1R - 428-54

WORKPLANS

Date:
12-5-10

Hansen, Edward J., EMNRD

From: Katie Jones [kjones@riceswd.com]
Sent: Thursday, March 03, 2011 4:04 PM
To: Hansen, Edward J., EMNRD
Cc: Hack Conder; Katie Lee
Subject: Hobbs C-30 vent (1R428-54) CAP Addendum
Attachments: Hobbs C-30 vent Proposed liner.pdf

Mr. Hansen,

This email is an Addendum to the Hobbs C-30 vent site (1R428-54) Corrective Action Plan, submitted to the NMOCD on December 3, 2010. Page 4, section: Recommendation, paragraph 2: text in blue lettering, below, will be added to the paragraph. Red lettering marked with a strike-through will be deleted. The new Plate 2 showing the proposed liner location is attached. If you need any further information, please let me or Hack know.

"Our recommended corrective action for the site is the installation of a 750 square foot synthetic liner approximately 4 feet below ground surface over the former site and re-vegetation of the ground surface. This proposed remedy will limit infiltration of precipitation and the subsequent migration of constituents of concern to ground water. As part of this effort, ROC plans to:

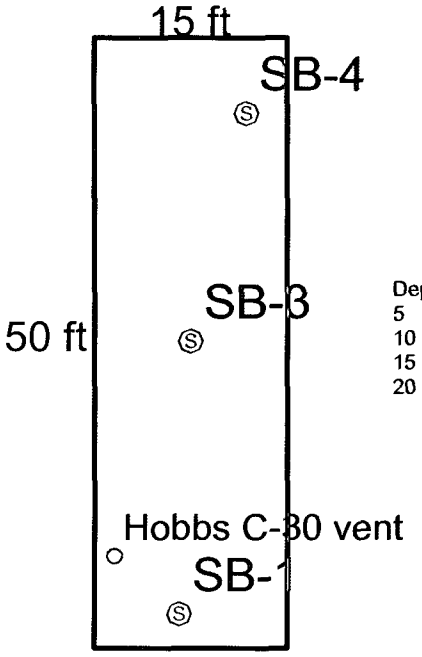
- ~~Scrape and remove large rocks and caliche,~~
- ~~Backfill the site with soil blended with amendments~~
- Install a synthetic liner approximately 4 feet below ground surface. This liner will be positioned over the locations of SB-1, SB-3 and SB-4 (See Plate 2). The liner will be 15 feet wide and 50 feet long.
- Evaluate excavated soil for use as backfill. Any soils requiring disposal will be properly disposed of at a NMOCD approved facility.
- Backfill the area over the liner with soil containing a chloride concentration of less than 500 mg/kg and a PID (field) reading of less than 100 ppm.
- Make sure the area is free of large rocks and caliche, and amend and grade soil at the site to match surrounding area grading.
- Broadcast seed by hand,
- Set up silt net fencing to protect new vegetation and inhibit erosion.

A synthetic liner installed below the root zone as proposed will inhibit the downward migration of water through the subsurface, slowing movement of chloride or soluble hydrocarbons toward ground water. Plants capture water through their roots, thereby reducing the volume of water infiltrating below the root zone. This natural "infiltration barrier" also helps protect ground water. Upon documentation of installation of the liner and re-seeding with an appropriate mix of native grasses we will submit a Termination Request for this site's regulatory file."

Thank you,

Katie Jones
Environmental Project Coordinator
RICE *Operating Company*

Proposed liner



SB-4

Depth	Cl-	PID	LAB Cl-	GRO	DRO	B	T	E	X
5	175	2.8							
10	178	6.5							
15	199	201							
20	175	164							
25	178	282	128	142	1290	<0.05	0.206	0.246	1.94
30	209	275							
35	206	221							
40	174	251	144	334	2800	<0.05	0.273	0.367	3.78

SB-3

Depth	Cl-	PID	LAB Cl-	GRO	DRO	B	T	E	X
5	207	1.3							
10	207	204	96	250	2200	<0.05	0.184	0.315	1.92
15	143	193							
20	141	221	176	55.9	849	<0.05	<0.05	0.155	1.53

SB-2

Depth	Cl-	PID	LAB Cl-	GRO	DRO
5	257	2.2	160	<10	<10
10	241	0.7			
15	149	2			
20	144	1	32	<10	<10

SB-1

Depth	Cl-	PID	LAB Cl-	GRO	DRO	B	T	E	X
15	217	59.8							
20	198	205							
25	229	300							
30	338	494							
35	338	614	304	536	3020	<0.05	0.543	0.924	6.35
40	308	294							
45	206	58							
50	205	38.8							
55	173	22.6							
60	180	23.6	48	<10	120	<0.05	0.07	0.081	0.474

RICE ENVIRONMENTAL CONSULTING & SAFETY, LLC

Hobbs C-30 vent

Legals: UL/C sec. 30
T18S R38E

Case #: 1R428-54

Plate 2

N W E S

0 5 10 20 Feet

Drawing date: 1-14-10
Drafted by: L. Weinheimer

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266.0745

December 3, 2010

Mr. Edward J. Hansen
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: **Rice Operating Company, Hobbs SWD System C-30 Vent Site: T-18-S, R-38-E, Section 30, Unit C, Lea County, New Mexico, (NMOCD CASE #1R428-54), Corrective Action Plan**

Mr. Hansen:

On behalf of Rice Operating Company (ROC), R.T. Hicks Consultants, Ltd. is submitting this Corrective Active Plan for the Hobbs C-30 Vent site. The investigation demonstrates that residual chloride and hydrocarbons in the vadose zone will not with reasonable probability contaminate ground water or surface water in excess of the standards in Subsections B and C of 19.15.30.9 NMAC through leaching, percolation or other transport mechanisms, or as the water table elevation fluctuates. Revegetation of the site, our recommended corrective action, meets the mandate of NMOCD Rules for protection of surface water and the environment.

Background

The Hobbs C-30 Vent is located northwest of the city of Hobbs, New Mexico at T-18-S, R-38-E, Section 30, in Unit C. The NMOCD-approved Investigation Characterization Plan (ICP), dated February 18, 2010 (Attachment A) includes background information, a site vicinity map, and a regional ground water gradient map for the site.

Field Programs

As a part of the approved ICP, ROC installed and sampled five 9- to 12-foot deep backhoe trenches on April 8 and 9, 2010 in an attempt to delineate the vertical and horizontal extent of hydrocarbons and chloride in the soil. See Plate 1A for a summary map that includes results of the field chloride analyses and hydrocarbon screening data as well as laboratory results for the soil samples used to verify the ROC field data.

Hicks Consultants supervised a deep soil sampling program to further delineate the extent and magnitude of media impact. On May 12, 2010, four 20- to 60-foot deep soil borings were drilled adjacent to the vent location and to the north and east of the previous trench excavations. ROC conducted field analysis of soil samples for chloride and volatile hydrocarbon vapors for the boring program. Plate 1B is a summary map that includes results of the field chloride analyses and hydrocarbon screening data as well as a laboratory results for the

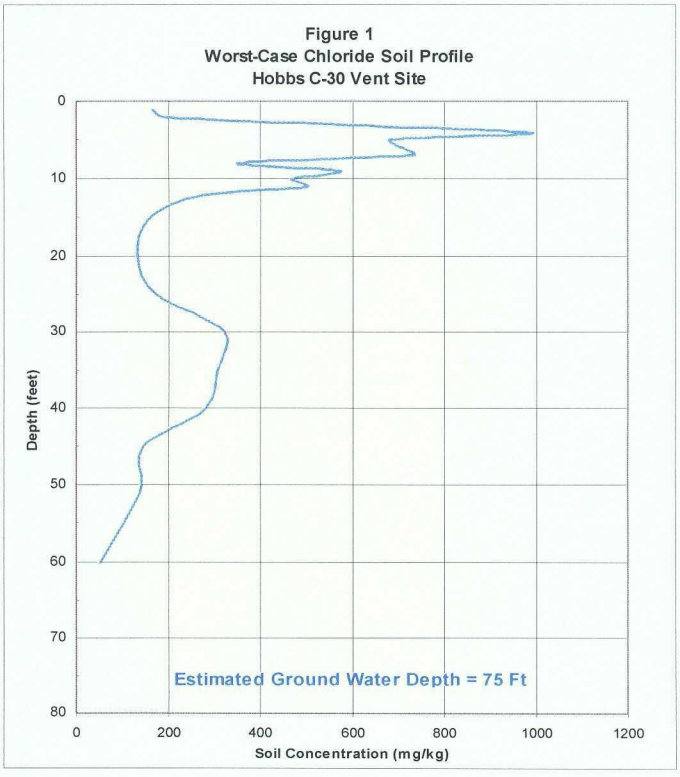
soil samples used to verify the ROC field data. Attachment B provides soil lithology logs which include the field chloride and hydrocarbon screening data and laboratory results. Attachment C provides the laboratory reports and chain of custody documents for all of the soil verification samples.

Results: Chloride

The initial ROC assessment showed that each of the five trenches encountered chloride concentrations above 250 mg/kg. These levels were limited to the soil from 3 to 7 feet below the surface in the center, west, and south trenches. The highest chloride concentration (885 mg/kg) was encountered at four feet below the surface at the trench located five feet east of the original vent. Both the north and east trenches indicated decreasing chloride concentrations with depth while remaining above 250 mg/kg, therefore soil borings were installed to delineate the chloride-impacted soil in these directions.

The first soil boring (SB-1) was drilled to a depth of 60 feet just east of the original vent location. Chloride concentrations slightly above 250 mg/kg were encountered from 30 to 40 feet below the surface. SB-2 was installed 20 feet east of SB-1 to a depth of 20 feet. It encountered chloride concentrations slightly above 250 mg/kg only at the five foot depth. SB-3 was installed 20 feet north of the original vent location, extended 20 feet in depth, and did not encounter chloride concentrations above 250 mg/kg. SB-4 was installed 40 feet north of the original vent location, extended 40 feet in depth, and did not encounter chloride concentrations above 250 mg/kg.

Figure 1
Worst-Case Chloride Soil Profile
Hobbs C-30 Vent Site



The trenching and soil borings show that the extent of the chloride-impacted soil is less than 1,600 ft^2, at depths of approximately 3 to 12 feet below the surface. Figure 1 is a worst-case composite profile of the chloride-impacted soil at the site. Field chloride results were calibrated based on the laboratory data.

Results: Hydrocarbons

Field screening of hydrocarbon vapors in the soil from the trenches identified concentrations greater than 100 ppm only in the center and north excavations (788 ppm maximum). Laboratory analysis of BTEX from these samples indicate maximum concentrations of benzene (<0.05 mg/kg), toluene (<0.05

mg/kg), ethylbenzene (0.359 mg/kg), and total xylenes (1.1 mg/kg) at 9 to 12 feet below the surface. Soil borings were installed to delineate the extent of hydrocarbon-impacted soil at the original vent location and to the north of the vent location.

Field screening of hydrocarbon vapors in the soil borings were measured from drill cutting samples because the soil was too hard to recover material with a split spoon sampler. The highest vapor reading was encountered near the original vent location (SB-1) at 35 feet below the surface (614 ppm). Laboratory analyses from this sample indicate concentrations of benzene (<0.05 mg/kg), toluene (0.543 mg/kg), ethylbenzene (0.924 mg/kg), and total xylenes (6.35 mg/kg). In addition, the sample contained gas and diesel range organics which are essentially non-soluble with respect to leaching. Hydrocarbons were also present at lower concentrations in SB-3 and SB-4 to the north. A summary of the laboratory results from all of the soil sampling events are provided on Table 1 below.

Table 1
Rice Operating Hobbs C-30 Vent Site
Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	PID (ppm)	Chloride (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	GRO (mg/kg)	DRO (mg/kg)
Source	5	4/8/10	--	**384**	--	--	--	--	--	<50	368
Excavation	9	4/8/10	341	128	<0.05	<0.05	0.359	<0.3	0.76	191	4,180
	12	4/8/10	320	160	<0.05	<0.05	0.108	<0.3	0.51	109	2,410
5' East	4	4/8/10	--	**992**	--	--	--	--	--	<10	<10
Excavation	12	4/8/10	--	**272**	--	--	--	--	--	<50	1,320
5' West	3	4/8/10	--	**608**	--	--	--	--	--	<50	137
Excavation	10	4/8/10	--	144	--	--	--	--	--	<50	3,050
5' South	4	4/8/10	--	**736**	--	--	--	--	--	<50	77
Excavation	9	4/8/10	--	160	--	--	--	--	--	<50	1,060
5' North	5	4/8/10	--	**576**	--	--	--	--	--	<50	209
Excavation	12	4/8/10	--	224	<0.05	<0.05	0.256	1.1	1.46	499	3,370
SB-1	35	5/12/10	614	**304**	<0.05	0.543	0.924	6.35	7.87	536	3,020
	60	5/12/10	23.6	48	<0.05	0.070	0.081	0.474	0.68	<10	120
SB-2	5	5/12/10	2.2	160	--	--	--	--	--	<10	<10
	20	5/12/10	1.0	32	--	--	--	--	--	<10	<10
SB-3	10	5/12/10	204	96	<0.05	0.184	0.315	1.92	2.47	250	2,200
	20	5/12/10	221	176	<0.05	<0.05	0.155	1.53	1.79	56	849
SB-4	25	5/12/10	282	128	<0.05	0.206	0.246	1.94	2.44	142	1,290
	40	5/12/10	251	144	<0.05	0.273	0.367	3.78	4.47	334	2,800

NMOCD Guideline Remediation Levels	**250**	**10**	--	--	--	**50**	**No regulatory standards have been established**
2006 NMED Soil Com./Indus. Vapor Exposure Risk Screening Guidelines		**25.8**	**252**	**128**	**82**	--	
	GW (DAF_{20})	0.0201	21.7	20.2	2.05	--	
Site Specific GW Protective Levels (DAF_{351})		**0.353**	**381**	**355**	**36.2**	--	

The site data that documents the residual mass of chloride in the vadose zone permit a conclusion that it will not contaminate ground water. Elevated concentrations of xylenes in the deep soil require further evaluation to insure the protection of the underlying ground water. The trenching and soil borings shows that the extent of the xylenes-impacted soil is 3,600 ft^2, at depths of approximately 5 to 45 feet below the surface.

Simulation Modeling

We used the VLEACH vadose zone model to determine if the xylenes identified during the site assessment would cause the underlying ground water to exceed the regulatory standard. The input to the model employed field data from the site, nearby locations, and conservative default values for parameters that were not measured at or near the site.

The simulation results indicate that a total of 1,500 years will be required for leaching to move the observed xylenes concentrations in the soil to ground water depth (See Figure 3 in Attachment D). During this time the xylenes mass input to the ground water will not be sufficient to cause concentrations in the ground water below the site to exceed the New Mexico water quality standard for xylenes. The model result shows the highest impact to ground water will occur about 800 years from now, with a concentration of 0.002 mg/L (the standard is 0.6 mg/L) (See Table 2, Attachment D).

VLEACH is conservative of ground water quality because the model does not take into account the natural biological degradation of the hydrocarbons. Attachment D provides an explanation of the data used and results from the simulation at the Hobbs C-30 Vent site. A detailed description of the model and a free windows-based program download is available from the USEPA at http://www.epa.gov/ada/csmos/models/vleach.html.

Recommendations

The site data that documents the residual mass of chloride and hydrocarbons in the vadose zone permit a conclusion that these constituents in the vadose zone will not with reasonable probability contaminate ground water or surface water, in excess of the standards in Subsection B and C of the 19.15.30.9 NMAC, through leaching, percolation or other transport mechanisms, or as the water table elevation fluctuates.

Our recommended corrective action for the site is re-vegetation of the ground surface to limit infiltration of precipitation and the subsequent migration of constituents of concern to ground water. As part of this effort, ROC plans to:

- Scrape and remove large rocks and caliche,
- Backfill the site with soil blended with amendments
- Broadcast seed by hand,
- Set up silt net fencing to protect new vegetation and inhibit erosion

Upon documentation of re-seeding with an appropriate mix of native grasses we will submit a Termination Request for this site's regulatory file.

ROC is the service provider (agent) for the Hobbs Salt Water Disposal System and has no ownership of any portion of pipeline, well or facility. The Hobbs SWD System is owned by a consortium of oil producers, System Parties, who provide all operating capital on a percentage ownership/usage basis.

Please contact Hack Conder of ROC at 575-393-9174 if you have any questions concerning this submission. Thank you for your time and consideration.

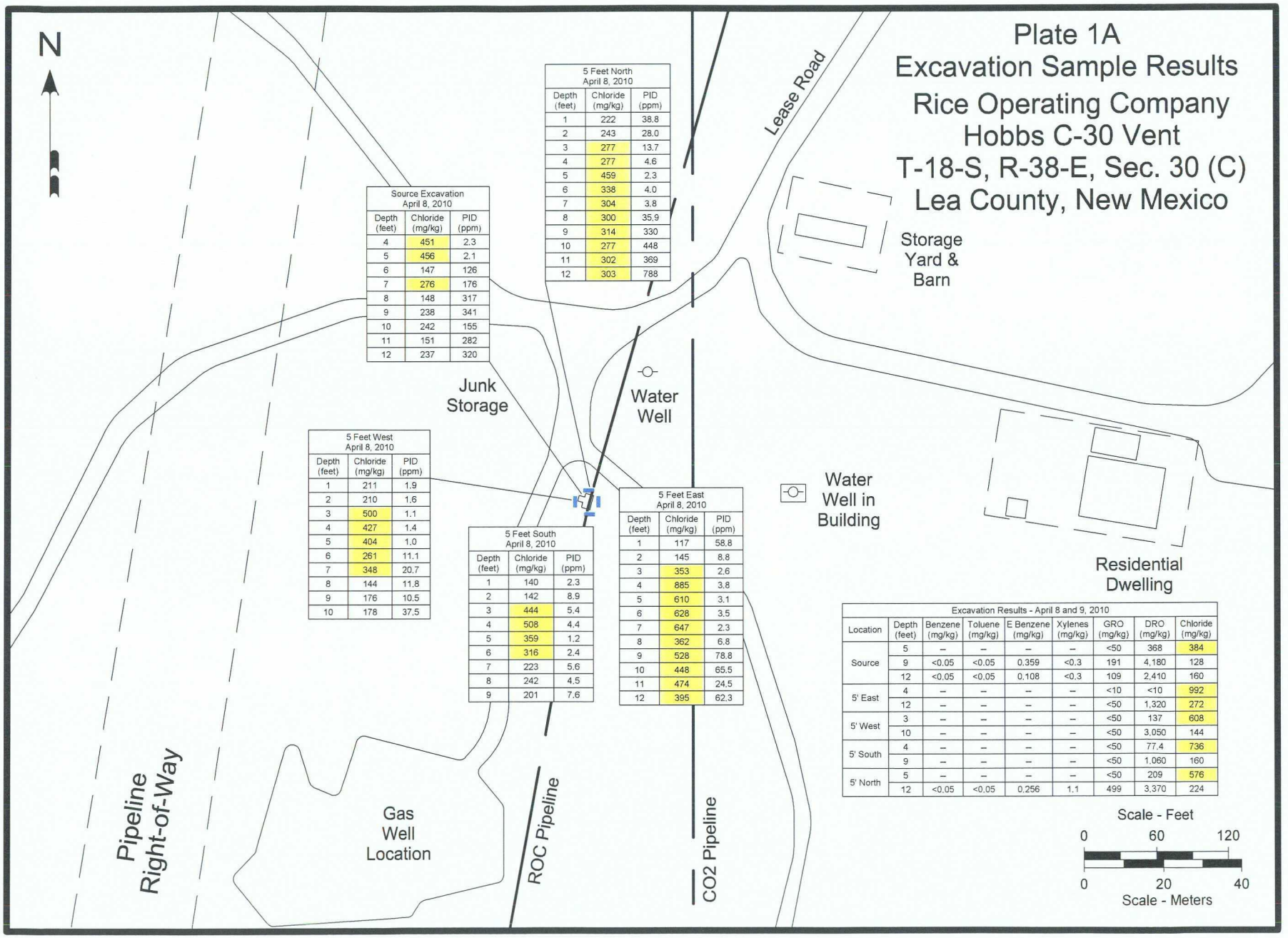
Sincerely,
R.T Hicks Consultants, Ltd.

Dale T Littlejohn
Geologist

Copy: Hack Conder, ROC

Plates

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104



Source Excavation
April 8, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm)
4	451	2.3
5	456	2.1
6	147	126
7	276	176
8	148	317
9	238	341
10	242	155
11	151	282
12	237	320

5 Feet North
April 8, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm)
1	222	38.8
2	243	28.0
3	277	13.7
4	277	4.6
5	459	2.3
6	338	4.0
7	304	3.8
8	300	35.9
9	314	330
10	277	448
11	302	369
12	303	788

5 Feet West
April 8, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm)
1	211	1.9
2	210	1.6
3	500	1.1
4	427	1.4
5	404	1.0
6	261	11.1
7	348	20.7
8	144	11.8
9	176	10.5
10	178	37.5

5 Feet South
April 8, 2010

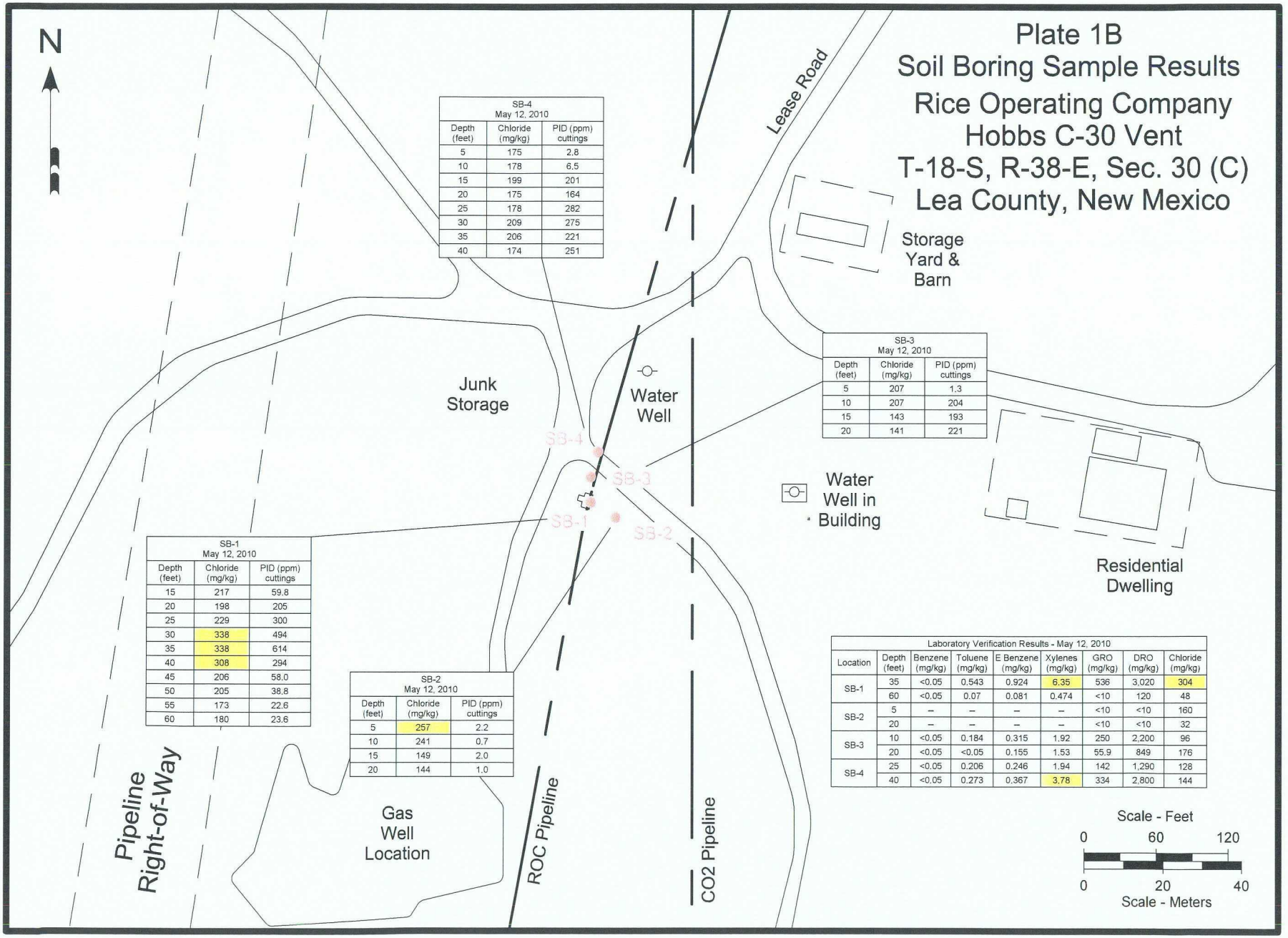
Depth (feet)	Chloride (mg/kg)	PID (ppm)
1	140	2.3
2	142	8.9
3	444	5.4
4	508	4.4
5	359	1.2
6	316	2.4
7	223	5.6
8	242	4.5
9	201	7.6

5 Feet East
April 8, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm)
1	117	58.8
2	145	8.8
3	353	2.6
4	885	3.8
5	610	3.1
6	628	3.5
7	647	2.3
8	362	6.8
9	528	78.8
10	448	65.5
11	474	24.5
12	395	62.3

Excavation Results - April 8 and 9, 2010

Location	Depth (feet)	Benzene (mg/kg)	Toluene (mg/kg)	E Benzene (mg/kg)	Xylenes (mg/kg)	GRO (mg/kg)	DRO (mg/kg)	Chloride (mg/kg)
Source	5	–	–	–	–	<50	368	384
	9	<0.05	<0.05	0.359	<0.3	191	4,180	128
	12	<0.05	<0.05	0.108	<0.3	109	2,410	160
5' East	4	–	–	–	–	<10	<10	992
	12	–	–	–	–	<50	1,320	272
5' West	3	–	–	–	–	<50	137	608
	10	–	–	–	–	<50	3,050	144
5' South	4	–	–	–	–	<50	77.4	736
	9	–	–	–	–	<50	1,060	160
5' North	5	–	–	–	–	<50	209	576
	12	<0.05	<0.05	0.256	1.1	499	3,370	224



SB-4
May 12, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm) cuttings
5	175	2.8
10	178	6.5
15	199	201
20	175	164
25	178	282
30	209	275
35	206	221
40	174	251

SB-3
May 12, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm) cuttings
5	207	1.3
10	207	204
15	143	193
20	141	221

SB-1
May 12, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm) cuttings
15	217	59.8
20	198	205
25	229	300
30	338	494
35	338	614
40	308	294
45	206	58.0
50	205	38.8
55	173	22.6
60	180	23.6

SB-2
May 12, 2010

Depth (feet)	Chloride (mg/kg)	PID (ppm) cuttings
5	257	2.2
10	241	0.7
15	149	2.0
20	144	1.0

Laboratory Verification Results - May 12, 2010

Location	Depth (feet)	Benzene (mg/kg)	Toluene (mg/kg)	E Benzene (mg/kg)	Xylenes (mg/kg)	GRO (mg/kg)	DRO (mg/kg)	Chloride (mg/kg)
SB-1	35	<0.05	0.543	0.924	6.35	536	3,020	304
	60	<0.05	0.07	0.081	0.474	<10	120	48
SB-2	5	–	–	–	–	<10	<10	160
	20	–	–	–	–	<10	<10	32
SB-3	10	<0.05	0.184	0.315	1.92	250	2,200	96
	20	<0.05	<0.05	0.155	1.53	55.9	849	176
SB-4	25	<0.05	0.206	0.246	1.94	142	1,290	128
	40	<0.05	0.273	0.367	3.78	334	2,800	144

Attachment A

Submitted ICP

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266.0745

February 18, 2010

Mr. Edward J. Hansen
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: **Investigation & Characterization Plan**
Hobbs C-30 Vent, NMOCD Case # 1R428-54
Township 18S, Range 37E, Section 30, Unit C

Mr. Hansen:

On behalf of Rice Operating Company (ROC), R.T. Hicks Consultants, Ltd. is pleased to submit this Investigation & Characterization Plan (ICP) for the Hobbs C-30 Vent site. Plate 1 is a map showing the site relative to major roads in the area. Plate 2 shows the site, nearby USGS monitoring wells, and a regional potentiometric surface map.

The work elements proposed below will allow us to characterize this site and develop an appropriate Corrective Action Plan.

1. ROC will identify and document the location of all current and historic equipment and pipelines associated with the site.
2. ROC will use a backhoe with a 12-foot vertical reach to install a series of sampling trenches in order to recover soil samples and delineate the lateral extent (and potentially the vertical extent) of impacted soil.
3. If characterization by the backhoe is insufficient to define the extent and magnitude of past releases, ROC and Hicks Consultants will use a drilling rig to drill one soil boring at the center of the source area to delineate the vertical extent of chloride in the soil.
4. Soil samples obtained by the backhoe or drilling rig will be obtained from regular intervals below ground surface.
5. Representative soil samples will be sent to a laboratory to allow for verification of the field chloride and PID results.
6. General soil texture descriptions will be provided for each sample trench or boring.
7. The criteria to delineate the extent of impact during trenching as well as in a soil boring is 5 point chloride decline vs. depth, or:
    a. After three consecutive samples demonstrate <250 ppm chloride using field analyses and <100ppm total hydrocarbon vapors using the headspace method, or
    b. After five consecutive samples show a decreasing trend of chloride and hydrocarbons and the last sample shows chloride < 250 ppm and total hydrocarbon vapors <100ppm.
    c. Soil boring to capillary fringe should neither (a) or (b) apply.
8. If the boring penetrates the capillary fringe, a monitoring well will be completed with a 2 or 4" diameter casing down gradient from confirmed impact for use during possible corrective actions. Ground water will be

analyzed for chloride, sulfate, TDS and BTEX if warranted. Plate 2 presents a potentiometric surface map for the site area.

9. If field analysis of hydrocarbon vapors and observations of staining show that hydrocarbon impact is unlikely at the site or below 20-feet, collection of samples from cuttings may be substituted for split spoon sampling (chloride only).

The ROC trench characterization will be employed to identify the lateral extent of chloride at the site, if possible. If trenching does not fully characterize the lateral extent of chloride at the site, boreholes will be advanced 20 feet beyond the furthest trenches where the soil data has an average chloride concentration greater than 1,000 mg/kg. The total depth of borings drilled to characterize lateral extent shall be 20 feet below ground surface with soil samples for delineation taken at 5 foot intervals.

Rice Operating Company (ROC) is the service provider (agent) for the Hobbs Saltwater Disposal System and has no ownership of any portion of pipeline, well, or facility. A consortium of oil producers who own the Hobbs System (System Parties) provide all operating capital on a percentage ownership/usage basis. Major projects require System Parties' authorization for expenditures (AFE) approval and work begins as funds are received. We will implement the work outlined herein after NMOCD approval and subsequent authorization from the System Parties. The Hobbs SWD system is in abandonment.

For all environmental projects, ROC will choose a path forward that:

1. Protects public health,
2. Provides the greatest net environmental benefit,
3. Complies with NMOCD Rules,
4. Is supported by good science.

Following the site characterization described above, a Corrective Action Plan with the data and analysis supportive of a procedure for site file termination, or a termination request will be submitted, depending on characterization findings.

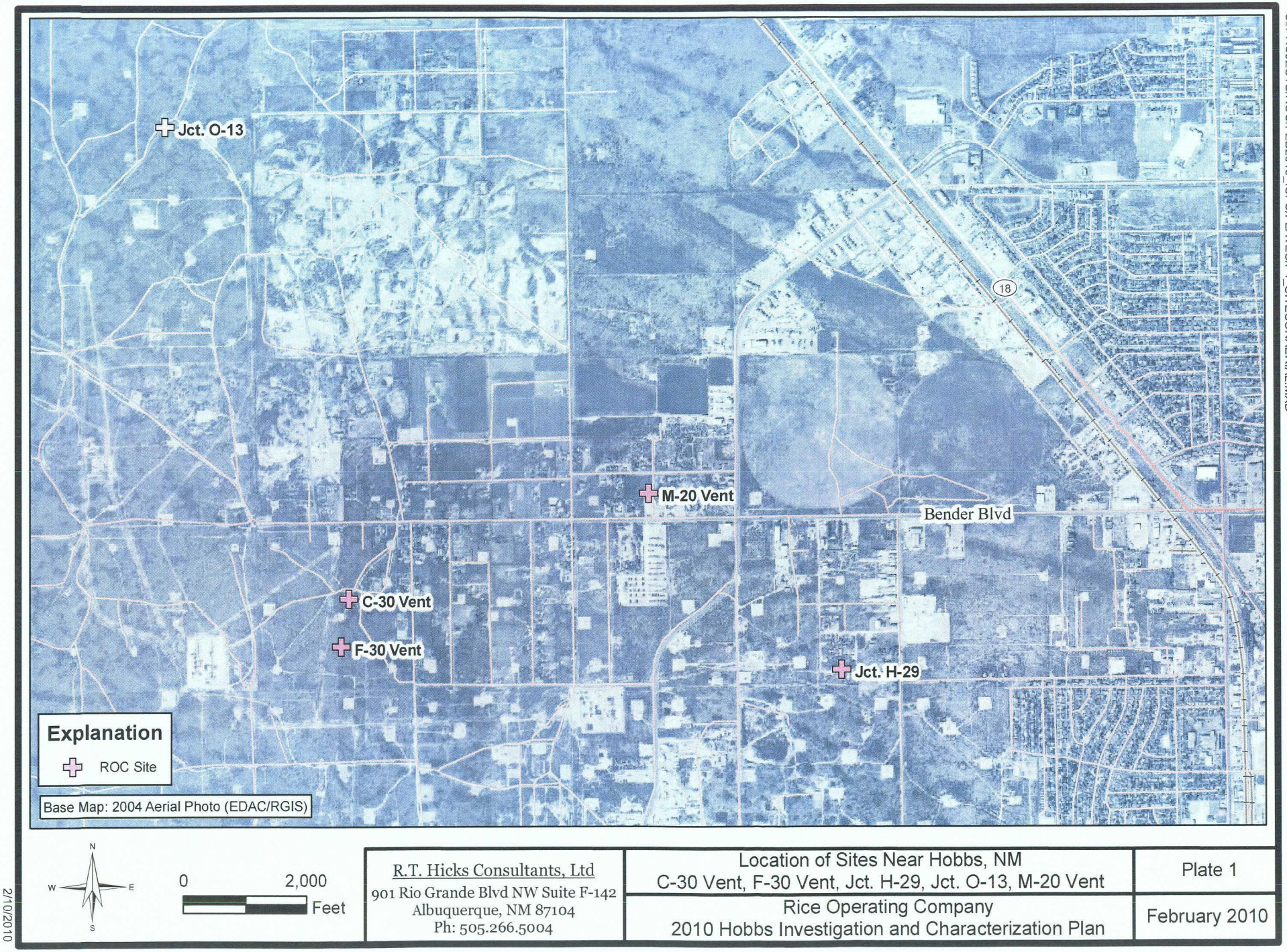
Please contact Hack Conder of ROC at 575-393-9174 if you have any questions concerning this submission. Thank you for your time and consideration.

Sincerely,
R.T Hicks Consultants, Ltd.

Katie Lee

Katie Lee
Project Scientist

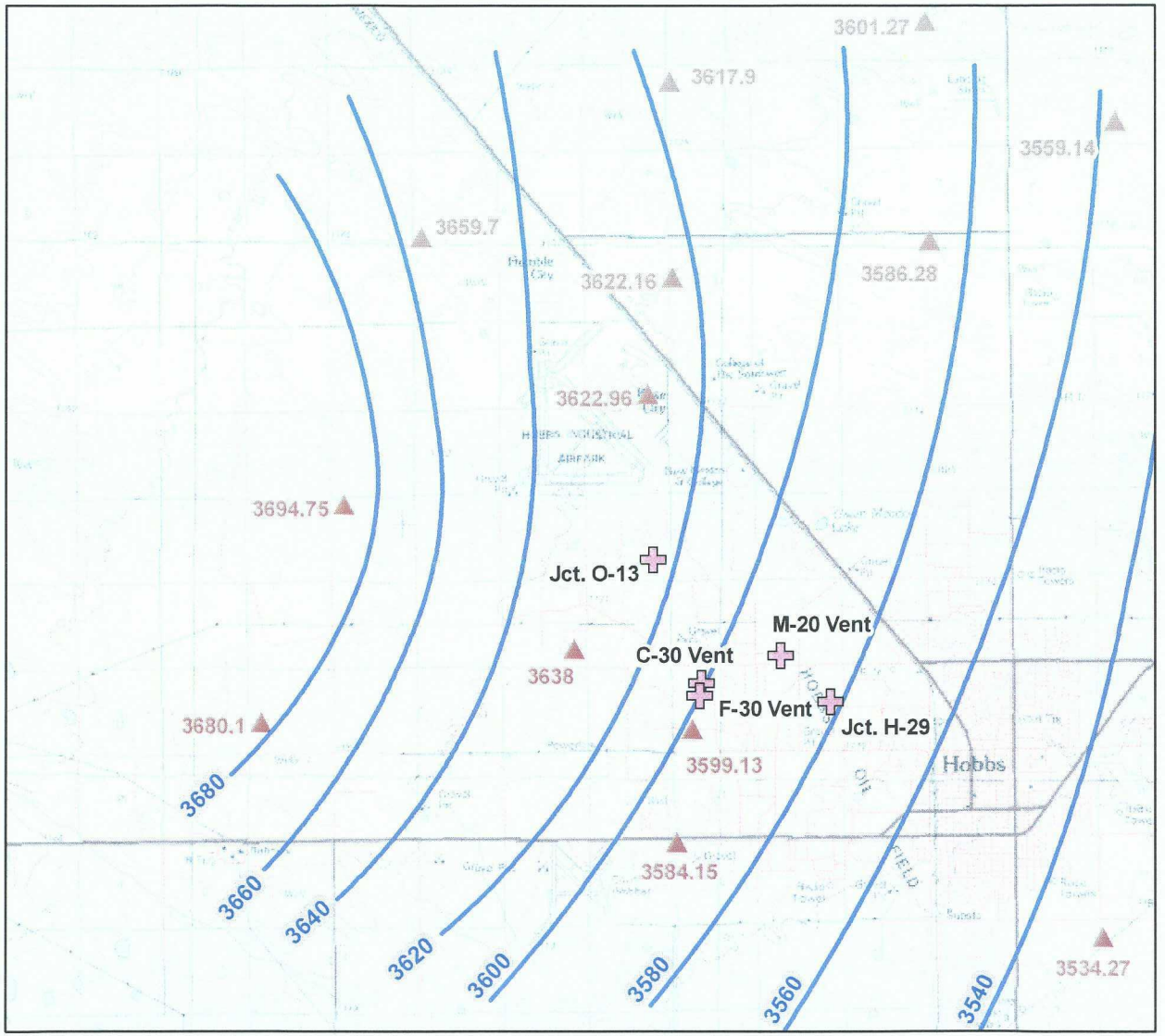
Copy: Hack Conder, ROC



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Location of Sites Near Hobbs, NM C-30 Vent, F-30 Vent, Jct. H-29, Jct. O-13, M-20 Vent	Plate 1
	Rice Operating Company 2010 Hobbs Investigation and Characterization Plan	February 2010

S:/PROJECTS/ROC/FEB2010_ICPS/PLATES/P1_SITESONAERIAL.MXD

2/10/2010



Explanation

- ROC Site
- USGS gauging station (2007) [ground water elevation (ft)]
- Potentiometric surface (ft amsl) (derived from USGS 2007)

N W E S

0 1 2 Miles

R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

2007 Poteniometric Surface Map
C-30 Vent, F-30 Vent, Jct. H-29, Jct. O-13, M-20 Vent

Rice Operating Company
2010 Hobbs Investigation and Characterization Plan

Plate 2

February 2010

2/10/2010

S:/PROJECTS/ROC/FEB2010_ICPS/PLATES/P2_2007POTENTIOMETRIC.MXD

Attachment B

Soil Boring Logs

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

Logger:	Dale Littlejohn
Driller:	Harrison & Cooper
Consultant:	R.T. Hicks
Drilling Method	Air Rotary
Start Date:	5/12/2010
End Date:	5/12/2010

RICE OPERATING COMPANY ROC SINCE 1955

Project Name: Hobbs C-30 Vent **Well ID:** SB # 1

Location: UL/C Sec 30 T18S R38E

Lat: N. 32* 43' 20.414" **County:** Lea

Long: W 103* 11' 28.309" **State:** NM

Comments: All samples from cuttings. Located at source of the former junction box location.

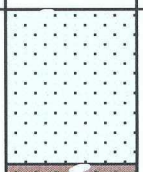
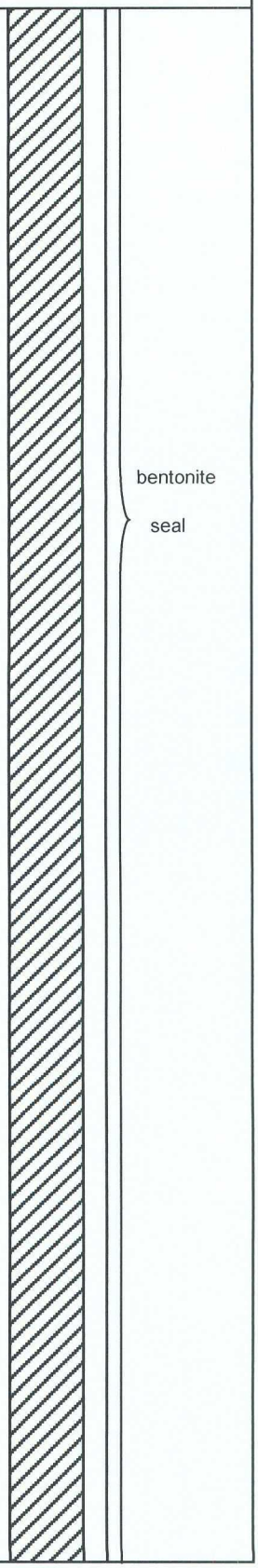
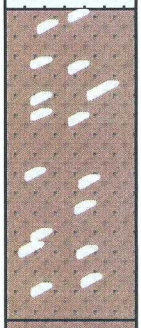
Drafted by: Jordan Woodfin

TD = 60 ft Estimated depth to GW = 75 ft

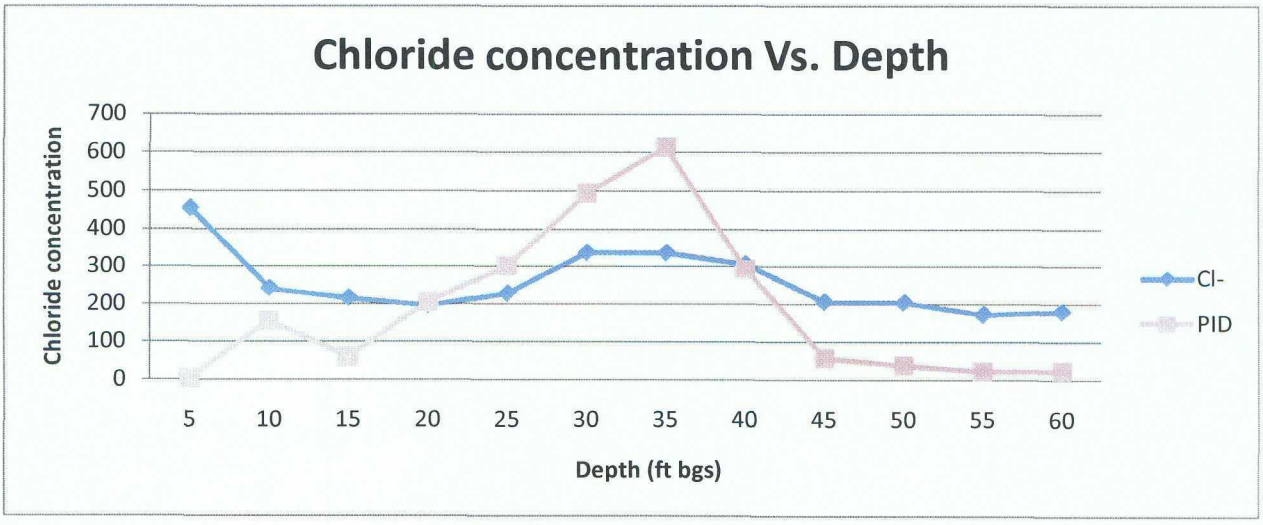
Depth (feet)	chloride field tests	LAB	PID	Description
				0ft-12ft SILT AND CALICHE dark brown to gray (backfill)
15 ft	217		59.8	12ft-23ft CALICHE
20 ft	198		205	grayish-brown (discolored) hydrocarbon oder

Lithology

Well Construction

Depth (feet)	chloride field tests	LAB	PID	Description	Lithology	Well Construction
				23ft-25ft SILT light grayish brown, very fine grain		
25 ft	229		300			
				25ft-30.5ft SAND AND SANDSTONE brown to light grayish brown,fine grain, moderately sorted, sub-rounded with interbedded gray sandstone, strong hydrocarbon oder at 30ft		
30 ft	338		494			
				31ft-43ft SAND brown to dark brown, fine to medium grain, well sorted, sub-rounded		
35 ft	338		614			
40 ft	308		294			
				43ft-48ft SAND brown to light brown, fine grain, well sorted, sub-angular		
45 ft	206		58			

Depth (feet)	chloride field tests	LAB	PID	Description	Lithology	Well Construction
50ft	205		38.8	48ft-60ft		
				SAND		
55 ft	173		22.6			
				brown, fine to medium grain, well sorted, rounded with interbedded fine grain sandstone		
60 ft	180		23.6			



Logger:	Dale Littlejohn
Driller:	Harrison & Cooper
Consultant:	R.T. Hicks
Drilling Method	Air Rotary
Start Date:	5/12/2010
End Date:	5/12/2010

RICE OPERATING COMPANY ROC SINCE 1955

Project Name: Hobbs C-30 Vent **Well ID:** SB # 2

Location: UL/C Sec 30 T18S R38E

Lat: N.32* 43' 20.334" **County:** Lea

Long: W. 103* 11' 28.076" **State:** NM

Comments: All samples from cuttings. Samples were taken 20' to the East of the former junction box.

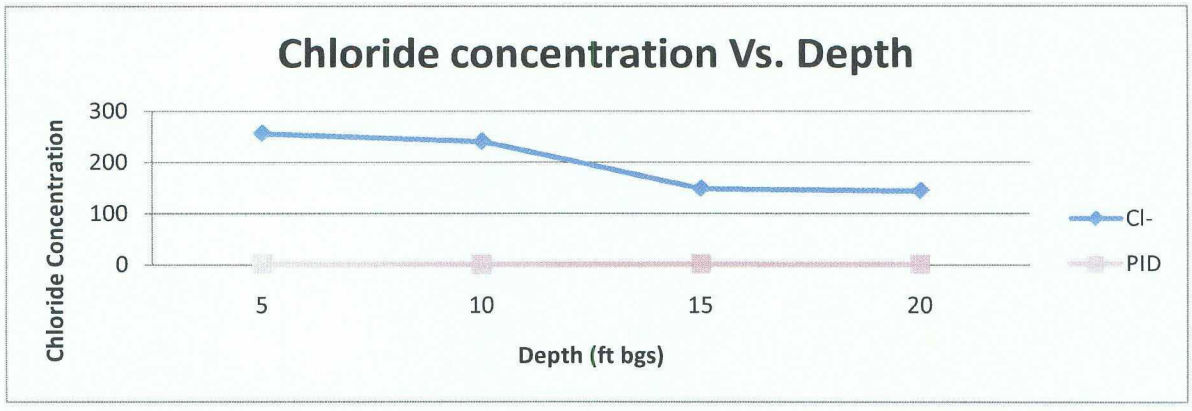
Drafted by: Lara Weinheimer

TD = 20 ft Estimated depth to GW = 75 ft

Depth (feet)	chloride field tests	LAB	PID	Description
				0ft-2ft SILT AND CALICHE dark brown
5 ft	257		2.2	2ft-20ft CALICHE, SILT, SANDSTONE AND QUARTZITE white to gray, with interbedded light brown silt, grayish white sandstone and grayish brown quartzite
10 ft	241		0.7	
15 ft	149		2	
20 ft	144		1	

Lithology

Well Construction: bentonite seal



Logger:	Dale Littlejohn
Driller:	Harrison & Cooper
Consultant:	R.T. Hicks
Drilling Method	Air Rotary
Start Date:	5/12/2010
End Date:	5/12/2010

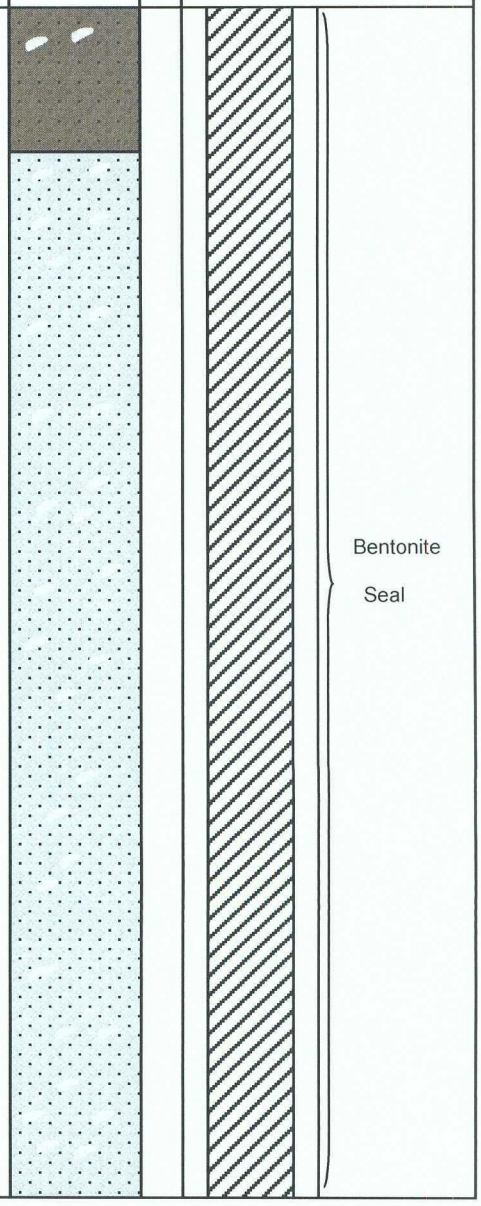
RICE OPERATING COMPANY
ROC
SINCE 1955

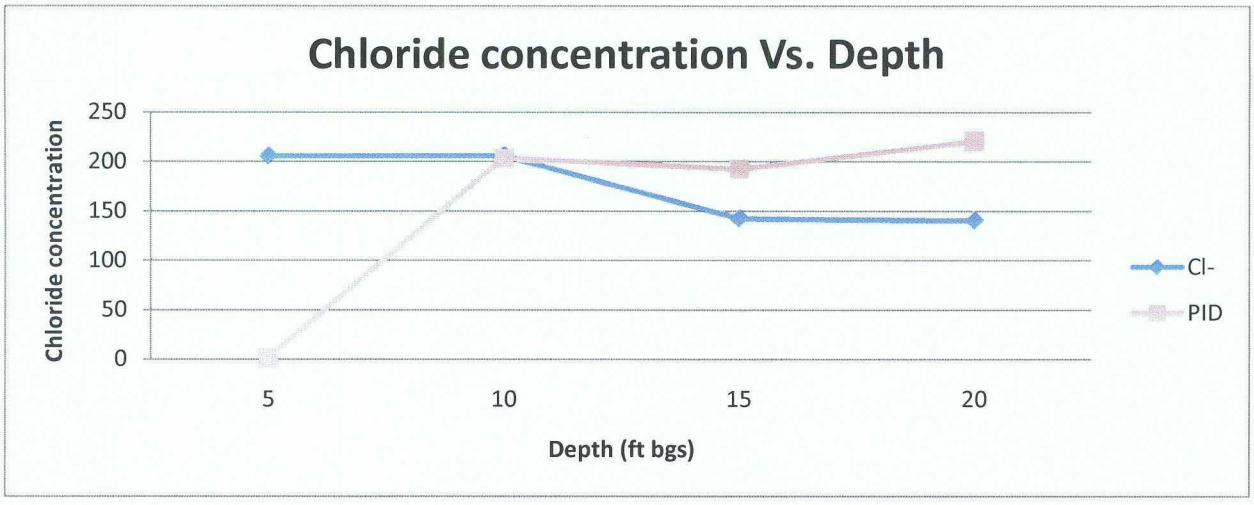
Project Name: Hobbs C-30 Vent **Well ID:** SB # 3

Location: UL/C Sec 30 T18S 38E
Lat: N 32* 43' 20.635" **County:** Lea
Long: W 103* 11' 28.294" **State:** NM

Comments: All samples from cuttings. Located 20' to the North of the former junction box.
Drafted by: Jordan Woodfin
TD = 20 ft Estimated depth to GW = 75 ft

Depth (feet)	chloride field tests	LAB	PID	Description
				0ft-2ft
				SILT AND CALICHE
				dark brown
5 ft	207		1.3	2ft-9ft
				SILT AND CALICHE
				white to gray, light brown grayish brown Hydrocarbon odor
10 ft	207		204	
				9ft-20ft
15 ft	143		193	
				CALICHE, SILT, QUARTZITE, AND SANDSTONE
20 ft	141		221	
				white to gray, light brown grayish brown Hydrocarbon odor




Chloride concentration Vs. Depth
Chloride concentration
250
200
150
100
50
0
5
10
15
20
Depth (ft bgs)
Cl-
PID

Logger:	Dale Littlejohn
Driller:	Harrison & Cooper
Consultant:	R.T. Hicks
Drilling Method	Air Rotary
Start Date:	5/12/2010
End Date:	5/12/2010

RICE OPERATING COMPANY ROC SINCE 1955

Project Name: Hobbs C-30 Vent **Well ID:** SB # 4

Location: UL/C Sec 30 T18S R38E

Lat: N 32* 43' 20.815" **County:** Lea

Long: W 103* 11' 28.239" **State:** NM

Comments: All samples from cuttings. Located at 40' to the North of the former junction box.

Drafted by: Lara Weinheimer

TD = 40 ft Estimated depth to GW = 75 ft

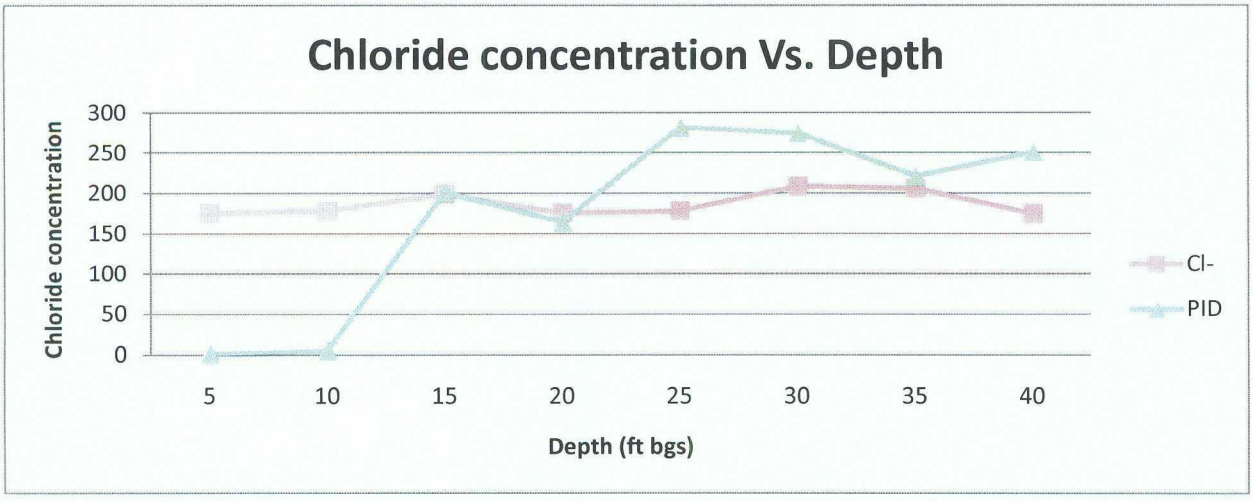
Depth (feet)	chloride field tests	LAB	PID	Description
				0ft-1ft
				CALICHE
				road base
				1ft-2ft
				CALICHE AND SILT
				dark brown
5 ft	175		2.8	2ft-7ft
				CALICHE AND SILT
				gray, very little silt (hydrocarbon odor)
				7ft-10ft
				CALICHE AND SILT
				gray, interbedded light brown grayish brown silt (hydrocarbon odor)
10 ft	178		6.5	
				10ft-26ft
15 ft	199		201	
				CALICHE, SILT, QUARTZITE, AND SANDSTONE
				white to gray with interbedded light brown grayish brown silt, (hydrocarbon odor)
20 ft	175		164	

Lithology

Well Construction

bentonite seal

Depth (feet)	chloride field tests	LAB	PID	Description	Lithology	Well Construction
25 ft	178		282			
				26ft-38ft SAND brown to reddish brown, fine grain, well sorted, sub-angular with interbedded (thin) quartzite and very fine sandstone		
30 ft	209		275			
35 ft	206		221			
40 ft	174		251	38ft-40ft SAND brown, fine to medium grain, well sorted, sub-rounded		



Attachment C

Laboratory Reports

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

April 19, 2010

Bruce Baker
Rice Operating Company
112 West Taylor
Hobbs, NM 88240

Re: Hobbs C-30 Vent (18/38)

Enclosed are the results of analyses for sample number H19644, received by the laboratory on 04/12/10 at 8:10 am.

Cardinal Laboratories is accredited through Texas NELAP for:

Method SW-846 8021	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method SW-846 8260	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method TX 1005	Total Petroleum Hydrocarbons

Certificate number T104704398-08-TX. Accreditation applies to solid and chemical materials and non-potable water matrices.

Cardinal Laboratories is accredited though the State of Colorado Department of Public Health and Environment for:

Method EPA 552.2	Haloacetic Acids (HAA-5)
Method EPA 524.2	Total Trihalomethanes (TTHM)
Method EPA 524.2	Regulated VOCs (V2, V3)

Accreditation applies to public drinking water matrices.

Total Number of Pages of Report: 5 (includes Chain of Custody)

Sincerely,

Celey D. Keene
Laboratory Director

This report conforms with NELAP requirements.

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: BRUCE BAKER
112 W. TAYLOR
HOBBS, NM 88240

Receiving Date: 04/12/10
Reporting Date: 04/19/10
Project Number: NOT GIVEN
Project Name: HOBBS C-30 VENT (18/38)
Project Location: HOBBS C-30 VENT (18/38)

Sampling Date: 04/08/10 & 04/09/10
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: JH
Analyzed By: AB/HM

LAB NUMBER	SAMPLE ID	GRO (C_6-C_{10}) (mg/kg)	DRO (>C_{10}-C_{28}) (mg/kg)	Cl* (mg/kg)
ANALYSIS DATE		04/15/10	04/15/10	04/13/10
H19644-1	SOURCE GRAB @ 5FT	<50.0	368	384
H19644-2	SOURCE GRAB @ 9FT	191	4,180	128
H19644-3	SOURCE BTM GRAB @ 12FT	109	2,410	160
H19644-4**	5' EAST GRAB @ 4FT	<10.0	<10.0	992
H19644-5	5' EAST 12FT BTM GRAB	<50.0	1,320	272
H19644-6	5' WEST GRAB @ 3FT	<50.0	137	608
H19644-7	5' WEST 10' BTM GRAB	<50.0	3,050	144
H19644-8	5' SOUTH GRAB @ 4FT	<50.0	77.4	736
H19644-9	5' SOUTH 9FT BTM GRAB	<50.0	1,060	160
H19644-10	5' NORTH GRAB @ 5FT	<50.0	209	576
H19644-11	5' NORTH 12 FT BTM GRAB	499	3,370	224
Quality Control		481	544	500
True Value QC		500	500	500
% Recovery		96.2	109	100
Relative Percent Difference		0.2	11.9	< 0.1

METHODS: TPH GRO & DRO: EPA SW-846 8015 M; Cl: Std. Methods 4500-Cl B

*Analyses performed on 1:4 w:v aqueous extracts.
Reported on wet weight.
**One or more TPH surrogates outside historical limits due to matrix interference.

Chemist

04/19/10
Date

H19644 TCL RICE

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: BRUCE BAKER
122 W. TAYLOR
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 04/12/10
Reporting Date: 04/14/10
Project Number: NOT GIVEN
Project Name: HOBBS C-30 VENT 18/38
Project Location: HOBBS C-30 VENT 18/38

Sampling Date: 04/08/10 & 04/09/10
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: JH
Analyzed By: ZL

LAB NUMBE SAMPLE ID	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL BENZENE (mg/kg)	TOTAL XYLENES (mg/kg)
ANALYSIS DATE	04/13/10	04/13/10	04/13/10	04/13/10
H19644-2 SOURCE GRAB @ 9FT	<0.050	<0.050	0.359	<0.300
H19644-3 SOURCE BTM GRAB @ 12FT	<0.050	<0.050	0.108	<0.300
H19644-11 5' NORTH 12FT BTM GRAB	<0.050	<0.050	0.256	1.10
Quality Control	0.046	0.043	0.045	0.130
True Value QC	0.050	0.050	0.050	0.150
% Recovery	92.0	86.0	90.0	86.7
Relative Percent Difference	2.7	<1.0	2.2	3.2

METHOD: EPA SW-846 8021B

TEXAS NELAP CERTIFICATION T104704398-08-TX FOR BENZENE, TOLUENE, ETHYL BENZENE, AND TOTAL XYLENES. Reported on wet weight.

Chemist

04/19/10
Date

CARDINAL LABORATORIES

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

101 East Marland, Hobbs, NM 88240 2111 Beechwood, Abilene, TX 79603
(505) 393-2326 FAX (505) 393-2476 (325) 673-7001 FAX (325)673-7020

Company Name:	Rice Operating Company	**BILL TO**	
Project Manager:	Bruce Baker	P.O. #:	
Address:	122 West Taylor	Company:	
City:	Hobbs	State: NM Zip: 88240	Attn:
Phone #:	575-393-9174	Fax #: 575-397-1471	Address:
Project #:		Project Owner:	City:
Project Name:	HOBBS C-30 VENT 18/38		State: Zip:
Project Location:	HOBBS C-30 VENT 18/38		Phone #:
Sampler Name:	Jordan Woodfin		Fax #:

FOR LAB USE ONLY				MATRIX						PRESERV			SAMPLING		ANALYSIS REQUEST									
Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER :	ACID/BASE:	ICE / COOL	OTHER :	DATE	TIME	Chlorides	TPH 8015 M	BTEX	Texas TPH						
H19644-1	Source grab @ 5 Ft	G	1			✓					✓		4-8-10	1000 am	✓	✓								
2	Source grab @ 9Ft	G	1			✓					✓		4-8-10	1145 am	✓	✓	✓							
3	Source btm grab @ 12Ft	G	1			✓					✓		4-8-10	1100 am	✓	✓	✓							
4	5' East grab @ 4Ft	G	1			✓					✓		4-8-10	730 p	✓	✓								
5	5' East 12Ft btm grab	G	1			✓					✓		4-9-10	900 am	✓	✓								
6	5' West grab @ 3Ft	G	1			✓					✓		4-9-10	100 pm	✓	✓								
7	5' West grab @ 10Ft btm grab	G	1			✓					✓		4-9-10	130 pm	✓	✓								
8	5' South grab @ 6Ft	G	1			✓					✓		4-9-10	10:30 am	✓	✓								
9	5' South 9Ft btm grab	G	1			✓					✓		4-9-10	1100 am	✓	✓								
10	5' North grab @ 5Ft	G	1			✓					✓		4-9-10	2:30 p	✓	✓								

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising whether based in contract or tort, shall be limited to the amount paid by the client for the analyses. All claims including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within 30 days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above stated reasons or otherwise.

Relinquished By: Jordan Woodfin	Date: 4-12-10 Time:	Received By:	Phone Result: ☐ Yes ☐ No Add'l Phone #:
			Fax Result: ☐ Yes ☐ No Add'l Fax #:
Relinquished By:	Date: 4/12/10 Time: 8:10	Received By: Jodi Henson	REMARKS: email results jwoodfin@riceswd.com; jpurvis@riceswd.com bbaker@riceswd.com KJONES@RICESWD.com LWEINHEIMER@RICESWD.com
Delivered By: (Circle One) Sampler - UPS - Bus - Other:		Sample Condition Cool: ☒ Yes ☐ No Intact: ☒ Yes ☐ No	CHECKED BY: (Initials)

† Cardinal cannot accept verbal changes. Please fax written changes to 505-393-2476

#26

NEED SAMPLES BACK, PLEASE

CARDINAL LABORATORIES

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

101 East Marland, Hobbs, NM 88240 2111 Beechwood, Abilene, TX 79603
(505) 393-2326 FAX (505) 393-2476 (325) 673-7001 FAX (325)673-7020

Company Name: Rice Operating Company	BILL TO
Project Manager: Bruce Baker	P.O. #:
Address: 122 West Taylor	Company:
City: Hobbs State: NM Zip: 88240	Attn:
Phone #: 575-393-9174 Fax #: 575-397-1471	Address:
Project #: Project Owner:	City:
Project Name: Hobbs C-30 Vent 13-38	State: Zip:
Project Location: Hobbs C-30 Vent 13-38	Phone #:
Sampler Name: Jordan Woodfin	Fax #:

FOR LAB USE ONLY				MATRIX						PRESERV.			SAMPLING		ANALYSIS REQUEST										
Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER :	ACID/BASE:	ICE / COOL	OTHER :	DATE	TIME	Chlorides	TPH 8015 M	BTEX	Texas TPH							
HA644-11	5' North 12ft Bluegrass	G	1			✓					✓		3:00p	4-9-10	✓	✓	✓								
			½			½					½														

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising whether based in contract or tort, shall be limited to the amount paid by the client for the analyses. All claims including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within 30 days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above stated reasons or otherwise.

Relinquished By: Jordan Woodfin	Date: 4-12-10 Time:	Received By:	Phone Result: ☐ Yes ☐ No Add'l Phone #:
			Fax Result: ☐ Yes ☐ No Add'l Fax #:
			REMARKS: email results jwoodfin@riceswd.com; jpurvis@riceswd.com bbaker@riceswd.com KJONES@RICESWD.COM LWEINHEIMER@RICESWD.COM
Relinquished By:	Date: 4/12/10 Time: 9:15	Received By: Jodi Henson	
Delivered By: (Circle One) Sampler - UPS - Bus - Other:	Sample Condition Cool: ☑ Yes ☐ No Intact: ☑ Yes ☐ No	CHECKED BY: (Initials)	

† Cardinal cannot accept verbal changes. Please fax written changes to 505-393-2476

#26

NEED SAMPLES BACK, PLEASE

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

May 18, 2010

Hack Conder
Rice Operating Company
112 West Taylor
Hobbs, NM 88240

Re: Hobbs C-30 Vent

Enclosed are the results of analyses for sample number H19882, received by the laboratory on 05/13/10 at 8:37 am.

Cardinal Laboratories is accredited through Texas NELAP for:

Method SW-846 8021	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method SW-846 8260	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method TX 1005	Total Petroleum Hydrocarbons

Certificate number T104704398-08-TX. Accreditation applies to solid and chemical materials and non-potable water matrices.

Cardinal Laboratories is accredited though the State of Colorado Department of Public Health and Environment for:

Method EPA 552.2	Haloacetic Acids (HAA-5)
Method EPA 524.2	Total Trihalomethanes (TTHM)
Method EPA 524.2	Regulated VOCs (V2, V3)

Accreditation applies to public drinking water matrices.

Total Number of Pages of Report: 4 (includes Chain of Custody)

Sincerely,

Celey D. Keene
Laboratory Director

This report conforms with NELAP requirements.

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: HACK CONDER
112 W. TAYLOR
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 05/13/10
Reporting Date: 05/17/10
Project Number: NOT GIVEN
Project Name: HOBBS C-30 VENT
Project Location: HOBBS C-30 VENT

Sampling Date: 05/12/10
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: JH
Analyzed By: ZL

LAB NUMBE SAMPLE ID	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL BENZENE (mg/kg)	TOTAL XYLENES (mg/kg)
ANALYSIS DATE	05/14/10	05/14/10	05/14/10	05/14/10
H19882-1 SB#1 @ 35FT	<0.050	0.543	0.924	6.35
H19882-2 SB#1 @ 60FT	<0.050	0.070	0.081	0.474
H19882-5 SB#3 @ 10FT	<0.050	0.184	0.315	1.92
H19882-6 SB#3 @ 20FT	<0.050	<0.050	0.155	1.53
H19882-7 SB#4 @ 25FT	<0.050	0.206	0.246	1.94
H19882-8 SB#4 @ 40FT	<0.050	0.273	0.367	3.78
Quality Control	0.017	0.017	0.018	0.055
True Value QC	0.020	0.020	0.020	0.060
% Recovery	85.0	85.0	90.0	91.7
Relative Percent Difference	9.4	4.8	5.8	4.1

METHOD: EPA SW-846 8021B

TEXAS NELAP CERTIFICATION T104704398-08-TX FOR BENZENE, TOLUENE, ETHYL BENZENE, AND TOTAL XYLENES. Reported on wet weight.

Chemist

05/18/10
Date

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: HACK CONDER
112 W. TAYLOR
HOBBS, NM 88240

Receiving Date: 05/13/10
Reporting Date: 05/17/10
Project Number: NOT GIVEN
Project Name: HOBBS C-30 VENT
Project Location: HOBBS C-30 VENT

Sampling Date: 05/12/10
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: JH
Analyzed By: AB/HM

LAB NUMBER	SAMPLE ID	GRO (C_6-C_{10}) (mg/kg)	DRO (>C_{10}-C_{28}) (mg/kg)	Cl* (mg/kg)
ANALYSIS DATE		05/16/10	05/16/10	05/14/10
H19882-1	SB#1 @ 35FT.	536	3,020	304
H19882-2	SB#1 @ 60FT.	<10.0	120	48
H19882-3	SB#2 @ 5FT.	<10.0	<10.0	160
H19882-4	SB#2 @ 20FT.	<10.0	<10.0	32
H19882-5	SB#3 @ 10FT.	250	2,200	96
H19882-6	SB#3 @ 20FT.	55.9	849	176
H19882-7	SB#4 @ 25FT.	142	1,290	128
H19882-8	SB #4 @ 40FT.	334	2,800	144
Quality Control		491	477	500
True Value QC		500	500	500
% Recovery		98.2	95.4	100
Relative Percent Difference		1.1	3.3	< 0.1

METHODS: TPH GRO & DRO: EPA SW-846 8015 M; Cl: Std. Methods 4500-Cl B
*Analyses performed on 1:4 w:v aqueous extracts.
Reported on wet weight. Not accredited for GRO/DRO and Chloride.

Chemist

05/18/10
Date

H19882 TCL RICE

CARDINAL LABORATORIES

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

101 East Marland, Hobbs, NM 88240 2111 Beechwood, Abilene, TX 79603
(505) 393-2326 FAX (505) 393-2476 (325) 673-7001 FAX (325)673-7020

Company Name:	Rice Operating Company	**BILL TO**	
Project Manager:	Hack Conder	P.O. #:	
Address:	122 West Taylor	Company:	
City:	Hobbs	State: NM Zip: 88240	Attn:
Phone #:	393-9174	Fax #: 397-1471	Address:
Project #:		Project Owner:	City:
Project Name:	~~Hobbs C-29 EOL~~	Hobbs C-30 VENT	State: Zip:
Project Location:	~~Hobbs C-29 EOL~~	Hobbs C-30 VENT	Phone #:
Sampler Name:	Jordan Woodfin		Fax #:

FOR LAB USE ONLY				MATRIX						PRESERV.			SAMPLING		ANALYSIS REQUEST										
Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER:	ACID/BASE:	ICE / COOL	OTHER:	DATE	TIME	Chlorides	TPH 8015 M	BTEX	Texas TPH	Complete Cations/Anions							
H19882-1	SB #1 @ 35 FT	G	1			✓					✓		5/12/10	10:24	✓	✓	✓								
2	SB #1 @ 60 FT	G	1			✓					✓		5/12/10	10:49	✓	✓	✓								
3	SB #2 @ 5 FT	G	1			✓					✓		5/12/10	1:09	✓	✓									
4	SB #2 @ 20 FT	G	1			✓					✓		5/12/10	1:18	✓	✓									
5	SB #3 @ 10 FT	G	1			✓					✓		5/12/10	1:51	✓	✓	✓								
6	SB #3 @ 20 FT	G	1			✓					✓		5/12/10	1:58	✓	✓	✓								
7	SB #4 @ 25 FT	G	1			✓					✓		5/12/10	2:45	✓	✓	✓								
8	SB #4 @ 40 FT	G	1			✓					✓		5/12/10	2:55	✓	✓	✓								

Relinquished By:	Jordan Woodfin	Date: 5/13/10 Time: 8:00	Received By:
Relinquished By:		Date: 5/13/10 Time: 8:37	Received By: Jodi Henson
Delivered By: (Circle One) Sampler - UPS - Bus - Other:		Sample Condition Cool: ☑ Yes ☐ No Intact: ☐ Yes ☐ No	CHECKED BY: (Initials)

Phone Result:	☐ Yes	☑ No	Add'l Phone #:
Fax Result:	☐ Yes	☑ No	Add'l Fax #:

REMARKS:

email results

Hconder@riceswd.com; Kjones@riceswd.com; Jwoodfin@riceswd.com

† Cardinal cannot accept verbal changes. Please fax written changes to 505-393-2476

#26

NEED SAMPLES BACK, PLEASE

Attachment D

VLEACH Model Results

R.T. Hicks Consultants, Ltd.
901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266.0745

Input and Results of the VLEACH Simulation Performed at the Rice Operating Co. Hobbs C-30 Vent Site

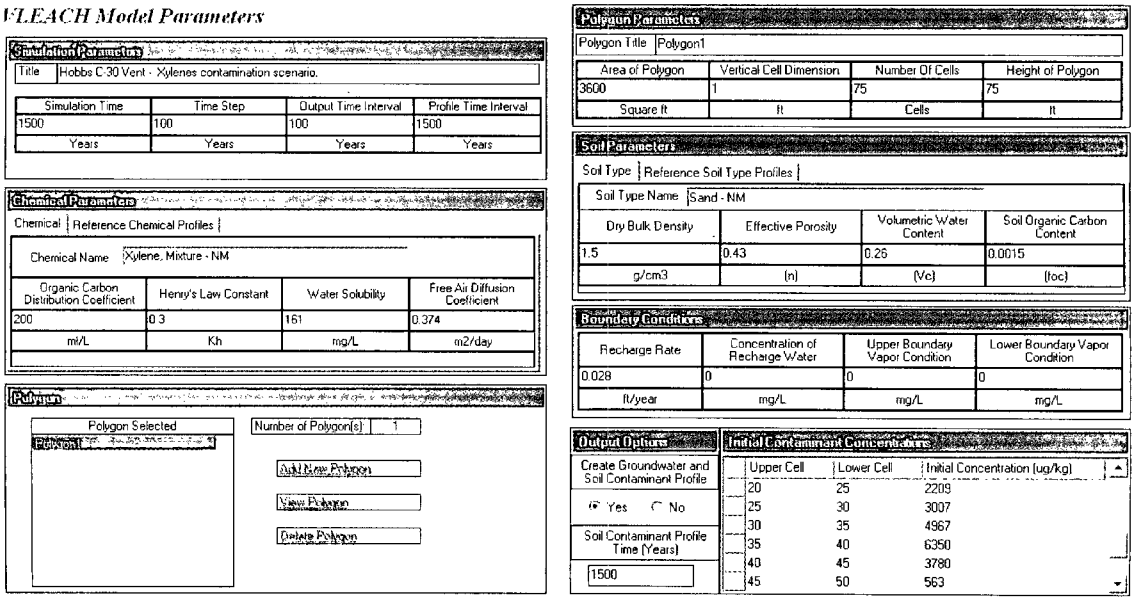
The specific parameters used in the simulation and diffusion to ground water equation at the site are presented in the table and figures below.

Table 1 – Common Parameters Employed in the VLEACH model for the Hobbs C-30 Vent Site

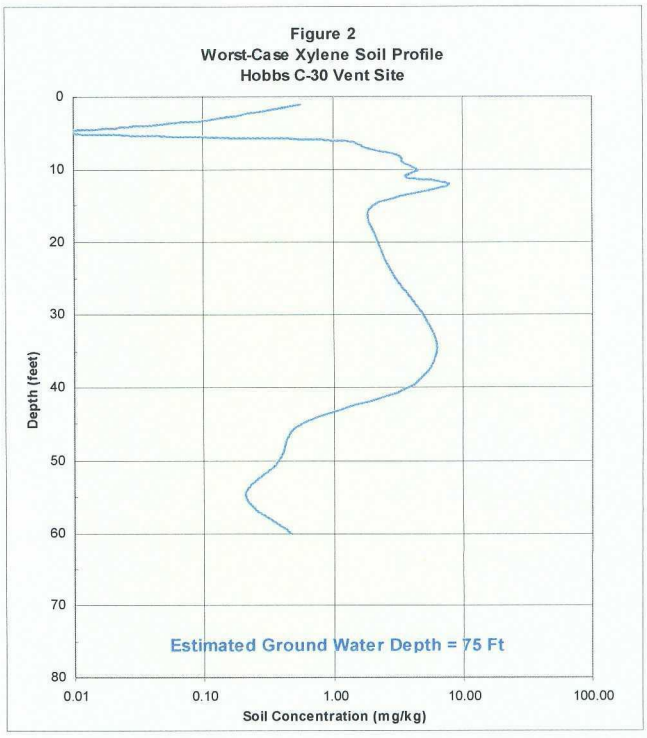
Model Parameter	Value	Source of Value
Xylene Chemical Parameters	Chemical Specific	NMED June 2006 Soil Screening Levels Document
Hydrocarbon Spill Area (ft^2)	3,600	Site Measurement
Groundwater Table Depth (ft)	75	Local Resident Information
Vadose Zone Soil Bulk Density (g/cm^3)	1.5	NMED June 2006 Document
Vadose Zone Porosity (unitless)	0.43	NMED June 2006 Document
Volumetric Water Content (%)	0.26	NMED June 2006 Document
Vadose Zone Soil Organic Content (f_{oc})	0.0015	NMED June 2006 Document
Recharge Rate (ft/year)	0.028	Musharrafieh 1999
Xylene Concentrations (ug/kg)	See Profile	Worst-Case Hydrocarbon Profile (Excavations & SB-1)
Slope of Water Table	0.003	Regional Map (Attachment A)
Hydraulic Conductivity (ft/d)	80	Musharrafieh 1999
Max width perpendicular to direction of GW flow (ft)	90	Site Measurement
Aquifer Porosity (unitless)	0.25	Prof. Judgment Conservative Assumption
Mixing zone depth in aquifer	6.6	Prof. Judgment Conservative Assumption

Figure 1 - Actual Input Screens from the VLEACH Model Program

VLEACH Model Parameters



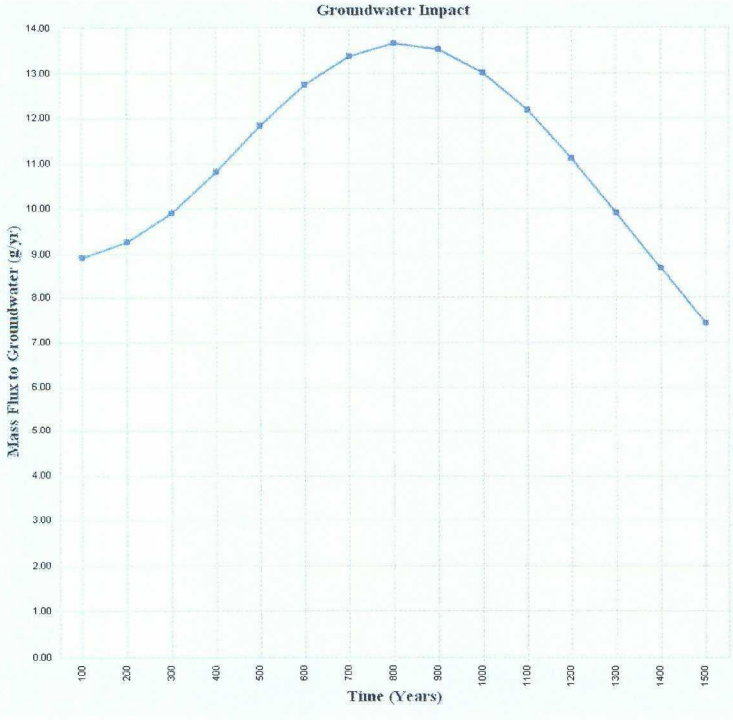
As a conservative measure a "worst-case" hydrocarbon soil profile was constructed by taking the highest xylenes concentration from each sampled depth as shown in Figure 2. Sampling depths for which laboratory results were not available were estimated from the field screening data. The xylene values from this profile were conservatively assumed to be present across the entire 3,600 ft² area.



The results from the VLEACH modeling relative to this assessment are provided as a graph that presents the subsurface impact as Mass Flux to Ground Water in grams/year (g/yr) as a function of future time as shown in Figure 3.

Simulation Time, Time Step, Output Time Interval, and Profile Time Interval were adjusted to provide a clear presentation of the results. The model result shows the highest impact to ground water will occur about 800 years from now.

Figure 3
Results of VLEACH Vadose Model for Xylenes



In order to compare the modeled results to the NMED ground water standard, the VLEACH output data required a conversion from g/yr to mg/L. This was performed by calculating the annual recharge (flux) volume from the spill area and the annual ground water flow volume below the spill area as shown:

Recharge is defined as: $Flux_{flow}(L/yr) = A \times R \times 29.317$ where,

A = spill area (ft^2)
R = recharge rate (ft/yr), and
29.317 = conversion factor from ft^3 to liters

Groundwater flow is defined as: $GW_{flow}(L/yr) = \left(\frac{k \times i}{\theta_T}\right) \times T_{aq} \times W \times 29.317$ where,

k = hydraulic conductivity of the aquifer (ft/yr)
i = groundwater gradient (ft/ft)
θ_T = porosity of the aquifer
T_{aq} = aquifer mixing zone thickness (ft) and,
W = length of the spill area (ft) perpendicular to the ground water gradient direction

The relationship between the annual recharge volume and the annual ground water flow volume was used to calculate the predicted ground water concentration for the initial (year zero) time and the maximum impact year time as demonstrated on the table below:

Table 2. Model Results for Total Xylenes

	Present Impact Data				Maximum Impact Data				NM
Chemical of Concern	Year	Impact (g/yr)	Leachate Conc. (mg/L)	GW Conc. (mg/L)	Year	Impact (g/yr)	Leachate Conc. (mg/L)	GW Conc. (mg/L)	Water Quality (mg/L)
Total Xylenes	0	9	3	0.001	800	14	5	0.002	0.6