Kansas
Corporation Commission

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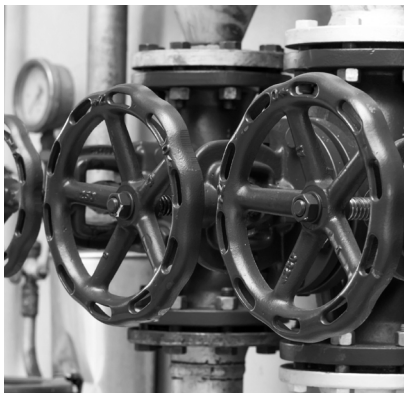


OIL & GAS REMEDIATION SITE STATUS REPORT | 2017

Abandoned Oil and Gas Well / Remediation Site Fund
Remediation Sites
Status Report

Introduction

During the 1996 legislative session, House Substitute for Senate Bill 755 was passed. K.S.A 55-192 and K.S.A. 55-193 created an Abandoned Oil and Gas Well / Remediation Fund with the expressed purpose of providing funds to the Kansas Corporation Commission to plug abandoned wells and remediate contamination sites (sites and wells having no responsible parties) related to oil and gas exploration and production activities. K.S.A. 55-194 also requires the Corporation Commission to prepare an annual Remediation Site Status Report for the office of the Governor and certain legislative committees. This report for the period January 1, 2016, through December 31, 2016, contains information for each of the sites with regard to the following: (1) A description and evaluation of the site; (2) the immediacy of the threat to public health and environment; (3) the level of remediation sought; (4) any unusual problems associated with the investigation or remediation; (5) any remedial efforts completed during the review period; (6) current contaminate level; (7) status of the site; (8) direct and indirect costs associated with remedial efforts; and (9) an estimate of the cost to achieve the recommended level of remediation or an estimate of the cost to conduct an investigation sufficient to determine the cost of remediation. The Site Remediation cash expenditures for FY2017 are projected to be approximately $125,000.

Site Inventory

The inventory of sites listed in the current Remediation Site Status Report consists of 51 sites. This report includes sites that were transferred to the control of the Kansas Corporation Commission (KCC) from the Kansas Department of Health and Environment (KDHE) by legislative action in 1995 and in-house sites already under KCC jurisdiction. Of the original 109 sites, four were combined with other sites. During previous evaluation periods, 77 sites have been resolved and 23 sites have been added. The current evaluation period, January 1, 2016, through December 31, 2016, ended without resolving or adding sites, resulting in a total of 51 active sites. Summary tables for site impacts and immediacy levels as well as estimated costs are found at the beginning of the report. The tables below provide an overview of distribution of sites with respect to both resources impacted and the range of immediacy levels for required remediation.

Distribution of Active Sites with Respect to Impacted Resources

Impacted Resources	Number of Sites
Groundwater, Surface Water, Soil and Well Problems (Cavity, Abandoned)	71
Public Water Supply	8
Domestic Supply	21
Stock Supply	14
Irrigation Supply	11

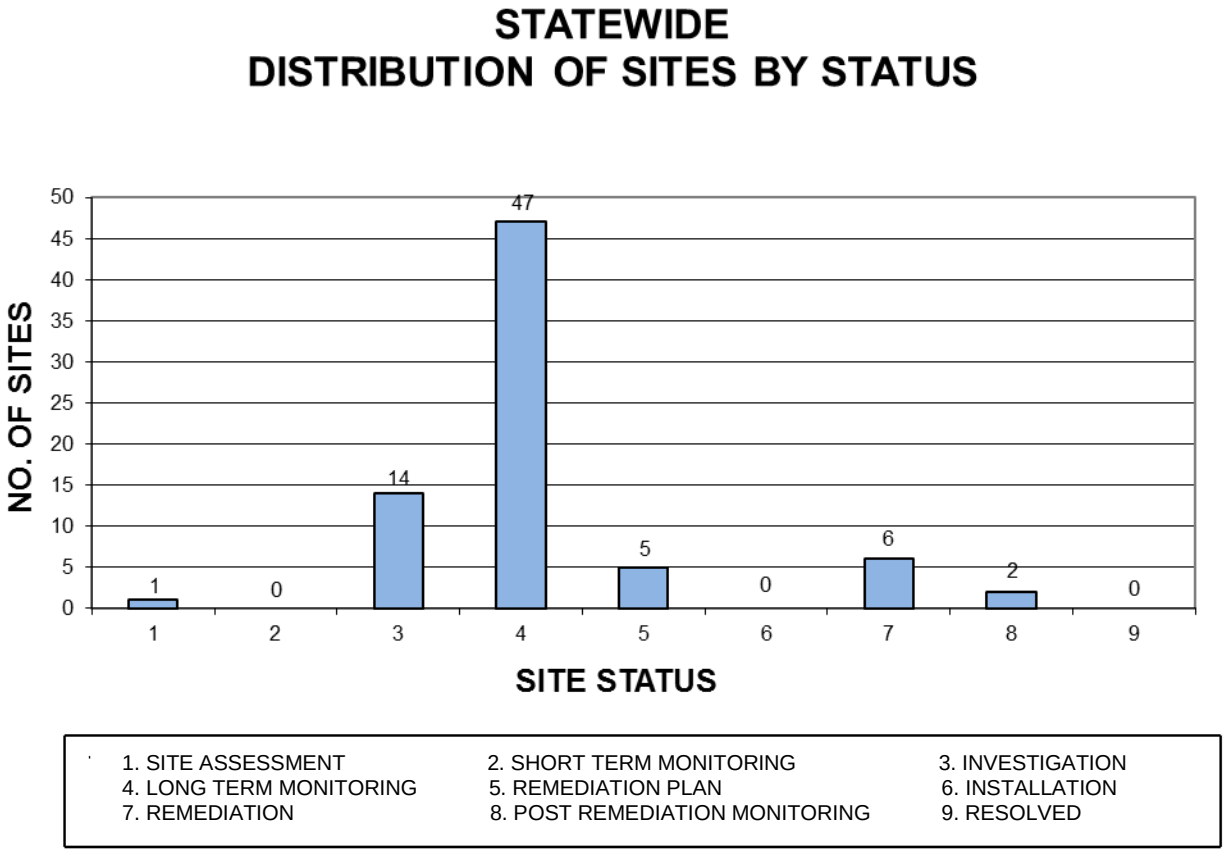
*Some sites have impacts to multiple resources

Distribution of Active Sites with Respect to Immediacy Levels

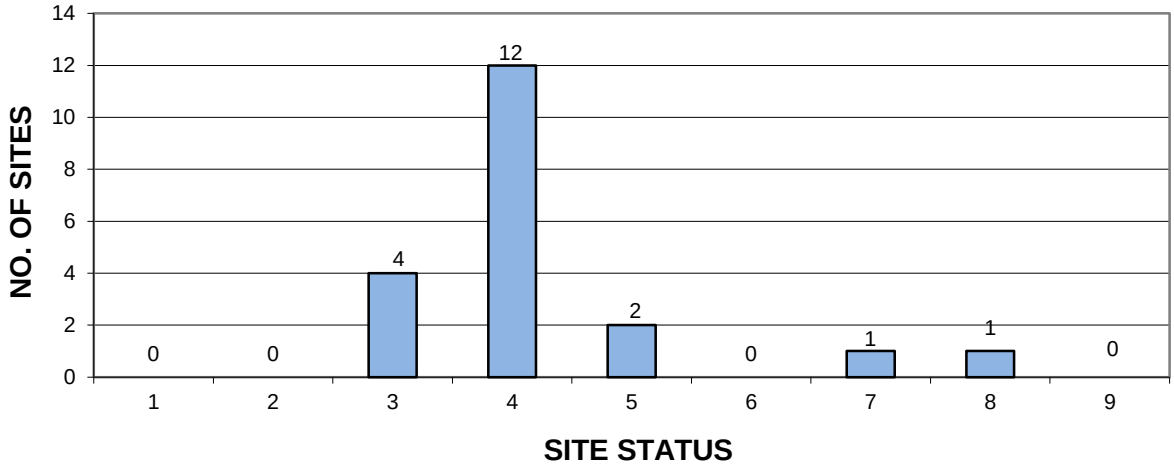
Range of Immediacy Level	No. of Sites
Low & Low to Moderate	25
Moderate	8
Moderate to High & High	12
Other (Under Remediation)	6
Total	51

Site Status

In general, each contamination site has a definable life cycle. This cycle begins with, and then follows, a sequence of investigatory and possible remedial activities which move the site toward ultimate resolution. The first phase of the cycle is the site assessment. This phase defines general site parameters and conditions forming the basis for additional efforts at the site. Once the assessment is complete the site moves on to a new phase. This next phase may be short term or long term monitoring followed by resolution of the site. Another scenario might include an extensive investigation phase followed by the installation of a monitoring system whose sample results may indicate the necessity for certain remedial activities and additional post remediation monitoring prior to resolution of the site. The following graphs depict the current status of the 51 listed sites on a statewide and KCC District basis.

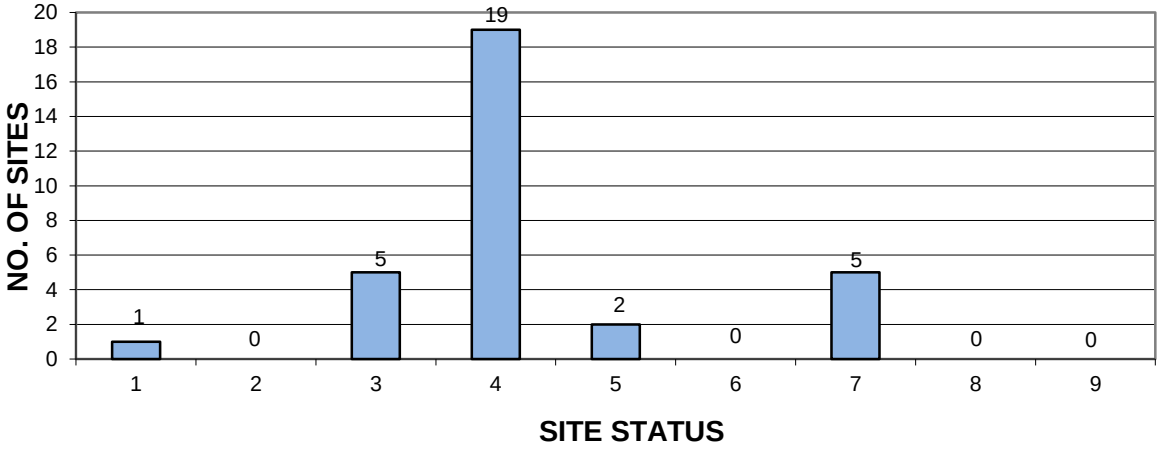


DISTRICT 1
DISTRIBUTION OF SITES BY STATUS



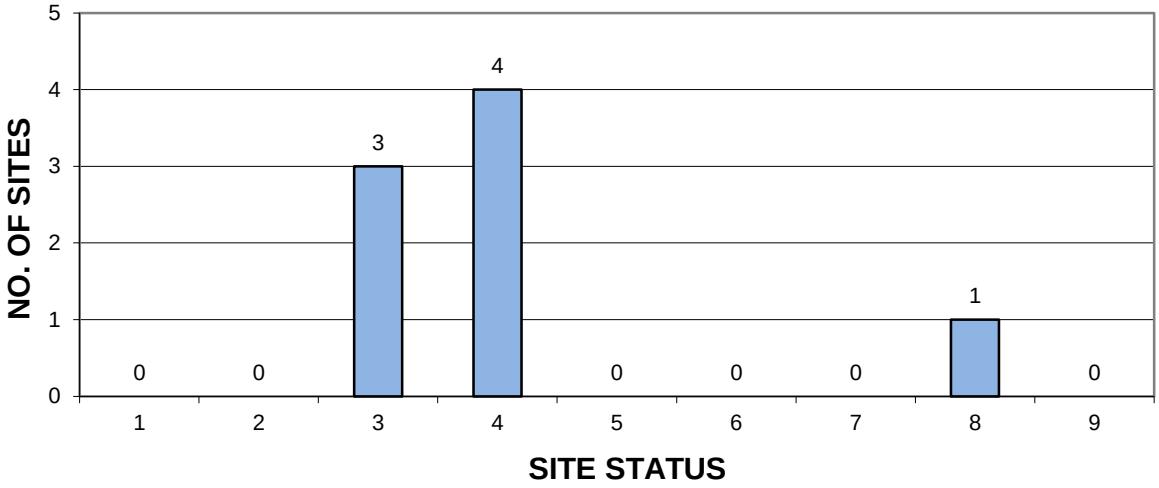
1. SITE ASSESSMENT	2. SHORT TERM MONITORING	3. INVESTIGATION
4. LONG TERM MONITORING	5. REMEDIATION PLAN	6. INSTALLATION
7. REMEDIATION	8. POST REMEDIATION MONITORING	9. RESOLVED

DISTRICT 2
DISTRIBUTION OF SITES BY STATUS



1. SITE ASSESSMENT	2. SHORT TERM MONITORING	3. INVESTIGATION
4. LONG TERM MONITORING	5. REMEDIATION PLAN	6. INSTALLATION
7. REMEDIATION	8. POST REMEDIATION MONITORING	9. RESOLVED

DISTRICT 3
DISTRIBUTION OF SITES BY STATUS



1. SITE ASSESSMENT	2. SHORT TERM MONITORING	3. INVESTIGATION
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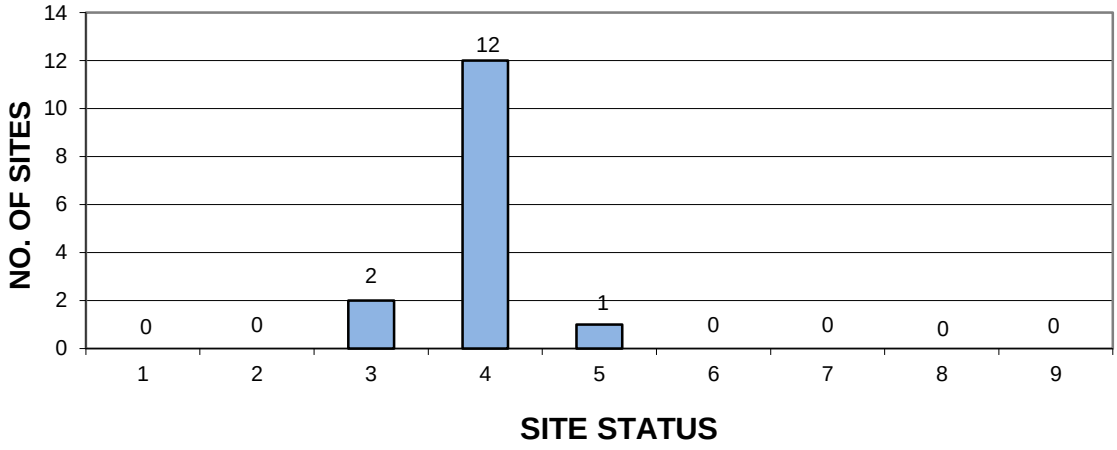
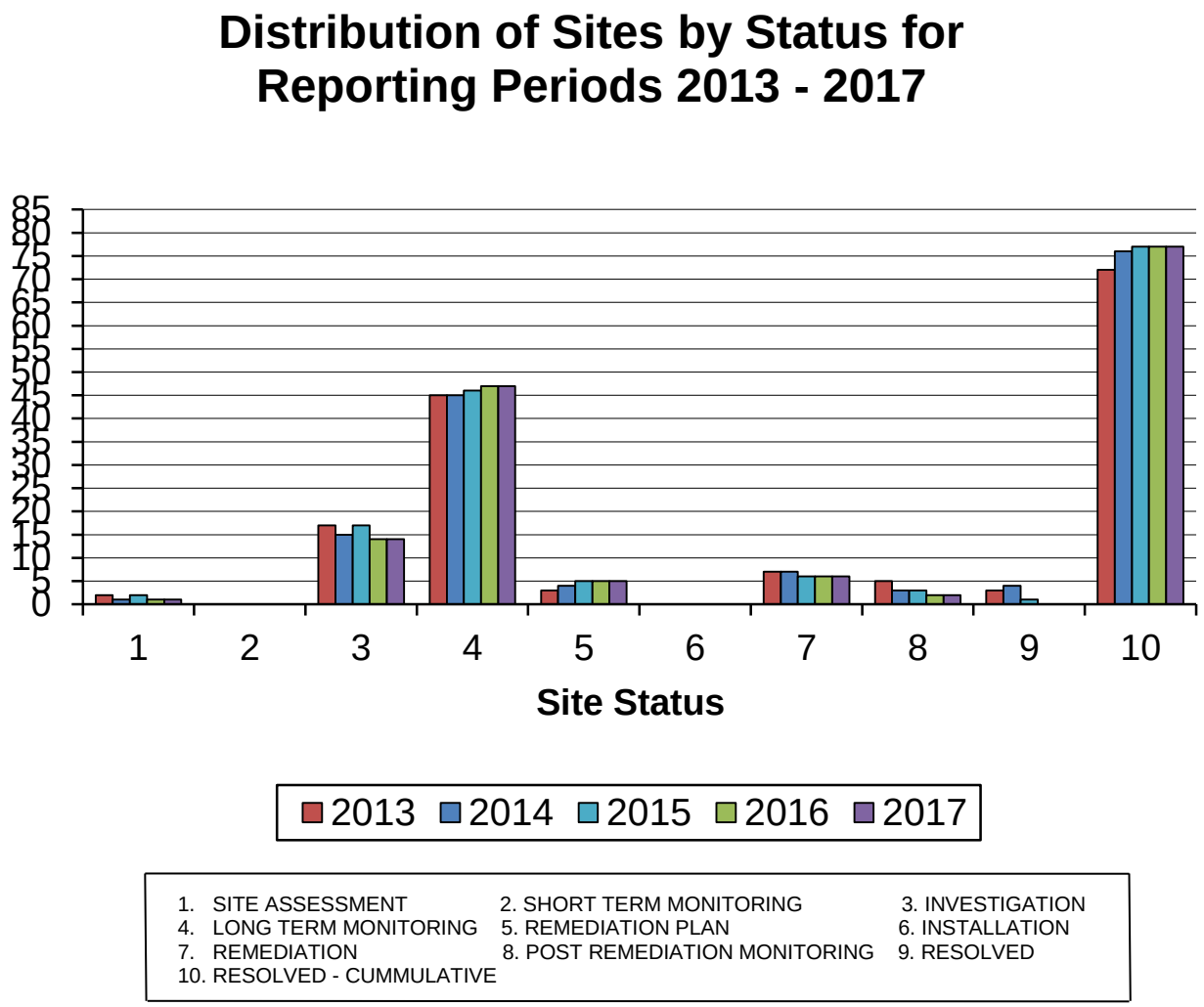
7. REMEDIATION	8. POST REMEDIATION MONITORING	9. RESOLVED

DISTRICT 4
DISTRIBUTION OF SITES BY STATUS



1. SITE ASSESSMENT	2. SHORT TERM MONITORING	3. INVESTIGATION
4. LONG TERM MONITORING	5. REMEDIATION PLAN	6. INSTALLATION
7. REMEDIATION	8. POST REMEDIATION MONITORING	9. RESOLVED

This graph depicts the distribution of sites by status for the reporting periods 2013 through 2017.



Conclusions

This report provides information concerning the location, resource impact, immediacy level, and site description and status for 51 listed contamination/remediation sites related to exploration and production activities in the state. In addition, data is presented with regard to staff expenditures for site management, administration, and inspections, as well as authorization and/or expenditures against the Abandoned Well / Remediation fund for investigatory and remedial activities at the sites.

The Conservation Division of the Corporation Commission is committed to work with the oil and gas industry of the state, other state agencies, and the public to provide a scientifically sound and technically based remediation program.

Impacts, Immediacy and Target Remediation Levels
For
Kansas Corporation Commission Contamination Sites

Site Name	County	KCC District	Impact	Immediacy	Target Level Of Remediation	Unusual Problems	Estimated Total Cost
Arlington	Reno	2	GW / Soil / DM / IR / WSW	UR	250 ppm	Yes	$ 7,500*
Balthazor	Graham	4	GW / Domestic(Sole Source)	Low	250 ppm	No	$ 10,000
Brazil	Neosho	3	SW / GW / PWS / Soil	Low-Mod	500 ppm	No	$ 63,000
Brothers	Rice	2	Groundwater	Low	500 ppm	Yes	$ 4,000
Burrton	Harvey/Reno	2	GW / Domestic / Irrigation	High	Variable	Yes	$3,000,000
Clawson(Mesa)	Haskell	1	Groundwater / Irrigation	Mod-High	500 ppm	Yes	$ 450(yr)*
Curtis	Stafford	1	Groundwater / Irrigation	Low-Mod	500-1000 ppm	Yes	$ 27,000
Dinkel	Ellis	4	GW / Domestic (SS)	Low	500 ppm	No	$ 30,000
EB-3C	Reno	2	Groundwater	Low	No Free Liquid Hydrocarbon	Yes	$ 8,000
Elm Creek	Rooks	4	GW / Domestic / Stock Well	Mod-High	500 ppm	Yes	$ 300,000
Enoch-Thompson	Pawnee	1	Groundwater / Stock Well	Low-Mod	1000 ppm	No	$ 500(yr)*
Fink, Leon	Graham	4	Groundwater / Stock Well	Low	500 ppm	Yes	$ 2,000
Fowler	Montgomery	3	Soil	Low	300 ppm	Yes	$ 4,500
French Sink	Stafford	1	WP (Cavity)	Mod-High	NA	Yes	$ 3,000

Site Name	County	KCC District	Impact	Immediacy	Target Level Of Remediation	Unusual Problems	Estimated Total Cost
Galva City	McPherson	2	Groundwater	UR	500 ppm	Yes	$ 500,000
Harbaugh	Barber	1	GW / Domestic / Stock Well	High	1000 ppm	Yes	$ 450,000*+
Hollow-Nikkel	Harvey	2	GW / Domestic / Irrigation	Moderate	500 ppm	Yes	$ 75,000
Hrencher	Barber	1	GW/ STK / Soil / SW	Mod-High	1000 ppm	No	$ 150,000
Irey - Hrabe	Rooks	4	Groundwater / SW	Moderate	500 ppm	No	$ 15,000
Jennings	Decatur	4	Groundwater / PWSW	Low-Mod	500 ppm	Yes	$ 2,000
Johnson, C	Rice	2	Groundwater / SD	Low	750 ppm	Yes	$ 2,500
Knackstedt	McPherson	2	WP (Cavity)	Moderate	NA	Yes	$ 5,000
Korf	Hodgeman	1	GW / SW/ Soil	Low	1000 ppm	Yes	$ 2,500*
Leesburg Sink	Stafford	1	WP (Cavity)	Mod-High	NA	Yes	$ 62,000*
Little River	Rice	2	Groundwater / PWS	High	300 ppm	Yes	$ 46,500
Macksville	Pawnee	1	Groundwater / IR	Mod-High	300 ppm	Yes	$ 20,000(yr)*
Mantooth	Montgomery	3	GW / Domestic (SS) / SW	Moderate	500 ppm	Yes	$ 10,000+
Maupin	Russell	4	Groundwater / Stock Well	Low	500 ppm	No	$ 2,000
McDonald - East	Linn	3	Surface Water	Low	500 ppm	No	$ 1,500(yr)
McPherson LandFill	McPherson	2	GW / DM / SD / INDWSW	UR	500 ppm	No	$ 26,500*

Site Name	County	KCC District	Impact	Immediacy	Target Level Of Remediation	Unusual Problems	Estimated Total Cost
Nikkel-Epps	McPherson	2	GW / Domestic (SS)	Mod-High	500 ppm	Yes	$ 20,000
Packard	Barber	1	GW / Water Well / STK	Moderate	1000 ppm	Yes	$ 10,000
Ruder	Ellis	4	Groundwater / SW	Moderate	500 ppm	Yes	$ 29,000
Running Turkey Ck	McPherson	2	DM/PWS/SW/SD/STK/IR	Mod-High	500 ppm	Yes	$ 125,000
Russell City	Russell	4	GW / Domestic / Irrigation	Low	1000 ppm	Yes	$ 400,000
Russell RWD #1	Russell	4	Groundwater / PWSW	Low-Mod	250 ppm	Yes	$ 33,000
Sample	Sedgwick	2	Groundwater	Low	500 ppm	Yes	$ 2,000
Sander	Russell	4	GW / Domestic / Stock Well	Low	1000 ppm	No	$ 300
Schraeder	Hodgeman	1	Groundwater / Stock Well	Low	350 ppm	No	$ 30,000
Schruben-Rogers	Rooks	4	GW / Domestic (SS)	Low	250 ppm	No	$ 2,000
Schulte Field	Sedgwick	2	GW / Domestic / PWSW	UR	500 ppm	Yes	$ 300,000
Selzer	McPherson	2	Groundwater / SW	Moderate	500-750 ppm	Yes	$ 20,000
Smith-Finn	Morton	1	Groundwater / Domestic	UR	500 ppm	Yes	$ 200,000*
South Spivey	Kingman	2	GW / DM / SW	Low	750 ppm	Yes	$ 5,000*
South Wichita	Sedgwick	2	GW / PWSW / DM / IR	Low	500 to 750 ppm	Yes	$ 43,000
Stowe-Zaid	Rice	2	Groundwater / Soil	Low	350 ppm	Yes	$ 12,000

Site Name	County	KCC District	Impact	Immediacy	Target Level Of Remediation	Unusual Problems	Estimated Total Cost
Trostle	Kingman	2	GW / Domestic / STK / Soil	Low	500 ppm	No	$ 2,500*
Voshell	McPherson	2	GW / SW / DM / IR / STK	Moderate	500 ppm	Yes	$ 20,000
Wildboy's	Barber	1	GW / SW / PWSW	Mod-High	500 ppm	No	$ **
Wingate	Wilson	3	Groundwater / Soil	Low	500 ppm	Yes	$ 15,000
Yoeman	Kingman	2	GW / DM /Stock Well	UR	NA	Yes	$ 56,000+
Total Estimated Cost							$6,155,250

ABDW=Abandoned Well DM=Domestic GW=Groundwater INDWSW=Industrial Water Supply Well IR=Irrigation Well
Mod=Moderate PWSW=Public Water Supply Well SD=Surface Damage STK=Stock Well SW=Surface Water
SS=Sole Source UR=Under Remediation WSW=Water Supply Well WP=Well Problem

*PRP – Potential Responsible Party involvement **See Harbaugh Site for costs +Actual costs have exceeded original estimate

CONTAMINATION SITE EXPENDITURES

SITE NAME	CONTROL NO.	STAFF HOURS	EXPENDITURE FOR STAFF HOUR	REMEDIATION FUND AUTHORIZATION / EXPENDITURE FY 2016/17	TOTAL
ARLINGTON	20030016-001	35	$1,035.66		
BALTHAZOR	970023-00	11	$306.44		
BRAZIL	990040-001	80	$2,264.24	$23.93	$10,791.18
BROTHERS	970029-00	16	$440.34		$4.26
BURRTON	970003-00	74	$1,993.58	$4,229.68	$328,707.35
CLAWSON	970005-00	8.5	$239.49		
CURTIS	970034-00	8.5	$239.49		$4,199.17
DINKEL	970035-00	7	$202.60		
EB-3C	970042-00	2	$65.42		$2,350.00
ELM CREEK	970043-00	34	$927.30		$29,212.25
ENOCH THOMPSON	970044-00	13.5	$350.26		
FINK	970007-00	5	$145.76		
FOWLER	970046-00	12.5	$361.42		
FRENCH	990002-001	6.5	$185.93		$346.50
GALVA CITY AREA	980033-001	228	$6,150.65	$6,872.42	$277,263.04
HARBAUGH	970049-00	133.5	$3,610.21	$12,155.44	$552,684.74
HOLLOW NIKKEL	970009-00	28	$761.70	$2,460.12	$39,703.01
HRENCHER	970051-00	11	$307.04		$189.94
IREY-HRABE	970053-00	18	$500.46		
JENNINGS	970054-00	8	$226.10		
JOHNSON	970055-00	5	$145.76		$416.28
KNACKSTEDT	970060-00	24	$654.58		$153.39
KORF	20140017-001	3	$92.20		
LEESBURG SINK	20040003-001	3	$92.20		$6,266.00
LITTLE RIVER	20000057-001	22	$601.02		$3,112.20
MACKSVILLE	970066-00	16	$440.34	$1,600.39	$81,737.61

SITE NAME	CONTROL NO.	STAFF HOURS	EXPENDITURE FOR STAFF HOUR	REMEDIATION FUND AUTHORIZATION / EXPENDITURE FY 2016/17	TOTAL
MANTOOTH	980058-001	80	$2,264.24		$17,349.00
MAUPIN	970068-00	15	$416.84		
MC DONALD-EAST	970070-00	39	$1,108.45		
MCPHERSON LANDFILL	980034-001	15	$482.76	$604.24	$21,069.45
NIKKLE-EPPS	20100082-001	10	$279.66		$8,318.75
PACKARD	970075-00	14.5	$401.30		$310.09
RUDER	970082-00	9	$252.88		$12,960.00
RUNNING TURKEY CREEK	20010033-001	19	$520.68		$61,603.07
RUSSELL CITY	970083-00	4	$118.98		$1,192.60
RUSSELL RWD #1	970084-00	6	$172.54		
SAMPLE	970088-00	6	$172.54		
SANDER	970089-00	6	$172.54		
SCHRAEDER	970013-00	13.5	$345.12		$1,590.90
SCHRUBEN-ROGERS	970014-00	7	$200.14		
SCHULTE	970015-00	163.5	$4,365.62	$878.06	$149,348.83
SELZER	970093-00	33	$889.78		$12,133.50
SMITH-FINN	970095-00	3.5	$105.59		
SOUTH SPIVEY	970096-00	32	$868.82		
SOUTH WICHITA	970016-00	31	$842.04		$10,767.02
STOWE-ZAID	20000035-001	11	$306.44		$4,057.85
TROSTLE	980038-001	24	$616.75		
VOSHELL	20030059-001	16	$440.34	$302.12	$19,880.80
WILDBOY'S	970017-00	9	$253.18		
WINGATE	970107-00	54	$1,531.30		$8,296.00
YEOMAN	20060021-001	13	$385.95		$93,690.76
Totals:		1447	$39,854.65	$29,126.40	$1,759,705.54

REMEDIATION

SITES

REPORT

2017

Project: *Arlington Site*

Site Location: The site is located approximately 5 miles west and 1 mile south of Arlington, Kansas. The brine spill, which was the source of the contamination at this site, took place on the Henson lease located in the NE/4 of Section 14, Township 25 South, Range 9 West, Reno County. Rama Operating Company is the Primary Responsible Party, and past operator of the Henson lease. The Henson lease has been plugged and abandoned for several years.

Impact/Immediacy: Impacts are to both soil and groundwater as a result of a large saltwater line leak from August 2000. Initially the spill impacted irrigation wells in the SE/4 of Section 11 and a domestic well on the lease in late 2001. The domestic well was abandoned and a new one was drilled, and the irrigation well was taken out of use for several seasons allowing the saltwater plume to migrate back to the southeast and be remediated in the NE/4 of Section 14. This site immediacy level should be classified as moderate.

Site Description: The south half of section 11 and northwestern section 13 is cultivated farmland with various crops grown. There is circle irrigation in both the SW/4 and SE/4 of section 11 and the northwest of section 13. The north half of section 14 is in CRP, and the topography is relatively flat with only eleven feet of total relief across the area. The subsurface strata consist of 3 to 4 feet of topsoil and brown clay grading into sands ranging in size from very fine to coarse mixed with clay layers down to the Harper Siltstone, which is the bedrock. Bedrock depths range from 47 to 56 feet. The highest chlorides have been found on the bedrock indicating the clay layers across the area are not contiguous forming aquitards. The only visible remnant of the line leak at the surface is a soil scar approximately 30 feet by 10 feet that is located near the center of the NE/4.

Unusual Problems: Water quality should be frequently monitored during summer because of offsetting irrigation wells to the east.

Status of the Project: Since 2001 Rama Operating Company has installed 16 monitoring wells and 8 recovery wells within the area of the Arlington contamination Site. From late 2010 to 2014, Rama has been allowed to move the site into post remediation monitoring. Up to that time Rama had utilized the recovery wells in an effort to remediate the immediate groundwater onsite. Rama installed a pump and lines to RW-8 and ran that recovery well during the summers of 2014-15 after chloride levels were found to remain high. Annual sampling by KCC has shown that the chloride plume has stayed mainly contained in the NE/4 of section 14, with the highest levels of chlorides found in MW #6 (11,250 mg/L). Chlorides have decreased in all of the monitoring wells surrounding that recovery well during the 2016 year. The overall water level has raised an average of 2.58 feet since 2015. Water level rise may be the reason behind the drop in chlorides tested during the summer of 2016. Bedrock mapping of the Harper Siltstone indicates a slight depression along the bedrock at MW #6; this also contains the highest concentration of saltwater at the site. 2016 groundwater elevations indicate that the generalized flow is to the east-southeast and there was a hydraulic gradient between MW-1 and MW-8 of 0.00098 ft/ft. It should be noted that RW-8 was running during water level measurements and it is assumed that this well has the ability to affect local groundwater and hydrology to a limited extent. Due to the age of the site it is difficult to determine the top of the surveyed casing and some well hydraulic data was thrown out if it looked erroneous. On June 9, 2016, KCC was onsite to sample the monitoring wells via air lift technology. MW-10 was found to be full of dirt, and is now considered destroyed. Prior to sampling, groundwater levels were measured in each monitoring well using a Huron electronic water level indicator. Air-lift technology was used to purge a minimum of three well volumes of groundwater from each well, save MW-15 which was pumped via submersible Proactive® Water-Spout water pump. Purge water was tested for conductivity and contained in a 250 gallon poly-tank if conductivity was high before being disposed of into a deep injection well located a quarter mile east of the site. Groundwater samples from each monitoring well were collected in one 250 (ml) polyurethane container for analysis at the KCC District #2 Laboratory. Each sample for this monitoring event was analyzed for the presence of Chloride by United States Environmental Protection Agency USEPA Silver Nitrate Buret Titration Method - Method 8225.

Level of Remediation Sought:

Ideal: 30 to 80 ppm (background)
Target: 250 ppm

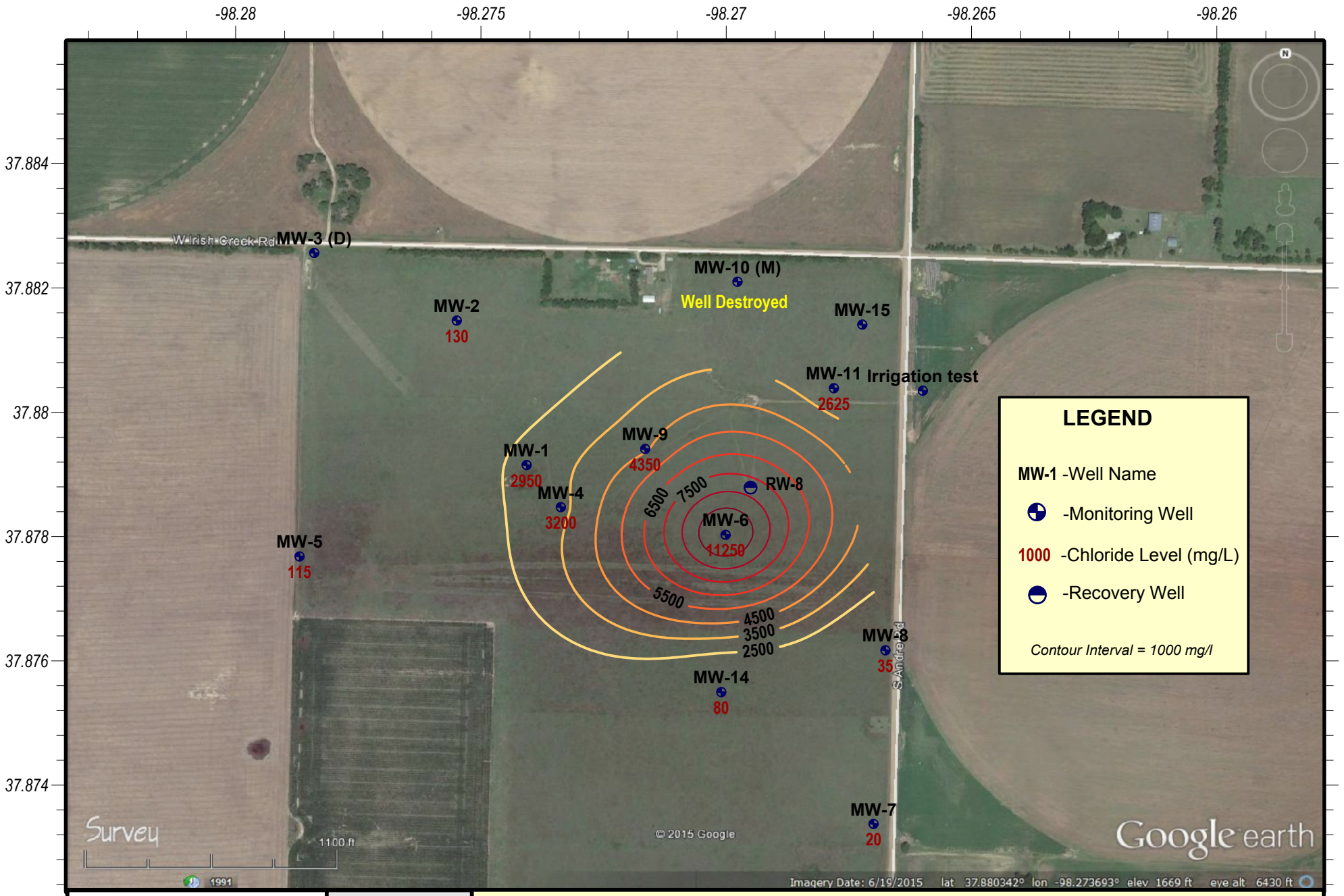
Recommendation for Future Work: It will be suggested to Rama Operating Company, to continue to run Recovery Well No. 8, and any possibly other recovery wells adjacent to MW #6 in an effort to expedite the remediation efforts since natural attenuation will not likely occur anytime soon. RW-8 is the closest recovery well to the "hot spot" in the plume, but has not shown a significant amount of effectiveness in regard to chloride levels. KCC will require analytical testing of recovered water for chlorides this next year. KCC believes if chloride levels of recovered water are low, the pump placed in RW-8 maybe set too high in the aquifer due to silting of the well in the past. This year showed lower chlorides which could be the result of higher groundwater elevation along with the pulling of higher chloride fluids towards the recovery well. KCC recommends continuing to monitor in 2016-2017.

Estimated Total Cost: $2500 for Annual Groundwater sampling and well repairs. Staff time will include performing reviews and research into reports remediating the Site.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
20030016-001	**35 Hrs. / $1,035.66**		

Current Contaminate Level: 11,250 mg/l in MW-6

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☐ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☒ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

N W E S

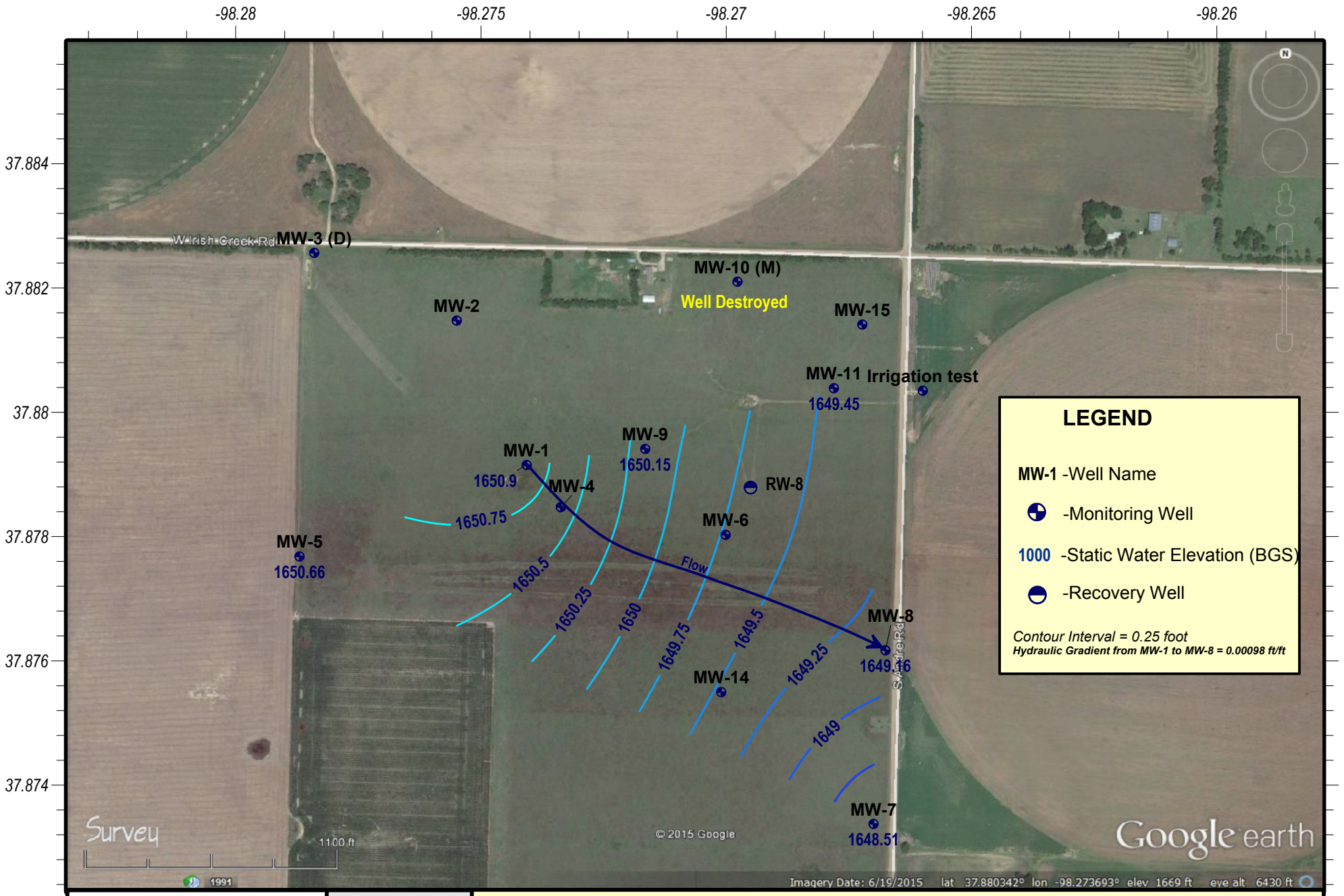
Arlington Contamination Site

Section 14 - Township 25 South - Range 9 West, Reno County, Kansas

2016 Chloride Levels

KCC Project code #20030016-001 - KCC District #2 Field Office

Well Sampled on 6/9/2016 - Map Drawn on 10/14/2016 by D. Bollenback



Kansas Corporation Commission

N W E S

Arlington Contamination Site

Section 14 - Township 25 South - Range 9 West, Reno County, Kansas

2016 Groundwater Elevation

KCC Project code #20030016-001 - KCC District #2 Field Office

Well Gauged on 6/9/2016 - Map Drawn on 10/5/2016 by D. Bollenback

Project: *Balthazor Contamination Site*

Site Location: Section 23 of Township 9 South, Range 21 West, Graham County.

Impact/Immediacy: Pollution from past oil field activity has impacted an aquifer which supplies domestic water to a homestead. The immediacy level is rated as low.

Site Description: At the time the site was listed, a well in section 14 was the sole source of water for the residence. Though the chloride concentration was at 600 ppm when it was last tested in 2002, this well is no longer utilized by the landowner. The sole source of domestic water for the residence is a water well to the south in section 23. The quarter that the water well is located in has three oil wells that are dry and abandoned, four that are plugged and abandoned, and four producers. The majority of these wells were originally drilled in the 1940's

Unusual Problems: None.

Status of Project: When the new domestic well was drilled in 2011 the chloride level was 2,300 ppm. In 2012 the chloride levels in the well were at 1,700 ppm, 700 ppm in 2013, and 600 ppm in 2014. In 2015, the concentration increased slightly to 750 ppm, but fell again in 2016 to 670 ppm. The three monitoring wells on the location have remained relatively stable with a subtle overall decrease in contamination. The contamination levels were 1,400 ppm in monitoring well #1, 1,500 ppm in monitoring well #2, and 60 ppm in monitoring well #3 during 2014, and 1,200 ppm, 1,550 ppm, and 95 ppm, respectively, in 2015. In 2016, the concentrations are 1,200 ppm in MW #1, 1,450 ppm in MW #2, and 140 ppm in MW #3.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 250 ppm Chloride

Recommendations for Future Work: The source of the contamination is likely an old brine pit in the NW/4 of Section 23, T.9S. R.21W., and the feasibility of decreasing the contamination level through remediation will be considered, but needs to be weighed against the site parameters. The contamination level will continue to be monitored.

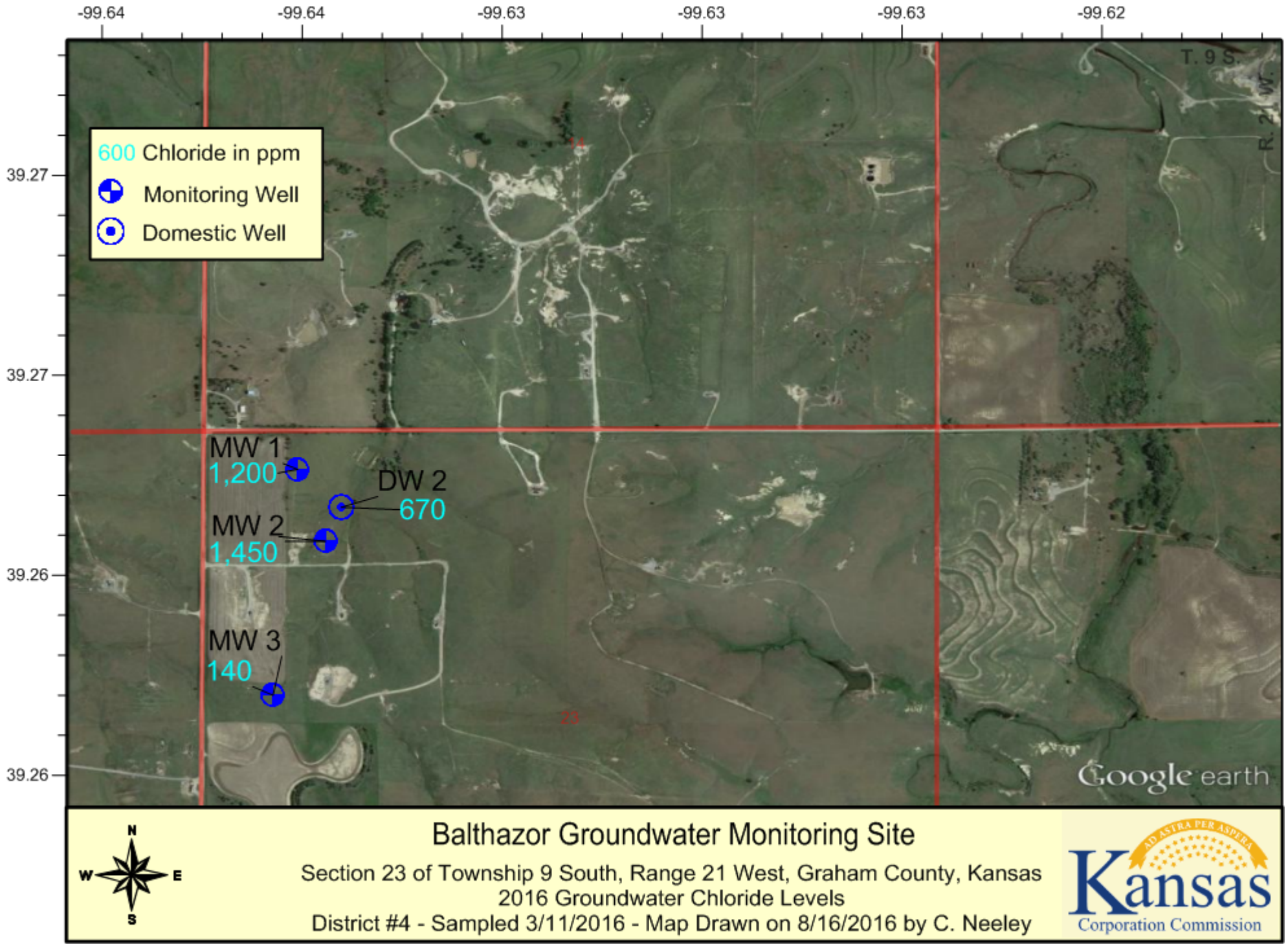
Estimated Total Costs: $10,000.00

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970023-00	**11 Hrs. / $306.44**		

Current Contaminate Level: 140 ppm to 1,450 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**


-99.64
-99.64
-99.63
-99.63
-99.63
-99.62
39.27
39.27
39.26
39.26
600 Chloride in ppm
Monitoring Well
Domestic Well
T. 9 S.
R. 21 W.
14
23
MW 1
1,200
DW 2
670
MW 2
1,450
MW 3
140
Google earth
N
W
E
S
Balthazor Groundwater Monitoring Site
Section 23 of Township 9 South, Range 21 West, Graham County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 3/11/2016 - Map Drawn on 8/16/2016 by C. Neeley
AD ASTRA PER ASPERA
Kansas
Corporation Commission

Project: *Brazil Contamination Site*

Site Location: Section 27, Township 28 South, Range 18 East, Neosho County.

Impact/Immediacy: Chloride contamination at this site has verified impacts to both surface water and soil resources with a strong potential for ongoing impact to groundwater resources. The immediacy level is rated as low to moderate for water resources and low to moderate for soil resources.

Site Description: The site consisted of an abandoned oil lease with 30 abandoned wells. Surface runoff over areas of past brine spillage and near surface leakage from abandoned wells is affecting both surface water and soil resources. The surface drainage through this lease is a minor tributary to the Neosho River, which is a public water supply source.

Unusual Problems: None.

Status of Project: The Fee Fund Plugging Project for this lease was completed in early spring of 1999. Twenty-three wells were plugged while seven of the wells were determined to already have been plugged. River Rock is the current CBM gas Operator. Post Rock (previous Operator) plugged an additional break out well in 2006. Four new monitoring wells were constructed in early 2012. These wells were specifically located to further determine the extent and possible source area of the chlorides impacting the area groundwater and surface soils. This property was leased by Post Rock and six new gas wells have been drilled in this section since 2006. Two additional surface casing only wells cut off below surface were discovered in 2016. The following sample results were obtained this year on: ***4/25/2016***: Well #MW01; 1,300 ppm Cl-; Well # MW02; 1,300 ppm Cl-. On ***11/4/2016***: Well #MW01; 1,300 ppm Cl-; Well # MW02; 1,200 Cl-; Well #MW03; 500 ppm Cl- and Well # MW04; 900 ppm Cl-. Overall CL- concentrations continue to trend down for the year.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendation for Future Work: Future work at the site will include plugging of OW57 and OW55, two abandoned oil wells discovered in 2016 through the use of data collected from monitoring wells correlated with google earth imagery, historical documents and focused metal detector surveys. Continued sampling of constructed monitoring wells and possible construction of additional monitoring wells. Additional field work to locate possible unplugged abandoned wells or old wells in which the initial plugs have failed. This information will assist in determining the location and extent of the brine impact.

Estimated Total Cost: Plugging cost for this site totaled $57697.10. Monitoring Well Construction completed in early 2012 totaled $8,196.00.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
990040-001	**80 Hrs. / $2,264.24**	**$23.93**	**$10,791.18**

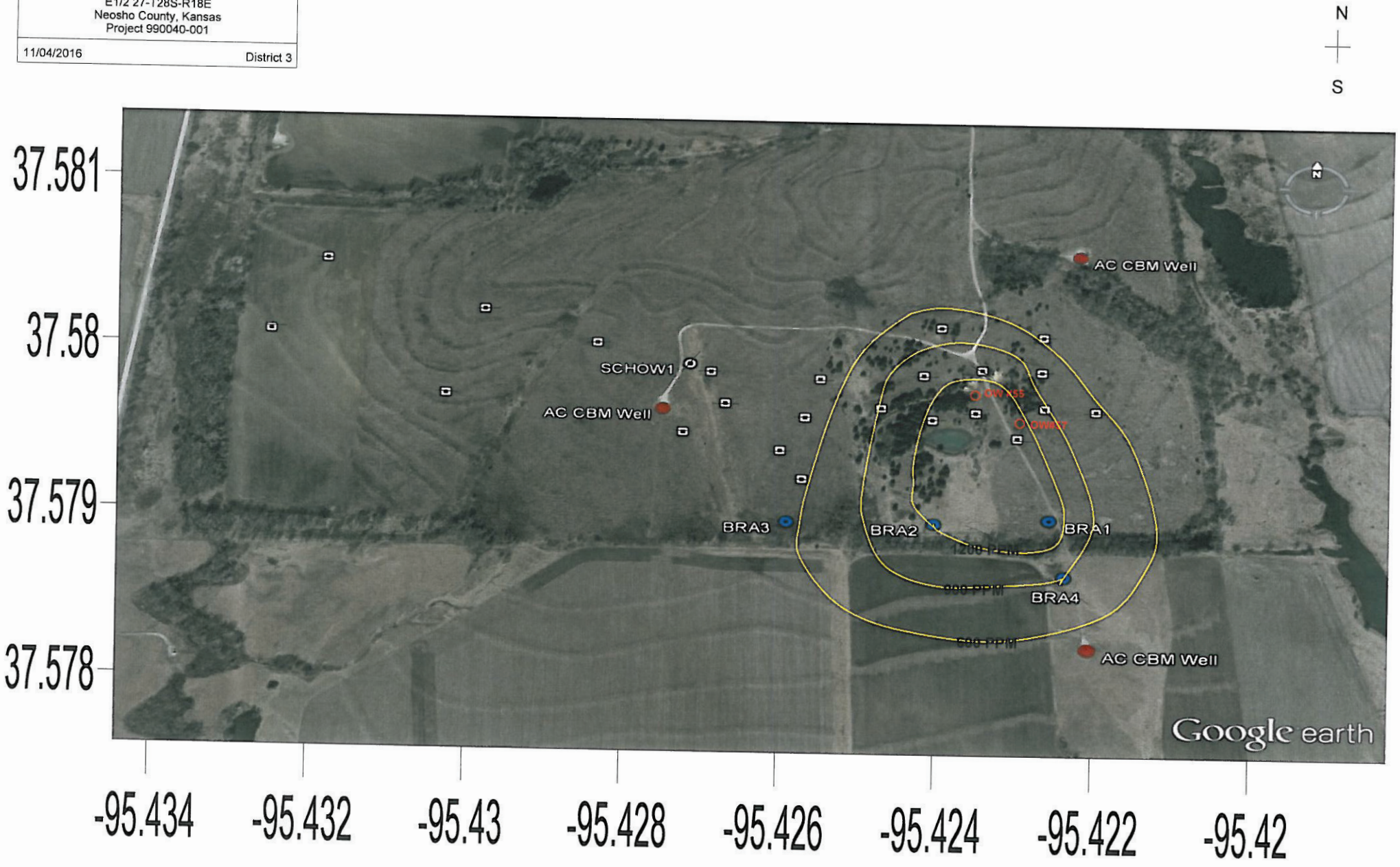
Current Contaminate Level: 500 ppm to 1,300 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

KANSAS CORPORATION COMMISSION
Brazil Remediation Site
E1/2 27-T28S-R18E
Neosho County, Kansas
Project 990040-001

11/04/2016 District 3



Contour Interval 300 ppm Cl-

Monitoring Well

Fee Fund Plugged Well

Active CBM Well

Project: *Brothers Contamination Site*

Site Location: This contamination site is located nine miles east, two and one half miles north of Sterling. The legal location is S/2 NE of Section 12, Township 21 South, Range 7 West, Rice County, Kansas.

Impact/Immediacy: Low immediacy. The only water wells within one mile are to the southwest and were drilled in the 1980s as oil field supply wells.

Site Description: The site is located in the Sand Hills of Rice County. The groundwater aquifer is a shallow permeable zone consisting of loose fine-grained sand underlain by a thick clay layer. There is a lower aquifer located below the impermeable clay which has better deliverability. The groundwater flow is to the south-southwest.

Unusual Problem: Monitoring wells onsite have shown that the aquifer has low deliverability in the upper aquifer.

Status of Project: KCC visited the site and collected water samples on June 7th, 2016. The landowner at this site has cut down all of the cedar trees located on site and left them on the ground. MW-1 could not be located and the location it was at was covered in a pile of cedar trees. It is unknown if the well is intact or if it has been destroyed. KCC laboratory results of the two monitoring wells show that chloride levels have dropped in the wells and the pond. MW-2 is screened in the lower aquifer and was 30 ppm chlorides. A sample was taken at the pond this year and was tested at 280 ppm chlorides. Frogs and other biota were witnessed in the pond. KCC did a recon of the leases to the north of the site but could not find anything that currently is adding to the issues at the Brothers site.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 500 mg/l Chloride

Recommendations for Future Work: KCC recommends that the site remain in the monitoring phase due to the lack of priority of the site. In the future KCC recommends that a Geoprobe® rig be used to probe the area surrounding the site. Probe work could indicate whether or not the chloride contamination is still high in the old drilling pit area. Probe work could also show whether or not this chloride contamination is part of a larger chloride situation from past oil field activities. Data found from a probing event could be used to help plan on a time table for site closure or help indicate other avenues of remediation in order to hasten clean up.

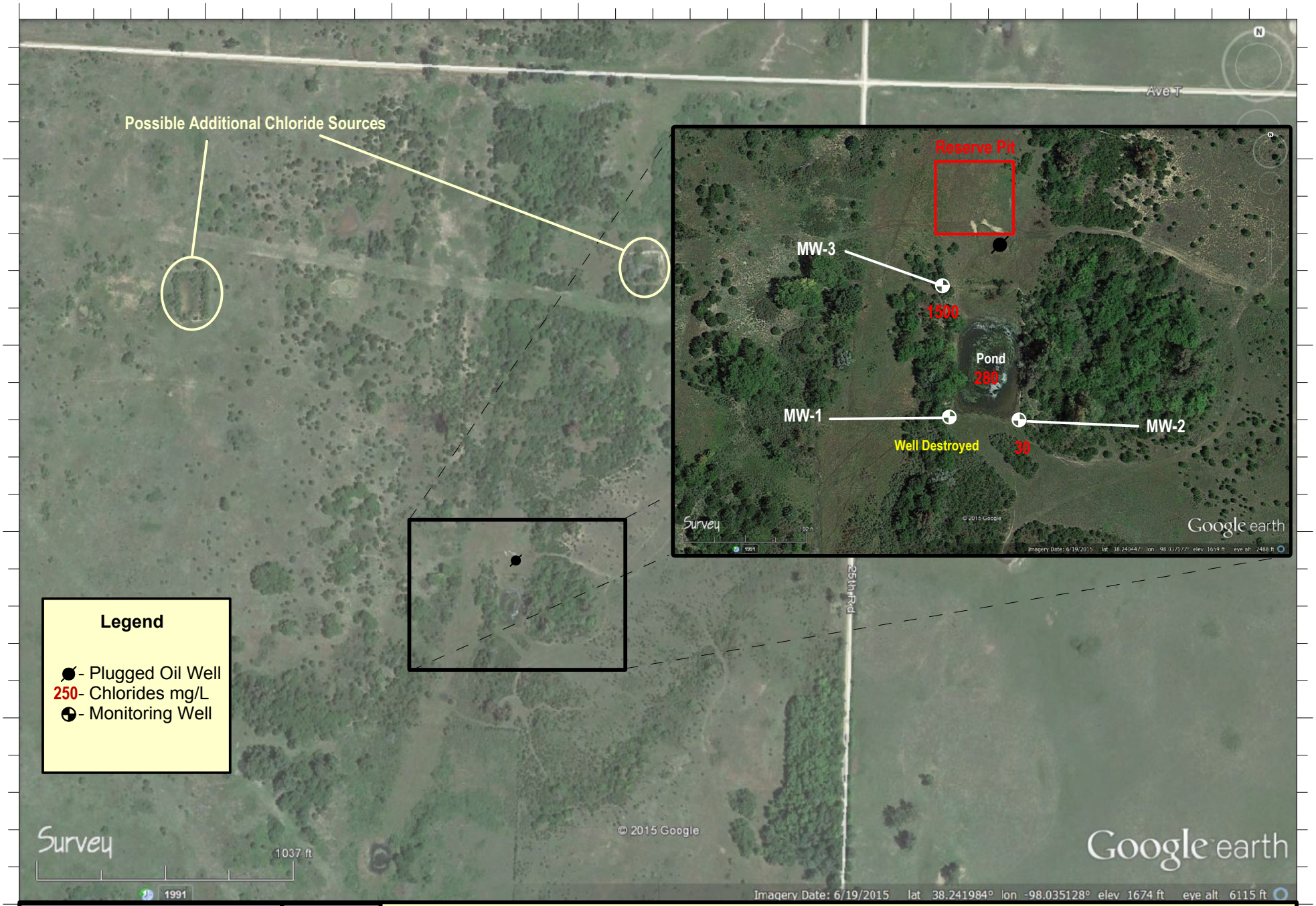
Estimated Total Costs: $750 for monitoring, research and report writing. Geoprobe work would cost around $4000.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970029-00	**16 Hrs / $440.34**		**$4.26**

Current Contaminate Level: 30 mg/l to 1500 mg/l Chloride **6/7/2016**

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

N W E S

Brothers Chloride Monitoring Site

S/2 NE of Section 12 of Township 21 South & Range 7 West, Rice County, Kansas

2016-17 Chloride Levels and Site Map

KCC Code #970029-00 - KCC District #2 Field Office - Well Sampled on 6/7/2016 - Map Drawn on 10/6/2016 by D.Bollenback

Project: *Burrton Contamination Site*

Site Location: The site is located in western Harvey County and eastern Reno County approximately 18 miles west of the city of Newton and 12 miles east of the city of Hutchinson. The site includes acreage in Townships 23 and 24 South, Ranges 3 and 4 West.

Impact/Immediacy: Presently the contamination site is affecting local domestic and irrigation wells. Hydrogeologic computer modeling shows portions of the plume will intercept parts of the Wichita Well Field within 50 years. The Equus Beds aquifer is a major source of public water supply for much of the population of Sedgwick County. This case is ranked at a very high level of immediacy based on the resource impacted and the size of the site.

Site Description: Total maximum area affected by the contamination covers approximately 25 to 30 square miles. In general, the contaminate plume is aligned in a northeast to southwest configuration parallel with the associated producing areas. A water quality-sampling network maintained by the local groundwater management district indicates oil field brine contamination of all three major zones within the Equus Beds Aquifer. Depth to groundwater ranges from 10 to 35 feet with saturated thickness in the order of 150 to 250 feet.

Unusual Problems: The need of suitable disposal facilities and the large area extent of the plume make the clean up of this site very costly. The physical day-to-day maintenance and monitoring of a withdrawal and disposal system of this size would require a large commitment of labor and resources. In addition, over pumping the aquifer as part of a remediation plan for oilfield brine could cause natural chlorides to migrate from the Arkansas River into the Equus Beds, thus impacting parts of the aquifer that are not contaminated.

Status of the Project: GMD #2 sampled the monitoring wells in the summer of 2016. This site is currently in monitoring status at the KCC but other entities including the city of Wichita are actively attempting to remediate the contamination problem. The City of Wichita's ASR project, a multi-million dollar investment, is directly attempting to remediate/slow the Burrton brine plume. District #2 continues to investigate private groundwater wells and water quality in the area including a geoprobe investigation to the northwest of Burrton in 2015. In 2016, the A zone showed increases in chlorides in EB-5A, EB-3AA, P28, and EB-20A. This year's high amount of precipitation could be leaching salts in the soil zone above the water table which could be the source for the increase chlorides in those wells. Other areas showed slight decreases in the A zone, which alternatively could be due the lack of salts in the soils in those location allowing for the rains to help dilute the water table's shallowest zone. The B Zone well EB-20B, EB-57B, PP28A, P30A, and P31A all increased slightly, except for P28A which rose by 230 mg/L chlorides. With the added influx of water from precipitation it could be that chlorides have been push past and over the upper aquatard and have enter the lower zone. If this trend continues, KCC may need to investigate more thoroughly this issue. Chlorides dropped in the B Zone along the western and eastern edges of the site, except for EB-20B on the far eastern edge. The lower C zone was relatively stable except for a 112 mg/L increase at EB-18C.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride

Target: Considering the variable conditions within the aquifer different areas within the contaminate plume would need to be evaluated separately during cleanup to insure that fresh and usable water is not being disposed of needlessly.

Recommendations for Future Work: Continue working with Groundwater District #2 including the funding of annual water well sampling and analysis of this critical data. KCC will continue to review data for locations for possible additional wells to help delineate the plume. Open communication with the USGS, City of Wichita, and GMD #2 regarding data exchange and future cooperation is essential for the study and remediation of this problem. KCC will concentrate research into high level A Zone plumes to investigate the possibly of remedial action in smaller areas of contamination. The increases in chlorides at EB-20A & 20B are troubling as those wells are located directly up gradient from the City of Wichita Water Well Field. KCC plans to investigate possible sources and pathways for the EB-20 Well battery chloride increase over the next year.

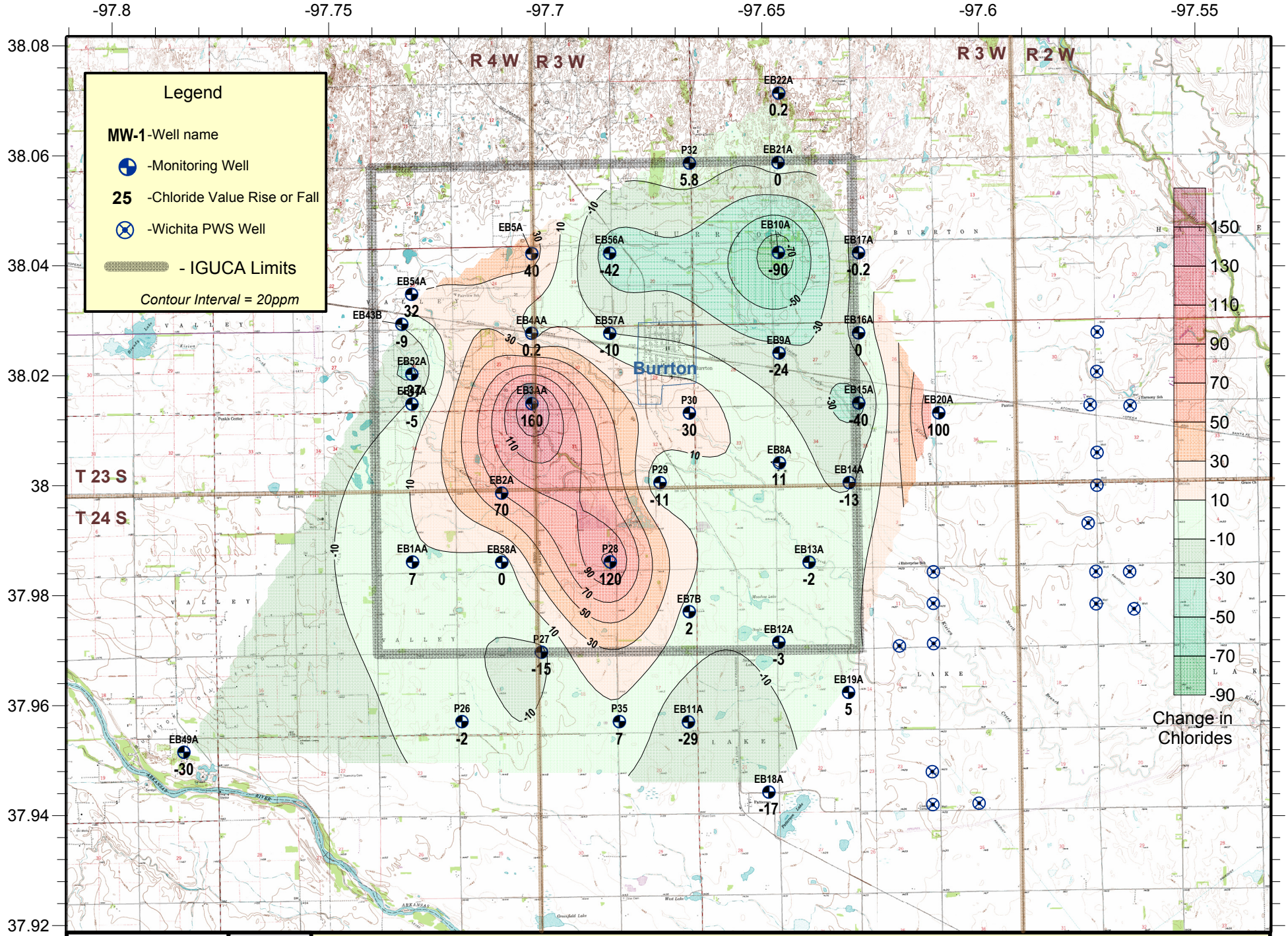
Estimated Total Cost: Cost associated with funding the sampling done by GMD #2, along with KCC staff research and report preparation. KCC Staff attends many meetings and conferences regarding the work being done regarding this site and will continue to do so. Installation of new wells along the eastern edge of the site to help delineate the plume movement could be needed in the future.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970003-00	**74 Hrs. / $1,993.58**	**$4,229.68**	**$328,707.35**

Current Contaminate Level: 1.9 mg/l EB22A to 1500 mg/l Cl- P28A

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☒ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

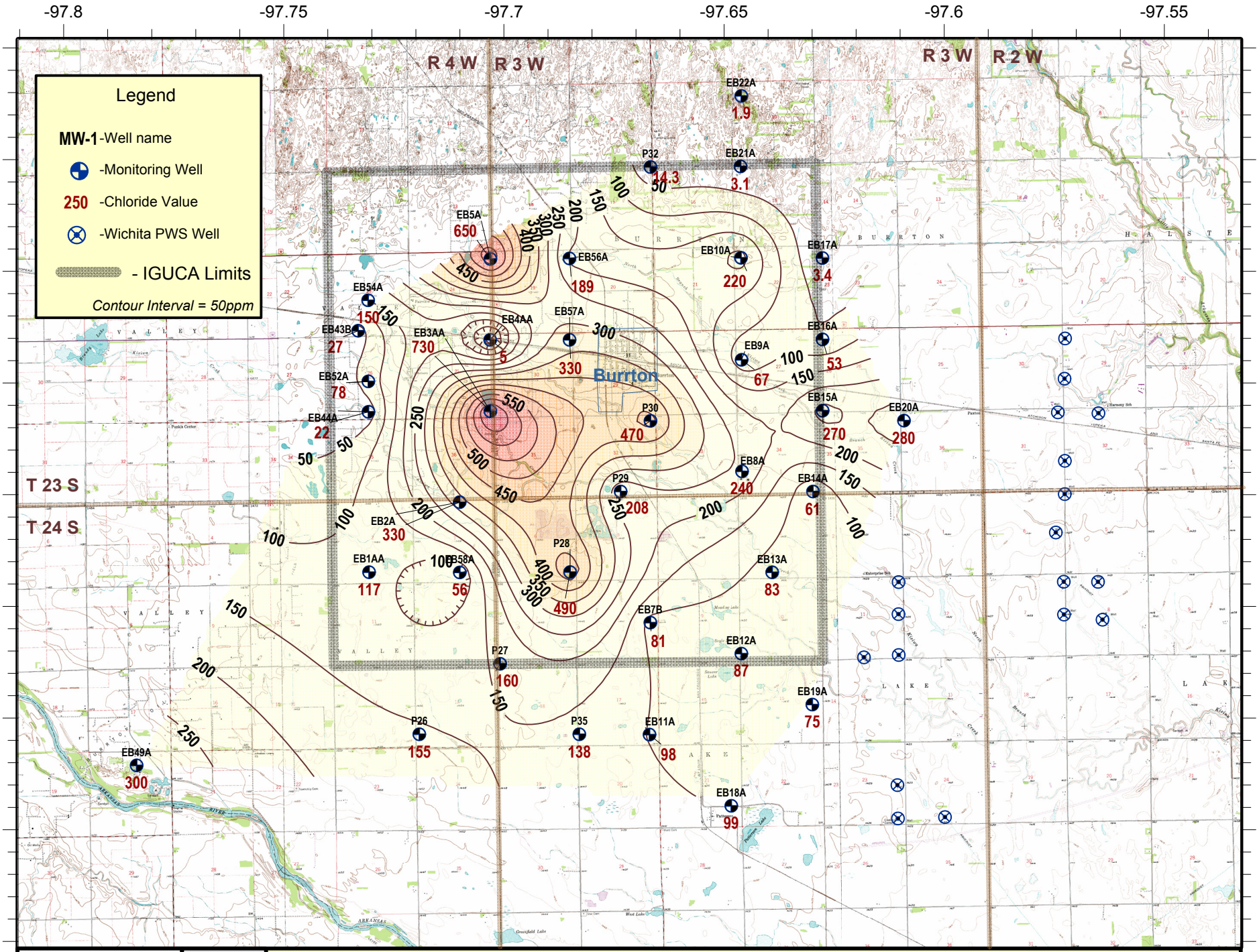
N

Burrton IGUCA Brine Contamination Field

A Zone Change of Chlorides Map From 2015 to 2016

Reno and Harvey Counties, Kansas

KCC Project Code #970042-00 - KCC District #2 Field office - Map drawn on 10/14/2016 by D. Bollenback


-97.8
-97.75
-97.7
-97.65
-97.6
-97.55
38.08
38.06
38.04
38.02
38
37.98
37.96
37.94
37.92
R 4 W
R 3 W
R 3 W
R 2 W
T 23 S
T 24 S
Legend
MW-1 -Well name
-Monitoring Well
250 -Chloride Value
-Wichita PWS Well
- IGUCA Limits
Contour Interval = 50ppm
Burrton
EB22A 1.9
P32 14.3
EB21A 3.1
EB5A 650
EB56A 189
EB10A 220
EB17A 3.4
EB54A 150
EB43B 27
EB3AA 730
EB4AA 5
EB57A 330
EB16A 53
EB9A 67
EB52A 78
EB44A 22
P30 470
EB15A 270
EB20A 280
EB8A 240
P29 208
EB14A 61
EB2A 330
P28 490
EB1AA 117
EB58A 56
EB13A 83
EB7B 81
EB12A 87
P27 160
EB19A 75
P26 155
P35 138
EB11A 98
EB49A 300
EB18A 99
Kansas
Corporation Commission
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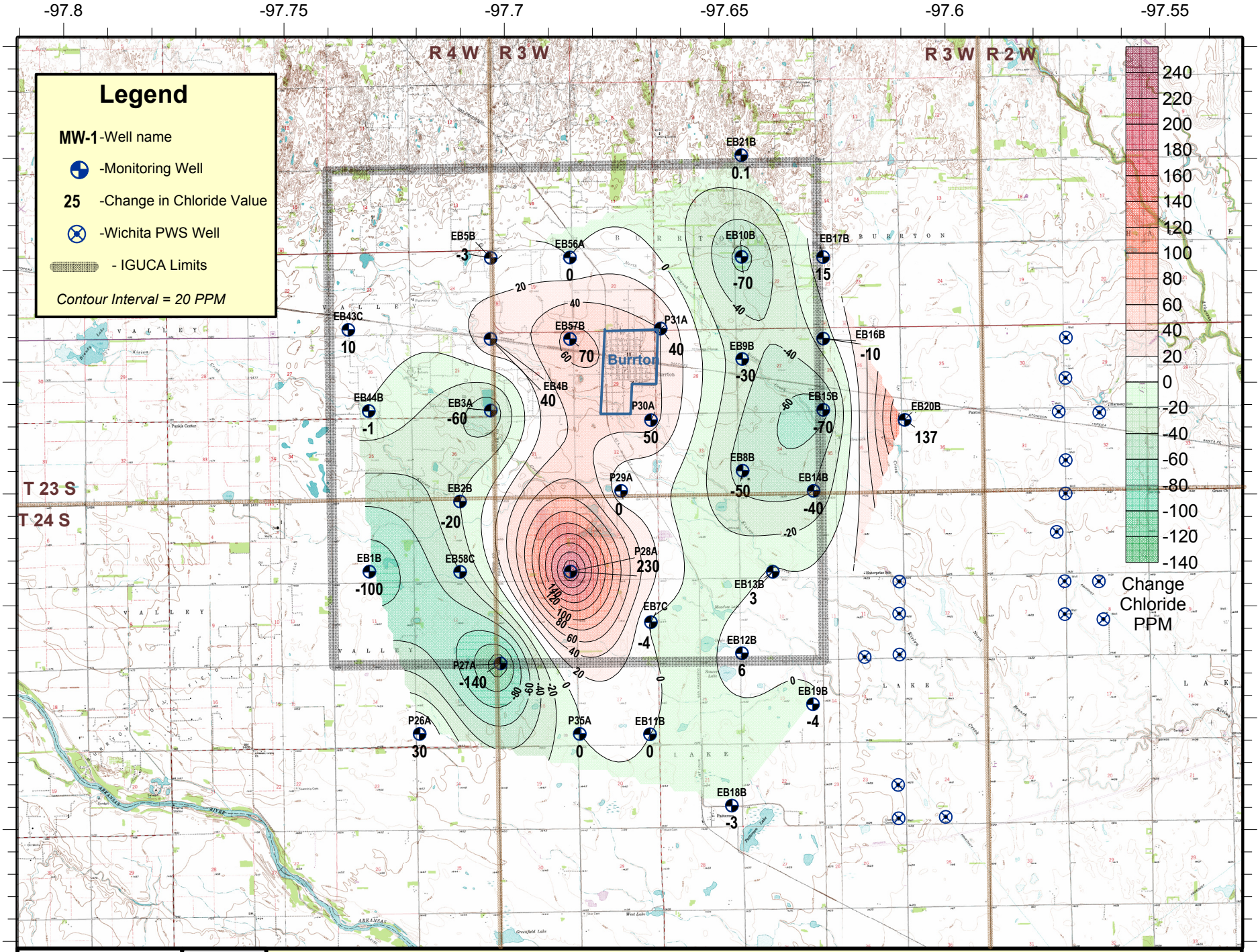
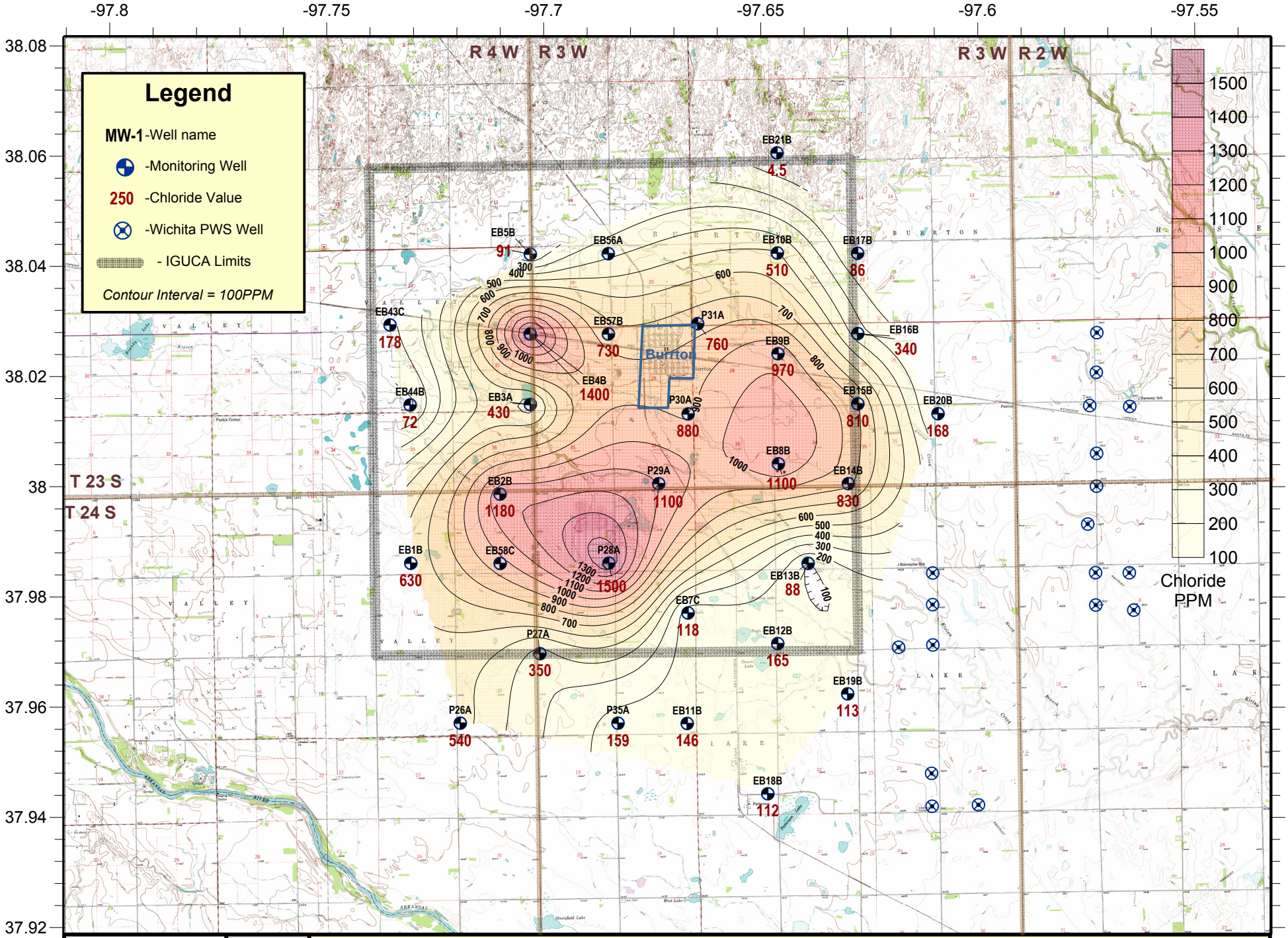
Burrton IGUCA Brine Contamination Field
A Zone Chloride Map Showing GMD#2 Groundwater Well Data from 2016
Reno and Harvey Counties, Kansas
KCC Project Code #970042-00 - KCC District #2 Field office - Map drawn on 10/13/2016 by D. Bollenback


Legend
MW-1 -Well name
-Monitoring Well
25 -Change in Chloride Value
-Wichita PWS Well
- IGUCA Limits
Contour Interval = 20 PPM
-97.8
-97.75
-97.7
-97.65
-97.6
-97.55
38.08
38.06
38.04
38.02
38
37.98
37.96
37.94
37.92
R 4 W
R 3 W
R 3 W
R 2 W
T 23 S
T 24 S
Burrton
EB21B 0.1
EB5B -3
EB56A 0
EB10B -70
EB17B 15
EB43C 10
EB57B 70
P31A 40
EB9B -30
EB16B -10
EB4B 40
EB44B -1
EB3A -60
P30A 50
EB15B -70
EB20B 137
EB8B -50
P29A 0
EB14B -40
EB2B -20
P28A 230
EB1B -100
EB58C
EB13B 3
EB7C -4
EB12B 6
P27A -140
EB19B -4
P26A 30
P35A 0
EB11B 0
EB18B -3
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
Change Chloride PPM
Kansas
Corporation Commission
N
Burrton IGUCA Brine Contamination Field
B Zone Chloride Map Showing GMD#2 Groundwater Well Data from 2016
Reno and Harvey Counties, Kansas
KCC Project Code #970042-00 - KCC District #2 Field office - Map drawn on 10/14/2016 by D. Bollenback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38.08
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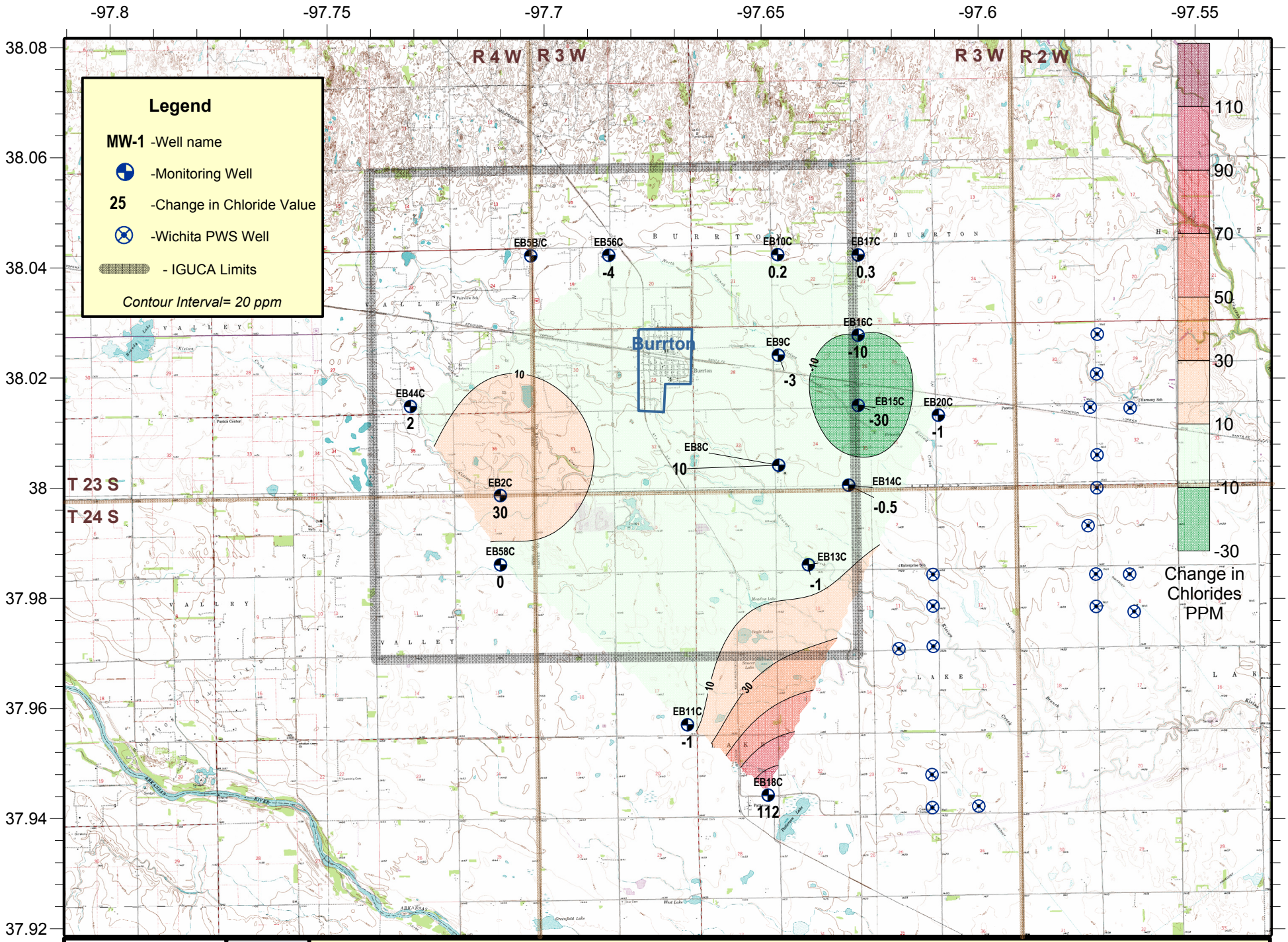
38.04
38.02
38
37.98
37.96
37.94
37.92
R 4 W
R 3 W
R 3 W
R 2 W
T 23 S
T 24 S
Legend
MW-1 -Well name
-Monitoring Well
250 -Chloride Value
-Wichita PWS Well
- IGUCA Limits
Contour Interval = 100PPM
Burrton
EB21B 4.5
EB5B 91
EB56A
EB10B 510
EB17B 86
EB43C 178
EB57B 730
P31A 760
EB16B 340
EB9B 970
EB4B 1400
EB44B 72
EB3A 430
P30A 880
EB15B 810
EB20B 168
EB8B 1100
P29A 1100
EB14B 830
EB2B 1180
EB1B 630
EB58C
P28A 1500
EB13B 88
EB7C 118
EB12B 165
P27A 350
EB19B 113
P26A 540
P35A 159
EB11B 146
EB18B 112
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
Chloride PPM
Kansas
Corporation Commission
N
Burrton IGUCA Brine Contamination Field
B Zone Chloride Map Showing GMD#2 Groundwater Well Data from 2016
Reno and Harvey Counties, Kansas
KCC Project Code #970042-00 - KCC District #2 Field office - Map drawn on 10/14/2016 by D. Bollenback



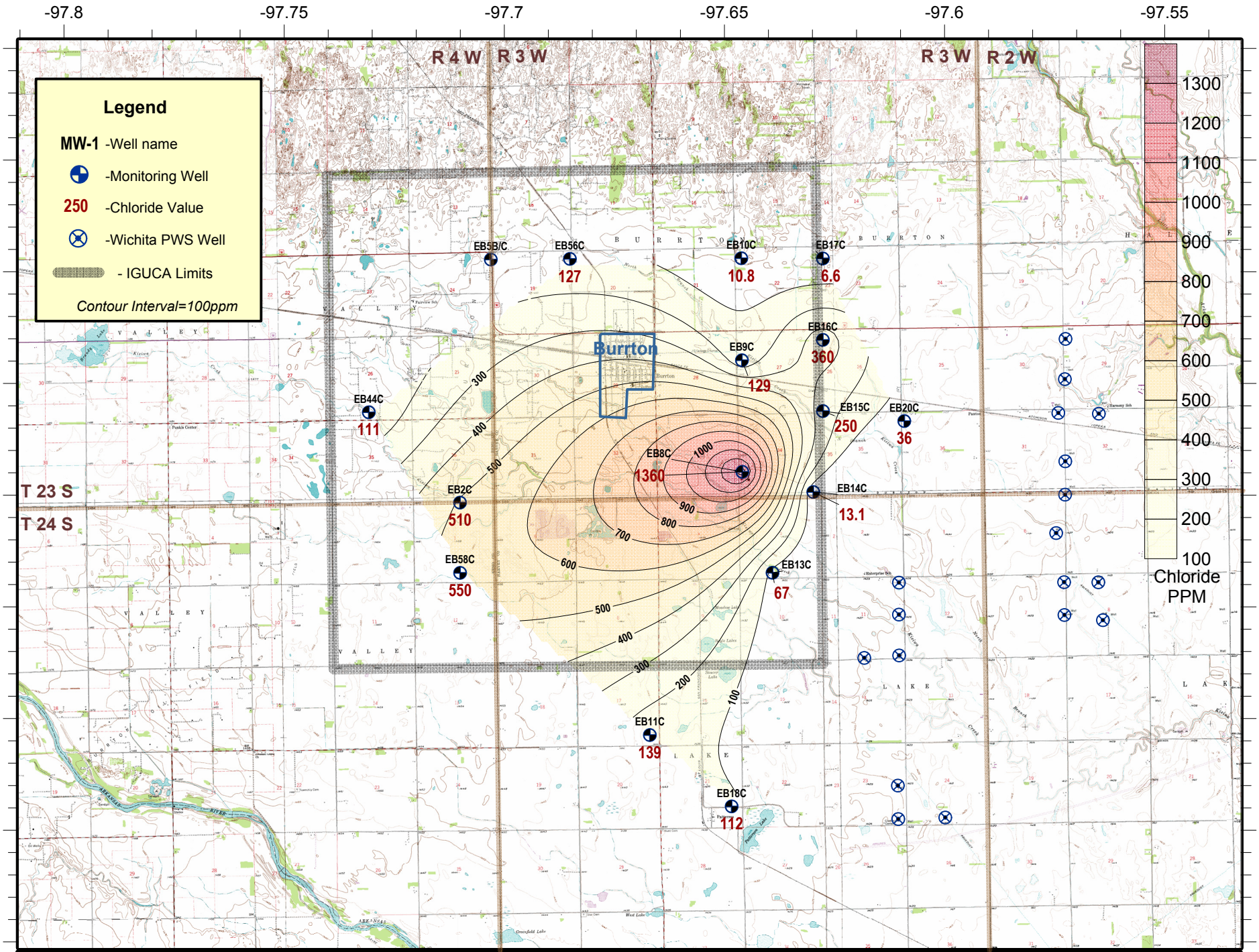
Kansas Corporation Commission

Burrton IGUCA Brine Contamination Field

C Zone Change in Chlorides Map 2015 to 2016

Reno and Harvey Counties, Kansas

KCC Project Code #970042-00 - KCC District #2 Field office - Map drawn on 10/14/2016 by D. Bollenback



Burrton IGUCA Brine Contamination Field

C Zone Chloride Map Showing GMD#2 Groundwater Well Data from 2016

Reno and Harvey Counties, Kansas

KCC Project Code #970042-00 - KCC District #2 Field office - Map drawn on 10/14/2016 by D. Bollenback

Project: ***Clawson Contamination Site***

Site Location: Legal location is East half of Section 33 and all of Section 34, Township 29 South, Range 34 West, Haskell County.

Impact/Immediacy: Irrigation well is contaminated and a pollution threat to other irrigation wells if contaminate is not contained to site. Site immediacy is rated at moderate to high and is under long term monitoring at the present time by the PRP.

Site Description: The site consists of a plume of brine-contaminated groundwater moving in an easterly direction. Area is blanketed by 500 feet of Ogallala sand and gravel. Bedrock underlying the Ogallala is the Dakota/Cheyenne formation. There is a total of 600 feet of freshwater bearing strata. Pollution occurs along a clay layer 360 feet below the surface (in the upper part of the freshwater aquifer). No domestic wells in the affected area. One irrigation well is currently polluted to the extent it cannot be used for irrigation purposes. Depth to groundwater is 300 feet. Depth to Cretaceous bedrock is 510 feet in the center of the SW/4 of Section 34. The Red Beds underlie the three aquifers at a depth of 635 feet.

Unusual Problems: High yield rates of the Ogallala formation and ongoing severe drought.

Status of Project: On October 12, 2016 DBS&A sampled seven monitoring wells on the Clawson site. Samples ranged from 576mg/L chloride in 05-01 to 3330mg/L chloride in well 05-02. Overall the chloride levels continue to decrease throughout the site. However, this sampling cycle showed an increase in concentrations throughout. The seventeen recovery and monitoring wells were plugged in October 2016.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: Modeling will be completed in 2017 to see how starting up the irrigation well for agriculture use would affect the plume. The 7 wells continue to be monitored until target concentrations are met. All of these expenses will be covered by the PRP and will only happen with the consent of the KCC.

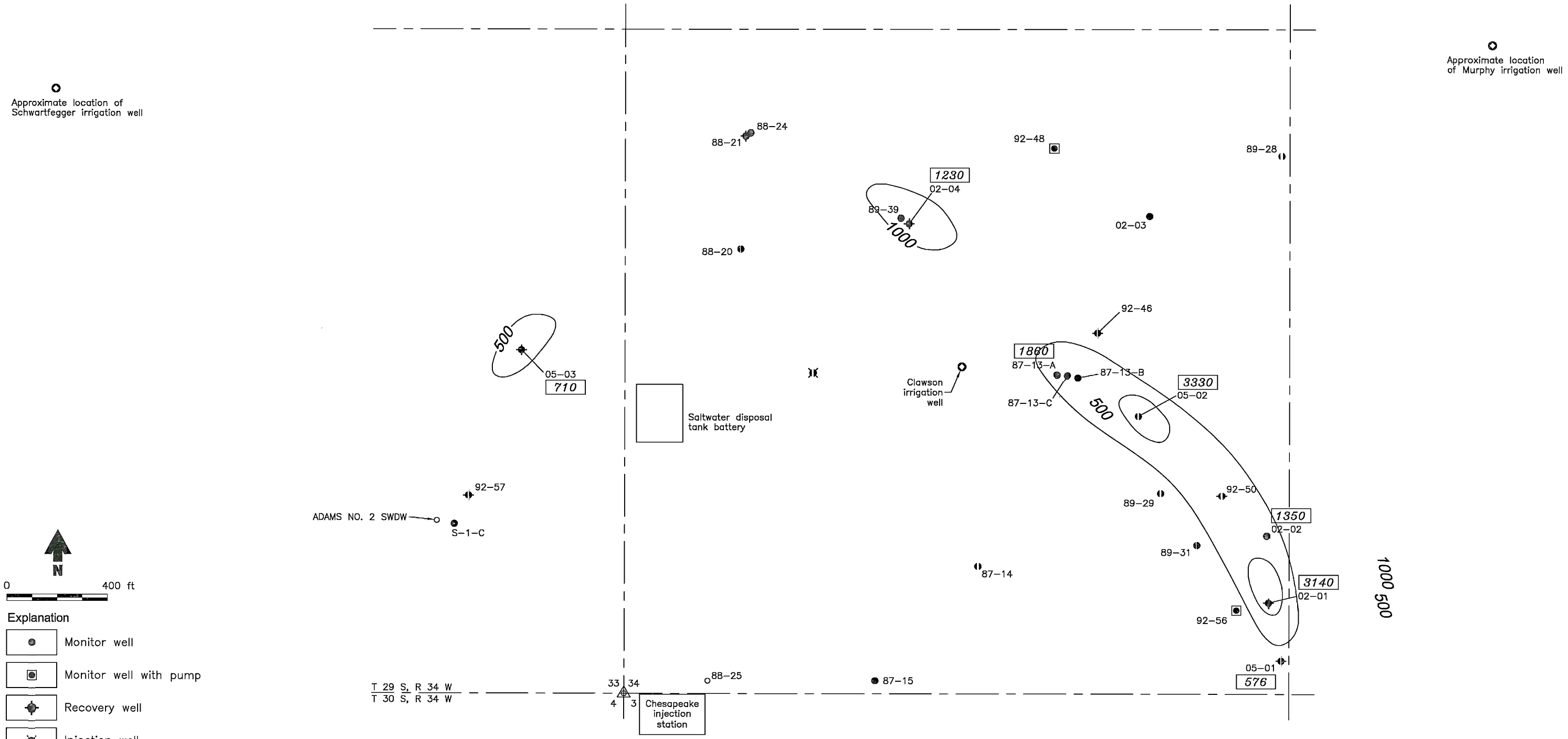
Estimated Total Costs: KCC - $450 a year. PRP – in excess of $2 million.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970005-00	**8.5 Hrs. / $239.49**		

Current Contaminate Level: 576 ppm Cl- to 3,330 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



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Daniel B. Stephens & Associates, Inc.
10/17/16

Haskell County Brine Cleanup
Haskell County, Kansas
Chloride Concentrations
October 12, 2016

Figure 3

Project: *Curtis Contamination Site*

Site Location: The legal location is Sections 23, 24, 25 & 26 of Township 24 South, Range 14 West, Stafford County.

Impact/Immediacy: The impact is to groundwater resources that have been contaminated by the flow of salt water from an old core drill hole. The core hole thought to be the source of contamination was plugged in 1988. This site has a low to moderate immediacy rating.

Site Description: This site was investigated after the Curtis irrigation well was reported salty. The aquifer in this area consists of unconsolidated material consisting mostly of sand and gravel, and is in general ninety feet thick. Several thin aquitards were encountered in the unconsolidated material. Bedrock consists of clay shale of various colors and was encountered at approximately 90 to 100 feet. The Curtis irrigation well tested salty upon completion and it was reportedly never used. It was also reported that no preliminary test boreholes were made before drilling the irrigation well. The irrigation well was probably drilled into the top of the bedrock and may have pumped chloride contaminated water from this zone.

Unusual Problems: The old core hole may have allowed cross flow of brine into the groundwater aquifer of the Rattlesnake Creek for more than forty years. The plume from this massive intrusion of brine extends to the northeast approximately two miles from the original source area.

Status of Project: Samples were taken from ten monitoring wells in 2016. The chlorides have remained steady in the area. The plume remains confined around MW-1.

Level of Remediation Sought:
Ideal: 250 ppm
Target: 500-1000 ppm

Recommendation for Future Work: MW-11 will need to be cleaned out in order to get a sample. Mapping of the coffining layer below the aquifer might reveal if there is a channel the brine is following, or electromagnetic induction profiling (EM), could be run to determine where the chlorides are, and pinpoint the highest impacted areas. This would give a better representation of the chlorides then the thin network of monitoring wells, and would help to pinpoint where future work would need to be focused. An EM survey would also help to identify if there is a current source of chloride intrusion.

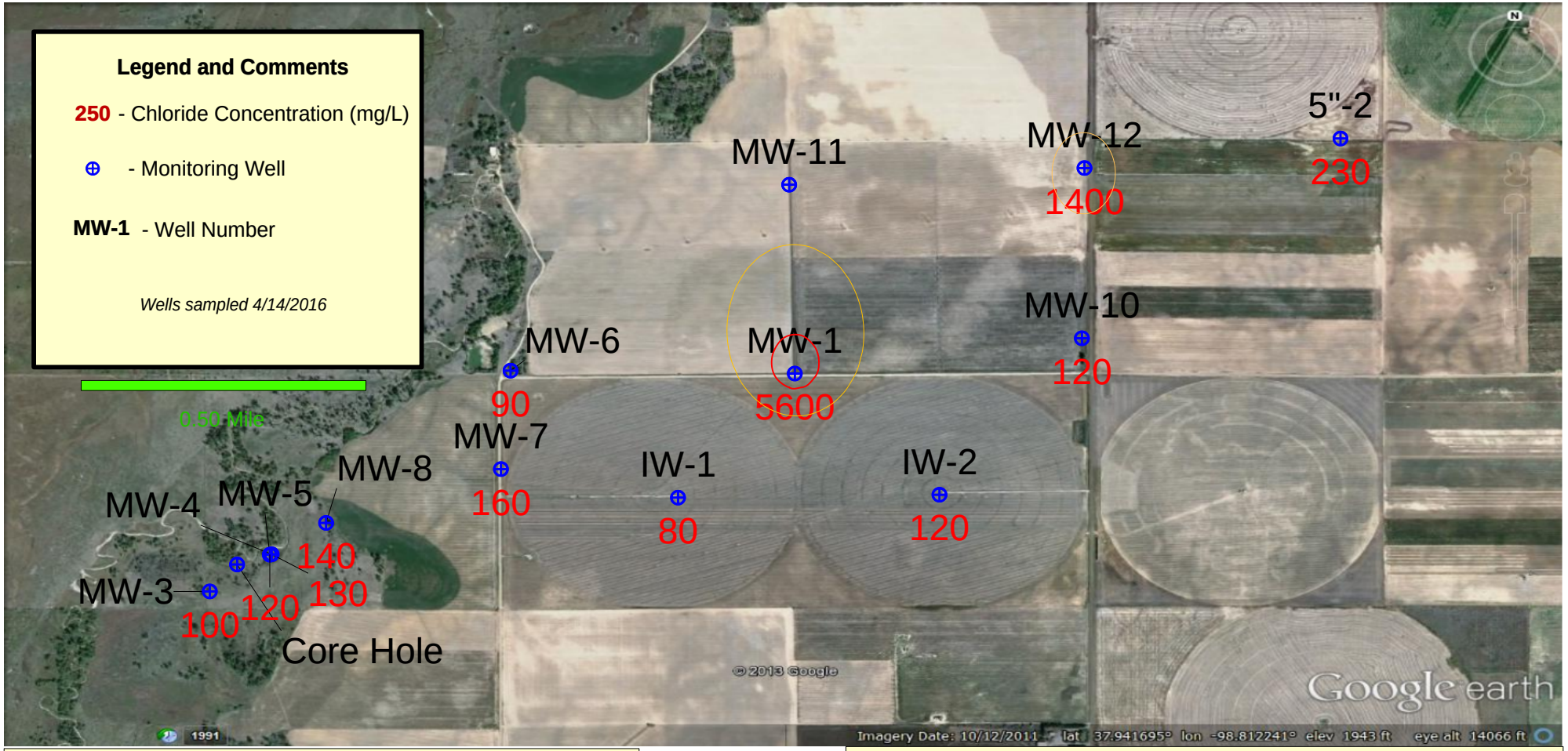
Estimated Total Costs: $27,000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970034-00	**8.5 Hrs. / $239.49**		**$4,199.17**

Current Contaminate Level: 80 ppm Cl- to 5600 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

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W E

S

Curtis Site

Sections 19/23/24/25/26-T24S-R14W
Stafford County, Kansas

2015 Area Map with Chlorides

KCC Control # 970034-00 District 1
K. Sullivan 4/19/16

Project: *Dinkel Contamination Site*

Site Location: SE/4 of Section 32, Township 13 South, Range 17 West, Ellis County.

Impact/Immediacy: Brine from oil field operations has impacted a shallow aquifer within the Big Creek drainage. The affected water was originally the sole source of domestic water for the farmstead, which is now on rural water. The immediacy level for this site is rated as low.

Site Description: This site is bounded on the north by I-70, positioned within the Younger oil field, and has active oil wells, enhanced recovery wells, and disposal wells in the vicinity. Possible contaminant sources include an evaporation pit (permit revoked July 1, 1958), a shallow injection well (injection authorization revoked September 3, 1969), or drilling pits associated with a nearby well.

Unusual Problems: None.

Status of Project: A total of 16 holes were drilled on the site in August and September of 2000, and three were completed as monitor wells. The household is on rural water, and the well water is now utilized for cattle. Pumping to waste may be utilized to remove contaminated water; however, the aquifer may not have the capacity to allow for appreciable gains when compared to the amount of water pumped. Because the house has a source of drinking water, and the chloride concentrations in the aquifer are not unsuitable for beef cattle, remediation is not warranted at this time.

Well ID	2012 Chlorides	2013 Chlorides	2014 Chlorides	2015 Chlorides	2016 Chlorides
5	1060 ppm	1300 ppm	1300 ppm	1400 ppm	1400 ppm
7	880 ppm	1000 ppm	900 ppm	900 ppm	750 ppm
9	1020 ppm	1200 ppm	1200 ppm	1100 ppm	1050 ppm

Level of Remediation Sought:

Ideal: 100 ppm Chloride

Target: 500 ppm Chloride

Recommendations for Future Work: Annual sampling will continue at this site.

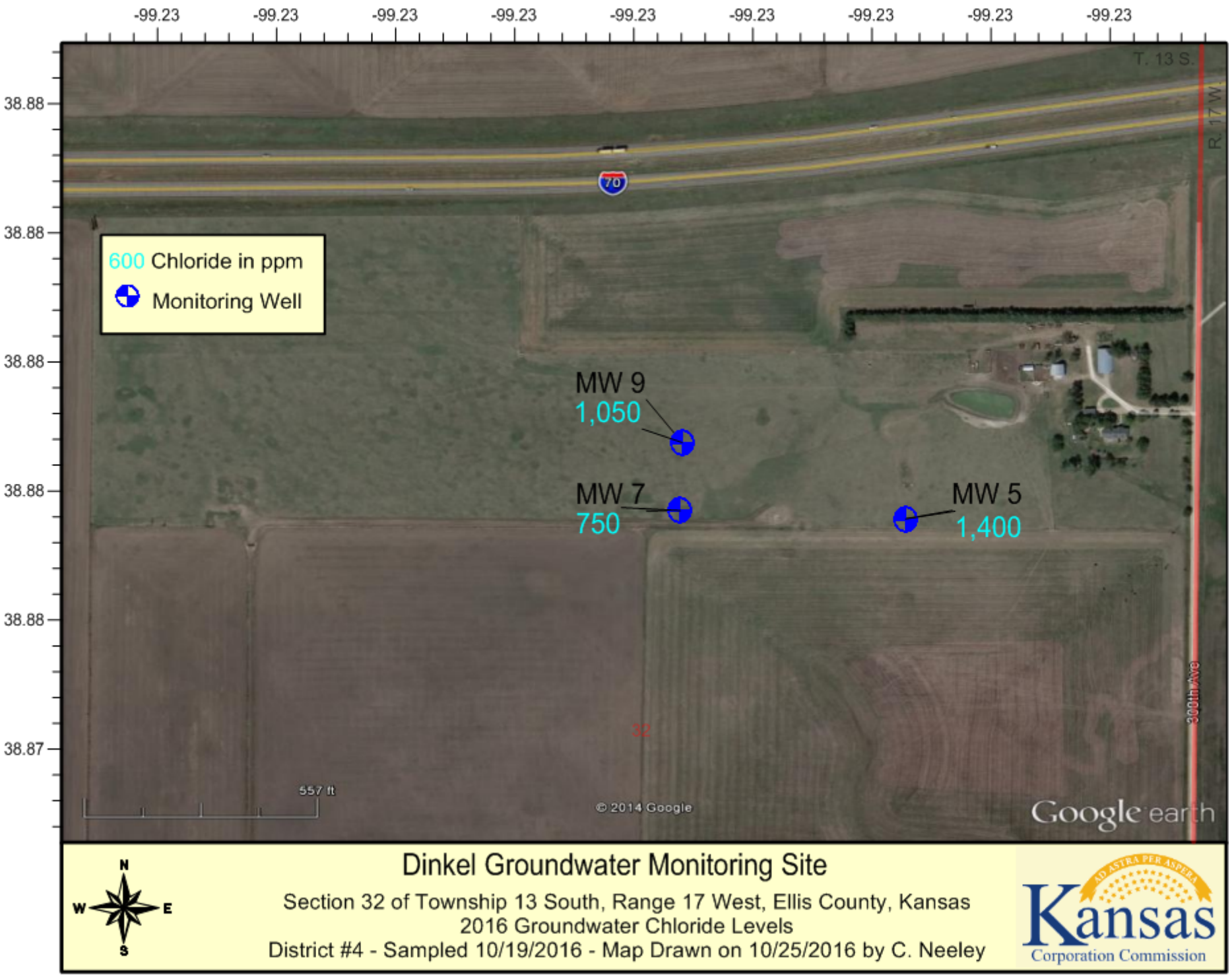
Estimated Total Costs: $28,000 to $30,000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17 Total**
970035-00	**7 Hrs. / $202.60**	

Current Contaminate Level: 750 ppm to 1,400 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**


-99.23
38.88
38.87
T. 13 S.
R. 17 W.
70
600 Chloride in ppm
Monitoring Well
MW 9
1,050
MW 7
750
MW 5
1,400
32
300th Ave
557 ft
© 2014 Google
Google earth
N
W
E
S
Dinkel Groundwater Monitoring Site
Section 32 of Township 13 South, Range 17 West, Ellis County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 10/19/2016 - Map Drawn on 10/25/2016 by C. Neeley
Kansas
Corporation Commission

Project: *Burrton Crude Oil EB-3C*

Site Location: The EB-3C contamination site is located at a crossroads located at the convergence of Sections 25 and 36, Township 23 South, Range 4 West and Sections 30 and 31 of Township 23 South and Range 3 West, Harvey and Reno County. The site is one mile west and one mile south of Burrton, Kansas.

Impact/Immediacy: Low immediacy level. The spill affects a shallow groundwater aquifer with no residences within a half mile. The area extent of contamination is believed to be less than one acre. No domestic water wells or irrigation wells are immediately down gradient of the site.

Site Description: The site is located in rural Harvey and Reno County. The land use is agricultural. The depth to groundwater is less than ten feet. The affected groundwater is the Equus Beds. The A layer of the Equus Beds is very permeable, is very productive and contains good water quality but is brine impacted locally.

Unusual Problems: This site is a hydrocarbon impacted site with problems different than brine impaction. The clay above the Equus Sands deepens down gradient and is acting as a trap for the crude oil. Historical static water levels have intersected this clay layer to the south and east.

Status of Project: KCC has evaluated multiple remedial techniques from natural attenuation, new well installation and hydro-carbon absorbing aqua-socks, and oxygenating chemical injection into the aquifer. KCC district #2 feels that injection of an oxygenating chemical would help speed-up natural break-down of the hydrocarbons by increasing micro-bioremediation. Due to the current low immediacy rating and low levels of free product KCC does not have plans to move forward with the remedial injection during 2017.

Level of Remediation Sought:

Ideal: Non –detect of TPH (Aqueous-Phase)
Target: No Free Liquid-Phase Hydrocarbon

Recommendations for Future Work: Nothing at this time as the site is listed as low priority and there have been no water wells drilled in the immediate area. In the future KCC may look into the use of an emulsifier to work in hand with the oxygenating treatment. The oxygenating compounds will continue to help breakdown any contaminates in aqueous form. After sufficient improvement is found KCC will close the site.

Estimated Total Costs: Approximately $5,000 to install shallow well/s and inject the remedial compounds.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Total
970042-00	2 Hrs. / $65.42	$	$2,350

Current Contaminate Level: NDA

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☒ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved

Kansas Corporation Commission

N W E S

Burrton EB-3C - Crude Oil Spill

Sections 30 & 31 - Township 23 South and Range 3 West, Reno County, Kansas

Annual Site Map 2016-17

KCC District #2 Field Office - Map Drawn by D.Bollenback on 10/6/2016

Project: *Elm Creek Contamination Site*

Site Location: Sections 19, 20, 29, 30, 31, and 32 of Township 7 South, Range 17 West
Sections 5, 6, 7, 8, 17, 18, 19, 20, 29, 30, 31, and 32 of Township 8 South, Range 17 West
Sections 5 and 6 of Township 9 South, Range 17 West, Rooks County

Impact/Immediacy: The Elm Creek alluvial aquifer has been contaminated by past oil field activity. Both domestic and stock wells are affected. The area is serviced by Rooks County Rural Water District #3, and the immediacy level for this site should be rated as moderate to high.

Site Description: Elm Creek is a tributary to the South Fork Solomon River, which it enters just downstream of Stockton, Kansas. Numerous complaints beginning in the mid 1900s led to wide-spread sampling, and the designation of approximately 40 square miles as the site. A series of monitoring wells were completed in the alluvial deposits of the drainage near the confluences of other streams with Elm Creek in an attempt to constrict the size of the contamination site by identifying the direction from which pollution originated. The installation of the monitor well net was completed in May of 1998, and sampled for 5 years by a third party. Following the sunset of the sampling contract, the well net was sampled quarterly for three years, and biannually for two years. Sampling is now performed annually by KCC staff.

Unusual Problems: The history of contamination in the Elm Creek area is extensive, and many of the possible sources of pollution were insufficiently documented. Additionally, the large areal extent of the site poses challenges for investigation and remediation.

Status of Project: Long-term monitoring has revealed that the chloride concentrations in the monitoring wells have remained the highest near the south end of the site. Presently, the chloride level in even the most severely impacted areas of the site do not preclude use of the water for stock use, irrigation of certain plants, or general non-potable use. Four monitoring wells contain chloride ions in concentrations which are above what is considered to be fresh water (500 ppm), five wells are below the freshwater threshold, but above drinking water standards (250 ppm), five wells are below the chloride concentration threshold for water suitable for human consumption.

Level of Remediation Sought:
Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: While the trend in contamination distribution has remained relatively stable, long-term monitoring should continue until the target level is reached, or the site parameters change in such a way as to warrant further investigation and remedial efforts.

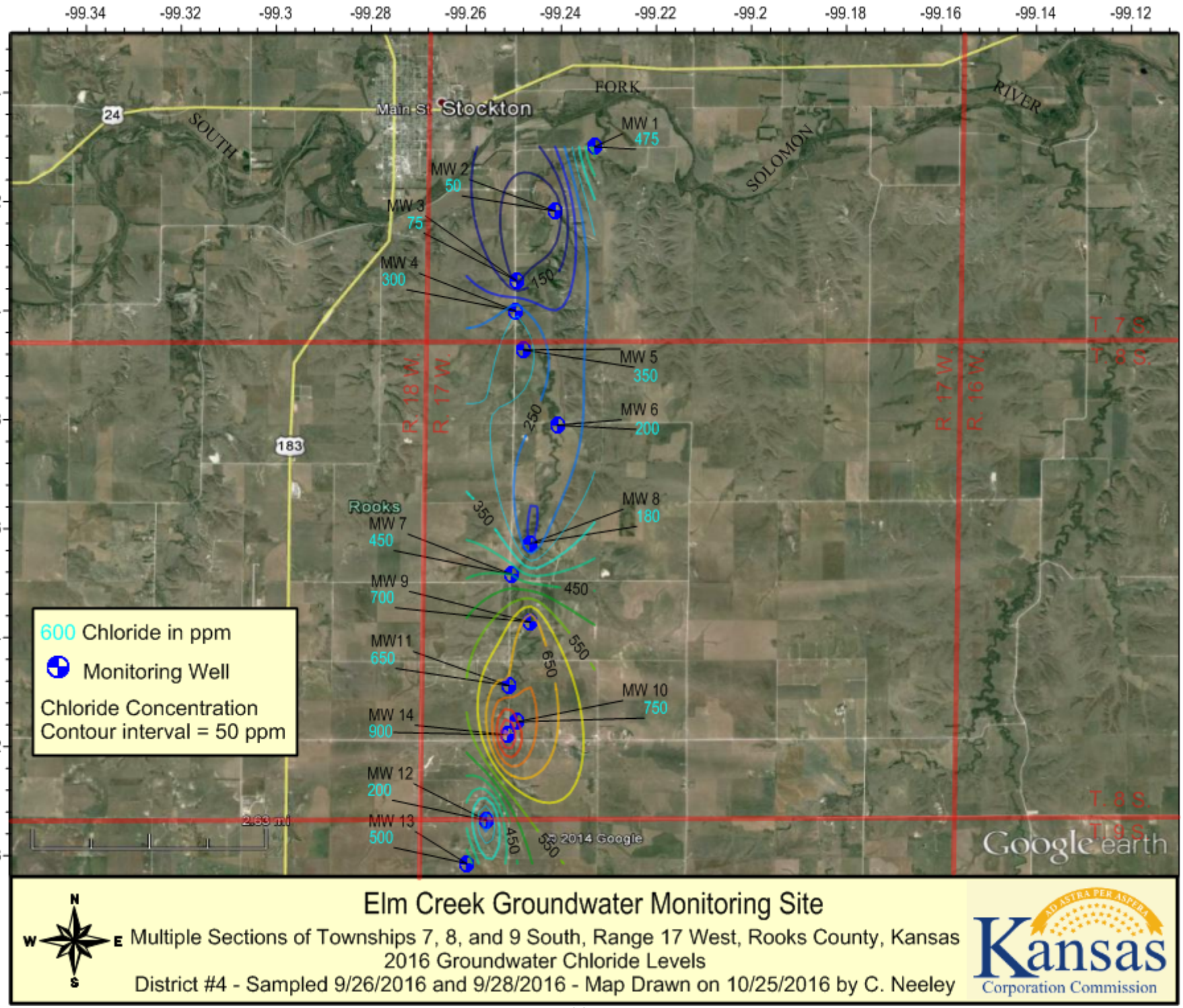
Estimated Total Cost: If warranted, remediation costs could reach a total of $250,000.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970043-00	**34 Hrs. / $927.30**		**$29,212.25**

Current Contaminate Level: 50 ppm to 900 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Elm Creek Groundwater Monitoring Site

Multiple Sections of Townships 7, 8, and 9 South, Range 17 West, Rooks County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 9/26/2016 and 9/28/2016 - Map Drawn on 10/25/2016 by C. Neeley

Kansas Corporation Commission

Project: *Enoch Thompson Contamination Site*

Site Location: Legal location is NW/4 Section 17, Township 21 South, Range 20 West, Pawnee County**.**

Impact/Immediacy: Stock well was damaged by chlorides from a line leak found near the SWDW. An irrigation well is located to the southwest of the site in the direction of the plume flow. Potential responsible parties drilled one recovery well and a replacement stock well in October 1988, thereafter the chlorides of which dropped through the years. The site is rated moderate to low in immediacy.

Site Description: The contamination is confined to a narrow alluvial scour channel filled with sandy gravel and silty clay. The high concentrate of brine water moved from the source area in the north to the south and contaminated Mr. Thompson's stock well.

Unusual Problems: None**.**

Status of Project: Five groundwater samples were collected in 2016. Chloride levels across the board have seen a decrease. The recovery system has been down since 2003 following P&A of the disposal well due to wellbore problems. KDHE-1, which has historically been the highest in terms of chlorides, was destroyed December 2003. The chloride plume continues to be localized in a relatively small area of alluvial scour between the recovery well and the plugged disposal well. It is unlikely that without the recovery well operational, the site will see any significant change in chlorides.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 1000 ppm Chloride

Recommendation for Future Work: Continue groundwater sampling on an annual basis to monitor movement of chloride plume through the area. Should a disposal well be drilled nearby, the feasibility of restarting the recovery well should be evaluated.

Estimated Total Cost: $500 for yearly sampling.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970044-00	**13.5 Hrs. / $350.26**		

Current Contaminate Level: 20 ppm Cl- to 2600 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

Kansas Corporation Commission

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Enoch Thompson Site

Section 17-T21S-R20W
Pawnee County, Kansas

2016 Area Map with Chlorides

KCC Control # 970044-00 District 1
K. Sullivan 7/8/16

Project: *Leon Fink Contamination Site*

Site Location: SE/4 of Section 22, and NE/4 of Section 27, Township 8 South, Range 22 West, Graham County.

Impact/Immediacy: Stock well in the Codell Formation testing high in chlorides. Immediacy level is rated as low.

Site Description: The site encompasses a stock well and a now abandoned domestic well. Both were drilled into the Codell sandstone which is a marginal aquifer in Graham County. The chloride was initially very low, but rose sharply in the stock well during the 1970's. Surface sources were considered, but due to the nature of the bedrock and the depth to the Codell aquifer, it is more likely that the pollution originated from a source below ground. The Fink #2 saltwater disposal well (SWD) was originally completed as an oil well in 1954, and converted to an enhanced oil recovery well before ultimately being converted back to a SWD. This well was long the subject of interest, but before the implementation of the Federal Underground Injection Control, there was little statutory authority to rigorously check the integrity of the well bore. For this reason, it was never proved or disproved that the well was the source; However, the construction of the well is highly suspect, and may or may not continue to be a conduit for saline water from brackish zones to enter the Codell despite the fact that the well was plugged in 1984.

Unusual Problems: The depth to the contaminated zone is approximately 250 to 300 feet, making investigation and remediation difficult.

Status of Project: The domestic well has been abandoned due to a water level that is inadequate for use by the owner, and the house has been abandoned as well. The last sample taken from this source in 2004 contained a chloride concentration of 200 ppm. Samples from the stock well continue to be tested, and the well is presently being utilized for livestock which will contribute to a reduction in chloride concentrations if the source has been eliminated. An overall downward trend has been observed over the history of the site, and the current contamination concentration is at 805 ppm.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: This site should be monitored long-term to ascertain if the source of chloride ions has been isolated from the useable water in the Codell Sandstone aquifer. An investigation of the Fink #2 and the water well should also be conducted.

Estimated Total Costs: $2000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17 Total**
970007-00	**5 Hrs. / $145.76**	

Current Contaminate Level: 805 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**


-99.78
-99.77
-99.77
-99.76
-99.76
39.34
39.34
39.34
39.33
39.33
39.33
22
T. 8 S.
R. 22 W.
Fink Livestock Well
805
600 Chloride in ppm
Livestock Well
27
1407 ft
© 2014 Google
Google earth
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W
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S
Leon Fink Groundwater Monitoring Site
Section 27 of Township 8 South, Range 22 West, Graham County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 3/11/2016 - Map Drawn on 8/16/2016 by C. Neeley
Kansas
Corporation Commission

Project: *Fowler Contamination Site*

Site Location: NE/4 of Section 19, Township 32 South, Range 14 East, Montgomery County.

Impact/Immediacy: Impact is to the soil. The immediacy is rated as low.

Site Description: Site is located below an old three-cell storage/settling pond.

Unusual Problems: Access to dependable sample locations and lack of monitoring wells.

Status of Project: Monitoring of small creek running through project area. The Fowler lease was approved for a Fee Fund Project in the fall of 2000. Approximately 112 wells were plugged in 2001. Samples were collected in 2016 on 10/31/2016. The surface sample from Location #1 tested 650 ppm Cl-; the sample from location #2 tested 100 ppm Cl-. Brine impacted areas continue to show significant improvement of vegetative growth as shown on 2015 aerial imagery (most current available).

Level of Remediation Sought:

Ideal: 200 ppm Chloride
Target: 300 ppm Chloride

Recommendation for Future Work: Future work on this site will consist of post remediation monitoring. Brine impacted area below old 3 cell storage pit has successfully been remediated and landowner has filled the eastern third with construction debris consisting of soil, rock, and asphalt.

Estimated Total Costs: Monitoring cost approximately $1,500.00 per year.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970046-00	**12.5 Hrs. / $361.42**		

Current Contaminate Level: 100 ppm Cl- to 650 ppm Cl-

Status: Active

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☐ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☒ **8. Post Rem. Monitoring**	☐ **9. Resolved**

KANSAS CORPORATION COMMISION
Fowler Remediation Site
NE19-T32S-R14E
Montgomery County, Kansas
Project 970046-00

11/05/2016 District 3

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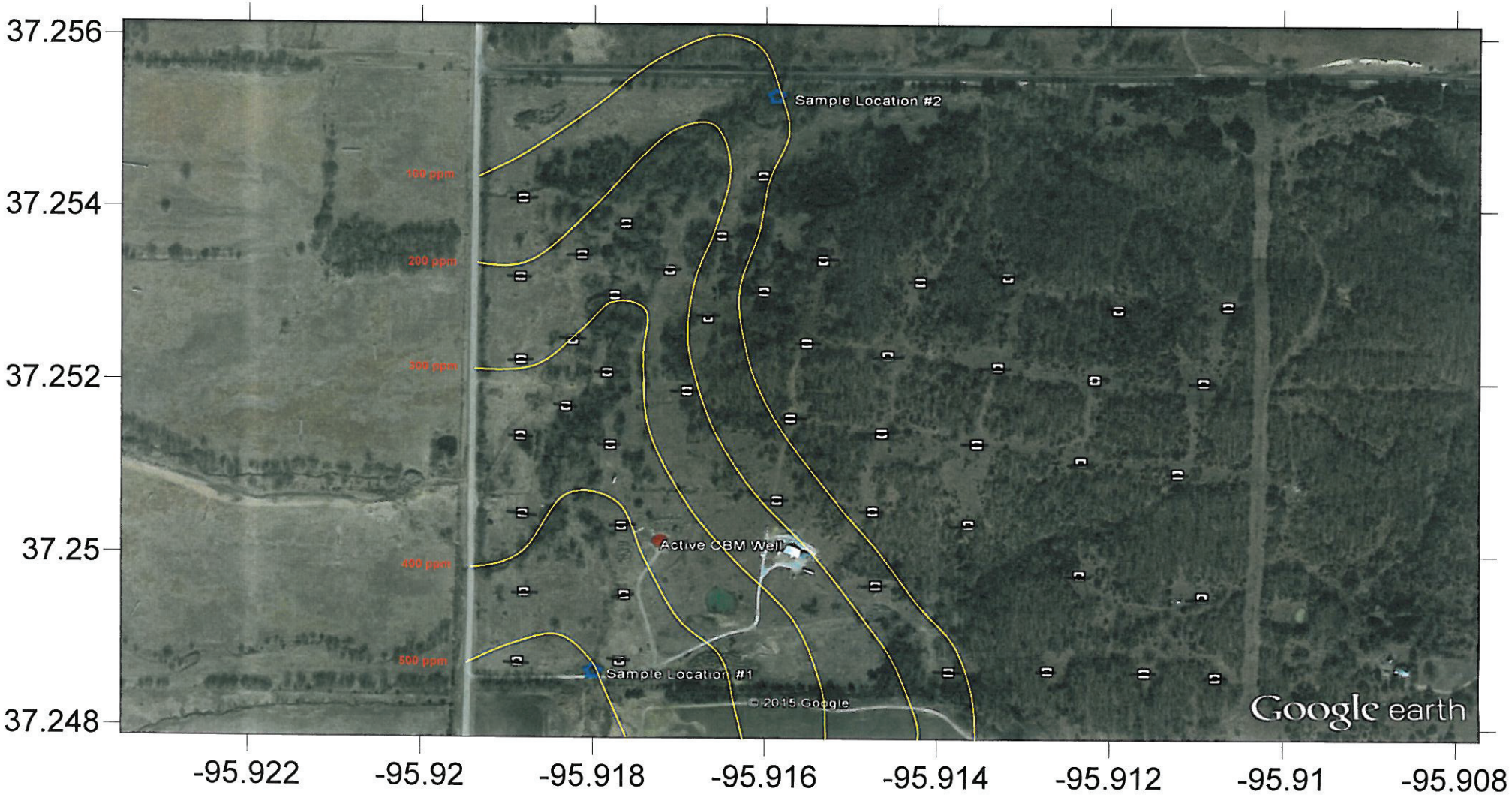


Contour Interval 100 ppm Cl-

Sample Locations

Fee Fund Plugged Well

Active CBM Well

Project: *French Contamination Site*

Site Location: The site is located in Section 17, Township 23 South, Range 13 West, Stafford County.

Impact/Immediacy: Potential exists for impacts on stock and irrigation resources. Subsidence around the French "A" 1 has developed into a sinkhole. Worst-case scenario would be a catastrophic collapse taking part of an east-west county road and several acres of farm ground. Probable action is a gentle downward movement of the area until stable. The site has a moderate to high rating.

Site Description: The site consists of an unplugged saltwater disposal well whose operation led to the development of a solution cavity. The site is located in a rural setting 330' north of a county road. Land use is agricultural with oil activities in the area. The subsidence at the site now covers an area of approximately 600 x 1000' in size.

Unusual Problems: A solution cavity was determined to exist under the existing location by a seismic survey conducted by the KGS. The seismic survey indicates the cavity is approximately 60' thick.

Status of the Project: Elevations were shot on 4/14/2016. The majority of the drop is in the eastern part of the sinkhole, with the most dramatic drop to the northeast. The eastern part of the sinkhole is dropping quicker than in the recent past. The seismic that was shot over it would indicate that the sinkhole will continue to subside to the east. Survey point 'Old BM' appears to have been destroyed during the past year.

Level of Remediation Sought:

Ideal: Stabilize cavity and plug well bore in accordance with KCC rules and regulations.

Target: Safely monitor site. Determine an acceptable plugging procedure, which will adequately address groundwater resources.

Recommendations for Future Work: Monitor stock wells and irrigation wells to the southeast of the depression. Resume the annual survey of the site to establish a current rate of subsidence. Monitor possible second depression to the southeast of the original depression.

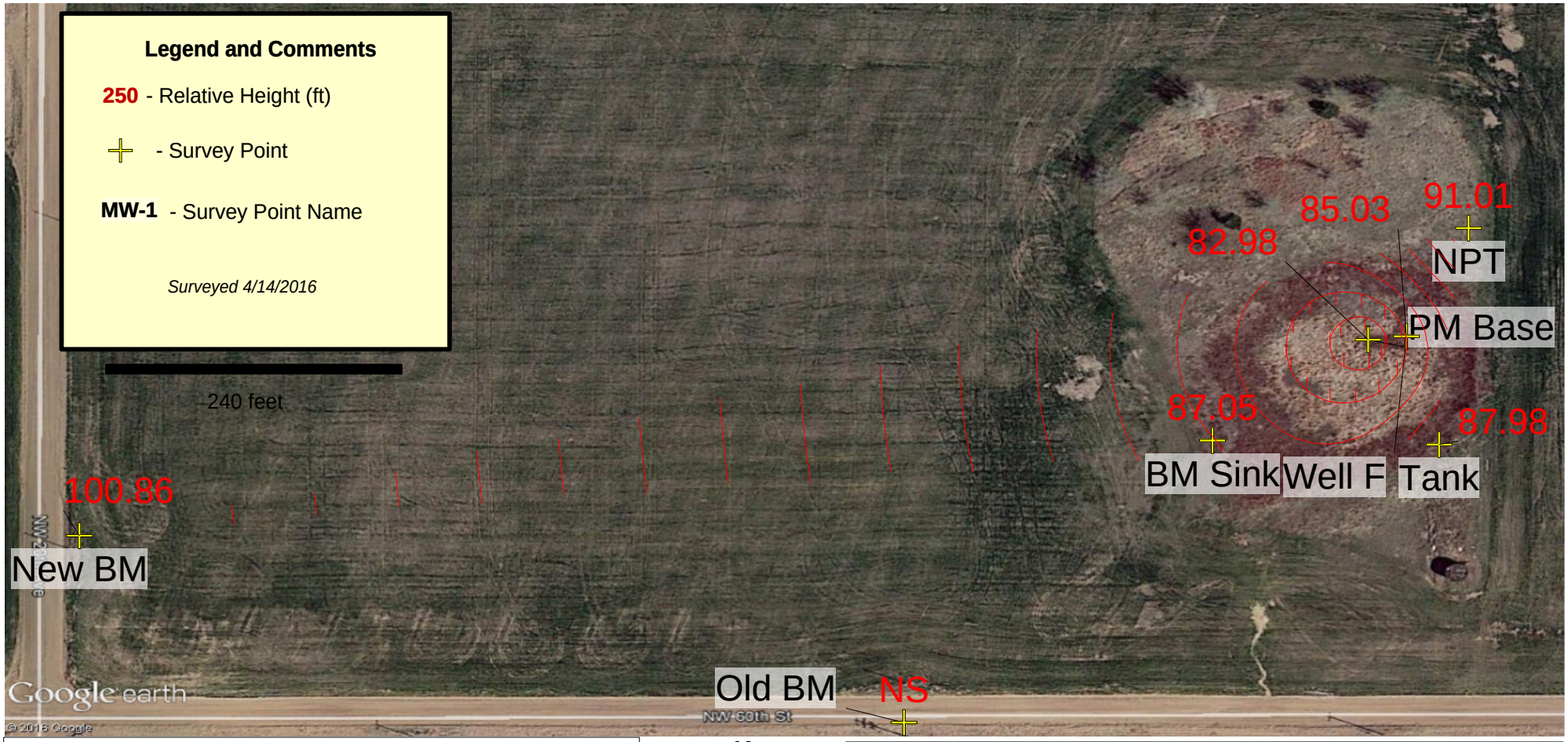
Estimated Total Costs: $3000.00

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
990002-001	**6.5 Hrs. / $185.93**		**$346.50**

Current Contaminate Level: Unknown.

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

N W E S

French Sinkhole

SW 1/4 Section 17-T23S-R13W

Change in Elevation Map

KCC Control #970002-001 District #1

K. Sullivan 4/19/2016

Project: *Galva City Area Contamination Site*

Site Location: This contamination site is located in Section 15 and 22 of Township 19 South, Range 2 West, which is half mile north and quarter mile east of Galva City in McPherson County.

Impact/Immediacy: This site has been up graded to a very high level of immediacy. Groundwater has been impacted and the potential for contamination to domestic and the public water supply at Galva City is very high. A water sample was taken from Galva City Well #3 in July 2006 and the chlorides tested 460 mg/l, 2007 tested 1170 mg/l and in July of 2008 tested 1200 mg/l. A Sample of the same public supply well was taken in 2011 and tested to be 670 mg/l. A sample was not available for 2014.

Site Description: The site is located in a rural area with topography of gentle sloping fields with a small drainage stream located east and west of site with the flow from the north to the southwest. This site is in the Ritz-Canton oil field, which has a past history of utilizing brine pits for the disposal of brine from the wells. The depth to the ground water is 17 $^{+/-}$ feet. There are buried paleo-channels in the area where the bedrock is encountered at approximately 60-100 feet which usually hold the highest chloride levels close to the top of the Wellington Shale. KCC has operated a recovery system at this site since 2005.

Unusual Problems: The disposal well will not take the amount of fluid necessary run all four recovery wells at the same time. High Chloride water deteriorates metal pumps, fittings, etc. Recovery pumps have short life spans and the local groundwater has high levels of iron which clog up lines and equipment. The age of the site requires constant vigilance into inspection and proactive and reactive repairs/modifications in order to keep it online.

Status of Project: August 2014 KCC completed the Phase III package which included the installation of 5 monitoring wells and 1 recovery well. Data obtained from these additional wells shows a strong chloride source to the east/northeast of the remedial site in section 14. There are multiple suspected pits in that section, including the prior location of a distillation refinery and associated pits that were operational in the forties. It appears that chlorides are following along the paleo-valley slope (top of the Wellington Formation) that is located northeast of Galva and pooling. There is a paleo high directly below the City and its PWS wells. This is suggests to be the only reason that the public water supply is still viable, as brine water is settling in the lower zones of the aquifer. The hydraulic gradient between MW-214 and MW-401was 0.00098836 ft/ft in 2016, and the average water level increase was 1.99' from 2015. The extremely high chlorides across the site showed stability during 2016 except for the monitoring wells within the radius of influence of RW-3 which has increased for the second year in a row. RW-3 had a pump failure which took it offline for 6 months while KCC bid out the work for replacement during 2014-15. RW-3 was put back online on October 4th, 2015 and was metered at pulling 62 gallons per minute with a chloride level of 25,500 mg/L. Recovery wells sampled on November 3, 2016 shows chloride levels of; RW-1(8,500 mg/L), RW-3(26,000 mg/L), and RW-5 (1,200 mg/L). RW-2 could not be sampled as the ball valve on the manifold was stuck closed. RW-3 has increased by 3,000 mg/L since it has been down over most of 2016. Due to limited disposal capacity of the SWDW shared with two other operators, RW-3 was no longer viable to run for long periods of time as it produced too much fluid. RW-5 which pumps at a rate of 28 GPM was the only well that the system could handle for most of 2016. KCC contacted contractor regarding moving the saltwater tank to the disposal well site in order to improve disposal capacity. KCC was waiting on written bids as of the writing of this report.

Level of Remediation Sought:

Ideal: 250 mg/l chlorides
Target 500 mg/l chlorides

Recommendations for Future Work: KCC will be putting together a follow up scope of work to continue with the Phase III started in 2014. Main focus of future work will be to the direction of the old refinery site and to the east of the remedial system. Evidence has shown a strong possibility that the refinery and its associate pits are large sources of the brine contamination that is encroaching on the City of Galva. Bedrock orientation as well as chloride levels in MW-114 support this idea. KCC will be looking into the possibility of multiple monitoring well and possible recovery well installations during the next phase. If more supporting evidence is found regarding the source potential of the refinery, KCC will contact KDHE as the refinery is listed as a no further action KDHE site. KCC is waiting on written bids in order to move the saltwater tank to the disposal well location. KCC also plans on requiring a barrel test to be performed by all parties that utilize the salt-water disposal well. The original and current contractual agreement states that the KCC has primacy and is allotted 5/8 of fluid disposal capacity of the well. The remedial system is in need of more disposal capacity and KCC will make sure the site is allotted the agreed upon percentage. The site would benefit from its own disposal well but that is extremely cost prohibitive.

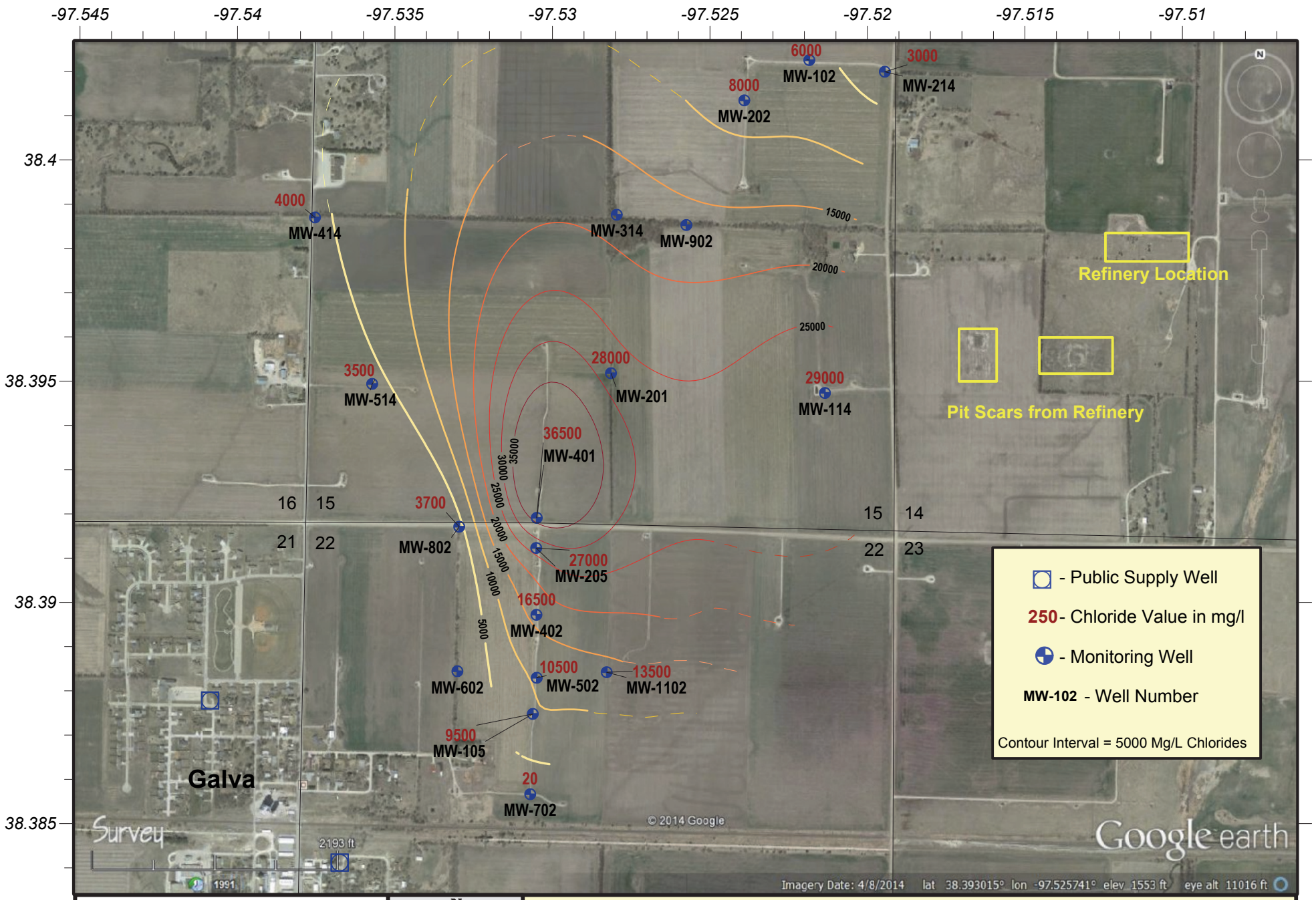
Estimated Total Costs: Regular annual costs are approximately $4,000-6,000. This includes Field work addressing, modifying, or repairing the remediation system, system inspection, groundwater sampling, research, and report writing. The continued Phase III work would cost in the $20,000-30,000 range.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
980033-001	**228 Hrs. / $6,150.65**	**$6,872.42**	**$277,263.04**

Current Contaminate Level: 36,500 mg/l (MW 401) to 3,000 mg/l (MW 214) chlorides for 2016

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☒ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



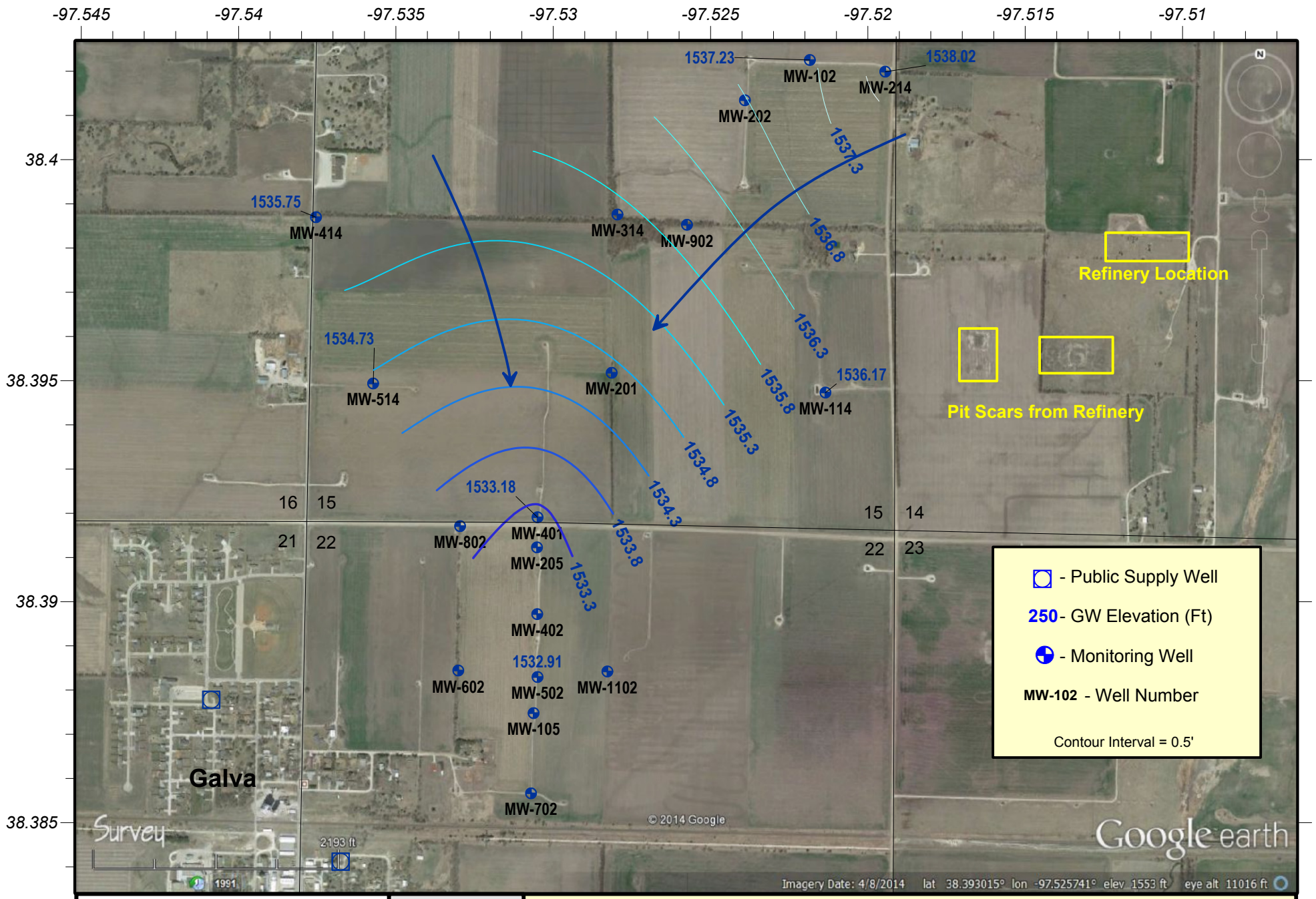
Kansas Corporation Commission

Galva City Brine Remediation Site

Sections 15, 16, 21,and 22 of Township 19 South and Range 2 West, McPherson County, Kansas

2016-17 Chloride Levels

KCC Control #980033-01 - KCC District #2 Field Office - Map Drawn on 11/4/2016 by D.Bollenback



Kansas Corporation Commission

Galva City Brine Remediation Site

Sections 15, 16, 21,and 22 of Township 19 South and Range 2 West, McPherson County, Kansas

2016 Groundwater Elevations

KCC Control #980033-01 - KCC District #2 Field Office - Map Drawn on 11/4/2016 by D.Bollenback

Kansas Corporation Commission

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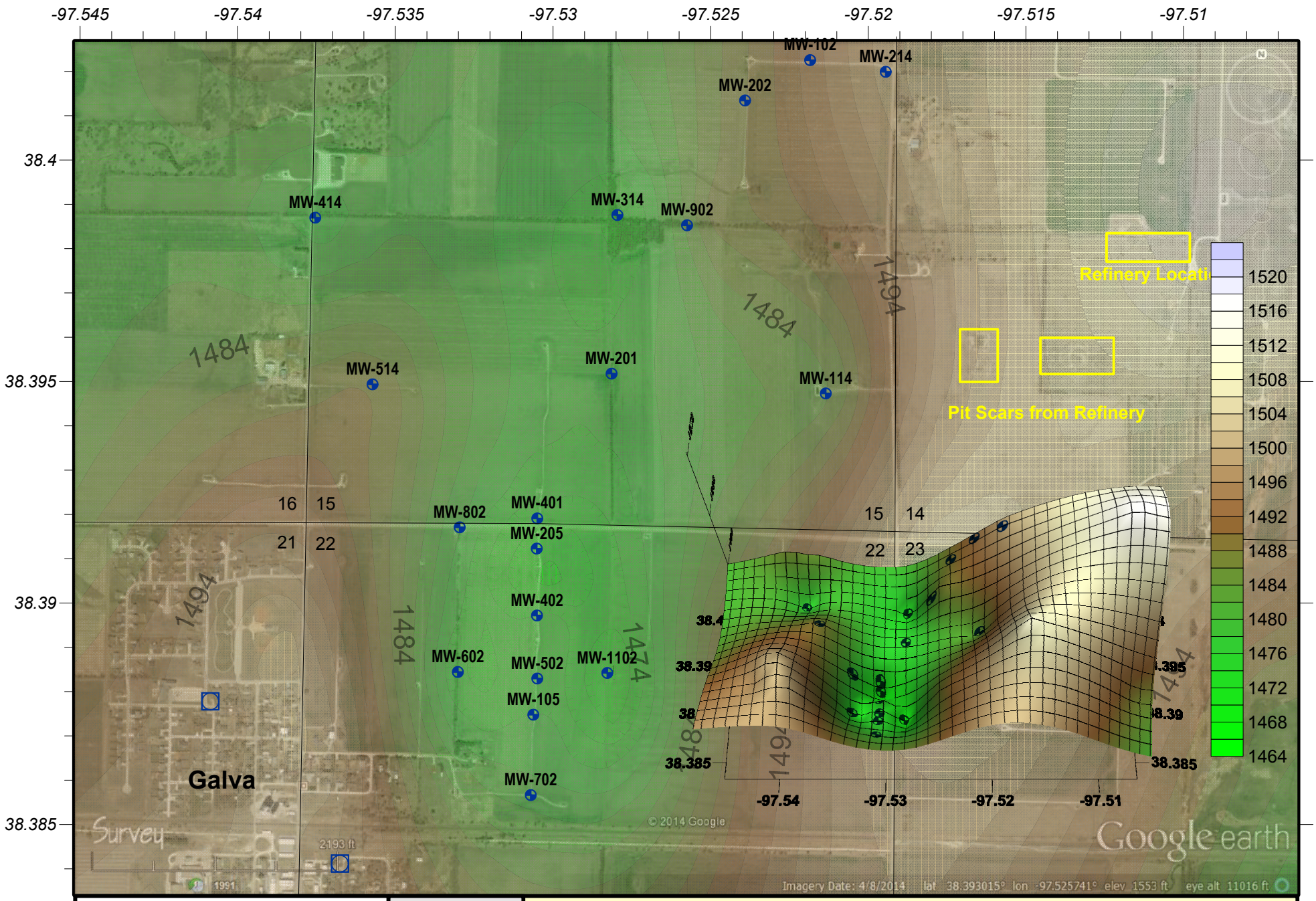
Galva Remediation Site

Recovery Well Locations and Site Map

Kansas Corporation Commission District #2 Field Office - Map drawn on 11/18/2015 by D. Bollenback



Kansas Corporation Commission

N W E S

Galva City Contamination Site

Sec. 15, 16, 21, &22 - T19S - R2W, McPherson County

Top of Wellington Formation

KCC Control #980033-01 - District #2 - D.Bollenback - 11/18/2015

Project: *Albert Harbaugh Contamination Site*

Site Location: Legal location is the SE/4 Section 20 & NE/4 Section 29, Township 33 South, Range 11West, Barber County.

Impact/Immediacy: The groundwater for domestic and stock wells has been contaminated from several sources on this project. This site is rated as high immediacy and remediation of the groundwater began on November 1, 1999.

Site Description: The site is located in the alluvial valley on the flood plain of the Medicine River, in the Rhodes Pool, approximately nine miles south of Medicine Lodge. This site covers an area of approximately 1000 feet wide and 3500 feet long. This location and others sites in the area are continually increasing the chlorides in the groundwater aquifer of the Medicine River valley.

Unusual Problems: It is probable that all source areas of natural halite pollution into the aquifer have not been identified. Areas of suspected sources have not continued to contribute to the contamination since the remediation of the ground water has been implemented. These areas are suspected to have achieved a natural closure at this time. Unless all the source areas are located and plugged, the contamination will continue until there is natural closure.

Status of Project: Project is shut-in waiting on repairs for the Saltwater Disposal Well. Repairs were made to the recovery system in August 2016. Thirty-three monitoring and recovery wells were sampled in 2016. One stock well has been sampled annually as well. Chloride values in the northwest corner of the site continue to be elevated at unacceptable levels, with values ranging from 6500 ppm in RW-1 to 1800 ppm and 2600 ppm respectively in monitoring wells 13 and 26. An unidentified flowing core hole near these wells is the probable source of these chlorides with other sources contributing additional contamination across the rest of the remediation site. Differences in chloride values of wells in close proximity to each other are attributed to different screening depths. Documentation for bids to repair the disposal well will be submitted.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 1000 ppm Chloride

Recommendation for Future Work: Obtain funds to repair disposal well. Monitor the recovery well system for effectiveness of chloride plume containment. Continue annual sampling of monitor wells and bimonthly sampling of the recovery wells after they have been restarted.

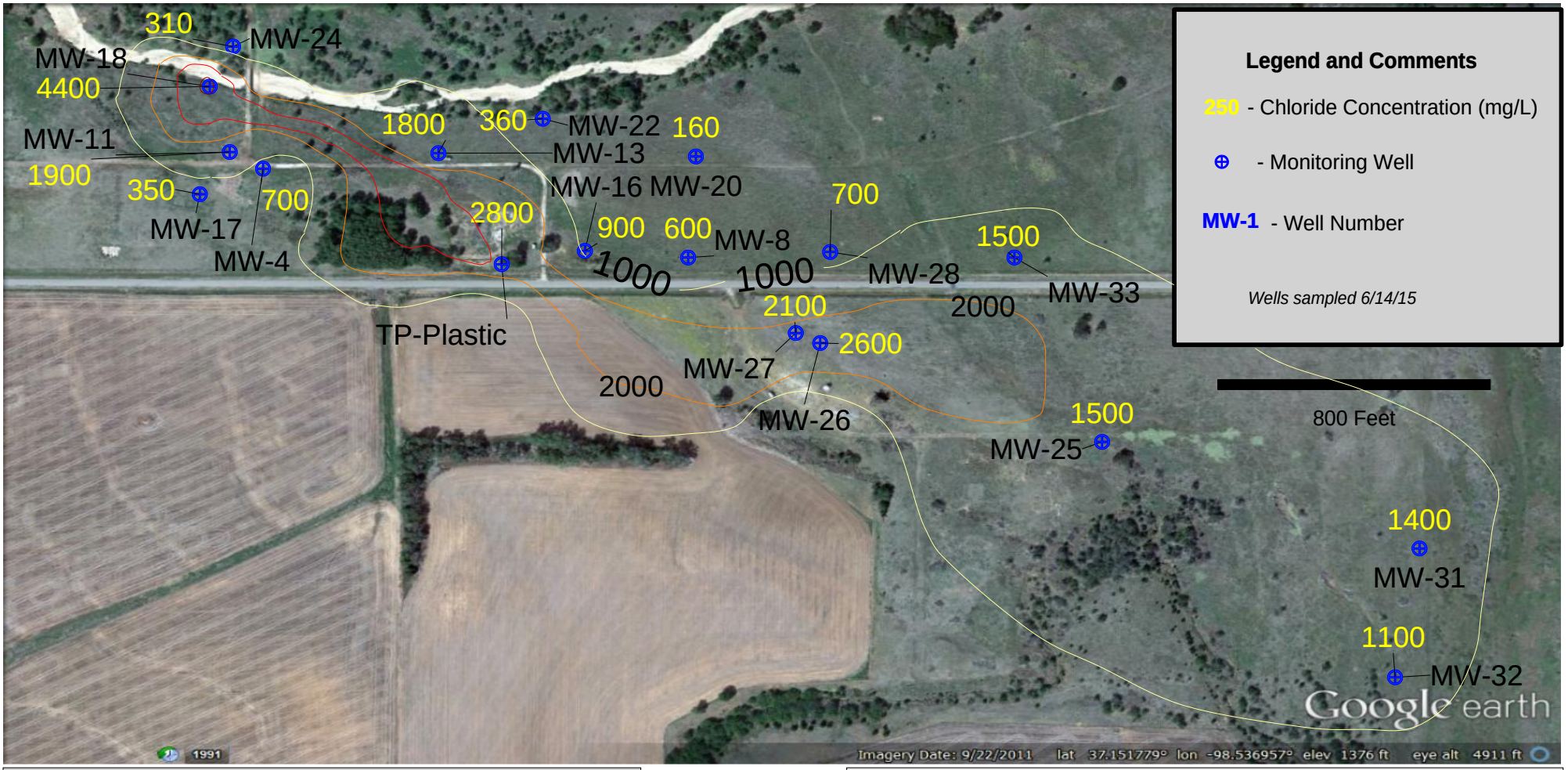
Estimated Total Cost: Total costs have exceeded the original estimate of $450,000. Costs for repairs are estimated at close to $80,000.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970049-00	**133.5 Hrs. / $3,610.21**	**$12,155.44**	**$552,684.74**

Current Contaminate Level: 160 ppm Cl- to 6,500 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

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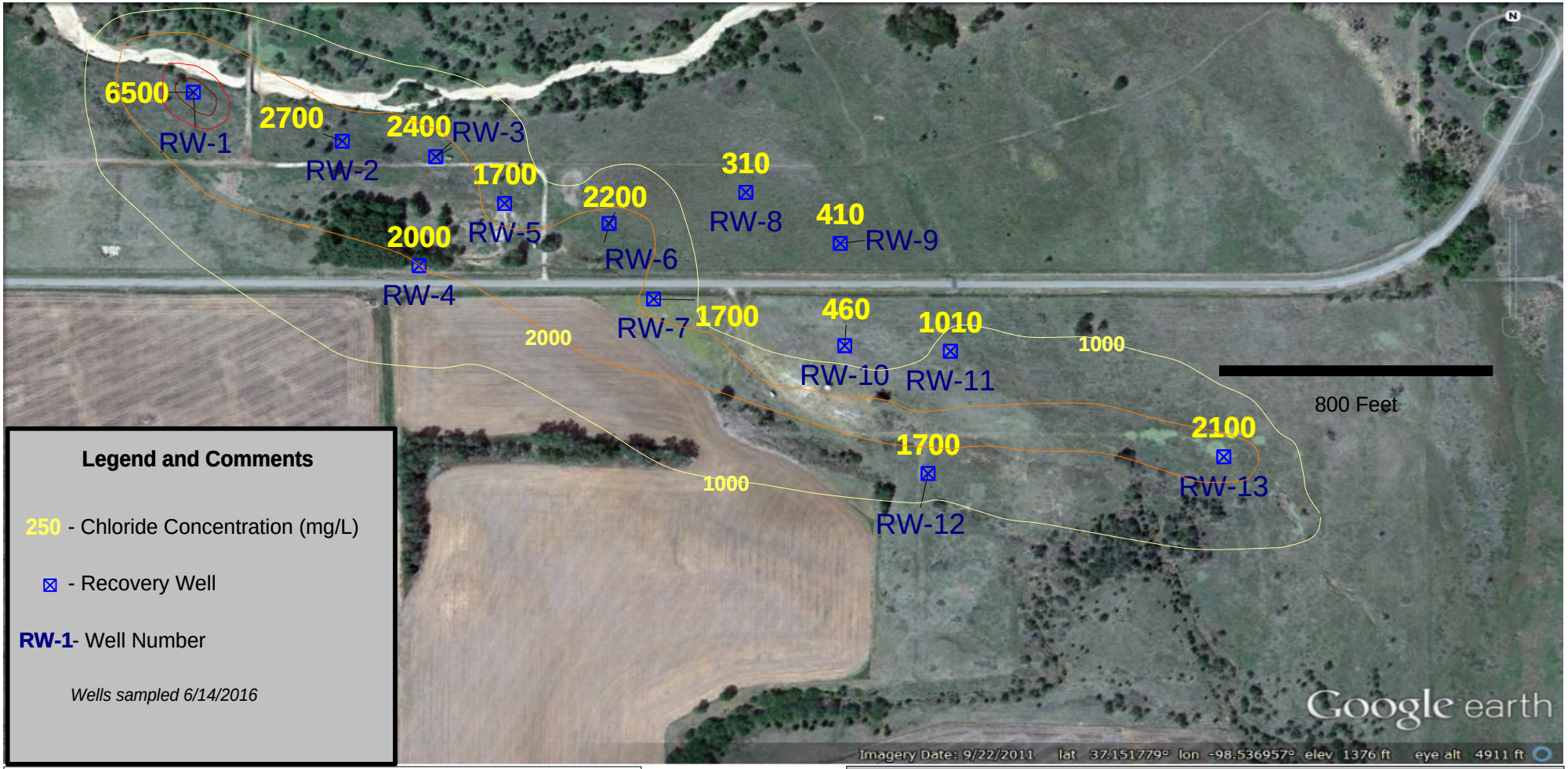
Harbaugh Site

Sections 20/29-T-33S-R11W
Barber County, Kansas

2016 Area Map with Monitoring Well Chlorides

KCC Control # 970049-00 District 1
K. Sullivan 6/15/16



Kansas Corporation Commission

N W E S

Harbaugh Site

Sections 20/29-T-33S-R11W
Barber County, Kansas

2016 Area Recovery Well Map with Chlorides

KCC Control # 970049-00 District #1
K. Sullivan 6/15/16

Project: *Hollow-Nikkel Contamination Site*

Site Location: The site is located in northwestern Harvey County approximately eighteen miles northwest of the city of Newton. The site includes parts of Sections 7, 8, 17, 18, 19, 20, 29, and 30 in Township 22 South, Range 3 West. This site is located within the Equus Beds Aquifer boundaries.

Impact/Immediacy: Potential impact is to irrigation and rural residential wells. Directly down gradient of the site there are nine domestic wells and irrigation well. This site should be rated at a moderate immediacy level. In the two years the city of McPherson has investigated the possibility of the area as a public water supply.

Site Description: The project area covers approximately 700 acres. The contaminate plume is aligned in a north to south configuration and is approximately 0.5 miles wide and 2 miles in length. Plume morphology appears to be controlled by a bedrock channel, which has an alignment similar to that of the plume. Contamination mapped to date is primarily confined to the lower zone of the Equus Beds aquifer, which consists of unconsolidated sand and gravel deposits and lies at a depth of 200 to 250 feet. The location near EB-34 is contaminated throughout all three zones of the aquifer.

Unusual Problems: In order to remediate this site, the planning, land access acquisition, and development of a good water disposal method would be very time and financially intensive.

Status of the Project: The Ground Water Management District #2 has been contracted to do annual water sampling with the KCC funding the analysis of the water samples. The City of McPherson, GMD#2, and the Kansas Water Office approached the KCC during the 2014 year in regards to the possibility of utilizing the local aquifer to supplement the City of McPherson's public water supply. KCC promised support in this endeavor in terms of personnel resources and expertise. Depending on the results from modeling and further study a remedial system could be necessary to allow for water to be shipped out of the area for public use. KCC understands that funding for this project by the City of McPherson may have stalled after repeated applications for Federal grant money, and continued research and work regarding the city's plans is on hold unless McPherson moves forward with plans in the area. A zone chloride levels varied overall. EB34A had a significant increase of 250 ppm chlorides from 2015. EB36A and EB31A also show lesser increases which could be from the heavy precipitation leaching salts form the soils above the aquifer. EB30A had a drop in Chlorides from 2015. All the wells within the B zone showed a drop in levels though many were minimal. C Zone wells showed the largest changes from the 2015 chloride levels, with the largest being 400 ppm increase in EB34C. EB35C also increased by 300 ppm. This could be from chlorides dropping out of the B Zone and into the C zone or movement of chlorides along the subsurface aquatard south from the EB36C location. EB27C had a drop of 600 ppm chlorides since 2015. EB27C has been a focal point for this investigation by the KCC and the chloride drop is a promising trend.

Level of Remediation Sought:

Ideal: 250 mg/l
Target: 500 mg/l

Recommendations for Future Work: KCC will continue to collect data from GMD #2 on an annual basis for monitoring purposes. Continue research and investigation into the northeastern area of this site especially in the area around EB27C. If the City of McPherson resumes their water project, KCC will allocate their professional expertise and similar resources to aid McPherson's research and planning.

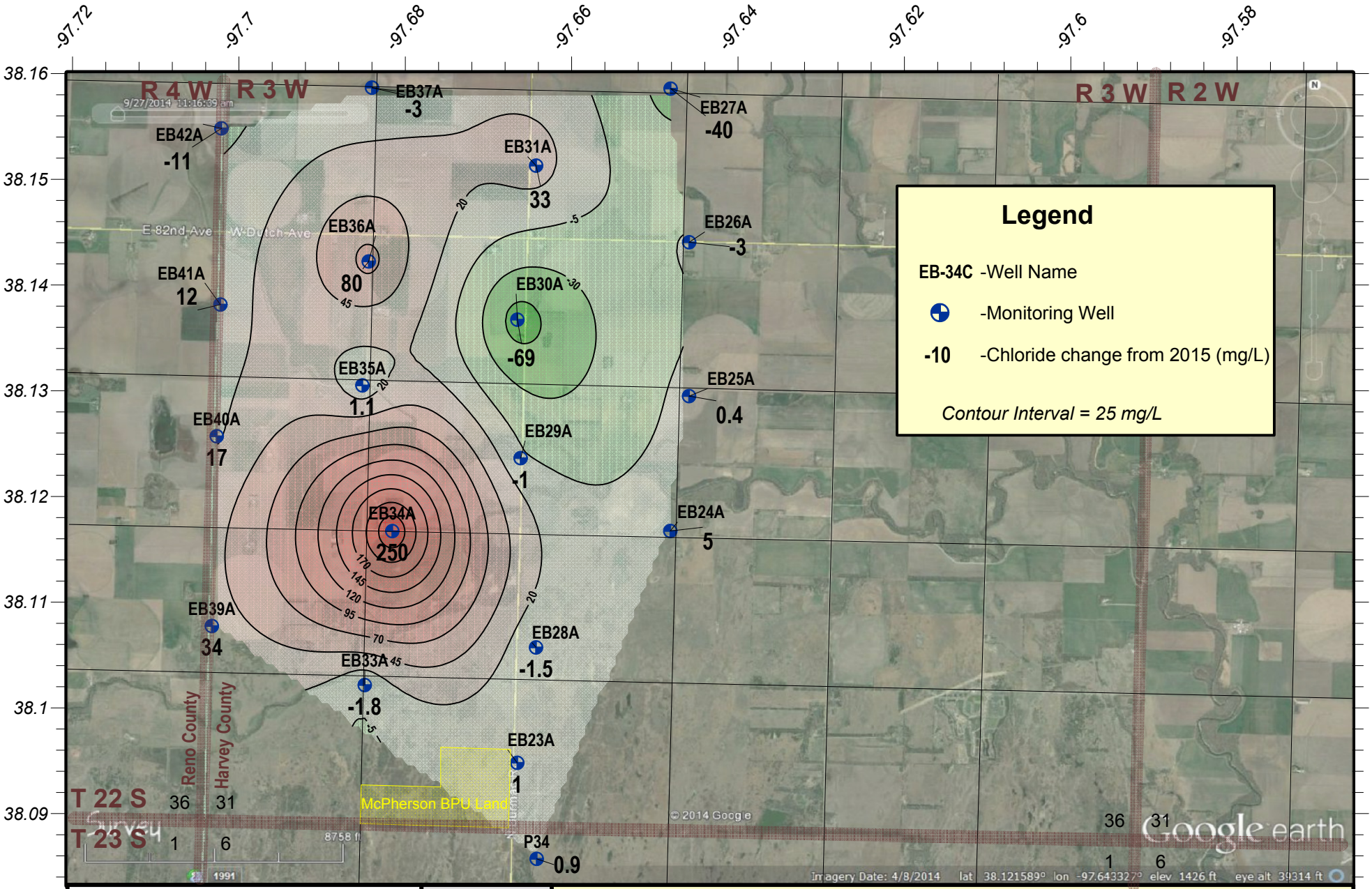
Estimated Total Costs: Time for district personnel to put together and analyze groundwater data obtained from GMD #2 plus research possible remediation avenues. Cost of staff time could increase substantially if the City of McPherson resumes their interest in obtaining a new source of water in the area.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970009-00	**28 Hrs. / $761.70**	**$2,460.12**	**$39,703.01**

Current Contaminate Level: Varies; There are hot spots in each zone.

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

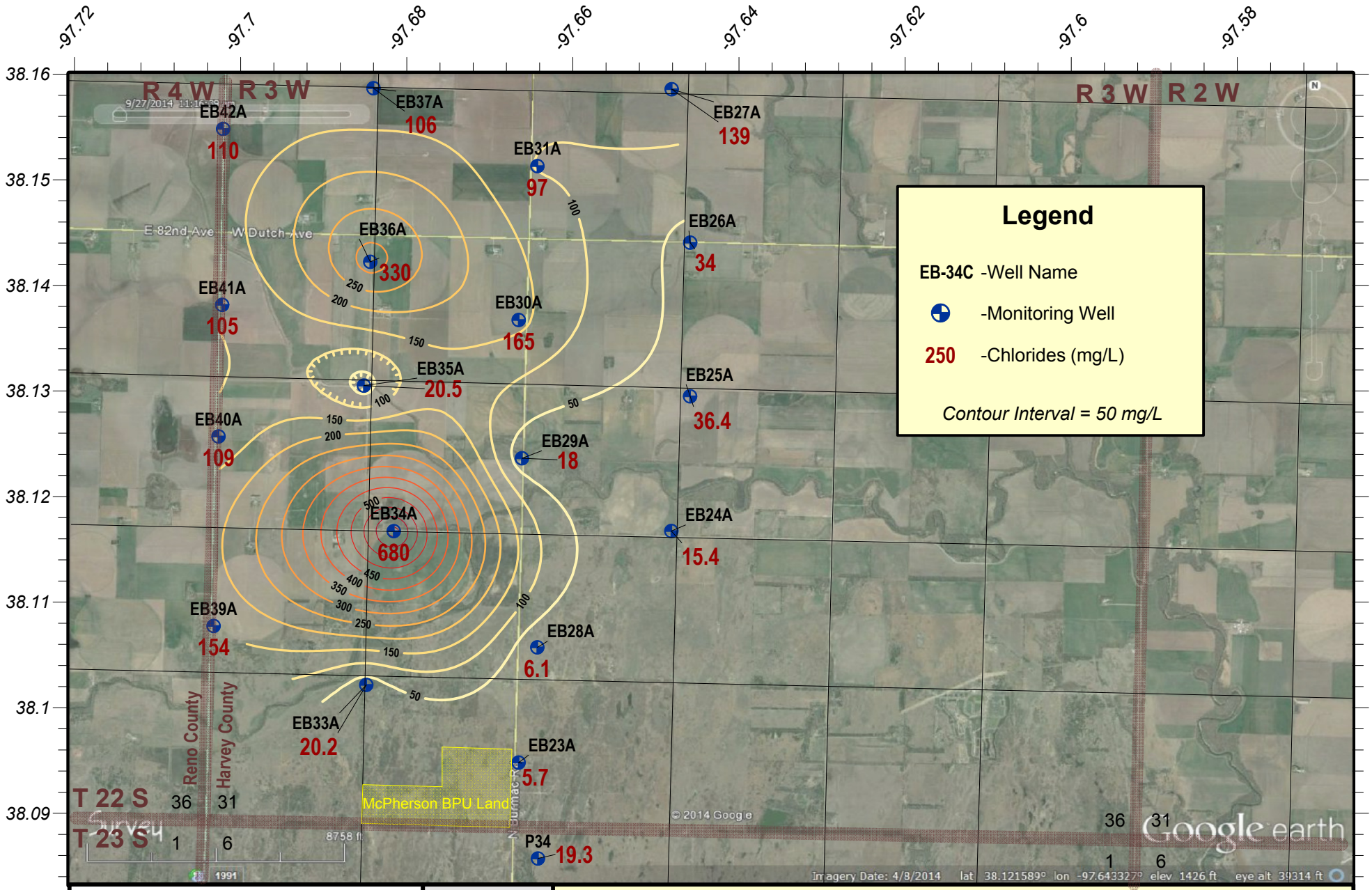
N W E S

Hollow-Nikkel Brine Contamination Site - KCC Control #970009-00

Multiple sections of Townships 22 & 23 South and Range 3 West, Harvey County, Kansas

2016 Chloride Level Changes in the Equus Beds A Zone from 2015

KCC District #2 Field Office - Wells sampled Summer of 2016 by GMD #2 - Map Drawn on 10/18/2016 by D. Bollenback



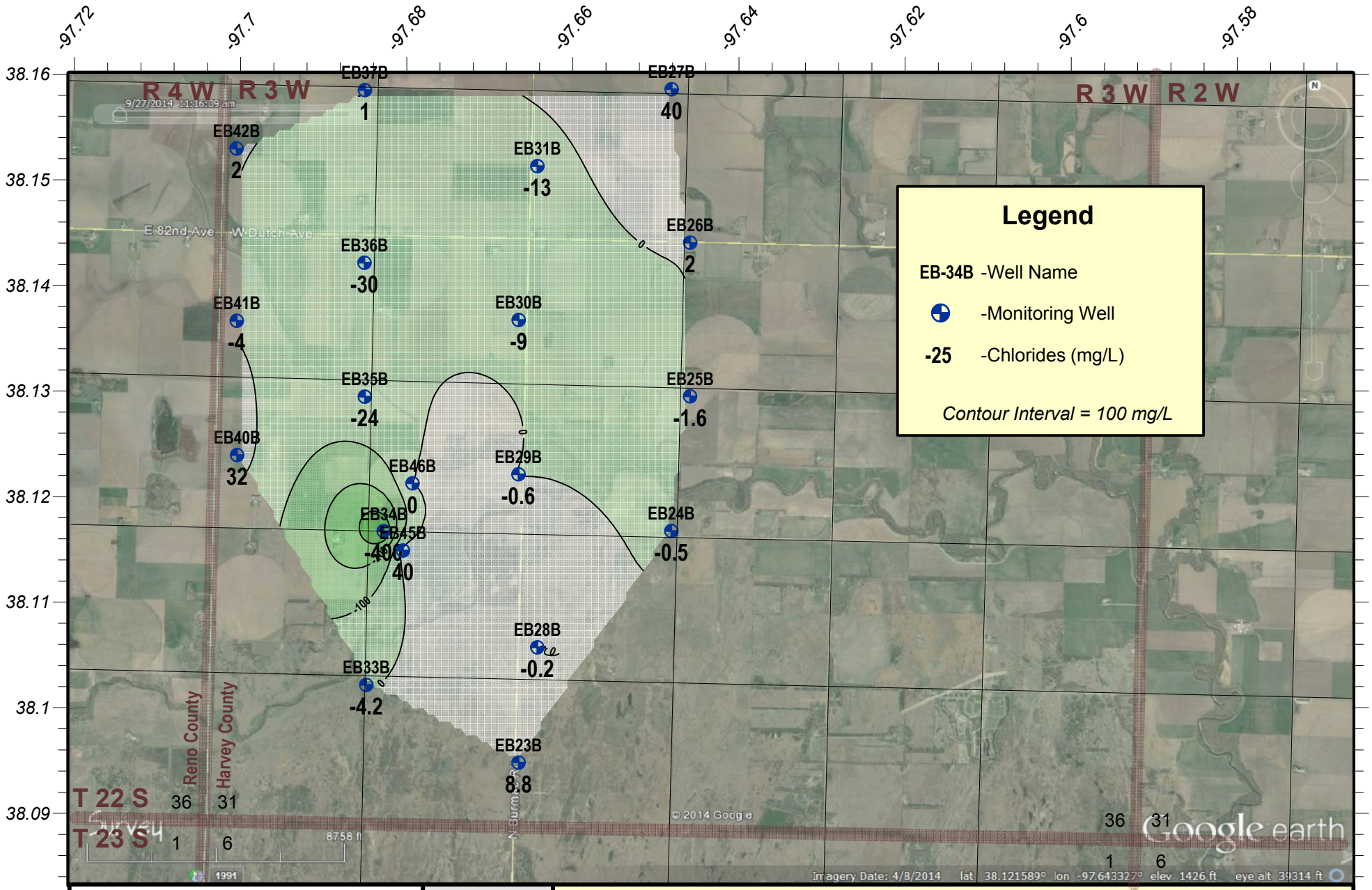
Kansas Corporation Commission

Hollow-Nikkel Brine Contamination Site - KCC Control #970009-00

Multiple sections of Townships 22 & 23 South and Range 3 West, Harvey County, Kansas

2016 Chloride Levels in the Equus Beds A Zone

KCC District #2 Field Office - Wells sampled Summer of 2016 by GMD #2 - Map Drawn on 10/18/2016 by D. Bollenback



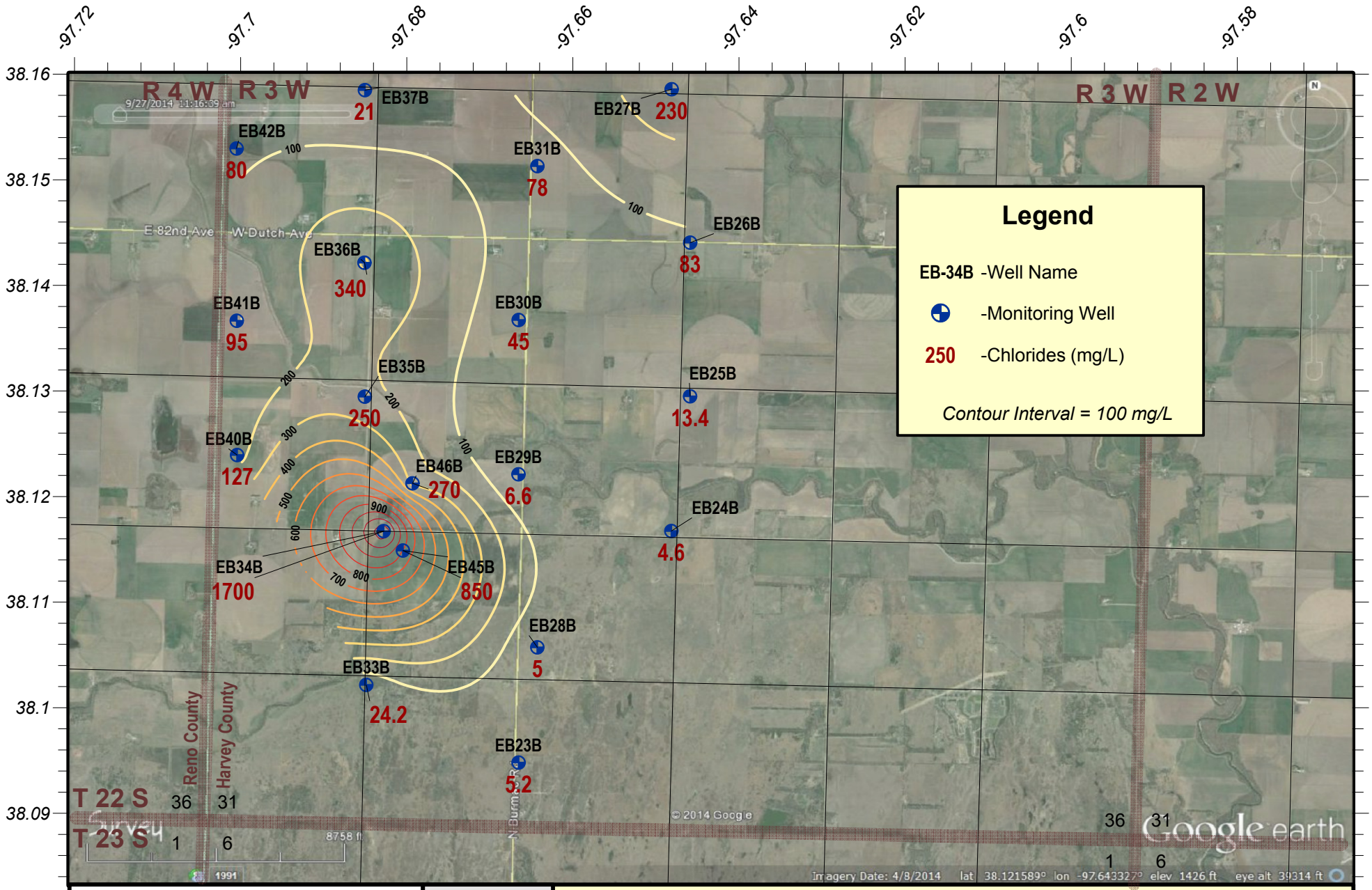
Kansas Corporation Commission

Hollow-Nikkel Brine Contamination Site - KCC Control #970009-00

Multiple sections of Townships 22 & 23 South and Range 3 West, Harvey County, Kansas

2016 Chloride Levels Change in the Equus Beds B Zone from 2015

KCC District #2 Field Office - Wells sampled Summer of 2016 by GMD #2 - Map Drawn on 10/18/2016 by D. Bollenback



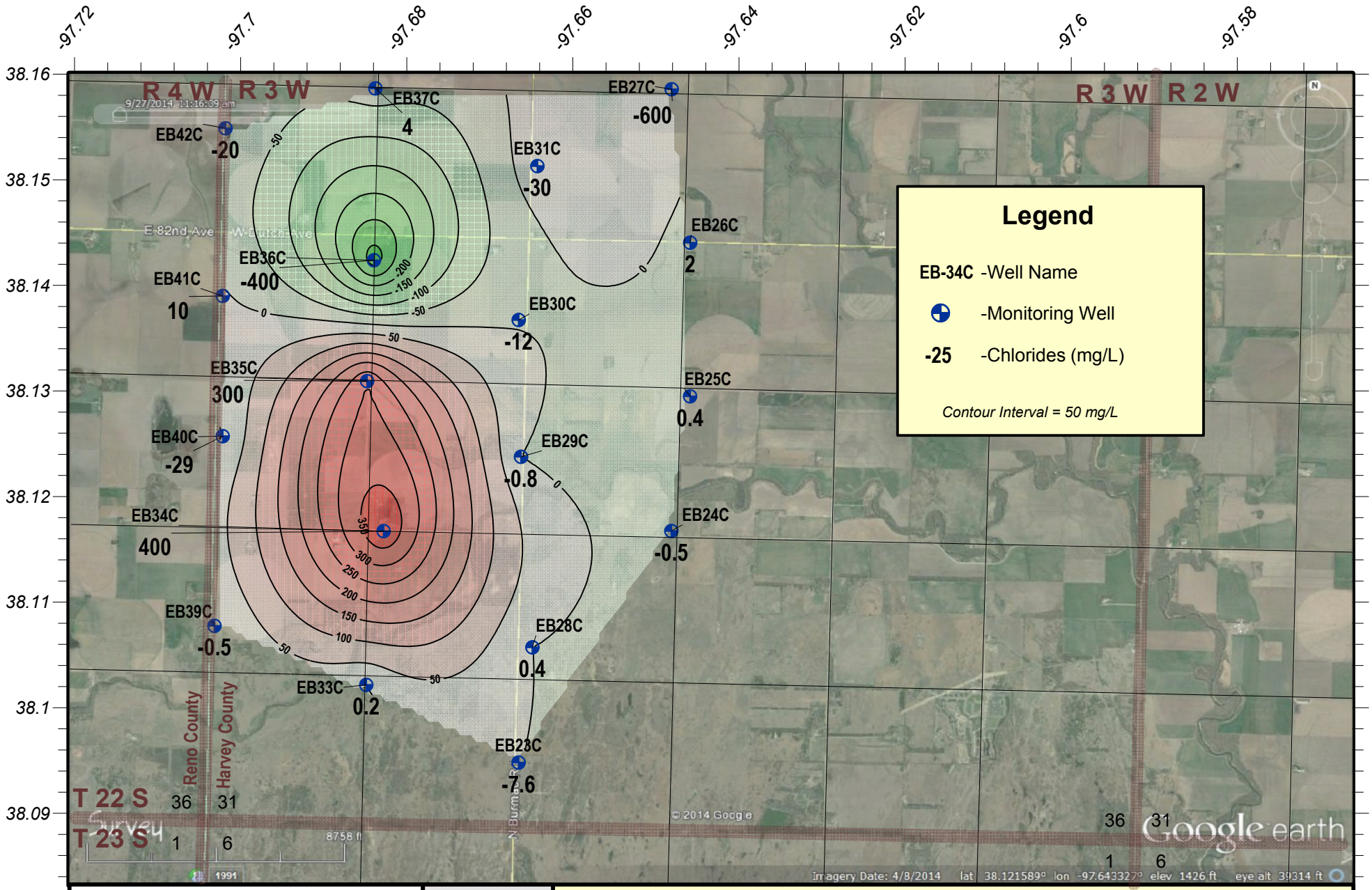
Kansas Corporation Commission

Hollow-Nikkel Brine Contamination Site - KCC Control #970009-00

Multiple sections of Townships 22 & 23 South and Range 3 West, Harvey County, Kansas

2016 Chloride Levels in the Equus Beds B Zone

KCC District #2 Field Office - Wells sampled Summer of 2016 by GMD #2 - Map Drawn on 10/18/2016 by D. Bollenback



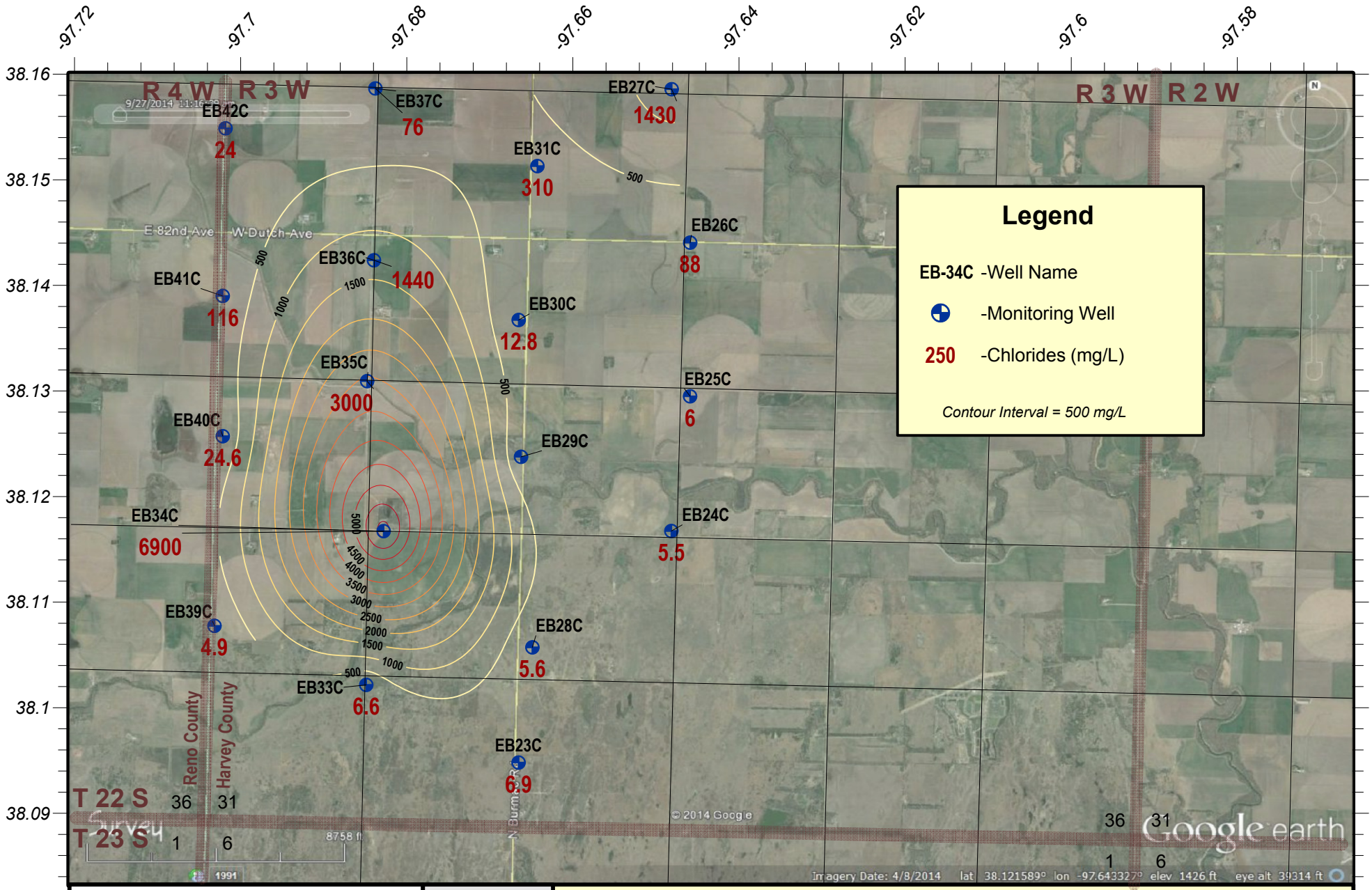
Kansas Corporation Commission

Hollow-Nikkel Brine Contamination Site - KCC Control #970009-00

Multiple sections of Townships 22 & 23 South and Range 3 West, Harvey County, Kansas

2016 Chloride Level Changes in the Equus Beds C Zone from 2015

KCC District #2 Field Office - Wells sampled Summer of 2016 by GMD #2 - Map Drawn on 10/18/2016 by D. Bollenback



Kansas Corporation Commission

N W E S

Hollow-Nikkel Brine Contamination Site - KCC Control #970009-00

Multiple sections of Townships 22 & 23 South and Range 3 West, Harvey County, Kansas

2016 Chloride Levels in the Equus Beds C Zone

KCC District #2 Field Office - Wells sampled Summer of 2016 by GMD #2 - Map Drawn on 10/18/2016 by D. Bollenback

Project: *Hrencher Contamination Site*

Site Location: Legal location is W/2 Section 36, Township 32 South, Range 12 West, Barber County**.**

Impact/Immediacy: The salt-water intrusion in the area affected the groundwater, small pond, stock wells and there is a salt scar near the pond. This site is classified as moderate to high for remediation.

Site Description: The surface area is predominately "red beds" of lower Permian age. The area is dissected by small drainage patterns and the alluvial channels filled with local parent material shale and gypsum. The area of high chlorides (1000 ppm +) is a narrow channel 300 feet wide and approximately 8000 feet long near the present stream. This small stream flows into the Medicine Lodge River within a half-mile.

Unusual Problems: None**.**

Status of Project: Eight groundwater samples were collected in 2016. Chloride levels overall in the project area have remained the same from 2015. Current chloride values at the site range from 190 ppm in MW-8 in the northwest area of the site, to 12,100ppm in MW-1. Comparing these values with historical data shows that the plume has moved to the southeast and stayed confined over the last several years. Since 2003 when the last full sampling event has taken place, MW-5, MW-7, and MW-11 have been destroyed. MW-5 was originally drilled to provide a profile of the chlorides in the main channel, whereas MW-7 was drilled to eliminate additional sources of contamination and has historically been fresh. MW-11 was drilled in order to evaluate the down gradient concentration of chlorides, but since it has been destroyed, the leading edge of the plume is left undefined.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 1000 ppm Chloride

Recommendation for Future Work: Continue sampling on an annual basis. As chloride levels have continued to increase down gradient, it may be necessary to design and install a remedial system for this site. Additional monitoring wells need to be drilled to define the toe of the plume. Further investigation and sampling will continue to determine if a remedial system is appropriate for this site.

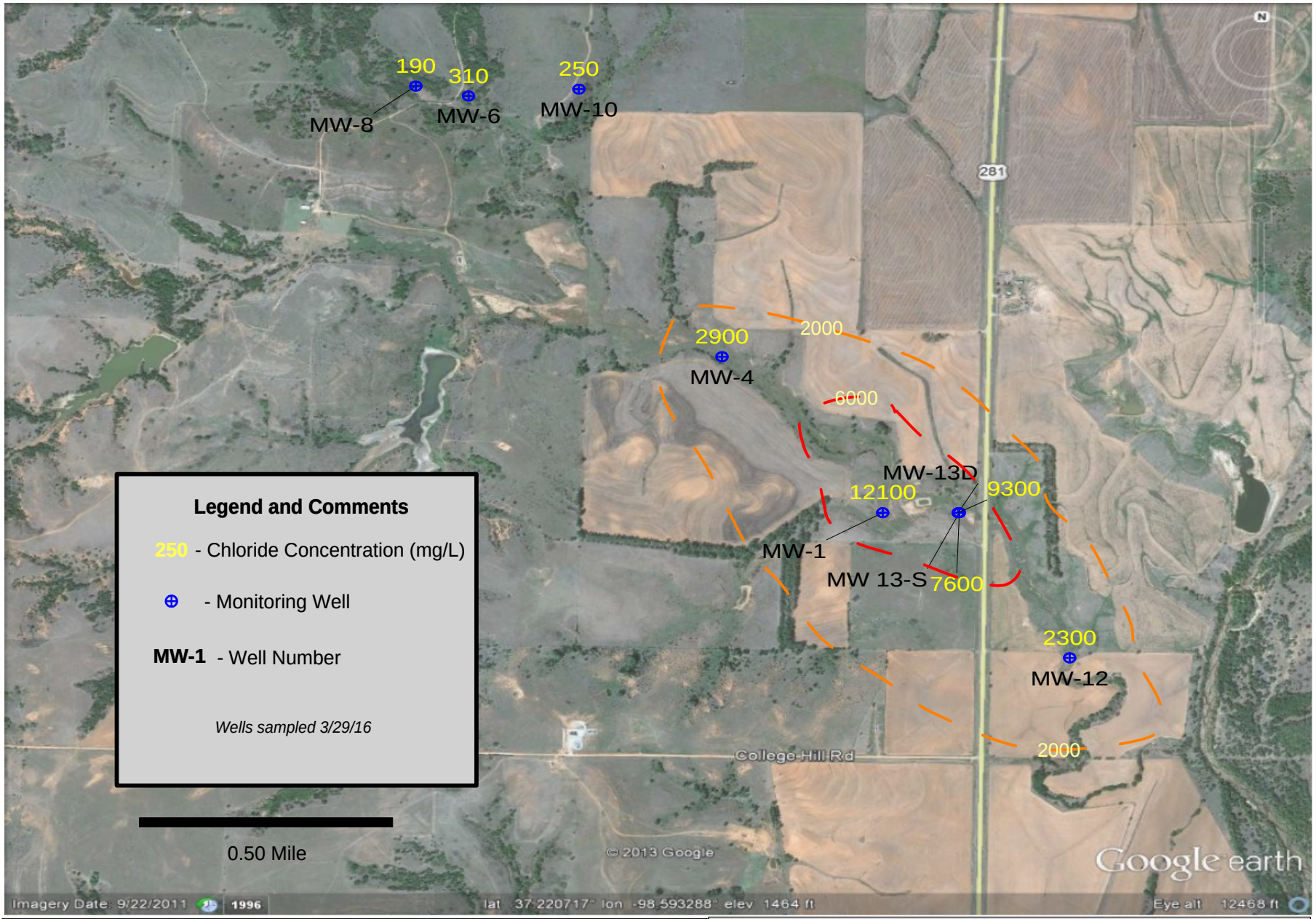
Estimated Total Cost: $150,000 if necessary to install a remediation system.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970051-00	**11 Hrs. / $307.04**		**$189.94**

Current Contaminate Level: 190 ppm Cl- to 12,100 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

N W E S

Hrencher Site

Sections 26/35/36-T-32S-R12W
Barber County, Kansas

2016 Area Map with Chlorides

KCC Control # 970051-00 District 1
K. Sullivan 6/15/16

Project: *Irey-Hrabe Contamination Site*

Site Location: Section 1 and Section 12 of Township 9 South, Range 17 West, Rooks County.

Impact/Immediacy: The groundwater near a former homestead has been impacted by repeated releases of brine on the surface and in the subsurface. The immediacy for this site is rated as moderate.

Site Description: A subtle drainage runs through the site from south to north, and an old farmstead is situated near this draw. Up to six water wells were drilled into the Codell Sandstone and terminated in the Blue Hill Shale, and one had dug well that is likely dug into alluvium overlying the Fort Hays Limestone. Contamination at the site can be attributed to an injection well which had pressurized a number of near-surface formations through failed casing and over pressurization, numerous spills that have occurred over a period of 50 years, and multiple surface pits.

Unusual Problems: None.

Status of Project: The site assessment has been completed, and an investigatory phase began in earnest in 2015. Six water samples were collected from two ponds which had chloride concentrations of 46,500 ppm and 11,500 ppm, and three open water wells, which range from 2,000 ppm to 12,500 ppm. The windmills have remained the same, but have not been pumped out to verify the chloride concentration of the groundwater. The surface water is still showing significant impacts, but the concentration of chloride has been greatly reduced by the significant rainfall in 2016. Ponds in the southern portion of the site range from 175 ppm to 2,250 ppm while the ponds in the northern section range from 650 ppm to 3,500 ppm.

Level of Remediation Sought:
Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: While samples have been collected through existing wells, these do not meet quality control standards for groundwater sampling. A network of monitoring wells and exploratory test holes should be drilled at this site to delineate the extent of the pollution.

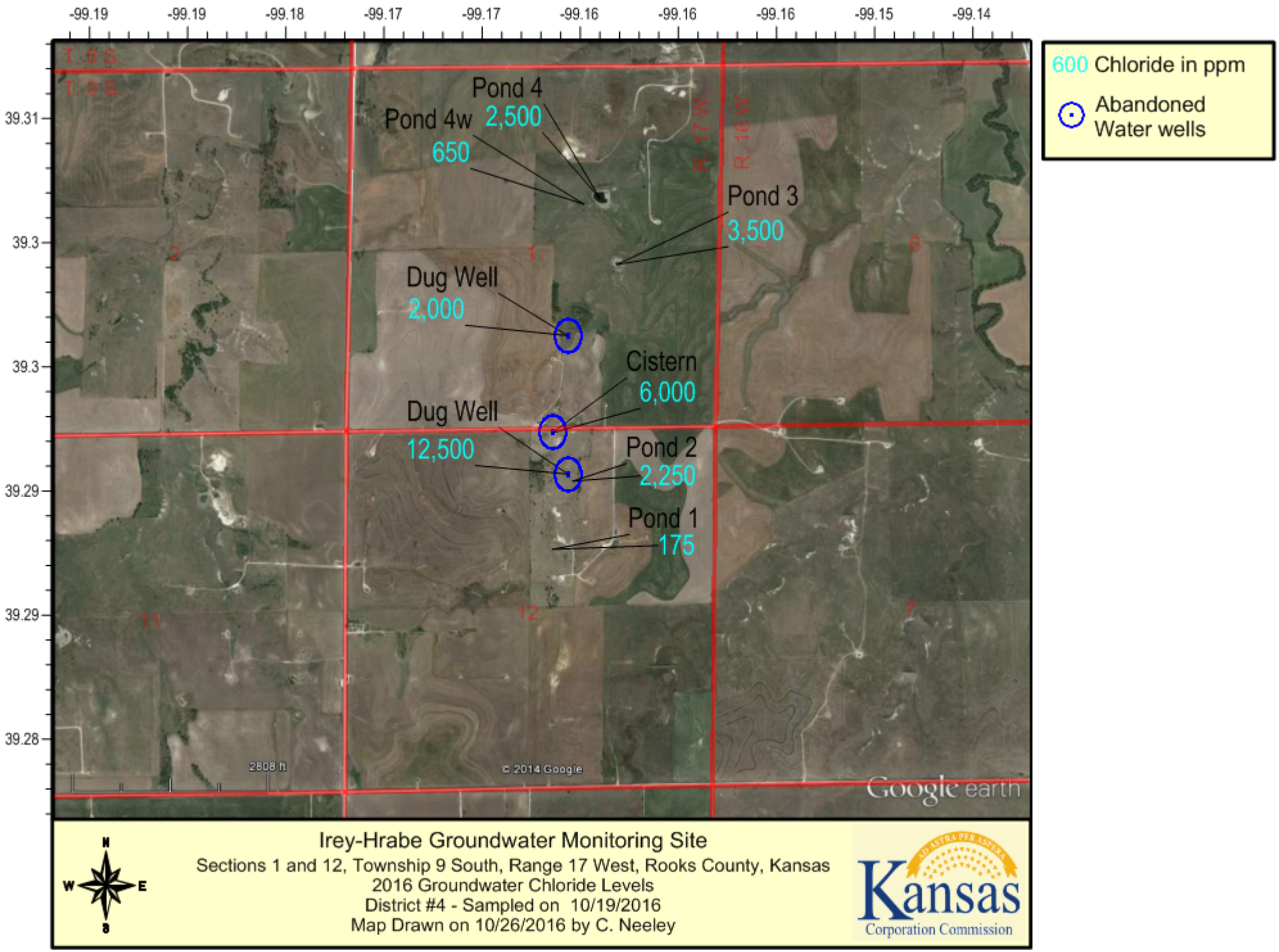
Estimated Total Costs: $15,000.00

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17 Total**
970053-00	**18 Hrs. / $500.46**	

Current Contaminate Level: Ponds: 175 ppm Cl- to 3,500 ppm Cl-
Water Wells: 2,000 ppm Cl- to 12,500 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**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-99.17
-99.17
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-99.16
-99.16
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-99.14
39.31
39.3
39.3
39.29
39.29
39.28
T. 8 S.
T. 9 S.
R. 17 W.
R. 16 W.
Pond 4
Pond 4w 2,500
650
Pond 3
3,500
Dug Well
2,000
Cistern
6,000
Dug Well
12,500
Pond 2
2,250
Pond 1
175
2
1
6
11
12
7
2808 ft
© 2014 Google
Google earth
600 Chloride in ppm
Abandoned Water wells
N
W
E
S
Irey-Hrabe Groundwater Monitoring Site
Sections 1 and 12, Township 9 South, Range 17 West, Rooks County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled on 10/19/2016
Map Drawn on 10/26/2016 by C. Neeley
Kansas
Corporation Commission

Project: *Jennings Contamination Site*

Site Location: NW/4 of Section 25, Township 4 South, Range 27 West, Decatur County.

Impact/Immediacy: Groundwater contaminated by poor oil field practices including spills and brine line leaks since the 1950s. Two city wells inside the city limits have experienced elevated chloride levels of varying intensity. Immediacy level is rated as low to moderate.

Site Description: The current city water supply is from a well located west and upstream of the tank battery area, which has not been impacted by oil field pollution, and remains a viable source. The two contaminated wells within the city limits are used for purposes other than human consumption.

Unusual Problems: The high hydraulic conductivity of the soil profile allows rapid transmission of contaminants to the water table. It has been shown that the chloride concentration is capable of large increases and decreases on an annual period, and this is possibly due to responses from spills or leaks on the lease.

Status of Project: In 2010, the level had fallen appreciably from 600 ppm to 150 ppm, and continued to fall to 100 ppm, which maintained through 2012. A slight increase to 200 ppm was observed during 2013, but this was still below drinking water standards for chloride concentration. However, in 2014, the concentration was found to be 850 ppm during routine annual testing. A month later, KCC staff returned to the site and pumped water to waste for 60 minutes. During this time samples were taken, and the chloride concentration stabilized at 950 ppm. During the previous two years, multiple large spills and discharges had taken place at the site which may have contributed to the observed increase. In early 2015, the chloride concentration had already fallen to 400 ppm, and fell further to 140 ppm in June 2016.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: Monitor on an annual basis. District staff will work to establish a cooperative relationship with the new operator regarding lease practices, and the implementation of safeguards to prevent pollution of the aquifer.

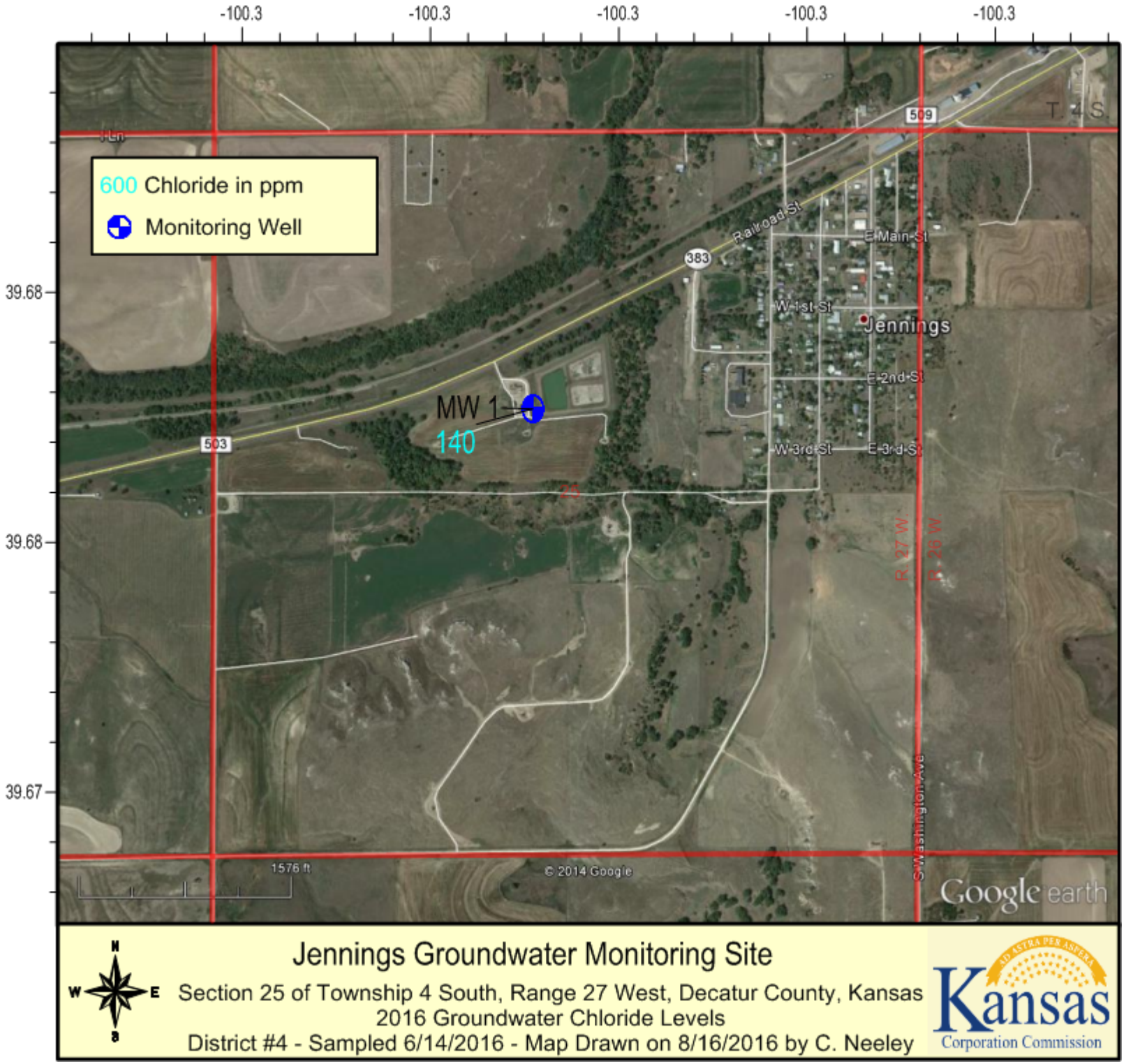
Estimated Total Costs: $2000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970054-00	**8 Hrs. / $226.10**		

Current Contaminate Level: 140 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**


-100.3
-100.3
-100.3
-100.3
-100.3
39.68
39.68
39.67
600 Chloride in ppm
Monitoring Well
MW 1
140
509
T. 4 S.
383
Railroad St
E Main St
W 1st St
Jennings
E 2nd St
W 3rd St
E 3rd St
503
25
R. 27 W.
R. 26 W.
S Washington Ave
1576 ft
© 2014 Google
Google earth
Jennings Groundwater Monitoring Site
Section 25 of Township 4 South, Range 27 West, Decatur County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 6/14/2016 - Map Drawn on 8/16/2016 by C. Neeley
Kansas
Corporation Commission

Project: *Johnson/Ramsey Contamination Site*

Site Location: The project is located nine miles east and two and one half miles north of Sterling, Kansas. The site covers the SW quarter of 7-21-6W and SE quarter of 12-21-7W Rice County. The area is considered to be located within the sand hills. The site is in the drainage systems of the Cow Creek and Sand Creek. Cow Creek is a tributary of Arkansas River and flows in a southeasterly direction.

Impact/Immediacy: The contamination impacts a relatively small surface and shallow subsurface area. The immediacy level is rated as low, but there are four domestic water wells in the northwest of section 18-21-6W which could change the immediacy level if found to be impacted.

Site Description: The site is located in grazing pastureland. Sediments at the site consist mainly of unconsolidated Pleistocene, recent to Wisconsinan aged deposits of Dune Sand (KGS bulletin 206). The immediate area is topographically flat, with slopes ranging from 0-2 percent. Based on the site evaluation to date, the underlying material to a depth of approximately 40 feet was found to consist primarily of loose sand, overlying thick dense clay to approximately 35 feet near the eastern edge of the site. The clay shallows to the west and is only 20-22 feet near MW-6. The groundwater moves to the southwest and flows to the surface in section 12-21-7W. The spot where the contaminated groundwater seeps to the surface is approximately two acres in size and is historically barren of vegetation. Recent years have seen the scar shrink in total area but there is still a kill zone in section 13.

Unusual Problems: Lack of access to the site.

Status of Project: KCC has not had access to the Johnson Site for two years. KCC was unable to acquire access before the fall end of sampling dates. KCC is currently attempting to reach the current landowner in order to request a new key as the locks have been changed. The fire road access to MW-6 is almost completely blocked with fallen trees and the lack of access to the main site along with the low priority of the site may expedite closure of this site. Most wells have been clear of the chloride contamination for years and those that still have contamination are not high enough to require remedial efforts.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 750 mg/l Chloride

Recommendations for Future Work: KCC will again try to obtain access during the winter of 2016-17. If access is obtained, KCC district staff recommends continued sampling for the next few years as chlorides are as high as 1500 mg/L in section 7, and in past years 4100 mg/L in section 12. These levels are lower than past sampling events but still not at the target levels originally set.

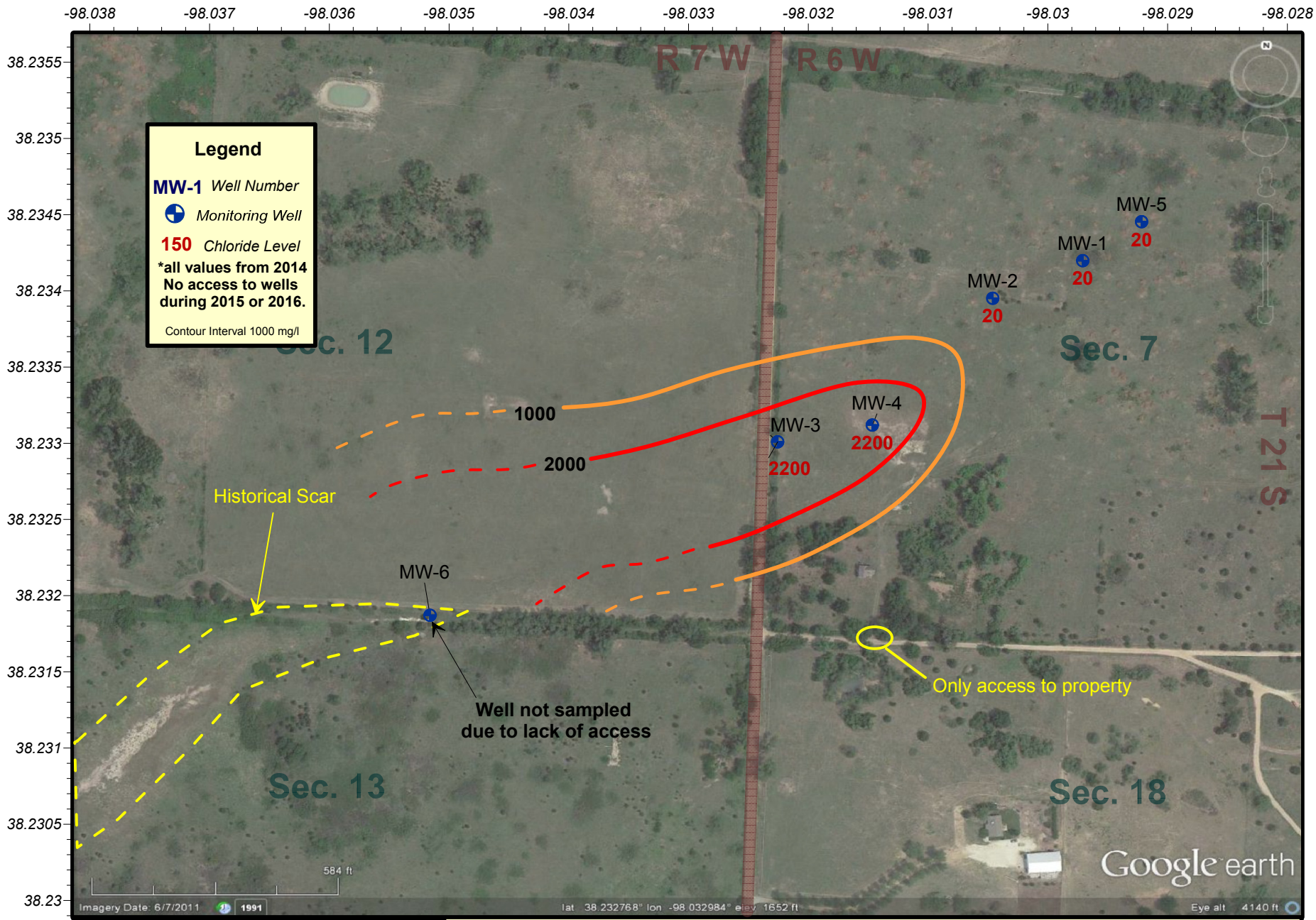
Estimated Total Costs: Total costs next year for annual water sampling, report writing and research: $750

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Fund Expenditures Total
970055-00	5 Hrs. / $145.76		$416.28

Current Contaminate Level: N/A

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved



Kansas Corporation Commission

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Johnson/Ramsey Monitoring Site - KCC Control # 970055-00

Section 7 of T 21 S & R 6 W, Section 12 of T 21 S & R 7 W and Section 13 of T 21 S & R 7 W Rice County, Kansas

2015 Site Map

District #2 - Sampled 7/8/2014 - Map Drawn 10/31/2016 by D.Bollenback

Project: *Knackstedt Site*

Site Location: The site is located eight miles west and four miles north of Inman. The legal location is N/2 N/2 NW NW of Section 30, Township 20 South, and Range 5 West, in McPherson County.

Impact/Immediacy: Potential exists for impacts on both rural domestic and stock water resources. Public safety issues have been mitigated with the re-routing of the local roadway affected by this site, the site is still ranked as moderate immediacy level due to the unknown extent of the dissolution.

Site Description: The site consists of an unplugged saltwater disposal well whose operation led to the development of an air filled underground void at an approximate depth of 430 feet. The size of the cavity has not been determined as of this date. The site is located immediately southeast of the intersection of Plum Street and Saxman Road. In 1995 the KCC agreed to provide funding for additional seismic efforts at this site by the Kansas Geological Survey. Land use is agricultural with oil and gas activities in the area.

Unusual Problems: The air filled nature of the cavity makes the design of an acceptable plugging project more difficult. The air filled nature of the cavity also restricts the nature and kind of investigatory methods applicable to this site.

Status of the Project: The cavity in the salt section of the Wellington Formation has been stable with only slight indication of any downward surface movement. The site was under periodic monitoring of surface elevations with respect to possible surface movement. Survey was made of the control points in July of 2013. The results of that survey indicated that the control points and/or benchmark have been compromised and are in need of replacement by a licenced surveyor. District Staff is currently in the process of writing up a scope of work to address this issue and plans to have a new system for surveying the depression. Site visit in June of 2016 didn't indicate any major subduction and the well cellar was holding water indicating the well was sealed from most surface water being introduced which could encourage accelerated subsidence.

Level of Remediation Sought:

Ideal: Stabilize cavity and plug well bore in accordance with KCC rules and regulations.

Target: Study results indicate a reduced need for further or complete cavity stabilization beyond the original well bore and an acceptable plugging procedure can be developed which adequately addresses both fresh water resources and public safety issues.

Recommendations for Future Work: KCC may discuss with the Kansas Geological Survey regarding the future surveying and other investigative techniques that could be used to delineate the cavern. Re-establish good control points and have them initially surveyed by a licensed surveyor.

Estimated Total Costs: $2500 to 5000 to have the benchmark/points resurveyed by a licensed surveyor.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Total
970060-00	24 Hrs. / $654.58		$153.39

Current Contaminate Level: Unstable well cavity

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved

Kansas Corporation Commission

N W E S

Knackstedt Depression Site

NW of Section 30 of Township 20 South and Range 5 West, McPherson County, Kansas

2016-17 Site Map

KCC Project Code #970060-00 - KCC District #2 Field Office - Map Drawn on 10/6/2016 by D.Bollenback

Project: *Korf Contamination Site*

Site Location: Legal location is the SE/4 of the SE/4 of the NE/4, Section 7, Township 23 South, Range 22 West.

Impact/Immediacy: There is a very slight chance of the plume impacting the area to the northeast. The site has a low rating.

Site Description: There are currently six monitoring wells on the site which are sampled on an annual basis. Land use is agricultural with oil activities to the south. The site is located at the bottom of a small valley carved by an intermittent stream. The aquifer is a mixture of weathered shale, clay, and some clayey sand sitting on top of the Cretaceous Dakota shale.

Unusual Problems: The aquifer is composed of weathered shale, shale, with some clayey sand. Due to this, water does not flow quickly through the area. This makes normal methods of treating the aquifer difficult to accomplish.

Status of Project: The project is currently in a monitoring phase. The saltwater plume is moving very slowly to the north northeast along the draw. The samples from the monitoring wells, while erratic at times, have shown a recent increase in chlorides. MW-3 was dry and therefore was not sampled. The other five wells were sampled and chlorides ranged from 20ppm-4,800ppm. There are three surface ponds on location that are sampled when they have water in them, but this year all three were dry during sampling.

Level of Remedation Sought:

Ideal: 250 ppm
Target: 1000 ppm

Recommendations for Future Work: Continue monitoring work until the aquifer reaches the target level.

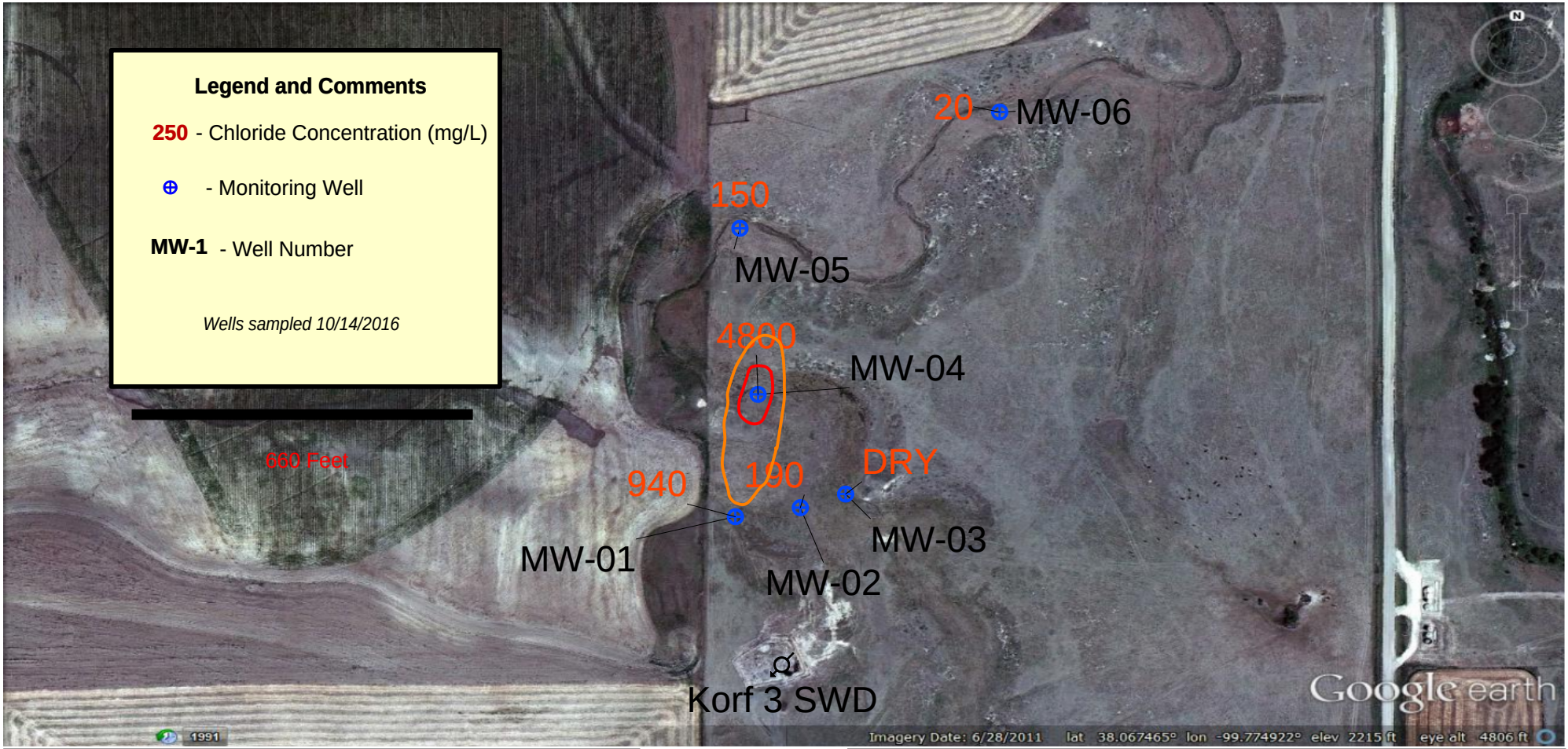
Estimated Total Costs: Costs covered by PRP.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17 Total**
20140017-001	**3 Hrs. / $92.20**	

Current Contaminate Level: 20 ppm Cl- to 4800 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☒ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

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Korf Site

Sections 7-T-23S-R22W
Hodgeman County, Kansas

2015-2016 Area Map with Chlorides

KCC Control # 20140017 District 1
K. Sullivan 10/25/16

Project: *Leesburg Sink Hole Site*

Site Location: The site is located in Section 12, Township 25 South, Range 13 West, Stafford County.

Impact/Immediacy: Potential exists for impacts on stock and irrigation resources. Subsidence around the Leesburg #302 and Leesburg #303 may develop into a sinkhole. Worst-case scenario would be a catastrophic collapse taking several acres of farm ground. Probable action is a gentle downward movement of the area until stable. The site has a moderate to high rating.

Site Description: The site consists of a plugged saltwater disposal well whose operation led to the probable development of a solution cavity. The site is located in a rural setting approximately 990' FEL and 2310' FSL of section 12. Land use is agricultural with oil activities in the area. The subsidence at the site now covers an area of approximately 350'x400' in size.

Unusual Problems: A solution cavity is thought to exist under the existing location.

Status of the Project: Elevation shot at 9/14/2016. There has been no change in elevation since the last survey in 2015. Other points were under water and unable to be surveyed.

Recommendations for Future Work: It is recommended the site continued to be surveyed annually to establish a subsidence rate. The ground level at the stake on the east side should be surveyed in addition to the Leesburg 302 if it is accessible (low/no water). Additional points on the north and south edges of the sink, as well as a point in the center of the sink should be added in order to more thoroughly describe the movement.

Level of Remediation Sought:

Ideal: Stabilize cavity.

Target: Safely monitor site.

Estimated Total Costs: RP -$62,000, plugging costs, seismic and installation of monitor wells.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
2004003-001	**3 Hrs. / $92.20**		**$6,266**

Current Contaminate Level: Unknown

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

ADVANTAGE ELEVATIONS
OIL FIELD SURVEYORS

BOX 8604 - PRATT, KS 67124
(620) 672-6491

914162
INVOICE NO.

LYONS & LYONS INC
OPERATOR

NO.

SINKHOLE (SAUNDERS LEASE)
FARM

STAFFORD
COUNTY

12 S | 25s T | 13w R

Approx. N/2 NE SE
LOCATION

ELEVATION: 1900.9' GR

LYONS & LYONS INC
1519 S Baltimore
Tulsa, OK 74119

N

AUTHORIZED BY: _____

SCALE: 1" = 1000'

Shot ground elevation at steel T-post at west edge of sinkhole.

Elevation Record at same point.

3/13/06	1904.9 gr.
5/15/08	1903.6 gr.
5/13/09	1903.4 gr.
4/27.12	1901.5 gr.
9/27/13	1901.5 gr.
11/21/14	1900.9 gr.
9/30/15	1900.9 gr.
9/14/16	1900.9 gr.

12

SINK HOLE

DATE STAKED: 9/14/16

Taylor Printing Inc., • Pratt, KS 67124 • 620-672-3656

Kansas Corporation Commission

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Leesburg Sinkhole

Section 12-T25S-R13W
Stafford County, Kansas

Change in Elevation Map

KCC Control # 2004003-001 District 1
K. Sullivan 10/05/2016

Project: *Little River Site*

Site Location: The site is located 4 miles north and one east of the southwest edge of the city of Little River. The area of contamination is in the SE/4 of section 29 and NE/4 of section 32 T 18S R6W, Rice County.

Impact/Immediacy: The impact is to the ground water supply for the city of Little River from unknown oil field source. The immediacy level is rated as high because of its potential impact to the existing public water supply wells.

Site Description: The Little River water well field is located in part of the Odessa Oil Field. The ground water table in this area is at a depth of thirty feet in a sandstone aquifer with an aquitard of blue shale at a depth of fifty to sixty feet. The sandstone has its highest increase in conductivity (chlorides) at a depth of 47 to 50 feet as indicated by a conductivity test in MW# 1. The source for the contamination may be from old core soundings, spills, pits or leaking wells.

Unusual Problems: Unknown sources and probably multiple sources for the contamination.

Status of Project: KCC sampled the Public Water Supply Wells and Monitoring Wells on November 3rd, 2016. Chloride values were found to be much lower than the 2015 event. KCC believes that the combinations the questionable lab data from 2015 as well as the heavy precipitation that has occurred over 2016 have contributed to these decreases. One well, PWS#10 did increase in chloride level and KCC plans to investigate possible up gradient sources for this. The increase is only 10 mg/L, so this maybe just a natural change due to hydrological fluid movement in the Dakota Sandstone.

Level of remediation Sought:

Ideal: 60 mg/l
Target: 300 mg/l

Recommendation for Future Work: KCC recommends continued annual sampling of the public water supply and monitoring wells for 2017. KCC will investigate up gradient sources of the increase in PWS #10.

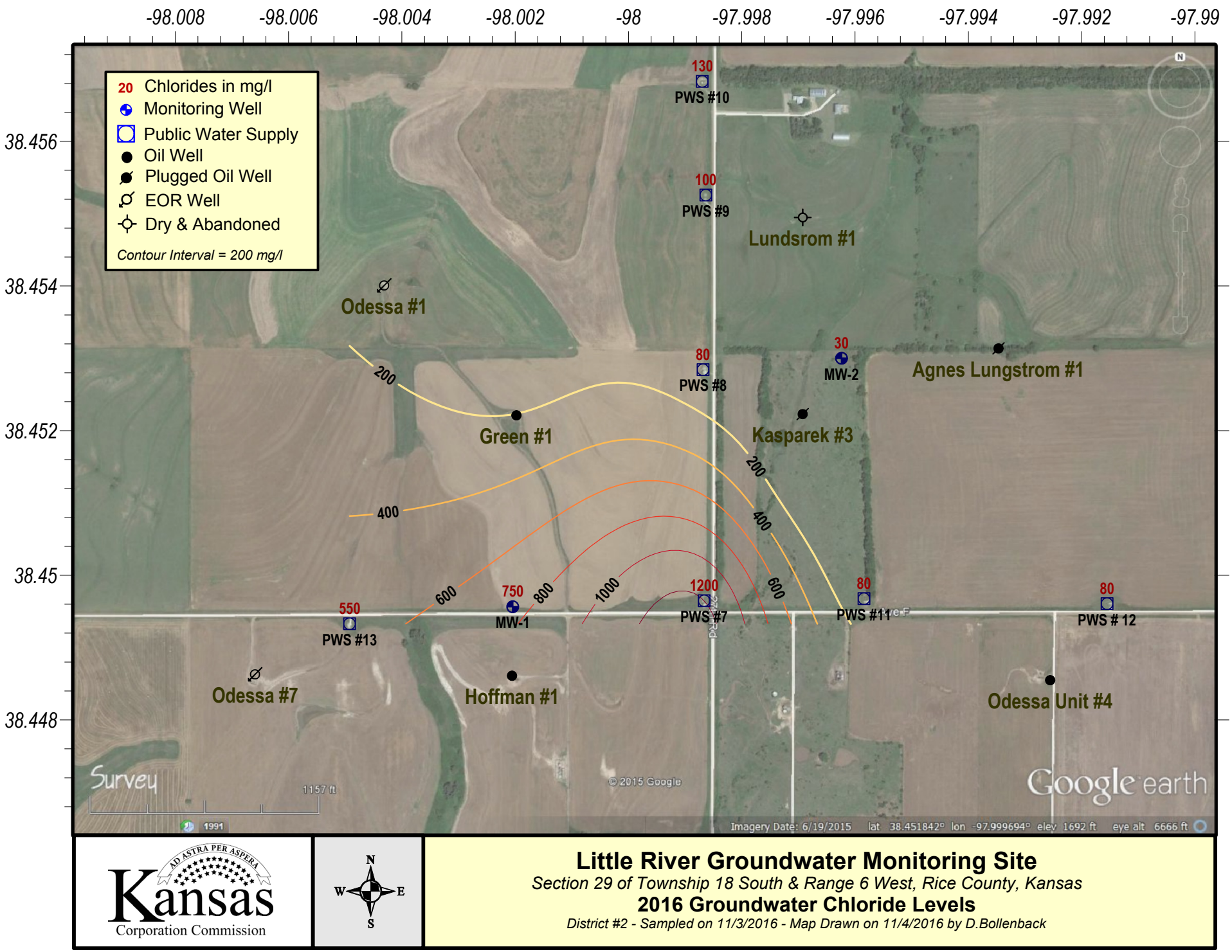
Estimated Total Costs: Time for staff to mobilize to site and sample the wells twice over the next year, perform the laboratory work, data entry, mapping, and report creation.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
20000057-001	**22 Hrs. / $601.02**		**$3,112.20**

Current Contaminate Level: 750 mg/l Cl^- MW #1 to 30 mg/l MW #2
1,200 mg/1 Cl- PWS #7

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**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-98
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-97.994
-97.992
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38.456
38.454
38.452
38.45
38.448
20 Chlorides in mg/l
Monitoring Well
Public Water Supply
Oil Well
Plugged Oil Well
EOR Well
Dry & Abandoned
Contour Interval = 200 mg/l
130
PWS #10
100
PWS #9
Lundsrom #1
Odessa #1
80
PWS #8
30
MW-2
Agnes Lungstrom #1
Green #1
Kasparek #3
200
400
600
800
1000
550
PWS #13
750
MW-1
1200
PWS #7
80
PWS #11
80
PWS # 12
Odessa #7
Hoffman #1
Odessa Unit #4
Survey
1157 ft
© 2015 Google
Google earth
Imagery Date: 6/19/2015 lat 38.451842° lon -97.999694° elev 1692 ft eye alt 6666 ft
Kansas
Corporation Commission
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Little River Groundwater Monitoring Site
Section 29 of Township 18 South & Range 6 West, Rice County, Kansas
2016 Groundwater Chloride Levels
District #2 - Sampled on 11/3/2016 - Map Drawn on 11/4/2016 by D.Bollenback

Project: *Macksville Contamination Site*

Site Location: Legal location of the site is in the S/2 SW Section 30, Township 23 South, Range 15 West, in Pawnee County.

Impact/Immediacy: An irrigation well is located in the NE/4 of this section which is in direct line with the natural flow of the groundwater. A new irrigation well was drilled and is being used to irrigate corn. Sampling shows that while the water in the well has been impacted, the water is below drinking water standards. The sinkhole itself seems to be growing to the north. Immediacy level is rated at Moderate-High due to the growing sinkhole.

Site Description: A sinkhole developed around an abandoned salt-water disposal well on July 21, 1988. Brine from the old well and possibly other sources entered the fresh water aquifer. The aquifer consists of sand and gravel overlying the Wellington Formation of Permian age. The salt-water plume is being monitored by thirty-seven wells. The plume is moving to the northeast from the sinkhole area towards an irrigation well.

Unusual Problems: Ground usage is lost over several acres due to the development of the sink. The depression is still increasing in size.

Status of Project: Samples were collected from 10 monitoring wells in 2016. Chlorides were either stable or rising compared to 2015. Chlorides at this site are below usable water standards in all except two wells. First is the MW-16d, where the chlorides are 1000ppm. The second is the MW-15d, where the chlorides are 520 ppm, right at the top of the usable water limit. Overall, the chlorides at this site have been steadily declining due to natural attenuation, but will likely remain elevated over background chlorides due to the higher chlorides that still reside in the pond formed by the sink, which are at 1,900ppm and have risen since last year. The only recovery well that is operational on this site it #1, and it is outside of the fugitive plume that is found in MW-15d and MW-16d. Further investigation and cost estimates will be obtained in 2017 to see if the any of the other three recovery wells would be helpful in remediation. The site was surveyed this year, and the numbers showed the sinkhole is still descending.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 300 ppm Chloride

Recommendations for Future Work: Chlorides, overall, have been stable for several years with a few key exceptions. If chlorides either stabilize or drop next year, plugging of the monitoring wells should begin. Since only two wells currently remain above the usable water standards it is recommended to begin plugging a majority of the wells at the site, starting with well in the SW/Q, and working back towards the fleeting plume. The results of running recovery wells three and four on monitoring wells 15D and 16D will be studied. The feasibility of purchasing a new pump to drain the pond will be considered. The site should also continue to be surveyed on an annual basis to track the current rate of subsidence.

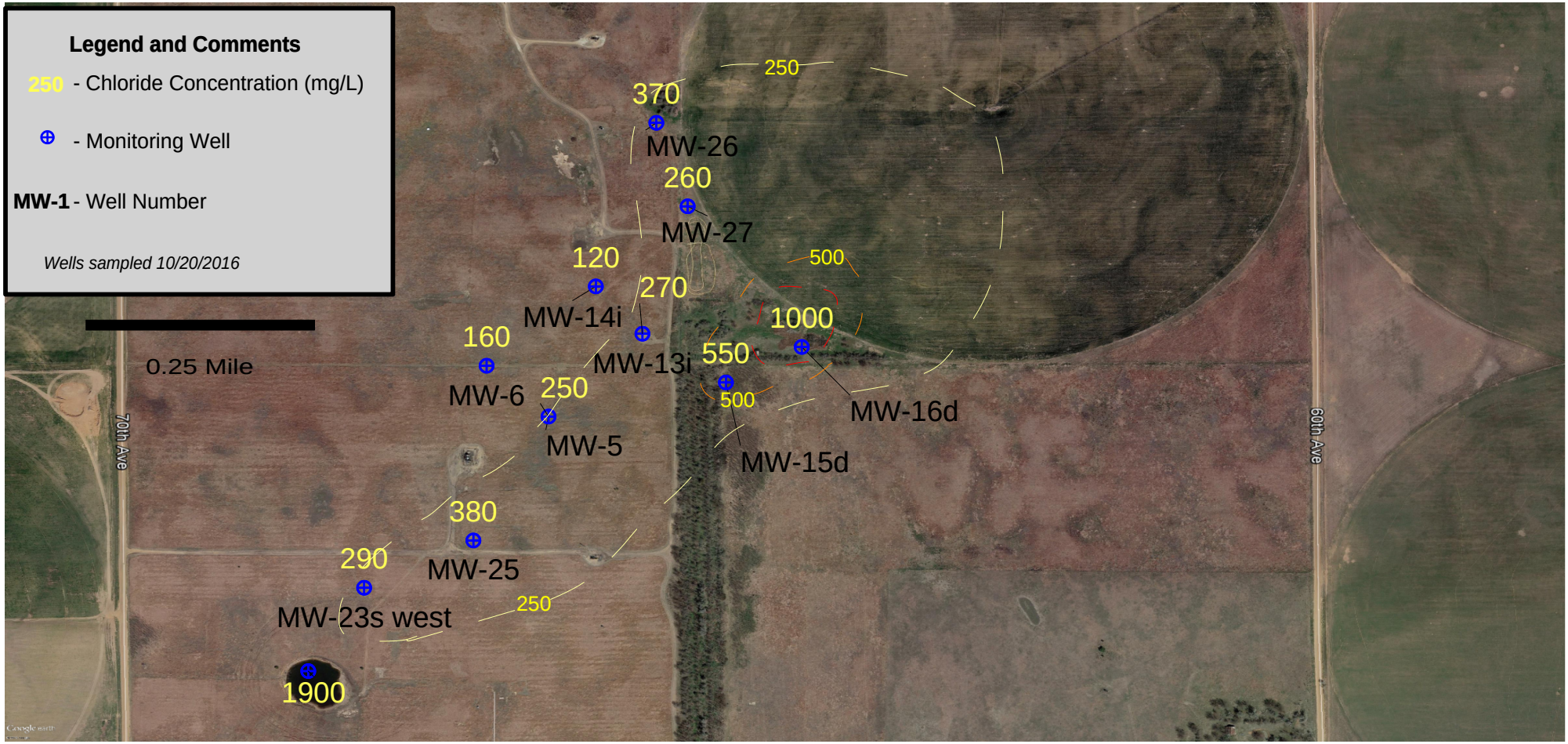
Estimated Total Cost: Costs to plug the wells have not yet been explored.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970066-00	**16 Hrs. / $440.34**	**$1,600.39**	**$81,737.61**

Current Contaminate Level: **Sink: 1,900 ppm Cl-**
MW-16d: 1,000 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☐ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☒ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

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Macksville Site

Section 30-T-23S-R15W
Pawnee County, Kansas

2016 Area Map with Chlorides

KCC Control # 970066-00 District 1
K. Sullivan 10/25/16

Project: *Mantooth Contamination Site*

Site Location: Section 20 & 29, Township 33 South, Range 14 East, Montgomery County.

Impact/Immediacy: Impact is to surface water and groundwater. The immediacy level is rated as moderate.

Site Description: The initial investigation was begun in May of 1996 by personal from the Chanute Office, in response to a complaint of brine in Deer Creek. At That Time the site consisted of an abandoned oil lease with as many as 41 abandoned well *locations, some of which were leaking brine at or near the surface and effecting both surface water and groundwater resources.* The site is situated immediately north of Deer Creek, a tributary of the Caney River in the Verdigris River Basin. In the spring of 1999 funds were approved for the excavation of abandoned well sites on this property. During that investigation 25 abandoned wells were confirmed and referenced by GPS.

Unusual Problems: Lack of detailed lease data concerning the number and location of wells drilled in the area is a significant problem in properly and completely assessing potential contaminates source areas for this site. However to date there have been 25 wells plugged in 1999 and an additional 10 wells in 2013. There are also several potential sources being investigated outside the physical lease boundaries of this site.

Status of Project: The Primary Fee Fund Project for this site was completed in the summer of 2000. Twenty-five abandoned wells were plugged. In 2012 the area of interest was expanded resulting in the discovery and plugging of an additional 10 wells in 2013. Data gathered from the well plugging operations and monitoring well sampling indicates that the source of the salt water plume is most likely located in the south half of the project. Leases immediately bordering this site are being inventoried and referenced by GPS to identify further environmental threats outside the original area of concern. The overall Cl- concentrations are still trending down. Six additional monitoring wells were completed in early 2012 to further evaluate the extent and to help determine the possible brine source. The following are the Cl- concentrations of this year's sampling:

MWE 01: 4,000 ppm Cl- (9/15/2016); 3,800 ppm Cl- (10/31/2016); ***MWE 02***: 3,200 ppm Cl- (9/15/2016); 2,900 ppm Cl-(10/31/2016); ***MWE 03:*** 3,100 ppm Cl- (9/15/2016); 3,000 ppm Cl-(10/31/2016); ***MWE 04***: 7,900 ppm Cl- (9/15/2016); 500 ppm (10/31/2016); ***MWE 05***: 600 ppm Cl- (3/31/2016); 500 ppm Cl- (9/15/2016); 400 ppm Cl-(10/31/2016); ***MWE 06***: 500 ppm Cl- (3/31/2016); 500 ppm Cl- (9/15/2016); 500 ppm (10/31/2016); ***MWE07***: 400 ppm Cl- (3/31/2016); 400 ppm Cl-(9/15/2016); 400 ppm Cl- (10/31/2016).

Level of Remediation Sought:

Ideal: Less than 250 ppm Chloride
Target: 500 ppm Chloride

Recommendation for Future Work: Continue monitoring in order to verify whether plugging of the existing abandoned wells eliminates the current source of saltwater contamination within the ground and surface water in the project area. Future work will be based upon the results of the sample analysis of the monitoring wells and Deer Creek. There have been 20 new CBM wells and associated SWD wells drilled in the last few years in section 20 & 29.

Estimated Total Costs: Fee Fund Plugging of 10 abandoned wells cost $77,926.

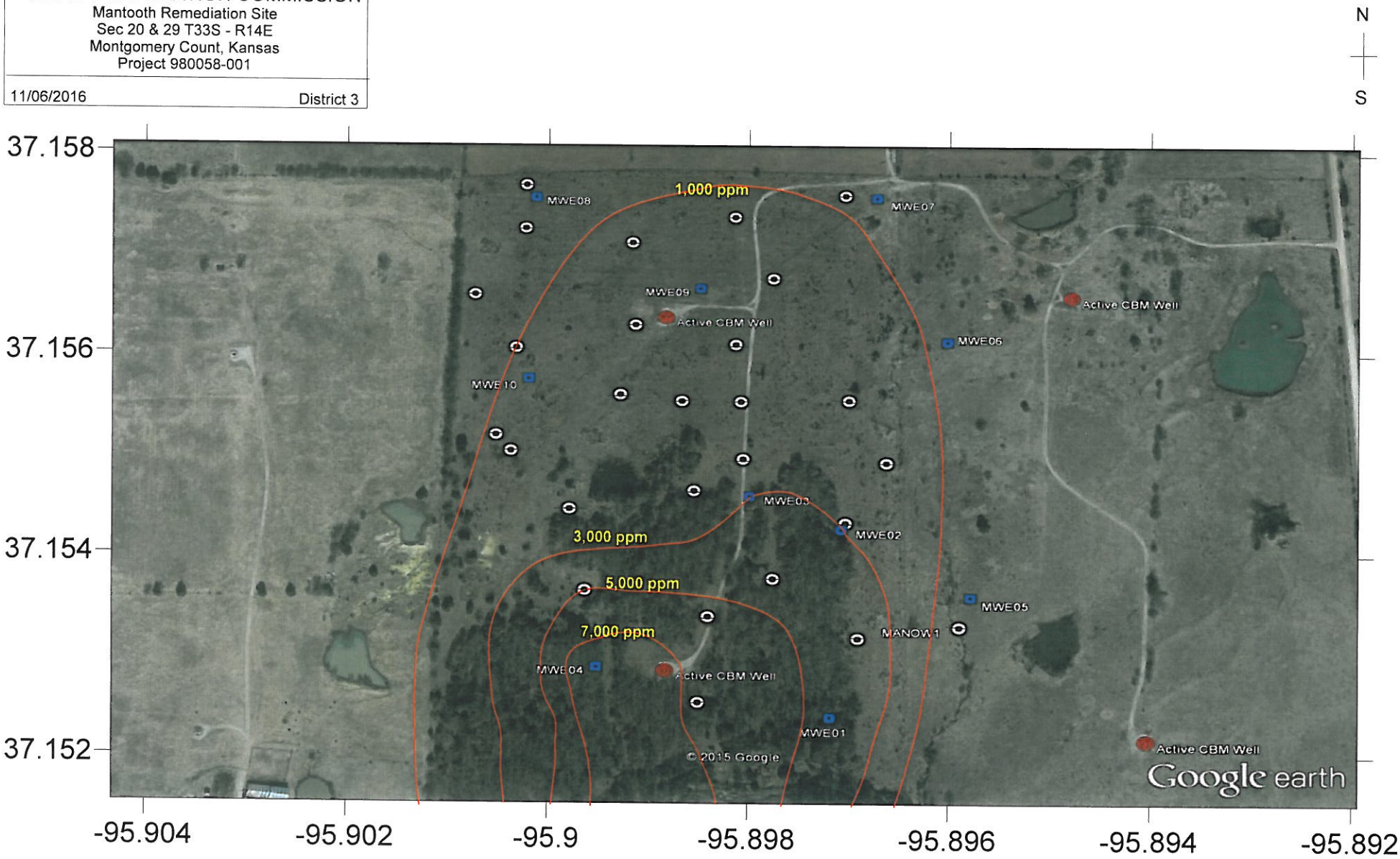
Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Fund Expenditures Total
980058-001	80 Hrs. / $2,264.24		$17,349

Current Contaminate Level: 400 ppm to 7,900 ppm Cl-
Status: Active

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☒ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved

KANSAS CORPORATION COMMISSION
Mantooth Remediation Site
Sec 20 & 29 T33S - R14E
Montgomery Count, Kansas
Project 980058-001

11/06/2016 District 3



Contour Interval 500 ppm Cl-

Monitoring Well

Fee Fund Plugged Well

Active CBM Well

Project: *Maupin Contamination Site*

Site Location: SE/4 of Section 9, Township 11 South, Range 15 West, Russell County.

Impact/Immediacy: Brine contamination of a shallow aquifer and a spring which is utilized for cattle. Immediacy level is rated as low.

Site Description: The site is rangeland at the head of a drainage within the Saline River Basin. Originally, the primary source of water for cattle in the pasture was a spring which had been developed as a source by diverting its water to an open stock tank. Nearby water wells and ponds were experiencing increases in chloride concentration by 1956, and a complaint regarding high chlorides in this spring was made in 1991. Following an investigation, five monitoring wells were drilled on the location, and the waters of this basin ranged in chlorides, including the spring, from 200 ppm to 3,400 ppm throughout the history of sampling. While the pollution has never caused the water to become unusable, the concentration of chloride in the spring is near the upper limit for stock use if it is the sole source of water for the cattle. Recently, a stock tank which is filled by water from the Ellsworth Rural Water District #1 is now available for the cattle to drink from.

Unusual Problems: None.

Status of Project: At this time, the chloride concentrations in the monitoring wells are 500 ppm at monitoring well 3, and 800 ppm at monitoring well 5, and the concentration of the spring-fed stock tank is 1,050 ppm. At this time, these levels do not warrant additional action.

Level of Remediation Sought:
Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: This site will continue to be monitored on an annual basis until closure.

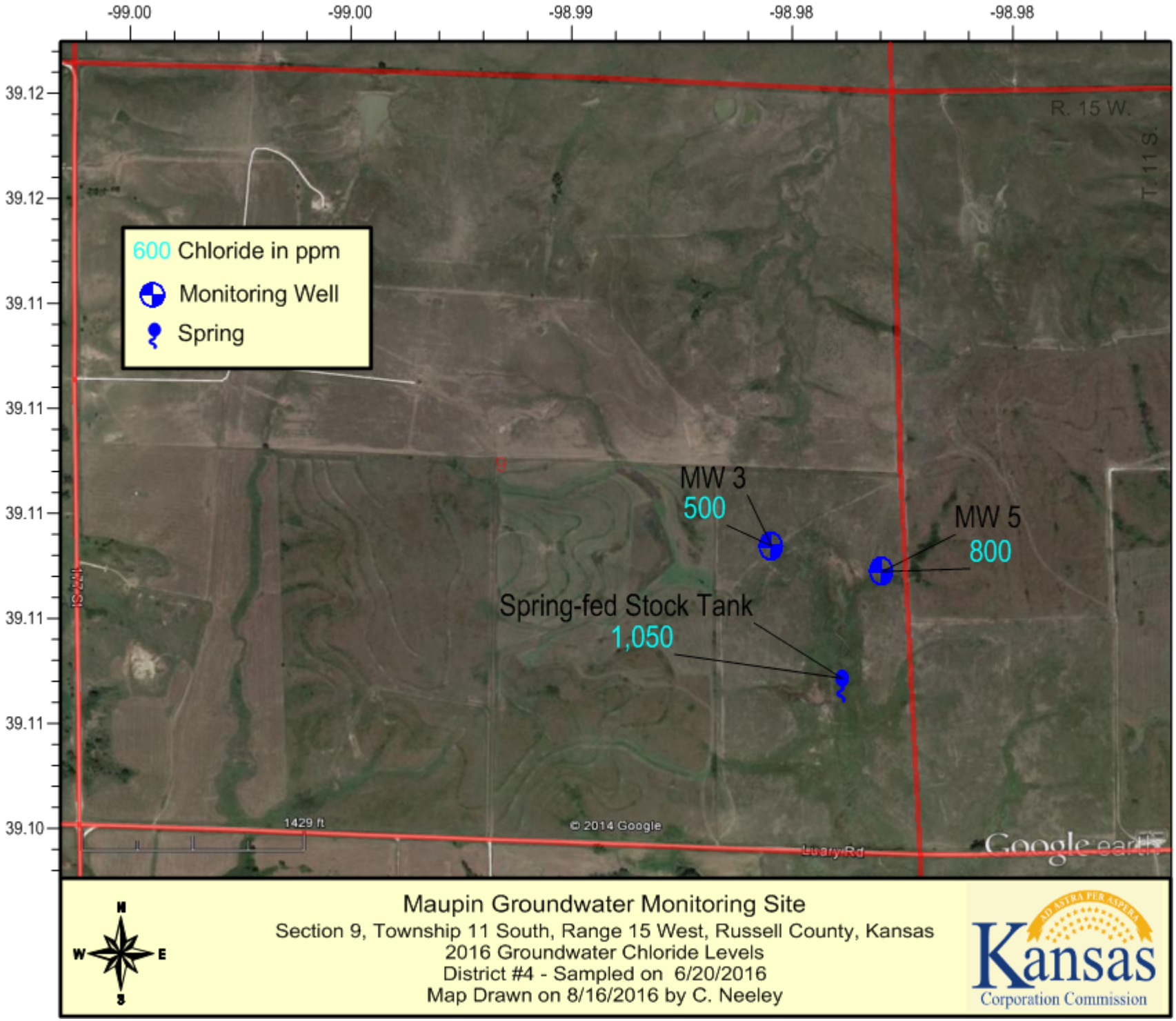
Estimated Total Costs: $2000.00

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17 Total**
970068-00	**15 Hrs. / $416.84**	

Current Contaminate Level: 500 ppm to 1,050 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**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600 Chloride in ppm
Monitoring Well
Spring
MW 3
500
MW 5
800
Spring-fed Stock Tank
1,050
9
1429 ft
© 2014 Google
Google earth
Maupin Groundwater Monitoring Site
Section 9, Township 11 South, Range 15 West, Russell County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled on 6/20/2016
Map Drawn on 8/16/2016 by C. Neeley
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Corporation Commission

Project: *McDonald-East Contamination Site*

Site Location: NW/4 of Section 27, Township 19 South, Range 22 East, Linn County.

Impact/Immediacy: Impact is to the surface water. Immediacy level is rated as low.

Site Description: This site is located at the bottom of a small, fairly steep drainage in the Cherryvale Shale. A seep originating from this drainage tested 3,300 ppm chloride in 1991, 6,500 ppm chloride in 1992, 750 ppm chloride on September 26, 1995 and 380 ppm chloride on January 26, 1998. Seepage within the drainage is intermittent based on precipitation in the area.

Unusual Problems: None.

Status of Project: The State has made an agreement with a local Operator to put this lease back into production and plug several of the injection wells and older oil wells. There are six monitoring wells located on the McDonald East Site in the NW ¼ of section 27–T19S–R22E. The following Cl- concentrations of sample results were obtained on 09/01/2016:

Monitoring well#2 (MCDE02): 400 ppm Cl-
Monitoring well#3 (MCDE03): 500 ppm Cl-
Monitoring well#4 (MCDE04): 600 ppm Cl-
Monitoring well#5 (MCDE05): 600 ppm Cl-
Monitoring well#6 (MCDE06): 300 ppm Cl-

Cl- levels spiked during 2010 and since have been trending down. Aggregate concentration of Cl- has again trended down, approximately 8% to below 500 ppm this year. Further monitoring on an annual basis is recommended for this site. Operator continues to produce this lease and future monitoring will determine if production activity has any impact on site.

Level of Remediation Sought:

Ideal: 200 ppm Chloride
Target: 500 ppm Chloride

Recommendation for Future Work: Continue sampling annually and monitoring injection activity on this lease.

Estimated Total Costs: $1,500.00 yearly.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970070-00	**39 Hrs. / $1,108.45**		

Current Contaminate Level: 300 ppm Cl- to 600 ppm Cl-

Status: Active

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

KANSAS CORPORATION COMMISSION
McDonald East Remediation Site
NW27-T19S-R22E
Linn County, Kansas
Project 970070-00

11/06/2016 District 3

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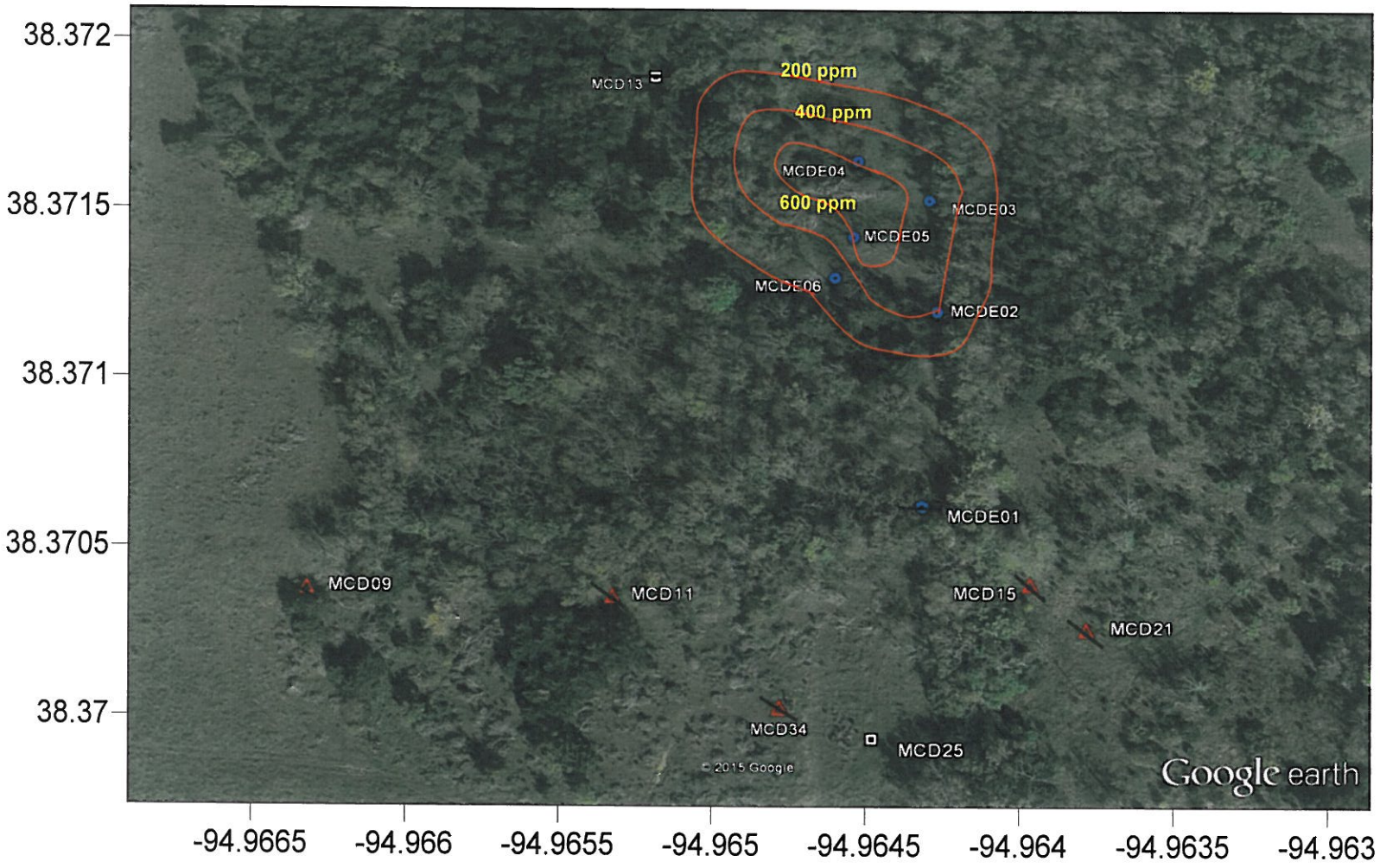


Contour Interval 100 ppm Cl-

Monitoring Well

Plugged UIC Well

Plugged Oil Well

Oil Well

Project: *McPherson Landfill-Johnson Oil Field Contamination Site*

Site Location: The McPherson Landfill itself is located in Section 34, Township 19 South, Range 3 West, in McPherson County, approximately .75 miles southeast of the city of McPherson. The affected areas include Sections 33 & 34, Township 19 South, Range 3 West, and Sections 3,4 & 5, Township 20 South, Range 3 West.

Impact/ Immediacy: The contamination has impacted industrial water supply wells for the CHS Refinery formerly the National Cooperative Refinery Association (NCRA), as well as domestic rural water wells. This site has a moderate immediacy level.

Site Description: The site is located in rural McPherson County near the old landfill and the CHS refinery. The area of contamination lies on the west side of the Johnson Oil Field, which is the probable source of the high salinity in the ground water.

Unusual Problems: None.

Status of Project: Since 2003 NCRA has annually provided a report on their East Refinery Groundwater Quality Improvement Project, and the Groundwater Monitoring Plan. A full report from the consulting company, Trihydro Corporation is on file with the KCC. The goals for this project include mitigating chloride impacted oil field brine water migrating from the Johnson Oil field east of the refinery, and preventing lateral movement of the identified hydrocarbon plume beneath the refinery toward the chloride remediation system. The remediation system consists of 12 recovery wells, RW-7 through RW-18, which are all screened in the lower portion of the Equus Beds aquifer. In 2016 a total of 144,600,000 gallons of chloride impacted water was recovered from seven of the recovery wells. The bulk of the recovery came from RW 7, RW 11, RW 12, RW 13, RW 14 and RW 18. Impacted water is disposed of down DW-3 which is a Class I nonhazardous injection well onsite.

Overall chloride levels in the 16 deep screened monitoring wells dropped due to the above normal rainfall received in 2016. The chloride levels dropped between 2.4% to 25% in the monitoring wells with the only increase occurring in EB402C which has historically had the highest chloride level for the entire site. In 2015 the National Cooperative Refinery Association (NCRA) became CHS Refinery.

Level of Remediation Sought:

Ideal: 250 ppm chlorides
Target: 500 ppm chlorides.

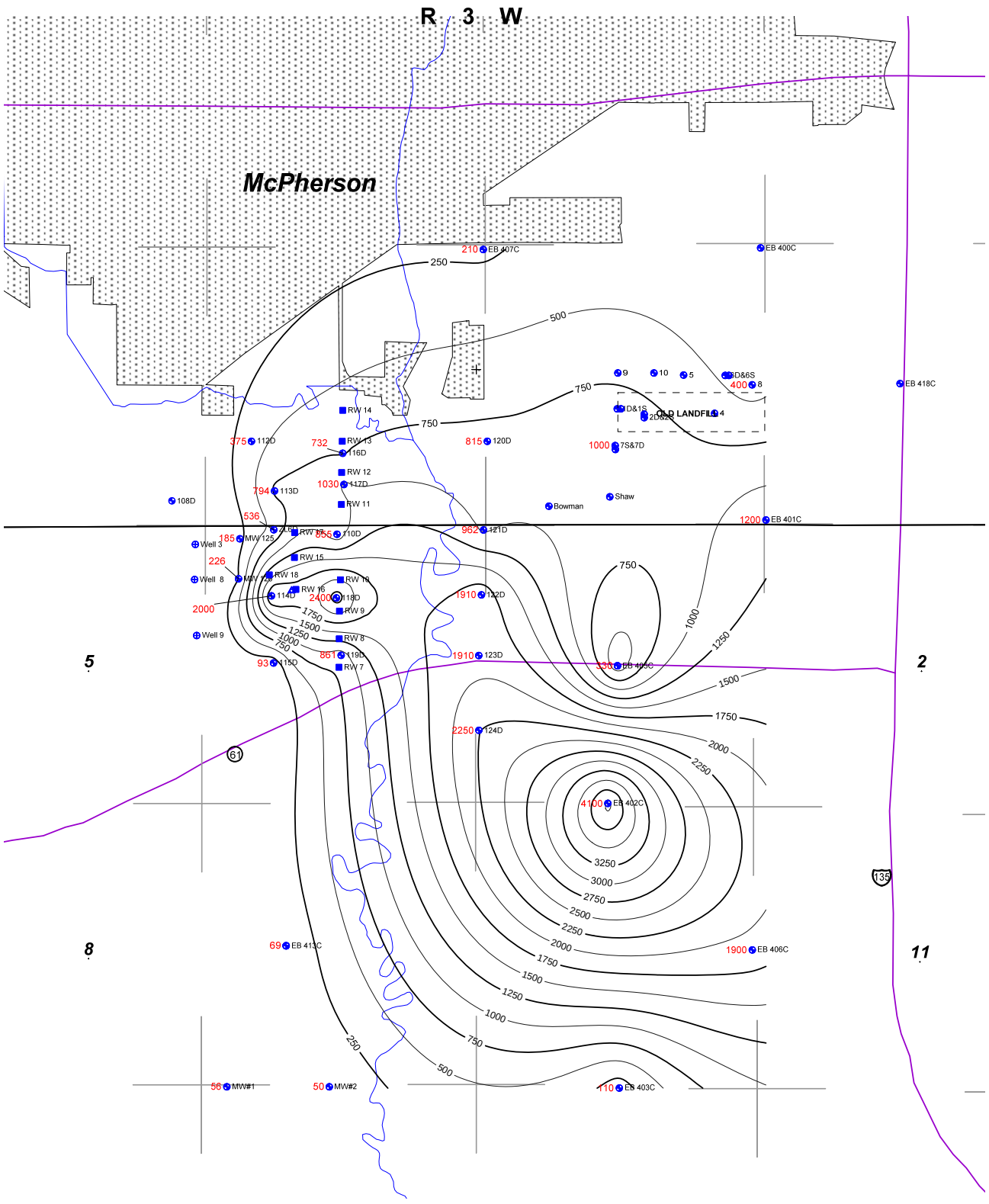
Recommendations for Future Work: Collect data on an annual basis from CHS, GMD2 and the old landfill.

Estimated Total Costs: KCC provides funding to GMD2 for sampling surrounding monitoring wells.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Total
980034-001	15 Hrs. / $482.76	$604.24	$21,069.45

Current Contaminate Level: 50 mg/l (MW-2) to 4,100 mg/l (EB 402C)
Recovery wells averaged 592 mg/l chlorides in 2016
Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☒ 7. Remediation (CHS)	☐ 8. Post Rem. Monitoring	☐ 9. Resolved


R 3 W
T 19 S
T 20 S
McPherson
OLD LANDFILL
Bowman
Shaw
5
2
8
11
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135
RW 14
RW 13
RW 12
RW 11
RW 15
RW 18
RW 16
RW 19
RW 9
RW 8
RW 7
210 EB 407C
EB 400C
EB 418C
400 8
1200 EB 401C
1910 122D
1910 123D
2250 124D
4100 EB 402C
1900 EB 406C
69 EB 411C
110 EB 403C
56 MW#1
50 MW#2
2400 118D
2000
1880 118D
Numbers in RED are Chloride Values
Numbers in BLACK are Monitoring Well Numbers
Contour Interval = 250 mg/l
LEGEND
Monitoring Well
NCRA Recovery Well
NCRA Water Supply Well
KANSAS CORPORATION COMMISSION
McPherson Landfill-Johnson Oil Field 2016
2016 CHLORIDE CONTOUR MAP
T19S & T20S-R3W, McPheron County, KS
Dist. 2 Control No. 980034-01 10-26-2016 J. Klock
SCALE
0 0.25 0.5 0.75 1
MILES

Project: *Nikkel-Epps*

Site Location: The Nikkel-Epps contamination site is located in the NE/4 of Section 18, Township 20 South, Range 1 West, in McPherson County.

Impact/Immediacy: Medium-high immediacy level. Chlorides here affect a shallow groundwater aquifer with multiple residences within a half mile some of which use the aquifer as the sole source of water. There is crop irrigation in the area side and down gradient as well.

Site Description: The aquifer consists of two to three sand units separated by clay layers. At the base of the aquifer lies the Wellington Shale. The aquifer appears to contain several possible aquitards, which could be impermeable clays separating the sands. It is unknown if these clays are continuous throughout the area. Due to the depth that the saltwater has been found it is assumed that potential pathways down to the Wellington formation exist. The land surface is flat irrigated farmland. Chlorides seem to be settling along the Wellington Shale contact. The top of the Wellington is an erosional disconformity which can allow for high relief channels and bumps with in the shallow aquifer.

Unusual Problems: Like many other chlorides problems in the area, the chlorides can be hit and miss and contained in 'hot spots' down-gradient of old evaporation pits and settling in deeper pockets within the aquifer.

Status of Project: Research done by Jeff Klock on the Epp's complaint in 2007 found that historically there have been other complaints and records of contamination around the Epp Site. On 3/6/2007 Mike Peterson, of Peterson Irrigation, called the KCC to report that the four irrigation wells he had installed for Ted Nikkel on the Epp's Property had become salty. On 3/7/2007, Jeff Klock with the KCC was onsite to investigate and took samples of the water from the irrigation wells. The Main well tested over 5,000 ppm chlorides. Samples sent to Dr. Donald Whittemore, at the Kansas Geological Survey, were found to have oil field brine as the source of the chlorides. On 8/26/2008, David Bollenback with the KCC returned to the site and sampled the three remaining irrigation wells. Sampling results ranged from 4,500 to 400 ppm chlorides increasing towards the south and the main well. Data from the irrigation logs indicate this maybe due to greater sand development towards the center of the site, which could account for the sinking saltwater plume. A composite sample of all the irrigation wells tested to be 2,300-ppm chlorides and is unusable for agricultural use. KCC recommended that the irrigation well not be used at this time. 6/4/09 KCC sampled the Ratzlaff house well just south of the irrigation wells and lab results at the KCC lab showed that chlorides were 890 ppm. The Ratzlaff's house well is their only source of water at this time. Monitoring well drilling commenced on November 30, 2011 where MW-1, MW-2, and MW-4 were drilled and completed. Heavy rains limited Rig and truck access until February 1, 2012. MW-3, MW-5, MW-3S, and MW-4S were drilled and installed between February 1 and 2, 2012. KCC has talked with the township manager regarding well that agricultural equipment had knocked over and broken MW-1, MW-4, and MW-4S which are located along the road on the north side of section 18. Investigation indicates that the tenant farmer destroyed the wells while discing the field. All monitoring wells were clearly marked with yellow KCC identification stickers and 6 feet long PVC markers prior to this occurrence. KCC has evaluated the chance of repairing the damaged wells but unfortunately the wells are beyond repair. On August 5th, 2016, MW-2, MW-3, MW-3S, and MW-5 groundwater monitoring wells, were gauged and sampled for chloride levels. Chloride levels have dropped in the three deep wells as much as 300 ppm. This could be due to the heavy precipitation this year and the known limited aquifer that exists.

Level of Remediation Sought:
Ideal: <250 ppm
Target: 500 ppm

Recommendations for Future Work: Due to other KCC projects requiring remediation funds, KCC has not addressed the damaged wells at the Nikkel-Epps Site. Without the Northern Wells the site is currently hard to interpret regarding chloride migration. Replacement wells will have to be installed in order to monitor this site for Chloride migration. Further soil borings and monitoring wells are needed northern sections of the site. MW-2 has increased in chlorides since over the last three years and confirms the need for an investigative Phase II work scope should be drawn up for consideration. New work will need to be focused to the north and east of the current site. Evidence suggests that the main brine plume has a source(s) in section 7.

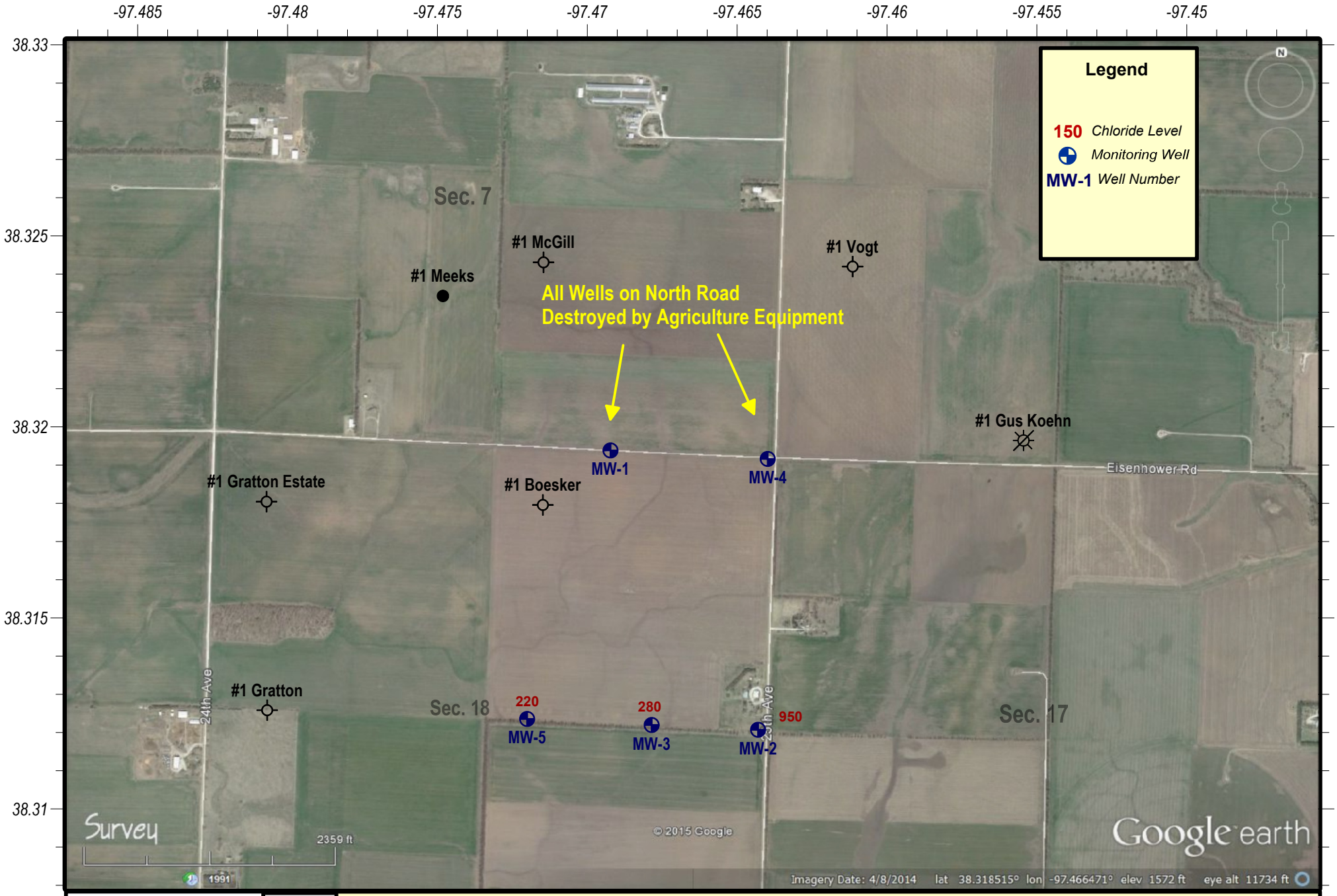
Estimated Total Costs: $10,000 to $30,000 to drill the new wells and repair broken wells during a Phase II investigation. The KCC District #2 will also need funding for sampling, research, and report preparation.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Total
20100082-001	10 Hrs. / $279.66		$8,318.75

Current Contaminate Level: MW-5 220 ppm to MW-2 950 ppm.

Status:

[X] 1. Site Assessment	[ ] 2. Short Term Monitoring	[X] 3. Investigation
[ ] 4. Long Term Monitoring	[ ] 5. Remediation Plan	[ ] 6. Installation
[ ] 7. Remediation	[ ] 8. Post Rem. Monitoring	[ ] 9. Resolved



Kansas Corporation Commission

Nikkel- Epps Contamination Site

NE Section 18 of T20S & R1W, McPherson County, Kansas

2016 Deep Monitoring Well Chlorides

District #2 - Control # 20100082-001 - Drawn on: 10/28/2016 by D.Bollenback

Project: *Packard Contamination Site*

Site Location: Legal location is Section 15, 22, 23 Township 31 South, Range 13 West, in Barber County. 7 miles west of Medicine Lodge on river road.

Impact/Immediacy: The ground water has been contaminated, and a very good water well has been contaminated with chlorides. Immediacy level is rated as moderate.

Site Description: The salt-water plume is moving to the south away from the Packard #1 oil well. It has contaminated the water supply well and could possibly damage the domestic well at the abandoned house, the supply well in the SE/4 of section 23, and the spring to the southwest.

Unusual Problems: The contamination could be from multiple sources.

Status of Project: A total of eight samples were taken in 2016. Four monitoring wells samples were taken in addition to three supply wells and one surface sample from a spring. Chloride data shows the plume remains confined. Chlorides historically have decreased, but over the past several years have remained consistent.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 1000 ppm Chloride

Recommendation for Future Work: Monitoring will continue on an annual basis as the area continues to be remediated by natural attenuation. As the groundwater in this area is relatively shallow, several holes may be augured in order to gather more comprehensive data on the size and whereabouts of the chlorides. Depending on the information gathered, additional permanent monitoring wells may need to be installed. Analytical may need to be run on the new south supply well in order to determine if the chlorides are of a natural source, or from oilfield activities.

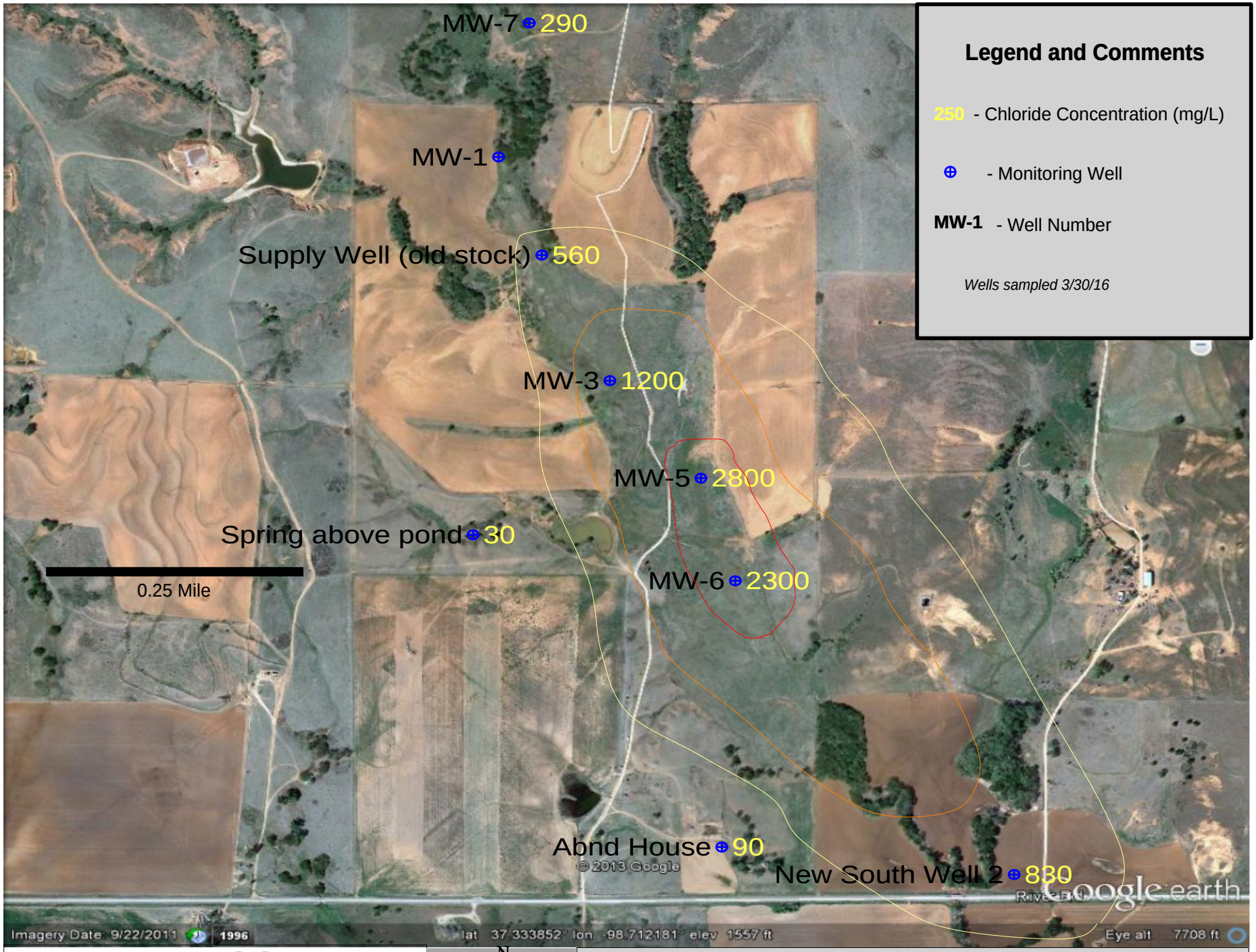
Estimated Total Costs: $10,000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/2017 Total**
970075-00	**14.5 Hrs. / $401.30**	**$310.09**

Current Contaminate Level: 30ppm CL- 2800 ppm CL-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

N W E S

Packard Contamination Site

Sections 15/22/23-T31S-R13W
Barber, County Kansas
2016 Area Map with Chlorides
KCC Control # 970075-00 District1-K. Sullivan 4-11-16

Project: *Ruder Contamination Site*

Site Location: Sections 17, 20, and 28 of Township 15 South, Range 18 West, Ellis County.

Impact/Immediacy: The Ruder Creek Alluvial Aquifer has been impacted by brine intrusion due to surface ponds, poorly constructed shallow disposal wells in the Cheyenne Sandstone, and numerous leaks. The Immediacy level for this site is rated as moderate.

Site Description: Ruder Creek runs south west of US 183 from near Hays to the Smoky Hill River near Schoenchen. North of the site, Ruder Creek is divided into east and west branches, which come together into the main trunk in the northern section of the site. The area is almost exclusively range land with a subtle relief from the uplands to the bed of the stream. Documented oil field pollution has existed in the drainage since the 1930's, and correspondence made during 1954 states that the west branch was fresh while the east branch and the main trunk of the stream were heavily impacted by brine. Historical aerial photographs show many pits and tank battery locations directly adjacent to the stream. The sources of pollution in this area have been numerous, and geographically as well as temporally wide spread, complicating the investigation and remediation of the overall issue.

Unusual Problems: Proximity to the City of Hays' public water supply well field.

Status of Project: Presently, the chloride concentrations in the monitoring wells range from 1,000 ppm in the northern end of the site, to 200 ppm in the southern monitoring well near the Smoky Hill River. This north-south chloride gradient has persisted for many years. Appreciable decreases in chloride contamination have not been observed throughout the duration of sampling, and it is unknown if the input of additional contaminants has been halted by the closure of surface pits, plugging of flowing wells, and general improvement of lease practices.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: Conspicuous potential sources of pollution have been identified on a historical aerial photograph, and a conductivity survey will be carried out and combined with additional groundwater sampling. This site will continue to be monitored on an annual basis, and resources will be compiled to identify other possible sources of pollution.

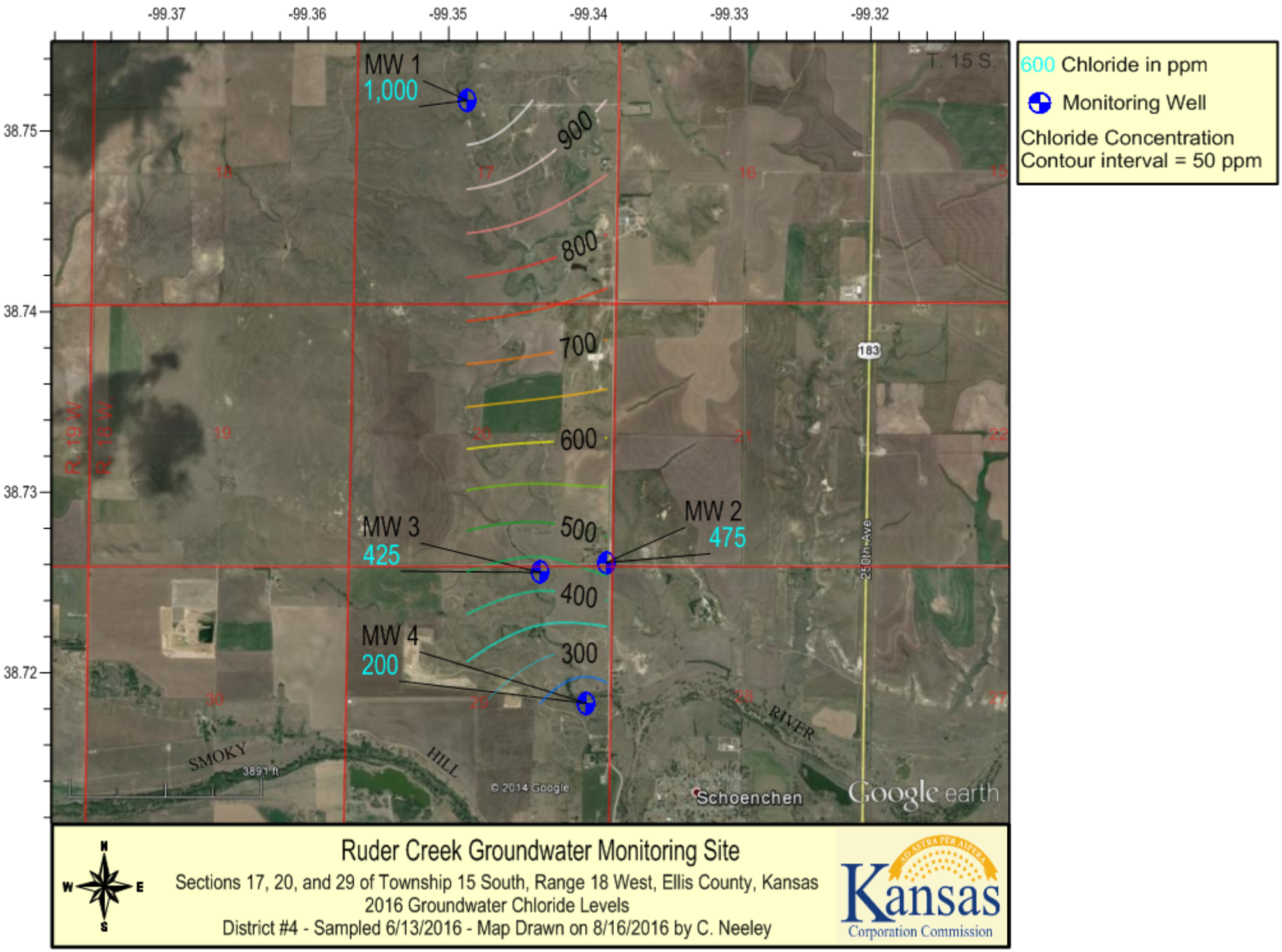
Estimated Total Costs: $29,000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970082-00	**9 Hrs. / $252.88**		**$12,960**

Current Contaminate Level: 200 ppm to 1,000 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**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-99.36
-99.35
-99.34
-99.33
-99.32
38.75
38.74
38.73
38.72
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MW 2
475
MW 3
425
MW 4
200
900
800
700
600
500
400
300
T. 15 S.
R. 19 W.
R. 18 W.
183
25 0th Ave
SMOKY
HILL
RIVER
Schoenchen
© 2014 Google
Google earth
600 Chloride in ppm
Monitoring Well
Chloride Concentration
Contour interval = 50 ppm
N
S
E
W
Ruder Creek Groundwater Monitoring Site
Sections 17, 20, and 29 of Township 15 South, Range 18 West, Ellis County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 6/13/2016 - Map Drawn on 8/16/2016 by C. Neeley
Kansas
Corporation Commission

Project*: Running Turkey Creek*

Site Location: The area of contaminated surface and ground water is in the Running Turkey drainage pattern and appears to start in the N/2 of 26-19S-2W. This area is within the Ritz Canton oil field, east of Galva, and extends south of Highway 56.

Impact/Immediacy: Oil field impact to the soil can be seen through out the area of the oil fields along the drainage basin. Due to the age of the area oil fields, many spills, line leaks and old brine pits have caused damage to soil and water resources. Ground water used for domestic, irrigation and potential public water supplies is the largest and problematic resource affected by the contamination zones. The immediacy rating is moderate to high.

Site Description: The topography of the area is flat to gently rolling hills. Most of the land is under cultivation. The ground water also flows generally in a south to southwest direction with minor hydrologic anomalies. The ground water contamination is highest near the bedrock contact. Local geology consists of fine textured soils that exhibit strong clay-pan development. These soils are underlain by loess deposits of Quaternary Age which lay on top of McPherson Formation sands and gravels. Depth to sands in the area ranges from as little as 5 feet to 60 feet. The Wellington Shale forms the bedrock in the area. The Wellington had been eroded prior to deposition of the McPherson and has erosional contact along with various paleo-valley and related structures.

Unusual Problems: In order to delineate this site a monitoring well matrix may have to spread for a large distance. Ritz-Canton Oil Field brine contamination can have multiple sources which will complicate delineation. It is unclear if direct connection of the north and far south (South of highway 56) wells is occurring or if they are separate plumes.

Status of the Project: This site is in a monitoring phase, though investigations are warranted in order to delineate the plume. The monitoring wells are sampled using submersible pumps or air-lift technology depending on the depth of the well. Overall the plume within this site has remained stable over 2016. MW-2101 had a small increase in chlorides from 2015. All wells were sampled on October 27, 2016. Three well volumes were purged from each well before a sample was taken.

Level of Remediation Sought:

Ideal: 250 mg/l mg/l
Target: 500 mg/l

Recommendation for Future Works: Continue with the annual monitoring program of the site as the highest chloride well is still over 20,000 mg/L chlorides. KCC District #2 plans to put together a scope of work which would entail the plugging/repair of certain wells within the site as well as the drilling and installation of no fewer than 5 new monitoring wells in order to delineate the very highly contaminated area in the east-northeast of the plume.

Estimated Total Cost: $1000 for annual sampling and research. If a new investigation is begun cost will rise as a sizable amount of time and research will be needed to plan the next phase of this site. Installation of more monitoring wells would range from $20,000 to 30,000.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Fund Expenditures Total
20010033-001	19 Hrs. / $520.68		$61,603.07

Current Contaminate Level: 60 mg/l Cl^- MW-2001 to 21,000 mg/l Cl^- MW-202 (Aquifer)

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☒ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved

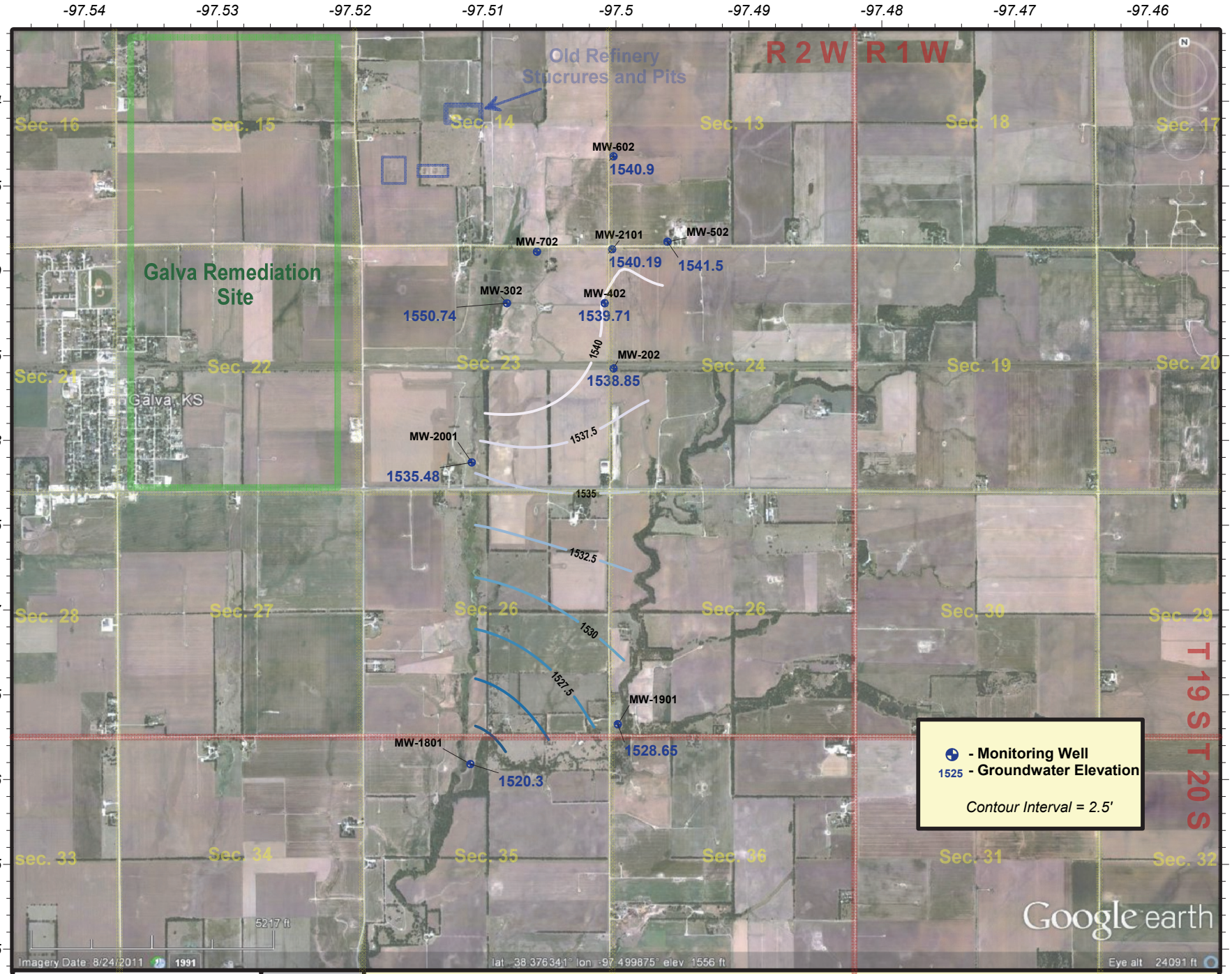
Kansas Corporation Commission

Northern Running Turkey Creek Contamination and Monitoring Site - KCC Control #20030059-001

Multiple sections in Township 19 & 20 South and Range 2 West, McPherson County, Kansas

2016 Groundwater Chloride Levels

District #2 - Sampled 10/27/2016 - Map Drawn on 11/1/2016 by D.Bollenback



Kansas Corporation Commission

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Northern Running Turkey Creek Contamination and Monitoring Site - KCC Control #20030059-001

Multiple sections in Township 19 & 20 South and Range 2 West, McPherson County, Kansas

2016 Groundwater Elevation Map

District #2 - Levels gauged 10/21/2016 - Map Drawn on 11/1/2016 by D.Bollenback

Project: *City of Russell Contamination Site*

Site Location: Within and around the City of Russell, in Parts of Township 13 South, Range 14 West and Township 14 S, Range 14 W, Russell County.

Impact/Immediacy: Brine contamination of a shallow aquifer utilized primarily for lawn and garden purposes such as irrigation of lawns. Immediacy level is rated as low.

Site Description: Potential sources include the approximately 334 wells drilled either in the city limits or in close proximity to the city limits, and the associated drill pits, lead lines, tank battery sites, brine tanks, brine lines, and emergency pits. In addition, there are 36 oil wells and UIC wells within this site that are either abandoned or have little or no documentation to confirm that they have been plugged. Test holes were drilled in the area during the summer of 2001 in an effort to delineate the source of the contamination. Data collected through the test holes, and other research indicated that the major contributor of chloride ions may be a former brine pit located to the northwest of the city. However, there has been extensive oil and gas development in the same vicinity, and the contribution from old drill pits and old line leaks has not been determined.

Unusual Problems: The investigation of all potential contamination sources would be costly and not without challenges. If remediation is initiated, the Disposal of contaminated water would incur severe costs and logistical problems.

Status of Project: In September of 2004, the monitor well tested at 2,200 ppm chloride. No samples were taken between 2004 and 2014, due to the well being inaccessible. In 2014, access to the well was gained, and the chloride concentration was 1,250 ppm and 1,500 in 2015. In 2016 the well was again inaccessible.

Level of Remediation Sought:
Ideal: 500 ppm Chloride
Target: 1000 ppm Chloride

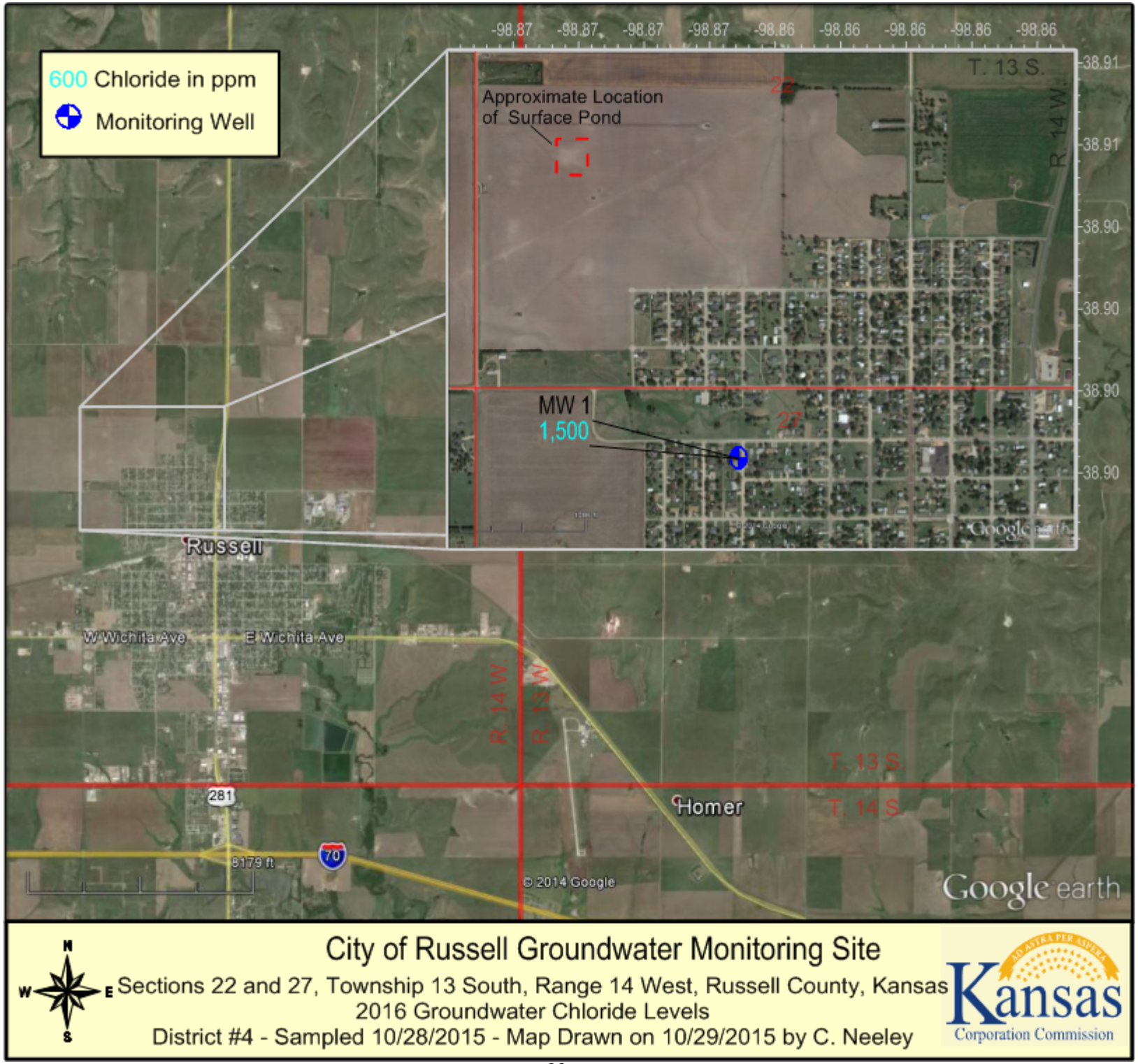
Recommendations for Future Work: Further research may be needed to determine whether remediation is justifiable, and what action should be taken. Additional samples may be collected in the future to determine the configuration of the brine plume, and if the chloride concentration in our monitoring well is characteristic for the entire area.

Estimated Total Costs: $400,000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970083-00	**4 Hrs. / $118.98**		**$1,192.60**

Current Contaminate Level: 1,500 ppm Cl^- (2015)
Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☒ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**


600 Chloride in ppm
Monitoring Well
Approximate Location of Surface Pond
MW 1
1,500
22
27
T. 13 S.
R. 14 W.
Russell
W Wichita Ave
E Wichita Ave
R. 14 W.
R. 13 W.
T. 13 S.
T. 14 S.
Homer
281
70
8179 ft
© 2014 Google
Google earth
-98.87
-98.86
38.91
38.90
N
S
E
W
City of Russell Groundwater Monitoring Site
Sections 22 and 27, Township 13 South, Range 14 West, Russell County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 10/28/2015 - Map Drawn on 10/29/2015 by C. Neeley
Kansas
Corporation Commission

Project: *Russell Rural Water District #1*

Site Location: Section 34 and 35, Township 14 South, Range 14 West, Russell County.

Impact/Immediacy: A public water supply well is producing water with elevated chloride content. The immediacy level is rated as low to moderate.

Site Description: The hydrology of the area is complicated through the interaction of a shallow drainage mantled with alluvium, the Smoky Hill aquifer, and the Dakota Sandstone aquifer. The public water supply well was drilled to the north of the river, likely in hopes of utilizing the alluvium. However, the well is sufficiently deep to be drawing water directly from either the Smoky Hill aquifer, or the Dakota. Additionally, the geology of the area may not provide a seal between the otherwise fresh shallow aquifers and the Dakota aquifer. Although the area has undergone significant oil and gas development, no active sources for pollution have been definitively identified. Furthermore, the Dakota Sandstone was an early disposal formation in the area. As such, any oil field brines found in this aquifer are of a non-point source origin.

Unusual Problems: Research conducted by the Kansas Geological Survey in 1991 and 1992 showed that the chloride content of the Smoky Hill River in the vicinity of this site ranged from 843 ppm to 1,879 ppm, with oil field brines contributing 11% to 29% of the total concentration. The major natural chloride source is the dissolution of halite in Permian strata, which migrates into and through the Dakota Sandstone into the alluvium and river itself. Because of the non-point source origin of the oil field brines, and the natural input of saline water, if the public supply well is drawing this water, remediation of this site would not be plausible; however, each household served by the RWD is utilizing a reverse osmosis filtration system, mitigating the problem to some degree.

Status of Project: Over the previous 5 years, the chloride concentrations of the monitoring wells have remained steadily between 500 ppm and 900 ppm. Presently, the wells contain chloride concentrations of 600 ppm in MW 1, and 850 ppm in MW 3, and 700 in MW 5.

Level of Remediation Sought:
Ideal: 100 ppm Chloride
Target: 250 ppm Chloride

Recommendations for Future Work: This site should be monitored on an annual basis. However, realistic goals for the usage of this public water supply, and the level of expected contamination should be developed through close coordination with the rural water district.

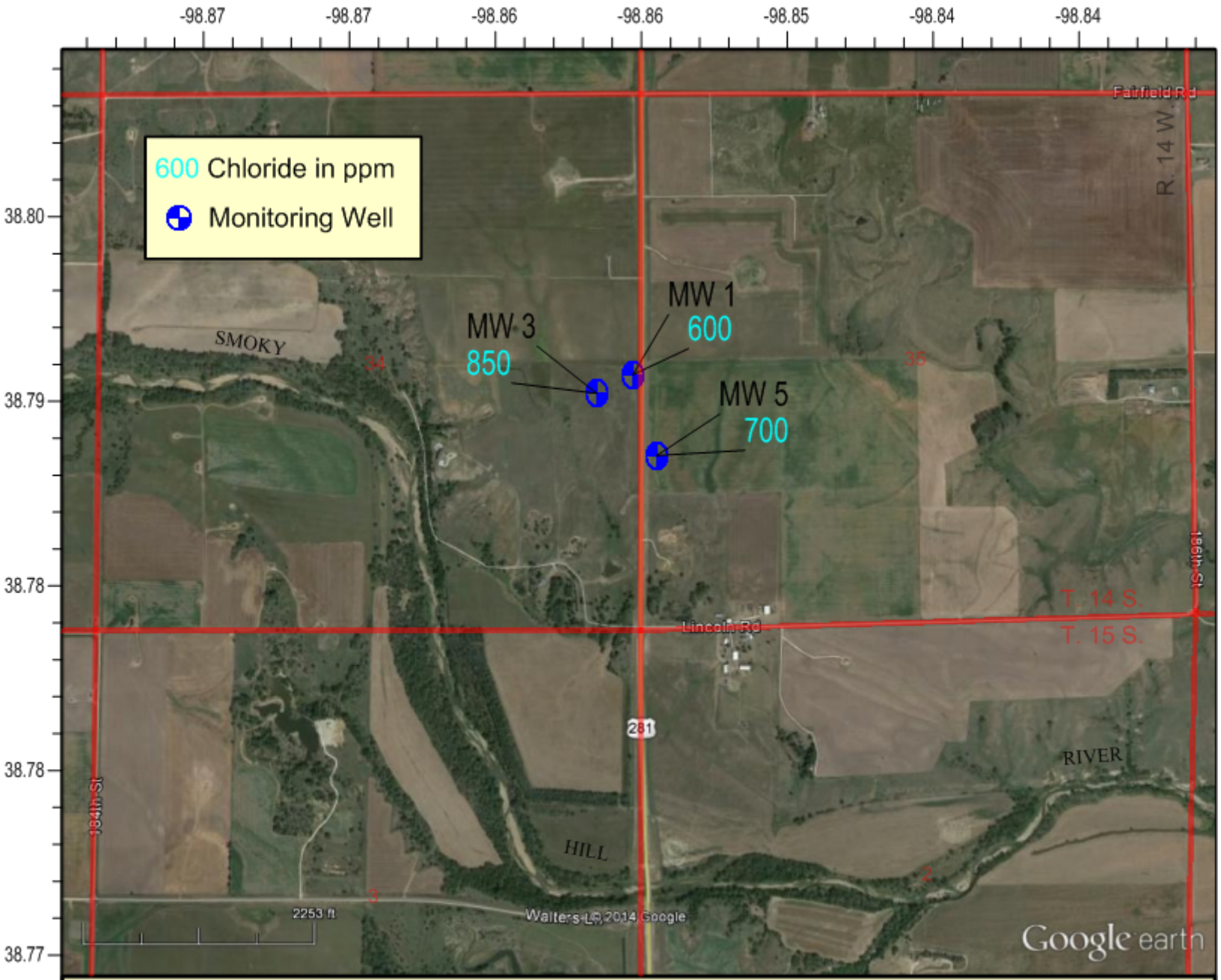
Estimated Total Costs: The estimated costs to KCC and KDHE for extensive studies in the past have been $30,000 or greater. Continued monitoring costs will be $3,000.00.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970084-00	**6 Hrs. / $172.54**		

Current Contaminate Level: 600 ppm to 850 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Russell Rural Water District #1 Groundwater Monitoring Site

Sections 34 and 35, Township 14 South, Range 14 West, Russell County, Kansas

2016 Groundwater Chloride Levels

District #4 - Sampled 6/13/2016 - Map Drawn on 8/16/2016 by C. Neeley

Kansas Corporation Commission

Project: *Sample Contamination Site*

Site Location: The contamination area is located one mile north of Wichita, adjacent to the intersection of 45th Street North and Rock Road. The legal location is the NW of the NW of Section 29 Township 26 South Range 2 East, Sedgwick County.

Impact\Immediacy: This site is very low immediacy. The chloride intrusion affects a groundwater aquifer that is very low volume. Housing development in the area could see rise in water well installation for domestic and heating/cooling systems.

Site Description: The site is located on the outskirts of a metropolitan housing development, but is being encroached on from all sides. The topsoil is hard clay (Wellington formation). The underlying aquifer is a thin low volume zone that is directly affected by precipitation. Total depth of the monitor well is nineteen feet.

Unusual problems: A portion of the chlorides is natural and could not readily be remediated. The aquifer is low volume and difficult to clean up. The urban setting logistically makes remediation difficult. Continued residential development could see increased attempts of use of the groundwater in the area.

Status of Project: A water sample was collected in 2016 tested 2,800 mg/L chlorides. The chlorides have decreased from 2015. The change in chlorides could be from multiple factors including more precipitation in 2015 and high water levels.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 500 mg/l Chloride

Recommendations for Future Work: Continue to monitor site. Site is located only one mile north of the District #2 Field Office so limited resources are needed to continue monitoring this site. Remediation of this site could be started by pumping fluid from the monitoring well to the oil field salt-water tank located on site. Research and investigate any new domestic wells in the area for contamination and begin sampling domestic wells in the area for annual report.

Estimated Total Costs: $300 per year for site inspection, sample collection, and research.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970088-00	**6 Hrs. / $172.54**		

Current Contaminate Level: 2800 mg/l

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

Kansas Corporation Commission

Sample 'A' Groundwater Monitoring Site

NW NW Section 29 of Township 26 South & Range 2 East, Sedgwick County, Kansas

2015-16 Area Map with Chloride Level of MW-1

KCC Project Code #970088-00 - District #2 Field Office - Site Sampled on 8/5/2016 - Map Drawn on 10/28/2016 by D.Bollenback

Project: *Sander Contamination Site*

Site Location: Section 03, Township 14 South, Range 15 West, Russell County.

Impact/Immediacy: A shallow aquifer and small drainage have been impacted by poor oil field practices. A stock well serves as the monitoring well. The immediacy level for this site is rated as low.

Site Description: The site is situated near the head of a small, intermittent tributary to Big Creek. The soils are Harney and Roxbury silt loam, and the area is divided equally between pasture along the creek, and cultivation in the higher portions of the location. Near-surface geological information is limited to data obtained through a few water well records covering many square miles; however, a reasonable hypothesis would be to expect topsoil to a depth of approximately six feet, atop a sand about ten feet thick. Shale bed rock is likely to be encountered at a depth of 15 to 20 feet below the surface, and a common depth for the area water wells is roughly 30 feet. The site is located within the Gorham oil field, which was discovered in 1926, and multiple water flood projects have been implemented within the field.

Unusual Problems: None.

Status of Project: Chloride levels were at 1,650 ppm in the stock well when it was tested in October 2005. Chloride concentrations dropped to 1,500 ppm in 2007 and again to 1,250 ppm in 2008. Samples were not collected between 2008 and 2014, due to the pump on the well being in disrepair, and incapable of lifting a sample. The sample gathered in 2014 was obtained from a domestic water well to the north in Sec. 34, T. 13 S., R. 15 W. the sample from this well was tested and contained 300 ppm chloride. Neither well was available to district staff in 2015. The well is now equipped with an electric pump and float switch which will enable sampling to be carried out. In 2016, a sample collected from a stock tank set at the pump was 675 ppm.

Level of Remediation Sought:
Ideal: 500 ppm Chloride
Target: 1000 ppm Chloride

Recommendations for Future Work: Continue to monitor until the target level has been reached and maintained.

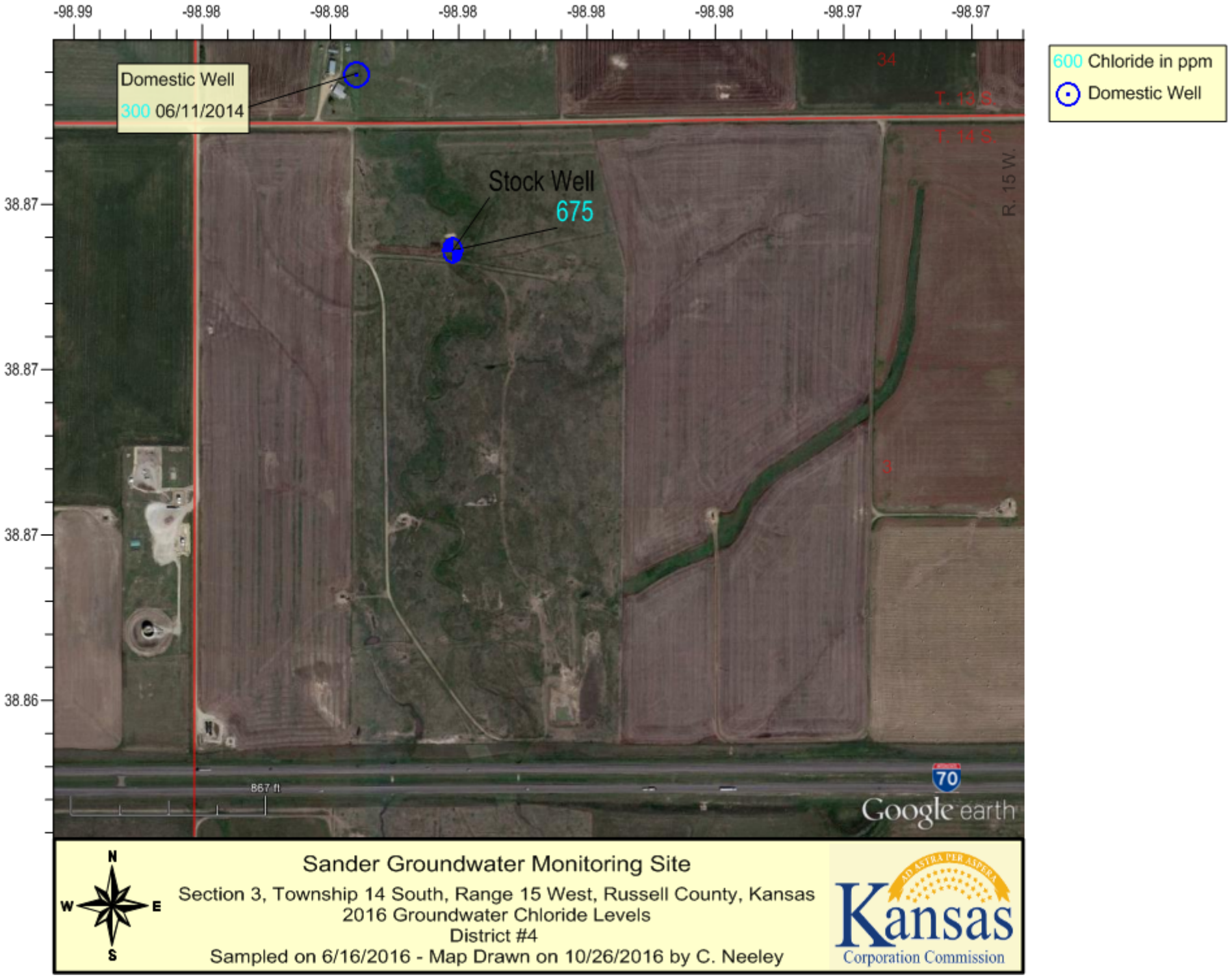
Estimated Total Costs: $300.00

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17 Total**
970089-00	**6 Hrs. / $172.54**	

Current Contaminate Level: 675 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**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38.87
38.87
38.87
38.86
Domestic Well
300 06/11/2014
Stock Well
675
34
T. 13 S.
T. 14 S.
R. 15 W.
3
867 ft
70
Google earth
600 Chloride in ppm
Domestic Well
N
W
E
S
Sander Groundwater Monitoring Site
Section 3, Township 14 South, Range 15 West, Russell County, Kansas
2016 Groundwater Chloride Levels
District #4
Sampled on 6/16/2016 - Map Drawn on 10/26/2016 by C. Neeley
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Kansas
Corporation Commission

Project: *Schraeder Contamination Site*

Site Location: Legal location is E/2 of Section 3 and W/2 of Section 2, Township 24 South, Range 24 West, Hodgeman County.

Impact/Immediacy: Contamination to groundwater, stock wells and possibly an irrigation well in the future. Immediacy level is rated as low.

Site Description: The chloride concentration of the Ogallala formation water supplying a stock well has been high in chlorides.

Unusual Problems: None.

Status of Project: Nine groundwater samples were taken in 2016. Chlorides in these samples ranged from 30ppm chlorides at a new windmill, to 2100ppm chlorides in Well C. These values overall have remained the same from the 2015samples. There has been a slow decline in the chlorides at this site due to natural attenuation; this trend is expected to continue in the future. Irrigation well B and Irrigation well J were unable to be sampled due to the electricity not being hooked up. Windmill F is damaged and not capable of pumping so no sample was taken. Windmill D, at the landowner's residence, was running and was sampled this year.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 350 ppm Chloride

Recommendations for Future Work: The landowner for Windmill F should be contacted to see if repairs are going to be made. If not, the idea of pulling the rods should be explored so the KCC can resume sampling this well.

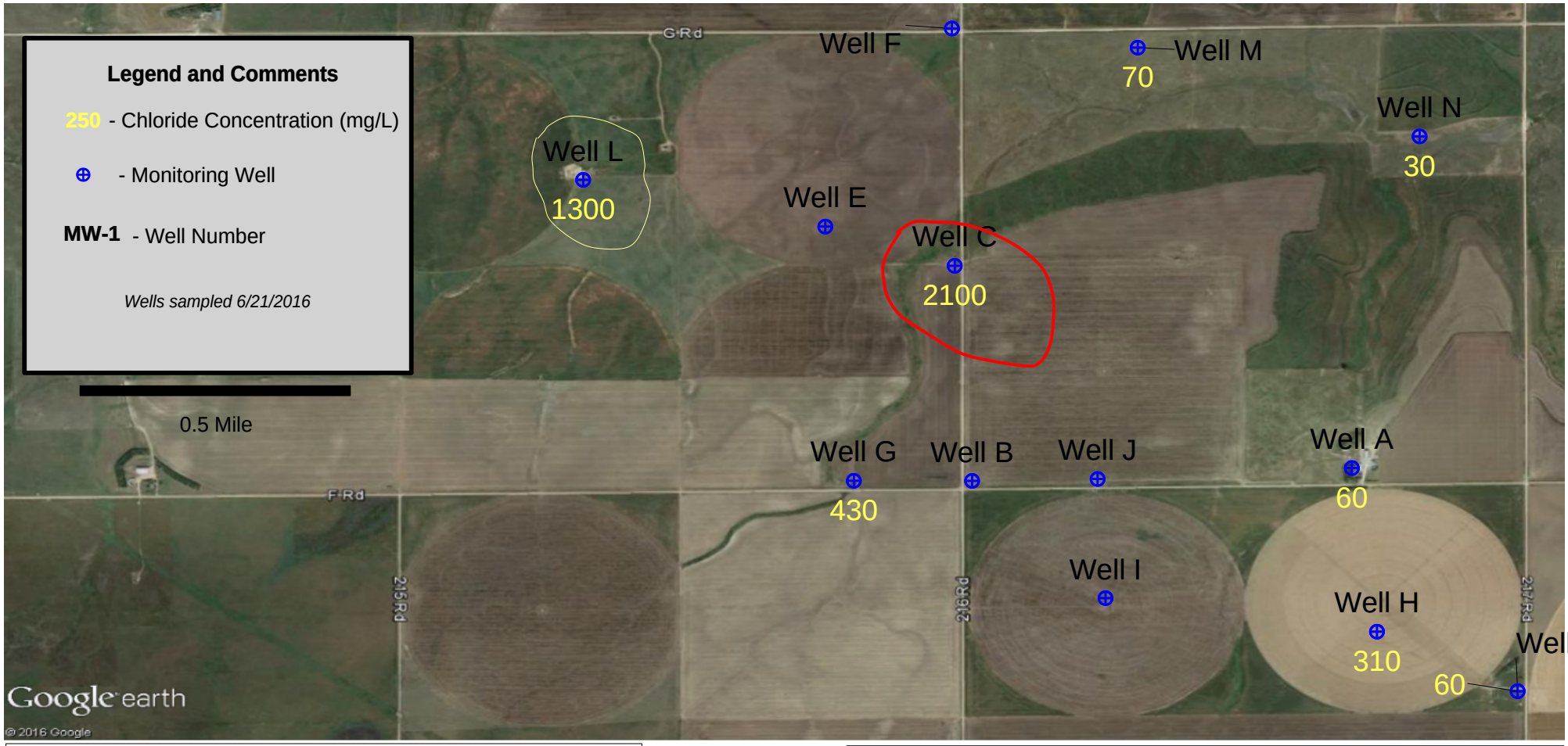
Estimated Total Costs: $30,000.00.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970013-00	**13.5 Hrs. / $345.12**		**$1,590.90**

Current Contaminate Level: 30ppm Cl- to 2100 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

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Schraeder Site

Sections 2/3/11-T-24S-R24W
Hodgeman County, Kansas

2016 Area Map with Chlorides

KCC Control # 970013-00 District 1
K. Sullivan 7/8/16

Project: *Schruben-Rogers Contamination Site*

Site Location: SE/4 of Section 18, Township 7 South, Range. 17 West, Rooks County.

Impact/Immediacy: Groundwater contained in an alluvial aquifer has been impacted by oil field brine. The Immediacy for this site is rated as low.

Site Description: This site is located on the eastern edge of the City of Stockton, approximately one third of a mile from the South Fork Solomon River. The water wells in the area are used primarily for lawn and garden and stock purposes, and draw water from an alluvial terrace. The soil in the area of the impacted wells is rapidly permeated by contaminants, making the water quality sensitive to lease practices. Extensive past studies failed to identify a primary source for chloride ions, but a number of potential causes of the pollution were noted. These potential sources are generalized as oil field practices rather than delineated definitively, and contribute to an accumulative effect; however, remediation was not initiated because a significant reduction of the chloride in the area wells was observed, and the utilization of other methods for obtaining water, i.e. municipal sources and reverse osmosis treatments.

Unusual Problems: None.

Status of Project: Several potential sources of pollution in the area have been removed over the last several years. The well on the Rogers' property has fallen appreciably since 1986, when the chloride concentration was 8,450 ppm, and has remained relatively stable in the range of 500 ppm to 750 ppm since 2008. In 2014, the chloride concentration was determined to be 625 ppm, 550 ppm in 2015, and 525 ppm in 2016.

Level of Remediation Sought:
Ideal: 100 ppm Chloride
Target: 250 ppm Chloride

Recommendations for Future Work: This site will be monitored annually to determine if the removal of potential sources has contributed to the reduction in contaminant levels. If additional work is warranted due to a rise in contaminant levels, additional geophysical and field research may be conducted in an effort to better delineate a source.

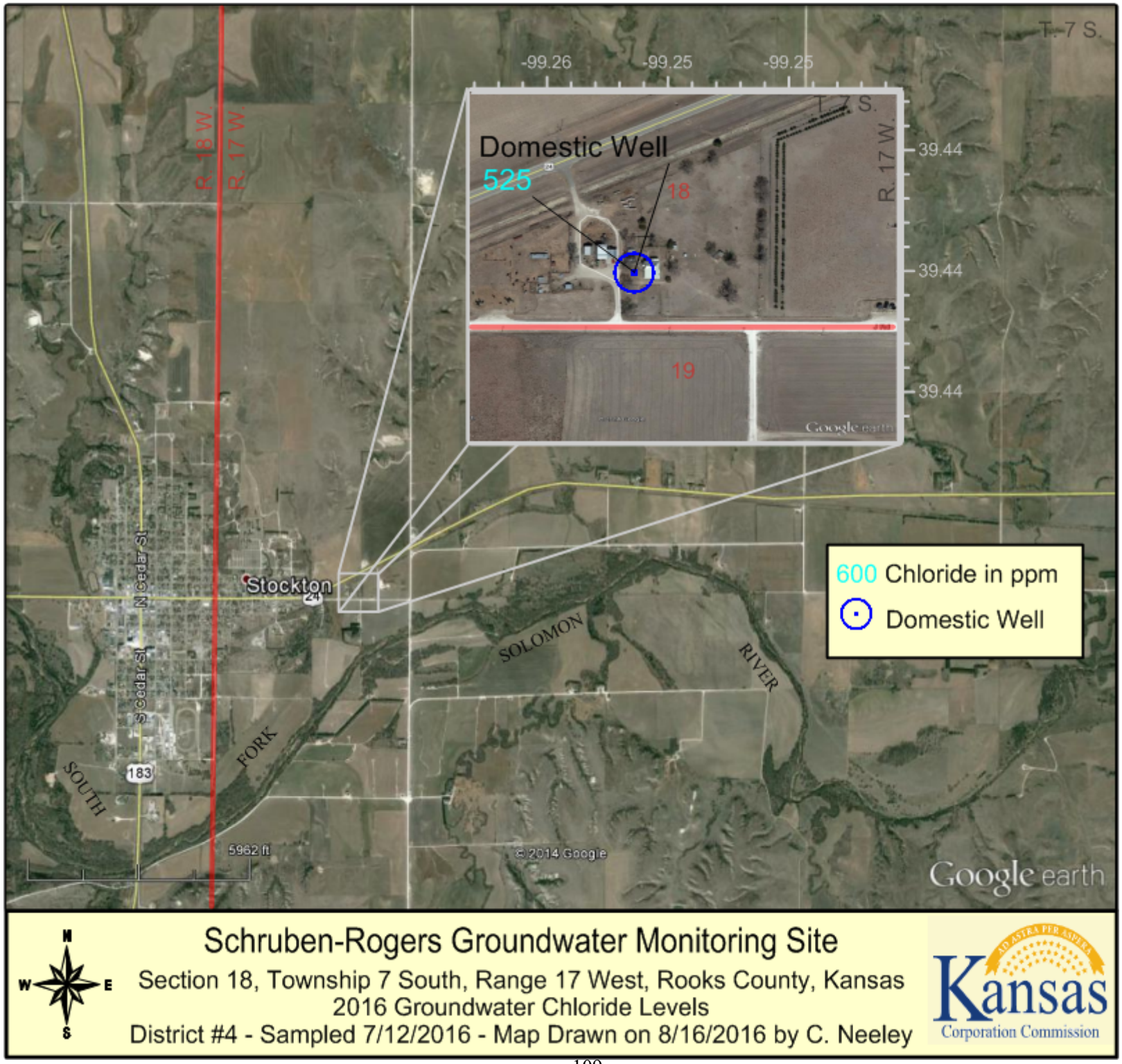
Estimated Total Costs: $2000

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970014-00	**7 Hrs. / $200.14**		

Current Contaminate Level: 525 ppm Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**


T. 7 S.
-99.26
-99.25
-99.25
R. 18 W.
R. 17 W.
Domestic Well
525
18
19
39.44
39.44
39.44
Google earth
Stockton
24
N Cedar St
Cedar St
183
SOUTH
FORK
SOLOMON
RIVER
5962 ft
© 2014 Google
Google earth
600 Chloride in ppm
Domestic Well
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Schruben-Rogers Groundwater Monitoring Site
Section 18, Township 7 South, Range 17 West, Rooks County, Kansas
2016 Groundwater Chloride Levels
District #4 - Sampled 7/12/2016 - Map Drawn on 8/16/2016 by C. Neeley
Kansas
Corporation Commission

Project: *Schulte Brine Remediation Site*

Site Location: The legal description is eastern half of sections 7 & 18, and all of Sections 8 and 17, Township 28 South, and Range 1 West of Sedgwick County, Kansas. To the northeast lies the Wichita Mid-Continent Airport. The site is in the drainage systems of the Cowskin Creek and Dry Creek. Dry Creek is a tributary of Cowskin Creek and flows in an easterly direction across the southern part of the site. The confluence of the two creeks is approximately three miles to the southeast of Schulte.

Impact/Immediacy: The impact is to groundwater resources including public supply wells and domestic water wells. The immediacy level is rated as moderate.

Site Description: The project area consists of a groundwater plume contaminated by oilfield brine moving in an east direction. The apparent source for the contamination is salt-water disposal ponds that were associated with activities in the Schulte oil field and some wells in section 6. The site is situated between Wichita Mid-Continent Airport to the northeast and the unincorporated town of Schulte to the west. The land use is a combination of light industrial, agricultural and residential. The aquifer consists of unconsolidated sand, clay and gravel deposits. New construction of commercial/industrial complexes have occurred directly east of the recovery wells at the site. Local geology consists of topsoil underlain by a brown to reddish clay to silty clay inter mixed with sand lenses. Upper clay thickness ranges from 8.5 feet to 33 feet from east to west. Below the top clay there is poorly sorted sand and gravel beds intermixed with thin clay and silt lenses. This sand unit thins to the west unlike the clays above. Under that top sand unit is a brown to red clay silty-clay aquatard that can be up to 60 feet in thickness near the west end of the site. Below the middle clay aquatard is another sand unit. This sand unit is poorly sorted fine to coarse grained with gravel and inter-bedded clay and silt layers. A bottom clay layer separates the sand from the blue Wellington Formation bedrock. Local hydrology is based within the two sand units that reside above the Permian bedrock but in between substantial clay layers. The middle clay aquatard separates the two aquifers and historical investigations suggest that the brine plume has in the past migrated along the top of this aquatard. Groundwater below the aquatard in the area of the plume has been tested and appears to be historically uncontaminated. The groundwater movement is to the east south-east, with almost easterly movement along the eastern edge of the site.

Unusual Problems: The construction of new structures over the possible plume down-gradient of the recovery system limits future recovery in that direction. Much of the area is for sale for future industrial expansion and could complicate continuance of the remediation of the site.

Status of Project: Remediation by the KCC began at this site on November 1, 2001. The site currently consists of 2 recovery wells, 11 monitoring wells, and one saltwater disposal well that is used to dispose of brine impacted water. On June 22nd, 2016, ten groundwater monitoring wells (MW-1, MW-6, MW-7, MW-8, MW-9, MW-15, MW-101, MW-201, MW-301, MW-401) were gauged and sampled. Prior to sampling, groundwater levels were measured in each monitoring well using an electronic water level indicator. A submersible Proactive® Water-Spout water pump was used to purge a minimum of three well volumes of groundwater from each well before sampling. Purge water was tested for conductivity prior to being discharged onto the ground surface at the site or contained in a 250 gallon poly-tank if conductivity was high before disposed of into a deep injection well. MW-4 was not sampled due to tree roots and poison ivy that have worked their way into the well blocking the casing and approach. It is doubtful that this well will be repaired and could be plugged at this time. Groundwater samples from each monitoring well were collected in one 250 (ml) polyurethane container for analysis at the KCC District #2 Laboratory. Each sample for this monitoring event was analyzed for the presence of Chloride by United States Environmental Protection Agency (USEPA) Method 9253 (Titrimetric, Silver Nitrate). The East Recovery well was found to have electrical issues down hole. With the current chloride levels being so low for recovery operations, it was decided not to put the resources into repairing the East well at this time. The North Recovery well was run intermittently throughout 2016. Groundwater levels below the ground surface ranged from approximately 11 to 30 feet in the sampled wells during this year's event, and increased an average of 0.61 feet since the 2014 gauging event. Groundwater flow direction flows to the southeast or east along the southern site border towards the center of the site before turning to an east direction toward the Cowskin Creek. The western hydraulic gradient was found to be 0.000799629 ft/ft between MW-1 and MW-9, and the eastern gradient was 0.002881579 ft/ft from MW-401 to MW-301. This indicates a slower water movement to the from the west side before the gradient increases to the east as it approaches the Cowskin Creek. The data resulting from the June 2016 groundwater sampling event show chloride level decreasing in the monitoring wells located down gradient in the center of the plume. These drops are possible related to the heavy precipitation over the last year and recharge of the local aquifer.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 500 mg/l Chloride

Recommendations for Future Work: The North Well currently is bi-weekly running when operating. The disposal well seems to be taking water at a rapid rate. Due to low chlorides and issues of freezing temperatures during the winter months, the site will be winterized and shut in for the 2016-17 winter. KCC will perform a rebound test upon warmer temperatures in the spring and then carefully monitor the chloride levels recovered. Chloride levels in the monitoring wells do not seem to be affected by the remedial system anymore as levels have dropped substantially since the system was built. KCC may move the site to a monitoring only status if this trend continues in 2017.

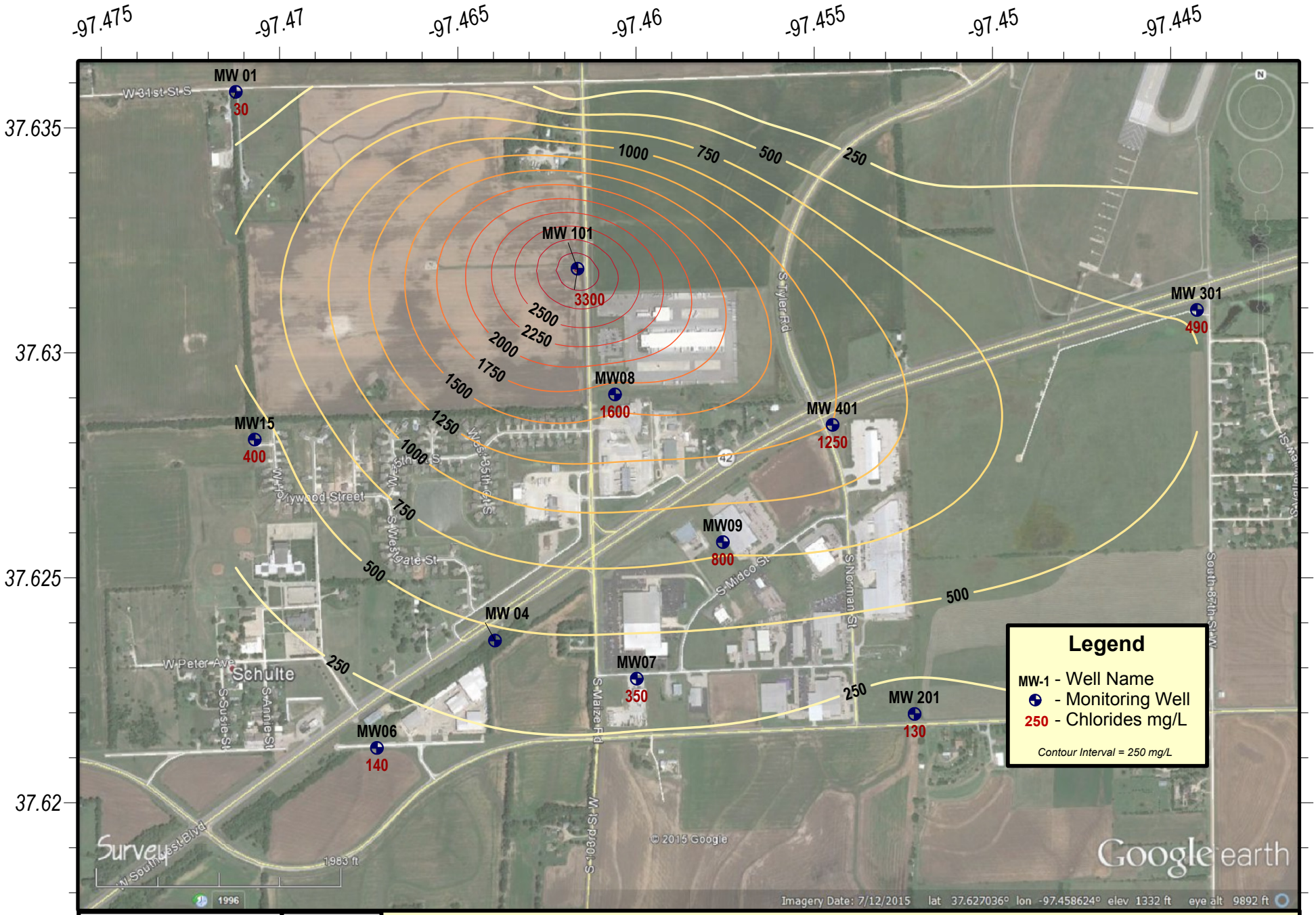
Estimated Total Costs: $8,000-10,000 to upkeep the remediation system, perform annual groundwater sampling, hire an electrician, and continue investigation of new water wells currently being installed inside the known plume.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Fund Expenditures Total
970015-00	163 Hrs. / $4,365.62	$878.06	$149,348.83

Current Contaminate Level: 30 mg/l in MW #1 to 3,300 mg/l in MW# 101

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☒ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved



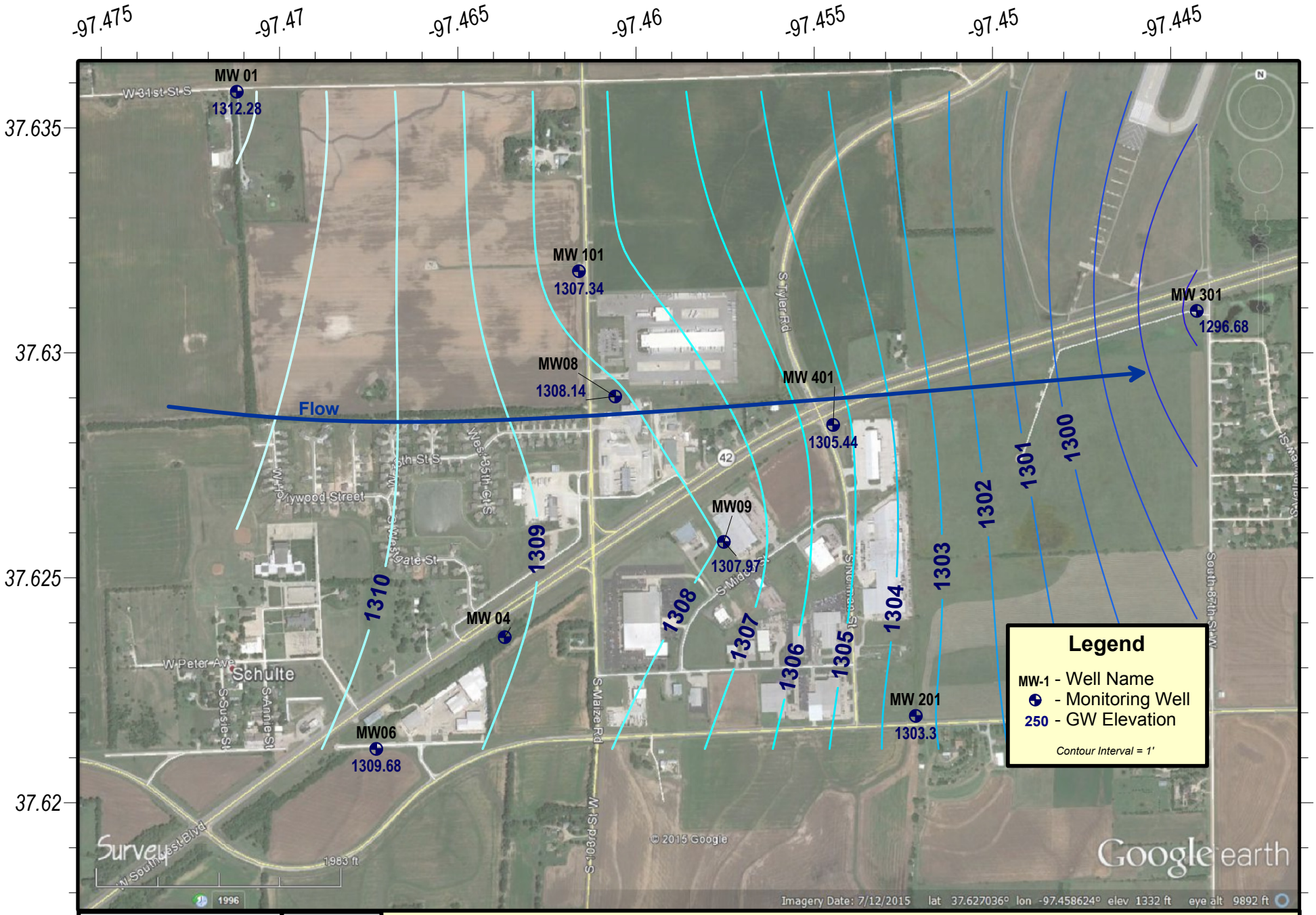
Schulte Remediation Site

Sections 7 & 8 of Township 28 and Range 1 West, Sedgwick County, Kansas

2016 Monitoring Well Chloride Levels

KCC Project Code #970015-00 - KCC District #2 Field Office

Site Wells sampled on 6/22/2016 - Map Drawn 10/24/2016 by D. Bollenback



Kansas Corporation Commission

Schulte Remediation Site

Sections 7 & 8 of Township 28 and Range 1 West, Sedgwick County, Kansas

2016 Groundwater Elevation

KCC Project Code #970015-00 - KCC District #2 Field Office

Site Wells Gauged on 6/22/2016 - Map Drawn 10/24/2016 by D. Bollenback

Project: *Selzer-Bitikofer Contamination Site*

Site Location: The Selzer-Bitikofer Site is two miles east and 2 miles south of Canton, McPherson County, Kansas, centered approximately at the corner of Iron Horse Road and 29nd Avenue, in Sections 35 and 36, Township 19 South, Range 1 West and sections 1 and 2, Township 20 South, Range 1 West. The Selzer-Bitikofer Site currently comprised of agricultural fields, pastures, and residences.

Impact/Immediacy: The site affects West Emma Creek and local groundwater. The immediacy level of the site is listed as moderate.

Site Description: Geologically, the site is located in far eastern edge of the Lower Arkansas River basin, and is characterized by fine textured soil with a silty clay loam surface soil and a strong clay pan development. Sediments at the site consist mainly of unconsolidated Pleistocene deposits of the McPherson Formation (KGS bulletin 79). The immediate area is topographically flat, with slopes ranging from 0-3 percent. Based on the site evaluation to date, the underlying material to a depth of approximately 35 feet was found to consist primarily of stiff clay and/or sandy clay, overlying fine to coarse sands of varying thickness. The sand member is underlain by an impermeable dense clay layer that is consistent throughout the site. Bedrock in the area consists of the Kiowa Shale Formation and lies approximately 50-70' below ground surface (KGS Bulletin 79). Bedrock was never encountered during site activities for verification. Based on groundwater data from the present site investigation, shallow groundwater is found at depths ranging from approximately 6 to 13 feet bgs at the site, and groundwater flow in the surface aquifer beneath the site to the south and southwest and nearly west closer to West Emma Creek. The principal water-bearing formation in the subject site area is thin varying thickness unconsolidated sand that lies between clay layers. This sand varies from fine to coarse grained and pinches off in some locations. Based on information obtained from the Kansas Rural Water Association, the subject site area is serviced by Marion Rural Water District (RWD) #4. Based on information obtained from the KGS WWC5 Database, there no public water supply (PWS) wells located within 1-mile from the subject site. There are three domestic wells (Bitikofer, Selzer and Huebert) located within ¼-mile from the subject site, but there known unregistered and open water wells in the area.

Unusual Problems: An aggressive withdrawal system could render the local water wells and West Emma Creek dry.

Status of Project: On October 17th, 2016, seven groundwater monitoring wells (MW-1, MW-3, MW-4, MW-5, MW-6, Klaassen East, and Klaaseen West) were gauged and sampled. Each sample for this monitoring event was analyzed for the presence of Chloride by United States Environmental Protection Agency Silver Nitrate Buret Titration Method 8225. All monitoring wells were found to be above 250 mg/L chlorides, ranging from 400 to 4,200 mg/L. There are currently no monitoring wells capable of delineating the plumes. Due to the heavy rains, muddy conditions, and crops in the access path, MW-7 and the northern creek sample could not be obtained this year. MW-3 is broken below surface and the very low chloride results this year could be erroneous. MW-3 is very shallow and will need to be replaced next year, although it may be installed with hand tools only. Chlorides appear to be lower due to the heavy precipitation over 2016. MW-4 cannot be sampled below 15' and also need to be replaced. KCC plans to produce another phase of work with additional monitoring wells and investigatory borings and both of these wells could be replaced at that time.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 500 to 750 mg/l Chloride

Recommendations for Future Work: KCC plans to perform a surface water survey of West Emma creek in order to delineate the chloride extents up stream. It is believed that chlorides are flowing out of the groundwater into the creek. KCC District #2 recommends that further investigation into the multiple plumes be conducted in the following years. Chlorides are exceptionally high in northern section 1 and with the possibility of plume movement into section 2; KCC feels that the Bitikofer Farm is endangered of losing it only water source. KCC feels that new monitoring wells to the north and east of the current well matrix are necessary to delineate and predict the future for the chloride migration at the Selzer Site. A deep soil boring down to the Kiowa Shale is also needed to increase our knowledge of the local geology. There are some questionable historical oil and gas wells in section 36, north of the site, which may need to be investigated for plug integrity.

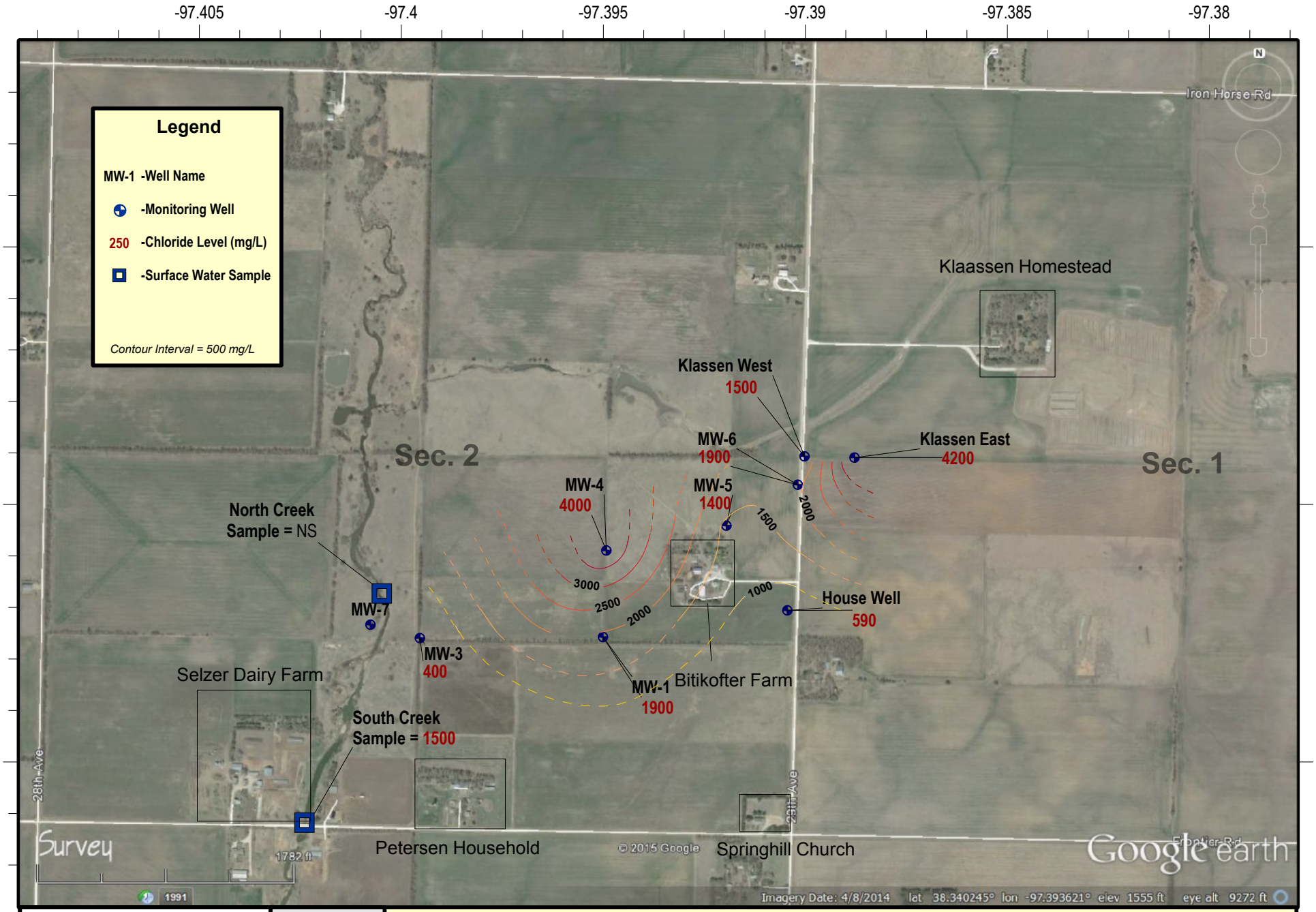
Estimated Total Cost: This site will require multiple visits during the next year. If additional monitoring wells are installed the cost for the 2016-17 year could be as high as $30,000 to 40,000.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
970093-00	**33 Hrs. / $889.78**		**$12,133.50**

Current Contaminate Level: 400 mg/l (MW-3) to 4,200 mg/l Cl- (Klassen East)

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

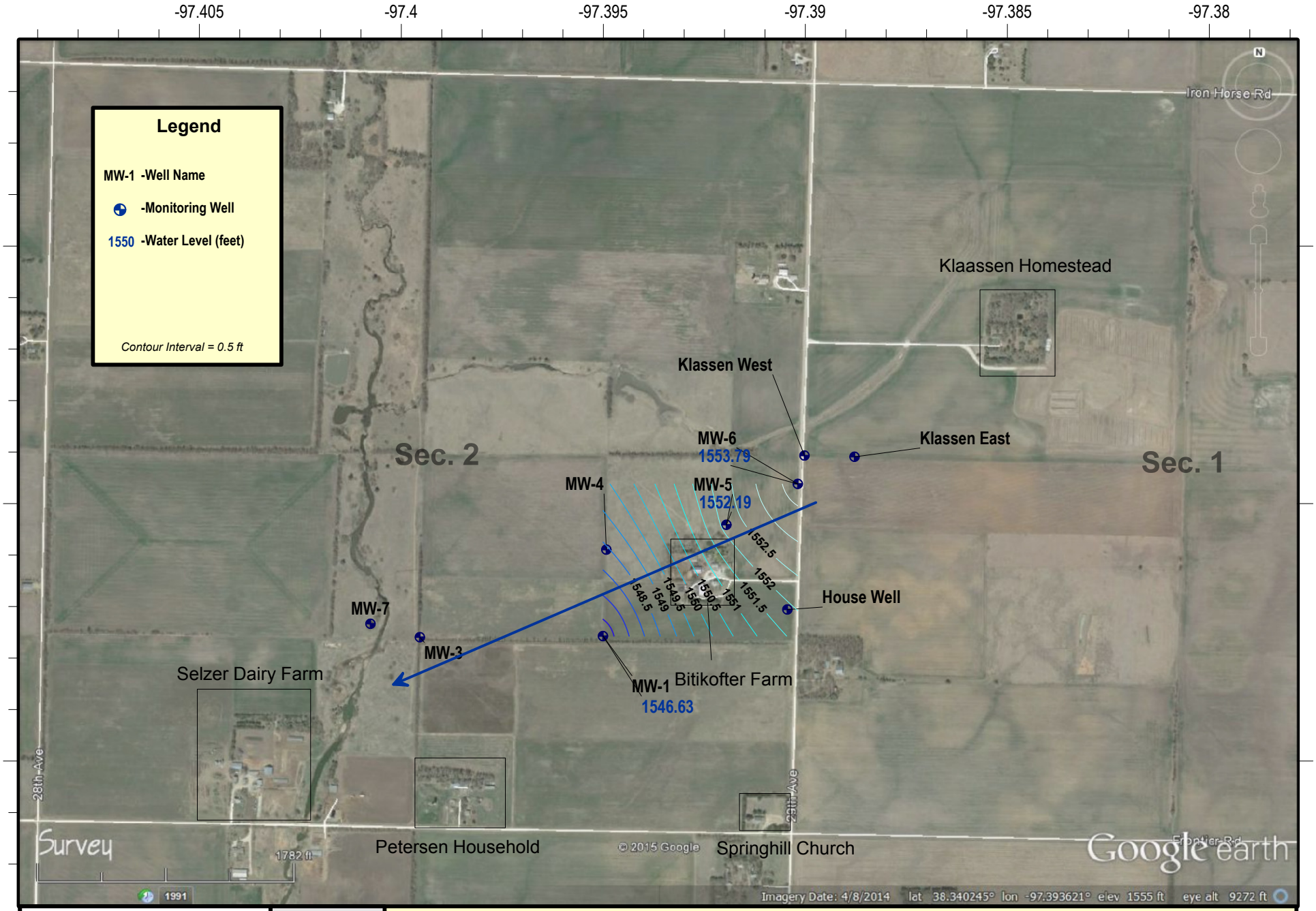
N W E S

Seltzer-Bitikofter Brine Contamination Site

Sections 1 and 2 of Township 20 South and Range 1 West, McPherson County, Kansas

2016 Chloride Levels

KCC Project Code #970093-00 - KCC District #2 Field Office - Wells Sampled on 10/17/2016 - Map Drawn on 10/18/2016 by D.Bollenback



Kansas Corporation Commission

N W E S

Seltzer-Bitikofter Brine Contamination Site

Sections 1 and 2 of Township 20 South and Range 1 West, McPherson County, Kansas

2016 Static Groundwater Levels

KCC Project Code #970093-00 - KCC District #2 Field Office - Wells Gauged on 10/17/2016 - Map Drawn on 10/24/2016 by D.Bollenback

Project: *Smith Finn Contamination Site*

Site Location: Legal location is SE/4 of Section 8 Township 34 South, Range 43 West, in Morton County.

Impact/Immediacy: The impact is to a house domestic well, which has exhibited high chloride levels. The PRP **(**Anadarko) drilled a new domestic well in January of 1989**.** This site has a moderate immediacy level.

Site Description: The project consists of a localized pollution of the groundwater in the Ogallala Formation. The area is on the south edge of the high plains as the terrain begins to break downward to the Cimarron River valley, which is located one and one-half miles to the south.

Unusual Problems: The threat of contaminated groundwater moving from the Smith-Finn property to land owned by the BLM. Multiple sand layers with different levels of contamination.

Status of Project: Progress continues to be made towards closure of the site. Chlorides continue to decrease overall throughout the site. A decision was made not to drill a replacement well for MW-9. Much of the current work is to find the small areas that are problematic and remediate those areas.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendation for Future Work: It is likely that MW 10-8, MW 11-8, and MW 12-8 will be plugged in the near future. PW-4 will remain operational until chlorides have dropped close to or into the fresh water standard. As the site has continued to make significant progress in the removal of chlorides, the project will begin to transition out of a remedial phase, into a monitoring phase.

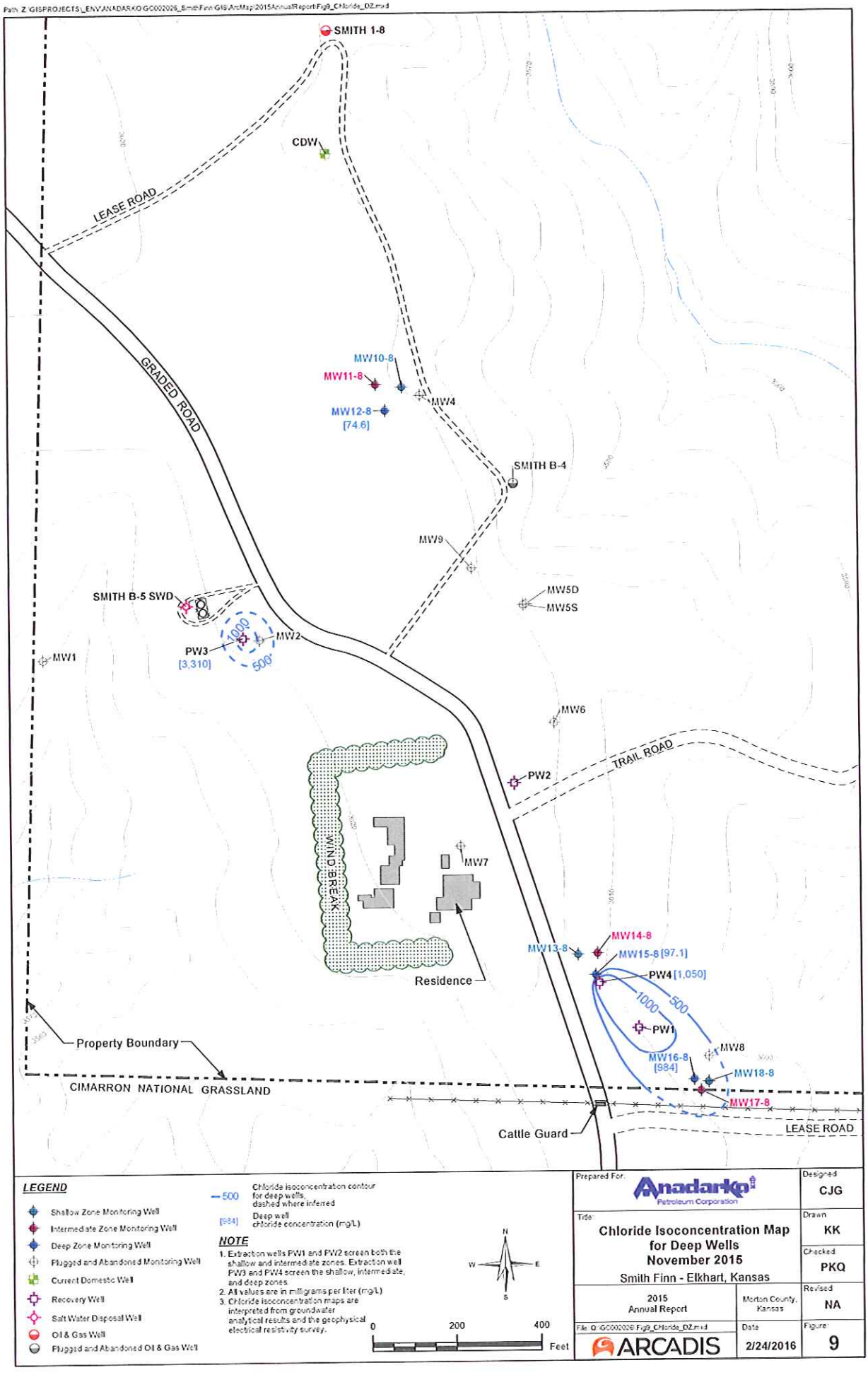
Estimated Total Costs: $200,000 for PRP.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970095-00	**3.5 Hrs. / $105.59**		

Current Contaminate Level: 5.90 ppm Cl- to 9,870 ppm Cl-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☒ **5. Remediation Plan**	☐ **6. Installation**
☒ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**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SMITH 1-8
CDW
LEASE ROAD
GRADED ROAD
MW10-8
MW11-8
MW12-8
[74.6]
MW4
SMITH B-4
MW9
MW5D
MW5S
SMITH B-5 SWD
PW3
[3,310]
MW2
MW1
1000
500
MW6
PW2
TRAIL ROAD
WIND BREAK
MW7
Residence
MW14-8
MW13-8
MW15-8 [97.1]
PW4 [1,050]
1000
500
PW1
MW8
MW16-8
[984]
MW18-8
MW17-8
Property Boundary
CIMARRON NATIONAL GRASSLAND
Cattle Guard
LEASE ROAD
LEGEND
Shallow Zone Monitoring Well
Intermediate Zone Monitoring Well
Deep Zone Monitoring Well
Plugged and Abandoned Monitoring Well
Current Domestic Well
Recovery Well
Salt Water Disposal Well
Oil & Gas Well
Plugged and Abandoned Oil & Gas Well
500 Chloride isoconcentration contour for deep wells, dashed where inferred
[984] Deep well chloride concentration (mg/L)
NOTE
1. Extraction wells PW1 and PW2 screen both the shallow and intermediate zones. Extraction well PW3 and PW4 screen the shallow, intermediate, and deep zones.
2. All values are in milligrams per liter (mg/L)
3. Chloride isoconcentration maps are interpreted from groundwater analytical results and the geophysical electrical resistivity survey.
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Feet
Prepared For: Anadarko Petroleum Corporation
Designed CJG
Title: Chloride Isoconcentration Map for Deep Wells November 2015
Smith Finn - Elkhart, Kansas
Drawn KK
Checked PKQ
2015 Annual Report
Morton County, Kansas
Revised NA
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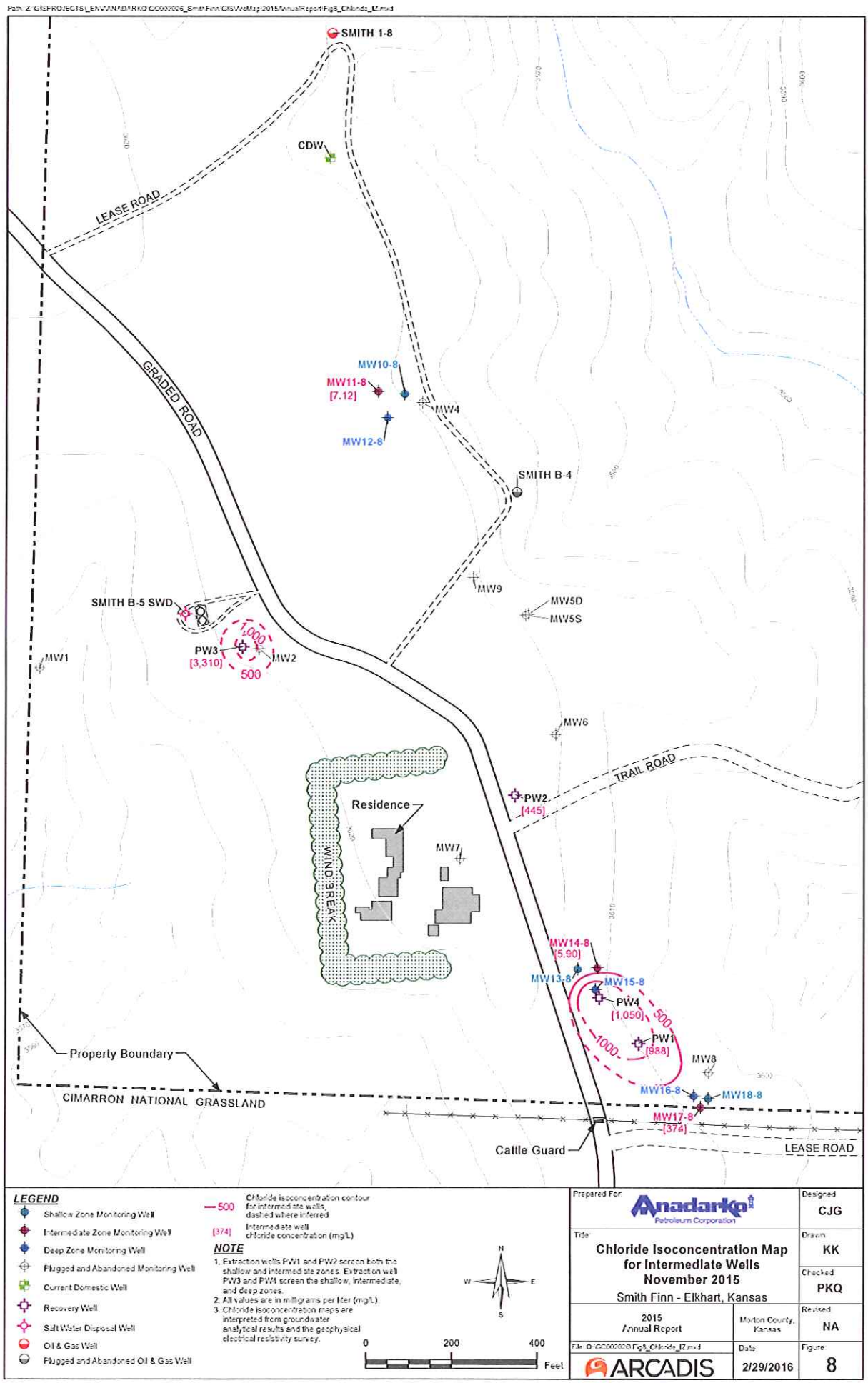
Date 2/24/2016
Figure 9
ARCADIS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SMITH 1-8
CDW
LEASE ROAD
GRADED ROAD
MW10-8
MW11-8
[7.12]
MW12-8
MW4
SMITH B-4
MW9
MW5D
MW5S
SMITH B-5 SWD
PW3
[3,310]
MW2
1,000
500
MW1
MW6
TRAIL ROAD
PW2
[445]
Residence
MW7
WIND BREAK
MW14-8
[5.90]
MW13-8
MW15-8
PW4
[1,050]
500
1000
PW1
[988]
MW8
MW16-8
MW18-8
MW17-8
[374]
Property Boundary
CIMARRON NATIONAL GRASSLAND
Cattle Guard
LEASE ROAD
LEGEND
Shallow Zone Monitoring Well
Intermediate Zone Monitoring Well
Deep Zone Monitoring Well
Plugged and Abandoned Monitoring Well
Current Domestic Well
Recovery Well
Salt Water Disposal Well
Oil & Gas Well
Plugged and Abandoned Oil & Gas Well
500 Chloride isoconcentration contour for intermediate wells, dashed where inferred
[374] Intermediate well chloride concentration (mg/L)
NOTE
1. Extraction wells PW1 and PW2 screen both the shallow and intermediate zones. Extraction well PW3 and PW4 screen the shallow, intermediate, and deep zones.
2. All values are in milligrams per liter (mg/L).
3. Chloride isoconcentration maps are interpreted from groundwater analytical results and the geophysical electrical resistivity survey.
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0
200
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Feet
Prepared For: Anadarko Petroleum Corporation
Designed: CJG
Title: Chloride Isoconcentration Map for Intermediate Wells November 2015
Smith Finn - Elkhart, Kansas
Drawn: KK
Checked: PKQ
2015 Annual Report
Morton County, Kansas
Revised: NA
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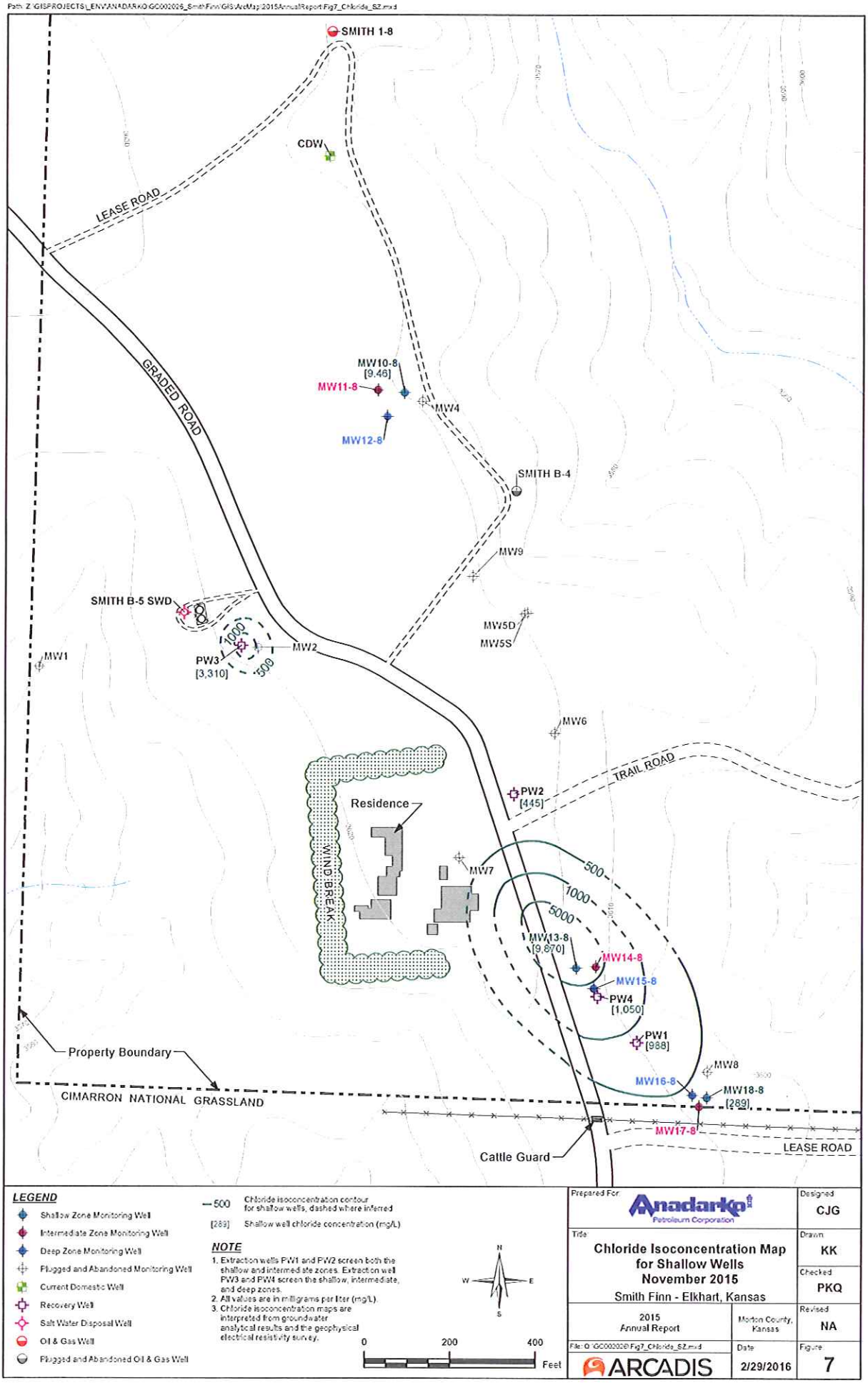
Date: 2/29/2016
Figure: 8
ARCADIS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SMITH 1-8
CDW
LEASE ROAD
GRADED ROAD
MW10-8 [9.46]
MW11-8
MW12-8
MW4
SMITH B-4
MW9
SMITH B-5 SWD
MW5D
MW5S
MW1
PW3 [3,310]
MW2
1000
500
MW6
TRAIL ROAD
PW2 [445]
Residence
WIND BREAK
MW7
500
1000
5000
MW13-8 [9,870]
MW14-8
MW15-8
PW4 [1,050]
PW1 [988]
MW8
MW16-8
MW18-8 [289]
MW17-8
Property Boundary
CIMARRON NATIONAL GRASSLAND
Cattle Guard
LEASE ROAD
LEGEND
Shallow Zone Monitoring Well
Intermediate Zone Monitoring Well
Deep Zone Monitoring Well
Plugged and Abandoned Monitoring Well
Current Domestic Well
Recovery Well
Salt Water Disposal Well
Oil & Gas Well
Plugged and Abandoned Oil & Gas Well
500 Chloride isoconcentration contour for shallow wells, dashed where inferred
[289] Shallow well chloride concentration (mg/L)
NOTE
1. Extraction wells PW1 and PW2 screen both the shallow and intermediate zones. Extraction well PW3 and PW4 screen the shallow, intermediate, and deep zones.
2. All values are in milligrams per liter (mg/L).
3. Chloride isoconcentration maps are interpreted from groundwater analytical results and the geophysical electrical resistivity survey.
N
W
E
S
0
200
400
Feet
Prepared For: Anadarko Petroleum Corporation
Designed CJG
Title
Chloride Isoconcentration Map for Shallow Wells November 2015
Smith Finn - Elkhart, Kansas
Drawn KK
Checked PKQ
2015 Annual Report
Morton County, Kansas
Revised NA
File: O:\GC000026\Fig7_Chloride_SZ.mxd
ARCADIS
Date 2/29/2016
Figure 7

Project: *South Spivey Contamination Site*

Site Location: The site area is located 3.5 miles south of the city of Spivey, near an unnamed tributary of the Chikaskia River. The legal location is in Sections 27 and 34 of Township 30 South, Range 8 West, in Kingman County.

Impact/Immediacy: The impacts are to groundwater resources associated with local domestic wells. The site is rated as low immediacy level.

Site Description: The project area lies within an intermittently flowing creek bed within the large Spivey-Grabs oil and gas field. The area is remote and the surface use is primarily the grazing of cattle. The surface geology is composed of unconsolidated sand and silt. Underlying this upper layer are fine-grained sands and silts that form the aquifer. The aquifer delivers a small amount of water, but the fluid level is very shallow making the aquifer easily accessible. The depth to the first confining layer is roughly 9 to 12 feet. In December 1994 General Atlantic Resources implemented a remediation plan and began withdrawing contaminated groundwater in the SE quarter of section 27. Due to low water yields the recovery system was shut down in 2000 and the KCC is doing post remediation monitoring.

Unusual problems: Withdrawal rate is low due to low permeability of aquifer.

Status of Project: The KCC has placed the South Spivey Site in an annual sampling program. Natural attenuation of the site is occurring but chloride readings have varied somewhat over the years with the annual precipitation amounts. The contaminated aquifer is so shallow chlorides levels seem to be in direct correlation with precipitation. All the wells within the South Spivey Site have big drops in chlorides, thought to be influenced by the recent rains. Since 2015 there has been almost record setting precipitation in the area. The highest chloride concentration was from well OB with 1,450 ppm chlorides in 2016. The pond was tested to be 260 ppm chlorides.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 750 mg/l Chloride

Recommendations for Future Work: Continue sampling all monitoring wells and surface waters on an annual basis. No other action is needed at this time as this site has a low immediacy rating.

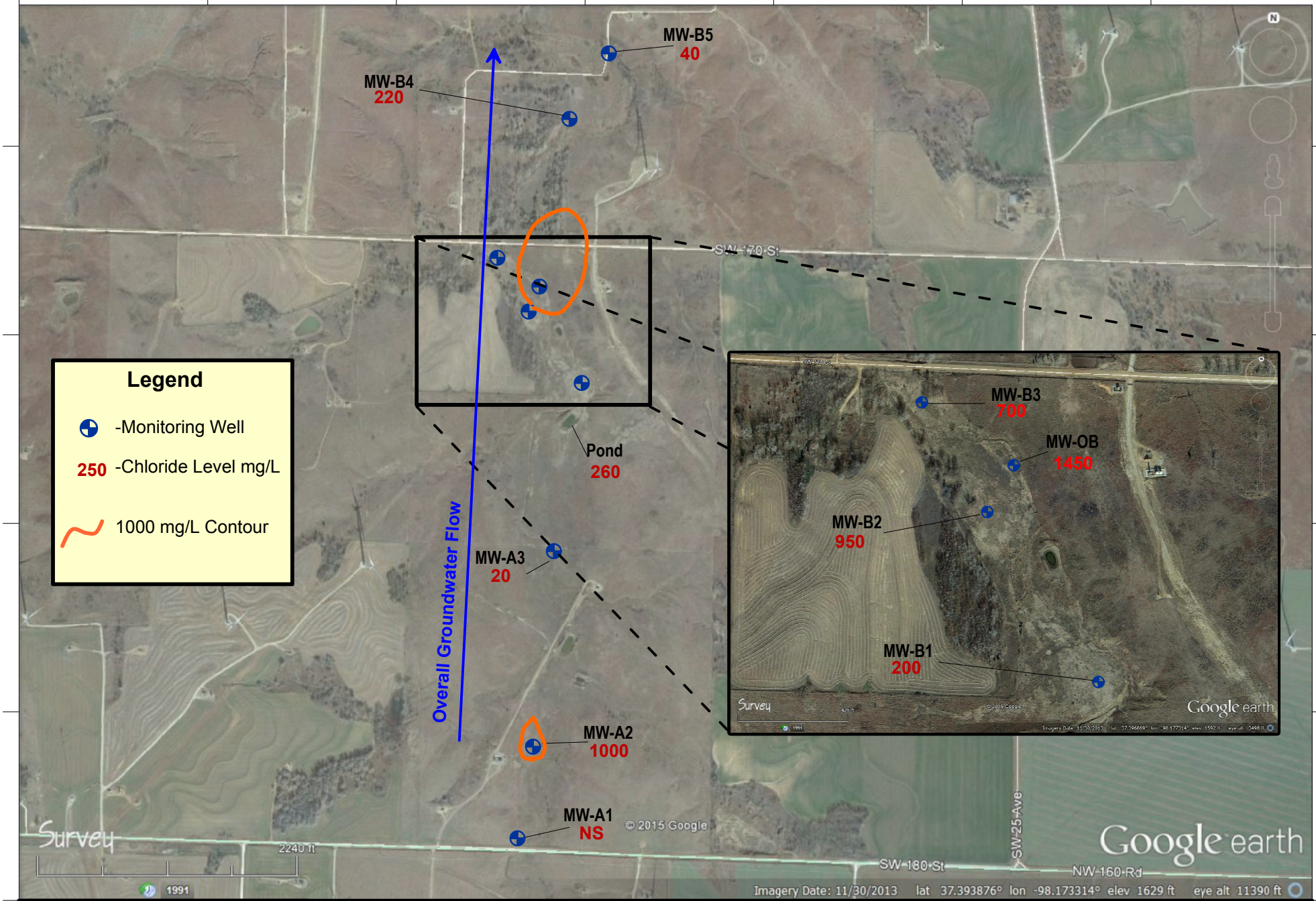
Estimated Total Costs: $1000 per year for sampling, testing, and research.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970096-00	**32 Hrs. / $868.82**		

Current Contaminate Level: 20 mg/l to 1450 mg/l Cl^-

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

South Spivey Brine Monitoring Site

Sections 27 & 34 of Township 30 South and Range 8 West, Kingman County, Kansas

Site Chloride Levels 2016-17

KCC District #2 Field Office - Site well sampled on 7/19/2016 - Map Drawn on 10/7/2016 by D.Bollenback

Project: *South Wichita Chloride Study*

Site Location: The South Wichita site is located near the intersection of the Kansas Turnpike and the Wichita Valley Center Floodway. The site is centered roughly near the intersection of 63rd St. South and Broadway, in south Wichita. The legal location is as follows: Sections 28, 29, 31, 32, 33, and 34 of Township 28 South, Range 1 East and Sections 3 and 4 of Township 29 South, Range 1 East.

Impact/Immediacy: The past impacts or potential impacts are to irrigation, domestic and municipal water uses. A low level of immediacy is warranted for this site due to the low levels of Chlorides. The area has a very high demand for water resources.

Site Description: The project area consists of an attenuated groundwater plume created by oilfield brine moving in a southeasterly direction. The site is situated in an area that is residential, agricultural, commercial and light industrial many of which utilize the local groundwater aquifer for water. The surface geology is composed of unconsolidated sand and silt. Underlying this zone are sands and gravels that form the aquifer. Historically, the aquifer has delivered large quantities of variable quality drinking water. The depth of most of the domestic water wells in the area range from 30 to 50 feet.

Unusual Problems: Even after 20-plus years many of the public still remembers and are interested in the brine pollution in the area. The site was originally discovered at the historically popular Blood Orchard which was ruined by brine contamination and the associated death of the fruit trees, which were never been brought back. The brine pollution has caused lingering hard feelings from many of the area residents.

Status of Project: KCC District #2 has placed this site into a biannual sampling program. This historical chloride plume from Blood Orchard has moved to the east-southeast at a very slow rate and has continued to decrease in chloride levels every year. KCC was scheduled to sample this site in its entirety this year but many wells are were not sampled due to rain, crops, or disrepair. Sampling in 2016 showed that the decrease in chloride trend is continuing. Heavy rains have been beneficial in this regard.

Level of Remediation Sought:

Ideal: 250 mg/l Chloride
Target: 500 to 750 mg/l Chloride

Recommendations for Future Work: A partial sampling program is scheduled for the 2017-2018 year. If the decreasing trend continues KCC may recommend the plugging of monitoring wells as this site is close to closure. Due to its local history the site has been allowed to continue past targeted and ideal chloride levels. With the age of the monitoring wells and the increased amount of maintenance and issues site closure will be looked at again this year.

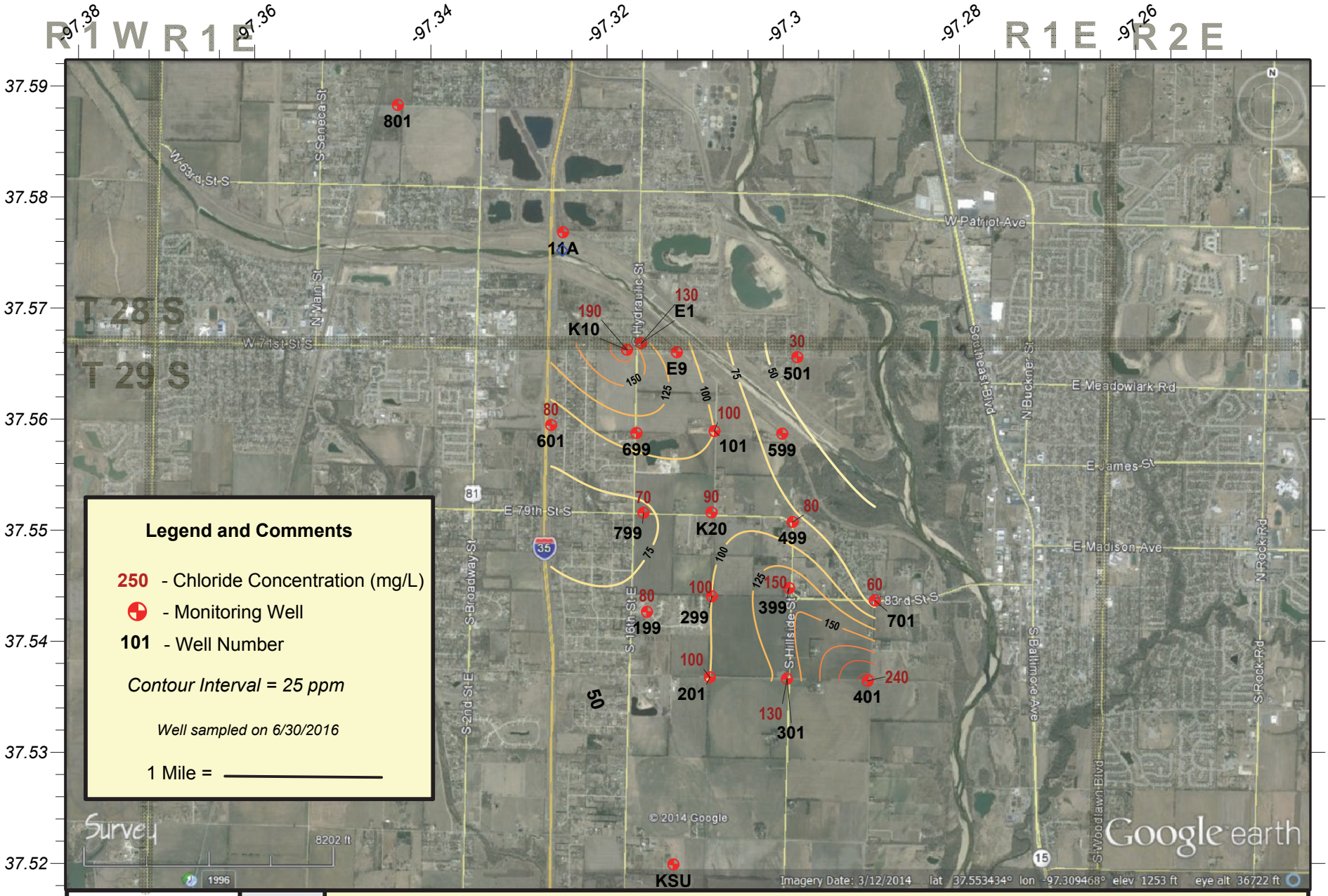
Estimated Total Costs: $1000 for staff time performing a full sampling program and preparing legislative report during the 2015-16 year.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Fund Expenditures Total
970016-00	31 Hrs. / $842.04		$10,767.02

Current Contaminate Level: Highest level is 240 mg/l @ 401

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved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S Rock Rd
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125
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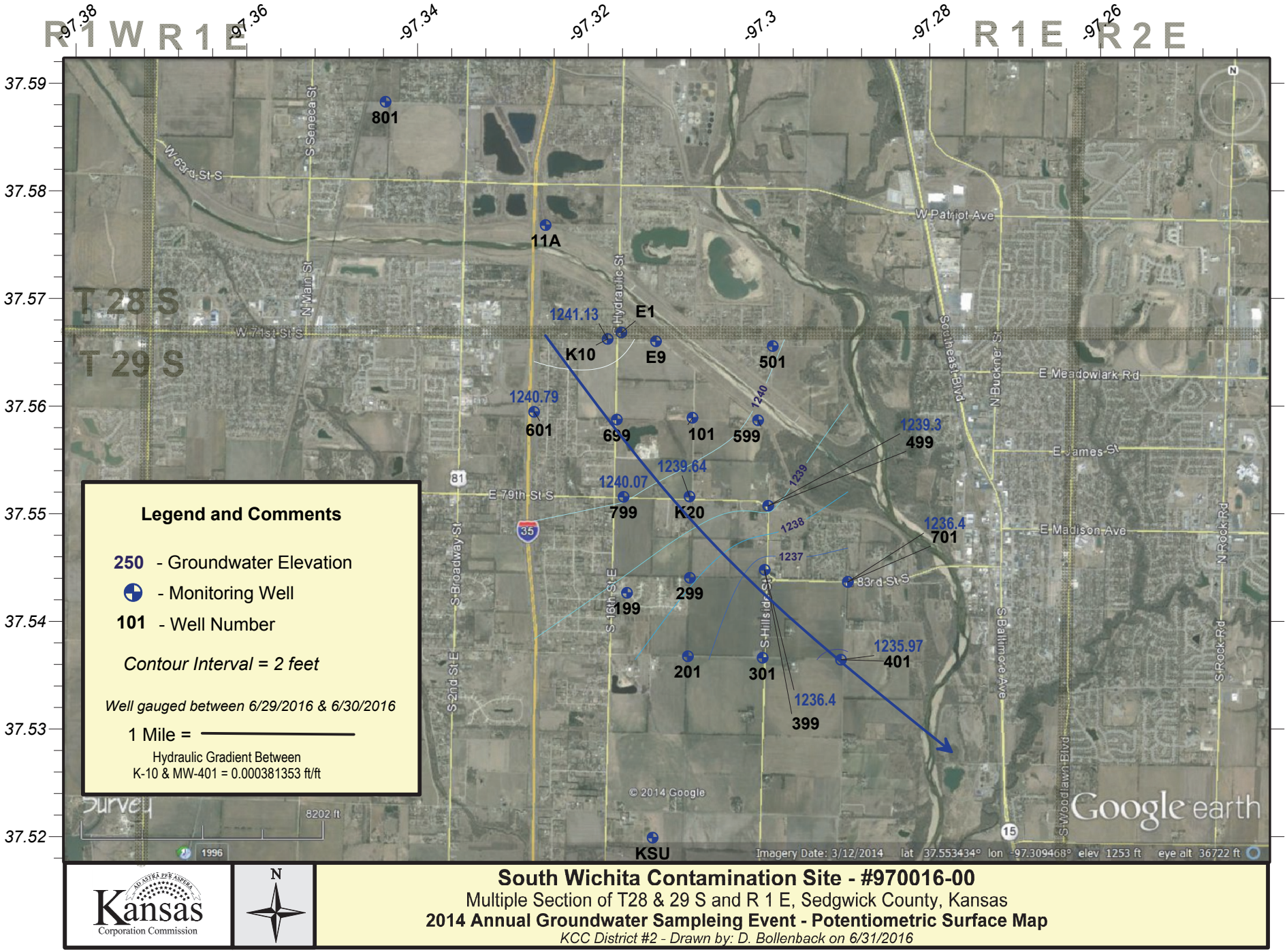
© 2014 Google
Google earth
Imagery Date: 3/12/2014 lat 37.553434° lon -97.309468° elev 1253 ft eye alt 36722 ft
Survey
8202 ft
1996
Legend and Comments
250 - Chloride Concentration (mg/L)
- Monitoring Well
101 - Well Number
Contour Interval = 25 ppm
Well sampled on 6/30/2016
1 Mile =
Kansas
Corporation Commission
N
South Wichita Brine Monitoring Site
Multiple Sections of Township 28 & 29 South and Range 1 East, Sedgwick County, Kansas
2015 Limited Sampling - Chloride Concentrations
KCC Project Code #970016-00 - KCC District #2 Field Office - Maps Drawn on 10/31/2016 by D.Bollenback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S Hydraulic St
W 63rd St S
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E 79th St S
W Patriot Ave
E Meadowlark Rd
E James St
E Madison Ave
83rd St S
S Broadway St
S 2nd St E
S 16th St E
S Hillside St
S Baltimore Ave
N Buckner St
Southeast Blvd
N Rock Rd
S Rock Rd
S Woodlawn Blvd
81
35
15
Legend and Comments
250 - Groundwater Elevation
- Monitoring Well
101 - Well Number
Contour Interval = 2 feet
Well gauged between 6/29/2016 & 6/30/2016
1 Mile =
Hydraulic Gradient Between
K-10 & MW-401 = 0.000381353 ft/ft
8202 ft
1996
© 2014 Google
Google earth
Imagery Date: 3/12/2014 lat 37.553434° lon -97.309468° elev 1253 ft eye alt 36722 ft
Kansas
Corporation Commission
N
South Wichita Contamination Site - #970016-00
Multiple Section of T28 & 29 S and R 1 E, Sedgwick County, Kansas
2014 Annual Groundwater Sampleing Event - Potentiometric Surface Map
KCC District #2 - Drawn by: D. Bollenback on 6/31/2016

Project: *Stowe-Zaid Contamination Site*

Site Location: The site is five miles south of the intersection of US 56 and Plume Street on the east side of Rice County. This site is in northwest part of Welch-Bornholdt oil field, and the lease has no production at the present time. The location is the SE/4 NE/4 Section 24, Township 20 South, Range 6 West, Rice County.

Impact/Immediacy: Impact is to the soil and groundwater. This site should be classified as low immediacy with the possibly of effecting domestic and stock wells and the aquifer of the Little Arkansas River. There is a rural water line in the area, which can provide service to the homes.

Site Description: Vegetation throughout the scar area has remained the same over the past years. Shallow groundwater levels and underflow are keeping the scar in place, as heavy rains might be pushing chlorides up onto the surface. There were large areas of scarred soil clearly visible during this year's visit. The Little Arkansas River is located half mile to the southwest of the site and that is the direction of the ground water flow, northeast to southwest. Investigations have shown that drilling pits and a tank battery could be the sources of the pollution.

Unusual Problems: The ground water table is very shallow due to the close proximity to the Arkansas River.

Status of the Project: The auger data from 2001 along with old aerial photos indicates the source area to be located northeast of the scar area. Up gradient and down gradient delineation has not been achieved to this date. The 2016 water sampling was done April 1st, 2016. The lower aquifer tested at 150 mg/l chlorides. MW-1S in the upper water horizon was sampled for the second year in a row as it has historically been dry. Fluid tested to be 2,600 ppm chlorides. MW-2 at the toe of the scar showed slight decrease from 2015 at 1,100 mg/l. Evidence appears to show that an aquatard is preventing the chlorides from moving down to the lower aquifer at a rapid rate. Sampling was done before the bulk of the 2016 heavy precipitation and the 2017 sampling event may show improvement of the site.

Recommendation for Future Work: Continue to sample monitoring wells. Due to the shallow nature of the contaminated aquifer it maybe possible to recover chloride polluted water via shallow recovery wells or trench system, but there is no disposal scenario available near by to dispose of the fluids. In light of this fact long term monitoring is suggested for the site. Increases in lower aquifer chlorides could require further investigation into the lower aquifer.

Level of Remediation Sought:

Ideal: 50 mg/l
Target: 350 mg/l

Estimated Total Costs: $800 annually for field inspection and monitoring, and research into ideas/alternatives to remediating the site or at least expediting the attenuation.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
20000035-001	**11 Hrs. / $306.44**		**$4,057.85**

Current Contaminate Level: 2,600 mg/l, MW #1S, 4/1/2016
150 mg/l Cl- Deep Aquifer 4/1/2016

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

Kansas Corporation Commission

Stowie-Zaid Shallow Brine Monitoring Site

Section 24 of Township 20 South and Range 6 West, Rice County, Kansas

2016-17 Chloride Levels

KCC District #2 Field Office - Wells sampled on 4/1/2016 - Map drawn on 10/28/2016 by D.Bollenback

Project: *Trostle Contamination Site*

Site Location: The site area is 2.3 miles west and 2.75 miles south of the town of Murdock, Kansas. The legal description is northeastern quarter of section 33, Township 28 South, and Range 6 West of Kingman County, Kansas. The site is in the drainage systems of Sand Creek which is located 1 mile north of the site. Sand Creek is a tributary of the South Fork Ninnescah River.

Impact/Immediacy: The high chlorides could impact the ground water affecting stock wells in the immediate area, as well as low lying draws which are usually dry, but containing water with high chlorides after a rainfall. The aquifer is very low yielding. There are erosion effects to the terrain where there is no vegetation. Site is classified as low immediacy.

Site Description: The area most affected historically is around the Trostle salt-water disposal well battery. There are seven monitoring wells below the Trostle salt-water disposal well that also have elevated chlorides. The most likely cause was something related to the salt-water tank such as discharges. This site was historically remediated via an interceptor trench but the system was abandoned after the holding tanks failed and the site was placed into the monitoring phase of investigation. There has only been one reported spill at the SWDW since 2005. Local hydrology is a perched aquifer system. Precipitation that infiltrated the Pleistocene Alluvium moves downward until it hit the impermeable red Ninnescah shale. Groundwater then flows down gradient on top of the shale. The general movement of fluids in the perched water table flows to the northwest-west.

Unusual Problems: None.

Status of Project: On August 17, 2016, eleven groundwater monitoring wells were sampled. A polyethylene disposable bailer was used to attempt purge a minimum of three well volumes of groundwater from each well before sampling. Almost all wells bailed dry before 3 well volumes could be purged, and those wells were sampled after recharge had taken place. Purge water was tested for conductivity and contained in a 250 gallon poly-tank if conductivity was high. All contained water was disposed into an authorized SWDW. Groundwater samples from each monitoring well were collected in one 250 (ml) polyurethane container for analysis at the KCC District #2 Laboratory. Laboratory results show lower chlorides downgradient of the tank battery. Record setting rains have occurred in the area since 2015, and are believed to have helped lower the local chloride levels. This influx of water can dilute the perched water table, and push chlorides in and out of areas on the site. Continued monitoring will be needed to establish if this will be a continuing trend.

Level of Remediation Sought:
Ideal: 250 mg/l Chloride
Target: 500 mg/l Chloride

Recommendations for Future Work: Due to the limited amount of water resources affected and with the recent data showing chlorides have been dropping, KCC recommends continuing sampling the Trostle on an annual basis.

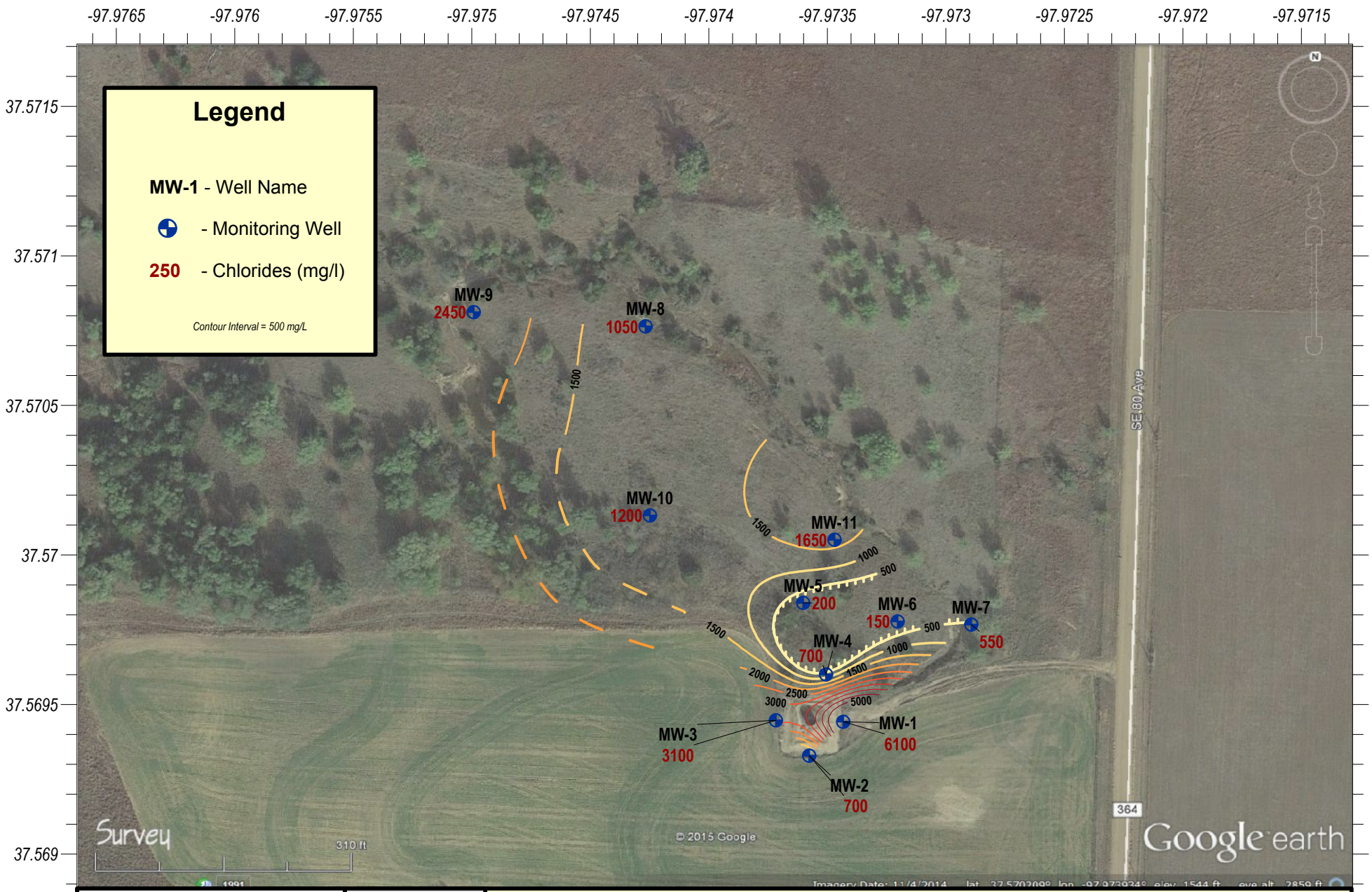
Estimated Long Term Cost: The estimated cost to the KCC will be $800 per year for inspection of site, running an analysis of the water, and data and report preparation.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
980038-001	**24 Hrs. / $616.75**		

Current Contaminate Level: 150 mg/l in MW-6 to 6,100 mg/l chlorides in MW-1

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

N W E S

Trostle Post-Remediation Brine Monitoring Site

Section 33 of Township 28 South and Range 6 West, Kingman County, Kansas

2016 Chloride Levels

KCC Control #980038-001 - Wells sampled on 8/17/2016 - Map Drawn on 10/11/2016 by D.Bollenback

Kansas Corporation Commission

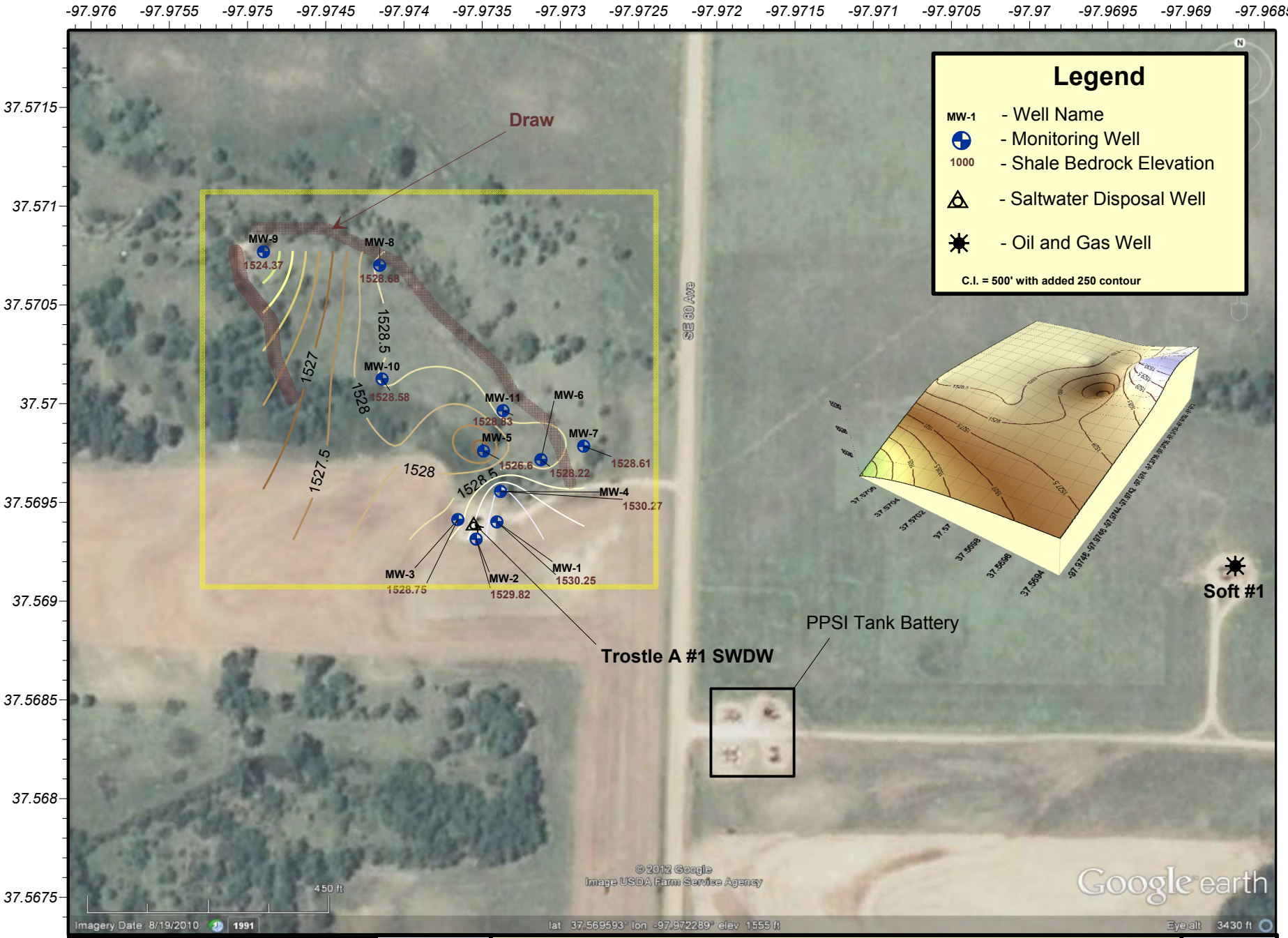
N W E S

Trostle Post-Remediation Brine Monitoring Site

Section 33 of Township 28 South and Range 6 West, Kingman County, Kansas

2016 Groundwater Elevation Map

KCC Control #980038-001 - Wells gauged on 8/17/2016 - Map Drawn on 10/11/2016 by D.Bollenback



Kansas Corporation Commission

N

Trostle Contamination and Monitoring Site
2012 Groundwater Sampling - Shale Bedrock Elevation
Section 33 of T28S and R6W, Kingman County, Kansas
KCC Control Number:#980038-001 - Map Drawn 9/4/2012 by D. Bollenback

Figure 3

Project: *Voshell Site*

Site Location: The Voshell site includes a portion of the Voshell Oil Field, and a large area between Elyria and Moundridge, Kansas. Parts of Townships 20 and 21 South and Ranges 2 and 3 West are within the Site boundaries.

Impact/Immediacy: Impact is to the shallow Equus Beds underlying the Voshell Oil Field, which has been affected by elevated chloride levels. Resources impacted include domestic and irrigation wells. The site is classified as moderate immediacy level.

Site Description: The land surface is flat irrigated farmland, which is dissected by Dry Turkey Creek and Running Turkey Creek. The aquifer ranges in thickness from eighty feet in the east of the site area to approximately two hundred feet in the west. The axis of the relatively thick McPherson channel can be mapped from the center of Section 31, T21S, R3W to the NW corner of Section 19 to the center of Section 5, and then northward from that point. The aquifer appears to contain several aquitards, which may or may not be continuous throughout the area.

Unusual Problems: Movement of the chloride plume toward irrigation wells can be somewhat accelerated by the effect of large irrigation well pumping. The plume will continue to migrate toward the McPherson channel located to the west of the Voshell Oil Field as long as there is deep pumping of the Equus Bed aquifer. New irrigations wells are drilled every year in the immediate area, and can cause erratic hydraulic movements of the plumes.

Status of the Project: In May of 2004, a cooperative agreement between the Kansas Corporation Commission (KCC) and the Equus Beds Groundwater Management District No. 2 (GMD 2) was entered into for the drilling of 10 groundwater monitoring wells in the Voshell oil field. The GMD 2 is responsible for water sampling and providing water quality data to the KCC of those wells. The initial seven wells were drilled north to south through the project area, and were drilled down to the Wellington shale bedrock. Approximately 21 wells associated with the Running Turkey Creek site monitored by the KCC have been moved under the control number of the Voshell site since 2012. The KCC wells were sampled by KCC staff in October of 2016. There are multiple wells that are in need of repair or need to be plugged due to age or damage. MW-501 has not been found and is believed to be covered my new roadwork and asphalt at its location. MW-1001 has been destroyed by farming equipment and cannot be repaired. The known plumes appear to be slowly moving to the southwest. KCC has begun water record research into the area west of the site during the 2014 year which continues through 2016. The western monitoring wells sampled by GMD have risen in chloride levels over the last year. Other areas seem to be stable or slightly lower which could be due to the recent heavy precipitation in the region.

Level of Remediation Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendation for Future Work: KCC plans to plug and/or repair all wells needing remedial work in conjunction with the Running Turkey Creek and Galva site during one multi-day event. KCC has discussed with GMD #2 adding additional monitoring wells west of the line of GMD wells on the west edge of the site. KCC and GMD could join resources in achieving this. Some detail delineating within the site boundaries are also recommended especially near the high chloride plume within the Voshell Oil Field. Due to the increased chlorides in the western monitoring wells with historical elevated levels, advancement of a well installation plan should be put together during 2017 and implemented before 2018.

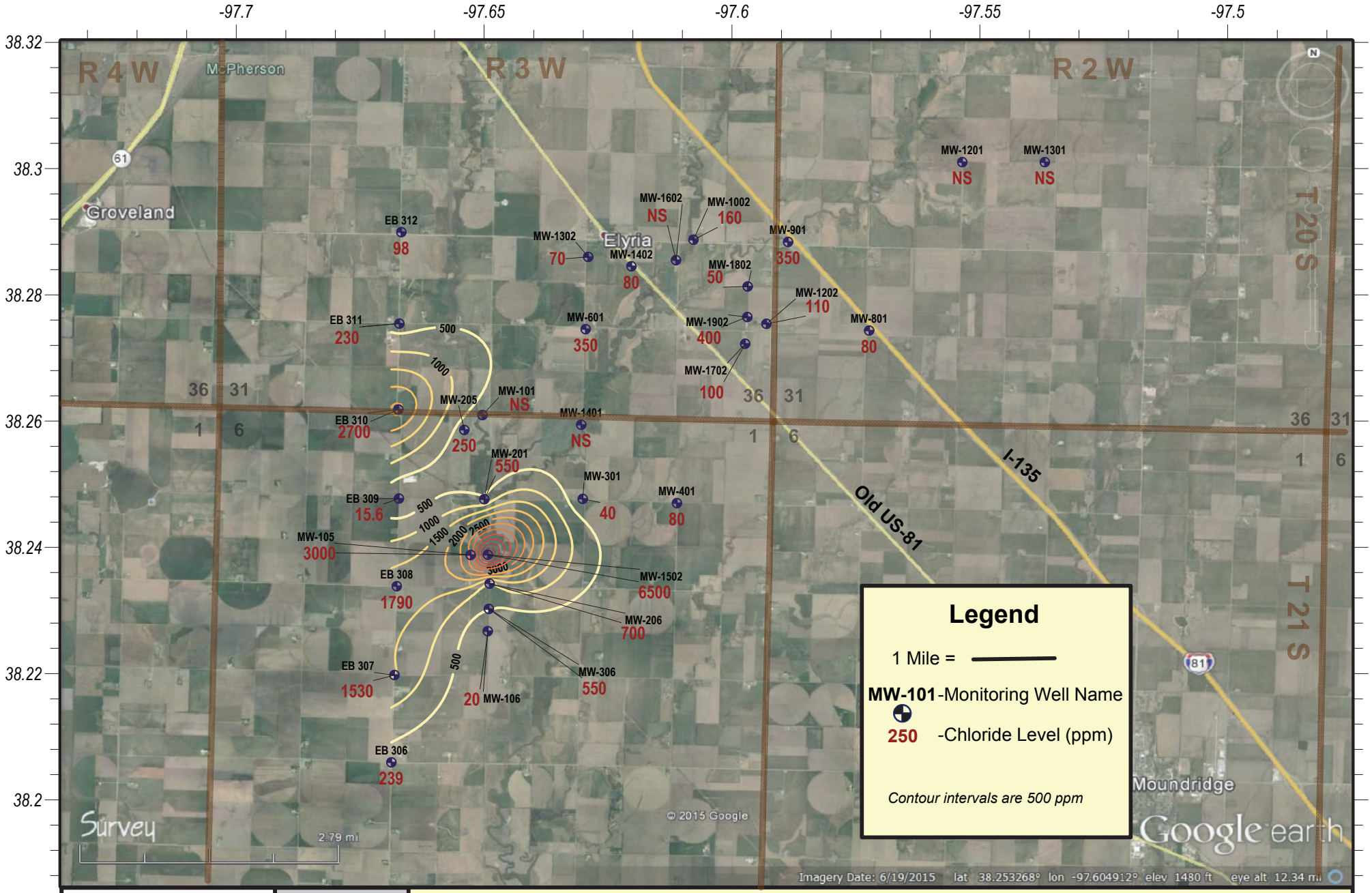
Estimated Total Costs: Cost of funding field work on repairs and sampling might be as much as $700-1000. Office research into the expansion of the well matrix will cost in staff time only. Funding provided by the KCC for this monitoring program will not exceed $20,000 without written mutual agreement of both parties. KCC believes a cost estimate of $20,000-40,000 dollars will be needed for the installation of new monitoring wells to delineate the site depending on the number of wells to be installed.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
20030059-001	**16 Hrs. / $440.34**	**$302.12**	**$19,880.80**

Current Contaminate Level: MW-1502 – 6,500 mg/l.

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

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Voshell Contamination Site

Multiple Section of Townships 20 & 21 South and Range 2 & 3 West, McPherson County, Kansas

2015 Groundwater Chloride Levels Map

District #2 - Control Number #20030059-001 - Sampled in October 19th & 27th, 2016 - Drawn on 11/2/16 by D.Bollenback

Project: *Wildboy's Land & Cattle Contamination Site*

Site Location: Legal location is NE/4 of Section 28, Township 33 South, Range 11 West, Barber County, 9 miles S of Medicine Lodge on Hwy 281, 1E, 1S, 1E into farmstead.

Impact/Immediacy: The impact is to the groundwater and surface water of the area. Immediacy level is rated at moderate to high.

Site Description: The site is located within the Medicine Lodge River Valley.

Unusual Problems: None.

Status of Project: During 2016, a total of six samples were taken, four from monitoring wells and two from stock wells. In general, the chlorides at this site have been quite variable. Since the last sampling event in 2015, chlorides have been relatively consistent. Current chlorides at the site are between 340 ppm in the western most stock well, and 5100 ppm in MW-3. Current number of monitoring wells does not provide adequate coverage of the plume in order to evaluate the extent to the south and southeast.

Level of Chloride Sought:

Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendations for Future Work: There are several oilfield supply wells downstream to the south that will be sampled in 2017 to help delineate the plume. Should chloride levels continue to elevate significantly in future sampling, implementation of a remedial system will be investigated.

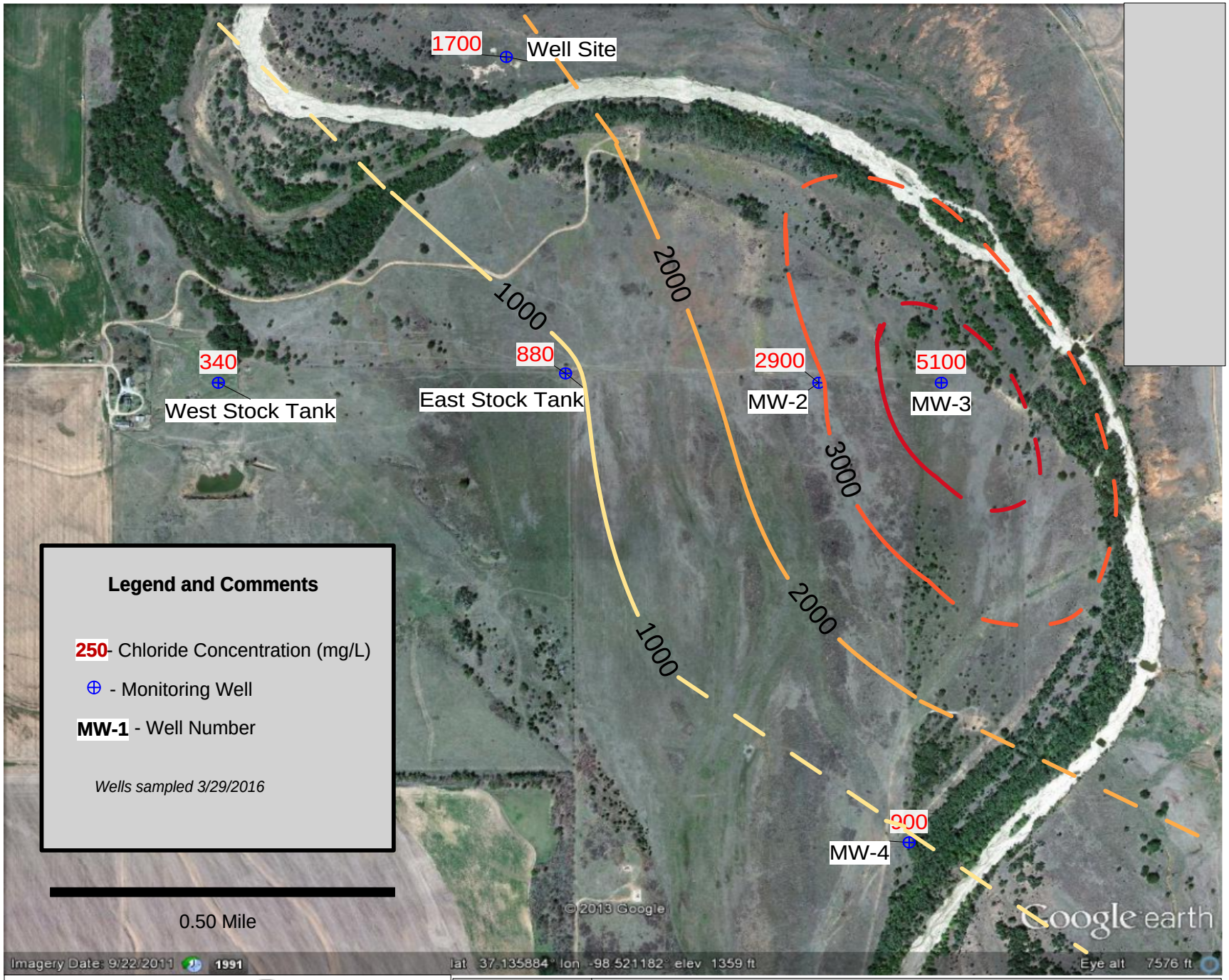
Estimated Total Cost: Installation of recovery system and disposal facility with long term monitoring. Costs associated with the installation of the disposal well are attached to the Harbaugh site.

Control No.	Staff Hours/Expenditures	Fund Expenditures FY 2016/17	Total
970017-00	9 Hrs. / $253.18		See Harbaugh

Current Contaminate Level: 340 ppm Cl- to 5100 ppm Cl-

Status:

☐ 1. Site Assessment	☐ 2. Short Term Monitoring	☐ 3. Investigation
☒ 4. Long Term Monitoring	☐ 5. Remediation Plan	☐ 6. Installation
☐ 7. Remediation	☐ 8. Post Rem. Monitoring	☐ 9. Resolved



Kansas Corporation Commission

N W E S

Wildboys Site

2016 Area Map with Chlorides

Sections 28/33-T-33S-R11W

Barber County, Kansas

KCC Control # 970017-00 District 1

K. Sullivan 6/15/16

Project: *Wingate Contamination Site*

Site Location: NE/4 of Section 17, Township 29 South, Range 17 East, Wilson County.

Impact/Immediacy: Impact is to the groundwater and soil. Immediacy level is rated as low.

Site Description: This site is located on gently sloping land used for agriculture. Much of the scar is located in a low-lying drainage area next to or within a waterway. Brine seepage originates from the Thayer coal bed or Cottage Grove Sandstone Member, which overlies the Chanute Shale in the higher areas.

Unusual Problems: This property is leased by River Rock. The Mary Douglas property located in the next ¼ section east contained 22 abandoned wells, many of which had high fluid levels and were old style completions. These abandoned wells are contributing to the source of the brine commingling with the shallow aquifer impacting the Wingate property. These wells were plugged by the State and the project was completed in February of 2009.

Status of Project: Four new monitoring wells were constructed on this project in early 2012. These wells were sampled three times on the following dates: 4/11/2016, 6/29/2016 and 11/03/2016. Statistical analysis of samples collected from these four new monitoring wells indicates Cl- concentrations are directly impacted to precipitation events and Oil & Gas producing activities within the immediate vicinity. The sample results for 2016 are as follows:
WIN1: 6,500, 6,000 and 6,000 ppm Cl-: ***WIN2***: 11,000, 5,000 and 2,000 ppm Cl-
WIN3: 3,000, 4,000 and 5,000 ppm Cl-: ***WIN4***: 7,000, 3,000 and 5,000 ppm Cl-

Level of Remediation Sought:
Ideal: 250 ppm Chloride
Target: 500 ppm Chloride

Recommendation for Future Work: Continue quarterly sampling. This site should possibly be expanded to include the Mary Douglas property located in NW 16-T29S-R17E WL Co. and the SE 17-T29S-R17E. Sampling in 2016 indicates that the primary source of brine is coming from the SSE of this project. Graphical analysis of the Cl- concentrations in these four wells indicates a spike in chlorides. These spikes in the graph indicate periods of influx of brines moving through the system strongly indicating an undiscovered bore hole(s) commuting with this shallow ground water zone. These are likely reflecting increased flood and or disposal fluids from active operations completed within the same zone or CBM wells that have been shut in or pumping at reduced rates temporarily increasing formation pressures allowing greater communication with possible undiscovered open bore holes. Further monitoring of existing wells and possible additional monitoring wells will help to delineate the extent and condition of this aquifer. Further review of KGS well data and GIS information may provide information on additional possible locations of abandoned wells for further field investigation.

Estimated Total Costs: Four new monitoring wells were completed at a cost of $8,196 in 2012.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures FY 2016/17**	**Total**
970107-00	**54 Hrs. / $1,531.30**		**$8,296**

Current Contaminate Level: 2,000 ppm Cl- to 11,000 ppm Cl-

Status:Active

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☒ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☐ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**

KANSAS CORPORATION COMMISSION
Wingate Remediation Site
NW 17-T29S-R17E
Wilson County, Kansas
Project 970170-00
11/05/2016 District 3

N
S

Contour Interval 500 ppm Cl-

Monitoring Well

Fee Fund Plugged Well

Project: *Yeoman Site*

Site Location: The Yeoman site is located in the center of the southeast quarter of section 35 T 28S R7W. This area is five miles south and three miles east of the city of Kingman in Kingman County.

Impact/Immediacy: The abandoned Yoeman #1 located in the center of the SE/4 has charged up shallow zones in the Permian Red Beds with gas. The site classification is high due to the remaining gas in place even after producing the gas from 5 monitoring / recovery wells.

Site Description: The Yeoman #1 is located in pasture used for grazing cattle. The Permian Red Beds are encountered at a depth of 50' consisting of very soft, sandy weathered red shale. The unconsolidated alluvium above the Red Beds consists of a fine to medium grain sand that is the primary shallow aquifer for this area. There are five monitoring /recovery wells offsetting the abandoned Yeoman #1 that were drilled to a total depth of 150 feet with gas encountered as shallow as 110 feet. Each monitoring / recovery well has approximately 90 feet of 7 inch surface casing set.

Unusual Problems: In early 2009, KCC staff became aware of gas coming up an abandoned water well in the SW corner of Sec. 30-28-6W, over a mile away from the Yeoman #1. The property owner is Harold Reida, and the water well is referred to as the Reida water well. Gas is still present in the Reida water well as of 2016.

Status of the Project: Currently there are five monitoring / recovery wells directly offsetting the Yeoman #1 that are being produced by Don Graber (Gra Ex LLC, KCC Lic. #33921) under an agreement with the KCC. Mr. Graber has been producing the recovery wells since November 2009 and has recovered a total of 162,247 Mcf as of September 1, 2016. For the past 12 months the five monitoring / recovery wells have averaged 73 Mcf per day into the sales line. A total cumulative amount of 224,785 Mcf of gas has been recovered from these 5 recovery wells starting back in April 2006. (From KGS Production Data)

In April 2010 the KCC District 2 office drilled an additional 6 monitoring wells around the perimeter of section 36 in the section east of the Yeoman site. This was done in an attempt to delineate the escaped gas, and follow the upward trend of the Permian red beds to the northeast. Gas was found at all 6 locations with small initial shut-in pressures varying from 15 to 37 psi at the wellhead. The Permian red beds were encountered as shallow as 14 feet in MW #8 in the NE corner of section 36 as compared to 44 feet in MW #6 that was drilled in the SE/4 of section 35 and is the closest monitoring well drilled to the 5 recovery wells.

Consistent recovery has occurred over the last 7 years, and recovery amounts are staying level as well as the pressure at the compressor station which has been a consistent 8-9 psi for the past several years. KCC / Gra Ex did not hook up recovery well No. 6 in 2016, and will first evaluate the gas potential through a flow test using KCC flow meter equipment.

Level of Remediation Sought:

Ideal: N/A

Target: N/A Complete the plugging of the Yeoman #1 once escaped gas has been depleted from the Red Beds.

Recommendation for Future Work: Continue to monitor gas production very closely with Don Graber. Flow test several recovery and monitoring wells for potential then make a decision as to whether to hook them up to the system.

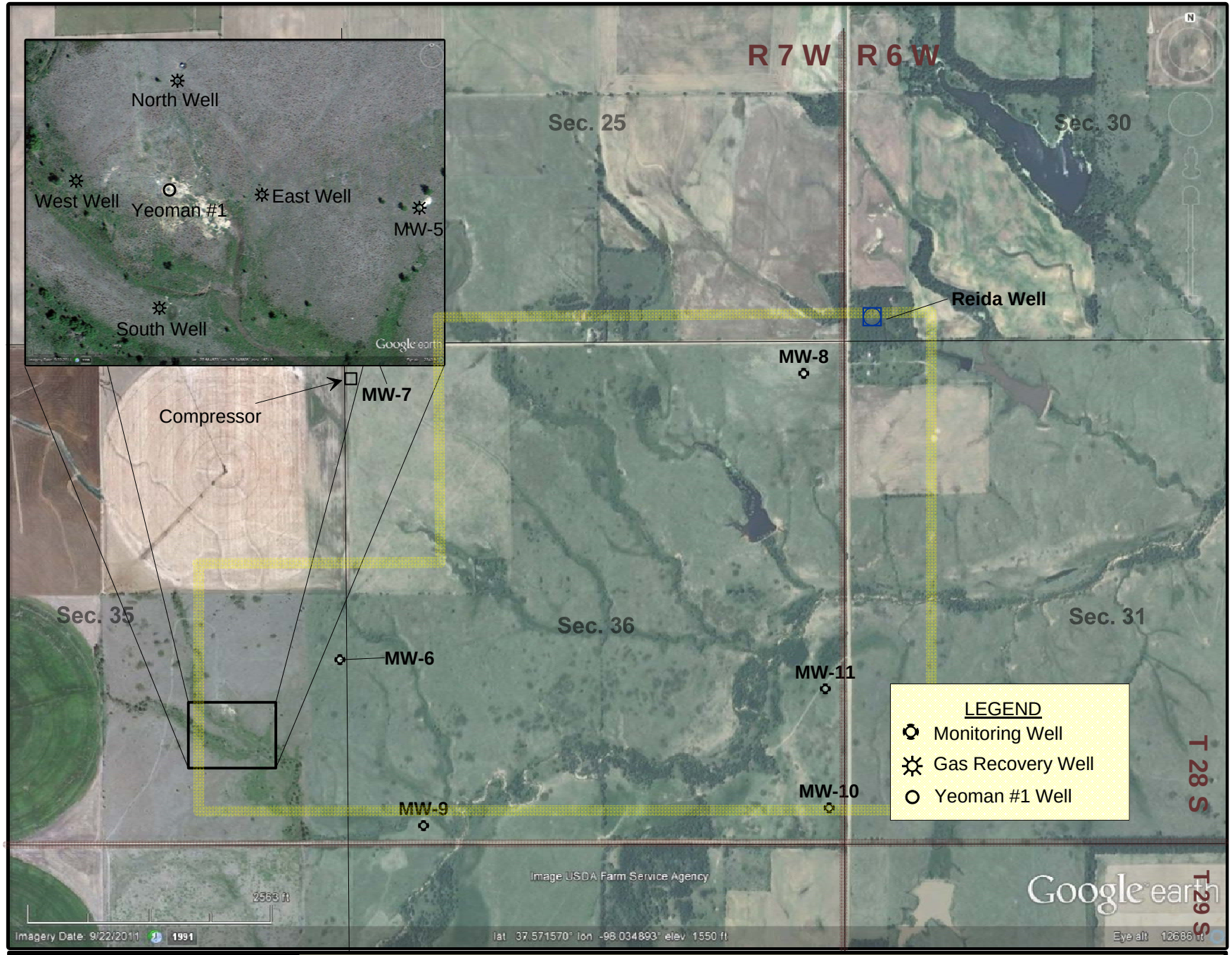
Estimated Total Costs: Plugging of the Yeoman #1 will be less than $25,000 and can be done through KCC fee fund. Additional installation of monitoring wells plus staff time on research and investigation would be an estimated $20,000.

Control No.	**Staff Hours/Expenditures**	**Fund Expenditures**	
		FY 2016/17	**Total**
20060021-001	**13 Hrs. / $385.95**		**$93,690.76**

Current Contaminate Level: Shallow Aquifer <70 ppm Cl-
Water from Permian Red Beds tested 625 ppm Cl- in well #5 at 150' TD
Total Gas Produced to date: 224,785 Mcf (KGS Production Data)

Status:

☐ **1. Site Assessment**	☐ **2. Short Term Monitoring**	☐ **3. Investigation**
☒ **4. Long Term Monitoring**	☐ **5. Remediation Plan**	☐ **6. Installation**
☒ **7. Remediation**	☐ **8. Post Rem. Monitoring**	☐ **9. Resolved**



Kansas Corporation Commission

Yeoman Escaped Shallow Gas Site
SE/4 of Section 35 and All of Section 36-T28S-R7W, Kingman Co., KS
Site Map for 2016-17 Legislative Reports
District #2 Control No. 20060021-001 11-1-2016 D. Bollenback

Kansas
Corporation Commission

Ryan Hoffman, Director of Conservation

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