1R - 425-88

WORKPLANS

Date:
12-27-10

Rice Environmental Consulting & Safety
P.O. Box 5630 Hobbs, NM 88241
Phone 575.393.4411 Fax 575.393.0293

CERTIFIED MAIL
RETURN RECIEPT NO. 7009 1680 0001 6619 6378

December 27th, 2010

Mr. Edward Hansen
New Mexico Energy, Minerals, & Natural Resources
Oil Conservation Division, Environmental Bureau
1220 S. St. Francis Drive
Santa Fe, New Mexico 87505

RE: **ICP REPORT and Corrective Action Plan Request**
Rice Operating Company – Vacuum SWD System
Vacuum D-31 EOL (1R425-88): UL/D sec. 31 T17S R35E

Mr. Hansen:

RICE Operating Company (ROC) has retained Rice Environmental Consulting and Safety (RECS) to address potential environmental concerns at the above-referenced site in the abandoned Vacuum Salt Water Disposal (SWD) system. ROC is the service provider (agent) for the Vacuum SWD System and has no ownership of any portion of the pipeline, well, or facility. The system is owned by a consortium of oil producers, System Parties, who provide all operating capital on a percentage/usage basis.

Background and Previous Work
The site is located approximately 0.3 miles south of Buckeye, New Mexico at UL/D sec. 31 T17S R35E as shown on the Site Location Map (Figure 1).

In 2009, ROC initiated work on the former Vacuum D-31 EOL junction box as part of the system abandonment. The site was delineated using a backhoe to form an excavation with dimensions 30x25x12-ft deep and soil samples were screened at regular intervals for both hydrocarbons and chlorides. A 4-wall, bottom, and blended backfill composite sample was collected from the excavation for laboratory verification. Laboratory results yielded negligible concentrations of gasoline range organics (GRO) and diesel range organics (DRO) in all samples. Chloride concentrations were confirmed at 672 mg/kg in the 4-wall composite, 1,200 mg/kg in the bottom composite, and 720 mg/kg in the blended backfill composite. The blended excavated soil (blended backfill composite) was returned to the excavation up to 5 feet below ground surface (bgs). A 5 foot deep shelf was excavated 5 feet further in each direction in preparation for a clay barrier. At 5 ft below ground surface (bgs), a 40x35 ft clay barrier was installed with a compaction test performed on May 21, 2009 (Appendix A). The remaining blended excavated soil was blended with clean, imported soil and placed over the clay barrier. Laboratory analysis of the blended backfill II composite confirmed a chloride concentration of 256 mg/kg. The area was contoured to the surrounding landscape, seeded, and an identification

plate was placed on the surface of the site to mark its location for future environmental considerations. NMOCD was notified of potential groundwater impact on March 12, 2009 and a junction box disclosure report was submitted to NMOCD with all the 2009 junction box closures and disclosures.

To further investigate depth of chloride, one soil bore was initiated at the site on June 19, 2009. Field chloride concentrations decreased with depth, which was confirmed by laboratory analysis of the 35 foot (1,500 mg/kg) and the 80 ft (272 mg/kg) samples. TPH (GRO and DRO) concentrations were negligible in both samples (Appendix B). The entire borehole was plugged with bentonite to the ground surface.

On behalf of ROC, RECS submitted an Investigation and Characterization Plan (ICP) to the NMOCD on October 26, 2010. The plan proposed additional investigative and characterization work at the site to determine if there is potential for groundwater degradation from residual chlorides at the site, as summarized below:

1. Using site specific data, a conservative chloride migration model will be used to determine if unsaturated chloride transport through the vadose zone would cause the underlying groundwater to exceed 250 mg/L in the future.
2. A visual inspection of the site will be conducted to determine if soil restoration is required to promote re-vegetation of the ground surface. Depending on the findings, the appropriate steps will be taken to re-vegetate the site. Vegetation acts as a 'natural infiltration barrier' because plants capture water through their roots, reducing the volume of water infiltrating below the root zone.
3. Collect regional hydrogeologic data to verify depth to groundwater in the area of this site. A one-half mile well inventory will be performed. The water well inventory will include a review of water well records listed on the New Mexico State Engineer Office and the United States Geologic Survey (USGS) websites.

ICP Investigative Results

As part of the Investigation and Characterization Plan approved by NMOCD on October 28, 2010, a conservative chloride migration model was utilized on the Vacuum D-31 EOL site to determine what, if any, affect the residual chlorides in the soil would have on the groundwater immediately beneath the site. The average contributed chloride concentration in the 20 ft interval above the water table (at approximately 80 ft, conservatively estimated based on the last sample collected from the soil bore) was 442 mg/kg minus the measured background chloride concentration of 194 mg/kg for a concentration of 248 mg/kg. It is estimated that the residual chlorides will decline at a rate of 1.6% per year, based upon an estimated rate of downward movement of 0.1 m/yr. Assuming an initial, background groundwater chloride concentration of 100 mg/kg (which is believed to be generally representative of groundwater in the Vacuum area), the estimated chloride concentration in groundwater beneath the site is projected to rise to approximately 180 mg/kg over the next few years and to then decline steadily over time (Appendix C).

Regional hydrogeologic data was collected from the New Mexico State Engineer Office and the United States Geologic Survey (USGS) websites. The data collected shows that there are two wells within a one-half mile radius from the site. An average depth to groundwater determined from wells in the one-half mile radius indicate that groundwater is approximately at 117 ft below ground surface (Appendix D).

Corrective Action Plan

Our recommended corrective action for the site is to import clean soil which will be blended with hay, peat moss, and organic compost and spread over the site. The material will be tilled in, and contoured to the surrounding area. Silk net fencing will be installed and the site seeded with native vegetation. The resultant vegetation will provide an infiltration barrier that will limit migration of constituents to groundwater. Plants capture water through their roots, thereby reducing the amount of water infiltrating through the root zone and carrying constituents through the vadose zone to groundwater.

Upon completion of the Corrective Action Plan, we anticipate that ROC will submit a written report that will request "remediation termination" for the site.

RECS appreciates the opportunity to work with you on this project. Please call Hack Conder at (575) 393-9174 or me if you have any questions or wish to discuss the site.

Sincerely,

Lara Weinheimer
Project Scientist
RECS
(575) 441-0431

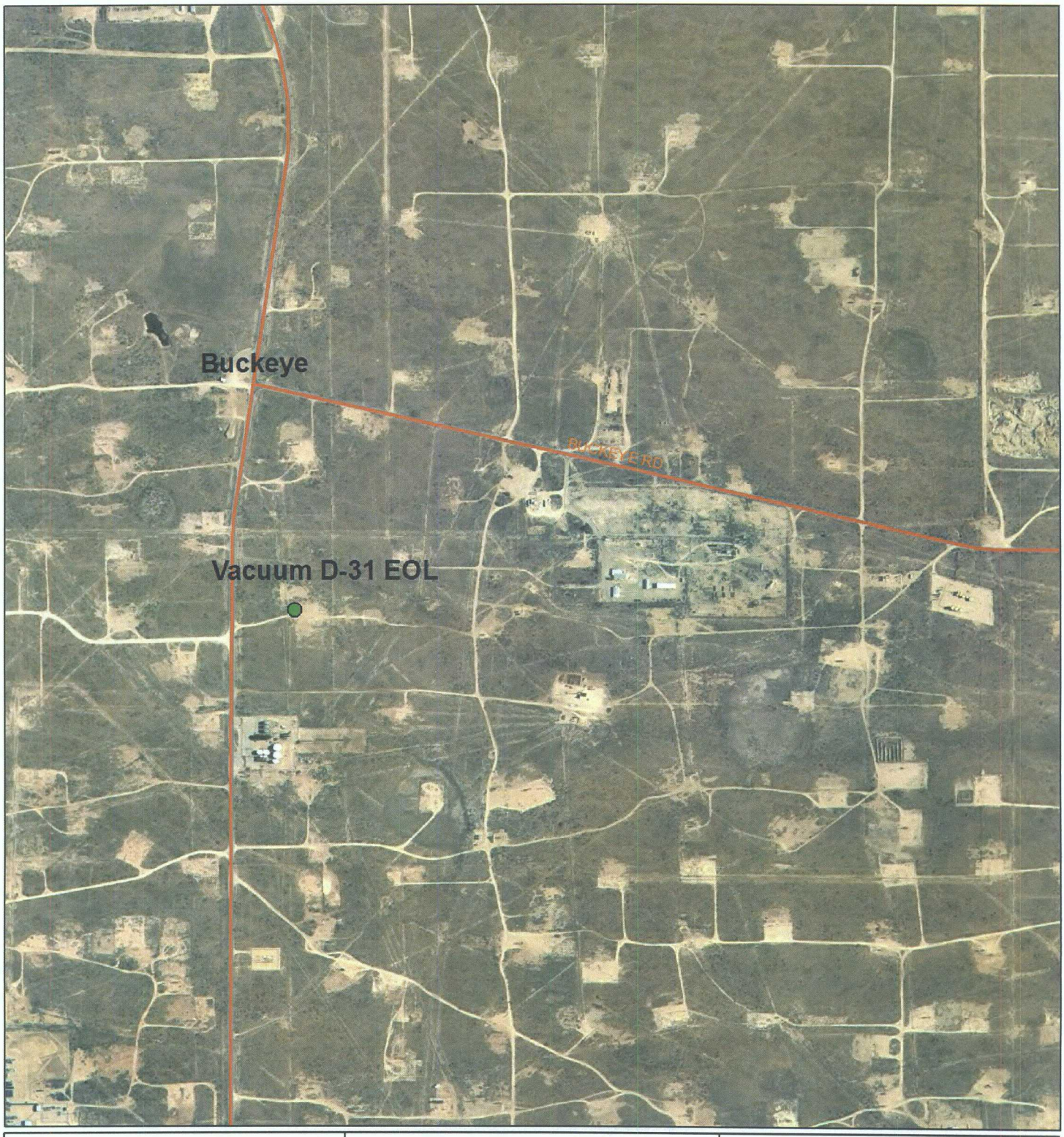
Attachments:

- Figures - Site location map
- Appendix A – Clay Barrier
- Appendix B – Soil Bore Log
- Appendix C – Chloride Migration Model
- Appendix D – Regional Hydrogeologic Data

Figures

RICE Environmental Consulting and Safety (RECS)
P.O. Box 5630 Hobbs, NM 88241
Phone 575.393.4411 Fax 575.393.0293

Site Location



RICE ENVIRONMENTAL RECS CONSULTING & SAFETY, LLC

Vacuum D-31 EOL

Legals: UL/D sec. 31
T17S R35E
NMOCD Case #: 1R425-88

FIGURE 1

0 500 1,000 2,000 Feet

Drawing date:
Revision date:
Drafted by:

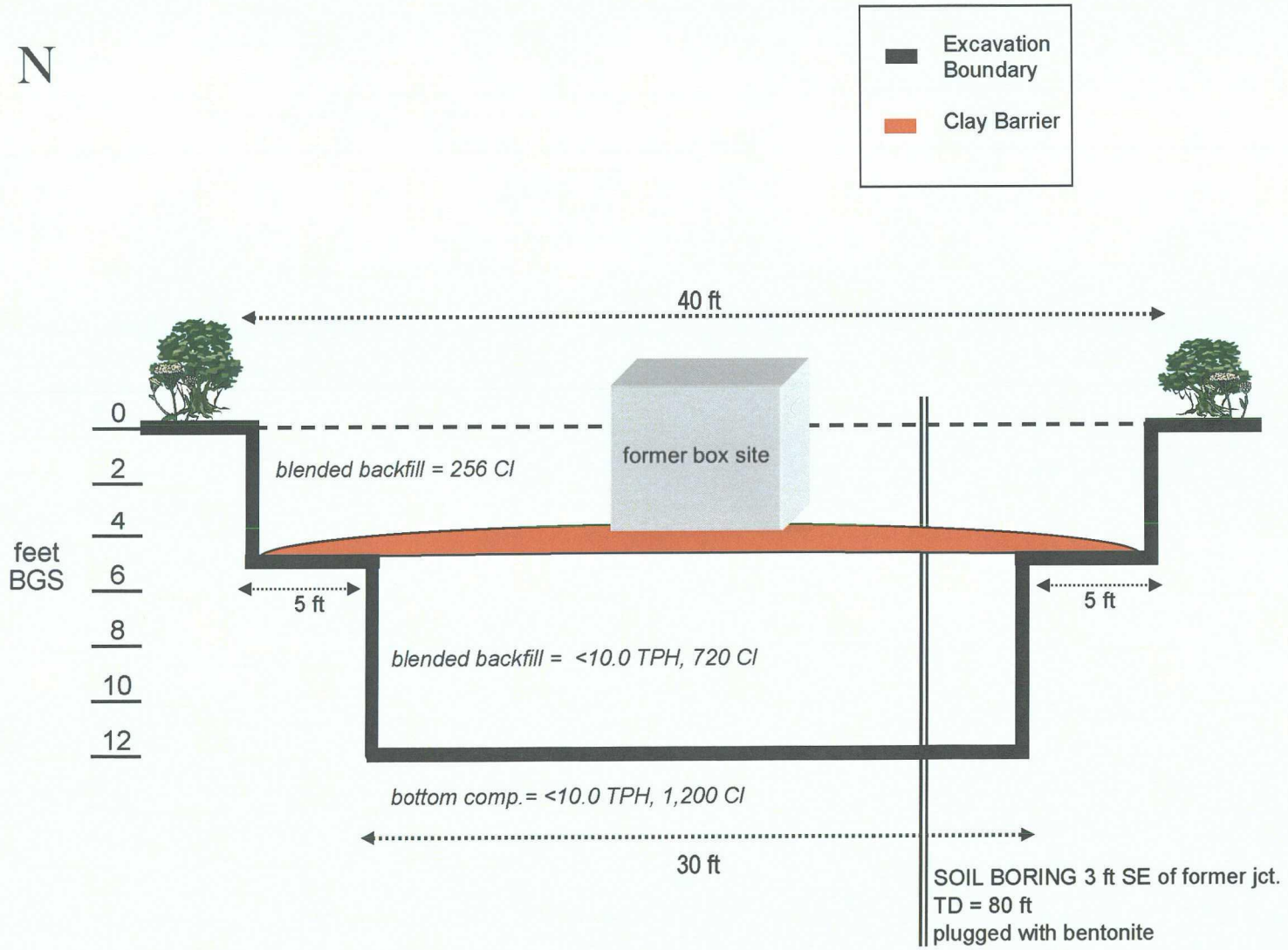
Appendix A

Clay Barrier

RICE Environmental Consulting and Safety (RECS)
P.O. Box 5630 Hobbs, NM 88241
Phone 575.393.4411 Fax 575.393.0293

Vacuum D-31 EOL
Unit 'D' Sec. 31, T17S, R35E

Excavation Cross-Section

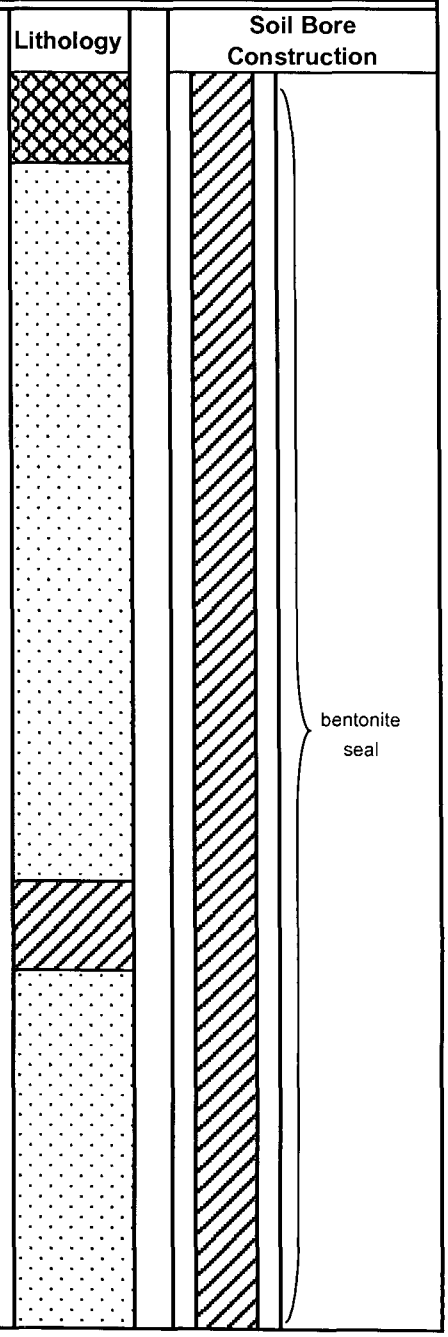


Appendix B
Soil Bore Log

RICE Environmental Consulting and Safety (RECS)
P.O. Box 5630 Hobbs, NM 88241
Phone 575.393.4411 Fax 575.393.0293

Logger:	Lara Weinheimer	**Client:** RICE Operating Company	**Well ID:** SB - 1
Driller:	Harrison & Cooper, Inc. Drilling		
Drilling Method:	Air rotary	**Project Name:** Vacuum D-31 EOL	
Start Date:	6-19-09		
End Date:	6-19-09	**Location:** Vacuum SWD System unit 'D' Sec.31 T17S, R35E Lea County, NM	
Comments: Located: 3 ft SE of the former junction box site TD = 80 ft GW = ~117 ft			

Depth (feet)	chloride field tests	PID	Description
			10 - 15 ft
			VERY FINE TO FINE SAND, ROCKY
15	861	0	light brown, caliche, chert, sandstone, dry
20	871	0	
25	844		15 - 45 ft
			VERY FINE TO FINE SAND
			light brown, dry
30	1393		
35	1412		
LAB	1500	GRO < 10	
		DRO < 10	
40	1338		
45	997		
			45 - 55 ft
			VERY FINE TO FINE SAND
50	1101		light brown, slightly moist
55	779		
			55 - 60 ft
			VERY FINE TO FINE SAND, QUARTIZE
60	525		reddish-brown, moist
			60 - 70 ft
65	531		VERY FINE TO FINE SAND
			reddish-brown, moist
70	510		
			70 - 75 ft
			VERY FINE TO FINE SAND
75	425		reddish-brown, slightly moist
			75 - 80 ft
			VERY FINE TO FINE SAND
80	300		reddish-brown, moist
LAB	272	GRO < 10	
		DRO < 10	



Appendix C

Chloride Migration Model

RICE Environmental Consulting and Safety (RECS)
P.O. Box 5630 Hobbs, NM 88241
Phone 575.393.4411 Fax 575.393.0293

Chloride Transport Model (CTM)

Date:

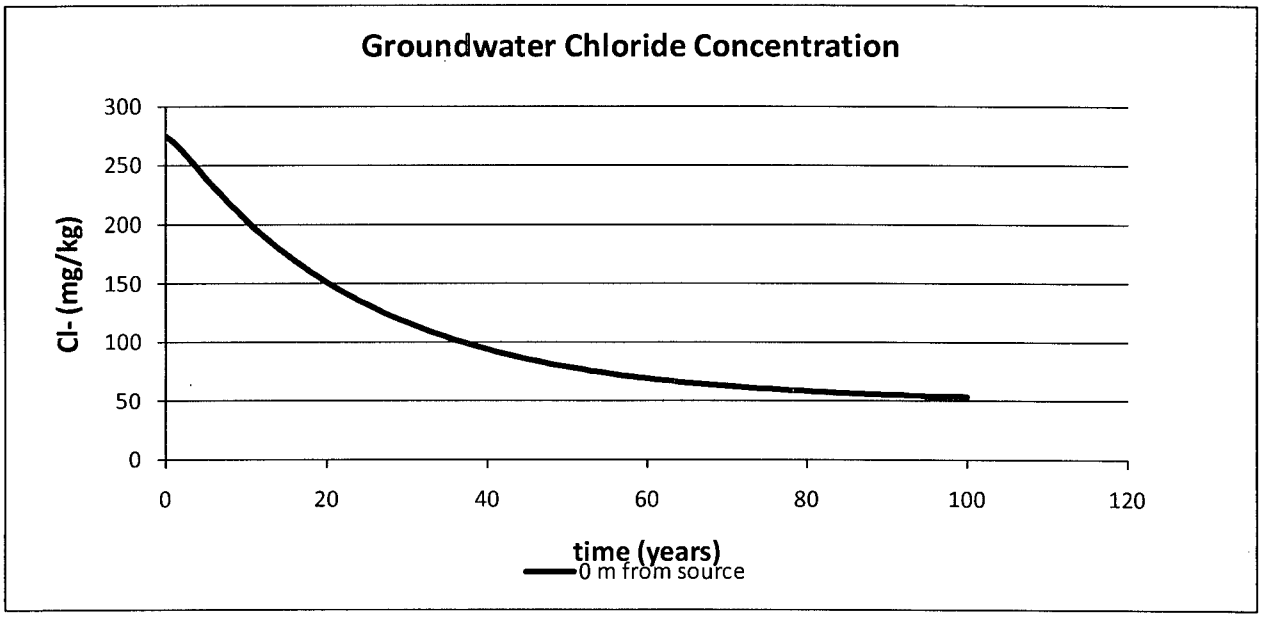
Unsaturated Zone Inputs

Parameter	Unit	Value	Notes
equivalent length (in direction of gw flow) of affected area	m	9.1	measured (equivalent to 30x30-ft)
equivalent width (perpendicular to gw flow) of affected area	m	9.1	measured/estimated
affected unsaturated zone thickness	m	6.1	measured/estimated
depth to water table	m	24.4	measured/estimated
avg Cl- conc of affected soil	mg/kg	442	measured/estimated
est. natural background Cl- conc	mg/kg	194	measured
unsat zone mass density	kg/m3	2,000	estimated/assumed
rate of Cl- percolation	m/yr	0.25	estimated/assumed

Saturated Zone Inputs

Parameter	Unit	Value	Notes
upgradient (baseline) Cl- conc	mg/kg	50	assumed (typical GW quality in Vacuum)
initial Cl- conc (Co)	mg/kg	275	asssumed (fit to model)
thickness of affected aquifer	m	3.0	prescribed by NMOCD (10 ft)
aquifer porosity	per cent	25%	estimated/assumed
rate of groundwater movement	m/yr	5.00	estimated/assumed

Year multiplier for graphical output 2

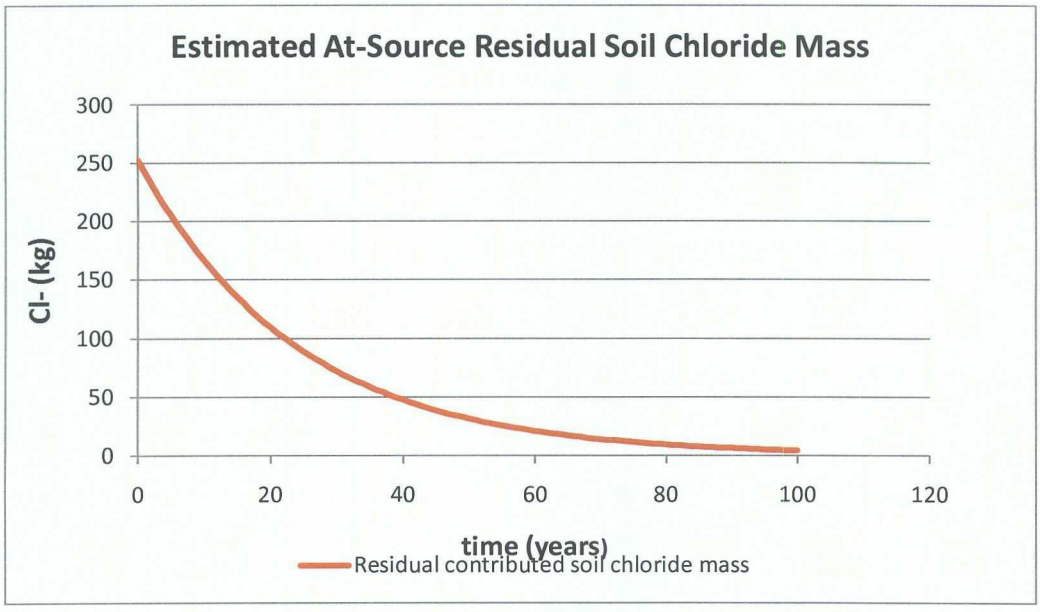

Groundwater Chloride Concentration
Cl- (mg/kg)
300
250
200
150
100
50
0
0
20
40
60
80
100
120
time (years)
0 m from source

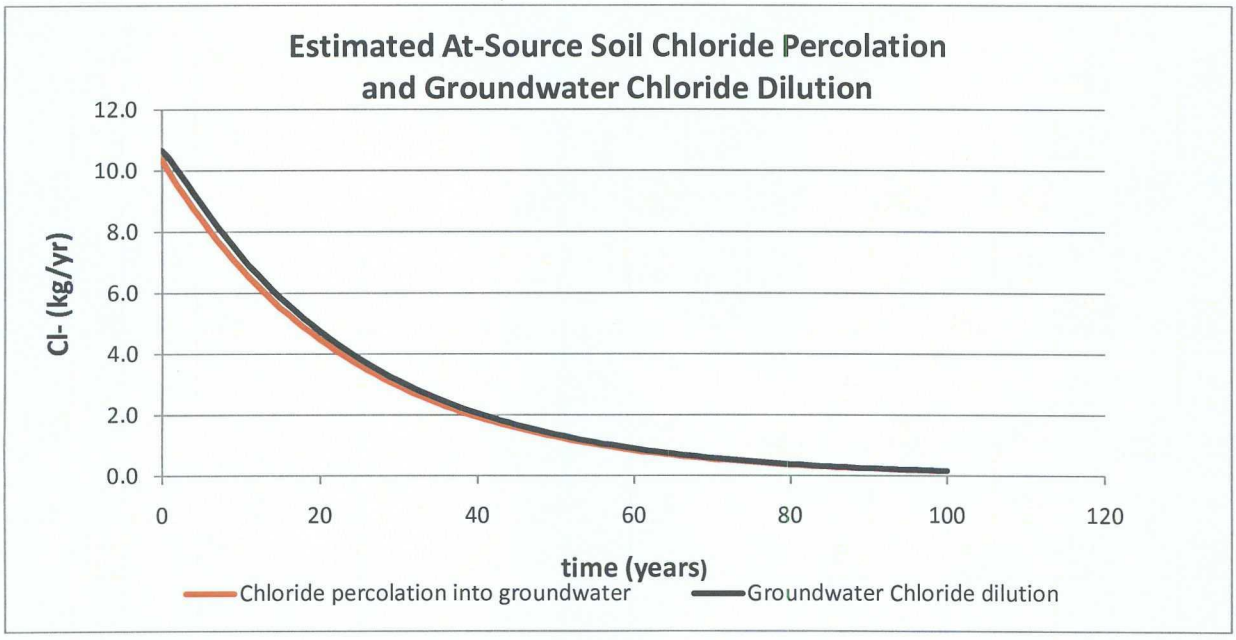
Unsaturated Zone Calculated Parameters

Parameter	Unit	Value	Notes
affected area	m2	84	
volume of affected soil	m3	510	
total mass of affected soils	kg	1,020,075	
Cl- conc attributed to source	mg/kg	248	
mass of contributed residual soil chloride	kg	253	
annual decline in residual chloride	per cent	4.1%	

Saturated Zone Calculated Parameters

Parameter	Unit	Value	Notes	
total volume of affected aquifer	m3	255		
sat volume of initial affected aquifer volume	m3	64		
mass of affected aquifer volume	kg	63,713		
initial Cl- mass in affected aquifer volume	kg	18		
annual dilution attenuation factor (DAF) in affected aquifer volume	per cent	54.7%		0.5
time for plume center to travel 100 meters	yrs	20.0		
time for gw cross section to traverse affected area	yrs	1.8		


Estimated At-Source Residual Soil Chloride Mass
300
250
200
150
100
50
0
Cl- (kg)
0
20
40
60
80
100
120
time (years)
Residual contributed soil chloride mass


Estimated At-Source Soil Chloride Percolation and Groundwater Chloride Dilution
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Cl- (kg/yr)
0
20
40
60
80
100
120
time (years)
Chloride percolation into groundwater
Groundwater Chloride dilution

Appendix D

Regional Hydrogeologic Data

RICE Environmental Consulting and Safety (RECS)
P.O. Box 5630 Hobbs, NM 88241
Phone 575.393.4411 Fax 575.393.0293

Vacuum
SWD System

D-31 EOL
site name

D	31	T17S	R35E
Unit Letter	Section	Township	Range

Groundwater Depth: 117 ft

Compiled by: Lara Weinheimer Date: 4/16/2009

Comments:

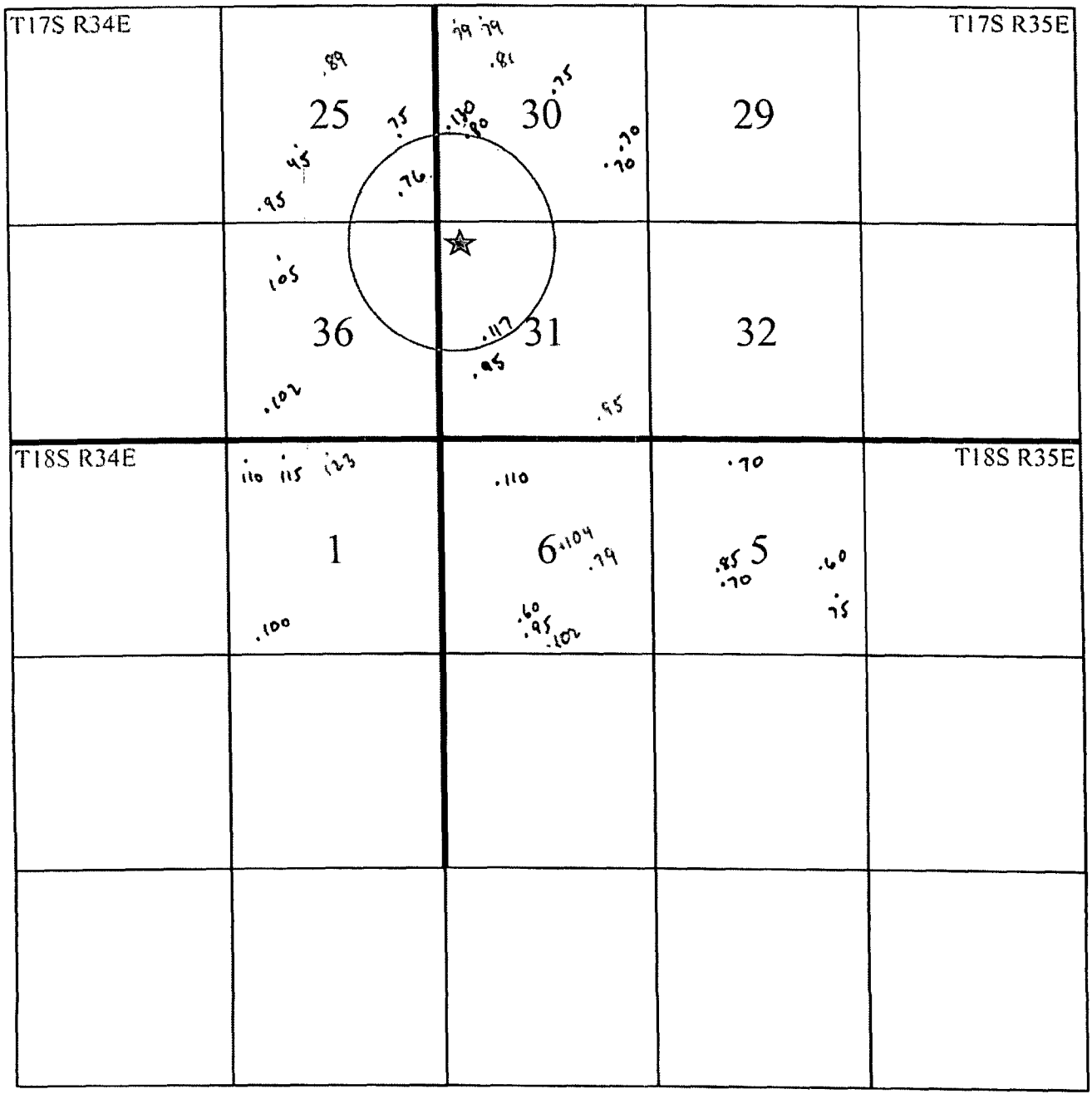
= Wells of unknown use (USGS)

= ROC wells

= Non-production wells (commercial, sanitation, domestic, stock)

= section (1 sq. mile)

= Subject Site



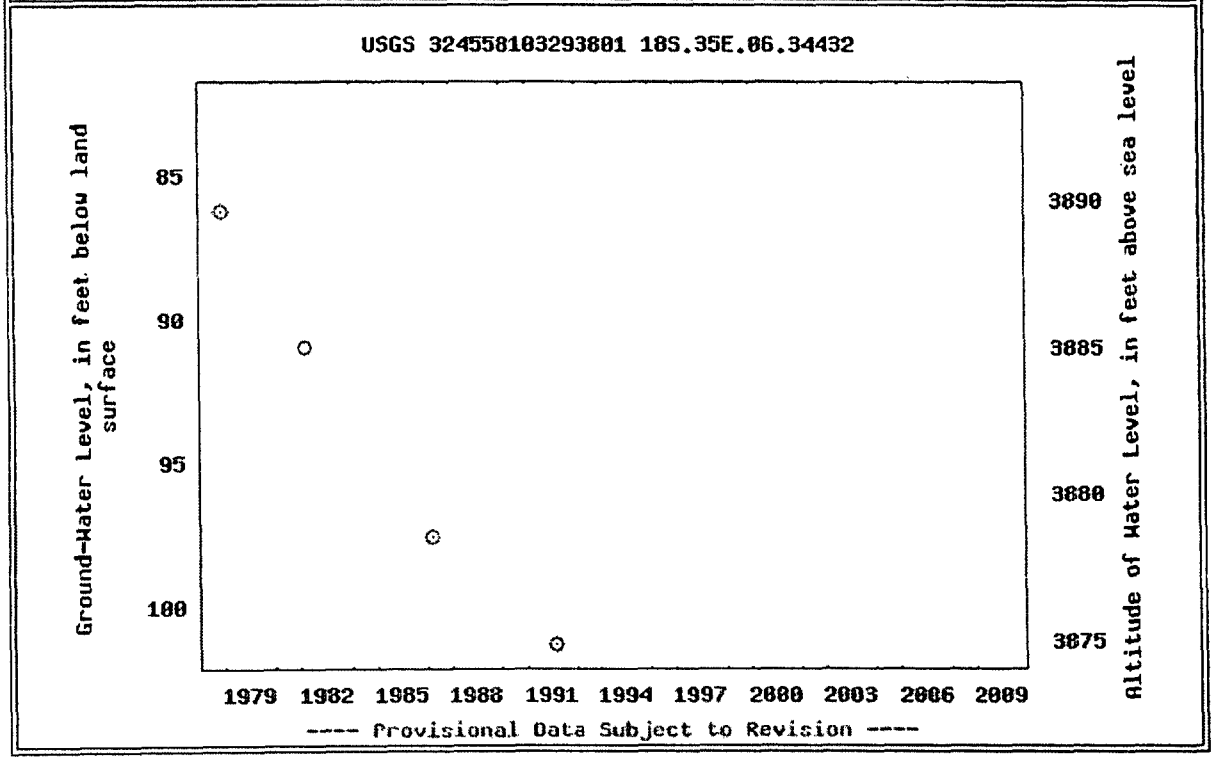
USGS 324558103293801 18S.35E.06.34432

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code
Latitude 32°46'13", Longitude 103°29'52" NAD27
Land-surface elevation 3,976.00 feet above sea level
NGVD29
The depth of the well is 150 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



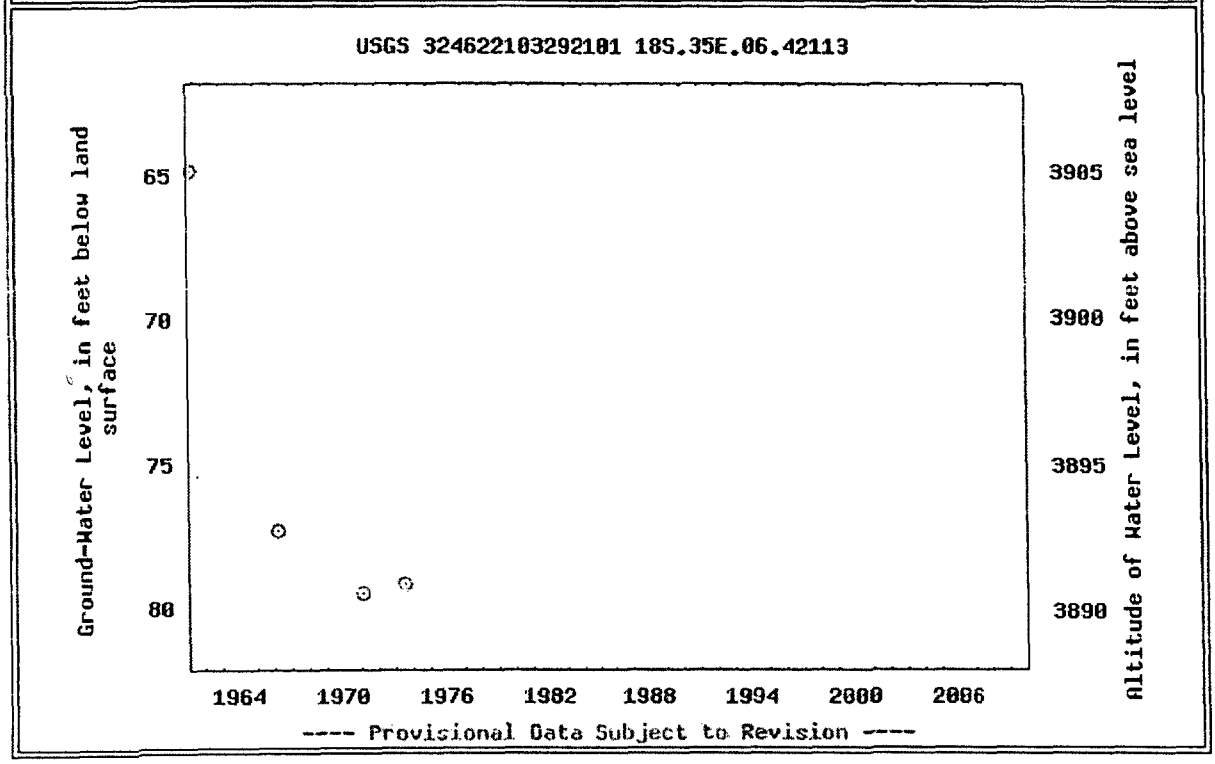
USGS 324622103292101 18S.35E.06.42113

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 13070007
Latitude 32°46'34", Longitude 103°29'31" NAD27
Land-surface elevation 3,970.00 feet above sea level
NGVD29
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



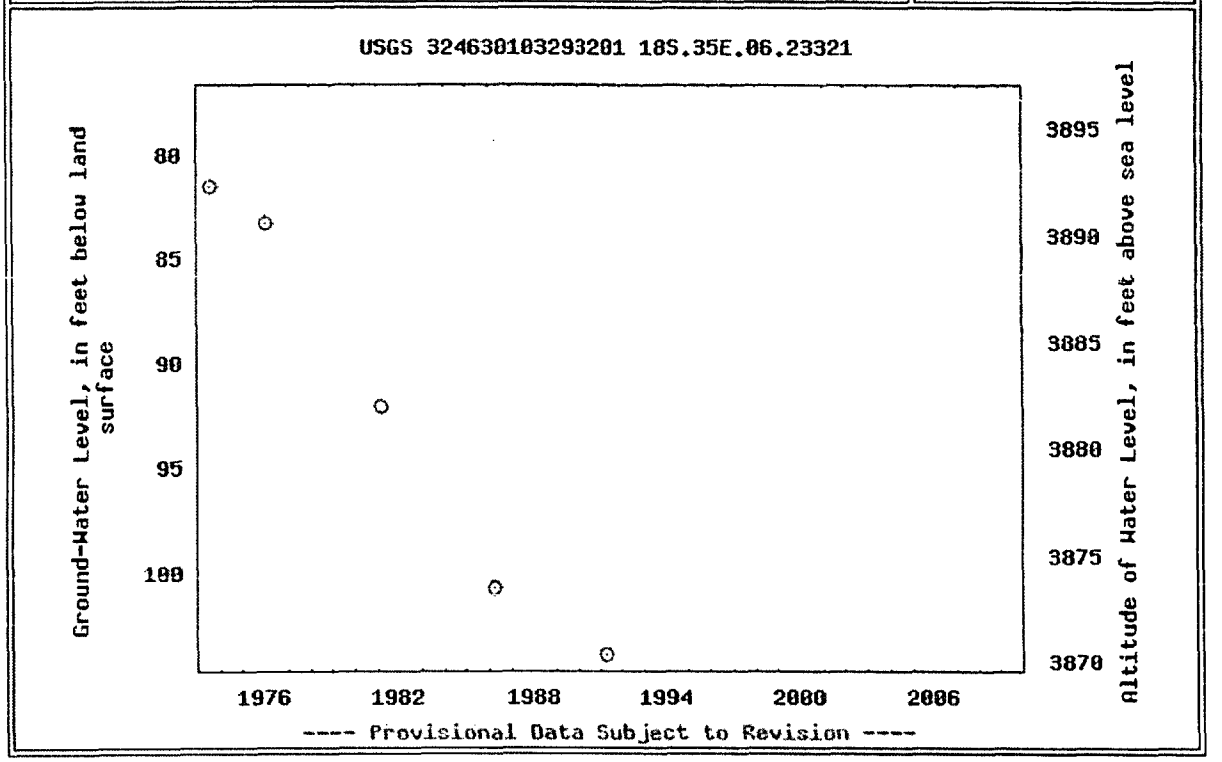
USGS 324630103293201 18S.35E.06.23321

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 13070007
Latitude 32°46'42", Longitude 103°29'43" NAD27
Land-surface elevation 3,974.00 feet above sea level
NGVD29
The depth of the well is 147 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



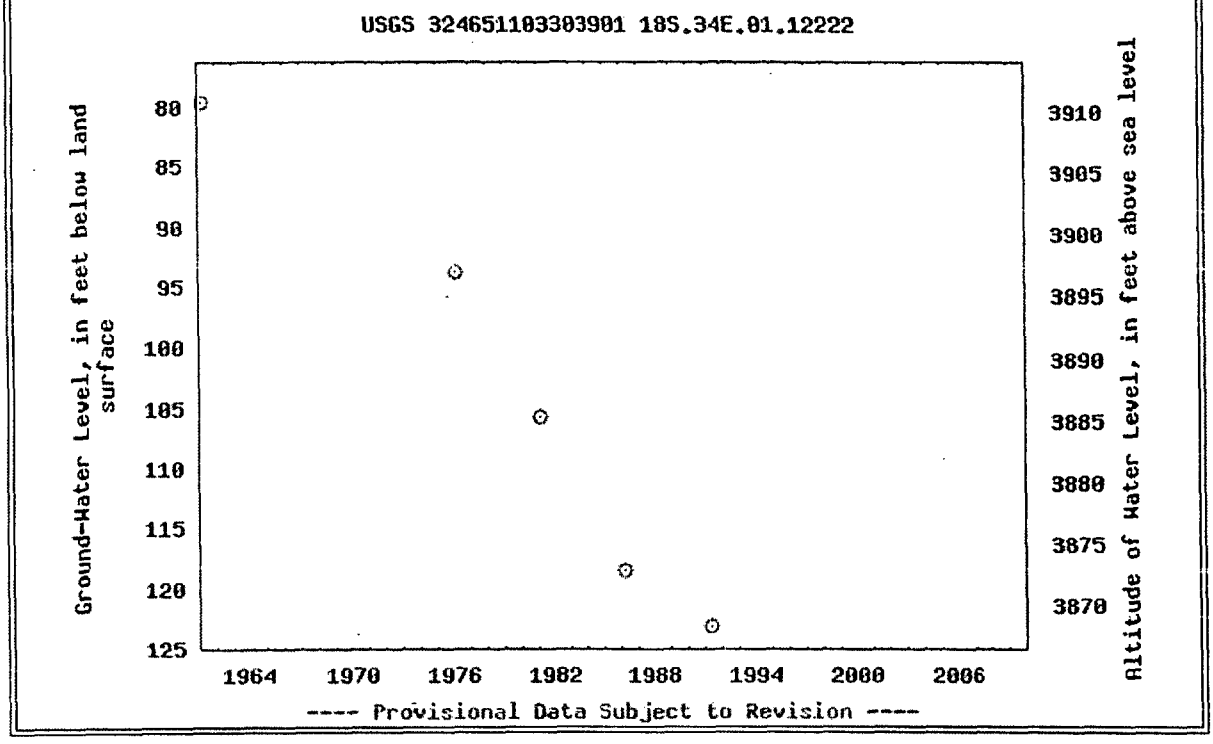
USGS 324651103303901 18S.34E.01.12222

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 13070007
Latitude 32°47'02", Longitude 103°30'50" NAD27
Land-surface elevation 3,991.00 feet above sea level
NGVD29
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



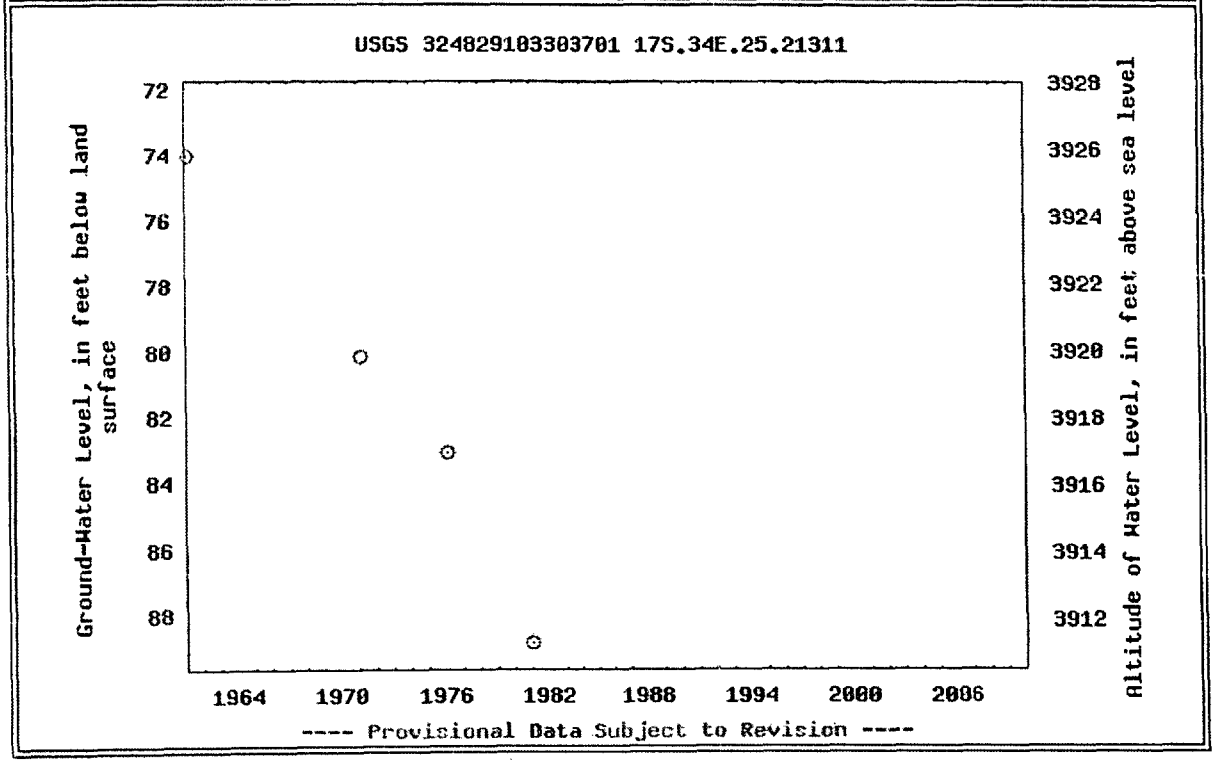
USGS 324829103303701 17S.34E.25.21311

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 12080003
Latitude 32°48'41", Longitude 103°30'48" NAD27
Land-surface elevation 4,000.00 feet above sea level
NGVD29
The depth of the well is 180 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



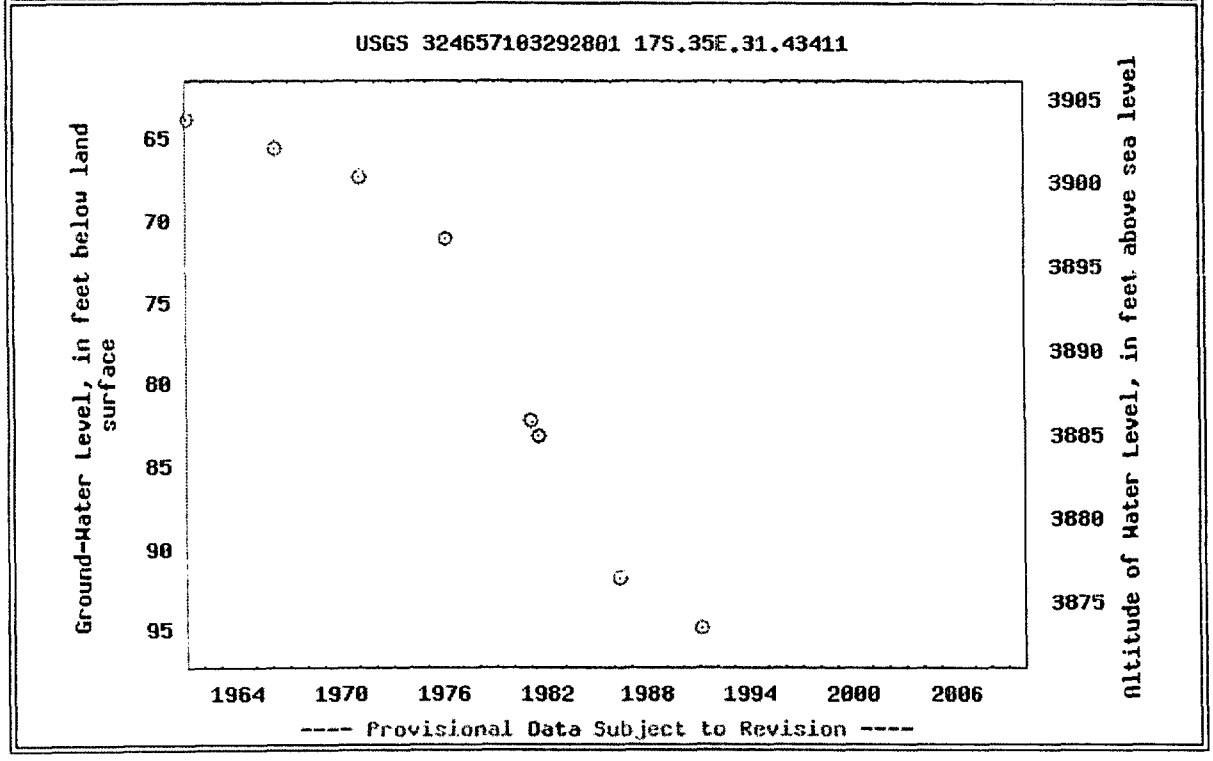
USGS 324657103292801 17S.35E.31.43411

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 13070007
Latitude 32°47'08", Longitude 103°29'38" NAD27
Land-surface elevation 3,968.00 feet above sea level
NGVD29
The depth of the well is 146 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



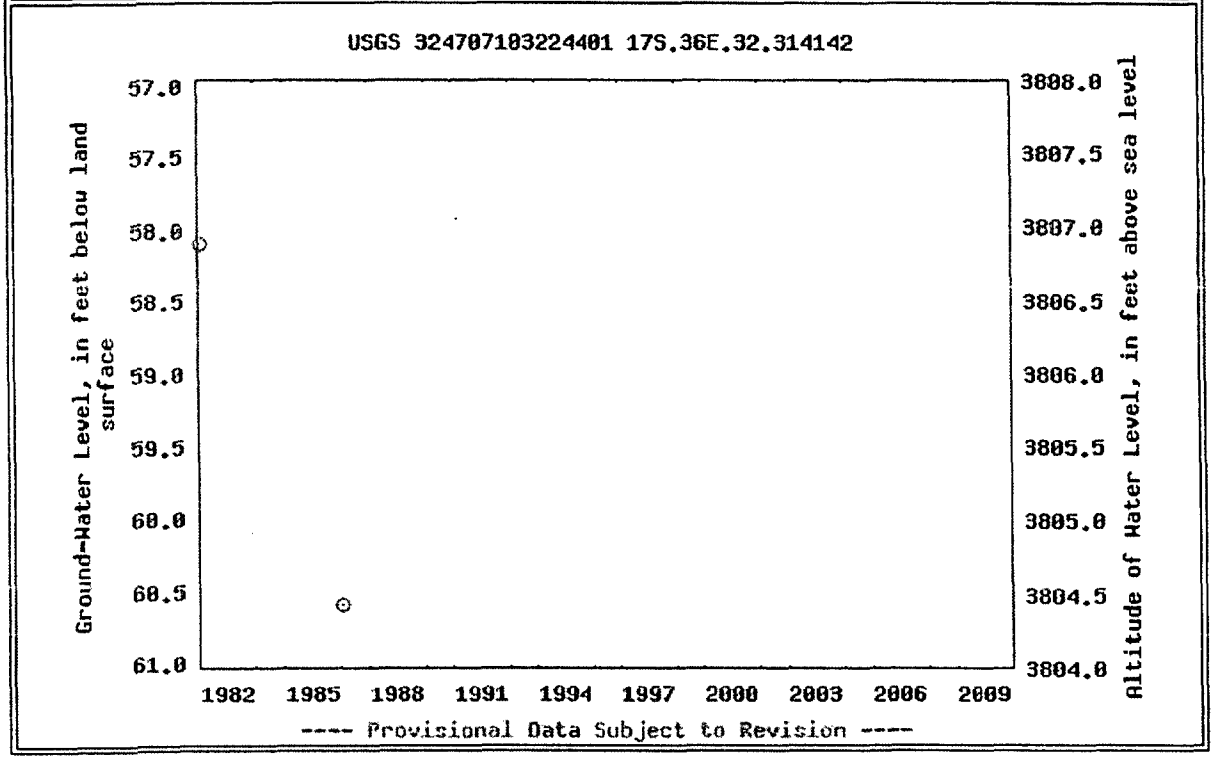
USGS 324707103224401 17S.36E.32.314142

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code
Latitude 32°47'19", Longitude 103°22'55" NAD27
Land-surface elevation 3,865.00 feet above sea level
NGVD29
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



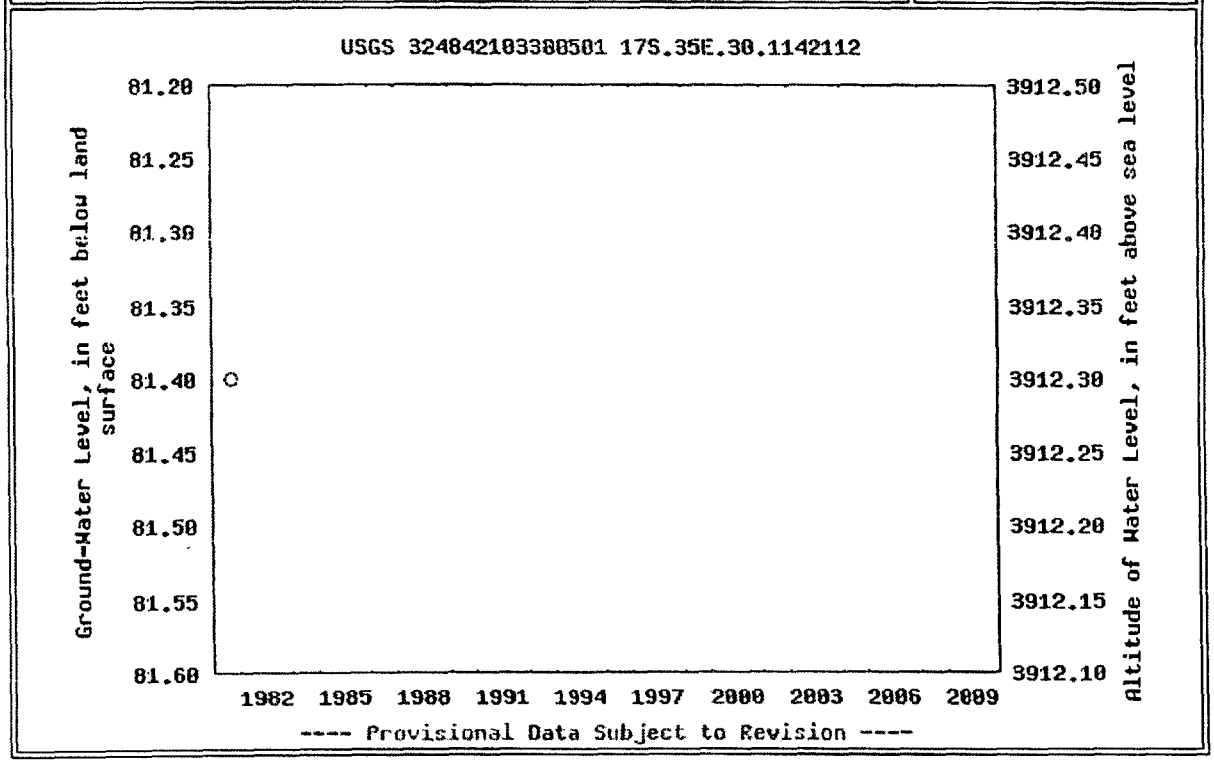
USGS 324842103300501 17S.35E.30.1142112

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 12080003
Latitude 32°48'42", Longitude 103°30'05" NAD27
Land-surface elevation 3,993.70 feet above sea level
NGVD29
The depth of the well is 244 feet below land surface.
The depth of the hole is 244 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



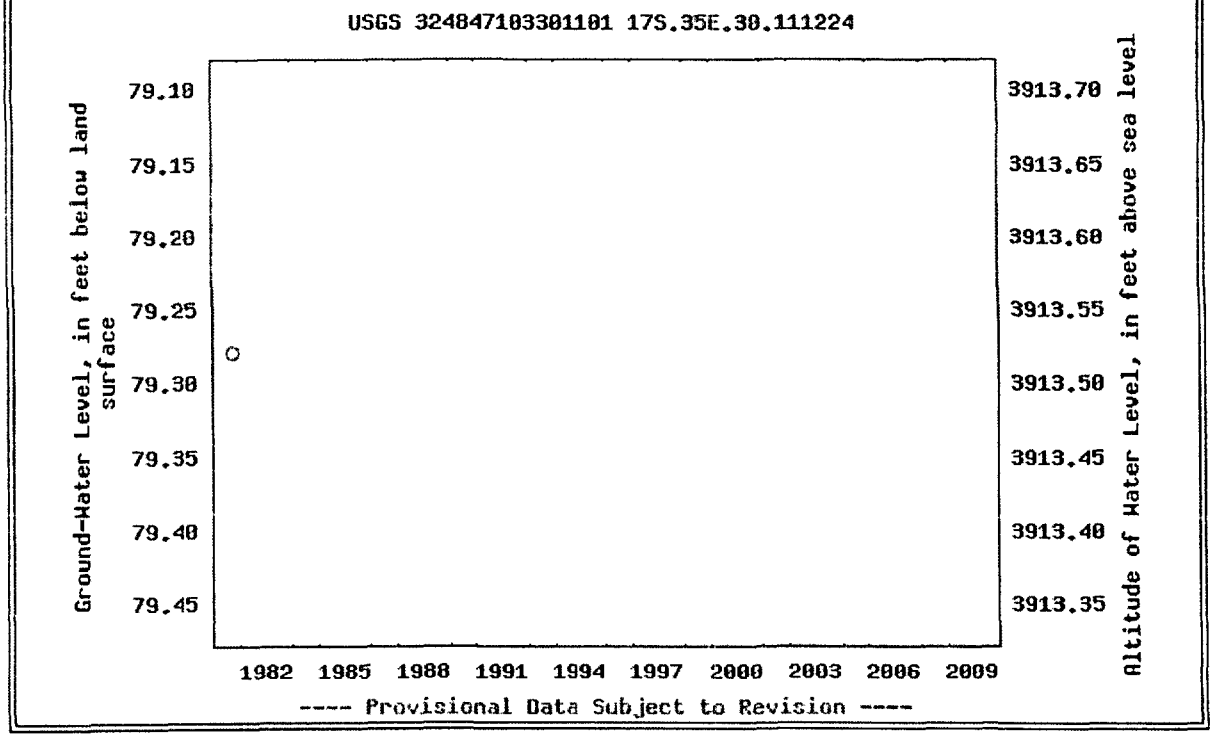
USGS 324847103301101 17S.35E.30.111224

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 12080003
Latitude 32°48'47", Longitude 103°30'11" NAD27
Land-surface elevation 3,992.80 feet above sea level
NGVD29
The depth of the well is 240 feet below land surface.
The depth of the hole is 240 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



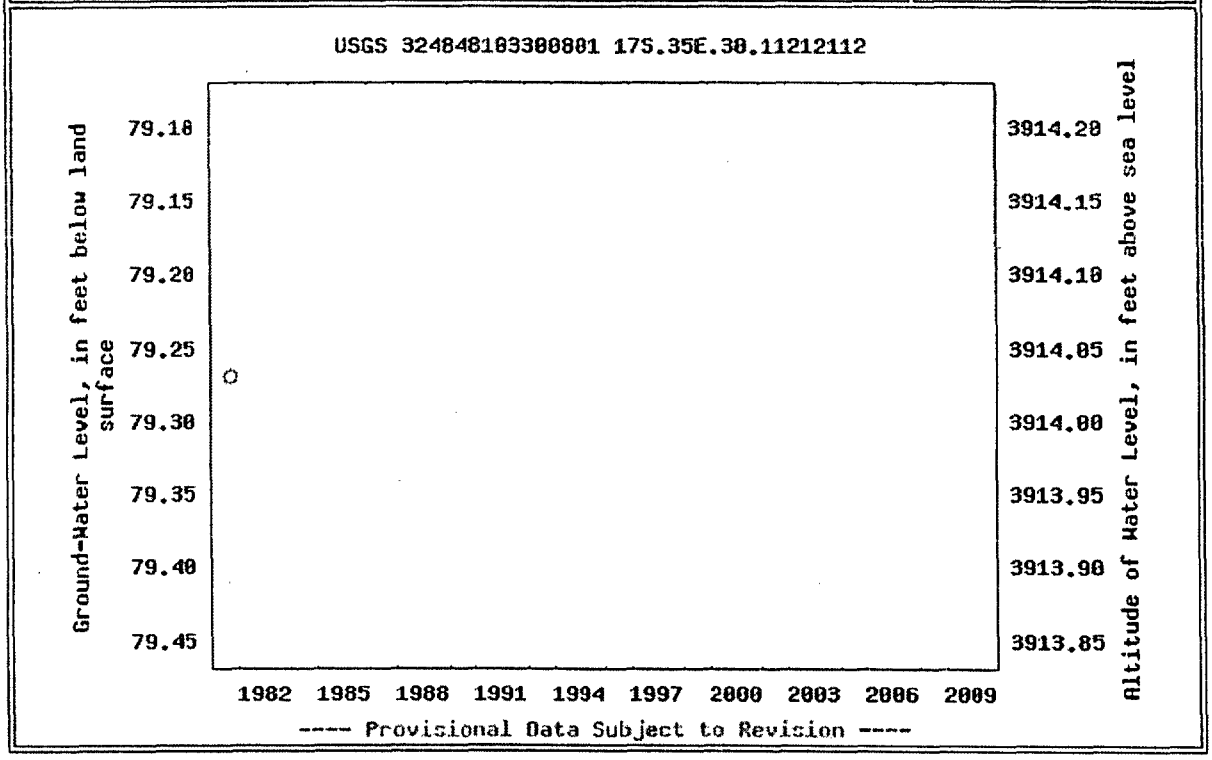
USGS 324848103300801 17S.35E.30.11212112

Available data for this site Ground-water: Field measurements GO

Lea County, New Mexico
Hydrologic Unit Code 12080003
Latitude 32°48'48", Longitude 103°30'08" NAD27
Land-surface elevation 3,993.30 feet above sea level
NGVD29
The depth of the well is 244 feet below land surface.
The depth of the hole is 244 feet below land surface.
This well is completed in the OGALLALA FORMATION (121OGLL) local aquifer.

Output formats

- Table of data
- Tab-separated data
- Graph of data
- Reselect period



New Mexico Office of the State Engineer
Water Column/Average Depth to Water

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters) (In feet)

POD Number	County	Q Q Q 64 16 4	Sec	Tws	Rng	X	Y	Depth Well	Depth Water	Water Column
L 04250	Lea		05	18S	35E	642378	3627565	112	60	52
L 04250 APPRO	Lea		05	18S	35E	642378	3627565	112	60	52
L 04591	Lea	4 2	05	18S	35E	642970	3627785	130	75	55
L 04591 APPRO	Lea	4 2	05	18S	35E	642970	3627785	130	75	55
L 04664	Lea	2 3	05	18S	35E	642171	3627371	140	70	70
L 04664 APPRO	Lea	2 3	05	18S	35E	642171	3627371	140	70	70
L 04796	Lea	4 4 3	06	18S	35E	640667	3626847	150	95	55
L 04796 APPRO	Lea	4 4 3	06	18S	35E	640667	3626847	150	95	55
L 04931	Lea	1 2	05	18S	35E	642561	3628183	237	70	167
L 05411	Lea	3 4	06	18S	35E	640970	3626952	120	60	60
L 05523	Lea	3 2	06	18S	35E	640956	3627761	147	85	62
L 10337	Lea	4 1 1	06	18S	35E	640268	3628055	190	110	80

Record Count: 12

Average Depth to Water: 77 feet
Minimum Depth: 60 feet
Maximum Depth: 110 feet

New Mexico Office of the State Engineer
Water Column/Average Depth to Water

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters) (In feet)

POD Number	County	Q 64	Q 16	Q 4	Sec	Tws	Rng	X	Y	Depth Well	Depth Water	Water Column
L 02134 DCL	Unknown		1	2	01	18S	34E	639365	3628137	113		
L 04160	Lea		3	3	01	18S	34E	638585	3626911	165	100	65
L 04160 APPRO	Lea		3	3	01	18S	34E	638585	3626911	165	100	65
L 05851 EXPL	Lea			1	01	18S	34E	638770	3627917			
L 06115	Lea	1	1	1	01	18S	34E	638460	3628217	230	110	120
L 06115 EXPL	Lea	1	1	1	01	18S	34E	638460	3628217	230	110	120
L 10467	Lea	2	2	1	01	18S	34E	639062	3628227	231	115	116

Record Count: 7

Average Depth to Water: 107 feet
Minimum Depth: 100 feet
Maximum Depth: 115 feet

New Mexico Office of the State Engineer
Water Column/Average Depth to Water

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters) (In feet)

POD Number	County	Q Q Q 64 16 4	Sec	Tws	Rng	X	Y	Depth Well	Depth Water	Water Column
L 02217	Lea	2 4	25	17S	34E	639730	3630571	120	75	45
L 02217 APPRO	Lea	2 4	25	17S	34E	639730	3630571	120	75	45
L 02308	Lea	4 4	25	17S	34E	639736	3630168	130	76	54
L 02308 APPRO	Lea	4 4	25	17S	34E	639736	3630168	130	76	54
L 05003	Lea	1	36	17S	34E	638742	3629538	135	105	30
L 05025	Lea	3 3	25	17S	34E	638530	3630143	157	95	62
L 05106	Lea	1 3	25	17S	34E	638524	3630547	150	95	55
L 05843 EXPL	Lea	3	36	17S	34E	638753	3628731	240		
L 06030	Lea	3 3	36	17S	34E	638552	3628530	230	102	128

Record Count: 9

Average Depth to Water: 87 feet
Minimum Depth: 75 feet
Maximum Depth: 105 feet

New Mexico Office of the State Engineer
Water Column/Average Depth to Water

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters) (In feet)

POD Number	County	Q Q Q 64 16 4	Sec	Tws	Rng	X	Y	Depth Well	Depth Water	Water Column
L 03875 S	Lea	3 3 4	30	17S	35E	640818	3630082	120		
L 03875 S2	Lea	3 3 4	30	17S	35E	640818	3630082	120		
L 03875 S3	Lea	4 3 4	30	17S	35E	641018	3630082	120		
L 03875 S4	Lea	3 3 4	30	17S	35E	640818	3630082	118		
L 04066	Lea	4 2	30	17S	35E	641309	3630994	116	70	46
L 04066 APPRO	Lea	4 2	30	17S	35E	641309	3630994	116	70	46
L 04247 A	Lea	3 1 3	31	17S	35E	640055	3628863	235	95	140
L 04247 AS	Lea	2 1 3	31	17S	35E	640255	3629063	232	117	115
L 04490 APPRO	Lea	4 2	30	17S	35E	641309	3630994	110	70	40
L 04601 APPRO	Lea		30	17S	35E	640741	3630779	125	50	75
L 05392	Lea	1 3	30	17S	35E	640132	3630579	145	80	65
L 05744	Lea	3 3 2	30	17S	35E	640806	3630889	122	75	47
L 06357 S2	Lea	3 1 1	30	17S	35E	640018	3631285	230	130	100
L 10445	Lea	4 2 4	29	17S	35E	643025	3630504	100		

Record Count: 14

Average Depth to Water: 84 feet

Minimum Depth: 50 feet

Maximum Depth: 130 feet