1R – 428 - 45

WORK PLAN

DATE:

04-02-2007

1R428-45
Work Plan
April 2, 2007

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Environmental Bureau
Oil Conservation Division

Corrective Action Plan

0-29 Vent Site

Section 29, T18S, R 38E
NMOCD Case #: 1-R0428-45

Prepared for:

Rice Operating Company
122 West Taylor
Hobbs, NM 88240

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

April 2, 2007

Mr. Wayne Price
Environmental Bureau Chief
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: NMOCD Case # 1R0428-45, O-29 Vent
Hobbs SWD System Abandonment
Corrective Action Plan

Dear Mr. Price:

On behalf of Rice Operating Company, R.T. Hicks Consultants, Ltd. is pleased to submit the attached Corrective Action Plan for the O-29 Vent site. This plan presents characterization activities, evaluations and conclusions as well as a proposal for closure of the site after the selected remedy is implemented.

If you have any questions or concerns, please do not hesitate to contact us.

Sincerely,
R.T. Hicks Consultants, Ltd.

Katie Lee

Katie Lee
Staff Scientist

Copy: Rice Operating Company
Hobbs NMOCD Office

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1.0 INTRODUCTION

The O-29 Vent, located west of Hobbs, New Mexico, in section 29, T18S, R38E, was a junction box in the Hobbs Salt Water Disposal (SWD) system, which disposed of produced water from the late 1950s until 2002, when the system closed. Future impacts from the system are not possible. With the abandonment of the system in 2002, Rice Operating Company (ROC) excavated and removed the SWD O-29 Vent and the uppermost three feet of the vadose zone. At the time of investigation, the excavation was filled with a mixture of sand-caliche. Activities at the site followed the NMOCD-approved workplan (August 6, 2004).

This Corrective Action Plan presents:

1) A description of the characterization activities performed by R.T. Hicks Consultants (Hicks Consultants) and Rice Operating Company (ROC) at the O-29 Vent site located in the Hobbs SWD,

2) Evaluations and conclusions drawn from activities performed,

3) A proposal for closure of the site after the selected remedy is implemented.

2.0 WORK ELEMENTS PERFORMED

Detailed descriptions of characterization activities are provided in Appendix A. Appendix B shows the results of field chloride measurements. Plate 1 is an aerial photograph of the site when it was active, taken between 1996 and 1998, showing the locations of the boring and background boring.

Activities included:

1. O-29 soil boring characterization.

2. Background soil boring characterization.

3. Field measurements consisted of chloride titration and PID readings for volatiles.

4. Two selected soil samples were submitted for laboratory

analysis in accordance with the workplan.

5. HYDRUS-1D simulation of the site.

6. Development of a corrective action plan.

3.0 CONCLUSIONS

3.1 ACTIVITIES AT THE O-29 VENT HAVE NOT CAUSED COCs TO REACH GROUND WATER.

From chloride concentration and PID measurement profiles (confirmed by laboratory analysis), Hicks Consultants concludes that saturated conditions between the surface and ground water never developed, that constituents of concern (COCs) reside in the upper two-thirds of the vadose zone and, therefore, that activities at this site have not caused COCs to reach ground water.

3.2 CHLORIDE CONCENTRATIONS WILL NOT EXCEED WQCC GROUND WATER STANDARDS.

Using highly conservative input data, HYDRUS-1D modeling of the vadose zone chlorides predicts that resulting ground water chloride concentrations will be below the 250 ppm Water Quality Control Commission (WQCC) secondary drinking water standard. At a nearby background monitoring well, over four years of data show that chloride concentration ranges from 111 mg/L to 301 mg/L, with an average concentration of 159 mg/L. The predicted chloride concentration increase at the O-29 site (42 mg/L) could not be differentiated from natural vegetation. The model inputs and methodology are discussed in Appendix C.

3.3 THE SITE PRESENTS NO THREAT TO FRESH WATER, PUBLIC HEALTH OR THE ENVIRONMENT.

Because residual petroleum hydrocarbons and chloride are not present in sufficient concentration or sufficient mass, Hicks Consultants concluded that the site represents no threat to fresh water, public health, or the environment (see discussion in Appendix A and Appendix C).

4.0 RECOMMENDATION

Hicks Consultants recommends that ROC create an infiltration barrier through re-vegetation of the ground surface at the O-29 Vent site. This remedy is protective of ground water quality, human health, and the environment. Upon documentation of this action, a closure report/request will be submitted to NMOCD.

Details of Characterization Activities At the O-29 Vent Site

Appendix A

APPENDIX A

1) O-29 SOIL BORING CHARACTERIZATION

The boring at the O-29 Vent site was drilled in November, 2004, to a depth of 65 feet within the capillary fringe at this site. Plate 2 illustrates the lithology and distribution of constituents of concern. From 0–35 feet below ground surface (bgs), the split spoon obtained samples at 5-foot intervals.

The dry and unconsolidated nature of the sand-silt from 35–60 feet bgs caused the loss of split-spoon samples during retrieval (with the exception of a caliche layer at 46 feet bgs that was successfully sampled with the split spoon).

Due to increased soil moisture at 60 feet bgs, the split spoon was able to retain samples to the total depth of 65 feet. In the interval between 35 feet bgs and 60 feet bgs, samples were collected from cuttings. This is the only material deviation from the NMOCD-approved workplan. Moist soil was observed at 65 feet bgs and depth to water was estimated at approximately 66 feet. The boring was plugged with Bentonite.

2) BACKGROUND SOIL BORING CHARACTERIZATION

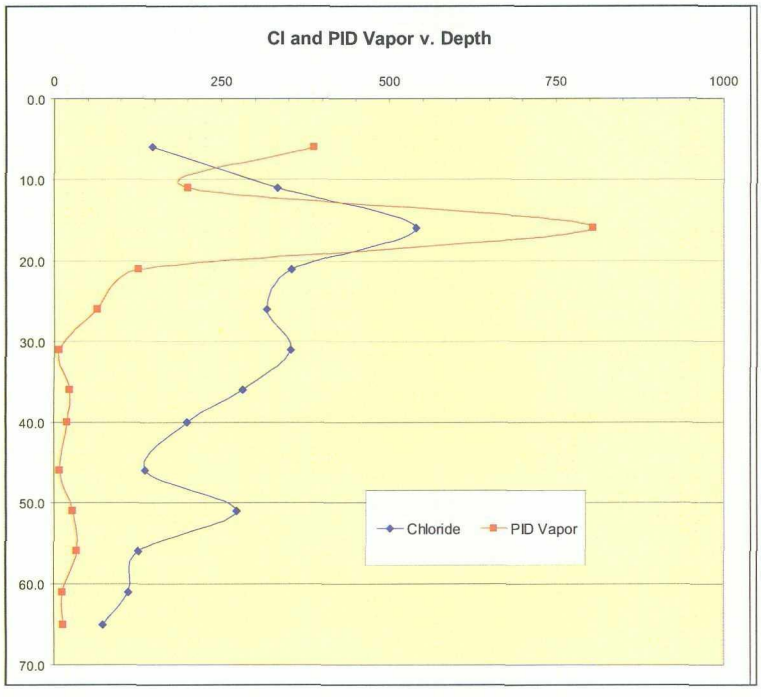
Samples taken from a background boring located about 4000 feet northwest of the site show that background chloride concentrations in the area are approximately 80 mg/kg. Appendix B presents the field data from this boring.

3) FIELD MEASUREMENTS

ROC took field measurements from each 5-foot sampling interval for chloride and volatiles in the field using the heated headspace method to measure total organic vapors by photoionization detector (PID). Samples were submitted to a laboratory from depths showing the highest field chloride and PID measurements (16 feet bgs) and from the capillary fringe (65 feet bgs); see Figure A-1. Plate 2 is a lithologic log of the boring with field chloride concentrations and PID measurements. Appendix B provides additional chemical data for the soil samples.

The maximum chloride concentration in the soil is 539 ppm at 16 feet bgs and chloride declines with depth, as shown by Figure A-1.

Figure A-1: Chloride Concentrations and PID Readings From Soil Boring Samples, O-29 Vent Site, November 4, 2004



Chloride concentrations reach approximate background levels at a depth of 56 feet bgs. Field evidence demonstrates that the chloride mass resides in the upper two-thirds of the vadose zone.

PID readings follow a pattern similar to that of chloride, peaking at 16 feet bgs with 804 ppm total organic vapors, and reaching background concentrations below 30 feet bgs.

Laboratory analysis of the soil sample from 16 feet bgs showed benzene, toluene, ethylbenzene and xylene (BTEX) are present in total aggregate concentration below 50 ppm (Table A-1).

Table A-1: Laboratory Analysis Results of Samples From the O-29 Boring.

SWD B-5 (O-29 Vent), November, 2004				
Constituent of Concern	16 ft. bgs	Detection Limit	65 ft. bgs	Detection Limit
	mg/kg (dry)			
Benzene	0.257	0.2	ND	0.025
Toluene	2.61		ND	
Ethyl benzene	5.4		ND	
Xylene (p/m)	25.8		ND	
Xylene (o)	2.55		ND	

BTEX was not detected in field laboratory analysis of the soil sample from the capillary fringe (65 feet bgs).

Field Measurements & Laboratory Results For Soil Samples

Appendix B

✓ O-29 Vent

Soil Bore

System: Hobbs Location: Vent @ 29 GW: 65 Landowner: Oxy

Soil Bore: @ Vent @ 29 GPS: Coord. System UTM 13 671817 E

ULI @ Sec. 29 T 18 R 38 Map Datum Nad83 3620861 N

Depth	Cl.	PID	Color	Time
6'	146	387	Tan Calithe Strong Smell	
11'	934	200	" "	
16'	539	804	" "	3:28
21'	359	126	Brown Calithe Some Smell	
26'	317	64.8	Tan Sandy Calithe Some Smell	
31'	353	7.3	Tan Sandy Calithe	
36'	281	23.2	Tan Sandy Calithe + Rock	
40'	198	12.8	Red Sand	
46'	135	8.3	Pink Fine Calithe	
51'	272	270	" "	
56'	126	34.1	" "	
61'	111	12.0	" "	
65'	72	13.9	Pink Cs Calithe + Sand	
			Some moisture	4:33

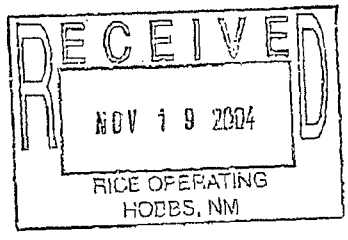
Notes: Got moisture @ 65' Took pictures @ base

Signature [signature] Date 11/4/04

rice Operating Co.	Project: Vent O-29	Fax: (505) 397-1471
122 W. Taylor	Project Number: None Given	Reported:
Hobbs NM, 88240	Project Manager: Roy Rascon	11/15/04 16:41

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SB @ 16'	4K10010-01	Soil	11/04/04 15:28	11/10/04 07:50
SB @ 65'	4K10010-02	Soil	11/04/04 16:33	11/10/04 07:50



12600 West I-20 East - Odessa, Texas 79765 - (432) 563-1800 - Fax (432) 563-1713

Operating Co.	Project: Vent O-29	Fax: (505) 397-1471
122 W. Taylor	Project Number: None Given	Reported:
Hobbs NM, 88240	Project Manager: Roy Rascon	11/15/04 16:41

Organics by GC

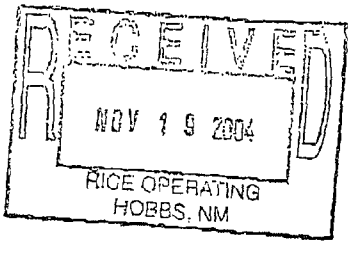
Environmental Lab of Texas

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SB @ 16' (4K10010-01) Soil									
Benzene	0.257	0.200	mg/kg dry	200	EK41501	11/12/04	11/12/04	EPA 8021B	
Toluene	2.61	0.200	"	"	"	"	"	"	
Ethylbenzene	5.40	0.200	"	"	"	"	"	"	
Xylene (p/m)	25.8	0.200	"	"	"	"	"	"	
Xylene (o)	2.55	0.200	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*156 %*	*80-120*		"	"	"	"	*S-04*
Surrogate: 4-Bromofluorobenzene		*140 %*	*80-120*		"	"	"	"	*S-04*
Gasoline Range Organics C6-C12	1480	10.0	mg/kg dry	1	EK41006	11/10/04	11/11/04	EPA 8015M	
Diesel Range Organics >C12-C35	3130	10.0	"	"	"	"	"	"	
Total Hydrocarbon C6-C35	4610	10.0	"	"	"	"	"	"	
Surrogate: 1-Chlorooctane		*122 %*	*70-130*		"	"	"	"	
Surrogate: 1-Chlorooctadecane		*121 %*	*70-130*		"	"	"	"	
SB @ 65' (4K10010-02) Soil									
Benzene	ND	0.0250	mg/kg dry	25	EK41501	11/12/04	11/12/04	EPA 8021B	
Toluene	ND	0.0250	"	"	"	"	"	"	
Ethylbenzene	ND	0.0250	"	"	"	"	"	"	
Xylene (p/m)	ND	0.0250	"	"	"	"	"	"	
Xylene (o)	ND	0.0250	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*96.2 %*	*80-120*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*108 %*	*80-120*		"	"	"	"	
Gasoline Range Organics C6-C12	ND	10.0	mg/kg dry	1	EK41006	11/10/04	11/11/04	EPA 8015M	
Diesel Range Organics >C12-C35	ND	10.0	"	"	"	"	"	"	
Total Hydrocarbon C6-C35	ND	10.0	"	"	"	"	"	"	
Surrogate: 1-Chlorooctane		*103 %*	*70-130*		"	"	"	"	
Surrogate: 1-Chlorooctadecane		*116 %*	*70-130*		"	"	"	"	

Operating Co.	Project: Vent O-29	Fax: (505) 397-1471
122 W. Taylor	Project Number: None Given	Reported:
Hobbs NM, 88240	Project Manager: Roy Rascon	11/15/04 16:41

General Chemistry Parameters by EPA / Standard Methods
Environmental Lab of Texas

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SB @ 16' (4K10010-01) Soil									
Chloride	**510**	20.0	mg/kg Wet	2	EK41210	11/10/04	11/11/04	SW 846 9253	
% Moisture	**12.0**		%	1	EK41101	11/10/04	11/11/04	% calculation	
SB @ 65' (4K10010-02) Soil									
Chloride	ND	20.0	mg/kg Wet	2	EK41210	11/10/04	11/11/04	SW 846 9253	
% Moisture	**10.0**		%	1	EK41101	11/10/04	11/11/04	% calculation	



Soil Bore

System: Hobbs Location: GW: 62' Landowner:

Soil Bore: [illegible] GPS. Coord. System UTM 13 671407 E

UL F Sec. 29 T 18 R 38 Map Datum Nad83 3621969 N

Depth	Cl.		PID		Color	Time
5'	127		2.0		Dark Brown	
6'	107		4.7		caliche	
11'	121		6.5		white caliche	
16'	84		1.3		[illegible]	
21'	51		4.3			
26'	111		2.7		[illegible]	
31'	52		5.9		[illegible]	
36'	56		3.3		Red fine caliche sandy	
41'	73		4.7		Brown [illegible]	
46'	106		5.4			
51'	77		2.9			
56'	47		4.3			
61'	55		3.6		Wet brown sand	9:50
					some moisture	

Notes: Hit ground water @ 62' Took pictures @ bore

Signature [illegible] Date 1/7/04

COPY

Rice Operating Co. 122 W. Taylor Hobbs NM, 88240	Project: Background Bore Project Number: None Given Project Manager: Kristin Pope	Fax: (505) 397-1471 Reported: 11/12/04 16:02

General Chemistry Parameters by EPA / Standard Methods
Environmental Lab of Texas

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SB @ 61.0 (4K10006-01) Soil									
Chloride	ND	20.0	mg/kg	Wet 2	EX41209	11/10/04	11/11/04	SW 846 9253	

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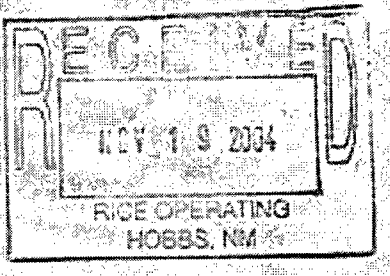
Rice Operating Co.	Project: Background Bore	Fax: (505) 397-1471
122 W. Taylor	Project Number: None Given	Reported:
Hobbs NM, 88240	Project Manager: Kristin Pope	11/12/04 16:02

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SB @ 61 ft	4K10006-01	Soil	11/03/04 00:00	11/10/04 07:50



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Modeling Input Parameters & Results

Appendix C

APPENDIX C

To model the effect of the vadose zone remedy's impact on ground water at the O-29 Vent site, output from HYDRUS-1D is used as input to a ground water mixing model.

HYDRUS-1D modeling simulated fluxes through the vadose zone. The HYDRUS-1D output becomes the input to a simple ground water mixing model to predict chloride concentration in a simulated monitoring well immediately down-gradient of the site. Section 3.0 of "Modeling Study of Produced Water Release Scenarios" (Hendrickx, et al.; 2005) provides a general description of this modeling approach (see Appendix D for reference works cited).

The observed vadose zone chloride profile was installed in the model. The present chloride load within the soil profile is the result of all previous events at the site and is based upon field observation and analysis producing the most accurate modeling approach.

The O-29 Vent field chloride data were integrated over the vertical depth of the vadose zone to obtain a chloride load of 9.54 kg/m2. The integrated chloride load of a nearby site is 7.89 kg/m2. Because the sites have similar chloride loads and soil properties, Hicks Consultants elected to modify the model of this nearby site to represent the O-29 Vent site. Site specific parameters were altered to represent the properties and dimensions of the O-29 Vent site. As chloride is conserved during migration through the vadose zone, the mixing model output was multiplied by a scaling factor (9.54/7.89 = 1.21) to obtain predicted chloride concentrations in the aquifer for the O-29 Vent site.

INPUT DATA:

Modeling inputs for the O-29 Vent site are presented in Table C-1.

Table C-1: HYDRUS-1D and Mixing Model Input Parameters

Input Parameter	Source
Vadose zone thickness - 60 feet	Field data and professional judgement
Vadose zone texture (Plate 3)	Field data
Dispersion length: <6% of model length	Professional judgement
Climate	2004 Hobbs, NM, data and Pearl Weather Station data
Soil moisture	HYDRUS-1D initial condition simulation
Initial soil chloride concentration profile	From ROC field measurements
Length of release parallel to ground water flow: 15 feet	ROC Field measurement
Background chloride in ground water: 100 ppm	Chemical analysis
Ground water flux: 8.6 cm/day	Calculated from published data
Aquifer thickness: 10 feet	Conservative choice

SOIL PROFILE

The modified model was constructed with a vadose zone soil profile representative of an excavated site (0 to 19 feet bgs). Although the O-29 Vent site was not excavated, this choice is considered conservative of ground water quality in that the upper 19 feet of the soil profile have been replaced with materials featuring higher hydraulic conductivities than the native materials (caliche) at the O-29 Vent site (See Plate 3).

Vadose zone thickness is 65 feet at the O-29 Vent site. The modified model uses a thickness of 60 feet. This primary effect of this difference is to reduce time of transit of infiltrated water through the vadose zone.

DISPERSION LENGTHS

Because of Hicks Consultants' recent experience with similar soils conservative dispersion lengths were employed. Standard practice calls for employing a dispersion length that is 10% of the model length. For each lithologic unit identified in Plate 3, a dispersion length less than 6% of the model thickness was installed (Table C-2 presents the dispersion lengths for each lithology).

Table C-2: Dispersion Lengths

O-29 Hydrus-1D Soil Profile Properties				
Material	Description	Length (cm)	Dispersion (cm)	% of Profile Length
1	Sandy loam	30	50	2.78
2	Caliche-sand	60	30	1.67
3	Caliche	90	10	0.56
4	Sand-silt	1070	100	5.56
5	Loamy sand	550	100	5.56

CLIMATE

Weather data used in the predictive modeling include Hobbs data from November, 2003, to December, 2004, plus an additional 45 years from the Pearl Weather Station, approximately 11 miles west of the Hobbs Airport. The Pearl Weather Station is the closest station to the O-29 Vent site featuring sufficiently complete weather data for the HYDRUS-1D input files.

SOIL MOISTURE

An initial soil moisture condition was obtained running a HYDRUS-1D simulation for 45 years using the weather data from the Pearl Weather Station. 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 an initial "steady state" soil moisture content. Vegetation was not allowed in order to create a "wetter" initial condition. This choice is conservative of ground water quality in that "wetter" soils have greater hydraulic conductivities.

The calculation of soil moisture content begins with an initial soil moisture input estimated by professional judgment. Then, sufficient years of weather data are run through the model to establish a "steady state" moisture content. Because only minimal changes in the HYDRUS-1D soil moisture content profile occurred after year 30 of the initial condition calculation, a 45 year simulation was considered acceptable to establish the initial moisture condition. Soil profiles hydrated in this manner were used in all simulations of chloride movement.

INITIAL CHLORIDE PROFILE

From the observed field data generated by ROC personnel, linearly interpolated chloride concentrations were assigned to the model's more finely spaced nodes of the hydrated soil profile.

MIXING MODEL INPUTS:

INFLUENCE DISTANCE

As the vent was oriented vertically, the affected surface area is small. Significant lateral impacts were not observed, and the disturbed area was measured as 11 feet by 15 feet.The affected diameter of the site parallel to ground water flow was taken as 15 feet to be conservative of ground water quality.

BACKGROUND CHLORIDE CONCENTRATION

From nearby well data, a value of 100 mg/L chloride for ground water was used for the predictive modeling.

HYDRAULIC CONDUCTIVITY

Hicks Consultants believes that the hydraulic conductivity of the saturated zone at the O-29 Vent site is similar to that observed for the Ogallala Aquifer throughout the general area. McAda (1984) simulated water level declines using a two-dimensional digital model and employed hydraulic conductivity values of 51-75 feet/day (1.9 E-4 to 2.8 E-4 m/s) in the area. According to Freeze and Cherry (1979), these values correspond to clean sand, which agrees with nearby lithologic descriptions of the saturated zone. A value of 45 feet/day was assumed for hydraulic conductivity of the uppermost saturated zone to be conservative of ground water quality.

GROUNDWATER GRADIENT

A hydraulic gradient of 0.0063 was calculated for this site (Intera Report and USGS Topographic Map). Using a hydraulic conductivity of 45 ft/day, ground water flux is calculated as 8.6 cm/day.

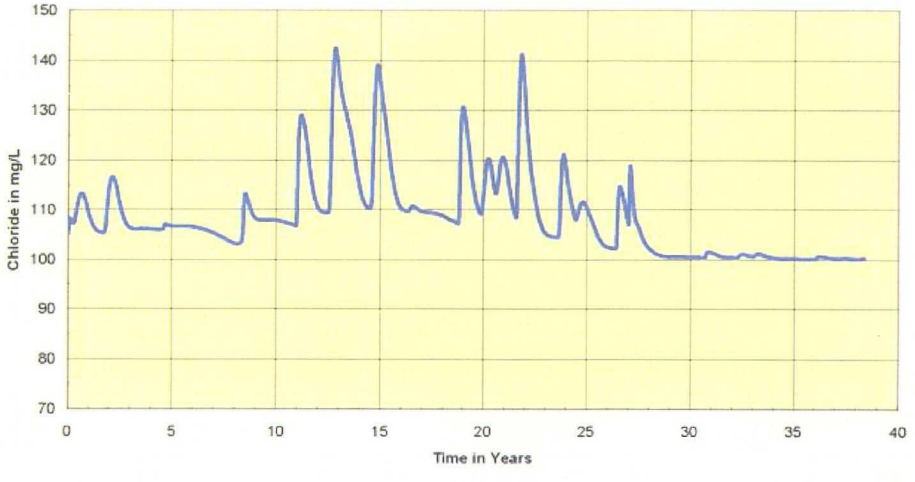
AQUIFER THICKNESS

Field data within Section 29 demonstrate that the aquifer is greater than 40 feet thick. A restricted aquifer thickness of 10 feet was employed in the mixing model in accordance with OCD request. This choice is conservative of ground water quality as it results in higher predicted chloride concentrations in a simulated monitoring well.

MODELING RESULTS:

Using the input data described above, HYDRUS-1D and the ground water mixing model predict no exceedance of WQCC ground water standards at the O-29 Vent site (see Figure C-1). For this simulation, it was assumed that no vegetation is present at the site.

Figure C-1: Predicted Chloride Concentration in the Aquifer for the O-29 Site with No Vegetation



As field chloride data demonstrate, impacts at this site are marginally greater than background; thus, an insignificant impact to ground water quality would be expected. As shown in Figure C-1, chloride concentration in the aquifer attains a maximum of 142 ppm approximately 13 years from now. The effect of the chloride load is no longer distinguishable 29 years from now.

Chloride concentration in ground water varies in response to natural causes. At a nearby background monitoring well, over four years of data show that chloride concentration ranges from 111 mg/L to 301 mg/L with an average concentration of 159 mg/L and a standard deviation of 59 mg/L. Therefore, the predicted chloride concentration increase at the O-29 site (42 mg/L) could not be differentiated from natural variation.

Works Consulted

Appendix D

APPENDIX D

Ash, S.R., 1963, Ground water conditions in northern Lea County, U.S. Geological Survey Hydrologic Investigations Atlas HA-62.

Hendrickx, J., Rodriguez, G., Hicks, R. T., and Simunek, January 2005, Modeling Study of Produced Water Release Scenarios, API Publication Number 4734, 11 pp.

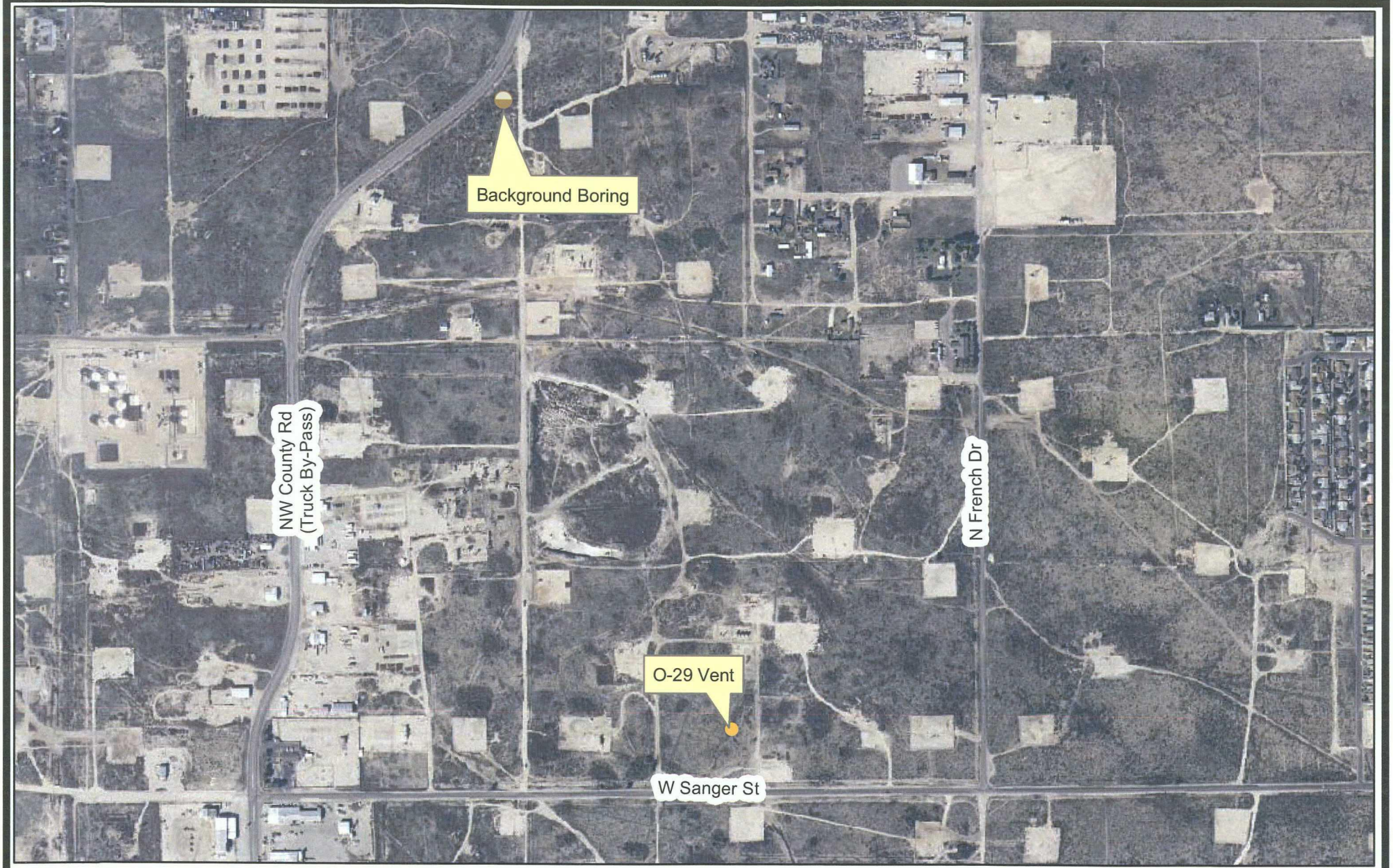
Intera Incorporated, July 8, 2003, Windmill Oil Site Ground Water Sampling Results, prepared for the New Mexico Oil Conservation Division, 3 pp.

McAda, D.P., 1985, Projected water-level declines in the Ogallala aquifer in Lea County, New Mexico, US Geological Survey Water-Resources Investigations Report 84-4062, 84 pp.

Musharrafieh, G. and Chudnoff, M., January 1999, Numerical Simulation of Groundwater Flow for Water Rights Administration in the Lea County Underground Water Basin New Mexico, New Mexico Office of the State Engineer Technical Report 99-1, 6 pp.

Nicholson Jr., A. and Clebsch, A., 1961, Geology and Ground Water Conditions of Southern Lea County, New Mexico, Ground Water Report 6, US Geological Survey, New Mexico Bureau of Mines and Mineral Resources.

Plates



Aerial Photo: http://rgis.unm.edu

0 500 1,000 2,000 3,000 4,000 Feet

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

2004 Aerial Photograph showing the O-29 Vent Site

Plate 1

Rice Operating Company : O-29 Vent Site
(NMOCD#: 1R0428-43)

March 2007

N W E S

Logger:	David Hamilton	**Client:**	**Boring ID:**
Driller:	Eades Drilling	Rice Operating Company	
Drilling Method:	Air Rotary	**Project Name:**	
Start Date:	11/4/2004	O-29 Vent	**O-29 Vent Site B-5 (65 feet)**
End Date:	11/4/2004	**Location:**	
		T18S R38E	
		Section 29, Unit O	

Depth (feet)	Description	Lithology	Comments	Field data		
				Depth	Chloride mg/kg	PID
0.0	Sand silt, caliche, tan, 0-17 feet					
2.0			Discolored, strong odor			
4.0						
6.0				6.0	146	387.0
8.0						
10.0				11.0	334	200.0
12.0						
14.0						
16.0	Well indurated caliche, 17-20 feet			16.0	539	804.0
18.0			Hard drilling with chattering of bit			
20.0	Very fine grained sand silt, some caliche, tan, 20-27 feet			21.0	354	126.0
22.0			Tan-yellow color			
24.0						
26.0	Very fine grained sand silt, tan-red, 27-42 feet			26.0	317	64.8
28.0						
30.0				31.0	353	7.3
32.0						
34.0						
36.0				36.0	281	23.2
38.0						
40.0				40.0	198	18.8
42.0	V. f, grained sand silt, caliche, tan, 42-44 ft.					
44.0	Well indurated caliche, very fine grained sand silt, tan, 44-51 feet					
46.0			Split spoon could only collect 0,5 ft. sample	46.0	135	8.3
48.0						
50.0	Very fine grained sand , tan , 51-60 feet			51.0	272	27.0
52.0						
54.0				56.0	126	34.1
56.0						
58.0						
60.0	Very fine grained sand silt, 60-65 feet			61.0	111	12.0
62.0						
64.0			Split spoon sample taken at 63-65 feet, soil damp. Hole backfilled with bentonite.	65.0	72	13.9
66.0						

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	Exploratory Boring	**March 2007**

HYDRUS-1D Vadose Zone Soil Profile	Client: Rice Operating Company Project Name: O-29 Vent	Location: T18S R38E Section 29

Depth (feet)	Description	Model Profile	Depth (feet)
0.0	Sandy loam 0-1 feet		0.0
2.0	Loamy sand, 1-19 feet		2.0
4.0			4.0
6.0			6.0
8.0			8.0
10.0			10.0
12.0			12.0
14.0			14.0
16.0			16.0
18.0	Sand, silt 19-20feet		18.0
20.0	Caliche, 20-22 feet		20.0
22.0	Sand, silt 22-34 feet		22.0
24.0			24.0
26.0			26.0
28.0			28.0
30.0			30.0
32.0			32.0
34.0	Caliche, 34-35 feet		34.0
36.0	Sand, silt, 35-45 feet		36.0
38.0			38.0
40.0			40.0
42.0			42.0
44.0	Sand , caliche, 45-47 feet		44.0
46.0	Sand, silt, 47-60 feet		46.0
48.0			48.0
50.0			50.0
52.0			52.0
54.0			54.0
56.0			56.0
58.0			58.0
60.0			60.0

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