



October 11, 2017

#5E25852-BG3

NMOCD District II  
Mike Bratcher  
811 S. First St.  
Artesia, NM 88210

SUBJECT: SOIL REMEDIATION WORK PLAN FOR THE INCIDENT AT THE Brushy Creek Gathering Station RELEASE, EDDY COUNTY, NEW MEXICO

Dear Mr. Bratcher,

On behalf of WPX Energy, Souder, Miller & Associates (SMA) has prepared this WORK PLAN that describes the assessment, initial delineation and proposed remediation for releases associated with the Brushy Creek Gathering Station releases. The site is in UNIT M, SECTION 25, TOWNSHIP 26S, RANGE 29E, NMPM, Eddy County, New Mexico, on Bureau of Land Management land. Figure 1 illustrates the vicinity and location of the site.

Table 1, below, summarizes information regarding the release.

Table 1: Release information and Site Ranking	
Name	Brushy Creek Gathering Station
Company	WPX Energy
RP Number	2RP-3811, 2RP-2742, 2RP-2796, 2RP-3195
API Number	30-015-24451
Location	32.005758° -103.944660°
Estimated Date of Release	Various
Date Reported to NMOCD	Various
Land Owner	Federal
Reported To	Mike Bratcher
Source of Release	See Attached C-141
Released Material	See Attached C-141
Released Volume	See Attached C-141
Recovered Volume	See Attached C-141
Net Release	See Attached C-141
Nearest Waterway	0.9 Miles from Red Bluff Lake
Depth to Groundwater	Estimated to be less than 100'
Nearest Domestic Water Source	Greater than 1,000 feet
NMOCD Ranking	10

## **1.0 Background**

This location currently has four open Remediation Permits for the location including: 2RP-3811, 2RP-2742, 2RP-2796, 2RP-3195. Equipment failures and human error have been the reasoning for the releases on the location. The impacted area is approximately 200 feet long by 100 feet wide. Release area is shown in Figure 2 and in Figure 3.

## **2.0 Site Ranking and Land Jurisdiction**

The release site is located approximately 0.9 miles north of the Red Bluff Lake, with an elevation of approximately 2,882 feet above sea level. SMA searched the New Mexico State Engineer's Office (NMOSE) online water well database for water wells in the vicinity of the release. Three wells are located within a three-mile radius of the site. Using a boring 0.4 miles southeast of location, drilled by SMA on September 13, 2017 no water was found at 70' bgs. After evaluation of the site using aerial photography and topographic maps, depth to groundwater is estimated to be less than 100 feet below ground surface (bgs).

Recommended Remediation Action Levels (RRALs) are determined by the site ranking according to the NMOCD *Guidelines for Remediation of Leaks, Spills, and Releases* (1993). Below in Table 2 are the remediation standards and the site ranking for this location. Justification for this site ranking is found in Figure 1 and Appendix B.

Table 2.

<b>Soil Remediation Standards</b>	<b>0 to 9</b>	<b>10 to 19</b>	<b>&gt;19</b>
<b>Benzene</b>	<b>10 PPM</b>	<b>10 PPM</b>	<b>10 PPM</b>
<b>BTEX</b>	<b>50 PPM</b>	<b>50 PPM</b>	<b>50 PPM</b>
<b>TPH</b>	<b>5000 PPM</b>	<b>1000 PPM</b>	<b>100 PPM</b>

<b>Depth to Groundwater</b>	<b>NMOCD Numeric Rank</b>
< 50 BGS = 20	
50' to 99' = 10	10
>100' = 0	
<b>Distance to Nearest Surface Water</b>	<b>NMOCD Numeric Rank</b>
< 200' = 20	
200' - 1000' = 10	
>1000' = 0	0
<b>Well Head Protection</b>	<b>NMOCD Numeric Rank</b>
<1000' (or <200' domestic) = 20	
> 1000' = 0	0
<b>Total Site Ranking</b>	<b>0</b>

## **3.0 Release Characterization**

On September 4, November 14, 2016, January 24 and 26, 2017 WPX staff collected samples and Vertex conducted a Geophysical Survey of the Area refer to APPENDIX C for further information

concerning the release data. The surface impact is estimated to be 2,115 square yards. This area encompasses the Brushy Creek Gathering Station with associated tank battery, equipment and buried lines. In Appendix D a model was used to determine the risk to groundwater.

#### **4.0 Soil Remediation Workplan**

SMA will oversee licensed driller to conduct a soil boring to delineate affected soils. After approval from area utilities owners via 811 and NMOCD. SMA will continuously guide the boring activities with a by collecting composite soil samples and logging geology downhole for field screening with a mobile titration unit (EPA 4500). The samples will be sent under chain-of-custody protocols to Hall Environmental Analysis Laboratory for analyses including chlorides by Method 300.0, volatile organics (BTEX) by Method 8021B, and MRO, DRO, and GRO by EPA Method 8015D.

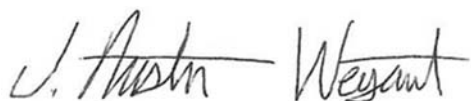
After delineation samples are submitted requested for deferment is being asked for this location. This area cannot be excavated due to the proximity of the operational equipment and un located buried pipelines.

#### **5.0 Scope and Limitations**

The scope of our services consisted of the performance of assessment sampling, verification of release stabilization, regulatory liaison, and preparation of this work plan. All work has been performed in accordance with generally accepted professional environmental consulting practices for oil and gas releases in the Permian Basin in New Mexico.

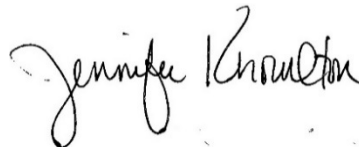
If there are any questions regarding this report, please contact either Austin Weyant at 575-689-8801 or Shawna Chubbuck at 505-325-7535.

Submitted by:  
SOUDER, MILLER & ASSOCIATES



Austin Weyant  
Project Scientist

Reviewed by:



Jennifer Knowlton, PE  
Senior Engineer II

**ATTACHMENTS:**

**Figures:**

Figure 1: Vicinity and Well Head Protection Map

Figure 2: Site and Sample Location Map

**Tables:**

Table 3: Summary of Sample Results

**Appendices:**

Appendix A: Form C141 Initial and Final

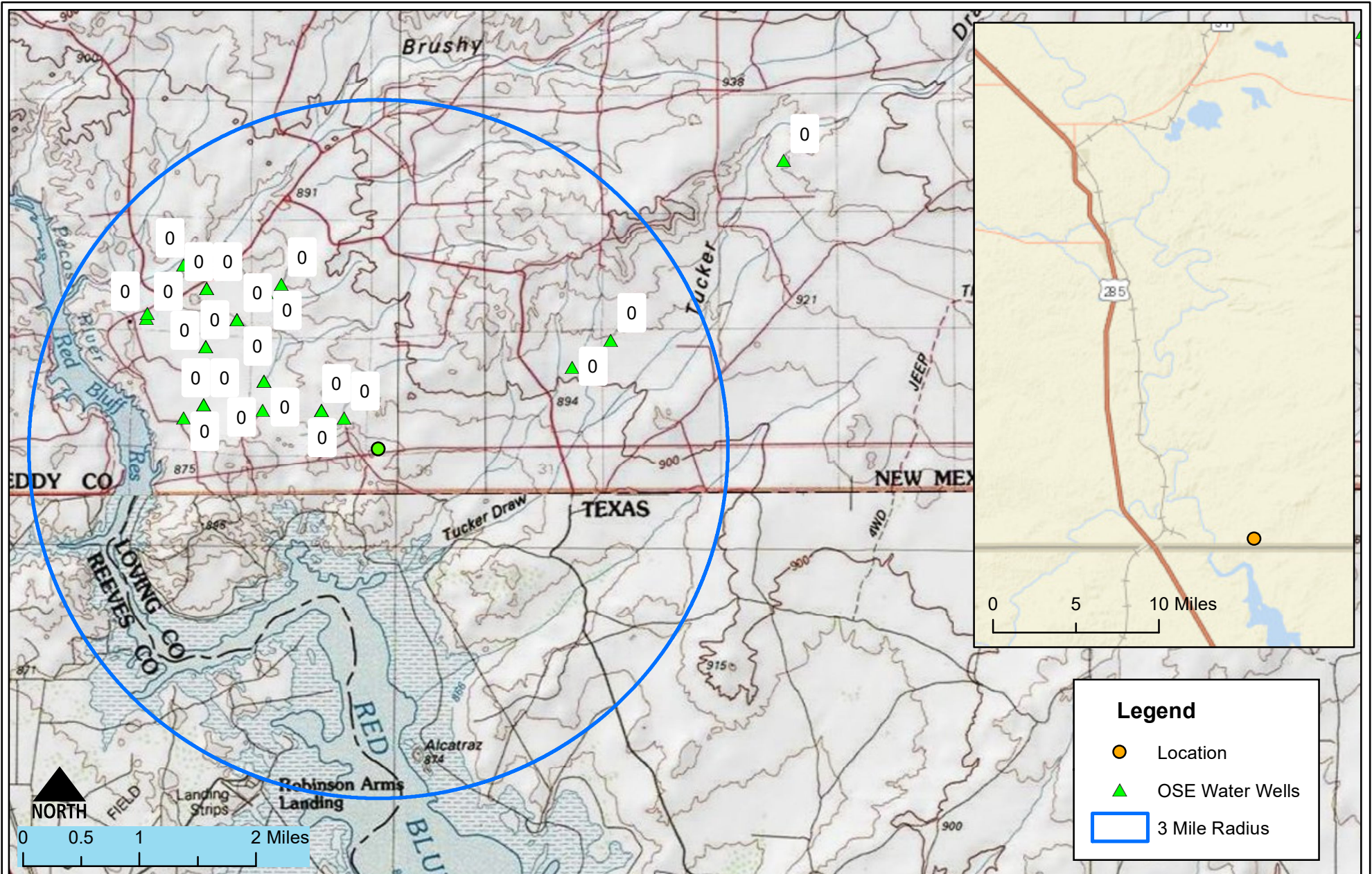
Appendix B: NMOSE Wells Report

Appendix C: Laboratory Analytical Reports

Appendix D: Groundwater Impact Risk Model

FIGURE 1  
VICINITY AND NMOSE  
DATA MAP





Vicinity and Well Head Protection Map  
Brushy Creek Gathering Station - RKI EXPLORATION & PRODUCTION, LLC  
S:22 T26S R25E, New Mexico

Figure 1

Date Saved:  
10/3/2017

By: _____	Date: _____	Revisions	Descr: _____
By: _____	Date: _____		Descr: _____
Copyright 2015 Souder, Miller & Associates - All Rights Reserved			

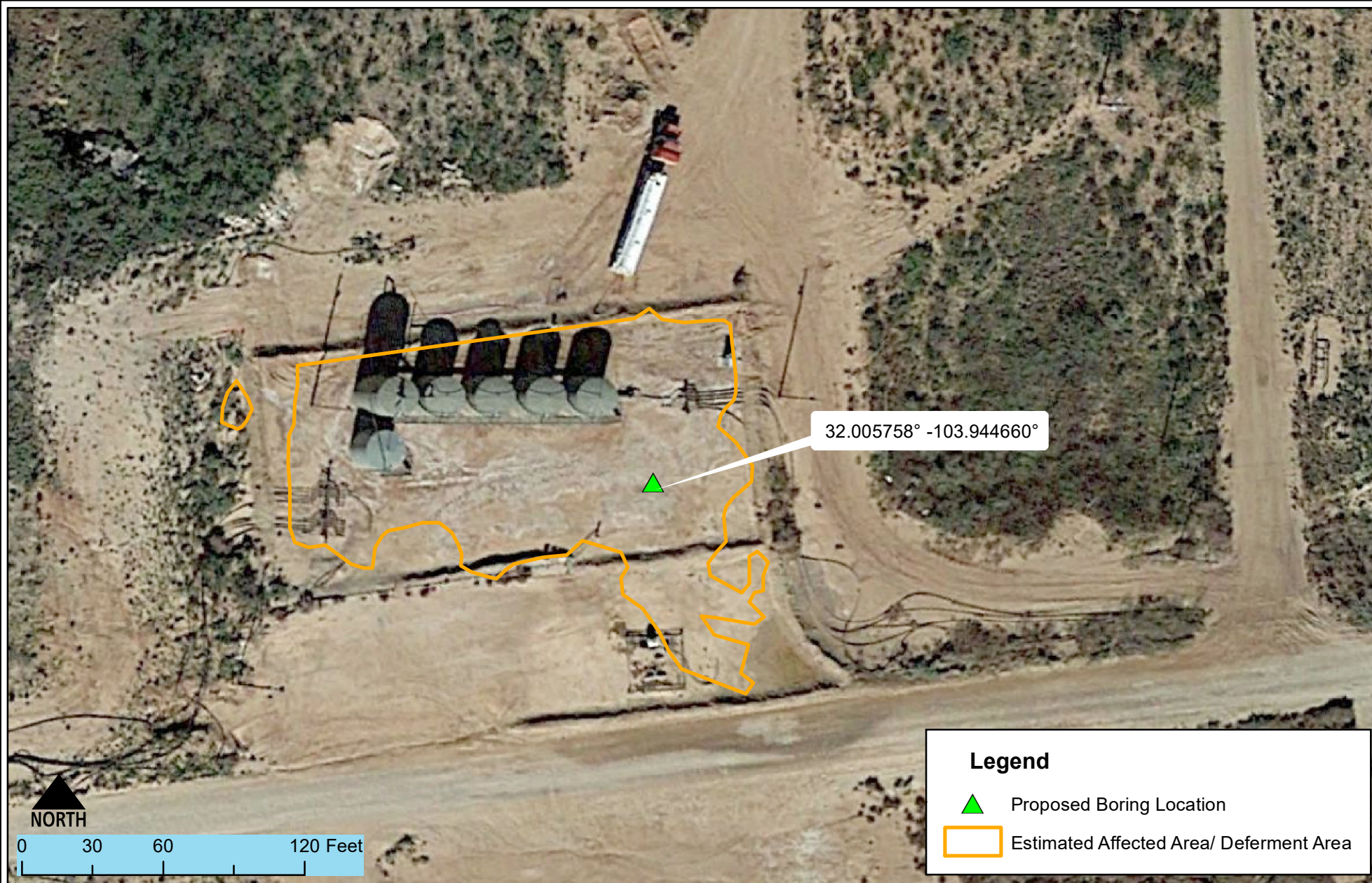
Drawn	Lucas Middleton
Checked	_____
Approved	_____



201 South Halaguena Street  
Carlsbad, New Mexico 88221  
(575) 689-7040  
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FIGURE 2  
LOCATION MAP





LOCATION MAP  
Brushy Creek Gathering Station  
S:25 T26S R29E, New Mexico

Figure 2

Date Saved:  
10/4/2017

By: _____	Date: _____	Revisions	Descr: _____
By: _____	Date: _____		Descr: _____

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Drawn	<u>Lucas Middleton</u>
Checked	_____
Approved	_____



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APPENDIX A  
FORM C141 INITIALS

District I  
1625 N. French Dr., Hobbs, NM 88240  
District II  
811 S. First St., Artesia, NM 88210  
District III  
1000 Rio Brazos Road, Aztec, NM 87410  
District IV  
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico  
Energy Minerals and Natural Resources  
Oil Conservation Division  
1220 South St. Francis Dr.  
Santa Fe, NM 87505

**NM OIL CONSERVATION**

ARTESIA DISTRICT

Form C-141  
Revised August 8, 2011

**JUL 28 2016**

Submit 1 Copy to appropriate District Office in  
accordance with 19.15.29 NMAC.

**RECEIVED**

**Release Notification and Corrective Action**

**nAB1621453181**

**OPERATOR**

☒ Initial Report ☐ Final Report

Name of Company	WPX Energy Inc/RKI	Contact	Karolina Blaney
Address	5315 Buena Vista Dr.	Telephone No.	970 589 0743
Facility Name: Brushy Draw Booster Station/Fed UCBHWW 1		Facility Type: Tank Farm	

Surface Owner: Federal	Mineral Owner: Federal	API No. 30-015-24034
------------------------	------------------------	----------------------

**LOCATION OF RELEASE**

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
M	25	26S	29E	660	FSL	660	FWL	Eddy

**Latitude: 32.005742 N Longitude: -103.944433 W**

**NATURE OF RELEASE**

Type of Release: Produced Water	Volume of Release: 380 Bbls	Volume Recovered: 340 Bbls
Source of Release Pipeline valve located in a valve can	Date and Hour of Occurrence 7/13/2016	Date and Hour of Discovery 7/13/2016 - 2345 hrs MT
Was Immediate Notice Given? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Required	If YES, To Whom? NMOCD Heather Patterson & Michael Bratcher, BLM Shelly Tucker	
By Whom? Karolina Blaney	Date and Hour: 7/14/16- 1645 hrs MT	
Was a Watercourse Reached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.\* N/A

Describe Cause of Problem and Remedial Action Taken.\*

The cause of the spill is equipment failure; a poly line running from the tank farm to an injection well ruptured. The compromised section of the line is located outside the SPCC containment but there was enough pressure in the line to spray it into the containment. The vast majority of spilled water was contained inside the dirt containment berm, approximately 5 bbls of produced water was sprayed outside the containment on the access road.

Describe Area Affected and Cleanup Action Taken.\*

The impacted area of the access road was scraped and impacted dirt was hauled off to a disposal facility. The access road will be sampled for BTEX and TPH in accordance with NM OCD Guidelines for Remediation of Leaks, Spills, and Releases. The impacted area will also be sampled for chlorides as required by BLM. Further remediation will be based on these results. The total ranking score for this site is 0 and the site will be remediated to levels specified in 0-9 column of the Guidelines document. This spill did impact any undisturbed land/pastures.

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, surface 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: <i>Karolina Blaney</i>	<b>OIL CONSERVATION DIVISION</b>	
Printed Name: Karolina Blaney	Signed By: <i>[Signature]</i> Approved by Environmental Specialist	
Title: Environmental Specialist	Approval Date: <i>7/28/16</i>	Expiration Date: <i>N/A</i>
E-mail Address: Karolina.blaney@wpenergy.com	Conditions of Approval: <b>Remediation per O.C.D. Rules &amp; Guidelines</b> <b>SUBMIT REMEDIATION PROPOSAL NO</b>	
Date: 7/28/2016 Phone: 970-589-0743	Attached <input type="checkbox"/> <b>LATER THAN: <i>7/28/16</i></b>	

\* Attach Additional Sheets If Necessary

*2RP-3811*

**Bratcher, Mike, EMNRD**

---

**From:** Blaney, Karolina <Karolina.Blaney@wpxenergy.com>  
**Sent:** Thursday, July 28, 2016 6:47 AM  
**To:** Tucker, Shelly; Patterson, Heather, EMNRD; Bratcher, Mike, EMNRD  
**Subject:** RE: WPX - Brushy Draw Tank Farm - C 141  
**Attachments:** Brushy Draw Booster Station - Initial C-141.doc

Good morning,  
Attached is the initial C-141 for the Brushy Draw Booster Station.  
Please let me know if you have any comments or concerns.  
Thank you and have a great day,

*Karolina Blaney*  
Environmental Specialist  
WPX Energy  
Office: (575) 885-7514  
Cell: (970) 589-0743  
[karolina.blaney@wpxenergy.com](mailto:karolina.blaney@wpxenergy.com)

---

**From:** Blaney, Karolina  
**Sent:** Thursday, July 14, 2016 4:48 PM  
**To:** 'Tucker, Shelly' <tucker@blm.gov>; 'heather.patterson@state.nm.us' <heather.patterson@state.nm.us>; 'mike.bratcher@state.nm.us' <mike.bratcher@state.nm.us>  
**Subject:** WPX - Brushy Draw Tank Farm - spill notification

Good afternoon,  
WPX had a produced water spill last night at the Brushy Draw Tank Farm. The Tank Farm is located south of the FED USBH 1 well, API # 30-015-24034. The legal description is S25, T26S, R29E. Coordinates: 32.0056803, -103.9439288. The cause of the spill is equipment failure; a poly line running from the tank farm to an injection well ruptured. The compromised section of the line is located outside the SPCC containment but there was enough pressure in the line to spray it into the containment. The vast majority of spilled water was contained inside the dirt containment berm, approximately 5 bbls of produced water was sprayed outside the containment on the access road. The total volume spilled and recovered is unknown as we are adding up the hauling tickets but it is expected to be more than 100 bbls. I will be submitting the C-141 and NTL-3A (if preferred) in the next 15 days. However, please don't hesitate to call if you have any questions, comments, or concerns.  
Thank you and have a great afternoon,

*Karolina Blaney*  
Environmental Specialist  
WPX Energy  
Office: (575) 885-7514  
Cell: (970) 589-0743  
[karolina.blaney@wpxenergy.com](mailto:karolina.blaney@wpxenergy.com)

District I  
1625 N. French Dr., Hobbs, NM 88240  
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811 S. First St., Artesia, NM 88210  
District III  
1000 Rio Brazos Road, Aztec, NM 87410  
District IV  
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico  
Energy Minerals and Natural Resources

Form C-141  
Revised August 8, 2011

Oil Conservation Division  
1220 South St. Francis Dr.  
Santa Fe, NM 87505

Submit 1 Copy to appropriate District Office in  
accordance with 19.15.29 NMAC.

Release Notification and Corrective Action

**nAB 1504054780**

<b>OPERATOR</b>		<input checked="" type="checkbox"/> Initial Report	<input type="checkbox"/> Final Report
Name of Company	RKIE&P, LLC	Contact	Taylor Jones
Address	210 Park Ave. - Ste. 900, OKC, OK 73102	Telephone No.	405-996-5782
Facility Name:	Brushy Creek Gathering Station	Facility Type :	Tank Battery
Surface Owner	Federal	Mineral Owner	NA
		API No.	30-015-24451

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
A	25	26S	29E		660 FSL		1980FWL	Eddy

Latitude: 32.007240348386 Longitude: -103.940095327473

NATURE OF RELEASE

Type of Release. Produced Water/Oil	Volume of Release: 1oil/10water Bbbs	Volume Recovered: 0oil/10water Bbbs
Source of Release Tanks overran	Date and Hour of Occurrence 01/22/15 - prior to 0800hrs MT	Date and Hour of Discovery 01/22/15 - 0800hrs MT
Was Immediate Notice Given? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Required	If YES, To Whom? N/A	
By Whom? N/A	Date and Hour N/A	
Was a Watercourse Reached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.\* N/A

**NM OIL CONSERVATION**  
ARTESIA DISTRICT

Describe Cause of Problem and Remedial Action Taken.\*

FEB 05 2015

More water was put into system and trucking company failed to haul sufficient loads away.

RECEIVED

Shut in wells and let station pump down. Had vac truck within 1 hour to suck up water out of containment.

Describe Area Affected and Cleanup Action Taken.\*

All fluid remained in secondary containment berm, 10/11Bbbs spilled were recovered.

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, surface 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: <i>Taylor Jones</i>		<b>OIL CONSERVATION DIVISION</b>	
Printed Name: Taylor Jones		Approved by Environmental Specialist: <i>[Signature]</i>	
Title: EHS Systems Specialist		Approval Date: 2/9/15	Expiration Date:
E-mail Address: TJones@rkixp.com		Conditions of Approval:	
Date: 02/05/15 Phone: 405-996-5782		Attached <input type="checkbox"/>	

Remediation per O.C.D. Rules & Guidelines  
SUBMIT REMEDIATION PROPOSAL NO  
LATER THAN: 3/9/15

\* Attach Additional Sheets If Necessary

2RP-2796



## **Patterson, Heather, EMNRD**

---

**From:** Taylor Jones <TJones@rkixp.com>  
**Sent:** Thursday, February 05, 2015 2:44 PM  
**To:** 'Heather.Patterson@state.nm.us'  
**Cc:** shughes@blm.gov; Zackary Laird  
**Subject:** RKI E&P Spill Notification and C-141  
**Attachments:** NM\_BrushyCreekGatheringStation\_InitialC141(020515)-signed.pdf

Heather,

Attached please find completed OCD form C-141 for a spill occurring at the RKI operated Brushy Creek Gathering Station in Eddy County, NM. Please feel free to contact myself or a local RKI representative with any questions.

Thank you,

Taylor Jones

**RKI Exploration & Production, LLC**

210 Park Avenue, Suite 900

Oklahoma City, OK 73102

405-996-5782 (o) | 405.326.0791 (m)

[TJones@RKIXP.com](mailto:TJones@RKIXP.com)

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District II  
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District III  
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State of New Mexico  
Energy Minerals and Natural Resources  
Oil Conservation Division  
1220 South St. Francis Dr.  
Santa Fe, NM 87505

NM OIL CONSERVATION

ARTESIA DISTRICT

JAN 16 2015

Submit 1 Copy to appropriate District Office in accordance with 19.15.29 NMAC.

RECEIVED

Form C-141  
Revised August 8, 2011

Release Notification and Corrective Action

NAB1501655607

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company	RKI E&P, LLC	Contact	Zack Laird
Address	210 Park Ave. - Ste. 900, OKC, OK 73102	Telephone No.	405-742-2696
Facility Name:	Brushy Creek Gathering Station	Facility Type :	Tank Battery

Surface Owner	Federal	Mineral Owner	NA	API No.	30-015-24451
---------------	---------	---------------	----	---------	--------------

LOCATION OF RELEASE

(UCBH WW Fed. #3)

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
A	25	26S	29E		660 FSL		1980FWL	Eddy

Latitude: 32.007240348386 Longitude: -103.940095327473

NATURE OF RELEASE

Type of Release. Produced Water/Oil	Volume of Release: 10oil/40water Bbls	Volume Recovered: 8oil/35water Bbls
Source of Release Tanks overran due to pump salt-off	Date and Hour of Occurrence 01/07/15 - prior to 0800hrs MT	Date and Hour of Discovery 01/07/15 - 0800hrs MT
Was Immediate Notice Given? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Not Required	If YES, To Whom? N/A	
By Whom? N/A	Date and Hour N/A	
Was a Watercourse Reached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.\* N/A

Describe Cause of Problem and Remedial Action Taken.\*

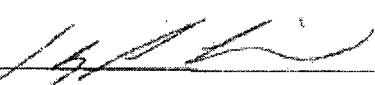
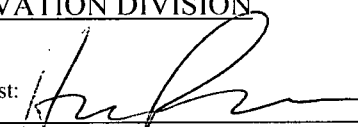
The transfer pump, which moves fluids from gathering battery to SWD well, salted off and tanks ran over. All fluids contained in secondary containment berm.

Wells producing to gathering battery were shut-in, vac trucks recovered free fluid and pump repairs were made. Plan to install high-level alarms/shutdowns on battery.

Describe Area Affected and Cleanup Action Taken.\*

All fluid remained in secondary containment berm, 43/50Bbls spilled were recovered.

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, surface 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: 		OIL CONSERVATION DIVISION	
Printed Name: Zack Laird		Approved by Environmental Specialist: 	
Title: Sr. EHS Manager		Approval Date: 1/16/15	Expiration Date: NA
E-mail Address: ZLaird@rkixp.com		Conditions of Approval:	
Date: 01/15/15 Phone: 405-987-2213		Remediation per O.C.D. Rules & Guidelines SUBMIT REMEDIATION PROPOSAL NO	
		Attached <input type="checkbox"/>	

\* Attach Additional Sheets If Necessary

ATER THAN: 2/16/15

2RP-2742

## **Patterson, Heather, EMNRD**

---

**From:** Zackary Laird <ZLaird@rkixp.com>  
**Sent:** Friday, January 16, 2015 9:05 AM  
**To:** Patterson, Heather, EMNRD  
**Cc:** Hughes, Solomon  
**Subject:** RKI E&P Spill Notification and C-141  
**Attachments:** NM\_BrushyCreekGatheringStation\_InitialC141(011515).pdf

Heather,

Attached please find completed OCD form C-141 for a spill occurring at the RKI operated Brushy Creek Gathering Station in Eddy County, NM. I used the legals for the RKI operated UCBH WW Federal 003 (API # 30-015-24451) as it is on the same pad as the gathering battery. I apologize for the delayed report.

Please feel free to contact myself or a local RKI representative with any questions.

Kind Regards,

Zack Laird | Sr. EHS Manager

**RKI Exploration & Production, LLC**

210 Park Avenue, Suite 900 | Oklahoma City, OK 73102

405.987.2213 (o) | 405.742.2696 (m) | [ZLaird@rkixp.com](mailto:ZLaird@rkixp.com)

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District II  
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1000 Rio Brazos Road, Aztec, NM 87410  
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1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico  
Energy Minerals and Natural Resources  
Oil Conservation Division  
1220 South St. Francis Dr.  
Santa Fe, NM 87505

Form C-141  
Revised August 8, 2011

Submit 1 Copy to appropriate District Office in  
accordance with 19.15.29 NMAC.

**Release Notification and Corrective Action**

**NAB1522341042** **OPERATOR** ☒ Initial Report ☐ Final Report

Name of Company	RKI E&P, LLC <b>246289</b>	Contact	Zack Laird
Address	210 Park Ave. - Ste. 900, OKC, OK 73102	Telephone No.	405-987-2213
Facility Name:	Brushy Creek Gathering Station	Facility Type :	Tank Battery

Surface Owner	Federal	Mineral Owner	NA	API No.	30-015-24451
---------------	---------	---------------	----	---------	--------------

**LOCATION OF RELEASE**

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
M	25	26S	29E		660 FSL		660FWL	Eddy

Latitude: 32.0070152 Longitude: -103.9444

**NATURE OF RELEASE**

Type of Release: Produced Water	Volume of Release: 200 Bbls	Volume Recovered: 185 Bbls
Source of Release: Tanks overran	Date and Hour of Occurrence 08/10/15 - prior to 0800hrs MT	Date and Hour of Discovery 08/10/15 - 0800hrs MT
Was Immediate Notice Given? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not Required	If YES, To Whom? Heather Patterson and Shelly Tucker (BLM)	
By Whom? Zack Laird	Date and Hour 08/10/15 - 12p CT	
Was a Watercourse Reached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If YES, Volume Impacting the Watercourse. N/A	
If a Watercourse was Impacted, Describe Fully.* N/A		

Describe Cause of Problem and Remedial Action Taken.\*

Water pump tripped and tanks ran over. Alarm was not sent due to faulty modem.

Pump reset and vac trucks dispatched to recover free fluids.

Describe Area Affected and Cleanup Action Taken.\*

All fluid remained in secondary containment, 185/200Bbls recovered


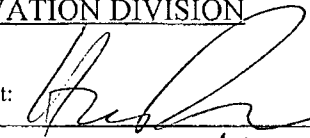
**NM OIL CONSERVATION**

ARTESIA DISTRICT

**AUG 10 2015**

**RECEIVED**

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, surface 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: 	<b>OIL CONSERVATION DIVISION</b>	
Printed Name: Zack Laird	Approved by Environmental Specialist: 	
Title: Sr. EHS Manager	Approval Date: <b>8/10/15</b>	Expiration Date: <b>N/A</b>
E-mail Address: Zlaird@rkixp.com	Conditions of Approval:	Attached <input type="checkbox"/>
Date: 08/10/15 Phone: 405-987-2213	<b>Remediation per O.C.D. Rules &amp; Guidelines</b>	

\* Attach Additional Sheets If Necessary

**SUBMIT REMEDIATION PROPOSAL NO  
LATER THAN: 9/11/16**

**2 RP-3195**



**Patterson, Heather, EMNRD**

---

**From:** Zackary Laird <ZLaird@rkixp.com>  
**Sent:** Monday, August 10, 2015 11:07 AM  
**To:** Patterson, Heather, EMNRD  
**Cc:** stucker@blm.gov  
**Subject:** RKI E&P Spill Notification and C-141  
**Attachments:** RKI\_BrushyCreekGatheringStation\_InitialC141(081015).pdf

Heather,

Per our discussion, please see attached OCD form C-141 for a spill occurring at the RKI operated Brushy Creek Gathering Station in Eddy County, NM (API # 30-015-24451).

Please let me know if you have any questions

Regards,

Zack Laird | Sr. EHS Manager  
**RKI Exploration & Production, LLC**  
210 Park Avenue, Suite 900 | Oklahoma City, OK 73102  
405.987.2213 (o) | 405.742.2696 (m) | [ZLaird@rkixp.com](mailto:ZLaird@rkixp.com)

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# APPENDIX B

## NMOSE WELLS REPORT



# New Mexico Office of the State Engineer

## Water Column/Average Depth to Water

(A CLW##### in the  
POD suffix indicates the  
POD has been replaced  
& no longer serves a  
water right file.)

(R=POD has  
been replaced,  
O=orphaned,  
C=the file is  
closed)

(quarters are 1=NW 2=NE 3=SW 4=SE)

(quarters are smallest to largest)

(NAD83 UTM in meters)

(In feet)

POD Number	POD Sub-Code	basin	County	Q 64	Q 16	Q 4	Sec	Tws	Rng	X	Y	Distance	Depth Well	Depth Water	Water Column
<a href="#">C 02038</a>	C	ED		3	2	4	26	26S	29E	599204	3541992*	642	200		
<a href="#">C 01354 X-3</a>	C	ED		2	1	3	23	26S	29E	598323	3543837	2649	170		
<a href="#">C 03605 POD1</a>	CUB	ED		4	2	3	27	26S	29E	596990	3541983	2724	45	0	45

Average Depth to Water: **0 feet**

Minimum Depth: **0 feet**

Maximum Depth: **0 feet**

Record Count: 3

### UTMNAD83 Radius Search (in meters):

**Easting (X):** 599681.3

**Northing (Y):** 3541562.19

**Radius:** 5000

\*UTM location was derived from PLSS - see Help

The data is furnished by the NMOSE/ISC and is accepted by the recipient with the expressed understanding that the OSE/ISC make no warranties, expressed or implied, concerning the accuracy, completeness, reliability, usability, or suitability for any particular purpose of the data.

## APPENDIX C

# REPORTS GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION FOR BRUSHY BOOSTER STATION





March 3, 2017

WPX Energy  
5315 Buena Vista Drive  
Carlsbad, New Mexico 88220

Attention: Karolina Blaney

Re: Geophysical Survey Results and Interpretation for Brushy Booster Station

Ms. Blaney,

WPX Energy (WPX) retained Vertex Resource Services Inc. (Vertex) to conduct electromagnetic (EM) and electrical resistivity tomography (ERT) surveys over a produced water release at the Brushy Booster Station (hereafter referred to as "site"). The site is located along State Line Road near Brushy Draw in New Mexico. Vertex personnel conducted the EM and ERT surveys on January 24 and 26, 2017. This letter reviews the results of the geophysical surveys at the site and discusses the possible origins of any anomalous subsurface electrical conductivity (EC) as it relates to chloride concentrations.

The origin of any geophysical anomaly is usually a combination of several factors. A discussion of factors affecting subsurface EC, such as soil saturation, salinity, soil type, etc., is included in Attachment 1. In an arid environment with alluvium cover, soil saturation and salinity will likely determine EC. A produced water spill will elevate both soil saturation and salinity above background conditions and ultimately increase subsurface EC above background as well. EM and ERT surveys measure subsurface EC and will be used to delineate the aerial and depth extent of elevated subsurface EC. Furthermore, the chloride concentrations from several soil samples were obtained to link chloride concentration to EC measured during the geophysical surveys.

## Background

Based on observations made while performing the EM survey, the site is set between two small washes. Surface water flows to the south, and there is an exposed bedrock outcrop northwest of the site. The rock has large fractures that appear to have been opened up by erosion and dissolution. The soil and subsoil is alluvium which, at this site, is composed mostly of sand with small amounts of silt and clay. Salt residue is visible on-site and across State Line Road. The origin of the salt crystals further south is less understood because the area was not identified during the initial spill response and assessment (see the release area in Figure 1 of Attachment 2).

WPX mentioned that caliche (a hardened soil layer cemented together with carbonates) maybe present and is thought to act as an impervious layer that will impede vertical seepage of chlorides. While caliche was not observed outcropping on-site nor was it present in the soil samples acquired on-site, caliche was found in several soil borings 1 mi. southeast of the site in Texas (Texas Water Development Board, 2014). The ERT cross section can be interpreted to show whether the caliche layer prevents migration of produced water impacts at depth.

## Electromagnetic Survey

The subsurface conductivity measured with the EM31 instrument is presented on Figure 1 (Attachment 2). In general, EC is elevated throughout the release area; one area of elevated EC (orange/red area) was identified:

1. Anomaly 1 – Main area of elevated EC correlates with the location of the surface within the bermed area. Elevated EC is contained onsite north of State Line Road. Less elevated EC is observed to extend south of State Line Road following the natural drainage direction. The depth of the measured EC within the anomaly ranges from 4 to 10 feet below ground surface (ft. bgs)

## Electrical Resistivity Tomography Survey

An ERT survey was proposed to determine the depth to which produced water has impacted the subsurface. The subsurface conductivity measured with the ERT system is presented as a cross section. Cross section A-A' is presented on Figure 2 (Attachment 2). The horizontal axis is the linear distance along the cross section line from A to A' measured in linear feet along line (ft. al). The vertical axis is relative elevation in ft. and is exaggerated by a factor of three over the horizontal axis to clearly show subsurface variations in EC.

1. Cross section A-A' – The first layer of elevated EC is discontinuous and extends from 98 to 220 ft. al (light blue, yellow to red shaded area). This layer is approximately 6 ft. bgs. There is a deeper zone of elevated EC that extends from 75 to 220 ft. al and from -10 ft. to -35 ft. in elevation. This layer correlates laterally with the EM anomaly observed (transition from red to orange shading). The deeper layer is thinner on the edges than in the middle and has a similar shape to the cross section of a creek channel. Elevated EC is not observed below 35 ft. bgs, suggesting that there is an impervious layer such as bedrock that the higher conductivity sediments are resting on top of. Three areas with extremely elevated EC, at 39, 56 and 172 ft. al, are likely due to a grounded metal object and/or subsurface utilities nearby. Metal interferes with the electrical current flow and can cause false anomalies to occur.

## Soil Sample Analysis

Two testholes were advanced with a hand auger and soil samples from 6 ft. bgs were submitted to Cardinal Laboratories in Hobbs, New Mexico. The soil samples were analyzed for texture, EC and chloride concentration. The soil samples were ordered to show a correlation between the geophysical results (EC) and chloride concentration, which is diagnostic of impacts from a produced water release. The soil sample analysis is presented in Attachment 3 and laboratory results are presented Attachment 4 (TH17-01 is Brushy Booster North and TH17-02 is Brushy Booster South). The table and graphs in Attachment 3 show that there is a positive correlation between EC measured by laboratory, EC from EM and ERT surveys, and chloride concentration.

## Correlation between Electrical Conductivity and Chloride Concentration

Previous soil sampling completed by WPX shows a correlation between EC and chloride concentration. The correlation is not linear in nature. Elevated chloride concentration increases the EC measured by the EM and ERT surveys from background to elevated levels over short distances. Two examples of this non-linear relationship are shown in the sharp boundaries between background and elevated EC in the ERT cross section (Figure 2) and the

quick transition from background to elevated EC in the EM survey (Figure 1) at the margins of Anomaly 1. To quantify the relationship, Attachment 3 presents a table with chloride concentration and EC for all soil samples on-site. Attachment 3 also presents two graphs detailing the non-linear relationship between chloride concentration and the EC measured in both the ERT and EM surveys. Since there were three measurements for each WPX sample location, the average and maximum chloride concentrations were compared to estimate the EC at different chloride concentrations. Both graphs show that EC at low chloride concentration is at or near background levels, and then with increasing chloride concentration, EC rises quickly to the maximum level and remains at this level with ever increasing chloride concentration.

At this site, The New Mexico Oil Conservation Division (NMOCD) has set the preferred cleanup concentration for chlorides to be 1,000 mg/kg (personal communication, Karolina Blaney, 2016), corresponding to EC values of 106 mS/m (transition from light green to yellow shading in Figure 1) for the EM Survey and 208 mS/m for the ERT survey (transition from dark blue to light blue shading in Figure 2). There is some discrepancy between the length of the elevated EC along A-A' and where the 106 mS/m contour crosses the ERT line. To adjust for this discrepancy, a zone of elevated chloride concentration has been identified that includes sample locations north of State Line Road with a chloride concentration exceeding 1,000 mg/kg (Figure 3). A contour level of 190 mS/m crosses A-A' near the extents of elevated EC from the ERT cross section.

### Additional Interpretation of Cross Section A-A'

The ERT cross section west of 98 ft. al does not correlate well with the soil samples if we simply conclude that elevated EC equates to elevated chloride concentration. Attachment 3 clearly shows that chloride concentration decreases with depth in the soil, yet the ERT cross section shows that on the western half of the survey EC is at or near background conditions until 11 ft. bgs. This discrepancy is explained by factoring in the extremely low soil moisture content that averages 15% for all soil samples. Subsurface electrical current flow is impeded in the near surface because there are no free disassociated ions to carry the current in the dry soils. The electrical current dives deeper and flows in the more conductive (saturated) layer at 11 ft. bgs. At this site, based on this analysis, there is a zone of highly saturated sediments sitting on top of an impervious layer which is likely the bedrock observed northwest of the site. Also, the bedrock does not appear to be saturated or fractured along A-A'.

Near-surface elevated EC east of 98 ft. al along A to A' is also due to increased soil saturation. The topography slopes to the south and east, and from the aerial photograph, it appears that surface water pools and flows to the southeast portion of the site. Based on this information, the soil is more saturated east of 98 ft. al along A-A' and will therefore have a greater EC compared to drier areas to the west.

The ERT cross section suggests that the near-surface zone of elevated chloride concentration is only 6 ft. thick, but there are soil samples at 7 ft. that exceed 1,000 mg/kg. Since chloride concentration decreases with depth, the depth at which the chloride concentration is below 1,000 mg/kg is calculated to be 10 ft. (Attachment 3).

## Conclusions and Recommendations

The EM and ERT surveys identified and delineated a zone of elevated chloride concentration. This zone is contained on-site inside the soil berm. Based on the results of the ERT and EM surveys, the zone encompasses an area of 20,494 ft<sup>2</sup>. The volume of soil impacted by the release is estimated to be approximately 7,591 yd<sup>3</sup> at 10 ft. thick.

Additionally, there are areas of visible salt impacts, elevated EC and chloride concentrations that exceed 1,000 mg/kg south of State Line Road around TH17-02. The origin of the off-site salt and elevated chlorides could be from surface water run-off or another unrelated produced water release. An additional ERT cross section in this area would not yield definitive results because there are two or three large metal pipelines buried in this area that would significantly interfere with electric current flow and produce spurious results. To investigate this area further, additional soil sampling is recommended.

Sincerely,



Michael Wallace, PGp  
MANAGER OF GEOPHYSICS – ENVIRONMENT

## Attachments

- Attachment 1. Additional Information
- Attachment 2. Figures
- Attachment 3. Soil Sample Analysis
- Attachment 4. Soil Sample Laboratory Report

## References

- Texas Water Development Board. (2014). *State of Texas Well Report for Tracking #381144*. Austin, Texas: Texas Water Development Board. <http://www2.twdb.texas.gov>.

## **ATTACHMENT 1**

### **Factors Affecting Subsurface Electrical Conductivity**

Subsurface electrical conductivity (EC) may increase due to a few factors, some natural and others man-made. Subsurface EC will naturally increase where there is increased water saturation, increased clay content, a combination of both, or saturated soils with a higher salt content. Man-made causes of increased EC usually involve the discharge of chemicals or water (salty or brackish water) that will increase saturation and/or the total dissolved solids in the subsurface. Buried metal objects also have high electrical conductivities and will produce anomalies. Some of the anomalies from metal objects are bipolar or tripolar because the magnetic fields generated from a buried metal object can be opposing (cancelling) the primary field from the instrument or enhancing it (adding).

### **Description of Electromagnetic Instrument and Measurements**

An electromagnetic (EM) conductivity survey utilizes Faraday's law of induction to measure soil and subsoil conductivity. A magnetic field is generated at a source coil which induces eddy currents in the earth. These eddy currents will flow through the subsurface and generate their own magnetic fields by Ampere's law. These secondary magnetic fields are measured at another coil separated some distance away from the transmitter. The ratio of the secondary magnetic field received to primary magnetic field is proportional to the subsurface conductivity. Depth of investigation for an EM survey is based on the separation between coils. Typical depths of investigation are 6 to 20 ft. for the EM31 instrument. The following website provides a description of the EM31 and how subsurface electrical conductivity is measured:

[http://www.eos.ubc.ca/ubcgif/iag/foundations/method-summ\\_files/em31-notes.htm](http://www.eos.ubc.ca/ubcgif/iag/foundations/method-summ_files/em31-notes.htm)

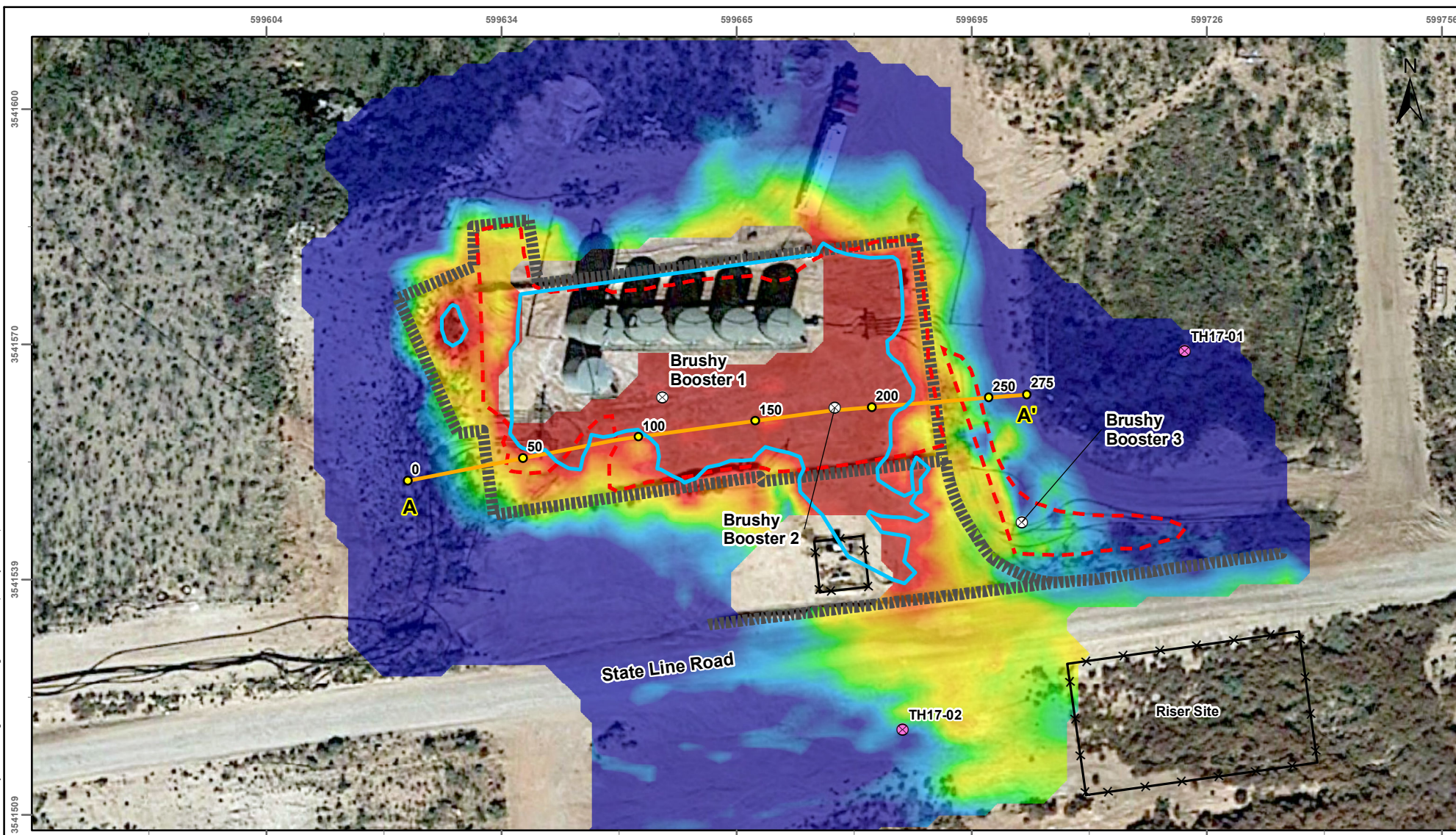
### **Description of Electrical Resistivity Tomography**

Electrical resistivity tomography (ERT) is a subsurface imaging technique that utilizes direct current and Ohm's Law to measure EC along a 2D plane (cross section) or within a 3D volume. Direct current is injected into the subsurface through two electrodes called the current dipole. Voltage is measured somewhere else on the earth with another dipole. Ohm's Law and the electrode positions are used to calculate the apparent EC. The apparent EC refers to what the EC would be under homogeneous conditions and not accounting for surrounding variation in EC that affects electrical current flow. Typically, a survey is setup along a surveyed line with electrodes (metal stakes pounded into the ground), cables, car battery, and control/measurement unit. The control unit is preprogrammed to energize two electrodes (current dipole) and measure the voltage between another two electrodes (voltage dipole). By switching the electrodes used, the EC is measured along the line at different depths. Typically, hundreds or even thousands of measurements are made to sample EC in the subsurface at high density. After measurements are collected, a modelling methodology called inversion is used to refine the estimate of depth and EC by using the physical equations that describe electrical current flow. After inversion modelling, ERT data is typically presented as a contoured cross section or set of cross sections. Visit the website below for more detail about ERT:

[https://archiv.ub.uniheidelberg.de/propylaeumdok/488/1/02\\_05\\_ullrich\\_et\\_al\\_resistivity.pdf](https://archiv.ub.uniheidelberg.de/propylaeumdok/488/1/02_05_ullrich_et_al_resistivity.pdf).

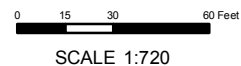
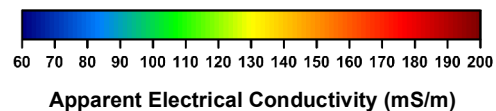
## **ATTACHMENT 2**





# Legend

- ERT Station
- ERT Survey Line
- x Vertex Sample Location
- Zone of Elevated Chloride Concentration
- x WPX Sample Location
- - - Release Area
- x Fence
- x Berm



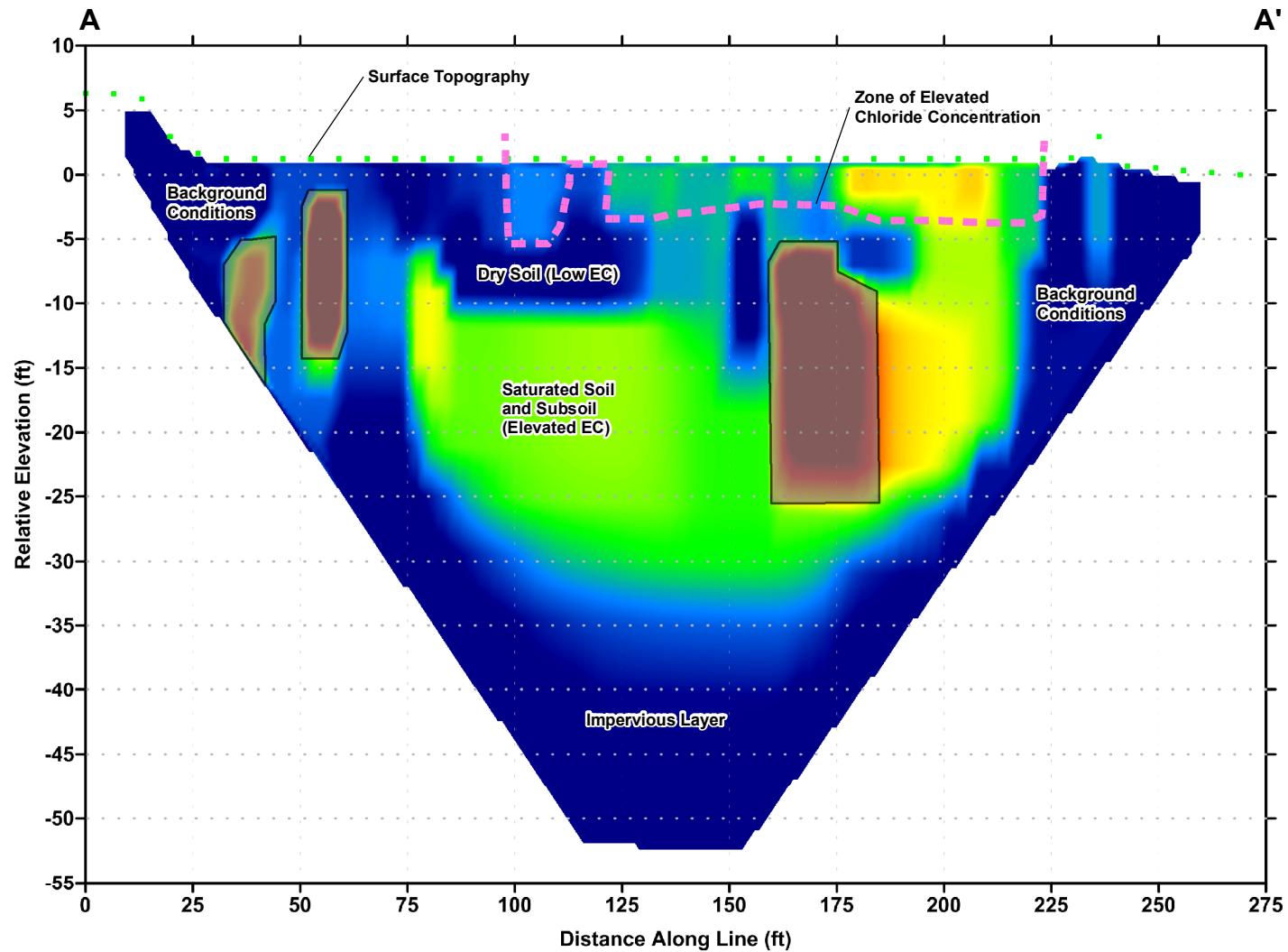
Notes: Aerial Image from Google, 2015

## WPXENERGY Site Diagram with EM Conductivity Overlay Brushy Booster Station

	DRAWN: MW	FIGURE:  <b>1</b>
	APPROVED: DH	
	DATE: FEB 21/17	

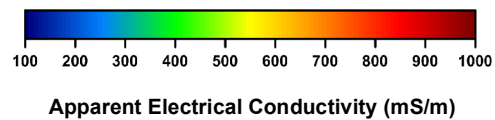
VERSATILITY. EXPERTISE.





#### Legend

Interference From Metal



Notes: Vertical Exaggeration = 3



**EC Cross Section A-A'**  
**Brushy Booster Station**

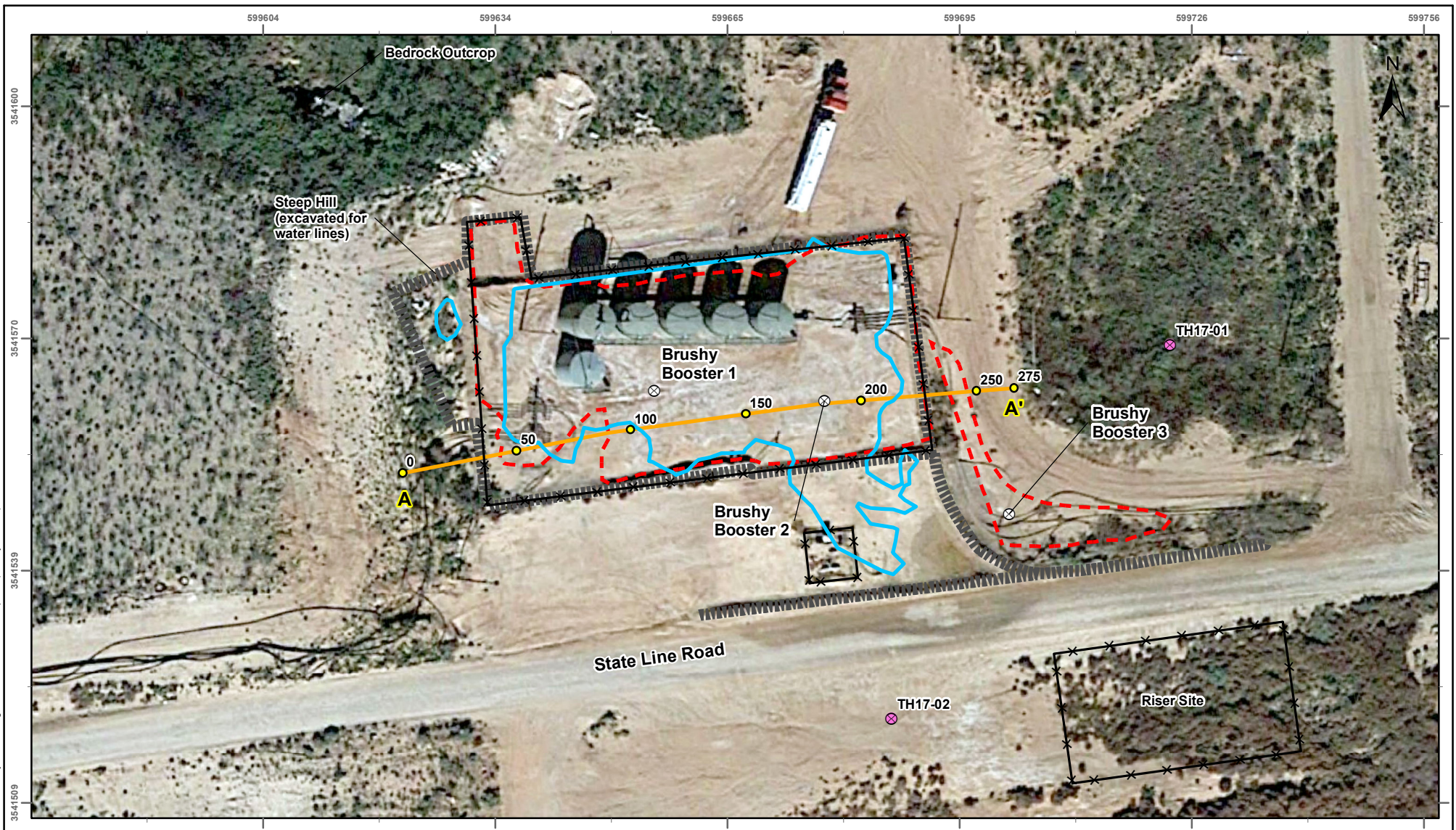


DRAWN: MW	FIGURE: <b>2</b>
APPROVED: DH	
DATE: FEB 21/17	

VERSATILITY. EXPERTISE.



Document Path: C:\Users\mwallace\Desktop\01\_projects\WPX\Brushy Booster\Figure 3 Area of Chloride Impacts (Brushy Booster).mxd



**Legend**

- ERT Station
- Vertex Sample Location
- WPX Sample Location
- Fence
- ERT Survey Line
- Zone of Elevated Chloride Concentration
- Release Area
- Berm

- Notes:
1. Zone of Elevated Chloride Concentration encompasses an area of 20,494 ft<sup>2</sup>
  2. Aerial Image from Google, 2015

0 15 30 60 Feet  
SCALE 1:720



**Area of  
Chloride Impacts  
Brushy Booster Station**



DRAWN: MW  
APPROVED: DH  
DATE: FEB 21/17

FIGURE:  
**3**

VERSATILITY. EXPERTISE.

## **ATTACHMENT 3**

# Soil Sample Analysis to Correlate Electrical Conductivity and Chloride Concentration

WPX Energy

Brushy Booster Station

Project #: 17E-00097

Sample Description			Salinity		Soil Properties			Geophysical	
Location	Depth (ft)	Date	Chloride (mg/kg)	Electrical Conductivity (mS/m)	Soil Moisture Content (%)	Percent Sand Content (%)	Percent Silt and Clay Content (%)	Electrical Conductivity from Electromagnetic Survey (mS/m)	Electrical Conductivity from Electrical Resistivity Tomography Survey (mS/m)
NMOCD Preferred Cleanup Concentration			1,000	-	-	-	-	-	-
<b>Background</b>									
TH17-01	6.0	January 26, 2017	32	273	-	88.8	11.2	11.573	29
<b>WPX Samples</b>									
Brushy Booster 1	3.0	September 4, 2016	7,300	-	12	-	-	202	178
	5.0	September 4, 2016	6,900	-	12	-	-	202	141
	7.0	November 14, 2016	2,400	-	24	-	-	202	74
Brushy Booster 2	3.0	September 4, 2016	17,000	-	11	-	-	205	498
	5.0	September 4, 2016	3,200	-	9.6	-	-	205	273
	7.0	November 14, 2016	4,100	-	20	-	-	205	159
Brushy Booster 3	0.5	September 4, 2016	630	-	19	-	-	85	-
<b>Vertex Samples</b>									
TH17-02	6.0	January 26, 2017	6,240	22,400	-	41.2	58.8	80	-

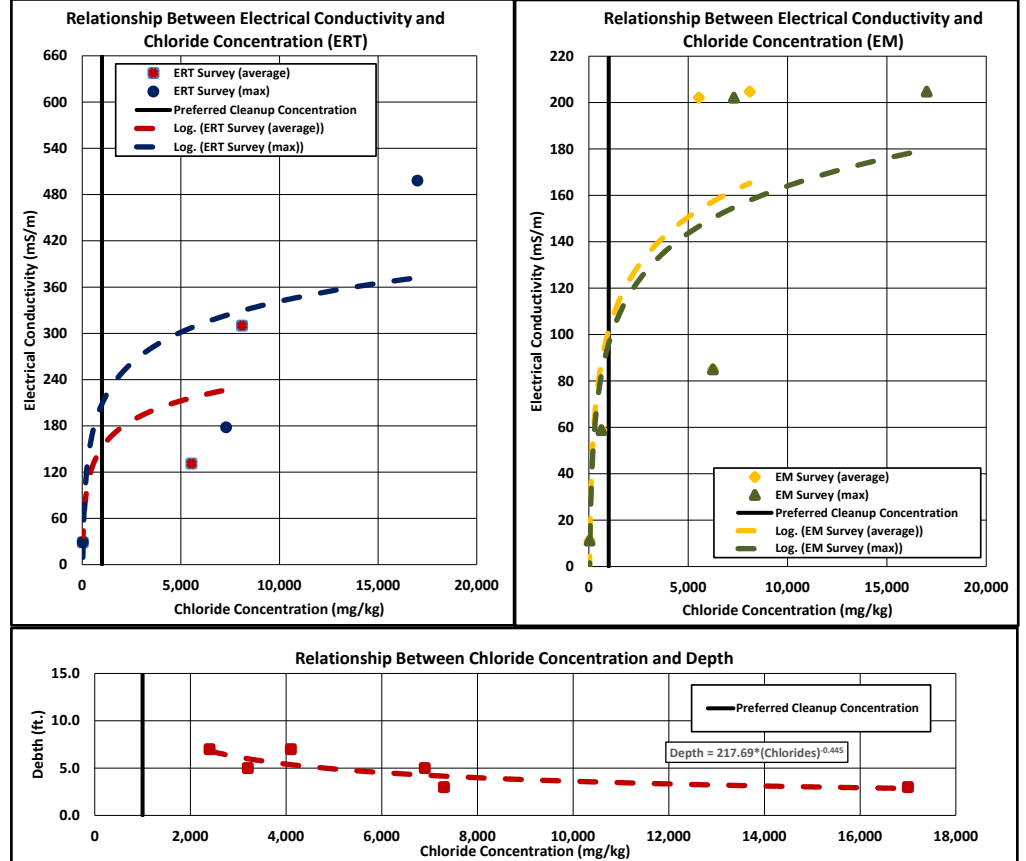
NMOCD Preferred Cleanup Concentration - Personal communication, Karolina Blaney, 2016

"- "- No standard/not analyzed

Shading indicates values (excluding those in background samples) exceeding comparative guidelines

Average refers to the average chloride concentration at a location

Max refers to the maximum recorded chloride concentration at a location



## **ATTACHMENT 4**





February 08, 2017

NATHAN CHANCLER

VERTEX RESOURCE GROUP

420 SOUTH MAIN, SUITE 202

TULSA, OK 74103

RE: SOIL SAMPLES

Enclosed are the results of analyses for samples received by the laboratory on 01/27/17 5:56.

Cardinal Laboratories is accredited through Texas NELAP under certificate number T104704398-16-8. 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/ga/lab\\_accred\\_certif.html](http://www.tceq.texas.gov/field/ga/lab_accred_certif.html).

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

Method EPA 552.2	Total Haloacetic Acids (HAA-5)
Method EPA 524.2	Total Trihalomethanes (TTHM)
Method EPA 524.4	Regulated VOCs (V1, V2, V3)

Cardinal Laboratories is accredited through the State of New Mexico Environment Department for:

Method SM 9223-B	Total Coliform and E. coli (Colilert MMO-MUG)
Method EPA 524.2	Regulated VOCs and Total Trihalomethanes (TTHM)
Method EPA 552.2	Total Haloacetic Acids (HAA-5)

Accreditation applies to public drinking water matrices for State of Colorado and New Mexico.

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

Lab Director/Quality Manager



**Analytical Results For:**VERTEX RESOURCE GROUP  
420 SOUTH MAIN, SUITE 202  
TULSA OK, 74103Project: SOIL SAMPLES  
Project Number: NONE GIVEN  
Project Manager: NATHAN CHANCLER  
Fax To: NAReported:  
08-Feb-17 13:54

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BRUSHY PIPELINE - SOUTH	H700206-01	Soil	25-Jan-17 13:00	27-Jan-17 05:56
BRUSHY PIPELINE - NORTH	H700206-02	Soil	25-Jan-17 13:30	27-Jan-17 05:56
BRUSHY BOOSTER - SOUTH	H700206-03	Soil	26-Jan-17 09:30	27-Jan-17 05:56
BRUSHY BOOSTER - NW	H700206-04	Soil	26-Jan-17 10:00	27-Jan-17 05:56

Cardinal Laboratories

\*=Accredited Analyte

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 client for analyses. All claims, including those for negligence or any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damage 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 the services hereunder by Cardinal, regardless of whether such claim is based upon any of the above stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.



Celey D. Keene, Lab Director/Quality Manager

**Analytical Results For:**

 VERTEX RESOURCE GROUP  
 420 SOUTH MAIN, SUITE 202  
 TULSA OK, 74103

 Project: SOIL SAMPLES  
 Project Number: NONE GIVEN  
 Project Manager: NATHAN CHANCLER  
 Fax To: NA

 Reported:  
 08-Feb-17 13:54

**BRUSHY PIPELINE - SOUTH**  
**H700206-01 (Soil)**

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
---------	--------	-----	-----------------	-------	----------	-------	---------	----------	--------	-------

**Cardinal Laboratories**
**Inorganic Compounds**

Chloride	<16.0		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	<b>2300</b>		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	

**Green Analytical Laboratories**
**Texture Classification 6Hr**

Textural Class	L			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	<b>43.8</b>			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	<b>12.5</b>			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	<b>43.8</b>			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

Cardinal Laboratories

\*=Accredited Analyte

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Celey D. Keene, Lab Director/Quality Manager

**Analytical Results For:**

 VERTEX RESOURCE GROUP  
 420 SOUTH MAIN, SUITE 202  
 TULSA OK, 74103

 Project: SOIL SAMPLES  
 Project Number: NONE GIVEN  
 Project Manager: NATHAN CHANCLER  
 Fax To: NA

 Reported:  
 08-Feb-17 13:54

**BRUSHY PIPELINE - NORTH**
**H700206-02 (Soil)**

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
---------	--------	-----	-----------------	-------	----------	-------	---------	----------	--------	-------

**Cardinal Laboratories**
**Inorganic Compounds**

Chloride	<16.0		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	<b>2370</b>		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	

**Green Analytical Laboratories**
**Texture Classification 6Hr**

Textural Class	L			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	<b>48.8</b>			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	<b>8.80</b>			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	<b>42.5</b>			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

Cardinal Laboratories

\*=Accredited Analyte

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Celey D. Keene, Lab Director/Quality Manager

**Analytical Results For:**

VERTEX RESOURCE GROUP  
 420 SOUTH MAIN, SUITE 202  
 TULSA OK, 74103

Project: SOIL SAMPLES  
 Project Number: NONE GIVEN  
 Project Manager: NATHAN CHANCLER  
 Fax To: NA

Reported:  
 08-Feb-17 13:54

**BRUSHY BOOSTER - SOUTH**
**H700206-03 (Soil)**

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
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**Cardinal Laboratories**
**Inorganic Compounds**

Chloride	6240		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	22400		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	

**Green Analytical Laboratories**
**Texture Classification 6Hr**

Textural Class	L		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	41.3		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	18.8		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	40.0		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

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Celey D. Keene, Lab Director/Quality Manager

### Analytical Results For:

VERTEX RESOURCE GROUP  
420 SOUTH MAIN, SUITE 202  
TULSA OK, 74103

Project: SOIL SAMPLES  
Project Number: NONE GIVEN  
Project Manager: NATHAN CHANCLER  
Fax To: NA

Reported:  
08-Feb-17 13:54

### BRUSHY BOOSTER - NW

H700206-04 (Soil)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
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#### Cardinal Laboratories

#### Inorganic Compounds

Chloride	32.0		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	273		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	

#### Green Analytical Laboratories

#### Texture Classification 6Hr

Textural Class	LS		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	88.8		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	10.0		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	1.30		%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

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Celey D. Keene, Lab Director/Quality Manager

### Analytical Results For:

VERTEX RESOURCE GROUP  
420 SOUTH MAIN, SUITE 202  
TULSA OK, 74103

Project: SOIL SAMPLES  
Project Number: NONE GIVEN  
Project Manager: NATHAN CHANCLER  
Fax To: NA

Reported:  
08-Feb-17 13:54

### Inorganic Compounds - Quality Control

#### Cardinal Laboratories

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD Limit	Notes
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#### Batch 7013102 - General Prep - Wet Chem

##### LCS (7013102-BS1)

Prepared & Analyzed: 31-Jan-17

Conductivity	488		uS/cm	500	97.6	80-120	
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##### Duplicate (7013102-DUP1)

Source: H700206-01

Prepared & Analyzed: 31-Jan-17

Conductivity	2270	1.00	uS/cm	2300	0.963	20	
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#### Batch 7013110 - 1:4 DI Water

##### Blank (7013110-BLK1)

Prepared: 31-Jan-17 Analyzed: 01-Feb-17

Chloride	ND	16.0	mg/kg				
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##### LCS (7013110-BS1)

Prepared: 31-Jan-17 Analyzed: 01-Feb-17

Chloride	432	16.0	mg/kg	400	108	80-120	
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##### LCS Dup (7013110-BSD1)

Prepared: 31-Jan-17 Analyzed: 01-Feb-17

Chloride	432	16.0	mg/kg	400	108	80-120	0.00	20
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Celey D. Keene, Lab Director/Quality Manager

**Analytical Results For:**VERTEX RESOURCE GROUP  
420 SOUTH MAIN, SUITE 202  
TULSA OK, 74103Project: SOIL SAMPLES  
Project Number: NONE GIVEN  
Project Manager: NATHAN CHANCLER  
Fax To: NAReported:  
08-Feb-17 13:54**Texture Classification 6Hr - Quality Control****Green Analytical Laboratories**

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
---------	--------	--------------------	-------	----------------	------------------	------	----------------	-----	--------------	-------

**Batch B702044 - General Prep - Wet Chem****Duplicate (B702044-DUP1)**

Source: H700206-02

Prepared &amp; Analyzed: 07-Feb-17

Sand, Percent	48.8	%			48.8			0.00	20	
Clay, Percent	8.80	%			8.80			0.00	20	
Silt, Percent	42.5	%			42.5			0.00	20	

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Celey D. Keene, Lab Director/Quality Manager



### Notes and Definitions

Texta	LS
Text	L
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

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Celey D. Keene, Lab Director/Quality Manager



## Page 10 of 10

## Vertex Resource Services

FOR LAB USE ONLY

**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

Relinquished BY:

Delivered By: (Circle One)

Sample	Condition	Cool	Intact
1	Yes	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	No	<input type="checkbox"/>	<input type="checkbox"/>

CHECKED BY: cd (Initials)  
#75

REMARKS:

APPENDIX D  
GROUNDWATER IMPACT RISK  
MODEL

New File

Choose FileNo file chosen

Save

Quick Start

Manual

AMIGO

Units

☐ Metric (m) ☒ English (inches)

Climate

Arid Hot (NM/W.Texas, Hobbs) ▾

Input for a Distant Well

Distance to Well 1000 [ft]

Source Width 10 [ft]

Longitudinal Dispersivity 10 [-]

Transverse Dispersivity 1 [-]

Groundwater Characteristics

Background Cl Concentration in Aquifer cGW = 447 [mg/L]

Aquifer porosity n = 0.3 [-]

Groundwater Table Depth D = 100 ▾ [ft]

Aquifer Thickness H = 20 [ft]

Slope of Water Table i = 0.02 [-]

Hydraulic Conductivity Ks = 3.28 [ft/d]

Groundwater Flux Q = 1.31 [ft2/d]

Source Characteristics

Chloride Load: Max. length of the spill in direction of GW flow:

M = 9.59 [kg/m2] L = 180 [ft]

Plant Uptake Trigger

☒ 1% Input Concentration

☐ 10% Input Concentration

Soil Profiles

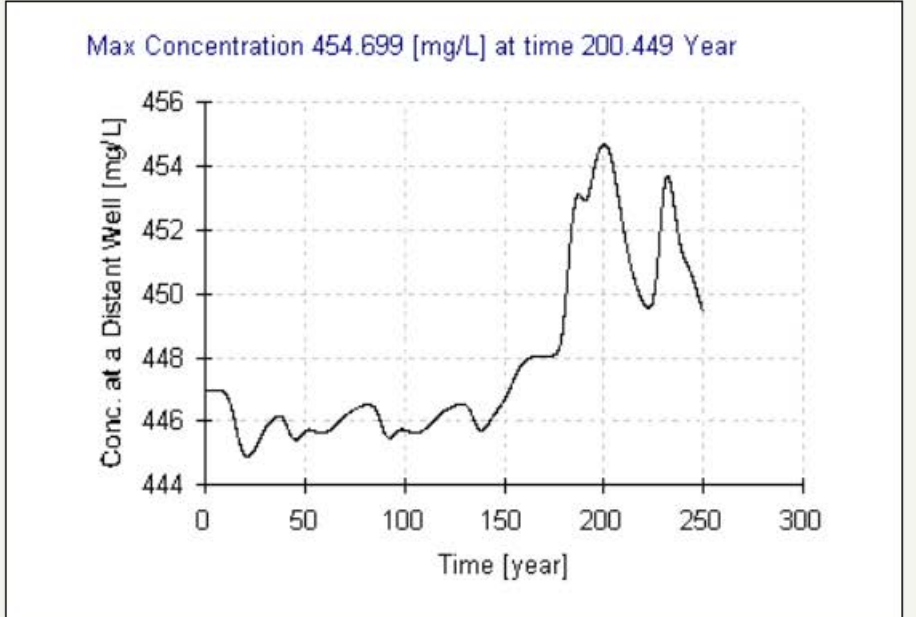
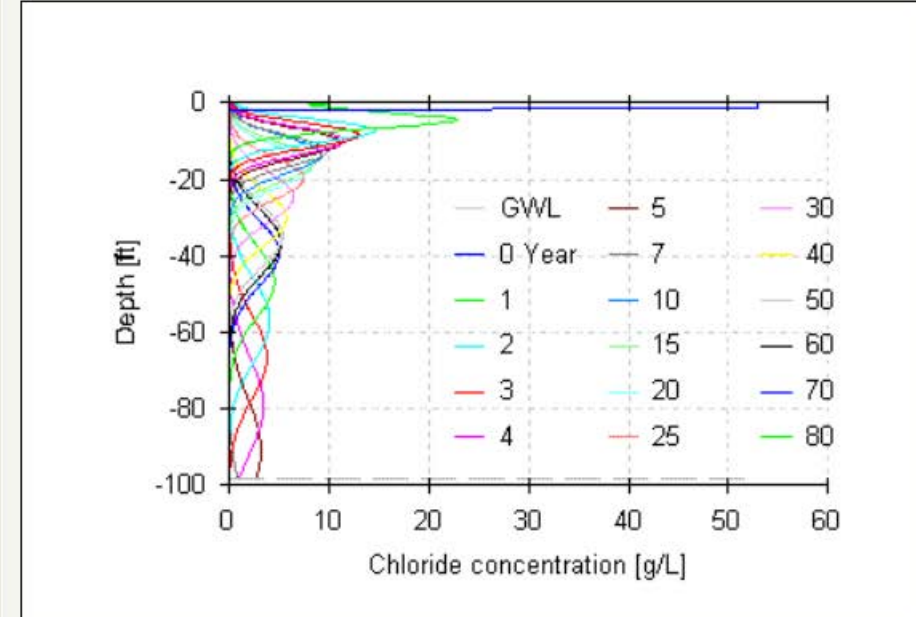
Surface Layer Medium Sand ▾

Soil Profile P9 - Sandy Clay (30) ▾

Output Charts

Quantity 1: Chloride concentration [g/L] ▾

Quantity 2: Conc. at a Distant Well [mg/L] ▾



Reduce

Display All

☒ Legend

Export

Export All

Refresh

☒ Auto-Refresh

Export

Export All