1-427-409

Approval & ICP/CAP Report

DATE
July 7, 2014

From:	Lowe, Leonard, EMNRD
To:	Hack Conder (hconder@riceswd.com)
Cc:	Oberding, Tomas, EMNRD; Katie Jones <kjones@riceswd.com> (kjones@riceswd.com); lflores@rice-ecs.com; Lara Weinheimer (lweinheimer@rice-ecs.com)
Subject:	Corrective Action Plan (1R427-409) Approval - ROC EME K-30 EOL
Date:	Monday, July 07, 2014 1:42:00 PM
Importance:	High

RE: ICP Report and Corrective Action Plan (CAP) for the Rice Operating Company's EME K-30 EOL
Unit Letter K, Section 30, T19S, R37E, NMPM, Lea County, New Mexico
Corrective Action Plan (1R427-409) Approval

Dear Mr. Conder:

The New Mexico Oil Conservation Division (OCD) has received the ICP Report and Corrective Action Plan for the EME K-30 EOL, dated **June 17, 2014**, and has conducted a review of the Plan. The Plan indicates that Rice Operating Company (ROC) has met the requirements of 19.15.29 NMAC (Rule 29; formerly, Rule 116) for a remediation plan. Therefore, the OCD hereby conditionally approves the Corrective Action Plan as proposed for above-referenced site in accordance with 19.15.29 NMAC:

ROC must submit to the OCD a report of the corrective actions within 270 days.

Please be advised that OCD approval of this plan does not relieve the owner/operator of responsibility should operations pose a threat to ground water, surface water, human health or the environment. In addition, OCD approval does not relieve the owner/operator of responsibility for compliance with any OCD, federal, state, or local laws and/or regulations.

If you have any questions regarding this matter, please contact me at 505-476-3492.

Leonard Lowe
Environmental Engineer
[Environmental Bureau]
Oil **C**onservation **D**ivision
Energy **M**inerals and **N**atural **R**esources **D**epartment
1220 South St. Frances
Santa Fe, New Mexico 87004
Office: 505-476-3492
Fax: 505-476-3462
E-mail: leonard.lowe@state.nm.us
Website: http://www.emnrd.state.nm.us/ocd/

RECS
RICE ENVIRONMENTAL
CONSULTING & SAFETY
PO Box 2948 | Hobbs, NM 88241 | Phone 575.393.2967

June 17, 2014

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

RE: **ICP Report & Corrective Action Plan (CAP)**
Rice Operating Company – EME SWD System
EME K-30 EOL (1R427-409): UL/K sec. 30 T19S R37E

Mr. Lowe:

RICE Operating Company (ROC) has retained Rice Environmental Consulting and Safety (RECS) to address potential environmental concerns at the above-referenced site in the EME Salt Water Disposal (SWD) system. 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 Parties, who provide all operating capital on a percentage ownership/usage basis.

Background and Previous Work

The site is located approximately 1.5 miles west of Monument, New Mexico in Unit K, Section 30, T19S R37E as shown on the Geographical Location (Figure 1). NM OSE records indicate that groundwater will likely be encountered at a depth of approximately 37 +/- feet.

In 2012, ROC initiated work on the former K-30 junction box. The site was delineated using a backhoe to form a 30 ft x 30 ft x 12 ft deep excavation and soil samples were screened at regular intervals for both hydrocarbons and chlorides. From the excavation, the four-wall composite and the bottom composite and the blended backfill were taken to a commercial laboratory for analysis. Laboratory tests of the four-wall composite showed a chloride reading of 960 mg/kg, a gasoline range organics (GRO) reading of non-detect and a diesel range organics reading (DRO) of 17.4 mg/kg. The bottom composite showed a chloride reading of 208 mg/kg and a GRO and DRO of non-detect. The blended backfill showed a chloride reading of 1,170 mg/kg and a GRO and DRO reading of non-detect. All 576 yards of the blended backfill were taken to a NMOCD approved facility for disposal. On September 11th, 2012, a 20-mil reinforced plastic liner was installed and properly seated at the base of the 12 ft excavation. The site was backfilled with clean, imported soil and the area was contoured to the surrounding landscape. NMOCD was notified of potential groundwater impact on January 30th, 2013 and a junction box

disclosure report was submitted to NMOCD with all the 2012 junction box closures and disclosures.

As part of the Investigation and Characterization Plan (ICP) submitted to NMOCD on October 15th, 2013, and approved on October 23th, 2013, three soil bores were installed at the site on April 16th, 2014. As the bores were advanced, soil samples were taken at regular intervals and field tested for chlorides and hydrocarbons. Representative samples from each bore were taken to a commercial laboratory for analysis (Appendix A). Laboratory analysis of SB-1 returned chloride concentrations of 240 at 15 ft bgs and 208 mg/kg at 18 ft bgs. SB-2 returned chloride concentrations of 1,090 mg/kg at 4 ft bgs and 160 mg/kg at 14 ft bgs. SB-3 returned chloride concentrations of 992 mg/kg at 10 ft bgs and 160 mg/kg at 18 ft bgs. GRO and DRO analysis returned values of non-detect in all bores at all depths. The bore holes were plugged in total with bentonite to the ground surface. An over-head power line and a buried gas line prevented a soil bore from being drilled on the western edge of the site. However, the previously excavated 15 ft west vertical resulted in concentrations that decreased with depth to a concentration of 571 mg/kg at 12 ft bgs. Chloride concentrations in the 15 ft east vertical also decreased with depth to a concentration of 451 mg/kg at 12 ft bgs.

To determine if the residual chlorides in the vadose zone pose a threat to groundwater quality, ROC ran the U.S. Environmental Protection Agency Exposure Assessment Multimedia Model (MULTIMED Version 1.5, 2005). Model outputs and the graph are included in Appendix B. With the impact area of 46 ft x 52 ft, the model output concludes that the peak concentration of chlorides in groundwater contributed by the vadose zone soils would be approximately 93.22 mg/L in 126 years. Since the estimated increase in chloride concentrations in groundwater from residual chloride migration is below the WQCC standard of 250 mg/L, no action is warranted for the groundwater at this site.

Corrective Action Plan

Based on the low concentrations observed at this site and the results of the multimed analysis, RECS recommends that ROC install a 20-mil reinforced poly liner at the site with dimensions of 46 ft x 52 ft at a depth of 4 – 5 ft bgs (Figure 2). The liner will extend 5 ft past the 15 ft west vertical, SB-2 and SB-3, and will extend 10 ft past the 15 ft east vertical. The southeast corner will be removed to remain a safe distance from a non-ROC line. The liner will inhibit the downward migration of constituents through the vadose zone. The excavation will be backfilled to ground surface and contoured to the surrounding area. The soils placed above the liner will have a laboratory chloride reading no greater than 500 mg/kg and a field PID measurement below 100 ppm. Excavated soils will be evaluated for use as backfill and any soil requiring disposal will be properly disposed of at a NMOCD approved facility. The soils over and surrounding the site will then be prepared with soil amendments as necessary and seeded with a native vegetative mix. Vegetation above the liner will also provide a natural infiltration barrier for the site since plants capture water through their roots thereby reducing the volume of water moving through the vadose zone.

Once the CAP work is completed by installing the 20-mil reinforced poly liner and seeding the site, ROC will submit a written report that will include a request for 'remediation termination' and site closure.

RECS appreciates the opportunity to work with you on this project. Please call Hack Conder at (575) 393-2967 or me if you have any questions or wish to discuss the site.

Sincerely,

Laura Flores
Rice Environmental Consulting & Safety (RECS)
Project Manager

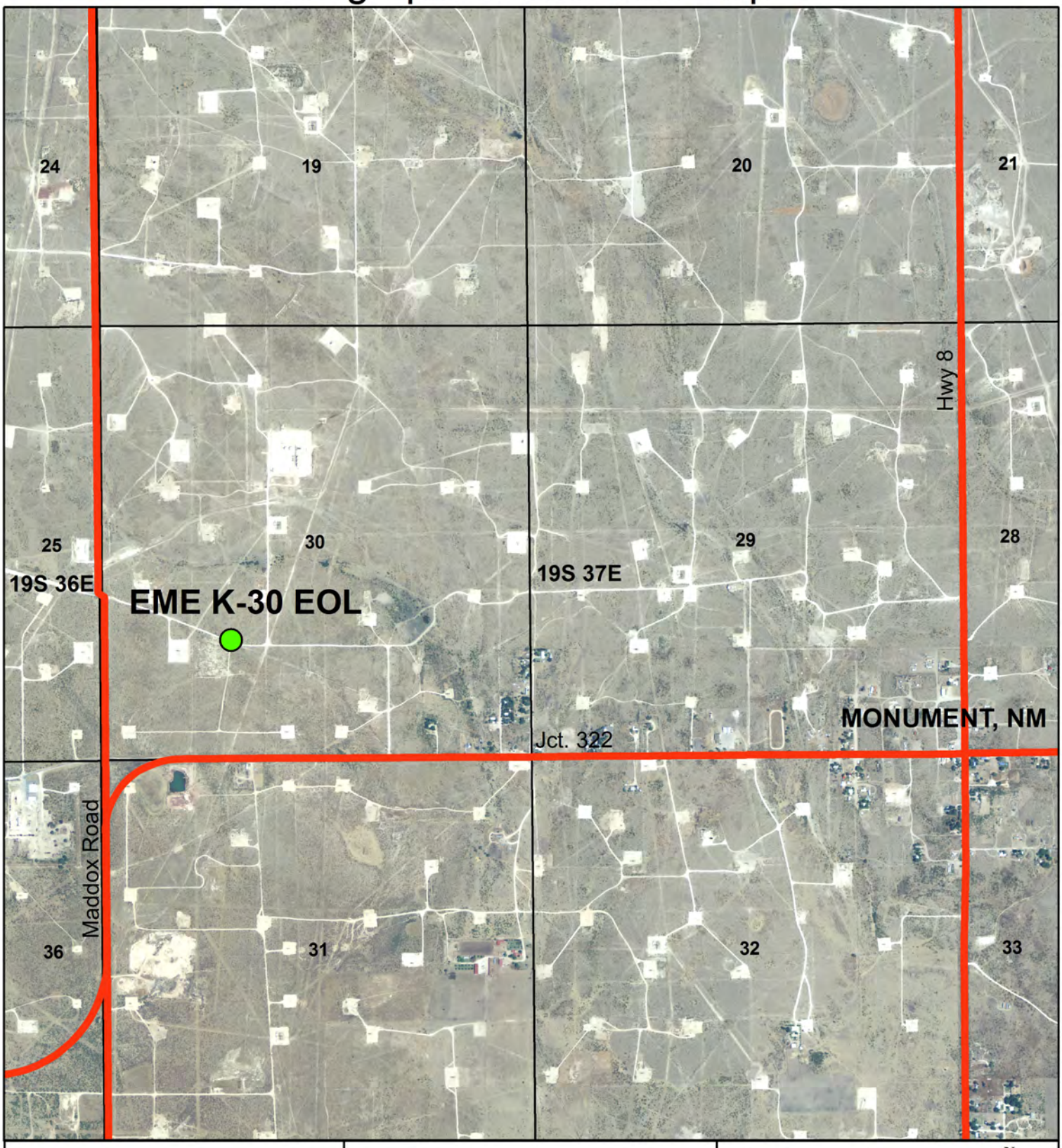
Attachments:

Figure 1 – Geographical Location Map
Figure 2 – Soil Bore Installation and Proposed Liner Map
Appendix A – Soil Bore Installation Documentation
Appendix B – Multimed Documentation

Figures

RICE Environmental Consulting and Safety (RECS)
P.O. Box 2948, Hobbs, NM 88241
Phone 575.393.2967

Geographical Location Map



RICE ENVIRONMENTAL CONSULTING & SAFETY, LLC

RECS

EME K-30 EOL

UL/K SECTION 30
T-19-S R-37-E
LEA COUNTY, NM

NMOCD Case #: 1R427-409

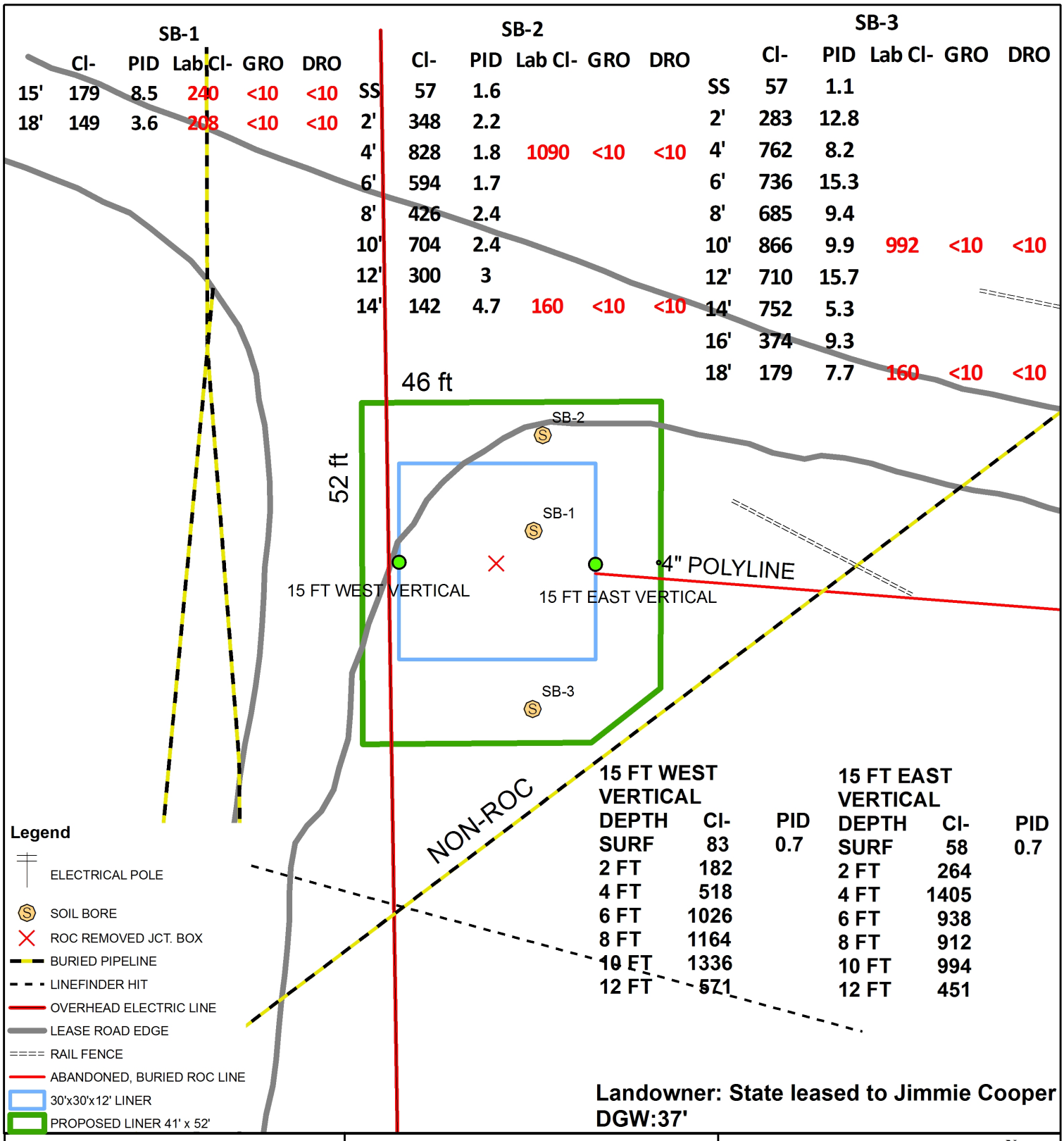
Figure 1

N
W E
S

0 0.25 0.5
Miles

Drawing date: 10/7/13
Drafted by: L. Weinheimer

Proposed Liner



RECS
RICE ENVIRONMENTAL
CONSULTING & SAFETY

EME K-30 EOL

Unit Letter K, Section 30
T-19-S R-37-E
LEA COUNTY, NM
NMOCD Case #: 1R427-409

Figure 2

N W E S

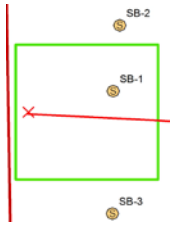
0 10 20
Feet

GPS Date: 4/10/14
Drawing date: 6/4/14
Drafted by: T. Grieco

Appendix A

Soil Bore Installation Documentation

RICE Environmental Consulting and Safety (RECS)
P.O. Box 2948 Hobbs, NM 88241
Phone 575.393.2967

Logger:	Edward Cesareo		RECS RICE ENVIRONMENTAL CONSULTING & SAFETY
Driller:	Harrison&Cooper		
Drilling Method:	Air Rotary		**Project Name:** EME K-30 EOL **Well ID:** SB-1
Start Date:	4/16/2014		
End Date:	4/16/2014		**Project Consultant:** RECS

Comments: Sampling began at 15', all samples were taken from cuttings. SB-1 is located 18' east of the former junction box site.

DRAFTED BY: Catherine Uršanić

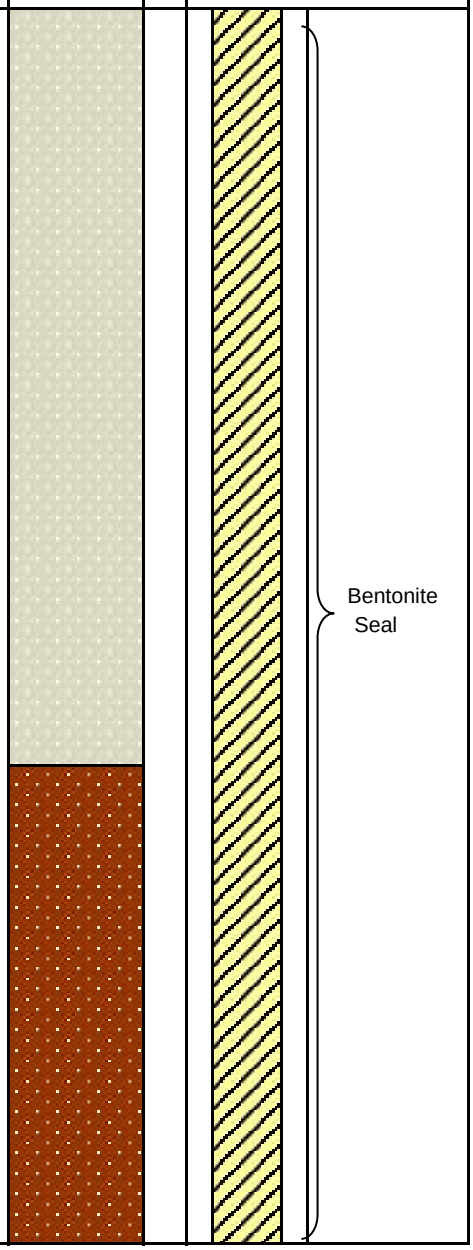
TD = 18' GW = 37'

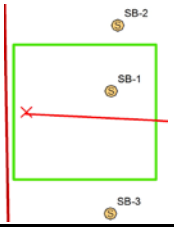
Location: UL/ K Sec. 30 T-19-S R-37-E

Lat: 32°37'40.539"N **Long:** 103°17'38.175"W

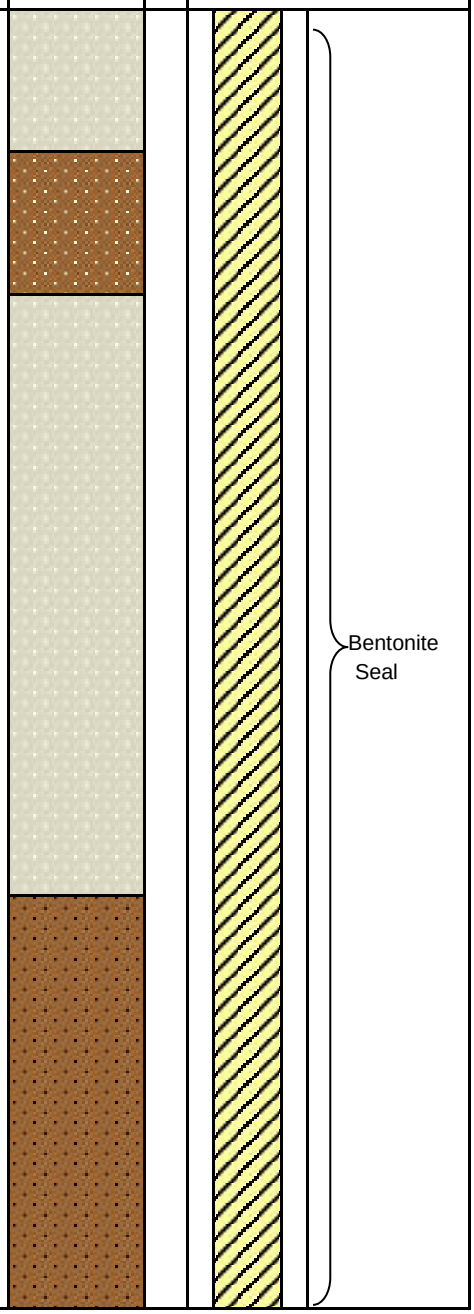
County:Lea **State**:NM

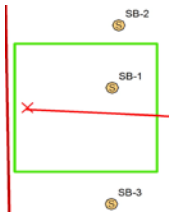
Depth (feet)	Chloride field tests	LAB	PID	Description
				TAN SILTY SAND / ROCK/ NO ODOR
SS				
3 ft				
6 ft				
9 ft				
12 ft				
				BROWN RED SAND / ROCK / NO ODOR
15 ft	179	Lab Cl-240	8.5	
		GRO <10		
		DRO <10		
18 ft	149	Lab Cl-208	3.6	
		GRO <10		
		DRO <10		



Logger:	Edward Cesareo		RECS RICE ENVIRONMENTAL CONSULTING & SAFETY
Driller:	Harrison&Cooper		**Project Name:** EME K-30 EOL **Well ID:** SB-2
Drilling Method:	Air Rotary		**Project Consultant:** RECS
Start Date:	4/16/2014		
End Date:	4/16/2014		
Comments: All samples were taken from cuttings. SB-2 is located 27' northeast of the former junction box site. **DRAFTED BY:** Catherine Uršanić TD = 14' GW = 37'			**Location:** UL/ K Sec. 30 T-19-S R-37-E **Lat:** 32°37'40.687"N **Long:** 103°17'38.158"W **County**:Lea **State**:NM

Depth (feet)	Chloride field tests	LAB	PID	Description
				TAN SILTY SAND / ROCK / NO ODOR
SS	57		1.6	
				BROWN SAND / ROCK / NO ODOR
2 ft	348		2.2	
				TAN SILTY SAND / ROCK / NO ODOR
4 ft	828	Lab Cl-1090	1.8	
		GRO <10		
		DRO <10		
6 ft	594		1.7	
8 ft	426		2.4	
10 ft	704		2.4	
				BROWN SAND / NO ODOR
12 ft	300		3	
14 ft	142	Lab Cl-160	4.7	
		GRO <10		
		DRO <10		



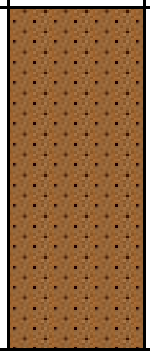
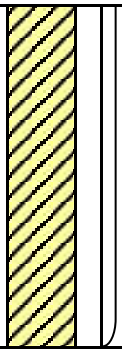
Logger:	Edward Cesareo		RECS RICE ENVIRONMENTAL CONSULTING & SAFETY
Driller:	Harrison&Cooper		**Project Name:** EME K-30 EOL **Well ID:** SB-3
Drilling Method:	Air Rotary		**Project Consultant:** RECS
Start Date:	4/16/2014		
End Date:	4/16/2014		
Comments: All samples were taken from cuttings. SB-3 is located 28' southeast of the former junction box site. **DRAFTED BY:** Catherine Uršanić			**Location:** UL/ K Sec. 30 T-19-S R-37-E
TD = 18'	GW = 37'		**Lat:** 32°37'40.27"N **County**:Lea
			Long: 103°17'38.178"W **State**:NM

Depth (feet)	Chloride field tests	LAB	PID	Description
				TAN SILTY SAND / ROCK / NO ODOR
SS	57		1.1	
				DARK BROWN SAND / ROCK/ NO ODOR
2 ft	283		12.8	
				TAN SILTY SAND / ROCK / NO ODOR
4 ft	762		8.2	
6 ft	736		15.3	
8 ft	685		9.4	
10 ft	866	Lab Cl-992	9.9	
		GRO <10		BROWN SAND / NO ODOR
		DRO <10		
12 ft	710		15.7	
14 ft	752		5.3	

Lithology

Well Construction

Bentonite Seal

Depth (feet)	Chloride field tests	LAB	PID	Description		Lithology		Well Construction
16 ft	374		9.3	BROWN SAND / NO ODOR				
18 ft	179	**Lab Cl-160**	7.7					
		GRO <10						
		DRO <10						

CARDINAL Laboratories

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

April 23, 2014

KATIE JONES

Rice Operating Company

112 W. Taylor

Hobbs, NM 88240

RE: EME K-30 EOL

Enclosed are the results of analyses for samples received by the laboratory on 04/16/14 15:50.

Cardinal Laboratories is accredited through Texas NELAP under certificate number T104704398-13-5. Accreditation applies to drinking water, non-potable water and solid and chemical materials. All accredited analytes are denoted by an asterisk (*). For a complete list of accredited analytes and matrices visit the TCEQ website at www.tceq.texas.gov/field/qa/lab_accred_certif.html.

Cardinal Laboratories is accreditated through 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 524.4	Regulated VOCs (V1, V2, V3)

Accreditation applies to public drinking water matrices.

This report meets NELAP requirements and is made up of a cover page, analytical results, and a copy of the original chain-of-custody. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Celey D. Keene

Celey D. Keene

Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
KATIE JONES
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	04/16/2014	Sampling Date:	04/16/2014
Reported:	04/23/2014	Sampling Type:	Soil
Project Name:	EME K-30 EOL	Sampling Condition:	Cool & Intact
Project Number:	NONE GIVEN	Sample Received By:	Jodi Henson
Project Location:	NONE GIVEN		

Sample ID: SB #1 15' (H401154-01)

Chloride, SM4500Cl-B **mg/kg** **Analyzed By: AP**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**240**	16.0	04/21/2014	ND	432	108	400	7.69	

TPH 8015M **mg/kg** **Analyzed By: CK**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	04/17/2014	ND	193	96.4	200	4.62	
DRO >C10-C28	<10.0	10.0	04/17/2014	ND	200	100	200	6.22	

Surrogate: 1-Chlorooctane	*114 %*	*65.2-140*
Surrogate: 1-Chlorooctadecane	*106 %*	*63.6-154*

Sample ID: SB #1 18' (H401154-02)

Chloride, SM4500Cl-B **mg/kg** **Analyzed By: AP**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**208**	16.0	04/21/2014	ND	432	108	400	7.69	

TPH 8015M **mg/kg** **Analyzed By: CK**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	04/17/2014	ND	193	96.4	200	4.62	
DRO >C10-C28	<10.0	10.0	04/17/2014	ND	200	100	200	6.22	

Surrogate: 1-Chlorooctane	*103 %*	*65.2-140*
Surrogate: 1-Chlorooctadecane	*95.1 %*	*63.6-154*

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
KATIE JONES
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	04/16/2014	Sampling Date:	04/16/2014
Reported:	04/23/2014	Sampling Type:	Soil
Project Name:	EME K-30 EOL	Sampling Condition:	Cool & Intact
Project Number:	NONE GIVEN	Sample Received By:	Jodi Henson
Project Location:	NONE GIVEN		

Sample ID: SB #2 4' (H401154-03)

Chloride, SM4500Cl-B mg/kg **Analyzed By: AP**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**1090**	16.0	04/21/2014	ND	432	108	400	7.69	

TPH 8015M mg/kg **Analyzed By: CK**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	04/17/2014	ND	193	96.4	200	4.62	
DRO >C10-C28	<10.0	10.0	04/17/2014	ND	200	100	200	6.22	

Surrogate: 1-Chlorooctane	*108 %*	*65.2-140*
Surrogate: 1-Chlorooctadecane	*99.1 %*	*63.6-154*

Sample ID: SB #2 14' (H401154-04)

Chloride, SM4500Cl-B mg/kg **Analyzed By: AP**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**160**	16.0	04/21/2014	ND	432	108	400	7.69	

TPH 8015M mg/kg **Analyzed By: CK**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	04/17/2014	ND	193	96.4	200	4.62	
DRO >C10-C28	<10.0	10.0	04/17/2014	ND	200	100	200	6.22	

Surrogate: 1-Chlorooctane	*113 %*	*65.2-140*
Surrogate: 1-Chlorooctadecane	*106 %*	*63.6-154*

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Analytical Results For:

Rice Operating Company
KATIE JONES
112 W. Taylor
Hobbs NM, 88240
Fax To: (575) 397-1471

Received:	04/16/2014	Sampling Date:	04/16/2014
Reported:	04/23/2014	Sampling Type:	Soil
Project Name:	EME K-30 EOL	Sampling Condition:	Cool & Intact
Project Number:	NONE GIVEN	Sample Received By:	Jodi Henson
Project Location:	NONE GIVEN		

Sample ID: SB #3 10' (H401154-05)

Chloride, SM4500Cl-B **mg/kg** **Analyzed By: AP**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**992**	16.0	04/21/2014	ND	432	108	400	7.69	

TPH 8015M **mg/kg** **Analyzed By: CK**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	04/17/2014	ND	193	96.4	200	4.62	
DRO >C10-C28	<10.0	10.0	04/17/2014	ND	200	100	200	6.22	

Surrogate: 1-Chlorooctane	*113 %*	*65.2-140*
Surrogate: 1-Chlorooctadecane	*103 %*	*63.6-154*

Sample ID: SB #3 18' (H401154-06)

Chloride, SM4500Cl-B **mg/kg** **Analyzed By: AP**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Chloride	**160**	16.0	04/21/2014	ND	432	108	400	7.69	

TPH 8015M **mg/kg** **Analyzed By: CK**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<10.0	10.0	04/17/2014	ND	193	96.4	200	4.62	
DRO >C10-C28	<10.0	10.0	04/17/2014	ND	200	100	200	6.22	

Surrogate: 1-Chlorooctane	*114 %*	*65.2-140*
Surrogate: 1-Chlorooctadecane	*107 %*	*63.6-154*

Cardinal Laboratories *=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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

Notes and Definitions

ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference
**	Samples not received at proper temperature of 6°C or below.
***	Insufficient time to reach temperature.
-	Chloride by SM4500Cl-B does not require samples be received at or below 6°C
	Samples reported on an as received basis (wet) unless otherwise noted on report

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

CARDINAL LABORATORIES
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	BILL TO
Project Manager: Katie Jones	P.O. #:
Address: 112 W. Taylor	Company:
City: Hobbs State: NM Zip: 88240	Attn:
Phone #: Fax #:	Address:
Project #: Project Owner:	City:
Project Name:	State: Zip:
Project Location: EME K-30 E.O.L. 19-S/37-E	Phone #:
Sampler Name: Edward Cesareo	Fax #:

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	ANALYSIS REQUEST: Chlorides	TPH 8015 M	BTEX	Texas TPH	Complete Cations/Anions	TDS
H401154																				
1	SB#1 15'	G	1			X					X		4-16-14	11:20	X	X				
2	SB#1 18'	G	1			X					X		4-16-14	11:25	X	X				
3	SB#2 4'	G	1			X					X		4-16-14	1:40	X	X				
4	SB#2 14'	G	1			X					X		4-16-14	1:45	X	X				
5	SB#3 10'	G	1			X					X		4-16-14	2:25	X	X				
6	SB#3 18'	G	1			X					X		4-16-14	2:30	X	X				

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 consequental 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: Edward Cesareo	Date: 4-16-14 Time: 3:50	Received By: Jodi Henson	Phone Result: ☐ Yes ☑ No Add'l Phone #:
Relinquished By:	Date: Time:	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 hconder@rice-ecs.com; Lweinheimer@rice-ecs.com; kjones@riceswd.com; Lpena@riceswd.com; Knorman@rice-ecs.com ecesareo@rice-ecs.com

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

#54

Appendix B

Multimed Model

RICE Environmental Consulting and Safety (RECS)
P.O. Box 2948 Hobbs, NM 88241
Phone 575.393.2967

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED (Version 1.50, 2005)

1
Run options
--- -------

Rice EME K-30 EOL

1R427-409
Chemical simulated is Chloride

Option Chosen Saturated and unsaturated zone models
Run was DETERMIN
Infiltration Specified By User: 1.524E-02 m/yr
Run was transient
Well Times: Entered Explicitly
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	7.01	1

DATA FOR MATERIAL 1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	3.60	-999.	-999.	-999.
Unsaturated zone porosity	--	CONSTANT	0.250	-999.	-999.	-999.
Air entry pressure head	m	CONSTANT	0.700	-999.	-999.	-999.
Depth of the unsaturated zone	m	CONSTANT	7.01	0.000	0.000	0.000

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.116	-999.	-999.	-999.
Brook and Corey exponent,EN	--	CONSTANT	-999.	-999.	-999.	-999.
ALFA coefficient	1/cm	CONSTANT	0.500E-02	-999.	-999.	-999.
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	-999.	-999.

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	- Number of different layers used		1
NTSTPS	- Number of time values concentration calc		40
DUMMY	- Not presently used		1
ISOL	- Type of scheme used in unsaturated zone		2
N	- Stehfest terms or number of increments		18
NTEL	- Points in Lagrangian interpolation		3
NGPTS	- Number of Gauss points		104
NIT	- Convolution integral segments		2
IBOUND	- Type of boundary condition		3
ITSGEN	- Time values generated or input		1
TMAX	- Max simulation time	--	0.0
WTFUN	- Weighting factor	--	1.2

OPTIONS CHOSEN

Convolution integral approach
Exponentially decaying continuous source
Computer generated times for computing concentrations

1

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Thickness of layer	m	CONSTANT	7.01	-999.	-999.	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	-999.	-999.
Percent organic matter	--	CONSTANT	0.000	-999.	-999.	-999.
Bulk density of soil for layer	g/cc	CONSTANT	1.99	-999.	-999.	-999.
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	-999.	-999.
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	-999.	-999.
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	-999.	-999.
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	-999.	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	-999.	-999.
Reference temperature	C	CONSTANT	25.0	-999.	-999.	-999.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	-999.	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	-999.	-999.
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Air diffusion coefficient	cm2/s	CONSTANT	-999.	-999.	-999.	-999.
Reference temperature for air diffusion	C	CONSTANT	-999.	-999.	-999.	-999.
Molecular weight	g/M	CONSTANT	-999.	-999.	-999.	-999.
Mole fraction of solute	--	CONSTANT	-999.	-999.	-999.	-999.
Vapor pressure of solute	mm Hg	CONSTANT	-999.	-999.	-999.	-999.
Henry`s law constant	atm-m^3/M	CONSTANT	-999.	-999.	-999.	-999.
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Not currently used		CONSTANT	0.000	0.000	0.000	0.000
Not currently used		CONSTANT	0.000	0.000	0.000	0.000

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.152E-01	-999.	-999.	-999.
Area of waste disposal unit	m^2	CONSTANT	222.	-999.	-999.	-999.
Duration of pulse	yr	DERIVED	0.100E-08	-999.	-999.	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	-999.	-999.
Recharge rate	m/yr	CONSTANT	0.000	-999.	-999.	-999.
Source decay constant	1/yr	CONSTANT	0.250E-01	0.000	0.000	0.000
Initial concentration at landfill	mg/l	CONSTANT	700.	-999.	-999.	-999.
Length scale of facility	m	DERIVED	-999.	-999.	-999.	-999.
Width scale of facility	m	DERIVED	-999.	-999.	-999.	-999.
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	-999.	-999.	-999.	-999.
Aquifer porosity	--	CONSTANT	0.300	-999.	-999.	-999.
Bulk density	g/cc	CONSTANT	1.86	-999.	-999.	-999.
Aquifer thickness	m	CONSTANT	6.10	-999.	-999.	-999.
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	-999.	-999.
Conductivity (hydraulic)	m/yr	CONSTANT	315.	-999.	-999.	-999.
Gradient (hydraulic)		CONSTANT	0.300E-02	-999.	-999.	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	-999.	-999.
Retardation coefficient	--	DERIVED	-999.	-999.	-999.	-999.
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	20.0	-999.	-999.	-999.
pH	--	CONSTANT	7.00	-999.	-999.	-999.
Organic carbon content (fraction)		CONSTANT	0.000	-999.	-999.	-999.
Well distance from site	m	CONSTANT	1.00	-999.	-999.	-999.
Angle off center	degree	CONSTANT	0.000	-999.	-999.	-999.
Well vertical distance	m	CONSTANT	0.000	-999.	-999.	-999.

1

TIME	CONCENTRATION
0.400E+02	0.00000E+00
0.600E+02	0.96745E+00
0.800E+02	0.15861E+02
0.100E+03	0.59273E+02
0.120E+03	0.90324E+02
0.140E+03	0.87818E+02
0.160E+03	0.67068E+02
0.180E+03	0.45124E+02
0.200E+03	0.28787E+02
0.220E+03	0.17655E+02

Chloride Concentration At The Receptor Well

Rice EME K-30 EOL