1R - 478

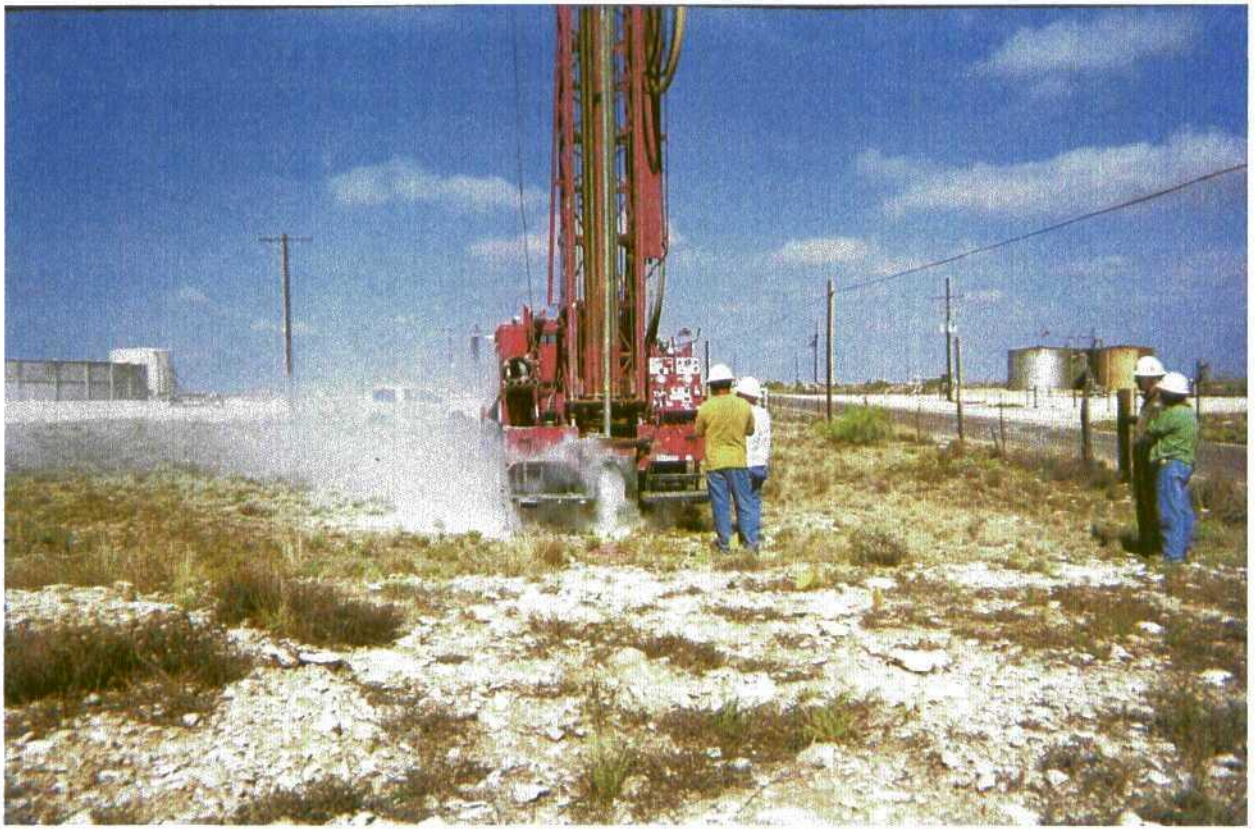
REPORTS

DATE:

2006

Investigation Characterization Report & Closure Request

Vacuum M-26 Produced Water Discharge
UL C Sec 35 T17S R35E
NMOCD Case No. 1R0478



Prepared: 12-28-06

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

Incident Characterization Report & Closure Request

Vacuum M-26 Produced Water Discharge
UL C Sec 35 T17S R35E

Contents

Investigation Characterization Report & Closure Request

Vacuum M-26 Produced Water Discharge
UL C Sec 35 T17S R35E

Background and Findings

This report presents the findings and recommendations of an evaluation of soil chloride levels associated with a small (**approx. 15 bbl) release of produced water, affecting an estimated 225 sq ft,** which occurred in August, 2003. This work was completed pursuant to an Incident Characterization Plan of February December 12th, 2005 (included in Appendix D).

The release site is located near Buckeye immediately south of CR-50, a few hundred feet east of a large Conoco-Phillips battery (Figure 1). The topography is gently sloping toward the southeast (Figure 2). Soils at the location are mapped as Kimbrough gravelly loam soil series, characterized by gravelly loam to a depth of approximately 6 inches, and underlain by calcium indurated caliche[1]. Vegetation is open range grassland and desert scrub. Groundwater is estimated to occur at a depth of approximately 51 feet[2], occurring in unconsolidated Tertiary alluvium of the Ogallala Formation[3], where the saturated thickness is estimated to be 100 ft[4].

Soil samples were taken on June 23rd, 2006 from the cuttings of an air-rotary drill rig, operated by Harrison and Cooper of Lubbock, Texas. Samples were taken from the surface to a depth of approximately 55 ft below ground surface. Borings were located as close to the release site as possible, limited by the presence of an active underground petroleum pipeline.

Soil chloride concentrations were exceedingly low (< 150 ppm) at all depths sampled, and diminish rapidly with depth in each of three borings, indicating that the released chloride did not measurably affect soils in close proximity; (Figures 3 and 4, and Tables 1 to 3). The effects of this spill were thus found to be highly localized and of minimal areal extent.

Natural vegetation has become reestablished across the area disturbed during the initial incident investigation and pipeline repair (Figure 5).

Modeling of the likely rate of movement of chlorides from the release to the groundwater **indicates that** the small mass of **residual chloride** at this location **does not pose a threat to groundwater quality** (Figure 6 and Appendix C).

These findings indicate that neither soils, vegetation nor groundwater have been impaired or threatened by this small release. **Therefore, no further actions are recommended with respect to this release. It is thus requested that OCD grant this release "closure" status.**

---

[1] 2004 SSURGO USDA Soils Map. Lea County, New Mexico Soil Survey.
[2] NM State Engineer Office. Water well records.
[3] USGS Geologica Map. Open File Report OF-97-82. Green & Jones, 1997.
[4] Musharrafieh, G. and Chudnoff, M. 2003. Numerical simulation of groundwater flow for water rights administration in the Lea County underground water basin New Mexico. N.M. Symposium on Hydrologic Modeling

Appendix A – Figures and Photographs

Figure 1- Aerial photograph showing **site location**.

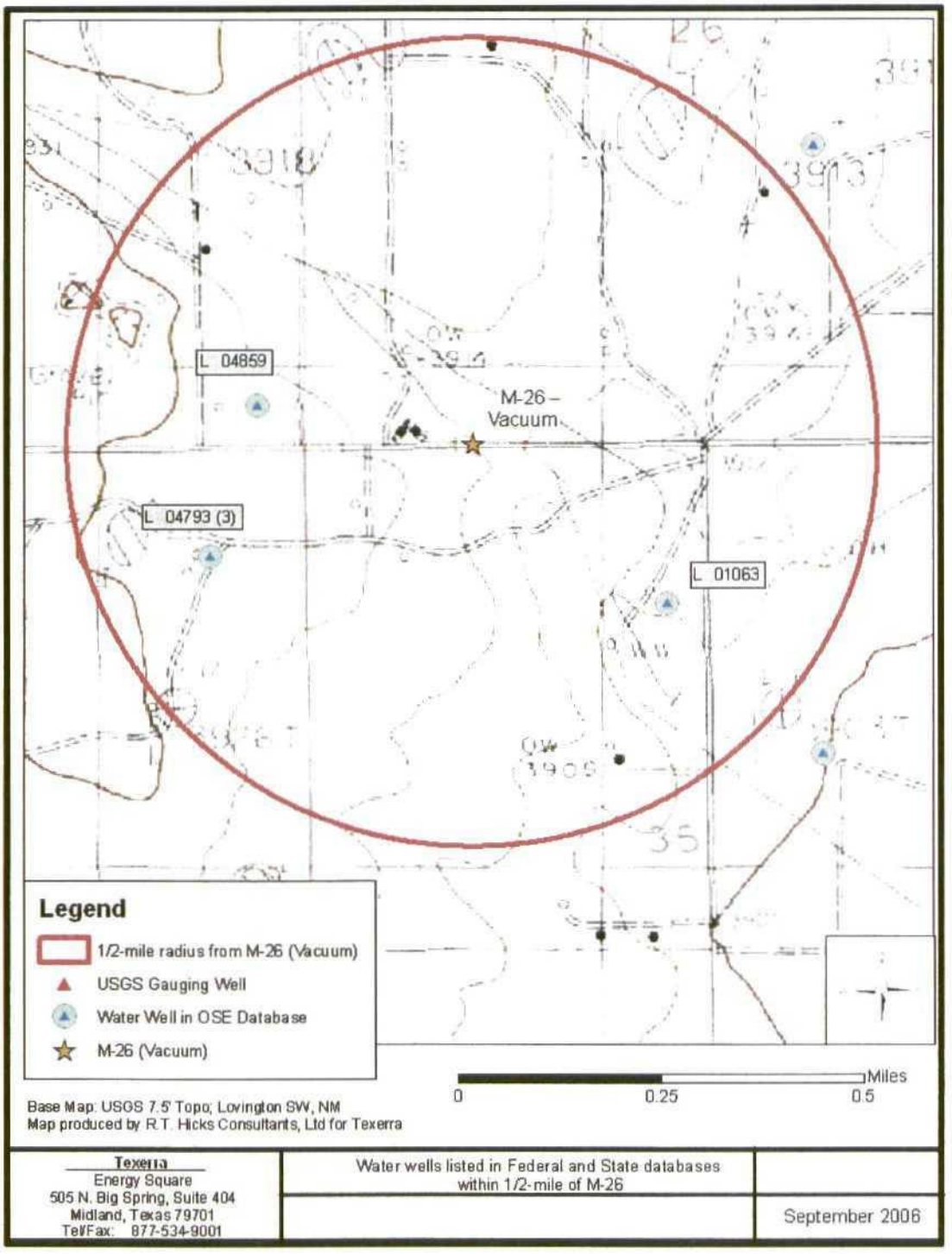


Figure 2 – Topographic map, showing locations of water wells in NM State Engineer database. The presumed direction of groundwater flow is toward the southeast.

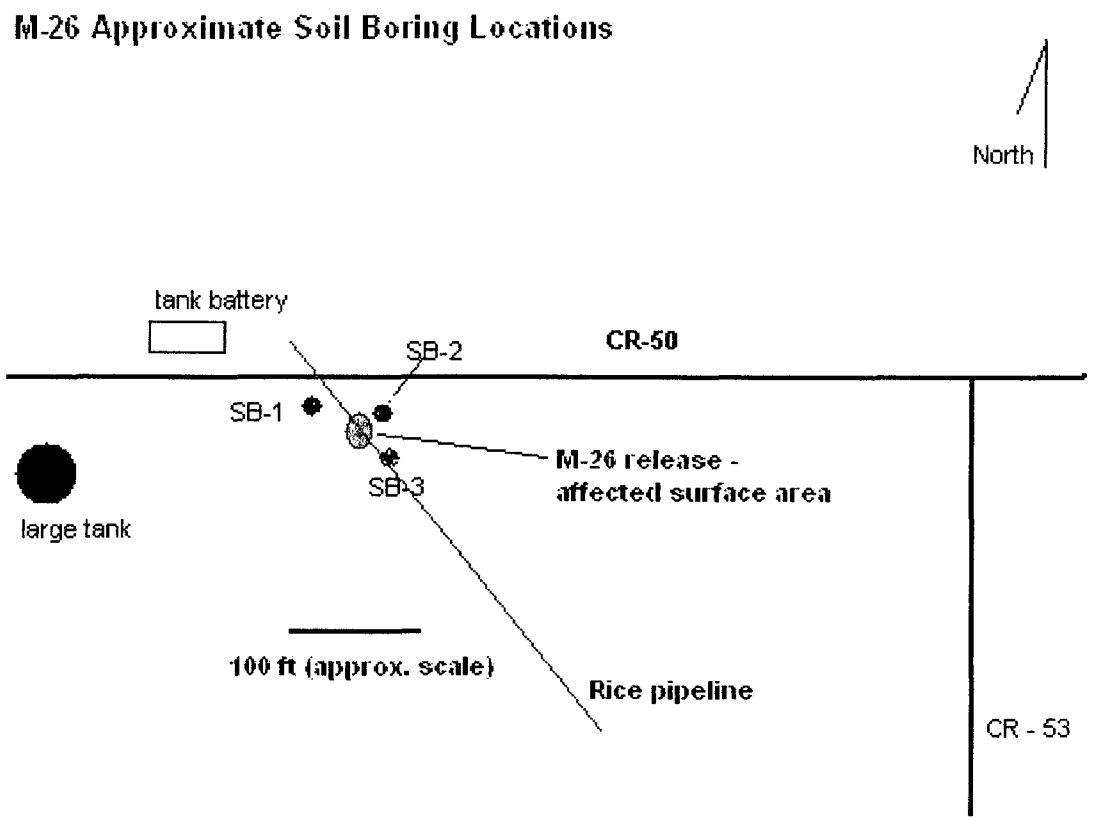


Figure 3 – Approximate soil boring locations.

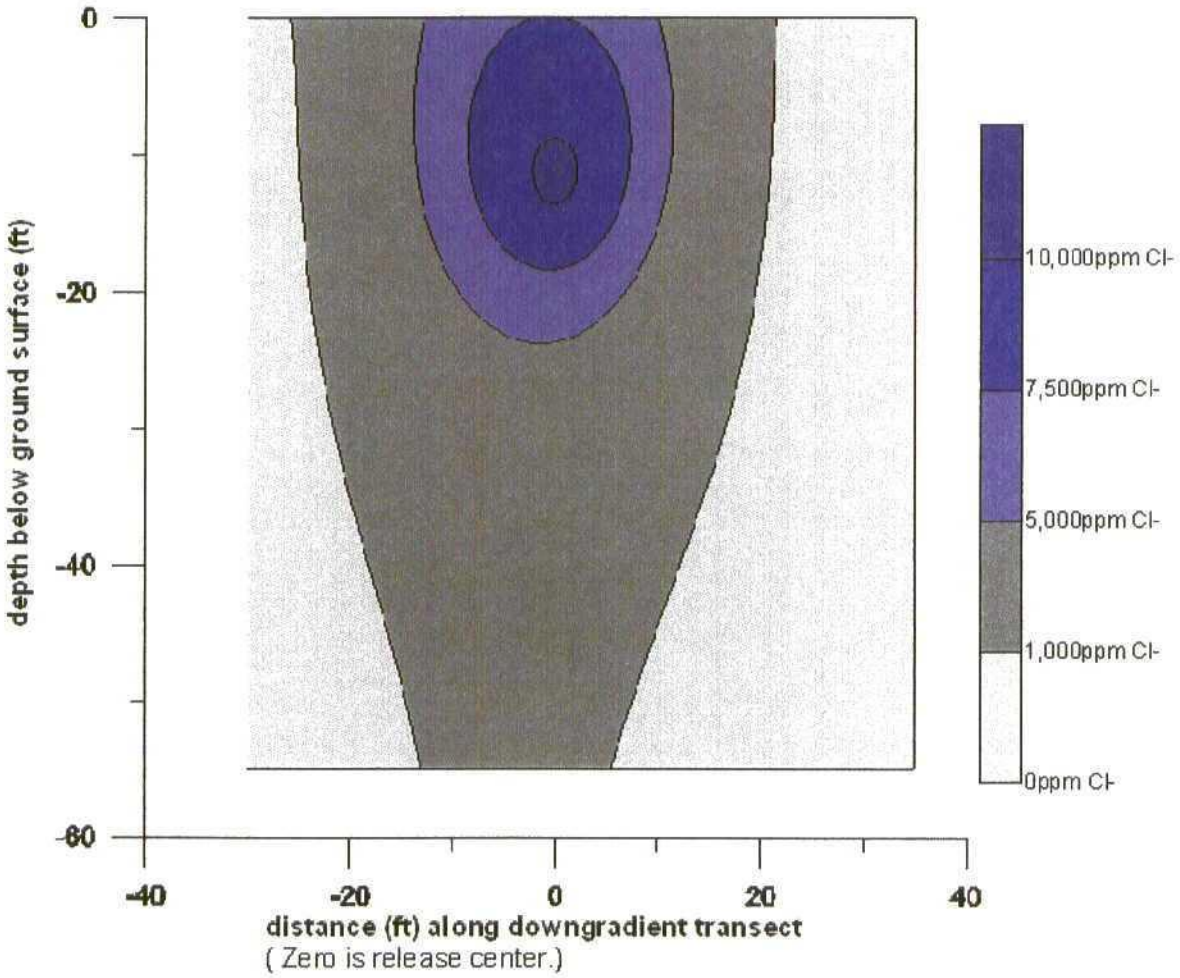
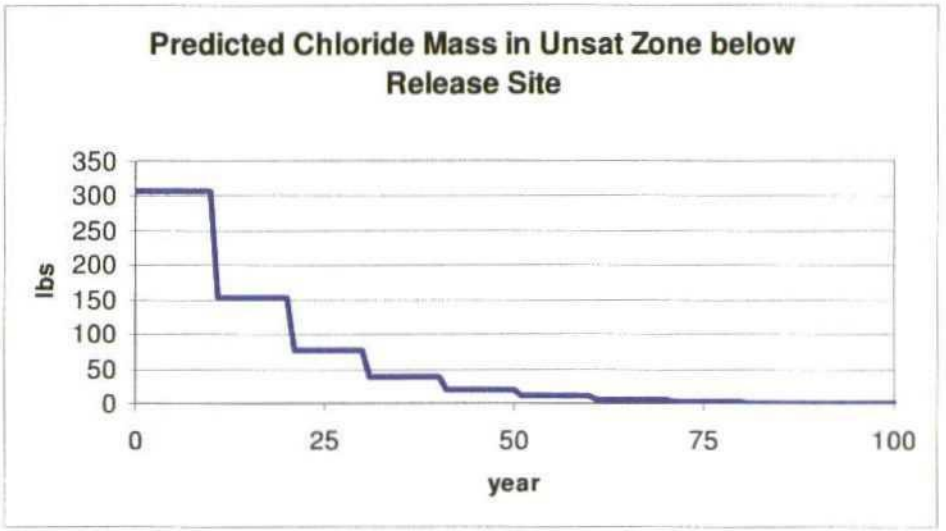


Figure 4- Interpolated soil chloride concentrations in a vertical slice along an upgradient to downgradient transect across the release center (from SB-1 to SB-3).

Figure 5- View of release site looking west. Photograph taken September 22nd, 2006



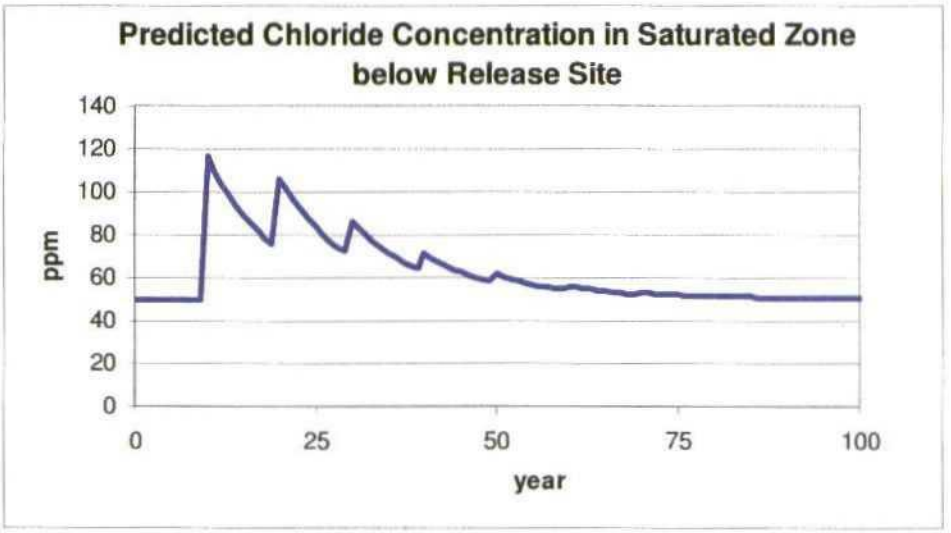


Figure 6 – Predicted loading of chloride to groundwater and subsequent dilution over a 100 year time frame, using the model **SCl-lpg**, described in Appendix C. **Figure 6**a (above) - Predicted attenuation of residual soil chloride mass over time. **Figure 6b** (below) - Predicted course of groundwater chloride concentrations over time, in response to periodic recharge and subsequent dilution. The presumed baseline groundwater chloride concentration is 50 ppm.

APPENDIX B – Soil Boring Logs and Chloride Concentrations

Soil Boring Log
Rice Operating Company
Vacuum Field SWD System
M-26 vent

Identification: **SB-1**
Location: approx. 40 ft west/northwest of release
Date: 6/23/2006
Driller: Ken Cooper (Harrison and Cooper, Inc.)
Drill method: Air Rotary
Logged by: L. Peter Galusky, Jr.

Depth	Field Chloride Test (ppm)	Lab Chloride Test (ppm)	Field OVM test (ppm)	Lab BTEX test (ppm)	Cutting Description
0					light gray caliche
-5	113		0		"
-10	122	16	0		"
-15	58		0		"
-20	60		0		"
-25	55		0		light brown sand
-30	29		0		"
-35	57		0		"
-40	28		0		"
-45	28		0		"
-50	29		0		"
-55	29	16	0		"
-60					

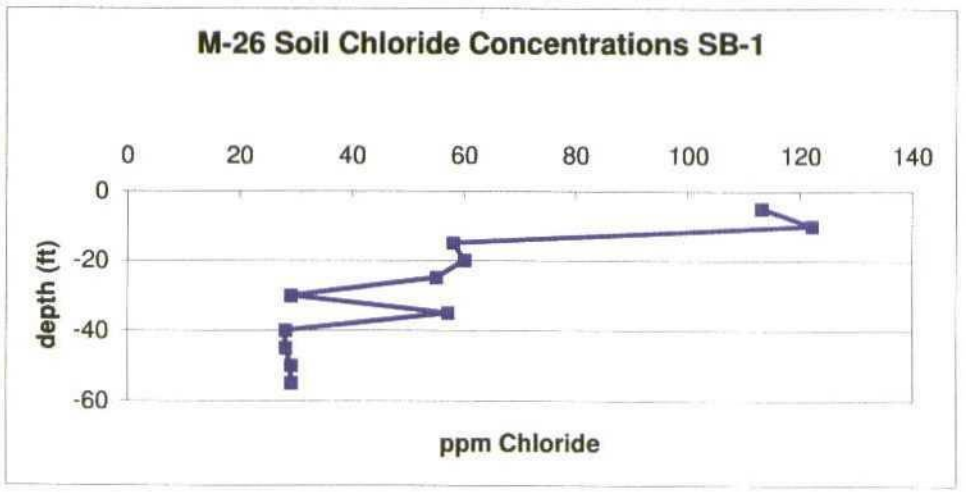


Table 1 – Soil boring log and chloride levels for SB-1.

Soil Boring Log
Rice Operating Company
Vacuum Field SWD System
M-26 vent

Identification: **SB-2**
Location: approx. 30 ft east/southeast of release
Date: 6/23/2006
Driller: Ken Cooper (Harrison and Cooper, Inc.)
Drill method: Air Rotary
Logged by: L. Peter Galusky, Jr.

Depth	Field Chloride Test (ppm)	Lab Chloride Test (ppm)	Field OVM test (ppm)	Lab BTEX test (ppm)	Cutting Description
0					light gray caliche
-5	120		0		"
-10	113		0		"
-15	57		0		"
-20	29		0		"
-25	62		0		light brown sand
-30	55		0		"
-35	59		0		"
-40	28		0		"
-45	59		0		"
-50	59		0		"
-55	28	32	0		"
-60					

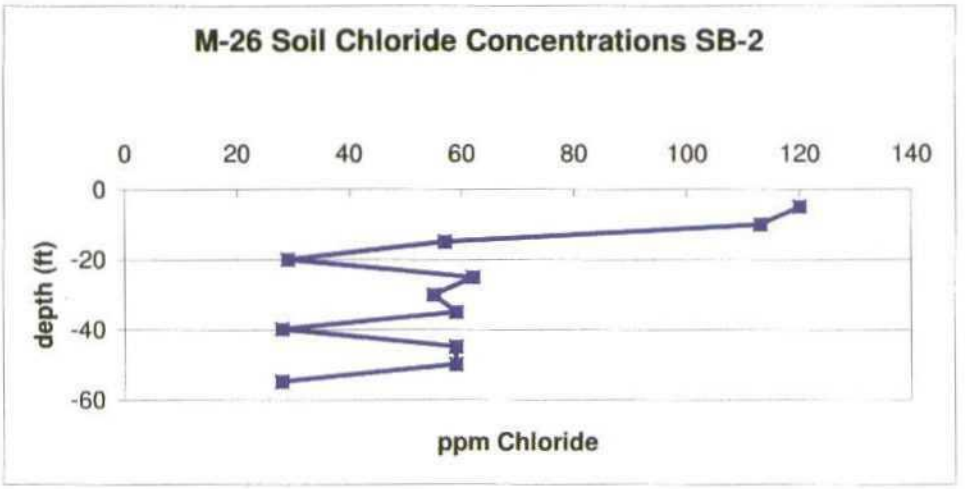


Table 2 – Soil boring log and chloride levels for SB-2.

Soil Boring Log
Rice Operating Company
Vacuum Field SWD System
M-26 vent

Identification: **SB-3**
Location: approx. 30 ft northeast of release
Date: 6/23/2006
Driller: Ken Cooper (Harrison and Cooper, Inc.)
Drill method: Air Rotary
Logged by: L. Peter Galusky, Jr.

Depth	Field Chloride Test (ppm)	Lab Chloride Test (ppm)	Field OVM test (ppm)	Lab BTEX test (ppm)	Cutting Description
0					light gray caliche
-5	61		0		"
-10	88		0		"
-15	27		0		"
-20	55		0		"
-25	58		0		light brown sand
-30	28		0		"
-35	56		0		"
-40	55		0		"
-45	55		0		"
-50	27		0		"
-55	29	16	0		"
-60					"

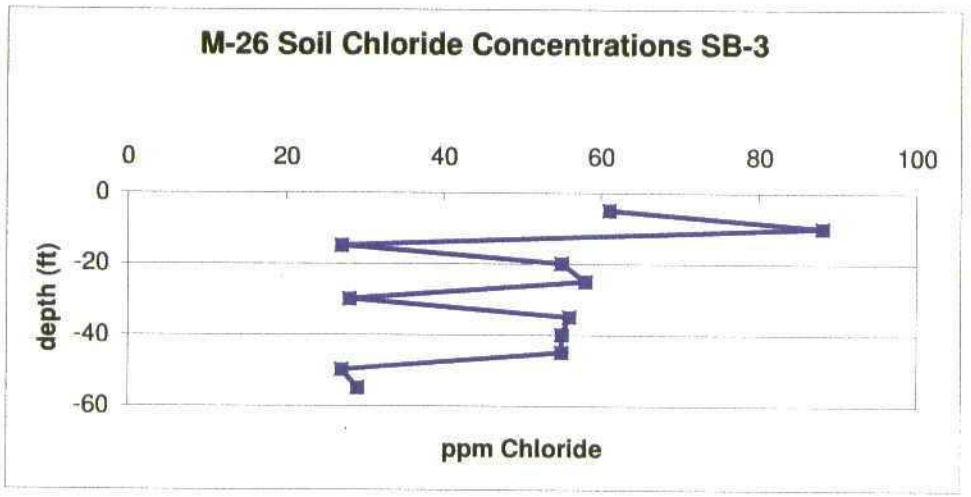


Table 3 – Soil boring log and chloride levels for SB-3.

Appendix C – Soil Chloride Model Rationale and Results

Rationale

A simple spreadsheet model (SCl-lpg) was developed to provide a means to estimate how residual soil chloride would affect groundwater chloride concentrations over time, under the conservative assumptions presented below.

The frequency of precipitation sufficient to affect significant groundwater recharge is assumed to be once every 10 years. During each recharge event (year), 50% of the residual soil chlorides are assumed to leached to the groundwater.

It is assumed that the leached chlorides are mixed only into the upper 10 feet of the underlying aquifer, (not into the entire 100 ft column of saturated thickness). Every year, it is assumed that (only) 10% of the chlorides in the saturated zone beneath area affected by the release site are removed through dilution by groundwater flow.

Other relevant parameter values used in the model:

- Aquifer porosity = 35%
- The chloride concentration of the released water is 55,000 ppm, which was representative of the value measured for a nearby Rice well (F-35).
- The estimated volume of release water is 15 bbls, per the initial incident report.
- The baseline chloride concentration of the groundwater is 50 ppm, as was recently measured in a nearby monitor well (for Rice site K-35-1).
- Note that the likely annual rate of groundwater movement is on the order of 50 ft/year, based upon hydraulic gradient and saturated hydraulic conductivity. Thus, the assumption of a 10% annual dilution rate of chlorides below the release site is conservative.

The logic (algorithm) and arithmetic of the model are simple, and the spreadsheet can be obtained at no cost from the author (L. Peter Galusky, Jr.) upon request.

Results

The model predicts that the residual soil chloride mass diminishes in a stepwise manner (indicative of the periodic "pulsed" nature of groundwater recharge) from 300 lbs to near zero within 50 years (Figure 6a).

Groundwater chloride concentration is predicted to rise from its baseline value of 50 ppm to a maximum value of approximately 120 ppm after the first recharge event (10 years). Dilution then causes a decline to approximately 80 ppm after nine years, followed by a lower "spike" to approximately 105 ppm. The predicted dilution of this and subsequently smaller "spikes" of chlorides continues through three more recharge-dilution cycles until baseline concentrations are reached at about 60 years (Figure 6b).

Appendix D - Incident Characterization Plan w/ OCD correspondence

- Incident Characterization Plan (ICP)
- C-141
- Preliminary soil chloride data
- Photographs taken during initial response
- OCD approval of ICP (e-mail)

L. Peter Galusky, Jr. Ph.D., P.G.
Consulting Hydrogeologist

December 12th, 2005

Mr. Wayne Price
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**
Vacuum M-26 Produced Water Discharge, UL C Sec 35 T17S R35E

CERTIFIED MAIL, RETURN RECEIPT 7005 0390 0002 9698 2631

Mr. Price:

RICE Operating Company (ROC) has retained L. Peter Galusky, Jr. Ph.D. to address potential environmental concerns at the above-referenced site. ROC is the service provider (operator) for the Vacuum SWD System and has no ownership of any portion of the pipeline, well, or facility. The System is owned by a consortium of oil producers, System 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

On July 1st, 2003 Rice Operating Company (ROC) discovered an accidental discharge of approximately 15 bbls of produced water at the referenced location, immediately south of CR-50 and approximately 4 ¼ miles east of Buckeye, New Mexico; (*please see Appendix A for site location map*). The produced water was released where a six-inch flow line had apparently settled and broken. This release affected approximately 225 square feet of soil material near the ground surface, based upon visual observation. The pipe was repaired at the break with a six inch clamp, and returned to service.

On August 20th, 2003 soils were excavated at the location of the break using a backhoe. Field tests were performed for chlorides (using field silver nitrate titration kits), the primary constituent of concern. The presence of hydrocarbons was also noted visually. Soils were evaluated to the practical reach of the backhoe (12 ft). Following this, the resulting pit was backfilled with the excavated soil material. In brief, chlorides exceeded 10,000 ppm to the limit of evaluation (12 ft), and there was a slight odor of hydrocarbons throughout, becoming very slight in soils taken from the bottom of the excavation. *Please see Appendix B for the correspondence record with OCD, as well as the results and photographs from the initial soils evaluation.*

The surface (ecological) impact of this release was relatively small. However, as the potential for groundwater contamination exists, this warrants further evaluation for chlorides and petroleum hydrocarbons, the constituents 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. There is no longer a threat of continued, compounded impact at this site as the source of the release has been corrected.

The release site is located immediately south of CR-50, a few hundred feet east of a large Conoco-Phillips battery. The topography is gently sloping toward the southeast, and the release site is adjacent to a southeasterly trending surface ephemeral drainageway. Soils on the site are mapped (as KO) in the Lea County Soil Survey[5] as belonging to the Kimbrough gravelly loam soil series. These are characterized by gravelly loam to a depth of approximately 6 inches, and this is underlain by several feet of calcium indurated caliche. Groundwater is estimated to occur at a depth of approximately 51 feet, occurring in unconsolidated Tertiary alluvium of the Ogallala Formation[6].

---

[5] USDA SCS. Soil Survey of Lea County, New Mexico. Issued January, 1974.

[6] New Mexico Bureau of Geology & Mineral Resources. 1982. Circular 175 – Western extent of the Ogallala Formation in New Mexico.

It should be noted that the source of this impact is historical. There is no longer a threat of continued, compounded impact at this site as the source of the release has been corrected and the Vacuum SWD System is no longer in service.

Investigation and Characterization Plan

Task 1 - Collect Regional Hydrogeologic Data

Published maps and reports of surficial geology, soils, hydrogeology and ecosystem characteristics will be reviewed and summarized to provide a context and baseline from which to evaluate the results of subsequent analysis. State and county records of water wells will be reviewed and summarized to identify downgradient receptors which could potentially be affected.

Task 2 - Evaluate Concentrations of Constituents of Concern in Soil (and Ground Water)

Soils samples will be taken from a sufficient number of selected representative locations and depths in order to quantify the areal extent and depth of contamination with respect to chlorides and hydrocarbons. Soil samples will be taken and tested for chlorides, using field titration methods, and for BTEX, using EPA-standard PID methodology. A small sub-set of samples at key locations (such as the total sampled depth, apparent "hot spots", etc.) will be sent to a commercial laboratory for verification/calibration of the field tests, according to standard EPA sampling and laboratory methods.

A limited number of monitoring wells may be constructed in selected, representative locations, generally where WQCC standards are exceeded within 10+/- feet of the water table and where the location of such wells will useful for hydrogeological analysis . All such monitoring wells will be constructed (with the annular space sealed with a cement/bentonite mix) per NM Dept. Environment standards; (see Appendix C).

Task 3 - Evaluate Risk of Groundwater Impact

The data gathered from this study will be summarized and presented in simple and clear graphs and maps. This will provide a means for an intuitive evaluation of the apparent potential for groundwater impacts. Additionally, simple spreadsheet vadose zone /or groundwater dilution models may be used as a supplemental, interpretive tool. The information thus obtained from this work will be evaluated to determine if there exists any substantial risk for groundwater impacts resulting from this release of produced water.

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 produced water leak does pose a present or future risk of impacting groundwater quality, then a *risk-based* corrective action plan (CAP) will be developed and proposed to OCD which addresses the identified risks.

I appreciate the opportunity to work with you 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.
Consulting Hydrogeologist

505 N. Big Spring, Suite 404
Midland, Texas 79701
Tel: 432-967-2128
E-mail: lpg@texerra.com
Web site: www.texerra.com

cc: CDH, KFP, file

attachments: site map, correspondence and photos as noted in the Appendix

Appendix A – Site Map

Figure 1 – Satellite photo (10,000 ft view) of M-26 ROC produced water release[7].

[7] From www.earth.google.com .

RICE Operating Company

122 West Taylor • Hobbs, New Mexico 88240
Phone: (505)393-9174 • Fax: (505) 397-1471

January 19, 2004

Paul Sheeley
NMOCD Hobbs Office
1625 N. French Drive
Hobbs, New Mexico

Re: Vacuum SWD System
ULM Sec. 35 T17S R35E
Lea County, New Mexico

C-141

Dear Mr. Paul Sheeley:

On July 1, 2003 Rice Operating Company (ROC) discovered an accidental discharge at the above referenced site. The release consisted of 15 bbls. which affected 225 square feet. ROC now wishes to notify the NMOCD of the future actions to be taken at this site.

On August 20, 2003 a vertical delineation was done with a backhoe. ROC trenched to 12' bgs sampling at every foot. At 12' bgs. a field test showed the chloride numbers remained at 12,000 ppm. The depth to groundwater is 51 feet. ROC has come to the conclusion that this site may have the potential for groundwater impact. ROC notified NMOCD Environmental Bureau Chief Roger Anderson on 1/16/04.

As for the surface. ROC feels that it will revegetate with natural attenuation. due to the small area affected.

Because this sites impact is beyond the scope of the ROC Generic Spill Work Plan. it will be prioritized and placed on the major project list for further characterization and if necessary. remediation. ROC will notify NMOCD and or submit a RBCA once the plan of action has been determined.

ROC requests approval of this C-141 as the Final Report. If you have any questions please call me at the above referenced number.

Sincerely,

Joe Gatts

Joe Gatts
Environmental Technician

Hand Delivery to OCD 1/19/04

District I
P.O. Box 1980, Hobbs, NM 88241-1980
District II
811 South First, Artesia, NM 88210
District III
1000 Rio Brazos, Aztec, NM 87410
District IV
2040 South Pacheco, Santa Fe, NM 87505

State of New Mexico
Energy, Minerals & Natural Resources Department
OIL CONSERVATION DIVISION
2040 South Pacheco
Santa Fe, NM 87505
OPERATOR'S MONTHLY REPORT

Form C-141
Originated 2/13/97

Submit 2 copies to Appropriate District Office in accordance with Rule 116 on back side of form

Release Notification and Corrective Action

OPERATOR ☐ Initial Report ☒ Final Report

Name	Contact
Rice Operating Company	Joe Gatts
Address	**Telephone No.**
122 West Taylor Hobbs, NM 88240	505-393-9174
Facility Name	**Facility Type**
Vacuum	SWD Disposal Line

Surface Owner	Mineral Owner	Lease No
State		

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South line	Feet from the	East/West Line	County
M	35	T17S	R35E					LEA

NATURE OF RELEASE

Type of Release	Volume of Release	Volume Recovered
Produced Water	15 bbls	10 bbls
Source of Release	**Date and Hour of Occurrence**	**Date and Hour of Discovery**
Pipeline	unknown	07/01/2003
Was Immediate Notice Given? ☐ Yes ☐ No ☒ Not Required	**If YES, To Whom?**	
By Whom?	**Date and Hour**	
Was a Watercourse Reached? ☐ Yes ☒ No	**If YES, Volume Impacting the Watercourse**	

If a Watercourse was Impacted, Describe Fully (Attach Additional Sheets If Necessary)

Describe Cause of Problem and Remedial Action Taken. (Attach Additional Sheets If Necessary)
Ground settled on 6" A/C pipe and pipe broke all the way around. Placed 6" clamp on pipe.

Describe Area Affected and Cleanup Action Taken. (Attach Additional Sheets If Necessary)
The released consisted of 15 bbls, which affected 225 square feet. Vertical delineation was done with a backhoe up to 12' bgs. It has been determined that the impact is out of the scope of ROC's Generic Spill and leak plan and may have the potential for groundwater impact. ROC will now prioritize and place this site the major projects list for further characterization and if necessary, remediation.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, human health or the environment. In addition, NMOCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Signature: Joe Gatts	OIL CONSERVATION DIVISION
Printed Name: Joe Gatts	Approved by District Supervisor:
Title: Environmental Technician	Approval Date: Expiration Date:
Date: 01/19/04 Phone: 505-393-9174	Conditions of Approval: Attached ☐

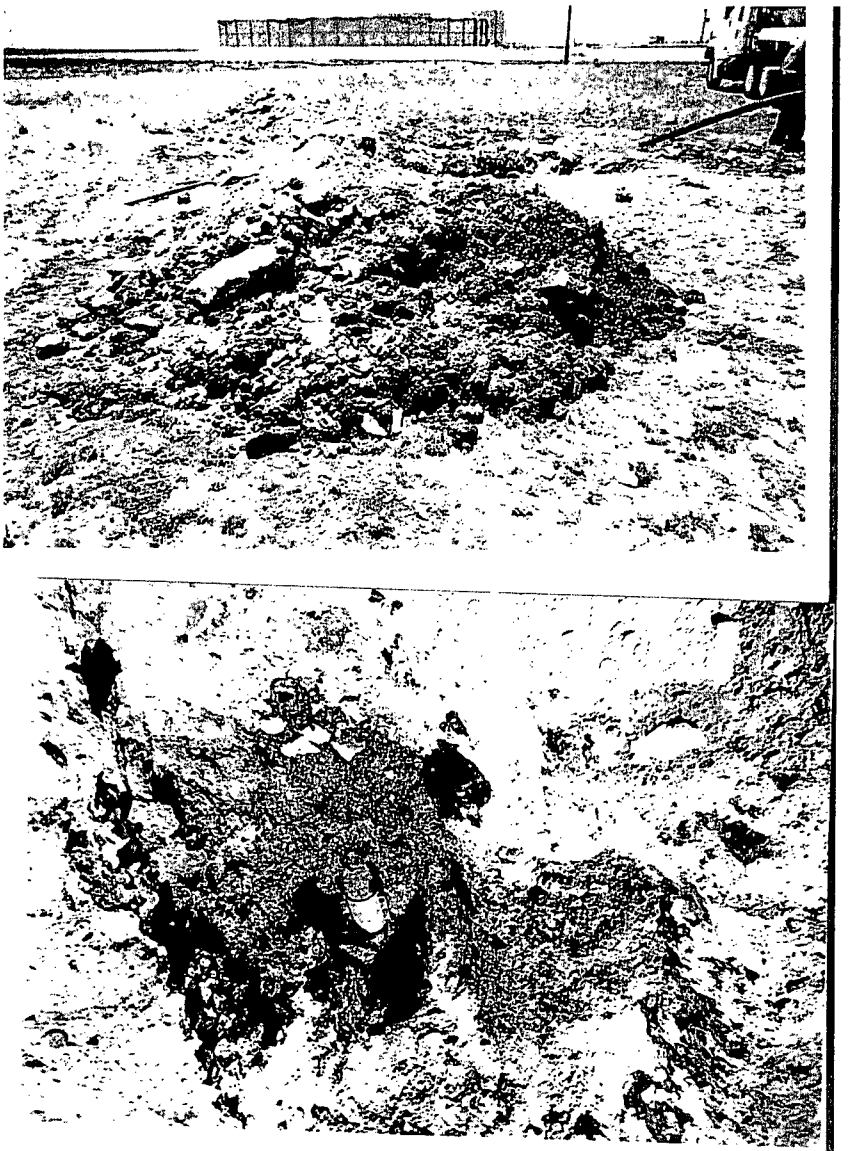
Hand Delivered to OCD 1/19/04

Vacuum M-26 leak

unit 'C', sec. 35, T17S, R37E

August 20, 2003 Backhoe Delineation with Field Tests

ft BGS	Soil Sample Lithology	Hydrocarbon Odor	[Cl-] ppm
6	dark brown caliche	slight	7243
7	light brown caliche	slight	10099
8	light brown caliche	slight	9009
9	light brown caliche	slight	12659
10	light brown caliche & sand	slight	11398
12	light brown caliche & sand	very slight	12337



Appendix C – NM Environmental Dept. Monitoring Well Standards

In order to accurately determine aquifer characteristics and obtain representative ground- water samples, it is important that monitoring wells be constructed and installed properly. In addition, the construction materials utilized should not alter the chemical composition of the groundwater in such a way as to interfere with the compounds being analyzed during assessment activities. The practices set forth in the American Society for Testing and Materials (ASTM) document D 5092-90 and in the State Engineer Office regulations should be followed, in addition to the items below (see schematic diagram below text):

- Borehole: The borehole should be drilled a minimum of 4 inches larger than the casing diameter, to allow for the emplacement of sand and sealant.

- Casing: The casing should, unless otherwise approved by the department, consist of Schedule 40 or heavier, flush mount threaded, o-ring sealed, PVC pipe of not less than two inches nominal inside diameter. Four inches nominal inside diameter may be appropriate for wells greater than or equal to 100 feet deep. No adhesive should be used to join the sections of casing.

- Screen: The screen should be of an appropriate length not to exceed 20 feet and should be machine slotted or other manufactured screen. The slot size should be appropriate for the grain size of the sand pack. No on-site or hack-saw slotting is permitted. A sediment sump should be attached to the base of the screen, with a cap at the bottom. The length of the sump may vary, depending on the nature and grain size of the formation, but should be a minimum of 2 feet in length. If the uppermost aquifer is unconfined, the top of the screen should be five feet above the water table to allow for seasonal fluctuations and to determine if NAPL is present. If the aquifer is confined, the top of the screen should be placed in such a way as to preserve the integrity of the aquifer.

- Filter pack: An annular space from 2 feet below to 2 feet above the screen should be packed with filter pack sand. The sand should be clean, silica based, and properly sized to prevent fines from entering the well. A tremmie pipe should be used for sand placement for wells greater than 50 feet deep.

- Filter pack seal: When appropriate, monitoring wells and piezometers should be constructed with a filter pack seal. The filter pack seal is to extend 1 foot above the top of the filter pack and should consist of 1 foot of clean, fine-grained silica sand.

- Bentonite seal: The annular space for at least 2 feet above the filter pack seal should be grouted or sealed with hydrated bentonite pellets, 0.25 or 0.5 inch in size as appropriate.