

**Kennedy/Jenks Consultants**  
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15 January 2015

Mr. Dane Johnson  
Senior Engineering Geologist  
Central Valley Regional Water Quality Control Board  
1685 E Street  
Fresno, California 93706

Subject: Interim Report on Phase 2 Subsurface Investigations at the Valley Water Management Company Edison Oil Field Fee 34 Facility and Race Track Hill  
K/J 1365027\*00

Dear Mr. Johnson:

This interim report on the Phase 2 Subsurface Investigations: Valley Water Management Company Edison Oil Field, Fee 34 Facility and Race Track Hill is submitted in compliance with the 13267 Order issued to Valley Water Management Company (VWMC) on 1 July 2014. A Work Plan describing the proposed investigations was submitted for Central Valley Regional Water Quality Control Board (Regional Board) approval on 14 November 2014 and reviewed with the Regional Board during a meeting on 2 October 2014. During that meeting, the Regional Board gave conceptual approval to the Phase 2 investigations plan.

**Background.** VWMC received the 13267 Order on 7 July 2014, and responded to the Regional Board on 29 July 2014 (Letter from Larry Bright, VWMC, to Clay Rodgers, Regional Board, dated 29 July 2014). The purpose of the letter was to once again reiterate the impossibility VWMC faces in complying with the requirement to complete all the work described in the 13267 Order by the final completion date of 15 January 2015 established in the Order.

The basis for our concerns with the schedule contained in the 13267 Order is summarized as follows. The work required to be performed by VWMC in the Order consists of three basic tasks:

1. Conduct investigations and studies necessary to determine whether potential adverse impacts on soil and groundwater quality have occurred.
2. Characterize the nature and extent of release, if any, from the subject facilities.
3. Once the characterization is complete, conduct studies to evaluate what corrective measures, if any, need to be taken to protect existing and potential future uses of impacted soils and groundwater.

Mr. Dane Johnson  
Central Valley Regional Water Quality Control Board  
15 January 2015  
Page 2

Step 2 cannot be undertaken until Step 1 is completed and Step 3 cannot be completed without first completing Step 2. VWMC has worked collaboratively with Regional Board staff to this point and agree that a phased approach is the best approach to conducting the evaluation for VWMC's Edison Oil Field sites, as mentioned in the 13267 Order. VWMC submitted a Work Plan for proposed Phase 2 work and contracted with a drilling company for Phase 2 well installation. Two additional shallow monitoring wells have been installed at Race Track Hill and 4 deep wells will be installed later this month (drillers in the area have been extremely busy so this was the earliest time we could contract for the drill rig specified for the deep wells). Drilling, well construction, development, sampling, and water quality analyses are expected to take 4-6 weeks to complete.

If the Phase 2 investigations do, in fact, result in defining the nature and extent of the release, if any, VWMC will then require a minimum of an additional six months to conduct the evaluation of what, if anything, need be done in response to the release. Alternatively, if the Phase 2 investigations do not adequately define the nature and extent of the release, a third phase of characterization will be required before the evaluation of need for corrective action can commence.

VWMC pursued Phase 1 investigations at Race Track Hill and the Fee 34 Facility in a voluntary manner prior to receiving a 13267 Order in order to hasten the investigations. VWMC intends to continue investigations diligently. Yet in spite of our commitment to continue in this manner, it is not possible for us to comply with the schedule set forth in the Order. The Interim report on subsurface investigations presented in this letter is intended to report our findings to date and our continued diligence in pursuing necessary investigations, in accordance with our Work Plans for drilling and the technical elements of the 13267 Order.

## Technical Summary of Subsurface Investigations

Phase 2 Subsurface Investigations at the Valley Water Management Company Edison Oil Field Sites consist of two drilling and monitoring well construction programs. One investigation focuses on the deep aquifers that underlie the Fee 34 Facility and Racetrack Hill. Three wells will be completed at Racetrack Hill and one well will be completed at the Fee 34 Facility (Figure 1). This investigation has not been completed and, therefore, is not discussed in this interim report. The following paragraphs provide a summary of the second subsurface investigation which addresses shallow subsurface stratigraphy and shallow monitoring well construction at the Racetrack Hill Facility. VWMC also identified wells within one mile of the VWMC sites, as required in the 13267 Order. A report on the wells identified was submitted to the Regional Board on 21 August 2014. This report also included a cross section for the Racetrack Hill Area based on local area well logs.

The objective of the Phase 2 shallow groundwater investigation is to provide a further assessment of shallow groundwater conditions down gradient of the Racetrack Hill Site (Figure 1). Two additional shallow groundwater monitoring wells were installed, developed, and surveyed to augment the three monitoring wells installed during Phase 1. New monitoring well RTH#5 was installed northeast of the Site near Cottonwood Creek, and new monitoring well

Mr. Dane Johnson  
Central Valley Regional Water Quality Control Board  
15 January 2015  
Page 3

RTH#6 was installed on the southwest side of the southernmost surface impoundment in the southern drainage (Figure 2). All five shallow monitoring wells were sampled and analyzed in December 2014 for inorganic constituents, Total Petroleum Hydrocarbons as crude oil (TPHc), and isotopic analysis of O<sup>18</sup> and deuterium.

**Results.** Boring Logs for the new wells (Attachment A) indicate that RTH#5 is completed in recent alluvium. This alluvium is in a drainage way that trends west to east losing approximately 80 feet elevation between the base of Racetrack Hill and Cottonwood Creek. The boring, which extended to 57 feet below ground surface (bgs), had an initial static water level at 33 feet bgs. The hollow stem auger could not advance past 57 feet bgs so the depth of the recent alluvium overlying the Santa Margarita Formation could not be determined.

Boring RTH#6 was advanced to 144 feet bgs with an initial static water level in the borehole at 120 feet bgs. Based on our boring logs, the sediments encountered are those of the Santa Margarita Formation. No evidence of moisture related to the adjacent produced water percolation was observed in the near surface core samples; no perched water or indication of horizontal movement were observed.

Wells were constructed in borings RTH#5 and RTH#6. Table 1 summarizes well construction details for all shallow wells at Racetrack Hill. The top of casing elevation for RTH#5 is at the lowest elevation of the wells and RTH#6 is at the highest elevation.

Groundwater elevation data for both April 2014 and December 2014 monitoring well sampling events are included in Table 2. Three wells have been sampled twice. Of these, RTH#1 has approximately the same water level in April and December. This is likely due to its location adjacent to an active percolation-evaporation pond that maintains water levels in the area. The two wells at the base of Race Track Hill, RTH#3 and RTH#4, both have static water levels approximately 6 feet lower in December than in April.

Figure 3 shows water level elevations for the December 2014 sampling event. No attempt was made to provide water level contours because there are undefined variables that affect groundwater flow in the area. This includes percolation discharge volume from the 21 ponds at Racetrack Hill, a large elevation change between wells on Racetrack Hill and those in the valley east of Racetrack Hill, and marked differences in subsurface conditions among the well locations.

An important objective of the Phase 2 Work Plan was to determine the flow direction of first-encountered ground water east of Racetrack Hill. Based on December 2014 results from RTH#3, RTH#4, and RTH#5, the apparent flow direction is to the northeast along the same path as the surface drainage way just north of Breckenridge Road. This assumes that groundwater encountered at RTH#5 is hydraulically connected to the groundwater in RTH#3 and RTH#4. This is discussed in the next section.

**Water Quality Monitoring Dataset.** The results of April 2014 and December 2014 groundwater sampling are shown in Tables 3 and 4. For this interim report, the results of the December 2014

Mr. Dane Johnson  
Central Valley Regional Water Quality Control Board  
15 January 2015  
Page 4

samples will be discussed here. Monitoring wells RTH#1 and RTH#6 are located directly adjacent to produced water percolation-evaporation ponds on Racetrack Hill. Water quality of these wells is expected to be related to the chemistry of produced water. RTH#3 and RTH#4 are at the base of Racetrack Hill and may have water quality affected by more than one water source. The same is true for RTH#5 but this well is much further from Racetrack Hill.

Electrical conductivity (EC) and boron (B) are highest at well RTH#1 and slightly lower at RTH#4 and RTH#6. These parameters are lowest at wells RTH#3 and RTH#5. RTH#5 is much lower in EC and B than all other wells, likely because it is furthest from Racetrack Hill and may not have been influenced by water from the Racetrack Hill ponds. This comparative trend among wells is consistent for a number of constituents including sodium (Na) and chloride (Cl) which are characteristically high in produced water. Calcium and total dissolved solids (TDS) also follow this trend. Nitrate nitrogen, sulfate ( $\text{SO}_4$ ), magnesium (Mg), potassium (K), and alkalinity ( $\text{HCO}_3$ ) all have different trends for the wells completed in first encountered groundwater.  $\text{SO}_4$ , Mg, K, and  $\text{HCO}_3$  all have concentrations equal to or greater than those at RTH#1. This suggests that there are other sources of groundwater that contribute salt ions, particularly at RTH#4.

The relationships among salt ions can be evaluated using a trilinear geochemical analysis (Figure 4). This figure shows that the wells on Racetrack Hill, RTH#1 and RTH#6, consistently plot near each other, because they are chemically similar. Wells RTH#3 and RTH#5 consistently plot at one end of the group of five wells because their geochemistry is markedly different. In addition, RTH#3 and RTH#5 are different from each other because RTH#5 has a geochemical make-up that is distinctly different from all other wells. EC, B, and Cl are much lower than the other wells and indicates that groundwater at this well location comes primarily from sources other than produced water discharge at Racetrack Hill. Well RTH#4 generally falls between the geochemistry of RTH#1/RTH#6 and RTH#3/RTH#5. This well also has higher Mg and  $\text{SO}_4$  concentrations than are present in the produced water or at RTH#1.

The sampling plan for the December 2014 sampling event also included TPHc and isotopes of oxygen and hydrogen. TPHc was not detected in any sample above the method reporting limit, 500  $\mu\text{g/l}$  (Table 4).

The preliminary analysis of wells at the Racetrack Hill site indicate that wells located on Racetrack Hill (RTH#1, RTH#6) have characteristics similar to produced water but generally at somewhat lower concentrations. The other wells have chemical differences from produced water that suggest that other groundwater sources are present at these wells. RTH#4 may have another source with elevated K, Mg, and  $\text{SO}_4$ . RTH#3 may have similar effects but the concentrations of B, Cl, and EC are lower than at RTH#4. This may be due to the distance of RTH#3 from the nearest percolation-evaporation ponds. As mentioned above, RTH#5 has very different water quality than that of the other four wells at Racetrack Hill.

Isotope analyses have not yet been completed by the specialty laboratory. Since isotopic analysis is a key part of evaluating potential component sources of groundwater, any further

Mr. Dane Johnson  
Central Valley Regional Water Quality Control Board  
15 January 2015  
Page 5

evaluation of sources of shallow groundwater at and near the Racetrack Hill site will be conducted when the laboratory dataset is complete in early February 2015.

## Evaluation of Alternative Discharge Methods

Two discharge alternatives to the Racetrack Hill discharge are under consideration and evaluation by VWMC. We continue to evaluate potential alternatives but, at this time, these have not been demonstrated to be viable.

1. **Produced Water Injection into an Exempt Aquifer.** As a contingency to the potential future loss of the VWMC disposal facility at Racetrack Hill, VWMC has made a decision to attempt to try and permit a Class II UIC disposal well, through DOGGR, at their Section 34 "C Plant" fee property. The purpose of this UIC project is to dispose of water produced from leases in the Edison Oil Field that are a part of the VWMC Racetrack Hill water disposal district. Injection will be into the Santa Margarita formation, which is an exempted aquifer in this portion of the Edison Oil Field. The injection facility would be on VWMC's "C Plant" property located near the southwest corner of Section 34, T29S/R29E, MDBM, Kern County, California. The proposal is to drill one new well initially, "Fee 34-1", into the Santa Margarita for testing of the proposed injection zone. VWMC may propose supplemental wells in the future if produced water volumes increase and/or the formation can accept an increase in injected produced water volumes. VWMC estimates that it will take up to two years to permit and drill this proposed disposal well. VWMC has conducted background research on properties and has completed the geological portion of the permit application.
2. **Discharge of Produced Water to an Irrigation District.** VWMC is in discussions with the Arvin-Edison Water Storage District regarding providing them with produced water to augment their irrigation water supply. The blended concentrations are being evaluated to assess agricultural suitability and the mechanics of piping the produced water to Arvin-Edison's canal system are under review.

Mr. Dane Johnson  
Central Valley Regional Water Quality Control Board  
15 January 2015  
Page 6

Please contact Gary Carlton, Larry Bright, or me if you wish to discuss any aspect of this interim report. VWMC plans to submit a final report on the Phase 2 subsurface characterization activities when the investigations have been completed. We anticipate the report will be submitted between mid-March and early April 2015.

Very truly yours,

KENNEDY/JENKS CONSULTANTS



Stuart W. Childs, PhD  
Senior Scientist

**Tables:**

Table 1: Monitoring Well Completion Details  
Table 2: Summary of Groundwater Elevation Data  
Table 3: Summary of Monitoring Well Sample Data – Inorganic Analytes  
Table 4: Summary of Monitoring Well Sample Data – TPH as Crude Oil Attachments:  
Attachment A: RTH # 5 and RTH #6 Boring Logs

**Figures:**

Figure 1: Site Location Map  
Figure 2: Race Track Hill Boring and Well Locations  
Figure 3: Groundwater Elevations – December 2014  
Figure 4: Geotechnical Analysis of Race Track Hill Groundwater Samples – December 2014

**Attachment A:** RTH # 5 and RTH #6 Boring Logs

cc: Clay Rodgers, CVRWQCB  
Larry Bright, Valley Water Management Company  
Jim Waldron, Valley Water Management Company  
Gary Carlton, Kennedy/Jenks Consultants

## Tables

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Table 1: Monitoring Well Completion Details

Well ID	Completion Date	Well Diameter (inches)	Top of Casing Elevation (ft AMSL) <sup>(a)</sup>	Drilled Depth (ft bgs) <sup>(b)</sup>	Well Screen		Sand Pack <sup>(d)</sup>		Bentonite Seal		Grout Seal	
					Top (ft bgs)	Bottom (ft bgs)	Top (ft bgs)	Bottom (ft bgs)	Top (ft bgs)	Bottom (ft bgs)	Top (ft bgs)	Bottom (ft bgs)
RTH#1	04/11/2014	4	1025.85	70.5	50	70	48	70.5	45	48	1.5	45.0
RTH#3	04/22/2014	4	879.39	105.1	84.6	104.6	82	105.1	76.2	82	1	76.2
RTH#4	04/17/2014	4	871.02	150	80	100	78	104	72	78	5	72
RTH#5	12/11/2014	4	810.8	57.4	27	57	24.5	57.4	22.5	24.5	3	22.5
RTH#6	12/10/2014	4	1059.82	145.0	113.5	143.5	111	145.0	107.8	111.0	1	107.8

**Notes:**

(a) "ft AMSL" denotes feet above mean sea level, NAVD88. RTH#1 through RTH#4 surveyed in June 2014 and RTH#5 and RTH#6 surveyed in December 2014 by Dee Jaspar and Associates.

(b) "ft bgs" denotes feet below ground surface.

Table 2: Summary of Groundwater Elevation Data

Monitoring Well	Measuring Point <sup>(a)</sup> Elevation (ft AMSL) <sup>(b)</sup>	Date	Depth to Groundwater (ft TOC) <sup>(c)</sup>	Groundwater Elevation (ft AMSL)
RTH #1	1025.85	4/30/2014	47.91	977.94
RTH #1	1025.85	12/22/2014	48.15	977.70
RTH #3	879.39	4/29/2014	80.83	798.56
RTH #3	879.39	12/22/2014	87.31	792.08
RTH #4	871.02	4/29/2014	78.45	792.57
RTH #4	871.02	12/22/2014	84.41	786.61
RTH#5	810.80	12/21/2014	33.45	777.35
RTH#6	1059.82	12/22/2014	120.31	939.51

**Notes:**

(a) Top of PVC Well Casing

(b) ft AMSL = feet above mean sea level, to NAVD88 datum. RTH#1 through RTH#4 surveyed in June 2014 and RTH#5 and RTH#6 were surveyed in December 2014 by Dee Jaspar & Associates.

(c) ft TOC = feet below top of casing

Table 3: Summary of Monitoring Well Sample Data - Inorganic Analytes

Monitoring Well	Sample Date	Sample Name	pH	Electrical	Total	Calcium	Magnesium	Sodium	Potassium	Boron	Bicarbonate	Carbonate	Chloride	Nitrate as N	Sulfate
				Conductivity	Dissolved						Alkalinity as	Alkalinity as			
			pH Units	@ 25°C	Solids @	mg/L	mg/L	mg/L	mg/L	mg/l	CaCO <sub>3</sub>	as CaCO <sub>3</sub>	mg/L	mg/L	mg/L
				µmhos/cm <sup>(a)</sup>	180°C	mg/L	mg/L	mg/L	mg/L	mg/l	mg/L	mg/L	mg/L	mg/L	mg/L
Produced Water	10/24/2014	RTH Discharge Water	7.49	5700	3000	100	10	1300	12	13	290	<10 <sup>(c)</sup>	1500	-	18
RTH #1	4/30/2014	RTH-1-140430	7.31	8,690	6,600	560	44	1,100	8.9	16	240	<8.2 <sup>(c)</sup>	2,900	7.1	42
RTH #1	12/22/2014	RTH #1 - 122214	7.26	8,650	7,000	550	45	1,300	9.0	16	220	<8.2	2,900	14	42
RTH #1	12/22/2014	QCFD-01-141222	7.24	8,700	7,000	560	45	1,300	9.0	16	220	<8.2	2,900	11	40
RTH #3	4/29/2014	RTH-3-140429	6.86	2,810	1,900	200	93	280	25	4.1	120	<8.2	510	0.7	680
RTH #3	12/23/2014	RTH#3-122314	6.91	1,920	1,500	170	81	180	22	0.65	100	<8.2	130	0.16	800
RTH #4	4/29/2014	RTH-4-010429	7.52	5,900	4,400	450	170	580	22	6.9	210	<8.2	1,700	8.3	510
RTH #4	4/29/2014	QCFD-01-140429	7.53	5,900	4,100	430	160	560	22	6.8	220	<8.2	1,700	8.4	510
RTH #4	12/22/2014	RTH #4 - 122214	7.38	6,540	5,100	490	180	680	23	5.4	210	<8.2	2,000	3.4	370
RTH #5	12/21/2014	RTH #5 - 122114	7.69	624	450	64	23	51	6.4	0.066	220	<4.1	26	0.57	92
RTH #6	12/23/2014	RTH #6 - 122314	7.34	4,680	3,500	400	48	570	22	3.0	190	<8.2	1,300	23	290

**Notes:**

- (a) µmhos/cm = micromhos per centimeter  
(b) mg/l = milligrams per liter  
(c) "<10", "<8.2" = not detected above the practical quantitation limit

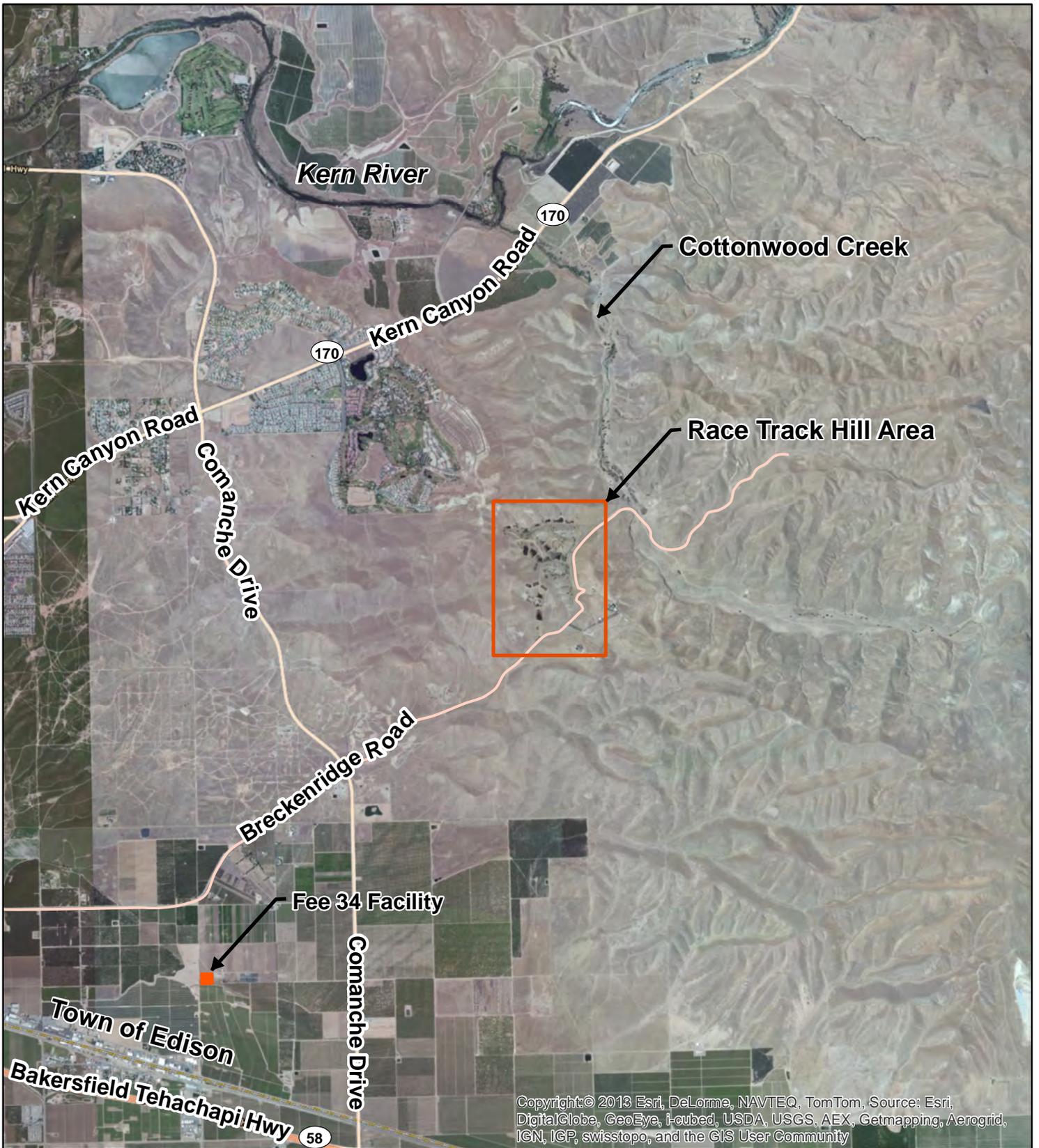
Table 4: Summary of Monitoring Well Sample Data - TPH as Crude Oil

Monitoring Well	Sample Date	Sample Name	TPH - Crude Oil $\mu\text{g/l}^{(a)}$
RTH #1	4/30/2014	RTH-1-140430	1,300
RTH #1	12/22/2014	RTH #1 - 122214	<500
RTH #1	12/22/2014	QCFD-01-141222	<500
RTH #3	4/29/2014	RTH-3-140429	<500
RTH #3	12/23/2014	RTH#3-122314	<500
RTH #4	4/29/2014	RTH-4-010429	<500
RTH #4	4/29/2014	QCFD-01-140429	<500
RTH #4	12/22/2014	RTH #4 - 122214	<500
RTH #5	12/21/2014	RTH #5 - 122114	<500
RTH #6	12/21/2014	RTH #6 - 122114	<500

**Note:**(a)  $\mu\text{g/l}$  = micrograms per liter

## Figures

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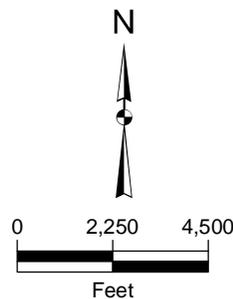


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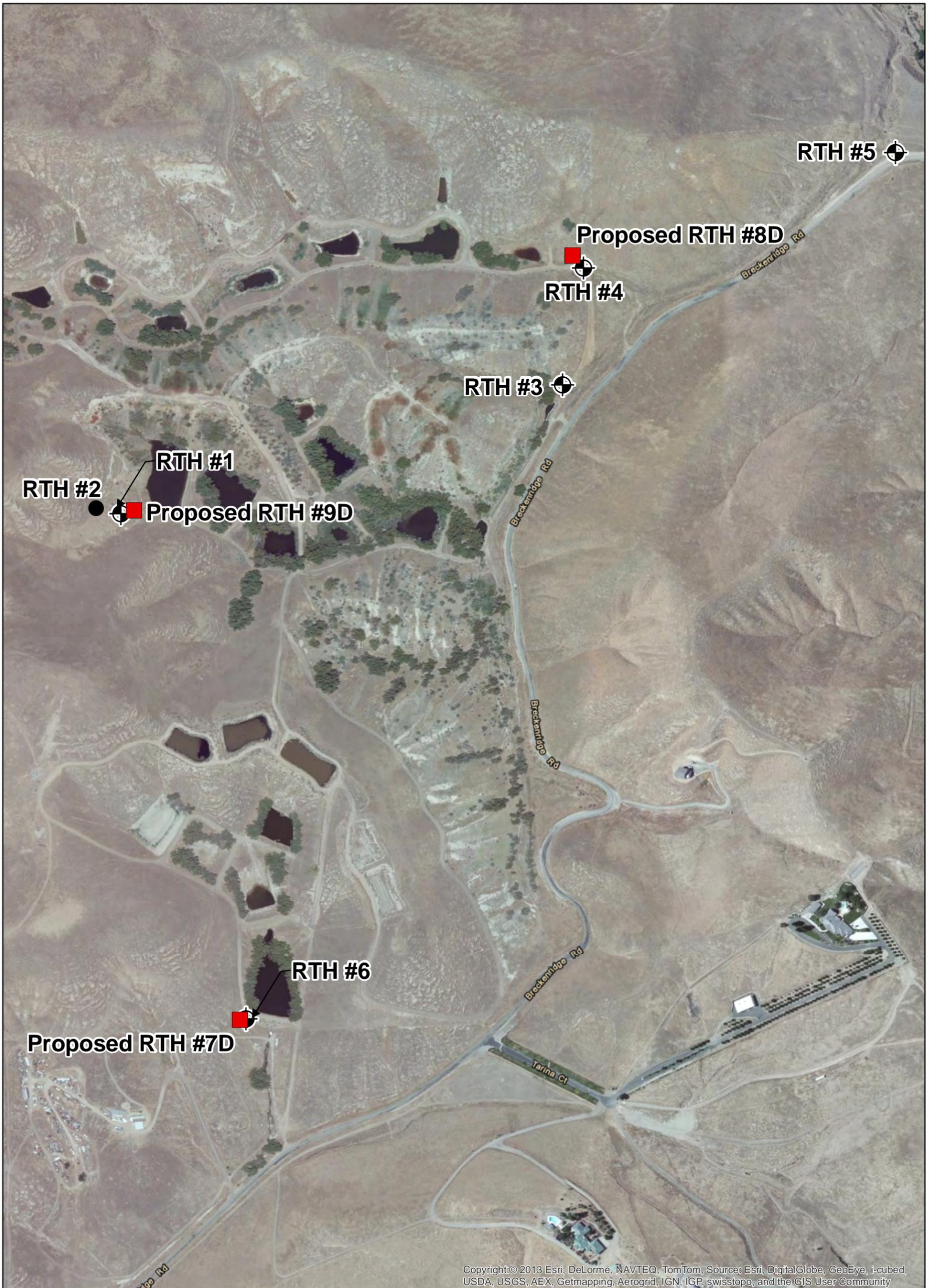
Valley Water Management Company  
Bakersfield, California

**Site Location Map**

K/J 1365027\*00  
January 2015



**Figure 1**



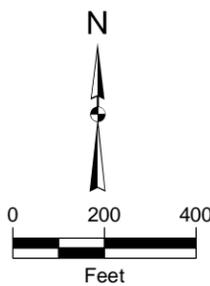
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**Legend:**

- Existing Soil Boring Location
- ⊕ Existing Shallow Monitoring Well Location
- Proposed Deep Monitoring Well Location (to be installed by others)

**Note:**

1). Race Track Hill Area is located at W1/2 Section 24 T27S R29E WDB&M.



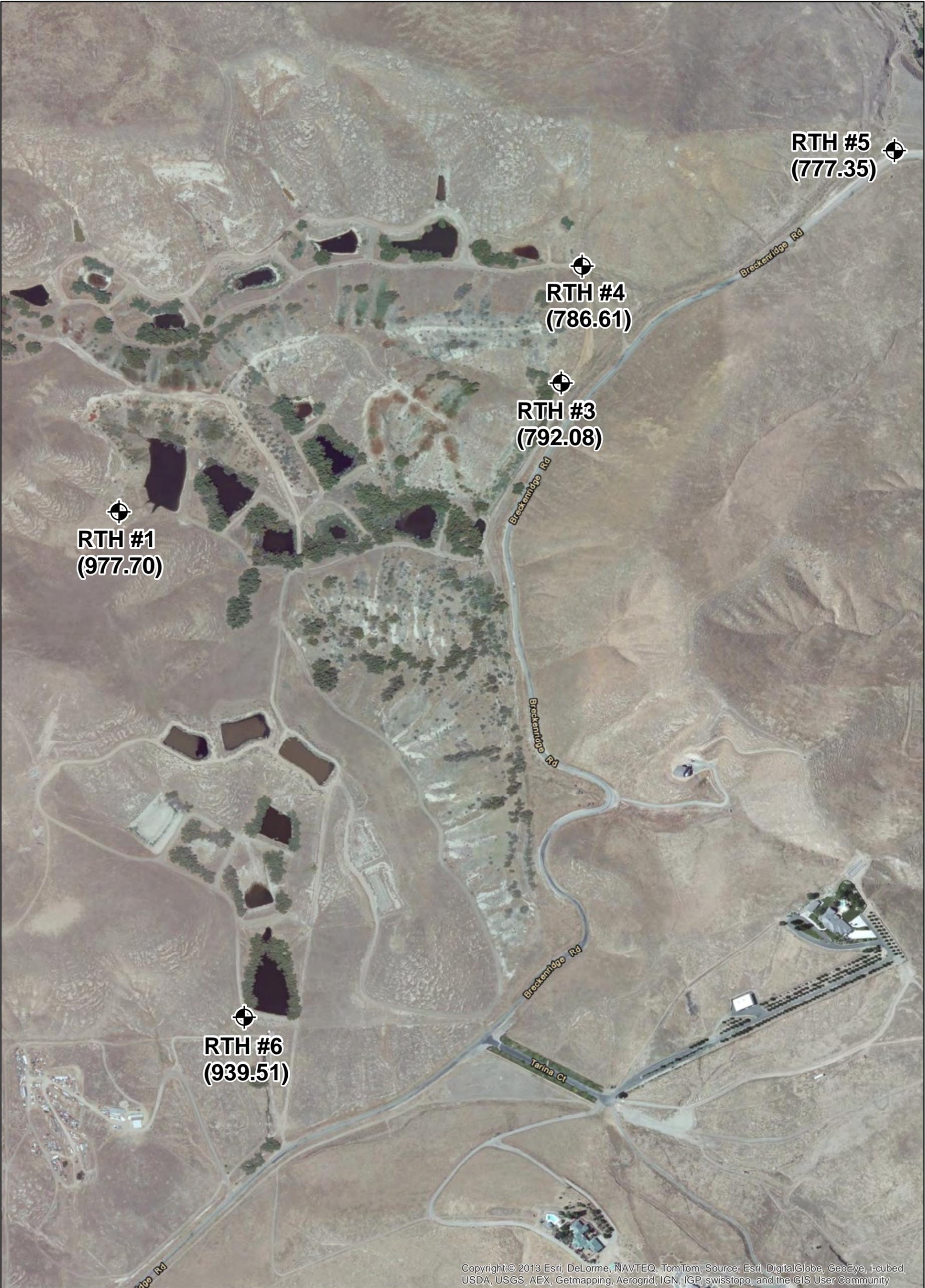
**Kennedy/Jenks Consultants**

Valley Water Management Company  
Bakersfield, California

**Race Track Hill Boring and Well Locations**

K/J 1365027\*00  
January 2015

**Figure 2**



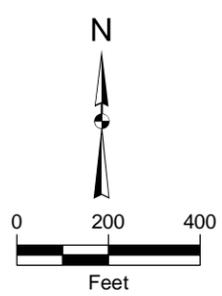
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**Legend:**

-  Shallow Monitoring Well Location
- RTH #1 (977.70) Groundwater Elevation (FT AMSL)

**Note:**

1). Race Track Hill Area is located at W1/2 Section 24 T27S R29E WDB&M.



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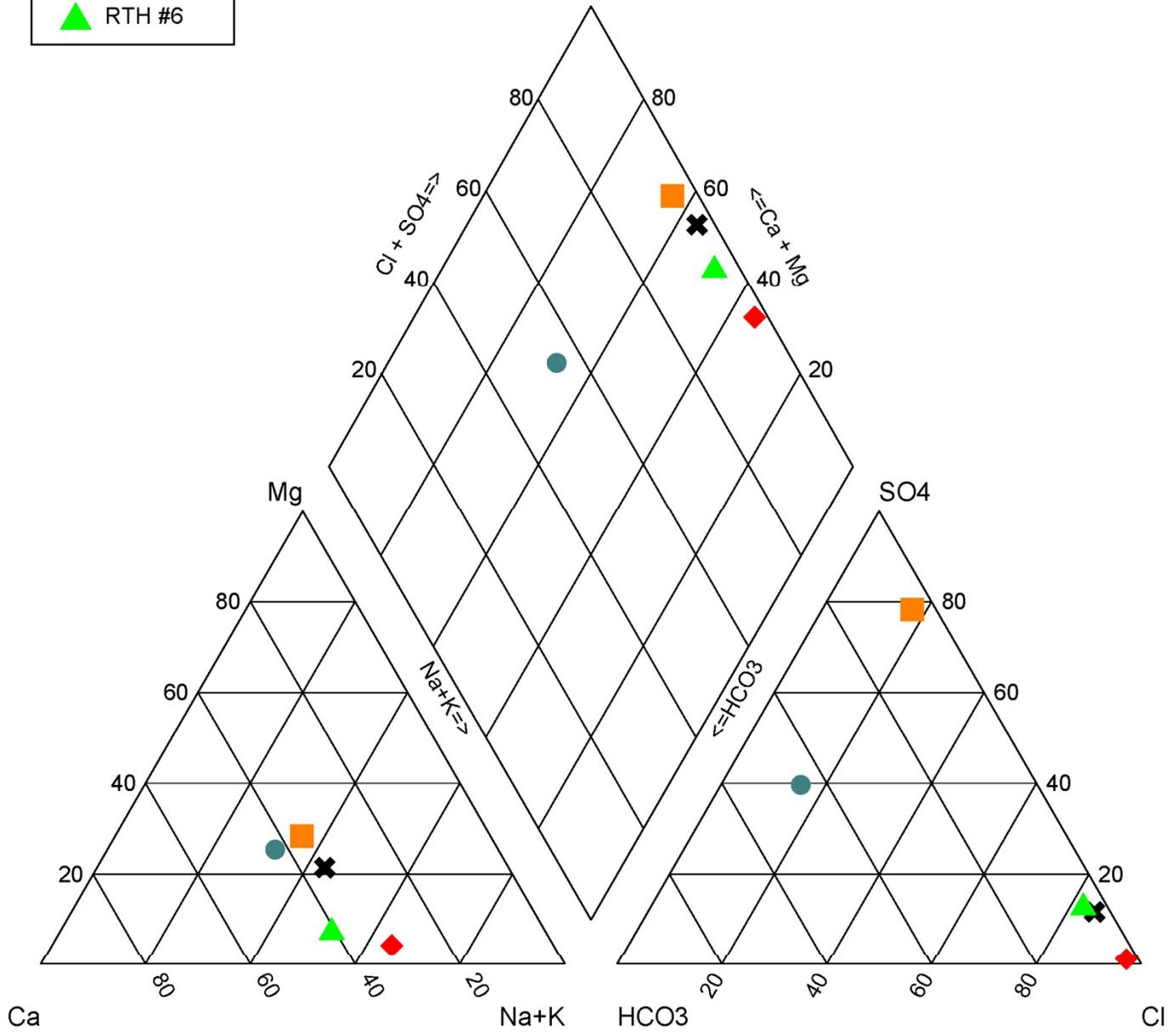
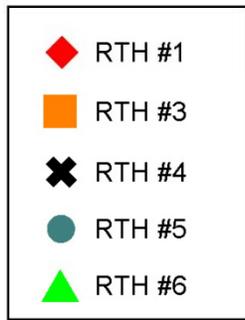
Valley Water Management Company  
Bakersfield, California

**Groundwater Elevations  
December 2014**

K/J 1365027\*00  
January 2015

**Figure 3**

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Bakersfield, California

**Geochemical Analysis of Racetrack Hill  
Groundwater Samples – December 2014**

K/J 1365027\*00  
January 2015

Figure 4

## Attachment A

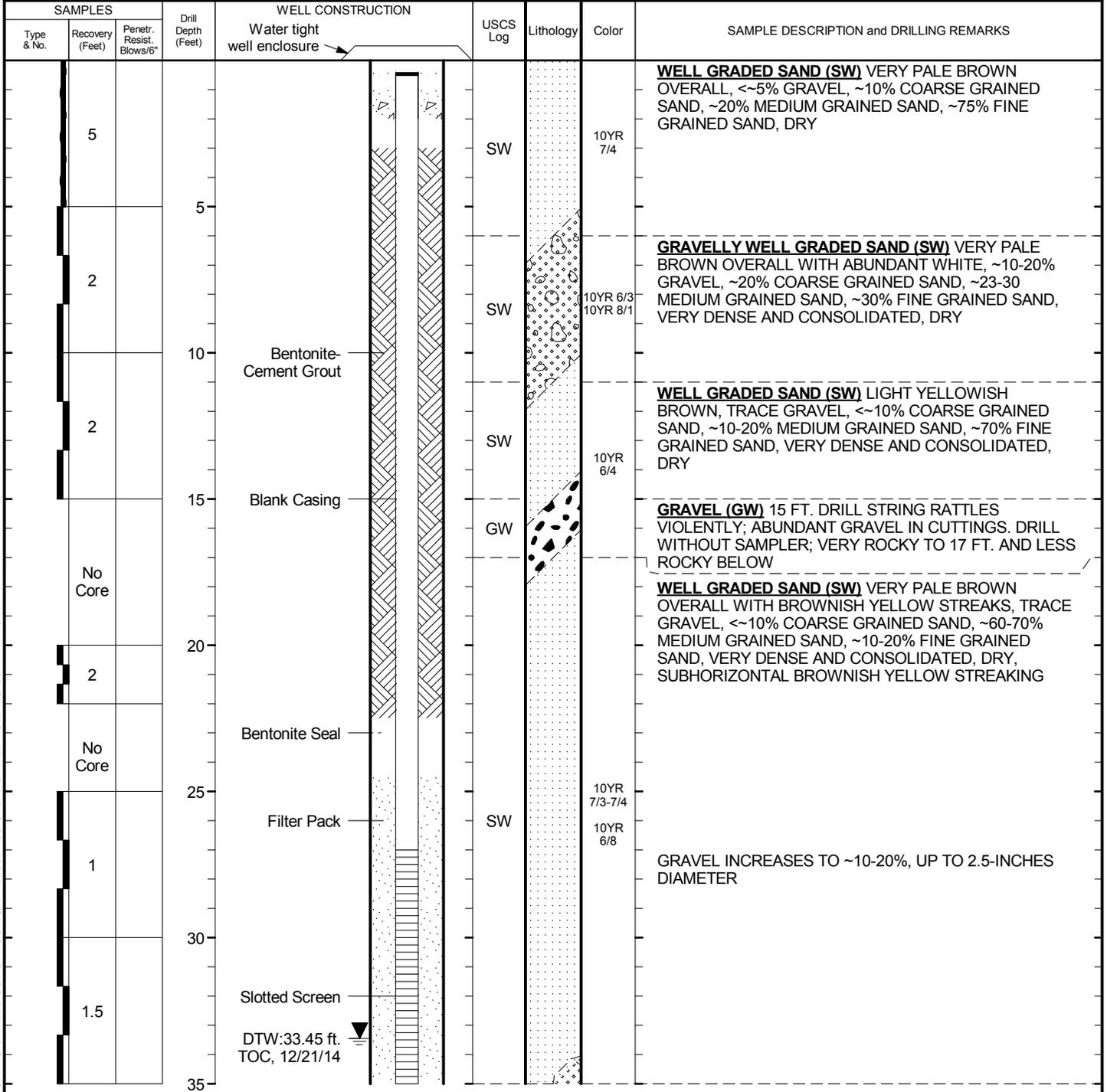
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RTH #5 and RTH #6 Boring Logs

# Boring & Well Construction Log

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BORING LOCATION <b>Breckenridge Road</b>		Well Name <b>RTH#5</b>	
DRILLING COMPANY <b>Gregg Drilling and Testing</b>		DRILLER <b>J. Sifuentes</b>	
DRILLING METHOD(S) <b>Hollow Stem Auger - CME 95</b>		DRILL BIT(S) SIZE Reamed with 10-in. augers	
ISOLATION CASING <b>n/a</b>		FROM TO FT. <b>n/a n/a</b>	
BLANK CASING <b>4-inch SCH 40 PVC</b>		FROM TO FT. <b>0.5 27.0</b>	
SLOTTED CASING <b>4-inch SCH 40 PVC 0.010-inch slotted</b>		FROM TO FT. <b>27.0 57.0</b>	
SIZE AND TYPE OF FILTER PACK <b>Cemex #2/12</b>		FROM TO FT. <b>24.5 57.4</b>	
SEAL <b>Wyo-Ben Medium Bent. Chips</b>		FROM TO FT. <b>22.5 24.5</b>	
GROUT <b>3% Bentonite Cement Grout</b>		FROM TO FT. <b>3 22.5</b>	
ELEVATION AND DATUM <b>TOC: 810.80 ft. AMSL</b>		TOTAL DEPTH <b>57.4 ft. bgs</b>	
DATE STARTED <b>12/11/14</b>		DATE COMPLETED <b>12/11/14</b>	
STATIC WATER ELEVATION <b>777.35 ft. AMSL</b>		NORTH <b>2332160.899</b>	
LOGGED BY <b>M. McLeod</b>		EAST <b>6319525.753</b>	
SAMPLING METHODS <b>Continuous coring</b>		WELL COMPLETION <input checked="" type="checkbox"/> SURFACE HOUSING <input type="checkbox"/> STAND PIPE <b>n/a</b> FT.	



BORING & WELL CONSTRUCTION 1365027.00.GPJ KENNEDY-JENKS.GDT 1/7/15

Project Name	Valley Water Management Co.	Project Number	1365027.00	Well Name	RTH#5
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SAMPLES			Drill Depth (Feet)	WELL CONSTRUCTION	USCS Log	Lithology	Color	SAMPLE DESCRIPTION and DRILLING REMARKS
Type & No.	Recovery (Feet)	Penetr. Resist. Blows/6"						
	2			First Encountered Water				<b>GRAVELLY WELL GRADED SAND (SW)</b> YELLOW OVERALL WITH BROWNISH YELLOW STREAKS, ~20% GRAVEL TO 2-INCHES, ~10%~20%~ COARSE GRAINED SAND, ~70% FINE GRAINED SAND, VERY DENSE, MOIST, ABUNDANT COARSE FELDSPAR AND QUARTZ
	No Core							
	1		40	Filter Pack			10YR 7/6	41 FT. MATERIAL IS WET. WATER LEVEL MEASURED AT APPX. 37 FT.
	No Core							
			45	Slotted Screen	SW		10YR 6/8	MATERIAL IS DENSE AND GRAVELLY-CANNOT PENETRATE WITH SAMPLE BARREL SO START ALTERNATING CORING/NON CORING RUNS
	No Core							
	1.5		50					50 FT. COLOR CHANGES TO BROWNISH YELLOW
	No Core							
			55				10YR 6/8	57 FT. AUGER REFUSAL
	No Core							

**NOTES**

1. ALL CONTACTS APPROXIMATE
2. BGS: BELOW GROUND SURFACE
3. COLOR DESIGNATION IN ACCORDANCE WITH THE MUNSELL SOIL COLOR CHARTS (KOLLMORGEN INSTRUMENTS CORPORATION, 1990)
4. SOIL CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM, ASTM D-2488-93

BORING & WELL CONSTRUCTION 1365027.00.GPJ KENNEDY-JENKS.GDT 1/7/15

# Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION <b>Race Track Hill</b>		Well Name <b>RTH#6</b>	
DRILLING COMPANY <b>Gregg Drilling and Testing</b>		DRILLER <b>J. Sifuentes</b>	
DRILLING METHOD(S) <b>Hollow Stem Auger - CME 95</b>		DRILL BIT(S) SIZE Reamed with 10-in. augers	
ISOLATION CASING <b>n/a</b>		Project Name <b>Valley Water Management Co.</b>	
BLANK CASING <b>4-inch SCH 40 PVC</b>		Project Number <b>1365027.00</b>	
SLOTTED CASING <b>4-inch SCH 40 PVC 0.010-inch slotted</b>		ELEVATION AND DATUM <b>TOC: 1059.82 ft. AMSL</b>	
SIZE AND TYPE OF FILTER PACK <b>Cemex #2/12</b>		TOTAL DEPTH <b>145.0 ft. bgs</b>	
SEAL <b>Wyo-Ben Medium Bent. Chips</b>		DATE STARTED <b>12/8/14</b>	
GROUT <b>3% Bentonite Cement Grout</b>		DATE COMPLETED <b>12/8/14</b>	
FROM TO FT.		STATIC WATER ELEVATION <b>939.51 ft. AMSL</b>	
FROM TO FT.		NORTH <b>2328430.428</b>	
FROM TO FT.		LOGGED BY <b>M. McLeod</b>	
FROM TO FT.		EAST <b>6316629.347</b>	
FROM TO FT.		SAMPLING METHODS <b>Continuous coring</b>	
FROM TO FT.		WELL COMPLETION <input type="checkbox"/> SURFACE HOUSING <input checked="" type="checkbox"/> STAND PIPE <b>3</b> FT.	

SAMPLES			Drill Depth (Feet)	WELL CONSTRUCTION		USCS Log	Lithology	Color	SAMPLE DESCRIPTION and DRILLING REMARKS
Type & No.	Recovery (Feet)	Penetr. Resist. Blows/6"		Stand pipe	Well cap				
	5		5			SM	10YR 5/4	<b>SILTY SAND (SM)</b> YELLOWISH BROWN, TRACE COARSE GRAINED SAND, ~10-20% MEDIUM GRAINED SAND, ~60-70% FINE GRAINED SAND, ~10% NON-PLASTIC FINES, DRY	
	4		10			SW	10YR 7/3	<b>WELL GRADED SAND (SW)</b> VERY PALE BROWN OVERALL, ~10-20% COARSE GRAINED SAND, ~20% MEDIUM GRAINED SAND, ~70% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED	
	5		15			ML	2.5Y 6/3	<b>SANDY SILT (ML)</b> LIGHT YELLOWISH BROWN OVERALL, ~20-30% FINE GRAINED SAND, ~70% NON-PLASTIC FINES, CEMENTED, BRITTLE, AND FRIABLE; BREAKS INTO SUBHORIZONTAL CHIPS	
	4		20	Bentonite-Cement Grout		ML	2.5Y 5/4 10YR 8/1	<b>SANDY SILT (ML)</b> LIGHT OLIVE BROWN AND WHITE, ~40% COARSE GRAINED SAND TO MEDIUM GRAINED SAND WHITE FELDSPAR AND QUARTZ; ~60% LIGHT OLIVE BROWN SILT MATRIX, VERY STIFF, NO PLASTICITY, DRY	
	5		25	Blank Casing		SW	10YR 6/3 10YR 5/8	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> PALE BROWN OVERALL WITH YELLOWISH BROWN STREAKS, ~20% GRAVEL, ~20% COARSE GRAINED SAND (MAINLY WHITE FELDSPAR), ~30% MEDIUM GRAINED SAND (INC. SOME MICAS), ~30% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED	
	4		30			SM	2.5Y 6/3 10YR 5/8	23 FT. SOME SUBHORIZONTAL COLOR BANDING <b>SILTY SAND (SM)</b> LIGHT YELLOWISH BROWN AND YELLOWISH BROWN BANDING, ~80% FINE GRAINED SAND INC. MICAS, ~20% NON-PLASTIC FINES, DRY	
	4.5		35			SW	10YR 6/3 10YR 5/8	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> PALE BROWN OVERALL WITH YELLOWISH BROWN STREAKS, ~20% GRAVEL, ~20% COARSE GRAINED SAND (MAINLY WHITE FELDSPAR), ~30% MEDIUM GRAINED SAND (INC. SOME MICAS), ~30% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED	

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Project Name			Valley Water Management Co.			Project Number			1365027.00			Well Name			RTH#6		
SAMPLES			WELL CONSTRUCTION			USCS Log	Lithology	Color	SAMPLE DESCRIPTION and DRILLING REMARKS								
Type & No.	Recovery (Feet)	Penetr. Resist. Blows/6"	Drill Depth (Feet)														
	4					SM		2.5Y 6/3	<b>SILTY SAND (SM)</b> LIGHT YELLOWISH BROWN AND WHITE, ~15% WHITE MEDIUM GRAINED SAND FELDSPAR, ~70% LIGHT YELLOWISH BROWN FINE GRAINED SAND, ~15% NON-PLASTIC FINES, MOIST?								
	5		40			SW		10YR 6/3 10YR 5/8	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> PALE BROWN OVERALL WITH YELLOWISH BROWN STREAKS, ~20% GRAVEL, ~20% COARSE GRAINED SAND (MAINLY WHITE FELDSPAR), ~30% MEDIUM GRAINED SAND (INC. SOME MICAS), ~30% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED								
	5		45			SM		2.5Y 6/3	<b>SILTY SAND OR SILTY SAND WITH CLAY (SM)</b> LIGHT YELLOWISH BROWN OVERALL, ~80% FINE GRAINED SAND INC. MICA, ~20% SILT AND SOME CLAY, VERY STIFF/DENSE, NO TO LOW PLASTICITY								
	5		50			ML		2.5Y 6/3	<b>SILTY SAND (SM)</b> LIGHT OLIVE BROWN AND WHITE, ~80% FINE GRAINED SAND INC. MICA, ~20% NON-PLASTIC FINES, BRITTLE AND BREAKS INTO SUBHORIZONTAL CHIPS								
	4.5		55			ML		2.5Y 5/3	<b>SANDY SILT (ML)</b> LIGHT YELLOWISH BROWN OVERALL, ~10% SCATTERED WHITE MEDIUM GRAINED SAND, ~20-30% SCATTERED FINE GRAINED SAND, ~60% NON-PLASTIC FINES AND POSS. CLAY, VERY STIFF, NO PLASTICITY, DRY								
	4.5		60	Bentonite-Cement Grout		ML		2.5Y 6/3	<b>SILT TO SANDY SILT (ML)</b> LIGHT OLIVE BROWN OVERALL, ~5-10% FINE GRAINED SAND, ~80-90% SILT, VERY STIFF AND BRITTLE								
	4.5		65			SM		2.5Y 6/2 2.5Y 7/2	<b>SANDY SILT (ML)</b> LIGHT YELLOWISH BROWN OVERALL, ~10-20% SCATTERED WHITE AND BLACK MEDIUM GRAINED SAND, ~80% NON-PLASTIC FINES, VERY STIFF, NO PLASTICITY								
	4		70	Blank Casing		SW		2.5Y 6/2	<b>SILTY SAND (SM)</b> LIGHT BROWNISH GRAY TO LIGHT BROWN, ~60% FINE GRAINED SAND INC. MICAS, ~40-20% NON-PLASTIC FINES, MOIST TO DRY								
	4		75			SM		2.5Y 5/3	<b>WELL GRADED SAND (SW)</b> LIGHT BROWNISH GRAY OVERALL, ~20% COARSE GRAINED SAND, ~40% MEDIUM GRAINED SAND, ~40% FINE GRAINED SAND, VERY DENSE, DRY								
	3.5		80			SW		2.5Y 7/2 2.5Y 5/8 10YR 8/1	<b>SILTY SAND (SM)</b> LIGHT OLIVE BROWN AND WHITE, ~40% WHITE COARSE GRAINED SAND - MEDIUM GRAINED SAND FELSPAR AND QUARTZ; ~60% LIGHT OLIVE BROWN FINE GRAINED SAND AND NON-PLASTIC FINES								
	3.5		85			SW		2.5Y 7/2 2.5Y 5/8 10YR 8/1	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> LIGHT GRAY WITH OLIVE YELLOW STAINS AND BLACK AND WHITE GRAINS, ~10% GRAVEL, ~20% COARSE GRAINED SAND, ~60% MEDIUM GRAINED SAND, ~10-20% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED								
	5		90			SM		2.5Y 6/3 2.5Y 6/8	<b>SILTY SAND (SM)</b> LIGHT YELLOWISH BROWN OVERALL WITH SOME SUBHORIZONTAL BANDING AND OLIVE YELLOW STAINING, ~80-90% FINE GRAINED SAND, ~10-20% NON-PLASTIC FINES								
	5		95			SM		2.5Y 5/3	<b>SILTY SAND (SM)</b> LIGHT OLIVE BROWN AND WHITE,								

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SAMPLES			Drill Depth (Feet)	WELL CONSTRUCTION			USCS Log	Lithology	Color	SAMPLE DESCRIPTION and DRILLING REMARKS							
Type & No.	Recovery (Feet)	Penetr. Resist. Blows/6"															
	4		85				SW	2.5Y 7/2 2.5Y 5/8 10YR 8/1	~40% WHITE COARSE GRAINED SAND - MEDIUM GRAINED SAND FELDSPAR AND QUARTZ; ~60% LIGHT OLIVE BROWN FINE GRAINED SAND AND NON-PLASTIC FINES  <b>WELL GRADED SAND WITH GRAVEL (SW)</b> LIGHT GRAY WITH OLIVE YELLOW STAINS AND BLACK AND WHITE GRAINS, ~10% GRAVEL, ~20% COARSE GRAINED SAND, ~60% MEDIUM GRAINED SAND, ~10-20% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED								
	3		90	Bentonite-Cement Grout			SM	2.5Y 5/2	<b>SILTY SAND (SM)</b> GRAYISH BROWN AND WHITE, ~20% WHITE COARSE GRAINED SAND - MEDIUM GRAINED SAND FELDSPAR AND QUARTZ; ~40-60% GB FINE GRAINED SAND AND ~40% GB NON-PLASTIC FINES								
	4		95	Blank Casing			SW	2.5Y 7/2 10YR 8/1	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> LIGHT GRAY WITH BLACK AND WHITE GRAINS, ~10% GRAVEL, ~20% COARSE GRAINED SAND, ~60% MEDIUM GRAINED SAND, ~10-20% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED								
	4.5		100				SM	2.5Y 5/2	<b>SILTY SAND (SM)</b> GRAYISH BROWN OVERALL, TRACE COARSE GRAINED SAND, ~10-20% MEDIUM GRAINED SAND, ~70% FINE GRAINED SAND, ~20% NON-PLASTIC FINES, VERY DENSE, DRY								
	4		105				SW	2.5Y 7/2 10YR 8/1	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> LIGHT GRAY WITH BLACK AND WHITE GRAINS, <10% GRAVEL, ~20% COARSE GRAINED SAND, ~60% MEDIUM GRAINED SAND, ~10-20% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED								
	4		110	Bentonite Seal			SW	2.5Y 7/2 10YR 8/1									
	3		115	Filter Pack			SW	2.5Y 6/2	<b>WELL GRADED SAND WITH SILT (SW)</b> LIGHT BROWNISH GRAY OVERALL, TRACE GRAVEL, TRACE COARSE GRAINED SAND, ~10-20 MEDIUM GRAINED SAND, ~70% FINE GRAINED SAND, ~10% NON-PLASTIC FINES, VERY DENSE, DRY								
	3		120	Slotted Screen			SW	2.5Y 7/2 10YR 8/1	<b>WELL GRADED SAND WITH GRAVEL (SW)</b> LIGHT GRAY WITH BLACK AND WHITE GRAINS, ~10% GRAVEL, ~20% COARSE GRAINED SAND, ~60% MEDIUM GRAINED SAND, ~10-20% FINE GRAINED SAND, VERY DENSE AND CONSOLIDATED								
	1		125	DTW: 120.31 ft. TOC, 12/22/14 First Encountered Water			SW		120-125 FT. DRILL WITHOUT SAMPLING DUE TO DENSITY AND GRAVEL BLOCKAGE 125 FT. AFTER LUNCH BREAK SOUND WATER LEVEL AT 123 FT. BGS								

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SAMPLES			Drill Depth (Feet)	WELL CONSTRUCTION		USCS Log	Lithology	Color	SAMPLE DESCRIPTION and DRILLING REMARKS								
Type & No.	Recovery (Feet)	Penetr. Resist. Blows/6"															
	3		130						<b>WELL GRADED SAND WITH GRAVEL</b> CONT'D								
	3		135	Filter Pack		SW		2.5Y 7/2 10YR 8/1	125-130 FT. SAMPLER BARREL IS WET								
	No core		140	Slotted Screen					135-140 FT. DRILL WITHOUT SAMPLING DUE TO DENSITY AND GRAVEL BLOCKAGE								
	3		145					2.5Y 6/2 10YR 8/1	140 FT. COLOR CHANGES TO LIGHT BROWNISH GRAY WITH WHITE AND BLACK GRAINS								

**NOTES**

1. ALL CONTACTS APPROXIMATE
2. BGS: BELOW GROUND SURFACE
3. COLOR DESIGNATION IN ACCORDANCE WITH THE MUNSELL SOIL COLOR CHARTS (KOLLMORGEN INSTRUMENTS CORPORATION, 1990)
4. SOIL CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM, ASTM D-2488-93

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