1R - 427-15

WORKPLANS

DATE:

3-20-08

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Date: Thu, 20 Mar 2008 10:06:11 -0700 (PDT)

From: "L. Peter Galusky, Jr. P.E." <lpg@texerra.com>

Subject: Rice Operating Company - EME State H EOL ICP Report & Monitoring Plan

To: "Edward J. Hansen" <edwardj.hansen@state.nm.us>

CC: "Kristin Pope" <kpope@riceswd.com>

IR427-15

Dear Edward,

Please find attached (in "zipped .pdf format") our ICP Report & Monitoring Plan for the above-referenced site. I will also send a hard-copy via certified U.S. Mail with return receipt number 7007 0710 0003 0305 3729 .

I look forward to your review and comments. Thank you.

Sincerely,

Pete G.

L. Peter Galusky, Jr. Ph.D.
Principal
Texerra
Energy Square
505 N. Big Spring, Suite 404
Midland, Texas 79701
E-mail: lpg@texerra.com
Web: www.texerra.com
Office Telephone/Fax: 877-534-9001

Attachments

Files:

EME_State_H_EOL_ICP_Report___Monitoring_Plan.zip (9.4MB)

Investigation Characterization Report and Monitoring Plan

EME State H EOL Produced Water Discharge
Unit E Sec 17 T 20S R 37E
NMOCD Case No. 1R427-15

Prepared: March 20th, 2008

Prepared by:

L. Peter Galusky, Jr. Ph.D.
Texerra
505 N. Big Spring, Suite 404
Midland, Texas 79701
Web: www.texerra.com
E-mail: lpg@texerra.com

Investigation Characterization Report and Monitoring Plan

EME State H EOL Produced Water Discharge
Unit E Sec 17 T 20S R 37E

Executive Summary

Rice Operating Company replaced two junction boxes (located five feet apart) at the referenced location with a new, concrete-lined box in October, 2003. Rice delineated soils beneath the former junction boxes for chloride and hydrocarbon levels, and subsequently notified OCD that this site had potential for groundwater impacts. Rice removed soils from beneath the two former junction boxes in a 20 ft by 20 ft by 14 ft deep excavation. A 1.5 ft thick clay barrier was then installed to preclude potential for further downward chloride migration. The excavated soil was backfilled into the excavation and contoured to the surrounding terrain. The disturbed area was then seeded with a blend of native vegetation. The surface (ecological) impact of this release was relatively small.

A soil and groundwater investigation was undertaken by Texerra on November 28th, 2007, pursuant to an OCD approved Investigation and Characterization Plan (ICP) for this location. Soils were found to exhibit moderately increased chloride levels at the site of the (presumed) release and less so 35 ft down-gradient. Petroleum hydrocarbon concentrations were not detectable. A groundwater sample taken from a near-source (35 ft down-gradient) monitor well exhibited a chloride concentration of 772 ppm, and petroleum hydrocarbons were not detected.

A conceptual, semi-quantitative model was developed to illustrate the probable time course of leaching soil chlorides into the groundwater, and the resulting effect on groundwater chloride concentrations for an anticipated plume of 250 ft in length, 82.5 ft in width and 10 ft in depth. Chloride concentrations in this reference plume peak at around 350 ppm at year four and decline to 250 ppm by about year 12. (We are presently at "year 5" from the removal of the source).

Since actual plume chloride concentrations are not likely to be uniform over any given area, it seems reasonable that the average chloride concentration over this reference plume area is on the order of 350 ppm, given that the present concentration near the source is 772 ppm. Our conceptual model would therefore project that chloride concentrations in this plume have peaked, and will decline to a value of about 250 ppm within approximately 5 years from now.

These lines of evidence and reasonable conjecture suggest that no additional site characterization is needed other than further groundwater monitoring. We thus propose to sample groundwater from the near-source well (MW-1) for chlorides on a quarterly basis until the desired end-point is reached. This course of action represents our proposed Monitoring Plan for this site.

Investigation Characterization Report and Monitoring Plan

EME State H EOL Produced Water Discharge
Unit E Sec 17 T 20S R 37E

Contents

Figures and Tables

Appendices

Background

This report presents the findings and recommendations of an evaluation of soil and groundwater chloride levels associated with the possible release of produced water at the subject site preceding the installation of a new SWD junction box in 2003. This work was completed pursuant to an Investigation Characterization Plan (ICP) of May 1st, 2007 which was approved by OCD. A copy of this ICP is included in the Appendix to this report.

The site is located approximately 3.5 miles south/southwest of Monument in Lea County (Figure 1). The topography is gently sloping toward the southeast. Soils on the site are mapped in the Lea County Soil Survey as belonging to Pyote-Maljamar-Kermit soil association. These are characterized as gently undulating and rolling, sandy soils of six feet or more depth overlying caliche. Groundwater is estimated to occur at a depth of approximately 30+/- feet, occurring in unconsolidated Tertiary alluvium of the Ogallala Formation, and is believed to flow toward the southeast in the direction of the surface topographic gradient.

Rice Operating Company replaced two junction boxes (located five feet apart) at this site with a new, concrete-lined box in October, 2003. Rice delineated soils beneath the former junction boxes for chloride and hydrocarbon levels, and subsequently notified OCD that this site has potential for groundwater impacts. Rice removed soils from beneath the two former junction boxes in a 20 ft by 20 ft by 14 ft deep excavation. A 1.5 ft thick clay barrier was then installed to preclude potential for further downward chloride migration. The excavated soil was backfilled into the excavation and contoured to the surrounding terrain. The disturbed area was then seeded with a blend of native vegetation. However, the surface (ecological) impact of this release was relatively small.

Soil samples were taken on November 28th, 2007 from the cuttings of rotary drill rig, operated by Atkins Engineering Associates, Inc. of Roswell, New Mexico (Figures 2 & 3). Samples were taken from the surface to the water table surface. The first soil boring (SB-1) was taken at the location of the former junction boxes. The second soil boring (MW-1) was taken approximately 35 ft southeast, in the presumed direction of groundwater flow, and into which a monitor well was installed. Soil samples were titrated for chlorides and analyzed for hydrocarbon vapors on-site in real time by Rice Operating Company personnel, using their standard field methodology and PID meter, respectively. A subset of soil samples was sent to Cardinal Laboratories in Hobbs for verification of field results. A groundwater sample from MW-1 was taken by Arc Environmental on December 13th, 2007 and analyzed for chlorides and petroleum organics.

The following pages summarize the results of the soil and groundwater data obtained to date, and present an analysis of the potential of the past release at this site for significantly affecting groundwater.

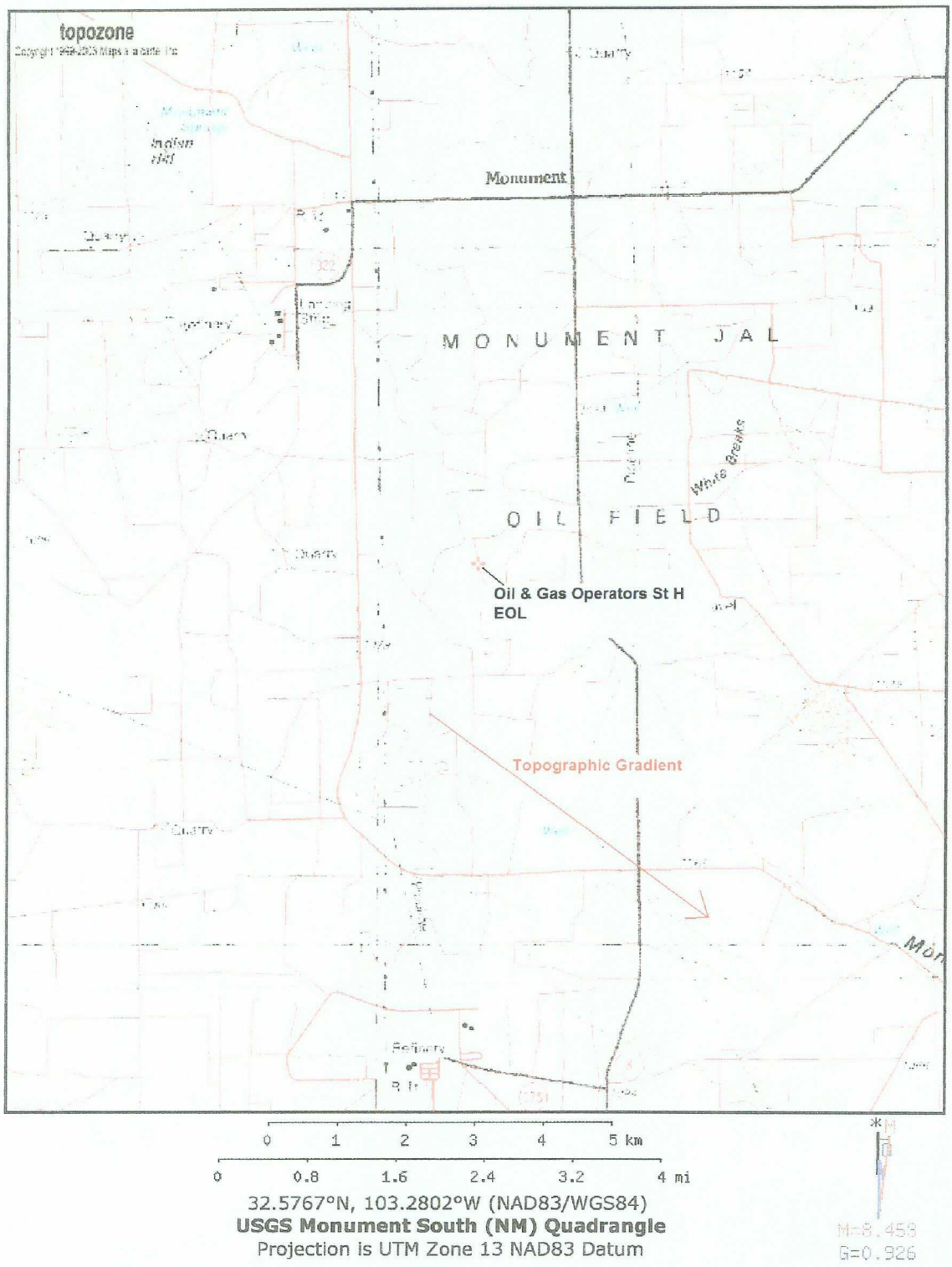


Figure 1 – Site Location Map (on USGS topographic base map)

Figure 2 – Atkins Engineering Associates drill rig at EME State H EOL on November 28th, 2007, setting up to drill SB-1 at former junction box location. View looking north/northwest.

Figure 3 – Atkins Engineering Associates drill rig at EME State H EOL on November 28th, 2007, drilling MW-1 approx. 35 ft southeast of former junction box location. View looking southeast.

Results of Field Sampling Efforts

Soils beneath the former junction box (at SB-1) exhibited moderately elevated chloride concentrations, ranging from approximately 750 ppm near the surface, to a maximum value of under 1,000 ppm at 20 ft depth, and declining to approximately 400 ppm at 28 ft bgs, where the water table capillary fringe was encountered. PID readings yielded undetectable levels of petroleum hydrocarbons. (See Table 1).

Approximately thirty-five feet down-gradient (in the presumed direction of groundwater flow), soils were less affected, with chloride values ranging from less than 150 ppm near the surface to a maximum value under 650 ppm at 15ft depth, and declining to less than 325 ppm below the water table surface at 40 ft bgs. Again, PID readings yielded undetectable levels of petroleum hydrocarbons (See Table 2).

A composite, interpolated view of approximate soil chloride locations across a vertical slice from the former junction box locations (SB-1) to the down-gradient soil boring (MW-1) is given in Figure 4. This appears to be indicative of a relatively small amount of produced water leakage occurring prior to the replacement of the former junction boxes.

The groundwater sample taken from MW-1 on December 13th yielded a chloride concentration of 772 ppm and undetectable levels of petroleum hydrocarbons (Figure 5). The absence of petroleum hydrocarbons is not surprising, since these were not found in the PID screening of the soil cutting. The concentration of chlorides found in the groundwater is indicative of a presumably small amount of produced water leakage, corroborating the soil chloride levels noted above.

It is possible that the moderately elevated (772 ppm) chloride level observed in MW-1 could be due to contamination from an up-gradient source. This could only be ruled out through the installation and sampling of an up-gradient well. However, the chlorides found in soils beneath the former junction boxes suggest that these were the likely source. Further, it would be exceedingly difficult to site an up-gradient monitor well, due to the presence of an active lease road and oil and gas facilities owned and operated by another party. Therefore, the existing monitor well (MW-1) would seem adequate for the purposes of evaluating the present and potential future impacts of (presumably minor) produced water leakage from the former junction boxes.

The question, then, turns to an evaluation of the potential for this past produced water leakage to substantially impact groundwater at some distance down-gradient from the (former) source. This question is addressed in the subsequent section, with the aid of a conceptually simple and semi-quantitative model which considers the potential for lingering effects of chloride leaching from the impacted soils on groundwater chloride concentrations.

Table 1 – Soil boring log and chemical parameters at SB-1, the site of the former junction box at EME State H EOL. The laboratory value for the 20 ft sample was roughly twice the field titrated value, and was believed to be spurious because the other three comparison samples (28 ft depth in this boring, and the 15 and 40 ft bgs samples in the MW-1 boring) were all very close to their field titrated values. The field titrated data were therefore used in this report.

Soil Boring Log
Rice Operating Company
EME Field SWD System
EME State H EOL

Identification:	**SB-1**
Location:	At former junction box location.
Date:	11/28/2007
Driller:	Atkins Engineering Associates, Inc.
Drill method:	Rotary Auger
Logged by:	L. Peter Galusky, Jr., Texerra
Total depth:	28 ft below ground surface
Screened interval:	n/a (no well installed)
Pipe diameter:	"

Depth (ft below ground surface)	Field Chloride Test (ppm)	Lab Chloride Test (ppm)	Field PID test (ppm)	Lab GRO test (ppm)	Lab DRO test (ppm)	Cutting Description
-5	751		1			light brown loamy sand
-10	730		2			olive brown loamy sand
-15	961		2			light gray caliche
-20	982	1,980	1			"
-25	886		1			gray caliche
-28	402	432	1			gray sandy clay; wet

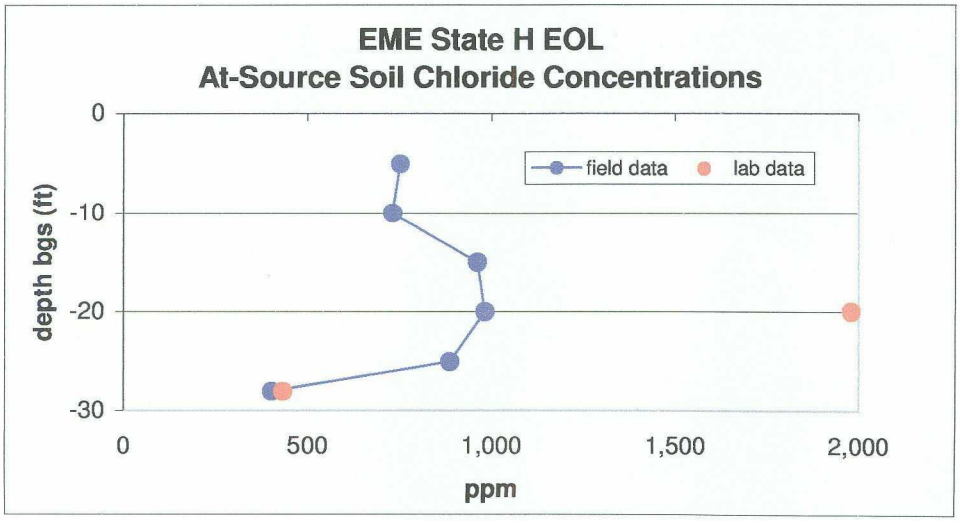
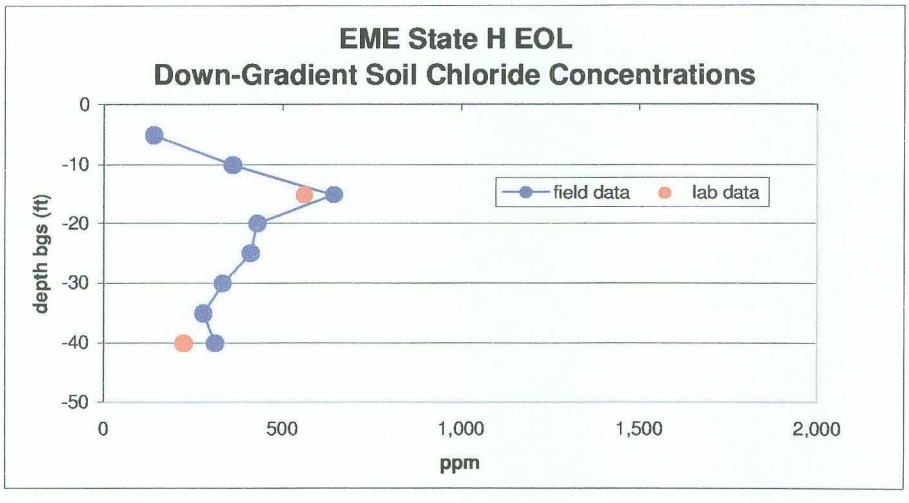


Table 2 – Soil boring log and chemical parameters at MW-1, approx. 35 ft southeast of the site of the former junction box at EME State H EOL.

Soil Boring Log
Rice Operating Company
EME Field SWD System
EME State H EOL

Identification:	**MW-1**
Location:	35 ft southeast of former junction box location
Date:	11/28/2007
Driller:	Atkins Engineering Associates, Inc.
Drill method:	Rotary auger
Logged by:	L. Peter Galusky, Jr., Texerra
Total depth:	45 ft below ground surface
Screened interval:	25 to 45 ft below ground surface
Pipe diameter:	2 inch

Depth (ft below ground surface)	Field Chloride Test (ppm)	Lab Chloride Test (ppm)	Field PID test (ppm)	Lab GRO test (ppm)	Lab DRO test (ppm)	Cutting Description	Well Schematic
-5	139			0		light tan fine sand	solid pipe
-10	361			1		light gray caliche	"
-15	643		560	1		"	"
-20	430			1		"	"
-25	411			1		"	"
-30	332			2		gray caliche; somewhat damp	screen
-35	280			1		gray sandy clay loam; wet at 32 ft	"
-40	312		224	3		"	"
-45						"	"



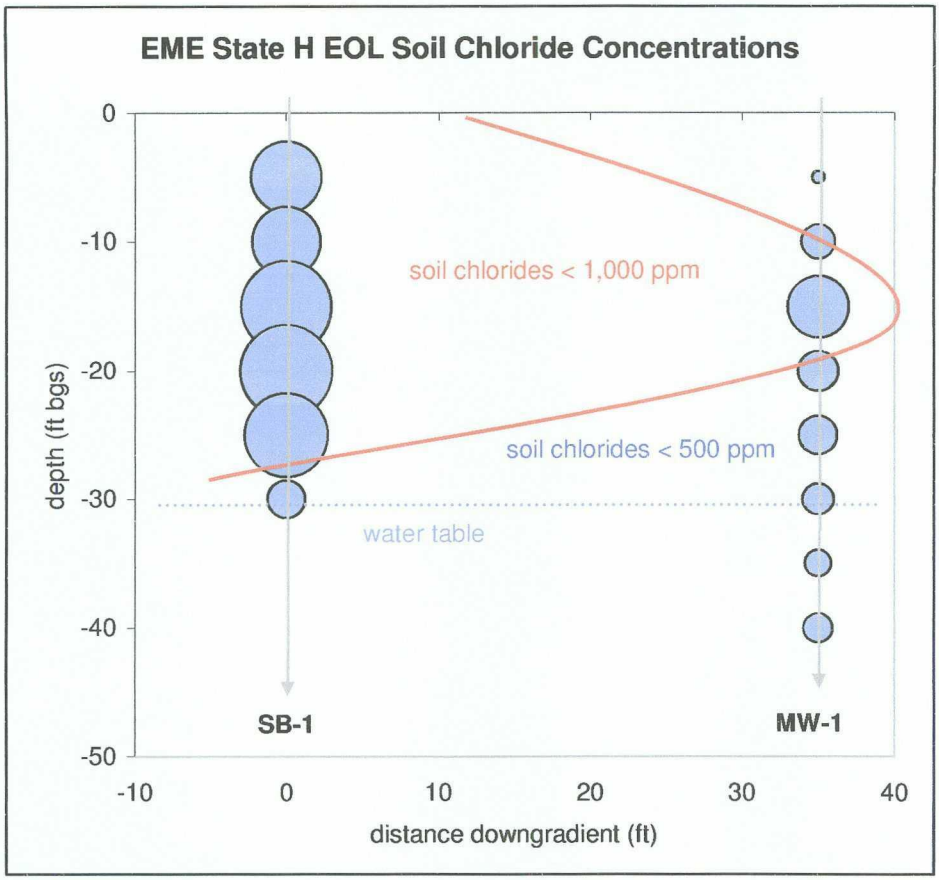


Figure 4 – Field titrated soil chloride concentrations, measured on 11-28-07. Red line illustrates approximate (visually interpolated) area containing soil chlorides values between 500 and 1,000 ppm.

A Conceptual Chloride Leaching Model

Scope and Rationale

A conceptual, semi-quantitative model was developed to assist in the interpretation of soil and groundwater chloride data and to shed light on the probable course of chloride movement.

The model was developed using the STELLA[1] computer simulation package. The schematic, or conceptual outline of the model (Figure 6) indicates two primary reservoirs for chlorides, the soil and the groundwater (shown as boxes in the left part of the diagram). Soil chlorides are assumed to leach into the groundwater at a constant, annual rate (5% per year), and groundwater chlorides are assumed to be diluted (by 50% per year) by normal groundwater flow across the site. The initial chloride mass in the soil (the connected circles in the upper, right part of the diagram) was

[1] STELLA is a product of ISEE Systems: http://www.iseesystems.com/ .

calculated based upon the estimated volume of soil affected (based upon a circular radius of 50 ft and a thickness of 30 ft) and the average chloride concentration (575 ppm). The volume of two reference plumes is calculated to provide a means for comparing the effects of chloride leaching immediately below the release site (a plume length of 100 ft and a width of 33 ft, 10 ft in thickness) to a slightly larger, diluted plume (250 ft length, 82.5 ft width, 10 ft thickness). The chloride concentrations over time for each of these plumes is then calculated by dividing the total amount of chloride in the groundwater (the bottom box) by the plume volumes. (These are represented in the lower, right portion of the diagram). The algebraic equations used (which are all very simple) in the model are given in the Appendix.

This conceptual model thus illustrates the time course of leaching a known (field estimated) quantity of soil chlorides into the groundwater, and the resulting effect on groundwater chloride concentrations for anticipated plumes of two volumes, as small "close-in" reference plume and an expanded (and thus more diluted) reference plume.

Model Results

The calculated decrease in soil chloride mass over time (Figure 7) simply illustrates the gradual loss of chlorides from the unsaturated zone due to leaching into the groundwater at the prescribed rate (10% per year).

Calculated groundwater chloride concentrations (Figure 8) in the smaller reference plume peak at around 2,200 ppm at year four, and then decline gradually over time. Chlorides in the larger reference plume (250 ft in length, 82.5 ft in width) peaks at around 350 ppm at year four and declines to 250 ppm by about year 12.

Actual groundwater chlorides near the source (MW-1) presently measure 772 ppm, and we are approximately 5 years out from the removal of the presumed source. Since actual plume chloride concentrations are not likely to be uniform over any given area, it seems reasonable to believe that the average chloride concentration over the larger reference plume area is on the order of 350 ppm. Our conceptual model would therefore project that chloride concentrations in this plume have peaked, and will decline to a value of about 250 ppm over the next 5+/- years.

Conclusions and Recommendations

Soils at the release site have apparently been affected by leakage from the former junction box pair, but only to a moderate degree. Further, as these were removed nearly five years ago (being replaced by a single, concrete junction box), the source of the release has long been removed. It is expected that soil chloride concentrations will diminish over time due to normal leaching, and that groundwater chloride concentrations will also continue to decrease, reaching a level of 250 ppm in approximately five years.

These lines of evidence and reasonable conjecture suggest that no additional site characterization is needed other than further groundwater monitoring. We thus propose to sample groundwater from the near-source well (MW-1) for chlorides on a quarterly basis until the desired end-point is reached. This course of action represents our proposed Monitoring Plan for this site.

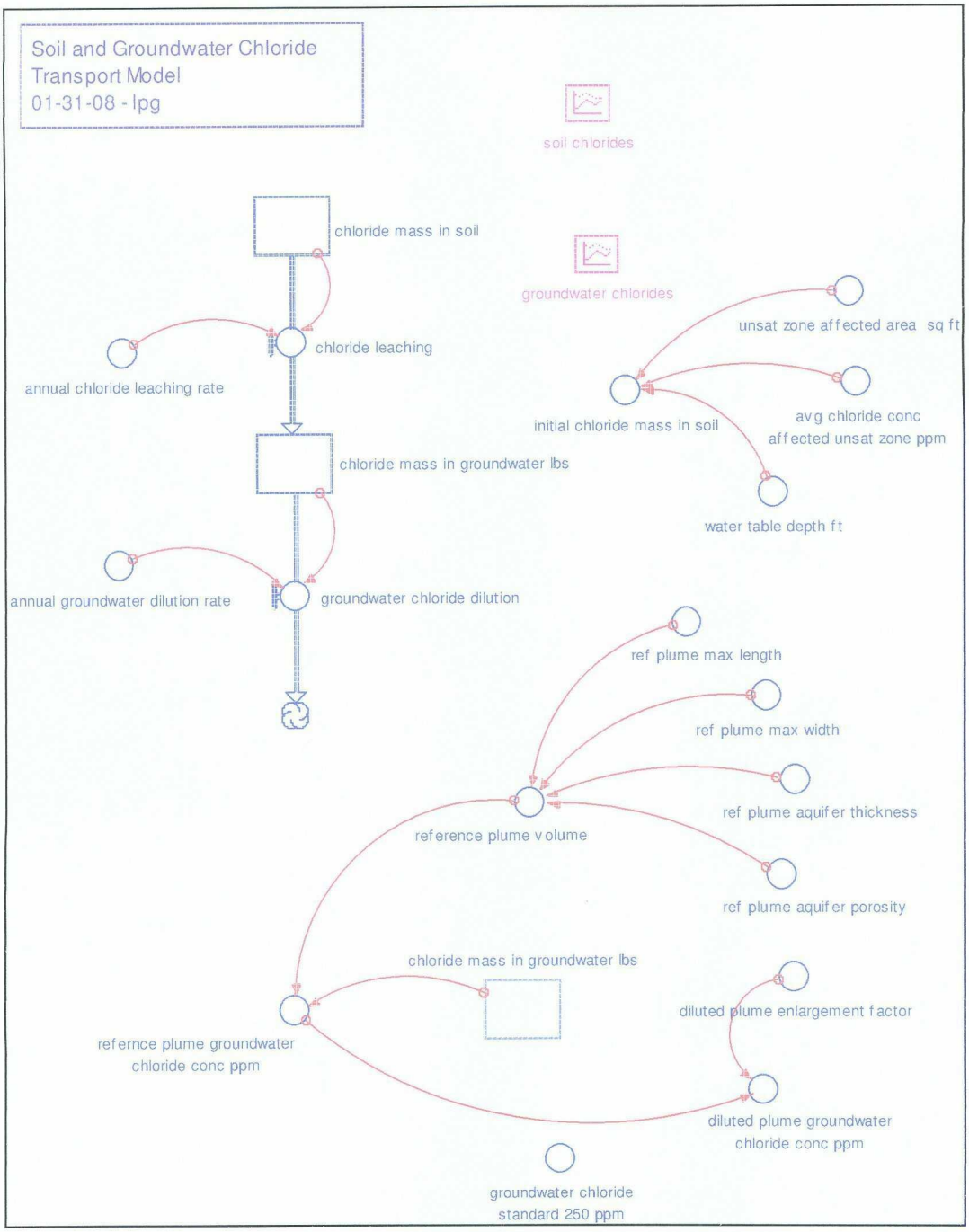


Figure 5 – Schematic outline of STELLA soil and groundwater chloride transport model.

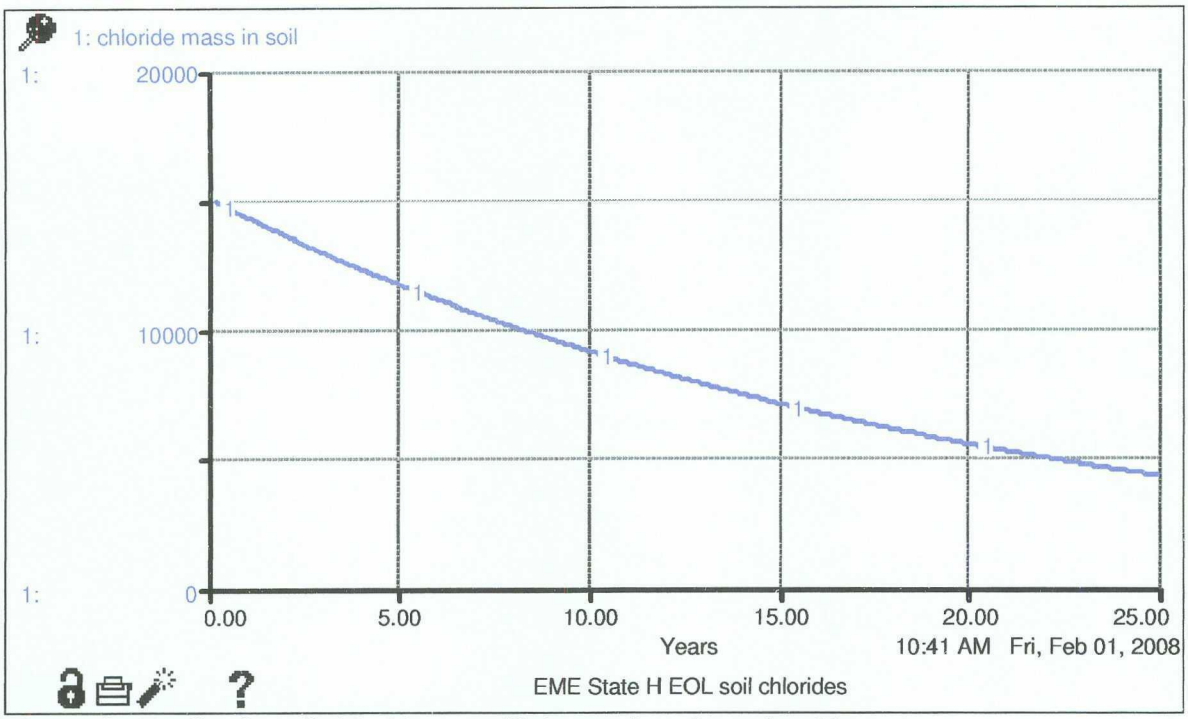


Figure 6 – Decline in soil chloride mass (lbs) over time due to leaching.

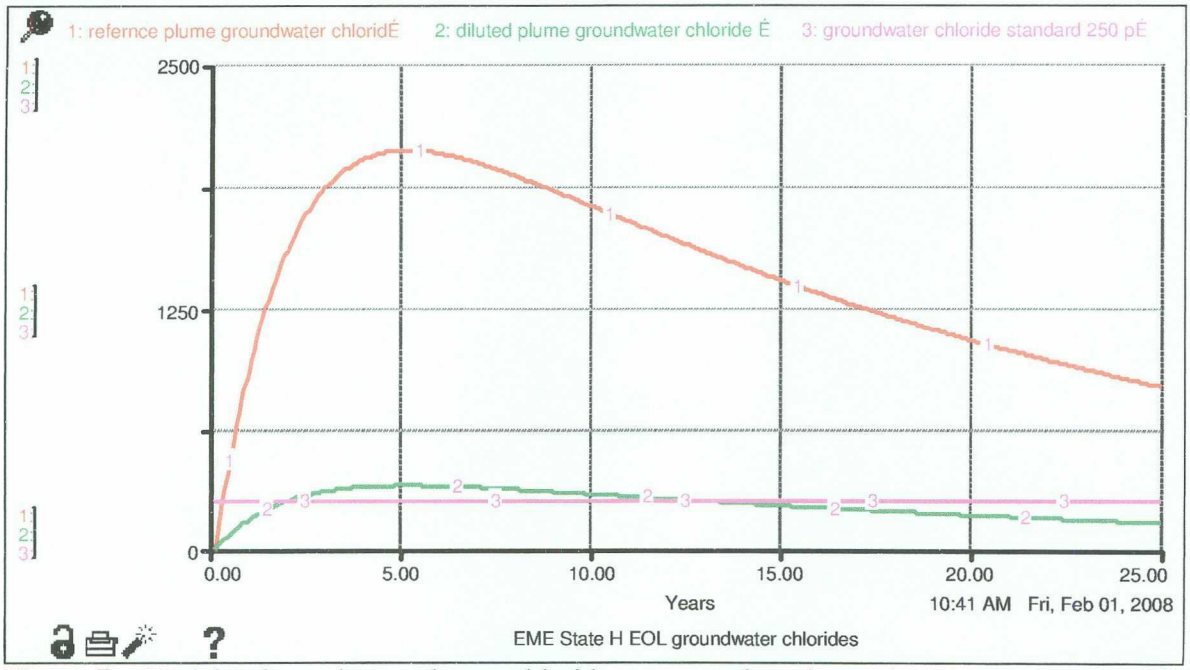


Figure 7 – Model estimated groundwater chloride concentrations (ppm) for a small, elliptical reference plume (100 ft max length, 33 ft max width) and a larger, elliptical reference plume (250 ft max length, 82.5 ft max width). The expanded and diluted plume illustrates a peak chloride concentration of approx. 350 ppm 4 yrs after the initial release, with levels declining to less than approximately 250 ppm 10 to 12 years from the initial release.

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: KRISTIN FARRIS-POPE
122 WEST TAYLOR
HOBBS, NM 88240
FAX TO: (575) 397-1471

Receiving Date: 12/07/07
Reporting Date: 12/07/07
Project Number: NOT GIVEN
Project Name: EME STATE 'H' EOL
Project Location: EME STATE 'H' EOL

Analysis Date: 12/07/07
Sampling Date: 11/28/07
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: AB
Analyzed By: KS

LAB NO.	SAMPLE ID	Cl⁻ (mg/kg)
H13875-1	MW #1 @ 15'	560
H13875-2	MW #1 @ 40'	224
H13875-3	SOIL BORE #1 @ 20'	1,980
H13875-4	SOIL BORE #1 @ 28'	432
Quality Control		500
True Value QC		500
% Recovery		100
Relative Percent Difference		2.0

METHOD: Standard Methods	4500-ClB

Note: Analyses performed on 1:4 w:v aqueous extracts.

Kristin Suprotto
Chemist

12/07/07
Date

H13875 RICE

Appendix A1 – Laboratory analyses of soil samples.

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:	Kristin Pope	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:	EME State 'H' EOL	State: Zip:	
Project Location:	EME State 'H' EOL	Phone #:	
Sampler Name:	L. Weinheimer	Fax #:	

ANALYSIS REQUEST: Chlodrides

FOR LAB USE ONLY Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	MATRIX: GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER :	PRESERV.: ACID/BASE:	ICE / COOL	OTHER :	SAMPLING: DATE	TIME	Chlodrides
H13875-1	MW #1 @ 15'	G	1			✓					✓		11-28-07	1:20	✓
-2	MW #1 @ 40'	G	1			✓					✓		11-28-07	2:30	✓
-3	Soil Bore #1 @ 20'	G	1			✓					✓		11-28-07	10:26	✓
-4	Soil Bore #1 @ 28'	G	1			✓					✓		11-28-07	10:44	✓

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: L. Weinheimer	Date: 12-7-07 Time: 3:00pm.	Received By:	Phone Result: ☐ Yes ☑ No Add'l Phone #:
Relinquished By:	Date: 12-7-07 Time: 3:00pm	Received By:	Fax Result: ☐ Yes ☑ No Add'l Fax #:
Delivered By: (Circle One) Sampler - UPS - Bus - Other:	Sample Condition: Cool ☒ Yes ☐ No; Intact ☒ Yes ☐ No	CHECKED BY: (Initials)	REMARKS: email results; kpope@riceswd.com; jpurvis@riceswd.com; Lweinheimer@rice.swd.com

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

Appendix A2 – Laboratory chain-of-custody form for soil samples.

WELL SAMPLING DATA FORM

CLIENT: RICE *Operating Company* WELL ID: Monitor Well #1

SYSTEM: EME DATE: December 13, 2007

SITE LOCATION: State "H" EOL SAMPLER: Rozanne Johnson

PURGING METHOD: ☐ Hand Bailed ☑ Pump, Type: Purge Pump

SAMPLING METHOD: ☑ Disposable Bailer ☐ Direct from Discharge Hose ☐ Other:

DISPOSAL METHOD OF PURGE WATER: ☐ On-site Drum ☐ Drums ☑ SWD Disposal Facility

TOTAL DEPTH OF WELL: 43.98 Feet
DEPTH TO WATER: 30.31 Feet
HEIGHT OF WATER COLUMN: 13.67 Feet
WELL VOLUME: 2.2 Gal.

2 In. Well Diameter
7 Gallons purged prior to sampling

TIME	TEMP. °C	COND. mS/cm	pH	PHYSICAL APPEARANCE AND REMARKS
14:15	18.9	3.25	7.74	Slight Odor
				Samples Collected
				BTEX (2-40ml VOA)
				Major Ions/TDS (1-1000ml Plastic)

COMMENTS:

Myron Model 6P instrument used to obtain pH, conductivity, and temperature measurements.

Delivered samples to Cardinal Laboratories in Hobbs, New Mexico for BTEX, Major Ions, and TDS analysis.

Appendix B1 – Well sampling field data for MW-1

CARDINAL LABORATORIES

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

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

Receiving Date: 12/14/07
Reporting Date: 12/20/07
Project Number: NOT GIVEN
Project Name: EME STATE "H" EOL
Project Location: T20S-R37E-SEC17E~LEA COUNTY, NM

Sampling Date: 12/14/07
Sample Type: WATER
Sample Condition: COOL & INTACT
Sample Received By: CK
Analyzed By: AB/HM/KS

LAB NUMBER SAMPLE ID	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Conductivity (uS/cm)	T-Alkalinity ($mgCaCO_3/L$)
ANALYSIS DATE:	12/19/07	12/18/07	12/18/07	12/19/07	12/18/07	12/18/07
H13926-1 MONITOR WELL #1	671	71.9	33.9	14.5	3,520	232
Quality Control	NR	49.2	54.0	3.19	1,411	NR
True Value QC	NR	50.0	50.0	3.00	1,413	NR
% Recovery	NR	98.5	108	106	99.9	NR
Relative Percent Difference	NR	< 0.1	6.1	10.2	0.7	NR
METHODS:		SM3500-Ca-D	3500-Mg E	8049	120.1	310.1

	Cl^- (mg/L)	SO_4 (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	pH (s.u.)	TDS (mg/L)
ANALYSIS DATE:	12/18/07	12/19/07	12/18/07	12/18/07	12/18/07	12/14/07
H13926-1 MONITOR WELL #1	772	459	0	283	7.75	2,154
Quality Control	490	27.8	NR	1000	7.06	NR
True Value QC	500	25.0	NR	1000	7.00	NR
% Recovery	98.0	111	NR	100	101	NR
Relative Percent Difference	2.0	17.4	NR	< 0.1	0.3	NR
METHODS:	SM4500-Cl-B	375.4	310.1	310.1	150.1	160.1

Chemist

12-21-07
Date

H13926 RIG

Appendix B2 - Laboratory analyses (inorganics) for first water sample taken from MW-1

CARDINAL LABORATORIES

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

ANALYTICAL RESULTS FOR
RICE OPERATING COMPANY
ATTN: KRISTIN FARRIS-POPE
122 WEST TAYLOR
HOBBS, NM 88240
FAX TO: (505) 397-1471

Receiving Date: 12/14/07
Reporting Date: 12/17/07
Project Number: NOT GIVEN
Project Name: EME STATE "H" EOL
Project Location: T20S-R37E-SEC17E ~ LEA CO., NM

Sampling Date: 12/14/07
Sample Type: WATER
Sample Condition: COOL & INTACT
Sample Received By: CK
Analyzed By: AB

LAB NUMBER	SAMPLE ID	BENZENE (mg/L)	TOLUENE (mg/L)	ETHYL BENZENE (mg/L)	TOTAL XYLENES (mg/L)
ANALYSIS DATE		12/17/07	12/17/07	12/17/07	12/17/07
H13926-1	MONITOR WELL #1	<0.001	<0.001	<0.001	<0.003
Quality Control		0.105	0.096	0.096	0.302
True Value QC		0.100	0.100	0.100	0.300
% Recovery		105	96	96	101
Relative Percent Difference		1.4	2.8	3.1	3.8

METHOD: EPA SW-846 8021B

Chemist

12/18/07
Date

Appendix B3 - Laboratory analyses (organics) for first water sample taken from MW-1

Page 1 of 1

101 East Marland – Hobbs, New Mexico 88240
Tel (505) 393-2326
Fax (505) 393-2476

Cardinal Laboratories, Inc.

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

LAB Order ID # _____

Company Name: RICE Operating Company	BILL TO Company: RICE Operating Company	PO#
Project Manager: Kristin Farris-Pope, Project Scientist	Address: (Street, City, Zip) 122 W Taylor Street ~ Hobbs, New Mexico 88240	
Address: (Street, City, Zip) 122 W Taylor Street ~ Hobbs, New Mexico 88240	Phone#: (505) 393-9174	Fax#: (505)397-1471
Phone #: (505) 393-9174	Fax #: (505)397-1471	
Project #:	Project Name: EME State "H" EOL	
Project Location: T20S-R37E-Sec17E ~ Lea County - New Mexico	Sampler Signature: Rozanne Johnson (505)631-9210 rozanne@valornet.com	

ANALYSIS REQUEST (Circle or Specify Method No.)

LAB # / LAB USE ONLY	FIELD CODE	(G)rab or (C)omp.	# CONTAINERS	MATRIX: WATER	SOIL	AIR	SLUDGE	PRESERVATIVE METHOD: HCL	HNO3	NaHSO4	H2SO4	ICE	NONE	SAMPLING: DATE (2007)	TIME	MTBE 8021B/602	BTEX 8021B/602	TPH 418.1/TX1005 / TX1005 Extended (C35)	PAH 8270C	Total Metals Ag As Ba Cd Cr Pb Se Hg 6010B/200.7	TCLP Metals Ag As Ba Cd Cr Pb Se Hg	TCLP Volatiles	TCLP Semi Volatiles	TCLP Pesticides	RCI	GCMS Vol. 8260B/624	GCMS Semi. Vol. 8270C/625	PCB's 8082/608	Pesticides 8081A/608	BOD, TSS, pH	Moisture Content	Chlorides	Turn Around Time ~ 24 Hours
	Monitor Well #1	G	3	X				2				1		12-14	14:15		X															X	X	X

Relinquished by: Rozanne Johnson	Date: 12-14-2007	Time: 14:40	Received by:	Date:	Time:
Relinquished by:	Date:	Time:	Received By: (Laboratory Staff)	Date: 12-14-07	Time: 14:40
Delivered By: (Circle One) Sampler - UPS - Bus - Other:			Sample Condition: Cool: Yes / No; Intact: Yes / No	CHECKED BY: (Initials)	

Phone Results	Yes	No	
Fax Results	Yes	No	Additional Fax Number:

REMARKS:

Email Results to: kpope@riceswd.com, lweinheimer@riceswd.com, rozanne@valornet.com

Appendix B4 – Laboratory chain-of-custody form for first water sample from MW-1.

State Variable: chloride mass in groundwater

chloride_mass_in_groundwater_lbs(t) = chloride_mass_in_groundwater_lbs(t - dt) + (chloride_leaching - groundwater_chloride_dilution) * dt
INIT chloride_mass_in_groundwater_lbs = 0

INFLOWS:

chloride_leaching = chloride_mass_in_soil*annual_chloride_leaching_rate

OUTFLOWS:

groundwater_chloride_dilution =
chloride_mass_in_groundwater_lbs*annual_groundwater_dilution_rate

State Variable: chloride mass in soil

chloride_mass_in_soil(t) = chloride_mass_in_soil(t - dt) + (- chloride_leaching) * dt
INIT chloride_mass_in_soil = 15000

OUTFLOWS:

chloride_leaching = chloride_mass_in_soil*annual_chloride_leaching_rate
annual_chloride_leaching_rate = 0.1
annual_groundwater_dilution_rate = 0.5
avg_chloride_conc_affected_unsat_zone_ppm = 575
diluted_plume_enlargement_factor = 2.5
diluted_plume_groundwater_chloride_conc_ppm =
refernce_plume_groundwater_chloride_conc_ppm/(diluted_plume_enlargement_factor^2)
groundwater_chloride_standard_250_ppm = 250
initial_chloride_mass_in_soil =
avg_chloride_conc_affected_unsat_zone_ppm*(3000*((unsat_zone_affected_area__sq_ft*water_table_depth_ft)/27))/10^6
reference_plume_volume =
PI*(ref_plume_max_length/2)*(ref_plume_max_width/2)*ref_plume_aquifer_thickness*ref_plume_aquifer_porosity_
refernce_plume_groundwater_chloride_conc_ppm =
(chloride_mass_in_groundwater_lbs/(reference_plume_volume/10^6*62))
ref_plume_aquifer_porosity_ = 0.35
ref_plume_aquifer_thickness = 10
ref_plume_max_length = 100
ref_plume_max_width = 33
unsat_zone_affected_area__sq_ft = PI*50^2
water_table_depth_ft = 30

Appendix C- STELLA model state variables, parameters and equations.

L. Peter Galusky, Jr. Ph.D., P.G.
Texerra

May 1st, 2007

Mr. Edward Hansen
New Mexico Energy, Minerals, & Natural Resources
Oil Conservation Division, Environmental Bureau
1220 S. St. Francis Drive
Santa Fe, New Mexico 87504

RE: **Investigation and Characterization Plan**
Rice Operating Company – EME SWD
State H EOL: Unit E Sec 17 T 20S R 37E

Sent via E-mail and U.S. Certified Mail: Return Receipt No. 7005 0390 0002 9898 2730

Dear Mr. Hansen:

RICE Operating Company (RICE) has retained my company to address potential environmental concerns at the above-referenced site. ROC is the service provider (agent) for the EME 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 Partners, who provide all operating capital on a percentage ownership/usage basis. Environmental projects of this magnitude require System Partner AFE approval, and work begins as funds are received. In general, project funding is not forthcoming until NMOCD approves the work plan. Therefore, your timely review of this submission would be greatly appreciated.

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

- protects public health,
- provides the greatest net environmental benefit,
- complies with NMOCD Rules, and
- is supported by good science.

Each site shall generally have three submissions, as described below:

1. This Investigation and Characterization Plan (ICP) is a proposal for data gathering and site characterization and assessment.

2. Upon evaluating the data and results from the ICP, a recommended remedy will be submitted in a Corrective Action Plan (CAP) if this is warranted.

3. Finally, after implementing the remedy, a Closure Report with final documentation will be submitted.

Background and Previous Work

The site is located approximately 3.5 miles south/southeast of Monument in Lea County (Figure 1). The topography is gently sloping toward the southeast. Soils on the site are mapped in the Lea County Soil Survey as belonging to Pyote-Maljamar-Kermit soil association. These are characterized as gently undulating and rolling, sandy soils of six feet or more depth overlying caliche. Groundwater is estimated to occur at a depth of approximately 27+/- feet, occurring in unconsolidated Tertiary alluvium of the Ogallala Formation, and is believed to flow toward the southeast in the direction of the surface topographic gradient.

As part of their on-going SWD facility upgrades, Rice replaced two junction boxes at this site, located approximately 5 ft apart, with a new, concrete-lined box in October, 2003. Rice subsequently delineated soils beneath the former junction boxes for chloride and hydrocarbon levels. PID readings indicated that hydrocarbons were not present in significant concentrations to the limit of vertical delineation, 14 ft below ground surface. However, chloride concentrations did not exhibit significant decline with depth, and ranged from 1,775 ppm at the surface to approximately 1,325 ppm at 14 ft below ground surface. OCD was then notified that this site has potential for groundwater impacts, and subsequent site investigation was then planned. (See: Appendix A – Junction Box Disclosure Report).

Rice removed soils from beneath the two former junction boxes in a 20 ft by 20 ft by 14 ft deep excavation. A 1.5 ft thick clay barrier was then installed to preclude potential for further downward chloride migration. The excavated soil was backfilled into the excavation and contoured to the surrounding terrain. The disturbed area was then seeded with a blend of native vegetation. A photographic chronology of these activities is provided in Appendix B.

The surface (ecological) impact of this release was relatively small. However, as some potential for groundwater contamination may exist, further evaluation is warranted for chlorides, the constituent of concern. Therefore, ROC proposes additional investigative work, as outlined in the Investigation and Characterization Plan (ICP) below, to more definitively evaluate the extent of contamination caused by the release, and to then evaluate the potential for groundwater degradation. Yet, it should be noted that the source of this impact is historical, since the older junction boxes have been replaced with a new, concrete water-tight junction box.

Proposed Work Elements

1. Summarize information and data collected by ROC to date.
2. Summarize additional, publicly available regional and local hydrological information.
3. Complete vertical and lateral delineation of soil chloride concentrations, and prepare graphics to illustrate the horizontal and vertical extent of contamination.

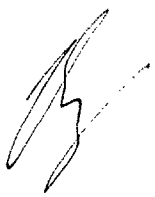
4. If warranted, install monitor wells sufficient to determine up-gradient, zone-of-release and down-gradient groundwater chloride concentrations. [All monitoring wells will be constructed (with the annular space sealed with a cement/bentonite mix) per NM Dept. Environment standards]. It should be noted, however, that the presence of active production facilities nearby may constrain the placement of borings and monitor wells.
5. Evaluate the risk of groundwater impact in light of the information obtained.

If the evaluation demonstrates that residual constituents pose no threat to ground water quality, then only a surface restoration plan will be proposed to OCD. If, as a result of this work, it is believed that this junction box site does pose a present or future risk of impacting groundwater quality, then a corrective action plan (CAP) will be developed and proposed to OCD.

I appreciate the opportunity to work with you and your staff on this project. Please call either myself, at the number below, or Kristin Farris Pope (ROC) at 505-393-9174, if you have any questions or wish to discuss these matters.

Thank you for your consideration.

Sincerely,



L. Peter (**Pete**) Galusky, Jr. Ph.D., P.G.
Principal

Texerra
505 N. Big Spring, Suite 404
Midland, Texas 70701
Tel: 432-634-9257
E-mail: lpg@texerra.com
Web site: www.texerra.com

cc: CDH, KFP, file
Attachments: site location map

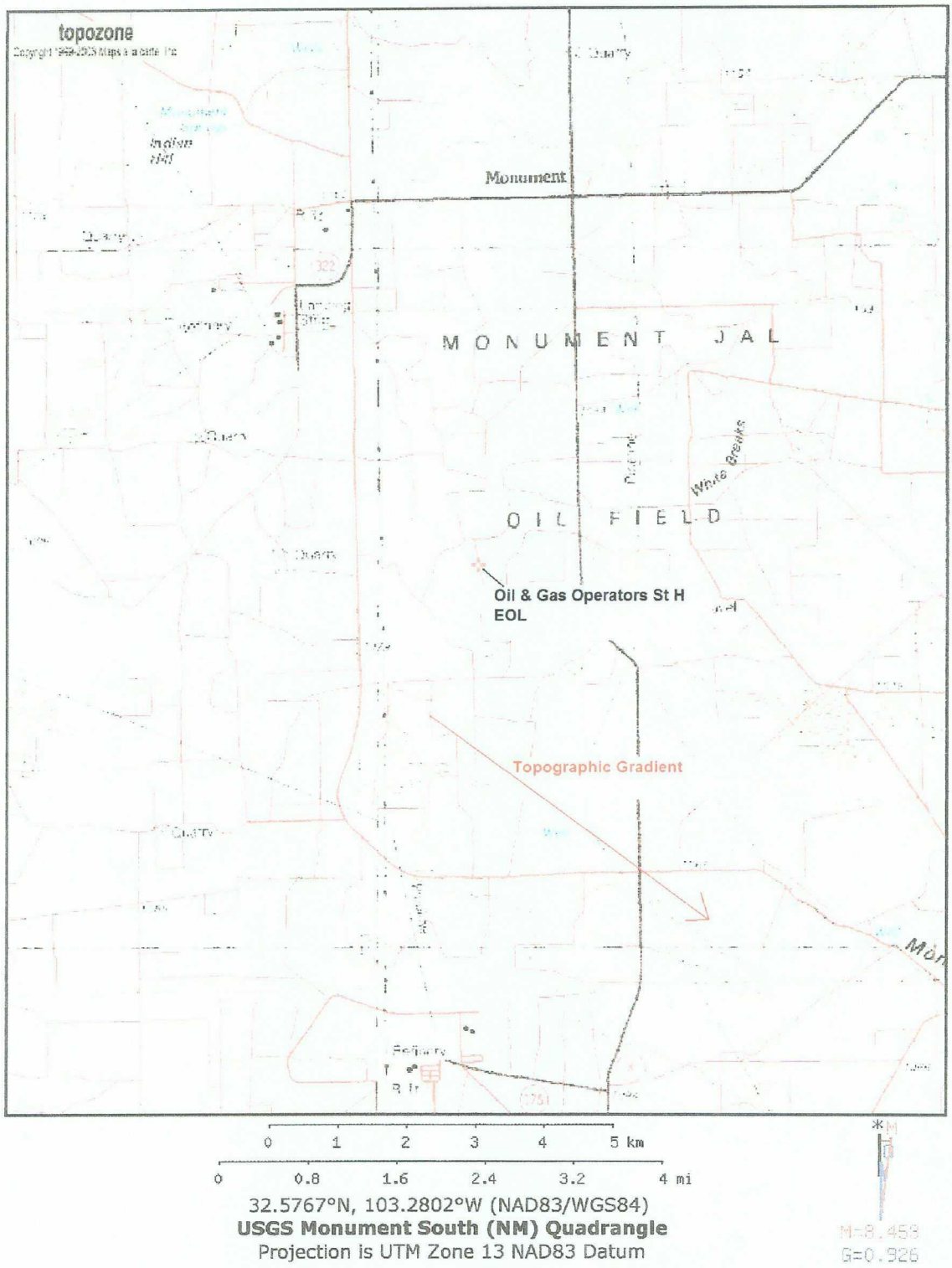


Figure 1 – Site Location Map.

Appendix A – Junction Box Disclosure Report

RICE OPERATING COMPANY
JUNCTION BOX DISCLOSURE* REPORT

BOX LOCATION

SWD SYSTEM	JUNCTION	UNIT	SECTION	TOWNSHIP	RANGE	COUNTY	BOX DIMENSIONS - FEET		
							Length	Width	Depth
EME	Oil & Gas State 'H' (north)	E	17	20S	37E	Lea	moved50 ft South		

LAND TYPE: BLM ____ STATE X FEE LANDOWNER ____ OTHER ____

Depth to Groundwater 27 feet NMOCD SITE ASSESSMENT RANKING SCORE: 20

Date Started 11/6/2003 Date Completed 11/21/2003 OCD Witness No

Soil Excavated 59 cubic yards Excavation Length 20 Width 20 Depth 4 feet

Soil Disposed 0 cubic yards Offsite Facility n/a Location n/a

FINAL ANALYTICAL RESULTS: **Sample Date** 11/7/2003 **Sample Depth** 4 ft bgs

Procure 5-point composite sample of bottom and 4-point composite sample of sidewalls. TPH, BTEX and Chloride laboratory test results completed by using an approved lab and testing procedures pursuant to NMOCD guidelines.

Sample Location	PID ppm	GRO mg/kg	DRO mg/kg	Chloride mg/kg
SIDEWALLS	0.0	<10.0	<10.0	416
BOTTOM	0.0	<10.0	<10.0	848
REMEDIATED	0.0	<10.0	<10.0	1180

General Description of Remedial Action: This site was composed of two boxes that were approximately 5 ft apart. Vertical delineation at each box did not result in a conclusive decline of chloride impact (see graph). All PID readings were 0.0 ppm and TPH concentrations were well below NMOCD guidelines. A 20 x 20 x 4-ft deep excavation was made around the boxes and at 4 ft bgs, a 1.5 ft compacted clay barrier was installed to inhibit further chloride migration. The excavated soil was landfarmed on site and then backfilled on top of the clay and the surface was contoured to the surrounding terrain. The disturbed surface has been seeded with a blend of native vegetation. A new EOL box has been built approximately 50 ft south of this location.

ADDITIONAL EVALUATION IS *HIGH* PRIORITY.

enclosures: chloride graph, photos, lab results, PID readings

CHLORIDE FIELD TESTS

LOCATION	DEPTH (ft)	ppm
Vertical	4	1633
	6	2699
	8	1845
	10	661
	12	1157
	14	2182
4-wall comp.	n/a	308
bottom comp.	4	848
remed. comp.	n/a	1025

I HEREBY CERTIFY THAT THE INFORMATION ABOVE IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

DATE 1/28/2004 PRINTED NAME Kristin Farris

SIGNATURE ____ TITLE Project Scientist

This site is a "DISCLOSURE." It will be placed on a prioritized list of similar sites for further consideration.

Appendix B – Photo chronology.

Figure 1 - Undisturbed north and south boxes: 08-06-2003.

Figure 2 - Completed new box 50 ft south of old boxes in background: 10-15-2003.

Appendix B – Photo chronology (continued)

Figure 5 - Seeding disturbed surface.

Figure 6 - Identification plate marking clay liner.

Appendix B – Photo chronology (continued)

Figure 3 - Beginning excavation and delineation: 11-06-2003,

Figure 4 - Testing compacted clay: 11-20-2003.