-06: Following the development of MW-1, a solar-powered pump (Abyss No. 1), was installed at the base of the aquifer. A rubber packer was placed five feet above the pump to restrict flow from the upper portion of the aquifer. Each month, a ground water sampling program sampled chloride-impacted ground water from the lower screen (pump) and upper screen (bailer).

12-18-06: A progress report submitted to the NMOCD described the closure of the former reserve pit, provided information regarding the final ET cover and described the installation of MW-1 and vadose zone moisture monitoring ports. The proposed Abatement Plan public notice and a request to begin using the withdrawn water for use in drilling was part of this submittal.

04/17/07: Gypsum blocks were installed in the soil moisture ports and checked to verify that they were working properly. Ground water samples were recovered from the deep screen (pump) and shallow screen (bailer) of MW-1.

05/01/07: Replaced Abyss No. 1 with Abyss No. 2 in MW-1. Abyss No. 1 ran for approximately 3,600 hours.

05/21/07: Direct wired the MW-1 pump to the solar power control box to by-pass faulty plug. Ground water samples were recovered from the deep screen (pump) and shallow screen (bailer) of MW-1.

05/23/07: A progress report submitted to the NMOCD described the on-going ground water recovery and monitoring efforts. A recommendation for additional monitoring well installation was part of this submittal.

05/30/07: Hicks Consultants supervised the installation of monitoring wells MW-2(s), MW-2(d), MW-3(s), and MW-3(d) to delineate the dissolved chloride plume in the ground water. Field activities continued through June 1, 2007. MW-2(s) was fully developed and MW-2(d), MW-3(s), and MW-3(d) were partially developed. All of the new monitoring wells were surveyed to determine the casing elevations relative to MW-1.

06/13/07: All of the monitoring wells, nearest water well, and the North windmill well were gauged. The North windmill was shut in and the pump in MW-1 was turned off on June 12, 2007 to allow the static water levels to recover. MW-2(d) and MW-3(s) were fully developed and MW-3(d) was partially developed (poor producer). All of the monitoring wells, including MW-1 (deep and shallow) were sampled.

07/18/07: Replaced Abyss No. 2 pump after 1,800 hours of operation with Abyss No. 1R (rebuilt) pump. The monitoring well casing elevations were re-surveyed to verify the June 1, 2007 data.

08/02/07: A progress report submitted to the NMOCD described the on-going ground water recovery /monitoring efforts, and the results of the monitoring well installation and sampling conducted in May and June 2007. A recommendation for two additional monitoring well clusters was part of this submittal.

08/07/07: Monitoring wells MW-4(s), MW-4(d), MW-5(s), and MW-5(d) were installed to the southwest and southeast of the former reserve pit in order to complete the delineation of the dissolved chloride in the ground water. Each of the new wells were developed and surveyed to determine the casing elevations relative to the existing wells. Sediment in MW-3(d) was clean out using compressed air and the well was fully developed. All of the monitoring wells were sampled to determine the concentrations of chloride and total dissolved solids.

12/07: First quarterly sampling event will take place after submission of this Abatement Plan Annual Report.

Summary of Activities Completed to Date

Initial Assessment
Following the discovery of elevated chloride concentrations in the soil below the former reserve pit by Samson, Ocotillio Environmental installed nine soil borings to define the extent of the impact to the soil. One of the soil borings was converted into a temporary monitoring well (TMW-1)in order to verify the impact to ground water. Details concerning these activities were provided with the September 22, 2006 Stage 1/Stage 2 Abatement Plan.

Closure of the Former Reserve Pit
From September 28 to October 23, 2006 the reserve pit was backfilled. An evapotranspiration (ET) cover and surface run-off infiltration area were constructed during the backfill operations. Following completion of the ET cover MW-1 was installed as a replacement to TMW-1 and three soil moisture monitoring ports were installed to verify the effectiveness of the ET cover. Detailed information concerning these activities were provided in the December 18, 2006 Progress Report. Re-seeding of the ET cover and the installation of gypsum blocks into the moisture ports occurred in April 2006. Based on monitoring of the gypsum blocks performed through August 9, 2007, as shown below, there is no indication that rain water is infiltrating the ET barrier.

Ground Water Pumping (Source Removal)
A solar-powered pump was installed in MW-1 on November 30, 2006, and the recovery of brine water, released for the reserve pit, along with ground water began at an average rate of 0.8 gallons per minute (gpm). All of the removed water is discharged into the on-site 500-barrel fiberglass tank, mixed with produced water from the gas well, and periodically transferred to a disposal facility. Information concerning these activities were provided in the May 23, 2007 Progress Report.

Dissolved Chloride Plume Delineation

Two clusters of monitoring wells, which included a shallow well screened at the surface of the aquifer and a deep well screened at the base of the aquifer, were installed to provide delineation of the chloride-impacted ground water to the northeast (MW-2) and the southeast (MW-3) of the former reserve pit. Information concerning the remediation/monitoring activities and the installation of MW-2 and MW-3 were provided in the August 2, 2007 Progress Report.

Activities Completed Since Previous Update

From August 7, to August 9, 2007 two additional clusters of monitoring wells were installed at the site. MW-4(s) and MW-4(d) were placed approximately 300 feet southeast from the former reserve pit to verify the down gradient extent of the chloride-impacted ground water. MW-5(s) and MW-5(d) were placed approximately 120 feet south of the former reserve pit in order to delineate the plume to the southwest of MW-3.

Each of the wells, including MW-1, MW-2, and MW-3, were drilled using a hollow-stem auger operated by Atkins Engineering of Roswell, NM. The shallow wells were screened with 20 feet of 2-inch (0.010-inch slot) PVC casing extending approximately 10 to 12 feet below the static water level and the deep wells were screened with 10 feet of similar casing placed at the base of the aquifer. Additional soil samples were not recovered during the drilling activity because the monitoring wells are located beyond the known extent of soil impact.

Following completion, each for the new wells were gauged, developed, and surveyed relative to the casing elevations of the existing monitoring wells. A site ground water gradient map was constructed using data from only MW-2, MW-4, and MW-5. Elevated dissolved solids in the ground water at the MW-1 and MW-3 locations increase the specific gravity of the water such that measured fluid levels do not accurately reflect the potentiometric energy of the aquifer.

Ground water samples were recovered from each of the project monitoring wells using disposable bailers (shallow wells) or a small submersible pump (deep wells) to determine the concentrations of chloride and total dissolved solids (TDS) with major anion and cation analyses performed on selective samples.

Appendix B

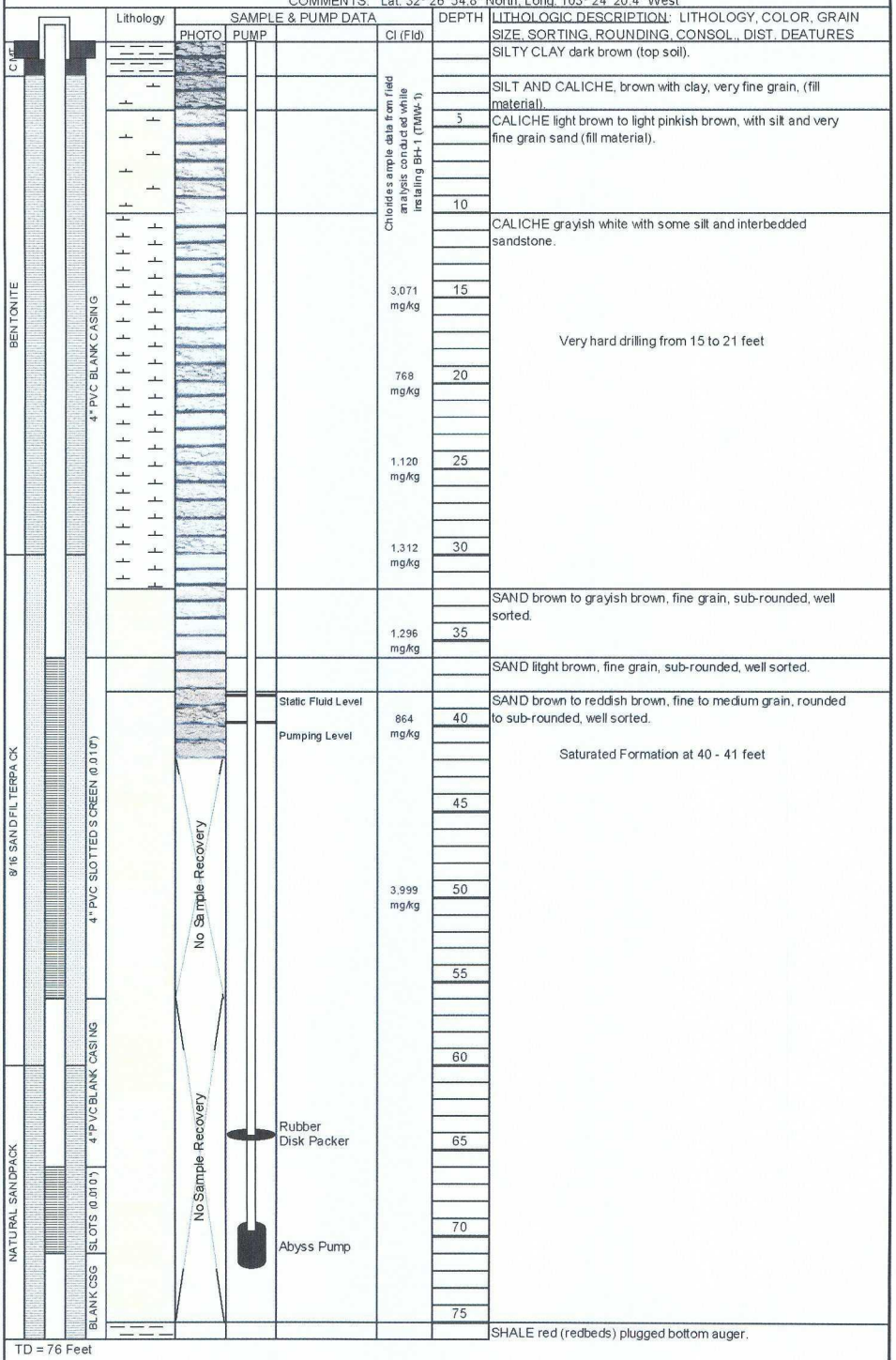
Appendix B
Lithology & Completion Logs

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

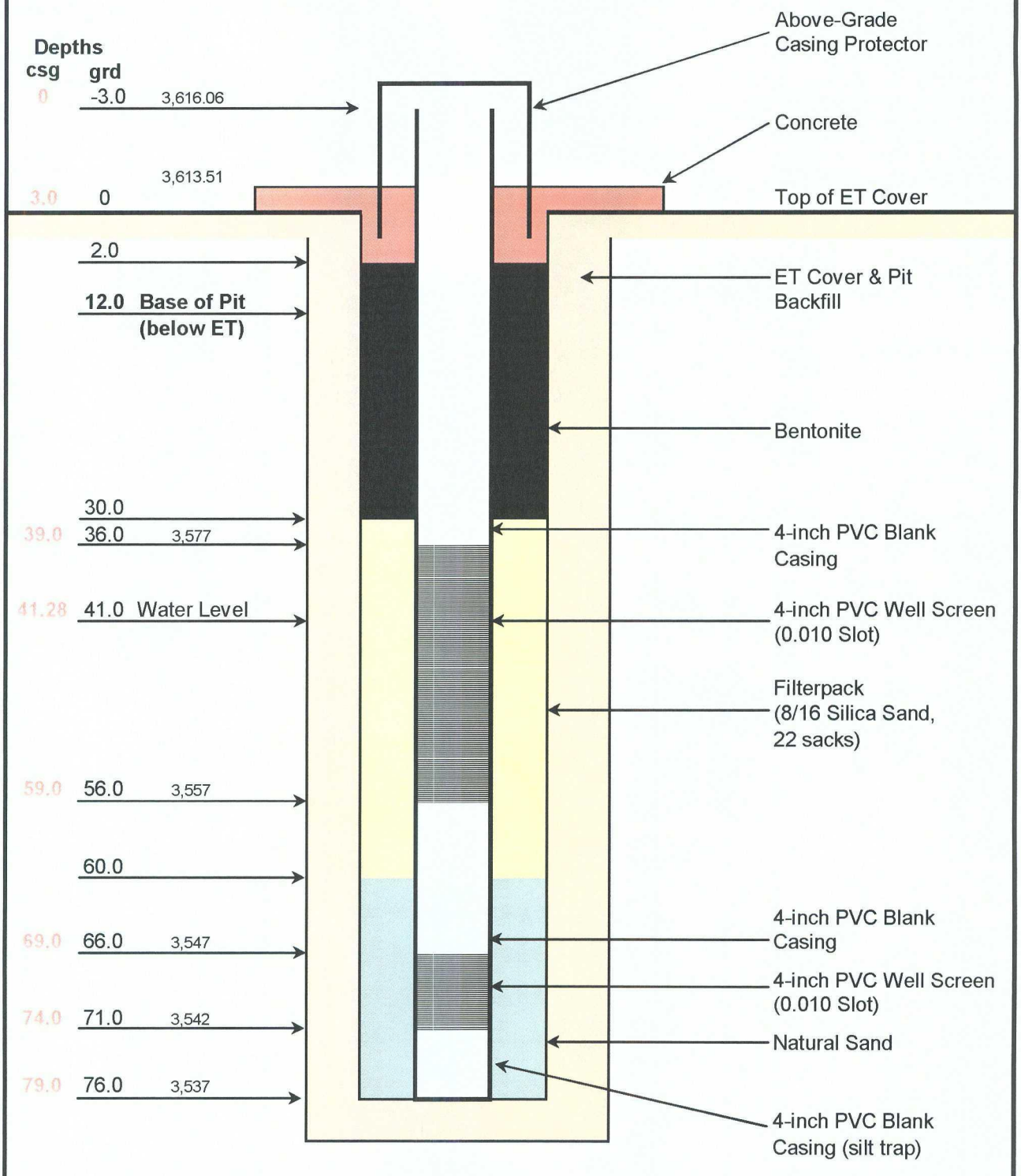
P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-1	TOTAL DEPTH:	76.0 Ft
SITE ID:	Samson Livestock "30"	CLIENT:	Samson Investment Co.
SURFACE ELEVATION:	3,613.51 (Csg= 3,616.06)	COUNTY:	Lea County
CONTRACTOR:	Atkins Engineering	STATE:	New Mexico
DRILLING METHOD:	Hollow-Stem	LOCATION:	T-21-S, R-35-E, Sec. 30 (P)
INSTALLATION DATE:	10/30/06	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	Site of TMW-1	FILE NAME:	\Livestock\Lithlogs (10-06)
COMMENTS:	Lat. 32° 26' 54.8" North, Long. 103° 24' 20.4" West		



TD = 76 Feet

E.T. PIT COVER MONITORING WELL CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site		**E.T. Pit Cover Monitoring Well No. 1**
	DATE: 9/5/06	REV. NO.: 1	
	AUTHOR: DTL	TECH: DTL	
	DRILLER: Proposed	FILE: \Lith (10-06)	

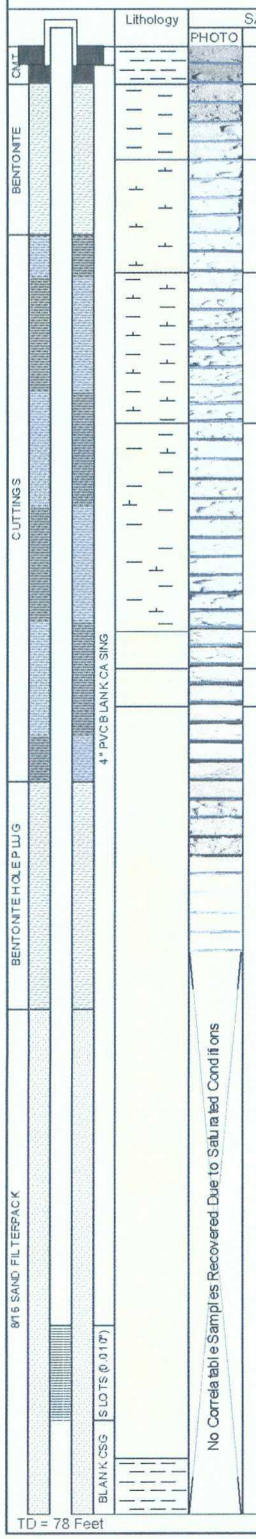
LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.: MW-2 (d)
SITE ID: Samson Livestock "30"
SURFACE ELEVATION: 3,614.43 (Csg= 3,615.95)
CONTRACTOR: Atkins Engineering
DRILLING METHOD: Hollow-Stem
INSTALLATION DATE: 5/30/07 - 5/31/07
WELL PLACEMENT: 143' east-northeast of MW-1
COMMENTS: Lat. 32° 26' 41.4" North, Long. 103° 24' 5.2" West

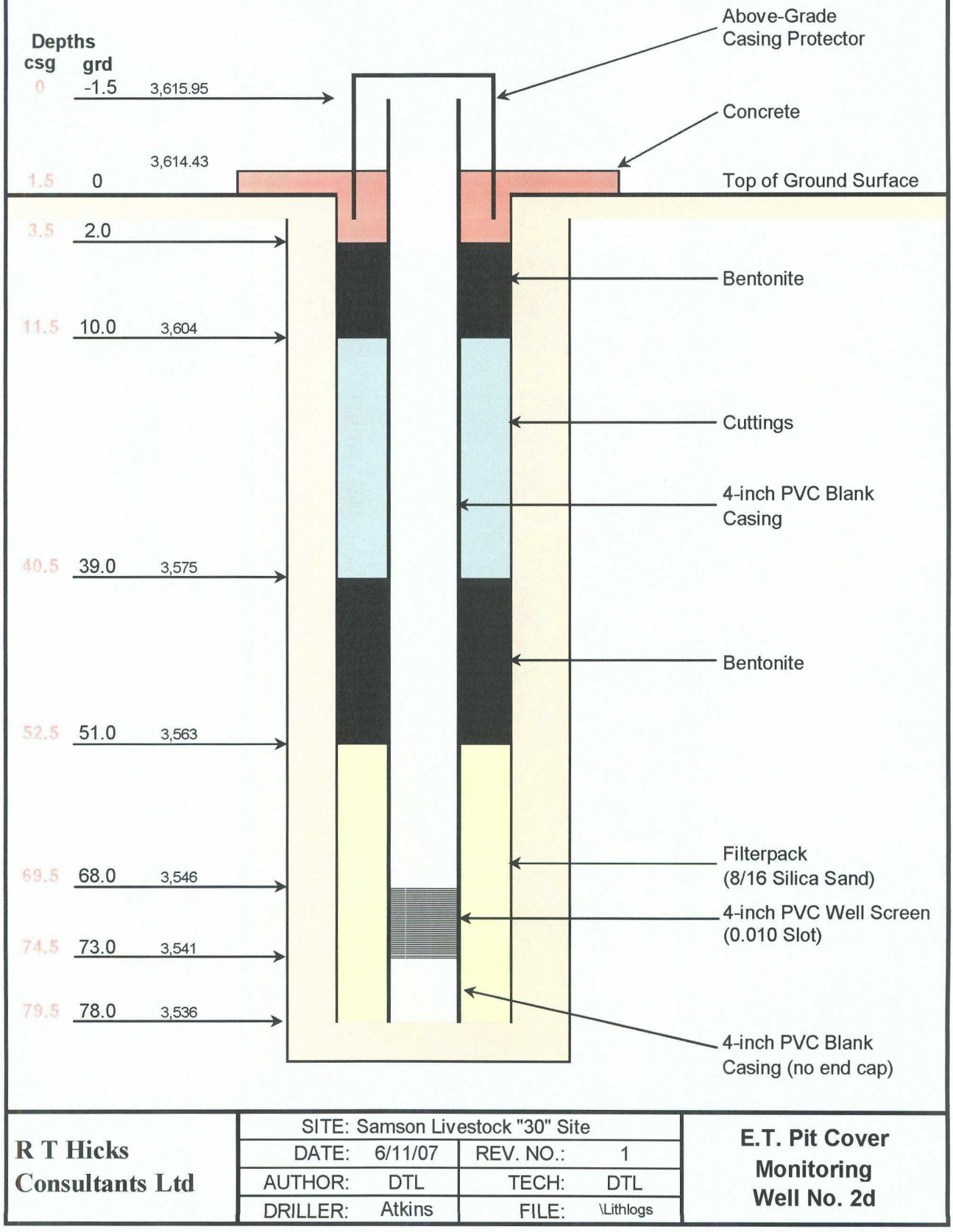
TOTAL DEPTH: 78.0 Ft
CLIENT: Samson Investment Co.
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-21-S, R-35-E, Sec. 30 (P)
FIELD REP.: Dale Littlejohn
FILE NAME: \Livestock\Lithlogs



Lithology	SAMPLE & PUMP DATA	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
	PHOTO — No Soil Samples Recovered		SILTY CLAY dark brown, very fine grain (top soil).
		5	SANDY SILT, brown with clay, very fine grain, with some caliche increasing with depth.
		10	CALICHE light gray with very fine grain silty sand.
		15	CALICHE AND SILT, tan to gray, with some very fine grain, well sorted sand. Very hard drilling from 19 to 20 feet.
		20	
		25	SILTY SAND, light brown, very fine grain, wells sorted with some caliche (decreasing with depth).
			Very hard drilling 27 feet (possible quartzite)
		30	
			SAND light brown, very fine grain, sub-rounded, well sorted, with 40% silt
		35	SAND brown, fine grain, rounded to sub-rounded, medium sorted, with very little caliche and silt.
	Top of Saturated Cuttings		SAND brown, medium grain, rounded, well sorted, with very little silt, moist
		40	
			Saturated Formation at 40 - 41 feet
		45	Shut down drilling in MW-2 (s) at 44 feet and tested groundwater through augers, the results are as follows:
		50	Temp = 73.2°F pH = 6.04 Cond. = 1.16 Fld TDS = 1000 ppm
	No Correlatable Samples Recovered Due to Saturated Conditions	55	
		60	
		65	
		70	
		75	
			SHALE red (redbeds) could not recover samples from split spoon but drilling resistance much greater.

TD = 78 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



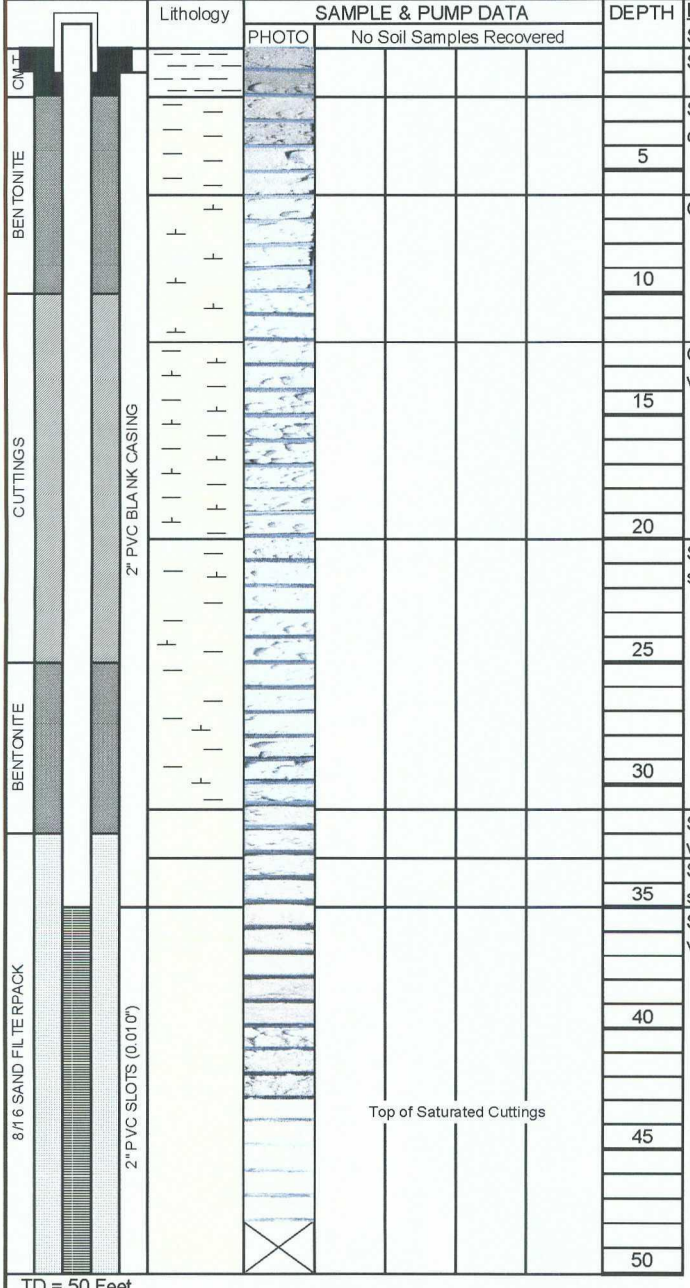
R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site			**E.T. Pit Cover Monitoring Well No. 2d**
	DATE: 6/11/07	REV. NO.: 1		
	AUTHOR: DTL	TECH: DTL		
	DRILLER: Atkins	FILE: \Lithlogs		

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

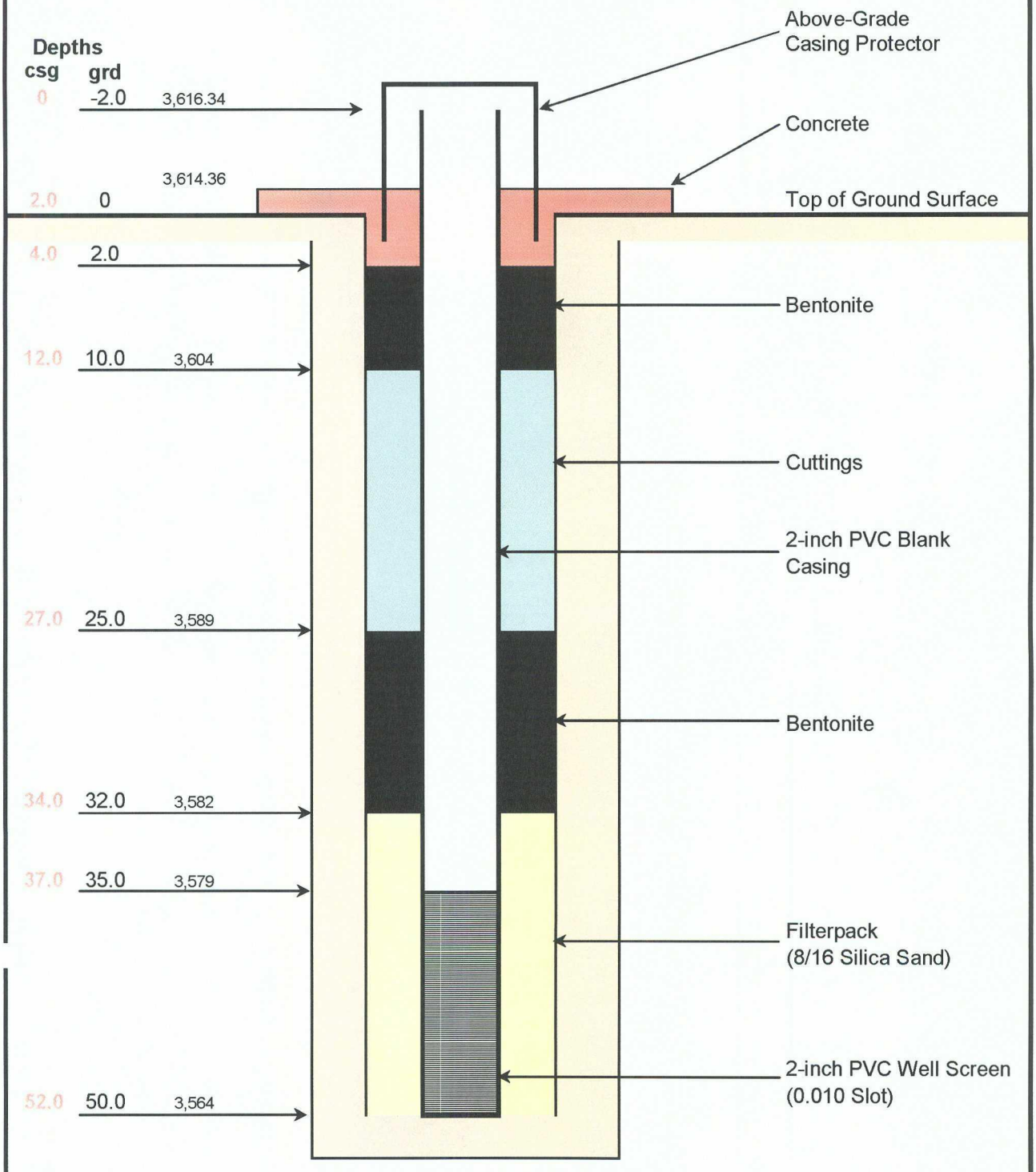
P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-2 (s)	TOTAL DEPTH:	50.0 Ft
SITE ID:	Samson Livestock "30"	CLIENT:	Samson Investment Co.
SURFACE ELEVATION:	3,614.36 (Csg= 3,616.34)	COUNTY:	Lea County
CONTRACTOR:	Atkins Engineering	STATE:	New Mexico
DRILLING METHOD:	Hollow-Stem	LOCATION:	T-21-S, R-35-E, Sec. 30 (P)
INSTALLATION DATE:	5/30/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	10 feet north of MW-2d	FILE NAME:	\Livestock\Lithlogs
COMMENTS:	Lat. 32° 26' 41.5" North, Long. 103° 24' 5.3" West		



TD = 50 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site			**E.T. Pit Cover Monitoring Well No. 2s**
	DATE:	6/11/07	REV. NO.:	1
	AUTHOR:	DTL	TECH:	DTL
	DRILLER:	Atkins	FILE:	\Lithlogs

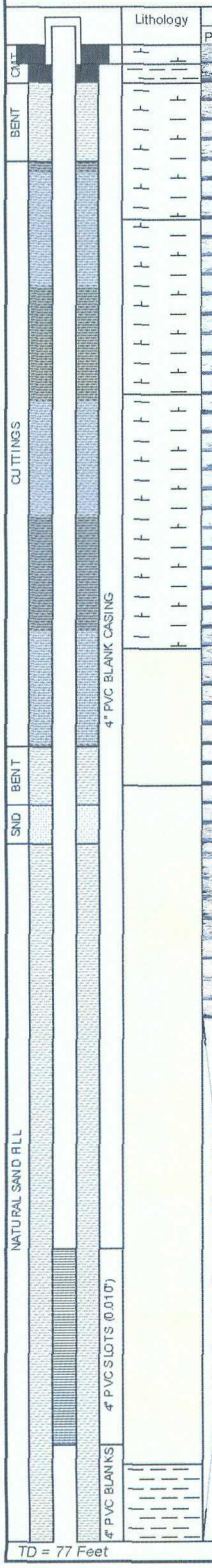
LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.: MW-3 (d)
SITE ID: Samson Livestock "30"
SURFACE ELEVATION: 3,614.56 (Csg= 3,616.68)
CONTRACTOR: Atkins Engineering
DRILLING METHOD: Hollow-Stem
INSTALLATION DATE: 5/31/07 - 6/1/07
WELL PLACEMENT: 5 feet southeast of MW-3s
COMMENTS: Lat. 32° 26' 39.7" North, Long. 103° 24' 5.6" West

TOTAL DEPTH: 77.0 Ft
CLIENT: Samson Investment Co.
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-21-S, R-35-E, Sec. 30 (P)
FIELD REP.: Dale Littlejohn
FILE NAME: \Livestock\Lithlogs



Lithology	SAMPLE & PUMP DATA (PHOTO / No Soil Samples Recovered)	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
			CALICHE, gray (drilling pad)
			SILTY CLAY, reddish brown, with some caliche.
			CALICHE AND SILT, light grayish brown, caliche increasing with depth
		5	
		10	CALICHE AND SILT, gray, with some quartz sand grains (<5% sand).
		15	
		20	CALICHE AND SILT, light brownish gray, with some fine grain sand (<10% sand)
		25	
		30	
			SAND, light brown, very fine grain, angular, medium sorted, with 30% silt
		35	Very hard drilling 27 feet (possible quartzite)
			SAND, brown, medium grain, wells sorted, rounded, with very little silt.
		40	
		45	Shut down drilling in MW-3 (s) at 44 feet and tested groundwater through augers, the results are as follows: Temp = 82.6°F pH = 6.00 Cond. = 4.61 Fld TDS = >1000 ppm
		50	
	No Correlatable Samples Recovered Due to Saturated Conditions	55	
		60	
		65	
		70	
			SHALE red (redbeds) could not recover samples from split spoon but drilling resistance much greater.
		75	

TD = 77 Feet

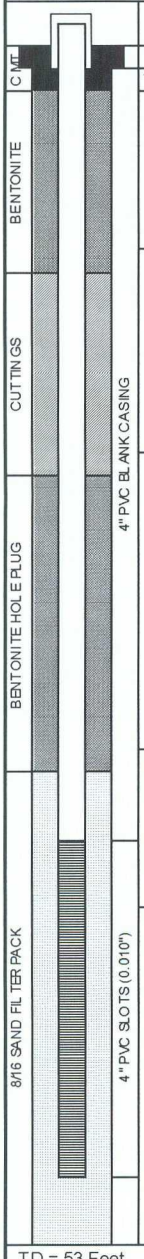
LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.: MW-3 (s)
SITE ID: Samson Livestock "30"
SURFACE ELEVATION: 3,614.67 (Csg= 3,616.78)
CONTRACTOR: Atkins Engineering
DRILLING METHOD: Hollow-Stem
INSTALLATION DATE: 5/31/07
WELL PLACEMENT: 179 feet southeast of MW-1
COMMENTS: Lat. 32° 26' 39.7" North, Long. 103° 24' 5.7" West

TOTAL DEPTH: 50.0 Ft
CLIENT: Samson Investment Co.
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-21-S, R-35-E, Sec. 30 (P)
FIELD REP.: Dale Littlejohn
FILE NAME: \Livestock\Lithlogs



Lithology	SAMPLE & PUMP DATA: PHOTO	SAMPLE & PUMP DATA: No Soil Samples Recovered	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
				CALICHE, gray (drilling pad)
				SILTY CLAY, reddish brown, with some caliche.
			5	CALICHE AND SILT, light grayish brown, caliche increasing with depth
			10	CALICHE AND SILT, gray, with some quartz sand grains (<5% sand).
			15	
			20	CALICHE AND SILT, light brownish gray, with some fine grain sand (<10% sand)
			25	
			30	
			35	SAND, light brown, very fine grain, angular, medium sorted, with 30% silt Very hard drilling 27 feet (possible quartzite)
			40	SAND, brown, medium grain, wells sorted, rounded, with very little silt.
			45	Shut down drilling in MW-3 (s) at 44 feet and tested groundwater through augers, the results are as follows: Temp = 82.6°F pH = 6.00 Cond. = 4.61 Fld TDS = >1000 ppm
			50	

TD = 53 Feet

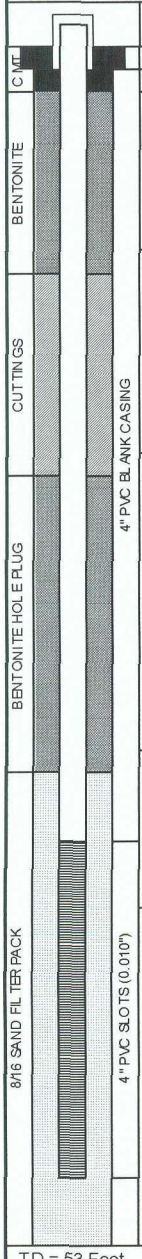
LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.: MW-3 (s)
SITE ID: Samson Livestock "30"
SURFACE ELEVATION: 3,614.67 (Csg= 3,616.78)
CONTRACTOR: Atkins Engineering
DRILLING METHOD: Hollow-Stem
INSTALLATION DATE: 5/31/07
WELL PLACEMENT: 179 feet southeast of MW-1
COMMENTS: Lat. 32° 26' 39.7" North, Long. 103° 24' 5.7" West

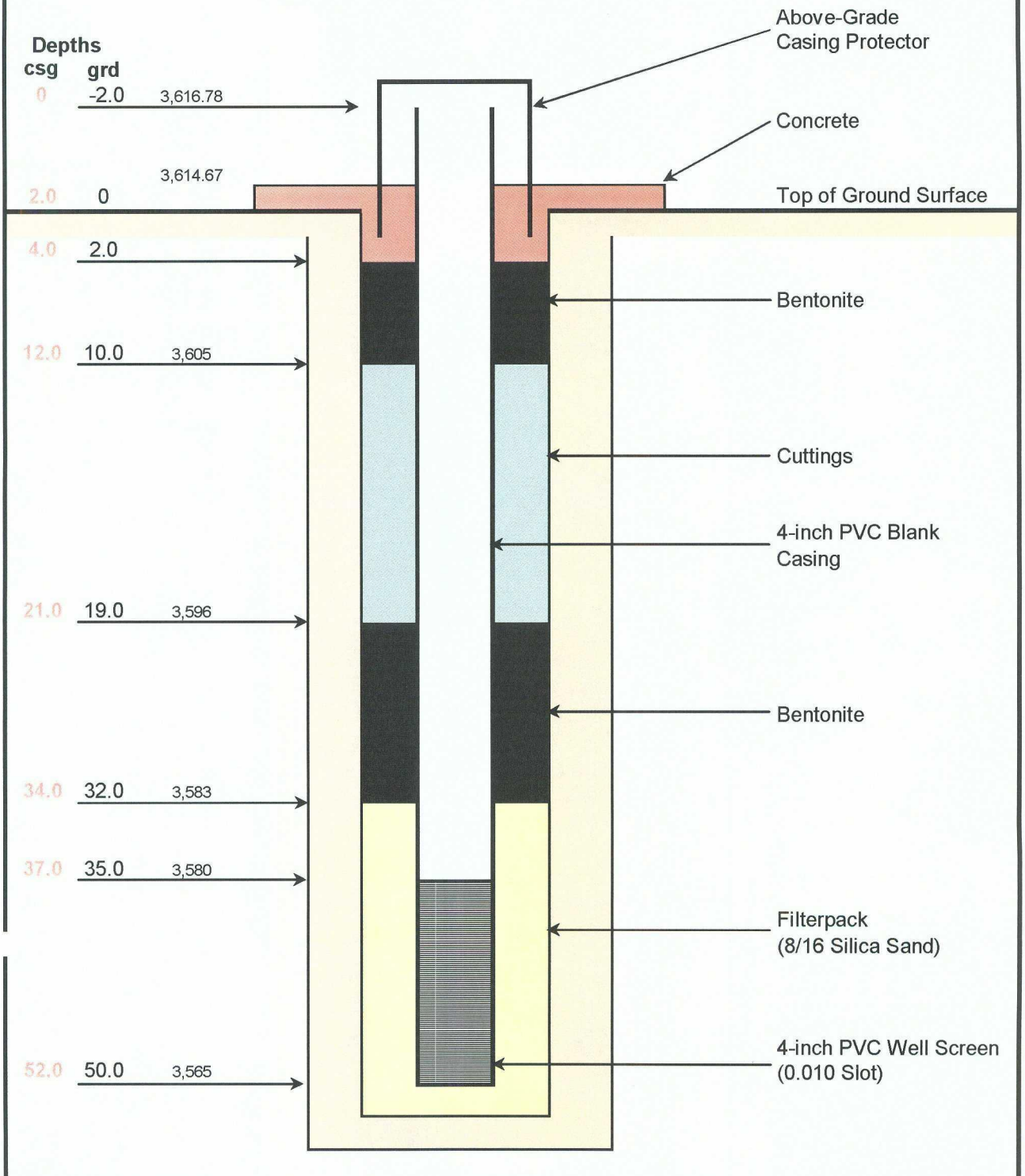
TOTAL DEPTH: 50.0 Ft
CLIENT: Samson Investment Co.
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-21-S, R-35-E, Sec. 30 (P)
FIELD REP.: Dale Littlejohn
FILE NAME: \Livestock\Lithlogs



Lithology	SAMPLE & PUMP DATA: PHOTO / No Soil Samples Recovered	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
			CALICHE, gray (drilling pad)
			SILTY CLAY, reddish brown, with some caliche.
			CALICHE AND SILT, light grayish brown, caliche increasing with depth
		5	
		10	CALICHE AND SILT, gray, with some quartz sand grains (<5% sand).
		15	
			CALICHE AND SILT, light brownish gray, with some fine
		20	grain sand (<10% sand)
		25	
		30	
			SAND, light brown, very fine grain, angular, medium sorted, with 30% silt
		35	
			Very hard drilling 27 feet (possible quartzite)
			SAND, brown, medium grain, wells sorted, rounded, with
		40	very little silt.
		45	
			Shut down drilling in MW-3 (s) at 44 feet and tested groundwater through augers, the results *are as follows:*
			Temp = 82.6°F
			pH = 6.00
			Cond. = 4.61
		50	Fld TDS = >1000 ppm

TD = 53 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site		**E.T. Pit Cover Monitoring Well No. 3s**
	DATE: 6/11/07	REV. NO.: 1	
	AUTHOR: DTL	TECH: DTL	
	DRILLER: Atkins	FILE: \Lithlogs	

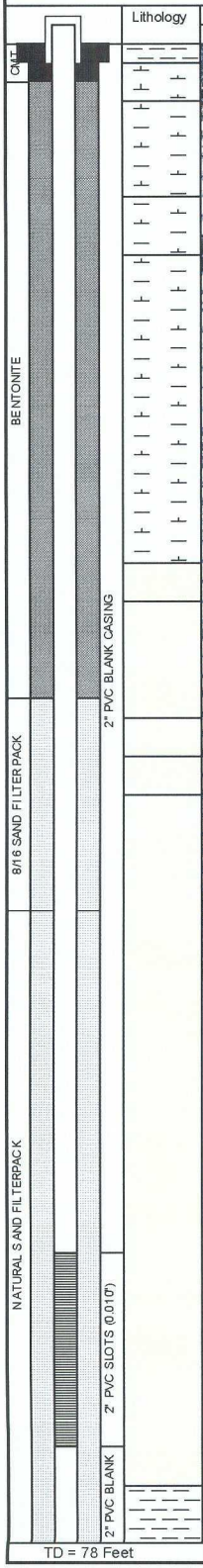
LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.: MW-4(d)
SITE ID: Samson Livestock "30"
SURFACE ELEVATION: 3,614.40 (Csg= 3,616.89)
CONTRACTOR: Atkins Engineering
DRILLING METHOD: Hollow-Stem
INSTALLATION DATE: 8/9/07
WELL PLACEMENT: South of lease road
COMMENTS: Lat. 32° 26' 37.8" North, Long. 103° 24' 4.5" West

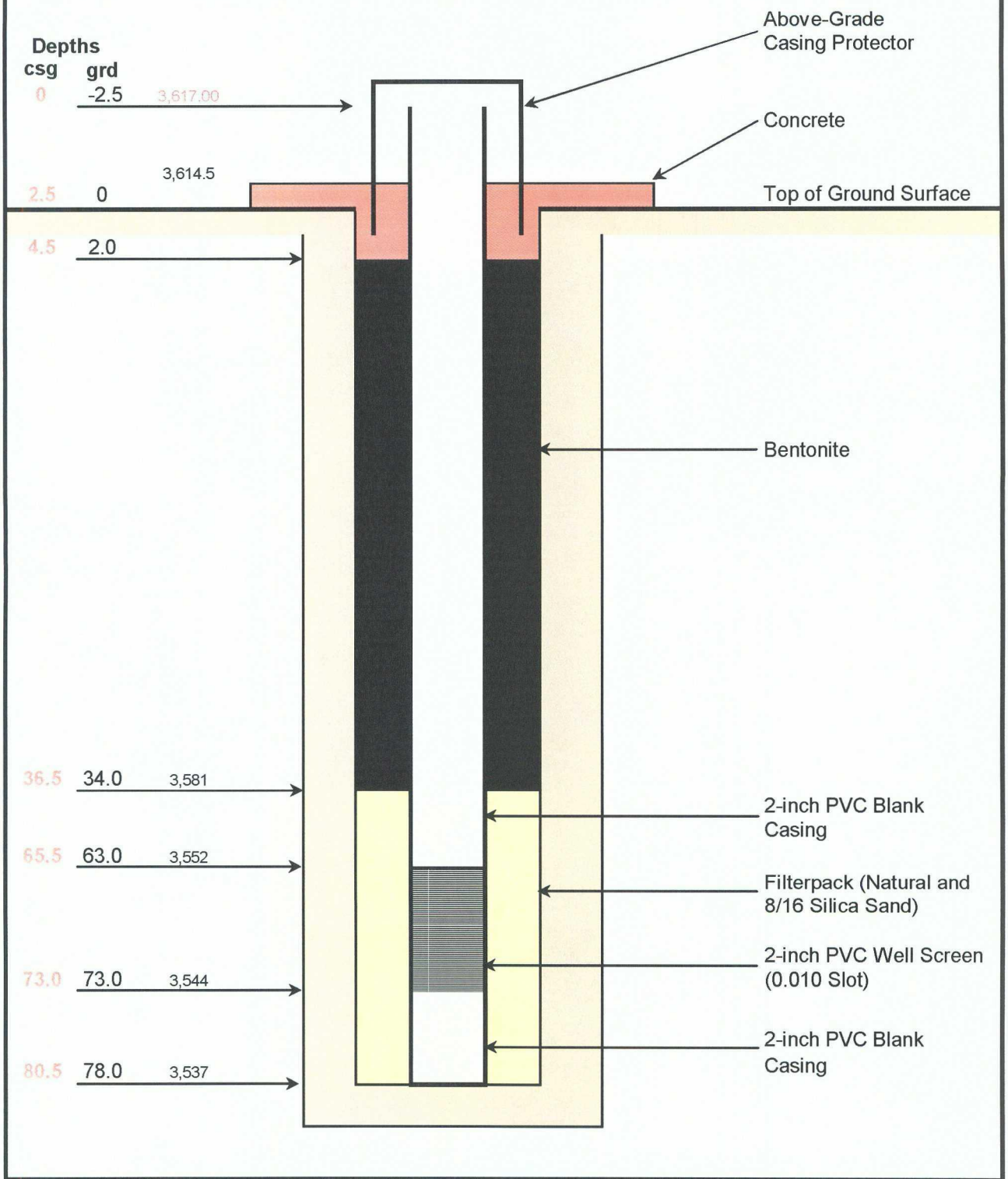
TOTAL DEPTH: 78.0 Ft
CLIENT: Samson Investment Co.
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-21-S, R-35-E, Sec. 30 (P)
FIELD REP.: Dale Littlejohn
FILE NAME: \Livestock\Lithlogs



Lithology	SAMPLE & PUMP DATA	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
	PHOTO — No Soil Samples Recovered		SILT, grayish brown (top soil).
			CALICHE, grayish brown, with some silt.
			CALICHE AND SILT, light brown.
		5	
			CALICHE AND SILT, light brown to light pinkish brown.
		10	
			CALICHE AND SILT, light brown to creme.
		15	
		20	
		25	
			SAND, light brown to pinkish brown, very fine grain, subangular, poorly sorted, with some silt.
		30	SAND, light reddish brown, fine grain, subrounded, well sorted.
		35	
			SAND, light reddish brown, fine grain, subrounded, well sorted, with layers of dark reddish brown quartzite.
			SAND, light reddish brown, fine grain, subrounded, well sorted, moist at 39 feet.
		40	SAND, brown, fine-medium grain, rounded, well sorted, wet, lost regular returns at 48 feet.
		45	
		50	
		55	
		60	
			Develop well (pumped dry at 12 gals): Temp = 70.4°F pH = 7.57 Cond. = 0.92
		65	
		70	
		75	
			SHALE red (redbeds) could not recover samples from split spoon but drilling resistance much greater and samples observed on bottom of drill bit.

TD = 78 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



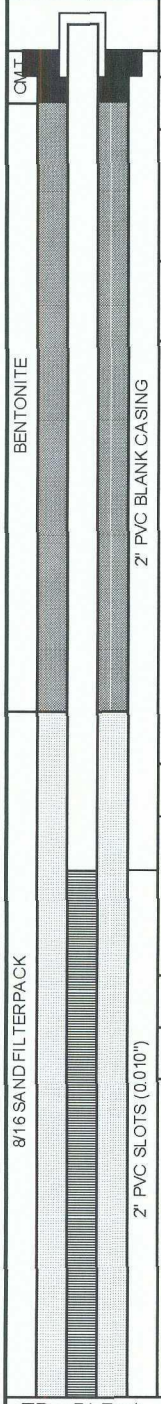
R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site			**Monitoring Well No. 4d**
	DATE: 6/11/07	REV. NO.: 1		
	AUTHOR: DTL	TECH: DTL		
	DRILLER: Atkins	FILE: \Lithlogs		

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-4(s)	TOTAL DEPTH:	51.0 Ft
SITE ID:	Samson Livestock "30"	CLIENT:	Samson Investment Co.
SURFACE ELEVATION:	3,614.4 (Csg= 3,616.89)	COUNTY:	Lea County
CONTRACTOR:	Atkins Engineering	STATE:	New Mexico
DRILLING METHOD:	Hollow-Stem	LOCATION:	T-21-S, R-35-E, Sec. 30 (P)
INSTALLATION DATE:	8/7/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	South of lease road	FILE NAME:	\Livestock\Lithlogs
COMMENTS:	Lat. 32° 26' 37.9" North, Long. 103° 24' 4.5" West		

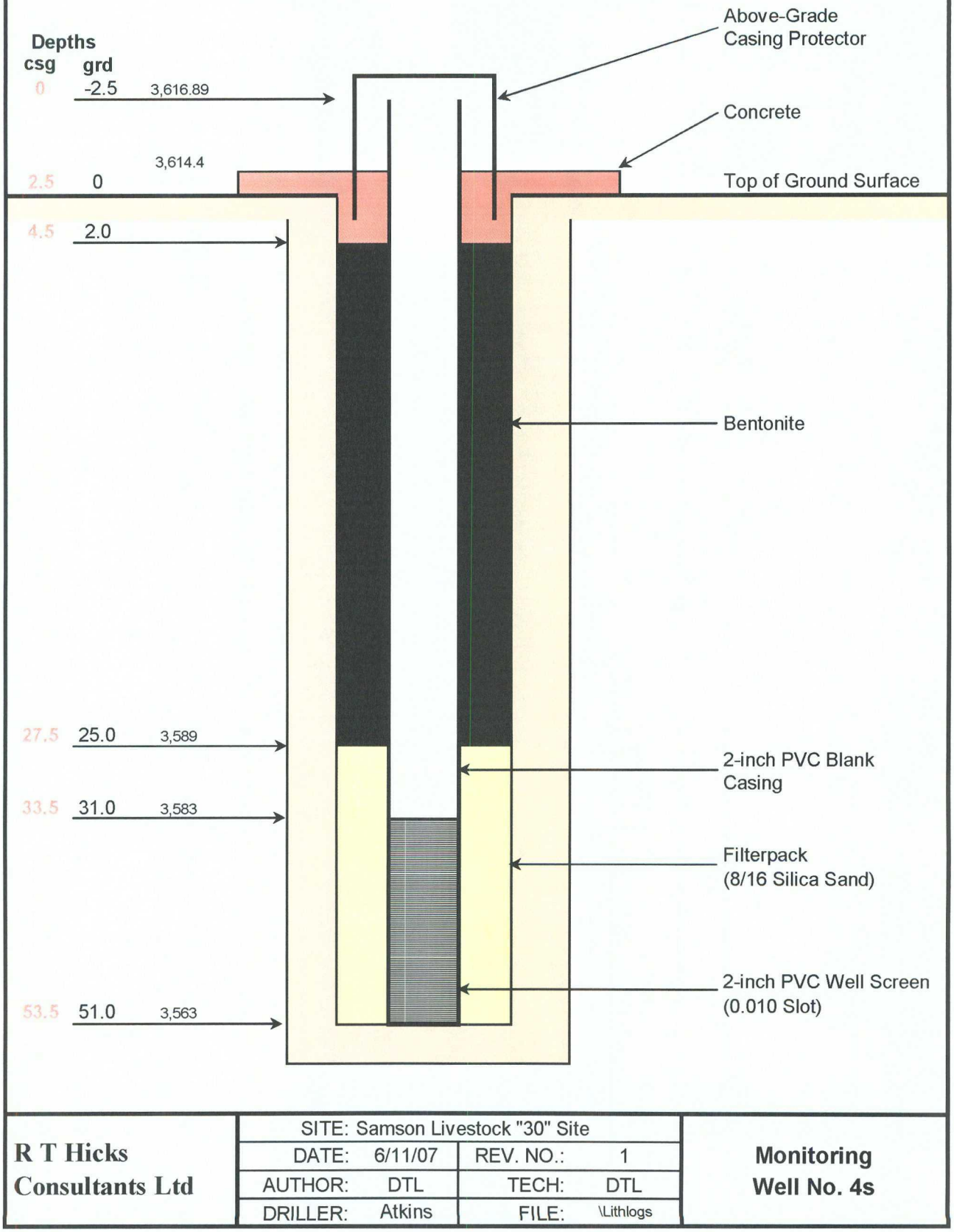


Lithology	SAMPLE & PUMP DATA: PHOTO	SAMPLE & PUMP DATA: No Soil Samples Recovered	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
				SILT, grayish brown (top soil).
				CALICHE, grayish brown, with some silt.
			5	CALICHE AND SILT, light brown.
			10	CALICHE AND SILT, light brown to light pinkish brown.
			15	CALICHE AND SILT, light brown to creme.
			20	
			25	
				SAND, light brown to pinkish brown, very fine grain, subangular, poorly sorted, with some silt.
			30	SAND, light reddish brown, fine grain, subrounded, well sorted.
			35	
				SAND, light reddish brown, fine grain, subrounded, well sorted, with layers of dark reddish brown quartzite.
				SAND, light reddish brown, fine grain, subrounded, well sorted, moist at 39 feet.
			40	SAND, brown, fine-medium grain, rounded, well sorted, wet, lost regular returns at 48 feet.
			45	
			50	

Develop well (12 gals):
Temp = 77.6° F
pH = 7.65
Cond. = 0.67

TD = 51 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site			**Monitoring Well No. 4s**
	DATE: 6/11/07	REV. NO.: 1		
	AUTHOR: DTL	TECH: DTL		
	DRILLER: Atkins	FILE: \Lithlogs		

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

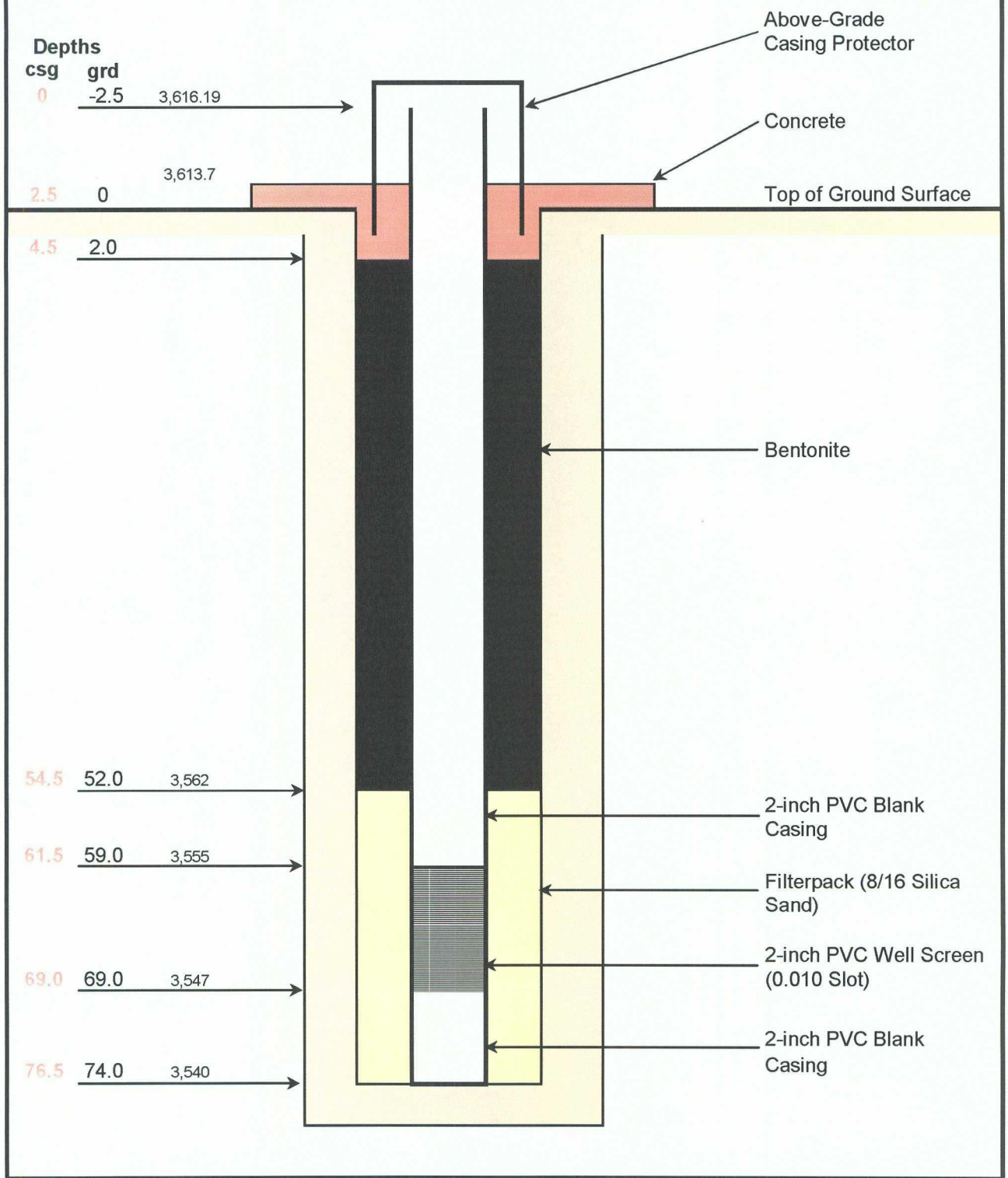
P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-5(d)	TOTAL DEPTH:	74.0 Ft
SITE ID:	Samson Livestock "30"	CLIENT:	Samson Investment Co.
SURFACE ELEVATION:	3,613.7 (Csg= 3,616.19)	COUNTY:	Lea County
CONTRACTOR:	Atkins Engineering	STATE:	New Mexico
DRILLING METHOD:	Hollow-Stem	LOCATION:	T-21-S, R-35-E, Sec. 30 (P)
INSTALLATION DATE:	8/7/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	West of Caliche Pad	FILE NAME:	\Livestock\Lithlogs
COMMENTS:	Lat. 32° 26' 38.9" North, Long. 103° 24' 7.5" West		

Lithology	SAMPLE & PUMP DATA: PHOTO / No Soil Samples Recovered	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
			SILT, grayish brown (top soil).
		5	CALICHE gray, with some light brown silt.
		10	CALICHE AND SILT, light brown to light pinkish brown with some very fine grain sand.
		15	CALICHE AND SILT, light brown to grayish creme.
		20	CALICHE gray, with some light brown silt.
		25	SILT with some Caliche and light brown, very fine grain sand.
		30	
		35	SAND, light brown becoming medium brown with depth, fine grain, subangular, well sorted, moist at 38 ft.
		40	SAND, brown, fine-medium grain, rounded, well sorted, wet, lost regular returns at 48 feet.
		45	
		50	
		55	Develop well (60 gals): Temp = 70.1°F pH = 7.32 Cond. = 0.83
		60	
		65	SILTY SHALE reddish gray,could not recover samples from split spoon but drilling resistance greater in this zone. Samples observed on bottom of drill bit were dry but did not resemble the classic the redbeds found in other wells.
		70	

TD = 74 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



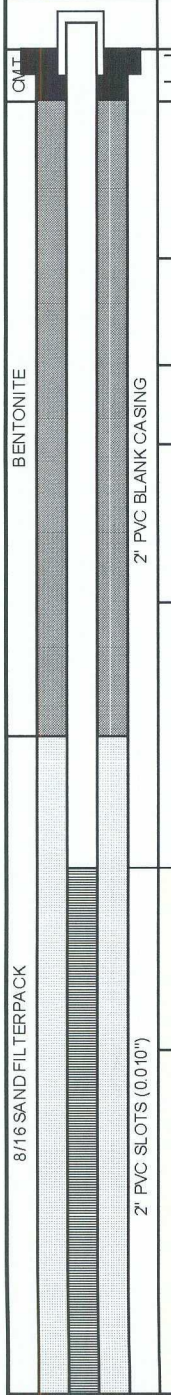
R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site			**Monitoring Well No. 5d**
	DATE: 6/11/07	REV. NO.: 1		
	AUTHOR: DTL	TECH: DTL		
	DRILLER: Atkins	FILE: \Lithlogs		

LITHOLOGIC LOG (MONITORING WELL)

R T Hicks Consultants Ltd

P O Box 7624
Midland, TX 79708
(432) 528-3878

MONITOR WELL NO.:	MW-5(s)	TOTAL DEPTH:	51.0 Ft
SITE ID:	Samson Livestock "30"	CLIENT:	Samson Investment Co.
SURFACE ELEVATION:	3,613.9 (Csg= 3,616.43)	COUNTY:	Lea County
CONTRACTOR:	Atkins Engineering	STATE:	New Mexico
DRILLING METHOD:	Hollow-Stem	LOCATION:	T-21-S, R-35-E, Sec. 30 (P)
INSTALLATION DATE:	8/7/07	FIELD REP.:	Dale Littlejohn
WELL PLACEMENT:	West of Caliche Pad	FILE NAME:	\Livestock\Lithlogs
COMMENTS:	Lat. 32° 26' 39.1" North, Long. 103° 24' 7.5" West		

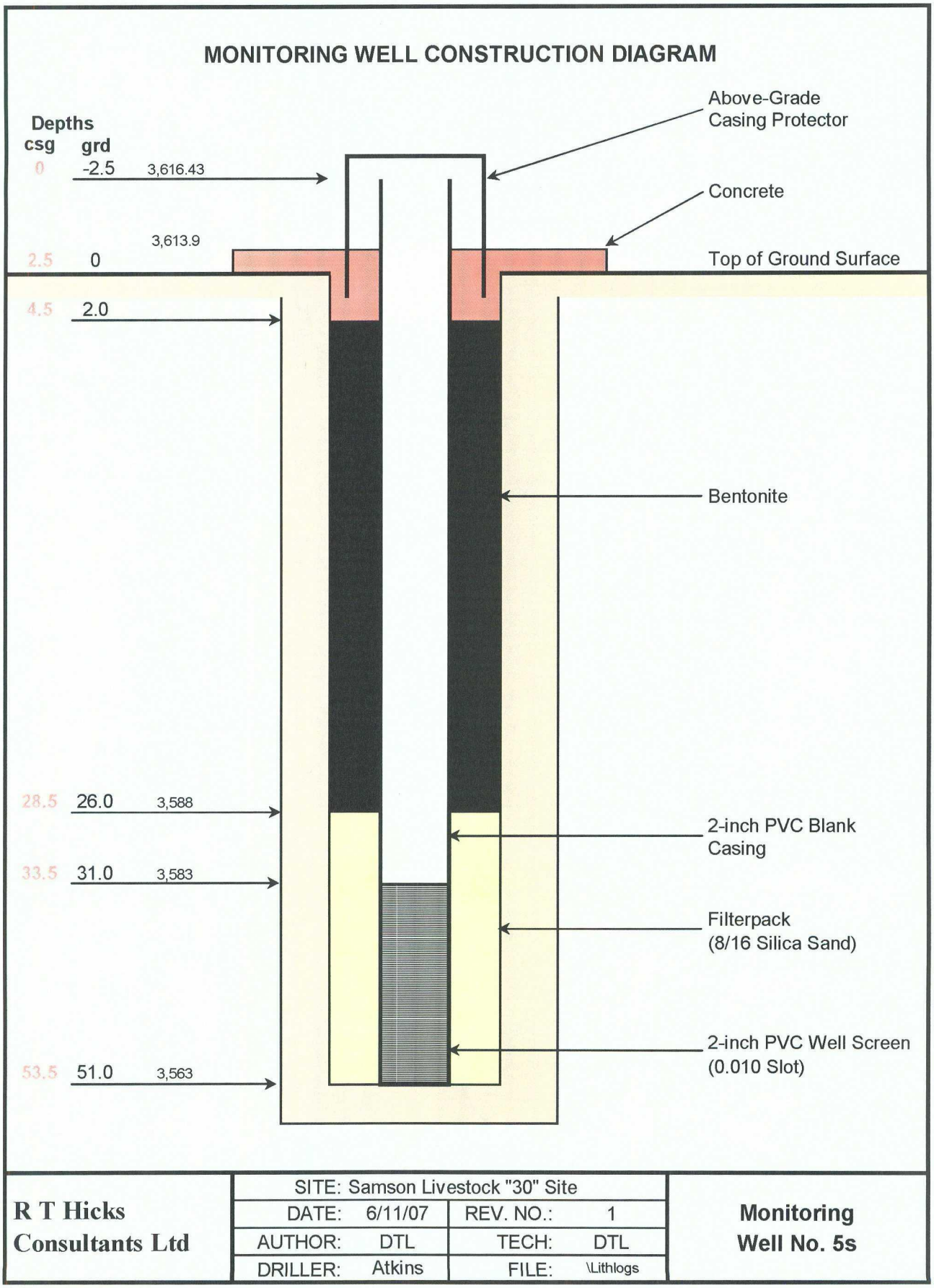


Lithology	SAMPLE & PUMP DATA					DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. DEATURES
	PHOTO	No Soil Samples Recovered					
							SILT, grayish brown (top soil).
						5	CALICHE gray, with some light brown silt.
						10	CALICHE AND SILT, light brown to light pinkish brown with some very fine grain sand.
						15	CALICHE AND SILT, light brown to grayish creme.
						20	CALICHE gray, with some light brown silt.
						25	SILT with some Caliche and light brown, very fine grain sand.
						30	
						35	SAND, light brown becoming medium brown with depth, fine grain, subangular, well sorted, moist at 38 ft.
						40	SAND, brown, fine-medium grain, rounded, well sorted, wet, lost regular returns at 48 feet.
						45	
						50	

Develop well (16 gals):
Temp = 81.0°F
pH = 7.54
Cond. = 0.68

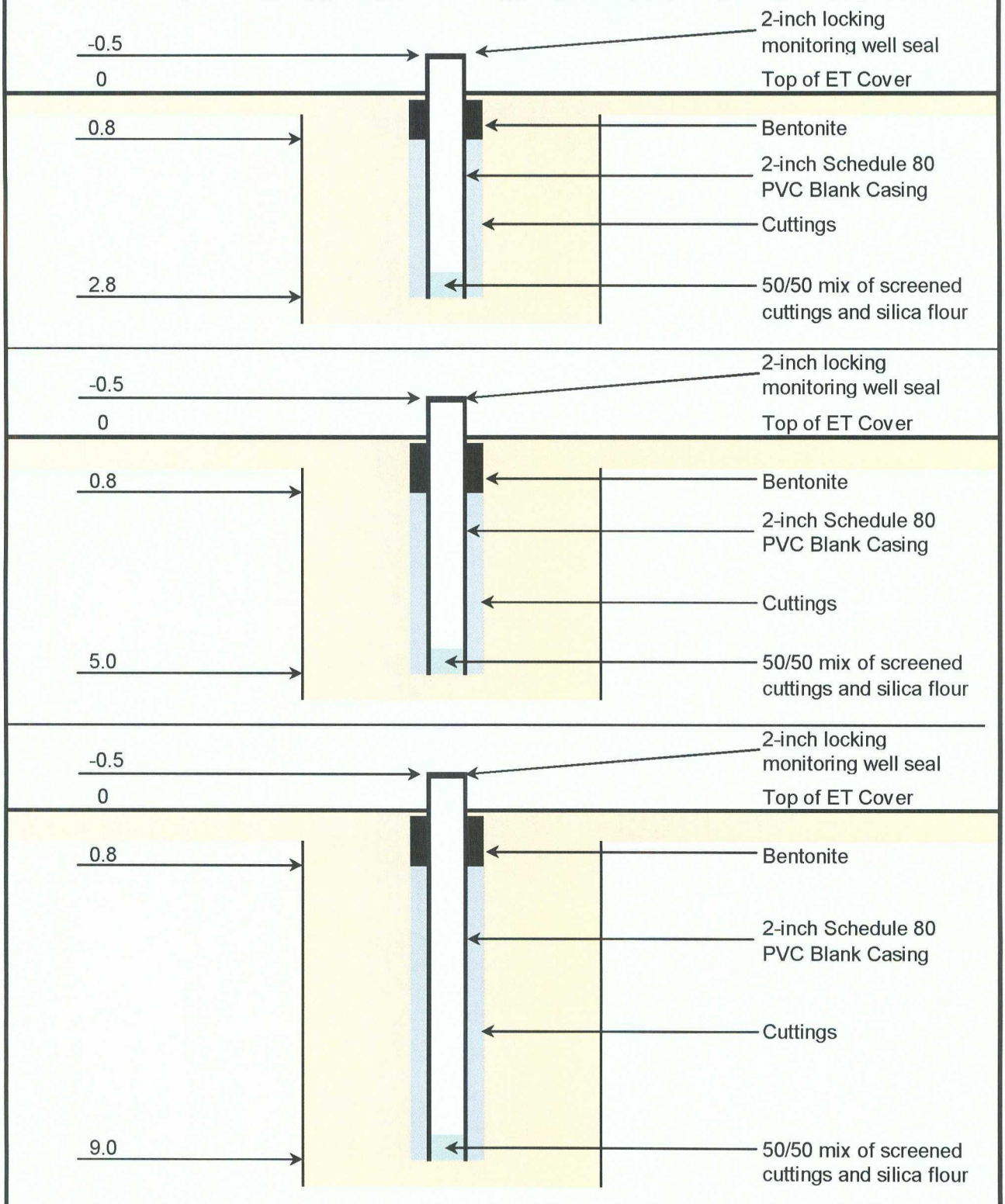
TD = 51 Feet

MONITORING WELL CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site		**Monitoring Well No. 5s**
	DATE: 6/11/07	REV. NO.: 1	
	AUTHOR: DTL	TECH: DTL	
	DRILLER: Atkins	FILE: \Lithlogs	

E.T. PIT COVER VADOSE ZONE ACCESS PORT CONSTRUCTION DIAGRAM



R T Hicks Consultants Ltd	SITE: Samson Livestock "30" Site		**E.T. Pit Cover Proposed Vadose Zone Monitoring Port**
	DATE: 10/12/06	REV. NO.: 1	
	AUTHOR: DTL	TECH: DTL	
	DRILLER: Proposed	FILE: \Lith (10-06)	

Appendix C

Appendix C – Impaired Water: Waste to Resource Plan

Summary

This recycling-reuse plan calls for using impaired ground water for drilling pad and access road construction as well as road dust suppression. In general, field protocols for the use of brackish water to construct roads will adhere to *The Gravel Roads Design and Maintenance Manual* and the chloride loading rate for the use of brackish water will adhere to the protocols outlined in *Dust Control on Low Volume Roads*, both of which can be obtained from the New Mexico Local Transportation Assistance Program (NMDOT).

Highly conservative simulation modeling, which exaggerate the potential impact to ground water, demonstrate that this water use plan will not cause ground water to exceed WQCC Standards at a place of reasonably foreseeable future use. However, the total chloride loading to roads or pads must be lower than that recommended in the above-referenced publications.

Use of Impaired Ground Water

Ground water that cannot be used for drilling an oil or gas well will be used to create the optimal water and chloride content to facilitate construction or repair of the surface layer of a drilling pad or access road or to minimize dust generation from gravel roads. The chloride concentration in the water used for construction or dust suppression must be evaluated in the field then adjusted as necessary to prevent over-loading of salt. In no case will the application of chloride-rich water for construction exceed the 0.2 kg/m^2 total limit established by simulation modeling.

Table 1 shows the water application rate required to produce the appropriate chloride concentration in the surface layer of low volume roads for dust suppression or construction. Four applications of ¼ inch of 10,000 mg/L chloride provide the recommended chloride concentration in the surface layer of the road.

Table 1: Water application calculation

10,000	chloride concentration of water in mg/L
0.25	chloride loading limit for road/pads (kg/m2)
0.006	meters of water applied per application (1/4 inch)
6.4	liters of water applied per square meter per application
0.064	kg of chloride applied per application
3.9	applications of water allowed to reach loading limit

If the mixing of small amounts of produced water from the well with water from the pump-and-use aquifer restoration strategy results in doubling the chloride concentration of residual water, then the water application rate is halved as a result.

The specific protocol for using impaired ground water in lieu of fresh water for drilling fluid make-up water, for road construction or for road dust suppression is:

1. At least one week prior to water use, Samson provides the following information to NMOCD, the surface landowner and/or surface leaseholder:
   a. The dates of the proposed drilling, dust suppression or construction program
   b. The locations of proposed water use
   c. A copy of the most recent ground water analysis from the recovery wells
   d. The name and address of the contractor performing the water hauling or application
   e. The phone numbers of the Samson representative and the contractor's representative
2. For each truckload of water, the contractor will record the date, time and location of water use.
3. Annually Samson will provide NMOCD and the Office of the State Engineer with a copy of the manifests associated with the water use and the quantity of water used.

Simulation Modeling

The simulation of the application of chloride to drill pads and roads used the input data described below.

HYDRUS INPUTS

Soil Profile - The vadose zone profile is 40 feet thick at the site. The vadose zone was assumed to consist of two-feet of loose silt loam overlying 38-feet of a sandy loam. This vadose zone texture, used in the HYDRUS-1D modeling, is considered highly conservative of ground water quality as these materials feature hydraulic conductivities greater than or equal to those present in the area.

Dispersion lengths - The model employed a dispersion length of 5% of the model length. Standard practice calls for employing a dispersion length that is 10% of the model length. The smaller dispersion length than "standard" causes the model to exaggerate the maximum chloride concentrations within the vadose zone compared to the standard method.

Climate - Weather data used in calculation of the initial condition and the predictive modeling was from the Pearl, New Mexico Weather Station approximately 15 miles north of the site. The weather data spans the 46 5 year period from July, 1946 to December 1992,

HYDRUS-1D can also employ a uniform yearly infiltration rate that will obviously smooth the temporal variations. However, because the atmospheric data are of high quality and nearby to the site, it is conservative of ground water quality to use this data as the surface input to HYDRUS-1D. This choice results in higher peak chloride concentrations in ground water due to temporally variable high fluxes from the vadose zone into ground water.

Soil Moisture - Because soils are relatively dry in this climate and vadose zone hydraulic conductivity varies with moisture content, it is important that simulation experiments of different remedial strategies begin with representative soil moisture content.

Commonly, the calculation of soil moisture content begins with using professional judgment as an initial input and then running sufficient years of weather data through the model to establish"steady state" moisture content.

To create the initial soil moisture content for this simulation, a simulation of moisture content was performed on the entire soil column. As only minimal changes in the HYDRUS-1D soil moisture content profile occurred after year 6 of the initial condition calculation., 46.5 years (1 cycle of the weather data) was considered sufficient to establish an initial moisture condition. We then allowed near saturation of the top surface of the vadose zone to simulate the application of chloride water or wet cuttings for the construction of the roads and pads.

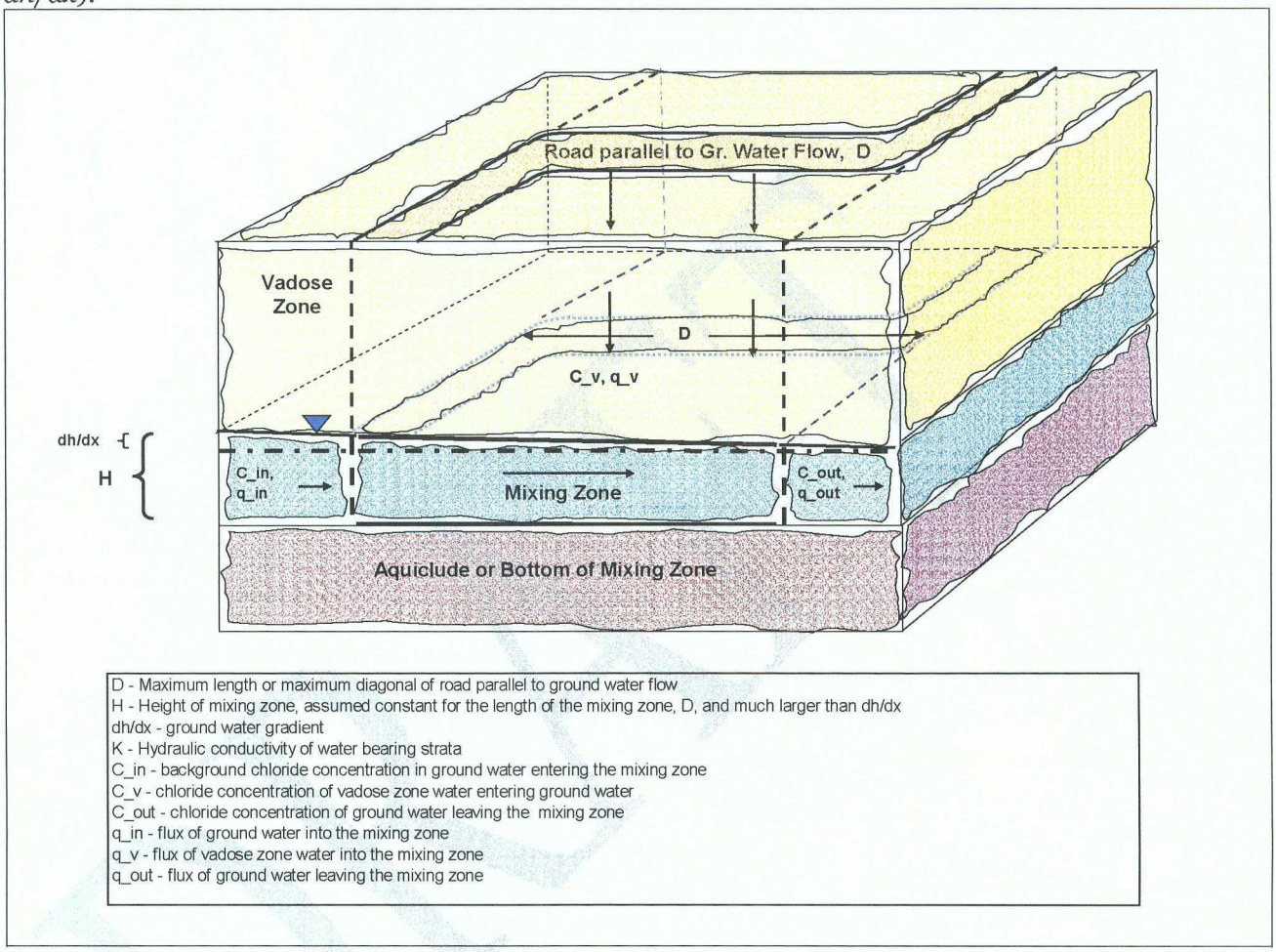
MIXING MODEL INPUTS

As described in API Publication 4734, the ground water mixing model takes the background chloride concentration in ground water multiplied by the ground water flux to calculate the total mass of ground water chloride entering the ground water mixing cell, which lies below the area of interest. The chloride and water flux from HYDRUS-1D is added to the ground water chloride mass and flux to create a final chloride concentration in ground water at a conceptual monitoring well located at the down gradient edge of the mixing cell (the down gradient end of the road segment). A schematic diagram of these inputs is shown in Figure 1.

Influence Distance (D) - The influence distance is defined as the maximal length of the application parallel to ground water flow direction. For these simulations, this distance can be taken as the longest section of road or production pad parallel to ground water flow.

Background Chloride Concentration (C_in) based upon professional judgment; a value of 75 mg/L chloride for ground water was used at this location. Although background chloride concentration in the immediate area of the site is about 50 mg/L, application of water for dust suppression or construction of pads and roads could be in an area distance from the site.

Figure 1: HYDRUS-1D input to the mixing zone is the chloride flux through time (C_v(t) x q_v(t)). Mixing Model inputs include the entering ground water chloride flux (C_in x q_in) and aquifer properties and dimensions (K, D, H, and dh/dx).



Hydraulic Conductivity (K) - Freeze and Cherry (1979) list hydraulic conductivities for clean sands as 10 feet/day to more than 2,500 feet/day. Silty sands have hydraulic conductivities of 0.03 feet/day to 300 feet/day. To be conservative of ground water quality, the saturated hydraulic conductivity of the uppermost saturated zone is assumed as 2 feet/day (0.61 m/day), within the range of a silty sand and slightly higher than that measured for the lower portion of the aquifer at the site but within the range of values we believe probable for the upper portion of the underlying aquifer. Selecting a relatively low hydraulic conductivity as an input reduces the amount of natural dilution that would take place beneath the application sites and is conservative of ground water quality.

Groundwater Gradient (dh/dx) – Because there is available well data to compute a ground water gradient in the area, a representative gradient of 0.001 was used within the predictive modeling. .

Aquifer Thickness (H) - A restricted aquifer thickness of 20 feet was employed in the mixing model as a conservative measure. The saturated thickness of the alluvial aquifer in the area is about 40-feet and our experience shows that chloride is typically dispersed throughout an aquifer within a short distance from a release or application site. Therefore the selection of a 20-foot thick mixing zone is conservative of ground water quality.

For all variables for which field data did not exist, assumptions conservative of ground water quality were made. A summary of the input parameters and a description of the source information used in the HYDRUS-1D model for this application are provided in Table 1 below.

Table 1: Modeling Inputs for the Pilot Application Predictive Modeling

Input Parameter	Source
Vadose Zone Thickness - 40 feet	Conservative assumption
Vadose Zone Texture (sand with loam surface)	Conservative assumption
Dispersion Length - 7.5% or less of model length	Professional judgment to be conservative of ground water quality
Climate - Daily Data	Pearl N.M. Weather Station data (near Hobbs)
Soil Moisture	HYDRUS-1D initial condition simulation plus chloride moisture application
Initial soil chloride concentration profile and Application schedule	Vadose zone profile set to 0.0 mg/L then allow one chloride application of 0.25kg/m2.
Aquifer Thickness - 20 feet	Conservative assumption
Background Chloride in Ground Water - 75 mg/L	Professional Judgment
Ground Water Flux - 0.002 feet/day	Calculated from saturated hydraulic conductivity and slope of topography
Length of Road/Pad parallel to ground water flow - 300 feet	to demonstrate effects of road segments or pad orientations parallel to ground water

RESULTS OF SIMULATION

Figures 2 and 3 are graphs of chloride concentration in a well located at the down gradient edge of a production pad or road segment which has received applications of brackigh water at a chloride loading rate of 0.25 kg/m^2 (for production pads) or 1.5 kg/m^2 (for a road parallel to ground water flow)

Figure 2 shows that the predicted chloride concentration in ground water down gradient from a 300 foot by 300 foot production pad is below the WQCC Standard of 250 mg/L.

Figure 2: Predicted Chloride Concentration in the Aquifer Beneath a Production Pad (Sandy Loam).
Chloride loading is 0.25 kg/m^2, Dimension of Pad Parallel to Ground Water Flow is 300 feet.

Figure 3 uses a higher chloride loading rate of 0.5 kg/m^2 in the simulation but the 30-foot wide road runs parallel to ground water flow. Although the chloride load is greater than in the pad construction simulation, the small length of the application parallel to ground water flow limits the mass of chloride that will enter the aquifer due to deep percolation.

Figure 3: Predicted Chloride Concentration in the Aquifer Beneath a Road (Sandy Loam).
Chloride loading is 0.5 kg/m^2, Dimension of Road Parallel to Ground Water Flow is 30 feet.

Finally, we believe that the loose sandy loam greatly overestimates the impact to ground water relative to the compacted road surface that would be present at the site.

Potential Impact on Surface Water

We do not anticipate any impact to surface water. The mass of chloride and other constituents added to the roads during construction and maintenance (dust suppression) is miniscule relative to the mass of water generated in the area during a large precipitation event. Monitoring the edges of the roads/pads will verify this conclusion.