FINAL

SECOND PHASE ENVIRONMENTAL INVESTIGATION
EL DORADO REFINERY
EL DORADO, KANSAS

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ACRONYMS

BGS	below ground surface
COCs	constituents of concerns
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
HASP	Health and Safety Plan
IDW	investigation-derived waste
KDHE	Kansas Department of Health and Environment
LNAPL	Light Nonaqueous Phase Liquid
MCLs	EPA Primary Drinking Water Maximum Contaminant Levels
µg/L	micrograms per liter
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
NGVD	National Geodetic Vertical Datum, 1929
PID	photo-ionization detector
PPE	personal protection equipment
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
SOP	standard operating procedure
USCS	Unified Soil Classification System
VOCs	volatile organic compounds

1.0 INTRODUCTION

This report presents the results of the Second Phase Environmental Investigation conducted at the El Paso Merchant Energy-Petroleum Company (EPMEPC) El Dorado Refinery located in El Dorado, Kansas (Site). The activities conducted during this investigation were proposed in the *Final Work Plan for Phase II Environmental Investigation, El Dorado Refinery, El Dorado, Kansas, February 2005 (Work Plan).* This investigation (Second Phase Investigation) was a follow-up to the first phase investigation which was discussed in the document entitled: *First Phase Comprehensive Investigation Report for the Coastal El Dorado Refinery, El Dorado, Kansas, Prepared by Brown & Caldwell and Shaw Environmental, Inc., January 22, 2004* (First Phase Report) (Shaw, 2004). The scope-of-work for the Second Phase Investigation was developed based on a review of the results presented in the First Phase Report. In addition, the proposed approach for the investigation was agreed upon during a meeting between representatives of El Paso Corporation and Kansas Department of Health and Environment (KDHE) conducted on August 31, 2004.

The goals of this Second Phase Investigation were to identify and evaluate potential contaminant migration pathways and potential receptors at the downgradient boundary of the Site. The ultimate goal of the investigation was to identify the need for possible Interim Measures that might be necessary to protect potential off-Site receptors.

The Site is currently undergoing demolition during which major structures and associated piping have been or will be decontaminated, demolished, and then removed from the Site. After demolition, potential source areas for soil and groundwater impacts will be much more accessible for future investigative work. After reviewing the results of the Second Phase Investigation and at the completion of the Site demolition, El Paso will work closely with KDHE to determine any appropriate future evaluations and actions that may be necessary for the Site.

2.0 SITE BACKGROUND

2.1 SITE AND VICINITY DESCRIPTION

The Site is located to the north of the City of El Dorado, Kansas. The Site is located in portions of Sections 26, 27, and 34, Township 25 South, Range 5 East, Butler County, Kansas. The Site location is shown on the topographic map on Figure 1. The Site includes the former refinery (referred to herein as the Main Process Area), vacant property to the west (referred to herein as the Asphalt Handing Area), wastewater/stormwater ponds to the east, and the former tank farm located due south of the refinery (referred to herein as the South Tank Farm Area). The Site does not include the adjacent Pester Burn Pond Superfund site, which is located north of the wastewater/stormwater ponds. A Site layout map is shown on Figure 2.

2.2 SITE HISTORY

The El Dorado Refinery was constructed in 1917 for the Pester Refining Company (Pester). Petro Atlas purchased the refinery in 1958, and within six months, sold the refinery to American Petrofina Oil and Chemical Company (Fina). Fina owned the refinery and surrounding property between 1958 and 1977. In 1977, Pester purchased the property from Fina and continued to operate the refinery until filing Chapter 11 bankruptcy on February 25, 1985. The crude unit and most of the other operational units were shut down in March 1985.

On April 10, 1986, Coastal Derby Refining Company purchased the land and equipment at the refinery from Pester, excluding the burn pond. At that time, the major process units at the refinery included crude oil distillation, hydrodesulfurization, catalytic reforming, fluid catalytic cracking, hydrofluoric (HF) alkylation, and Residual Oil Supercritical Extraction (ROSE). The refinery produced regular and unleaded gasoline, #2 fuel oil, #6 fuel oil, propane, and asphalt.

In 2001, El Paso Corporation completed a merger with Coastal Corporation. An asphalt blending facility was operated at the Site until September 2004. El Paso currently operates a wastewater/stormwater treatment facility at the Site.

2.3 CURRENT SITE CONDITIONS

Decontamination and demolition activities are currently taking place at the Site. Decontamination of piping and equipment in the process units has been completed. Decontamination of the piping in the former South Tank Farm Area of the refinery is currently underway. Tank decontamination within the refinery is not yet complete. Several of the major structures have been disassembled/demolished, and removed from the Site. These structures include the ROSE, Crude, HF, and GasCon units. The boiler and boiler building have also been removed.

Structures currently remaining at the Site include the Fluid Catalytic Cracker (FCC) unit and the Platformer, located west of the FCC. The cooling tower near the Marley Pond is still in place. There are also some boilers/heaters remaining. Piping in overhead racks is still intact and there are several tanks and buildings still erected throughout the Site.

The wastewater/stormwater treatment facility is still in operation at the Site. This system consists of a stormwater pond, an API separator, an Induced Air Flotation (IAF) unit, three holding ponds, equalization basin, a complete mix activated sludge (CMAS) basin, a clarifier, three aeration basins, and a polishing pond.

There are two discharge points from the treatment facility. The regular discharge point is designated as “Outfall 001” and is located to the east of the northeastern-most wastewater/stormwater pond. An alternate discharge point, designated as “Outfall 002” is located at the third holding pond (the southeastern-most pond). Water is treated in the wastewater/stormwater treatment facility and discharged via Outfall 001 into the West Branch Walnut River under NPDES Permit #WA-09-P001.

2.4 PROJECT HISTORY

Previous investigations at the Site began in 1986 when Sunbelt Environmental Management, Inc. (Sunbelt) of Oklahoma City, Oklahoma was retained by Pester. Pester retained Sunbelt to perform a Site investigation and field study of their production facilities for the KDHE. Results of this investigation/study are presented in the report entitled: "*Preliminary Field Summary for Investigation of The Pester Refining Company at El Dorado, Kansas, prepared by Sunbelt Environmental Management, Inc. and Mid West Analytical Labs, Inc., March 1987.*"

In response to Consent Order Number 03-E0021 between EPC and the KDHE, Shaw Environmental, Inc. and Brown & Caldwell were retained to perform a comprehensive investigation (CI) for the Site. The results of this CI are presented in the report entitled: "*First Phase Comprehensive Investigation Report for the Coastal El Dorado Refinery, El Dorado, Kansas, Prepared by Brown & Caldwell and Shaw Environmental, Inc., January 22, 2004*." (First Phase Report).

MWH was retained be El Paso Corporation in August 2004 to prepare a Work Plan for the Second Phase Investigation. The Work Plan was approved by the KDHE on March 22, 2005.

2.5 DESCRIPTION OF REGIONAL PHYSICAL CHARACTERISTICS

2.5.1 Surface Features

The Site is located in the Flint Hills physiographic province. The topography of the region is characterized by gently rolling, flat topped hills, where erosion resistant cherty limestone is present near the ground surface. The ground surface at the Site slopes gently from the uplands on the west side of the Site toward the West Branch Walnut River, which bounds the northeastern portion of the Site. Ground surface elevations at the Site range from approximately 1350 feet above the 1929 National Geodetic Vertical Datum (NGVD) in the uplands at the northwest portion of the Site, to approximately 1280 feet above the NGVD east of the Site and adjacent to the West Branch Walnut River.

The northeast portion of the Site is bounded to the east by the West Branch Walnut River and to the north by the Pester Burn Pond Superfund site. The central and southern portions of the Site are bounded to the east by Topeka Street and by railroad and residential properties. Vacant land bounds the Site to the north and west. Residential and railroad properties are located to the south of the Site. A Union Tank Car facility is located to the south of the wastewater/stormwater ponds.

2.5.2 Surface Water

The West Branch Walnut River abuts the northeastern portion of the Site. The streambed is composed of silt, sand, and gravel overlying bedrock, with an average bank height of approximately 15 feet (KFFGC, 1978). An unnamed intermittent drainage crosses the South Tank Farm Area and flows into the West Branch Walnut River approximately 1,800 feet east of the Site. A series of wastewater/stormwater treatment ponds are located at the northeastern portion of the Site. Water is treated in the ponds and then discharged via an outfall into the West Branch Walnut River under NPDES Permit #WA-09-P001.

Groundwater springs are present at the central part of the refinery, at the base of the catalytic cracking unit (CC spring) and to the east of the Pester Ponds, adjacent to the West Branch Walnut River (Pester Spring).

2.5.3 Regional Geology

The Site is underlain by Lower Permian Age bedrock units of the Chase Group, which are comprised of layers of limestone, cherty limestone, dolomitic limestone, dolomite, cherty limestone, and shale (Aber, 1991). A regional stratigraphic section is presented on Figure 3.

The uplands around El Dorado consist of the Doyle Shale Formation and the Barnestone Limestone Formation. The Townada Limestone and Holmesville Shale Members of the Doyle Shale Formation are present in the Site vicinity (Zeller, 1968). Underlying the

Doyle Shale Formation is the Barnestone Limestone Formation, which is comprised of the Fort Riley Limestone, Oketo Shale, and the Florence Limestone Members. Underlying the Barnestone Limestone Formation is the Blue Springs Shale Member of the Matfield Shale.

Valley sediments consist primarily of clay, silt, sand, and gravel, in which poorly developed paleo-soils are present a few feet below the modern surface (Aber 1991). Modern soils tend to be thick, heavy, and poorly drained in the river valleys, but tend to be thin, variable, and permeable in the uplands. Sediments deposited along the West Branch Walnut River and its tributaries consist mainly of locally derived material, including pebbles of limestone and chert (Leonard, 1972).

A total of 23 anticlines and synclines with surface expression have been identified in Butler County. Large-scale regional tectonic features significantly influence much of the topography of the Butler County Area.

2.5.4 Regional Hydrogeology

Groundwater is readily available in most areas of the Flint Hills region (Aber, 2004). The principal aquifers in the region occur in the Nolands, Winfield, and Barneston Limestone. Sinkholes are common where these units crop out in uplands, and springs commonly emerge from these units in valleys and stream channels. However, according to Leonard (1972), a regional aquifer is not present in the Walnut River Basin. Instead, the small, shallow aquifers that do exist are discontinuous horizontally and vertically and are normally subject only to local recharge. These shallow, thin aquifers are typically formed as the result of weathered bedrock and/or flood plain deposits and are typically not used as a source of groundwater. Groundwater in the Walnut River Basin aquifers typically contains elevated levels of sulfate and chloride (USDA, 1975). The USGS also noted that concentrations of dissolved solids, nitrate, sulfate, and chloride in most of the sampled groundwater of the Walnut River Basin exceed recommended standards for drinking water.

The location and status of water wells within a ½ mile radius of the Site were evaluated as part of the Second Phase Investigation. The well search is discussed in Sections 3.5 and 4.4.1. The municipal water supply for the City of El Dorado is obtained from El Dorado Lake, which is located approximately 1½ miles east of the Site, across the West Branch Walnut River.

3.0 FIELD INVESTIGATION

3.1 INTRODUCTION

The goals of the Second Phase Investigation were to identify and evaluate potential contaminant migration pathways and potential receptors at the downgradient boundary of the Site. The ultimate goal of the investigation was to identify the need for possible Interim Measures that might be necessary to protect potential off-Site receptors.

This section presents a summary of the field investigations conducted as part of the Second Phase Investigation. Tasks conducted included geophysical testing, a water supply well survey, seep inspections, surface water sampling, installation of numerous monitoring wells, groundwater sampling, and slug testing of monitoring wells.

The following lithostratigraphic units have been identified beneath the Site: alluvium and bedrock residuum, Doyle Shale (including both the Townada Limestone and Holmesville Shale Members), the Barnestone Limestone Formation (comprised of the Fort Riley Limestone, Oketo Shale, and the Florence Limestone Members), and the Blue Springs Shale Member of the Matfield Shale. The Kansas Geological Survey Geologic Map of Butler County (KGS, 2000) indicates that the Doyle Shale underlies the majority of the Site and that alluvium is present along the West Branch Walnut River. Based on field observations, alluvium is present along the West Branch Walnut River. The Doyle Shale is interpreted to occur in upland areas at the northwest and southern areas of the Site based on the natural gamma logging performed in deep wells at the Site (discussed in Section 3.4). Despite the fact that very little shale has been described in boring logs in these areas, the interpreted location of the Doyle Shale (which includes a central limestone member) from the natural gamma logs is utilized in all discussions provided in this report. Monitoring wells at the Site have been grouped based on the interpreted lithostratigraphic unit in which they were screened. These well groupings include: alluvium and highly weathered bedrock residuum, the Doyle Shale (as interpreted from the natural gamma log), the Fort Riley Limestone, and the Florence Limestone. Data

from wells completed in the Doyle Shale are evaluated in two ways in this report; as a stand-alone data set, and in conjunction with data from the alluvial/weathered bedrock wells (collectively referred to as the Shallow System).

Investigation activities for the Second Phase Investigation were initiated on January 13, 2005 when MWH personnel inspected the banks of the West Branch Walnut River and the intermittent drainage that crosses the South Tank Farm Area. Investigation activities were completed on August 12, 2005 with the collection of the final groundwater samples. Each of the investigation tasks is discussed in detail in the following sections.

Specific objectives of the Second Phase Investigation included the following:

- Identification and characterization of contaminant migration pathways at the eastern (downgradient) boundary of the Site.
- Assessment of the geotechnical characteristics of the alluvium and weathered bedrock adjacent to the West Branch Walnut River.
- Identification of possible water supply well locations within an approximately ½ mile radius of the Site.
- Evaluation of the lithology of the Barnestone Limestone (including the Fort Riley Limestone, Oketo Shale, and the Florence Limestone).
- Characterization of the general chemistry of the surface water and groundwater at the Site and evaluation of the source of hydrocarbons seeping into the West Branch Walnut River.
- Evaluation of groundwater contaminant levels in the alluvium and the Fort Riley Limestone at the northern portion of the Site.
- Assessment of the extent of free product in groundwater.
- Establishment of a groundwater sampling program to evaluate contaminant concentrations over time.

Tasks that were performed during the Second Phase Investigation included the following:

- Installation of three monitoring wells (OW-1, OW-2, and OW-39) upgradient of the Main Process Area of the refinery. These monitoring wells were installed to evaluate the condition of the shallow groundwater upgradient of the Main Process Area at the Site.
- Installation of eight shallow (alluvium/residuum) monitoring wells around the wastewater/stormwater ponds, adjacent to the West Branch Walnut River (monitoring wells OW-27T, OW-28T, OW-29, OW-30, OW-31, OW-32, OW-33, OW-36). These monitoring wells are depicted on Figure 2. These wells are being utilized to assess the groundwater contaminant concentrations and flow directions in the vicinity of the stormwater/wastewater ponds.
- Installation of 14 shallow monitoring wells (OW-13, OW-14, OW-16, OW-18T, OW-19T, OW-21, OW-22T, OW 23T, OW-24, OW-25, OW-26, OW-35, OW-37, and OW-38) within the Main Process Area of the refinery. These wells were installed to evaluate the extent and likely source areas of groundwater contaminants and light non-aqueous phase liquid (LNAPL).
- Installation of two shallow monitoring wells (OW-08 and OW-09) downgradient and one shallow monitoring well (OW-07) upgradient of monitoring well N6-1 in the South Tank Farm Area. These wells were installed to evaluate the extent of hydrocarbon impacts in the groundwater in this area.
- Installation of three shallow monitoring wells (OW-10, OW-11, and OW-12) in the vicinity of monitoring well N5-3 in the southeast portion of the South Tank Farm Area. These monitoring wells were installed to evaluate the source of hydrocarbon impacts in groundwater in this area.
- Installation of four monitoring wells (OW-03, OW-04, OW-05, and OW-06) in the competent portion of the Fort Riley Limestone. These wells are being used to evaluate potential contaminant levels in the competent portion of the unit. Monitoring wells OW-03, OW-04, and OW-05 were installed adjacent to the West Branch Walnut River near identified seep locations. Monitoring well OW-06 was installed adjacent to well N5-3 in the South Tank Farm Area. All of the wells were

installed adjacent to shallow monitoring wells in order to evaluate the relationship between the different water-bearing zones.

- Conducted natural gamma geophysical testing in the four deepest monitoring wells at the Site. (N3-1, W-01D, W-15D, and W-29D). Geophysical testing was conducted to evaluate subsurface lithology and to assess the possible presence of the Oketo Shale.
- Collection of geotechnical data from borings drilled for installation of monitoring wells OW-03, OW-31, and OW-33.
- Slug testing in selected groundwater monitoring wells to evaluate horizontal hydraulic conductivities.
- Installation of staff gauges within the West Branch Walnut River.
- Analysis of surface water and groundwater samples for general chemistry parameters to assess the potential source and migration pathways of groundwater.
- Sampling and analysis of groundwater samples for Skinner List Parameters in order to evaluate the nature and extent of contaminants.

3.2 SEEP INSPECTIONS

On January 13, 2005, MWH personnel inspected the banks of the West Branch Walnut River and the intermittent drainage located at the southern portion of the Site. Several hydrocarbon seeps were observed on the western bank of the West Branch Walnut River and one hydrocarbon seep was observed on the south bank of the intermittent drainage that crosses the South Tank Farm Area. These seep locations were also observed during inspections conducted in April, July, and August 2005. Observed seep locations are shown on Figure 4.

3.3 STAFF GAUGE INSTALLATION AND SURFACE WATER SAMPLING

Staff gauges were installed at the Site on April 20, 2005 in the locations shown on Figure 4. However, prior to the Site-wide monitoring event conducted on June 14, 2005, two of the staff gauges on the West Branch Walnut River were washed away during a flood. During the Site-wide monitoring on June 14, 2005, surface water levels were noted at the

two remaining staff gauges, in the wastewater/stormwater ponds (based on surveyed reference points), in the intermittent creek (water levels measured by a Kansas-certified surveyor), and in all groundwater monitoring wells at the Site. These data are discussed in Section 4.4.2.1.

As part of the Second Phase Investigation, surface water samples were collected upstream and downstream of the Site, and adjacent to the primary seep location. Surface water was sampled from both the West Branch Walnut River and the intermittent drainage that crosses the South Tank Farm Area. Surface water sample locations are depicted on Figure 4. Surface water samples were also collected from the Marley Pond (adjacent to the cooling tower at the east side of the Main Process Area), from the wastewater/stormwater ponds, and from the spring emanating from the base of the catalytic cracking unit (CC Spring). The ponds were sampled and analyzed in order to evaluate the relationship between surface water and groundwater in the northern portion of the Site. These surface water sample locations are also depicted on Figure 4.

3.3.1 Deviations from the Work Plan

Two of the staff gauges installed within the West Branch Walnut River were destroyed during a flood prior to the second quarter Site-wide water level monitoring event. Deviations from the Work Plan during the collection of surface water samples in the West Branch Walnut Creek included the use of the equal-width-increment (EWI) method for determining streamflow, as opposed to the equal-discharge-increment (EDI) method. In addition, the sample point for each transect was chosen based on the highest discharge point along the transect, as opposed to the point representing 25% of the total cumulative flow as specified in the Work Plan.

3.4 GEOPHYSICAL LOGGING

Geophysical logging was performed in monitoring wells that are completed in the four deepest wells at the Site (N3-1, W-01D, W-15D, and W-29D). Natural gamma testing was performed in the wells in order to evaluate subsurface lithology. In addition, the data

from the geophysical survey was utilized to evaluate the possible presence of the Oketo Shale beneath the Fort Riley Limestone. The Oketo Shale is reported to be locally absent; however, a geophysical survey at a neighboring property reportedly indicated the presence of the Oketo Shale.

Borehole geophysical logging was performed in the four deepest monitoring wells at the Site on March 3, 2005. Geophysical work was performed by Frontier Logging, Inc., and included natural gamma logging.

Geophysical logging was performed using a truck-mounted logging system. The logging tool and cable were decontaminated prior to use and upon completion of logging each well using methods described in the Work Plan.

3.5 WATER SUPPLY WELL SURVEY

A field survey was conducted to evaluate the potential presence of water supply wells in the vicinity of the Site. The survey consisted of a review of publicly available records of wells within a ½-mile radius of the Site and a visual inspection of properties adjoining the Site. The survey area, extending ½ mile in all directions from the Site property boundary, is shown on Figure 5. A summary of water wells in the Site vicinity is presented on Table 1.

The records review was performed using well records available through the Kansas Geological Survey (KGS) website. Based on discussions with City of El Dorado officials, the city exercises no authority governing construction or use of private wells within city limits, and maintains no records of wells. In addition, a request was made to the City of El Dorado to provide residential water use records for the city. However, city personnel stated that they could not release this information to the public. The well records search included portions of Sections 26, 27, 34, and 35 of Township 25S, Range 5E. The results of the well search are discussed in Section 4.4.1.

3.6 XRF SCREENING

An x-ray fluorescence (XRF) spectrometer was utilized to screen metal concentrations in surficial soils at the Site. The objective of the investigation was to identify potential areas of elevated metal concentrations in surface soils to protect surface water around the Site. Metal concentration data will be utilized when planning storm water control measures. Although this evaluation was not part of the scope of the Work Plan for the Second Phase Investigation, it is included in Appendix A for reference and is summarized in Section 4.1.

3.7 SOIL BORINGS AND SHALLOW MONITORING WELL INSTALLATION

3.7.1 Soil Borings and Shallow Monitoring Well Installation

Thirty-one shallow monitoring wells were installed at the Site. These shallow monitoring wells were installed within the alluvium and weathered bedrock overlying the competent portion of the Fort Riley Limestone. Due to the ongoing refinery demolition, six of the wells located within the Main Process Area were installed as temporary wells.

A hollow-stem auger rig was utilized to advance the borings within the unconsolidated material and into the weathered portion of the Fort Riley Limestone. Soil samples were continuously collected using a split barrel sampling system. Soils were logged in accordance with the Unified Soil Classification System (USCS) protocol by an MWH hydrogeologist. Boring logs for each of the wells are included in Appendix B.

Borings for proposed monitoring well locations OW-15 and OW-20 did not yield groundwater. Therefore, these two borings were not completed as monitoring wells and were backfilled with hydrated bentonite chips in accordance with State regulations.

Proposed monitoring wells OW-17 and OW-34 were not installed due to the close proximity of the demolition activities taking place at the Site.

Soil headspace gas was monitored in the field from ground surface to total boring depths using a photo-ionization detector (PID). Each sample core was split down the middle. Half of the core was then divided into 1-foot and 2-foot composites, which were placed into zip lock bags. The zip-lock bags were then allowed to sit at ambient temperature for a minimum of 20 minutes (or in the field vehicle near the heater during the cold weather). The bagged samples were then screened with the PID that had been calibrated to an isobutylene standard. Procedures for drilling and soil description are presented in the Work Plan. PID data are shown on the boring logs in Appendix B.

All shallow monitoring wells were constructed of 2-inch, Schedule 40 PVC casing with 0.01 inch slotted screens, and were either 5, 10, or 15 feet in length, depending on where the competent portion of the Fort Riley Limestone was encountered. Monitoring wells OW-02, OW-07, OW-16, OW-18T, OW-19T, OW-21, and OW-35 were completed with 5-foot screened intervals. Monitoring wells OW-24, OW-25, OW-27T, and OW-37 were completed with 15-foot screened intervals. All other monitoring wells were completed with 10-foot screened intervals.

The well screens were extended across the groundwater table within the unconsolidated material and/or weathered Fort Riley Limestone. The PVC riser casings were extended from the top of the well screen to above the ground surface. The annular space between the borehole wall and the well screen was filled with 10/20 silica sand from the bottom of the borehole to approximately two feet above the top of the well screen. Approximately two feet of hydrated bentonite pellets or chips were placed above the sand. Bentonite pellets/chips were placed above the sand pack to the ground surface. A locking above ground protector was placed within a concrete pad at the top of the well. Specific monitoring well installation procedures were presented in the Work Plan. Monitoring well completion details are provided on Table 2.

Six of the shallow monitoring wells were installed as temporary monitoring wells. Monitoring wells OW-18T, OW-19T, OW-22T, OW-23T, OW-27T, and OW-28T were

installed as temporary wells due to their close proximity to the demolition activities and high traffic areas at the Site.

Once the data evaluation for the Second Phase Investigation has been completed, the temporary monitoring wells will be properly plugged and abandoned per State regulations.

3.7.2 Deviations from the Work Plan-Temporary Wells

Deviations from the Work Plan during the installation of the shallow monitoring wells included the length of well screens, modification of well completion procedures, and the installation of temporary monitoring wells. Well screens 15 feet in length were installed in monitoring wells OW-24, OW-25, OW-27T, and OW-37, while the Work Plan had called for screen lengths of 10 feet or less. In these wells, the groundwater table was encountered shallower than expected with respect to the thickness of unconsolidated material and the depth to competent bedrock. Thus, to achieve the goal of screening the well across the groundwater table as well into the weathered Fort Riley limestone, a longer well screen was required.

As previously stated, monitoring wells OW-18T, OW-19T, OW-22T, OW-23T, OW-27T, and OW-28T were installed as temporary wells due to their close proximity to the demolition activities and high traffic areas at the Site.

3.8 DEEP MONITORING WELL INSTALLATION

3.8.1 Surface Casing Installation

Four monitoring wells (OW-03, OW-04, OW-05, and OW-06) were installed within the competent portion of the Fort Riley Limestone. A truck-mounted, hollow-stem auger rig was utilized to advance borings through the unconsolidated material and into the upper five feet of the competent portion of the Fort Riley Limestone. As with the shallow monitoring wells, rock samples were continuously collected using a split barrel sampling

system. Soils were logged in accordance with the Unified Soil Classification System (USCS) protocol by an MWH hydrogeologist.

Conductor casings were installed prior to advancement of the boring into the competent portion of the Fort Riley Limestone. The conductor casings consisted of 8-inch diameter Schedule 80 PVC casing with a cap attached to the bottom. The conductor casings were installed from the ground surface to approximately 5 feet below the top of the Fort Riley Limestone (below any significant fractures or weathering within the Fort Riley Limestone). The conductor casing was then placed directly into the open hole. Any displaced fluids were collected for proper disposal. The conductor casings were cemented in place with cement grout, which was emplaced via a tremmie pipe from the bottom up. The cement grout was allowed to set up for at least 48 hours prior to additional drilling. Where necessary, clean, potable water was added to the inside of the conductor casing to hold it in place while the cement grout cured. All water was removed after the grout cured and prior to continued drilling.

3.8.2 Rock Coring

Once the cement grout cured, the borings were advanced through the center of the conductor casing. A truck-mounted, water rotary rig was utilized to advance the borings within the Fort Riley Limestone. Rock core samples were continuously collected within the Fort Riley Limestone using an NX core barrel. The core barrel and bit were attached to the drill string. The core barrel was lowered down the hole on the drill string and rotated. Clean, potable water was used during rock coring.

Rock samples were logged in accordance with the American Society for Testing and Materials (ASTM) protocol by an MWH hydrogeologist. Soil and rock headspace gas was monitored in the field from ground surface to total boring depths using a PID. Headspace testing was performed as described in the Work Plan. Specific procedures for drilling and rock description were presented in the Work Plan.

3.8.3 Deep Monitoring Well Installation

The results of the geophysical survey were utilized for initially targeting the total depth of each boring. The rock core of the Fort Riley Limestone was carefully evaluated during drilling in order to assess depth intervals containing significant fractures or secondary porosity. This information was used to determine where to place the well screens in the Fort Riley Limestone monitoring wells. Rock coring logs are included in Appendix B.

Once rock coring was complete, the core barrel was removed from the hole. The core hole was then reamed out with a tri-cone bit to provide an 8-inch diameter boring for monitoring well installation. After reaming and prior to well installation, the open borehole was bailed with a 4-inch steel bailer to remove fluids and cuttings from the borehole. Due to low yield, the boreholes were purged to near dryness prior to well installation.

Monitoring wells were constructed of 2-inch, Schedule 40 PVC casing. Each well screen was 10 feet in length and contained 0.01-inch slots. A well centralizer was placed at the base of the well screen. The PVC casing riser extended from the top of the well screen to above the ground surface. The annular space between the borehole wall and the well screen was filled with 10/20 silica sand from the bottom of the borehole to approximately two feet above the top of the well screen. Approximately two feet of hydrated bentonite chips were placed above the silica sand. Cement grout was placed above the bentonite chips to the ground surface. A locking aboveground protector was placed within a concrete pad at the top of the well. Specific monitoring well installation procedures were presented in the Work Plan.

3.8.4 Monitoring Well Development

All monitoring wells installed were developed using a submersible pump, clean, polyethylene bailer, or both. An attempt was made to recover all fluids lost during drilling. Field parameters of pH, specific conductivity, temperature, oxidation-reduction

potential (ORP), dissolved oxygen (DO), and turbidity were monitored during well development and sampling.

Well development was continued until a minimum of three borehole volumes had been removed from the well and the final three consecutive water quality parameters were stabilized as outlined in the Work Plan.

3.8.5 Deviations from the Work Plan

One deviation from the Work Plan was a change in the drilling method used to drill the deep Fort Riley Limestone monitoring wells. Air rotary drilling was initially proposed and attempted as the method to advance the borings into the competent portion of the Fort Riley Limestone. This method did not allow drill cuttings to return to the surface sufficiently. Therefore, the drilling method was changed to water rotary drilling methods. This method was successful in advancing the borings into the Fort Riley Limestone in order to install the deep monitoring wells.

Excess water was lost in the hole during the drilling of monitoring wells OW-05 and OW-39. The Work Plan states that at least three times the volume of water lost in the hole during drilling is to be removed before being considered properly developed. Effort was made to remove these volumes of water. However, due to the very low yield, these two monitoring wells went dry after approximately one to three gallons each time development was attempted. Therefore, these two wells were developed on a daily basis for approximately two weeks in order to adequately develop the wells. These wells were considered developed after being bailed dry at least four times and after water quality parameters had stabilized.

3.9 GROUNDWATER SAMPLING ACTIVITIES

Groundwater is monitored at the Site within the alluvium and weathered bedrock (collectively referred to as the Shallow System), the Fort Riley Limestone, and the Florence Limestone. Groundwater monitoring wells were also completed within the

Doyle Formation. However, because of the highly fractured, weathered nature of this formation, these wells are included as part of the Shallow System.

The monitoring wells that are screened within the Shallow System (alluvium, Doyle Formation, and weathered bedrock residuum) include: Fina/MW-38, N2-2, N2-3, N2-5, N2-6, N3-2, N3-3, N3-4, N5-3, W-01S, W-03, W-15S, W-16S, W-22, W-23, W-24, W-26, and W-29S. Groundwater present in the Shallow System is under water table conditions (unconfined). During the Second Phase Investigation, 31 additional shallow wells were installed (listed on Table 2).

The deep monitoring wells within the Site monitoring network are screened within the competent portions of the Fort Riley Limestone (N4-1 and W-29D) and the Florence Limestone (N3-1, W-01D, and W-15D).

As part of the Second Phase Investigation, the following monitoring wells were installed in the competent portion of the Fort Riley Limestone: OW-03, OW-04, OW-05 and OW-06. The groundwater encountered within the competent Fort Riley Limestone and Florence Limestone is under confined to semi-confined conditions.

Low-flow sampling techniques were attempted in all of the monitoring wells at the Site, with the exception of monitoring wells with insufficient water column, low yield, or containing light non-aqueous phase liquids (LNAPL). Not all monitoring wells at the Site were conducive to low-flow sampling techniques. All groundwater level and LNAPL measurement data are provided on Table 3. The subsections below present the sampling methodologies utilized for the collection of groundwater samples during the First Quarter 2005, Second Quarter 2005, and Second Phase Investigation sampling events. Field notes recorded during groundwater sampling events are presented in Appendix C. The groundwater sampling results are presented in Section 4.5. Fluid levels were measured in all wells prior to each sampling event. These data are presented on Table 3. Hydrographs of selected wells are presented in Appendix D. Maps of groundwater table and potentiometric surface elevations and LNAPL thickness measurements are included on Figures 6 through 14 and are discussed in Section 4.5.

3.9.1 First Quarter 2005 Sampling Event

With the exception of the four monitoring wells that had insufficient saturated thickness or a history of purging dry (N3-3, N4-3, W-22, and W-29S) and the three monitoring wells with LNAPL present (N2-5, N2-6, and N6-1), low-flow sampling techniques were attempted on the remaining monitoring wells within the Site-wide monitoring network.

Low-flow groundwater sampling was conducted using dedicated Teflon bladder pumps. The minimum volume purged from each well was equal to at least two times the volume of the tubing and the pump. Flow rates between 100 milliliters per minute (mL/min) and 400 mL/min were utilized during sampling.

Depth to water measurements were collected during purging procedures to monitor drawdown. No drawdown was observed in monitoring wells N3-4, N4-4, W-15S, and W-15D. For the remaining monitoring wells that were conducive to low-flow sampling techniques, the drawdown ranged from 0.01 foot in monitoring well N3-1 to 0.71 foot in monitoring well W-29D. The recommended drawdown of 0.33 foot was exceeded in monitoring well W-29D (0.71 foot), however, the decision was made to continue to low flow this monitoring well because groundwater samples collected in this manner are more representative of aquifer conditions then samples collected using traditional methods (purging to pump intake or bailing). Also, the groundwater level in this well at the time of sample collection was 49.43 feet above the top of the screen.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Purging continued until these measurements had stabilized. Once stabilization had occurred, the sample containers were filled, taking care to minimize volatilization during the collection of the VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

Four monitoring wells were not conducive to low-flow sampling techniques (monitoring wells N2-1, N2-4, N4-1, and W-08). The water levels in these monitoring wells could not be stabilized even at flow rates of less than or equal to 100 mL/min. In these cases, the water column was purged to the pump intake.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection. Care was taken to minimize any potential volatilization during the collection of the VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

Due to insufficient saturated thicknesses or a history of being purged dry, groundwater samples collected from monitoring wells N3-3, N4-3, W-22, and W-29S were purged and sampled utilizing bailer-sampling techniques. Each monitoring well that required bailing was purged and sampled with a new, clean, dedicated polyethylene bailer. The monitoring wells were bailed until at least three well volumes had been purged or the well bailed dry.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Monitoring well N3-3 was purged until three well volumes had been evacuated. Monitoring wells N4-3, W-22, and W-29S bailed dry before yielding three well volumes. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection.

Samples were collected by pouring the groundwater from the bailer, taking care to minimize potential volatilization during the collection of VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

3.9.2 Second Quarter 2005 Groundwater Sampling

With the exception of four monitoring wells that had insufficient saturated thickness or a history of purging dry (N3-3, N4-3, W-22, and W-29S) and the two monitoring wells with LNAPL present (N2-5 and N2-6), low-flow sampling techniques were attempted on the remaining monitoring wells within the Site-wide monitoring network.

Depth to water measurements were collected during purging procedures to monitor drawdown. No drawdown was observed in monitoring wells N2-2, N2-3, N6-1, and W-15S. For the remaining monitoring wells that were conducive to low-flow sampling

techniques, the drawdown ranged from 0.02 feet in monitoring well N3-2 to 2.11 feet in monitoring well W-29D. The recommended drawdown of 0.33 feet was exceeded in monitoring wells Fina/MW-38 (0.46 foot), N2-2 (0.46 foot), W-03 (0.38 feet), and W-29D (2.11 feet), however, the decision was made to continue to low flow these wells because the samples collected in this manner are more representative of aquifer conditions than samples collected using traditional methods (purging to pump intake or bailing).

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection. Care was taken to minimize any potential volatilization during the collection of the VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

Four monitoring wells were not conducive to low-flow sampling techniques (monitoring wells N2-1, N2-4, N4-1, and W-08). The water levels in these monitoring wells could not be stabilized even at flow rates of less than or equal to 100 mL/min. In these cases, the water column was purged to the pump intake and then allowed to stablize.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection. Care was taken to minimize any potential volatilization during the collection of the VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

Due to insufficient saturated thicknesses or a history of being purged dry, groundwater samples collected from monitoring wells N3-3, N4-3, W-22, and W-29S were purged and sampled utilizing bailer-sampling techniques. Monitoring well N3-3 was purged until three well volumes had been evacuated. Monitoring wells N4-3, W-22, and W-29S bailed dry before yielding three well volumes. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Monitoring well N3-3 was purged until three well volumes had been evacuated. Monitoring wells N4-3, W-22, and W-29S bailed dry before yielding three well volumes. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection.

Samples were collected by pouring the groundwater from the bailer, taking care to minimize potential volatilization during the collection of VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

3.9.3 Second Phase Investigation Groundwater Sampling

With the exception of monitoring wells that had insufficient saturated thicknesses or wells with very low groundwater recharge rates, low-flow sampling techniques were attempted on all of the newly installed monitoring wells at the Site.

Low-flow groundwater sampling was conducted using dedicated and non-dedicated Teflon bladder pumps. When utilizing non-dedicated pumps, the pumps were properly decontaminated as outlined in Appendix A of the Work Plan. Field blanks were collected from pumps following decontamination (one per day of sampling with non-dedicated pumps). The minimum volume purged from each well was equal to at least two times the volume of the tubing and the pump. Flow rates between 125 milliliters per minute (mL/min) and 500 mL/min were utilized during sampling.

Depth to water measurements were collected during purging procedures to monitor drawdown. No drawdown was observed in monitoring wells OW-01, OW-06, OW-07, OW-12, OW-24, OW-28T, OW-35, and OW-36. For the remaining monitoring wells that were conducive to low-flow sampling techniques, the maximum drawdowns ranged from 0.02 foot in monitoring well OW-31 to 0.32 foot in monitoring well OW-02. The recommended drawdown of 0.33 foot was not exceeded in any of the newly installed monitoring wells at the Site.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Purging continued until these measurements had

stabilized. Once stabilization had occurred, the sample containers were filled, taking care to minimize volatilization during the collection of the VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

Three monitoring wells were not conducive to low-flow sampling techniques (monitoring wells OW-08, OW-23T, and OW-26). The water levels in these monitoring wells could not be stabilized even at flow rates of less than or equal to 100 mL/min. In these cases, the water column was purged to the pump intake.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection. Care was taken to minimize any potential volatilization during the collection of the VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

Due to insufficient saturated thicknesses or very low groundwater recharge rates, groundwater samples collected from monitoring wells OW-03, OW-04, OW-05, OW-13, OW-14, OW-16, OW-19T, OW-29, OW-32, and OW-39were purged and sampled utilizing bailer-sampling techniques. Each monitoring well that required bailing was purged and sampled with a new, clean, dedicated polyethylene bailer. The monitoring wells were bailed until at least three well volumes had been purged or the well bailed dry.

Groundwater quality parameters (temperature, pH, conductivity, DO, ORP, and turbidity) were collected during purging. Monitoring wells OW-13 and OW-14 were purged until three well volumes had been evacuated. Monitoring wells OW-03, OW-04, OW-05, OW-16, OW-19T, OW-29, OW-32, and OW-39bailed dry before yielding three well volumes. Groundwater samples were collected after the water level had recovered sufficiently to produce enough volume for sample collection.

Samples were collected by pouring the groundwater from the bailer, taking care to minimize any potential volatilization during the collection of VOCs. Labeled samples were then immediately placed in a cooler containing ice for sample preservation.

3.9.4 Deviations from the Work Plan

The recommended drawdown of 0.33 feet was exceeded in monitoring well W-29D during the First Quarter 2005 Sampling Event, in monitoring wells Fina/MW-38 (0.46 feet), N2-2 (0.46 feet), W-03 (0.38 foot), and W-29D (2.11 feet) during the Second Quarter 2005 sampling event. However, as previously stated, the decision was made to continue to low flow these wells because the samples collected in this manner are more representative of aquifer conditions then samples collected using traditional methods (purging to pump intake or bailing).

3.10 SLUG TESTING

Clean, dedicated bailers, pressure transducers, and data loggers were utilized to conduct rising head slug tests in selected monitoring wells at the Site. Slug tests were performed in order to evaluate the horizontal hydraulic conductivity of water-bearing zones beneath the Site. The tests were performed in all of the monitoring wells along the eastern boundary of the Site as well as selected wells from other areas. The data for the slug tests are included in Appendix E and are summarized on Table 4.

3.10.1 Rising-Head Slug Tests

Sixty-two slug tests were performed at 32 on-Site wells from July 19, 2005 to July 27, 2005, to evaluate the horizontal hydraulic conductivity of water-bearing zones beneath the Site. Clean, dedicated bailers, pressure transducers, and a handheld portable computer were utilized to conduct the rising head slug tests. Only rising head slug tests were performed, as opposed to falling head slug tests as the majority of the wells are water table wells (i.e., screened across the water table). Slug tests were performed in twenty-three wells screened in the upper alluvium and weathered limestone, six wells screened in the Fort Riley limestone, and three wells screened in the Florence limestone. These wells included fourteen along the West Branch Walnut River, eight in the South Tank Farm Area, four in the Asphalt Handling Area, and six in and around the Main Process Area Displacement data were measured with an In-Situ mini Troll pressure transducer rated at 5 pounds per square inch (PSI) and a handheld portable computer equipped with Win-

Situ 4.0 software. Displacement was induced by removing a volume of water with a 0.75- or 1.5-inch diameter disposable polyethylene bailer, either 3- or 4-feet in length, from each test well. The length and diameter of bailer used in a given well was based on an analysis of the well logs, the screened formation, the diameter of the well, and the height of the water column in the well. Static water levels were measured prior to installing the pressure transducer and bailer. After stabilization of the groundwater level with the pressure transducer set, a depth to water from top of casing reference was set on the transducer, after which the bailer was lowered into the well. After the water level stabilized with both the pressure transducer and bailer set, the bailer was removed from the well and the test was initiated.

Displacement data collected by the pressure transducer were downloaded onto a computer using Win-Situ 4.0 software. The initial displacement height of water was determined based on the user-defined reference. With the exception of monitoring wells OW-03, OW-04, OW-05, OW-06, and W-29D, at least two rising head slug tests were performed in each well. Only one slug test was performed in monitoring wells OW-03, OW-04, OW-05, OW-06, and W-29D. The methods employed for conducting rising head slug tests followed the Work Plan.

3.10.2 Deviations from the Work Plan

There were no significant deviations from the Work Plan during the performance of the rising head slug tests.

3.11 LABORATORY TESTING

3.11.1 Analytical Testing

All groundwater samples collected during the First and Second Quarter 2005 Sampling Events were analyzed for benzene, toluene, ethylbenzene, total xylenes (BTEX), methyl tert-Butyl ether (MTBE), total petroleum hydrocarbons in the gasoline and diesel ranges (TPH-GRO and TPH-DRO, respectively), and metals (arsenic, barium, beryllium, cadmium, chromium, lead, magnesium, and nickel).

All of the surface water and groundwater samples collected during the Second Phase Investigation were analyzed for the 1997 EPA Skinner List parameters. In addition, all samples were analyzed for general chemistry parameters (alkalinity, chloride, nitrate, sulfate, etc.) in order to evaluate general water quality and to evaluate the relationship between surface water and groundwater, and groundwater flow paths. Specific analytical parameters and methods that were analyzed are listed in the Quality Assurance Project Plan (QAPP) in the Work Plan. Measurements of temperature, pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and specific conductivity were measured in the field during sampling.

All groundwater and surface water samples (with the exception of total chromium, trivalent chromium, and hexavalent chromium) were analyzed by Severn Trent Laboratory (STL) located in Pensacola, Florida. Due to a short holding time (24 hours) the analysis for total chromium and hexavalent chromium was conducted by Continental Analytical Services, Inc. (CAS) located in Salina, Kansas. Both STL and CAS are Kansas State certified laboratories. Procedures for sample handling and control, including chain-of-custody procedures, were presented in the Work Plan. Analyses were conducted in accordance with the procedures and methods specified in the Work Plan.

One field duplicate sample was collected for every twenty samples (i.e., a frequency of 5%). In addition, trip blanks were submitted with each ice chest containing water samples for volatile organic compounds (VOC) analysis. Field blanks were collected on a one per day basis whenever non-dedicated groundwater sampling equipment was used to collect groundwater samples.

Samples were also collected from selected wells and the groundwater spring at the CC Spring for additional analysis for stable isotopes oxygen-18 (^{18}O) and deuterium (^{2}H). The purpose of the analysis was to assess the relationship (if any) between the water-bearing zones beneath the Site and the groundwater spring at the Catalytic Cracking Unit (CC Spring). Samples collected for stable isotopic analysis were analyzed at Geochron Laboratory located in Cambridge, Massachusetts.

3.11.2 Geotechnical Testing

Representative samples were collected from the alluvium and the weathered bedrock adjacent to the West Branch Walnut River for geotechnical testing. Geotechnical testing that was performed included the following: sieve testing, dry bulk density, specific gravity, Atterberg limits, and shear strength. A hollow–stem auger was utilized to advance Shelby tube samplers for the geotechnical analyses. After collection, caps were placed on the ends of the Shelby tubes, and the samples were shipped to Geotechnical Services, Inc. (GSI), located in Wichita, Kansas, for testing. Physical test data are included in Appendix F and are summarized on Table 5.

4.0 FINDINGS AND DISCUSSION

4.1 XRF EVALUATION

An XRF spectrometer was utilized to screen metal concentrations in surficial soils at the Site. The objective of the investigation was to identify potential areas of elevated metal concentrations in surface soils to protect surface water around the Site. Metal concentration data will be utilized when planning storm water control measures. Although this evaluation was not part of the scope of work in the Work Plan for the Second Phase Investigation, it is included in Appendix A for reference.

The results of the XRF screening indicated the presence of potentially elevated chromium and lead levels in surficial soils at the Main Process Area and along the west side of the wastewater/stormwater pond berm. In addition, elevated arsenic levels were indicated in surficial soils at the Main Process Area and at the southern end of the South Tank Farm Area.

4.2 SURFACE WATER

4.2.1 Seep Inspections

Hydrocarbon seeps have been identified along the west bank of the West Branch Walnut River. The seeps were located with a global positioning system (GPS) unit and noted on a Site map, which is included on Figure 4. The locations of the seeps were observed during each quarterly event (conducted in April, July, and August 2005). The condition of the seeps was generally consistent during each observation. No new seeps were observed, and evidence of continuing product seepage and petroleum odors were reported.

A seep inspection was also conducted on August 30, 2005. However, a storm and unusually heavy rain had occurred during the week preceding the seep inspection, and had resulted in the river overflowing its banks. On the date of the inspection, the river was still several feet above the normal stage, which obscured the view of several seeps

and there was generally limited access. The riverbank in general was more saturated than in previous inspections. Therefore, at this time, no seeps or petroleum odors were noticeable in the areas where seeps had previously been observed.

4.2.2 Flow Measurement and Sample Results

Site reconnaissance for the surface water sampling was conducted by MWH field team members on May 31, 2005. Staff gauge readings for locations on the West Branch Walnut River were also collected in order to assess safe baseflow conditions for wading during flow measurement and sample collection. Surface water sampling was conducted at the Site from June 1 to June 9, 2005.

Surface water samples were analyzed for the Skinner List parameters discussed in Section 3.11. Analytical data are presented in Appendix G and are summarized in Tables 6 through 9. Analytical data detected above laboratory reporting limits are presented in Tables 10 through 12. Footnotes for the analytical summary tables are presented in Table 21.

4.2.2.1 West Branch Walnut River

As part of the Second Phase Investigation, surface water was sampled in the West Branch Walnut River at the locations shown on Figure 4. Samples were collected upstream and downstream of the Site, and adjacent to the primary seep location. Sampling and flow measurement transect locations are shown on Figure 4.

On June 7, 2005, discharge measurements were recorded and samples were collected from Transects #1 and #4 in the West Branch Walnut River. Sampling of the West Branch Walnut River was concluded on June 8, 2005 with the sampling of Transects #2 and #3. Discharge measurements made on June 2, 2005, for Transects #2 and #3 were used in determining sample point locations. All sampling Transects were safely waded during these activities, although a boat was utilized to carry sampling equipment for the

sampling of Transect #4 due to the steep banks and relatively deep water in comparison to the other transect locations.

Water quality parameters were collected (temperature, pH, conductivity, DO, ORP, and turbidity) prior to sample collection at several intervals along each transect. Discrete samples were collected from the locations representing the maximum total discharge determined by the transect flow measurement. Samples were collected at approximately one foot below the surface of the water using a Van Dorn thief sampler.

On June 14, 2005, it was observed that two of the staff gauges at Transects #2 and #3 had washed away after heavy rains hit the area on June 13, 2005. The staff gauge at Transect #1 was not damaged since it is permanently affixed to a large concrete structure. The staff gauge at Transect #4, which is positioned on the downstream side of a tree near the west bank of the river, also remained intact.

Volatile Organic Compounds

- No VOCs were detected above laboratory reporting limits in any of the surface water samples collected from the West Branch Walnut River.

Semi-Volatile Organic Compounds

- There were no Semi-Volatile Organic Compounds detected above laboratory reporting limits in any of the surface water samples collected from the West Branch Walnut River.

Total Petroleum Hydrocarbons

- There were no gasoline-range total petroleum hydrocarbons (TPH-GRO) detected above laboratory reporting limits in any of the surface water samples collected from the West Branch Walnut River.
- TPH in the C10-C28 range was detected above laboratory reporting limits in the sample collected from Transect #1 (23J µg/L). There are no surface water standards for total petroleum hydrocarbons.

- TPH in the C28-C35 range was detected above laboratory reporting limits in samples collected from Transect #1 (27J µg/L) and Transect #4 (38J µg/L). There are no surface water standards for total petroleum hydrocarbons.
- TPH above the C10 range was detected above laboratory reporting limits in samples collected from Transect #1 (55 µg/L) and Transect #4 (34 µg/L). There are no surface water standards for total petroleum hydrocarbons.

Metals

- Arsenic was detected above laboratory reporting limits in the sample collected from Transect #2 the West Branch Walnut River at a concentration of 0.005 mg/L. The Kansas Surface Water Quality Standard (SWQS) of 0.000018 mg/L for arsenic was exceeded in this sample.
- Barium was detected above laboratory reporting limits in all samples collected from the West Branch Walnut River at a concentration of 0.2 mg/L for each of the four Transects. The Kansas SWQS of 1.0 mg/L for barium was not exceeded.
- Calcium was detected above laboratory reporting limits in all samples collected from the West Branch Walnut River at concentrations ranging from 49 mg/L to 57 mg/L. The Kansas SWQS for calcium has not been established.
- Iron was detected above laboratory reporting limits in all samples collected from the West Branch Walnut River at concentrations ranging from 3.9 mg/L to 5.2 mg/L. The Kansas SWQS for iron has not been established.
- Lead was detected above laboratory reporting limits in 2 of the 4 samples collected from the West Branch Walnut River. Lead was detected above laboratory reporting limits in samples collected for Transect #1 and Transect #3 at concentrations of 0.0053 mg/L and 0.0051 mg/L, respectively. The Kansas SWQS of 0.015 mg/L for lead was not exceeded for either of these samples.
- Magnesium was detected above laboratory reporting in all samples collected from the West Branch Walnut River at concentrations ranging from 11 mg/L to 12 mg/L. The Kansas SWQS for magnesium has not been established.
- Manganese was detected above laboratory reporting in all samples collected from the West Branch Walnut River at concentrations ranging from 0.20 mg/L to 0.22 mg/L. The Kansas SWQS for manganese has not been established.

- Mercury was detected above laboratory reporting limits in all of the 4 samples collected from the West Branch Walnut River. Mercury was detected above laboratory reporting limits at concentrations of 0.00063 mg/L at Transect #1, 0.0014 mg/L at Transect #2, 0.0063J mg/L at Transect #3, and 0.0026 mg/L at Transect #4. The Kansas SWQS of 0.00014 mg/L for mercury was exceeded for each of these samples.
- Potassium was detected above laboratory reporting in all samples collected from the West Branch Walnut River at concentrations ranging from 4 mg/L to 4.4 mg/L. The Kansas SWQS for potassium has not been established.
- Sodium was detected above laboratory reporting in all samples collected from the West Branch Walnut River at concentrations ranging from 29 mg/L to 34J mg/L. The Kansas SWQS for sodium has not been established.
- Vanadium was detected above laboratory reporting in all samples collected from the West Branch Walnut River at concentrations ranging from 0.013 mg/L to 0.015 mg/L. The Kansas SWQS for vanadium has not been established.

General Chemistry

- The Kansas SWQS of 250 mg/L for chloride of was not exceeded in any of the surface water samples collected from the West Branch Walnut River. Chloride results for samples collected from the West Branch Walnut River ranged from 40 mg/L to 46J mg/L.
- The Kansas SWQS of 2.0 mg/L for fluoride was not exceeded in any of the surface water samples collected from the West Branch Walnut River. Fluoride results for the samples collected from the river ranged from 0.26 mg/L to 0.35 mg/L.
- The Kansas SWQS of 10 mg/L for nitrate was not exceeded in any of the surface water samples collected from the West Branch Walnut River. Nitrate results for the samples collected from the river ranged from 0.76 mg/L to 0.97 mg/L.
- The Kansas SWQS of 250 mg/L for sulfate was not exceeded in any of the surface water samples collected from the West Branch Walnut River. Sulfate results for the samples collected from the river ranged from 16 mg/L to 18 mg/L.

4.2.2.2 Intermittent Creek

As part of the Second Phase Investigation, surface water was sampled in the intermittent drainage that crosses the South Tank Farm Area at the locations shown on Figure 4. Samples from the intermittent drainage were collected on June 1, 2005. The three sample points along this unnamed creek located at the South Tank Farm Area were designated Transect #5, Transect #6, and Transect #7. Transect #5 is the furthest downgradient location along this drainage and is located approximately 75 feet west of Topeka Street near the eastern Site boundary. Transect #6 is located approximately 100 feet east of the road that crosses through the middle of the South field and terminates between Tanks 110 and 112. Transect #7 is the furthest upstream, western-most sample location along the intermittent drainage, about 100 feet upstream from a convergence point with another unnamed intermittent drainage. At this point the area becomes very marshy and the surface water is relatively stagnant. Discharge measurements were made along this intermittent drainage; however, flow was so minimal that it was undetected by the flow meter. Therefore, due to the shallow depths, samples were collected from the deepest point along each Transect with a bailer.

Volatile Organic Compounds

There were no VOCs detected above laboratory reporting limits in any of the surface water samples submitted from the Intermittent Creek.

Semi-Volatile Organic Compounds

Semi-Volatile Organic Compounds were not detected above laboratory reporting limits in any of the surface water samples collected from the Intermittent Creek.

Total Petroleum Hydrocarbons

- There were no TPH-GRO concentrations detected above laboratory reporting limits in any of the surface water samples collected from the Intermittent Creek.
- TPH in the C10-C28 range was detected above laboratory reporting limits in samples collected from Transect #5 (40 µg/L), Transect #6 (27 µg/L), and Transect #7 (60 µg/L). There are no surface water standards for total petroleum hydrocarbons.

- TPH in the C28-C35 range was detected above laboratory reporting limits in samples collected from Transect #5 (57 µg/L), Transect #6 (69 µg/L), and Transect #7 (81 µg/L). There are no surface water standards for total petroleum hydrocarbons.
- TPH above the C10 range was detected above laboratory reporting limits in samples collected from Transect #5 (95 µg/L), Transect #6 (91 µg/L), and Transect #7 (16 µg/L). There are no surface water standards for total petroleum hydrocarbons.

Metals

- Barium was detected above laboratory reporting limits in all samples collected from the Intermittent Creek at concentrations that ranged from 0.24 mg/L to 0.27 mg/L for each of the three Transects. The Kansas SWQS of 1.0 mg/L for barium was not exceeded.
- Calcium was detected above laboratory reporting limits in all samples collected from the Intermittent Creek at concentrations ranging from 110 mg/L to 120 mg/L. The Kansas SWQS for calcium has not been established.
- Iron was detected above laboratory reporting limits in all samples collected from the Intermittent Creek at concentrations ranging from 0.39 mg/L to 0.72 mg/L. The Kansas SWQS for iron has not been established.
- Magnesium was detected above laboratory reporting in all samples collected from the Intermittent Creek at concentrations ranging from 15 mg/L to 17 mg/L. The Kansas SWQS for magnesium has not been established.
- Manganese was detected above laboratory reporting in all samples collected from the Intermittent Creek at concentrations ranging from 0.22 mg/L to 0.26 mg/L. The Kansas SWQS for manganese has not been established.
- Potassium was detected above laboratory reporting in all samples collected from the Intermittent Creek at concentrations ranging from 2.5 mg/L to 3.2 mg/L. The Kansas SWQS for potassium has not been established.
- Sodium was detected above laboratory reporting in all samples collected from the Intermittent Creek at concentrations ranging from 140 mg/L to 200 mg/L. The Kansas SWQS for sodium has not been established.

General Chemistry

- Chloride was detected above laboratory reporting limits at all three Transects in the Intermittent Creek. The Kansas SWQS of 250 mg/L for chloride was exceeded in the surface water samples collected from Transect #6 (350 mg/L) and Transect #7 (280 mg/L). The result for the chloride concentration at Transect #5 was 230 mg/L.
- The Kansas SWQS of 2.0 mg/L for fluoride was not exceeded in any of the surface water samples collected from the Intermittent Creek. Results for the creek ranged from 0.31 mg/L to 0.34 mg/L.
- The Kansas SWQS of 250 mg/L for sulfate was not exceeded in any of the surface water samples collected from the Intermittent Creek. Sulfate results for the samples collected from the river ranged from 21 mg/L to 24 mg/L.

4.2.2.3 Surface Water Ponds

Surface water samples were collected at five locations from the wastewater/stormwater ponds located in the northeast section of the Site. The locations were designated the Marley Pond, Northeast Pond, Northwest Pond, Southeast Pond, and Southwest Pond. The surface water ponds were sampled on June 9, 2005. The sampling was conducted by paddling a boat out to the approximate center of the pond and dropping an anchor in order to remain stationary during sample collection. The total depth at the sample point was measured and water quality parameters were collected (temperature, pH, conductivity, DO, ORP, and turbidity) prior to sample collection. A discrete sample was collected at approximately the midpoint of the total depth of the water using a Van Dorn thief sampler.

Volatile Organic Compounds

The only VOC detected above laboratory reporting limits was 1,2-dibromo-3-chloropropane in the Marley Pond sample at a concentration of 0.021 µg/L. There is no Kansas SWQS established for this compound. However, this concentration does not exceed the MCL of 0.20 µg/L (EPA-Safe Drinking Water Act). There were no VOCs

detected above laboratory reporting limits in any of the other surface water samples collected from the surface water ponds.

Semi-Volatile Organic Compounds

- There were no Semi-Volatile Organic Compounds detected above laboratory reporting limits in any of the surface water samples collected from the surface water pond.

Total Petroleum Hydrocarbons

- No concentrations of TPH-GRO were detected above laboratory reporting limits in any of the surface water samples collected from the surface water ponds.
- TPH in the C10-C28 range was detected above laboratory reporting limits in samples collected from the Marley Pond (320 µg/L), Northeast Pond (560 µg/L), Northwest Pond (290 µg/L), Southeast Pond (760 µg/LL), and Southwest Pond (870 µg/L). There are no surface water standards for total petroleum hydrocarbons.
- TPH in the C28-C35 range was detected above laboratory reporting limits in samples collected from the Northeast Pond (78 µg/L), Northwest Pond (180 µg/L), Southeast Pond (290 µg/L), and Southwest Pond (160 µg/L). There are no surface water standards for total petroleum hydrocarbons.
- TPH above the C10 range was detected above laboratory reporting limits in samples collected from the Marley Pond (340 µg/L), Northeast Pond (650 µg/L), Northwest Pond (410 µg/L), Southeast Pond (910 µg/L), and Southwest Pond (1000 µg/L). There are no surface water standards for total petroleum hydrocarbons.

Metals

- Barium was detected above laboratory reporting limits in all samples collected from the surface water ponds at concentrations ranging from 0.11 mg/L to 0.12 mg/L. The Kansas SWQS of 1.0 mg/L for barium was not exceeded.
- Calcium was detected above laboratory reporting limits in all samples collected from the surface water ponds at concentrations ranging from 41 mg/L to 49 mg/L. The Kansas SWQS for calcium has not been established.

- Chromium III was detected above laboratory reporting limits in the sample collected from the Marley Pond at a concentration of 0.016 mg/L. The Kansas SWQS of 0.05 mg/L for chromium III was not exceeded.
- Total chromium was detected above laboratory reporting limits in the sample collected from the Marley Pond at a concentration of 0.016 mg/L. The Kansas SWQS of 0.1 mg/L for total chromium was not exceeded.
- Copper was detected above laboratory reporting limits in the sample collected from the Marley Pond at a concentration of 0.021 mg/L. The Kansas SWQS of 1.3 mg/L for copper was not exceeded.
- Iron was detected above laboratory reporting limits in all samples collected from the surface water ponds at concentrations ranging from 0.2 mg/L to 7.4 mg/L. The Kansas SWQS for iron has not been established.
- Lead was detected above laboratory reporting limits in 3 of the 5 samples collected from the surface water ponds. Lead was detected above laboratory reporting limits in samples collected for the Marley Pond (0.071 mg/L), Northwest Pond (0.037 mg/L), and Southwest Pond (0.0067 mg/L). The Kansas SWQS of 0.015 mg/L for lead was exceeded in the samples from the Marley Pond and the Northwest Pond.
- Magnesium was detected above laboratory reporting in all samples collected from the surface water ponds at concentrations ranging from 4.8 mg/L to 8.8 mg/L. The Kansas SWQS for magnesium has not been established.
- Manganese was detected above laboratory reporting in all samples collected from the surface water ponds at concentrations ranging from 0.053 mg/L to 0.15 mg/L. The Kansas SWQS for manganese has not been established.
- Mercury was detected above laboratory reporting limits in all of the 5 samples collected from the surface water ponds. Mercury was detected above laboratory reporting limits at concentrations of 0.0033 mg/L in the Marley Pond, 0.00062 mg/L in the Northeast Pond, 0.0036 mg/L in the Northwest Pond, 0.00095 mg/L in the Southeast Pond, and 0.007 mg/L in the Southwest Pond. The Kansas SWQS of 0.00014 mg/L for mercury was exceeded for each of these samples.
- Nickel was detected above laboratory reporting limits in the sample collected from the Marley Pond at a concentration of 0.0097 mg/L. The Kansas SWQS of 0.61 mg/L for nickel was not exceeded.

- Potassium was detected above laboratory reporting in all samples collected from the surface water ponds at concentrations ranging from 4.5 mg/L to 6.5 mg/L. The Kansas SWQS for potassium has not been established.
- Sodium was detected above laboratory reporting in all samples collected from the surface water ponds at concentrations ranging from 25 mg/L to 160 mg/L. The Kansas SWQS for sodium has not been established.
- Vanadium was detected above laboratory reporting in the sample collected from the Marley Pond at a concentration of 0.02 mg/L. The Kansas for vanadium has not been established.
- Zinc was detected above laboratory reporting in the samples collected from the Marley Pond (0.087 mg/L) and the Northwest Pond (0.032 mg/L). The Kansas SWQS 0.74 mg/L for zinc was not exceeded in either of these samples.

General Chemistry

- The Kansas SWQS of 250 mg/L for chloride of was not exceeded in any of the surface water samples collected from the ponds. Chloride results for samples collected from the ponds ranged from 22 mg/L in the Marley Pond to 220 mg/L in the Northeast and Southeast Ponds.
- Fluoride was detected above laboratory report limits in all of the surface water samples collected from the ponds. The detection of fluoride in the Northeast Pond was equal to the Kansas SWQS standard of 2.0 mg/L. The Kansas SWQS for fluoride was not exceeded in any of the other ponds. Fluoride results for the samples collected from the other ponds ranged from 0.76 mg/L to 1.5 mg/L.
- Nitrate was detected above the laboratory reporting limit in the Marley Pond at a concentration of 0.67 mg/L. This concentration does not exceed the Kansas SWQS of 10 mg/L for nitrate.
- The Kansas SWQS of 250 mg/L for sulfate was not exceeded in any of the surface water samples collected from the ponds. Sulfate results for the samples collected from the ponds ranged from 33 mg/L to 61J mg/L.

4.2.2.4 Catalytic Cracking Unit Spring

A surface water sample was collected from the spring emanating from the ground at the base of the catalytic cracking unit (CC Spring). The CC Spring was sampled on April 15, 2005. During sampling, care was taken to minimize disturbance of the sediments at the bottom of the "pool". The sample was obtained by submersing the appropriate sample containers in the water directly at the mouth of the spring. Water quality parameters were collected (temperature, pH, conductivity, DO, ORP, and turbidity) prior to sample collection.

Volatile Organic Compounds

- Benzene was detected in the CC Spring above the laboratory reporting limit. Benzene was detected at 29D µg/L, which exceeds the Kansas SWQS of 1.2 µg/L.

Total Petroleum Hydrocarbons

No concentrations of TPH-GRO were detected above laboratory reporting limits in any of the surface water samples collected from the surface water ponds.

TPH in the C10-C28 range was detected above laboratory reporting limits in the sample collected from the CC Spring at a concentration of 330 µg/L. There are no surface water standards for total petroleum hydrocarbons.

TPH in the C28-C35 range was detected above laboratory reporting limits in sample collected from the CC Spring at a concentration of 150 µg/L. There are no surface water standards for total petroleum hydrocarbons.

- TPH above the C10 range was detected above laboratory reporting limits in samples collected from the CC Spring. TPH above the C10 range was detected at 410 µg/L. There are no surface water standards for total petroleum hydrocarbons.

Metals

- Barium was detected above the laboratory reporting limit. Barium was detected at a concentration of 0.25 mg/L. This concentration does not exceed the Kansas SWQS standard of 1.0 mg/L.
- Calcium was detected above laboratory reporting limit at a concentration of 140 mg/L. There is no surface water standard established for calcium.

- Iron was detected above the laboratory reporting limit at a concentration of 6.0 mg/L. There is no surface water standard established for iron.
- Magnesium was detected above laboratory reporting limit at a concentration of 18 mg/L. There is no surface water standard established for magnesium.
- Manganese was detected above the laboratory reporting limit at a concentration of 0.12 mg/L. There is no surface water standard established for iron.
- Potassium was detected above the laboratory reporting limit at a concentration of 1.1 mg/L. There is no surface water standard established for potassium.
- Sodium was detected above the laboratory reporting limit at a concentration of 72 mg/L. There is no surface water standard established for sodium.

General Chemistry

- The Kansas SWQS of 250 mg/L for chloride of was not exceeded in the surface water sample collected from the CC Spring. The chloride result for sample collected from the CC Spring was 100 mg/L.
- Fluoride was detected above laboratory report limits in the surface water sample collected from the CC Spring at 0.54 mg/L. The detection of fluoride in the CC Spring does not exceed the Kansas SWQS standard of 2.0 mg/L.
- Nitrate was detected above the laboratory reporting limit in the CC Spring at 0.73 mg/L. This concentration does not exceed the Kansas SWQS of 10 mg/L for nitrate.
- The Kansas SWQS of 250 mg/L for sulfate was not exceeded in the CC Spring. The concentration of sulfate detected in the CC Spring was 55 mg/L.

4.3 GEOLOGY

4.3.1 Geophysical Logging

Natural gamma logging was performed in the four deepest wells at the Site (wells N3-1, W-01D, W-15D, and W-29D) by Frontier Logging, Inc. The natural gamma plots for each well are shown on Figure 15. Natural gamma logs respond to radioactivity within the subsurface soil/rock. The radioactivity is naturally occurring and is ubiquitous in the

environment. Natural gamma levels are typically highest in clays and shale. Therefore, natural gamma logs can be used to pick out clay/shale layers in the subsurface.

An interpretation of the natural gamma logs is presented on Figure 15. Figure 15 shows the interpreted contacts between the Doyle Shale, the Fort Riley Limestone, the Oketo Shale, the Florence Limestone, and the Blue Springs Shale beneath the Site. The logs also suggest that the Oketo Shale is present across the entire Site.

4.3.2 Geotechnical Testing

Shallow soil samples for geotechnical testing were collected from selected Second Phase Investigation boring locations along the West Branch Walnut River. The Second Phase Investigation boring locations selected for the geotechnical analysis were OW-03, OW-31, and OW-33. Two Shelby tubes were collected from each location and submitted to GSI for geotechnical characterization testing. GSI submitted results of this testing in a report dated April 15, 2005.

Table 5 presents the results for the geotechnical testing. The laboratory report is presented in Appendix F. Reported parameters include moisture content, wet/dry unit weight, unconfined compressive strength, Atterberg limits, % passing through No. 200 Sieve, and specific gravity. Based on the geotechnical testing, the alluvial soil was identified as CL (clay) and the weathered bedrock was identified as GC (gravelly clay).

4.3.3 Boring Logs and Cross-sections

Boring logs were recorded during the installation of the new Second Phase Investigation monitoring wells. Data was collected to determine geologic lithology and stratigraphy, including depth to groundwater at each boring location. The data collected and recorded on the boring logs was evaluated in the field to establish appropriate construction specifications for the monitoring wells. Soil and rock samples collected were also field screened with a photoionization detector (PID) to delineate the vertical extent of

contamination in each boring and the horizontal extent of contamination at the Site. The boring logs and monitoring well completion diagrams are located in Appendix B.

Sediments described in the boring logs of the shallow wells primarily consist of silt and clay with minor amounts of sand and gravel typically found at the base of the alluvium. These sediments are associated with the West Branch Walnut River. The alluvium from the surface to above the weathered Fort Riley Limestone is described in the boring logs as predominantly silty clay with a thickness ranging from approximately 4 to 20 feet. Underlying the alluvial soils was weathered bedrock residuum, which was typically comprised of limestone fragments and/or clay.

The total measured depth of the shallow monitoring wells range from 8.0 feet below ground surface (bgs) in monitoring well OW-21 to 26.3 feet bgs in well OW-01. There were 25 shallow borings that were completed as permanent monitoring with the following designations: OW-01, OW-02, OW-07, OW-08, OW-09, OW-10, OW-11, OW-12, OW-13, OW-14, OW-16, OW-21, OW-24, OW-25, OW-26, OW-29, OW-30, OW-31, OW-32, OW-33, OW-35, OW-36, OW-37, OW-38, and OW-39. Shallow borings with temporary monitoring well completions were designated OW-18T, OW-19T, OW-22T, OW-23T, OW-27T, and OW-28T.

The uppermost competent bedrock unit underlying the majority of the Site is the Fort Riley Limestone. Bedrock was largely described as consisting of argillaceous limestone and limestone that was thin-bedded to massive, and highly to minimally fractured. Solution voids and fracturing typically decreased with depth. Total measured depth of the deep monitoring wells ranged from 39.5 feet bgs in well OW-05 to 45.5 feet bgs in well OW-06. Deep borings were all completed as permanent monitoring wells and were designated OW-03, OW-04, OW-05, and OW-06.

A map showing lines of geologic cross-section is included as Figure 16. Geologic cross-sections are included as Figures 17 through 23. All of the cross-sections except for B – B' (Figure 19) illustrate the interpreted locations of alluvium/residuum, Doyle Shale, Fort Riley Limestone, Oketo Shale, Florence Limestone, and the Blue Springs Shale. The

locations of the Doyle Shale and the Oketo Shale are interpreted based on the natural gamma logs, which were discussed in Section 4.3.1. The Doyle Shale has been eroded away between the central portion of the Main process Area and the West Branch Walnut River. This is illustrated on Figure 17 (Cross-section A1-A1') and Figures 19 (Cross-section B-B') through 22 (Cross-section E-E').

4.4 GROUNDWATER

4.4.1 Water Supply Well Survey

A field survey was conducted to evaluate the potential presence of water supply wells in the vicinity of the Site. The survey consisted of a review of publicly available records of wells within a ½-mile radius of the Site and a visual inspection of properties adjoining the Site. The survey area, extending ½ mile in all directions from the Site property boundary, is shown on Figure 5. A summary of water wells in the Site vicinity is presented on Table 1.

The records review was performed using well records available through the Kansas Geological Survey (KGS) website. Based on discussions with City of El Dorado officials, the city exercises no authority governing construction or use of private wells within the city limits, and maintains no records of wells. The well records search included portions of Sections 26, 27, 34, and 35 of Township 25S, Range 5E, and portions of Sections 2 and 3 of Township 26S, Range 5E. Based on a detailed analysis of the search results, six water supply wells were identified as potentially present within the area of interest. These include two wells in Section 26, one well in Section 27, two wells in Section 34, and one well in Section 35 of Township 25S. No wells were identified in Section 3 of Township 26S.

The visual inspection was performed by touring the properties adjacent to the Site, and looking for indications of supply wells, such as well houses, pressure tanks, or well casings. The visual inspection was performed on August 30 and 31, 2005, by driving on public roads and viewing adjoining properties. No features were observed on the properties listed in the records search that would suggest the presence of water supply

wells. However, two wells were observed to the west of the Site. Both wells were apparently not in use. No entry was made onto private property, and no attempts were made to contact owners of properties adjoining the Site during this phase of the survey.

4.4.2 Groundwater Bearing Zones

Based on the data collected during the Second Phase Investigation, three different water-bearing zones have been identified beneath the Site. These include the shallow groundwater-bearing zone under water table conditions (alluvium/weathered bedrock and the Doyle Shale collectively referred to as the Shallow System) and the confined to partially confined groundwater encountered within fractures at the base of the Fort Riley Formation and within the Florence Limestone. Natural gamma logs and field observations indicate that the groundwater at the base of the Fort Riley Limestone is confined by upper, less fractured portions of the Fort Riley Limestone. The groundwater in the Florence Limestone is confined by the presence of the Oketo Shale directly above the unit.

The limited connection between the three water-bearing zones is evidenced by the differing groundwater potentiometric surface elevations in clustered well sets (discussed in Section 4.4.2). This is illustrated on Figure 15 and on the cross-sections on Figures 17 through 22 (the cross-section location map is included on Figure 16).

Significant mounding is not apparent in monitoring wells completed around the wastewater/stormwater ponds. This is illustrated on Figure 21 (Cross-section D-D'). This indicates that infiltration of surface water through the base of the ponds is limited; which is likely due to the presence of a liner at the base of the ponds. However, mounding is evident beneath the Spray Pond located to the east of the Main Process Area. As shown on Figure 21, the mounding is likely containing the LNAPL in the shallow alluvium/residuum to the east of the Spray Pond.

Based on the slug test data (discussed in Section 4.4.4) and on field observations, the most transmissive of the water-bearing zones is the Shallow Zone. Within the Shallow

Zone, the residuum and alluvium are comprised of primarily silty clay. The underlying highly fractured and weathered limestone (included as part of the Shallow System) is highly transmissive. The location of the highly fractured bedrock is shown on the cross-sections on Figures 17 through 23.

The approximate thickness of the Shallow System, Fort Riley Limestone, and the Florence Limestone at the eastern edge of the Site are depicted on Figure 19 (Cross-section B-B'). Groundwater flux estimates were made for each of the water-bearing zones based on the following:

$Q = KIA$

Where: Q = groundwater flow rate
K = hydraulic conductivity
I = gradient
A = cross-sectional area.

Average values for each of the above parameters were utilized to calculate the groundwater flux rates for each of the water-bearing zones beneath the eastern boundary of the Site (area adjacent to the wastewater/stormwater ponds illustrated on Figure 19). The following flux rates were estimated:

- Shallow Zone: 2.64 ft^3/min
- Fort Riley Limestone: 0.0006539 ft^3/min
- Florence Limestone: 0.6034 ft^3/min

As shown by the flux estimates, the flux in the Shallow Zone is approximately **4,000 times** that in the competent Fort Riley Limestone and **4 times** that in the Florence Limestone.

4.4.2.1 Groundwater Level and LNAPL Measurement Results

First Quarter Groundwater Level and LNAPL Measurement Results

Groundwater level and light non-aqueous phase liquid (LNAPL) thickness measurements were collected on March 21, 2005 from 33 monitoring wells at the Site. Depth to groundwater in the shallow monitoring wells ranged from 2.50 feet bgs in monitoring well Fina/MW-38 to 16.58 feet bgs in monitoring well N4-3. Potentiometric heads in the Fort Riley Limestone monitoring wells was 11.02 feet bgs in well N4-1 and 18.35 feet bgs in well W-29D. Potentiometric heads in the Florence monitoring wells ranged from 3.35 feet above ground surface in well W-01D to 26.44 feet bgs in well W-15D. Groundwater elevation data for the First Quarter 2005 sampling event are included on Table 3.

Groundwater elevation data collected from the shallow monitoring wells during the First Quarter 2005 sampling event were utilized to prepare the groundwater table elevation map presented as Figure 6. Figure 6 indicates a shallow groundwater flow direction toward the east with an average Site-wide gradient of approximately 0.016 feet per foot (ft/ft).

During the First Quarter 2005 Sampling Event, only two wells were completed in the competent Fort Riley Formation (wells W-29D and N4-1) and three wells completed in the Florence Limestone (N3-1, W-01D, and W-15D. There is insufficient well data to calculate horizontal gradients for these two water-bearing zones. Data from these wells are included on Table 3. Figure 7 shows the groundwater potentiometric surface in the Florence Limestone during the First Quarter, 2005.

Several monitoring well clusters have been installed at the Site for the purpose of comparing shallow and deep groundwater levels and groundwater quality. Groundwater level differences were compared in monitoring well clusters W-22/N3-1, W-01S/W-01D, W-15S/W-15D, and W-29S/W-29D. Vertical gradients were calculated based on

differences in the groundwater elevations between clustered wells (deep groundwater elevation minus shallow groundwater elevation). The results are as follows:

- W-01S/W-01D – monitoring well W-01S is screened within the unconsolidated alluvium and well W-01D is completed in the competent Fort Riley Limestone. The difference in groundwater elevations was 13.93 feet, which indicates an upward gradient.

- W-15S/W-15D – monitoring well W-15S is screened within the unconsolidated alluvium and well W-15D is completed in the competent Florence Limestone. The difference in groundwater elevations was –9.23 feet, which indicates a downward gradient.

- W-22/N3-1 – monitoring well W-22 is screened within the unconsolidated alluvium and well N3-1 is completed in the competent Florence Limestone. The difference in groundwater elevations was 15.94 feet, which indicates an upward gradient.

- W-29S/W-29D – monitoring well W-29S is screened within the Doyle Formation and well W-29D is completed in the competent Fort Riley Formation. The difference in groundwater elevations was –4.70 feet, which indicates a downward gradient.

LNAPL was encountered in three monitoring wells at the Site. LNAPL was present in monitoring wells N2-5, N2-6, and N6-1 at apparent thicknesses of 0.51 foot, 8.64 feet, and 0.03 foot, respectively. Monitoring wells N2-5 and N2-6 are located in the vicinity of the tank car loading rack and the spray pond. Monitoring well N6-1 is located adjacent to the above ground storage Tank 112 in the South Tank Farm Area. Graphs depicting historic groundwater elevations and LNAPL thicknesses in monitoring wells N2-5, N2-6, and N6-1 are included in Appendix D.

Second Quarter Groundwater Level and LNAPL Measurement Results

Groundwater level and LNAPL thickness measurements were collected prior to the onset of sampling activities. Groundwater and LNAPL thickness measurements were collected on May 17, 2005 from 33 monitoring wells at the Site. Depth to groundwater in the shallow monitoring wells ranged from 2.76 feet below ground surface (bgs) in

monitoring well Fina/MW-38 to 17.93 feet bgs in monitoring well N4-3. Potentiometric heads in the deeper Fort Riley Limestone groundwater monitoring wells were 21.08 feet bgs in well W-29D and 11.59 feet bgs in well N4-1. Potentiometric heads in the Florence monitoring wells ranged from 2.24 feet above ground surface in well W-01D to 27.68 feet bgs in well W-15D.

Site-wide groundwater level and LNAPL thickness measurements were also collected once the Second Quarter 2005 sampling event was complete. Groundwater level and LNAPL thickness measurements were collected from both the monitoring wells in the monitoring network as well as the newly installed Second Phase monitoring wells. In addition, surface water elevations were measured at the two staff gauges on the West Branch Walnut River, in the wastewater/stormwater ponds, and in the intermittent drainage in the South Tank Farm Area. The Site-wide groundwater level and LNAPL thickness measurement round was conducted on June 14, 2005. During this Site-wide round, depth to groundwater in the shallow monitoring wells ranged from 0.90 feet above ground surface in monitoring well OW-21 to no groundwater present in monitoring well OW-13.

The potentiometric heads in the Fort Riley monitoring wells ranged from 2.98 feet below ground surface in monitoring well OW-06 to 11.22 feet bgs in monitoring well N4-1. Groundwater levels in the Florence monitoring wells ranged from 4.46 feet above ground surface in monitoring well W-01D N3-1 to 23.51 feet bgs in monitoring well W-15D.

Groundwater elevation data for the groundwater level and LNAPL thickness measurements collected on both May 17, 2005 and June 14, 2005 are included on Table 3. Groundwater elevation data collected from the shallow monitoring wells during the June 14, 2005 Site-wide round were utilized to prepare the groundwater table elevation map presented as Figure 8. Figure 8 indicates a shallow groundwater flow direction toward the east with an average Site-wide gradient of approximately 0.016ft/ft.

Groundwater elevation data collected from the Fort Riley monitoring wells on June 14, 2005 were utilized to prepare the groundwater table elevation map presented as Figure 9.

Figure 9 indicates a groundwater flow direction toward the east with an average Site-wide gradient of approximately 0.012 ft/ft.

Groundwater elevation data collected from the Florence Limestone monitoring wells on June 14, 2005 were utilized to prepare the groundwater elevation map presented as Figure 10. There are only three monitoring wells completed within the Florence Limestone (N3-1, W01D, and W-15D). Therefore, there is insufficient data to calculate the horizontal gradient for this water-bearing zone..

As stated in Section 3.8.1.1, several monitoring well clusters have been installed at the Site for the purpose of comparing shallow and deep groundwater levels and groundwater quality. As part of the Second Phase Investigation, monitoring wells OW-03, OW-04, OW-05, and OW-06 were installed to evaluate potential contaminant levels in the competent portion of the Fort Riley Limestone near the West Branch Walnut River and in the South Tank Farm Area. Groundwater level differences were compared in monitoring well clusters OW-03/W-22/N3-1, OW-04/OW-31, OW-05/W-01S/W-01D, OW-06/N5-3, W-15S/W-15D, and W-29S/W-29D. Vertical gradients were calculated based on differences in the groundwater elevations between clustered wells (deep groundwater elevation minus shallow groundwater elevation). For the monitoring well clusters with three wells in the cluster, the vertical gradients were calculated between the wells screened in adjacent units. The results are as follows:

- <u>OW-03/W-22/N3-1</u> - monitoring well W-22 is screened within the unconsolidated alluvium, well OW-03 is screened within the competent portion of the Fort Riley Limestone, and well N3-1 is completed in the competent Florence Limestone. The difference in groundwater elevations between well OW-03 and well W-22 was 2.03 feet, which indicates an upward gradient. The difference between wells N3-1 and OW-03 was 12.23 feet, which also indicates an upward gradient.

- <u>OW-04/OW-31</u> – monitoring well OW-31 is completed in the unconsolidated alluvium and well OW-04 is completed in the competent portion of the Fort Riley

Limestone. The difference in groundwater elevations between the two wells was 0.44 feet, indicating an upward gradient.

- OW-05/W-01S/W-01D – monitoring well W-01S is screened within the unconsolidated alluvium, well OW-05 is screened within the Fort Riley Limestone, and well W-01D is completed in the Florence Limestone. The difference in groundwater elevations between wells OW-05 and W-01S was –3.19 feet, which indicates a downward gradient. The difference in groundwater elevations between well W-01D and well OW-05 was 15.83 feet, indicating an upward gradient.

- OW-06/N5-3 – monitoring well N5-3 is completed in the unconsolidated alluvium and well OW-06 is completed in the competent portion of the Fort Riley Limestone. The difference in groundwater elevation between the wells was -0.85 foot, which indicates a downward gradient.

- W-15S/W-15D – monitoring well W-15S is screened within the unconsolidated alluvium and well W-15D is completed in the competent Florence Limestone. The difference in groundwater elevations was –10.26 feet, which indicates a downward gradient.

- W-29S/W-29D – monitoring well cluster W-29S/W-29D is screened within the competent portion of the Fort Riley Limestone. The difference in groundwater elevations was –0.55 foot, which indicates a downward gradient.

LNAPL was encountered in two monitoring wells at the Site during the May 17, 2005 groundwater level elevation and LNAPL measurement round, LNAPL was present in monitoring wells N2-5 and N2-6 at apparent thicknesses of 0.59 foot and 12.77 feet, respectively. Monitoring wells N2-5 and N2-6 are located in the vicinity of the tank car loading rack and the spray pond. Graphs depicting historic groundwater elevations and LNAPL thicknesses in monitoring wells N2-5, N2-6, N6-1, and OW-18T are included in Appendix D.

During the June 14, 2005 groundwater level elevation and LNAPL measurement round, LNAPL was encountered in wells N2-6, N6-1, and OW-18T at apparent thicknesses of 11.51 feet, 0.04 feet, and 0.41 foot, respectively.

Second Phase Investigation Groundwater Level and LNAPL Measurement Results

Groundwater level and LNAPL thickness measurements were collected from the newly installed "OW series" Second Phase Investigation monitoring wells on April 7, 2005 (excluding monitoring wells OW-03 through OW-06 and OW-39, which had not been installed at that date). Two Site-wide groundwater levels and LNAPL thickness measurement rounds (both quarterly and newly installed monitoring wells) were conducted during the Second Phase Investigation. Site-wide groundwater level and LNAPL thickness measurements were collected on June 14, 2005 (discussed above) and August 2, 2005 from 68 monitoring wells. For the purposes of reporting in this section, only the August 2, 2005 groundwater levels will be discussed. Groundwater level and LNAPL thickness measurements are presented in Table 3.

During the August 2, 2005 Site-wide round, depth to groundwater in the shallow monitoring wells ranged from 0.13 feet above ground surface in monitoring well OW-21 to no groundwater present in monitoring well OW-13.

On August 2, 2005, potentiometric heads in the Fort Riley monitoring wells ranged from 7.67 feet below ground surface in monitoring well OW-06 22.42 feet bgs in monitoring well W-29D on August 2, 2005.

During the August 2, 2005 round, groundwater levels ranged from 0.03 feet above ground surface in monitoring well W-01D to 28.42 feet bgs in monitoring well W-15D. Groundwater elevation data for the Second Phase Investigation are included on Table 3.

The August 2, 2005 groundwater elevation data collected from the monitoring wells completed in the Shallow System, Fort Riley Limestone, and Florence Limestone during the Second Phase Investigation were utilized to prepare the groundwater table/potentiometric elevation maps presented as Figures 11, 12, and 13. Figure 11 indicates a shallow groundwater flow direction toward the east with an average Site-wide

gradient of approximately 0.015 (ft/ft). Figure 12 indicates a groundwater flow direction toward the east with an average Site-wide gradient of approximately 0.013 (ft/ft). As previously stated, there are an insufficient number of monitoring wells completed in the Florence Limestone to calculate a horizontal groundwater gradient for that water-bearing zone.

Several monitoring well clusters have been installed at the Site for the purpose of comparing shallow and deep groundwater levels and groundwater quality. During the Second Phase Investigation, monitoring wells OW-3, OW-04, OW-05, and OW-06 were installed to evaluate potential contaminant levels in the competent portion of the Fort Riley Limestone near the West Branch Walnut River and in the South Tank Farm Area. Groundwater level differences were compared in monitoring well clusters OW-03/W-22/N3-1, OW-04/OW-31, OW-05/W-01S/W-01D, OW-06/N5-3, W-15S/W-15D, and W-29S/W-29D. Vertical gradients were calculated based on differences in the groundwater elevations between clustered wells (deep groundwater elevation minus shallow groundwater elevation). For the monitoring well clusters with three wells in the cluster, the vertical gradients were calculated between the wells screened in adjacent units. The results are as follows:

- OW-03/W-22/N3-1 - monitoring well W-22 is screened within the unconsolidated alluvium, well OW-03 is screened within the competent portion of the Fort Riley Limestone, and well N3-1 is completed in the competent Florence Limestone. The difference in groundwater elevations between well OW-03 and well W-22 was 3.1 feet, which indicates an upward gradient. The difference between wells N3-1 and OW-03 was 10.41 feet, which indicates an upward gradient.

- OW-04/OW-31 – monitoring well OW-31 is completed in the unconsolidated alluvium and well OW-04 is completed in the competent portion of the Fort Riley Limestone. The difference in groundwater elevations between the two wells was -0.57 feet, indicating a downward gradient.

- OW-05/W-01S/W-01D – monitoring well W-01S is screened within the unconsolidated alluvium, well OW-05 is screened within the Fort Riley Limestone,

and well W-01D is completed in the Florence Limestone. The difference in groundwater elevations between wells OW-05 and W-01S was 2.27 feet, which indicates an upward gradient. The difference in groundwater elevations between well W-01D and well OW-05 was 9.35 feet, indicating an upward gradient.

- OW-06/N5-3 – monitoring well N5-3 is completed in the unconsolidated alluvium and well OW-06 is completed in the competent portion of the Fort Riley Limestone. The difference in groundwater elevation between the wells was 0.33 foot, which indicates an upward gradient.

- W-15S/W-15D – monitoring well W-15S is screened within the unconsolidated alluvium and well W-15D is completed in the competent Florence Limestone. The difference in groundwater elevations was –10.22 feet, which indicates a downward gradient.

- W-29S/W-29D – monitoring well W-29S is screened with the competent portion of the Fort Riley Limestone and well W-29D is completed in the competent Florence Limestone. The difference in groundwater elevations was –7.13 feet, which indicates a downward gradient.

During the August 2, 2005 Site-wide groundwater and LNAPL measurement round, LNAPL was encountered in seven monitoring wells at the Site. Apparent LNAPL thicknesses are shown on Figure 14. LNAPL was present in monitoring wells N2-5, N2-6, N6-1, OW-12, OW-18T, OW-25, and OW-37. LNAPL thicknesses in these monitoring wells ranged from an apparent thickness of 0.07 foot in monitoring wells N6-1 and OW-37 to an apparent thickness of 13.88 feet in monitoring well N2-6. Monitoring wells N2-5 and N2-6 are located in the vicinity of the tank car loading rack and the spray pond. Monitoring well N6-1 is located adjacent to the above ground storage Tank 112 in the South Tank Farm Area. Monitoring well OW-12 is located along the east property boundary in the South Tank Farm Area. Monitoring wells OW-18T, OW-25, and OW-37 are located within the Main Process Area. Graphs depicting historic groundwater elevations and LNAPL thicknesses in monitoring wells N2-5, N2-6, and N6-1 are included in Appendix D.

4.4.3 Hydrographs

Hydrographs were constructed for all of the monitoring well clusters and individual monitoring wells at the Site (Site-wide monitoring network wells and newly installed Second Phase wells) and are included in Appendix D.

Rain gauge and stream gauge data from January 1, 2004 through August 15, 2005 were collected from the Walnut River gauging station which is located downstream of the Site. The United States Corps of Engineers, Tulsa District, manages the Walnut River gauging station. The steam gauge and rain gauge data were obtained from the Tulsa District Corps of Engineers, located in Tulsa, Oklahoma. Real-time stream and rain gauge data are also available from the Tulsa District Corps of Engineers website, presented in the Reference section of this report.

The stream gauge and rain gauge data were plotted on the hydrographs in Appendix D in order to compare the correlation between stream and rain gauge data and groundwater levels in the monitoring wells. Rain gauge data were plotted on each hydrograph and stream gauge data were plotted on the hydrographs for monitoring wells/monitoring well clusters located in the vicinity of the West Branch Walnut River.

General trends are apparent in the hydrographs. The hydrographs for the monitoring wells included in the Site-wide monitoring network indicate increasing groundwater levels between the first and third quarters of 2004, followed by a decrease in groundwater levels during the fourth quarter 2004. Groundwater levels generally increased in the majority of the Site-wide monitoring network wells from the fourth quarter 2004 through the first quarter 2005, followed by a general decrease in groundwater levels into the second quarter 2005.

The hydrographs for monitoring wells Fina/MW-38, N1-1, N2-2, N2-5, N2-6, N4-3, and W-24 indicate a decrease in groundwater levels between the fourth quarter 2004 and the first quarter 2005, followed by an increase in groundwater level into the second quarter 2005. The hydrograph for monitoring well W-16S indicates more variability than the majority of the other Site-wide monitoring network wells. Groundwater level elevation

increased in monitoring well W-16S from the fourth quarter 2004 to the first quarter 2005 followed by a decrease in groundwater level elevation into the second quarter 2005. The groundwater level pattern during the June 14 and August 2, 2005 groundwater level rounds was the same as the majority of the other wells, with an increased groundwater level during the June 14 round and decreased groundwater level during the August 2, 2005 round.

Two Site-wide groundwater level elevation and LNAPL thickness measurement rounds were conducted following the installation of the Second Phase monitoring wells ("OW" series monitoring wells). With the exception of monitoring wells OW-05, OW-13, OW-24, and OW-35, groundwater levels increased in all of the monitoring wells during the June 14, 2005 groundwater level measurement round followed by a decrease in groundwater elevations during the August 2, 2005 groundwater level measurement round. The groundwater elevation had not decreased in monitoring well OW-05 during the August 2, 2005 round, as it had in the majority of the other monitoring wells. Monitoring well OW-13 was dry during both the June 14 and August 2, 2005 groundwater level monitoring rounds. The groundwater level in monitoring well OW-24 had decreased between the June 14, 2005 round, followed by an increase in the groundwater level elevation during the August 2, 2005 round. The hydrograph for monitoring well OW-35 indicates a decrease in groundwater level between the June 14 and August 2, 2005 rounds.

General trends in the stream gauge and rain gauge data are also apparent on the hydrographs for individual monitoring wells and monitoring well clusters. Both stream gauge data and rain gauge data are plotted on the hydrographs for the monitoring wells near the West Branch Walnut River and wastewater/stormwater ponds (monitoring wells N3-2, N3-3, N3-4, OW-27T, OW-28T, OW-29, OW-30, OW-31, OW-32, OW-33, W-03, W-23, and monitoring wells clusters OW-05/W-01S/W-01D and N3-1/OW-03/W-22). There is a strong correlation between the stream gauge data, rain gauge data, and groundwater levels in these monitoring wells and monitoring well cluster N3-1/OW-03/W-22. The stream gauge data, rain gauge data, and groundwater levels in monitoring well cluster OW-05/W-01S/W-01D correlate fairly well with the exception of the

groundwater level in monitoring well OW-05. As previously mentioned, the groundwater level in well OW-05 had not decreased during the August 2, 2005 round, as had the groundwater level elevations in the majority of the other monitoring wells.

The groundwater levels in the remaining monitoring wells clusters (N5-3/OW-06, OW-04/OW-31, W-15S/W-15D, and W-29S/W-29D) at the Site are relatively consistent with the rain gauge data received from the Walnut River gauging station. Increased groundwater level elevations in the monitoring wells are also relatively consistent with periods of elevated rainfall.

4.4.4 Slug Testing

Slug Test Data Analysis

There are several analytical methods that are commonly used to analyze groundwater slug test data. The most commonly used methods require the use of a curve based on the raising or lowering of the water table with time. The Bouwer and Rice (1976) methods for confined and unconfined aquifers were used to analyze the data from the sixty-two slug tests at the Site.

Analysis of the data with the Bouwer and Rice equation provided an estimate of the hydraulic conductivity of the aquifer at each well.

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{R}\right)}{2L_e} \frac{1}{t} \ln \frac{H_t}{H_o}$$

where: K = hydraulic conductivity (L/T)

r_c = radius of the well casing (L)

R = radius of the gravel envelope (L)

R_e = effective radial distance over which head is dissipated (L)

L_e = length of the well screen (L)

H_o = drawdown at time t = 0 (L)

H_t = drawdown at time t = t (L)

t = time since H= H_o (T)

Data for the Site slug tests were analyzed using Aquifer Test Solver (AQTESOLV; Duffield and Rumbaugh, 1991). This software uses curve-matching or visual estimation for most aquifer test applications including the Bouwer and Rice method, with options for confined and unconfined aquifer solutions.

Displacement data collected by the pressure transducer was download onto a computer using Win-Situ 4.0 software. Initial displacement was determined based on the user-defined depth to groundwater using top of casing as the reference. Time-displacement plots were created for each well for the rising head data and well specific information such as screen length and casing radius. The displacement data was imported into AQTESOLV and analyzed using the visual curve matching procedure for all slug tests. The results of the AQTESOLV visual solution for the Bouwer and Rice method are presented in Table 4. The data were evaluated using a combination of the Butler (1998) recommended normalized head range of 0.2 to 0.3 for the Bouwer and Rice method, and analysis of the field logbook notes regarding the formation response to the slug tests. The AQTESOLV curve matching solutions are provided in Appendix E.

An arithmetic average hydraulic conductivity (K, ft/min) for each well with multiple slug tests was determined and is presented in Table 4 as well as on Figure 24, which illustrates the spatial distribution of estimated hydraulic conductivities. Geometric means for hydraulic conductivity were calculated for shallow wells, and for those wells screened in the Fort Riley Limestone and the Florence Limestone formations. The geometric means are posted on Figure 24 based on the location of wells in one of four regions: Asphalt Handling Area, Main Process Area, West Branch Walnut River, and South Tank Farm Area. Average hydraulic conductivity values for all wells ranged from 2.068E-07 ft/min for monitoring well OW-05, a Fort Riley Limestone well along the West Branch Walnut River, to 0.122 ft/min for monitoring well W-15S, a shallow well at the southern extent of the South Tank Farm. The estimated values for hydraulic conductivity along the West Branch Walnut River and in the South Tank Farm Area were similar. Shallow K values of 0.0115 ft/min and 0.0155 ft/min, Fort Riley K values of 1.17E-06 ft/min and 3.85E-06 ft/min, and Florence Limestone K values of 4.89E-03 ft/min and 3.76E-03 ft/min, were

calculated for wells along the river and in the South Tank Farm Area, respectively. The geometric mean hydraulic conductivity for the shallow wells in the Asphalt Handling Area (6.97E-05 ft/min) was approximately 200 times less than the shallow K values along the West Branch Walnut River and in the South Tank Farm Area.

4.5 GROUNDWATER ANALYTICAL DATA

4.5.1 First Quarter 2005 Groundwater Analytical Data

Groundwater analytical results for the First Quarter 2005 Sampling Event are presented in Tables 13 through 17. Analytical data detected above laboratory reporting limits are presented in Tables 18 through 20. Footnotes for the analytical summary tables are presented in Table 21. Complete laboratory analytical reports for the First Quarter 2005 Sampling Event are included in Appendix G. Analytical data validation is provided in Appendix H. The analytical results for the groundwater samples were compared to the KDHE Tier 2 Risk-Based Screening Levels (RBSLs) for the Groundwater Pathway, Non-residential Scenario (from the RSK Manual - 3rd Version, March 2003). Parameters that were detected above laboratory reporting limits above KDHE Tier 2 RBSLs are discussed below.

Volatile Organic Compounds

Benzene was detected above laboratory reporting limits in 6 of the 30 groundwater samples collected at the Site. Benzene was detected above laboratory reporting limits in monitoring wells Fina/MW-38 (5,200 µg/L), N2-3 (540 µg/L), N2-4 (65 µg/L), N3-4 (13 µg/L), W-22 (120 µg/L), and W-24 (150 µg/L). Benzene concentrations exceeded the KDHE Tier 2 RBSL of 5.0 µg/L in all monitoring wells with detections of benzene. Benzene concentrations in groundwater are depicted on Figure 25. Benzene was detected above laboratory reporting limits in monitoring wells located within the Main Process Area and around the wastewater/stormwater ponds. Benzene was not detected above laboratory reporting limits in any of the groundwater samples collected from the Fort Riley Limestone or the Florence Limestone monitoring wells.

- Ethylbenzene was detected above laboratory reporting limits in 3 of the 30 samples collected at the Site. Ethylbenzene was detected above laboratory reporting limits in monitoring well N2-4 (11 µg/L, N5-1 (5.2 µg/L), and W-24 (7.1 µg/L). The Tier 2 RBSL for ethylbenzene is 700 µg/L, which was not exceeded in any of these wells.

- Methyl tert-butyl ether (MTBE) was detected above laboratory reporting limits in 4 of the 30 samples collected at the Site. MTBE was detected above laboratory reporting limits in monitoring wells N3-2 (16 µg/L), N3-4 (5.9 µg/L), N4-1 (210 µg/L), and N4-2 (20 µg/L). The Tier 2 RBSL for MTBE is 20 µg/L, which was exceeded in N4-1. The MTBE concentration in the groundwater sample from monitoring well N4-2 was equal to the KDHE Tier 2 RBSL of 20 µg/L.

- Toluene was detected above laboratory reporting limits in 4 of the 30 groundwater samples collected at the Site. Toluene was detected above laboratory reporting limits in monitoring wells Fina/MW-38 (420 µg/L), N2-4 (13 µg/L), W-22 (6.7 µg/L), and W-24 (6.3 µg/L). The Tier 2 RBSL for toluene of 1,000 µg/L was not exceeded in any of these wells.

- Total xylenes were detected above laboratory reporting limits in 5 of the 30 groundwater samples collected at the Site. Total xylenes were detected above laboratory reporting limits in monitoring wells Fina/MW-38 (570 µg/L), N2-4 (42 µg/L), N5-2 (28 µg/L), W-22 (13 µg/L), and W-24 (16 µg/L). The Tier 2 RBSL for total xylenes 10,000 µg/L was not exceeded in any of these wells.

Metals

Arsenic was detected above laboratory reporting limits in 10 of the 30 samples collected. Arsenic was detected above laboratory reporting limits in groundwater samples collected from monitoring wells Fina/MW-38 (0.01 mg/L), N2-2 (0.013 mg/L), N2-3 (0.035 mg/L), N3-2 (0.069 mg/L), N3-3 (0.056 mg/L), N3-4 (0.0053 mg/L), N5-3 (0.031 mg/L), W-15D (0.0083 mg/L), W-22 (0.064 mg/L), and W-24 (0.0092 mg/L). The KDHE Tier 2 RBSL of 0.01 mg/L was exceeded in groundwater samples collected from wells N2-2, N2-3, N3-2, N3-3, N5-3, and W-22. The arsenic

level in the groundwater sample from monitoring well Fina/MW-38 was equal to the KDHE Tier 2 RBSL of 0.01 mg/L.

- Barium was detected above laboratory reporting limits in all 30 groundwater samples collected at the Site at concentrations ranging from 0.028 mg/L to 1.3 mg/L. The KDHE Tier 2 RBSL of 2.0 mg/L was not exceeded in any of the wells.

- Beryllium was detected above laboratory reporting limits in one of the 30 groundwater samples collected at the Site at a concentration of 0.004 mg/L (well N3-3). This detection was equal to the KDHE Tier 2 RBSL of 0.004 mg/L.

- Chromium was detected above laboratory reporting limits in 3 of the 30 groundwater samples collected at the Site. Chromium was detected in wells N3-3, W-22, W-29S at concentrations of 0.074 mg/L, 0.0088 mg/L, and 0.0056 mg/L. The KDHE Tier 2 RBSL of 0.10 mg/L was not exceeded in any of the wells.

- Lead was detected above laboratory reporting limits in 5 of the 30 samples. Lead was detected above laboratory reporting limits in monitoring wells N3-3, N3-4, N4-3, W-22, and W-29S at concentrations of 0.046 mg/L, 0.0056 mg/L, 0.0069 mg/L, 0.011 mg/L, and 0.005 mg/L, respectively. The KDHE Tier 2 RBSL of 0.015 mg/L for lead was exceeded in monitoring well N3-3.

- Manganese was detected above laboratory reporting limits in 21 of the 30 samples. Manganese was detected above laboratory reporting limits in monitoring wells with concentrations ranging from 0.016 mg/L in well N3-1 to 33 mg/L in well N3-4. The KDHE Tier 2 RBSL of 0.05 mg/L was exceeded in 19 of the monitoring wells (Fina/MW-38, N2-2, N2-3, N2-4, N3-2, N3-3, N3-4, N4-1, N4-2, N4-3, N5-2, N5-3, W-01S, W-03, W-15D, W-22, W-23, W-24, W-26, and W-29S).

Total Petroleum Hydrocarbons

- TPH-GRO concentrations were detected above laboratory reporting limits in 9 of the 30 samples collected. TPH-GRO was detected above laboratory reporting

limits in these 9 samples ranging from 100 µg/L in monitoring well N2-2 to 1,800 µg/L in monitoring well N2-3. The KDHE Tier 2 RBSL of 500 µg/L was exceeded in samples collected from monitoring wells Fina/MW-38, N2-3, N2-4, N3-3, W-22, and W-24. TPH-GRO concentrations for the First Quarter 2005 are depicted on Figure 26. TPH-GRO was detected above laboratory reporting limits in monitoring wells located within the Main Process Area and around the wastewater/stormwater ponds.

- TPH in the C10-C28 range was detected above laboratory reporting limits in 11 of the 30 samples collected. TPH-DRO was detected above laboratory reporting limits in these 11 samples ranging from 230 µg/L in monitoring well N5-3 to 2,700 µg/L in monitoring well N2-3. The KDHE Tier 2 RBSL for TPH-DRO of 720 µg/L was exceeded in five wells in samples collected from monitoring wells Fina/MW-38, N2-3, N3-4, W-22, and W-24. TPH-DRO concentrations for the First Quarter 2005 are depicted on Figure 27. TPH-DRO was detected above laboratory reporting limits in monitoring wells located within the refinery and around the wastewater ponds.

4.5.2 Second Quarter 2005/Second Phase Investigation Groundwater Analytical Data

Groundwater analytical results for the Second Quarter 2005/Second Phase Investigation sampling event are presented in Tables 13 through 17. Analytical data detected above laboratory reporting limits are presented in Tables 18through 20. Complete laboratory analytical reports for the Second Quarter 2005 Sampling Event are included in Appendix G. Analytical data validation is provided in Appendix H. The analytical results for the groundwater samples were compared to the KDHE Tier 2 RBSLs for the Groundwater Pathway, Non-residential Scenario (taken from the RSK Manual - 3rd Version, March 2003). Parameters that were detected above laboratory reporting limits above KDHE Tier 2 RBSLs are discussed below.

Volatile Organic Compounds

Volatile Organic Compounds - Second Quarter 2005

- Benzene was detected above laboratory reporting limits in 11 of the 31 samples collected at the Site. Benzene was detected above laboratory reporting limits in monitoring wells Fina/MW-38 (250 µg/L), N2-2 (1.2 µg/L), N2-3 (570 µg/L), N2-4 (110 µg/L), N3-3 (4.5 µg/L), N3-4 (77 µg/L), N4-1 (1.7 µg/L), N6-1 (10 µg/L), W-22 (160 µg/L), W-23 (9.8 µg/L), and W-24 (150 µg/L). Benzene concentrations exceeded the KDHE Tier 2 RBSL of 5.0 µg/L in monitoring wells Fina/MW-38, N2-3, N2-4, N3-4, N6-1, W-22, W-23, and W-24. Benzene concentrations in groundwater are depicted on Figure 28. Benzene was detected above laboratory reporting limits in monitoring wells located within the refinery and around the wastewater ponds. Benzene was not detected above laboratory reporting limits in any of the groundwater samples collected from monitoring wells completed within the Fort Riley Limestone or the Florence Limestone.

- MTBE was detected above laboratory reporting limits in 5 of the 31 samples collected at the Site. MTBE was detected above laboratory reporting limits in monitoring wells N3-2 (17 µg/L), N3-4 (25J µg/L), N4-1 (140 µg/L), N4-2 (22 µg/L), and W-22 (11 µg/L). The KDHE Tier 2 RBSL for MTBE of 20 µg/L was exceeded in N3-4, N4-1, and N4-2.

Volatile Organic Compounds - Second Phase Investigation

- Benzene was detected above laboratory reporting limits in 19 of the 34 samples collected from the new wells at the Site installed for the Second Phase Investigation Investigation. Benzene was detected above laboratory reporting limits in monitoring wells OW-02 (650 µg/L), OW-08 (270 µg/L), OW-09 (150 µg/L), OW-13 (370 µg/L), OW-16 (12 µg/L), OW-19T (1,800 µg/L), OW-22 (180 µg/L), OW-24 (700 µg/L), OW-25 (260 µg/L), OW-27T (22 µg/L), OW-28T (25 µg/L), OW-29 (100 µg/L), OW-30 (21 µg/L), OW-31 (270 µg/L), OW-32 (26 µg/L), OW-35 (2.3 µg/L), OW-36 (44 µg/L), OW-37 (9,700 µg/L), and OW-38 (68 µg/L). Benzene concentrations exceeded the KDHE Tier 2 RBSL of 5.0 µg/L in 18 of the 19

monitoring wells with benzene detections. Benzene concentrations in groundwater are depicted on Figure 28.

- MTBE was detected above laboratory reporting limits in 11 of the 34 samples collected from the Second Phase Investigation monitoring wells at the Site. MTBE was detected above laboratory reporting limits in monitoring wells OW-02 (650 µg/L), OW-09 (48 µg/L), OW-13 (5,300 µg/L), OW-14 (10 µg/L), OW-24 (330 µg/L), OW-25 (200 µg/L), OW-28T (6 µg/L), OW-30 (42 µg/L), OW-31 (46 µg/L), OW-32 (41 µg/L), OW-33 (14 µg/L), and OW-38 (16 µg/L). The Tier 2 Level for MTBE of 20 µg/L was exceeded in 8 of the 11 monitoring wells with MTBE detections.

Semi-Volatile Organic Compounds – Second Phase Investigation

- Acenaphthene was detected above laboratory reporting limits in monitoring well OW-19T at a concentration of 480 µg/L. This is below the KDHE Tier 2 BRSL of 490 µg/L.
- Bis (2-ethylhexyl) Phthalate exceeded the KDHE Tier 2 RBSL (6.0 µg/L) in 1 of the 34 of the groundwater samples collected at the Site. Bis (2-ethylhexyl) Phthalate was detected in monitoring well OW-30 at a concentration of 59 µg/L. Bis (2-ethylhexyl) phthalate is a common laboratory contaminant, however it was not found in the associated blank.
- 2-Methylnaphthalene was detected above laboratory reporting limits in 12 of the 34 groundwater samples collected. Concentrations ranged from 10 µg/L in well OW-08 to 8,000 µg/L in well OW-19T. There is no KDHE Tier 2 RBSL for 2-Methylnaphthalene in groundwater.
- 2,4-Dimethyl phenol was detected above laboratory reporting limits monitoring well OW-29 at a concentration of 12J µg/L. There is no KDHE Tier 2 RBSL for 2,4-Dimethyl phenol in groundwater.
- Fluorene was detected above laboratory reporting limits in 1 of the 34 groundwater samples collected at the Site. Fluorene was detected at a concentration of 640 µg/L in well OW-19T. The KDHE Tier 2 RBSL of 280 µg/L was exceeded in the sample collected from well OW-19T.

- Naphthalene was detected above laboratory reporting limits in 10 of the 34 groundwater samples collected at the Site. Naphthalene concentrations ranged from 12 µg/L in OW-09 to 1,500 µg/L in OW-19T. The KDHE Tier 2 RBSL of 350 µg/L was exceeded in the groundwater sample collected from well OW-19T.
- Phenanthrene was detected above laboratory reporting limits in 2 of the 34 groundwater samples collected. Phenanthrene was detected in monitoring wells OW-14 and well OW-19T at concentrations of 19 µg/L and 2,200 µg/L, respectively. There is no KDHE Tier 2 RSBL for phenanthrene in groundwater.
- Phenol was detected above laboratory reporting limits in 6 of the 34 groundwater samples at the Site. Phenol was detected in wells OW-14 (16 µg/L), OW-22 (15 µg/L), OW-24 (16 µg/L), OW-25 (15 µg/L), OW-37 (32 µg/L), and OW-38 (15 µg/L). There were no exceedances of the KDHE Tier 2 RBSL of 58,000 µg/L.
- Pyrene was detected above laboratory reporting limits in monitoring well OW-19T at a concentration of 250 µg/L. This concentration does not exceed the KDHE Tier 2 RBSL of 720 µg/L.

Metals - Second Quarter 2005

- Arsenic was detected above laboratory reporting limits in 13 of the 31 samples collected. Arsenic was detected above laboratory reporting limits in groundwater samples collected from monitoring wells Fina/MW-38 (0.017 mg/L), N2-2 (0.0095 mg/L), N2-3 (0.041 mg/L), N3-2 (0.057 mg/L), N3-3 (0.04 mg/L), N3-4 (0.0075 mg/L), N4-2 (0.006 mg/L), N5-2 (0.0066 mg/L), N5-3 (0.021 mg/L), W-1S (0.0073 mg/L), W-15D (0.016 mg/L), W-22 (0.095 mg/L), and W-24 (0.011 mg/L). The KDHE Tier 2 RBSL of 0.01 mg/L was exceeded in 8 of these groundwater samples.

- Barium was detected above laboratory reporting limits in all 31 groundwater samples collected at the Site at concentrations ranging from 0.050 mg/L to 0.80 mg/L. The KDHE Tier 2 RBSL of 2.0 mg/L was not exceeded in any of the wells.

- Chromium was detected above laboratory reporting limits in 3 of the 31 groundwater samples collected at the Site. Chromium was detected in wells N3-3

(0.038 mg/L), W-22 (0.029 mg/L), and W-29S (0.010 mg/L). The KDHE Tier 2 RBSL of 0.10 mg/L was not exceeded in these monitoring wells.

- Lead was detected above laboratory reporting limits in 3 of the 31 samples. Lead was detected above laboratory reporting limits in monitoring wells N3-3, W-22, and W-29S at concentrations of 0.022 mg/L, 0.023 mg/L, and 0.0068 mg/L, respectively. The KDHE Tier 2 RBSL of 0.015 mg/L for lead was exceeded in monitoring wells N3-3 and W-22.

- Manganese was detected above laboratory reporting limits in 23 of the 31 samples. Manganese was detected above laboratory reporting limits in monitoring wells with concentrations ranging from 0.01 mg/L in N4-4 to 24 mg/L in N3-4. The KDHE Tier 2 RBSL of 0.05 mg/L was exceeded in 22 of these monitoring wells (Fina/MW-38, N2-2, N2-3, N2-4, N3-2, N3-3, N3-4, N4-1, N4-2, N4-3, N5-2, N5-3, N6-1, W-01S, W-03, W-15D, W-22, W-23, W-24, W-26, W-29D, and W-29S).

- Nickel was detected above laboratory reporting limits in 10 of the 31 samples. Nickel was detected above laboratory reporting limits in monitoring wells with concentrations ranging from 0.0053 mg/L in well N3-2 to 0.064 mg/L in N4-2. The KDHE Tier 2 RBSL of 0.10 mg/L was not exceeded in any of these monitoring wells.

Metals – Second Phase Investigation

- Arsenic was detected above laboratory reporting limits in 23 of the 34 samples collected. Arsenic was detected above laboratory reporting limits in groundwater samples collected from monitoring wells OW-08 (0.0057 mg/L), OW-09 (0.008 mg/L), OW-10 (0.026 mg/L), OW-12 (0.0059 mg/L), OW-13 (0.0065 mg/L), OW-14 (0.078 mg/L), OW-16 (0.041 mg/L), OW-19T (0.021 mg/L), OW-21 (0.0092 mg/L), OW-22 (0.035 mg/L), OW-23T (0.0098 mg/L), OW-24 (0.029 mg/L), OW-25 (0.012 mg/L), OW-27T (0.017 mg/L), OW-28T (0.015 mg/L), OW-29 (0.042 mg/L), OW-30 (0.037 mg/L), OW-31 (0.071 mg/L), OW-32 (0.071 mg/L), OW-33 (0.082 mg/L), OW-35 (0.008 mg/L), OW-37 (0.048 mg/L),

and OW-38 (0.042 mg/L). The KDHE Tier 2 RBSL of 0.01 mg/L was exceeded in 16 of these groundwater samples.

- Barium was detected above laboratory reporting limits in all of the Second Phase Investigation samples at concentrations ranging from 0.043 mg/L to 2.9 mg/L. The KDHE Tier 2 RBSL of 2.0 mg/L for barium was exceeded in monitoring well OW-14 (2.9 mg/L).

- Beryllium was detected above laboratory reporting limits in two of the 34groundwater samples from monitoring wells OW-14 (0.008 mg/L) and OW-16 (0.0042). Both of these samples exceeded the KDHE Tier 2 RBSL of 0.004 mg/L.

- Cadmium was detected above laboratory reporting limits in one of the 34groundwater samples at a concentration of 0.0052 mg/L (well OW-14). This detection slightly exceeded the KDHE Tier 2 RBSL of 0.005 mg/L.

- Calcium was detected above laboratory reporting limits in all of the 34 groundwater samples collected ranging from 33 mg/L in well OW-26 to 1500 mg/L in well OW-14. There is no KDHE Tier 2 RBSL for calcium in groundwater.

- Chromium was detected above laboratory reporting limits in 6 of the 34 Second Phase Investigation samples from monitoring wells OW-06 (0.015 mg/L), OW-13 (0.24 mg/L), OW-14 (0.036 mg/L), OW-16 (0.012 mg/L), OW-19T (0.135 mg/L), and OW-32 (0.043 mg/L). The groundwater samples from wells OW-13 and OW-19T exceeded the KDHE Tier 2 RBSL of 0.1 mg/L.

- Chromium III was detected above laboratory reporting limits in 4 of the 34 groundwater samples. Trivalent chromium was detected in wells OW-06, OW-13, OW-14, and OW-32 at concentrations of 0.015 mg/L, 0.240 mg/L, 0.036 mg/L, and 0.043 mg/L, respectively. There is no KDHE Tier 2 RBSL for trivalent chromium in groundwater.

- Cobalt was detected above laboratory reporting limits in 4 of the 34 groundwater samples collected from monitoring wells OW-14 (0.069 mg/L), OW-16 (0.037 mg/L), OW-27T (0.022 mg/L), and OW-32 (0.027 mg/L). There is no KDHE Tier 2 RBSL for cobalt in groundwater.

- Copper was detected above laboratory reporting limits in 4 of the 34 groundwater samples collected from monitoring wells OW-14 (0.13 mg/L), OW-16 (0.051 mg/L), OW-19T (0.015 mg/L), and OW-32 (0.065 mg/L). There KDHE Tier 2 RBSL of 1.3 mg/L was not exceeded in any of these wells.

- Hexavalent chromium was detected above laboratory reporting limits in 2 of the 34 groundwater samples. Hexavalent chromium was detected in wells OW-19T and OW-32 at concentrations of 0.135 mg/L, and 0.043 mg/L, respectively. There is no KDHE Tier 2 RBSL for hexavalent chromium in groundwater.

- Iron was detected above laboratory reporting limits in 33 of the 34 groundwater samples collected ranging from 0.10 mg/L in well OW-07 to 130 mg/L in well OW-14. There is no KDHE Tier 2 RBSL for iron in groundwater.

- Lead was detected above laboratory reporting limits in 7 of the 34 samples. Lead was detected above laboratory reporting limits in monitoring wells OW-08, OW-13, OW-14, OW-16, OW-19T, OW-29, and OW-32 at concentrations ranging from 0.0062 mg/l to 0.11 mg/L. The KDHE Tier 2 RBSL of 0.015 mg/L for lead was exceeded in monitoring wells OW-14 (0.11 mg/L), OW-16 (0.048 mg/L), OW-19T (0.02 mg/L), OW-29 (0.017 mg/L), and OW-32 (0.05 mg/L).

- Magnesium was detected above laboratory reporting limits in all of the 34 groundwater samples at concentrations ranging from 7.5 mg/L in well OW-11 to 220 mg/L in well OW-19T. There is no KDHE Tier 2 RBSL for potassium in groundwater.

- Manganese was detected above laboratory reporting limits in 30 of the 34 Second Phase Investigation samples. Manganese was detected above laboratory reporting limits in monitoring wells with concentrations ranging from 0.037 mg/L in OW-

04 to 13 mg/L in OW-16. The KDHE Tier 2 RBSL of 0.05 mg/L was exceeded in 30 of these monitoring wells.

- Nickel was detected above laboratory reporting limits in 11 of the 34 groundwater samples at concentrations ranging from 0.0058 mg/L to 0.17 mg/L. The KDHE Tier 2 RBSL of 0.1 mg/L for nickel exceeded in monitoring well OW-14 (0.17 mg/L).

- Potassium was detected above laboratory reporting limits in 23 of the 34 groundwater samples at concentrations ranging from 1.1 mg/L in well OW-37 to 27 mg/L in well OW-14. There is no KDHE Tier 2 RBSL for potassium in groundwater.

- Sodium was detected above laboratory reporting limits in all of the 34 groundwater samples at concentrations ranging from 17 mg/L in well OW-07 to 1000 mg/L in well OW-19T. There is no KDHE Tier 2 RBSL for sodium in groundwater.

- Vanadium was detected above laboratory reporting limits in 7 of the 34 groundwater samples at concentrations ranging from 0.015 mg/L in well OW-13 to 0.22 mg/L in well OW-14. The KDHE Tier 2 RBSL of 0.71 mg/L was not exceeded in either well.

- Zinc was detected above laboratory reporting limits in 13 of the 34 groundwater samples at concentrations ranging from 0.027 mg/L in well OW-12 to 0.74 mg/L in well OW-14. The KDHE Tier 2 RBSL of 5.0 mg/L was not exceeded in any of the wells.

Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons - Second Quarter 2005

- TPH-GRO was detected above laboratory reporting limits in 12 of the 31 samples collected. TPH-GRO was detected above laboratory reporting limits in these 12 samples ranging from 100 µg/L in monitoring well N4-1 to 3,300 µg/L in monitoring

well N2-3. The KDHE Tier 2 RBSL of 500 µg/L was exceeded in 8 samples collected from monitoring wells Fina/MW-38, N2-3, N2-4, N3-3, N6-1, W-22, W-23, and W-24. TPH-GRO concentrations for the Second Quarter 2005 are depicted on Figure 29.

- TPH in the C10-C28 range was detected above laboratory reporting limits in 10 of the 31 samples collected. TPH-DRO was detected above laboratory reporting limits in these 10 samples ranging from 330 µg/L in monitoring well N2-2 to 5,400 µg/L in monitoring well N3-4. The KDHE Tier 2 RBSL for TPH-DRO of 720 µg/L was exceeded in eight wells in samples collected from monitoring wells Fina/MW-38, N2-3, N2-4, N3-2, N3-3, N3-4, W-22, and W-24. TPH-DRO concentrations for the Second Quarter 2005 are depicted on Figure 30.

Total Petroleum Hydrocarbons – Second Phase Investigation

- TPH-GRO was detected above laboratory reporting limits in 25 of the 34 samples collected. TPH-GRO was detected above laboratory reporting limits in these 27 samples ranging from 100 µg/L in monitoring wells OW-1 and OW-33 to 13,000 µg/L in monitoring well OW-19T. The KDHE Tier 2 RBSL of 500 µg/L was exceeded in 18 samples collected from monitoring wells OW-02, OW-08, OW-09, OW-13, OW-16, OW-19T, OW-22, OW-24, OW-25, OW-27T, OW-28T, OW-29, OW-30, OW-31, OW-32, OW-35, OW-36, and OW-37. TPH-GRO concentrations for the Second Phase Investigation are depicted on Figure 29.

- TPH in the C10-C28 range was detected above laboratory reporting limits in all of the 34 samples collected. TPH-DRO was detected above laboratory reporting limits in these samples ranging from 110 µg/L in monitoring well OW-3 to 1,000,000 µg/L in monitoring well OW-19T. The KDHE Tier 2 RBSL for TPH-DRO of 720 µg/L was exceeded in 24 of the groundwater samples collected (monitoring wells OW-01, OW-02, OW-08, OW-09, OW-10, OW-12, OW-14, OW-16, OW-19T, OW-22, OW-23T, OW-24, OW-25, OW-26, OW-27T, OW-28T, OW-29, OW-30, OW-31, OW-32, OW-33, OW-36, OW-37, and OW-38). TPH-DRO concentrations for the Second Phase Investigation are depicted on Figure 30.

- TPH in the C28-C35 range was detected above laboratory reporting limits in 18 of the 34 samples collected. TPH in the C28-C35 range was detected above laboratory reporting limits in these 18 samples ranging from 24 µg/L in monitoring well OW-08 to 720J µg/L in monitoring well OW-29. There is no a KDHE Tier 2 RSBL for this range of hydrocarbons (C28-C35).

- TPH above the C10 range was detected above laboratory reporting limits all of the 34 samples collected. TPH above the C10 range was detected above laboratory reporting limits in these 34 samples ranging from 150 µg/L in monitoring well OW-13 to 1,000,000 µg/L in monitoring well OW-19T. There is no KDHE Tier 2 RSBL for this total range of hydrocarbons (above C10).

General Chemistry

- Chloride was detected in all 34 of the groundwater samples collected ranging from 13 mg/L in well OW-12 to 1,900 mg/L in well OW-19T. There is no Kansas Tier 2 RBSL for chloride in groundwater.
- Fluoride was detected above laboratory report limits in all 34 of the groundwater samples collected at the Site ranging from 0.32 mg/L in wells OW-16 and OW-23T to 3.5 mg/L in well OW-32. There is no Kansas Tier 2 RBSL for fluoride in groundwater.
- Nitrate was detected above the laboratory reporting limit in 21 of the 34 samples collected at the Site. Nitrate concentrations ranged from 0.10 mg/L in well OW-11 to 1.0 mg/L in well OW-23T. The Kansas Tier 2 RBSL of 45 mg/L for nitrate was not exceeded in any of these wells.
- Sulfate was detected above laboratory detection limits in 10 of the 34 groundwater samples collected at the Site. Sulfate concentrations ranged from 0.50 mg/L in well OW-24 to 230 mg/L in well OW-05. There is no Kansas RBSL for sulfate in groundwater.

Geochemical Data Evaluation

Major-ion (Ca, Mg, Na, K, SO_4, Cl, CO_3, & HCO_3) data were collected from monitoring wells at the Site, in order to evaluate the connections (or lack thereof) between the various aquifers at the Site. Data utilized as part of this evaluation were obtained from

the Second Phase Investigation, the Fourth Quarter 2004 Sampling Event, and from the Pester spring sample (supplied by the KDHE). The analysis of the results of the geochemical testing is provided in Appendix I. A summary of the conclusions from the evaluation is provided below.

The sum of the milliequivalents of the cations should balance with the sum of the milliequivalents of the anions in a groundwater sample. Accordingly, a cation/anion balance was performed to assess the viability of the general chemistry data. Unfortunately, many of the cations and anions did not balance in the groundwater samples. According to STL personnel, matrix interferences caused the imbalance. Despite the imbalance; however, the data were deemed useable for the qualitative evaluation that was performed.

The data were used to generate both Stiff Diagrams, which were placed on a Site map, and a series of trilinear plots. The various sample locations were then analyzed as a function of the lithologic units sampled by the various wells. In the case of this Site, the extensive presence of hydrocarbons in the groundwater has resulted in microbiological activity and the generation of reducing conditions, as indicated by negative ORPs optimal for the growth of micro-organisms capable of reducing nitrate and sulfate, and the associated oxidation of hydrocarbons. The general lack of nitrate and sulfate ions in the subsurface indicates that these organisms, especially sulfate-reducing bacteria (SRB) are widespread in the subsurface at the Site. Most of the groundwater samples from the shallow units are essentially devoid of sulfate, thereby essentially eliminating the use of the anion triangle and the central diamond for the trilinears. Only well N3-4 contains elevated sulfate concentration.

The map showing the Stiff diagrams shows that wells with the highest total dissolved solids concentrations are in the north-central part of the Site and are composed of calcium bicarbonate water types. By contrast, samples from wells in the South Tank Farm Area are less concentrated, and are of a sodium bicarbonate type.

A plot of wells completed in the Doyle Shale is generally similar to the trilinear plot of shallow wells, with low Mg concentrations and a trend of points showing varying

percentages of Na+K to Ca. Only Doyle well W15S is outside this trend. Samples from the CC Spring and Pester Spring are similar in composition to the shallow and Doyle units, indicating that these springs are fed from these lithological units.A trilinear plot of wells completed in the Fort Riley Limestone does not show a clear cation trend, but the wells are generally dissimilar from wells sampled in the over-lying Doyle or shallow unit. In general, the cation composition is higher in Mg. Only well N4-1 is similar to the composition of the overlying Doyle and shallow lithological units. Wells from the Fort Riley Limestone unit commonly include approximately 20% sulfate as the anion composition, except for well W-29D, which raises question about possible vertical leakage for this well.

A Site map showing Stiff diagrams for all surface water, groundwater, and spring samples collected is included in Appendix I. Water with similar Stiff plots have similar geochemical compositions and typically have a common source. As shown on Figure A in Appendix I, the shallow groundwater within the Doyle Shale at the western half of the Site is very similar in composition to the CC Spring sample. In addition, shallow wells in the southeast corner of the South Tank Farm Area are similar in composition. Also, the wells to the south and east of Topeka Road (south of the Main Process Area) are all highly mineralized and have similar composition. Stiff diagrams for the surface water samples collected from the wastewater/stormwater ponds are less concentrated, but of similar composition as the groundwater sample from the Florence Limestone well N3-1. This suggests that groundwater from the Florence Limestone may be flowing upward through fractures and into the surface water ponds.

Florence Limestone Wells

Wells screened in the Florence Limestone unit are lower in Mg content than wells from the overlying Fort Riley Limestone unit, but higher in Mg than wells from the shallow and Doyle Shale units. The Florence Limestone wells have lower relative sulfate concentrations than do the wells from the overlying Fort Riley Limestone unit, but do contain approximately 10% sulfate, with the exception of the groundwater sample collected from well W-15D.

Stable Isotope Data

A distinct evaporative enrichment trend is observed for groundwater data within the shallow alluvium. The fractional evaporative loss required to produce this isotopic distribution has been quantified and is found to be approximately 12%. The proximity of sampled wells to the wastewater/stormwater ponds suggests that evaporation of these surface waters, and subsequent recharge, are providing the source of isotopic enrichment for the shallow alluvial waters. The isotopic depletion and scatter observed in groundwater, particularly that of the Doyle Shale, is suggestive of a three end-member isotopic mixing scenario. Given the current data set, it is difficult to speculate on the origin of the third end-member. A discussion of the stable isotope data is presented in Appendix J.

The isotopic composition of the CC Spring sample is similar in composition to the Site-average groundwater value, suggesting that it, like the shallow groundwater, is influenced primarily by direct precipitation.

Analytical Time Trend Plots

Concentration versus time graphs for benzene, TPH-DRO, and TPH-GRO for the monitoring wells within the Site-wide monitoring network are included in Appendix K. Results below the detection limit are plotted at the detection limit (i.e., results less than 1.0 μg/L are plotted as 1.0 μg/L). Appendix K does not include graphs for monitoring well N2-5, N2-6, and N6-1. These monitoring wells have not historically been sampled due to the presence of LNAPL (with the exception of monitoring well N2-5, which was sampled once during the third quarter 2004 and monitoring well N6-1 which was sampled once during the second quarter of 2005).

Apparent Increasing Trends in Contaminant Concentrations Over Time

Following is a summary of the monitoring wells that have shown apparent increases on the contaminant versus time graphs for benzene, TPH-DRO, and/or TPH-GRO.

Benzene. Benzene concentrations have shown an increase over time in groundwater samples collected from monitoring wells N2-4 and W-22. Monitoring well N2-4 is

located immediately downgradient of the refinery and monitoring well W-22 is located to the northeast of the wastewater/stormwater ponds.

TPH-DRO. TPH-DRO concentrations have increased over time in the groundwater samples collected from several of the monitoring wells at the Site. The monitoring wells are located within the Main Process Area (N2-3 and Fina/MW-38), downgradient of the Main Process Area (N2-4), and around the wastewater/stormwater ponds (N3-3, W-22, and W-24).

TPH-GRO. TPH-GRO concentrations have increased over time in the groundwater samples collected from monitoring well N2-4. Monitoring well N2-4 is located downgradient of the Main Process Area.

Apparent Decreasing Trends in Contaminant Concentrations Over Time

Following is a summary of the monitoring wells that have shown apparent decreases on the contaminant versus time graphs for benzene, TPH-DRO, and/or TPH-GRO.

Benzene. Benzene concentrations have shown a decrease over time in groundwater samples collected from monitoring wells N2-2. Monitoring well N2-2 is located within the Main Process Area.

TPH-GRO. TPH-GRO concentrations have decreased over time in the groundwater samples collected from monitoring wells within the Main Process Area (N2-2), around the wastewater/stormwater ponds (W-23 and W-24), and monitoring well N5-3, located in the South Tank Farm Area.

Groundwater Level Elevation and Contaminant Concentration Apparent Trends Over Time

The graphs included in Appendix K also depict historic groundwater elevations through August 2, 2005. In general, there does not appear to be a Site-wide correlation between contaminant concentrations and fluctuations in groundwater elevations.

4.6 CONTAMINANT MIGRATION PATHWAYS AND POTENTIAL RECEPTORS

Surface water flow at the Main Process Area is channeled into the wastewater/stormwater ponds for treatment. Migration via air dispersion is not expected to be a significant migration pathway at the Site. The primary contaminant off-Site migration pathway is through groundwater. Three different water-bearing zones have been identified beneath the Site, including the Shallow System under water table conditions (alluvium/weathered bedrock and the Doyle Shale) and the confined to partially confined groundwater encountered within fractures at the base of the Fort Riley Limestone Formation and within the Florence Limestone. The most transmissive of the water-bearing zones is within the portion of the Shallow System that is comprised of highly fractured and weathered limestone. As shown by the flux estimates, the flux in the Shallow Zone is approximately **4,000 times** that in the competent Fort Riley Limestone and **4 times** that in the Florence Limestone.

Although general chemistry and stable isotope data indicate a possible connection between the three water-bearing zones, the groundwater potentiometric data suggest that the connection between the zones is limited. The lack of significant groundwater impacts detected in the wells completed in the Fort Riley Limestone and the Florence Limestone also suggest a lack of connection between the zones. Given that the deeper water-bearing zones are largely confined, the upward gradient likely prevents contaminants that are present in the Shallow Zone from penetrating into the deeper zones along fractures.

As discussed in Section 4.4.1, no groundwater supply wells have been identified downgradient from the Site. In addition, no significant Site-related contaminant levels have been detected in surface water samples to date. Accordingly, no immediate threat to off-Site receptors has been identified as part of the Second Phase Investigation. Long-term risks will be evaluated as part of a future Site-wide risk assessment.

5.0 SUMMARY OF FINDINGS AND CONCLUSIONS

5.1 REGIONAL HYDROGEOLOGY

- Ground surface elevations at the Site range from approximately 1350 feet above the NGVD in the uplands at the northwest portion of the Site, to approximately 1280 feet above the NGVD east of the Site and adjacent to the West Branch Walnut River.
- The uplands around El Dorado are underlain by the Doyle Shale Formation and the Barnestone Limestone Formation. The Townada Limestone and Holmesville Shale Members of the Doyle Shale Formation are present in the Site vicinity (Zeller, 1968). Underlying the Doyle Shale Formation is the Barnestone Limestone Formation, which is comprised of the Fort Riley Limestone, Oketo Shale, and the Florence Limestone Members. Underlying the Barnestone Limestone Formation is the Blue Springs Shale Member of the Matfield Shale.
- Groundwater is readily available in most areas of the Flint Hills region (Aber, 2004). The principal aquifers in the region occur in the Nolands, Winfield, and Barnestone Limestone. Sinkholes are common where these units crop out in uplands, and springs commonly emerge from these units in valleys and stream channels. However, according to Leonard (1972), a regional aquifer is not present in the Walnut River Basin. Instead, the small, shallow aquifers that do exist are discontinuous horizontally and vertically and are normally subject only to local recharge.

5.2 SITE GEOLOGY

- An interpretation of the natural gamma logs shows that the Oketo Shale is present across the entire Site.
- The alluvium from the surface to above the weathered Fort Riley Limestone is described in the boring logs as predominantly silty clay with a thickness ranging from approximately 4 to 20 feet. Underlying the alluvial soils was weathered bedrock residuum, which was typically comprised of limestone fragments and/or clay.
- Bedrock was largely described as consisting of argillaceous limestone and limestone that were thin-bedded to massive, and highly to minimally fractured. Solution voids and fracturing typically decreased with depth.

5.3 SITE GROUNDWATER

- Three different water-bearing zones have been identified beneath the Site. These include the shallow groundwater-bearing zone under water table conditions (alluvium/weathered bedrock and the Doyle Shale collectively referred to as the Shallow System) and the confined to partially confined groundwater encountered within fractures at the base of the Fort Riley Formation and within the Florence Limestone.
- Natural gamma logs and field observations indicate that the groundwater at the base of the Fort Riley Limestone is confined by upper, less fractured portions of the Fort Riley Limestone. The groundwater in the Florence Limestone is confined by the presence of the Oketo Shale directly above the unit.
- The limited connection between the three water-bearing zones is evidenced by the differing groundwater potentiometric surface elevations in clustered well sets.
- Based on the slug test data and on field observations, the most transmissive of the water-bearing zones is the highly fractured and weathered limestone underlying the residuum and alluvium.
- The following groundwater flux rates were estimated: Shallow Zone: 2.64 ft^3/min, Fort Riley Limestone: 0.0006539 ft^3/min, Florence Limestone: 0.6034 ft^3/min. As shown by the flux estimates, the flux in the Shallow Zone is approximately **4,000 times** that in the competent Fort Riley Limestone and **4 times** that in the Florence Limestone.
- On August 2, 2005, the shallow groundwater flow direction was toward the east with an average Site-wide gradient of approximately 0.015 ft/ft. The Fort Riley groundwater flow direction was toward the east with an average Site-wide gradient of approximately 0.013 ft/ft.
- LNAPL was measured in three areas of the Site: the southern portion of the Main Process Area, and the southwest and southeast portions of the Southern Tank Farm Area on August 2, 2005. The thickest apparent accumulation of LNAPL (13.88 feet) was measured in monitoring well N2-6, which is located to the east of the tank car loading area and southwest of the Spray Ponds in the Main Process Area. LNAPL

apparent thicknesses of 0.07 feet and 0.29 feet were measured in monitoring wells N6-1 and OW-12, respectively, in the South Tank Farm Area.

- Significant mounding is not apparent in monitoring wells completed around the wastewater/stormwater ponds. This indicates that infiltration of surface water through the base of the ponds is limited, which is likely due to the presence of a liner at the base of the ponds. However, mounding is evident beneath the Spray Pond located to the east of the Main Process Area. The mounding is likely containing the LNAPL in the shallow alluvium/residuum to the east of the Spray Pond.

5.4 XRF SCREENING

- The results of the XRF screening indicated the possible presence of elevated chromium and lead levels in surface soil at the Main Process Area and along the west side of the wastewater/stormwater pond berm. In addition, possibly elevated arsenic levels were indicated in surface soil at the Main Process Area and at the southern end of the South Tank Farm Area.

5.5 SURFACE WATER DATA-WEST BRANCH WALNUT RIVER

- TPH levels (above the C10 range) up to 55 μg/L (Transect #1) were detected in the surface water samples collected from the West Branch Walnut River. There are no Kansas SWQS for TPH in surface water.
- Arsenic was detected above the Kansas SWQS of 0.000018 mg/L in the surface water sample collected from Transect #2 at a concentration of 0.005 mg/L.
- Mercury was detected above the Kansas SWQS of 0.00014 mg/L in all of the surface water samples collected from the West Branch Walnut River at concentrations up to 0.0026 mg/L (Transect #4).

5.6 SURFACE WATER DATA-INTERMITTENT CREEK

- TPH levels (above the C10 range) up to 95 μg/L (Transect #5) were detected in the surface water samples collected from the intermittent creek that crosses the South Tank Farm Area. There are no Kansas SWQS for TPH in surface water.
- The Kansas SWQS of 250 mg/L for chloride was exceeded in the surface water samples collected from Transect #6 (350 mg/L) and Transect #7 (280 mg/L).

5.7 SURFACE WATER DATA-PONDS

- TPH levels (above the C10 range) up to 1,000 µg/L (Southwest Pond) were detected in the surface water samples collected from the ponds at the Site. There are no Kansas SWQS for TPH in surface water.
- The Kansas SWQS of 0.015 mg/L for lead was exceeded in the surface water sample collected from the Marley Pond (0.071 mg/L) and the Northwest Pond (0.037 mg/L).
- The Kansas SWQS of 0.00014 mg/L for mercury was exceeded in all 5 samples collected from the surface water ponds. Mercury was detected at concentrations of 0.0033 mg/L in the Marley Pond, 0.00062 mg/L in the Northeast Pond, 0.0036 mg/L in the Northwest Pond, 0.00095 mg/L in the Southeast Pond, and 0.007 mg/L in the Southwest Pond.

5.8 CATALYTIC CRACKING UNIT SPRING

- Benzene was detected at 29 µg/L in the CC Spring. This concentration of benzene exceeds the Kansas SWQS of 1.2 µg/L.
- TPH levels (above the C10 range) were detected at 410 µg/L in the CC Spring. There are no Kansas SWQS for TPH in surface water.

5.9 GROUNDWATER GEOCHEMISTRY

- The presence of hydrocarbons in the groundwater has resulted in microbiological activity and the generation of reducing conditions, as indicated by negative ORPs. This is optimal for the growth of micro-organisms capable of reducing nitrate and sulfate, and the associated oxidation of hydrocarbons.
- Samples from the CC Spring (spring at the catalytic cracking unit) and Pester Spring are similar in composition to groundwater in the Shallow System and Doyle Shale, indicating that these springs are fed from these lithological units.
- The shallow groundwater within the Doyle Shale at the western half of the Site and in the southeast corner of the South Tank Farm Area are very similar in general chemistry composition to the CC Spring sample. Also, the wells to the south and east of Topeka Road (south of the Main Process Area) are all highly mineralized and have similar compositions. Stiff diagrams of the surface water samples collected from the

wastewater/stormwater ponds are less concentrated, but of similar composition to the groundwater sample from the Florence Limestone Well N3-1. This suggests that groundwater from the Florence Limestone may be flowing upward through fractures and into the surface water ponds.

- The distinct evaporative enrichment trend observed in stable isotope data collected from wells in the proximity of the wastewater/stormwater ponds suggests that evaporation of these surface waters, and subsequent recharge, are providing the source of isotopic enrichment for the shallow alluvial waters in this area. The CC Spring sample isotopic composition is similar in composition to the Site-average groundwater value, suggesting that it, like the shallow groundwater, is influenced primarily by direct precipitation.

5.10 GROUNDWATER ANALYTICAL DATA

This section presents a summary of the findings and conclusions from the groundwater sample analyses collected as part of the first and second quarterly monitoring events and the Second Phase Investigation.

- Benzene was detected at levels up to 9,700 µg/L in groundwater at the Site. Benzene levels exceeded the KDHE Tier 2 RBSL of 5.0 µg/L in groundwater samples from 26 monitoring wells.
- MTBE was detected at levels up to 5,300 µg/L (OW-13). MTBE exceeded the KDHE Tier 2 RBSL of 20 µg/L in groundwater samples from 11 monitoring wells.
- Bis (2-ethylhexyl) Phthalate exceeded the KDHE Tier 2 RBSL of 6.0 µg/L in monitoring well OW-30 at a concentration of 59 µg/L. This analyte is a common laboratory and field contaminant.
- Fluorene (640 µg/L) and naphthalene (1,500 µg/L) exceeded the KDHE Tier 2 RBSLs of 280 µg/L and 350 µg/L, respectively, in the groundwater sample collected from monitoring well OW-19T. A heavy petroleum sheen was observed on top of the groundwater when sampling this well.

- TPH-GRO was detected at levels up to 13,000 µg/L (OW-19T) in groundwater samples. The KDHE Tier 2 RBSL for TPH-GRO (500 µg/L) was exceeded in groundwater samples from 26 monitoring wells.
- TPH in the C10-C28 range (DRO) was detected at levels up to 1,000,000 µg/L in groundwater samples. TPH in the C10-C28 range exceeded the KDHE Tier 2 RBSL of 720 µg/L in groundwater samples from 32 monitoring wells.
- Arsenic was detected at levels up to 0.095 mg/L in groundwater samples. Arsenic exceeded the KDHE Tier 2 RBSL of 0.01 mg/L in groundwater samples from 24 monitoring wells.
- Barium exceeded the KDHE Tier 2 RBSL of 2.0 mg/L in the groundwater sample from monitoring well OW-14, which contained a barium concentration of 2.9 mg/L.
- Beryllium exceeded the KDHE Tier 2 RBSL of 0.004 mg/L in the groundwater samples from wells OW-14 and OW-16, which contained beryllium concentrations of 0.008 mg/L and 0.0042 mg/L, respectively.
- Cadmium exceeded the KDHE Tier 2 RBSL of 0.005 mg/L in the groundwater sample from well OW-14, which contained a cadmium concentration of 0.0052 mg/L.
- Chromium exceeded the KDHE Tier 2 RBSL of 0.1 mg/L in groundwater samples from wells OW-13 and OW-19T, which contained chromium concentrations of 0.24 mg/L and 0.135 mg/L, respectively.
- Lead was detected at levels up to 0.11 mg/L in groundwater samples. Lead exceeded the KDHE Tier 2 RBSL of 0.015 mg/L in groundwater samples from 7 monitoring wells.
- Nickel exceeded the KDHE Tier 2 RBSL of 0.1 mg/L in the groundwater sample from monitoring well OW-14, which contained a nickel concentration of 0.17 mg/L.
- All of the KDHE Tier 2 RBSL exceedances for barium, beryllium, cadmium, chromium, and lead were associated with wells that were sampled with bailers because of poor well yield. This likely contributed to the elevated metal levels by creating turbulence within the wells, which entrained sediment in the groundwater. The use of low-flow pumps in the other wells sampled minimized turbulence during sampling, and thus reduced the amount of sediment in the groundwater.

- Manganese was detected at levels up to 33 mg/L in groundwater samples. Manganese exceeded the KDHE Tier 2 RBSL of 0.05 mg/L in groundwater samples from 52 monitoring wells. The manganese levels are likely consistent with natural, background levels.

5.11 OFF-SITE MIGRATION PATHWAYS AND POTENTIAL RECEPTORS

- The primary contaminant off-Site migration pathway is through groundwater.
- No groundwater supply wells have been identified downgradient from the Site. In addition, no significant Site-related contaminant levels have been detected in the water samples collected from the West Branch Walnut River and the intermittent creek to date.
- No immediate threat to off-Site receptors was identified during the Second Phase Investigation. Long-term risks will be evaluated as part of a future Site-wide risk assessment.

6.0 RECOMMENDATIONS

The following recommendations are based on the findings and conclusions of the Second Phase Environmental Investigation of the El Dorado Refinery.

Interim Measures

It is recommended that an Interim Measure be implemented at the eastern portion of the Site (along the West Branch Walnut River) to prevent hydrocarbon seeps from occurring in this area. The proposed Interim Measure is a cut-off trench located between the wastewater/stormwater ponds and the West Branch Walnut River. The trench should be extended horizontally along the entire length of the wastewater/stormwater ponds and vertically to the top of the competent bedrock. The objective of installing the trench will be to prevent the flow of impacted groundwater and hydrocarbons through the Shallow System (alluvium/weathered bedrock) and into the West Branch Walnut River. An Interim Measure conceptual design package will be prepared and submitted to the KDHE for approval.

Soil Investigation

A soil investigation Work Plan will be prepared for submittal to the KDHE. The Work Plan will describe the tasks that will be undertaken to further investigate metal and hydrocarbon levels in near surface soils at the Site. In addition, background levels will be established for soils in the Site-vicinity for comparison with soil sample data from the facility. The Work Plan will be implemented after the completion of all Phase 2 demolition activities.

Expanded Groundwater Investigation

A Work Plan will be prepared for an additional groundwater investigation at the Site. The expanded investigation will focus on the following areas of the Site:

- Asphalt Handling Area – asphalt and other process materials were historically handled at the western portion of the facility. A groundwater investigation will be conducted in this area to assess the possible presence of source areas that may have resulted from past uses.

- Main Process Area – additional groundwater investigation tasks will be performed to assess the locations of the principal sources of soil and groundwater impacts in this area. In addition, the investigation will be conducted to better define the relationship between the groundwater in the Doyle Shale at the western portion of the Site, with the shallow groundwater within the Shallow System beneath the Main Process Area.
- South Tank Farm Area – An additional investigation will be performed to better define the extent and source of LNAPL and groundwater impact at the southwestern corner of the South Tank Farm Area (in the vicinity of monitoring wells N6-1, OW-08, and OW-09).

Risk Assessment

A Work Plan will be prepared for a baseline risk assessment of the Site. The risk assessment will consist of an evaluation of risks posed by soil and groundwater contaminants at the Site to human health. Both forward and backward risk calculations will be performed in order to quantify the risk to human health, and to calculate preliminary remediation goals for the Site.

Groundwater Monitoring

It is proposed that beginning in 2006, the Site-wide groundwater monitoring program be conducted on a semi-annual basis. In addition, it is proposed that the following analytical parameters be utilized for all future groundwater monitoring (including the fourth quarter 2005 event):

- TPH – GRO and DRO
- VOCs – benzene and MTBE
- Metals – arsenic

Fluid levels in all groundwater monitoring wells at the Site will be measured prior to beginning groundwater sampling. Where practical, groundwater samples will be collected using low-flow techniques. The following wells are proposed for future groundwater monitoring (including the fourth quarter 2005 event):

- Asphalt Handling Area – OW-1, OW-2, and OW-39.
- Main Process Area – W-24, OW-25, N2-4, and OW-37.

- Wastewater/Stormwater Ponds – OW-29, W-22/OW-3, OW-04, N3-2, W-01S/OW-05, and N3-3.
- South Tank Farm Area – N6-1, OW-8, OW-9, OW-10, and OW-12.

The results of the Second Phase Investigation demonstrated that the groundwater in the Florence Limestone was not significantly threatened by the hydrocarbon impacts that have been detected within the Shallow Groundwater System. The investigation indicated that the upward groundwater gradient in the primary areas of impact and the presence of the Oketo Shale and low permeability units above the Florence Limestone prevented it from being affected. According, it is proposed that the three Florence Limestone monitoring wells be plugged and abandoned (monitoring wells N3-1, W-01D, and W-15D).

7.0 REFERENCES

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Table 1
Water Supply Well Survey
El Paso Corporation
El Dorado Refinery, Kansas

Map Well Number	Well Owner	Location*	Status
1	Alpine PEI, Inc.	SW SW SW Sec 27	Not in Use
2	Robert Call	NW SE NW Sec 34	Not in Use
3	Unknown	SW SE SW Sec 34	Unknown
4	Unknown	SW SW SW Sec 35	Unknown
5	Susan B. Anthony Hospital	NW NW NW Sec 35	Plugged**
6	Hart	SW SW NE Sec 35	Plugged
7	Unknown	NW NW SW Sec 26	Plugged

Notes:
*All locations are in Township 255 Range SE
** Well may have been mislocated on KGS map based on address on well record.
KGS-Kansas Geological Survey Water Well Database

Table 1
Water Supply Well Survey
El Paso Corporation
El Dorado Refinery, Kansas

Data Source
KGS/Visual Inspection
KGS/Visual Inspection
KGS
KGS
KGS
KGS
KGS

TABLE 2
SITE MONITORING WELL INFORMATION
EL PASO CORPORATION
EL DORADO REFINERY, EL DORADO, KANSAS
(Page 1 of 2)

Well ID	Northing	Easting	Top of Casing Elevation (ft AMSL)	Ground Surface Elevation (ft AMSL)	Total Depth of Well (ft bgs)	Measured Depth to Bottom of Well (ft below TOC)	Stickup/ Flushmount	Stickup/ Flushmount Height From Survey (ft)	Casing Diameter (inches)	Screened Interval (ft bgs)	Screened Interval (ft below TOC)	Pump Installed (yes/no)	Observations	Low Flow/Bail/Purge			Additional Comments		
														1Q05	2Q05	Phase 2	1Q05	2Q05	Phase 2
FINA/MW-38	1744575.310	1786229.860	1,306.26	1,304.34	19.25	15.9	Stickup	1.92	2	9-19*	10.92-20.92*	Yes	Mod to strong petro odor	Low Flow	Low Flow		250 ml/min, max drawdown = 0.10	500 ml/min, max drawdown = 0.46	
N1-1	1745964.190	1785744.490	1,316.25	1,313.68	22.50	25.1	Stickup	2.57	2	7-22.5	9.57-25.07	No	None	Low Flow	Low Flow		200 ml/min, max drawdown = 0.02	300 ml/min, max drawdown = 0.28	
N2-1	1743805.370	1784592.770	1,334.30	1,331.99	24.50	27	Stickup	2.31	2	9-24	11.31-26.31	No	None	Purge	Purge		Purged to pump intake	Purged to pump intake	
N2-2	1744752.310	1786130.690	1,310.32	1,307.42	21.00	23.8	Stickup	2.90	2	6-21	8.90-23.90	Yes	Mod petro odor	Low Flow	Low Flow		300 ml/min, max drawdown = 0.32	360 ml/min, no drawdown	
N2-3	1744352.210	1785992.660	1,309.42	1,307.11	15.00	17.4	Stickup	2.31	2	5-15	7.31-17.31	Yes	Mod petro odor	Low Flow	Low Flow		200 ml/min, max drawdown = 0.33	250 ml/min, no drawdown	
N2-4	1743475.540	1786585.960	1,302.80	1,300.56	26.00	28	Stickup	2.24	2	15-26	17.24-28.24	Yes	Mod petro odor	Purge	Purge		Purged to pump intake	Purged to pump intake	
N2-5	1744247.420	1786375.690	1,305.19	1,302.29	19.00	19.00	Stickup	2.90	2	14-19	16.9-21.90	No	Product, yellow/brown, strong petro odor (no product noted 6/14/05)	--	--		Not sampled - product	Not sampled - product	
N2-6	1744108.240	1786248.970	1,302.16	1,302.39	20.00	20.00	Flushmount	-0.23	2	5-20	4.77-19.77	No	Product, dark brown to black, weathered petro odor	--	--		Not sampled - product	Not sampled - product	
N3-1	1744600.610	1787271.670	1,294.10	1,291.83	78.80	81.2	Stickup	2.27	2	73.8-78.8	76.07-81.07	Yes	None	Low Flow	Low Flow		100 ml/min, max drawdown = 0.01	500 ml/min, max drawdown = 0.07	
N3-2	1743905.270	1787606.400	1,290.26	1,287.71	16.00	18.34	Stickup	2.55	--	6-16	8.55-18.55	No	Mod petro odor	Low Flow	Low Flow		225 ml/min, max drawdown = 0.26	200 ml/min, max drawdown = 0.02	
N3-3	1743452.080	1787473.300	1,293.08	1,290.81	17.25	19.4	Stickup	2.27	--	7.25-17.25	9.52-19.52	No	Slight to mod petro odor	Bail	Bail		Bailed	Bailed	
N3-4	1743629.310	1787137.350	1,294.31	1,291.93	18.50	21	Stickup	2.38	2	6.5-18.5	8.88-20.88	Yes	None	Low Flow	Low Flow		250 ml/min, no drawdown	330 ml/min, max drawdown = 1.11	
N4-1	1743217.680	1786150.260	1,310.61	1,308.29	23.00	25.4	Stickup	2.32	2	13-23	15.32-25.32	No	Slight petro odor	Purge	Purge		Purged to pump intake	Purged to pump intake	
N4-2	1742451.310	1786157.500	1,313.50	1,311.22	28.00	30.5	Stickup	2.28	2	13-28	15.28-30.28	No	None	Low Flow	Low Flow		250 ml/min, max drawdown = 0.18	350 ml/min, max drawdown = 0.26	
N4-3	1742741.670	1785467.500	1,323.34	1,321.11	20.1	22.5	Stickup	2.23		5.1-20.1	7.33-22.33	No	None	Bail	Bail		Bailed	Bailed	
N4-4	1742868.320	1784042.940	1,332.25	1,329.42	23.00	26.3	Stickup	2.83	2	8-23	10.83-25.83	Yes	None	Low Flow	Low Flow		400 ml/min, no drawdown	360 ml/min, max drawdown = 0.12	
N5-1	1741905.910	1786159.810	1,311.20	1,309.24	23.50	25.5	Stickup	1.96	2	13-23	14.96-24.96	Yes	None	Low Flow	Low Flow		150 ml/min, max drawdown = 0.17	300 ml/min, max drawdown = 0.12	
N5-2	1741324.750	1786178.390	1,309.77	1,307.52	28.00	30.4	Stickup	2.25	2	18-28	20.25-30.25	Yes	Mod petro odor	Low Flow	Low Flow		200 ml/min, max drawdown = 0.02	500 ml/min, max drawdown = 0.23	
N5-3	1740806.200	1786165.650	1,302.43	1,300.22	20.00	22.9	Stickup	2.21	2	5-20	7.21-22.21	No	Mod petro odor	Low Flow	Low Flow		250 ml/min, max drawdown = 0.29	250 ml/min, max drawdown = 0.31	
N6-1	1740265.150	1784555.110	1,313.84	1,311.72	23.50	23.50	Stickup	2.12	2	13.5-23.5	15.62-25.62	No	Product, clear (no product noted during 2Q05 sampling)	--	Low Flow		Not sampled - product	250 ml/min, no drawdown	
W-01D	1743588.970	1787714.040	1,292.67	1,288.01	92.40	94.2	Stickup	4.66	4	67-87	71.66-91.66	Yes	None	Low Flow	Low Flow		300 ml/min, max drawdown = 0.32	500 ml/min, max drawdown = 0.20	
W-01S	1743563.490	1787733.750	1,290.15	1,287.23	19.90	20	Stickup	2.92	4	9-17	11.92-19.92	Yes	Mod petro odor	Low Flow	Low Flow		200 ml/min, max drawdown = 0.07	300 ml/min, max drawdown = 0.05	
W-03	1744614.320	1786798.220	1,305.68	1,303.85	19.25	20	Stickup	1.83	4	8-18	9.83-19.83	Yes	Mod petro odor	Low Flow	Low Flow		200 ml/min, max drawdown = 0.20	425 ml/min, max drawdown = 0.38	
W-08	1746074.570	1785607.590	1,319.90	1,316.99	22.80	23	Stickup	2.91	4	10-20	12.91-22.91	Yes	None	Purge	Purge		Purged to pump intake	Purged to pump intake	
W-15D	1739057.450	1786116.480	1,324.78	1,324.16	130.00	129	Flushmount	0.62	4	109-129	109.62-129.62	Yes	None	Low Flow	Low Flow		200 ml/min, max drawdown = 0.02	500 ml/min, max drawdown = 0.08	
W-15S	1739011.200	1786190.690	1,323.81	1,321.93	22.90	23	Stickup	1.88	4	11-21	12.88-22.88	Yes	None	Low Flow	Low Flow		350 ml/min, no drawdown	350 ml/min, no drawdown	
W-16S	1739122.280	1783660.770	1,337.41	1,335.97	21.35	21.4	Stickup	1.44	4	9-17	10.44-18.44	Yes	None	Low Flow	Purge		200 ml/min, max drawdown = 0.28	Purged to pump intake	
W-22	1744592.880	1787274.250	1,293.94	1,292.09	16.5	18.9	Stickup	1.85	4	6.5-16.5	8.35-18.35	No	None	Bail	Bail		Bailed	Bailed	
W-23	1744552.830	1786447.340	1,304.88	1,302.72	18.60	18.8	Stickup	2.16	4	6.3-16.3	8.46-18.46	Yes	Mod petro odor	Low Flow	Low Flow		175 ml/min, max drawdown = 0.07	400 ml/min, max drawdown = 0.24	
W-24	1744789.040	1786362.290	1,306.35	1,304.12	19.05	19.1	Stickup	2.23	4	11.5-16.5	13.73-18.73	Yes	Mod petro odor	Low Flow	Low Flow		260 ml/min, max drawdown = 0.10	500 ml/min, max drawdown = 0.24	
W-26	1740245.530	1786107.230	1,298.18	1,296.85	10.67	10.8	Stickup	1.33	4	6-8.5	7.33-9.83	Yes	None	Low Flow	Low Flow		125 ml/min, max drawdown = 0.25	100 ml/min, max drawdown = 0.12	
W-29D	1745725.310	1784620.120	1,340.93	1,339.15	80.70	80.6	Stickup	1.78	4	63-83	64.78-84.78	Yes	None	Low Flow	Low Flow		100 ml/min, max drawdown = 0.71	225 ml/min, max drawdown = 0.08	
W-29S	1745716.570	1784626.930	1,341.21	1,339.16	24.60	24.9	Stickup	2.05	4	15-22.5	17.05-24.55	No	None	Bail	Bail		Bailed	Bailed	
OW-01	1745122.740	1785373.780	1324.08	1321.24	26.3	28	Stickup	2.84	2	16-26	18.84-28.84	No	Very strong petro odor, sheen (product noted when drilling)			Low Flow			350 ml/min, no drawdown
OW-02	1744073.930	1785480.480	1320.33	1317.54	11	13.11	Stickup	2.79	2	5.2-10.2	7.99-12.99	No	Paint thinner odor			Low Flow			150 ml/min, max drawdown = 0.32
OW-03	1744608.885	1787268.556	1294.00	1291.70	40.5	42.8	Stickup	2.30	2	30-40	32.30-42.30	No	None			Bail			Bailed
OW-04	1744262.391	1787372.083	1290.45	1288.03	40.5	40.35	Stickup	2.41	2	28-38	30.41-40.41	No	None			Bail			Bailed
OW-05	1743607.353	1787714.279	1290.46	1287.86	39.5	42.33	Stickup	2.60	2	29-39	31.60-41.60	No	None			Bail			Bailed
OW-06	1740782.110	1786184.073	1302.26	1299.69	45.5	47.95	Stickup	2.57	2	35-45	37.57-47.57	No	None			Low Flow			350 ml/min, no drawdown
OW-07	1739775.950	1783960.060	1327.5	1324.53	10	13.27	Stickup	2.97	2	5-10	7.97-12.97	No	None			Low Flow			450 ml/min, no drawdown
OW-08	1740448.550	1784435.070	1314.98	1312.12	15	17.43	Stickup	2.86	2	4.8-14.8	7.66-17.66	No	Slight petro odor, slight sheen			Purge			Purged to pump intake
OW-09	1740319.740	1784917.310	1312.8	1310.02	15.25	17.48	Stickup	2.78	2	4.6-14.6	7.38-17.38	No	Strong petro odor			Low Flow			400 ml/min, max drawdown = 0.20
OW-10	1740561.350	1785754.770	1304.44	1301.62	18	19.67	Stickup	2.82	2	6-16	8.82-18.82	No	Strong petro odor, sheen**			Low Flow			150 ml/min, drawdown = 0.17
OW-11	1741076.790	1786047.140	1305.34	1302.42	17	20.3	Stickup	2.92	2	7-17	9.92-19.92	No	None			Low Flow			450 ml/min, drawdown = 0.05
OW-12	1740519.360	1786185.030	1300.51	1297.62	18	19.47	Stickup	2.89	2	6.9-16.9	9.79-19.79	No	Mod petro odor, product (on 8/2/05) very black, heavy odor			Low Flow			125 ml/min, no drawdown
OW-13	1743311.420	1785869.740	1315.43	1312.75	22.4	25.26	Stickup	2.68	2	12.4-22.4	15.08-25.08	No	Slight petro odor, slight sheen noted during Phase II sampling			Bail			Bailed
OW-14	1743344.620	1786142.650	1310.26	1307.61	15	17.22	Stickup	2.65	2	4.6-14.6	7.25-17.25	No	None			Bail			Bailed
OW-16	1743468.970	1786587.030	1303.46	1300.64	14.2	17.07	Stickup	2.82	2	9-14	11.75-16.75	No	Slight petro odor			Bail			Bailed
OW-18T	1744031.050	1785984.520	1308.68	1305.93	10	12.07	Stickup	2.75	2	5-10	7.94-12.94	No	Very strong odor, product (on 8/2/05) very black			not sampled			Not sampled
OW-19T	1744422.240	1785781.520	1317.5	1314.56	12.5	15.02	Stickup	2.94	2	7.5-12.5	10.08-15.08	No	Very strong odor, heavy sheen**			Bail			Bailed
OW-21	1745437.580	1785971.590	1311.61	1309.03	8	11.04	Stickup	2.58	2	2.9-7.9	6.17-11.17	No	Thick, musty odor, sheen**			Low Flow			200 ml/min, drawdown = 0.15
OW-22T	1744280.580	1786118.220	1308.35	1305.36	16	18.05	Stickup	2.99	2	6-16	8.98-18.98	No	Slight petro odor			Low Flow			125 ml/min, max drawdown = 0.30
OW-23T	1744385.970	1786220.020	1307.36	1304.09	20	23.15	Stickup	3.27	2	10-20	12.72-22.72	No	Slight petro odor, sheen			Purge			Purged to pump intake
OW-24	1743901.680	1786273.700	1304.85	1301.87	23	25.77	Stickup	2.98	2	7-22	10.00-25.00	No	Strong petro odor, heavy sheen**			Low Flow			450 ml/min, no drawdown
OW-25	1744068.170	1786425.370	1303.18	1300.46	20	22.02	Stickup	2.72	2	4-19	4.19-19.19	No	Strong petro odor, product (on 8/2/05) light yellow to clear, weathered diesel odor			Low Flow			450 ml/min, drawdown = 0.06
OW-26	1743901.560	1786491.430	1302.62	1299.62	18.8	21.46	Stickup	3.00	2	8.8-18.8	9.37-19.37	No	Slight petro odor			Purge			Purged to pump intake
OW-27T	1744293.940	1786612.230	1303.43	1303.24	21	19.85	Stickup	0.19	2	6-21	8.62-23.62	No	Mod petro odor, sheen**			Low Flow			175 ml/min, drawdown = 0.07
OW-28T	1743939.050	1786886.460	1301.57	1301	19.5	19.96	Stickup	0.57	2	9-19	11.88-21.88	No	Slight petro odor			Low Flow			500 ml/min, no drawdown

TABLE 2
SITE MONITORING WELL INFORMATION
EL PASO CORPORATION
EL DORADO REFINERY, EL DORADO, KANSAS
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Well ID	Northing	Easting	Top of Casing Elevation (ft AMSL)	Ground Surface Elevation (ft AMSL)	Total Depth of Well (ft bgs)	Measured Depth to Bottom of Well (ft below TOC)	Stickup/ Flushmount	Stickup/ Flushmount Height From Survey (ft)	Casing Diameter (inches)	Screened Interval (ft bgs)	Screened Interval (ft below TOC)	Pump Installed (yes/no)	Observations	Low Flow/Bail/Purge			Additional Comments		
														1Q05	2Q05	Phase 2	1Q05	2Q05	Phase 2
OW-29	1744706.010	1787047.620	1294.68	1292.06	19.5	22.38	Stickup	2.62	2	9-19	11.97-21.97	No	Mod petro odor, very heavy sheen during Phase II sampling, dark brown to black			Bail			Bailed
OW-30	1744437.370	1787302.090	1293.19	1290.31	19.5	20.23	Stickup	2.88	2	8.25-18.25	10.93-20.93	No	Mod petro odor			Low Flow			225 ml/min, max drawdown = 0.17
OW-31	1744258.210	1787378.500	1290.32	1287.35	15	17.71	Stickup	2.97	2	4.9-14.9	7.92-17.92	No	Slight petro odor			Low Flow			450 ml/min, max drawdown = 0.02
OW-32	1744108.600	1787465.490	1294.23	1291.55	20	21.98	Stickup	2.68	2	8.75-18.75	11.77-21.77	No	Mod petro odor			Bail			Bailed
OW-33	1743744.720	1787671.630	1291.61	1288.59	19.2	22.65	Stickup	3.02	2	9.2-19.2	12.18-22.18	No	Mod petro odor			Low Flow			300 ml/min, max drawdown = 0.06
OW-35	1744995.760	1786116.450	1307.76	1304.74	9.3	10.29	Stickup	3.02	2	5-10	7.88-12.88	No	Strong petro odor			Low Flow			450 ml/min, no drawdown
OW-36	1744730.480	1786600.110	1304.79	1301.81	18	20.98	Stickup	2.98	2	7.65-17.65	10.75-20.75	No	Slight to mod petro odor, sheen**			Low Flow			250 ml/min, no drawdown
OW-37	1743663.110	1786259.740	1304.01	1301.13	22.1	24.18	Stickup	2.88	2	7-22	9.36-24.36	No	Mod to strong petro odor, product (on 8/2/05) dark yellow/brown to brown			Low Flow			400 ml/min, max drawdown = 0.22
OW-38	1743652.660	1786541.250	1301.94	1298.84	19	21.49	Stickup	3.10	2	8-18	8.00-18.00	No	Slight petro odor			Low Flow			250 ml/min, max drawdown = 0.05
OW-39	1745069.945	1784612.475	1340.81	1338.45	25.5	24.95	Stickup	2.36	2	12-22	12.00-22.00	No	None			Bail			Bailed

NOTES:
*10-foot screen interval assumed
** Sheen observed in monitoring well during well development, 2Q05 sampling event, or Phase II sampling.

TABLE 3
GROUNDWATER ELEVATION DATA
JANUARY 2004 THROUGH NOVEMBER 2004
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL
FINA_MW-38	1/6/2004	1,306.26	4.89	---	0.00	---	1,301.37	---
FINA_MW-38	4/6/2004	1,306.26	3.5	---	0.00	---	1,302.76	---
FINA_MW-38	7/13/2004	1,306.26	2.71	---	0.00	---	1,303.55	---
FINA_MW-38	11/15/2004	1306.26	4.12	---	0.00	---	1,302.14	---
FINA_MW-38	3/21/2005	1306.26	4.42	---	0.00	---	1,301.84	---
FINA_MW-38	5/17/2005	1306.26	4.68	---	0.00	---	1,301.58	---
FINA_MW-38	6/14/2005	1306.26	3	---	0.00	---	1,303.26	---
FINA_MW-38	8/2/2005	1306.26	4.59	---	0.00	---	1,301.67	---

N1-1	1/6/2004	1,316.25	16.4	---	0.00	---	1,299.85	---
N1-1	4/6/2004	1,316.25	13.16	---	0.00	---	1,303.09	---
N1-1	7/13/2004	1,316.25	13.45	---	0.00	---	1,302.80	---
N1-1	11/15/2004	1316.25	13.68	---	0.00	---	1,302.57	---
N1-1	3/21/2005	1316.25	14.82	---	0.00	---	1,301.43	---
N1-1	5/17/2005	1316.25	16.09	---	0.00	---	1,300.16	---
N1-1	6/14/2005	1316.25	10.02	---	0.00	---	1,306.23	---
N1-1	8/2/2005	1316.25	15.97	---	0.00	---	1,300.28	---

N2-1	1/6/2004	1,334.30	18.35	---	0.00	---	1,315.95	---
N2-1	4/6/2004	1,334.30	16.7	---	0.00	---	1,317.60	---
N2-1	7/13/2004	1,334.30	16.8	---	0.00	---	1,317.50	---
N2-1	11/15/2004	1,334.30	18.76	---	0.00	---	1,315.54	---
N2-1	3/21/2005	1,334.30	16.97	---	0.00	---	1,317.33	---
N2-1	5/17/2005	1,334.30	17.15	---	0.00	---	1,317.15	---
N2-1	6/9/2005	1,334.30	16.88	---	0.00	---	1,317.42	---
N2-1	6/14/2005	1,334.30	11.19	---	0.00	---	1,323.11	---
N2-1	8/2/2005	1,334.30	17.58	---	0.00	---	1,316.72	---

N2-2	1/6/2004	1,310.32	6.49	---	0.00	---	1,303.83	---
N2-2	4/6/2004	1,310.32	5.65	---	0.00	---	1,304.67	---
N2-2	7/13/2004	1,310.32	5.26	---	0.00	---	1,305.06	---
N2-2	11/15/2004	1,310.32	6.43	---	0.00	---	1,303.89	---
N2-2	3/21/2005	1,310.32	6.82	---	0.00	---	1,303.50	---
N2-2	5/17/2005	1,310.32	7.02	---	0.00	---	1,303.30	---
N2-2	6/14/2005	1,310.32	5.79	---	0.00	---	1,304.53	---
N2-2	8/2/2005	1,310.32	7.08	---	0.00	---	1,303.24	---

N2-3	1/6/2004	1,309.42	7.19	---	0.00	---	1,302.23	---
N2-3	4/6/2004	1,309.42	5.45	---	0.00	---	1,303.97	---
N2-3	7/13/2004	1,309.42	5.4	---	0.00	---	1,304.02	---
N2-3	11/15/2004	1,309.42	6.69	---	0.00	---	1,302.73	---
N2-3	3/21/2005	1,309.42	5.61	---	0.00	---	1,303.81	---
N2-3	5/17/2005	1,309.42	5.92	---	0.00	---	1,303.50	---
N2-3	6/14/2005	1,309.42	5.32	---	0.00	---	1,304.10	---
N2-3	8/2/2005	1,309.42	5.86	---	0.00	---	1,303.56	---

N2-4	1/6/2004	1,302.80	11.24	---	0.00	---	1,291.56	---
N2-4	4/6/2004	1,302.80	8.94	---	0.00	---	1,293.86	---
N2-4	7/13/2004	1,302.80	8.72	---	0.00	---	1,294.08	---
N2-4	11/15/2004	1,302.80	10.68	---	0.00	---	1,292.12	---
N2-4	3/21/2005	1,302.80	9.02	---	0.00	---	1,293.78	---
N2-4	5/17/2005	1,302.80	10.05	---	0.00	---	1,292.75	---
N2-4	6/14/2005	1,302.80	8.27	---	0.00	---	1,294.53	---
N2-4	8/2/2005	1,302.80	11.15	---	0.00	---	1,291.65	---

N2-5	1/6/2004	1,305.19	10.85	---	0.00	---	1,294.34	---

TABLE 3
GROUNDWATER ELEVATION DATA
JANUARY 2004 THROUGH NOVEMBER 2004
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL
N2-5	4/6/2004	1,305.19	9.3	---	0.00	---	1,295.89	---
N2-5	7/13/2004	1,305.19	8.74	---	0.00	---	1,296.45	---
N2-5	11/15/2004	1,305.19	10.01	9.61	0.40	9.69	1,295.18	1295.50
N2-5	3/21/2005	1,305.19	10.35	9.84	0.51	9.94	1,294.84	1295.25
N2-5	5/17/2005	1,305.19	10.7	10.11	0.59	10.23	1,294.49	1294.96
N2-5	6/14/2005	1,305.19	8.28	---	---	---	1,296.91	---
N2-5	8/2/2005	1,305.19	11.19	10.37	0.82	10.53	1,294.00	1294.66
N2-6	1/6/2004	1,302.16	12.7	5.44	7.26	6.89	1,289.46	1295.27
N2-6	4/6/2004	1,302.16	15.39	3.46	11.93	5.85	1,286.77	1296.31
N2-6	7/13/2004	1,302.16	16.24	4.35	11.89	6.73	1,285.92	1295.43
N2-6	11/15/2004	1,302.16	12.05	5.15	6.90	6.53	1,290.11	1295.63
N2-6	3/21/2005	1,302.16	14.2	5.56	8.64	7.29	1,287.96	1294.87
N2-6	5/17/2005	1,302.16	16.77	4	12.77	6.55	1,285.39	1295.61
N2-6	6/14/2005	1,302.16	14.2	2.69	11.51	4.99	1,287.96	1297.17
N2-6	8/2/2005	1,302.16	17.84	3.96	13.88	6.74	1,284.32	1295.42
N3-1	1/6/2004	1,294.10	3.26	---	0.00	---	1,290.84	---
N3-1	4/6/2004	1,294.10	1.12	---	0.00	---	1,292.98	---
N3-1	7/13/2004	1,294.10	0.55	---	0.00	---	1,293.55	---
N3-1	11/15/2004	1,294.10	2.86	---	0.00	---	1,291.24	---
N3-1	3/21/2005	1,294.10	1.59	---	0.00	---	1,292.51	---
N3-1	5/17/2005	1,294.10	2.46	---	0.00	---	1,291.64	---
N3-1	6/9/2005	1,294.10	1.39	---	0.00	---	1,292.71	---
N3-1	6/14/2005	1,294.10	0.25	---	0.00	---	1,293.85	---
N3-1	8/2/2005	1,294.10	4.06	---	0.00	---	1,290.04	---

N3-2	1/6/2004	1,290.26	12.72	---	0.00	---	1,277.54	---
N3-2	4/6/2004	1,290.26	12.08	---	0.00	---	1,278.18	---
N3-2	7/13/2004	1,290.26	11.75	---	0.00	---	1,278.51	---
N3-2	11/15/2004	1290.26	12.5	---	0.00	---	1,277.76	---
N3-2	3/21/2005	1,290.26	12.23	---	0.00	---	1,278.03	---
N3-2	5/17/2005	1,290.26	12.63	---	0.00	---	1,277.63	---
N3-2	6/14/2005	1,290.26	10.31	---	0.00	---	1,279.95	---
N3-2	8/2/2005	1,290.26	13.1	---	0.00	---	1,277.16	---

N3-3	1/6/2004	1,293.08	14.94	---	0.00	---	1,278.14	---
N3-3	4/6/2004	1,293.08	13.51	---	0.00	---	1,279.57	---
N3-3	7/13/2004	1,293.08	12.57	---	0.00	---	1,280.51	---
N3-3	11/15/2004	1,293.08	14.58	---	0.00	---	1,278.50	---
N3-3	3/21/2005	1,293.08	14.1	---	0.00	---	1,278.98	---
N3-3	5/17/2005	1,293.08	14.6	---	0.00	---	1,278.48	---
N3-3	6/14/2005	1,293.08	9.1	---	0.00	---	1,283.98	---
N3-3	8/2/2005	1,293.08	15.49	---	0.00	---	1,277.59	---

N3-4	1/6/2004	1,294.31	6.67	---	0.00	---	1,287.64	---
N3-4	4/6/2004	1,294.31	5.39	---	0.00	---	1,288.92	---
N3-4	7/13/2004	1,294.31	4.94	---	0.00	---	1,289.37	---
N3-4	11/15/2004	1,294.31	5.14	---	0.00	---	1,289.17	---
N3-4	3/21/2005	1,294.31	5.67	---	0.00	---	1,288.64	---
N3-4	5/17/2005	1,294.31	6.31	---	0.00	---	1,288.00	---
N3-4	6/14/2005	1,294.31	4.31	---	0.00	---	1,290.00	---
N3-4	8/2/2005	1,294.31	7.06	---	0.00	---	1,287.25	---

N4-1	1/6/2004	1,310.61	14.78	---	0.00	---	1,295.83	---
N4-1	4/6/2004	1,310.61	13.34	---	0.00	---	1,297.27	---
N4-1	7/13/2004	1,310.61	13.23	---	0.00	---	1,297.38	---
N4-1	11/15/2004	1,310.61	13.97	---	0.00	---	1,296.64	---
N4-1	3/21/2005	1,310.61	13.34	---	0.00	---	1,297.27	---
N4-1	5/17/2005	1,310.61	13.91	---	0.00	---	1,296.70	---
N4-1	6/14/2005	1,310.61	13	---	0.00	---	1,297.61	---
N4-1	8/2/2005	1,310.61	14.26	---	0.00	---	1,296.35	---

TABLE 3
GROUNDWATER ELEVATION DATA
JANUARY 2004 THROUGH NOVEMBER 2004
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL

N4-2	1/6/2004	1,313.50	21.23	---	0.00	---	1,292.27	---
N4-2	4/6/2004	1,313.50	19.43	---	0.00	---	1,294.07	---
N4-2	7/13/2004	1,313.50	19.02	---	0.00	---	1,294.48	---
N4-2	11/15/2004	1,313.50	21.51	---	0.00	---	1,291.99	---
N4-2	3/21/2005	1,313.50	18.82	---	0.00	---	1,294.68	---
N4-2	5/17/2005	1,313.50	19.39	---	0.00	---	1,294.11	---
N4-2	6/14/2005	1,313.50	18.75	---	0.00	---	1,294.75	---
N4-2	8/2/2005	1,313.50	19.95	---	0.00	---	1,293.55	---

N4-3	1/6/2004	1,323.34	19.74	---	0.00	---	1,303.60	---
N4-3	4/6/2004	1,323.34	18	---	0.00	---	1,305.34	---
N4-3	7/13/2004	1,323.34	17.71	---	0.00	---	1,305.63	---
N4-3	11/15/2004	1,323.34	18.03	---	0.00	---	1,305.31	---
N4-3	3/21/2005	1,323.34	18.81	---	0.00	---	1,304.53	---
N4-3	5/17/2005	1,323.34	20.16	---	0.00	---	1,303.18	---
N4-3	6/14/2005	1,323.34	14.17	---	0.00	---	1,309.17	---
N4-3	8/2/2005	1,323.34	19.15	---	0.00	---	1,304.19	---

N4-4	1/6/2004	1,332.25	18.86	---	0.00	---	1,313.39	---
N4-4	4/6/2004	1,332.25	15.84	---	0.00	---	1,316.41	---
N4-4	7/13/2004	1,332.25	15.64	---	0.00	---	1,316.61	---
N4-4	11/15/2004	1,332.25	17.13	---	0.00	---	1,315.12	---
N4-4	3/21/2005	1,332.25	16.61	---	0.00	---	1,315.64	---
N4-4	5/17/2005	1,332.25	17.44	---	0.00	---	1,314.81	---
N4-4	6/14/2005	1,332.25	10.26	---	0.00	---	1,321.99	---
N4-4	8/2/2005	1,332.25	19.39	---	0.00	---	1,312.86	---

N5-1	1/6/2004	1,311.20	19.63	---	0.00	---	1,291.57	---
N5-1	4/6/2004	1,311.20	16.11	---	0.00	---	1,295.09	---
N5-1	7/13/2004	1,311.20	15.88	---	0.00	---	1,295.32	---
N5-1	11/15/2004	1,311.20	20.3	---	0.00	---	1,290.90	---
N5-1	3/21/2005	1,311.20	15.78	---	0.00	---	1,295.42	---
N5-1	5/17/2005	1,311.20	16.68	---	0.00	---	1,294.52	---
N5-1	6/14/2005	1,311.20	15.63	---	0.00	---	1,295.57	---
N5-1	8/2/2005	1,311.20	18.13	---	0.00	---	1,293.07	---

N5-2	1/6/2004	1,309.77	16.03	---	0.00	---	1,293.74	---
N5-2	4/6/2004	1,309.77	14.42	---	0.00	---	1,295.35	---
N5-2	7/13/2004	1,309.77	14.18	---	0.00	---	1,295.59	---
N5-2	11/15/2004	1,309.77	16.06	---	0.00	---	1,293.71	---
N5-2	3/21/2005	1,309.77	14.14	---	0.00	---	1,295.63	---
N5-2	5/17/2005	1,309.77	14.76	---	0.00	---	1,295.01	---
N5-2	6/14/2005	1,309.77	14.02	---	0.00	---	1,295.75	---
N5-2	8/2/2005	1,309.77	15.79	---	0.00	---	1,293.98	---

N5-3	1/6/2004	1,302.43	11.14	---	0.00	---	1,291.29	---
N5-3	4/6/2004	1,302.43	7.22	---	0.00	---	1,295.21	---
N5-3	7/13/2004	1,302.43	6.46	---	0.00	---	1,295.97	---
N5-3	11/15/2004	1,302.43	10.33	---	0.00	---	1,292.10	---
N5-3	3/21/2005	1,302.43	8.11	---	0.00	---	1,294.32	---
N5-3	5/17/2005	1,302.43	9.39	---	0.00	---	1,293.04	---
N5-3	6/9/2005	1,302.43	6.7	---	0.00	---	1,295.73	---
N5-3	6/14/2005	1,302.43	4.87	---	0.00	---	1,297.56	---
N5-3	8/2/2005	1,302.43	10.74	---	0.00	---	1,291.69	---

TABLE 3
GROUNDWATER ELEVATION DATA
JANUARY 2004 THROUGH NOVEMBER 2004
EL PASO CORPORATION
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL
N6-1	1/6/2004	1,313.84	6.35	6.3	0.05	6.31	1,307.49	1307.53
N6-1	4/6/2004	1,313.84	5.5	5.45	0.05	5.46	1,308.34	1308.38
N6-1	7/13/2004	1,313.84	5.11	5.09	0.02	5.09	1,308.73	1308.75
N6-1	11/15/2004	1,313.84	6.9	6.87	0.03	6.88	1,306.94	1306.96
N6-1	3/21/2005	1,313.84	5.28	5.25	0.03	5.26	1,308.56	1308.58
N6-1	5/17/2005	1,313.84	5.99	---	---	---	1,307.85	---
N6-1	6/14/2005	1,313.84	5.86	5.82	0.04	5.83	1,307.98	1308.01
N6-1	8/2/2005	1,313.84	6.15	6.08	0.07	6.09	1,307.69	1307.75
W-01D	1/6/2004	1,292.67	3.49	---	0.00	---	1,289.18	---
W-01D	4/6/2004	1,292.67	0.92	---	0.00	---	1,291.75	---
W-01D	7/13/2004	1,292.67	2.65	---	0.00	---	1,290.02	---
W-01D	11/15/2004	1,292.67	3.05	---	0.00	---	1,289.62	---
W-01D	3/21/2005	1,292.67	1.31	---	0.00	---	1,291.36	---
W-01D	5/17/2005	1,292.67	2.42	---	0.00	---	1,290.25	---
W-01D	6/9/2005	1,292.67	1.32	---	0.00	---	1,291.35	---
W-01D	6/14/2005	1,292.67	0.2	---	0.00	---	1,292.47	---
W-01D	8/2/2005	1,292.67	4.63	---	0.00	---	1,288.04	---

W-01S	1/6/2004	1,290.15	13.15	---	0.00	---	1,277.00	---
W-01S	4/6/2004	1,290.15	12.45	---	0.00	---	1,277.70	---
W-01S	7/13/2004	1,290.15	12.21	---	0.00	---	1,277.94	---
W-01S	11/15/2004	1,290.15	13.11	---	0.00	---	1,277.04	---
W-01S	3/21/2005	1,290.15	12.72	---	0.00	---	1,277.43	---
W-01S	5/17/2005	1,290.15	13.06	---	0.00	---	1,277.09	---
W-01S	6/9/2005	1,290.15	12.33	---	0.00	---	1,277.82	---
W-01S	6/14/2005	1,290.15	10.32	---	0.00	---	1,279.83	---
W-01S	8/2/2005	1,290.15	13.75	---	0.00	---	1,276.40	---

W-03	1/6/2004	1,305.68	14.33	---	0.00	---	1,291.35	---
W-03	4/6/2004	1,305.68	13.1	---	0.00	---	1,292.58	---
W-03	7/13/2004	1,305.68	12.47	---	0.00	---	1,293.21	---
W-03	11/15/2004	1,305.68	13.32	---	0.00	---	1,292.36	---
W-03	3/21/2005	1,305.68	13.63	---	0.00	---	1,292.05	---
W-03	5/17/2005	1,305.68	13.86	---	0.00	---	1,291.82	---
W-03	6/14/2005	1,305.68	11.54	---	0.00	---	1,294.14	---
W-03	8/2/2005	1,305.68	13.99	---	0.00	---	1,291.69	---

W-08	1/6/2004	1,319.90	17.08	---	0.00	---	1,302.82	---
W-08	4/6/2004	1,319.90	14.21	---	0.00	---	1,305.69	---
W-08	7/13/2004	1,319.90	14.77	---	0.00	---	1,305.13	---
W-08	11/15/2004	1,319.90	16.48	---	0.00	---	1,303.42	---
W-08	3/21/2005	1,319.90	16.15	---	0.00	---	1,303.75	---
W-08	5/17/2005	1,319.90	16.41	---	0.00	---	1,303.49	---
W-08	6/14/2005	1,319.90	8.87	---	0.00	---	1,311.03	---
W-08	8/2/2005	1,319.90	16.65	---	0.00	---	1,303.25	---

W-15D	1/6/2004	1,324.78	29.57	---	0.00	---	1,295.21	---
W-15D	4/6/2004	1,324.78	25.95	---	0.00	---	1,298.83	---
W-15D	7/13/2004	1,324.78	25.99	---	0.00	---	1,298.79	---
W-15D	11/15/2004	1,324.78	28.99	---	0.00	---	1,295.79	---
W-15D	3/21/2005	1,324.78	27.06	---	0.00	---	1,297.72	---
W-15D	5/17/2005	1,324.78	28.3	---	0.00	---	1,296.48	---
W-15D	6/14/2005	1,324.78	24.13	---	0.00	---	1,300.65	---
W-15D	8/2/2005	1,324.78	29.04	---	0.00	---	1,295.74	---

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GROUNDWATER ELEVATION DATA
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL

W-15S	1/6/2004	1,323.81	18.09	---	0.00	---	1,305.72	---
W-15S	4/6/2004	1,323.81	15.3	---	0.00	---	1,308.51	---
W-15S	7/13/2004	1,323.81	14.98	---	0.00	---	1,308.83	---
W-15S	11/15/2004	1,323.81	18.04	---	0.00	---	1,305.77	---
W-15S	3/21/2005	1,323.81	16.86	---	0.00	---	1,306.95	---
W-15S	5/17/2005	1,323.81	17.65	---	0.00	---	1,306.16	---
W-15S	6/14/2005	1,323.81	12.9	---	0.00	---	1,310.91	---
W-15S	8/2/2005	1,323.81	17.85	---	0.00	---	1,305.96	---

W-16S	1/6/2004	1,337.41	15.29	---	0.00	---	1,322.12	---
W-16S	4/6/2004	1,337.41	4.45	---	0.00	---	1,332.96	---
W-16S	7/13/2004	1,337.41	5.43	---	0.00	---	1,331.98	---
W-16S	11/15/2004	1,337.41	11.84	---	0.00	---	1,325.57	---
W-16S	3/21/2005	1,337.41	8.83	---	0.00	---	1,328.58	---
W-16S	5/17/2005	1,337.41	15.25	---	0.00	---	1,322.16	---
W-16S	6/14/2005	1,337.41	2.48	---	0.00	---	1,334.93	---
W-16S	8/2/2005	1,337.41	15.72	---	0.00	---	1,321.69	---

W-22	1/6/2004	1,293.94	17.71	---	0.00	---	1,276.23	---
W-22	4/6/2004	1,293.94	17.11	---	0.00	---	1,276.83	---
W-22	7/13/2004	1,293.94	16.31	---	0.00	---	1,277.63	---
W-22	11/15/2004	1,293.94	17.53	---	0.00	---	1,276.41	---
W-22	3/21/2005	1,293.94	17.37	---	0.00	---	1,276.57	---
W-22	5/17/2005	1,293.94	17.23	---	0.00	---	1,276.71	---
W-22	6/9/2005	1,293.94	16.65	---	0.00	---	1,277.29	---
W-22	6/14/2005	1,293.94	14.35	---	0.00	---	1,279.59	---
W-22	8/2/2005	1,293.94	17.41	---	0.00	---	1,276.53	---

W-23	1/6/2004	1,304.88	9.48	---	0.00	---	1,295.40	---
W-23	4/6/2004	1,304.88	7.46	---	0.00	---	1,297.42	---
W-23	7/13/2004	1,304.88	6.38	---	0.00	---	1,298.50	---
W-23	11/15/2004	1,304.88	7.74	---	0.00	---	1,297.14	---
W-23	3/21/2005	1,304.88	8.11	---	0.00	---	1,296.77	---
W-23	5/17/2005	1,304.88	8.59	---	0.00	---	1,296.29	---
W-23	6/14/2005	1,304.88	5.1	---	0.00	---	1,299.78	---
W-23	8/2/2005	1,304.88	9	---	0.00	---	1,295.88	---

W-24	1/6/2004	1,306.35	9.85	---	0.00	---	1,296.50	---
W-24	4/6/2004	1,306.35	7.28	---	0.00	---	1,299.07	---
W-24	7/13/2004	1,306.35	6.09	---	0.00	---	1,300.26	---
W-24	11/15/2004	1,306.35	7.57	---	0.00	---	1,298.78	---
W-24	3/21/2005	1,306.35	8.16	---	0.00	---	1,298.19	---
W-24	5/17/2005	1,306.35	8.4	---	0.00	---	1,297.95	---
W-24	6/14/2005	1,306.35	5.28	---	0.00	---	1,301.07	---
W-24	8/2/2005	1,306.35	8.78	---	0.00	---	1,297.57	---

W-26	1/6/2004	1,298.18	4.6	---	0.00	---	1,293.58	---
W-26	4/6/2004	1,298.18	4.33	---	0.00	---	1,293.85	---
W-26	7/13/2004	1,298.18	4.71	---	0.00	---	1,293.47	---
W-26	11/15/2004	1,298.18	4.82	---	0.00	---	1,293.36	---
W-26	3/21/2005	1,298.18	4.42	---	0.00	---	1,293.76	---
W-26	5/17/2005	1,298.18	5.53	---	0.00	---	1,292.65	---
W-26	6/14/2005	1,298.18	3.44	---	0.00	---	1,294.74	---
W-26	8/2/2005	1,298.18	8.1	---	0.00	---	1,290.08	---

TABLE 3
GROUNDWATER ELEVATION DATA
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL

W-29D	1/6/2004	1,340.93	24.8	---	0.00	---	1,316.13	---
W-29D	4/6/2004	1,340.93	16.26	---	0.00	---	1,324.67	---
W-29D	7/13/2004	1,340.93	17.41	---	0.00	---	1,323.52	---
W-29D	11/15/2004	1,340.93	25.21	---	0.00	---	1,315.72	---
W-29D	3/21/2005	1,340.93	20.13	---	0.00	---	1,320.80	---
W-29D	5/17/2005	1,340.93	22.86	---	0.00	---	1,318.07	---
W-29D	6/9/2005	1,340.93	12.44	---	0.00	---	1,328.49	---
W-29D	6/14/2005	1,340.93	12.93	---	0.00	---	1,328.00	---
W-29D	8/2/2005	1,340.93	24.2	---	0.00	---	1,316.73	---

W-29S	1/6/2004	1,341.21	19.41	---	0.00	---	1,321.80	---
W-29S	4/6/2004	1,341.21	14.71	---	0.00	---	1,326.50	---
W-29S	7/13/2004	1,341.21	14.92	---	0.00	---	1,326.29	---
W-29S	11/15/2004	1,341.21	21.91	---	0.00	---	1,319.30	---
W-29S	3/21/2005	1,341.21	15.71	---	0.00	---	1,325.50	---
W-29S	5/17/2005	1,341.21	16.18	---	0.00	---	1,325.03	---
W-29S	6/9/2005	1,341.21	12.52	---	0.00	---	1,328.69	---
W-29S	6/14/2005	1,341.21	12.66	---	0.00	---	1,328.55	---
W-29S	8/2/2005	1,341.21	17.35	---	0.00	---	1,323.86	---

OW-01	4/7/2005	1324.08	7.09	---	0.00	---	1,316.99	---
OW-01	6/14/2005	1324.08	3.59	---	0.00	---	1,320.49	---
OW-01	8/2/2005	1324.08	11.11	---	0.00	---	1,312.97	---

OW-02	4/7/2005	1320.33	7.27	---	0.00	---	1,313.06	---
OW-02	6/14/2005	1320.33	6.61	---	0.00	---	1,313.72	---
OW-02	8/2/2005	1320.33	8.64	---	0.00	---	1,311.69	---

OW-03	6/2/2005	1294.00	14.66	---	0.00	---	1,279.34	---
OW-03	6/9/2005	1294.00	14.09	---	0.00	---	1,279.91	---
OW-03	6/14/2005	1294.00	12.38	---	0.00	---	1,281.62	---
OW-03	8/2/2005	1294.00	14.37	---	0.00	---	1,279.63	---

OW-04	6/2/2005	1290.45	10.81	---	0.00	---	1,279.64	---
OW-04	6/9/2005	1290.45	10.19	---	0.00	---	1,280.26	---
OW-04	6/14/2005	1290.45	8.34	---	0.00	---	1,282.11	---
OW-04	8/2/2005	1290.45	11.48	---	0.00	---	1,278.97	---

OW-05	6/9/2005	1290.46	21.67	---	0.00	---	1,268.79	---
OW-05	6/14/2005	1290.46	13.82	---	0.00	---	1,276.64	---
OW-05	8/2/2005	1290.46	11.77	---	0.00	---	1,278.69	---

OW-06	6/2/2005	1302.26	8.15	---	0.00	---	1,294.11	---
OW-06	6/9/2005	1302.26	7.31	---	0.00	---	1,294.95	---
OW-06	6/14/2005	1302.26	5.55	---	0.00	---	1,296.71	---
OW-06	8/2/2005	1302.26	10.24	---	0.00	---	1,292.02	---

OW-07	4/8/2005	1327.50	2.99	---	0.00	---	1,324.51	---
OW-07	6/14/2005	1327.50	1.88	---	0.00	---	1,325.62	---
OW-07	8/2/2005	1327.50	5.68	---	0.00	---	1,321.82	---

OW-08	4/7/2005	1314.98	8	---	0.00	---	1,306.98	---
OW-08	6/14/2005	1314.98	6.95	---	0.00	---	1,308.03	---
OW-08	8/2/2005	1314.98	10.02	---	0.00	---	1,304.96	---

TABLE 3
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Well Identification	Gauging Date	Top of Casing Elevation Feet, AMSL	Depth to Water Feet, TOC	Depth to LNAPL Feet, TOC	LNAPL Thickness Feet	Corrected Depth to Water Feet, TOC	Groundwater Elevation Feet, AMSL	Corrected Groundwater Elevation Feet, AMSL

OW-09	4/7/2005	1312.80	7.14	---	0.00	---	1,305.66	---
OW-09	6/14/2005	1312.80	6.29	---	0.00	---	1,306.51	---
OW-09	8/2/2005	1312.80	9.62	---	0.00	---	1,303.18	---

OW-10	4/8/2005	1304.44	8.36	---	0.00	---	1,296.08	---
OW-10	6/14/2005	1304.44	6.44	---	0.00	---	1,298.00	---
OW-10	8/2/2005	1304.44	11.39	---	0.00	---	1,293.05	---

OW-11	4/8/2005	1305.34	9.07	---	0.00	---	1,296.27	---
OW-11	6/14/2005	1305.34	9.48	---	0.00	---	1,295.86	---
OW-11	8/2/2005	1305.34	11.3	---	0.00	---	1,294.04	---

OW-12	4/8/2005	1300.51	7.79	---	0.00	---	1,292.72	---
OW-12	6/14/2005	1300.51	4.49	---	0.00	---	1,296.02	---
OW-12	8/2/2005	1300.51	10.84	10.55	0.29	10.61	1,289.67	1289.90
OW-13	4/7/2005	1315.43	19.59	---	0.00	---	1,295.84	---
OW-13	6/14/2005	1315.43	19.57	---	0.00	---	1,295.86	---
OW-13	8/2/2005	1315.43	19.57	---	0.00	---	1,295.86	---

OW-14	4/7/2005	1310.26	12.29	---	0.00	---	1,297.97	---
OW-14	6/14/2005	1310.26	12.12	---	0.00	---	1,298.14	---
OW-14	8/2/2005	1310.26	13.8	---	0.00	---	1,296.46	---
OW-14	8/12/2005	1310.26	17.22	---	0.00	---	1,293.04	---

OW-16	4/7/2005	1303.46	9.44	---	0.00	---	1,294.02	---
OW-16	6/14/2005	1303.46	8.19	---	0.00	---	1,295.27	---
OW-16	8/2/2005	1303.46	12.23	---	0.00	---	1,291.23	---

OW-18T	4/7/2005	1308.68	10.41	---	0.00	---	1,298.27	---
OW-18T	6/14/2005	1308.68	9.56	9.15	0.41	9.23	1,299.12	1299.45
OW-18T	8/2/2005	1308.68	11.95	9.55	2.40	10.03	1,296.73	1298.65
OW-19T	4/7/2005	1317.50	11.48	---	0.00	---	1,306.02	---
OW-19T	6/14/2005	1317.50	10.76	---	0.00	---	1,306.74	---
OW-19T	8/2/2005	1317.50	10.92	---	0.00	---	1,306.58	---

OW-21	4/7/2005	1311.61	2.53	---	0.00	---	1,309.08	---
OW-21	6/14/2005	1311.61	1.68	---	0.00	---	1,309.93	---
OW-21	8/2/2005	1311.61	2.45	---	0.00	---	1,309.16	---

OW-22T	4/7/2005	1308.35	9.56	---	0.00	---	1,298.79	---
OW-22T	6/14/2005	1308.35	8.83	---	0.00	---	1,299.52	---
OW-22T	8/2/2005	1308.35	9.67	---	0.00	---	1,298.68	---

OW-23T	4/7/2005	1307.36	9.33	---	0.00	---	1,298.03	---
OW-23T	6/14/2005	1307.36	6.74	---	0.00	---	1,300.62	---
OW-23T	8/2/2005	1307.36	8.76	---	0.00	---	1,298.60	---
OW-24	4/7/2005	1304.85	8.28	---	0.00	---	1,296.57	---
OW-24	6/14/2005	1304.85	12.31	---	0.00	---	1,292.54	---
OW-24	8/2/2005	1304.85	8.63	---	0.00	---	1,296.22	---
OW-25	4/7/2005	1303.18	8.26	---	0.00	---	1,294.92	---
OW-25	6/14/2005	1303.18	6.65	---	0.00	---	1,296.53	---
OW-25	8/2/2005	1303.18	8.88	8.65	0.23	8.70	1,294.30	1294.48

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OW-26	4/8/2005	1302.62	6.46	---	0.00	---	1,296.16	---
OW-26	6/14/2005	1302.62	4.69	---	0.00	---	1,297.93	---
OW-26	8/2/2005	1302.62	6.86	---	0.00	---	1,295.76	---

OW-27T	4/7/2005	1303.43	8.94	---	0.00	---	1,294.49	---
OW-27T	6/14/2005	1303.43	6.6	---	0.00	---	1,296.83	---
OW-27T	8/2/2005	1303.43	9.37	---	0.00	---	1,294.06	---

OW-28T	4/7/2005	1301.57	9.71	---	0.00	---	1,291.86	---
OW-28T	6/14/2005	1301.57	8.46	---	0.00	---	1,293.11	---
OW-28T	8/2/2005	1301.57	10.85	---	0.00	---	1,290.72	---
OW-29	4/8/2005	1294.68	14.42	---	0.00	---	1,280.26	---
OW-29	6/14/2005	1294.68	13.11	---	0.00	---	1,281.57	---
OW-29	8/2/2005	1294.68	14.82	---	0.00	---	1,279.86	---
OW-30	4/7/2005	1293.19	13.42	---	0.00	---	1,279.77	---
OW-30	6/14/2005	1293.19	12.78	---	0.00	---	1,280.41	---
OW-30	8/2/2005	1293.19	15.06	---	0.00	---	1,278.13	---

OW-31	4/7/2005	1,290.32	10.2	---	0.00	---	1,280.12	---
OW-31	6/9/2005	1,290.32	9.37	---	0.00	---	1,280.95	---
OW-31	6/14/2005	1,290.32	8.65	---	0.00	---	1,281.67	---
OW-31	8/2/2005	1,290.32	10.78	---	0.00	---	1,279.54	---

OW-32	4/7/2005	1,294.23	15.38	---	0.00	---	1,278.85	---
OW-32	6/14/2005	1,294.23	13.52	---	0.00	---	1,280.71	---
OW-32	8/2/2005	1,294.23	16.23	---	0.00	---	1,278.00	---

OW-33	4/7/2005	1,291.61	13.15	---	0.00	---	1,278.46	---
OW-33	6/14/2005	1,291.61	10.96	---	0.00	---	1,280.65	---
OW-33	8/2/2005	1,291.61	14.14	---	0.00	---	1,277.47	---

OW-35	4/7/2005	1,307.76	0.4	---	0.00	---	1,307.36	---
OW-35	6/14/2005	1,307.76	2.79	---	0.00	---	1,304.97	---
OW-35	8/2/2005	1,307.76	3.96	---	0.00	---	1,303.80	---

OW-36	4/7/2005	1,304.79	9.06	---	0.00	---	1,295.73	---
OW-36	6/14/2005	1,304.79	6.42	---	0.00	---	1,298.37	---
OW-36	8/2/2005	1,304.79	9.79	---	0.00	---	1,295.00	---

OW-37	4/7/2005	1,304.01	8.05	---	0.00	---	1,295.96	---
OW-37	6/14/2005	1,304.01	7.01	---	0.00	---	1,297.00	---
OW-37	8/2/2005	1,304.01	9.16	9.09	0.07	9.10	1,294.85	1294.91
OW-38	4/7/2005	1,301.94	7.82	---	0.00	---	1,294.12	---
OW-38	6/14/2005	1,301.94	6.67	---	0.00	---	1,295.27	---
OW-38	8/2/2005	1,301.94	10.11	---	0.00	---	1,291.83	---

OW-39	6/9/2005	1,340.81	13.49	---	0.00	---	1,327.32	---
OW-39	6/14/2005	1,340.81	10.56	---	0.00	---	1,330.25	---
OW-39	8/2/2005	1,340.81	23.58	---	0.00	---	1,317.23	---

Notes:
Depth to water and groundwater elevation corrected using an assumed specific gravity of 0.8 for LNAPL.
--- = Not applicable
AMSL = Above Mean Sea Level
TOC= Measured relative to top of casing

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Well and Slug Test Identification	**N2-3#1**	**N2-3#2**	**N2-4#1**	**N2-4#3**	**OW-16#1**	**OW-16#2**	**OW-16#3**	**OW-16#4**	**OW-24#1**
Site Well Location	Refinery	Refinery	Refinery	Refinery	Refinery	Refinery	Refinery	Refinery	Refinery
Test Date	7/22/05	7/22/05	7/21/05	7/26/05	7/21/05	7/21/05	7/26/05	7/26/05	7/27/05
Water Elevation (ft amsl)	1303.70	1303.70	1291.71	1291.72	1291.994	1291.981	1291.762	1291.739	1296.311
Depth to Static Water (ft btoc)	5.718	5.724	11.088	11.079	11.466	11.479	11.698	11.721	8.539
Depth to Static Water (ft bgs)	3.408	3.414	8.848	8.839	8.646	8.659	8.878	8.901	5.559
Initial Displacement (s(0); ft)	2.534	2.275	2.201	2.652	3.839	2.267	2.632	1.740	1.403
Static Water Column Height (H; ft)	11.592	11.586	17.152	17.161	5.514	5.501	5.282	5.259	17.161
Aquifer Saturated Thickness (D; ft)	11.592	11.586	17.152	17.161	5.514	5.501	5.282	5.259	17.161
Total Depth of Well Screen Penetration (H; ft)	11.592	11.586	17.152	17.161	5.354	5.341	5.122	5.099	16.441
Top of Confining Layer (for Confined Aquifer Analysis)									
Bottom of Confining Layer (for Confined Aquifer Analysis)									
Casing radius (r(c);ft)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Effective well radius (r(w); ft)	0.323	0.323	0.250	0.250	0.333	0.333	0.333	0.333	0.333
Filter Pack Porosity	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Screen Length (L; ft)	10	10	11	11	5	5	5	5	15
Screened Material	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone
Bailer Information									
Diameter (inches)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Length (inches)	36	36	48	48	48	36	36	36	36
Length correction (inches)									
Length corrected (inches)	36	36	48	48	48	36	36	36	36
Bailer Volume (gal)	0.275	0.275	0.367	0.367	0.367	0.275	0.275	0.275	0.275
Water volume per foot of screen (gal/ft)	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
Number of bailers used	1	1	1	1	1	1	1	1	1
Calculated Bailer Displacement (ft)	1.688	1.688	2.250	2.250	2.250	1.688	1.688	1.688	1.688
Aqtesolv Solution: Bouwer-Rice	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined
Hydraulic Conductivity (K; ft/min)	1.881E-03	1.906E-03	8.269E-06	5.939E-06	1.560E-04	1.665E-04	1.671E-04	1.402E-04	6.886E-03
Average Hydraulic Conductivity by Well (ft/min)		1.89E-03		7.10E-06				1.57E-04	

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Well and Slug Test Identification	**OW-24#2**	**OW-01#1**	**OW-01#2**	**OW-02#1**	**OW-02#2**	**N5-3#1**	**N5-3#2**	**OW-08#1**	**OW-08#2**
Site Well Location	Refinery	Refinery	Refinery	Refinery	Refinery	South Tank	South Tank	South Tank	South Tank
Test Date	7/27/05	7/24/05	7/24/05	7/24/05	7/24/05	7/24/05	7/24/05	7/25/05	7/25/05
Water Elevation (ft amsl)	1296.316	1314.265	1314.256	1312.423	1312.524	1292.27	1292.27	1305.396	1305.239
Depth to Static Water (ft btoc)	8.534	9.815	9.824	7.907	7.806	10.156	10.165	9.584	9.741
Depth to Static Water (ft bgs)	5.554	6.975	6.984	5.117	5.016	7.946	7.955	6.724	6.881
Initial Displacement (s(0); ft)	1.415	1.365	1.9	1.567	1.978	4.717	3.048	2.774	3.449
Static Water Column Height (H; ft)	17.166	19.025	19.016	5.083	5.184	12.054	12.045	8.276	8.119
Aquifer Saturated Thickness (D; ft)	17.166	19.025	19.016	5.083	5.184	12.054	12.045	8.276	8.119
Total Depth of Well Screen Penetration (H; ft)	16.446	19.025	19.016	5.083	5.184	12.054	12.045	8.076	7.919
Top of Confining Layer (for Confined Aquifer Analysis)									
Bottom of Confining Layer (for Confined Aquifer Analysis)									
Casing radius (r(c);ft)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Effective well radius (r(w); ft)	0.333	0.25	0.25	0.344	0.344	0.323	0.323	0.313	0.313
Filter Pack Porosity	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Screen Length (L; ft)	15	10	10	5	5	15	15	10	10
Screened Material	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone
Bailer Information									
Diameter (inches)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Length (inches)	36	36	36	36	36	48	48	36	36
Length correction (inches)									
Length corrected (inches)	36	36	36	36	36	48	48	36	36
Bailer Volume (gal)	0.275	0.275	0.275	0.275	0.275	0.367	0.367	0.275	0.275
Water volume per foot of screen (gal/ft)	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
Number of bailers used	1	1	1	1	1	1	1	1	1
Calculated Bailer Displacement (ft)	1.688	1.6875	1.6875	1.6875	1.6875	2.250	2.250	1.688	1.688
Aqtesolv Solution: Bouwer-Rice	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined
Hydraulic Conductivity (K; ft/min)	5.960E-03	7.223E-03	7.246E-03	2.290E-02	1.379E-02	1.496E-03	1.517E-03	2.064E-02	2.819E-02
Average Hydraulic Conductivity by Well (ft/min)	6.42E-03		7.23E-03		1.83E-02		1.51E-03		2.44E-02

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Well and Slug Test Identification	**OW-09#1**	**OW-09#2**	**N5-1#1**	**N5-1#3**	**N5-1#4**	**W-15S#1**	**W-15S#2**	**N4-1#1**	**N4-1#3**
Site Well Location	South Tank	South Tank	South Tank	South Tank	South Tank	South Tank	South Tank	South Tank	South Tank
Test Date	7/25/05	7/25/05	7/22/05	7/24/05	7/24/05	7/25/05	7/25/05	7/22/05	7/24/05
Water Elevation (ft amsl)	1303.77	1303.761	1294.26	1294.12	1294.12	1306.31	1306.32	1295.90	1295.70
Depth to Static Water (ft btoc)	9.030	9.039	16.942	17.083	17.083	17.497	17.490	14.706	14.912
Depth to Static Water (ft bgs)	6.250	6.259	14.982	15.123	15.123	15.617	15.610	12.386	12.592
Initial Displacement (s(0); ft)	1.667	2.234	2.227	5.552	3.362	0.478	1.170	3.543	1.997
Static Water Column Height (H; ft)	8.350	8.341	8.518	8.377	8.377	5.383	5.390	10.614	10.408
Aquifer Saturated Thickness (D; ft)	8.350	8.341	8.518	8.377	8.377	5.383	5.390	14.000	14.000
Total Depth of Well Screen Penetration (H; ft)	8.350	8.341	8.018	7.877	7.877	5.383	5.390	14.000	14.000
Top of Confining Layer (for Confined Aquifer Analysis)								9.000	9.000
Bottom of Confining Layer (for Confined Aquifer Analysis)								23.000	23.000
Casing radius (r(c);ft)	0.083	0.083	0.083	0.083	0.083	0.167	0.167	0.083	0.083
Effective well radius (r(w); ft)	0.297	0.297	0.250	0.250	0.250	0.333	0.333	0.250	0.250
Filter Pack Porosity	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Screen Length (L; ft)	10	10	10	10	10	10	10	10	10
Screened Material	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Alluvium / Weathered Limestone (Doyle)	Fort Riley Limestone	Fort Riley Limestone
Bailer Information									
Diameter (inches)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Length (inches)	36	36	36	48	48	48	48	36	36
Length correction (inches)									
Length corrected (inches)	36	36	36	48	48	48	48	36	36
Bailer Volume (gal)	0.275	0.275	0.275	0.367	0.367	0.367	0.367	0.275	0.275
Water volume per foot of screen (gal/ft)	0.163	0.163	0.163	0.163	0.163	0.653	0.653	0.163	0.163
Number of bailers used	1	1	1	1	1	1	2	1	1
Calculated Bailer Displacement (ft)	1.688	1.688	1.688	2.250	2.250	0.563	1.125	1.688	1.688
Aqtesolv Solution: Bouwer-Rice	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Confined	Confined
Hydraulic Conductivity (K; ft/min)	6.686E-02	6.517E-02	4.886E-03	4.741E-03	6.376E-03	1.504E-01	9.453E-02	4.139E-06	1.962E-06
Average Hydraulic Conductivity by Well (ft/min)		6.60E-02			5.33E-03		1.22E-01		3.05E-06

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Well and Slug Test Identification	**OW-06#1**	**W-15D#1**	**W-15D#2**	**N3-2#1**	**N3-2#2**	**N3-3#1**	**N3-3#2**	**OW-29#1**	**OW-29#2**
Site Well Location	South Tank	South Tank	South Tank	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River
Test Date	7/25/05	7/25/05	7/25/05	7/20/05	7/20/05	7/21/05	7/21/05	7/19/05	7/19/05
Water Elevation (ft amsl)	1290.699	1295.76	1295.69	1277.35	1277.36	1278.02	1278.02	1280.28	1280.17
Depth to Static Water (ft btoc)	11.558	29.017	29.086	12.913	12.902	15.059	15.057	14.400	14.510
Depth to Static Water (ft bgs)	8.987	28.397	28.466	10.363	10.352	12.789	12.787	11.780	11.890
Initial Displacement (s(0); ft)	2.614	0.944	0.947	3.009	1.699	0.921	1.148	1.879	3.047
Static Water Column Height (H; ft)	36.013	100.603	100.534	5.637	5.648	4.461	4.463	7.220	7.110
Aquifer Saturated Thickness (D; ft)	25.500	39.000	39.000	5.637	5.648	4.461	4.463	7.220	7.110
Total Depth of Well Screen Penetration (H; ft)	25.000	49.800	49.800	5.637	5.648	4.461	4.463	7.220	7.110
Top of Confining Layer (for Confined Aquifer Analysis)	20.000	79.200	79.200						
Bottom of Confining Layer (for Confined Aquifer Analysis)	45.500	118.200	118.200						
Casing radius (r(c);ft)	0.083	0.167	0.167	0.083	0.083	0.083	0.083	0.086	0.086
Effective well radius (r(w); ft)	0.344	0.333	0.333	0.323	0.323	0.323	0.323	0.297	0.297
Filter Pack Porosity	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Screen Length (L; ft)	10	20	20	10	10	10	10	10	10
Screened Material	Fort Riley Limestone	Florence Limestone	Florence Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone
Bailer Information									
Diameter (inches)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Length (inches)	48	36	36	36	36	36	36	48	48
Length correction (inches)									
Length corrected (inches)	48	36	36	36	36	36	36	48	48
Bailer Volume (gal)	0.367	0.275	0.275	0.275	0.275	0.275	0.275	0.367	0.367
Water volume per foot of screen (gal/ft)	0.163	0.653	0.653	0.163	0.163	0.163	0.163	0.174	0.174
Number of bailers used	1	2	2	1	1	1	1	1	1
Calculated Bailer Displacement (ft)	2.250	0.844	0.844	1.688	1.688	1.688	1.688	2.107	2.107
Aqtesolv Solution: Bouwer-Rice	Confined	Confined	Confined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined
Hydraulic Conductivity (K; ft/min)	7.023E-06	3.731E-03	3.786E-03	1.558E-02	1.475E-02	1.342E-02	1.345E-02	1.177E-02	1.196E-02
Average Hydraulic Conductivity by Well (ft/min)	7.02E-06		3.76E-03		1.52E-02		1.34E-02		1.19E-02

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Well and Slug Test Identification	**OW-30#1**	**OW-30#2**	**OW-31#1**	**OW-31#2**	**OW-32#1**	**OW-32#2**	**OW-33#1**	**OW-33#2**	**W-01S#1**
Site Well Location	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River
Test Date	7/20/05	7/20/05	7/20/05	7/20/05	7/20/05	7/20/05	7/20/05	7/20/05	7/21/05
Water Elevation (ft amsl)	1278.37	1278.37	1279.81	1279.81	1278.30	1278.30	1277.88	1277.88	1276.77
Depth to Static Water (ft btoc)	14.823	14.824	10.507	10.506	15.929	15.930	13.730	13.728	13.377
Depth to Static Water (ft bgs)	11.943	11.944	7.537	7.536	13.249	13.250	10.710	10.708	10.457
Initial Displacement (s(0); ft)	2.696	2.541	2.138	2.250	2.896	1.814	2.040	2.261	0.519
Static Water Column Height (H; ft)	6.457	6.456	7.363	7.364	5.951	5.950	8.490	8.492	6.543
Aquifer Saturated Thickness (D; ft)	6.457	6.456	7.363	7.364	5.951	5.950	8.490	8.492	6.543
Total Depth of Well Screen Penetration (H; ft)	6.457	6.456	7.363	7.364	5.501	5.500	8.490	8.492	6.543
Top of Confining Layer (for Confined Aquifer Analysis)									
Bottom of Confining Layer (for Confined Aquifer Analysis)									
Casing radius (r(c);ft)	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.167
Effective well radius (r(w); ft)	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.333
Filter Pack Porosity	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Screen Length (L; ft)	10	10	10	10	10	10	10	10	8
Screened Material	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone
Bailer Information									
Diameter (inches)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Length (inches)	48	48	48	48	36	36	48	48	48
Length correction (inches)									
Length corrected (inches)	48	48	48	48	36	36	48	48	48
Bailer Volume (gal)	0.367	0.367	0.367	0.367	0.275	0.275	0.367	0.367	0.367
Water volume per foot of screen (gal/ft)	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.653
Number of bailers used	1	1	1	1	1	1	1	1	1
Calculated Bailer Displacement (ft)	2.107	2.107	2.107	2.107	1.580	1.580	2.107	2.107	0.563
Aqtesolv Solution: Bouwer-Rice	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined
Hydraulic Conductivity (K; ft/min)	1.913E-02	1.963E-02	4.399E-02	4.341E-02	1.138E-02	1.205E-02	6.231E-02	4.960E-02	4.755E-03
Average Hydraulic Conductivity by Well (ft/min)		1.94E-02		4.37E-02		1.17E-02		5.60E-02	

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Well and Slug Test Identification	**W-01S#2**	**W-22#1**	**W-22#2**	**OW-03#1**	**OW-04#1**	**OW-05#1**	**N3-1#1**	**N3-1#2**	**W-01D#1**
Site Well Location	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River	Walnut River
Test Date	7/21/05	7/19/05	7/19/05	7/19/05	7/20/05	7/21/05	7/19/05	7/19/05	7/22/05
Water Elevation (ft amsl)	1276.76	1276.76	1276.77	1280.31	1279.56	1278.52	1291.947	1291.997	1289.659
Depth to Static Water (ft btoc)	13.392	17.180	17.172	13.690	10.889	11.946	2.153	2.103	3.011
Depth to Static Water (ft bgs)	10.472	15.330	15.322	11.394	8.477	9.346	-0.117	-0.167	-1.649
Initial Displacement (s(0); ft)	0.475	0.239	0.234	2.417	3.976	4.399	1.697	1.685	0.625
Static Water Column Height (H; ft)	6.528	1.170	1.178	29.106	29.523	29.654	78.917	78.967	94.049
Aquifer Saturated Thickness (D; ft)	6.528	1.170	1.178	24.000	30.500	23.500	27.000	27.000	38.000
Total Depth of Well Screen Penetration (H; ft)	6.528	1.170	1.178	23.500	28.000	23.000	27.000	27.000	35.000
Top of Confining Layer (for Confined Aquifer Analysis)				16.500	10.000	16.000	51.800	51.800	52.000
Bottom of Confining Layer (for Confined Aquifer Analysis)				40.500	40.500	39.500	78.800	78.800	90.000
Casing radius (r(c);ft)	0.167	0.167	0.167	0.086	0.086	0.086	0.083	0.083	0.167
Effective well radius (r(w); ft)	0.333	0.333	0.333	0.297	0.297	0.297	0.250	0.250	0.333
Filter Pack Porosity	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Screen Length (L; ft)	8	10	10	10	10	10	5	5	20
Screened Material	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Alluvium / Weathered Limestone	Fort Riley Limestone	Fort Riley Limestone	Fort Riley Limestone	Florence Limestone	Florence Limestone	Florence Limestone
Bailer Information									
Diameter (inches)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Length (inches)	48	48	48	48	36	48	36	36	48
Length correction (inches)		28.5	28.5						
Length corrected (inches)	48	19.5	19.5	48	36	48	36	36	48
Bailer Volume (gal)	0.367	0.149	0.149	0.367	0.275	0.367	0.275	0.275	0.367
Water volume per foot of screen (gal/ft)	0.653	0.653	0.653	0.174	0.174	0.174	0.163	0.163	0.653
Number of bailers used	1	1	1	1	1	1	1	1	1
Calculated Bailer Displacement (ft)	0.563	0.229	0.229	2.107	1.580	2.107	1.688	1.688	0.563
Aqtesolv Solution: Bouwer-Rice	Unconfined	Unconfined	Unconfined	Confined	Confined	Confined	Confined	Confined	Confined
Hydraulic Conductivity (K; ft/min)	4.315E-03	5.709E-04	5.651E-04	1.875E-06	4.168E-06	2.068E-07	1.423E-02	1.955E-02	1.388E-03
Average Hydraulic Conductivity by Well (ft/min)	4.54E-03		5.68E-04	1.88E-06	4.17E-06	2.07E-07		1.69E-02	

Table 5 Geotechnical Data
El Paso Corporation
El Dorado Refinery, Kansas

Boring No.	Sample No.	USCS Group Symbol	Moisture Content (%)	Wet Unit Weight (lb/ft^3)	Dry Unit Weight (lb/ft^3)	Unconfined Compressive Strength (lb/ft^3)	Atterberg Limits			Percent Passing No.200 Sieve	Specific Gravity
							Liquid Limit	Plastic Limit	Plasticity Index		
OW-03	7-9	CL	26.7	122.8	96.9	1.32	36	19	17	97.4	2.72
OW-03	14-16	GC	18.5	131.6	111.0	NA	31	19	12	35.3	2.70
OW-31	3-5	CL	27.6	118.6	93.2	0.84	39	22	17	93.9	2.72
OW-31	8-10	CL	24.6	125.7	100.9	2.67	39	21	18	93.3	2.71
OW-33	7-9	CL	29.3	114.0	88.2	NA	36	18	18	88.8	2.71
OW-33	13-15	CL	27.8	125.4	98.2	0.12	36	21	15	70.8	2.72

TABLE 6

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 2)

	Analyte (µg/L):	**1,1,1-Trichloroethane**	**1,1,2,2-Tetrachloroethane**	**1,1,2-Trichloroethane**	**1,1-Dichloroethane**	**1,1-Dichloroethene**	**1,2-Dibromo-3-chloropropane**	**1,2-Dibromoethane (Ethylene dibromide)**	**1,2-Dichlorobenzene**	**1,2-Dichloroethane**	**1,2-Dichloropropane**	**1,3-Dichlorobenzene**	**1,4-Dichlorobenzene**	**1,4-Dioxane (p-Dioxane)**	**2-Hexanone**	**Acetone**	**Benzene**	**Bromodichloromethane**	**Bromoform**	**Bromomethane**	**Carbon disulfide**	**Carbon tetrachloride**
	KANSAS SW[(b)] (µg/L):	**200**	**0.17**	**0.6**	**NA**	**0.057**	**NA**	**NA**	**600**	**0.38**	**5**	**400**	**75**	**NA**	**NA**	**NA**	**1.2**	**0.27**	**4.3**	**100**	**NA**	**0.25**
Location Identification	**Date Collected**																					
CC	4/15/2005	*<1.1 D*	*<1.9 D*	*<1 D*	*<1.6 D*	*<1 D*	<0.02	<0.02	*<1 D*	*<1.3 D*	*<1.7 D*	*<1 D*	*<1 D*	*<5000 D*	*<7.5 D*	*<9 D*	**29 D**	*<2 D*	*<1.5 D*	*<4 D*	*<1 D*	*<1 D*
MARLEY POND	6/9/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	**0.021**	<0.019	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
NORTHEAST POND	6/9/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.019	<0.019	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
NORTHWEST POND	6/9/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
SOUTHEAST POND	6/9/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.019	<0.019	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
SOUTHWEST POND	6/9/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.019	<0.019	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-1	6/7/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-2	6/8/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-2 Dup	6/8/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-3	6/8/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-4	6/7/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-5	6/1/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-6	6/1/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRANSECT-7	6/1/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
Field QC Samples																						
EQUIPMENT BLANK	6/8/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.02	<0.02	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRIP BLANK	4/15/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	<0.019	<0.019	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRIP BLANK	6/1/2005	<1	*<0.37*	*<0.2*	<1	*<0.2*	--	--	<1	*<0.2*	<1	<1	<1	<1000	<25	**<25**	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRIP BLANK	6/7/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	--	--	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRIP BLANK	6/8/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	--	--	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2
TRIP BLANK	6/9/2005	<5	*<0.37*	*<0.2*	<5	*<0.2*	--	--	<5	*<0.2*	<5	<5	<5	<1000	<25	<25	<1	*<0.4*	*<0.3*	<5	<5	<0.2

Refer to Table 21 for footnotes.

TABLE 6

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 2)

	Analyte (µg/L):	**Chlorobenzene**	**Chloroethane**	**Chloroform**	**Chloromethane**	**cis-1,2-Dichloroethylene**	**cis-1,3-Dichloropropene**	**Dibromochloromethane**	**Ethylbenzene**	**Methyl ethyl ketone (2-Butanone)**	**Methyl isobutyl ketone (4-Methyl-2-pentanone)**	**Methylene chloride**	**Styrene**	**tert-Butyl methyl ether**	**Tetrachloroethylene (PCE)**	**Toluene**	**trans-1,2-Dichloroethene**	**trans-1,3-Dichloropropene**	**Trichloroethylene (TCE)**	**Vinyl acetate**	**Vinyl chloride**	**Xylenes, Total**
	KANSAS SW[(b)] (µg/L):	**100**	**NA**	**5.7**	**NA**	**70**	**10**	**0.41**	**700**	**NA**	**NA**	**4.7**	**100**	**NA**	**0.8**	**1000**	**100**	**10**	**2.7**	**NA**	**2**	**10000**
Location Identification	**Date Collected**																					
CC	4/15/2005	*<1 D*	*<1.5 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<4 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1.8 D*	*<1 D*	*<1 D*	*<1.2 D*	*<1 D*	*<1 D*	*<1 D*	*<1.8 D*
MARLEY POND	6/9/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
NORTHEAST POND	6/9/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
NORTHWEST POND	6/9/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
SOUTHEAST POND	6/9/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
SOUTHWEST POND	6/9/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-1	6/7/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-2	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-2 Dup	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-3	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-4	6/7/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-5	6/1/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-6	6/1/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRANSECT-7	6/1/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
Field QC Samples																						
EQUIPMENT BLANK	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRIP BLANK	4/15/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRIP BLANK	6/1/2005	<1	<2	<1	<5	<1	*<0.2*	*<0.2*	<1	**<25**	<25	*<0.2*	<5	<5	*<0.35*	<1	<1	*<0.24*	*<0.2*	<25	*<0.2*	<1
TRIP BLANK	6/7/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRIP BLANK	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10
TRIP BLANK	6/9/2005	<5	<5	<5	<5	<5	*<0.2*	*<0.2*	<5	<25	<25	*<0.2*	<5	<5	*<0.35*	<5	<5	*<0.24*	*<0.2*	<25	*<0.2*	<10

Refer to Table 21 for footnotes.

TABLE 7

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 3)

	Analyte (µg/L):	1,2-Dichlorobenzene	1,2-Diphenylhydrazine	1,3-Dichlorobenzene	1,4-Dichlorobenzene	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethyl phenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol (o-Cresol)	2-Nitrophenol	3,3'-Dichlorobenzidine	4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether	4-Nitrophenol
	KANSAS SW[(b)] (µg/L):	**600**	**0.04**	**400**	**75**	**2.1**	**93**	**540**	**70**	**0.11**	**NA**	**1700**	**NA**	**NA**	**NA**	**NA**	**0.04**	**13.4**	**NA**	**NA**	**NA**	**NA**
Location Identification	**Date Collected**																					
CC	4/15/2005	<10	*<0.29*	<10	<10	*<3.3*	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	*<2.7*	*<13*	<10	<10	<10	<10
MARLEY POND	6/9/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
NORTHEAST POND	6/9/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
NORTHWEST POND	6/9/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
SOUTHEAST POND	6/9/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
SOUTHWEST POND	6/9/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
TRANSECT-1	6/7/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
TRANSECT-2	6/8/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
TRANSECT-2 Dup	6/8/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
TRANSECT-3	6/8/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
TRANSECT-4	6/7/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8
TRANSECT-5	6/1/2005	<9.7	*<0.28*	<9.7	<9.7	*<3.2*	<9.7	<9.7	<49	*<3.6*	*<3.6*	<9.7	<9.7	<9.7	<9.7	<9.7	*<2.6*	*<13*	<9.7	<9.7	<9.7	<9.7
TRANSECT-6	6/1/2005	<10	*<0.29*	<10	<10	*<3.3*	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	*<2.7*	*<13*	<10	<10	<10	<10
TRANSECT-7	6/1/2005	<9.8	*<0.28*	<9.8	<9.8	*<3.2*	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	*<2.6*	*<13*	<9.8	<9.8	<9.8	<9.8

Refer to Table 21 for footnotes.

TABLE 7

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 3)

	Analyte (µg/L):	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzidine**	**Benzo(a)anthracene**	**Benzo(b)fluoranthene**	**Benzo(g,h,i)perylene**	**Benzo(k)fluoranthene**	**Benzo[e]pyrene**	**Benzyl butyl phthalate**	**bis(2-chloroethoxy) Methane**	**bis(2-chloroethyl) Ether (2-Chloroethyl Ether)**	**bis(2-chloroisopropyl) Ether**	**bis(2-ethylhexyl) Phthalate**	**Chrysene**	**Di-n-butyl phthalate**	**Di-n-octylphthalate**	**Dibenz(a,h)anthracene**	**Diethyl Phthalate**
	KANSAS SW[(b)] (µg/L):	**200**	**NA**	**110000**	**540**	**0.0028**	**0.0028**	**NA**	**0.0028**	**NA**	**100**	**NA**	**0.031**	**1400**	**1.8**	**0.0028**	**2700**	**NA**	**0.0028**	**5**
Location Identification	**Date Collected**																			
CC	4/15/2005	<10	<10	<10	*<18*	*<0.16*	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	*<0.14*	<10	*<0.12*	*<0.09*	*<0.2*
MARLEY POND	6/9/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
NORTHEAST POND	6/9/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
NORTHWEST POND	6/9/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
SOUTHEAST POND	6/9/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
SOUTHWEST POND	6/9/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
TRANSECT-1	6/7/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
TRANSECT-2	6/8/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
TRANSECT-2 Dup	6/8/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
TRANSECT-3	6/8/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
TRANSECT-4	6/7/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*
TRANSECT-5	6/1/2005	<9.7	<9.7	<9.7	*<17*	*<0.16*	*<0.11*	<9.7	*<0.16*	<9.7	<9.7	<9.7	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.7	*<0.12*	*<0.087*	*<0.19*
TRANSECT-6	6/1/2005	<10	<10	<10	*<18*	*<0.16*	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	*<0.14*	<10	*<0.12*	*<0.09*	*<0.2*
TRANSECT-7	6/1/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	*<0.14*	<9.8	*<0.12*	*<0.088*	*<0.2*

Refer to Table 21 for footnotes.

TABLE 7

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 3 of 3)

	Analyte (µg/L):	**Dimethyl phthalate**	**Fluoranthene**	**Fluorene**	**Hexachlorobenzene**	**Hexachlorocyclopentadiene**	**Hexachloroethane**	**Indeno(1,2,3-c,d)Pyrene**	**Isophorone**	**m,p-Cresol**	**n-Nitroso-di-n-propylamine**	**n-Nitrosodimethylamine**	**n-Nitrosodiphenylamine**	**Naphthalene**	**Nitrobenzene**	**Pentachlorophenol**	**Phenanthrene**	**Phenol**	**Pyrene**	**Pyridine**	**Quinoline**
	KANSAS SW[(b)] (µg/L):	**313000**	**300**	**1300**	**0.00075**	**240**	**1.9**	**0.0028**	**8.4**	**NA**	**0.005**	**0.00069**	**5**	**NA**	**17**	**0.28**	**NA**	**21000**	**960**	**NA**	**NA**
Location Identification	**Date Collected**																				
CC	4/15/2005	<10	<10	<10	*<0.35*	<10	*<0.41*	*<0.11*	*<2.9*	<10	*<0.32*	*<0.23*	*<0.13*	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
MARLEY POND	6/9/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
NORTHEAST POND	6/9/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
NORTHWEST POND	6/9/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
SOUTHEAST POND	6/9/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
SOUTHWEST POND	6/9/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
TRANSECT-1	6/7/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
TRANSECT-2	6/8/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
TRANSECT-2 Dup	6/8/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
TRANSECT-3	6/8/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
TRANSECT-4	6/7/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
TRANSECT-5	6/1/2005	<9.7	<9.7	<9.7	*<0.34*	<9.7	*<0.4*	*<0.11*	*<2.8*	<9.7	*<0.31*	*<0.22*	*<0.13*	<9.7	*<0.28*	*<6.3*	<9.7	<9.7	<9.7	*<4*	<9.7
TRANSECT-6	6/1/2005	<10	<10	<10	*<0.35*	<10	*<0.41*	*<0.11*	*<2.9*	<10	*<0.32*	*<0.23*	*<0.13*	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
TRANSECT-7	6/1/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	*<0.4*	*<0.11*	*<2.8*	<9.8	*<0.31*	*<0.22*	*<0.13*	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8

Refer to Table 21 for footnotes.

TABLE 8

METALS RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 1)

	Analyte (mg/L):	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium III	Chromium, Hexavalent	Chromium, Total	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	KANSAS SW[(b)] (mg/L)	**0.006**	**0.000018**	**1**	**0.004**	**0.005**	**NA**	**0.05**	**NA**	**0.1**	**NA**	**1.3**	**NA**	**0.015**	**NA**	**NA**	**0.00014**	**0.61**	**NA**	**0.05**	**0.05**	**NA**	**0.002**	**NA**	**0.74**
Location Identification	**Date Collected**																								
CC	4/15/2005	*<0.004*	*<0.004*	**0.25**	<0.003	<0.005	**140**	<0.02	<0.01	<0.01	<0.01	<0.01	**6**	<0.005	**18**	**0.12**	*<0.00007*	<0.005	**1.1**	<0.01	<0.005	**72**	*<0.003*	<0.01	<0.02
MARLEY POND	6/9/2005	*<0.004*	*<0.004*	**0.12**	<0.003	<0.005	**49**	**0.016**	<0.02	**0.016**	<0.01	**0.021**	**7.4**	**0.071**	**4.8**	**0.15**	**0.0033**	**0.0097**	**4.5**	<0.01	<0.005	**25**	*<0.003*	**0.02**	**0.087**
NORTHEAST POND	6/9/2005	*<0.004*	*<0.004*	**0.11**	<0.003	<0.005	**43**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.2**	<0.005	**8.8**	**0.053**	**0.00062**	<0.005	**5.5**	<0.01	<0.005	**150 D**	*<0.003*	<0.01	<0.02
NORTHWEST POND	6/9/2005	*<0.004*	*<0.004*	**0.11**	<0.003	<0.005	**41**	<0.01	<0.02	<0.01	<0.01	<0.01	**1.6**	**0.037**	**6.3**	**0.067**	**0.0036**	<0.005	**5.8**	<0.01	<0.005	**71**	*<0.003*	<0.01	**0.032**
SOUTHEAST POND	6/9/2005	*<0.004*	*<0.004*	**0.12**	<0.003	<0.005	**45**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.33**	<0.005	**7.1**	**0.08**	**0.00095**	<0.005	**6.5**	<0.01	<0.005	**160 D**	*<0.003*	<0.01	<0.02
SOUTHWEST POND	6/9/2005	*<0.004*	*<0.004*	**0.11**	<0.003	<0.005	**44**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.43**	**0.0067**	**6.8**	**0.11**	**0.007**	<0.005	**6.1**	<0.01	<0.005	**130 D**	*<0.003*	<0.01	<0.02
TRANSECT-1	6/7/2005	*<0.004*	*<0.004*	**0.2**	<0.003	<0.005	**50**	<0.01	<0.02	<0.01	<0.01	<0.01	**5.1**	**0.0053**	**11**	**0.21**	**0.00063**	<0.005	**4.4**	<0.01	<0.005	**29**	*<0.003*	**0.015**	<0.02
TRANSECT-2	6/8/2005	*<0.004*	**0.005**	**0.2**	<0.003	<0.005	**57**	<0.01	<0.02	<0.01	<0.01	<0.01	**4.2**	<0.005	**12**	**0.21**	**0.0014**	<0.005	**4**	<0.01	<0.005	**34**	*<0.003*	**0.013**	<0.02
TRANSECT-2 Dup	6/8/2005	*<0.004*	*<0.004*	**0.2**	<0.003	<0.005	**57**	<0.01	<0.02	<0.01	<0.01	<0.01	**4.1**	**0.0054**	**12**	**0.2**	**0.0014**	<0.005	**4**	<0.01	<0.005	**33**	*<0.003*	**0.013**	<0.02
TRANSECT-3	6/8/2005	*<0.004*	*<0.004*	**0.2**	<0.003	<0.005	**55**	<0.01	<0.02	<0.01	<0.01	<0.01	**3.9**	**0.0051**	**12**	**0.22**	**0.0063 J**	<0.005	**4**	<0.01	<0.005	**34 J**	*<0.003*	**0.013**	<0.02
TRANSECT-4	6/7/2005	*<0.004*	*<0.004*	**0.2**	<0.003	<0.005	**49**	<0.01	<0.02	<0.01	<0.01	<0.01	**5.2**	<0.005	**11**	**0.21**	**0.0026**	<0.005	**4.4**	<0.01	<0.005	**29**	*<0.003*	**0.015**	<0.02
TRANSECT-5	6/1/2005	*<0.004*	*<0.004*	**0.24**	<0.003	<0.005	**110**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.59**	<0.005	**16**	**0.26**	*<0.00007*	<0.005	**3.2**	<0.01	<0.005	**140 D**	*<0.003*	<0.01	<0.02
TRANSECT-6	6/1/2005	*<0.004*	*<0.004*	**0.27**	<0.003	<0.005	**120**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.39**	<0.005	**17**	**0.22**	*<0.00007*	<0.005	**2.8**	<0.01	<0.005	**200 D**	*<0.003*	<0.01	<0.02
TRANSECT-7	6/1/2005	*<0.004*	*<0.004*	**0.26**	<0.003	<0.005	**120**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.72**	<0.005	**15**	**0.23**	*<0.00007*	<0.005	**2.5**	<0.01	<0.005	**160 D**	*<0.003*	<0.01	<0.02

Refer to Table 21 for footnotes.

TABLE 9

CHEMISTRY PARAMETER RESULTS SUMMARY FOR SURFACE WATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 1)

	Analyte (mg/L):	Total dissolved solids (Residue, filterable)	Chloride (As Cl)	Fluoride	Nitrogen, Nitrate (as N) (E300)	Nitrogen, Nitrite (E300)	Sulfate (As SO4)	Alkalinity, Bicarbonate (as $CaCO_3$)	Alkalinity, Carbonate (as CaCO3)	Alkalinity, Hydroxide	Alkalinity, Total (as CaCO3)	Nitrogen, Nitrate (as N) (E353.2)	Nitrogen, nitrate-nitrite (E353.2)	Nitrogen, Nitrite (E353.2)	Nitrogen, Nitrite (E354.1)	Sulfide	Cyanide
	KANSAS SW[(b)] (mg/L)	**NA**	**250**	**2**	**10**	**10**	**250**	**NA**	**NA**	**NA**	**NA**	**10**	**10**	**10**	**10**	**NA**	**0.2**
Location Identification	**Date Collected**																
CC	4/15/2005	**600**	**100**	**0.54**	**0.73**	<0.1	**55**	**370**	0	0	**370**	**1.1**	--	--	<0.1	<1	<0.005
MARLEY POND	6/9/2005	**190**	**22**	**0.76**	**0.67**	<0.1	**33**	**120**	0	0	**120**	--	--	--	--	<1	<0.005
NORTHEAST POND	6/9/2005	**560**	**220**	**2**	<0.1	<0.1	**61 J**	**110**	0	0	**110**	--	--	--	--	<1	<0.005
NORTHWEST POND	6/9/2005	**320**	**83**	**1.3**	<0.1	<0.1	**55**	**100**	0	0	**100**	--	--	--	--	<1	<0.005
SOUTHEAST POND	6/9/2005	**560**	**220**	**1.5**	<0.1	<0.1	**54**	**110**	0	0	**110**	--	--	--	--	<1	<0.005
SOUTHWEST POND	6/9/2005	**500**	**190**	**1.4**	<0.1	<0.1	**53**	**110**	0	0	**110**	--	--	--	--	<1	<0.005
TRANSECT-1	6/7/2005	**290**	**40**	**0.26**	**0.76**	<0.1	**16**	**160**	0	0	**160**	--	--	--	--	<1	<0.005
TRANSECT-2	6/8/2005	**310**	**45**	**0.35**	**0.97**	<0.1	**18**	**180**	0	0	**180**	--	--	--	--	<1	<0.005
TRANSECT-2 Dup	6/8/2005	**300**	**45**	**0.36**	**0.84**	<0.1	**18**	**180**	0	0	**180**	--	--	--	--	<1	<0.005
TRANSECT-3	6/8/2005	**300**	**46 J**	**0.31**	**0.83**	<0.1	**18**	**170**	0	0	**180**	--	--	--	--	<1	<0.005
TRANSECT-4	6/7/2005	**290**	**41**	**0.35**	**0.91**	<0.1	**16**	**160**	0	0	**160**	--	--	--	--	<1	<0.005
TRANSECT-5	6/1/2005	**740**	**230**	**0.34**	<0.1	<0.1	**24**	**310**	**1.2**	0	**310**	--	--	--	--	<1	<0.005
TRANSECT-6	6/1/2005	**910**	**350**	**0.34**	<0.1	<0.1	**23**	**310**	**1**	0	**310**	--	--	--	--	<1	<0.005
TRANSECT-7	6/1/2005	**820**	**280**	**0.31**	<0.1	<0.1	**21**	**310**	0	0	**310**	--	--	--	--	<1	<0.005

Refer to Table 21 for footnotes.

TABLE 10

DETECTIONS ONLY - ORGANIC COMPOUNDS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 1)

	Location Identification	**CC**	**MARLEY POND**	**NORTHEAST POND**	**NORTHWEST POND**	**SOUTHEAST POND**	**SOUTHWEST POND**	**TRANSECT-1**	**TRANSECT-4**	**TRANSECT-5**	**TRANSECT-6**	**TRANSECT-7**
	Date Collected	**4/15/2005**	**6/9/2005**	**6/9/2005**	**6/9/2005**	**6/9/2005**	**6/9/2005**	**6/7/2005**	**6/7/2005**	**6/1/2005**	**6/1/2005**	**6/1/2005**
Analyte/Methods (Units)	**KANSAS SW[b] (µg/L)**											
Petroleum Hydrocarbons (µg/l)												
Petroleum hydrocarbons above C-10	**NA**	**410**	**340 B**	**650 B**	**410 B**	**910 B**	**1000 B**	**55**	**34**	**95**	**91**	**160**
PHCC10C28	**NA**	**330**	**320**	**560**	**290**	**760**	**870**	**23 J**	<20 UJ	**40**	**27**	**60**
PHCC28C35	**NA**	**150**	<20	**78 B**	**180 B**	**290 B**	**160 B**	**27 JB**	**38 JB**	**57**	**69**	**81**
Volatile Organic Compounds (µg/L)												
1,2-Dibromo-3-chloropropane	**NA**	<0.02	**0.021**	<0.019	<0.02	<0.019	<0.019	<0.02	<0.02	<0.02	<0.02	<0.02
Benzene	**1.2**	**29 D**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Refer to Table 21 for footnotes.

TABLE 11

DETECTIONS ONLY - METALS COMPOUNDS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 2)

Analyte/Methods (Units)	Location Identification Date Collected KANSAS SW[b] (mg/L)	CC 4/15/2005	MARLEY POND 6/9/2005	NORTHEAST POND 6/9/2005	NORTHWEST POND 6/9/2005	SOUTHEAST POND 6/9/2005	SOUTHWEST POND 6/9/2005	TRANSECT-1 6/7/2005	TRANSECT-2 6/8/2005
Metals (mg/L)									
Arsenic	**0.000018**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	**0.005**
Barium	**1**	**0.25**	**0.12**	**0.11**	**0.11**	**0.12**	**0.11**	**0.2**	**0.2**
Calcium	**NA**	**140**	**49**	**43**	**41**	**45**	**44**	**50**	**57**
Chromium III	**0.05**	<0.02	**0.016**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02
Chromium, Total	**0.1**	<0.01	**0.016**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	**1.3**	<0.01	**0.021**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	**NA**	**6**	**7.4**	**0.2**	**1.6**	**0.33**	**0.43**	**5.1**	**4.2**
Lead	**0.015**	<0.005	**0.071**	<0.005	**0.037**	<0.005	**0.0067**	**0.0053**	<0.005
Magnesium	**NA**	**18**	**4.8**	**8.8**	**6.3**	**7.1**	**6.8**	**11**	**12**
Manganese	**NA**	**0.12**	**0.15**	**0.053**	**0.067**	**0.08**	**0.11**	**0.21**	**0.21**
Mercury	**0.00014**	*<0.00007*	**0.0033**	**0.00062**	**0.0036**	**0.00095**	**0.007**	**0.00063**	**0.0014**
Nickel	**0.61**	<0.005	**0.0097**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	**NA**	**1.1**	**4.5**	**5.5**	**5.8**	**6.5**	**6.1**	**4.4**	**4**
Sodium	**NA**	**72**	**25**	**150 D**	**71**	**160 D**	**130 D**	**29**	**34**
Vanadium	**NA**	<0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	**0.015**	**0.013**
Zinc	**0.74**	<0.02	**0.087**	<0.02	**0.032**	<0.02	<0.02	<0.02	<0.02

Refer to Table 21 for footnotes.

TABLE 11

DETECTIONS ONLY - METALS COMPOUNDS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 2)

	Location Identification	**TRANSECT-2 Dup**	**TRANSECT-3**	**TRANSECT-4**	**TRANSECT-5**	**TRANSECT-6**	**TRANSECT-7**
	Date Collected	**6/8/2005**	**6/8/2005**	**6/7/2005**	**6/1/2005**	**6/1/2005**	**6/1/2005**
Analyte/Methods (Units)	**KANSAS SW[(b)] (mg/L)**						
Metals (mg/L)							
Arsenic	**0.000018**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*
Barium	**1**	**0.2**	**0.2**	**0.2**	**0.24**	**0.27**	**0.26**
Calcium	**NA**	**57**	**55**	**49**	**110**	**120**	**120**
Chromium III	**0.05**	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium, Total	**0.1**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	**1.3**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	**NA**	**4.1**	**3.9**	**5.2**	**0.59**	**0.39**	**0.72**
Lead	**0.015**	**0.0054**	**0.0051**	<0.005	<0.005	<0.005	<0.005
Magnesium	**NA**	**12**	**12**	**11**	**16**	**17**	**15**
Manganese	**NA**	**0.2**	**0.22**	**0.21**	**0.26**	**0.22**	**0.23**
Mercury	**0.00014**	**0.0014**	**0.0063 J**	**0.0026**	*<0.00007*	*<0.00007*	*<0.00007*
Nickel	**0.61**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	**NA**	**4**	**4**	**4.4**	**3.2**	**2.8**	**2.5**
Sodium	**NA**	**33**	**34 J**	**29**	**140 D**	**200 D**	**160 D**
Vanadium	**NA**	**0.013**	**0.013**	**0.015**	<0.01	<0.01	<0.01
Zinc	**0.74**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Refer to Table 21 for footnotes.

TABLE 12

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 4)

		Location Identification	**CC**	**MARLEY POND**	**NORTHEAST POND**
		Date Collected	**4/15/2005**	**6/9/2005**	**6/9/2005**
Analyte/Methods (Units)	**KANSAS SW[(b)] (mg/L)**				
Chemistry Parameters (mg/L)					
Total dissolved solids (Residue, filterable)	**NA**		**600**	**190**	**560**
Chloride (as Cl)	**250**		**100**	**22**	**220**
Fluoride	**2**		**0.54**	**0.76**	**2**
Nitrogen, Nitrate (as N)	**10**		**0.73**	**0.67**	<0.1
Sulfate (as SO_4)	**250**		**55**	**33**	**61 J**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**		**370**	**120**	**110**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**		0	0	0
Alkalinity, Total (as $CaCO_3$)	**NA**		**370**	**120**	**110**
Nitrogen, Nitrate (as N)	**10**		**1.1**	--	--

Refer to Table 21 for footnotes.

TABLE 12

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 4)

		Location Identification	**NORTHWEST POND**	**SOUTHEAST POND**	**SOUTHWEST POND**
		Date Collected	**6/9/2005**	**6/9/2005**	**6/9/2005**
Analyte/Methods (Units)	**KANSAS SW[b] (mg/L)**				
Chemistry Parameters (mg/L)					
Total dissolved solids (Residue, filterable)	**NA**		**320**	**560**	**500**
Chloride (as Cl)	**250**		**83**	**220**	**190**
Fluoride	**2**		**1.3**	**1.5**	**1.4**
Nitrogen, Nitrate (as N)	**10**		<0.1	<0.1	<0.1
Sulfate (as SO_4)	**250**		**55**	**54**	**53**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**		**100**	**110**	**110**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**		0	0	0
Alkalinity, Total (as $CaCO_3$)	**NA**		**100**	**110**	**110**
Nitrogen, Nitrate (as N)	**10**		--	--	--

Refer to Table 21 for footnotes.

TABLE 12

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 3 of 4)

		Location Identification	**TRANSECT-1**	**TRANSECT-2**	**TRANSECT-2 Dup**	**TRANSECT-3**
		Date Collected	**6/7/2005**	**6/8/2005**	**6/8/2005**	**6/8/2005**
Analyte/Methods (Units)	**KANSAS SW[(b)] (mg/L)**					
Chemistry Parameters (mg/L)						
Total dissolved solids (Residue, filterable)	**NA**		**290**	**310**	**300**	**300**
Chloride (as Cl)	**250**		**40**	**45**	**45**	**46 J**
Fluoride	**2**		**0.26**	**0.35**	**0.36**	**0.31**
Nitrogen, Nitrate (as N)	**10**		**0.76**	**0.97**	**0.84**	**0.83**
Sulfate (as SO_4)	**250**		**16**	**18**	**18**	**18**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**		**160**	**180**	**180**	**170**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**		0	0	0	0
Alkalinity, Total (as $CaCO_3$)	**NA**		**160**	**180**	**180**	**180**
Nitrogen, Nitrate (as N)	**10**		**--**	**--**	**--**	**--**

Refer to Table 21 for footnotes.

TABLE 12

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR SURFACE WATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 4 of 4)

Analyte/Methods (Units)	KANSAS SW[(b)] (mg/L)	Location Identification Date Collected	TRANSECT-4 6/7/2005	TRANSECT-5 6/1/2005	TRANSECT-6 6/1/2005	TRANSECT-7 6/1/2005
Chemistry Parameters (mg/L)						
Total dissolved solids (Residue, filterable)	**NA**		**290**	**740**	**910**	**820**
Chloride (as Cl)	**250**		**41**	**230**	**350**	**280**
Fluoride	**2**		**0.35**	**0.34**	**0.34**	**0.31**
Nitrogen, Nitrate (as N)	**10**		**0.91**	<0.1	<0.1	<0.1
Sulfate (as SO_4)	**250**		**16**	**24**	**23**	**21**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**		**160**	**310**	**310**	**310**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**		0	**1.2**	**1**	0
Alkalinity, Total (as $CaCO_3$)	**NA**		**160**	**310**	**310**	**310**
Nitrogen, Nitrate (as N)	**10**		--	--	--	--

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 8)

	Analyte (µg/L):	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane (Ethylene dibromide)	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,4-Dioxane (p-Dioxane)	2-Hexanone	Acetone	Benzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride
	KDHE RSK[a] (µg/L):	**200**	**1**	**5**	**1300**	**70**	**NA**	**0.05**	**600**	**5**	**5**	**NA**	**75**	**260**	**230**	**930**	**5**	**80**	**80**	**10**	**30**	**5**
Location Identification	**Date Collected**																					
FINA MW-38	3/30/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**5200 D**	--	--	--	--	--
FINA MW-38	5/25/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**250**	--	--	--	--	--
N1-1	3/29/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N1-1	5/25/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N2-1	3/29/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N2-1	5/25/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N2-2	3/30/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N2-2	5/31/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.2**	--	--	--	--	--
N2-3	3/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**540 D**	--	--	--	--	--
N2-3	5/31/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**570 D**	--	--	--	--	--
N2-4	3/24/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**65**	--	--	--	--	--
N2-4	5/25/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**110**	--	--	--	--	--
N3-1	3/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N3-1	5/27/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N3-2	3/30/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N3-2	5/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N3-3	5/20/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**4.5**	--	--	--	--	--
N3-4	3/29/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**13**	--	--	--	--	--
N3-4	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**77**	--	--	--	--	--
N3-4 Dup	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**61**	--	--	--	--	--
N4-1	3/29/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N4-1	5/20/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	--	--	--	--	--
N4-2	3/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N4-2	5/20/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N4-3	3/24/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N4-3	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N4-4	3/28/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N4-4	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-1	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-2	3/28/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-2 Dup	3/28/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-2	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-3	3/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-3	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N5-3 Dup	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
N6-1	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**10**	--	--	--	--	--
OW-01	4/19/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-02	4/18/2005	*<1.1 D*	*<1.9 D*	*<1 D*	*<1.6 D*	*<1 D*	<0.02	<0.02	*<1 D*	*<1.3 D*	*<1.7 D*	*<1 D*	*<1 D*	*<5000 D*	*<7.5 D*	*<9 D*	**650 D**	*<2 D*	*<1.5 D*	*<4 D*	*<1 D*	*<1 D*
OW-03	6/28/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Analyte (µg/L):	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane (Ethylene dibromide)	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,4-Dioxane (p-Dioxane)	2-Hexanone	Acetone	Benzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride
	KDHE RSK[a] (µg/L):	**200**	**1**	**5**	**1300**	**70**	**NA**	**0.05**	**600**	**5**	**5**	**NA**	**75**	**260**	**230**	**930**	**5**	**80**	**80**	**10**	**30**	**5**
Location Identification	**Date Collected**																					
OW-04	6/28/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-05	6/30/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-06	6/30/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-07	4/11/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-08	4/15/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	**270**	<5	<5	<5	<5	<5
OW-09	4/13/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**150**	<5	<5	<5	<5	<5
OW-09 Dup	4/13/2005	<5	*<0.37*	<5	<5	<5	<0.019	**0.049 J**	<5	<5	<5	<5	<5	<1000	<25	<25	**170**	<5	<5	<5	<5	<5
OW-10	4/13/2005	<5	*<0.37*	<5	<5	<5	**0.025**	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-11	4/12/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-12	4/12/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-13	4/11/2005	*<11 D*	*<19 D*	*<10 D*	*<16 D*	*<10 D*	**0.12**	<0.019	*<10 D*	*<13 D*	*<17 D*	*<10 D*	*<10 D*	*<50000 D*	*<75 D*	*<90 D*	**370 D**	*<20 D*	*<15 D*	*<40 D*	*<10 D*	*<10 D*
OW-14	4/11/2005	<5	*<0.37*	<5	<5	<5	**0.034**	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-16	4/15/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**12**	<5	<5	<5	<5	<5
OW-19T	4/15/2005	*<2.1 D*	*<3.7 D*	*<2 D*	*<3.1 D*	*<2 D*	<0.02	<0.02	*<2 D*	*<2.5 D*	*<3.4 D*	*<2 D*	*<2 D*	*<10000 D*	*<15 D*	*<18 D*	**1800 D**	*<4 D*	*<3 D*	*<8 D*	*<2 D*	*<2 D*
OW-21	4/19/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-22	4/8/2005	<5	*<0.37*	<5	<5	<5	**0.025**	<0.018	<5	<5	<5	<5	<5	<1000	<25	<25	**180**	<5	<5	<5	<5	<5
OW-23T	4/12/2005	<5	*<0.37*	<5	<5	<5	**0.027**	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-24	4/15/2005	*<1.1 D*	*<1.9 D*	*<1 D*	*<1.6 D*	*<1 D*	<0.019	<0.019	*<1 D*	*<1.3 D*	*<1.7 D*	*<1 D*	*<1 D*	*<5000 D*	*<7.5 D*	*<9 D*	**700 D**	*<2 D*	*<1.5 D*	*<4 D*	*<1 D*	*<1 D*
OW-25	4/14/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	**260**	<5	<5	<5	<5	<5
OW-26	4/15/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-27T	4/11/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**22**	<5	<5	<5	<5	<5
OW-28T	4/8/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**25**	<5	<5	<5	<5	<5
OW-28T Dup	4/8/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**26**	<5	<5	<5	<5	<5
OW-29	6/29/2005	<5	*<0.37*	<5	<5	<5	**0.062 J**	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	**100**	<5	<5	<5	<5	<5
OW-30	6/30/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	**21**	<5	<5	<5	<5	<5
OW-31	6/29/2005	*<1.1 D*	*<1.9 D*	*<1 D*	*<1.6 D*	*<1 D*	**0.053**	<0.019	*<1 D*	*<1 D*	*<1.7 D*	*<1 D*	*<1 D*	*<5000 D*	*<7.5 D*	*<9 D*	**270 D**	*<2 D*	*<1.5 D*	*<4 D*	*<1 D*	*<1 D*
OW-32	6/28/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**26**	<5	<5	<5	<5	<5
OW-33	6/15/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
OW-35	4/18/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**2.3**	<5	<5	<5	<5	<5
OW-36	4/19/2005	*<1.1 D*	*<1.9 D*	*<1 D*	*<1.6 D*	*<1 D*	<0.02	<0.02	*<1 D*	*<1.3 D*	*<1.7 D*	*<1 D*	*<1 D*	*<5000 D*	*<7.5 D*	*<9 D*	**44 D**	*<2 D*	*<1.5 D*	*<4 D*	*<1 D*	*<1 D*
OW-37	4/13/2005	*<4.2 D*	*<7.4 D*	*<4 D*	*<6.2 D*	*<4 D*	<0.019	<0.019	*<4 D*	*<5 D*	*<6.8 D*	*<4 D*	*<4 D*	*<20000 D*	*<30 D*	*<36 D*	**9700 D**	*<8 D*	*<6 D*	*<16 D*	*<4 D*	*<4 D*
OW-38	4/18/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	**68**	<5	<5	<5	<5	<5
OW-39	6/30/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
W-01D	5/26/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-01S	5/20/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-03	3/30/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-03	5/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-08	3/30/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-08	5/26/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 3 of 8)

	Analyte (µg/L):	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane (Ethylene dibromide)	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,4-Dioxane (p-Dioxane)	2-Hexanone	Acetone	Benzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride
	KDHE RSK[a] (µg/L):	**200**	**1**	**5**	**1300**	**70**	**NA**	**0.05**	**600**	**5**	**5**	**NA**	**75**	**260**	**230**	**930**	**5**	**80**	**80**	**10**	**30**	**5**
Location Identification	**Date Collected**																					
W-15D	3/28/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-15D	5/18/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-15S	3/28/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-15S	5/18/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-16S	3/24/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-16S	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-22	3/24/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**120**	--	--	--	--	--
W-22	5/19/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**160**	--	--	--	--	--
W-23	3/29/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-23	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**9.8**	--	--	--	--	--
W-24	3/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**150**	--	--	--	--	--
W-24	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**150**	--	--	--	--	--
W-26	3/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-26	5/18/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-29D	3/24/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-29D	5/27/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-29S	3/24/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
W-29S	5/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
Field QC Samples																						
EB01	3/17/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EB1	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB2	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB3	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB4	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB5	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB6	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	**3**	<5	<5	<5	<5	<5
EB7	4/22/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB8	4/22/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EB9	4/22/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
EQ-1	5/21/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 4 of 8)

	Analyte (µg/L):	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane (Ethylene dibromide)	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,4-Dioxane (p-Dioxane)	2-Hexanone	Acetone	Benzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride
	KDHE RSK[a] (µg/L):	**200**	**1**	**5**	**1300**	**70**	**NA**	**0.05**	**600**	**5**	**5**	**NA**	**75**	**260**	**230**	**930**	**5**	**80**	**80**	**10**	**30**	**5**
Location Identification	**Date Collected**																					
EQ-2	5/26/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ-3	5/26/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ4	6/2/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ5	6/2/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ6	6/2/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ7	6/2/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ8	6/2/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQ9	6/3/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
EQUIPMENT BLANK	6/8/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
FIELDBLANK	4/22/2005	<5	*<0.37*	<5	<5	<5	--	--	<5	<5	<5	<5	<5	<1000	<25	<25	<1	**14**	<5	<5	<5	<5
TRIP BLANK	3/17/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	3/22/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	3/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	3/24/2005	--	--	--	--	--	--	--	--	<5	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	3/28/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	3/29/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<	--	--	--	--	--
TRIP BLANK	3/30/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	4/8/2005	<5	*<0.37*	<5	<5	<5	--	--	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/11/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/12/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/13/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/14/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/15/2005	<5	*<0.37*	<5	<5	<5	<0.019	<0.019	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/16/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/19/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	4/22/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	5/18/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	5/19/2005	<1	--	<1	<1	<1	--	--	<1	<1	<1	<1	<1	--	--	**5.1 T**	<1	--	--	--	**0.24 T**	<1
TRIP BLANK	5/21/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	5/23/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	5/26/2005	<1	--	<1	<1	<1	--	--	<1	<1	<1	<1	<1	--	--	**7.6 T**	<1	--	--	--	<5	<1
TRIP BLANK	5/31/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	6/2/2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--
TRIP BLANK	6/8/2005	<5	*<0.37*	<5	<5	<5	--	--	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	6/15/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	6/28/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	6/29/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5
TRIP BLANK	6/30/2005	<5	*<0.37*	<5	<5	<5	<0.02	<0.02	<5	<5	<5	<5	<5	<1000	<25	<25	<1	<5	<5	<5	<5	<5

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Analyte (µg/L):	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethylene	cis-1,3-Dichloropropene	Dibromochloromethane	Ethylbenzene	Methyl ethyl ketone (2-Butanone)	Methyl isobutyl ketone (4-Methyl-2-pentanone)	Methylene chloride	Styrene	tert-Butyl methyl ether	Tetrachloroethylene (PCE)	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethylene (TCE)	Vinyl acetate	Vinyl chloride	Xylenes, Total
	KDHE RSK[a] (µg/L):	**100**	**NA**	**80**	**40**	**7**	**2**	**80**	**700**	**2800**	**NA**	**5**	**100**	**20**	**5**	**1000**	**100**	**2**	**5**	**NA**	**2**	**10000**
Location Identification	**Date Collected**																					
FINA MW-38	3/30/2005	--	--	--	--	--	--	--	*<5 D*	--	--	--	--	*<5 D*	--	**420 D**	--	--	--	--	--	**570 D**
FINA MW-38	5/25/2005	--	--	--	--	--	--	--	**7.6**	--	--	--	--	<5	--	**19**	--	--	--	--	--	**38**
N1-1	3/29/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<5
N1-1	5/25/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N2-1	3/29/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<5
N2-1	5/25/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N2-2	3/30/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N2-2	5/31/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N2-3	3/22/2005	--	--	--	--	--	--	--	*<1 D*	--	--	--	--	*<1 D*	--	*<1 D*	--	--	--	--	--	*<1.8 D*
N2-3	5/31/2005	--	--	--	--	--	--	--	<25 D	--	--	--	--	<25 D	--	<25 D	--	--	--	--	--	**50 D**
N2-4	3/24/2005	--	--	--	--	--	--	--	**11**	--	--	--	--	<5	--	**13**	--	--	--	--	--	**42**
N2-4	5/25/2005	--	--	--	--	--	--	--	**14**	--	--	--	--	<5	--	**20**	--	--	--	--	--	**55**
N3-1	3/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N3-1	5/27/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N3-2	3/30/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**16**	--	<5	--	--	--	--	--	<10
N3-2	5/22/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**17**	--	<5	--	--	--	--	--	<10
N3-3	5/20/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N3-4	3/29/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**5.9**	--	<5	--	--	--	--	--	<5
N3-4	5/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**25 J**	--	<5	--	--	--	--	--	<10
N3-4 Dup	5/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**19**	--	<5	--	--	--	--	--	<10
N4-1	3/29/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**210**	--	<5	--	--	--	--	--	<5
N4-1	5/20/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**140**	--	<5	--	--	--	--	--	<10
N4-2	3/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**20**	--	<5	--	--	--	--	--	<10
N4-2	5/20/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**22**	--	<5	--	--	--	--	--	<10
N4-3	3/24/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N4-3	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N4-4	3/28/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N4-4	5/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N5-1	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	**12**
N5-2	3/28/2005	--	--	--	--	--	--	--	**5.2**	--	--	--	--	<5	--	<5	--	--	--	--	--	**28**
N5-2 Dup	3/28/2005	--	--	--	--	--	--	--	**5.2**	--	--	--	--	<5	--	<5	--	--	--	--	--	**28**
N5-2	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N5-3	3/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N5-3	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N5-3 Dup	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
N6-1	5/23/2005	--	--	--	--	--	--	--	**96**	--	--	--	--	<5	--	**5**	--	--	--	--	--	**85**
OW-01	4/19/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-02	4/18/2005	*<1 D*	*<1.5 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<4 D*	*<1 D*	*<1 D*	*<1 D*	**650 D**	*<1.8 D*	*<1 D*	*<1 D*	*<1.2 D*	*<1 D*	*<1 D*	*<1 D*	*<1.8 D*
OW-03	6/28/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10

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TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 6 of 8)

Analyte (µg/L):		Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethylene	cis-1,3-Dichloropropene	Dibromochloromethane	Ethylbenzene	Methyl ethyl ketone (2-Butanone)	Methyl isobutyl ketone (4-Methyl-2-pentanone)	Methylene chloride	Styrene	tert-Butyl methyl ether	Tetrachloroethylene (PCE)	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethylene (TCE)	Vinyl acetate	Vinyl chloride	Xylenes, Total
KDHE RSK[a] (µg/L):		**100**	**NA**	**80**	**40**	**7**	**2**	**80**	**700**	**2800**	**NA**	**5**	**100**	**20**	**5**	**1000**	**100**	**2**	**5**	**NA**	**2**	**10000**
Location Identification	**Date Collected**																					
OW-04	6/28/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-05	6/30/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-06	6/30/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-07	4/11/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-08	4/15/2005	<5	<5	<5	<5	<5	*<0.2*	<5	**270**	<25	<25	<5	<5	<5	<5	**14**	<5	*<0.24*	<5	<25	*<0.2*	**260**
OW-09	4/13/2005	<5	<5	<5	<5	<5	*<0.2*	<5	**32**	<25	<25	<5	<5	**48**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**13**
OW-09 Dup	4/13/2005	<5	<5	<5	<5	<5	*<0.2*	<5	**35**	<25	<25	<5	<5	**52**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**14**
OW-10	4/13/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-11	4/12/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-12	4/12/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-13	4/11/2005	*<10 D*	*<15 D*	*<10 D*	*<10 D*	*<10 D*	*<10 D*	*<10 D*	*<10 D*	*<40 D*	*<10 D*	*<10 D*	*<10 D*	**5300 D**	*<18 D*	*<10 D*	*<10 D*	*<12 D*	*<10 D*	*<10 D*	*<10 D*	*<18 D*
OW-14	4/11/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	**10**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-16	4/15/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	**18**	<5	*<0.24*	<5	<25	*<0.2*	**72**
OW-19T	4/15/2005	*<2 D*	*<2.9 D*	*<2 D*	*<2 D*	*<2 D*	*<2 D*	*<2 D*	**410 D**	*<7.9 D*	*<2 D*	*<2 D*	*<2 D*	*<2 D*	*<3.5 D*	*<2 D*	*<2 D*	*<2.4 D*	*<2 D*	*<2 D*	*<2 D*	**1200 D**
OW-21	4/19/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	**10**	<5	*<0.24*	<5	<25	*<0.2*	**10**
OW-22	4/8/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	**8.2**	<5	*<0.24*	<5	<25	*<0.2*	**14**
OW-23T	4/12/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-24	4/15/2005	*<1 D*	*<1.5 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<4 D*	*<1 D*	*<1 D*	*<1 D*	**330 D**	*<1.8 D*	*<1 D*	*<1 D*	*<1.2 D*	*<1 D*	*<1 D*	*<1 D*	*<1.8 D*
OW-25	4/14/2005	<5	<5	<5	<5	<5	*<0.2*	<5	**7.1**	<25	<25	<5	<5	**200**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**18**
OW-26	4/15/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-27T	4/11/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**11**
OW-28T	4/8/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**18**
OW-28T Dup	4/8/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	**6**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**19**
OW-29	6/29/2005	<5	<5	<5	<5	<5	*<0.2*	<5	**77**	<25	<25	<5	<5	<5	<5	**68**	<5	*<0.24*	<5	<25	*<0.2*	**320**
OW-30	6/30/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	**42**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	**10**
OW-31	6/29/2005	*<1 D*	*<1.5 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<4 D*	*<1 D*	*<1 D*	*<1 D*	**46 D**	*<1.8 D*	*<1 D*	*<1 D*	*<1.2 D*	*<1 D*	*<1 D*	*<1 D*	*<1.8 D*
OW-32	6/28/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	**41**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-33	6/15/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	**14**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-35	4/18/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-36	4/19/2005	*<1 D*	*<1.5 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<4 D*	*<1 D*	*<1 D*	*<1 D*	*<1 D*	*<1.8 D*	*<1 D*	*<1 D*	*<1.2 D*	*<1 D*	*<1 D*	*<1 D*	**100 D**
OW-37	4/13/2005	*<4 D*	*<5.8 D*	*<4 D*	*<4 D*	*<4 D*	*<4 D*	*<4 D*	**430 D**	*<16 D*	*<4 D*	*<4 D*	*<4 D*	*<4 D*	*<7 D*	**350 D**	*<4 D*	*<4.8 D*	*<4 D*	*<4 D*	*<4 D*	**920 D**
OW-38	4/18/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	**16**	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
OW-39	6/30/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
W-01D	5/26/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-01S	5/20/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-03	3/30/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-03	5/22/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-08	3/30/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-08	5/26/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 7 of 8)

	Analyte (µg/L):	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethylene	cis-1,3-Dichloropropene	Dibromochloromethane	Ethylbenzene	Methyl ethyl ketone (2-Butanone)	Methyl isobutyl ketone (4-Methyl-2-pentanone)	Methylene chloride	Styrene	tert-Butyl methyl ether	Tetrachloroethylene (PCE)	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethylene (TCE)	Vinyl acetate	Vinyl chloride	Xylenes, Total
	KDHE RSK[a] (µg/L):	**100**	**NA**	**80**	**40**	**7**	**2**	**80**	**700**	**2800**	**NA**	**5**	**100**	**20**	**5**	**1000**	**100**	**2**	**5**	**NA**	**2**	**10000**
Location Identification	**Date Collected**																					
W-15D	3/28/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-15D	5/18/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-15S	3/28/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-15S	5/18/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-16S	3/24/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-16S	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-22	3/24/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	**6.7**	--	--	--	--	--	**13**
W-22	5/19/2005	--	--	--	--	--	--	--	<5	--	--	--	--	**11**	--	**11**	--	--	--	--	--	**27**
W-23	3/29/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<5
W-23	5/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-24	3/22/2005	--	--	--	--	--	--	--	**7.1**	--	--	--	--	<5	--	**6.3**	--	--	--	--	--	**16**
W-24	5/23/2005	--	--	--	--	--	--	--	**9.8**	--	--	--	--	<5	--	**7.3**	--	--	--	--	--	**18**
W-26	3/22/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-26	5/18/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-29D	3/24/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-29D	5/27/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-29S	3/24/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
W-29S	5/22/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
Field QC Samples																						
EB01	3/17/2005	--	--	--	--	--	--	--	<1	--	--	--	--	<5	--	<5	--	--	--	--	--	<2
EB1	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB2	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB3	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB4	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB5	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB6	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB7	4/22/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB8	4/22/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EB9	4/22/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
EQ-1	5/21/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10

Refer to Table 21 for footnotes.

TABLE 13

VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 8 of 8)

	Analyte (µg/L):	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethylene	cis-1,3-Dichloropropene	Dibromochloromethane	Ethylbenzene	Methyl ethyl ketone (2-Butanone)	Methyl isobutyl ketone (4-Methyl-2-pentanone)	Methylene chloride	Styrene	tert-Butyl methyl ether	Tetrachloroethylene (PCE)	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethylene (TCE)	Vinyl acetate	Vinyl chloride	Xylenes, Total
	KDHE RSK[a] (µg/L):	**100**	**NA**	**80**	**40**	**7**	**2**	**80**	**700**	**2800**	**NA**	**5**	**100**	**20**	**5**	**1000**	**100**	**2**	**5**	**NA**	**2**	**10000**
Location Identification	**Date Collected**																					
EQ-2	5/26/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ-3	5/26/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ4	6/2/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ5	6/2/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ6	6/2/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ7	6/2/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ8	6/2/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQ9	6/3/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
EQUIPMENT BLANK	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
FIELDBLANK	4/22/2005	<5	<5	**35**	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	3/17/2005	--	--	--	--	--	--	--	<1	--	--	--	--	<5	--	<5	--	--	--	--	--	<2
TRIP BLANK	3/22/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	3/23/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	3/24/2005	--	--	--	--	--	--	--	<5	--	--	--	--	--	--	<5	--	--	--	--	--	<10
TRIP BLANK	3/28/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	3/29/2005	--	--	--	--	--	--	--	<	--	--	--	--	<	--	<	--	--	--	--	--	<
TRIP BLANK	3/30/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	4/8/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/11/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/12/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/13/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/14/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/15/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/16/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/19/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	4/22/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	5/18/2005	--	--	--	--	--	--	--	<1	--	--	--	--	<5	--	<1	--	--	--	--	--	<10
TRIP BLANK	5/19/2005	<1	<2	<1	--	<1	--	--	<1	**2.1 T**	**0.32 T**	<5	--	<10	<1	<1	<1	--	<1	--	*<0.3*	<1
TRIP BLANK	5/21/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	5/23/2005	--	--	--	--	--	--	--	<1	--	--	--	--	--	--	<1	--	--	--	--	--	<1
TRIP BLANK	5/26/2005	<1	<2	<1	--	<1	--	--	<1	**2.2 T**	<50	<5	--	<10	<1	**0.53 T**	<1	--	<1	--	*<0.3*	<1
TRIP BLANK	5/31/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	6/2/2005	--	--	--	--	--	--	--	<5	--	--	--	--	<5	--	<5	--	--	--	--	--	<10
TRIP BLANK	6/8/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	6/15/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	6/28/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	6/29/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10
TRIP BLANK	6/30/2005	<5	<5	<5	<5	<5	*<0.2*	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	*<0.24*	<5	<25	*<0.2*	<10

Refer to Table 21 for footnotes.

TABLE 14

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 6)

	Analyte (µg/L):	1,2-Dichlorobenzene	1,2-Diphenylhydrazine	1,3-Dichlorobenzene	1,4-Dichlorobenzene	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethyl phenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol (o-Cresol)	2-Nitrophenol	3,3'-Dichlorobenzidine	4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether	4-Nitrophenol
	KDHE RSK[a] (µg/L):	**600**	**NA**	**NA**	**75**	**170**	**250**	**1800**	**200**	**4**	**4**	**NA**	**NA**	**NA**	**4700**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Location Identification	**Date Collected**																					
OW-01	4/19/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-02	4/18/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-03	6/28/2005	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<20	<9.8	<9.8	<9.8	<9.8
OW-04	6/28/2005	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<20	<9.8	<9.8	<9.8	<9.8
OW-05	6/30/2005	<10	<10	<10	<10	<10	<10	<10	<51	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
OW-06	6/30/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
OW-07	4/11/2005	<11	<11	<11	<11	<11	<11	<11	<56	*<4.1*	*<4.1*	<11	<11	<11	<11	<11	<56	<56	<11	<11	<11	<11
OW-08	4/15/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**10**	<10	<10	<50	<50	<10	<10	<10	<10
OW-09	4/13/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50 R	<50	<10	<10	<10	<10
OW-09 Dup	4/13/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-10	4/13/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-11	4/12/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-12	4/12/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-13	4/11/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-14	4/11/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**140**	<10	<10	<50	<50	<10	<10	<10	<10
OW-16	4/15/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-19T	4/16/2005	*<7.2 D*	*<5.8 D*	*<7.8 D*	*<7.2 D*	*<66 D*	*<110 D*	*<7 D*	*<380 D*	*<74 D*	*<74 D*	*<6 D*	*<6.4 D*	**8000 D**	*<18 D*	*<6.8 D*	*<54 D*	*<260 D*	*<1.8 D*	*<160 D*	*<6.4 D*	*<12 D*
OW-21	4/19/2005	<10	<10	<10	<10	<10 UJ	<10 R	<10 R	<50 UJ	*<3.7 UJ*	*<3.7*	<10	<10 R	<10	<10 R	<10 R	<50	<50 UJ	<10	<10 R	<10	<10 UJ
OW-22	4/8/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-23T	4/12/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-24	4/15/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**92**	<10	<10	<50	<50	<10	<10	<10	<10
OW-25	4/14/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**17**	<10	<10	<50	<50	<10	<10	<10	<10
OW-26	4/15/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-27T	4/11/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
OW-28T	4/8/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50 R	<50	<10	<10	<10	<10
OW-28T Dup	4/8/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50 R	<50	<10	<10	<10	<10
OW-29	6/29/2005	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	**12 J**	<49	*<3.6*	*<3.6*	<9.8	<9.8	**74**	<9.8	<9.8	<9.8	<20	<9.8	<9.8	<9.8	<9.8
OW-30	6/30/2005	<10	<10	<10	<10	<10	<10	<10	<51	*<3.8*	*<3.8*	<10	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
OW-31	6/29/2005	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	**21**	<9.8	<9.8	<9.8	<20	<9.8	<9.8	<9.8	<9.8
OW-32	6/28/2005	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	**33**	<9.8	<9.8	<9.8	<20	<9.8	<9.8	<9.8	<9.8
OW-33	6/15/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
OW-35	4/18/2005	<10	<10	<10	<10	<10	<10 R	<10 R	<50	*<3.7*	*<3.7*	<10	<10 R	**20**	<10 R	<10 R	<50	<50	<10	<10 R	<10	<10

Refer to Table 21 for footnotes.

TABLE 14

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 6)

	Analyte (µg/L):	1,2-Dichlorobenzene	1,2-Diphenylhydrazine	1,3-Dichlorobenzene	1,4-Dichlorobenzene	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethyl phenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol (o-Cresol)	2-Nitrophenol	3,3'-Dichlorobenzidine	4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether	4-Nitrophenol
	KDHE RSK[a] (µg/L):	**600**	**NA**	**NA**	**75**	**170**	**250**	**1800**	**200**	**4**	**4**	**NA**	**NA**	**NA**	**4700**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Location Identification	**Date Collected**																					
OW-36	4/19/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**180 D**	<10	<10	<50	<50	<10	<10	<10	<10
OW-37	4/13/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**99**	<10	<10	<50	<50	<10	<10	<10	<10
OW-38	4/18/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	**110**	<10	<10	<50	<50	<10	<10	<10	<10
OW-39	6/30/2005	<10	<10	<10	<10	<10	<10	<10	<51	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<10	<20	<10	<10	<10	<10
Field QC Samples																						
EB1	4/16/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
EB2	4/16/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
EB3	4/16/2005	<10	<10	<10	<10	<10	<10 R	<10 R	<50	*<3.7*	*<3.7*	<10	<10 R	<10	<10 R	<10 R	<50	<50	<10	<10 R	<10	<10
EB4	4/16/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
EB5	4/16/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
EB6	4/16/2005	<10	<10	<10	<10	<10	<10	<10	<50	*<3.7*	*<3.7*	<10	<10	<10	<10	<10	<50	<50	<10	<10	<10	<10
EB7	4/22/2005	<11	<11	<11	<11	<11	<11	<11	<56	*<4.1*	*<4.1*	<11	<11	<11	<11	<11	<56	<56	<11	<11	<11	<11
EB8	4/22/2005	<12	<12	<12	<12	<12	<12	<12	<62	*<4.6*	*<4.6*	<12	<12	<12	<12	<12	<62	<62	<12	<12	<12	<12
EB9	4/22/2005	<12	<12	<12	<12	<12	<12	<12	<59	*<4.4*	*<4.4*	<12	<12	<12	<12	<12	<59	<59	<12	<12	<12	<12
EQUIPMENT BLANK	6/8/2005	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<49	*<3.6*	*<3.6*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8 R	<20	<9.8	<9.8	<9.8	<9.8

Refer to Table 21 for footnotes.

TABLE 14

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 3 of 6)

	Analyte (µg/L):	Acenaphthene	Acenaphthylene	Anthracene	Benzidine	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzo[e]pyrene	Benzyl butyl phthalate	bis(2-chloroethoxy) Methane	bis(2-chloroethyl) Ether (2-Chloroethyl Ether)	bis(2-chloroisopropyl) Ether	bis(2-ethylhexyl) Phthalate	Chrysene	Di-n-butyl phthalate	Di-n-octylphthalate	Dibenz(a,h)anthracene	Diethyl Phthalate
	KDHE RSK[a] (µg/L):	**490**	**NA**	**2300**	**0.01**	**0.4**	**0.2**	**0.3**	**NA**	**3**	**NA**	**12000**	**NA**	**0.2**	**7**	**0.6**	**40**	**NA**	**8**	**0.01**	**78000**
Location Identification	**Date Collected**																				
OW-01	4/19/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-02	4/18/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-03	6/28/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	--	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	<9.8	<9.8	*<0.12*	*<0.088*	<9.8
OW-04	6/28/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	--	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	<9.8	<9.8	*<0.12*	*<0.088*	<9.8
OW-05	6/30/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.091*	<10
OW-06	6/30/2005	<10	<10	<10	*<18*	*<0.16*	*<0.1*	*<0.11*	<10	*<0.16*	--	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-07	4/11/2005	<11	<11	<11	*<20*	*<0.18*	--	*<0.12*	<11	*<0.18*	<11	<11	<11	*<0.54*	*<0.41*	*<0.41*	<11	<11	*<0.13*	*<0.1*	<11
OW-08	4/15/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-09	4/13/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-09 Dup	4/13/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-10	4/13/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-11	4/12/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-12	4/12/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-13	4/11/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-14	4/11/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-16	4/15/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-19T	4/16/2005	**480 D**	*<7.2 D*	*<4.6 D*	*<360 D*	*<3.2 D*	--	*<2.2 D*	*<1.6 D*	*<3.2 D*	*<2 D*	*<2.4 D*	*<8.8 D*	*<9.8 D*	*<7.4 D*	*<7.4 D*	*<2.8 D*	*<4.4 D*	*<2.4 D*	*<1.8 D*	*<4 D*
OW-21	4/19/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-22	4/8/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-23T	4/12/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-24	4/15/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-25	4/14/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-26	4/15/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-27T	4/11/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-28T	4/8/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-28T Dup	4/8/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-29	6/29/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	--	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	<9.8	<9.8	*<0.12*	*<0.088*	<9.8
OW-30	6/30/2005	<10	<10	<10	*<18*	*<0.16*	*<0.1*	*<0.11*	<10	*<0.16*	--	<10	<10	*<0.5*	*<0.38*	**59**	<10	<10	*<0.12*	*<0.092*	<10
OW-31	6/29/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	--	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	<9.8	<9.8	*<0.12*	*<0.088*	<9.8
OW-32	6/28/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	--	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	<9.8	<9.8	*<0.12*	*<0.088*	<9.8
OW-33	6/15/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-35	4/18/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10

Refer to Table 21 for footnotes.

TABLE 14

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 4 of 6)

	Analyte (µg/L):	Acenaphthene	Acenaphthylene	Anthracene	Benzidine	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzo[e]pyrene	Benzyl butyl phthalate	bis(2-chloroethoxy) Methane	bis(2-chloroethyl) Ether (2-Chloroethyl Ether)	bis(2-chloroisopropyl) Ether	bis(2-ethylhexyl) Phthalate	Chrysene	Di-n-butyl phthalate	Di-n-octylphthalate	Dibenz(a,h)anthracene	Diethyl Phthalate
	KDHE RSK[a] (µg/L):	**490**	**NA**	**2300**	**0.01**	**0.4**	**0.2**	**0.3**	**NA**	**3**	**NA**	**12000**	**NA**	**0.2**	**7**	**0.6**	**40**	**NA**	**8**	**0.01**	**78000**
Location Identification	**Date Collected**																				
OW-36	4/19/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-37	4/13/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-38	4/18/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
OW-39	6/30/2005	<10	<10	<10	*<18*	*<0.16*	*<0.1*	*<0.11*	<10	*<0.16*	--	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.091*	<10
Field QC Samples																					
EB1	4/16/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
EB2	4/16/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
EB3	4/16/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
EB4	4/16/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
EB5	4/16/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
EB6	4/16/2005	<10	<10	<10	*<18*	*<0.16*	--	*<0.11*	<10	*<0.16*	<10	<10	<10	*<0.49*	*<0.37*	*<0.37*	<10	<10	*<0.12*	*<0.09*	<10
EB7	4/22/2005	<11	<11	<11	*<20*	*<0.18*	--	*<0.12*	<11	*<0.18*	<11	<11	<11	*<0.54*	*<0.41*	*<0.41*	<11	<11	*<0.13*	*<0.1*	<11
EB8	4/22/2005	<12	<12	<12	*<22*	*<0.2*	--	*<0.14*	<12	*<0.2*	<12	<12	<12	*<0.6*	*<0.46*	*<0.46*	<12	<12	*<0.15*	*<0.11*	<12
EB9	4/22/2005	<12	<12	<12	*<21*	*<0.19*	--	*<0.13*	<12	*<0.19*	<12	<12	<12	*<0.58*	*<0.44*	*<0.44*	<12	<12	*<0.14*	*<0.11*	<12
EQUIPMENT BLANK	6/8/2005	<9.8	<9.8	<9.8	*<18*	*<0.16*	--	*<0.11*	<9.8	*<0.16*	<9.8	<9.8	<9.8	*<0.48*	*<0.36*	*<0.36*	<9.8	<9.8	*<0.12*	*<0.088*	<9.8

Refer to Table 21 for footnotes.

TABLE 14

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 5 of 6)

	Analyte (µg/L):	Dimethyl phthalate	Fluoranthene	Fluorene	Hexachlorobenzene	Hexachlorocyclopentadiene	Hexachloroethane	Indeno(1,2,3-c,d)Pyrene	Isophorone	m,p-Cresol	n-Nitroso-di-n-propylamine	n-Nitrosodimethylamine	n-Nitrosodiphenylamine	Naphthalene	Nitrobenzene	Pentachlorophenol	Phenanthrene	Phenol	Pyrene	Pyridine	Quinoline
	KDHE RSK[a] (µg/L):	**NA**	**890**	**280**	**1**	**NA**	**70**	**0.2**	**NA**	**470**	**NA**	**NA**	**NA**	**350**	**5**	**1**	**NA**	**58000**	**720**	**9**	**NA**
Location Identification	**Date Collected**																				
OW-01	4/19/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-02	4/18/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-03	6/28/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8 UJ	<9.8	*<0.11*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
OW-04	6/28/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8 UJ	<9.8	*<0.11*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
OW-05	6/30/2005	<10	<10	<10	*<0.35*	<10 UJ	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.6*	<10	<10	<10	*<4.1*	<10
OW-06	6/30/2005	<10	<10	<10	*<0.35*	<10 UJ	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-07	4/11/2005	<11	<11	<11	*<0.39*	<11	<11	*<0.12*	<11	<11	<11	<11	<11	<11	*<0.32*	*<7.2*	<11	<11	<11	*<4.6*	<11
OW-08	4/15/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**44**	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-09	4/13/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**12**	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-09 Dup	4/13/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-10	4/13/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-11	4/12/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-12	4/12/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-13	4/11/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-14	4/11/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**68**	*<0.29*	*<6.5*	**19**	**16**	<10	*<4.1*	<10
OW-16	4/15/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-19T	4/16/2005	*<6.2 D*	*<3.4 D*	**640 D**	*<7 D*	*<28 D*	*<8.2 D*	*<2.2 D*	*<5.8 D*	*<19 D*	*<6.4 D*	*<4.6 D*	*<2.6 D*	**1500 D**	*<5.8 D*	*<130 D*	**2200 D**	*<7.8 D*	**250 D**	*<82 D*	*<200 D*
OW-21	4/19/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10 R	<10	<10	<10	<10	*<0.29*	*<6.5 UJ*	<10	<10	<10	*<4.1*	<10
OW-22	4/8/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	**15**	<10	*<4.1*	<10
OW-23T	4/12/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-24	4/15/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**140**	*<0.29*	*<6.5*	<10	**16**	<10	*<4.1*	<10
OW-25	4/14/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**34**	*<0.29*	*<6.5*	<10	**15**	<10	*<4.1*	<10
OW-26	4/15/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-27T	4/11/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-28T	4/8/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-28T Dup	4/8/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-29	6/29/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	<9.8	*<0.11*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	*<0.28*	*<6.4*	<9.8	<9.8	<9.8	*<4*	<9.8
OW-30	6/30/2005	<10	<10	<10	*<0.36*	<10 UJ	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.3*	*<6.6*	<10	<10	<10	*<4.2*	<10
OW-31	6/29/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	<9.8	*<0.11*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	*<0.28*	*<6.4*	<9.8	<9.8	<9.8	*<4*	<9.8
OW-32	6/28/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8 UJ	<9.8	*<0.11*	<9.8	<9.8	<9.8	<9.8	<9.8	**37**	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8
OW-33	6/15/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-35	4/18/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10 R	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10

Refer to Table 21 for footnotes.

TABLE 14

SEMI-VOLATILE ORGANIC COMPOUND RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 6 of 6)

	Analyte (µg/L):	**Dimethyl phthalate**	**Fluoranthene**	**Fluorene**	**Hexachlorobenzene**	**Hexachlorocyclopentadiene**	**Hexachloroethane**	**Indeno(1,2,3-c,d)Pyrene**	**Isophorone**	**m,p-Cresol**	**n-Nitroso-di-n-propylamine**	**n-Nitrosodimethylamine**	**n-Nitrosodiphenylamine**	**Naphthalene**	**Nitrobenzene**	**Pentachlorophenol**	**Phenanthrene**	**Phenol**	**Pyrene**	**Pyridine**	**Quinoline**
	KDHE RSK[a] (µg/L):	**NA**	**890**	**280**	**1**	**NA**	**70**	**0.2**	**NA**	**470**	**NA**	**NA**	**NA**	**350**	**5**	**1**	**NA**	**58000**	**720**	**9**	**NA**
Location Identification	**Date Collected**																				
OW-36	4/19/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**210 D**	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
OW-37	4/13/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**140**	*<0.29*	*<6.5*	<10	**32**	<10	*<4.1*	<10
OW-38	4/18/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	**110**	*<0.29*	*<6.5*	<10	**15**	<10	*<4.1*	<10
OW-39	6/30/2005	<10	<10	<10	*<0.35*	<10 UJ	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.6*	<10	<10	<10	*<4.1*	<10
Field QC Samples																					
EB1	4/16/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
EB2	4/16/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
EB3	4/16/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10 R	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
EB4	4/16/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
EB5	4/16/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
EB6	4/16/2005	<10	<10	<10	*<0.35*	<10	<10	*<0.11*	<10	<10	<10	<10	<10	<10	*<0.29*	*<6.5*	<10	<10	<10	*<4.1*	<10
EB7	4/22/2005	<11	<11	<11	*<0.39*	<11	<11	*<0.12*	<11	<11	<11	<11	<11	<11	*<0.32*	*<7.2*	<11	<11	<11	*<4.6*	<11
EB8	4/22/2005	<12	<12	<12	*<0.43*	<12	<12	*<0.14*	<12	<12	<12	<12	<12	<12	*<0.36*	*<8*	<12	<12	<12	*<5.1*	<12
EB9	4/22/2005	<12	<12	<12	*<0.41*	<12	<12	*<0.13*	<12	<12	<12	<12	<12	<12	*<0.34*	*<7.6*	<12	<12	<12	*<4.8*	<12
EQUIPMENT BLANK	6/8/2005	<9.8	<9.8	<9.8	*<0.34*	<9.8	<9.8	*<0.11*	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	*<0.28*	*<6.3*	<9.8	<9.8	<9.8	*<4*	<9.8

Refer to Table 21 for footnotes.

TABLE 15

PETROLEUM HYDROCARBON RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 3)

	Analyte (µg/L):	Petroleum hydrocarbons above C-10	PHC as diesel fuel	PHC as gasoline	PHCC10C28	PHCC10C35	PHCC28C35	PHCJP8
	KDHE RSK[a] (µg/L):	**NA**	**720**	**500**	**720**	**NA**	**NA**	**NA**
Location Identification	**Date Collected**							
FINA MW-38	3/30/2005	--	--	**770 J**	**850**	--	--	--
FINA MW-38	5/25/2005	--	--	**1100 D**	**2700**	--	--	--
N1-1	3/29/2005	--	--	<110	<0.0	--	--	--
N1-1	5/25/2005	--	--	<100	<110	--	--	--
N2-1	3/29/2005	--	--	<100	<0.0	--	--	--
N2-1	5/25/2005	--	--	<100	<110	--	--	--
N2-2	3/30/2005	--	--	**100**	<100	--	--	--
N2-2	5/31/2005	--	--	**160**	**330**	--	--	--
N2-3	3/22/2005	--	--	**1800 D**	**2700**	--	--	--
N2-3	5/31/2005	--	--	**3300 D**	**5000**	--	--	--
N2-4	3/24/2005	--	--	**1100**	**270 J**	--	--	--
N2-4	5/25/2005	--	--	**1800 D**	**1200**	--	--	--
N3-1	3/23/2005	--	--	<100	<100	--	--	--
N3-1	5/27/2005	--	--	<100	<98	--	--	--
N3-2	3/30/2005	--	--	**140**	<100	--	--	--
N3-2	5/22/2005	--	--	**120**	**810**	--	--	--
N3-3	3/25/2005	--	--	**900 D**	**240**	--	--	--
N3-3	5/20/2005	--	--	**1300 J**	**980**	--	--	--
N3-4	3/29/2005	--	--	<110	**2000**	--	--	--
N3-4	5/23/2005	--	--	**400J**	**5400**	--	--	--
N3-4 Dup	5/23/2005	--	--	**230**	**8500**	--	--	--
N4-1	3/29/2005	--	--	**140**	**650**	--	--	--
N4-1	5/20/2005	--	--	**100**	<100	--	--	--
N4-2	3/23/2005	--	--	<100	**310**	--	--	--
N4-2	5/20/2005	--	--	<100	<98	--	--	--
N4-3	3/24/2005	--	--	<100	<100	--	--	--
N4-3	5/19/2005	--	--	<100	<98	--	--	--
N4-4	3/28/2005	--	--	<100	<100	--	--	--
N4-4	5/23/2005	--	--	<100	<100	--	--	--
N5-1	3/25/2005	--	--	<100	<100	--	--	--
N5-1	5/19/2005	--	--	<100	<110	--	--	--
N5-2	3/28/2005	--	--	<100	<110	--	--	--
N5-2 Dup	3/28/2005	--	--	<100	<100	--	--	--
N5-2	5/19/2005	--	--	<100	<100	--	--	--
N5-3	3/23/2005	--	--	<100	**230**	--	--	--
N5-3	5/19/2005	--	--	<100	<100	--	--	--
N5-3 Dup	5/19/2005	--	--	<100	<100	--	--	--
N6-1	5/23/2005	--	--	**1500 D**	**690**	--	--	--
OW-01	4/19/2005	**1000**	<100	**100**	**990**	--	<20	<100
OW-02	4/18/2005	**1800**	<100	**2300 D**	**1700**	--	**77**	<100
OW-03	6/28/2005	**260 J**	<110	<100	**110 J**	--	**180 J**	<110
OW-04	6/28/2005	**210 J**	<98	<100	**130 J**	--	**120 J**	<98
OW-05	6/30/2005	**300 JB**	<100	<100	**240 J**	--	**91 J**	<100
OW-06	6/30/2005	**160 JB**	<100	<100	**120 J**	--	**51 J**	<100
OW-07	4/11/2005	--	<110	<100	<22	<22	<22	<110
OW-08	4/15/2005	**1100**	<100	**3200 D**	**1100**	--	**24**	<100
OW-09	4/13/2005	--	<100	**560**	**1800**	**1800**	**39**	<100
OW-09 Dup	4/13/2005	--	<100	**540 D**	**1400**	**1400**	**31**	<100
OW-10	4/13/2005	--	<100	**180 J**	**2100**	**2100**	**170**	<100
OW-11	4/12/2005	--	<500	<100	<100	<100	<100	<500
OW-12	4/12/2005	--	<500	**150 J**	**820**	**690**	<100	<500
OW-13	4/11/2005	--	<100	**5900 D**	**130**	**150**	**48**	<100
OW-14	4/11/2005	--	*<0.15 D*	<100	**11000 D**	**11000 D**	*<0.029 D*	*<0.15 D*
OW-16	4/15/2005	**1500**	<100	**820 D**	**1400**	--	**190**	<100
OW-19T	4/15/2005	--	--	**13000 D**	--	--	--	--
OW-19T	4/17/2005	**1000000 D**	*<12 D*	--	**1000000 D**	--	*<2.3 D*	*<12 D*
OW-21	4/19/2005	**440**	<100	**100**	**470**	--	<20	<100
OW-22	4/8/2005	**10000 D**	*<0.15 D*	**580**	**10000 D**	--	**440 D**	*<0.15 D*
OW-23T	4/12/2005	--	<500	**220 J**	**4000**	**3900**	<100	<500
OW-24	4/15/2005	**3300**	<100	**3000 D**	**3300**	--	<20	<100
OW-25	4/14/2005	**2400**	<100	**1400 D**	**2300**	--	<20	<100
OW-26	4/15/2005	**1500**	<110	<100	**1500**	--	<21	<110
OW-27T	4/11/2005	--	<110	**640 DJ**	**8000 D**	**8000 D**	<110 D	<110
OW-28T	4/8/2005	**3200**	<100	**730 J**	**3200**	--	<20	<100
OW-28T Dup	4/8/2005	**2900**	<100	**640 J**	**2900**	--	<20	<100
OW-29	6/29/2005	**9400 J**	*<0.15 D*	**2900 DJ**	**8700**	--	**720 J**	*<0.15 D*
OW-30	6/30/2005	**2500 JB**	<110	**650**	**2300 J**	--	**160 J**	<110

Refer to Table 21 for footnotes.

TABLE 15

PETROLEUM HYDROCARBON RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 3)

	Analyte (µg/L):	**Petroleum hydrocarbons above C-10**	**PHC as diesel fuel**	**PHC as gasoline**	**PHCC10C28**	**PHCC10C35**	**PHCC28C35**	**PHCJP8**
	KDHE RSK[a] (µg/L):	**NA**	**720**	**500**	**720**	**NA**	**NA**	**NA**
Location Identification	**Date Collected**							
OW-31	6/29/2005	**5500 J**	<100	**3100 DJ**	**5800**	--	<97	<100
OW-32	6/28/2005	**4900 J**	<100	**3100 DJ**	**5000 J**	--	<98	<100
OW-33	6/15/2005	**1700**	<95	**100**	**1500**	--	**180**	<95
OW-35	4/18/2005	**670**	<100	**540 D**	**650**	--	**25**	<100
OW-36	4/19/2005	**1500**	<100	**1500 D**	**1500**	--	**81**	<100
OW-37	4/13/2005	--	<100	**4300 D**	**3600**	**3600**	**510**	<100
OW-38	4/18/2005	**3100**	<100	**220**	**3100**	--	<20	<100
OW-39	6/30/2005	**310 JB**	<110	<100	**220 J**	--	**120 J**	<110
W-01D	3/25/2005	--	--	<100	<100	--	--	--
W-01D	5/26/2005	--	--	<100	<110	--	--	--
W-01S	3/25/2005	--	--	<100	**250**	--	--	--
W-01S Dup	3/25/2005	--	--	<100	**100**	--	--	--
W-01S	5/20/2005	--	--	<100	<100	--	--	--
W-03	3/30/2005	--	--	<100	<100	--	--	--
W-03	5/22/2005	--	--	<100	<100	--	--	--
W-08	3/30/2005	--	--	<100	<100	--	--	--
W-08	5/26/2005	--	--	*<170 D*	<100	--	--	--
W-15D	3/28/2005	--	--	<100	<110	--	--	--
W-15D	5/18/2005	--	--	<100	<100	--	--	--
W-15S	3/28/2005	--	--	<100	<110	--	--	--
W-15S	5/18/2005	--	--	<100	<100	--	--	--
W-16S	3/24/2005	--	--	<100	<100	--	--	--
W-16S	5/19/2005	--	--	<100	<100	--	--	--
W-22	3/24/2005	--	--	**800**	**820 J**	--	--	--
W-22	5/19/2005	--	--	**3100 D**	**990**	--	--	--
W-23	3/29/2005	--	--	<110	<0.0	--	--	--
W-23	5/23/2005	--	--	**790**	<100	--	--	--
W-24	3/22/2005	--	--	**1100 D**	**1400**	--	--	--
W-24	5/23/2005	--	--	**1400 D**	**1400**	--	--	--
W-26	3/22/2005	--	--	<100	<100	--	--	--
W-26	5/18/2005	--	--	<100	<100	--	--	--
W-29D	3/24/2005	--	--	<100	<100	--	--	--
W-29D	5/27/2005	--	--	<100	<95	--	--	--
W-29S	3/24/2005	--	--	<100	<100	--	--	--
W-29S	5/22/2005	--	--	<100	<95	--	--	--
Field QC Samples								
EB01	3/17/2005	--	--	--	--	--	--	<100
EB1	4/16/2005	<21	<110	<100	<21	--	<21	<110
EB2	4/16/2005	<20	<100	<100	<20	--	<20	<100
EB3	4/16/2005	<20	<100	<100	<20	--	<20	<100
EB4	4/16/2005	<20	<100	<100	<20	--	<20	<100
EB5	4/16/2005	<20	<100	<100	<20	--	<20	<100
EB6	4/16/2005	<20	<100	<100	<20	--	<20	<100
EB7	4/22/2005	<20	<100	<100	<20	--	<20	<100
EB8	4/22/2005	**190**	<100	<100	**130**	--	**130**	<100
EB9	4/22/2005	<20	<100	<100	<20	--	<20	<100
EQ-1	5/21/2005	--	--	<100	<110	--	--	--
EQ-2	5/26/2005	--	--	<100	<100	--	--	--
EQ-3	5/26/2005	--	--	<100	<110	--	--	--
EQ4	6/2/2005	--	--	<100	<100	--	--	--
EQ5	6/2/2005	--	--	<100	<100	--	--	--
EQ6	6/2/2005	--	--	<100	<98	--	--	--
EQ7	6/2/2005	--	--	<100	<100	--	--	--
EQ8	6/2/2005	--	--	<100	<100	--	--	--
EQ9	6/3/2005	--	--	<100	<100	--	--	--
EQUIPMENT BLANK	6/8/2005	<20	<98	<20	<20	<98	--	<100
TRIP BLANK	3/17/2005	--	--	--	--	--	--	<100
TRIP BLANK	3/22/2005	--	--	--	--	--	--	<100
TRIP BLANK	3/23/2005	--	--	--	--	--	--	<100
TRIP BLANK	3/24/2005	--	--	--	--	--	--	<100
TRIP BLANK	3/25/2005	--	--	<100	--	--	--	--
TRIP BLANK	3/28/2005	--	--	<100	--	--	--	--
TRIP BLANK	3/29/2005	--	--	<100	--	--	--	--
TRIP BLANK	3/30/2005	--	--	<100	--	--	--	--
TRIP BLANK	4/8/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/11/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/12/2005	--	--	--	--	--	--	<100

Refer to Table 21 for footnotes.

TABLE 15

PETROLEUM HYDROCARBON RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 3 of 3)

	Analyte (µg/L):	**Petroleum hydrocarbons above C-10**	**PHC as diesel fuel**	**PHC as gasoline**	**PHCC10C28**	**PHCC10C35**	**PHCC28C35**	**PHCJP8**
	KDHE RSK[a] (µg/L):	**NA**	**720**	**500**	**720**	**NA**	**NA**	**NA**
Location Identification	**Date Collected**							
TRIP BLANK	4/13/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/14/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/15/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/16/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/19/2005	--	--	--	--	--	--	<100
TRIP BLANK	4/22/2005	--	--	--	--	--	--	<100
TRIP BLANK	5/18/2005	--	--	--	--	--	--	<100
TRIP BLANK	5/19/2005	--	--	--	--	--	--	<100
TRIP BLANK	5/21/2005	--	--	--	--	--	--	<100
TRIP BLANK	5/26/2005	--	--	--	--	--	--	<100
TRIP BLANK	5/31/2005	--	--	--	--	--	--	<100
TRIP BLANK	6/2/2005	--	--	--	--	--	--	<100
TRIP BLANK	6/15/2005	--	--	--	--	--	--	<100
TRIP BLANK	6/28/2005	--	--	--	--	--	--	<100
TRIP BLANK	6/29/2005	--	--	--	--	--	--	<100
TRIP BLANK	6/30/2005	--	--	--	--	--	--	<100

Refer to Table 21 for footnotes.

TABLE 16

METALS RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 4)

	Analyte (mg/L):	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium III	Chromium, Hexavalent	Chromium, Total	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	KDHE RSK[a] (mg/L)	**0.006**	**0.01**	**2**	**0.004**	**0.005**	**NA**	**NA**	**NA**	**0.1**	**NA**	**1.3**	**NA**	**0.015**	**NA**	**0.05**	**0.002**	**0.1**	**NA**	**0.05**	**0.1**	**NA**	**NA**	**0.71**	**5**
Location Identification	**Date Collected**																								
FINA MW-38	3/30/2005	--	**0.01**	**0.17**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.46**	--	<0.005	--	--	--	--	--	--	--
FINA MW-38	5/25/2005	--	**0.017**	**0.17**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.75**	--	<0.005	--	--	--	--	--	--	--
N1-1	3/29/2005	--	<0.005	**0.051**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
N1-1	5/25/2005	--	<0.005	**0.051**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
N2-1	3/29/2005	--	<0.005	**0.19**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
N2-1	5/25/2005	--	<0.005	**0.19**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
N2-2	3/30/2005	--	**0.013**	**0.32**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.94**	--	<0.005	--	--	--	--	--	--	--
N2-2	5/31/2005	--	**0.0095**	**0.31**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1**	--	<0.005	--	--	--	--	--	--	--
N2-3	3/22/2005	--	**0.035**	**0.34**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.84**	--	<0.005	--	--	--	--	--	--	--
N2-3	5/31/2005	--	**0.041**	**0.32**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.78**	--	<0.005	--	--	--	--	--	--	--
N2-4	3/24/2005	--	<0.005	**0.7**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**3.2**	--	**0.011**	--	--	--	--	--	--	--
N2-4	5/25/2005	--	<0.005	**0.76**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**2.7**	--	**0.012**	--	--	--	--	--	--	--
N3-1	3/23/2005	--	<0.005	**0.058**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.016**	--	<0.005	--	--	--	--	--	--	--
N3-1	5/27/2005	--	<0.005	**0.054**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
N3-2	3/30/2005	--	**0.069**	**0.59**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.8**	--	<0.005	--	--	--	--	--	--	--
N3-2	5/22/2005	--	**0.057**	**0.54**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.7**	--	**0.0053**	--	--	--	--	--	--	--
N3-3	3/25/2005	--	**0.056**	**1.3**	**0.004**	<0.005	--	--	--	**0.074**	--	--	--	**0.046**	--	**5.5**	--	**0.084**	--	--	--	--	--	--	--
N3-3	5/20/2005	--	**0.04**	**0.8**	<0.003	<0.005	--	--	--	**0.038**	--	--	--	**0.022**	--	**4.7**	--	**0.043**	--	--	--	--	--	--	--
N3-4	3/29/2005	--	**0.0053**	**0.028**	<0.003	<0.005	--	--	--	<0.005	--	--	--	**0.0056**	--	**33**	--	**0.034**	--	--	--	--	--	--	--
N3-4	5/23/2005	--	**0.0075**	**0.05**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**24**	--	**0.024**	--	--	--	--	--	--	--
N3-4 Dup	5/23/2005	--	**0.0074**	**0.053**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**24**	--	**0.024**	--	--	--	--	--	--	--
N4-1	3/29/2005	--	<0.005	**0.14**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.59**	--	<0.005	--	--	--	--	--	--	--
N4-1	5/20/2005	--	<0.005	**0.15**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.068**	--	<0.005	--	--	--	--	--	--	--
N4-2	3/23/2005	--	<0.005	**0.077**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.65**	--	**0.064**	--	--	--	--	--	--	--
N4-2	5/20/2005	--	**0.006**	**0.074**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.66**	--	**0.064**	--	--	--	--	--	--	--
N4-3	3/24/2005	--	<0.005	**0.34**	<0.003	<0.005	--	--	--	<0.005	--	--	--	**0.0069**	--	**0.14**	--	<0.005	--	--	--	--	--	--	--
N4-3	5/19/2005	--	<0.005	**0.39**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.089**	--	**0.014**	--	--	--	--	--	--	--
N4-4	3/28/2005	--	<0.005	**0.19**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.011**	--	<0.005	--	--	--	--	--	--	--
N4-4	5/23/2005	--	<0.005	**0.26**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.01**	--	<0.005	--	--	--	--	--	--	--
N5-1	3/25/2005	--	<0.005	**0.17**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.018**	--	**0.011**	--	--	--	--	--	--	--
N5-1	5/19/2005	--	<0.005	**0.19**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
N5-2	3/28/2005	--	<0.005	**0.16**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.46**	--	<0.005	--	--	--	--	--	--	--
N5-2 Dup	3/28/2005	--	<0.005	**0.16**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.47**	--	<0.005	--	--	--	--	--	--	--
N5-2	5/19/2005	--	**0.0066**	**0.19**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.49**	--	<0.005	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 16

METALS RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 2 of 4)

	Analyte (mg/L):	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium III	Chromium, Hexavalent	Chromium, Total	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	KDHE RSK[a] (mg/L)	**0.006**	**0.01**	**2**	**0.004**	**0.005**	**NA**	**NA**	**NA**	**0.1**	**NA**	**1.3**	**NA**	**0.015**	**NA**	**0.05**	**0.002**	**0.1**	**NA**	**0.05**	**0.1**	**NA**	**NA**	**0.71**	**5**
Location Identification	**Date Collected**																								
N5-3	3/23/2005	--	**0.031**	**0.41**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.8**	--	<0.005	--	--	--	--	--	--	--
N5-3	5/19/2005	--	**0.021**	**0.39**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.8**	--	<0.005	--	--	--	--	--	--	--
N5-3 Dup	5/19/2005	--	**0.02**	**0.4**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.8**	--	<0.005	--	--	--	--	--	--	--
N6-1	5/23/2005	--	<0.005	**0.28**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.17**	--	<0.005	--	--	--	--	--	--	--
OW-01	4/19/2005	*<0.004*	<0.005	**0.22**	<0.003	<0.005	**130**	<0.01	<0.02	<0.01	<0.01	<0.01	**9.3**	<0.005	**23**	**0.45**	<0.0002	<0.005	<1	<0.01	<0.005	**100 D**	<0.01	<0.01	<0.02
OW-02	4/18/2005	*<0.004*	<0.005	**0.22**	<0.003	<0.005	**130**	<0.01	<0.02	<0.01	<0.01	<0.01	**1.2**	<0.005	**36**	**0.28**	<0.0002	<0.005	**3.5**	<0.01	<0.005	**120 D**	<0.01	<0.01	<0.02
OW-03	6/28/2005	*<0.004*	<0.005	**0.054**	<0.003	<0.005	**88**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.2**	<0.005	**61**	<0.01	<0.0002	<0.005	**2.5**	<0.01	<0.005	**140 D**	<0.01	<0.01	**0.088**
OW-04	6/28/2005	*<0.004*	<0.005	**0.065**	<0.003	<0.005	**91**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.71**	<0.005	**61**	**0.037**	<0.0002	<0.005	**3.2 J**	<0.01	<0.005	**160 D**	<0.01	<0.01	<0.02
OW-05	6/30/2005	*<0.004*	<0.005	**0.16**	<0.003	<0.005	**420**	<0.01	<0.02	<0.01	<0.01	<0.01	**9.5**	<0.005	**88**	**0.4**	<0.0002	**0.018**	**7.3**	<0.01	<0.005	**140 D**	<0.01	<0.01	**0.51**
OW-06	6/30/2005	*<0.004*	<0.005	**0.043**	<0.003	<0.005	**72**	**0.015**	<0.02	**0.015**	<0.01	<0.01	<0.1	<0.005	**48**	<0.01	<0.0002	<0.005	<1	<0.01	<0.005	**57**	<0.01	<0.01	**0.078**
OW-07	4/11/2005	*<0.004*	<0.005	**0.23**	<0.003	<0.005	**130**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.1**	<0.005	**7.6**	<0.01	<0.0002	<0.005	<1	<0.01	<0.005	**17**	<0.01	<0.01	<0.02
OW-08	4/15/2005	*<0.004*	**0.0057**	**0.42**	<0.003	<0.005	**120**	<0.02	<0.01	<0.01	<0.01	<0.01	**2.2**	**0.0077**	**23**	**2.8**	<0.0002	<0.005	<1	<0.01	<0.005	**98**	<0.01	<0.01	**0.032**
OW-09	4/13/2005	*<0.004*	**0.008**	**0.16**	<0.003	<0.005	**98**	<0.02	<0.01 UJ	<0.01	<0.01	<0.01	**1.9**	<0.005	**71**	**0.12**	<0.0002	<0.005	**2.2**	<0.01	<0.005	**140 D**	<0.01	<0.01	<0.02
OW-09 Dup	4/13/2005	*<0.004*	**0.0058**	**0.16**	<0.003	<0.005	**95**	<0.02	<0.01	<0.01	<0.01	<0.01	**1.8**	<0.005	**70**	**0.12**	<0.0002	<0.005	**2.2**	<0.01	<0.005	**130 D**	<0.01	<0.01	<0.02
OW-10	4/13/2005	*<0.004*	**0.026**	**0.37**	<0.003	<0.005	**68**	<0.02	<0.01	<0.01	<0.01	<0.01	**4.7**	<0.005	**15**	**0.86**	<0.0002	<0.005	<1	<0.01	<0.005	**400 D**	<0.01	<0.01	**0.15**
OW-11	4/12/2005	*<0.004*	<0.005	**0.14**	<0.003	<0.005	**45**	<0.01	<0.02	<0.01	<0.01	<0.01	**0.18**	<0.005	**7.5**	**0.11**	<0.0002	<0.005	<1	<0.01	<0.005	**440**	<0.01	<0.01	<0.02
OW-12	4/12/2005	*<0.004*	**0.0059**	**0.68**	<0.003	<0.005	**110**	<0.01	<0.02 UJ	<0.01	<0.01	<0.01	**2.2**	<0.005	**19**	**0.53**	<0.0002	<0.005	**1.1**	<0.01	<0.005	**45**	<0.01	<0.01	**0.027**
OW-13	4/11/2005	*<0.004*	**0.0065**	**0.57**	<0.003	<0.005	**770**	**0.24**	<0.02	**0.24**	<0.01	<0.01	**9.3**	**0.0062**	**22**	**1.1**	<0.0002	**0.0058**	**3.2**	<0.01	<0.005	**38**	<0.01	**0.015**	<0.02
OW-14	4/11/2005	*<0.004*	**0.078**	**2.9**	**0.008**	**0.0052**	**1500**	**0.036**	<0.02	**0.036**	**0.069**	**0.13**	**130**	**0.11**	**62**	**5.9**	<0.0002	**0.17**	**27**	<0.01	<0.005	**48**	<0.01	**0.22**	**0.74**
OW-16	4/15/2005	*<0.004*	**0.041**	**0.81**	**0.0042**	<0.005	**1200 D**	<0.02	**0.012**	**0.012**	**0.037**	**0.051**	**69**	**0.048**	**59**	**13**	<0.0002	**0.082**	**15**	<0.01	<0.005	**110 D**	<0.01	**0.12**	**0.15**
OW-19T	4/15/2005	--	--	--	--	--	--	<0.02	**0.135**	**0.135**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OW-19T	4/16/2005	*<0.004*	**0.021**	**0.83**	<0.003	<0.005	**1400 D**	--	--	--	<0.01	**0.015**	**15**	**0.02**	**220**	**0.72**	<0.0002	**0.026**	**10**	<0.01	<0.005	**1100 D**	<0.01	**0.032**	**0.27**
OW-21	4/19/2005	*<0.004*	**0.0092**	**0.47**	<0.003	<0.005	**87**	<0.01	<0.02	<0.01	<0.01	<0.01	**5.1**	<0.005	**14**	**1.2**	<0.0002	<0.005	<1	<0.01	<0.005	**160 D**	<0.01	<0.01	<0.02
OW-22	4/8/2005	*<0.004*	**0.035**	**0.34**	<0.003	<0.005	**130**	<0.01	<0.02	<0.01	<0.01	<0.01	**8.6**	<0.005	**32**	**0.69**	<0.0002	**0.0077**	**6**	<0.01	<0.005	**550**	<0.01	<0.01	<0.02
OW-23T	4/12/2005	*<0.004*	**0.0098**	**1.2**	<0.003	<0.005	**270**	<0.02	<0.01	<0.01	<0.01	<0.01	**2.6**	<0.005	**76**	**11**	<0.0002	**0.0074**	**18**	<0.01	<0.005	**730**	<0.01	<0.01	<0.02
OW-24	4/15/2005	*<0.004*	**0.029**	**0.26**	<0.003	<0.005	**130**	<0.02	<0.01	<0.01	<0.01	<0.01	**10**	<0.005	**27**	**1.5**	<0.0002	<0.005	<1	<0.01	<0.005	**110 D**	<0.01	<0.01	<0.02
OW-25	4/14/2005	*<0.004*	**0.012**	**0.42**	<0.003	<0.005	**100**	<0.02	<0.01	<0.01	<0.01	<0.01	**7.5**	<0.005	**24**	**0.7**	<0.0002	<0.005	**1.1**	<0.01	<0.005	**250 D**	<0.01	<0.01	<0.02
OW-26	4/15/2005	*<0.004*	<0.005	**0.14**	<0.003	<0.005	**33**	<0.02	<0.01	<0.01	<0.01	<0.01	**0.92**	<0.005	**8.5**	**0.68**	<0.0002	<0.005	<1	<0.01	<0.005	**330 D**	<0.01	<0.01	<0.02
OW-27T	4/11/2005	*<0.004*	**0.017**	**0.21**	<0.003	<0.005	**220**	<0.01	<0.02	<0.01	**0.022**	<0.01	**9.4**	<0.005	**50**	**9.2**	<0.0002	**0.0073**	**63**	<0.01	<0.005	**190**	<0.01	<0.01	<0.02
OW-28T	4/8/2005	*<0.004*	**0.015**	**0.3**	<0.003	<0.005	**67**	<0.01	<0.02 UJ	<0.01	<0.01	<0.01	**7**	<0.005	**12**	**2.1**	<0.0002	<0.005	**1.8 J**	<0.01	<0.005	**300**	<0.01	<0.01	<0.02
OW-28T Dup	4/8/2005	*<0.004*	**0.017**	**0.28**	<0.003	<0.005	**61**	<0.01	<0.02	<0.01	<0.01	<0.01	**5.5**	<0.005	**11**	**2**	<0.0002	<0.005	**1.7 J**	<0.01	<0.005	**300**	<0.01	<0.01	<0.02
OW-29	6/29/2005	*<0.004*	**0.042**	**0.32**	<0.003	<0.005	**390**	<0.01	<0.02	<0.01	<0.01	<0.01	**17**	**0.017**	**13**	**1.7**	<0.0002	**0.012**	**3**	<0.01	<0.005	**260 D**	<0.01	**0.024**	**0.04**
OW-30	6/30/2005	*<0.004*	**0.037**	**0.48**	<0.003	<0.005	**120**	<0.01	<0.02	<0.01	<0.01	<0.01	**15**	<0.005	**27**	**2.4**	<0.0002	<0.005	**2.4**	<0.01	<0.005	**250 D**	<0.01	<0.01	<0.02
OW-31	6/29/2005	*<0.004*	**0.071**	**0.5**	<0.003	<0.005	**100**	<0.01	<0.02	<0.01	<0.01	<0.01	**18**	<0.005	**23**	**2.4**	<0.0002	<0.005	**2.3**	<0.01	<0.005	**220 D**	<0.01	<0.01	<0.02

Refer to Table 21 for footnotes.

TABLE 16

METALS RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Analyte (mg/L):	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium III	Chromium, Hexavalent	Chromium, Total	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	KDHE RSK[a] (mg/L)	**0.006**	**0.01**	**2**	**0.004**	**0.005**	**NA**	**NA**	**NA**	**0.1**	**NA**	**1.3**	**NA**	**0.015**	**NA**	**0.05**	**0.002**	**0.1**	**NA**	**0.05**	**0.1**	**NA**	**NA**	**0.71**	**5**
Location Identification	**Date Collected**																								
OW-32	6/28/2005	*<0.004*	**0.071**	**2**	<0.003	<0.005	**1400**	**0.043**	<0.02	**0.043**	**0.027**	**0.065**	**66**	**0.05**	**45**	**6.5**	<0.0002	**0.09**	**19**	<0.01	<0.005	**230 D**	<0.01	**0.16**	**0.22**
OW-33	6/15/2005	*<0.004*	**0.082**	**0.89**	<0.003	<0.005	**100**	<0.01	<0.02	<0.01	<0.01	<0.01	**14**	<0.005	**19**	**1.5**	<0.0002	**0.006**	**1.2**	<0.01	<0.005	**190 D**	<0.01	<0.01	**0.061**
OW-35	4/18/2005	*<0.004*	**0.008**	**0.35**	<0.003	<0.005	**130**	<0.01	<0.02	<0.01	<0.01	<0.01	**4.2**	<0.005	**20**	**0.8**	<0.0002	<0.005	**1.3 J**	<0.01	<0.005	**170 D**	<0.01	<0.01	<0.02
OW-36	4/19/2005	*<0.004*	<0.005	**0.24**	<0.003	<0.005	**95**	<0.01	<0.02	<0.01	<0.01	<0.01	**3**	<0.005	**24**	**2.2**	<0.0002	<0.005	<1	<0.01	<0.005	**130 D**	<0.01	<0.01	<0.02
OW-37	4/13/2005	*<0.004*	**0.048**	**0.6**	<0.003	<0.005	**160**	<0.02	<0.01	<0.01	<0.01	<0.01	**16**	<0.005	**30**	**1.5**	<0.0002	<0.005	**1**	<0.01	<0.005	**190 D**	<0.01	<0.01	<0.02
OW-38	4/18/2005	*<0.004*	**0.042**	**0.69**	<0.003	<0.005	**130**	<0.01	<0.02	<0.01	<0.01	<0.01	**12**	<0.005	**24**	**2.2**	<0.0002	<0.005	<1	<0.01	<0.005	**120 D**	<0.01	<0.01	<0.02
OW-39	6/30/2005	*<0.004*	<0.005	**0.37**	<0.003	<0.005	**310**	<0.01	<0.02	<0.01	<0.01	<0.01	**11**	<0.005	**30**	**0.19**	<0.0002	<0.005	**3.1**	<0.01	<0.005	**40**	<0.01	**0.021**	**0.069**
W-01D	3/25/2005	--	<0.005	**0.052**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-01D	5/26/2005	--	<0.005	**0.05**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-01S	3/25/2005	--	<0.005	**0.26**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.85**	--	<0.005	--	--	--	--	--	--	--
W-01S Dup	3/25/2005	--	**0.005**	**0.26**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.84**	--	<0.005	--	--	--	--	--	--	--
W-01S	5/20/2005	--	**0.0073**	**0.27**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.3**	--	<0.005	--	--	--	--	--	--	--
W-03	3/30/2005	--	<0.005	**0.072**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.64**	--	**0.017**	--	--	--	--	--	--	--
W-03	5/22/2005	--	<0.005	**0.1**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.4**	--	**0.016**	--	--	--	--	--	--	--
W-08	3/30/2005	--	<0.005	**0.054**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-08	5/26/2005	--	<0.005	**0.059**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-15D	3/28/2005	--	**0.0083**	**0.37**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.063**	--	**0.0071**	--	--	--	--	--	--	--
W-15D	5/18/2005	--	**0.016**	**0.5**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.085**	--	**0.014**	--	--	--	--	--	--	--
W-15S	3/28/2005	--	<0.005	**0.073**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-15S	5/18/2005	--	<0.005	**0.077**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-16S	3/24/2005	--	<0.005	**0.084**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-16S	5/19/2005	--	<0.005	**0.15**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
W-22	3/24/2005	--	**0.064**	**0.48**	<0.003	<0.005	--	--	--	**0.0088**	--	--	--	**0.011**	--	**1.5**	--	**0.01**	--	--	--	--	--	--	--
W-22	5/19/2005	--	**0.095**	**0.61**	<0.003	<0.005	--	--	--	**0.029**	--	--	--	**0.023**	--	**2**	--	**0.027**	--	--	--	--	--	--	--
W-23	3/29/2005	--	<0.005	**0.064**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.096**	--	<0.005	--	--	--	--	--	--	--
W-23	5/23/2005	--	<0.005	**0.22**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.7**	--	<0.005	--	--	--	--	--	--	--
W-24	3/22/2005	--	**0.0092**	**0.3**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**2.5**	--	<0.005	--	--	--	--	--	--	--
W-24	5/23/2005	--	**0.011**	**0.28**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**2.4**	--	<0.005	--	--	--	--	--	--	--
W-26	3/22/2005	--	<0.005	**0.44**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.3**	--	<0.005	--	--	--	--	--	--	--
W-26	5/18/2005	--	<0.005	**0.4**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**1.7**	--	<0.005	--	--	--	--	--	--	--
W-29D	3/24/2005	--	<0.005	**0.2**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.027**	--	<0.005	--	--	--	--	--	--	--
W-29D	5/27/2005	--	<0.005	**0.25**	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	**0.14**	--	<0.005	--	--	--	--	--	--	--
W-29S	3/24/2005	--	<0.005	**0.21**	<0.003	<0.005	--	--	--	**0.0056**	--	--	--	**0.005**	--	**0.055**	--	<0.005	--	--	--	--	--	--	--
W-29S	5/22/2005	--	<0.005	**0.26**	<0.003	<0.005	--	--	--	**0.01**	--	--	--	**0.0068**	--	**0.12**	--	**0.0074**	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 16

METALS RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Analyte (mg/L):	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Calcium**	**Chromium III**	**Chromium, Hexavalent**	**Chromium, Total**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Magnesium**	**Manganese**	**Mercury**	**Nickel**	**Potassium**	**Selenium**	**Silver**	**Sodium**	**Thallium**	**Vanadium**	**Zinc**
	KDHE RSK[a] (mg/L)	**0.006**	**0.01**	**2**	**0.004**	**0.005**	**NA**	**NA**	**NA**	**0.1**	**NA**	**1.3**	**NA**	**0.015**	**NA**	**0.05**	**0.002**	**0.1**	**NA**	**0.05**	**0.1**	**NA**	**NA**	**0.71**	**5**
Location Identification	**Date Collected**																								
Field QC Samples																									
EQ-1	5/21/2005	--	<0.005	<0.01	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
EQ-2	5/26/2005	--	<0.005	<0.01	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--
EQ-3	5/26/2005	--	<0.005	<0.01	<0.003	<0.005	--	--	--	<0.005	--	--	--	<0.005	--	<0.01	--	<0.005	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 17

CHEMISTRY PARAMETER RESULTS SUMMARY FOR GROUNDWATER SAMPLES
MARCH THORUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Analyte (mg/L):	Total dissolved solids (Residue, filterable)	Chloride (As Cl)	Fluoride	Nitrogen, Nitrate (as N) (E300)	Nitrogen, Nitrite (E300)	Sulfate (As SO4)	Alkalinity, Bicarbonate (as $CaCO_3$)	Alkalinity, Carbonate (as CaCO3)	Alkalinity, Hydroxide	Alkalinity, Total (as CaCO3)	Nitrogen, Nitrate (as N) (E353.2)	Nitrogen, nitrate-nitrite (E353.2)	Nitrogen, Nitrite (E353.2)	Nitrogen, Nitrite (E354.1)	Sulfide	Cyanide
	KDHE RSK[a] (mg/L)	NA	NA	NA	45	NA	NA	NA	NA	NA	NA	10	NA	NA	NA	NA	0.2
Location Identification	**Date Collected**																
OW-01	4/19/2005	**670**	**180**	**0.56**	<0.1	<0.1	**22**	**380**	0	0	**380**	**0.18**	--	--	<0.1	<1	<0.005
OW-02	4/18/2005	**720**	**52**	**0.64**	<0.1	<0.1	**21**	**630**	**1**	0	**630**	**0.17**	--	--	<0.1	<1	<0.005
OW-03	6/28/2005	**1000**	**250**	**2.7**	**0.39**	<0.1	**170**	**440**	0	0	**440**	--	--	--	--	<1	<0.005
OW-04	6/28/2005	**1000**	**260**	**2.5**	<0.1	<0.1	**160**	**280**	0	0	**280**	--	--	--	--	<1	<0.005
OW-05	6/30/2005	**990**	**190**	**2.5**	**0.58**	<0.1	**230**	**570**	**1.6**	0	**580**	--	--	--	--	<1	<0.005 UJ
OW-06	6/30/2005	**640**	**100**	**2.3**	<0.1	<0.1	**110**	**250**	0	0	**250**	--	--	--	--	<1	<0.005 UJ
OW-07	4/11/2005	**410**	**16**	**0.33**	<0.1	<0.1	**29**	**370**	0	0	**370**	--	--	--	--	<1	<0.005
OW-08	4/15/2005	**590**	**33**	**0.36**	<0.1	<0.1	**6.3**	**540**	0	0	**540**	**0.18**	--	--	<0.1	<1	<0.005
OW-09	4/13/2005	**830**	**140**	**0.46**	<0.1 UJ	<0.1	**51 J**	**570**	**1**	0	**570**	<0.1	<0.1	<0.1	<0.1	<1	<0.005
OW-09 Dup	4/13/2005	**830**	**140**	**0.55**	<0.1	<0.1	**51**	**580**	**1**	0	**580**	<0.1	<0.1	<0.1	<0.1	<1	<0.005
OW-10	4/13/2005	**1200**	**240**	**1.1**	<0.1	<0.1	**1.9**	**820**	**2**	0	**820**	<0.1	<0.1	<0.1	<0.1	<1	<0.005
OW-11	4/12/2005	**980**	**220**	**0.67**	**0.1**	<0.1	**70**	**540**	**1**	0	**540**	**0.18**	**0.18**	<0.1	<0.1	<1	<0.005
OW-12	4/12/2005	**510**	**13**	**0.53**	<0.1	<0.1	**21**	**450**	0	0	**450**	<0.1	<0.1	<0.1	<0.1	<1	<0.005
OW-13	4/11/2005	**430**	**35**	**0.9**	<0.1	<0.1	**46**	**3600**	**6**	0	**3600**	--	--	--	--	<1	<0.005
OW-14	4/11/2005	**840**	**37**	**0.69**	<0.1	<0.1	**2.5**	**6600**	**6**	0	**6600**	--	--	--	--	<1	<0.005
OW-16	4/15/2005	**940**	**270**	**0.32**	<0.1	<0.1	**82**	**3000**	**2**	0	**3000**	**0.23**	--	--	<0.1	<1	<0.005
OW-19T	4/17/2005	**4000**	--	--	--	--	--	**2400**	**3**	0	**2400**	--	--	--	--	--	--
OW-19T	4/18/2005	**4700**	**1900**	**0.41**	<0.1	<0.1	**27**	**2500**	**4**	0	**2500**	**0.2**	--	--	<0.1	<1	<0.005
OW-21	4/19/2005	**650**	**72 J**	**0.97**	<0.1	<0.1	**34 J**	**490**	0	0	**490**	**0.19**	--	--	<0.1	<1	<0.005
OW-22	4/8/2005	**1600**	**480**	**0.59**	<0.1	<0.1	**29**	**640**	0	0	**640**	**0.42**	--	--	<0.1	<1	<0.005
OW-23T	4/12/2005	**2400**	**930**	**0.32**	**0.76**	<0.1	**4.9**	**920**	**3**	0	**920**	**1**	**1**	<0.1	<0.1	<1	<0.005
OW-24	4/15/2005	--	**130**	**0.65**	<0.1	<0.1	**0.5**	**530**	0	0	**530**	**0.2**	--	--	<0.1	<1	<0.005
OW-24	4/18/2005	**690**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OW-25	4/14/2005	**990**	**300**	**1**	<0.1	<0.1	**15**	**460**	0	0	**460**	**0.32**	--	--	<0.1	<1	<0.005
OW-26	4/15/2005	**940**	**48**	**0.68**	<0.1	<0.1	**19**	**810**	**2**	0	**810**	<0.1	--	--	<0.1	<1	<0.005
OW-27T	4/11/2005	**880**	**360**	**1.6**	<0.1	<0.1	**98**	**460**	**1**	0	**460**	--	--	--	--	<1	**0.0065**
OW-28T	4/8/2005	**870**	**210**	**0.77 J**	<0.1 UJ	<0.1	**0.53**	**470**	0	0	**470**	**0.13**	--	--	<0.1	<1	<0.005
OW-28T Dup	4/8/2005	**860**	**210**	**0.79 J**	<0.1 UJ	<0.1	**0.53**	**470**	**1**	0	**470**	**0.15**	--	--	<0.1	<1	<0.005
OW-29	6/29/2005	**750**	**200**	**0.77 J**	<0.1	<0.1	**3.5**	**690**	0	0	**690**	--	--	--	--	<1	<0.005
OW-30	6/30/2005	**960**	**290**	**1.8**	<0.1	<0.1	**0.59**	**500**	0	0	**500**	--	--	--	--	<1	<0.005 UJ
OW-31	6/29/2005	**920**	**270**	**1.5 J**	<0.1	<0.1	<0.5	**440**	0	0	**440**	--	--	--	--	<1	<0.005
OW-32	6/28/2005	**860**	**240**	**3.5**	<0.1	<0.1	**2.7**	**7200**	**7.6**	0	**7200**	--	--	--	--	<1	<0.005
OW-33	6/15/2005	**840**	**210 D**	**1.1**	<0.1	<0.1	<0.5	**470**	0	0	**470**	--	--	--	--	<1	<0.005
OW-35	4/18/2005	**850**	**240**	**0.82**	<0.1	<0.1	**12**	**450**	**1**	0	**450**	**0.2**	--	--	<0.1	<1	<0.005
OW-36	4/19/2005	**640**	**120**	**0.59**	<0.1	<0.1	**0.9**	**480**	0	0	**490**	**0.22**	--	--	<0.1	<1	<0.005
OW-37	4/13/2005	**990**	**240**	**0.5**	<0.1	<0.1	<0.5	**580**	0	0	**580**	<0.1	<0.1	<0.1	<0.1	<1	<0.005
OW-38	4/18/2005	**740**	**170**	**0.62**	<0.1	<0.1	**0.56**	**450**	0	0	**450**	**0.19**	--	--	<0.1	<1	<0.005
OW-39	6/30/2005	**490**	**22**	**0.6**	**0.77**	<0.1	**41**	**440**	0	0	**440**	--	--	--	--	<1	<0.005 UJ

Refer to Table 21 for footnotes.

TABLE 18

DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	**FINA/MW-38**	**FINA/MW-38**	**N2-2**	**N2-2**	**N2-3**	**N2-3**	**N2-4**
	Date Collected	**3/30/2005**	**5/25/2005**	**3/30/2005**	**5/31/2005**	**3/22/2005**	**5/31/2005**	**3/24/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**							
Petroleum Hydrocarbons (µg/L)								
Petroleum hydrocarbons above C-10	**NA**	--	--	--	--	--	--	--
PHCC10C28	**720**	**850**	**2700**	<100	**330**	**2700**	**5000**	**270 J**
PHCC28C35	**NA**	--	--	--	--	--	--	--
PHC as gasoline	**500**	**770 J**	**1100 D**	**100**	**160**	**1800 D**	**3300 D**	**1100**
Volatile Organic Compounds (µg/L)								
1,2-Dibromo-3-chloropropane	**NA**	--	--	--	--	--	--	--
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	--	--	--	--	--	--	--
Benzene	**5**	**5200 D**	**250**	<1	**1.2**	**540 D**	**570 D**	**65**
Ethylbenzene	**700**	*<5 D*	**7.6**	<5	<5	*<1 D*	*<1 D*	**11**
tert-Butyl methyl ether	**20**	*<5 D*	<5	<5	<5	*<1 D*	*<1 D*	<5
Toluene	**1000**	**420 D**	**19**	<5	<5	*<1 D*	*<1 D*	**13**
Xylenes, Total	**10000**	**570 D**	**38**	<10	<10	*<1.8 D*	**50 D**	**42**
Semi-Volatile Organic Compounds (µg/L)								
2,4-Dimethyl phenol	**1800**	--	--	--	--	--	--	--
2-Methylnaphthalene	**NA**	--	--	--	--	--	--	--
Acenaphthene	**490**	--	--	--	--	--	--	--
bis(2-ethylhexyl) Phthalate	**6**	--	--	--	--	--	--	--
Fluorene	**280**	--	--	--	--	--	--	--
Naphthalene	**350**	--	--	--	--	--	--	--
Phenanthrene	**NA**	--	--	--	--	--	--	--
Phenol	**58000**	--	--	--	--	--	--	--
Pyrene	**720**	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 18

DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	N2-4	N3-2	N3-2	N3-3	N3-3	N3-4	N3-4	N3-4 Dup
	Date Collected	5/25/2005	3/30/2005	5/22/2005	3/25/2005	5/20/2005	3/29/2005	5/23/2005	5/23/2005
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**								
Petroleum Hydrocarbons (µg/L)									
Petroleum hydrocarbons above C-10	**NA**	--	--	--	--	--	--	--	--
PHCC10C28	**720**	**1200**	<100	**810**	**240**	**980**	**2000**	**5400**	**8500**
PHCC28C35	**NA**	--	--	--	--	--	--	--	--
PHC as gasoline	**500**	**1800 D**	**140**	**120**	**900 D**	**1300 J**	<100	**400 J**	**230**
Volatile Organic Compounds (µg/L)									
1,2-Dibromo-3-chloropropane	**NA**	--	--	--	--	--	--	--	--
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	--	--	--	--	--	--	--	--
Benzene	**5**	**110**	<1	<1	--	**4.5**	**13**	**77**	**61**
Ethylbenzene	**700**	**14**	<5	<5	--	<5	<5	<5	<5
tert-Butyl methyl ether	**20**	<5	**16**	**17**	--	<5	**5.9**	**25 J**	**19**
Toluene	**1000**	**20**	<5	<5	--	<5	<5	<5	<5
Xylenes, Total	**10000**	**55**	<10	<10	--	<10	<10	<10	<10
Semi-Volatile Organic Compounds (µg/L)									
2,4-Dimethyl phenol	**1800**	--	--	--	--	--	--	--	--
2-Methylnaphthalene	**NA**	--	--	--	--	--	--	--	--
Acenaphthene	**490**	--	--	--	--	--	--	--	--
bis(2-ethylhexyl) Phthalate	**6**	--	--	--	--	--	--	--	--
Fluorene	**280**	--	--	--	--	--	--	--	--
Naphthalene	**350**	--	--	--	--	--	--	--	--
Phenanthrene	**NA**	--	--	--	--	--	--	--	--
Phenol	**58000**	--	--	--	--	--	--	--	--
Pyrene	**720**	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 18

DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	**N4-1**	**N4-1**	**N4-2**	**N4-2**	**N5-1**	**N5-2**	**N5-2 Dup**	**N5-3**
	Date Collected	**3/29/2005**	**5/20/2005**	**3/23/2005**	**5/20/2005**	**5/19/2005**	**3/28/2005**	**3/28/2005**	**3/23/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**								
Petroleum Hydrocarbons (µg/L)									
Petroleum hydrocarbons above C-10	**NA**	--	--	--	--	--	--	--	--
PHCC10C28	**720**	**650**	<100	**310**	<98	<110	<110	<100	**230**
PHCC28C35	**NA**	--	--	--	--	--	--	--	--
PHC as gasoline	**500**	**140**	**100**	<100	<100	<100	<100	<100	<100
Volatile Organic Compounds (µg/L)									
1,2-Dibromo-3-chloropropane	**NA**	--	--	--	--	--	--	--	--
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	--	--	--	--	--	--	--	--
Benzene	**5**	<1	**1.7**	<1	<1	<1	<1	<1	<1
Ethylbenzene	**700**	<5	<5	<5	<5	<5	**5.2**	**5.2**	<5
tert-Butyl methyl ether	**20**	**210**	**140**	**20**	**22**	<5	<5	<5	<5
Toluene	**1000**	<5	<5	<5	<5	<5	<5	<5	<5
Xylenes, Total	**10000**	<10	<10	<10	<10	**12**	**28**	**28**	<10
Semi-Volatile Organic Compounds (µg/L)									
2,4-Dimethyl phenol	**1800**	--	--	--	--	--	--	--	--
2-Methylnaphthalene	**NA**	--	--	--	--	--	--	--	--
Acenaphthene	**490**	--	--	--	--	--	--	--	--
bis(2-ethylhexyl) Phthalate	**6**	--	--	--	--	--	--	--	--
Fluorene	**280**	--	--	--	--	--	--	--	--
Naphthalene	**350**	--	--	--	--	--	--	--	--
Phenanthrene	**NA**	--	--	--	--	--	--	--	--
Phenol	**58000**	--	--	--	--	--	--	--	--
Pyrene	**720**	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

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DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	**N6-1**	**OW-01**	**OW-02**	**OW-03**	**OW-04**	**OW-05**	**OW-06**	**OW-08**
	Date Collected	**5/23/2005**	**4/19/2005**	**4/18/2005**	**6/28/2005**	**6/28/2005**	**6/30/2005**	**6/30/2005**	**4/15/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**								
Petroleum Hydrocarbons (µg/L)									
Petroleum hydrocarbons above C-10	**NA**	--	**1000**	**1800**	**260 J**	**210 J**	**300 JB**	**160 JB**	**1100**
PHCC10C28	**720**	**690**	**990**	**1700**	**110 J**	**130 J**	**240 J**	**120 J**	**1100**
PHCC28C35	**NA**	--	<20	**77**	**180 J**	**120 J**	**91 J**	**51 J**	**24**
PHC as gasoline	**500**	**1500 D**	**100**	**2300 D**	<100	<100	<100	<100	**3200 D**
Volatile Organic Compounds (µg/L)									
1,2-Dibromo-3-chloropropane	**NA**	--	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.019
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	--	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.019
Benzene	**5**	**10**	<1	**650 D**	<1	<1	<1	<1	**270**
Ethylbenzene	**700**	**96**	<5	*<1 D*	<5	<5	<5	<5	**270**
tert-Butyl methyl ether	**20**	<5	<5	**650 D**	<5	<5	<5	<5	<5
Toluene	**1000**	**5**	<5	*<1 D*	<5	<5	<5	<5	**14**
Xylenes, Total	**10000**	**85**	<10	*<1.8 D*	<10	<10	<10	<10	**260**
Semi-Volatile Organic Compounds (µg/L)									
2,4-Dimethyl phenol	**1800**	--	<10	<10	<9.8	<9.8	<10	<10	<10
2-Methylnaphthalene	**NA**	--	<10	<10	<9.8	<9.8	<10	<10	**10**
Acenaphthene	**490**	--	<10	<10	<9.8	<9.8	<10	<10	<10
bis(2-ethylhexyl) Phthalate	**6**	--	*<0.37*	*<0.37*	*<0.36*	*<0.36*	*<0.37*	*<0.37*	*<0.37*
Fluorene	**280**	--	<10	<10	<9.8	<9.8	<10	<10	<10
Naphthalene	**350**	--	<10	<10	<9.8	<9.8	<10	<10	**44**
Phenanthrene	**NA**	--	<10	<10	<9.8	<9.8	<10	<10	<10
Phenol	**58000**	--	<10	<10	<9.8	<9.8	<10	<10	<10
Pyrene	**720**	--	<10	<10	<9.8	<9.8	<10	<10	<10

Refer to Table 21 for footnotes.

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DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	**OW-09**	**OW-09 Dup**	**OW-10**	**OW-12**	**OW-13**	**OW-14**	**OW-16**	**OW-19T**
	Date Collected	**4/13/2005**	**4/13/2005**	**4/13/2005**	**4/12/2005**	**4/11/2005**	**4/11/2005**	**4/15/2005**	**4/15/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**								
Petroleum Hydrocarbons (µg/L)									
Petroleum hydrocarbons above C-10	**NA**	**1800**	**1400**	**2100**	**690**	**150**	**11000 D**	**1500**	--
PHCC10C28	**720**	**1800**	**1400**	**2100**	**820**	**130**	**11000 D**	**1400**	--
PHCC28C35	**NA**	**39**	**31**	**170**	<100	**48**	*<29 D*	**190**	--
PHC as gasoline	**500**	**560**	**540 D**	**180 J**	**150 J**	**5900 D**	<100	**820 D**	**13000 D**
Volatile Organic Compounds (µg/L)									
1,2-Dibromo-3-chloropropane	**NA**	<0.02	<0.019	**0.025**	<0.019	**0.12**	**0.034**	<0.02	<0.02
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	<0.02	**0.049 J**	<0.019	<0.019	<0.019	<0.019	<0.02	<0.02
Benzene	**5**	**150**	**170**	<1	<1	**370 D**	<1	**12**	**1800 D**
Ethylbenzene	**700**	**32**	**35**	<5	<5	*<10 D*	<5	<5	**410 D**
tert-Butyl methyl ether	**20**	**48**	**52**	<5	<5	**5300 D**	**10**	<5	*<2 D*
Toluene	**1000**	<5	<5	<5	<5	*<10 D*	<5	**18**	*<2 D*
Xylenes, Total	**10000**	**13**	**14**	<10	<10	*<18 D*	<10	**72**	**1200 D**
Semi-Volatile Organic Compounds (µg/L)									
2,4-Dimethyl phenol	**1800**	<10	<10	<10	<10	<10	<10	<10	--
2-Methylnaphthalene	**NA**	<10	<10	<10	<10	<10	**140**	<10	--
Acenaphthene	**490**	<10	<10	<10	<10	<10	<10	<10	--
bis(2-ethylhexyl) Phthalate	**6**	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	--
Fluorene	**280**	<10	<10	<10	<10	<10	<10	<10	--
Naphthalene	**350**	**12**	<10	<10	<10	<10	**68**	<10	--
Phenanthrene	**NA**	<10	<10	<10	<10	<10	**19**	<10	--
Phenol	**58000**	<10	<10	<10	<10	<10	**16**	<10	--
Pyrene	**720**	<10	<10	<10	<10	<10	<10	<10	--

Refer to Table 21 for footnotes.

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DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	**OW-19T**	**OW-19T**	**OW-21**	**OW-22**	**OW-23T**	**OW-24**	**OW-25**	**OW-26**
	Date Collected	**4/16/2005**	**4/17/2005**	**4/19/2005**	**4/8/2005**	**4/12/2005**	**4/15/2005**	**4/14/2005**	**4/15/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**								
Petroleum Hydrocarbons (µg/L)									
Petroleum hydrocarbons above C-10	**NA**	--	**1000000 D**	**440**	**10000 D**	**3900**	**3300**	**2400**	**1500**
PHCC10C28	**720**	--	**1000000 D**	**470**	**10000 D**	**4000**	**3300**	**2300**	**1500**
PHCC28C35	**NA**	--	*<2300 D*	<20	**440 D**	<100	<20	<20	<21
PHC as gasoline	**500**	--	--	**100**	**580**	**220 J**	**3000 D**	**1400 D**	<100
Volatile Organic Compounds (µg/L)									
1,2-Dibromo-3-chloropropane	**NA**	--	--	<0.02	**0.025**	**0.027**	<0.019	<0.019	<0.019
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	--	--	<0.02	<0.018	<0.019	<0.019	<0.019	<0.019
Benzene	**5**	--	--	<1	**180**	<1	**700 D**	**260**	<1
Ethylbenzene	**700**	--	--	<5	<5	<5	*<1 D*	**7.1**	<5
tert-Butyl methyl ether	**20**	--	--	<5	<5	<5	**330 D**	**200**	<5
Toluene	**1000**	--	--	**10**	**8.2**	<5	*<1 D*	<5	<5
Xylenes, Total	**10000**	--	--	**10**	**14**	<10	*<1.8 D*	**18**	<10
Semi-Volatile Organic Compounds (µg/L)									
2,4-Dimethyl phenol	**1800**	*<7 D*	--	<10 R	<10	<10	<10	<10	<10
2-Methylnaphthalene	**NA**	**8000 D**	--	<10	<10	<10	**92**	**17**	<10
Acenaphthene	**490**	**480 D**	--	<10	<10	<10	<10	<10	<10
bis(2-ethylhexyl) Phthalate	**6**	*<7.4 D*	--	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*
Fluorene	**280**	**640 D**	--	<10	<10	<10	<10	<10	<10
Naphthalene	**350**	**1500 D**	--	<10	<10	<10	**140**	**34**	<10
Phenanthrene	**NA**	**2200 D**	--	<10	<10	<10	<10	<10	<10
Phenol	**58000**	*<7.8 D*	--	<10	**15**	<10	**16**	**15**	<10
Pyrene	**720**	**250 D**	--	<10	<10	<10	<10	<10	<10

Refer to Table 21 for footnotes.

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DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
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	Location Identification	**OW-27T**	**OW-28T**	**OW-28T Dup**	**OW-29**	**OW-30**	**OW-31**	**OW-32**
	Date Collected	**4/11/2005**	**4/8/2005**	**4/8/2005**	**6/29/2005**	**6/30/2005**	**6/29/2005**	**6/28/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**							
Petroleum Hydrocarbons (µg/L)								
Petroleum hydrocarbons above C-10	**NA**	**8000 D**	**3200**	**2900**	**9400 J**	**2500 JB**	**5500 J**	**4900 J**
PHCC10C28	**720**	**8000 D**	**3200**	**2900**	**8700**	**2300 J**	**5800**	**5000 J**
PHCC28C35	**NA**	*<32 D*	<20	<20	**720 J**	**160 J**	<97	<98
PHC as gasoline	**500**	**640 DJ**	**730 J**	**640 J**	**2900 DJ**	**650**	**3100 DJ**	**3100 DJ**
Volatile Organic Compounds (µg/L)								
1,2-Dibromo-3-chloropropane	**NA**	<0.02	<0.02	<0.02	**0.062 J**	<0.019	**0.053**	<0.02
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	<0.02	<0.02	<0.02	<0.019	<0.019	<0.019	<0.02
Benzene	**5**	**22**	**25**	**26**	**100**	**21**	**270 D**	**26**
Ethylbenzene	**700**	<5	<5	<5	**77**	<5	*<1 D*	<5
tert-Butyl methyl ether	**20**	<5	<5	**6**	<5	**42**	**46 D**	**41**
Toluene	**1000**	<5	<5	<5	**68**	<5	*<1 D*	<5
Xylenes, Total	**10000**	**11**	**18**	**19**	**320**	**10**	*<1.8 D*	<10
Semi-Volatile Organic Compounds (µg/L)								
2,4-Dimethyl phenol	**1800**	<10	<10	<10	**12 J**	<10	<9.8	<9.8
2-Methylnaphthalene	**NA**	<10	<10	<10	**74**	<10	**21**	**33**
Acenaphthene	**490**	<10	<10	<10	<9.8	<10	<9.8	<9.8
bis(2-ethylhexyl) Phthalate	**6**	*<0.37*	*<0.37*	*<0.37*	*<0.36*	**59**	*<0.36*	*<0.36*
Fluorene	**280**	<10	<10	<10	<9.8	<10	<9.8	<9.8
Naphthalene	**350**	<10	<10	<10	<9.8	<10	<9.8	**37**
Phenanthrene	**NA**	<10	<10	<10	<9.8	<10	<9.8	<9.8
Phenol	**58000**	<10	<10	<10	<9.8	<10	<9.8	<9.8
Pyrene	**720**	<10	<10	<10	<9.8	<10	<9.8	<9.8

Refer to Table 21 for footnotes.

TABLE 18

DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Location Identification	**OW-33**	**OW-35**	**OW-36**	**OW-37**	**OW-38**	**OW-39**	**W-01S**
	Date Collected	**6/15/2005**	**4/18/2005**	**4/19/2005**	**4/13/2005**	**4/18/2005**	**6/30/2005**	**3/25/2005**
Analyte/Methods (Units)	**KDHE RSK [(a)] (µg/L)**							
Petroleum Hydrocarbons (µg/L)								
Petroleum hydrocarbons above C-10	**NA**	**1700**	**670**	**1500**	**3600**	**3100**	**310 JB**	--
PHCC10C28	**720**	**1500**	**650**	**1500**	**3600**	**3100**	**220 J**	**250**
PHCC28C35	**NA**	**180**	**25**	**81**	**510**	<20	**120 J**	--
PHC as gasoline	**500**	**100**	**540 D**	**1500 D**	**4300 D**	**220**	<100	<100
Volatile Organic Compounds (µg/L)								
1,2-Dibromo-3-chloropropane	**NA**	<0.019	<0.02	<0.02	<0.019	<0.019	<0.02	--
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	<0.019	<0.02	<0.02	<0.019	<0.019	<0.02	--
Benzene	**5**	<1	**2.3**	**44 D**	**9700 D**	**68**	<1	--
Ethylbenzene	**700**	<5	<5	*<1 D*	**430 D**	<5	<5	--
tert-Butyl methyl ether	**20**	**14**	<5	*<1 D*	*<4 D*	**16**	<5	--
Toluene	**1000**	<5	<5	*<1 D*	**350 D**	<5	<5	--
Xylenes, Total	**10000**	<10	<10	**100 D**	**920 D**	<10	<10	--
Semi-Volatile Organic Compounds (µg/L)								
2,4-Dimethyl phenol	**1800**	<10	<10 R	<10	<10	<10	<10	--
2-Methylnaphthalene	**NA**	<10	**20**	**180 D**	**99**	**110**	<10	--
Acenaphthene	**490**	<10	<10	<10	<10	<10	<10	--
bis(2-ethylhexyl) Phthalate	**6**	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	*<0.37*	--
Fluorene	**280**	<10	<10	<10	<10	<10	<10	--
Naphthalene	**350**	<10	<10	**210 D**	**140**	**110**	<10	--
Phenanthrene	**NA**	<10	<10	<10	<10	<10	<10	--
Phenol	**58000**	<10	<10	<10	**32**	**15**	<10	--
Pyrene	**720**	<10	<10	<10	<10	<10	<10	--

Refer to Table 21 for footnotes.

TABLE 18

DETECTIONS ONLY - ORGANIC COMPOUNDS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Location Identification	W-01S Dup	W-22	W-22	W-23	W-24	W-24
	Date Collected	3/25/2005	3/24/2005	5/19/2005	5/23/2005	3/22/2005	5/23/2005
Analyte/Methods (Units)	**KDHE RSK [a] (µg/L)**						
Petroleum Hydrocarbons (µg/L)							
Petroleum hydrocarbons above C-10	**NA**	--	--	--	--	--	--
PHCC10C28	**720**	**100**	**820 J**	**990**	<100	**1400**	**1400**
PHCC28C35	**NA**	--	--	--	--	--	--
PHC as gasoline	**500**	<100	**800**	**3100 D**	**790**	**1100 D**	**1400 D**
Volatile Organic Compounds (µg/L)							
1,2-Dibromo-3-chloropropane	**NA**	--	--	--	--	--	--
1,2-Dibromoethane (Ethylene dibromide)	**0.05**	--	--	--	--	--	--
Benzene	**5**	--	**120**	**160**	**9.8**	**150**	**150**
Ethylbenzene	**700**	--	<5	<5	<5	**7.1**	**9.8**
tert-Butyl methyl ether	**20**	--	<5	**11**	<5	<5	<5
Toluene	**1000**	--	**6.7**	**11**	<5	**6.3**	**7.3**
Xylenes, Total	**10000**	--	**13**	**27**	<10	**16**	**18**
Semi-Volatile Organic Compounds (µg/L)							
2,4-Dimethyl phenol	**1800**	--	--	--	--	--	--
2-Methylnaphthalene	**NA**	--	--	--	--	--	--
Acenaphthene	**490**	--	--	--	--	--	--
bis(2-ethylhexyl) Phthalate	**6**	--	--	--	--	--	--
Fluorene	**280**	--	--	--	--	--	--
Naphthalene	**350**	--	--	--	--	--	--
Phenanthrene	**NA**	--	--	--	--	--	--
Phenol	**58000**	--	--	--	--	--	--
Pyrene	**720**	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	FINA/MW-38 3/30/2005	FINA/MW-38 5/25/2005	N1-1 3/29/2005	N1-1 5/25/2005	N2-1 3/29/2005	N2-1 5/25/2005	N2-2 3/30/2005	N2-2 5/31/2005	N2-3 3/22/2005
Metals (mg/L)										
Arsenic	**0.01**	**0.01**	**0.017**	<0.005	*<0.004*	<0.005	*<0.004*	**0.013**	**0.0095**	**0.035**
Barium	**2**	**0.17**	**0.17**	**0.051**	**0.051**	**0.19**	**0.19**	**0.32**	**0.31**	**0.34**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	**NA**	--	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	**NA**	--	--	--	--	--	--	--	--	--
Manganese	**0.05**	**0.46**	**0.75**	<0.01	<0.01	<0.01	<0.01	**0.94**	**1**	**0.84**
Nickel	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	**NA**	--	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	N2-3 5/31/2005	N2-4 3/24/2005	N2-4 5/25/2005	N3-1 3/23/2005	N3-1 5/27/2005	N3-2 3/30/2005	N3-2 5/22/2005	N3-3 3/25/2005	N3-3 5/20/2005	N3-4 3/29/2005
Metals (mg/L)											
Arsenic	**0.01**	**0.041**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	**0.069**	**0.057**	**0.056**	**0.04**	**0.0053**
Barium	**2**	**0.32**	**0.7**	**0.76**	**0.058**	**0.054**	**0.59**	**0.54**	**1.3**	**0.8**	**0.028**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	**0.004**	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.074**	**0.038**	<0.005
Cobalt	**NA**	--	--	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.046**	**0.022**	**0.0056**
Magnesium	**NA**	--	--	--	--	--	--	--	--	--	--
Manganese	**0.05**	**0.78**	**3.2**	**2.7**	**0.016**	<0.01	**1.8**	**1.7**	**5.5**	**4.7**	**33**
Nickel	**0.1**	<0.005	**0.011**	**0.012**	<0.005	<0.005	<0.005	**0.0053**	**0.084**	**0.043**	**0.034**
Potassium	**NA**	--	--	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	N3-4 5/23/2005	N3-4 Dup 5/23/2005	N4-1 3/29/2005	N4-1 5/20/2005	N4-2 3/23/2005	N4-2 5/20/2005	N4-3 3/24/2005	N4-3 5/19/2005	N4-4 3/28/2005	N4-4 5/23/2005
Metals (mg/L)											
Arsenic	**0.01**	**0.0075**	**0.0074**	<0.005	*<0.004*	*<0.004*	**0.006**	*<0.004*	*<0.004*	*<0.004*	*<0.004*
Barium	**2**	**0.05**	**0.053**	**0.14**	**0.15**	**0.077**	**0.074**	**0.34**	**0.39**	**0.19**	**0.26**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	**NA**	--	--	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0069**	<0.005	<0.005	<0.005
Magnesium	**NA**	--	--	--	--	--	--	--	--	--	--
Manganese	**0.05**	**24**	**24**	**0.59**	**0.068**	**0.65**	**0.66**	**0.14**	**0.089**	**0.011**	**0.01**
Nickel	**0.1**	**0.024**	**0.024**	<0.005	<0.005	**0.064**	**0.064**	<0.005	**0.014**	<0.005	<0.005
Potassium	**NA**	--	--	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	N5-1 3/25/2005	N5-1 5/19/2005	N5-2 3/28/2005	N5-2 Dup 3/28/2005	N5-2 5/19/2005	N5-3 3/23/2005	N5-3 5/19/2005	N5-3 Dup 5/19/2005	N6-1 5/23/2005
Metals (mg/L)										
Arsenic	**0.01**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	**0.0066**	**0.031**	**0.021**	**0.02**	*<0.004*
Barium	**2**	**0.17**	**0.19**	**0.16**	**0.16**	**0.19**	**0.41**	**0.39**	**0.4**	**0.28**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	**NA**	--	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	**NA**	--	--	--	--	--	--	--	--	--
Manganese	**0.05**	**0.018**	<0.01	**0.46**	**0.47**	**0.49**	**1.8**	**1.8**	**1.8**	**0.17**
Nickel	**0.1**	**0.011**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	**NA**	--	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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	Location Identification	**OW-01**	**OW-02**	**OW-03**	**OW-04**	**OW-05**	**OW-06**	**OW-07**	**OW-08**	**OW-09**
	Date Collected	**4/19/2005**	**4/18/2005**	**6/28/2005**	**6/28/2005**	**6/30/2005**	**6/30/2005**	**4/11/2005**	**4/15/2005**	**4/13/2005**
Analyte/Methods (Units)	**KDHE RSK[a] (mg/L)**									
Metals (mg/L)										
Arsenic	**0.01**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	**0.0057**	**0.008**
Barium	**2**	**0.22**	**0.22**	**0.054**	**0.065**	**0.16**	**0.043**	**0.23**	**0.42**	**0.16**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	**130**	**130**	**88**	**91**	**420**	**72**	**130**	**120**	**98**
Chromium III	**NA**	<0.01	<0.01	<0.01	<0.01	<0.01	**0.015**	<0.01	<0.02	<0.02
Chromium, Hexavalent	**NA**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01 UJ
Chromium, Total	**0.1**	<0.01	<0.01	<0.01	<0.01	<0.01	**0.015**	<0.01	<0.01	<0.01
Cobalt	**NA**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	**1.3**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	**NA**	**9.3**	**1.2**	**0.2**	**0.71**	**9.5**	<0.1	**0.1**	**2.2**	**1.9**
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0077**	<0.005
Magnesium	**NA**	**23**	**36**	**61**	**61**	**88**	**48**	**7.6**	**23**	**71**
Manganese	**0.05**	**0.45**	**0.28**	<0.01	**0.037**	**0.4**	<0.01	<0.01	**2.8**	**0.12**
Nickel	**0.1**	<0.005	<0.005	<0.005	<0.005	**0.018**	<0.005	<0.005	<0.005	<0.005
Potassium	**NA**	<1	**3.5**	**2.5**	**3.2 J**	**7.3**	<1	<1	<1	**2.2**
Sodium	**NA**	**100 D**	**120 D**	**140 D**	**160 D**	**140 D**	**57**	**17**	**98**	**140 D**
Vanadium	**0.71**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	**5**	<0.02	<0.02	**0.088**	<0.02	**0.51**	**0.078**	<0.02	**0.032**	<0.02

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification Date Collected KDHE RSK[a] (mg/L)	OW-09 Dup 4/13/2005	OW-10 4/13/2005	OW-11 4/12/2005	OW-12 4/12/2005	OW-13 4/11/2005	OW-14 4/11/2005	OW-16 4/15/2005	OW-19T 4/15/2005	OW-19T 4/16/2005
Metals (mg/L)										
Arsenic	**0.01**	**0.0058**	**0.026**	*<0.004*	**0.0059**	**0.0065**	**0.078**	**0.041**	--	**0.021**
Barium	**2**	**0.16**	**0.37**	**0.14**	**0.68**	**0.57**	**2.9**	**0.81**	--	**0.83**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	**0.008**	**0.0042**	--	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0052**	<0.005	--	<0.005
Calcium	**NA**	**95**	**68**	**45**	**110**	**770**	**1500**	**1200 D**	--	**1400 D**
Chromium III	**NA**	<0.02	<0.02	<0.01	<0.01	**0.24**	**0.036**	<0.02	<0.02	--
Chromium, Hexavalent	**NA**	<0.01	<0.01	<0.02	<0.02 UJ	<0.02	<0.02	**0.012**	**0.135**	--
Chromium, Total	**0.1**	<0.01	<0.01	<0.01	<0.01	**0.24**	**0.036**	**0.012**	**0.135**	--
Cobalt	**NA**	<0.01	<0.01	<0.01	<0.01	<0.01	**0.069**	**0.037**	--	<0.01
Copper	**1.3**	<0.01	<0.01	<0.01	<0.01	<0.01	**0.13**	**0.051**	--	**0.015**
Iron	**NA**	**1.8**	**4.7**	**0.18**	**2.2**	**9.3**	**130**	**69**	--	**15**
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	**0.0062**	**0.11**	**0.048**	--	**0.02**
Magnesium	**NA**	**70**	**15**	**7.5**	**19**	**22**	**62**	**59**	--	**220**
Manganese	**0.05**	**0.12**	**0.86**	**0.11**	**0.53**	**1.1**	**5.9**	**13**	--	**0.72**
Nickel	**0.1**	<0.005	<0.005	<0.005	<0.005	**0.0058**	**0.17**	**0.082**	--	**0.026**
Potassium	**NA**	**2.2**	<1	<1	**1.1**	**3.2**	**27**	**15**	--	**10**
Sodium	**NA**	**130 D**	**400 D**	**440**	**45**	**38**	**48**	**110 D**	--	**1100 D**
Vanadium	**0.71**	<0.01	<0.01	<0.01	<0.01	**0.015**	**0.22**	**0.12**	--	**0.032**
Zinc	**5**	<0.02	**0.15**	<0.02	**0.027**	<0.02	**0.74**	**0.15**	--	**0.27**

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	OW-21 4/19/2005	OW-22 4/8/2005	OW-23T 4/12/2005	OW-24 4/15/2005	OW-25 4/14/2005	OW-26 4/15/2005	OW-27T 4/11/2005	OW-28T 4/8/2005	OW-28T Dup 4/8/2005
Metals (mg/L)										
Arsenic	**0.01**	**0.0092**	**0.035**	**0.0098**	**0.029**	**0.012**	*<0.004*	**0.017**	**0.015**	**0.017**
Barium	**2**	**0.47**	**0.34**	**1.2**	**0.26**	**0.42**	**0.14**	**0.21**	**0.3**	**0.28**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	**87**	**130**	**270**	**130**	**100**	**33**	**220**	**67**	**61**
Chromium III	**NA**	<0.01	<0.01	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01
Chromium, Hexavalent	**NA**	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02 UJ	<0.02
Chromium, Total	**0.1**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	**NA**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.022**	<0.01	<0.01
Copper	**1.3**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	**NA**	**5.1**	**8.6**	**2.6**	**10**	**7.5**	**0.92**	**9.4**	**7**	**5.5**
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	**NA**	**14**	**32**	**76**	**27**	**24**	**8.5**	**50**	**12**	**11**
Manganese	**0.05**	**1.2**	**0.69**	**11**	**1.5**	**0.7**	**0.68**	**9.2**	**2.1**	**2**
Nickel	**0.1**	<0.005	**0.0077**	**0.0074**	<0.005	<0.005	<0.005	**0.0073**	<0.005	<0.005
Potassium	**NA**	<1	**6**	**18**	<1	**1.1**	<1	**63**	**1.8 J**	**1.7 J**
Sodium	**NA**	**160 D**	**550**	**730**	**110 D**	**250 D**	**330 D**	**190**	**300**	**300**
Vanadium	**0.71**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	**5**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	OW-29 6/29/2005	OW-30 6/30/2005	OW-31 6/29/2005	OW-32 6/28/2005	OW-33 6/15/2005	OW-35 4/18/2005	OW-36 4/19/2005	OW-37 4/13/2005	OW-38 4/18/2005	OW-39 6/30/2005
Metals (mg/L)											
Arsenic	**0.01**	**0.042**	**0.037**	**0.071**	**0.071**	**0.082**	**0.008**	*<0.004*	**0.048**	**0.042**	*<0.004*
Barium	**2**	**0.32**	**0.48**	**0.5**	**2**	**0.89**	**0.35**	**0.24**	**0.6**	**0.69**	**0.37**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	**390**	**120**	**100**	**1400**	**100**	**130**	**95**	**160**	**130**	**310**
Chromium III	**NA**	<0.01	<0.01	<0.01	**0.043**	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01
Chromium, Hexavalent	**NA**	<0.02	<0.02	<0.02	<0.02	--	<0.02	<0.02	<0.01	<0.02	<0.02
Chromium, Total	**0.1**	<0.01	<0.01	<0.01	**0.043**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	**NA**	<0.01	<0.01	<0.01	**0.027**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	**1.3**	<0.01	<0.01	<0.01	**0.065**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	**NA**	**17**	**15**	**18**	**66**	**14**	**4.2**	**3**	**16**	**12**	**11**
Lead	**0.015**	**0.017**	<0.005	<0.005	**0.05**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	**NA**	**13**	**27**	**23**	**45**	**19**	**20**	**24**	**30**	**24**	**30**
Manganese	**0.05**	**1.7**	**2.4**	**2.4**	**6.5**	**1.5**	**0.8**	**2.2**	**1.5**	**2.2**	**0.19**
Nickel	**0.1**	**0.012**	<0.005	<0.005	**0.09**	**0.006**	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	**NA**	**3**	**2.4**	**2.3**	**19**	**1.2**	**1.3 J**	<1	**1**	<1	**3.1**
Sodium	**NA**	**260 D**	**250 D**	**220 D**	**230 D**	**190 D**	**170 D**	**130 D**	**190 D**	**120 D**	**40**
Vanadium	**0.71**	**0.024**	<0.01	<0.01	**0.16**	<0.01	<0.01	<0.01	<0.01	<0.01	**0.021**
Zinc	**5**	**0.04**	<0.02	<0.02	**0.22**	**0.061**	<0.02	<0.02	<0.02	<0.02	**0.069**

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	W-01D 3/25/2005	W-01D 5/26/2005	W-01S 3/25/2005	W-01S Dup 3/25/2005	W-01S 5/20/2005	W-03 3/30/2005	W-03 5/22/2005	W-08 3/30/2005	W-08 5/26/2005
Metals (mg/L)										
Arsenic	**0.01**	*<0.004*	*<0.004*	*<0.004*	**0.005**	**0.0073**	*<0.004*	*<0.004*	*<0.004*	*<0.004*
Barium	**2**	**0.052**	**0.05**	**0.26**	**0.26**	**0.27**	**0.072**	**0.1**	**0.054**	**0.059**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	**NA**	--	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	**NA**	--	--	--	--	--	--	--	--	--
Manganese	**0.05**	<0.01	<0.01	**0.85**	**0.84**	**1.3**	**0.64**	**1.4**	<0.01	<0.01
Nickel	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	**0.017**	**0.016**	<0.005	<0.005
Potassium	**NA**	--	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	W-15D 3/28/2005	W-15D 5/18/2005	W-15S 3/28/2005	W-15S 5/18/2005	W-16S 3/24/2005	W-16S 5/19/2005	W-22 3/24/2005	W-22 5/19/2005	W-23 3/29/2005	W-23 5/23/2005
Metals (mg/L)											
Arsenic	**0.01**	**0.0083**	**0.016**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	**0.064**	**0.095**	<0.005	*<0.004*
Barium	**2**	**0.37**	**0.5**	**0.073**	**0.077**	**0.084**	**0.15**	**0.48**	**0.61**	**0.064**	**0.22**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0088**	**0.029**	<0.005	<0.005
Cobalt	**NA**	--	--	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.011**	**0.023**	<0.005	<0.005
Magnesium	**NA**	--	--	--	--	--	--	--	--	--	--
Manganese	**0.05**	**0.063**	**0.085**	<0.01	<0.01	<0.01	<0.01	**1.5**	**2**	**0.096**	**1.7**
Nickel	**0.1**	**0.0071**	**0.014**	<0.005	<0.005	<0.005	<0.005	**0.01**	**0.027**	<0.005	<0.005
Potassium	**NA**	--	--	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 19

DETECTIONS ONLY - METALS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	W-24 3/22/2005	W-24 5/23/2005	W-26 3/22/2005	W-26 5/18/2005	W-29D 3/24/2005	W-29D 5/27/2005	W-29S 3/24/2005	W-29S 5/22/2005
Metals (mg/L)									
Arsenic	**0.01**	**0.0092**	**0.011**	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*	*<0.004*
Barium	**2**	**0.3**	**0.28**	**0.44**	**0.4**	**0.2**	**0.25**	**0.21**	**0.26**
Beryllium	**0.004**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium	**0.005**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	**NA**	--	--	--	--	--	--	--	--
Chromium III	**NA**	--	--	--	--	--	--	--	--
Chromium, Hexavalent	**NA**	--	--	--	--	--	--	--	--
Chromium, Total	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0056**	**0.01**
Cobalt	**NA**	--	--	--	--	--	--	--	--
Copper	**1.3**	--	--	--	--	--	--	--	--
Iron	**NA**	--	--	--	--	--	--	--	--
Lead	**0.015**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.005**	**0.0068**
Magnesium	**NA**	--	--	--	--	--	--	--	--
Manganese	**0.05**	**2.5**	**2.4**	**1.3**	**1.7**	**0.027**	**0.14**	**0.055**	**0.12**
Nickel	**0.1**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0074**
Potassium	**NA**	--	--	--	--	--	--	--	--
Sodium	**NA**	--	--	--	--	--	--	--	--
Vanadium	**0.71**	--	--	--	--	--	--	--	--
Zinc	**5**	--	--	--	--	--	--	--	--

Refer to Table 21 for footnotes.

TABLE 20

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 1 of 6)

Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	OW-01 4/19/2005	OW-02 4/18/2005	OW-03 6/28/2005	OW-04 6/28/2005	OW-05 6/30/2005	OW-06 6/30/2005	OW-07 4/11/2005	OW-08 4/15/2005
Chemistry Parameters (mg/L)									
Total dissolved solids (Residue, filterable)	**NA**	**670**	**720**	**1000**	**1000**	**990**	**640**	**410**	**590**
Chloride (as Cl)	**NA**	**180**	**52**	**250**	**260**	**190**	**100**	**16**	**33**
Fluoride	**NA**	**0.56**	**0.64**	**2.7**	**2.5**	**2.5**	**2.3**	**0.33**	**0.36**
Nitrogen, Nitrate (as N)	**45**	<0.1	<0.1	**0.39**	<0.1	**0.58**	<0.1	<0.1	<0.1
Sulfate (as SO_4)	**NA**	**22**	**21**	**170**	**160**	**230**	**110**	**29**	**6.3**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**	**380**	**630**	**440**	**280**	**570**	**250**	**370**	**540**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**	0	**1**	0	0	**1.6**	0	0	0
Alkalinity, Total (as $CaCO_3$)	**NA**	**380**	**630**	**440**	**280**	**580**	**250**	**370**	**540**
Nitrogen, Nitrate (as N)	**10**	**0.18**	**0.17**	--	--	--	--	--	**0.18**
Nitrogen, nitrate-nitrite	**NA**	--	--	--	--	--	--	--	--
Cyanide	**0.2**	<0.005	<0.005	<0.005	<0.005	<0.005 UJ	<0.005 UJ	<0.005	<0.005

Refer to Table 21 for footnotes.

TABLE 20

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	OW-09 4/13/2005	OW-09 Dup 4/13/2005	OW-10 4/13/2005	OW-11 4/12/2005	OW-12 4/12/2005	OW-13 4/11/2005	OW-14 4/11/2005
Chemistry Parameters (mg/L)								
Total dissolved solids (Residue, filterable)	**NA**	**830**	**830**	**1200**	**980**	**510**	**430**	**840**
Chloride (as Cl)	**NA**	**140**	**140**	**240**	**220**	**13**	**35**	**37**
Fluoride	**NA**	**0.46**	**0.55**	**1.1**	**0.67**	**0.53**	**0.9**	**0.69**
Nitrogen, Nitrate (as N)	**45**	<0.1 UJ	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1
Sulfate (as SO_4)	**NA**	**51 J**	**51**	**1.9**	**70**	**21**	**46**	**2.5**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**	**570**	**580**	**820**	**540**	**450**	**3600**	**6600**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**	**1**	**1**	**2**	**1**	0	**6**	**6**
Alkalinity, Total (as $CaCO_3$)	**NA**	**570**	**580**	**820**	**540**	**450**	**3600**	**6600**
Nitrogen, Nitrate (as N)	**10**	<0.1	<0.1	<0.1	**0.18**	<0.1	--	--
Nitrogen, nitrate-nitrite	**NA**	<0.1	<0.1	<0.1	**0.18**	<0.1	--	--
Cyanide	**0.2**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Refer to Table 21 for footnotes.

TABLE 20

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
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Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	OW-16 4/15/2005	OW-19T 4/17/2005	OW-19T 4/18/2005	OW-21 4/19/2005	OW-22 4/8/2005	OW-23T 4/12/2005	OW-24 4/15/2005
Chemistry Parameters (mg/L)								
Total dissolved solids (Residue, filterable)	**NA**	**940**	**4000**	**4700**	**650**	**1600**	**2400**	--
Chloride (as Cl)	**NA**	**270**	--	**1900**	**72 J**	**480**	**930**	**130**
Fluoride	**NA**	**0.32**	--	**0.41**	**0.97**	**0.59**	**0.32**	**0.65**
Nitrogen, Nitrate (as N)	**45**	<0.1	--	<0.1	<0.1	<0.1	**0.76**	<0.1
Sulfate (as SO_4)	**NA**	**82**	--	**27**	**34 J**	**29**	**4.9**	**0.5**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**	**3000**	**2400**	**2500**	**490**	**640**	**920**	**530**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**	**2**	**3**	**4**	0	0	**3**	0
Alkalinity, Total (as $CaCO_3$)	**NA**	**3000**	**2400**	**2500**	**490**	**640**	**920**	**530**
Nitrogen, Nitrate (as N)	**10**	**0.23**	--	**0.2**	**0.19**	**0.42**	**1**	**0.2**
Nitrogen, nitrate-nitrite	**NA**	--	--	--	--	--	**1**	--
Cyanide	**0.2**	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005

Refer to Table 21 for footnotes.

TABLE 20

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 4 of 6)

Analyte/Methods (Units)	Location Identification / Date Collected / KDHE RSK[a] (mg/L)	OW-24 4/18/2005	OW-25 4/14/2005	OW-26 4/15/2005	OW-27T 4/11/2005	OW-28T 4/8/2005	OW-28T Dup 4/8/2005	OW-29 6/29/2005
Chemistry Parameters (mg/L)								
Total dissolved solids (Residue, filterable)	**NA**	**690**	**990**	**940**	**880**	**870**	**860**	**750**
Chloride (as Cl)	**NA**	--	**300**	**48**	**360**	**210**	**210**	**200**
Fluoride	**NA**	--	**1**	**0.68**	**1.6**	**0.77 J**	**0.79 J**	**0.77 J**
Nitrogen, Nitrate (as N)	**45**	--	<0.1	<0.1	<0.1	<0.1 UJ	<0.1 UJ	<0.1
Sulfate (as SO_4)	**NA**	--	**15**	**19**	**98**	**0.53**	**0.53**	**3.5**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**	--	**460**	**810**	**460**	**470**	**470**	**690**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**	--	0	**2**	**1**	0	**1**	0
Alkalinity, Total (as $CaCO_3$)	**NA**	--	**460**	**810**	**460**	**470**	**470**	**690**
Nitrogen, Nitrate (as N)	**10**	--	**0.32**	<0.1	--	**0.13**	**0.15**	--
Nitrogen, nitrate-nitrite	**NA**	--	--	--	--	--	--	--
Cyanide	**0.2**	--	<0.005	<0.005	**0.0065**	<0.005	<0.005	<0.005

Refer to Table 21 for footnotes.

TABLE 20

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 5 of 6)

	Location Identification	**OW-30**	**OW-31**	**OW-32**	**OW-33**	**OW-35**	**OW-36**	**OW-37**	**OW-38**
	Date Collected	**6/30/2005**	**6/29/2005**	**6/28/2005**	**6/15/2005**	**4/18/2005**	**4/19/2005**	**4/13/2005**	**4/18/2005**
Analyte/Methods (Units)	**KDHE RSK[a] (mg/L)**								
Chemistry Parameters (mg/L)									
Total dissolved solids (Residue, filterable)	**NA**	**960**	**920**	**860**	**840**	**850**	**640**	**990**	**740**
Chloride (as Cl)	**NA**	**290**	**270**	**240**	**210 D**	**240**	**120**	**240**	**170**
Fluoride	**NA**	**1.8**	**1.5 J**	**3.5**	**1.1**	**0.82**	**0.59**	**0.5**	**0.62**
Nitrogen, Nitrate (as N)	**45**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate (as SO_4)	**NA**	**0.59**	<0.5	**2.7**	<0.5	**12**	**0.9**	<0.5	**0.56**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**	**500**	**440**	**7200**	**470**	**450**	**480**	**580**	**450**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**	0	0	**7.6**	0	**1**	0	0	0
Alkalinity, Total (as $CaCO_3$)	**NA**	**500**	**440**	**7200**	**470**	**450**	**490**	**580**	**450**
Nitrogen, Nitrate (as N)	**10**	--	--	--	--	**0.2**	**0.22**	<0.1	**0.19**
Nitrogen, nitrate-nitrite	**NA**	--	--	--	--	--	--	<0.1	--
Cyanide	**0.2**	<0.005 UJ	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Refer to Table 21 for footnotes.

TABLE 20

DETECTIONS ONLY - CHEMISTRY PARAMETERS FOR GROUNDWATER SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS
(Page 6 of 6)

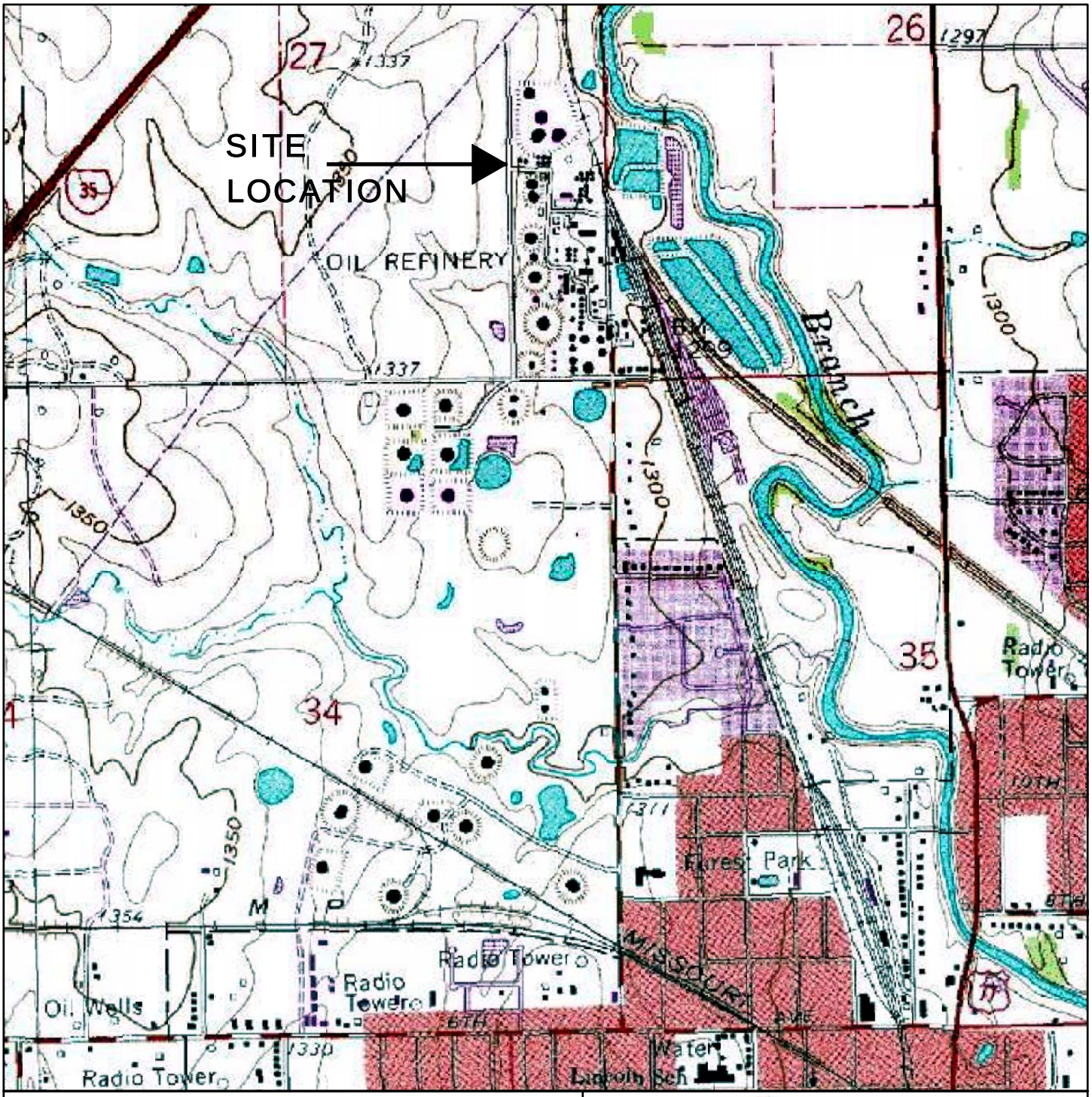
	Location Identification	**OW-39**
	Date Collected	**6/30/2005**
Analyte/Methods (Units)	**KDHE RSK[(a)] (mg/L)**	
Chemistry Parameters (mg/L)		
Total dissolved solids (Residue, filterable)	**NA**	**490**
Chloride (as Cl)	**NA**	**22**
Fluoride	**NA**	**0.6**
Nitrogen, Nitrate (as N)	**45**	**0.77**
Sulfate (as SO_4)	**NA**	**41**
Alkalinity, Bicarbonate (as $CaCO_3$)	**NA**	**440**
Alkalinity, Carbonate (as $CaCO_3$)	**NA**	0
Alkalinity, Total (as $CaCO_3$)	**NA**	**440**
Nitrogen, Nitrate (as N)	**10**	--
Nitrogen, nitrate-nitrite	**NA**	--
Cyanide	**0.2**	<0.005 UJ

Refer to Table 21 for footnotes.

TABLE 21

FOOTNOTES
LABORATORY RESULT SUMMARIES
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

(a)	Risk -Based Standards of Kansas (Kansas Department of Health and Environment, 2003 and 2003 and 2004 revisions). Groundwater Pathway standards used.
(b)	Kansas Surface Water Quality Standards (Kansas Department of Health and Environment, 2003).
Dup	Duplicate
PHC	Petroleum hydrocarbons
µg/L	micrograms per liter
mg/L	milligrams per liter
--	Not scheduled
CHEM	Chemistry parameters
GW	Groundwater
NA	Not analyzed
QC	Quality Control
SW	Surface water
VOC	Volatile Organic Compounds
Bold	Bolded result indicates positively identified compound.
Italics	Italics indicates the data was reported to the method detection limit.
Shaded	Shaded result indicates result or reporting limit is greater than or equal to the listed standards.
B	Analyte detected in an associated blank.
D	Sample dilution required for analysis; reported values reflect the dilution.
J	Data are estimated due to associated quality control data.
R	Associated quality control did not meet acceptance criteria.
T	Result is between the method detection limit and the reporting limit.
UJ	Potential low bias; possible false negative.



EXPLANATION

N

SCALE IN FEET

0 500 1,000 2,000

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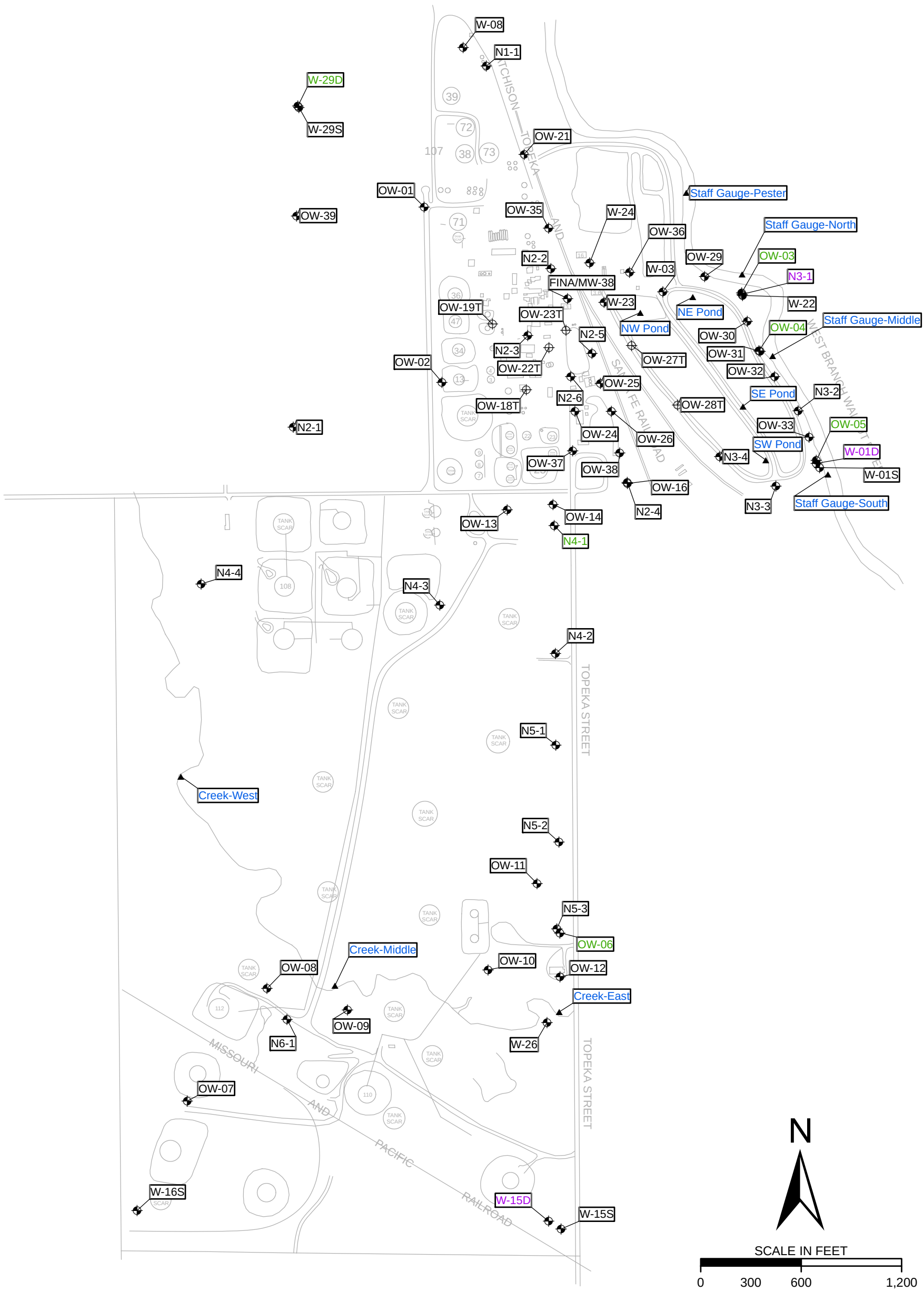
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SITE LOCATION MAP

MWH

SCALE:	FIGURE No:
As Noted	***1***



EXPLANATION

- OW-08 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK)
- OW-08 — FORT RILEY LIMESTONE MONITORING WELL
- OW-08 — FLORENCE LIMESTONE MONITORING WELL
- OW-22T — TEMPORARY MONITORING WELL
- SW Pond — SURFACE WATER GAUGE LOCATION

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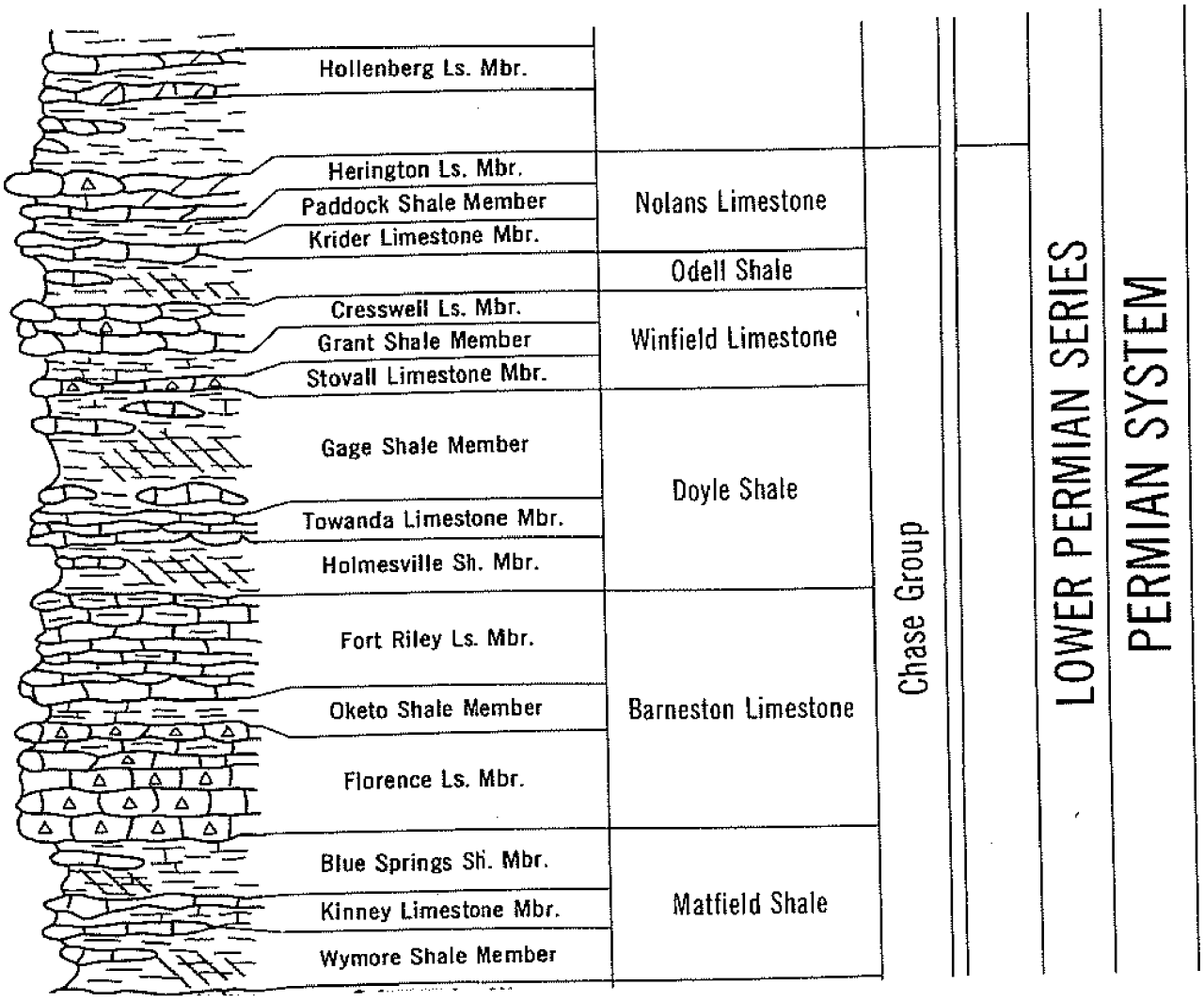
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SITE LAYOUT

MWH

SCALE:	FIGURE No:
As Noted	2



REFERENCE: ZELLER, 1968

REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Stratigraphic Column	09/05	WEP	MPW	

MWH

PROJECT No.: 1004317

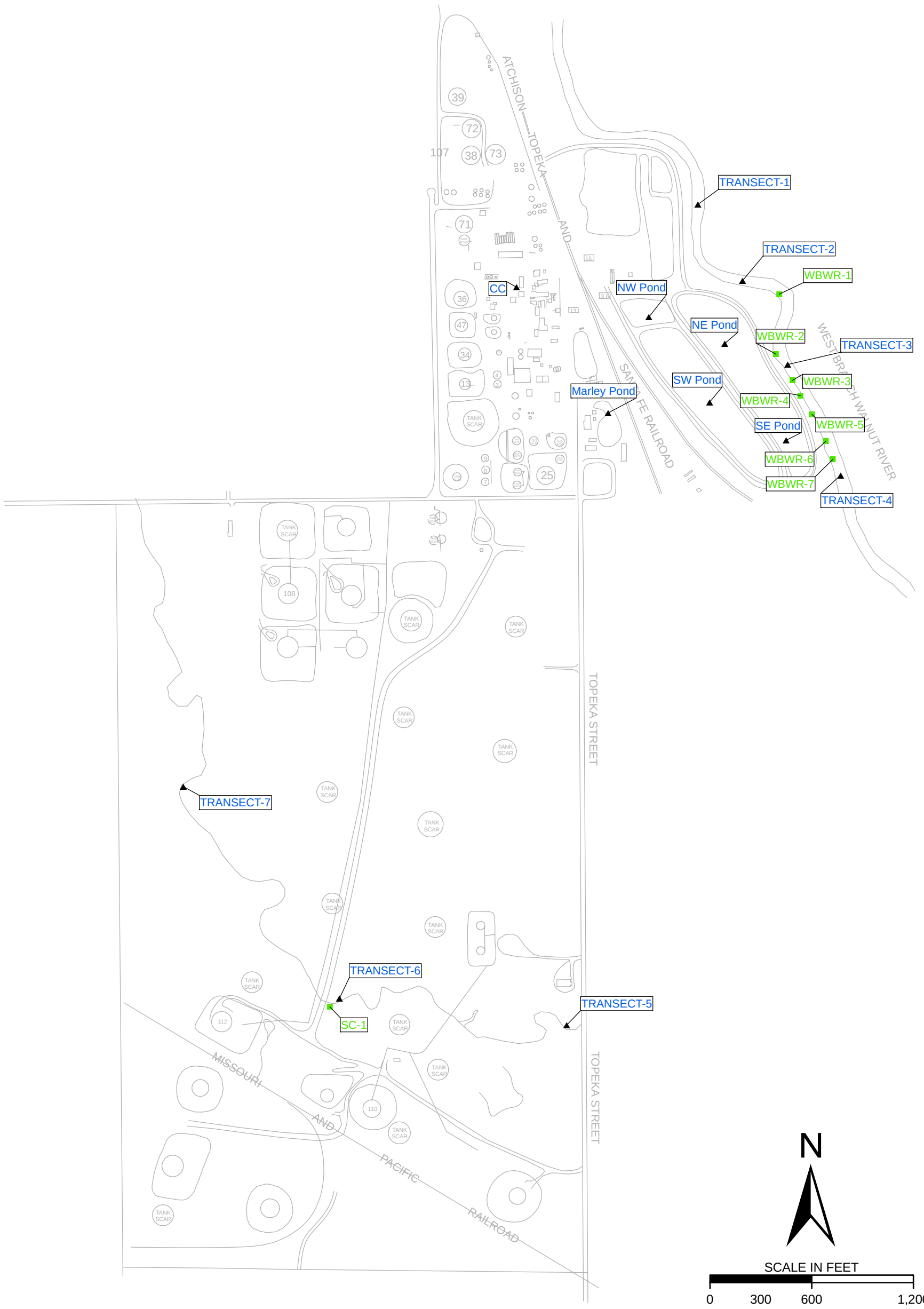
AutoCAD FILE: Stratigraphic.dwg

SCALE: N/A

FIGURE 3

elpaso

REGIONAL STRATIGRAPHIC COLUMN
EL DORADO, KS



EXPLANATION

- ■ WBWR-1 — SEEP LOCATION
- ▲ SW Pond — SURFACE WATER SAMPLE LOCATION

NOTES:
WBWR = WEST BRANCH WALNUT RIVER
CC = CATALYTIC CRACKER UNIT, SAMPLE LOCATION IS A SPRING UNDER THE UNIT

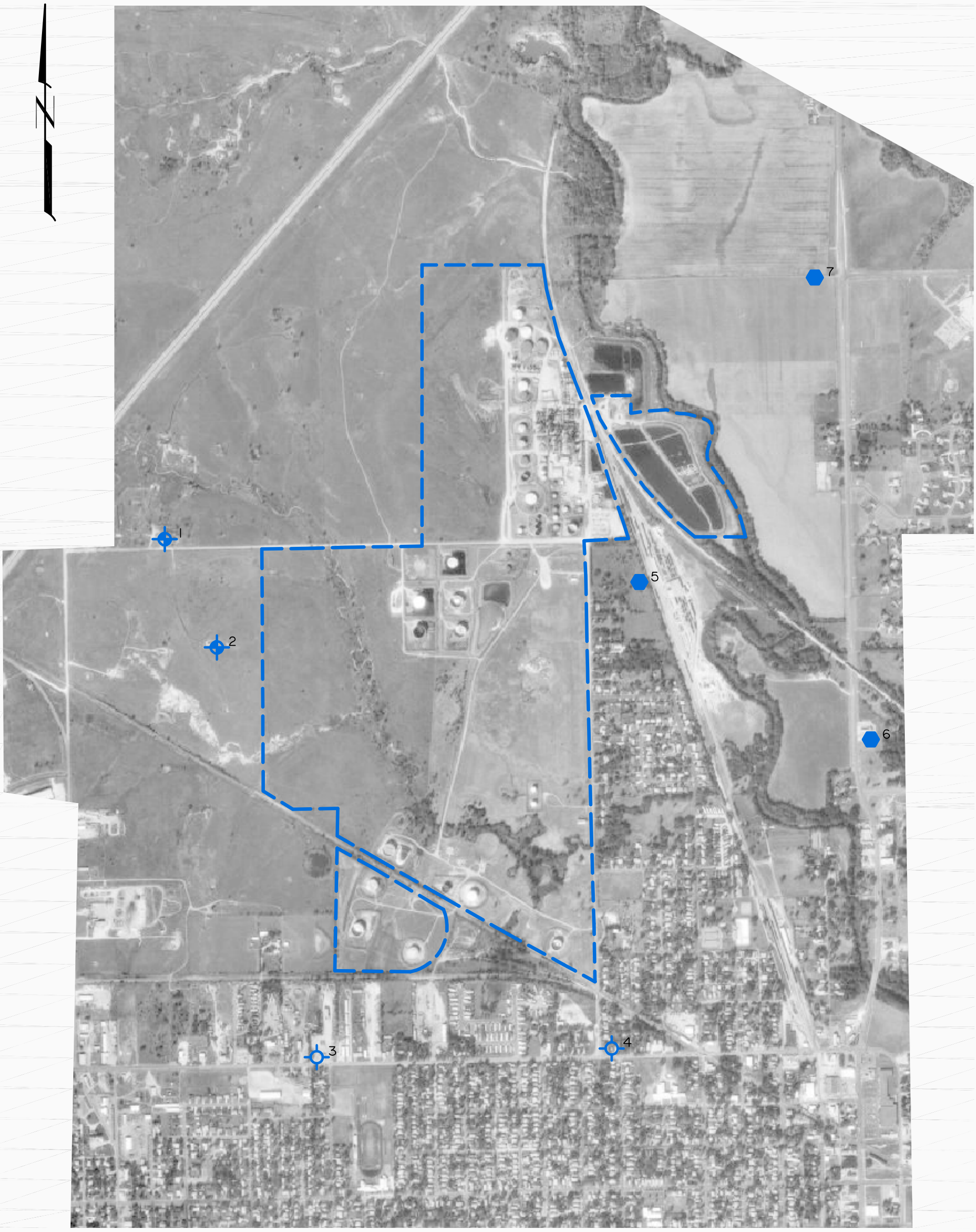
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SEEP LOCATIONS AND SURFACE WATER SAMPLE LOCATIONS

MWH

SCALE:	FIGURE No:
As Noted	***4***



REFERENCES: USGS AERIAL PHOTOGRAPHY, EL DORADO, KS 1997; KANSAS GEOLOGICAL SURVEY WATER WELL DATABASE URL://WWW.KGS.KU.EDU/MAGELLAN/WATERWELL/INDEX.HTML JULY 29, 2004.

NOTE: SEE TABLE FOR WELL SUMMARY

500' 0 500' 1000'
SCALE IN FEET

LEGEND

PROPERTY BOUNDARY

CONFIRMED WELL LOCATION

WELL LOCATION FROM KGS DATABASE - UNABLE TO CONFIRM STATUS

ABANDONED WELL LOCATION FROM KGS DATABASE

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PROJECT: *El Dorado Refinery Site*

DRAWING TITLE: *Water Well Location Map*

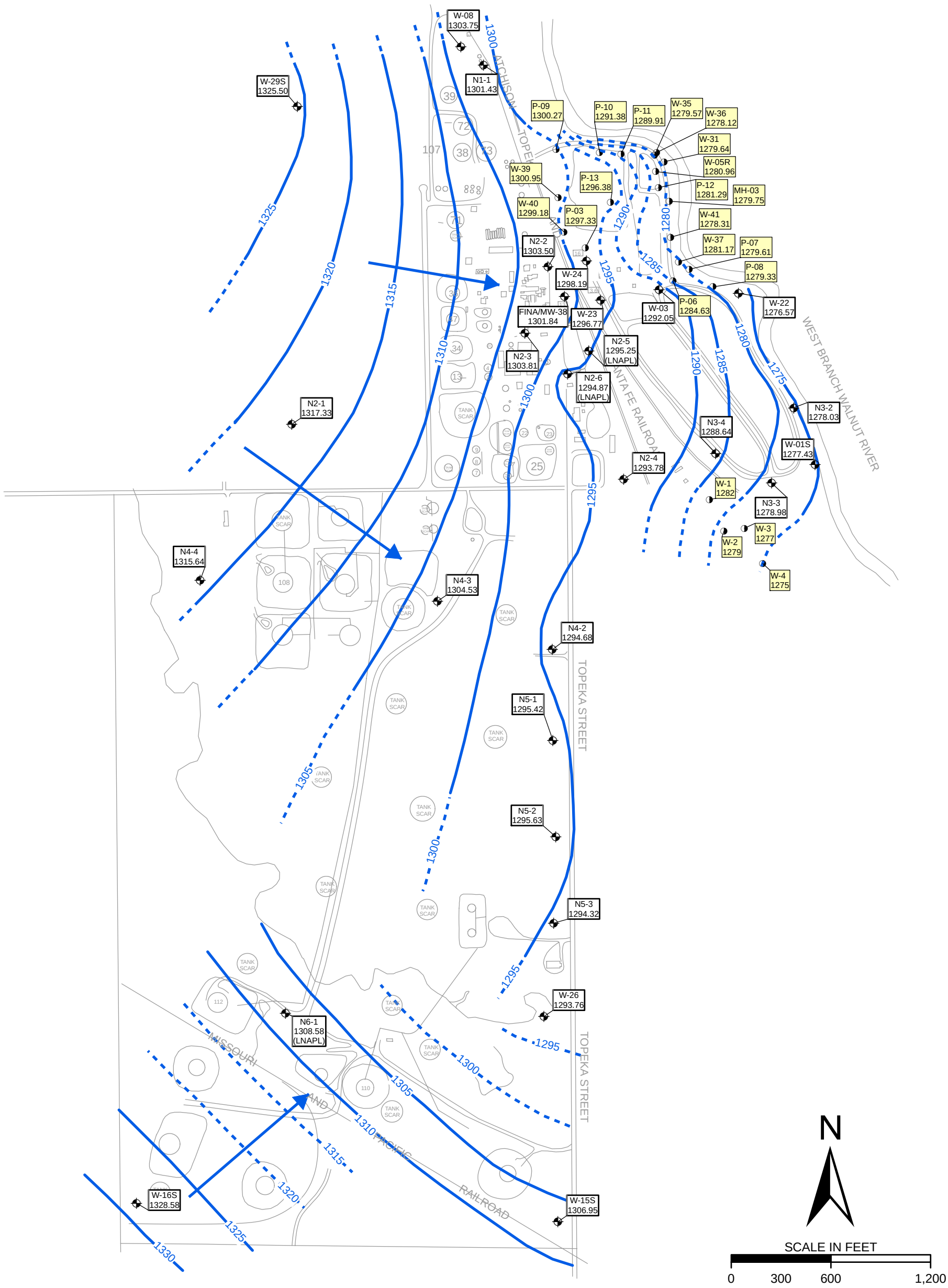
MWH

Sheet 1 Of 1 Sheets

SCALE: 1:1000

Figure No. 5

AutoCAD FILE: *Arial Image State Plane* PROJECT NUMBER:



EXPLANATION

N2-4 1293.78 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) AND GROUNDWATER ELEVATION, FEET AMSL, 3/21/2005

W-40 1299.18 — OFFSITE PESTER AND UNION TANK CAR MONITORING WELLS AND GROUNDWATER ELEVATION, FEET AMSL, 4/14-18/2005

GROUNDWATER TABLE CONTOUR, FEET AMSL, 3/21/2005

GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.
(LNAPL) = DENOTES PRESENCE OF LNAPL IN WELL. GROUNDWATER ELEVATION CORRECTED USING AN ASSUMED SPECIFIC GRAVITY OF 0.8.
GROUNDWATER TABLE INFERRED (DASHED LINE) NEAR OFFSITE WELLS.

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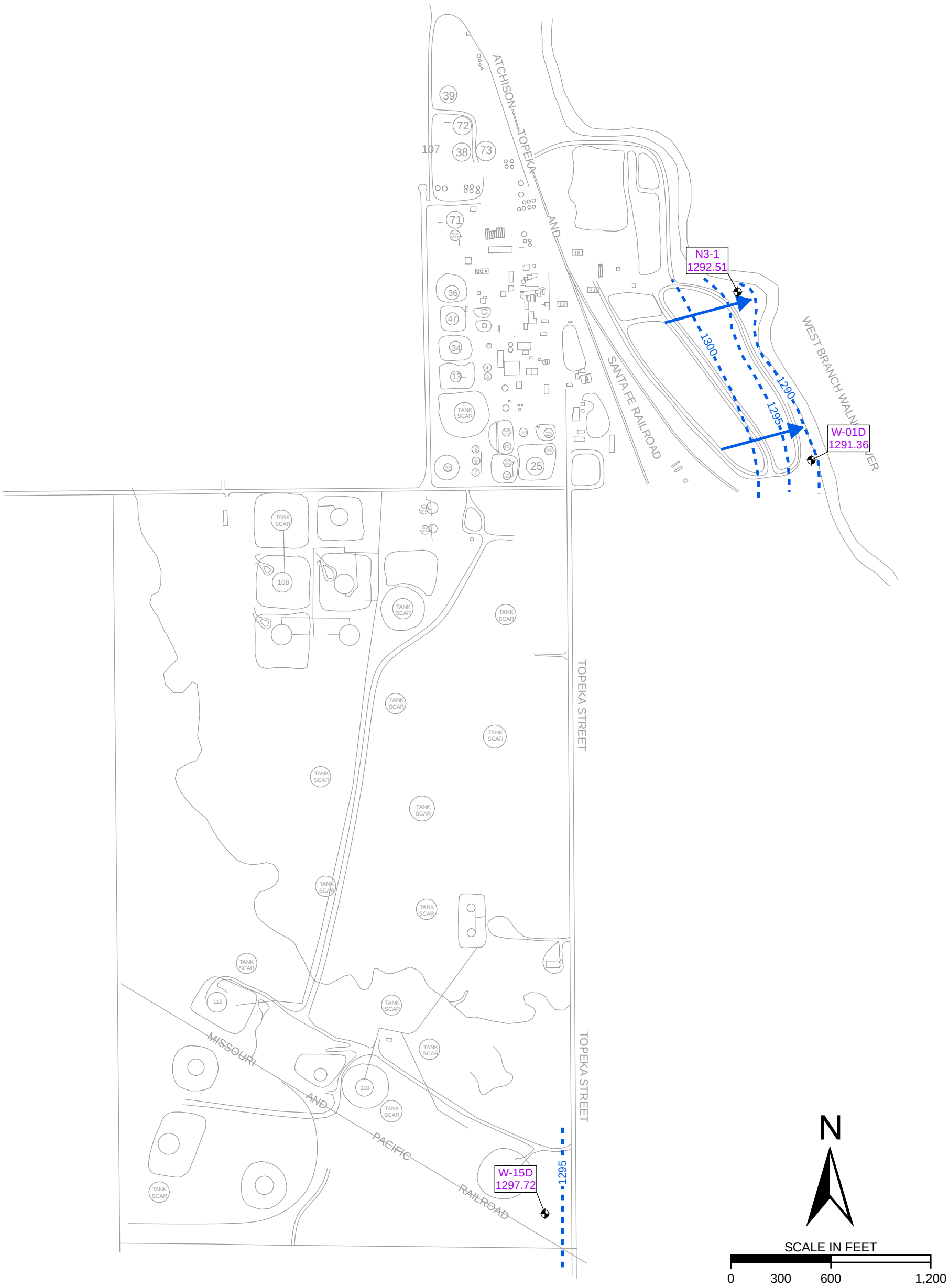
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

FIRST QUARTER 2005 SHALLOW WELLS GROUNDWATER TABLE MAP

MWH

SCALE:	FIGURE No:
As Noted	***6***



EXPLANATION

W-01D 1291.36 — FLORENCE MONITORING WELL AND GROUNDWATER ELEVATION, FEET AMSL, 3/21/2005

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, FEET AMSL, 3/21/2005

GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.

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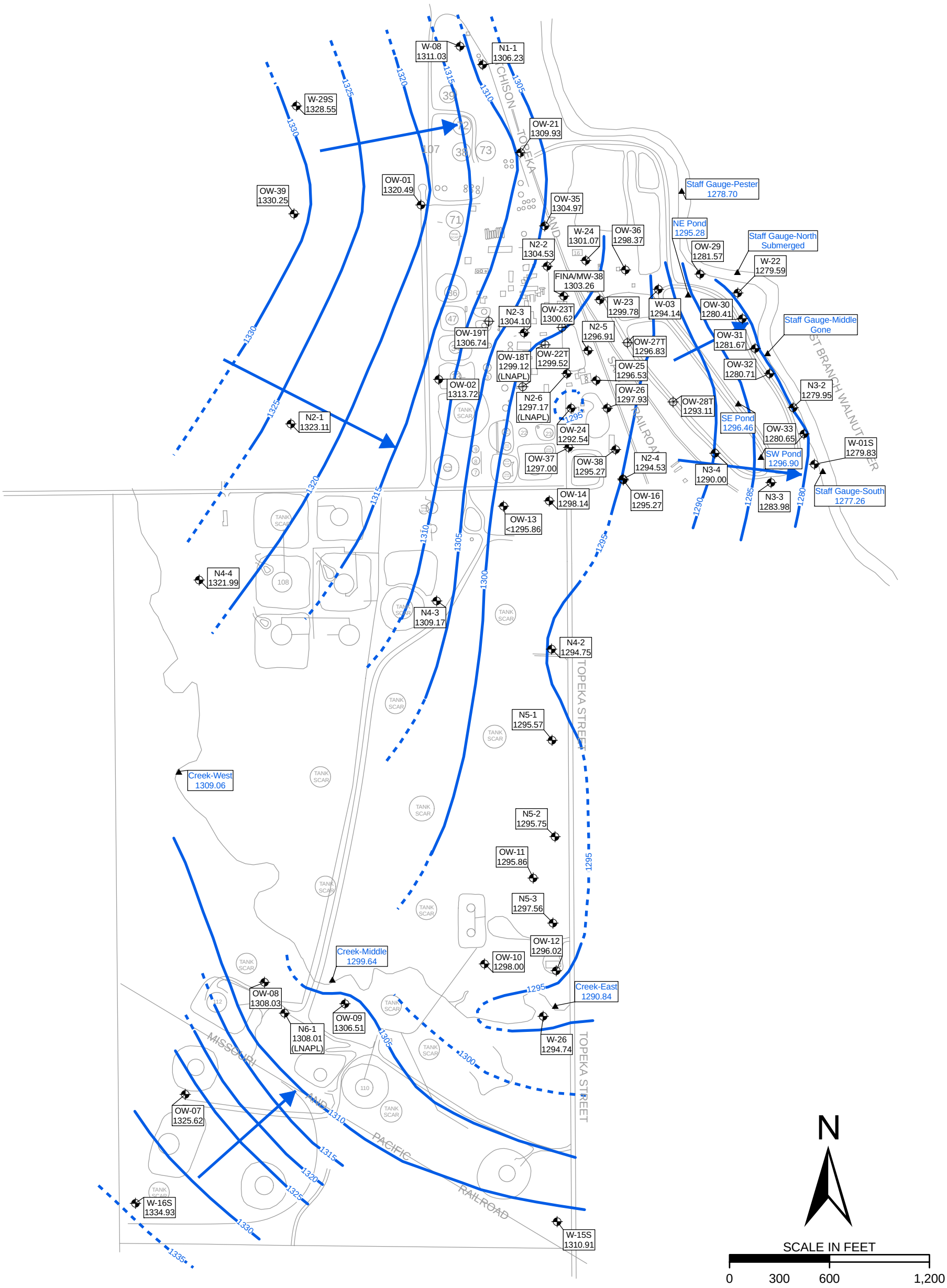
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

FIRST QUARTER 2005 FLORENCE LIMESTONE GROUNDWATER POTENTIOMETRIC SURFACE MAP

MWH

SCALE:	FIGURE No:
As Noted	***7***



EXPLANATION

N2-4 1294.53	SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) AND GROUNDWATER ELEVATION, FEET AMSL, 6/14/2005
OW-22T 1299.52	TEMPORARY MONITORING WELL AND GROUNDWATER ELEVATION, FEET AMSL, 6/14/2005
SW Pond 1296.90	SURFACE WATER GAUGE LOCATION AND WATER ELEVATION, FEET AMSL, 6/14/2005
	GROUNDWATER TABLE CONTOUR, FEET AMSL, 6/14/2005
	GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.
(LNAPL) = DENOTES PRESENCE OF LNAPL IN WELL. GROUNDWATER ELEVATION CORRECTED USING AN ASSUMED SPECIFIC GRAVITY OF 0.8.

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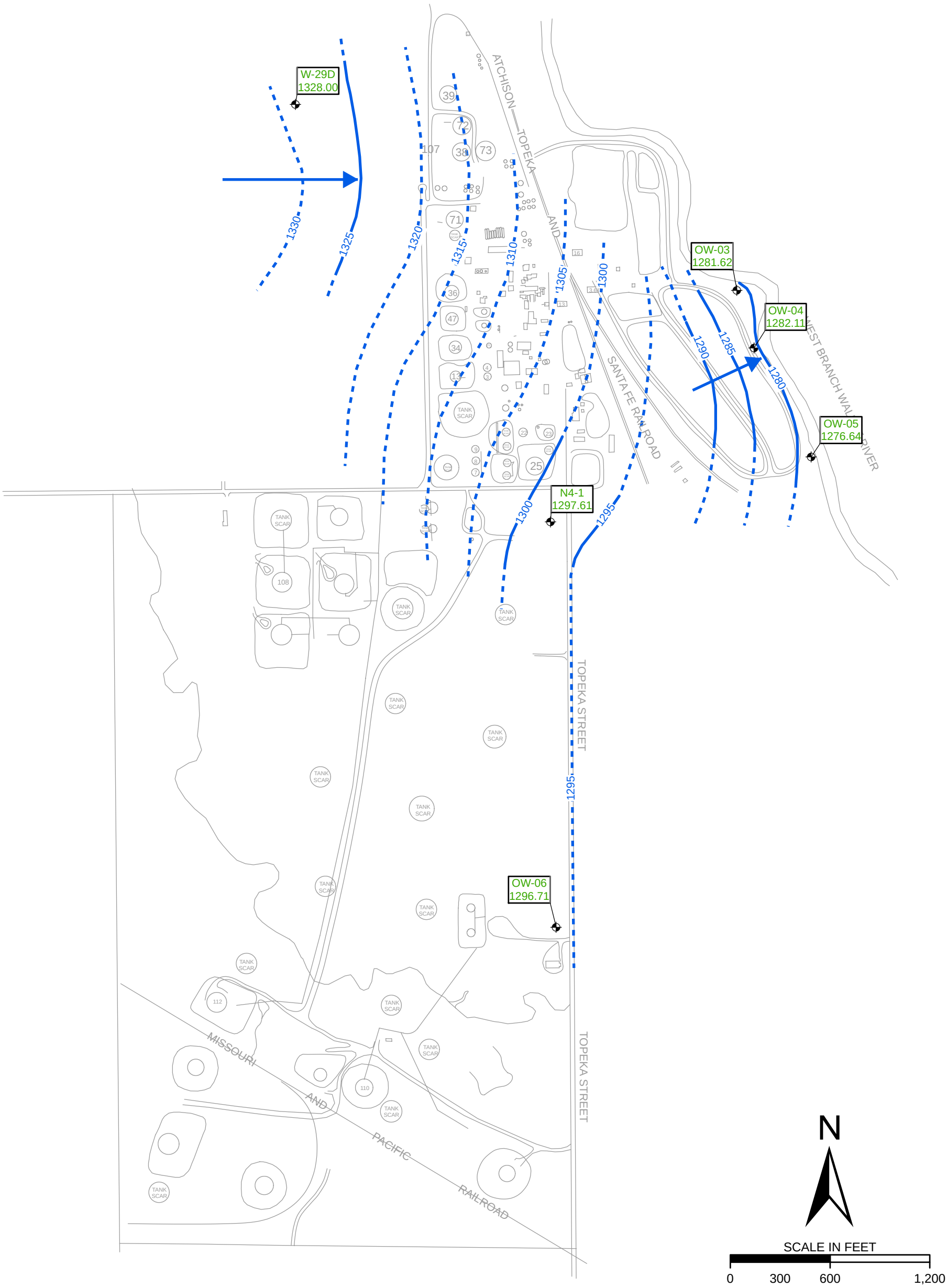
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

SECOND QUARTER 2005 SHALLOW WELLS GROUNDWATER TABLE MAP

MWH

SCALE:	FIGURE No:
As Noted	***8***



EXPLANATION

OW-06 1296.71 — FORT RILEY MONITORING WELL AND GROUNDWATER ELEVATION, FEET AMSL, 6/14/2005

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, FEET AMSL, 6/14/2005

GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.

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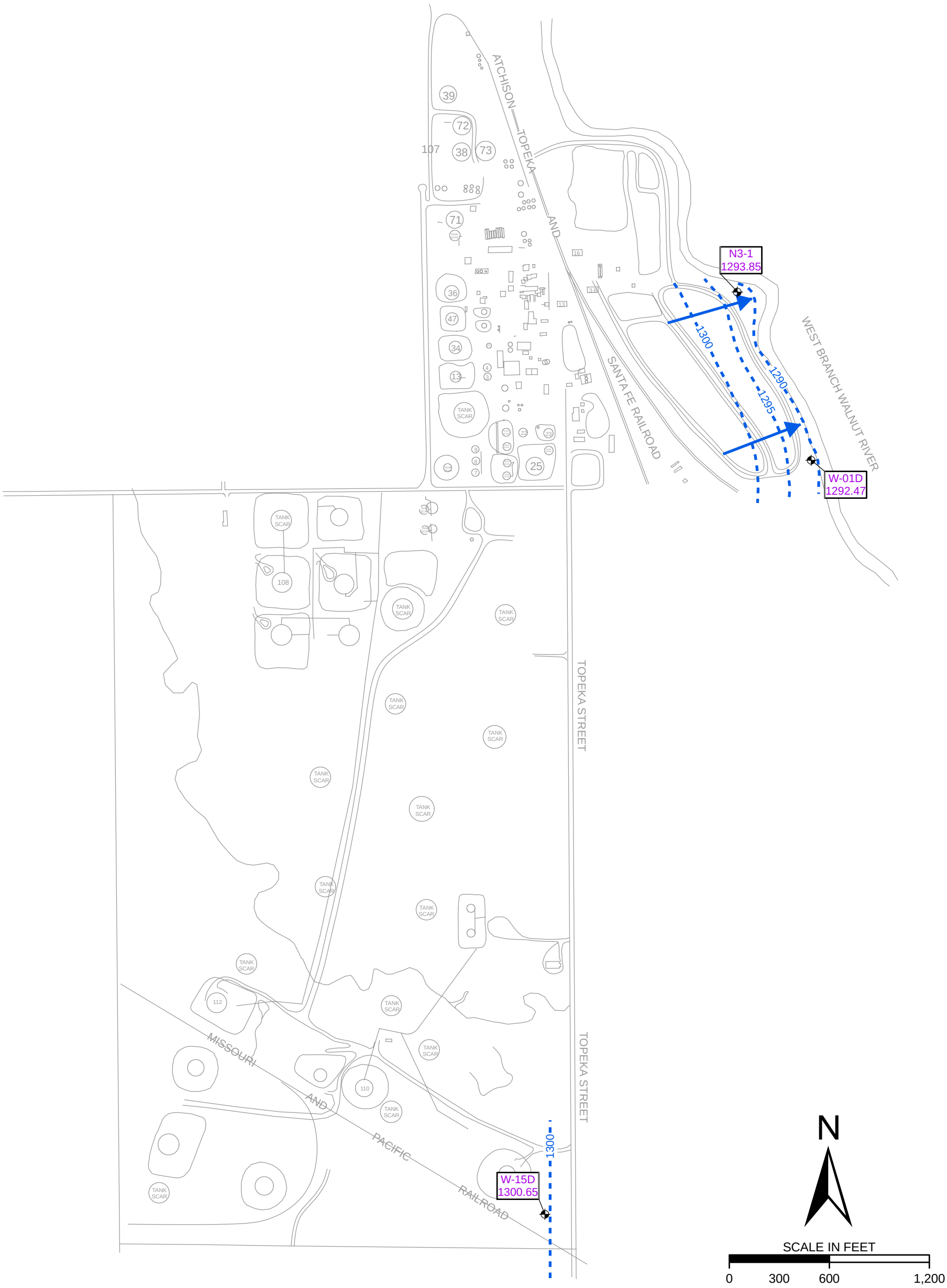
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SECOND QUARTER 2005 FORT RILEY LIMESTONE GROUNDWATER POTENTIOMETRIC SURFACE MAP

MWH

SCALE:	FIGURE No:
As Noted	***9***



EXPLANATION

W-01D 1292.47 — FLORENCE MONITORING WELL AND GROUNDWATER ELEVATION, FEET AMSL, 6/14/2005

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, FEET AMSL, 6/14/2005

GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.

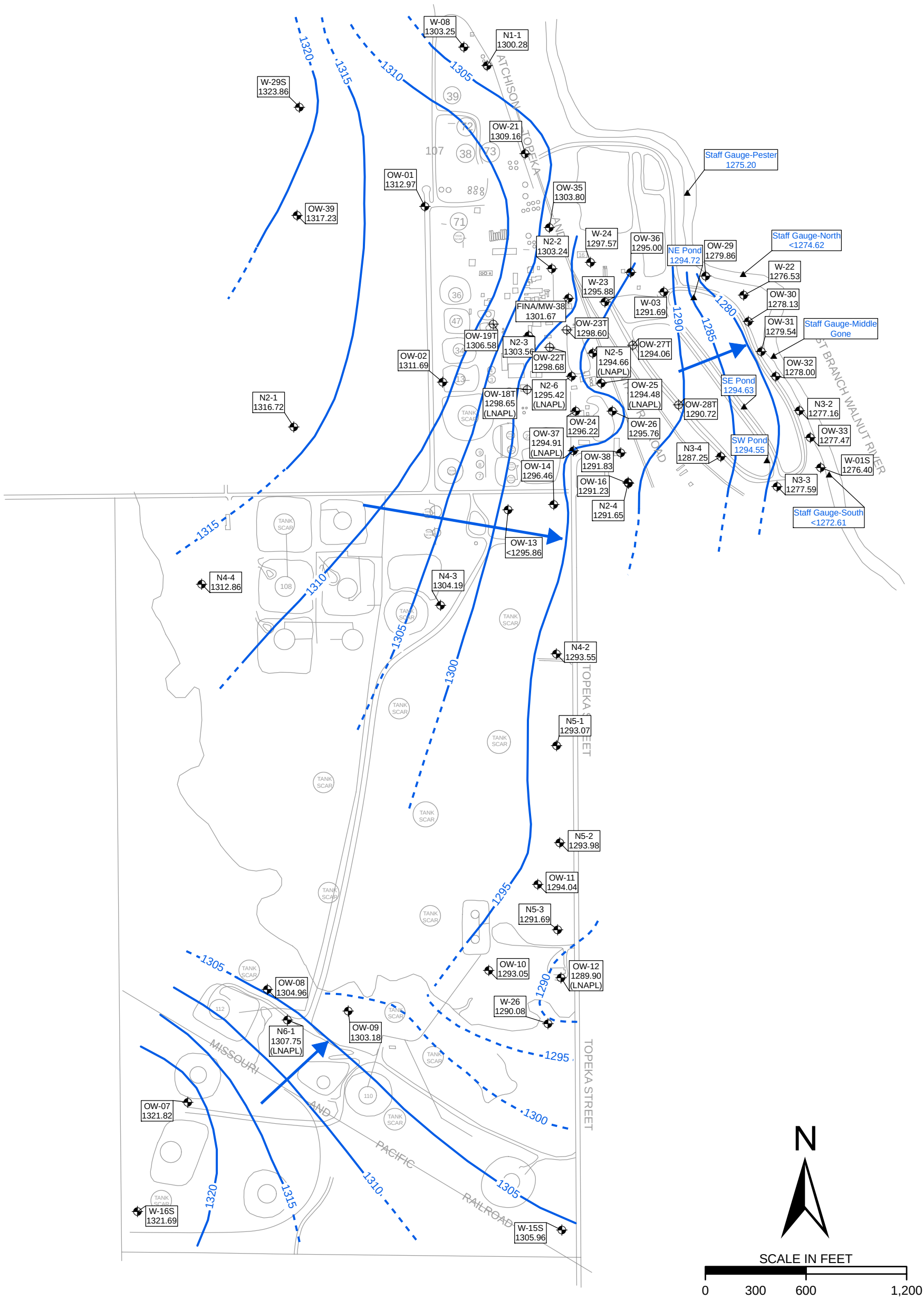
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SECOND QUARTER 2005 FLORENCE LIMESTONE GROUNDWATER POTENTIOMETRIC SURFACE MAP

MWH

SCALE:	FIGURE No:
As Noted	***10***



EXPLANATION

N2-4 1291.65	SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) AND GROUNDWATER ELEVATION, FEET AMSL, 8/2/2005
OW-22T 1298.68	TEMPORARY MONITORING WELL GROUNDWATER ELEVATION, FEET AMSL, 8/2/2005
SW Pond 1294.55	SURFACE WATER GAUGE LOCATION WATER ELEVATION, FEET AMSL, 8/2/2005
	GROUNDWATER TABLE CONTOUR, FEET AMSL, 8/2/2005
	GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.
(LNAPL) = DENOTES PRESENCE OF LNAPL IN WELL. GROUNDWATER ELEVATION CORRECTED USING AN ASSUMED SPECIFIC GRAVITY OF 0.8.

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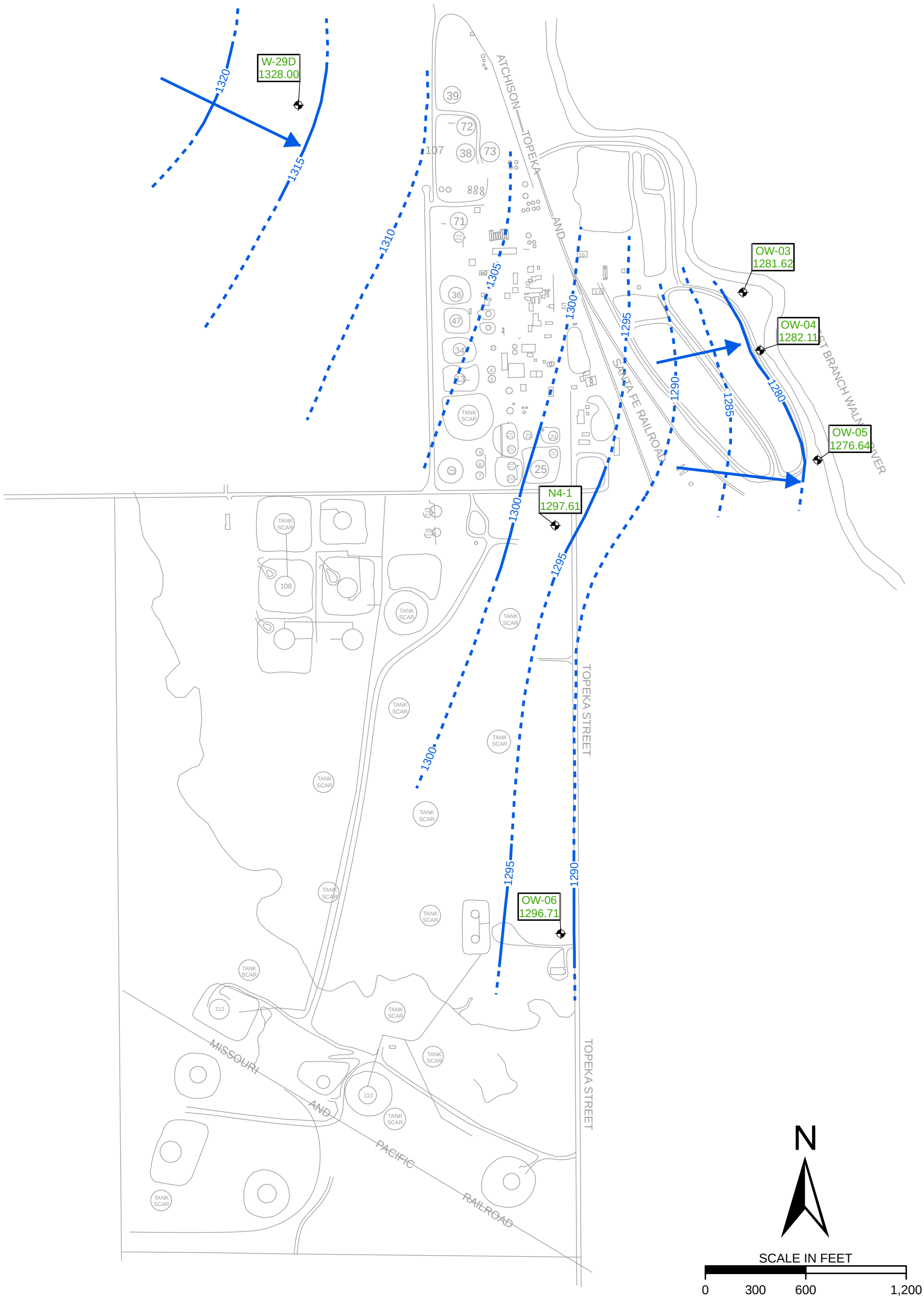
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

AUGUST 2, 2005
SHALLOW WELLS
GROUNDWATER TABLE MAP

MWH

SCALE:	FIGURE No:
As Noted	***11***



EXPLANATION

OW-06 1296.71 — FORT RILEY MONITORING WELL AND GROUNDWATER ELEVATION, FEET AMSL, 8/2/2005

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, FEET AMSL, 8/2/2005

GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.

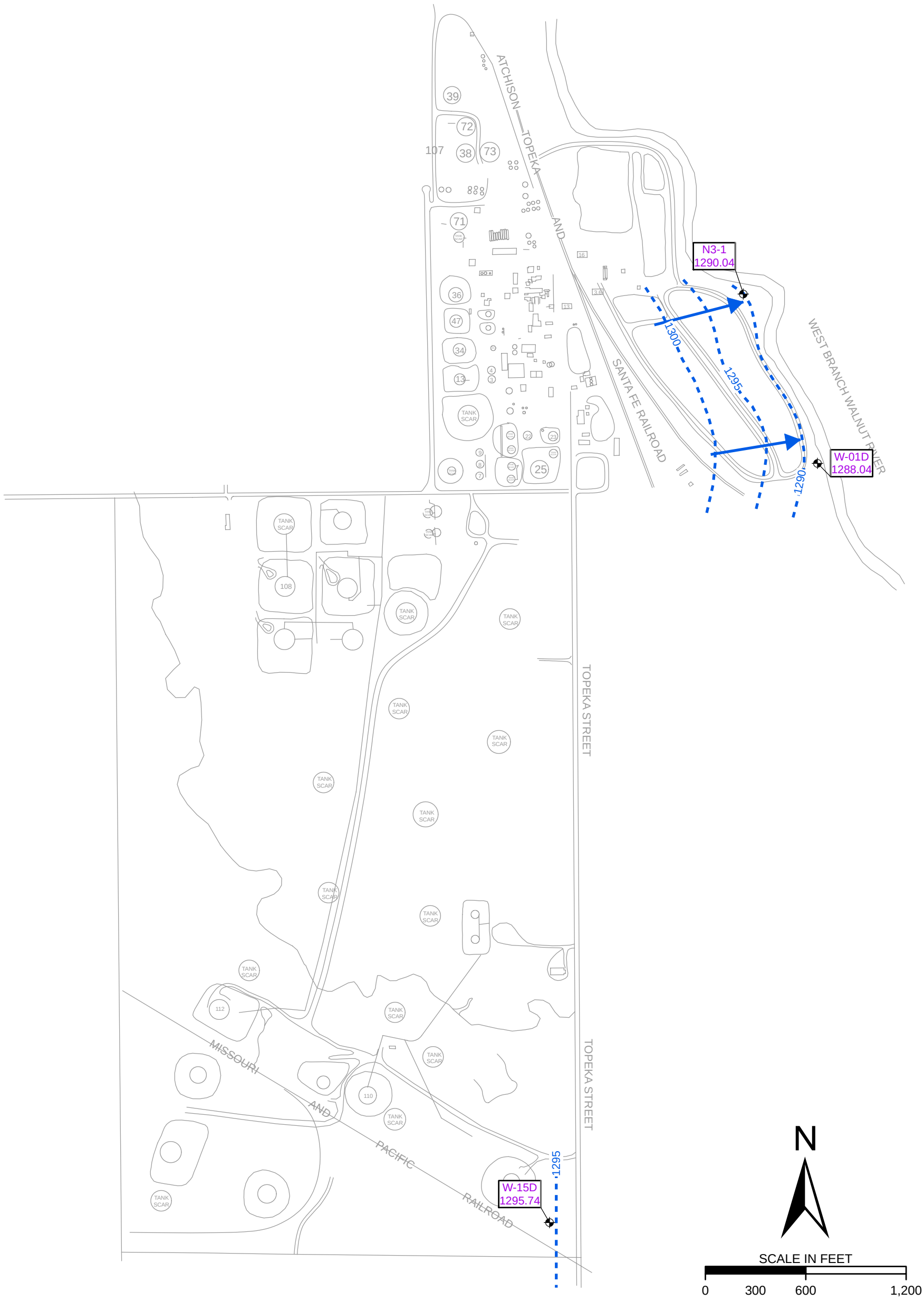
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
AUGUST 2, 2005 FORT RILEY LIMESTONE GROUNDWATER POTENTIOMETRIC SURFACE MAP

MWH

SCALE:	FIGURE No:
As Noted	***12***



EXPLANATION

N2-4 1291.65 — FLORENCE MONITORING WELL AND GROUNDWATER ELEVATION, FEET AMSL, 8/2/2005

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, FEET AMSL, 8/2/2005

GROUNDWATER FLOW DIRECTION

NOTES:
CONTOUR INTERVAL = 5 FEET.

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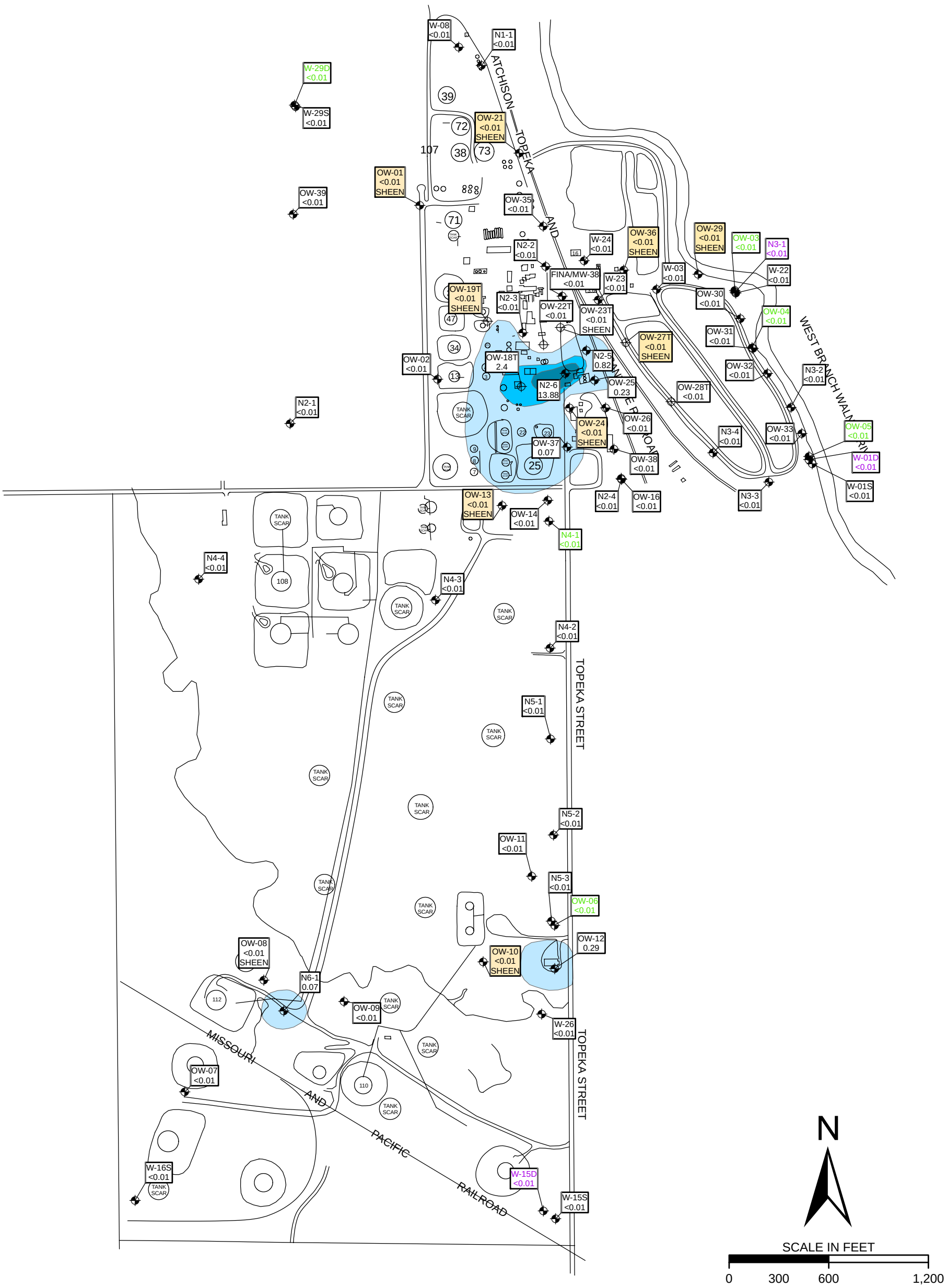
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
AUGUST 2, 2005 FLORENCE LIMESTONE GROUNDWATER POTENTIOMETRIC SURFACE MAP

MWH

SCALE:	FIGURE No:
As Noted	***13***



EXPLANATION

- OW-12 0.29 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) LNAPL THICKNESS (FT) OBSERVED AUGUST 2, 2005
- W-29D <0.01 — INTERMEDIATE MONITORING WELL (UPPER BEDROCK) LNAPL THICKNESS (FT) OBSERVED AUGUST 2, 2005
- N3-1 <0.01 — DEEP MONITORING WELL (FLORENCE LIMESTONE) LNAPL THICKNESS (FT) OBSERVED AUGUST 2, 2005
- OW-24 <0.01 SHEEN — MONITORING WELL WITH SHEEN OBSERVED DURING PHASE II INVESTIGATION, DEVELOPMENT, AND/OR 2Q05
- OW-18T 2.4 — TEMPORARY SHALLOW MONITORING WELL LNAPL THICKNESS (FT) OBSERVED AUGUST 2, 2005

NOTES:

<0.01 = WELL WITHOUT MEASURED LNAPL THICKNESS
SHEEN = LNAPL SHEEN OBSERVED DURING WATER LEVEL GAUGING, AUGUST 2, 2005.

SHADED REGIONS:

- LNAPL THICKNESS <0.01 FT
- LNAPL THICKNESS 0.01-1 FT
- LNAPL THICKNESS >1-10 FT
- LNAPL THICKNESS >10 FT

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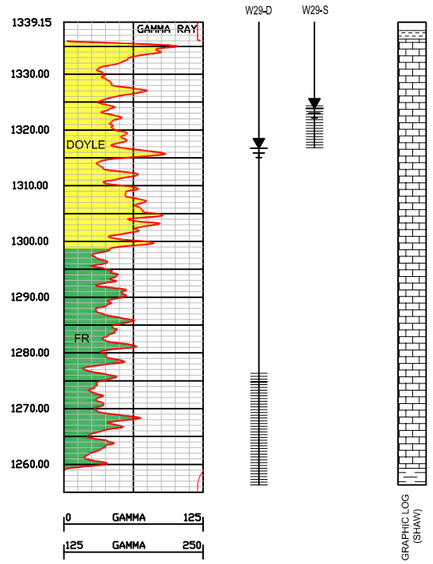
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

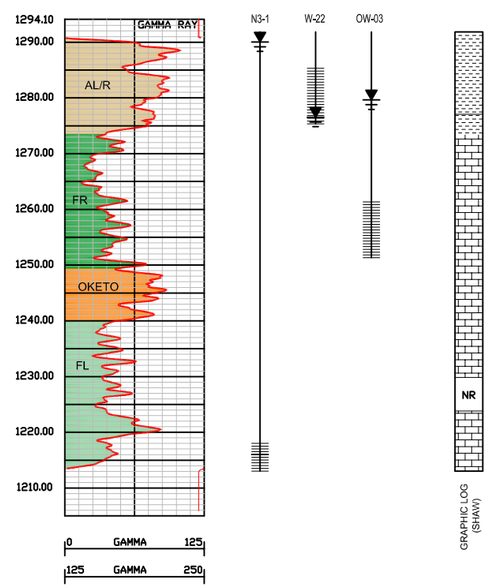
AUGUST 2, 2005
LNAPL ISOPACH MAP

MWH

SCALE:	FIGURE No:
As Noted	***14***



WELLS #: W29-D
W29-S



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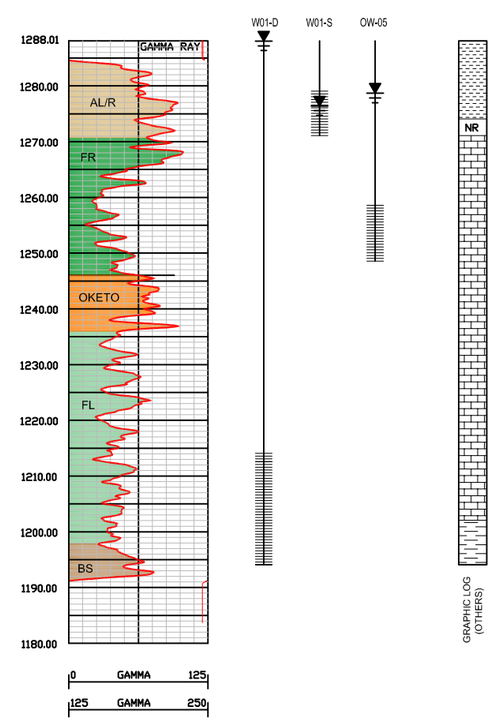
W-22
OW-03



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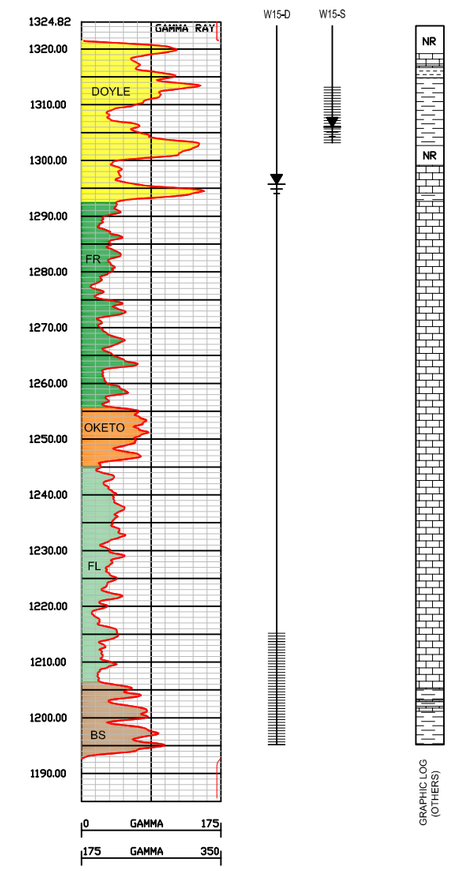
W01-S
OW-05



WELLS #: W15-D
W15-S

LEGEND

AL/R	ALLUVIUM/RESIDIUM
DOYLE	DOYLE SHALE
FR	FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
OKETO	OKETO SHALE MEMBER (BARNESTON LIMESTONE)
FL	FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
BS	BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)

GW POTENTIOMETRIC SURFACE ELEVATION, 8/2/05

WELL SCREEN INTERVAL

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	EL DORADO LOGS	7/18/05	WEP	MPW	

elpaso

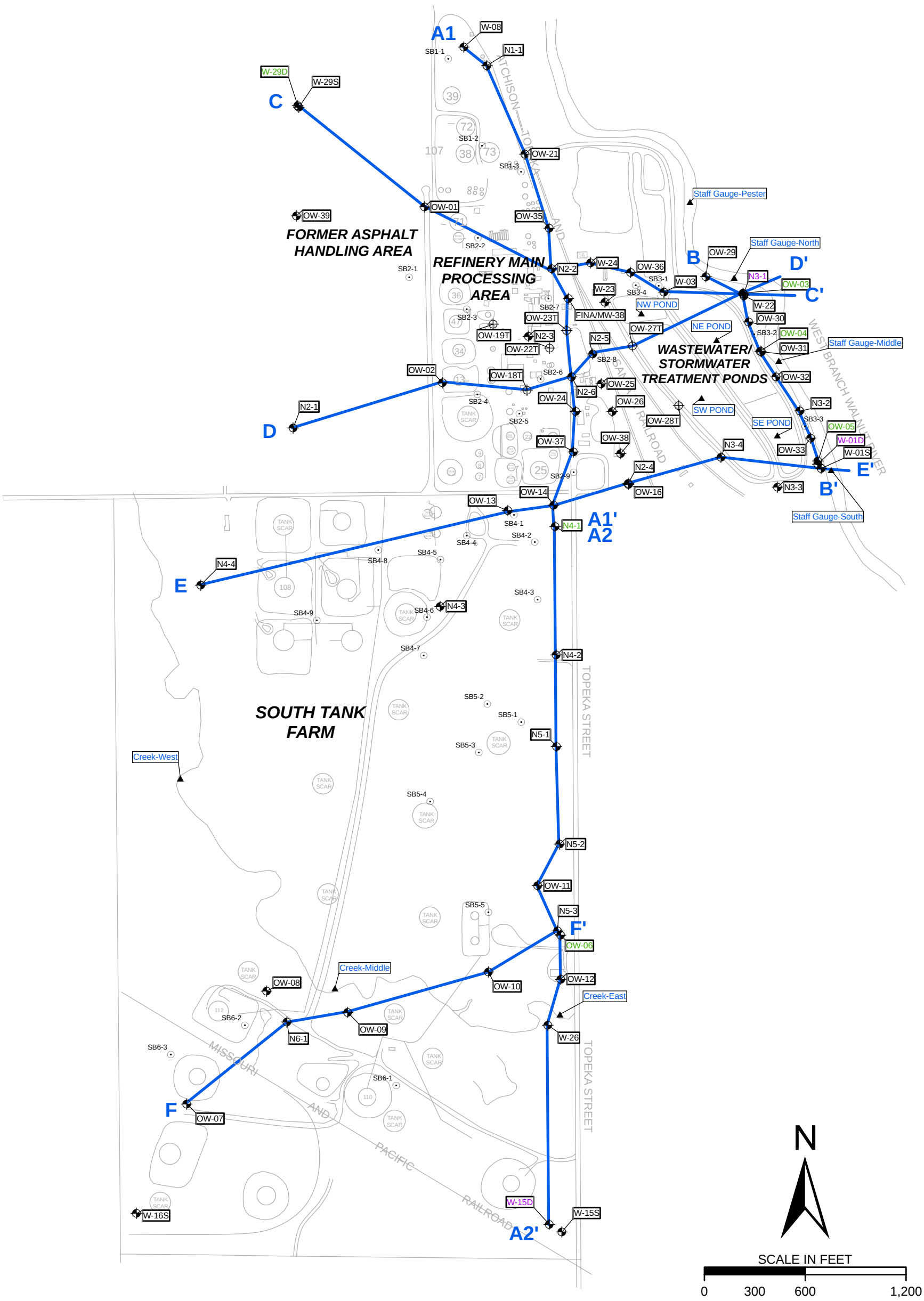
PROJECT: EL DORADO REFINERY, EL DORADO, KS

FIGURE TITLE: GAMMA LOG INTERPRETATION AND CLUSTERED WELL DATA

MWH

MWH PROJECT NO:	DATE:	SHEET	FIGURE No.
1004306	7/18/05	1 OF 1	15

AutoCAD FILE: Drill Logs, Gamma-Ray.dwg PROJECT NUMBER: 1004306



EXPLANATION

- OW-08 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK)
- OW-08 — FORT RILEY MONITORING WELL
- OW-08 — FLORENCE MONITORING WELL
- OW-22T — TEMPORARY MONITORING WELL
- SB6-1 — SOIL BORING
- B —— B' — CROSS-SECTION LINE

elpaso

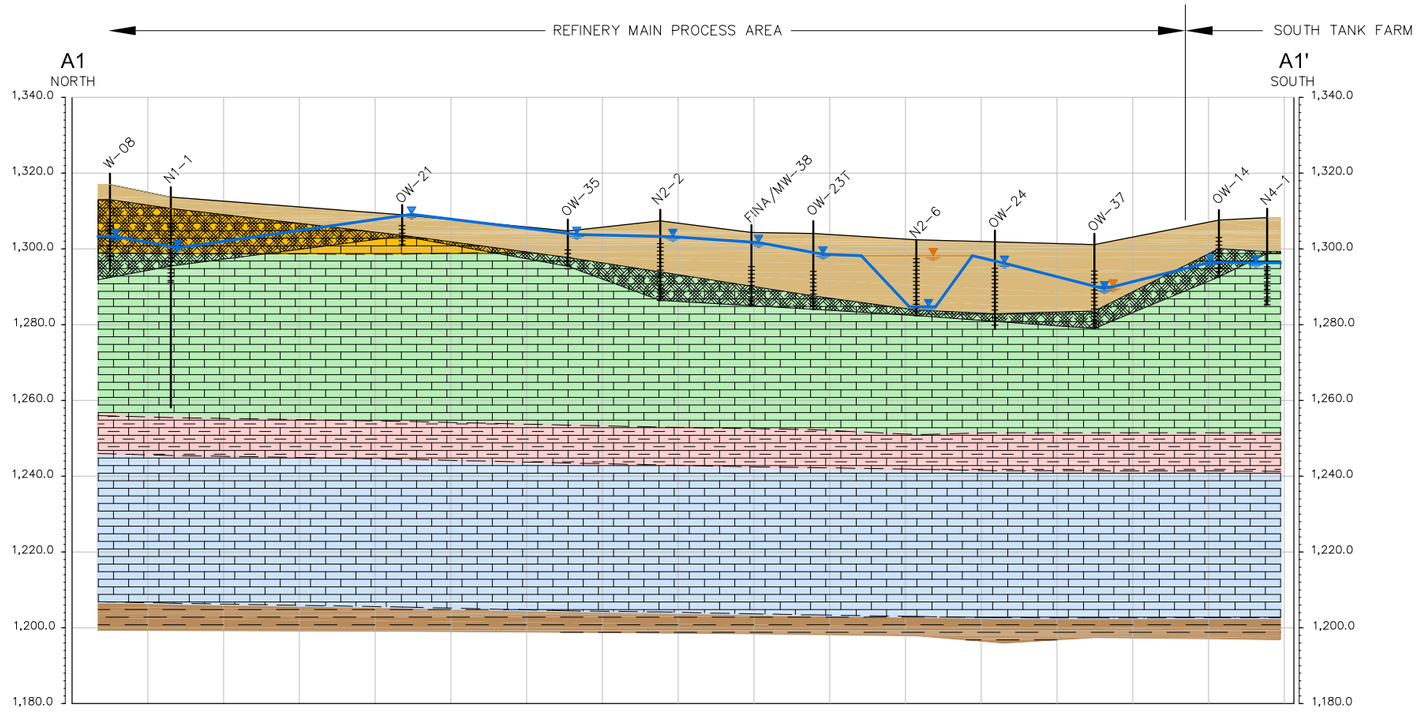
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

LINES OF GEOLOGIC CROSS-SECTION

MWH

SCALE:	FIGURE No:
As Noted	16



LEGEND

- APPARENT TOP OF LNAPL ELEVATION, 8/02/05, FEET AMSL
- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)
- WELL SCREEN LOCATION
- SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

elpaso

PROJECT:
EL DORADO REFINERY, EL DORADO, KS

DRAWING TITLE:
GEOLOGIC CROSS-SECTION A1-A1'

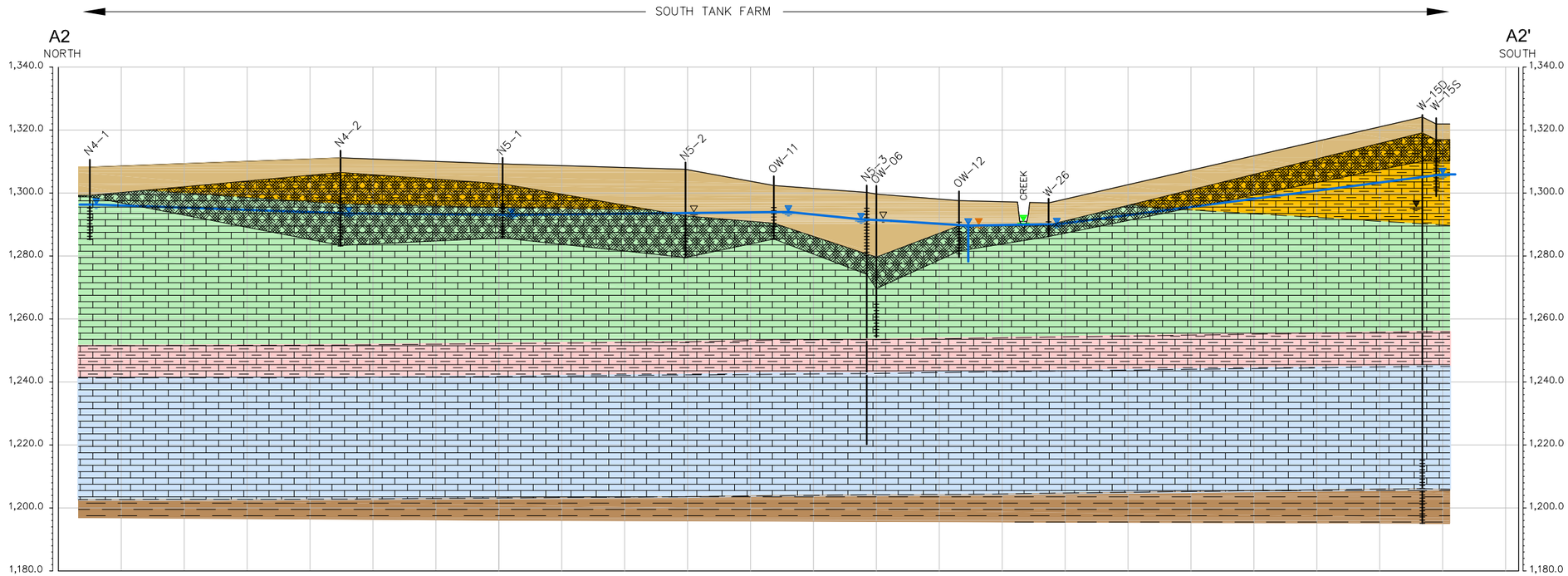
MWH

Sheet 17 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 17

AutoCAD FILE: Cross-Sections.dwg PROJECT NUMBER: 1004317



LEGEND

- APPARENT TOP OF LNAPL ELEVATION, 8/02/05, FEET AMSL
- SURFACE WATER ELEVATION, 8/2/05, FEET AMSL
- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)

WELL SCREEN LOCATION

SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

elpaso

PROJECT:
EL DORADO REFINERY, EL DORADO, KS

DRAWING TITLE:
GEOLOGIC CROSS-SECTION A2-A2'

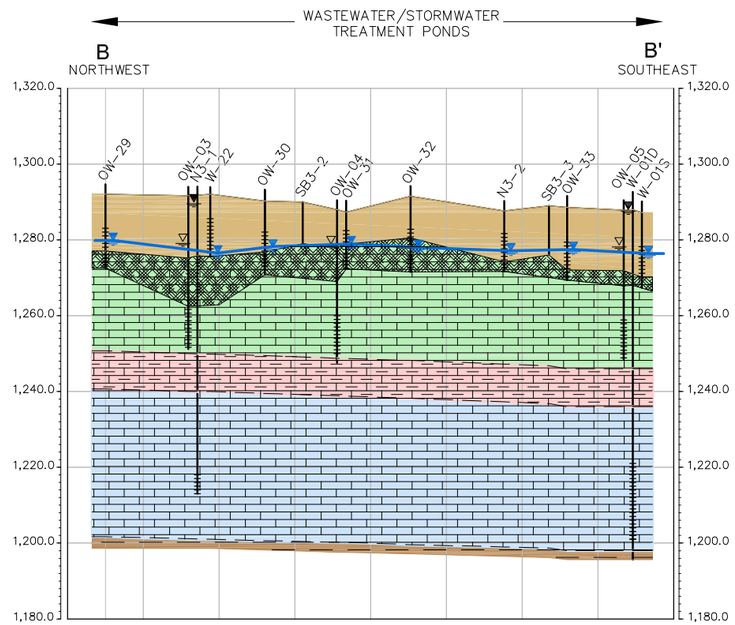
MWH

Sheet 18 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 18

AutoCAD FILE: Cross-Sections.dwg PROJECT NUMBER: 1004317



LEGEND

- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)
- WELL SCREEN LOCATION
- SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

elpaso

PROJECT:
EL DORADO REFINERY, EL DORADO, KS

DRAWING TITLE:
GEOLOGIC CROSS-SECTION B-B'

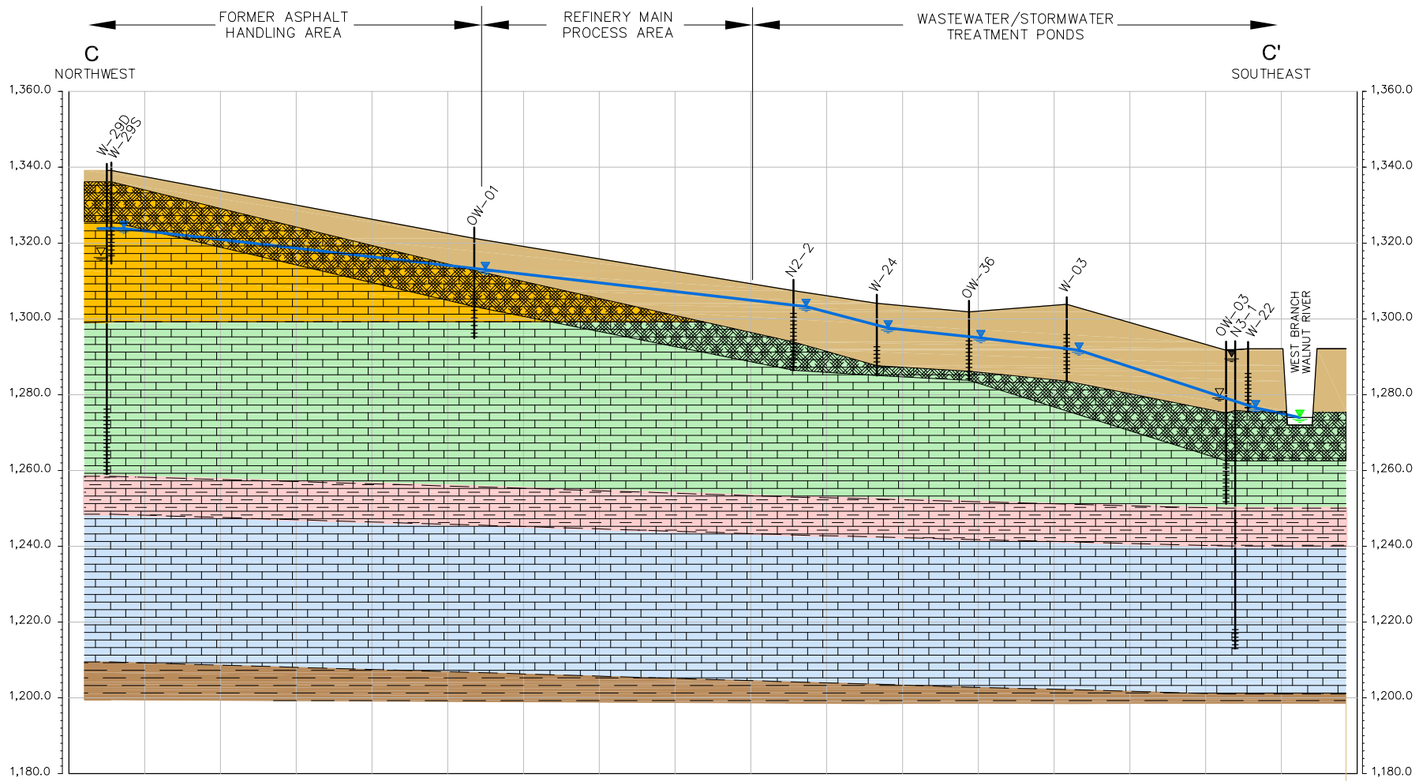
MWH

Sheet 19 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 19

AutoCAD FILE: Cross-Sections.dwg PROJECT NUMBER: 1004317



LEGEND

- SURFACE WATER ELEVATION, 8/2/05, FEET AMSL
- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)
- WELL SCREEN LOCATION
- SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

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PROJECT:
EL DORADO REFINERY, EL DORADO, KS

DRAWING TITLE:
GEOLOGIC CROSS-SECTION C-C'

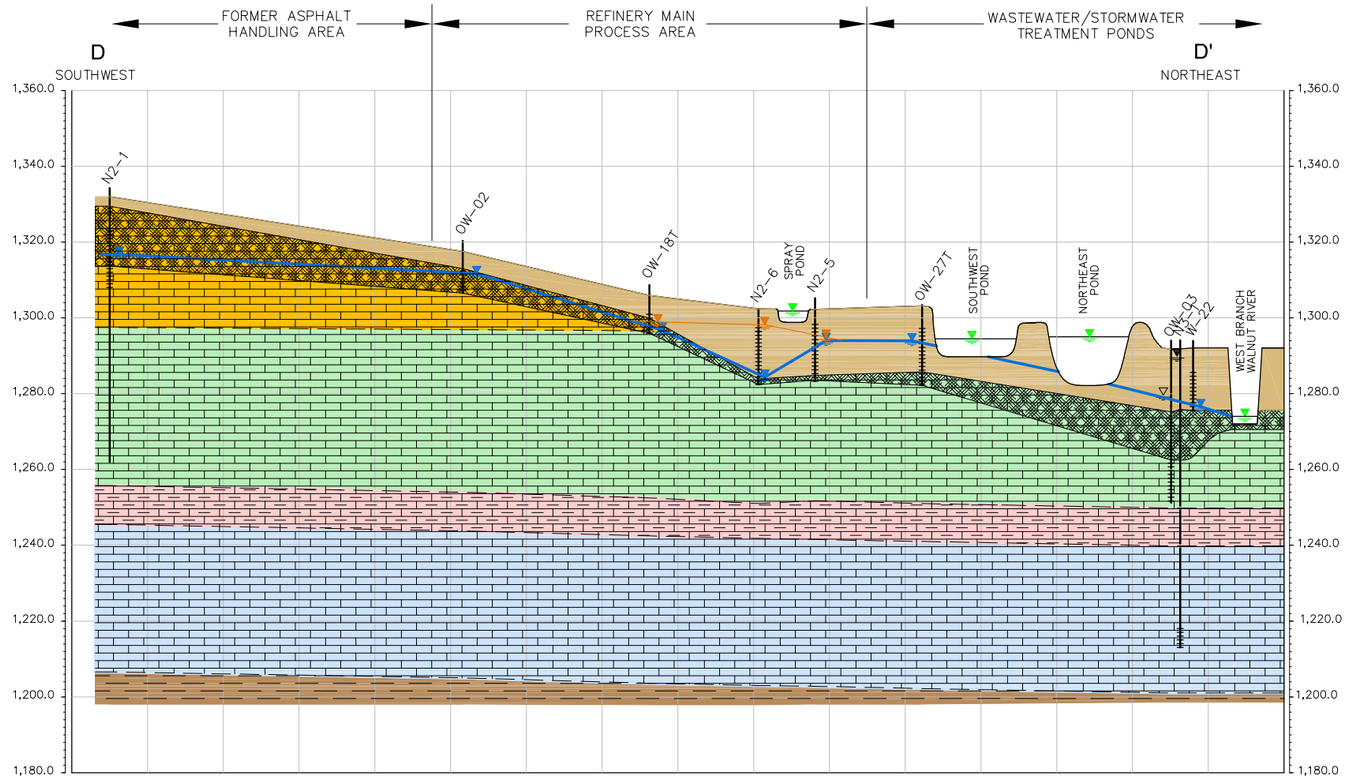
MWH

Sheet 20 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 20

AutoCAD FILE: Cross-Sections.dwg PROJECT NUMBER: 1004317



LEGEND

- APPARENT TOP OF LNAPL ELEVATION, 8/02/05, FEET AMSL
- SURFACE WATER ELEVATION, 8/2/05, FEET AMSL
- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)
- WELL SCREEN LOCATION
- SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

PROJECT NUMBER: 1004317

AutoCAD FILE: Cross-Sections.dwg

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PROJECT:
EL DORADO REFINERY, EL DORADO, KS

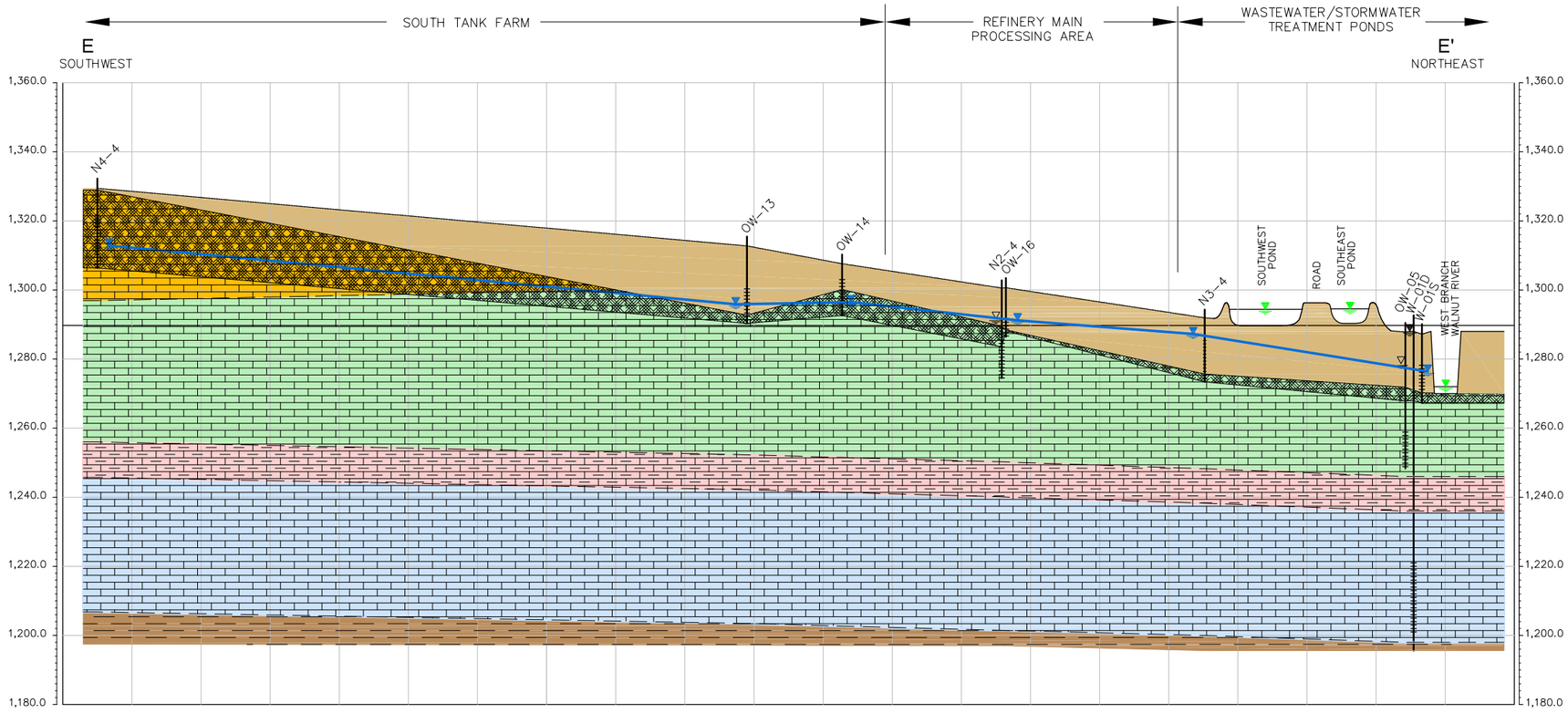
DRAWING TITLE:
GEOLOGIC CROSS-SECTION D-D'

MWH

Sheet 21 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 21



LEGEND

- SURFACE WATER ELEVATION, 8/2/05, FEET AMSL
- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)
- WELL SCREEN LOCATION
- SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

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PROJECT:
EL DORADO REFINERY, EL DORADO, KS

DRAWING TITLE:
GEOLOGIC CROSS-SECTION E-E'

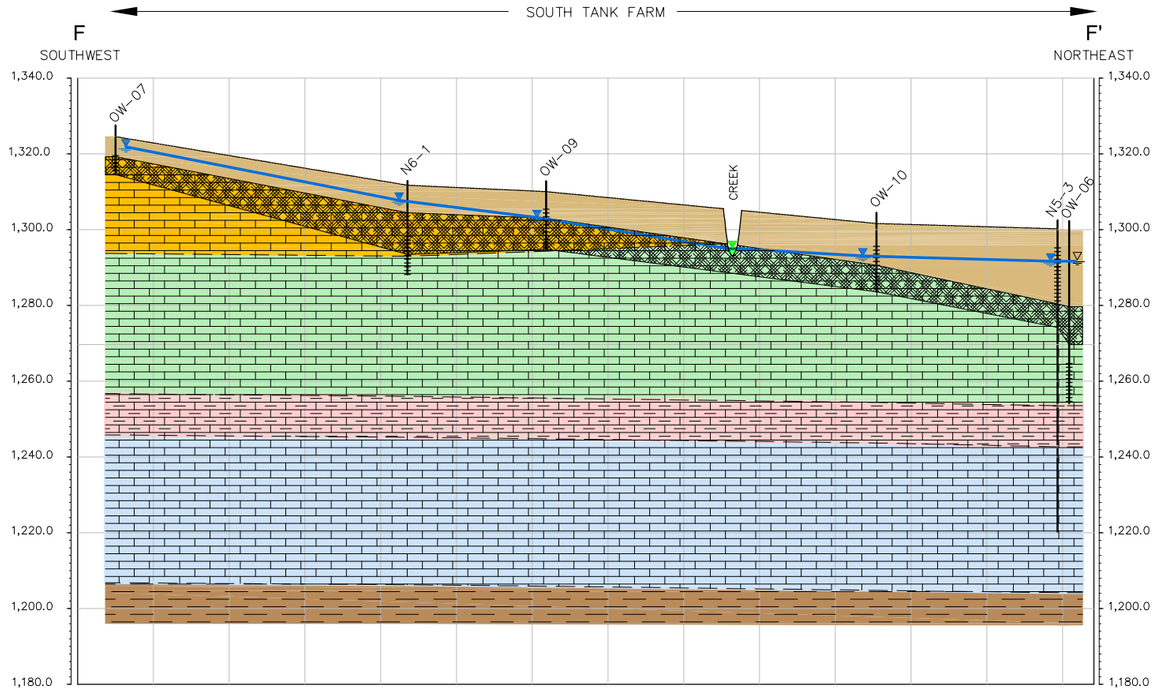
MWH

Sheet 22 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 22

AutoCAD FILE: Cross-Sections.dwg PROJECT NUMBER: 1004317



LEGEND

- SURFACE WATER ELEVATION, 8/2/05, FEET AMSL
- SHALLOW WELL – GROUNDWATER TABLE ELEVATION, 8/2/05, FEET AMSL
- FORT RILEY WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FLORENCE WELL – GROUNDWATER POTENTIOMETRIC SURFACE ELEVATION, 8/2/05, FEET AMSL
- FRACTURED ROCK
- LIMESTONE FORMATION
- SHALE FORMATION
- LIMESTONE/SHALE FORMATION
- ALLUVIUM / RESIDUUM
- DOYLE SHALE
- FORT RILEY LIMESTONE MEMBER (BARNESTON LIMESTONE)
- OKETO SHALE MEMBER (BARNESTON LIMESTONE)
- FLORENCE LIMESTONE MEMBER (BARNESTON LIMESTONE)
- BLUE SPRINGS SHALE MEMBER (MATFIELD SHALE)
- WELL SCREEN LOCATION
- SOIL BORING

40'
0
0
400'

HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 40'
VERTICAL EXAGGERATION 10X

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PROJECT:
EL DORADO REFINERY, EL DORADO, KS

DRAWING TITLE:
GEOLOGIC CROSS-SECTION F-F'

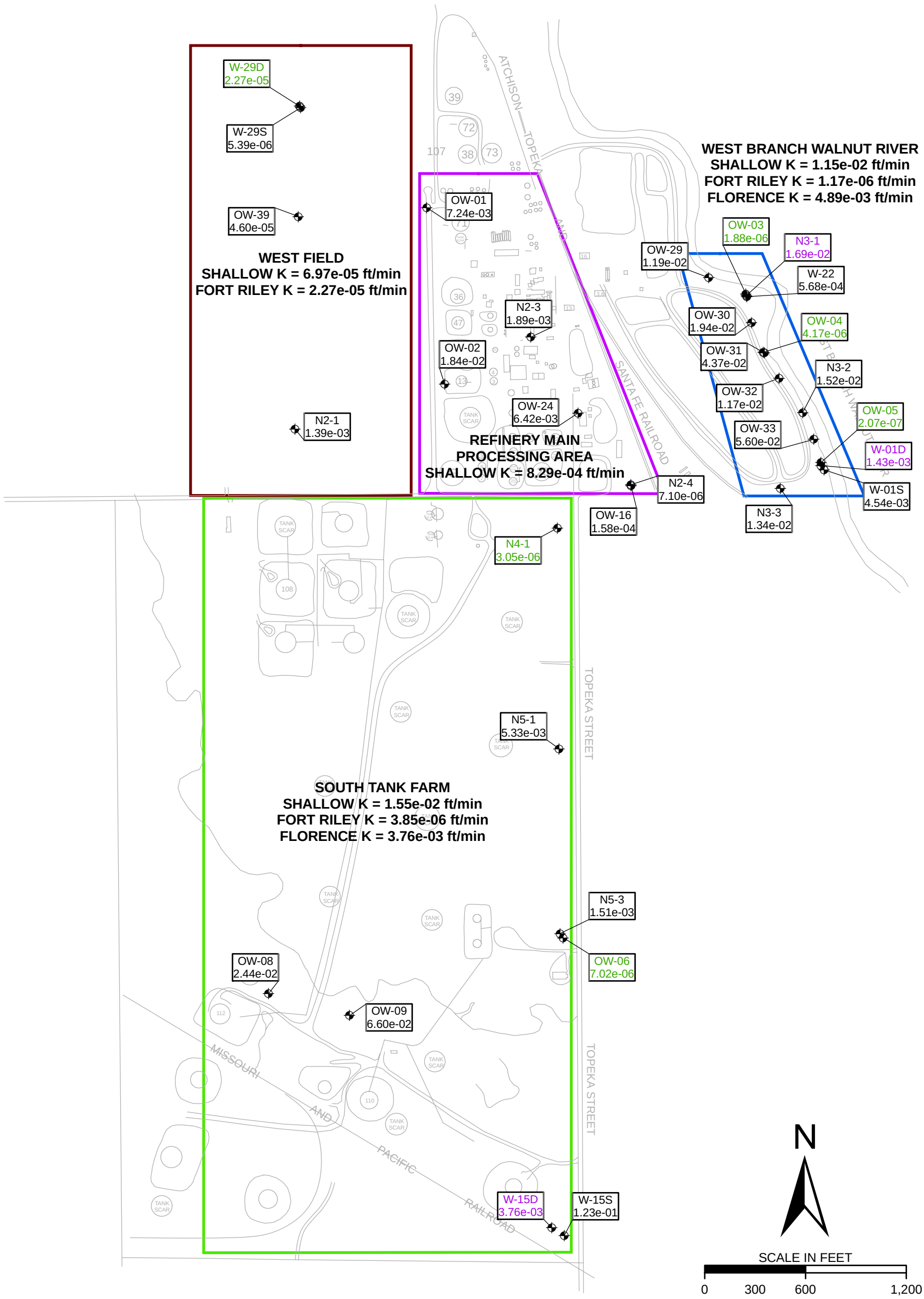
MWH

Sheet 23 Of 30 Sheets

SCALE: 1" = 400' (Horz)

Figure No.: 23

AutoCAD FILE: Cross-Sections.dwg PROJECT NUMBER: 1024317



EXPLANATION

- OW-24 6.42e-03 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) AND HYDRAULIC CONDUCTIVITY, K (ft/min)
- OW-06 7.02e-06 — FORT RILEY MONITORING WELL AND HYDRAULIC CONDUCTIVITY, K (ft/min)
- W-15D 3.76e-03 — FLORENCE MONITORING WELL AND HYDRAULIC CONDUCTIVITY, K (ft/min)

NOTES:
ESTIMATED HYDRAULIC CONDUCTIVITY GEOMETRIC MEANS PRESENTED BY FORMATION AND WELL LOCATION IN ONE OF FOUR AREAS: WEST FIELD, REFINERY MAIN PROCESSING AREA, WEST BRANCH WALNUT RIVER, AND SOUTH TANK FARM.

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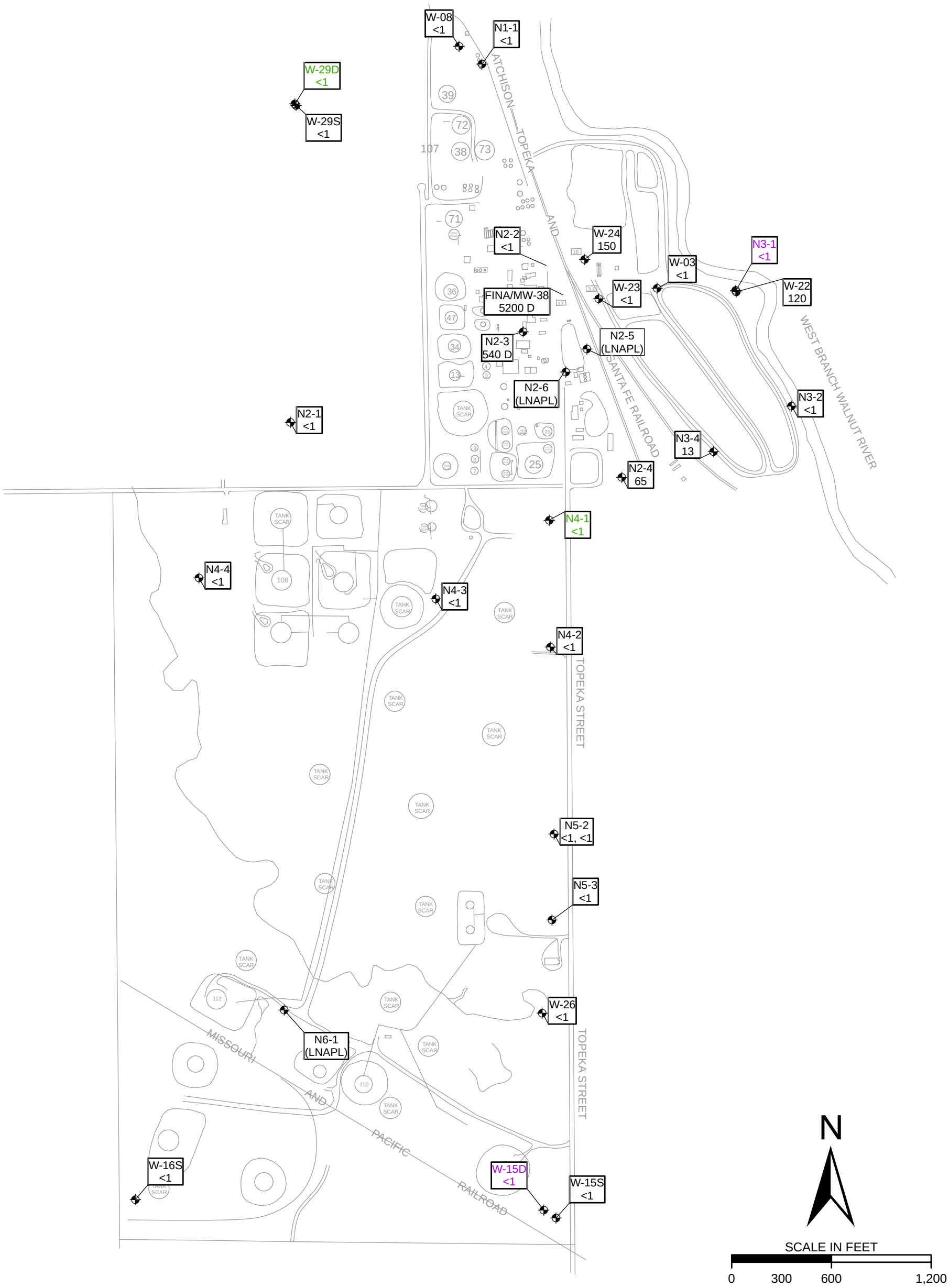
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
HYDRAULIC CONDUCTIVITY DATA

MWH

SCALE:	FIGURE No:
As Noted	***24***



EXPLANATION

N2-4 65 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK)
BENZENE CONCENTRATION IN GROUNDWATER (ug/L), MARCH 21-30, 2005

W-29D <1 — FORT RILEY MONITORING WELL
BENZENE CONCENTRATION IN GROUNDWATER (ug/L), MARCH 24-29, 2005

N3-1 <1 — FLORENCE MONITORING WELL
BENZENE CONCENTRATION IN GROUNDWATER (ug/L), MARCH 23-28, 2005

NOTES:
KDHE RSK LEVEL FOR BENZENE IN GROUNDWATER IS 5 ug/L.
<1 = BENZENE NOT DETECTED IN SAMPLE.
DUPLICATE SAMPLE RESULTS ARE SEPARATED BY A COMMA.
(LNAPL) = WELL NOT SAMPLED DUE TO PRESENCE OF LNAPL.

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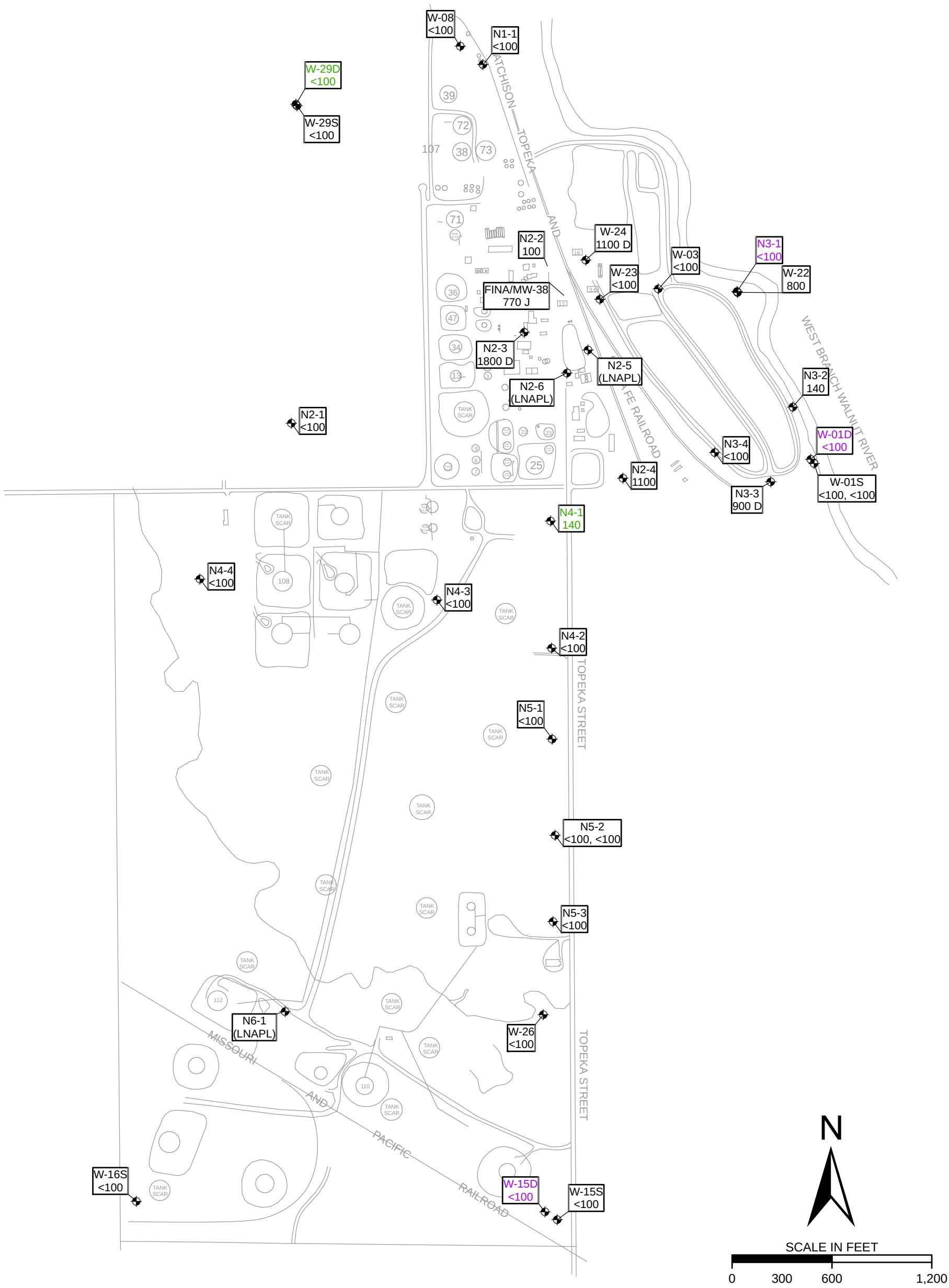
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
FIRST QUARTER 2005 BENZENE IN GROUNDWATER MAP

MWH

SCALE:	FIGURE No:
As Noted	***25***



EXPLANATION

N2-4 1100 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK)
TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), MARCH 21-30, 2005

N4-1 140 — FORT RILEY MONITORING WELL
TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), MARCH 24-29, 2005

N3-1 <100 — FLORENCE MONITORING WELL
TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), MARCH 23-28, 2005

NOTES:
KDHE RSK LEVEL FOR TPH-GRO IN GROUNDWATER IS 500 ug/L.
<100 = TPH-GRO NOT DETECTED IN SAMPLE.
DUPLICATE SAMPLE RESULTS ARE SEPARATED BY A COMMA.
(LNAPL) = WELL NOT SAMPLED DUE TO PRESENCE OF LNAPL.

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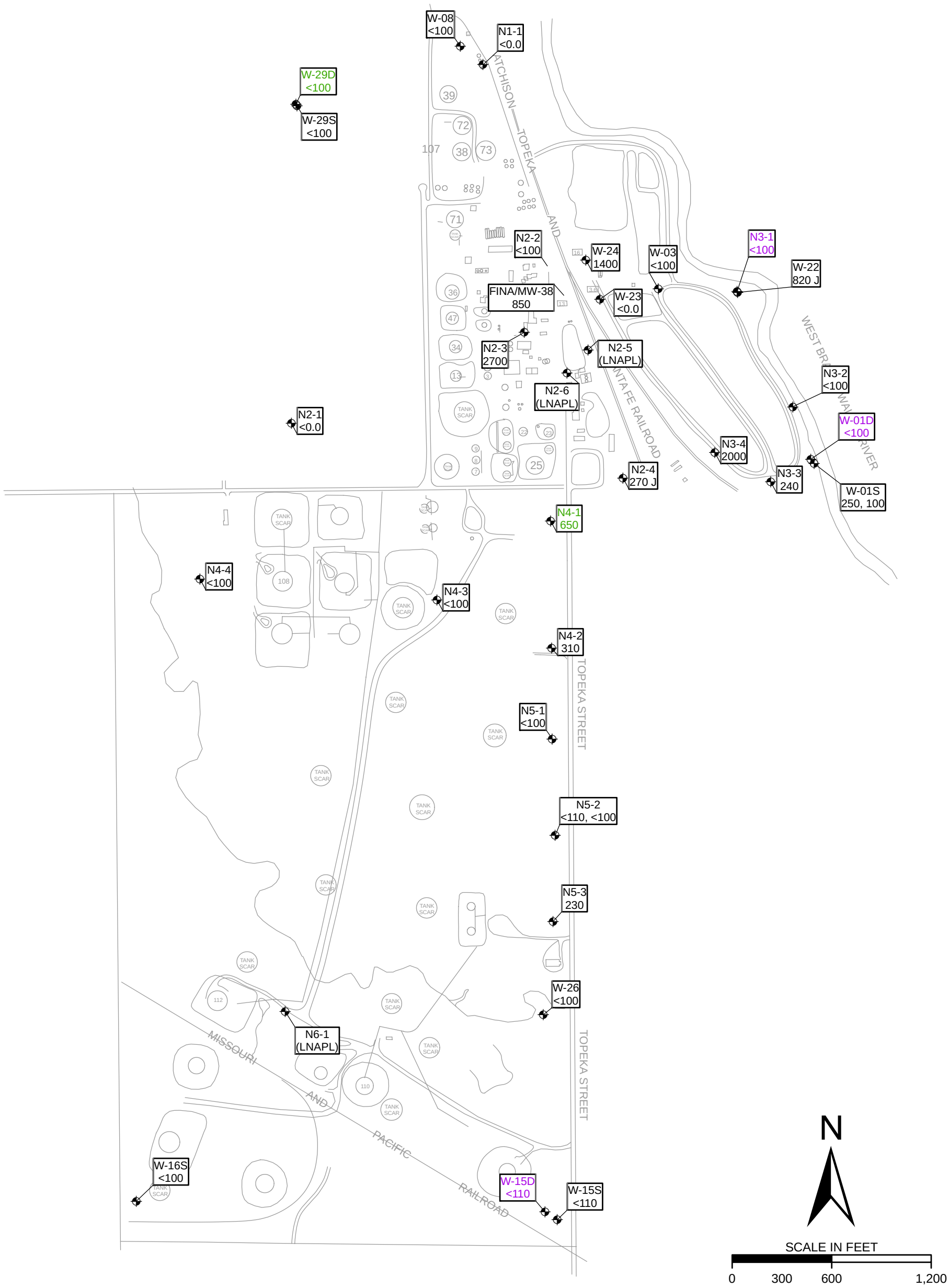
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
FIRST QUARTER 2005 TPH-GRO IN GROUNDWATER MAP

MWH

SCALE:	FIGURE No:
As Noted	***26***



EXPLANATION

N3-4 2000 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK)
TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), MARCH 21-30, 2005

N4-1 650 — FORT RILEY MONITORING WELL
TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), MARCH 24-29, 2005

N3-1 <100 — FLORENCE MONITORING WELL
TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), MARCH 23-28, 2005

NOTES:
KDHE RSK LEVEL FOR TPH-DRO IN GROUNDWATER IS 720 ug/L.
<100 = TPH-DRO NOT DETECTED IN SAMPLE.
DUPLICATE SAMPLE RESULTS ARE SEPARATED BY A COMMA.
(LNAPL) = WELL NOT SAMPLED DUE TO PRESENCE OF LNAPL.

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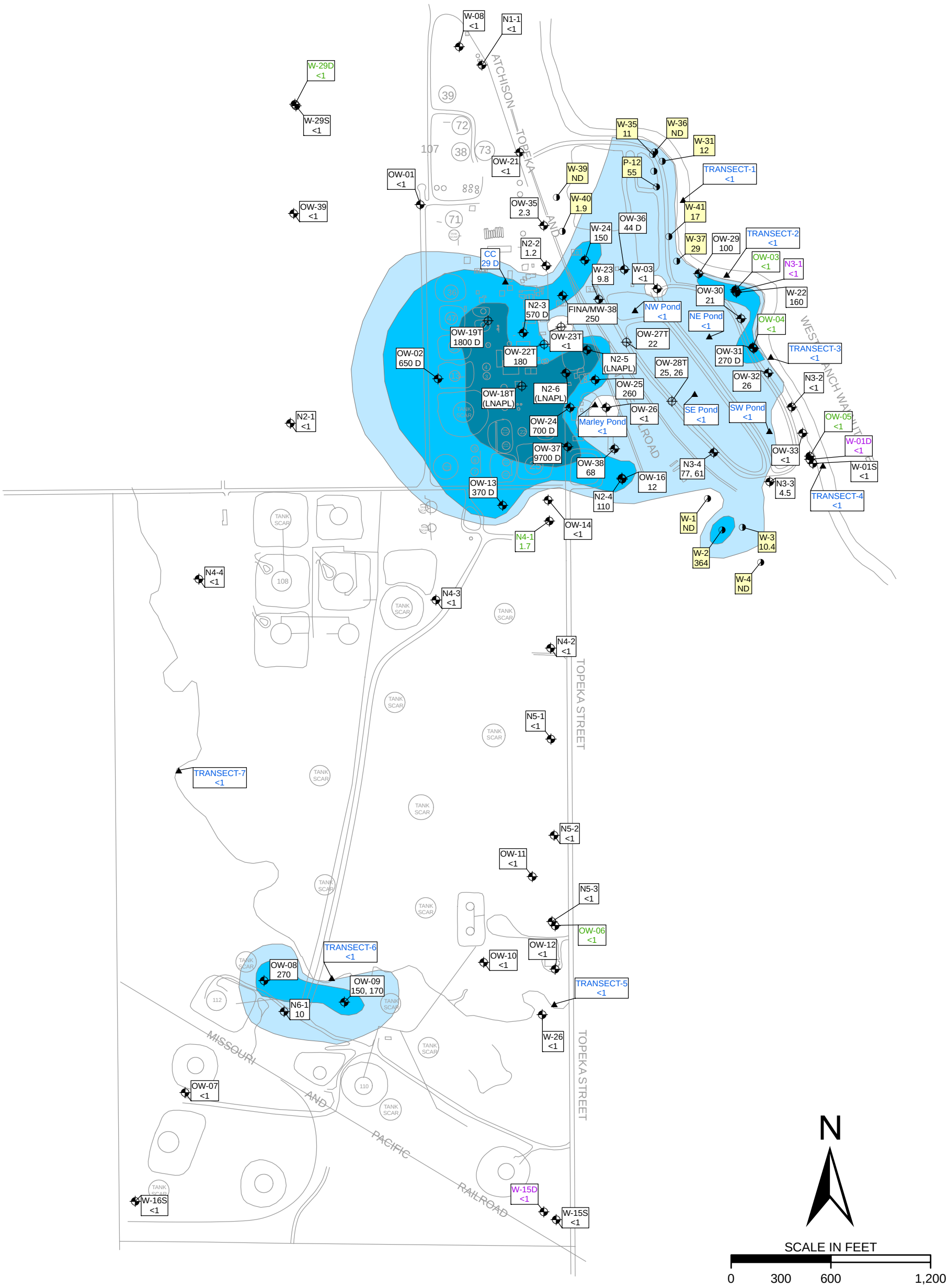
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
FIRST QUARTER 2005 TPH-DRO IN GROUNDWATER MAP

MWH

SCALE:	FIGURE No:
As Noted	***27***



EXPLANATION

OW-09 150	SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) BENZENE CONCENTRATION IN GROUNDWATER (ug/L), APRIL 8 TO JUNE 30, 2005
W-29D <1	FORT RILEY MONITORING WELL BENZENE CONCENTRATION IN GROUNDWATER (ug/L), MAY 20 TO JUNE 30, 2005
N3-1 <1	FLORENCE MONITORING WELL BENZENE CONCENTRATION IN GROUNDWATER (ug/L), MAY 18-27, 2005
W-2 364	OFFSITE PESTER AND UNION TANK CAR MONITORING WELLS BENZENE CONCENTRATION IN GROUNDWATER (ug/L), APRIL 14-20, 2005
SW Pond 870	SURFACE WATER SAMPLING LOCATION BENZENE CONCENTRATION IN WATER (ug/L), APRIL 15 TO JUNE 9, 2005
OW-22T	TEMPORARY MONITORING WELL

NOTES:
KDHE RSK LEVEL FOR BENZENE IN GROUNDWATER IS 5 ug/L.
<1 = BENZENE NOT DETECTED IN SAMPLE.
DUPLICATE SAMPLE RESULTS ARE SEPARATED BY A COMMA.
(LNAPL) = WELL NOT SAMPLED DUE TO PRESENCE OF LNAPL.
ONLY DATA FROM SHALLOW GROUNDWATER WELLS SHADED, ACCORDING TO SHADING SCHEME AT RIGHT.

SHADED REGIONS:
- BENZENE <5 ug/L
- BENZENE 5-100 ug/L
- BENZENE >100-1000 ug/L
- BENZENE >1,000 ug/L

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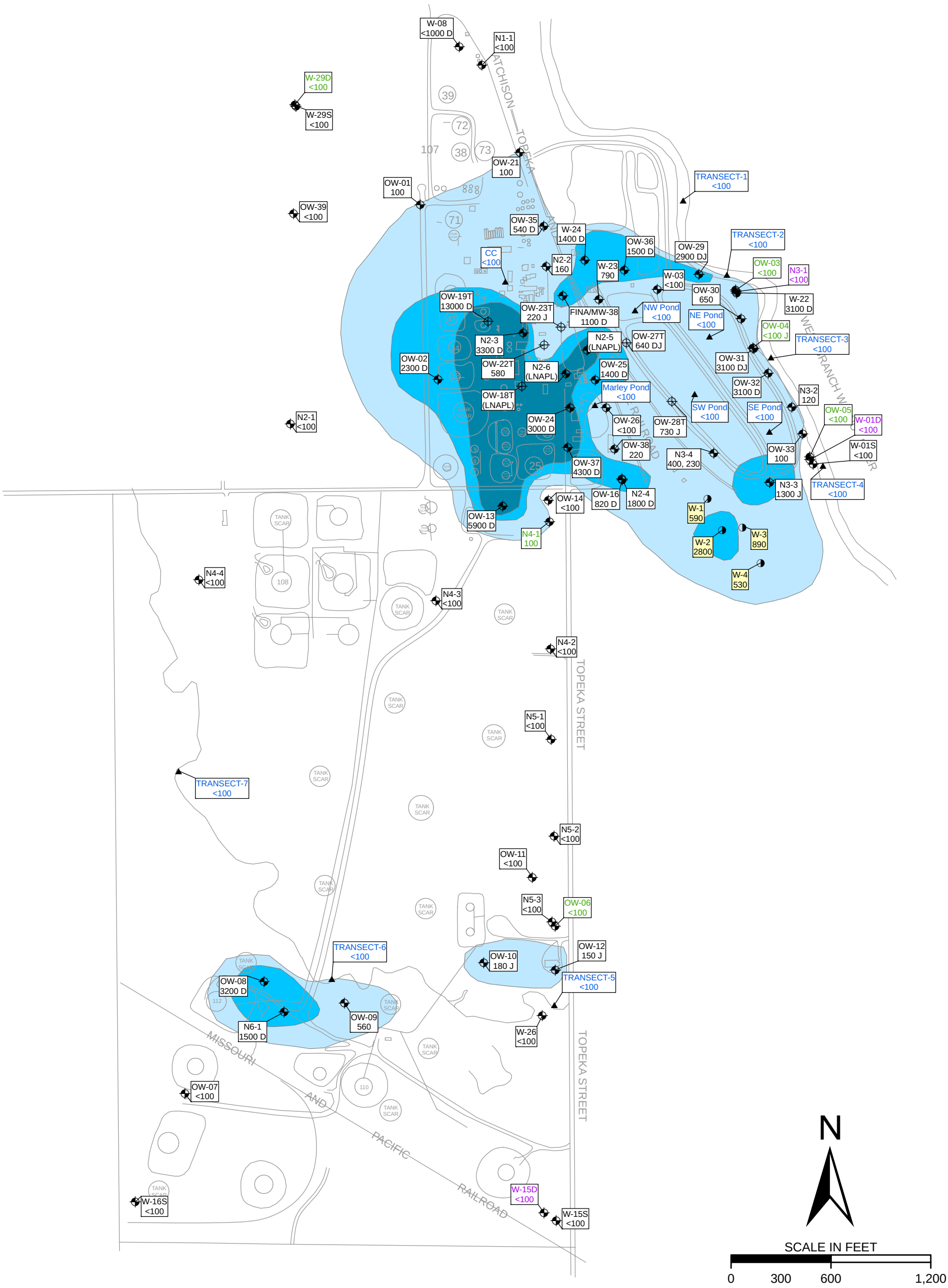
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SECOND QUARTER 2005 BENZENE IN GROUNDWATER MAP

MWH

SCALE: *As Noted*

FIGURE No: ***28***



EXPLANATION

OW-09 560	SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), APRIL 8 TO JUNE 30, 2005
N4-1 100	FORT RILEY MONITORING WELL TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), MAY 20 TO JUNE 30, 2005
N3-1 <100	FLORENCE MONITORING WELL TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), MAY 18-27, 2005
W-1 590	OFFSITE PESTER AND UNION TANK CAR MONITORING WELLS TPH-GRO CONCENTRATION IN GROUNDWATER (ug/L), APRIL 14-20, 2005
SW Pond 870	SURFACE WATER SAMPLING LOCATION TPH-GRO CONCENTRATION IN WATER (ug/L), APRIL 15 TO JUNE 9, 2005
OW-22T	TEMPORARY MONITORING WELL

NOTES:
KDHE RSK LEVEL FOR TPH-GRO IN GROUNDWATER IS 500 ug/L.
<100 = TPH-GRO NOT DETECTED IN SAMPLE.
DUPLICATE SAMPLE RESULTS ARE SEPARATED BY A COMMA.
(LNAPL) = WELL NOT SAMPLED DUE TO PRESENCE OF LNAPL.
ONLY DATA FROM SHALLOW GROUNDWATER WELLS SHADED, ACCORDING TO SHADING SCHEME AT RIGHT.

SHADED REGIONS:
- TPH-GRO <100 ug/L
- TPH-GRO 100-1,000 ug/L
- TPH-GRO >1,000-3,000 ug/L
- TPH-GRO >3,000 ug/L

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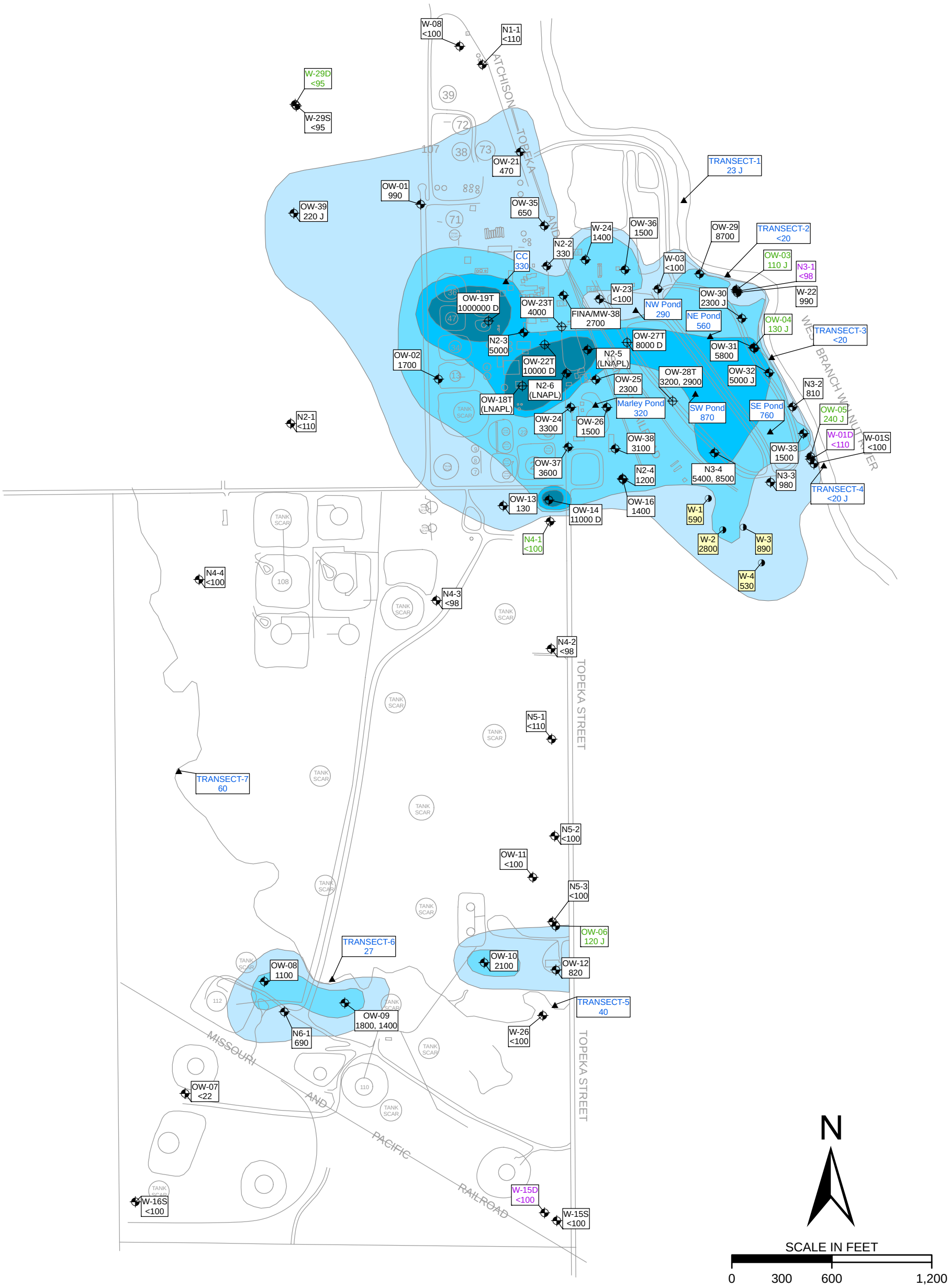
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SECOND QUARTER 2005 TPH-GRO IN GROUNDWATER MAP

MWH

SCALE:	FIGURE No:
As Noted	***29***



EXPLANATION

- N2-4 1200 — SHALLOW MONITORING WELL (ALLUVIUM & WEATHERED BEDROCK) TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), APRIL 8 TO JUNE 30, 2005
- W-29D <100 — FORT RILEY MONITORING WELL TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), MAY 20 TO JUNE 30, 2005
- N3-1 <100 — FLORENCE MONITORING WELL TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), MAY 18-27, 2005
- W-1 590 — OFFSITE PESTER AND UNION TANK CAR MONITORING WELLS TPH-DRO CONCENTRATION IN GROUNDWATER (ug/L), APRIL 14-20, 2005
- SW Pond 870 — SURFACE WATER SAMPLING LOCATION TPH-DRO CONCENTRATION IN WATER (ug/L), APRIL 15 TO JUNE 9, 2005
- OW-22T — TEMPORARY MONITORING WELL

NOTES:
KDHE RSK LEVEL FOR TPH-DRO IN GROUNDWATER IS 720 ug/L.
<100 = TPH-DRO NOT DETECTED IN SAMPLE.
DUPLICATE SAMPLE RESULTS ARE SEPARATED BY A COMMA.
(LNAPL) = WELL NOT SAMPLED DUE TO PRESENCE OF LNAPL.
ONLY DATA FROM SHALLOW GROUNDWATER WELLS SHADED, ACCORDING TO SHADING SCHEME AT RIGHT.

SHADED REGIONS:
- TPH-DRO <100 ug/L
- TPH-DRO 100-1,000 ug/L
- TPH-DRO >1,000-5,000 ug/L
- TPH-DRO >5,000-10,000 ug/L
- TPH-DRO >10,000 ug/L

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PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
SECOND QUARTER 2005 TPH-DRO IN GROUNDWATER MAP

MWH

SCALE:	FIGURE No:
As Noted	***30***

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the in situ and intrusive analysis of the 26 analytes listed in Table 1 for soil and sediment samples. Some common elements are not listed in Table 1 because they are considered "light" elements that cannot be detected by field portable x-ray fluorescence (FPXRF). They are: lithium, beryllium, sodium, magnesium, aluminum, silicon, and phosphorus. Most of the analytes listed in Table 1 are of environmental concern, while a few others have interference effects or change the elemental composition of the matrix, affecting quantitation of the analytes of interest. Generally elements of atomic number 16 or greater can be detected and quantitated by FPXRF.

1.2 Detection limits depend on several factors, the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement spectral interferences. General instrument detection limits for analytes of interest in environmental applications are shown in Table 1. These detection limits apply to a clean matrix of quartz sand (silicon dioxide) free of interelement spectral interferences using long (600-second) count times. These detection limits are given for guidance only and will vary depending on the sample matrix, which instrument is used, and operating conditions. A discussion of field performance-based detection limits is presented in Section 13.4 of this method. The clean matrix and field performance-based detection limits should be used for general planning purposes, and a third detection limit discussed, based on the standard deviation around single measurements, should be used in assessing data quality. This detection limit is discussed in Sections 9.7 and 11.3.

1.3 Use of this method is restricted to personnel either trained and knowledgeable in the operation of an XRF instrument or under the supervision of a trained and knowledgeable individual. This method is a screening method to be used with confirmatory analysis using EPA-approved methods. This method's main strength is as a rapid field screening procedure. The method detection limits (MDL) of FPXRF are above the toxicity characteristic regulatory level for most RCRA analytes. If the precision, accuracy, and detection limits of FPXRF meet the data quality objectives (DQOs) of your project, then XRF is a fast, powerful, cost effective technology for site characterization.

2.0 SUMMARY OF METHOD

2.1 The FPXRF technologies described in this method use sealed radioisotope sources to irradiate samples with x-rays. X-ray tubes are used to irradiate samples in the laboratory and are beginning to be incorporated into field portable instruments. When a sample is irradiated with x-rays, the source x-rays may undergo either scattering or absorption by sample atoms. This later process is known as the photoelectric effect. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. Electrons in outer shells have higher energy states than inner shell electrons, and the outer shell electrons give off energy as they cascade down into the inner shell vacancies. This rearrangement of electrons

results in emission of x-rays characteristic of the given atom. The emission of x-rays, in this manner, is termed x-ray fluorescence.

Three electron shells are generally involved in emission of x-rays during FPXRF analysis of environmental samples: the K, L, and M shells. A typical emission pattern, also called an emission spectrum, for a given metal has multiple intensity peaks generated from the emission of K, L, or M shell electrons. The most commonly measured x-ray emissions are from the K and L shells; only metals with an atomic number greater than 57 have measurable M shell emissions.

Each characteristic x-ray line is defined with the letter K, L, or M, which signifies which shell had the original vacancy and by a subscript alpha (α) or beta (β), which indicates the higher shell from which electrons fell to fill the vacancy and produce the x-ray. For example, a K_α line is produced by a vacancy in the K shell filled by an L shell electron, whereas a K_β line is produced by a vacancy in the K shell filled by an M shell electron. The K_α transition is on average 6 to 7 times more probable than the K_β transition; therefore, the K_α line is approximately 7 times more intense than the K_β line for a given element, making the K_α line the choice for quantitation purposes.

The K lines for a given element are the most energetic lines and are the preferred lines for analysis. For a given atom, the x-rays emitted from L transitions are always less energetic than those emitted from K transitions. Unlike the K lines, the main L emission lines (L_α and L_β) for an element are of nearly equal intensity. The choice of one or the other depends on what interfering element lines might be present. The L emission lines are useful for analyses involving elements of atomic number (Z) 58 (cerium) through 92 (uranium).

An x-ray source can excite characteristic x-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element, that is, the K absorption edge, L absorption edge, or M absorption edge energy. The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies of the particular element, and the L absorption edge energy is approximately the sum of the L and M line energies. FPXRF is more sensitive to an element with an absorption edge energy close to but less than the excitation energy of the source. For example, when using a cadmium-109 source, which has an excitation energy of 22.1 kiloelectron volts (keV), FPXRF would exhibit better sensitivity for zirconium which has a K line energy of 15.7 keV than to chromium, which has a K line energy of 5.41 keV.

2.2 Under this method, inorganic analytes of interest are identified and quantitated using a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an electrically excited x-ray tube is used to generate characteristic x-ray emissions from elements in a sample. Up to three sources may be used to irradiate a sample. Each source emits a specific set of primary x-rays that excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the source is selected according to its excitation efficiency for the element of interest.

For measurement, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments: in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis.

Sample analysis is then initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and are converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter. Within the detector, energies of the characteristic x-rays are converted into a train of electric pulses, the amplitudes of which are linearly proportional to the energy of the x-rays. An electronic multichannel analyzer (MCA) measures the pulse amplitudes, which is the basis of qualitative x-ray analysis. The number of counts at a given energy per unit of time is representative of the element concentration in a sample and is the basis for quantitative analysis. Most FPXRF instruments are menu-driven from software built into the units or from personal computers (PC).

The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurement times (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

FPXRF instruments can be calibrated using the following methods: internally using fundamental parameters determined by the manufacturer, empirically based on site-specific calibration standards (SSCS), or based on Compton peak ratios. The Compton peak is produced by backscattering of the source radiation. Some FPXRF instruments can be calibrated using multiple methods.

3.0 DEFINITIONS

3.1 FPXRF: Field portable x-ray fluorescence.

3.2 MCA: Multichannel analyzer for measuring pulse amplitude.

3.3 SSCS: Site specific calibration standard.

3.4 FP: Fundamental parameter.

3.5 ROI: Region of interest.

3.6 SRM: Standard reference material. A standard containing certified amounts of metals in soil or sediment.

3.7 eV: Electron Volt. A unit of energy equivalent to the amount of energy gained by an electron passing through a potential difference of one volt.

3.8 Refer to Chapter One and Chapter Three for additional definitions.

4.0 INTERFERENCES

4.1 The total method error for FPXRF analysis is defined as the square root of the sum of squares of both instrument precision and user- or application-related error. Generally, instrument precision is the least significant source of error in FPXRF analysis. User- or application-related error is generally more significant and varies with each site and method used. Some sources of interference can be minimized or controlled by the instrument operator, but others cannot. Common sources of user- or application-related error are discussed below.

4.2 Physical matrix effects result from variations in the physical character of the sample. These variations may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, if any analyte exists in the form of very fine particles in a coarser-grained matrix, the analyte's concentration measured by the FPXRF will vary depending on how fine particles are distributed within the coarser-grained matrix. If the fine particles "settle" to the bottom of the sample cup, the analyte concentration measurement will be higher than if the fine particles are not mixed in well and stay on top of the coarser-grained particles in the sample cup. One way to reduce such error is to grind and sieve all soil samples to a uniform particle size thus reducing sample-to-sample particle size variability. Homogeneity is always a concern when dealing with soil samples. Every effort should be made to thoroughly mix and homogenize soil samples before analysis. Field studies have shown heterogeneity of the sample generally has the largest impact on comparability with confirmatory samples.

4.3 Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediment that are saturated with water. This error can be minimized by drying the samples in a convection or toaster oven. Microwave drying is not recommended because field studies have shown that microwave drying can increase variability between FPXRF data and confirmatory analysis and because metal fragments in the sample can cause arcing to occur in a microwave.

4.4 Inconsistent positioning of samples in front of the probe window is a potential source of error because the x-ray signal decreases as the distance from the radioactive source increases. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface.

4.5 Chemical matrix effects result from differences in the concentrations of interfering elements. These effects occur as either spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Both effects are common in soils contaminated with heavy metals. As examples of absorption and enhancement effects; iron (Fe) tends to absorb copper (Cu) x-rays, reducing the intensity of the Cu measured by the detector, while chromium (Cr) will be enhanced at the expense of Fe because the absorption edge of Cr is slightly lower in energy than the fluorescent peak of iron. The effects can be corrected mathematically through the use of fundamental parameter (FP) coefficients. The effects also can be compensated for using SSCS, which contain all the elements present on site that can interfere with one another.

4.6 When present in a sample, certain x-ray lines from different elements can be very close in energy and, therefore, can cause interference by producing a severely overlapped spectrum. The degree to which a detector can resolve the two different peaks depends on the energy resolution of the detector. If the energy difference between the two peaks in electron volts is less than the resolution of the detector in electron volts, then the detector will not be able to fully resolve the peaks.

The most common spectrum overlaps involve the K_β line of element Z-1 with the K_α line of element Z. This is called the K_α/K_β interference. Because the K_α:K_β intensity ratio for a given element usually is about 7:1, the interfering element, Z-1, must be present at large concentrations to cause a problem. Two examples of this type of spectral interference involve the presence of large concentrations of vanadium (V) when attempting to measure Cr or the presence of large concentrations of Fe when attempting to measure cobalt (Co). The V K_α and K_β energies are 4.95

and 5.43 keV, respectively, and the Cr K_α energy is 5.41 keV. The Fe K_α and K_β energies are 6.40 and 7.06 keV, respectively, and the Co K_α energy is 6.92 keV. The difference between the V K_β and Cr K_α energies is 20 eV, and the difference between the Fe K_β and the Co K_α energies is 140 eV. The resolution of the highest-resolution detectors in FPXRF instruments is 170 eV. Therefore, large amounts of V and Fe will interfere with quantitation of Cr or Co, respectively. The presence of Fe is a frequent problem because it is often found in soils at tens of thousands of parts per million (ppm).

4.7 Other interferences can arise from K/L, K/M, and L/M line overlaps, although these overlaps are less common. Examples of such overlap involve arsenic (As) K_α/lead (Pb) L_α and sulfur (S) K_α/Pb M_α. In the As/Pb case, Pb can be measured from the Pb L_β line, and As can be measured from either the As K_α or the As $K_ß$ line; in this way the interference can be corrected. If the As K_β line is used, sensitivity will be decreased by a factor of two to five times because it is a less intense line than the As K_α line. If the As K_α line is used in the presence of Pb, mathematical corrections within the instrument software can be used to subtract out the Pb interference. However, because of the limits of mathematical corrections, As concentrations cannot be efficiently calculated for samples with Pb:As ratios of 10:1 or more. This high ratio of Pb to As may result in no As being reported regardless of the actual concentration present.

No instrument can fully compensate for this interference. It is important for an operator to understand this limitation of FPXRF instruments and consult with the manufacturer of the FPXRF instrument to evaluate options to minimize this limitation. The operator's decision will be based on action levels for metals in soil established for the site, matrix effects, capabilities of the instrument, data quality objectives, and the ratio of lead to arsenic known to be present at the site. If a site is encountered that contains lead at concentrations greater than ten times the concentration of arsenic it is advisable that all critical soil samples be sent off site for confirmatory analysis by an EPA-approved method.

4.8 If SSCS are used to calibrate an FPXRF instrument, the samples collected must be representative of the site under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentrations of the contaminants of concern at a given time and location. Analytical results for representative samples reflect variations in the presence and concentration ranges of contaminants throughout a site. Variables affecting sample representativeness include differences in soil type, contaminant concentration variability, sample collection and preparation variability, and analytical variability, all of which should be minimized as much as possible.

4.9 Soil physical and chemical effects may be corrected using SSCS that have been analyzed by inductively coupled plasma (ICP) or atomic absorption (AA) methods. However, a major source of error can be introduced if these samples are not representative of the site or if the analytical error is large. Another concern is the type of digestion procedure used to prepare the soil samples for the reference analysis. Analytical results for the confirmatory method will vary depending on whether a partial digestion procedure, such as SW-846 Method 3050, or a total digestion procedure, such as Method 3052 is used. It is known that depending on the nature of the soil or sediment, Method 3050 will achieve differing extraction efficiencies for different analytes of interest. The confirmatory method should meet the project data quality objectives.

XRF measures the total concentration of an element; therefore, to achieve the greatest comparability of this method with the reference method (reduced bias), a total digestion procedure should be used for sample preparation. However, in the study used to generate the performance data for this method, the confirmatory method used was Method 3050, and the FPXRF data

compared very well with regression correlation coefficients (r^2 often exceeding 0.95, except for barium and chromium. See Table 9 in Section 17.0). The critical factor is that the digestion procedure and analytical reference method used should meet the data quality objectives (DQOs) of the project and match the method used for confirmation analysis.

4.10 Ambient temperature changes can affect the gain of the amplifiers producing instrument drift. Gain or drift is primarily a function of the electronics (amplifier or preamplifier) and not the detector as most instrument detectors are cooled to a constant temperature. Most FPXRF instruments have a built-in automatic gain control. If the automatic gain control is allowed to make periodic adjustments, the instrument will compensate for the influence of temperature changes on its energy scale. If the FPXRF instrument has an automatic gain control function, the operator will not have to adjust the instrument's gain unless an error message appears. If an error message appears, the operator should follow the manufacturer's procedures for troubleshooting the problem. Often, this involves performing a new energy calibration. The performance of an energy calibration check to assess drift is a quality control measure discussed in Section 9.2.

If the operator is instructed by the manufacturer to manually conduct a gain check because of increasing or decreasing ambient temperature, it is standard to perform a gain check after every 10 to 20 sample measurements or once an hour whichever is more frequent. It is also suggested that a gain check be performed if the temperature fluctuates more than 10 to 20°F. The operator should follow the manufacturer's recommendations for gain check frequency.

5.0 SAFETY

5.1 Proper training for the safe operation of the instrument and radiation training should be completed by the analyst prior to analysis. Radiation safety for each specific instrument can be found in the operators manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required. Licenses for radioactive materials are of two types; (1) general license which is usually provided by the manufacturer for receiving, acquiring, owning, possessing, using, and transferring radioactive material incorporated in a device or equipment, and (2) specific license which is issued to named persons for the operation of radioactive instruments as required by local state agencies. There should be a person appointed within the organization that is solely responsible for properly instructing all personnel, maintaining inspection records, and monitoring x-ray equipment at regular intervals. A copy of the radioactive material licenses and leak tests should be present with the instrument at all times and available to local and national authorities upon request. X-ray tubes do not require radioactive material licenses or leak tests, but do require approvals and licenses which vary from state to state. In addition, fail-safe x-ray warning lights should be illuminated whenever an x-ray tube is energized. Provisions listed above concerning radiation safety regulations, shielding, training, and responsible personnel apply to x-ray tubes just as to radioactive sources. In addition, a log of the times and operating conditions should be kept whenever an x-ray tube is energized. Finally, an additional hazard present with x-ray tubes is the danger of electric shock from the high voltage supply. The danger of electric shock is as substantial as the danger from radiation but is often overlooked because of its familiarity.

5.2 Radiation monitoring equipment should be used with the handling of the instrument. The operator and the surrounding environment should be monitored continually for analyst exposure to radiation. Thermal luminescent detectors (TLD) in the form of badges and rings are used to monitor operator radiation exposure. The TLDs should be worn in the area of most frequent exposure. The maximum permissible whole-body dose from occupational exposure is 5

Roentgen Equivalent Man (REM) per year. Possible exposure pathways for radiation to enter the body are ingestion, inhaling, and absorption. The best precaution to prevent radiation exposure is distance and shielding.

5.3 Refer to Chapter Three for guidance on some proper safety protocols.

6.0 EQUIPMENT AND SUPPLIES

6.1 FPXRF Spectrometer: An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer, such as an MCA, that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system. These components and additional, optional items, are discussed below.

6.1.1 Excitation Sources: Most FPXRF instruments use sealed radioisotope sources to produce x-rays in order to irradiate samples. The FPXRF instrument may contain between one and three radioisotope sources. Common radioisotope sources used for analysis for metals in soils are iron (Fe)-55, cadmium (Cd)-109, americium (Am)-241, and curium (Cm)-244. These sources may be contained in a probe along with a window and the detector; the probe is connected to a data reduction and handling system by means of a flexible cable. Alternatively, the sources, window, and detector may be included in the same unit as the data reduction and handling system.

The relative strength of the radioisotope sources is measured in units of millicuries (mCi). All other components of the FPXRF system being equal, the stronger the source, the greater the sensitivity and precision of a given instrument. Radioisotope sources undergo constant decay. In fact, it is this decay process that emits the primary x-rays used to excite samples for FPXRF analysis. The decay of radioisotopes is measured in "half-lives." The half-life of a radioisotope is defined as the length of time required to reduce the radioisotopes strength or activity by half. Developers of FPXRF technologies recommend source replacement at regular intervals based on the source's half-life. The characteristic x-rays emitted from each of the different sources have energies capable of exciting a certain range of analytes in a sample. Table 2 summarizes the characteristics of four common radioisotope sources.

X-ray tubes have higher radiation output, no intrinsic lifetime limit, produce constant output over their lifetime, and do not have the disposal problems of radioactive sources but are just now appearing in FPXRF instruments An electrically-excited x-ray tube operates by bombarding an anode with electrons accelerated by a high voltage. The electrons gain an energy in electron volts equal to the accelerating voltage and can excite atomic transitions in the anode, which then produces characteristic x-rays. These characteristic x-rays are emitted through a window which contains the vacuum required for the electron acceleration. An important difference between x-ray tubes and radioactive sources is that the electrons which bombard the anode also produce a continuum of x-rays across a broad range of energies in addition to the characteristic x-rays. This continuum is weak compared to the characteristic x-rays but can provide substantial excitation since it covers a broad energy range. It has the undesired property of producing background in the spectrum near the analyte x-ray lines when it is scattered by the sample. For this reason a filter is often used between the x-ray tube and the sample to suppress the continuum radiation while passing the characteristic

x-rays from the anode. This filter is sometimes incorporated into the window of the x-ray tube. The choice of accelerating voltage is governed by the anode material, since the electrons must have sufficient energy to excite the anode, which requires a voltage greater than the absorption edge of the anode material. The anode is most efficiently excited by voltages 2 to 2.5 times the edge energy (most x-rays per unit power to the tube), although voltages as low as 1.5 times the absorption edge energy will work. The characteristic x-rays emitted by the anode are capable of exciting a range of elements in the sample just as with a radioactive source. Table 3 gives the recommended operating voltages and the sample elements excited for some common anodes.

6.1.2 Sample Presentation Device: FPXRF instruments can be operated in two modes: in situ and intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. For most FPXRF instruments operated in the intrusive mode, the probe is rotated so that the window faces upward. A protective sample cover is placed over the window, and the sample cup is placed on top of the window inside the protective sample cover for analysis.

6.1.3 Detectors: The detectors in the FPXRF instruments can be either solid-state detectors or gas-filled, proportional counter detectors. Common solid-state detectors include mercuric iodide (HgI_2), silicon pin diode and lithium-drifted silicon Si(Li). The HgI_2 detector is operated at a moderately subambient temperature controlled by a low power thermoelectric cooler. The silicon pin diode detector also is cooled via the thermoelectric Peltier effect. The Si(Li) detector must be cooled to at least -90 °C either with liquid nitrogen or by thermoelectric cooling via the Peltier effect. Instruments with a Si(Li) detector have an internal liquid nitrogen dewar with a capacity of 0.5 to 1.0 liter. Proportional counter detectors are rugged and lightweight, which are important features of a field portable detector. However, the resolution of a proportional counter detector is not as good as that of a solid-state detector. The energy resolution of a detector for characteristic x-rays is usually expressed in terms of full width at half-maximum (FWHM) height of the manganese K_α peak at 5.89 keV. The typical resolutions of the above mentioned detectors are as follows: HgI_2-270 eV; silicon pin diode-250 eV; Si(Li)–170 eV; and gas-filled, proportional counter-750 eV.

During operation of a solid-state detector, an x-ray photon strikes a biased, solid-state crystal and loses energy in the crystal by producing electron-hole pairs. The electric charge produced is collected and provides a current pulse that is directly proportional to the energy of the x-ray photon absorbed by the crystal of the detector. A gas-filled, proportional counter detector is an ionization chamber filled with a mixture of noble and other gases. An x-ray photon entering the chamber ionizes the gas atoms. The electric charge produced is collected and provides an electric signal that is directly proportional to the energy of the x-ray photon absorbed by the gas in the detector.

6.1.4 Data Processing Units: The key component in the data processing unit of an FPXRF instrument is the MCA. The MCA receives pulses from the detector and sorts them by their amptitudes (energy level). The MCA counts pulses per second to determine the height of the peak in a spectrum, which is indicative of the target analyte's concentration. The spectrum of element peaks are built on the MCA. The MCAs in FPXRF instruments have from 256 to 2,048 channels. The concentrations of target analytes are usually shown in parts per million on a liquid crystal display (LCD) in the instrument. FPXRF instruments can store both spectra and from 100 to 500 sets of numerical analytical results. Most FPXRF

instruments are menu-driven from software built into the units or from PCs. Once the data–storage memory of an FPXRF unit is full, data can be downloaded by means of an RS-232 port and cable to a PC.

6.2 Spare battery chargers.

6.3 Polyethylene sample cups: 31 millimeters (mm) to 40 mm in diameter with collar, or equivalent (appropriate for FPXRF instrument).

6.4 X-ray window film: Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 micrometers (µm) thick.

6.5 Mortar and pestle: glass, agate, or aluminum oxide; for grinding soil and sediment samples.

6.6 Containers: glass or plastic to store samples.

6.7 Sieves: 60-mesh (0.25 mm), stainless-steel, Nylon, or equivalent for preparing soil and sediment samples.

6.8 Trowels: for smoothing soil surfaces and collecting soil samples.

6.9 Plastic bags: used for collection and homogenization of soil samples.

6.10 Drying oven: standard convection or toaster oven, for soil and sediment samples that require drying.

7.0 REAGENTS AND STANDARDS

7.1 Pure Element Standards: Each pure, single-element standard is intended to produce strong characteristic x-ray peaks of the element of interest only. Other elements present must not contribute to the fluorescence spectrum. A set of pure element standards for commonly sought analytes is supplied by the instrument manufacturer, if required for the instrument; not all instruments require the pure element standards. The standards are used to set the region of interest (ROI) for each element. They also can be used as energy calibration and resolution check samples.

7.2 Site-specific Calibration Standards: Instruments that employ fundamental parameters (FP) or similar mathematical models in minimizing matrix effects may not require SSCS. If the FP calibration model is to be optimized or if empirical calibration is necessary, then SSCSs must be collected, prepared, and analyzed.

7.2.1 The SSCS must be representative of the matrix to be analyzed by FPXRF. These samples must be well homogenized. A minimum of ten samples spanning the concentration ranges of the analytes of interest and of the interfering elements must be obtained from the site. A sample size of 4 to 8 ounces is recommended, and standard glass sampling jars should be used.

7.2.2 Each sample should be oven-dried for 2 to 4 hours at a temperature of less than 150°C. If mercury is to be analyzed, a separate sample portion must remain undried, as heating may volatilize the mercury. When the sample is dry, all large, organic debris and

nonrepresentative material, such as twigs, leaves, roots, insects, asphalt, and rock should be removed. The sample should be ground with a mortar and pestle and passed through a 60-mesh sieve. Only the coarse rock fraction should remain on the screen.

7.2.3 The sample should be homogenized by using a riffle splitter or by placing 150 to 200 grams of the dried, sieved sample on a piece of kraft or butcher paper about 1.5 by 1.5 feet in size. Each corner of the paper should be lifted alternately, rolling the soil over on itself and toward the opposite corner. The soil should be rolled on itself 20 times. Approximately 5 grams of the sample should then be removed and placed in a sample cup for FPXRF analysis. The rest of the prepared sample should be sent off site for ICP or AA analysis. The method use for confirmatory analysis should meet the data quality objectives of the project.

7.3 Blank Samples: The blank samples should be from a "clean" quartz or silicon dioxide matrix that is free of any analytes at concentrations above the method detection limits. These samples are used to monitor for cross-contamination and laboratory-induced contaminants or interferences.

7.4 Standard Reference Materials: Standard reference materials (SRM) are standards containing certified amounts of metals in soil or sediment. These standards are used for accuracy and performance checks of FPXRF analyses. SRMs can be obtained from the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), the Canadian National Research Council, and the national bureau of standards in foreign nations. Pertinent NIST SRMs for FPXRF analysis include 2704, Buffalo River Sediment; 2709, San Joaquin Soil; and 2710 and 2711, Montana Soil. These SRMs contain soil or sediment from actual sites that has been analyzed using independent inorganic analytical methods by many different laboratories.

8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Sample handling and preservation procedures used in FPXRF analyses should follow the guidelines in Chapter Three, Inorganic Analytes.

9.0 QUALITY CONTROL

9.1 Refer to Chapter One for additional guidance on quality assurance protocols. All field data sheets and quality control data should be maintained for reference or inspection.

9.2 Energy Calibration Check: To determine whether an FPXRF instrument is operating within resolution and stability tolerances, an energy calibration check should be run. The energy calibration check determines whether the characteristic x-ray lines are shifting, which would indicate drift within the instrument. As discussed in Section 4.10, this check also serves as a gain check in the event that ambient temperatures are fluctuating greatly (> 10 to 20°F).

The energy calibration check should be run at a frequency consistent with manufacturers recommendations. Generally, this would be at the beginning of each working day, after the batteries are changed or the instrument is shut off, at the end of each working day, and at any other time when the instrument operator believes that drift is occurring during analysis. A pure element such as iron, manganese, copper, or lead is often used for the energy calibration check. A manufacturer-recommended count time per source should be used for the check.

9.2.1 The instrument manufacturer's manual specifies the channel or kiloelectron volt level at which a pure element peak should appear and the expected intensity of the peak.

The intensity and channel number of the pure element as measured using the radioactive source should be checked and compared to the manufacturer's recommendation. If the energy calibration check does not meet the manufacturer's criteria, then the pure element sample should be repositioned and reanalyzed. If the criteria are still not met, then an energy calibration should be performed as described in the manufacturer's manual. With some FPXRF instruments, once a spectrum is acquired from the energy calibration check, the peak can be optimized and realigned to the manufacturer's specifications using their software.

9.3 Blank Samples: Two types of blank samples should be analyzed for FPXRF analysis: instrument blanks and method blanks. An instrument blank is used to verify that no contamination exists in the spectrometer or on the probe window.

9.3.1 The instrument blank can be silicon dioxide, a Teflon block, a quartz block, "clean" sand, or lithium carbonate. This instrument blank should be analyzed on each working day before and after analyses are conducted and once per every twenty samples. An instrument blank should also be analyzed whenever contamination is suspected by the analyst. The frequency of analysis will vary with the data quality objectives of the project. A manufacturer-recommended count time per source should be used for the blank analysis. No element concentrations above the method detection limits should be found in the instrument blank. If concentrations exceed these limits, then the probe window and the check sample should be checked for contamination. If contamination is not a problem, then the instrument must be "zeroed" by following the manufacturer's instructions.

9.3.2 A method blank is used to monitor for laboratory-induced contaminants or interferences. The method blank can be "clean" silica sand or lithium carbonate that undergoes the same preparation procedure as the samples. A method blank must be analyzed at least daily. The frequency of analysis will depend on the data quality objectives of the project. To be acceptable, a method blank must not contain any analyte at a concentration above its method detection limit. If an analyte's concentration exceeds its method detection limit, the cause of the problem must be identified, and all samples analyzed with the method blank must be reanalyzed.

9.4 Calibration Verification Checks: A calibration verification check sample is used to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest. A check sample should be analyzed at the beginning of each working day, during active sample analyses, and at the end of each working day. The frequency of calibration checks during active analysis will depend on the data quality objectives of the project. The check sample should be a well characterized soil sample from the site that is representative of site samples in terms of particle size and degree of homogeneity and that contains contaminants at concentrations near the action levels. If a site-specific sample is not available, then an NIST or other SRM that contains the analytes of interest can be used to verify the accuracy of the instrument. The measured value for each target analyte should be within ±20 percent (%D) of the true value for the calibration verification check to be acceptable. If a measured value falls outside this range, then the check sample should be reanalyzed. If the value continues to fall outside the acceptance range, the instrument should be recalibrated, and the batch of samples analyzed before the unacceptable calibration verification check must be reanalyzed.

9.5 Precision Measurements: The precision of the method is monitored by analyzing a sample with low, moderate, or high concentrations of target analytes. The frequency of precision measurements will depend on the data quality objectives for the data. A minimum of one precision sample should be run per day. Each precision sample should be analyzed 7 times in replicate. It

is recommended that precision measurements be obtained for samples with varying concentration ranges to assess the effect of concentration on method precision. Determining method precision for analytes at concentrations near the site action levels can be extremely important if the FPXRF results are to be used in an enforcement action; therefore, selection of at least one sample with target analyte concentrations at or near the site action levels or levels of concern is recommended. A precision sample is analyzed by the instrument for the same field analysis time as used for other project samples. The relative standard deviation (RSD) of the sample mean is used to assess method precision. For FPXRF data to be considered adequately precise, the RSD should not be greater than 20 percent with the exception of chromium. RSD values for chromium should not be greater than 30 percent.

The equation for calculating RSD is as follows:

$$RSD = (SD/\text{Mean Concentration}) \times 100$$

where:

RSD	=	Relative standard deviation for the precision measurement for the analyte
SD	=	Standard deviation of the concentration for the analyte
Mean Concentration	=	Mean concentration for the analyte

The precision or reproducibility of a measurement will improve with increasing count time, however, increasing the count time by a factor of 4 will provide only 2 times better precision, so there is a point of diminishing return. Increasing the count time also improves the detection limit, but decreases sample throughput.

9.6 Detection Limits: Results for replicate analyses of a low-concentration sample, SSCS, or SRM can be used to generate an average site-specific method detection and quantitation limits. In this case, the method detection limit is defined as 3 times the standard deviation of the results for the low-concentration samples and the method quantitation limit is defined as 10 times the standard deviation of the same results. Another means of determining method detection and quantitation limits involves use of counting statistics. In FPXRF analysis, the standard deviation from counting statistics is defined as $SD = (N)^{1/2}$, where SD is the standard deviation for a target analyte peak and N is the net counts for the peak of the analyte of interest (i.e., gross counts minus background under the peak). Three times this standard deviation would be the method detection limit and 10 times this standard deviation would be the method quantitation limit. If both of the above mentioned approaches are used to calculate method detection limits, the larger of the standard deviations should be used to provide the more conservative detection limits.

This SD based detection limit criteria must be used by the operator to evaluate each measurement for its useability. A measurement above the average calculated or manufacturer's detection limit, but smaller than three times its associated SD, should not be used as a quantitative measurement. Conversely, if the measurement is below the average calculated or manufacturer's detection limit, but greater than three times its associated SD. It should be coded as an estimated value.

9.7 Confirmatory Samples: The comparability of the FPXRF analysis is determined by submitting FPXRF-analyzed samples for analysis at a laboratory. The method of confirmatory analysis must meet the project and XRF measurement data quality objectives. The confirmatory samples must be splits of the well homogenized sample material. In some cases the prepared

sample cups can be submitted. A minimum of 1 sample for each 20 FPXRF-analyzed samples should be submitted for confirmatory analysis. This frequency will depend on data quality objectives. The confirmatory analyses can also be used to verify the quality of the FPXRF data. The confirmatory samples should be selected from the lower, middle, and upper range of concentrations measured by the FPXRF. They should also include samples with analyte concentrations at or near the site action levels. The results of the confirmatory analysis and FPXRF analyses should be evaluated with a least squares linear regression analysis. If the measured concentrations span more than one order of magnitude, the data should be log-transformed to standardize variance which is proportional to the magnitude of measurement. The correlation coefficient (r^2) for the results should be 0.7 or greater for the FPXRF data to be considered screening level data. If the r^2 is 0.9 or greater and inferential statistics indicate the FPXRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Instrument Calibration: Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator's manual for each specific FPXRF instrument. Generally, however, three types of calibration procedures exist for FPXRF instruments: FP calibration, empirical calibration, and the Compton peak ratio or normalization method. These three types of calibration are discussed below.

10.2 Fundamental Parameters Calibration: FP calibration procedures are extremely variable. An FP calibration provides the analyst with a "standardless" calibration. The advantages of FP calibrations over empirical calibrations include the following:

- No previously collected site-specific samples are required, although site-specific samples with confirmed and validated analytical results for all elements present could be used.

- Cost is reduced because fewer confirmatory laboratory results or calibration standards are required.

However, the analyst should be aware of the limitations imposed on FP calibration by particle size and matrix effects. These limitations can be minimized by adhering to the preparation procedure described in Section 7.2. The two FP calibration processes discussed below are based on an effective energy FP routine and a back scatter with FP (BFP) routine. Each FPXRF FP calibration process is based on a different iterative algorithmic method. The calibration procedure for each routine is explained in detail in the manufacturer's user manual for each FPXRF instrument; in addition, training courses are offered for each instrument.

10.2.1 Effective Energy FP Calibration: The effective energy FP calibration is performed by the manufacturer before an instrument is sent to the analyst. Although SSCS can be used, the calibration relies on pure element standards or SRMs such as those obtained from NIST for the FP calibration. The effective energy routine relies on the spectrometer response to pure elements and FP iterative algorithms to compensate for various matrix effects.

Alpha coefficients are calculated using a variation of the Sherman equation, which calculates theoretical intensities from the measurement of pure element samples. These coefficients indicate the quantitative effect of each matrix element on an analyte's measured

x-ray intensity. Next, the Lachance Traill algorithm is solved as a set of simultaneous equations based on the theoretical intensities. The alpha coefficients are then downloaded into the specific instrument.

The working effective energy FP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of sampling. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. A manufacturer-recommended count time per source should be used for the calibration check. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A percent difference (%D) is then calculated for each target analyte. The %D should be within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line or the y-intercept value for the analyte. The SRM or SSCS is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

The equation to calibrate %D is as follows:

$$\%D = ((C_s - C_k) / C_k) \times 100$$

where:

%D = Percent difference
C_k = Certified concentration of standard sample
C_s = Measured concentration of standard sample

10.2.2 BFP Calibration: BFP calibration relies on the ability of the liquid nitrogen-cooled, Si(Li) solid-state detector to separate the coherent (Compton) and incoherent (Rayleigh) backscatter peaks of primary radiation. These peak intensities are known to be a function of sample composition, and the ratio of the Compton to Rayleigh peak is a function of the mass absorption of the sample. The calibration procedure is explained in detail in the instrument manufacturer's manual. Following is a general description of the BFP calibration procedure.

The concentrations of all detected and quantified elements are entered into the computer software system. Certified element results for an NIST SRM or confirmed and validated results for an SSCS can be used. In addition, the concentrations of oxygen and silicon must be entered; these two concentrations are not found in standard metals analyses. The manufacturer provides silicon and oxygen concentrations for typical soil types. Pure element standards are then analyzed using a manufacturer-recommended count time per source. The results are used to calculate correction factors in order to adjust for spectrum overlap of elements.

The working BFP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of the analysis. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. The standard sample is analyzed using a manufacturer-recommended count time per source to check the

calibration curve. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A %D is then calculated for each target analyte. The %D should fall within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line the y-intercept value for the analyte. The standard sample is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

10.3 Empirical Calibration: An empirical calibration can be performed with SSCS, site-typical standards, or standards prepared from metal oxides. A discussion of SSCS is included in Section 7.2; if no previously characterized samples exist for a specific site, site-typical standards can be used. Site-typical standards may be selected from commercially available characterized soils or from SSCS prepared for another site. The site-typical standards should closely approximate the site's soil matrix with respect to particle size distribution, mineralogy, and contaminant analytes. If neither SSCS nor site-typical standards are available, it is possible to make gravimetric standards by adding metal oxides to a "clean" sand or silicon dioxide matrix that simulates soil. Metal oxides can be purchased from various chemical vendors. If standards are made on site, a balance capable of weighing items to at least two decimal places is required. Concentrated ICP or AA standard solutions can also be used to make standards. These solutions are available in concentrations of 10,000 parts per million, thus only small volumes have to be added to the soil.

An empirical calibration using SSCS involves analysis of SSCS by the FPXRF instrument and by a conventional analytical method such as ICP or AA. A total acid digestion procedure should be used by the laboratory for sample preparation. Generally, a minimum of 10 and a maximum of 30 well characterized SSCS, site-typical standards, or prepared metal oxide standards are required to perform an adequate empirical calibration. The number of required standards depends on the number of analytes of interest and interfering elements. Theoretically, an empirical calibration with SSCS should provide the most accurate data for a site because the calibration compensates for site-specific matrix effects.

The first step in an empirical calibration is to analyze the pure element standards for the elements of interest. This enables the instrument to set channel limits for each element for spectral deconvolution. Next the SSCS, site-typical standards, or prepared metal oxide standards are analyzed using a count time of 200 seconds per source or a count time recommended by the manufacturer. This will produce a spectrum and net intensity of each analyte in each standard. The analyte concentrations for each standard are then entered into the instrument software; these concentrations are those obtained from the laboratory, the certified results, or the gravimetrically determined concentrations of the prepared standards. This gives the instrument analyte values to regress against corresponding intensities during the modeling stage. The regression equation correlates the concentrations of an analyte with its net intensity.

The calibration equation is developed using a least squares fit regression analysis. After the regression terms to be used in the equation are defined, a mathematical equation can be developed to calculate the analyte concentration in an unknown sample. In some FPXRF instruments, the software of the instrument calculates the regression equation. The software uses calculated intercept and slope values to form a multiterm equation. In conjunction with the software in the instrument, the operator can adjust the multiterm equation to minimize interelement interferences and optimize the intensity calibration curve.

It is possible to define up to six linear or nonlinear terms in the regression equation. Terms can be added and deleted to optimize the equation. The goal is to produce an equation with the smallest regression error and the highest correlation coefficient. These values are automatically computed by the software as the regression terms are added, deleted, or modified. It is also possible to delete data points from the regression line if these points are significant outliers or if they are heavily weighing the data. Once the regression equation has been selected for an analyte, the equation can be entered into the software for quantitation of analytes in subsequent samples. For an empirical calibration to be acceptable, the regression equation for a specific analyte should have a correlation coefficient of 0.98 or greater or meet the DQOs of the project.

In an empirical calibration, one must apply the DQOs of the project and ascertain critical or action levels for the analytes of interest. It is within these concentration ranges or around these action levels that the FPXRF instrument should be calibrated most accurately. It may not be possible to develop a good regression equation over several orders of analyte concentration.

10.4 Compton Normalization Method: The Compton normalization method is based on analysis of a single, certified standard and normalization for the Compton peak. The Compton peak is produced from incoherent backscattering of x-ray radiation from the excitation source and is present in the spectrum of every sample. The Compton peak intensity changes with differing matrices. Generally, matrices dominated by lighter elements produce a larger Compton peak, and those dominated by heavier elements produce a smaller Compton peak. Normalizing to the Compton peak can reduce problems with varying matrix effects among samples. Compton normalization is similar to the use of internal standards in organics analysis. The Compton normalization method may not be effective when analyte concentrations exceed a few percent.

The certified standard used for this type of calibration could be an NIST SRM such as 2710 or 2711. The SRM must be a matrix similar to the samples and must contain the analytes of interests at concentrations near those expected in the samples. First, a response factor has to be determined for each analyte. This factor is calculated by dividing the net peak intensity by the analyte concentration. The net peak intensity is gross intensity corrected for baseline interference. Concentrations of analytes in samples are then determined by multiplying the baseline corrected analyte signal intensity by the normalization factor and by the response factor. The normalization factor is the quotient of the baseline corrected Compton K_α peak intensity of the SRM divided by that of the samples. Depending on the FPXRF instrument used, these calculations may be done manually or by the instrument software.

11.0 PROCEDURE

11.1 Operation of the various FPXRF instruments will vary according to the manufacturers' protocols. Before operating any FPXRF instrument, one should consult the manufacturer's manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later on in analysis.

11.2 Each FPXRF instrument should be operated according to the manufacturer's recommendations. There are two modes in which FPXRF instruments can be operated: in situ and intrusive. The in situ mode involves analysis of an undisturbed soil sediment or sample. Intrusive analysis involves collection and preparation of a soil or sediment sample before analysis. Some FPXRF instruments can operate in both modes of analysis, while others are designed to operate in only one mode. The two modes of analysis are discussed below.

11.3 For in situ analysis, one requirement is that any large or nonrepresentative debris be removed from the soil surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots, and concrete. Another requirement is that the soil surface be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel. During the study conducted to provide data for this method, this modest amount of sample preparation was found to take less than 5 minutes per sample location. The last requirement is that the soil or sediment not be saturated with water. Manufacturers state that their FPXRF instruments will perform adequately for soils with moisture contents of 5 to 20 percent but will not perform well for saturated soils, especially if ponded water exists on the surface. Another recommended technique for *in situ* analysis is to tamp the soil to increase soil density and compactness for better repeatability and representativeness. This condition is especially important for heavy element analysis, such as barium. Source count times for in situ analysis usually range from 30 to 120 seconds, but source count times will vary among instruments and depending on required detection limits.

11.4 For intrusive analysis of surface or sediment, it is recommended that a sample be collected from a 4- by 4-inch square that is 1 inch deep. This will produce a soil sample of approximately 375 grams or 250 cm^3, which is enough soil to fill an 8-ounce jar. The sample should be homogenized, dried, and ground before analysis. The sample can be homogenized before or after drying. The homogenization technique to be used after drying is discussed in Section 4.2. If the sample is homogenized before drying, it should be thoroughly mixed in a beaker or similar container, or if the sample is moist and has a high clay content, it can be kneaded in a plastic bag. One way to monitor homogenization when the sample is kneaded in a plastic bag is to add sodium fluorescein dye to the sample. After the moist sample has been homogenized, it is examined under an ultraviolet light to assess the distribution of sodium fluorescein throughout the sample. If the fluorescent dye is evenly distributed in the sample, homogenization is considered complete; if the dye is not evenly distributed, mixing should continue until the sample has been thoroughly homogenized. During the study conducted to provide data for this method, the homogenization procedure using the fluorescein dye required 3 to 5 minutes per sample. As demonstrated in Sections 13.5 and 13.7, homogenization has the greatest impact on the reduction of sampling variability. It produces little or no contamination. Often, it can be used without the more labor intensive steps of drying, grinding, and sieving given in Sections 11.5 and 11.6. Of course, to achieve the best data quality possible all four steps must be followed.

11.5 Once the soil or sediment sample has been homogenized, it should be dried. This can be accomplished with a toaster oven or convection oven. A small aliquot of the sample (20 to 50 grams) is placed in a suitable container for drying. The sample should be dried for 2 to 4 hours in the convection or toaster oven at a temperature not greater than 150°C. Microwave drying is not a recommended procedure. Field studies have shown that microwave drying can increase variability between the FPXRF data and confirmatory analysis. High levels of metals in a sample can cause arcing in the microwave oven, and sometimes slag forms in the sample. Microwave oven drying can also melt plastic containers used to hold the sample.

11.6 The homogenized dried sample material should be ground with a mortar and pestle and passed through a 60-mesh sieve to achieve a uniform particle size. Sample grinding should continue until at least 90 percent of the original sample passes through the sieve. The grinding step normally takes an average of 10 minutes per sample. An aliquot of the sieved sample should then be placed in a 31.0-mm polyethylene sample cup (or equivalent) for analysis. The sample cup should be one-half to three-quarters full at a minimum. The sample cup should be covered with a 2.5 µm Mylar (or equivalent) film for analysis. The rest of the soil sample should be placed in a jar, labeled, and archived for possible confirmation analysis. All equipment including the mortar, pestle,

and sieves must be thoroughly cleaned so that any cross-contamination is below the MDLs of the procedure or DQOs of the analysis.

12.0 DATA ANALYSIS AND CALCULATIONS

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in parts per million and can be downloaded to a PC, which can provide a hard copy printout. Individual measurements that are smaller than three times their associated SD should not be used for quantitation.

13.0 METHOD PERFORMANCE

13.1 This section discusses four performance factors, field-based method detection limits, precision, accuracy, and comparability to EPA-approved methods. The numbers presented in Tables 4 through 9 were generated from data obtained from six FPXRF instruments. The soil samples analyzed by the six FPXRF instruments were collected from two sites in the United States. The soil samples contained several of the target analytes at concentrations ranging from nondetect to tens of thousands of mg/kg.

13.2 The six FPXRF instruments included the TN 9000 and TN Lead Analyzer manufactured by TN Spectrace; the X-MET 920 with a SiLi detector and X-MET 920 with a gas-filled proportional detector manufactured by Metorex, Inc.; the XL Spectrum Analyzer manufactured by Niton; and the MAP Spectrum Analyzer manufactured by Scitec. The TN 9000 and TN Lead Analyzer both have a HgI_2 detector. The TN 9000 utilized an Fe-55, Cd-109, and Am-241 source. The TN Lead Analyzer had only a Cd-109 source. The X-Met 920 with the SiLi detector had a Cd-109 and Am-241 source. The X-MET 920 with the gas-filled proportional detector had only a Cd-109 source. The XL Spectrum Analyzer utilized a silicon pin-diode detector and a Cd-109 source. The MAP Spectrum Analyzer utilized a solid-state silicon detector and a Cd-109 source.

13.3 All data presented in Tables 4 through 9 were generated using the following calibrations and source count times. The TN 9000 and TN Lead Analyzer were calibrated using fundamental parameters using NIST SRM 2710 as a calibration check sample. The TN 9000 was operated using 100, 60, and 60 second count times for the Cd-109, Fe-55, and Am-241 sources, respectively. The TN Lead analyzer was operated using a 60 second count time for the Cd-109 source. The X-MET 920 with the Si(Li) detector was calibrated using fundamental parameters and one well characterized site-specific soil standard as a calibration check. It used 140 and 100 second count times for the Cd-109 and Am-241 sources, respectively. The X-MET 920 with the gas-filled proportional detector was calibrated empirically using between 10 and 20 well characterized site-specific soil standards. It used 120 second times for the Cd-109 source. The XL Spectrum Analyzer utilized NIST SRM 2710 for calibration and the Compton peak normalization procedure for quantitation based on 60 second count times for the Cd-109 source. The MAP Spectrum Analyzer was internally calibrated by the manufacturer. The calibration was checked using a well-characterized site-specific soil standard. It used 240 second times for the Cd-109 source.

13.4 Field-Based Method Detection Limits: The field-based method detection limits are presented in Table 4. The field-based method detection limits were determined by collecting ten replicate measurements on site-specific soil samples with metals concentrations 2 to 5 times the expected method detection limits. Based on these ten replicate measurements, a standard deviation on the replicate analysis was calculated. The method detection limits presented in Table 4 are defined as 3 times the standard deviation for each analyte.

The field-based method detection limits were generated by using the count times discussed earlier in this section. All the field-based method detection limits were calculated for soil samples that had been dried and ground and placed in a sample cup with the exception of the MAP Spectrum Analyzer. This instrument can only be operated in the in situ mode, meaning the samples were moist and not ground.

Some of the analytes such as cadmium, mercury, silver, selenium, and thorium were not detected or only detected at very low concentrations such that a field-based method detection limit could not be determined. These analytes are not presented in Table 4. Other analytes such as calcium, iron, potassium, and titanium were only found at high concentrations (thousands of mg/kg) so that reasonable method detection limits could not be calculated. These analytes also are not presented in Table 4.

13.5 Precision Measurements: The precision data is presented in Table 5. Each of the six FPXRF instruments performed 10 replicate measurements on 12 soil samples that had analyte concentrations ranging from nondetects to thousands of mg/kg. Each of the 12 soil samples underwent 4 different preparation techniques from in situ (no preparation) to dried and ground in a sample cup. Therefore, there were 48 precision data points for five of the instruments and 24 precision points for the MAP Spectrum Analyzer. The replicate measurements were taken using the source count times discussed at the beginning of this section.

For each detectable analyte in each precision sample a mean concentration, standard deviation, and RSD was calculated for each analyte. The data presented in Table 5 is an average RSD for the precision samples that had analyte concentrations at 5 to 10 times the MDL for that analyte for each instrument. Some analytes such as mercury, selenium, silver, and thorium were not detected in any of the precision samples so these analytes are not listed in Table 5. Some analytes such as cadmium, nickel, and tin were only detected at concentrations near the MDLs so that an RSD value calculated at 5 to 10 times the MDL was not possible.

One FPXRF instrument collected replicate measurements on an additional nine soil samples to provide a better assessment of the effect of sample preparation on precision. Table 6 shows these results. The additional nine soil samples were comprised of three from each texture and had analyte concentrations ranging from near the detection limit of the FPXRF analyzer to thousands of mg/kg. The FPXRF analyzer only collected replicate measurements from three of the preparation methods; no measurements were collected from the *in situ* homogenized samples. The FPXRF analyzer conducted five replicate measurements of the in situ field samples by taking measurements at five different points within the 4-inch by 4-inch sample square. Ten replicate measurements were collected for both the intrusive undried and unground and intrusive dried and ground samples contained in cups. The cups were shaken between each replicate measurement.

Table 6 shows that the precision dramatically improved from the in situ to the intrusive measurements. In general there was a slight improvement in precision when the sample was dried and ground. Two factors caused the precision for the in situ measurements to be poorer. The major factor is soil heterogeneity. By moving the probe within the 4-inch by 4-inch square, measurements of different soil samples were actually taking place within the square. Table 6 illustrates the dominant effect of soil heterogeneity. It overwhelmed instrument precision when the FPXRF analyzer was used in this mode. The second factor that caused the RSD values to be higher for the in situ measurements is the fact that only five versus ten replicates were taken. A lesser number of measurements caused the standard deviation to be larger which in turn elevated the RSD values.

13.6 Accuracy Measurements: Five of the FPXRF instruments (not including the MAP Spectrum Analyzer) analyzed 18 SRMs using the source count times and calibration methods given at the beginning of this section. The 18 SRMs included 9 soil SRMs, 4 stream or river sediment SRMs, 2 sludge SRMs, and 3 ash SRMs. Each of the SRMs contained known concentrations of certain target analytes. A percent recovery was calculated for each analyte in each SRM for each FPXRF instrument. Table 7 presents a summary of this data. With the exception of cadmium, chromium, and nickel, the values presented in Table 7 were generated from the 13 soil and sediment SRMs only. The 2 sludge and 3 ash SRMs were included for cadmium, chromium, and nickel because of the low or nondetectable concentrations of these three analytes in the soil and sediment SRMs.

Only 12 analytes are presented in Table 7. These are the analytes that are of environmental concern and provided a significant number of detections in the SRMs for an accuracy assessment. No data is presented for the X-MET 920 with the gas-filled proportional detector. This FPXRF instrument was calibrated empirically using site-specific soil samples. The percent recovery values from this instrument were very sporadic and the data did not lend itself to presentation in Table 7.

Table 8 provides a more detailed summary of accuracy data for one FPXRF instrument (TN 9000) for the 9 soil SRMs and 4 sediment SRMs. Table 8 shows the certified value, measured value, and percent recovery for five analytes. These analytes were chosen because they are of environmental concern and were most prevalently certified for in the SRM and detected by the FPXRF instrument. The first nine SRMs are soil and the last 4 SRMs are sediment. Percent recoveries for the four NIST SRMs were often between 90 and 110 percent for all analytes.

13.7 Comparability: Comparability refers to the confidence with which one data set can be compared to another. In this case, FPXRF data generated from a large study of six FPXRF instruments was compared to SW-846 Methods 3050 and 6010 which are the standard soil extraction for metals and analysis by inductively coupled plasma. An evaluation of comparability was conducted by using linear regression analysis. Three factors were determined using the linear regression. These factors were the y-intercept, the slope of the line, and the coefficient of determination (r^2).

As part of the comparability assessment, the effects of soil type and preparation methods were studied. Three soil types (textures) and four preparation methods were examined during the study. The preparation methods evaluated the cumulative effect of particle size, moisture, and homogenization on comparability. Due to the large volume of data produced during this study, linear regression data for six analytes from only one FPXRF instrument is presented in Table 9. Similar trends in the data were seen for all instruments.

Table 9 shows the regression parameters for the whole data set, broken out by soil type, and by preparation method. The soil types are as follows: soil 1--sand; soil 2--loam; and soil 3--silty clay. The preparation methods are as follows: preparation 1--in situ in the field; preparation 2--in situ, sample collected and homogenized; preparation 3--intrusive, with sample in a sample cup but sample still wet and not ground; and preparation 4--sample dried, ground, passed through a 40-mesh sieve, and placed in sample cup.

For arsenic, copper, lead, and zinc, the comparability to the confirmatory laboratory was excellent with r^2 values ranging from 0.80 to 0.99 for all six FPXRF instruments. The slopes of the regression lines for arsenic, copper, lead, and zinc, were generally between 0.90 and 1.00 indicating the data would need to be corrected very little or not at all to match the confirmatory laboratory data. The r^2 values and slopes of the regression lines for barium and chromium were

not as good as for the other for analytes, indicating the data would have to be corrected to match the confirmatory laboratory.

Table 9 demonstrates that there was little effect of soil type on the regression parameters for any of the six analytes. The only exceptions were for barium in soil 1 and copper in soil 3. In both of these cases, however, it is actually a concentration effect and not a soil effect causing the poorer comparability. All barium and copper concentrations in soil 1 and 3, respectively, were less than 350 mg/kg.

Table 9 shows there was a preparation effect on the regression parameters for all six analytes. With the exception of chromium, the regression parameters were primarily improved going from preparation 1 to preparation 2. In this step, the sample was removed from the soil surface, all large debris was removed, and the sample was thoroughly homogenized. The additional two preparation methods did little to improve the regression parameters. This data indicates that homogenization is the most critical factor when comparing the results. It is essential that the sample sent to the confirmatory laboratory match the FPXRF sample as closely as possible.

Section 11.0 of this method discusses the time necessary for each of the sample preparation techniques. Based on the data quality objectives for the project, an analyst must decide if it is worth the extra time required to dry and grind the sample for small improvements in comparability. Homogenization requires 3 to 5 minutes. Drying the sample requires one to two hours. Grinding and sieving requires another 10 to 15 minutes per sample. Lastly, when grinding and sieving is conducted, time must be allotted to decontaminate the mortars, pestles, and sieves. Drying and grinding the samples and decontamination procedures will often dictate that an extra person be on site so that the analyst can keep up with the sample collection crew. The cost of requiring an extra person on site to prepare samples must be balanced with the gain in data quality and sample throughput.

13.8 The following documents may provide additional guidance and insight on this method and technique:

13.8.1 Hewitt, A.D. 1994. "Screening for Metals by X-ray Fluorescence Spectrometry/Response Factor/Compton K_α Peak Normalization Analysis." *American Environmental Laboratory.* Pages 24-32.

13.8.2 Piorek, S., and J.R. Pasmore. 1993. "Standardless, In Situ Analysis of Metallic Contaminants in the Natural Environment With a PC-Based, High Resolution Portable X-Ray Analyzer." *Third International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals.* Las Vegas, Nevada. February 24-26, 1993. Volume 2, Pages 1135-1151.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical management for Waste Reduction* available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington D.C. 20036, (202) 872-4477.

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1. Metorex. X-MET 920 User's Manual.

2. Spectrace Instruments. 1994. Energy Dispersive X-ray Fluorescence Spectrometry: An Introduction.

3. TN Spectrace. Spectrace 9000 Field Portable/Benchtop XRF Training and Applications Manual.

4. Unpublished SITE data, recieved from PRC Environment Management, Inc.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

The pages to follow contain Tables 1 through 9 and a method procedure flow diagram.

TABLE 1
INTERFERENCE FREE DETECTION LIMITS

Analyte	Chemical Abstract Series Number	Detection Limit in Quartz Sand (milligrams per kilogram)
Antimony (Sb)	7440-36-0	40
Arsenic (As)	7440-38-0	40
Barium (Ba)	7440-39-3	20
Cadmium (Cd)	7440-43-9	100
Calcium (Ca)	7440-70-2	70
Chromium (Cr)	7440-47-3	150
Cobalt (Co)	7440-48-4	60
Copper (Cu)	7440-50-8	50
Iron (Fe)	7439-89-6	60
Lead (Pb)	7439-92-1	20
Manganese (Mn)	7439-96-5	70
Mercury (Hg)	7439-97-6	30
Molybdenum (Mo)	7439-93-7	10
Nickel (Ni)	7440-02-0	50
Potassium (K)	7440-09-7	200
Rubidium (Rb)	7440-17-7	10
Selenium (Se)	7782-49-2	40
Silver (Ag)	7440-22-4	70
Strontium (Sr)	7440-24-6	10
Thallium (Tl)	7440-28-0	20
Thorium (Th)	7440-29-1	10
Tin (Sn)	7440-31-5	60
Titanium (Ti)	7440-32-6	50
Vanadium (V)	7440-62-2	50
Zinc (Zn)	7440-66-6	50
Zirconium (Zr)	7440-67-7	10

Source: References 1, 2, and 3

TABLE 2
SUMMARY OF RADIOISOTOPE SOURCE CHARACTERISTICS

Source	Activity (mCi)	Half-Life (Years)	Excitation Energy (keV)	Elemental Analysis Range	
Fe-55	20-50	2.7	5.9	Sulfur to Chromium Molybdenum to Barium	K Lines L Lines
Cd-109	5-30	1.3	22.1 and 87.9	Calcium to Rhodium Tantalum to Lead Barium to Uranium	K Lines K Lines L Lines
Am-241	5-30	458	26.4 and 59.6	Copper to Thulium Tungsten to Uranium	K Lines L Lines
Cm-244	60-100	17.8	14.2	Titanium to Selenium Lanthanum to Lead	K Lines L Lines

Source: Reference 1, 2, and 3

TABLE 3
SUMMARY OF X-RAY TUBE SOURCE CHARACTERISTICS

Anode Material	Recommended Voltage Range (kV)	K-alpha Emission (keV)	Elemental Analysis Range	
Cu	18-22	8.04	Potassium to Cobalt Silver to Gadolinium	K Lines L Lines
Mo	40-50	17.4	Cobalt to Yttrium Europium to Radon	K Lines L Lines
Ag	50-65	22.1	Zinc to Technicium Ytterbium to Neptunium	K Lines L Lines

Source: Reference 4

Notes: The sample elements excited are chosen by taking as the lower limit the same ratio of excitation line energy to element absorption edge as in Table 2 (approximately 0.45) and the requirement that the excitation line energy be above the element absorption edge as the upper limit (L2 edges used for L lines). K-beta excitation lines were ignored.

TABLE 4
FIELD-BASED METHOD DETECTION LIMITS (mg/kg)[a]

Analyte	Instrument					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	55	NR	NR	NR	NR	NR
Arsenic	60	50	55	50	110	225
Barium	60	NR	30	400	NR	NR
Chromium	200	460	210	110	900	NR
Cobalt	330	NR	NR	NR	NR	NR
Copper	85	115	75	100	125	525
Lead	45	40	45	100	75	165
Manganese	240	340	NR	NR	NR	NR
Molybdenum	25	NR	NR	NR	30	NR
Nickel	100	NR	NA	NA	NA	NR
Rubidium	30	NR	NR	NR	45	NR
Strontium	35	NR	NR	NR	40	NR
Tin	85	NR	NR	NR	NR	NR
Zinc	80	95	70	NA	110	NA
Zirconium	40	NR	NR	NR	25	NR

Source: Reference 4

[a] MDLs are related to the total number of counts taken. See Section 13.3 for count times used to generate this table.
NR Not reported.
NA Not applicable; analyte was reported but was not at high enough concentrations for method detection limit to be determined.

TABLE 5
PRECISION

Analyte	Average Relative Standard Deviation for Each Instrument at 5 to 10 Times the MDL					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	6.54	NR	NR	NR	NR	NR
Arsenic	5.33	4.11	3.23	1.91	12.47	6.68
Barium	4.02	NR	3.31	5.91	NR	NR
Cadmium	29.84[a]	NR	24.80[a]	NR	NR	NR
Calcium	2.16	NR	NR	NR	NR	NR
Chromium	22.25	25.78	22.72	3.91	30.25	NR
Cobalt	33.90	NR	NR	NR	NR	NR
Copper	7.03	9.11	8.49	9.12	12.77	14.86
Iron	1.78	1.67	1.55	NR	2.30	NR
Lead	6.45	5.93	5.05	7.56	6.97	12.16
Manganese	27.04	24.75	NR	NR	NR	NR
Molybdenum	6.95	NR	NR	NR	12.60	NR
Nickel	30.85[a]	NR	24.92[a]	20.92[a]	NA	NR
Potassium	3.90	NR	NR	NR	NR	NR
Rubidium	13.06	NR	NR	NR	32.69[a]	NR
Strontium	4.28	NR	NR	NR	8.86	NR
Tin	24.32[a]	NR	NR	NR	NR	NR
Titanium	4.87	NR	NR	NR	NR	NR
Zinc	7.27	7.48	4.26	2.28	10.95	0.83
Zirconium	3.58	NR	NR	NR	6.49	NR

Source: Reference 4

[a] These values are biased high because the concentration of these analytes in the soil samples was near the detection limit for that particular FPXRF instrument.
NR Not reported.
NA Not applicable; analyte was reported but was below the method detection limit.

TABLE 6
PRECISION AS AFFECTED BY SAMPLE PREPARATION

Analyte	Average Relative Standard Deviation for Each Preparation Method		
	In Situ-Field	Intrusive-Undried and Unground	Intrusive-Dried and Ground
Antimony	30.1	15.0	14.4
Arsenic	22.5	5.36	3.76
Barium	17.3	3.38	2.90
Cadmium[a]	41.2	30.8	28.3
Calcium	17.5	1.68	1.24
Chromium	17.6	28.5	21.9
Cobalt	28.4	31.1	28.4
Copper	26.4	10.2	7.90
Iron	10.3	1.67	1.57
Lead	25.1	8.55	6.03
Manganese	40.5	12.3	13.0
Mercury	ND	ND	ND
Molybdenum	21.6	20.1	19.2
Nickel[a]	29.8	20.4	18.2
Potassium	18.6	3.04	2.57
Rubidium	29.8	16.2	18.9
Selenium	ND	20.2	19.5
Silver[a]	31.9	31.0	29.2
Strontium	15.2	3.38	3.98
Thallium	39.0	16.0	19.5
Thorium	NR	NR	NR
Tin	ND	14.1	15.3
Titanium	13.3	4.15	3.74
Vanadium	NR	NR	NR
Zinc	26.6	13.3	11.1
Zirconium	20.2	5.63	5.18

Source: Reference 4

[a] These values may be biased high because the concentration of these analytes in the soil samples was near the detection limit.
ND Not detected.
NR Not reported.

TABLE 7
ACCURACY

Analyte	Instrument															
	TN 9000				TN Lead Analyzer				X-MET 920 (SiLi Detector)				XL Spectrum Analyzer			
	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec	SD	n	Range of % Rec.	Mean % Rec.	SD
Sb	2	100-149	124.3	NA	--	--	--	--	--	--	--	--	--	--	--	--
As	5	68-115	92.8	17.3	5	44-105	83.4	23.2	4	9.7-91	47.7	39.7	5	38-535	189.8	206
Ba	9	98-198	135.3	36.9	--	--	--	--	9	18-848	168.2	262	--	--	--	--
Cd	2	99-129	114.3	NA	--	--	--	--	6	81-202	110.5	45.7	--	--	--	--
Cr	2	99-178	138.4	NA	--	--	--	--	7	22-273	143.1	93.8	3	98-625	279.2	300
Cu	8	61-140	95.0	28.8	6	38-107	79.1	27.0	11	10-210	111.8	72.1	8	95-480	203.0	147
Fe	6	78-155	103.7	26.1	6	89-159	102.3	28.6	6	48-94	80.4	16.2	6	26-187	108.6	52.9
Pb	11	66-138	98.9	19.2	11	68-131	97.4	18.4	12	23-94	72.7	20.9	13	80-234	107.3	39.9
Mn	4	81-104	93.1	9.70	3	92-152	113.1	33.8	--	--	--	--	--	--	--	--
Ni	3	99-122	109.8	12.0	--	--	--	--	--	--	--	--	3	57-123	87.5	33.5
Sr	8	110-178	132.6	23.8	--	--	--	--	--	--	--	--	7	86-209	125.1	39.5
Zn	11	41-130	94.3	24.0	10	81-133	100.0	19.7	12	46-181	106.6	34.7	11	31-199	94.6	42.5

Source: Reference 4

n Number of samples that contained a certified value for the analyte and produced a detectable concentration from the FPXRF instrument.
SD Standard deviation.
NA Not applicable; only two data points, therefore, a SD was not calculated.
%Rec. Percent recovery.
-- No data.

TABLE 8
ACCURACY FOR TN 9000[a]

Standard Reference Material	Arsenic			Barium			Copper			Lead			Zinc		
	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.
RTC CRM-021	24.8	ND	NA	586	1135	193.5	4792	2908	60.7	144742	149947	103.6	546	224	40.9
RTC CRM-020	397	429	92.5	22.3	ND	NA	753	583	77.4	5195	3444	66.3	3022	3916	129.6
BCR CRM 143R	--	--	--	--	--	--	131	105	80.5	180	206	114.8	1055	1043	99.0
BCR CRM 141	--	--	--	--	--	--	32.6	ND	NA	29.4	ND	NA	81.3	ND	NA
USGS GXR-2	25.0	ND	NA	2240	2946	131.5	76.0	106	140.2	690	742	107.6	530	596	112.4
USGS GXR-6	330	294	88.9	1300	2581	198.5	66.0	ND	NA	101	80.9	80.1	118	ND	NA
NIST 2711	105	104	99.3	726	801	110.3	114	ND	NA	1162	1172	100.9	350	333	94.9
NIST 2710	626	722	115.4	707	782	110.6	2950	2834	96.1	5532	5420	98.0	6952	6476	93.2
NIST 2709	17.7	ND	NA	968	950	98.1	34.6	ND	NA	18.9	ND	NA	106	98.5	93.0
NIST 2704	23.4	ND	NA	414	443	107.0	98.6	105	106.2	161	167	103.5	438	427	97.4
CNRC PACS-1	211	143	67.7	--	772	NA	452	302	66.9	404	332	82.3	824	611	74.2
SARM-51	--	--	--	335	466	139.1	268	373	139.2	5200	7199	138.4	2200	2676	121.6
SARM-52	--	--	--	410	527	128.5	219	193	88.1	1200	1107	92.2	264	215	81.4

Source: Reference 4

[a] All concentrations in milligrams per kilogram.
%Rec. Percent recovery.
ND Not detected.
NA Not applicable.
-- No data.

TABLE 9
REGRESSION PARAMETERS FOR COMPARABILITY[1]

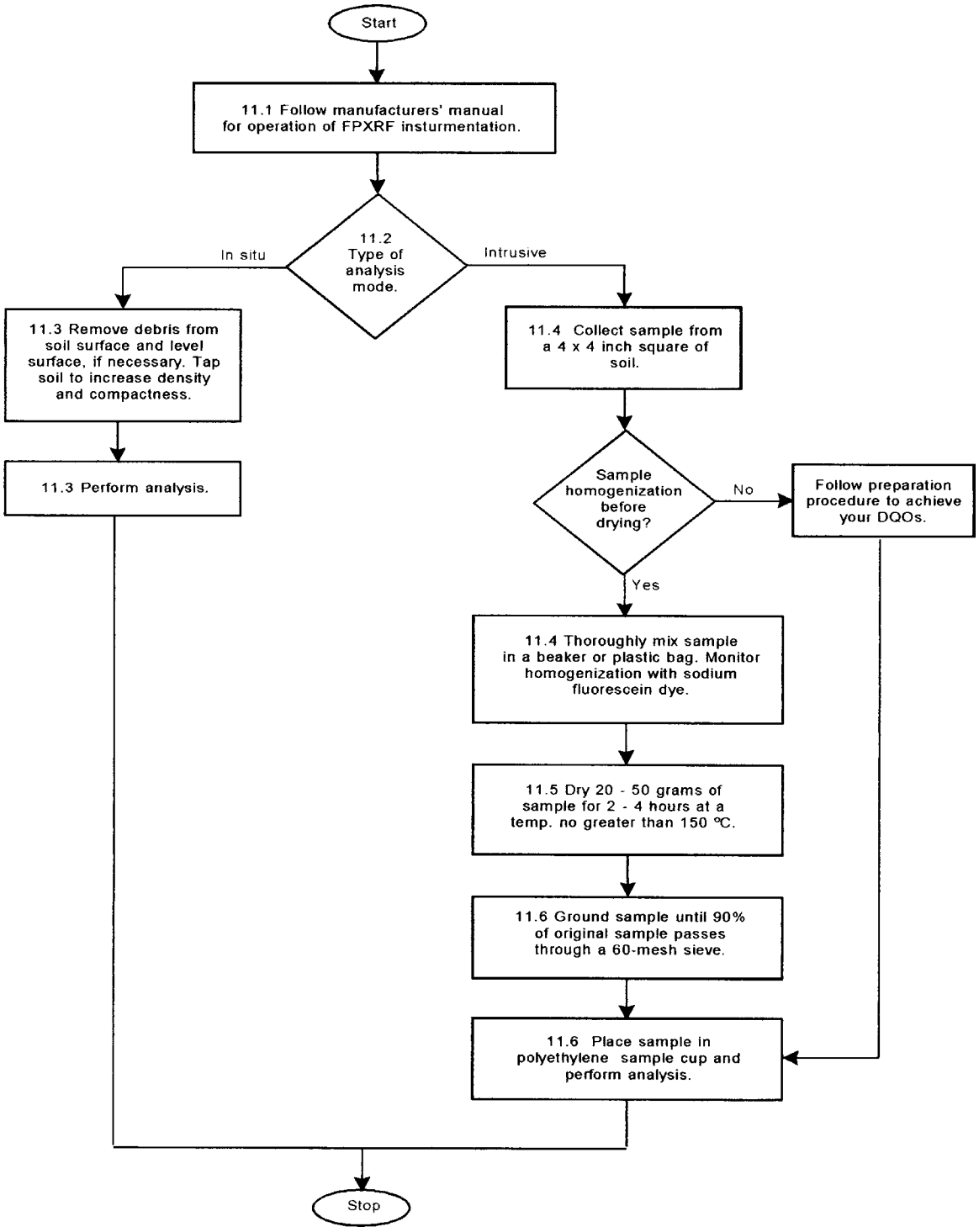
	Arsenic				Barium				Copper			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	824	0.94	1.62	0.94	1255	0.71	60.3	0.54	984	0.93	2.19	0.93
Soil 1	368	0.96	1.41	0.95	393	0.05	42.6	0.11	385	0.94	1.26	0.99
Soil 2	453	0.94	1.51	0.96	462	0.56	30.2	0.66	463	0.92	2.09	0.95
Soil 3	—	—	—	—	400	0.85	44.7	0.59	136	0.46	16.60	0.57
Prep 1	207	0.87	2.69	0.85	312	0.64	53.7	0.55	256	0.87	3.89	0.87
Prep 2	208	0.97	1.38	0.95	315	0.67	64.6	0.52	246	0.96	2.04	0.93
Prep 3	204	0.96	1.20	0.99	315	0.78	64.6	0.53	236	0.97	1.45	0.99
Prep 4	205	0.96	1.45	0.98	313	0.81	58.9	0.55	246	0.96	1.99	0.96

	Lead				Zinc				Chromium			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	1205	0.92	1.66	0.95	1103	0.89	1.86	0.95	280	0.70	64.6	0.42
Soil 1	357	0.94	1.41	0.96	329	0.93	1.78	0.93	—	—	—	—
Soil 2	451	0.93	1.62	0.97	423	0.85	2.57	0.90	—	—	—	—
Soil 3	397	0.90	2.40	0.90	351	0.90	1.70	0.98	186	0.66	38.9	0.50
Prep 1	305	0.80	2.88	0.86	286	0.79	3.16	0.87	105	0.80	66.1	0.43
Prep 2	298	0.97	1.41	0.96	272	0.95	1.86	0.93	77	0.51	81.3	0.36
Prep 3	302	0.98	1.26	0.99	274	0.93	1.32	1.00	49	0.73	53.7	0.45
Prep 4	300	0.96	1.38	1.00	271	0.94	1.41	1.01	49	0.75	31.6	0.56

Source: Reference 4

[1] Log-transformed data
n Number of data points
r^2 Coefficient of determination
Int. Y-intercept
— No applicable data

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT



Metals in Soil Analysis Using Field Portable X-ray Fluorescence

A guideline to using portable XRF according to EPA Method 6200, basic overview of the technique of x-ray fluorescence (XRF), appropriate data quality assurance protocols and sample preparation steps for operators analyzing prepared soil samples.

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Section 1: Regulatory Status for Field Portable XRF

EPA Reference Method 6200 has been incorporated into SW486 under RCRA, and is now available for field portable XRF analysis of soils and sediments. Please call or email Innov-X Systems for a copy of Method 6200.

Method 6200: Field Portable XRF Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment.

Features of this method:

1. It is a field screening method, for analysis of *in-situ* or bagged samples.
2. The method provides basic quality assurance methods, including calibration verification, determination of instrument precision, accuracy and limit of detection.
3. The method recognizes the some XRF instruments do not require site-specific calibrations by the operator, that is, the factory calibration provides appropriate data quality.
4. The method recommends that a minimum of 5-10% of samples tested by XRF be confirmed by an outside laboratory using a total-digestion EPA analytical reference method.

The purpose of EPA Method 6200 is NOT to replace laboratory analysis. There are two primary sources of error in assessing a site for metal concentration: **Analytical error** and **Sampling error**. Analytical error is the error in the analysis of any one sample by whatever technique is used, for example XRF, ICP, or AA. Sampling error arises when too few samples are collected and tested. In this case an incomplete picture of the extent of metals contamination may be obtained. Although any one sample may be analyzed with very high analytical accuracy, measuring too few samples may result in contamination plumes being mis-judged in size, or depth into the soil. In extreme cases contamination may missed entirely.

EPA Method 6200 was developed to reduce Sampling Errors by increasing the number of samples measured. In general, a large number of screening-level measurements provide a better characterization of contamination than a small number of measurements produced by sample removal and analytical analysis. Portable XRF is an ideal tool to make a large quantity of measurements in a short period of time. A large number of in-situ samples provides detailed data on contamination profiles, depth (provided surface soil is moved aside), and approximate contamination levels. Portable XRF also can provide results with a high degree of analytical accuracy on any given sample. Please see Section 2 “Overview of Field Usage” for this discussion.

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Section 2: Overview of Field Usage:

Field portable XRF is generally used in three ways to test for metals in soil:

- **In-situ soil testing:** The XRF is placed directly onto the ground for soil testing. Operators remove any plant growth and foreign objects so that the analyzer probe is flush to the soil.
- **Bagged soil sample testing.** A soil sample is collected in a thin plastic bag (i.e. a "Baggie") and testing directly through the Baggie. Except for a few elements – namely Cr, V and Ba – testing through the thin plastic used for a plastic bag has little effect on the test result. Results for Cr, V and Ba will be lower by 20-30%.
- **Prepared soil sample testing.** Prepared sample testing assures the operator of the maximum possible accuracy. Prepared sample tests require a sample to be collected, dried if necessary, sieved and ground into a powder. The prepared sample is then placed into a baggie or XRF cup for analysis. **A complete Soil Preparation Guide is provided in Appendix 1.**

All analytical methods require a uniform, homogenous sample for the best results. **XRF is no different!** The methods described in EPA Method 6200, namely In-situ and bagged sample testing, are considered *field-screening methods*. Although a field-screening method, in-situ testing is a valuable technique because it generates a great deal of data very quickly. Prepared soil samples generally offer the best accuracy, albeit with several minutes of sample preparation required per sample.

Figure 1. Use of a field portable XRF for in-situ soil testing.

Subsection 2-A: Data Quality Objectives.

The objectives of the testing generally determine the mixture of in-situ versus prepared sample testing. It is important to understand your data quality objectives (DQO) in order to determine the appropriate mix of field screening and prepared sample testing.

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In-situ testing usually provides only screening-level data quality. This is because analytical testing always requires a uniform, homogeneous sample matrix. A laboratory achieves this by digesting the sample into a hot acid before analysis. Testing directly on the ground does not ensure uniformity is met. Preparing a sample provides a uniform sample and likely better analytical data quality, although several minutes of testing time is required.

Most portable XRF operators use a mixture of in-situ and prepared sample testing. Several examples are described below. The exact mixture of in-situ and prepared sample testing depends upon the goals of the soil testing. The examples below serve as guidelines. Please contact Innov-X (1-866-4 Innov-X or 866-446-6689) to discuss your specific testing requirements.

Example 1: Initial site investigation to provide detailed contamination data with efficient use of laboratory analysis costs.

Problem: Site needs to be assessed for metals contamination. Little information is available about what metals are present, likely contamination levels or geographic profile of contamination.

The goal of testing is to determine what metals are present at what levels, both in area and in depth into soil. Additionally, testing will locate possible contamination plumes and/or possible sources of contamination.

Recommended Testing Plan: This example uses predominately in-situ testing. The analyst will perform in-situ testing, and gather samples into plastic bags for XRF analysis. A testing grid should be established in two or three dimensions, every several feet. XRF tests can be taken at each location or bagged samples can be collected from each location for later analysis. The in-situ data for each element analyzed may be plotted in a 2-dimensional grid (X, Y coordinates versus elemental concentration) to profile a site. These concentration profiles are ideal for showing contamination patterns, boundaries and plumes. Combining this data with historical use data from the site often allows the operator to deduce sources of contamination. Obtaining this level of geographic data with purely laboratory analysis would produce excessive analytical costs.

Prepared sample analysis should also be done to confirm the regions where in-situ data indicates low or non-detected levels of metal contaminant. There is little need to prepare areas where in-situ testing indicates high concentration levels. Innov-X recommends the same procedure as EPA Method 6200. For locations where in-situ tested indicate low or non-detected concentrations, calculate the total number of in-situ tests, collect 5% of this number of tests from the various locations, and prepare these samples according to Appendix 1. Use these prepared samples to confirm the findings of the in-situ testing. Send a subset of these prepared samples to a laboratory for confirmatory results.

Cost Justification. To adequately characterize a site may require 100-200 samples/acre to be sure the contaminated areas are firmly established. This work may be done with in-situ testing to generate laboratory savings of $5,000 - $10,000/acre depending upon the number of elements being analyzed. The cost reduction in off-site analysis often justifies the price of the XRF.

Example 2: Monitor remediation efforts and assure site meets clearance levels before contractors leave the site.

Goal: Minimize remediation costs by only treating contaminated soil, and obtain immediate verification that various site locations meet clearance objectives.

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Recommended Testing Plan: This type of project uses a lot of both in-situ and prepared sample testing. Use in-situ testing to thoroughly delineate contamination regions in both area and depth. To determine depth profiles, test surface soil, remove at least 1-2 inches, and retest. Repeat this step as necessary to profile contamination depth to guide remediation activities. (XRF is a surface technique and only analysis the first few mm of soil sample). As part of clearance, collect several samples from "cleared" area. Prepare samples according to Appendix 1 and test with portable XRF.

If XRF indicates that concentration levels are in excess of clearance requirements, then continue remediation efforts.

If XRF indicates concentration levels are below clearance requirements, then discontinue remediation efforts, send a subset of the samples to an analytical laboratory to confirm results. Most operators safely assume that the cleanup requirements have been met for the elements in question, but await final analysis from the laboratory.

If XRF lists concentration levels as non-detected, but the detection level reported exceeds clearance requirements, send samples to a laboratory for final results.

Cost Justification: In-situ results are used to guide remediation efforts, in order to obtain maximum efficiency. Efficiency is produced because contamination boundaries are firmly established, thus avoiding remediation efforts with "clean" soil. Prepared sample testing is used to assure that clearance requirements are met on-site in near real-time (pending laboratory confirmation). Costs savings are generated by avoiding clearance failures. The contractors can leave the site earlier and will not be called back to the site for additional cleanup.

Important Note: Never clear a site based solely on in-situ testing. Always use well-prepared samples to make a clearance decision.

Example 3: Minimize volume of hazardous waste for treatment or disposal.

Goal: For some cleanup projects, the cost of soil disposal in a hazardous waste landfill is much greater than disposal in a standard landfill. Testing soil samples with XRF may minimize the amount of "clean" soil that is inadvertently shipped to a hazardous-waste landfill.

Recommended Testing Plan: This example is almost entirely prepared sample testing. Representative samples are removed from the soil being hauled to landfill. Obtaining an accurate analysis of the samples is crucial for making a hazardous versus non-hazardous determination. For this reason, prepared sample testing is strongly recommended.

Important Note: These types of samples are subject to TCLP procedures for the landfill determination. In general, 20 times the XRF result should be less than the allowable limit for the metal in question. Please contact Innov-X Systems for more details on testing samples versus TCLP regulatory requirements.

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Section 3: Quality Assurance.

Quality assurance is detailed for both the proper use of the analyzer (which is also provided in Method 6200) and for verifying the data quality of in-situ testing. All operators should perform the QC procedure, regardless of their data quality objectives. Method 6200 has strict requirements about quality assurance. Additionally, Innov-X recommends that operators verify the data quality of in-situ test results, if they are using in-situ data to guide their reporting or remediation decisions. Procedures are listed below:

3.1: Proper verification of instrument operation

These procedures are taken from EPA Method 6200 and updated to be specific to the Innov-X analyzer. Quality assurance here consists of testing known standards to verify calibration, as well as testing blank standards to determine limits of detection and to check for sample cross-contamination or instrument contamination. EPA Method 6200 provides a detailed procedure, which is provided here in abbreviated form.

Components of instrument QC:

1. An energy calibration check sample at least twice daily
2. An instrument blank for every 20 environmental samples
3. A method blank for every 20 prepared samples
4. A calibration verification check sample for every 20 samples
5. A precision sample at least one per day.
6. A confirmatory sample for every 10 environmental samples

Energy Calibration Check: The Innov-X analyzer performs this automatically; this is the purpose of the standardization check when the analyzer is started. The software does not allow the analyzer to be used if the standardization is not completed.

Instrument Blank: The operator should use the SiO_2 (silicon dioxide) blank provided with the analyzer. The purpose of this test is to verify there is no contamination on the analyzer window or other component that is "seen" by the x-rays. Method 6200 recommends an instrument blank at least once per day, preferably every 20 samples. For either in-situ or prepared-sample testing, the operator should just test the SiO_2 blank to be sure there are no reported contaminant metals.

Method Blank: The purpose of the method blank is to verify that cross-contamination is not introduced into samples during the sample preparation process. Method 6200 recommends following the sample preparation procedures with clean SiO_2 once very 20 prepared samples. This QC step is not required if the operator is not preparing samples.

Calibration Verification: Innov-X provides NIST standard reference samples for calibration check by operator. The operator should perform a 2-minute test on a NIST standard. The difference between the XRF result for an element and the value of the standard should be 20% or less. Calibration Verification should be performed upon instrument startup and periodically during testing. Note: Innov-X recommends a calibration check every 4 hours. EPA Method 6200 recommends a calibration check every 20 samples NIST reference standards are generally applicable for Pb, As, Cr, Cu, Zn. Innov-X provides additional reference standards for other RCRA or Priority Pollutant metals including Cd, Se, Ag, Hg, Ag, Ba, Sn, Sb, and Ni.

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Precision Verification: Quoting from EPA "A minimum of one precision sample should be run per day by conducting from 7 to 10 replicate measurements of the sample. The precision is assessed by calculating a relative standard deviation (RSD) of the replicate measurements for the analyte. The RSD values should be less than 20 percent for most analytes, except chromium, for which the value should be less than 30 percent.

Confirmatory Sample: It is recommended that one confirmatory sample is run for every 10 samples collected. According to EPA Method 6200: "Confirmatory samples are collected from the same sample material that is analyzed on site, but are sent to an off-site laboratory for formal analysis. The purpose of a confirmatory sample is to judge the accuracy of the data obtained by analysis on site and to allow corrections, if necessary."

Important Notes about confirmatory samples:

Innov-X always recommends that customers compare prepared-sample results to laboratory results. To do this, collect and prepare a sample following the protocols of Appendix 1. Take a subsample and submit to the laboratory for analysis. The single largest error in XRF analysis is lack of sample preparation. For the best comparison, always use prepared samples.

3.2: Determining data quality of in-situ testing:

For operators relying extensively on in-situ testing, it is important to determine the data quality of this testing at a given site. *This protocol is not intended for every sample, but rather for a small percentage of samples considered representative of the site.* If the operator can demonstrate that quantitative data is achieved with little or no sample preparation, then the site characterization will be completed much more quickly but correctly.

For example, an operator may be able to demonstrate that the XRF result changes considerably when samples are passed through a 2 mm sieve, but that XRF results do NOT change appreciably upon finer sieving. In this case the operator can conclude that good XRF data is achievable with only 2 mm sieving. Sieving only to this level requires far less time than a more robust sample preparation. A protocol to determine the appropriate level of sample preparation is the following:

1. Delineate a region of soil approximately 4" x 4".
2. Perform several in-situ tests in this area, or collect the top (approximately) quarter inch of soil from this region, bag the soil, test through the bag. In either case, average the results.
3. If you did not bag the in-situ test sample, collect the top (approximately) quarter inch of soil from this region and sieve through the 2 mm sieve provided. Otherwise sieve the bagged sample used for the in-situ test. Thoroughly mix the sieved sample, and place some of the sieved material into an XRF cup, and perform a test of this sample.
4. If the results of this prepared sample differ less than 20% with the average in-situ result, this indicates the soil in this region is reasonably homogeneous. The data quality in this case is probably at the semi-quantitative level, rather than just screening data.
5. If the results differ by more than 20%, this indicates the soil is not very homogeneous, and there are serious particle size effects affecting your in-situ measurements.
6. In this case, sieve the sample through the 250 ~m sieve. Mix this sample and place a sub-sample into an XRF cup for testing. If this result differs from the previous by less than 20% then this indicates that at a minimum the 2mm sieving is necessary to achieve higher data quality.

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7. If this result differs by more than 20% from the sample sieved through 2 mm, then particle size effects are still affecting the XRF result. In this case samples should be sieved through 125 µm to assure data quality at the quantitative level.

Section 4: Calibration for Innov-X Portable XRF

The Innov-X analyzer may run three different calibration methods, described below. In nearly all cases, customers use the Compton Normalization method. This method (recognized in EPA 6200) offers speed, ease of use, and generally good accuracy for concentration ranges from the ppm level up to 2-3% concentrations. As most field-testing is seeking to remediate or locate environmental contaminants, the upper limit of the calibration (2-3%) is generally not a limitation. If customers do require a calibration up to 100% concentration (i.e. a pure element) then Innov-X recommends they also include the Fundamental Parameters (FP) software module with the analyzer. The FP module may be added at time of purchase or as an upgrade at any later date.

Note: In general customers do not need to calibrate the Innov-X analyzer for soil testing. The analyzer is delivered with a factory calibration, generally based upon the Compton Normalization (CN) method. The CN method has been proven over the past several years to provide a robust calibration generally independent of site-specific soil matrix chemistry. The operator may calibrate the Innov-X system if desired, but calibration is not required to use the analyzer effectively. All customers should follow the QC procedure described in Section 3, which includes a check of the calibration.

The final model is the empirical calibration. In this case, customers run standards to generate calibration curves for various elements in specific soil matrices. Provided the sample is well-prepared, the empirical method generally yields the most accurate result. In our experience, the accuracy gains going from Compton Normalization to Empirical Mode are small and not worth the extra effort in setting up calibration curves. (The greatest source of error for in-field XRF analysis of soil is lack of adequate sample preparation, thus there is little gained in developing a sophisticated empirical calibration if the operator does to grind and homogenize the all measured samples).

Calibration Requirements:

The concentration of an element in a soil sample is well-described by the formula:

$$w_i = \frac{k_i}{M(Z,i)} I_i$$

k_i = calibration constant for element "i"

ω_i = concentration of element "i" – the quantity being measured.

I_i = measured x-ray intensity from element "i"

M(Z,I) = Soil matrix value

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The factory calibration determines the value of the calibration constants k_i for each element, and a typical value M(Z,I). The calibration method – either CN, fundamental parameters, or empirical – performs the necessary corrections to the value M(Z,I) that are important for the site-specific soil chemistry. The XRF analyzer uses the measured intensity of each element's fluorescence from the sample, and the calibration data, to produce elemental concentrations.

Compton Normalization:

The Compton Normalization method calibration consists of the analysis of a single, well-characterized standard, such as an SRM or SSCS. The standard data are normalized to the Compton peak. The Compton peak is produced from incoherent backscattering of X-ray radiation from the excitation source and is present in the spectrum of every sample. The matrix affects the way in which source radiation is scattered off the samples. This scatter is directly related to the intensity of the Compton peak. For that reason, normalizing to the Compton peak can reduce problems with matrix effects that vary among samples. Compton normalization is similar to the use of internal standards in analysis for organic analytes.

Fundamental Parameters Calibration:

The fundamental parameters (FP) calibration is a "standardless" calibration. Rather than establishing a unit's calibration curve by measuring its response to standards that contain analytes of known concentrations, FP calibration relies on the known physics of the spectrometer's response to pure elements to set the calibration. Built-in mathematical algorithms are used to adjust the calibration for analysis of soil samples and to compensate for the effects of the soil matrix. The FP calibration is performed by the manufacturer, but the analyst can adjust the calibration curves (slope and y-intercept) on the bases of results of analyses of check samples, such as SRMs which are analyzed in the field.

Empirical Calibration:

The empirical calibration method requires that a number of site-specific calibration standards (SSCS) are used to establish calibration parameters. The instrument response to known analytes is measured and used to create calibration curves. Empirical calibration is effective because the samples used closely match the sample matrix. SSCSs are well-prepared samples collected from the site of interest in which the concentrations of analytes have been determined by inductively coupled plasma (ICP), atomic absorption (AA), or other methods approved by the US Environmental Protection Agency (EPA). The standards should contain all the analytes of interest and interfering analytes. Manufacturers recommend that 10 to 20 calibration samples be used to generate a calibration curve. The empirical method is the least desirable calibration method as it requires that new standards and curves are generated for each site that is analyzed.

Section 5: Effects of Moisture on XRF Results:

Sample moisture has two effects on XRF results:

- It alters the soil chemistry, since water is another chemical compound that comprises the soil matrix.
- Moisture impedes the ability to properly prepare samples.

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- Laboratory results are provided on a "dry weight" basis.

Effect on Soil Chemistry:

While the presence of significant moisture does impact the soil chemistry, modern XRF analyzers all perform automatic corrections for variations in soil chemistry from site to site. Indeed, such variations are expected, and that is the reason analyzers use Compton Normalization or fundamental parameters, in order to correct for moisture content changes as well as other differences in soil geochemistry.

EPA Method 6200 states "Moisture content above 20 percent may cause problems, since moisture alters the soil matrix for which the FPXRF has been calibrated." However, the Compton Normalization or fundamental parameters methods are implemented in order to automatically correct results for changes to the soil matrix. Thus, we believe that soil moisture is not a significant effect on accuracy due to effects of soil matrix, except for the "dilution" effect that can cause discrepancies with laboratory results which is described below.

Sample preparation issues:

The inability to adequately prepare a wet sample is, we believe, the single biggest contributor to errors when testing wet samples. It is very difficult to grind or sieve a wet sample. The highest quality XRF results are generally obtained from prepared samples. If the operator is unwilling to dry the sample to prepare it, comparisons to the laboratory may yield poorer correlation since the samples are not homogeneous.

Laboratory Tests on Dry-Weigh Basis:

Laboratories always dry samples prior to analysis. They report percent weight content based upon a dry sample basis. Portable XRF may often be used to analyze wet samples in the field, and results are thus reported that include the moisture content. Thus, with all other factors the same, the laboratory will report results higher than portable XRF. The results will be higher by the amount of moisture content in the sample. For example laboratory results will be 10% higher compared to XRF results, if the sample contained 10% by weight water when it was tested with XRF. Recall, this applies to samples where other possible sources of error are the same or negligible.

Section 6: Comparing XRF Results to Laboratory Results:

Innov-X strongly recommends that operators compare prepared sample results to laboratory results. This is because prepared-sample results yield the best possible accuracy with portable XRF. Moreover, the most common source of error is due to non-uniform samples. The XRF technique, nor can any analytical technique, properly account for non-uniform sample types.

To perform a comparison between XRF results and laboratory:

1. Collect a sample and prepare it according to the sample preparation guide in Appendix 1.

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2. Take a sub-sample (5-10 grams) of the fully-prepared sample, place it into an XRF cup and perform at least a one-minute test on that sample.

3. Send the same sample to the laboratory for wet chemistry analysis.

4. Require the laboratory to use a total-digestion method. If the laboratory does not use a total digestion method, they may not extract all of the elemental metal from the sample. In this case, the lab result will be lower than the XRF result. Incomplete sample digestion is one of the most commons sources of laboratory error, thus it is very important to request a total digestion method.

Example of Error: The operator collects a bag of sample, performs XRF analysis on one part of the bag, and sends the bag, or part of the bag of sample to a laboratory for analysis. The laboratory reports a very different value than the operator obtained with the XRF.

Problem: Since the sample is very non-homogeneous, the operator did not obtain a result that was representative of the entire bag of sample. The lab analyzed a different part of the sample and obtained a very different result due to the non-uniformity of the sample. The solution to this problem is, at a minimum, to test several locations in the bag of sample and report the average value. Also note the differences between the tests, as this is indicative of the non-uniformity of the sample. Operator should send entire bag of sample to the lab, and instruct lab to prepare the sample before removing sub-sample for lab analysis.

Best Practice: The operator should homogenize and prepare the entire bag of sample, and then collect a sub sample for XRF testing. After testing, the same sample should be sent to the lab.

Section 7: Common Interferences:

An interference occurs when the spectral peak from one element overlaps either partially or completely with the spectral peak of another. If the XRF is calibrated for both elements (CASE 1) i.e. the one causing the interference and the one being interfered with, it is generally capable of correctly handling the interference. In this case, the element being interfered with may be measured with a poorer detection limit or poorer precision, but the analytical results should still be acceptable for field-portable XRF. If the XRF is not calibrated for the element causing the interference (CASE 2), then the XRF may report the presence of elements not in the sample, or greatly elevated concentrations of elements in or not in the sample.

Example CASE 1: Lead and arsenic. Most XRFs are calibrated for lead and arsenic. Lead interferes with arsenic (not vice-versa though). The net effect is a worsened detection limit for arsenic, and poorer precision. The XRF handles the correction automatically, but the precision is affected. The loss of precision is also reported by the XRF. (Please refer to Innov-X Applications Sheet: *In-field Analysis of Lead and Arsenic in Soil Using Portable XRF* for more detail).

Example CASE 2: Bromine in the sample, but XRF is not calibrated for bromine. Bromine, as a fire retardant, is being seen more and more in soil and other sample types. For this reason, Innov-X analyzers include Br in the calibration data. If Br is not calibrated, but is present in the sample, the analyzer will report highly elevated levels of Pb, Hg and As. The levels will depend upon the concentration of Br in the sample.

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Interferences between elements can be broadly categorized into a) Z, Z-1, Z+1 interferences, and b) K/L interferences. Interference type "a" occurs when high levels of an element of atomic number Z are present. This can cause elevated levels of elements with atomic number Z-1 or Z+1. Generally, portable XRFs have good correction methods, so this interference only causes problems with very high levels of the element in question. Example: High concentrations of Fe (Z=26) in excess of 10% may cause elevated levels of Mn or Co (Z=25 or Z=27 respectively).

The type "b" interference occurs when the L-shell line of one element overlaps with the K-shell spectral line of another element. The most common example is the lead/arsenic interference where the L-alpha line of lead is in nearly the exact same location as the K-alpha line of arsenic.

Sample preparation protocol provided in Appendix 1

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ANALYTICAL REPORT

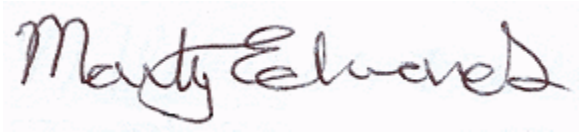
Job Number: 400-3201-1

Job Description: EPC El Dorado, KS

For:

El Paso Energy Corporation
P.O. Box 2511
Houston, TX 77252

Attention: Jen Allender



Marty Edwards
Project Manager I
medwards@stl-inc.com
07/15/2005

cc: Julie L Collins

The test results in this report meet all NELAP requirements for accredited parameters. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced except in full with written approval from the laboratory.

METHOD SUMMARY

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Description	Lab Location	Method	Preparation Method
Matrix: Solid			
Inductively Coupled Plasma - Atomic Emission Spectrometry	STL-PEN	SW846 6010B	
Acid Digestion of Sediments, Sludges, and Soils	STL-PEN		SW846 3050B
Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)	STL-PEN	SW846 7471A	
Mercury in Solid or Semi-Solid Waste (Manual	STL-PEN		SW846 7471A
Percent Moisture	STL-PEN	EPA 160.3	

LAB REFERENCES:

STL-PEN = STL-Pensacola

METHOD REFERENCES:

EPA - US Environmental Protection Agency

SW846 - "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986
And Its Updates.

SAMPLE SUMMARY

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
400-3201-1	F1-12-3	Solid	06/07/2005 0924	06/17/2005 0920
400-3201-2	B1-1-3	Solid	06/08/2005 1006	06/17/2005 0920
400-3201-3	C1-2-3	Solid	06/08/2005 1054	06/17/2005 0920
400-3201-4	F1-9-2	Solid	06/09/2005 0954	06/17/2005 0920
400-3201-5	J1-14-1	Solid	06/09/2005 1534	06/17/2005 0920
400-3201-6	G1-11-3	Solid	06/09/2005 1644	06/17/2005 0920
400-3201-7	G1-10-3	Solid	06/10/2005 1356	06/17/2005 0920
400-3201-8	B1-8-2	Solid	06/12/2005 1033	06/17/2005 0920
400-3201-9	D1-10-1	Solid	06/12/2005 1217	06/17/2005 0920
400-3201-10	D1-10-3	Solid	06/12/2005 1238	06/17/2005 0920
400-3201-11	C1-10-1	Solid	06/12/2005 1248	06/17/2005 0920
400-3201-12	C1-9-2	Solid	06/13/2005 1028	06/17/2005 0920
400-3201-13	A1-14-1	Solid	06/13/2005 1133	06/17/2005 0920
400-3201-14	B1-14-2	Solid	06/13/2005 1155	06/17/2005 0920
400-3201-15	B1-14-4	Solid	06/13/2005 1500	06/17/2005 0920
400-3201-16	C2-18-1	Solid	06/14/2005 0903	06/17/2005 0920
400-3201-17	C2-10-1	Solid	06/14/2005 1642	06/17/2005 0920
400-3201-18	F2-9-1	Solid	06/15/2005 1054	06/17/2005 0920
400-3201-19	E2-4-1	Solid	06/15/2005 1321	06/17/2005 0920

SAMPLE RESULTS

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: F1-12-3

Lab Sample ID:	400-3201-1		Date Sampled:	06/07/2005 0924
Client Matrix:	Solid	% Moisture: 24	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	2.0		Initial Weight/Volume:	1.21 g
Date Analyzed:	06/25/2005 0153		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<1.1		1.1
Arsenic		120		1.1
Barium		360		2.2
Cadmium		4.9		1.1
Chromium		9300		1.1
Lead		65		1.1
Selenium		<2.2		2.2

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6295 g
Date Analyzed:	06/23/2005 1716		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.13		0.010

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: B1-1-3

Lab Sample ID:	400-3201-2		Date Sampled:	06/08/2005 1006
Client Matrix:	Solid	% Moisture: 5.0	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.09 g
Date Analyzed:	06/25/2005 0124		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.48		0.48
Arsenic		13		0.48
Barium		150		0.97
Cadmium		1.0		0.48
Chromium		67		0.48
Lead		740		0.48
Selenium		<0.97		0.97

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6130 g
Date Analyzed:	06/23/2005 1718		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.36		0.0086

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: C1-2-3

Lab Sample ID:	400-3201-3		Date Sampled:	06/08/2005 1054
Client Matrix:	Solid	% Moisture: 13	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.13 g
Date Analyzed:	06/25/2005 0159		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.51		0.51
Arsenic		33		0.51
Barium		170		1.0
Cadmium		1.9		0.51
Chromium		140		0.51
Lead		1600		0.51
Selenium		<1.0		1.0

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8226	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	25		Initial Weight/Volume:	.6070 g
Date Analyzed:	06/23/2005 1910		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		9.4		0.24

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: F1-9-2

Lab Sample ID:	400-3201-4	Date Sampled:	06/09/2005 0954
Client Matrix:	Solid % Moisture: 27	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331		Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177		Lab File ID:	JUN24A
Dilution:	1.0			Initial Weight/Volume:	1.09 g
Date Analyzed:	06/25/2005 0204			Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.63		0.63
Arsenic		17		0.63
Barium		240		1.3
Cadmium		2.3		0.63
Chromium		940		0.63
Lead		1600		0.63
Selenium		2.3		1.3

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225		Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168		Lab File ID:	N/A
Dilution:	2.0			Initial Weight/Volume:	.6374 g
Date Analyzed:	06/23/2005 1813			Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.62		0.021

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: J1-14-1

Lab Sample ID:	400-3201-5		Date Sampled:	06/09/2005 1534
Client Matrix:	Solid	% Moisture: 22	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.21 g
Date Analyzed:	06/25/2005 0210		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.53		0.53
Arsenic		11		0.53
Barium		210		1.1
Cadmium		1.4		0.53
Chromium		580		0.53
Lead		780		0.53
Selenium		<1.1		1.1

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6396 g
Date Analyzed:	06/23/2005 1732		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.47		0.010

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: G1-11-3

Lab Sample ID:	400-3201-6		Date Sampled:	06/09/2005 1644
Client Matrix:	Solid	% Moisture: 23	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.22 g
Date Analyzed:	06/25/2005 0216		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.53		0.53
Arsenic		19		0.53
Barium		250		1.1
Cadmium		3.6		0.53
Chromium		1200		0.53
Lead		1000		0.53
Selenium		3.0		1.1

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	5.0		Initial Weight/Volume:	.6263 g
Date Analyzed:	06/23/2005 1815		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		1.2		0.052

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: G1-10-3

Lab Sample ID:	400-3201-7		Date Sampled:	06/10/2005 1356
Client Matrix:	Solid	% Moisture: 28	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.19 g
Date Analyzed:	06/25/2005 0236		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.59		0.59
Arsenic		21		0.59
Barium		270		1.2
Cadmium		2.8		0.59
Chromium		1300		0.59
Lead		3000		0.59
Selenium		2.2		1.2

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	5.0		Initial Weight/Volume:	.6297 g
Date Analyzed:	06/23/2005 1816		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		1.1		0.055

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: B1-8-2

Lab Sample ID:	400-3201-8	Date Sampled:	06/12/2005 1033
Client Matrix:	Solid % Moisture: 20	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331		Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177		Lab File ID:	JUN24A
Dilution:	1.0			Initial Weight/Volume:	1.22 g
Date Analyzed:	06/25/2005 0241			Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.51		0.51
Arsenic		24		0.51
Barium		130		1.0
Cadmium		1.7		0.51
Chromium		1500		0.51
Lead		65		0.51
Selenium		<1.0		1.0

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225		Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	.6358 g
Date Analyzed:	06/23/2005 1737			Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.16		0.0098

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: D1-10-1

Lab Sample ID:	400-3201-9		Date Sampled:	06/12/2005 1217
Client Matrix:	Solid	% Moisture: 21	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.11 g
Date Analyzed:	06/25/2005 0247		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.57		0.57
Arsenic		7.4		0.57
Barium		160		1.1
Cadmium		1.2		0.57
Chromium		73		0.57
Lead		120		0.57
Selenium		<1.1		1.1

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8226	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	25		Initial Weight/Volume:	.6095 g
Date Analyzed:	06/23/2005 1912		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		8.1		0.26

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: D1-10-3

Lab Sample ID:	400-3201-10		Date Sampled:	06/12/2005 1238
Client Matrix:	Solid	% Moisture: 9.0	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.17 g
Date Analyzed:	06/25/2005 0253		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.47		0.47
Arsenic		4.2		0.47
Barium		59		0.94
Cadmium		0.57		0.47
Chromium		36		0.47
Lead		33		0.47
Selenium		<0.94		0.94

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6396 g
Date Analyzed:	06/23/2005 1808		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.23		0.0086

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: C1-10-1

Lab Sample ID:	400-3201-11		Date Sampled:	06/12/2005 1248
Client Matrix:	Solid	% Moisture: 24	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.22 g
Date Analyzed:	06/25/2005 0259		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.54		0.54
Arsenic		28		0.54
Barium		130		1.1
Cadmium		1.1		0.54
Chromium		4300		0.54
Lead		56		0.54
Selenium		<1.1		1.1

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6243 g
Date Analyzed:	06/23/2005 1742		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.51		0.010

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: C1-9-2

Lab Sample ID:	400-3201-12		Date Sampled:	06/13/2005 1028
Client Matrix:	Solid	% Moisture: 14	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.23 g
Date Analyzed:	06/25/2005 0305		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.47		0.47
Arsenic		39		0.47
Barium		110		0.95
Cadmium		4.1		0.47
Chromium		300		0.47
Lead		170		0.47
Selenium		<0.95		0.95

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6270 g
Date Analyzed:	06/23/2005 1744		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.17		0.0093

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: A1-14-1

Lab Sample ID:	400-3201-13	Date Sampled:	06/13/2005 1133
Client Matrix:	Solid % Moisture: 22	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331		Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177		Lab File ID:	JUN24A
Dilution:	1.0			Initial Weight/Volume:	1.50 g
Date Analyzed:	06/25/2005 0310			Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.43		0.43
Arsenic		6.8		0.43
Barium		190		0.85
Cadmium		0.92		0.43
Chromium		22		0.43
Lead		9500		0.43
Selenium		<0.85		0.85

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225		Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	.6394 g
Date Analyzed:	06/23/2005 1746			Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.033		0.010

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: B1-14-2

Lab Sample ID:	400-3201-14		Date Sampled:	06/13/2005 1155
Client Matrix:	Solid	% Moisture: 9.0	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.52 g
Date Analyzed:	06/25/2005 0316		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.36		0.36
Arsenic		2.7		0.36
Barium		53		0.72
Cadmium		<0.36		0.36
Chromium		4.9		0.36
Lead		2400		0.36
Selenium		<0.72		0.72

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6397 g
Date Analyzed:	06/23/2005 1747		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.022		0.0086

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: B1-14-4

Lab Sample ID:	400-3201-15	Date Sampled:	06/13/2005 1500
Client Matrix:	Solid % Moisture: 13	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8475		Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8289		Lab File ID:	JUN28B
Dilution:	2.0			Initial Weight/Volume:	1.04 g
Date Analyzed:	06/29/2005 0315			Final Weight/Volume:	100 mL
Date Prepared:	06/24/2005 1120				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<1.1		1.1
Arsenic		110		1.1
Barium		51		2.2
Cadmium		2.5		1.1
Chromium		160		1.1
Lead		1000		1.1
Selenium		<2.2		2.2

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8226		Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168		Lab File ID:	N/A
Dilution:	10			Initial Weight/Volume:	.6140 g
Date Analyzed:	06/23/2005 1913			Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		1.9		0.093

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: C2-18-1

Lab Sample ID:	400-3201-16		Date Sampled:	06/14/2005 0903
Client Matrix:	Solid	% Moisture: 20	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.17 g
Date Analyzed:	06/25/2005 0322		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		2.3		0.53
Arsenic		62		0.53
Barium		110		1.1
Cadmium		4.0		0.53
Chromium		17		0.53
Lead		820		0.53
Selenium		1.5		1.1

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6392 g
Date Analyzed:	06/23/2005 1754		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.040		0.0097

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: C2-10-1

Lab Sample ID:	400-3201-17		Date Sampled:	06/14/2005 1642
Client Matrix:	Solid	% Moisture: 3.0	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.22 g
Date Analyzed:	06/25/2005 0328		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.42		0.42
Arsenic		7.2		0.42
Barium		97		0.85
Cadmium		<0.42		0.42
Chromium		18		0.42
Lead		44		0.42
Selenium		<0.85		0.85

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6446 g
Date Analyzed:	06/23/2005 1756		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.013		0.0080

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: F2-9-1

Lab Sample ID:	400-3201-18		Date Sampled:	06/15/2005 1054
Client Matrix:	Solid	% Moisture: 18	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.24 g
Date Analyzed:	06/25/2005 0347		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.49		0.49
Arsenic		7.0		0.49
Barium		110		0.99
Cadmium		<0.49		0.49
Chromium		25		0.49
Lead		32		0.49
Selenium		<0.99		0.99

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8225	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	.6127 g
Date Analyzed:	06/23/2005 1758		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		0.028		0.0099

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Client Sample ID: E2-4-1

Lab Sample ID:	400-3201-19		Date Sampled:	06/15/2005 1321
Client Matrix:	Solid	% Moisture: 5.8	Date Received:	06/17/2005 0920

6010B Inductively Coupled Plasma - Atomic Emission Spectrometry

Method:	6010B	Analysis Batch: 400-8331	Instrument ID:	ICP-AES
Preparation:	3050B	Prep Batch: 400-8177	Lab File ID:	JUN24A
Dilution:	1.0		Initial Weight/Volume:	1.08 g
Date Analyzed:	06/25/2005 0353		Final Weight/Volume:	100 mL
Date Prepared:	06/23/2005 1205			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Silver		<0.49		0.49
Arsenic		7.5		0.49
Barium		170		0.98
Cadmium		<0.49		0.49
Chromium		34		0.49
Lead		96		0.49
Selenium		<0.98		0.98

7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)

Method:	7471A	Analysis Batch: 400-8226	Instrument ID:	PE FLOW
Preparation:	7471A	Prep Batch: 400-8168	Lab File ID:	N/A
Dilution:	10		Initial Weight/Volume:	.6194 g
Date Analyzed:	06/23/2005 1915		Final Weight/Volume:	25 mL
Date Prepared:	06/23/2005 1055			

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	RL
Mercury		1.8		0.085

General Chemistry

Client Sample ID: **F1-12-3**

Lab Sample ID: 400-3201-1
Client Matrix: Solid

Date Sampled: 06/07/2005 0924
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	76		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: **B1-1-3**

Lab Sample ID: 400-3201-2
Client Matrix: Solid

Date Sampled: 06/08/2005 1006
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	95		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: **C1-2-3**

Lab Sample ID: 400-3201-3
Client Matrix: Solid

Date Sampled: 06/08/2005 1054
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	87		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: **F1-9-2**

Lab Sample ID: 400-3201-4
Client Matrix: Solid

Date Sampled: 06/09/2005 0954
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	73		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

General Chemistry

Client Sample ID: J1-14-1

Lab Sample ID: 400-3201-5
Client Matrix: Solid

Date Sampled: 06/09/2005 1534
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	78		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: G1-11-3

Lab Sample ID: 400-3201-6
Client Matrix: Solid

Date Sampled: 06/09/2005 1644
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	77		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: G1-10-3

Lab Sample ID: 400-3201-7
Client Matrix: Solid

Date Sampled: 06/10/2005 1356
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	72		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: B1-8-2

Lab Sample ID: 400-3201-8
Client Matrix: Solid

Date Sampled: 06/12/2005 1033
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	80		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

General Chemistry

Client Sample ID: D1-10-1

Lab Sample ID: 400-3201-9 Date Sampled: 06/12/2005 1217
Client Matrix: Solid Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	79		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: D1-10-3

Lab Sample ID: 400-3201-10 Date Sampled: 06/12/2005 1238
Client Matrix: Solid Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	91		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: C1-10-1

Lab Sample ID: 400-3201-11 Date Sampled: 06/12/2005 1248
Client Matrix: Solid Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	76		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: C1-9-2

Lab Sample ID: 400-3201-12 Date Sampled: 06/13/2005 1028
Client Matrix: Solid Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	86		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

General Chemistry

Client Sample ID: **A1-14-1**

Lab Sample ID: 400-3201-13
Client Matrix: Solid

Date Sampled: 06/13/2005 1133
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	78		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: **B1-14-2**

Lab Sample ID: 400-3201-14
Client Matrix: Solid

Date Sampled: 06/13/2005 1155
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	91		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: **B1-14-4**

Lab Sample ID: 400-3201-15
Client Matrix: Solid

Date Sampled: 06/13/2005 1500
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	87		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: **C2-18-1**

Lab Sample ID: 400-3201-16
Client Matrix: Solid

Date Sampled: 06/14/2005 0903
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	80		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

General Chemistry

Client Sample ID: C2-10-1

Lab Sample ID: 400-3201-17
Client Matrix: Solid

Date Sampled: 06/14/2005 1642
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	97		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: F2-9-1

Lab Sample ID: 400-3201-18
Client Matrix: Solid

Date Sampled: 06/15/2005 1054
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	82		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

Client Sample ID: E2-4-1

Lab Sample ID: 400-3201-19
Client Matrix: Solid

Date Sampled: 06/15/2005 1321
Date Received: 06/17/2005 0920

Analyte	Result	Qual	Units	RL	Dil	Method
Percent Solids	94		%	0.10	1.0	160.3

Anly Batch: 400-8151 Date Analyzed 06/18/2005 0000

QUALITY CONTROL RESULTS

Client: El Paso Energy Corporation

Job Number: 400-3201-1

QC Association Summary

Lab Sample ID	Client Sample ID	Client Matrix	Method	Prep Batch
Metals				
Prep Batch: 400-8168				
LCS 400-8168/23-A	Lab Control Spike	Solid	7471A	
MB 400-8168/24-A	Method Blank	Solid	7471A	
400-3201-1	F1-12-3	Solid	7471A	
400-3201-2	B1-1-3	Solid	7471A	
400-3201-2MS	Matrix Spike	Solid	7471A	
400-3201-2MSD	Matrix Spike Duplicate	Solid	7471A	
400-3201-3	C1-2-3	Solid	7471A	
400-3201-4	F1-9-2	Solid	7471A	
400-3201-5	J1-14-1	Solid	7471A	
400-3201-6	G1-11-3	Solid	7471A	
400-3201-7	G1-10-3	Solid	7471A	
400-3201-8	B1-8-2	Solid	7471A	
400-3201-9	D1-10-1	Solid	7471A	
400-3201-10	D1-10-3	Solid	7471A	
400-3201-11	C1-10-1	Solid	7471A	
400-3201-12	C1-9-2	Solid	7471A	
400-3201-13	A1-14-1	Solid	7471A	
400-3201-14	B1-14-2	Solid	7471A	
400-3201-15	B1-14-4	Solid	7471A	
400-3201-16	C2-18-1	Solid	7471A	
400-3201-17	C2-10-1	Solid	7471A	
400-3201-18	F2-9-1	Solid	7471A	
400-3201-19	E2-4-1	Solid	7471A	

Client: El Paso Energy Corporation

Job Number: 400-3201-1

QC Association Summary

Lab Sample ID	Client Sample ID	Client Matrix	Method	Prep Batch
Metals				
Prep Batch: 400-8177				
LCS 400-8177/23-A	Lab Control Spike	Solid	3050B	
MB 400-8177/22-A	Method Blank	Solid	3050B	
400-3201-1	F1-12-3	Solid	3050B	
400-3201-2	B1-1-3	Solid	3050B	
400-3201-2MS	Matrix Spike	Solid	3050B	
400-3201-2MSD	Matrix Spike Duplicate	Solid	3050B	
400-3201-3	C1-2-3	Solid	3050B	
400-3201-4	F1-9-2	Solid	3050B	
400-3201-5	J1-14-1	Solid	3050B	
400-3201-6	G1-11-3	Solid	3050B	
400-3201-7	G1-10-3	Solid	3050B	
400-3201-8	B1-8-2	Solid	3050B	
400-3201-9	D1-10-1	Solid	3050B	
400-3201-10	D1-10-3	Solid	3050B	
400-3201-11	C1-10-1	Solid	3050B	
400-3201-12	C1-9-2	Solid	3050B	
400-3201-13	A1-14-1	Solid	3050B	
400-3201-14	B1-14-2	Solid	3050B	
400-3201-16	C2-18-1	Solid	3050B	
400-3201-17	C2-10-1	Solid	3050B	
400-3201-18	F2-9-1	Solid	3050B	
400-3201-19	E2-4-1	Solid	3050B	
Prep Batch: 400-8289				
LCS 400-8289/19-A	Lab Control Spike	Solid	3050B	
MB 400-8289/18-A	Method Blank	Solid	3050B	
400-3201-15	B1-14-4	Solid	3050B	
400-3322-C-2-B MS	Matrix Spike	Solid	3050B	
400-3322-C-2-C MSD	Matrix Spike Duplicate	Solid	3050B	

Client: El Paso Energy Corporation

Job Number: 400-3201-1

QC Association Summary

Lab Sample ID	Client Sample ID	Client Matrix	Method	Prep Batch
Metals				
Analysis Batch:400-8225				
LCS 400-8168/23-A	Lab Control Spike	Solid	7471A	400-8168
MB 400-8168/24-A	Method Blank	Solid	7471A	400-8168
400-3201-1	F1-12-3	Solid	7471A	400-8168
400-3201-2	B1-1-3	Solid	7471A	400-8168
400-3201-2MS	Matrix Spike	Solid	7471A	400-8168
400-3201-2MSD	Matrix Spike Duplicate	Solid	7471A	400-8168
400-3201-4	F1-9-2	Solid	7471A	400-8168
400-3201-5	J1-14-1	Solid	7471A	400-8168
400-3201-6	G1-11-3	Solid	7471A	400-8168
400-3201-7	G1-10-3	Solid	7471A	400-8168
400-3201-8	B1-8-2	Solid	7471A	400-8168
400-3201-10	D1-10-3	Solid	7471A	400-8168
400-3201-11	C1-10-1	Solid	7471A	400-8168
400-3201-12	C1-9-2	Solid	7471A	400-8168
400-3201-13	A1-14-1	Solid	7471A	400-8168
400-3201-14	B1-14-2	Solid	7471A	400-8168
400-3201-16	C2-18-1	Solid	7471A	400-8168
400-3201-17	C2-10-1	Solid	7471A	400-8168
400-3201-18	F2-9-1	Solid	7471A	400-8168
Analysis Batch:400-8226				
400-3201-3	C1-2-3	Solid	7471A	400-8168
400-3201-9	D1-10-1	Solid	7471A	400-8168
400-3201-15	B1-14-4	Solid	7471A	400-8168
400-3201-19	E2-4-1	Solid	7471A	400-8168

Client: El Paso Energy Corporation

Job Number: 400-3201-1

QC Association Summary

Lab Sample ID	Client Sample ID	Client Matrix	Method	Prep Batch
Metals				
Analysis Batch:400-8331				
LCS 400-8177/23-A	Lab Control Spike	Solid	6010B	400-8177
MB 400-8177/22-A	Method Blank	Solid	6010B	400-8177
400-3201-1	F1-12-3	Solid	6010B	400-8177
400-3201-2	B1-1-3	Solid	6010B	400-8177
400-3201-2MS	Matrix Spike	Solid	6010B	400-8177
400-3201-2MSD	Matrix Spike Duplicate	Solid	6010B	400-8177
400-3201-3	C1-2-3	Solid	6010B	400-8177
400-3201-4	F1-9-2	Solid	6010B	400-8177
400-3201-5	J1-14-1	Solid	6010B	400-8177
400-3201-6	G1-11-3	Solid	6010B	400-8177
400-3201-7	G1-10-3	Solid	6010B	400-8177
400-3201-8	B1-8-2	Solid	6010B	400-8177
400-3201-9	D1-10-1	Solid	6010B	400-8177
400-3201-10	D1-10-3	Solid	6010B	400-8177
400-3201-11	C1-10-1	Solid	6010B	400-8177
400-3201-12	C1-9-2	Solid	6010B	400-8177
400-3201-13	A1-14-1	Solid	6010B	400-8177
400-3201-14	B1-14-2	Solid	6010B	400-8177
400-3201-16	C2-18-1	Solid	6010B	400-8177
400-3201-17	C2-10-1	Solid	6010B	400-8177
400-3201-18	F2-9-1	Solid	6010B	400-8177
400-3201-19	E2-4-1	Solid	6010B	400-8177
Analysis Batch:400-8475				
LCS 400-8289/19-A	Lab Control Spike	Solid	6010B	400-8289
MB 400-8289/18-A	Method Blank	Solid	6010B	400-8289
400-3201-15	B1-14-4	Solid	6010B	400-8289
400-3322-C-2-B MS	Matrix Spike	Solid	6010B	400-8289
400-3322-C-2-C MSD	Matrix Spike Duplicate	Solid	6010B	400-8289

Client: El Paso Energy Corporation

Job Number: 400-3201-1

QC Association Summary

Lab Sample ID	Client Sample ID	Client Matrix	Method	Prep Batch
General Chemistry				
Analysis Batch:400-8151				
400-3201-1	F1-12-3	Solid	160.3	
400-3201-2	B1-1-3	Solid	160.3	
400-3201-3	C1-2-3	Solid	160.3	
400-3201-4	F1-9-2	Solid	160.3	
400-3201-5	J1-14-1	Solid	160.3	
400-3201-6	G1-11-3	Solid	160.3	
400-3201-7	G1-10-3	Solid	160.3	
400-3201-8	B1-8-2	Solid	160.3	
400-3201-9	D1-10-1	Solid	160.3	
400-3201-10	D1-10-3	Solid	160.3	
400-3201-11	C1-10-1	Solid	160.3	
400-3201-12	C1-9-2	Solid	160.3	
400-3201-13	A1-14-1	Solid	160.3	
400-3201-14	B1-14-2	Solid	160.3	
400-3201-15	B1-14-4	Solid	160.3	
400-3201-16	C2-18-1	Solid	160.3	
400-3201-17	C2-10-1	Solid	160.3	
400-3201-18	F2-9-1	Solid	160.3	
400-3201-19	E2-4-1	Solid	160.3	

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Method Blank - Batch: 400-8177

Method: 6010B
Preparation: 3050B

Lab Sample ID: MB 400-8177/22-A
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/25/2005 0059
Date Prepared: 06/23/2005 1205

Analysis Batch: 400-8331
Prep Batch: 400-8177
Units: mg/Kg

Instrument ID: ICP-AES
Lab File ID: JUN24A
Initial Weight/Volume: 1 g
Final Weight/Volume: 100 mL

Analyte	Result	Qual	RL
Silver	<0.50		0.50
Arsenic	<0.50		0.50
Barium	<1.0		1.0
Cadmium	<0.50		0.50
Chromium	<0.50		0.50
Lead	<0.50		0.50
Selenium	<1.0		1.0

Laboratory Control Sample - Batch: 400-8177

Method: 6010B
Preparation: 3050B

Lab Sample ID: LCS 400-8177/23-A
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/25/2005 0104
Date Prepared: 06/23/2005 1205

Analysis Batch: 400-8331
Prep Batch: 400-8177
Units: mg/Kg

Instrument ID: ICP-AES
Lab File ID: JUN24A
Initial Weight/Volume: 1.02 g
Final Weight/Volume: 100 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Silver	100	100	102	53 - 147	
Arsenic	109	100	93	80 - 120	
Barium	191	190	99	82 - 118	
Cadmium	108	100	96	81 - 119	
Chromium	151	150	100	79 - 121	
Lead	155	150	96	80 - 120	
Selenium	92.5	79	86	76 - 124	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 400-8177

Method: 6010B
Preparation: 3050B

MS Lab Sample ID:	400-3201-2	Analysis Batch: 400-8331	Instrument ID: ICP-AES
Client Matrix:	Solid	Prep Batch: 400-8177	Lab File ID: JUN24A
Dilution:	1.0		Initial Weight/Volume: 1.03 g
Date Analyzed:	06/25/2005 0135		Final Weight/Volume: 100 mL
Date Prepared:	06/23/2005 1205		

MSD Lab Sample ID:	400-3201-2	Analysis Batch: 400-8331	Instrument ID: ICP-AES
Client Matrix:	Solid	Prep Batch: 400-8177	Lab File ID: JUN24A
Dilution:	1.0		Initial Weight/Volume: 1.06 g
Date Analyzed:	06/25/2005 0141		Final Weight/Volume: 100 mL
Date Prepared:	06/23/2005 1205		

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Silver	93	91	75 - 125	5	20		
Arsenic	89	88	75 - 125	3	20		
Barium	109	96	75 - 125	6	20		
Cadmium	91	89	75 - 125	5	20		
Chromium	91	149	75 - 125	29	20		*
Lead	-49	-92	75 - 125	6	20	B 4	B 4
Selenium	80	78	75 - 125	5	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Method Blank - Batch: 400-8289

Method: 6010B
Preparation: 3050B

Lab Sample ID: MB 400-8289/18-A
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/29/2005 0135
Date Prepared: 06/24/2005 1120

Analysis Batch: 400-8475
Prep Batch: 400-8289
Units: mg/Kg

Instrument ID: ICP-AES
Lab File ID: JUN28B
Initial Weight/Volume: 1 g
Final Weight/Volume: 100 mL

Analyte	Result	Qual	RL
Silver	<1.0		1.0
Arsenic	<1.0		1.0
Barium	<2.0		2.0
Cadmium	<1.0		1.0
Chromium	<1.0		1.0
Lead	<1.0		1.0
Selenium	<2.0		2.0

Laboratory Control Sample - Batch: 400-8289

Method: 6010B
Preparation: 3050B

Lab Sample ID: LCS 400-8289/19-A
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/29/2005 0140
Date Prepared: 06/24/2005 1120

Analysis Batch: 400-8475
Prep Batch: 400-8289
Units: mg/Kg

Instrument ID: ICP-AES
Lab File ID: JUN28B
Initial Weight/Volume: 1 g
Final Weight/Volume: 100 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Silver	106	110	104	53 - 147	
Arsenic	115	110	94	80 - 120	
Barium	203	210	102	82 - 118	
Cadmium	114	110	92	81 - 119	
Chromium	160	160	98	79 - 121	
Lead	164	160	94	80 - 120	
Selenium	98.2	87	88	76 - 124	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 400-8289

Method: 6010B
Preparation: 3050B

MS Lab Sample ID:	400-3322-C-2-B MS	Analysis Batch: 400-8475	Instrument ID: ICP-AES
Client Matrix:	Solid	Prep Batch: 400-8289	Lab File ID: JUN28B
Dilution:	1.0		Initial Weight/Volume: 1.06 g
Date Analyzed:	06/29/2005 0158		Final Weight/Volume: 100 mL
Date Prepared:	06/24/2005 1120		

MSD Lab Sample ID:	400-3322-C-2-C MSD	Analysis Batch: 400-8475	Instrument ID: ICP-AES
Client Matrix:	Solid	Prep Batch: 400-8289	Lab File ID: JUN28B
Dilution:	1.0		Initial Weight/Volume: 1.08 g
Date Analyzed:	06/29/2005 0204		Final Weight/Volume: 100 mL
Date Prepared:	06/24/2005 1120		

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Silver	97	96	75 - 125	3	20		
Arsenic	96	96	75 - 125	2	20		
Barium	108	108	75 - 125	2	20		
Cadmium	97	97	75 - 125	2	20		
Chromium	101	101	75 - 125	2	20		
Lead	101	100	75 - 125	3	20	B	B
Selenium	90	88	75 - 125	3	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Method Blank - Batch: 400-8168

Method: 7471A
Preparation: 7471A

Lab Sample ID: MB 400-8168/24-A
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/23/2005 1711
Date Prepared: 06/23/2005 1055

Analysis Batch: 400-8225
Prep Batch: 400-8168
Units: mg/Kg

Instrument ID: PE FLOW INJECTION
Lab File ID: N/A
Initial Weight/Volume: .6000 g
Final Weight/Volume: 25 mL

Analyte	Result	Qual	RL
Mercury	<0.0083		0.0083

Laboratory Control Sample - Batch: 400-8168

Method: 7471A
Preparation: 7471A

Lab Sample ID: LCS 400-8168/23-A
Client Matrix: Solid
Dilution: 5.0
Date Analyzed: 06/23/2005 1713
Date Prepared: 06/23/2005 1055

Analysis Batch: 400-8225
Prep Batch: 400-8168
Units: mg/Kg

Instrument ID: PE FLOW INJECTION
Lab File ID: N/A
Initial Weight/Volume: .2027 g
Final Weight/Volume: 25 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	1.75	1.9	111	68 - 132	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 400-8168

Method: 7471A
Preparation: 7471A

MS Lab Sample ID: 400-3201-2
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/23/2005 1720
Date Prepared: 06/23/2005 1055

Analysis Batch: 400-8225
Prep Batch: 400-8168

Instrument ID: PE FLOW INJECTION
Lab File ID: N/A
Initial Weight/Volume: .6275 g
Final Weight/Volume: 25 mL

MSD Lab Sample ID: 400-3201-2
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 06/23/2005 1722
Date Prepared: 06/23/2005 1055

Analysis Batch: 400-8225
Prep Batch: 400-8168

Instrument ID: PE FLOW INJECTION
Lab File ID: N/A
Initial Weight/Volume: .6127 g
Final Weight/Volume: 25 mL

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Mercury	-85	-92	75 - 125	3	20	4	4

Calculations are performed before rounding to avoid round-off errors in calculated results.

DATA REPORTING QUALIFIERS

Client: El Paso Energy Corporation

Job Number: 400-3201-1

Lab Section	Qualifier	Description
Metals		
	B	Compound was found in the blank and sample.
	*	LCS, LCSD, MS, MSD, MD, or Surrogate exceeds the control limits
	4	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.

SERIAL NUMBER: 10001

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SEVERN TRENT **STL**

STL Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001
Fax: 850-478-2671
Website: www.stl-inc.com

QUOTE NO.

BOTTLE ORDER NO.

ORDER - LOG-IN NO.: C400-3201

CLIENT: EL PASO CORPORATION

ADDRESS: 1835 N. TOPEKA ST, EL DORADO, KS 67042

PAGE 1 OF 2

PROJECT NAME: EL DORADO REFINERY

PROJECT NO.: 1004316.011801

CLIENT PROJECT MANAGER: RYAN HULTGREN

PROJECT LOC. (STATE): KANSAS

SAMPLED BY: RYAN HULTGREN

CONTRACT / P.O. NO.: SEE CONTRACT S-STLI-ELDORADO-001

CLIENT PHONE: 303-291-2222

CLIENT E-MAIL OR FAX: 3032912180 RYAN.HULTGREN@MWHGLOBAL.COM

TAT REQUESTED: RUSH NEEDS LAB PREAPPROVAL X NORMAL - 10 BUSINESS DAYS
□ 1 DAY □ 2 DAYS □ 3 DAYS □ 5 DAYS □ 20 DAYS (Package) □ OTHER:

SAMPLE DISPOSAL: □ RETURN TO CLIENT □ DISPOSAL BY LAB
X SEE CONTRACT □ OTHER:

POSSIBLE HAZARD IDENTIFICATION: Δ NON-HAZARD Δ FLAMMABLE Δ RADIOACTIVE Δ POISON B Δ UNKNOWN Δ OTHER:

NO. OF COOLERS PER SHIPMENT: 1

REQUESTED ANALYSIS: RCRA 8 METALS METHOD 6010B

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	No Preservative	HCL - Hydrochloric Acid	HNO3 - Nitric Acid	H2SO4 - Sulfuric Acid or H3PO4	NAOH - Sodium Hydroxide	CH3OH - Methanol	NAHSO4 - Sodium Bisulfate	NA2S2O3 - Sodium Thiosulfate	Other:	Drinking Water	Ageuous GW, SW, WW	Solid, Semisolid, Sediment	Air	NonAqueous (Oil,Solvent, etc.)	NUMBER OF CONTAINERS SUBMITTED	SPECIAL INSTRUCTIONS/ CONDITIONS OF RECEIPT
6/7/05	0924	F1-12-3	X											X			1	
6/8/05	1006	B1-1-3	X											X			1	
6/8/05	1054	C1-2-3	X											X			1	
6/9/05	0954	F1-9-2	X											X			1	
6/9/05	1534	J1-14-1	X											X			1	
6/9/05	1644	G1-11-3	X											X			1	
6/10/05	1356	G1-10-3	X											X			1	
6/12/05	1033	B1-8-2	X											X			1	
6/12/05	1217	D1-10-1	X											X			1	
6/12/05	1238	D1-10-3	X											X			1	
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6/13/05	1028	C1-9-2	X											X			1	
6/13/05	1133	A1-14-1	X											X			1	

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
EMPTY CONTAINERS			[signature]	6/16/05	1600			

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
[signature]	6/6/05	1200						

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	CUSTODY INTACT?	CUSTODY SEAL NO.	REMARKS:
[signature]	6/7/05	0920	Δ YES Δ NO	N/A	4.9°C

LAB USE ONLY - SAMPLE NUMBER

SERIAL NUMBER: 9666

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SEVERN TRENT **STL**

STL Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001
Fax: 850-478-2671
Website: www.stl-inc.com

QUOTE NO.	BOTTLE ORDER NO.	ORDER - LOG-IN NO.
	MPE	C 400-3301

CLIENT	ADDRESS	PAGE	OF
EL PASO CORPORATION	1835 N. TOPEKA ST EL DORADO, KS 67042	2	2

PROJECT NAME	PROJECT NO.	CLIENT PROJECT MANAGER	PROJECT LOC. (STATE)
EL DORADO REFINERY	10043316.011801	RYAN HULTGREN	KANSAS

SAMPLED BY	CONTRACT / P.O. NO.
RYAN HULTGREN	SEE CONTRACT C-STL1-ELDORADO-001

CLIENT PHONE	CLIENT E-MAIL OR FAX
303-291-2222	303-291-2180

TAT REQUESTED: RUSH NEEDS LAB PREAPPROVAL ☒ NORMAL - 10 BUSINESS DAYS
☐ 1 DAY ☐ 2 DAYS ☐ 3 DAYS ☐ 5 DAYS ☐ 20 DAYS (Package) ☐ OTHER:

SAMPLE DISPOSAL: ☐ RETURN TO CLIENT ☐ DISPOSAL BY LAB
☐ SEE CONTRACT ☐ OTHER:

REQUESTED ANALYSIS: RCRA 8 METALS METHOD 6010B

POSSIBLE HAZARD IDENTIFICATION
Δ NON-HAZARD
Δ FLAMMABLE
Δ RADIOACTIVE
Δ POISON B
Δ UNKNOWN
Δ OTHER:

NO. OF COOLERS PER SHIPMENT: 1

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	No Preservative	HCL - Hydrochloric Acid	HNO3 - Nitric Acid	H2SO4 - Sulfuric Acid or H3PO4	NAOH - Sodium Hydroxide	CH3OH - Methanol	NAHSO4 - Sodium Bisulfate	NA2S2O3 - Sodium Thiosulfate	Other:	Drinking Water	Aqueous GW, SW, WW	Solid, Semisolid, Sediment	Air	NonAqueous (Oil,Solvent, etc.)	NUMBER OF CONTAINERS SUBMITTED	SPECIAL INSTRUCTIONS/ CONDITIONS OF RECEIPT
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6/13/05	1500	B1-14-4	X											X			1	
6/14/05	0903	C2-18-1	X											X			1	
6/14/05	1642	C2-10-1	X											X			1	
6/15/05	1054	F2-9-1	X											X			1	
6/15/05	1321	E2-4-1	X											X			1	

LAB USE ONLY - SAMPLE NUMBER

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RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
[signature]	6/6/05	1200						

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	CUSTODY INTACT?	CUSTODY SEAL NO.	REMARKS:
[signature]	6/17/05	0920	▲ YES Δ NO	N/A	4.9°C

STL PENSACOLA
Certifications, Memberships & Affiliations

Alabama *Department of Environmental Management, Laboratory ID No. 40150 (Drinking Water by Reciprocity with FL), expires 06/30/05*

Arizona *Department of Health Services, Lab ID No. AZ0589 (Hazardous Waste & Wastewater), expires 01/11/05*

Arkansas *Department of Pollution Control and Ecology, (88-0689) (Environmental), expires 07/01/05*

California *Department of Health Services,* ***ELAP*** *Laboratory ID No. 2510 (Hazardous Waste and Wastewater), expires 03/31/06*

Connecticut *Department of Health Services, Connecticut Lab Approval No. PH-0697 (D W, H W and Wastewater), expires 09/30/05*

Florida *DOH,* ***NELAP*** *Laboratory ID No. E81010 (Drinking Water, Hazardous Waste and Wastewater), expires 06/30/05*

Florida *DEP/DOH CompQAP # 980156*

Illinois *Environmental Laboratory Accreditation Program (ELAP),* ***NELAP*** *Laboratory ID No. 200041 (Wastewater and Hazardous Waste), expires 10/09/04*

Iowa *Department of Natural Resources, Laboratory ID No. 367 (Wastewater, UST, Solid Waste, & Contaminated Sites), expires 08/01/06*

Kansas *Department of Health & Environment,* ***NELAP*** *Laboratory ID No. E10253 (Wastewater and Hazardous Waste), expires 10/31/04*

Kentucky *NR&EPC, Laboratory ID No. 90043 (Drinking Water), expires 12/31/04*

Kentucky *Petroleum Storage Tank Env Assurance Fund, Laboratory ID No. 0053 (UST), expires 11/7/05*

Louisiana *DEQ, LELAP,* ***NELAP*** *Laboratory ID No. 02075, Agency Interest ID 30748. Environmental, expires 6/30/05*

Maryland *DH&MH Laboratory ID No. 233 (Drinking Water by Reciprocity with Florida), expires 09/30/05*

Massachusetts *DEP, Laboratory ID No. M-FL094 (Wastewater), expires 06/30/05*

Michigan *Bureau of E&OccH, Laboratory ID No.9912 (Drinking Water by Reciprocity with Florida), expires 06/30/05*

New Hampshire *DES ELAP,* ***NELAP*** *Laboratory ID No. 250502 (Drinking Water & Wastewater), expires 08/16/05*

New Jersey *DEP&E,* ***NELAP*** *Laboratory ID No. FL006 (Wastewater and Hazardous Waster), expires 06/30/05*

North Carolina *DENR, Laboratory ID No. 314 (Hazardous Waste and Wastewater), expires 12/31/05*

North Dakota *DH&Consol Labs, Laboratory ID No. R-108 Wastewater and Hazardous Waste by Reciprocity with Arizona), expires 06/30/04*

Oklahoma *Department of Environmental Quality, Laboratory ID No. 9810 (Hazardous Waste and Wastewater), expires 08/31/05*

Pennsylvania *Department of Environmental Resources,* ***NELAP*** *Laboratory ID No. 68-467 (Drinking Water & Wastewater), expires 12/01/04*

South Carolina *DH&EC, Laboratory ID No. 96026 (Wastewater & Solids/Hazardous Waste by Reciprocity with FL), expires 06/30/05*

Tennessee *Department of Health & Environment, Laboratory ID No. 02907 (Drinking Water), expires 10/15/07*

Virginia *Department of General Services, Laboratory ID No. 00008 (Drinking Water by Reciprocity with FL), expires 06/30/05*

West Virginia *DOE, Office of Water Resources, Laboratory ID No. 136 (Haz Waste and Wastewater), expires 04/30/05*

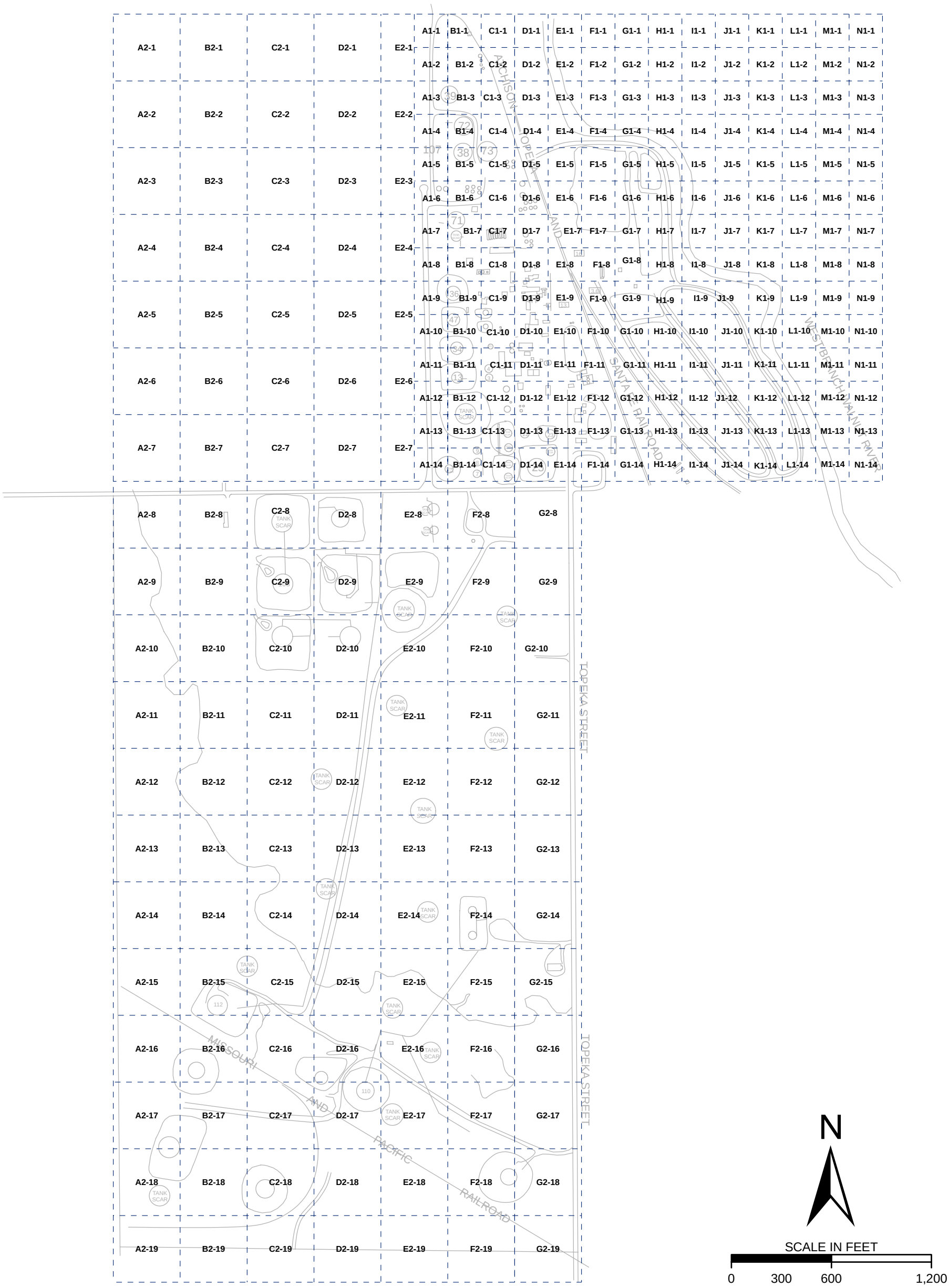
EPA ICR *(Information Collection Rule) Approved Laboratory, Laboratory ID No. ICRFL031*

NFESC *(Naval Facilities Engineering Services Center), expires September 7, 2004*

USACE *(United States Army Corps. of Engineers), MRD, expires July 16, 2005*

STL Pensacola also has a foreign soil permit to accept soils from locations other than the continental United States. Permit No. S-37599

certlist\condcert.lst revised 05/04/05



EXPLANATION

B1-2 XRF GRID CELL NOTATION
COLUMN - ROW

SAMPLING GRID

elpaso

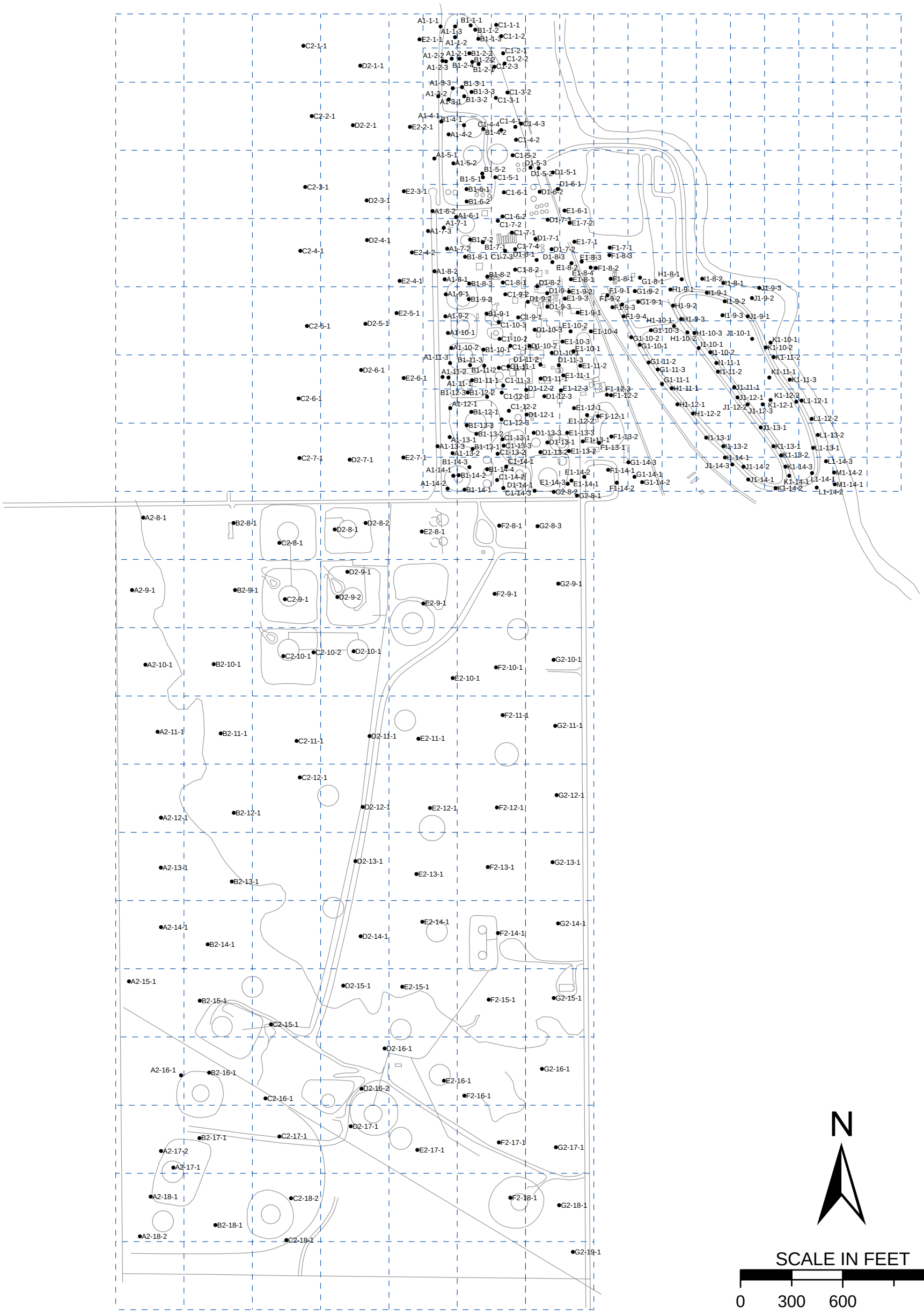
PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:

PHASE I XRF
SAMPLING LAYOUT
JUNE 2005

MWH

SCALE:	FIGURE No:
As Noted	***2-1***



EXPLANATION

- B1-2-2 XRF ANALYSIS LOCATION
- SAMPLING GRID

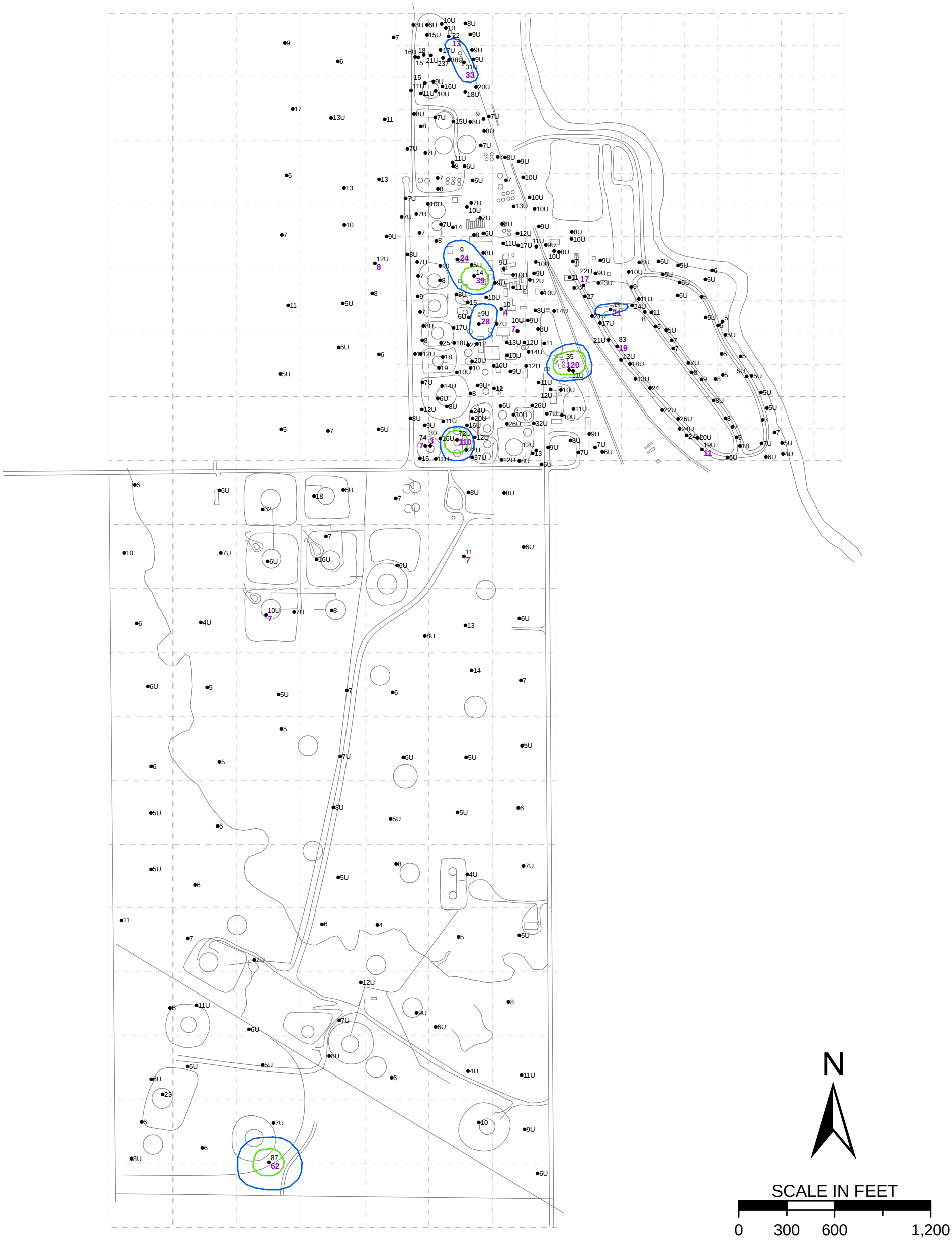
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF SAMPLING LOCATIONS

MWH

SCALE:	FIGURE No.
As Noted	3-1



EXPLANATION

• 87 / 62	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL ARSENIC (ppm) and LAB ANALYZED SOIL ARSENIC (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL ARSENIC ISOPLETHS

—— 20 ppm

—— 38 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL ARSENIC RESULTS

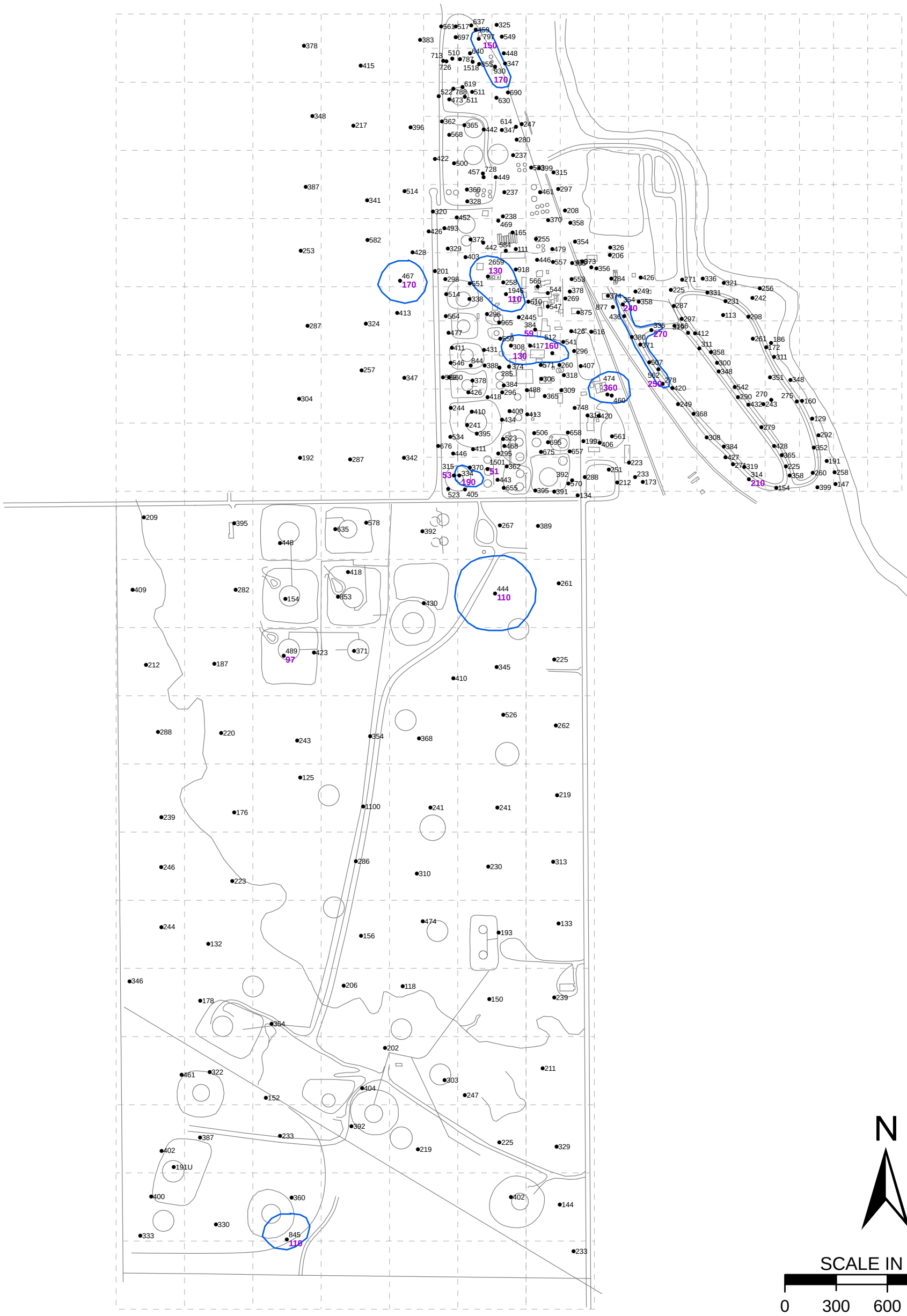
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL ARSENIC CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-2***



EXPLANATION

87 62	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL BARIUM (ppm) and LAB ANALYZED SOIL BARIUM (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL BARIUM ISOPLETHS

100 ppm

140,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL BARIUM RESULTS

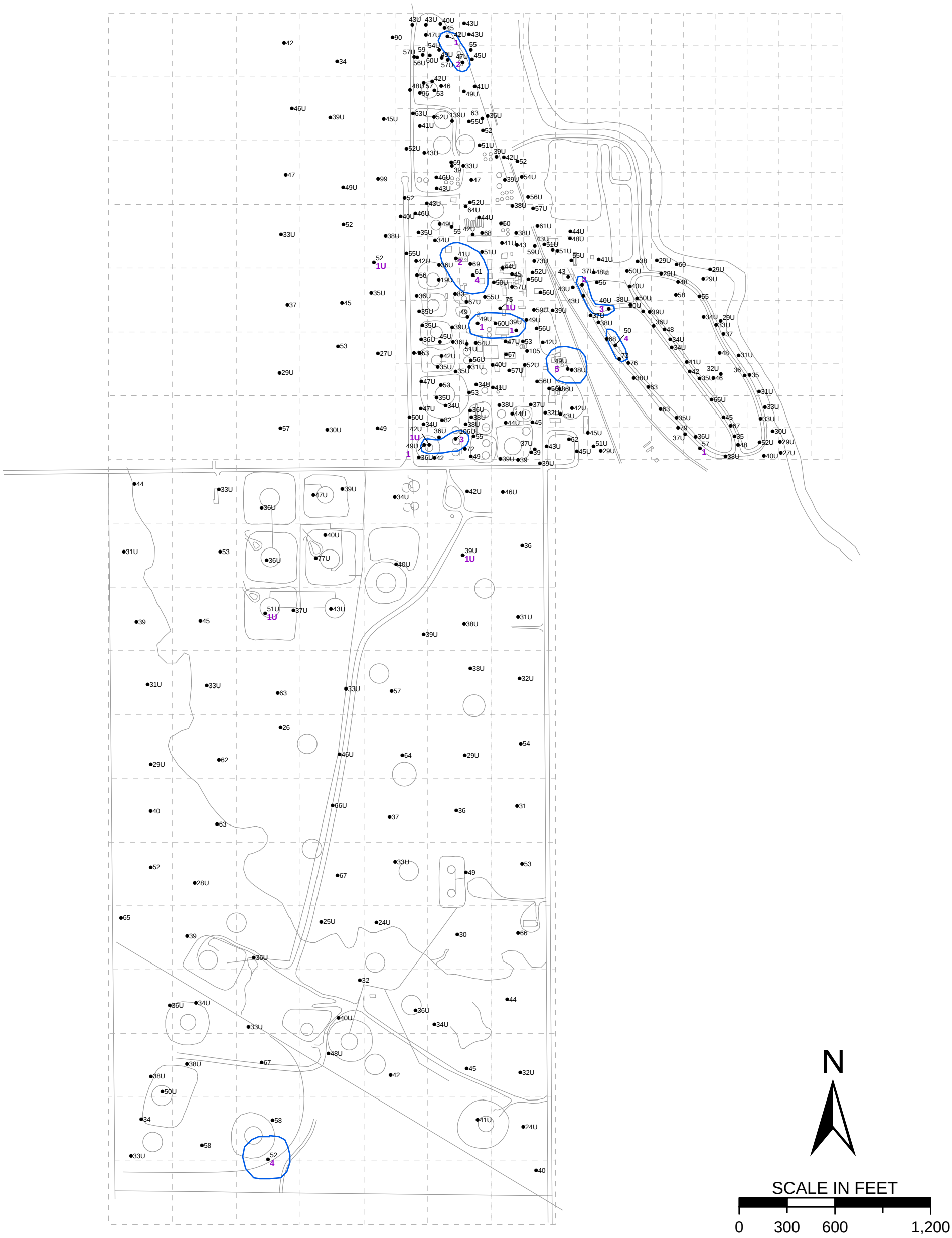
elpaso

EL DORADO REFINERY - EL DORADO, KS

PHASE I XRF AND LABORATORY SURFACE SOIL BARIUM CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-3***



EXPLANATION

• 52 / 4	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL CADMIUM (ppm) and LAB ANALYZED SOIL CADMIUM (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL CADMIUM ISOPLETHS

1

1,000 KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL CADMIIUM RESULTS

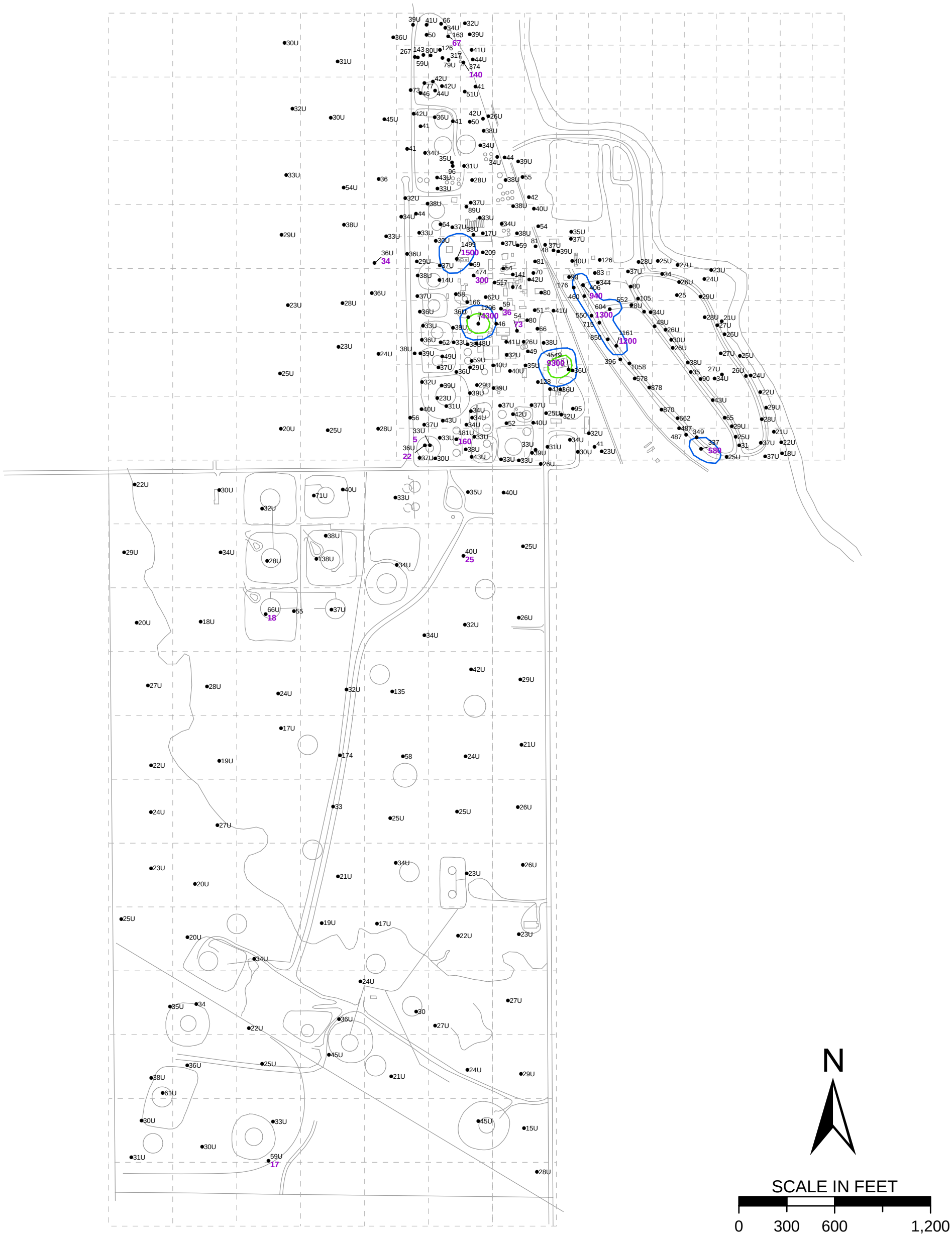
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL CADMIUM CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-4***



EXPLANATION

• 1161 **1200**	XRF ANALYSIS LOCATION WITH SURFACE SOIL CHROMIUM (ppm) and LAB ANALYZED SOIL CHROMIUM (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL CHROMIUM ISOPLETHS

400 ppm

4,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL CHROMIUM RESULTS

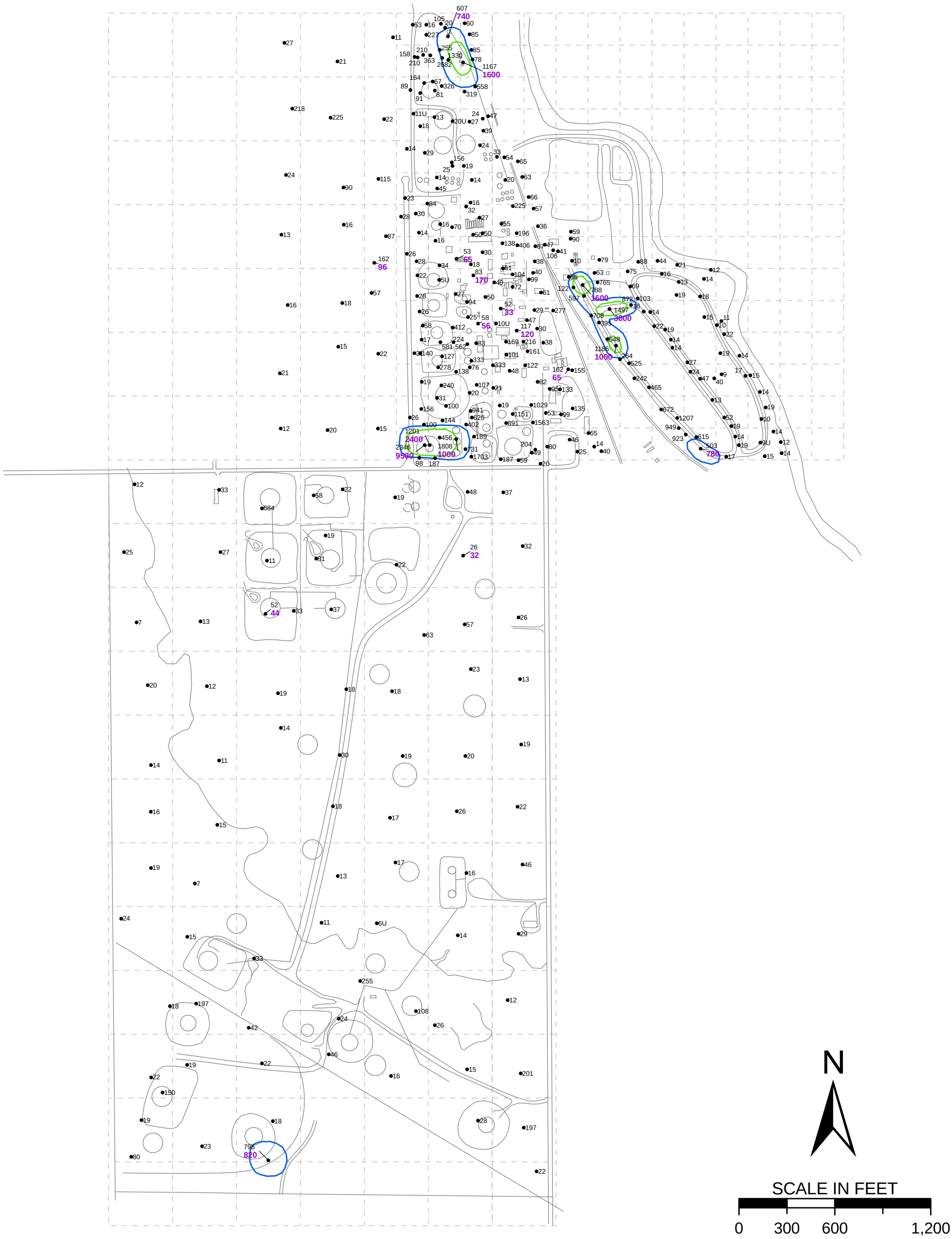
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL CHROMIUM CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-5***



EXPLANATION

• 795 **820**	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL LEAD (ppm) and LAB ANALYZED SOIL LEAD (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL LEAD ISOPLETHS

100 ppm

1,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL LEAD RESULTS

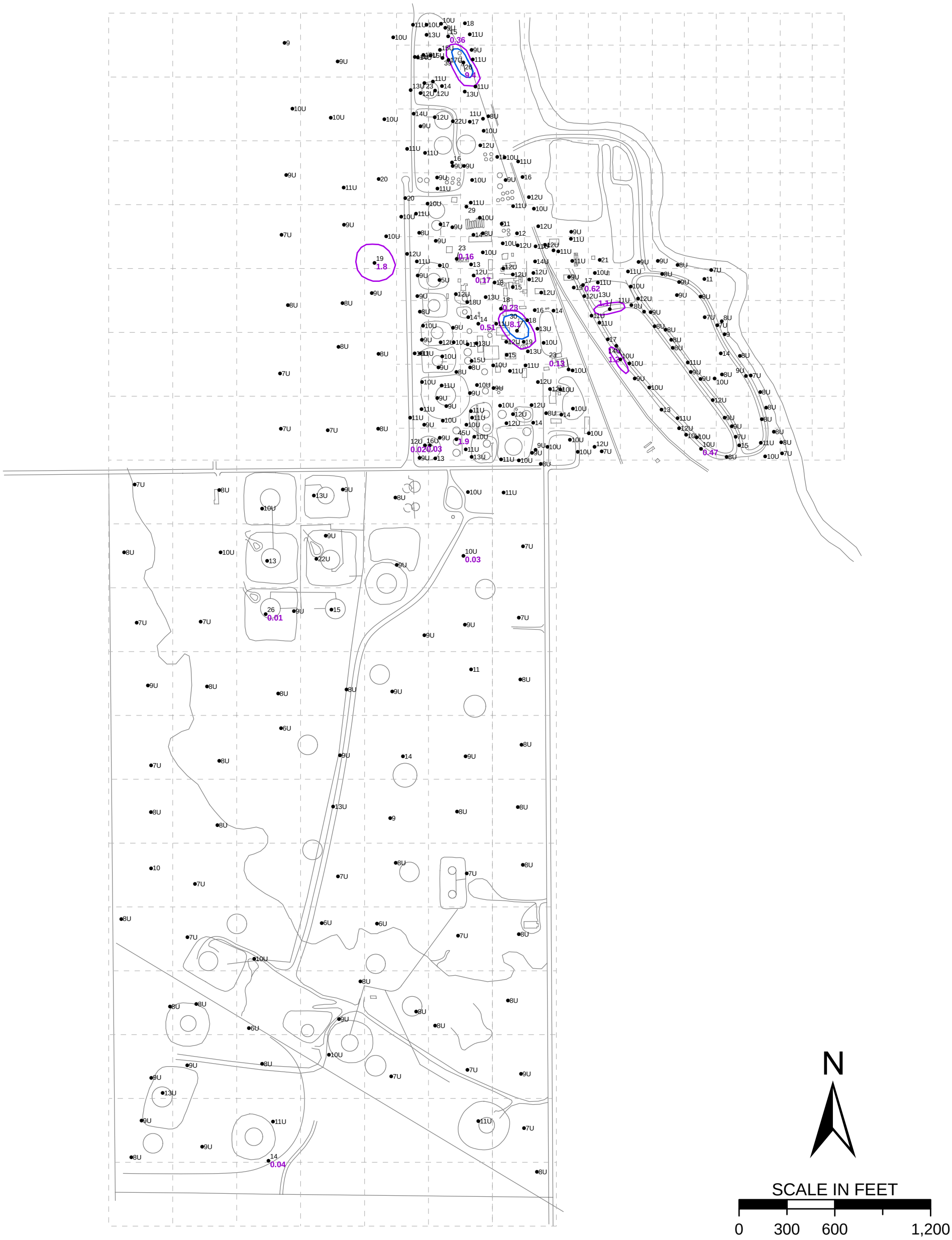
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL LEAD CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-6***



EXPLANATION

• 14 **0.04**	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL MERCURY (ppm) and LAB ANALYZED SOIL MERCURY (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL MERCURY ISOPLETHS

—— 1 ppm

—— 5 ppm

—— 20 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 0.01 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL MERCURY RESULTS

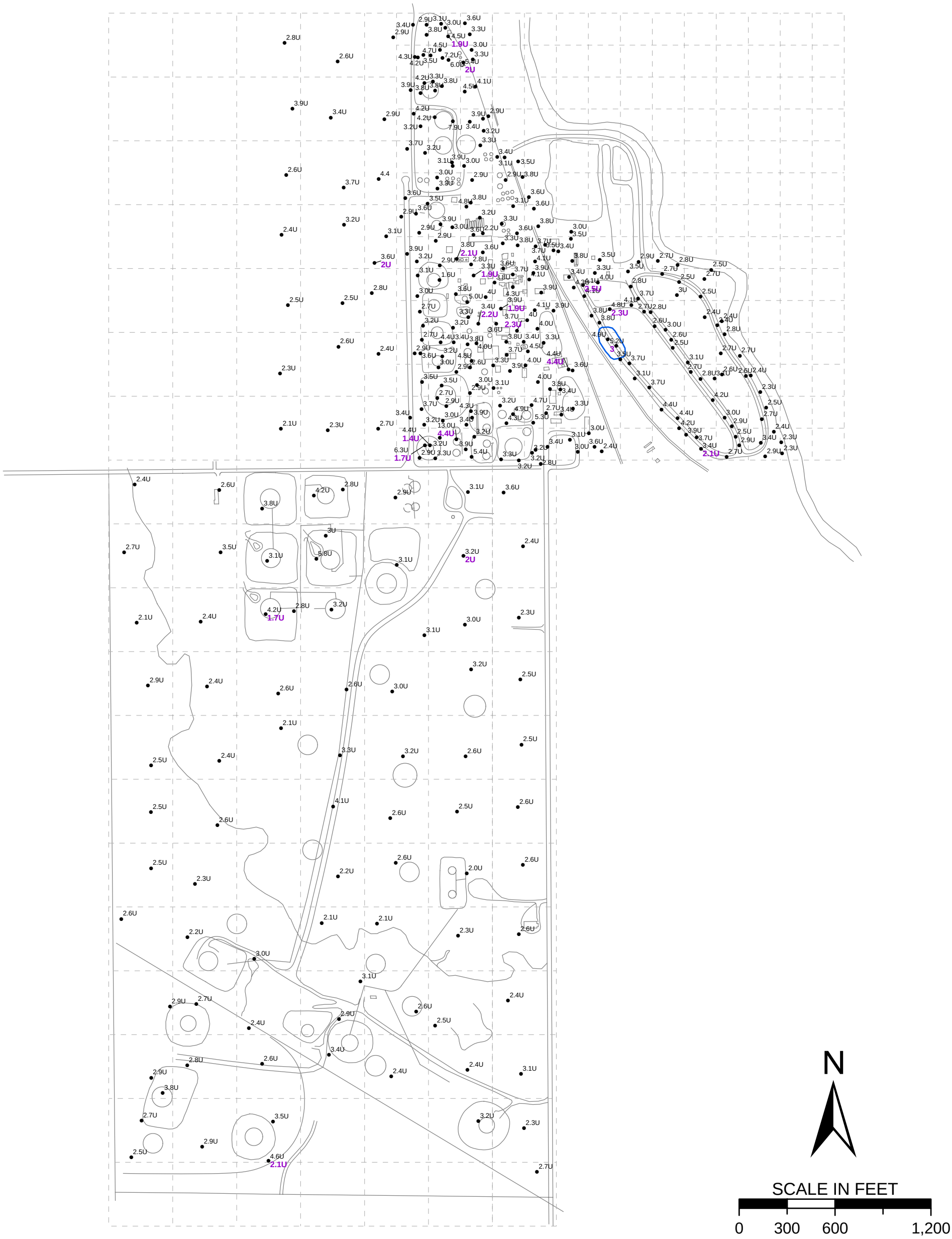
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL MERCURY CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-7***



EXPLANATION

• 4.6U **2.1U**	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL SELENIUM (ppm) and LAB ANALYZED SOIL SELENIUM (ppm)
2.1U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL SELENIUM ISOPLETHS

3 ppm

10,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 0.1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL SELENIUM RESULTS

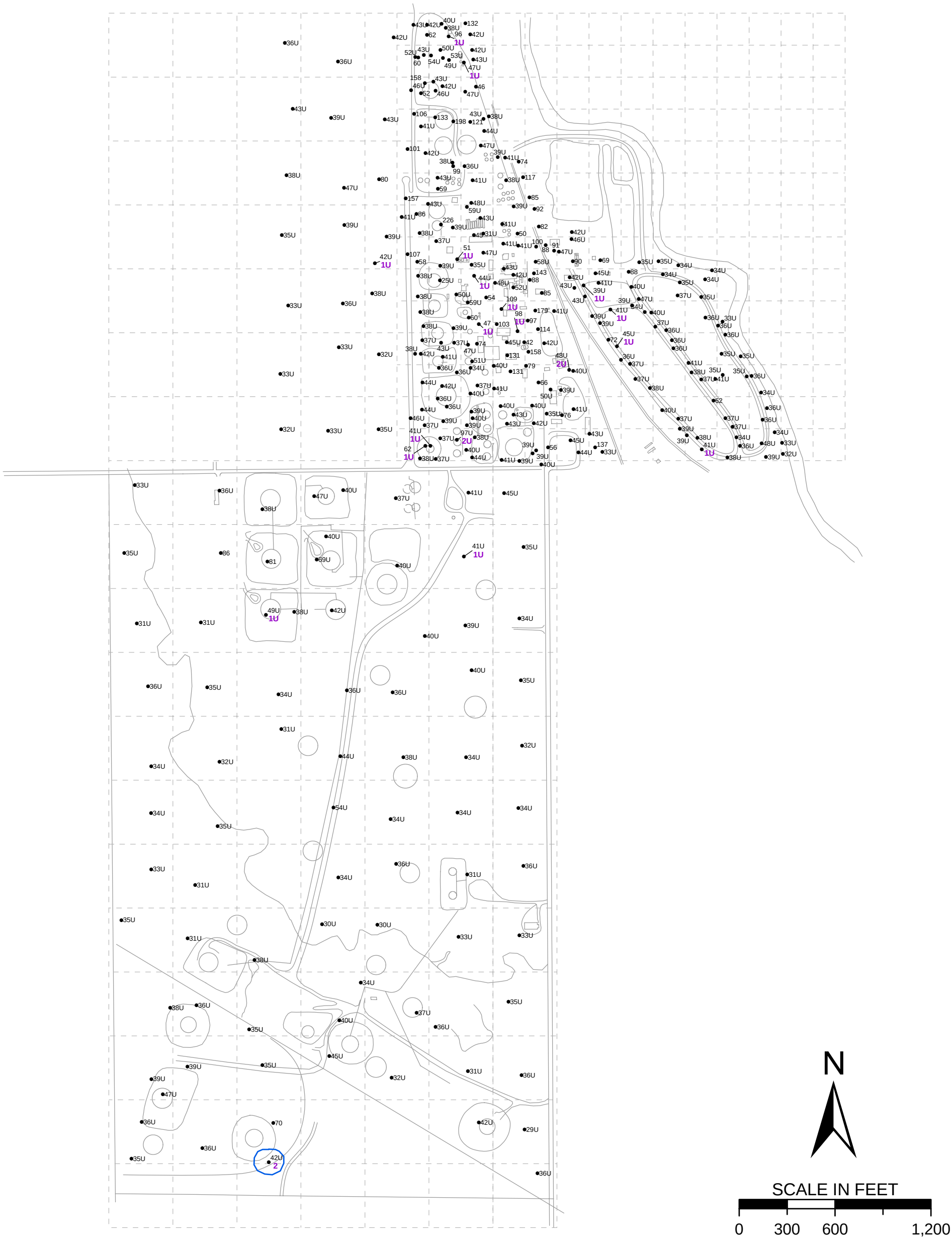
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL SELENIUM CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-8***



EXPLANATION

• 42U / 2	XRF ANALYSIS LOCATION WITH XRF SURFACE SOIL SILVER (ppm) and LAB ANALYZED SOIL SILVER (ppm)
10U	XRF OR LAB RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL SILVER ISOPLETHS

2 ppm

10,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON LAB ANALYSIS SOIL SILVER RESULTS

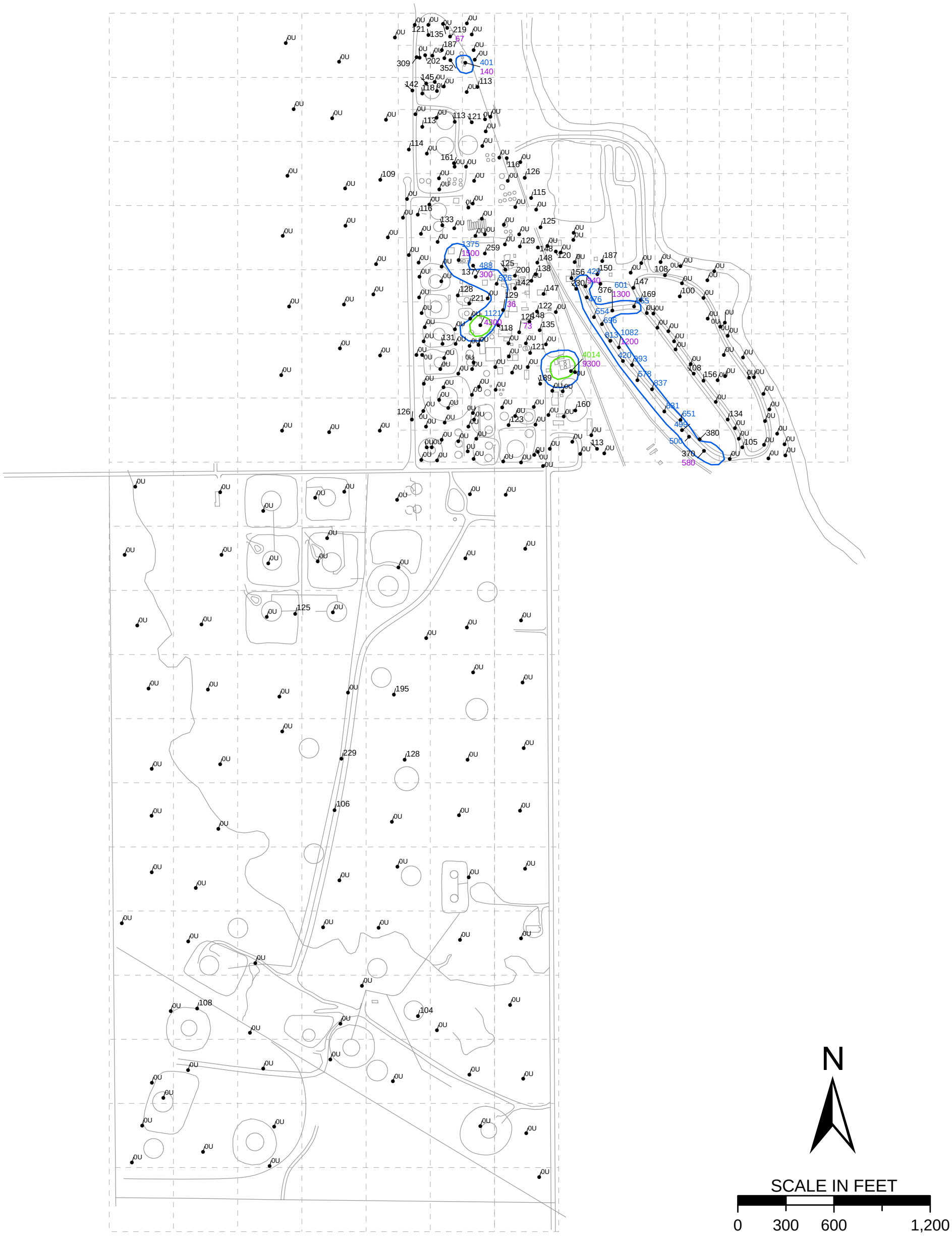
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF AND LABORATORY SURFACE SOIL SILVER CONCENTRATIONS

MWH

SCALE:	FIGURE No.
As Noted	***3-9***



EXPLANATION

• 4014 9300	XRF ANALYSIS LOCATION WITH CALCULATED SURFACE SOIL CHROMIUM (ppm), COLORED ACCORDING TO ISOPLETH LEVEL LAB ANALYZED SOIL CHROMIUM (ppm)
0U	CALCULATED XRF RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL CHROMIUM ISOPLETHS

400 ppm

4,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON CALCULATED XRF RESULTS CORRECTED FOR MOISTURE (DRY WEIGHT BASIS) AND LAB ANALYSIS SOIL RESULTS

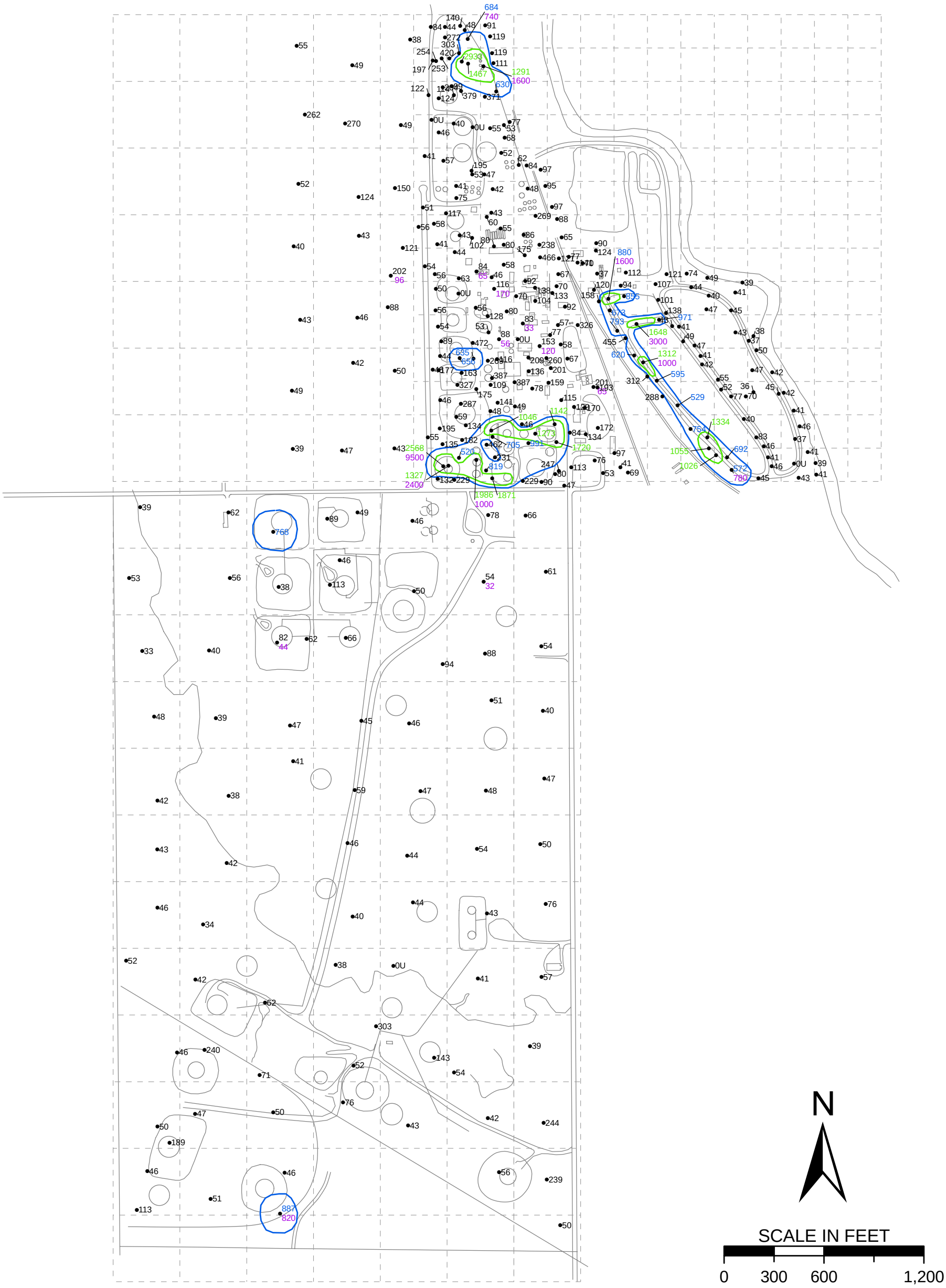
elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF SURFACE SOIL CHROMIUM CONCENTRATIONS - CALCULATED FROM CORRELATION WITH OFFSITE LAB RESULTS

MWH

SCALE:	FIGURE No.
As Noted	***3-10***



EXPLANATION

• 1648 / 3000	XRF ANALYSIS LOCATION WITH CALCULATED SURFACE SOIL LEAD (ppm), COLORED ACCORDING TO ISOPLETH LEVEL LAB ANALYZED SOIL LEAD (ppm)
0U	CALCULATED XRF RESULT LESS THAN LIMIT OF DETECTION (LOD)

SURFACE SOIL LEAD ISOPLETHS

500 ppm

1,000 ppm KDHE RSK LEVEL

NOTES:
ALL CONCENTRATIONS ROUNDED TO NEAREST 1 PPM
ISOPLETHS DRAWN BASED ON CALCULATED XRF RESULTS CORRECTED FOR MOISTURE (DRY WEIGHT BASIS) AND LAB ANALYSIS SOIL RESULTS

elpaso

PROJECT:
EL DORADO REFINERY - EL DORADO, KS

TITLE:
PHASE I XRF SURFACE SOIL LEAD CONCENTRATIONS CALCULATED FROM CORRELATION WITH OFFSITE LAB RESULTS

MWH

SCALE: *As Noted*

FIGURE No. ***3-11***

APPENDIX A

PHASE I XRF INVESTIGATION
EL DORADO REFINERY
EL DORADO, KANSAS

October 2005

Prepared for:
El Paso Corporation
2 North Nevada Avenue
Colorado Springs, Colorado
80903

Prepared by:
MWH
111 South Whittier, Suite 5100
Wichita, Kansas
67207

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2.2 PHASE I SAMPLING METHODS 2-4
2.2.1 XRF Methods for Metals 2-4
2.2.2 Background Sampling 2-5
2.2.3 Quality Assurance/ Quality Control Methods 2-6
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3-4	Phase I XRF and Laboratory Surface Soil Cadmium Concentrations
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3-9	Phase I XRF and Laboratory Surface Soil Silver Concentrations
3-10	Phase I XRF Surface Soil Chromium Concentrations Calculated From Correlation with Offsite Lab Results
3-11	Phase I XRF Surface Soil Lead Concentrations Calculated From Correlation with Offsite Lab Results

LIST OF ATTACHMENTS

ATTACHMENT	TITLE
Attachment A	EPA Method 6200
Attachment B	Metals in Soil Analysis Using Field Portable X-ray Fluorescence
Attachment C	Soil Sample Analytical Data

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the results of a surface soil screening investigation at the El Dorado Refinery (Site) in El Dorado, Kansas. The investigation was performed by MWH for El Paso Corporation (EPC) on behalf of El Paso Merchant Energy-Petroleum Company. The objective of the investigation, as outlined in the Work Plan for XRF Investigation El Dorado Refinery May 2005 (Work Plan), was to identify potential areas of elevated metal concentrations in surface soils to protect surface water around the Site. Metal concentration data will be utilized when planning storm water control measures. A portable field x-ray fluorescence (XRF) spectrometer was used as a screening tool to analyze metal concentrations throughout the Site.

Stormwater is currently managed under the Kansas National Pollutant Discharge Elimination System (NPDES). Stormwater generally flows from west to east and north to south across the Site to one of many locations including sumps and ponds. Stormwater from the Site eventually flows into a series of wastewater ponds located at the eastern boundary of the Site and then discharges from an outfall into the West Branch of the Walnut River.

The El Dorado Refinery is currently undergoing demolition of all Site facilities. The demolition process is being conducted in two phases, above-ground and below-ground. The above-ground phase includes decontamination and demolition of all above-ground piping, tanks, and equipment. The below-ground phase will include demolition of buildings, underground piping, concrete footings, and drainage structures.

Field XRF investigations will be carried out in phases in order to identify areas of elevated metal concentrations during and after demolition activities at the Site. This report describes the results of the first phase (Phase I) of the investigation which occurred during above-ground demolition activities at the Site and provides a general screening of metal concentrations in surface soils that were accessible during the on-going demolition

activities. All activities were coordinated with the on-Site demolition contractors to establish areas of the Site that were accessible for the XRF investigation. This document includes tabulated and plotted data collected during the Phase I investigation, which will be evaluated in order to identify areas of the Site that contain elevated metal concentrations in surface soils. Phase I data will also be utilized to assess the need for conducting a Phase II XRF investigation. If conducted, a Phase II XRF investigation will include an expanded assessment of areas that were identified as containing elevated metal concentrations in Phase I. If necessary, a Phase III XRF investigation will be conducted in order to collect XRF measurements and samples in areas that were not accessible during Phase I and Phase II including locations beneath tanks and concrete footings.

1.2 DOCUMENT ORGANIZATION

Following this section, the document is organized as follows:

- Section 2.0 – Field Sampling Program
- Section 3.0 – Results
- Section 4.0 – References

2.0 FIELD SAMPLING PROGRAM

2.1 SAMPLING DESIGN AND STRATEGY

The complete soil screening investigation will be conducted in a phased approach in order to evaluate metal concentrations in surface soil at the Site. This report addresses the results from Phase I of the investigation, conducted from June 6, 2005 through June 16, 2005. The results from Phase I will be utilized to assess the necessity of conducting further investigation during Phase II. Both Phase I and Phase II will be conducted concurrently with the demolition activities at the Site. If necessary, Phase III will be performed as areas become accessible during demolition activities. The following is a summary of the tasks addressed during Phase I.

Phase I Sampling Layout

The Phase I sampling layout developed for the Site is shown on Figure 2-1, *Phase I XRF Sampling Layout*. The primary objectives of the Phase I investigation included the following:

- Perform a general screening of the Site to identify areas of elevated metal concentrations in surface soils.
- Collect soil samples for off-Site laboratory analysis to confirm XRF data.
- Assess the need for conducting a Phase II XRF investigation.
- If necessary, determine specific areas that warrant further investigation during Phase II.

As shown on Figure 2-1, the Site was divided into northern, northwestern, and southern regions. The northern region encompassed the refining and processing facilities, the northwestern area included the former asphalt disposal area, and the southern region included the south tank farm. The northern region was divided into 200 feet by 200 feet grid cells and the northwestern and southern regions were divided into 400 feet by 400 feet grid cells. Grid cell locations for samples were identified by a column heading and

row heading. In the northern region, columns ranged from A1 through N1, and rows ranged from 1 through 14. The northwestern and southern regions shared a column and row heading design, with columns ranging A2 through G2, and rows ranging from 1 through 7 in the northwestern region, and 8 through 19 in the southern region. XRF sampling did not occur in grid cells located outside the approximate Site boundary. Grid cells located in the Pester Burn Pond Superfund site in the northeast portion of the Site were excluded from the investigation.

An in-situ tool (field XRF) was used to measure surface soil concentrations of target analytes in each grid cell during Phase I. A Global Positioning System (GPS) was used to identify grid cell boundaries during field activities. According to the Work Plan, as many as three measurements were to be collected per grid cell in the northern portion of the Site and only one or two measurements were to be collected per grid cell in the southern portion of the Site. In six grid cells in the northern region, four measurements were made instead of just three, due to the presence of visual evidence of apparent impacts. The XRF locations were biased towards areas exhibiting visual evidence of potential elevated metal concentrations, such as debris piles or stained soils, and areas at or near former and existing Site facilities whose processes had the potential to contribute to elevated metal concentrations in soil. These facilities included former tank areas, unpaved roadways, cooling towers, and other facilities based on visual assessment of the Site. If visual or historical evidence did not exist within a grid cell to guide measurement locations, only one measurement location was selected near the center of the grid cell.

The analytes reported during XRF in-situ screening were the eight (8) Resource Conservation and Recovery Act (RCRA) metals, which include arsenic, barium, cadmium, chromium, lead, selenium, mercury, and silver. In addition to the in-situ field measurements, soil samples were collected from nineteen (19) of the in-situ locations for off-Site laboratory confirmatory analysis for the RCRA 8 metals by EPA Methods 6010B and 7471A. The sampling methods for in-situ and laboratory analysis are described in Section 2.2.

The Phase I screening data were tabulated and plotted in order to assess the need for conducting a Phase II XRF investigation. The difference in RCRA 8 concentrations between the in-situ measurements and laboratory results were compared and a correlation was developed to scale in-situ metals measurements in order to compare the in-situ metals results to screening levels. Screening levels utilized for comparison with the Phase I data were based on the KDHE Tier 2 Risk-Based Standards (RSK) for ingestion of soil in industrial areas. The screening levels for the RCRA 8 metals are 38 mg/kg for arsenic, 140,000 mg/kg for barium, 1,000 mg/kg for cadmium, 4,000 mg/kg for chromium, 1,000 mg/kg for lead, 10,000 mg/kg for selenium, 20 mg/kg for mercury, and 10,000 mg/kg for silver.

2.2 PHASE I SAMPLING METHODS

2.2.1 XRF Methods for Metals

Within each grid area, XRF in-situ measurements were collected in accordance with EPA Method 6200 and generally followed the suggested method from the XRF device manufacturer, Innov-X Systems, *Metals in Soil Analysis using Field Portable X-ray Fluorescence* (Innov-X Systems, Inc., 2003). Both the EPA and Innov-X Systems methods are included in this report as Appendices A and B, respectively. A handheld XRF analyzer was used to measure metal concentrations in soil. Samples were measured in-situ by placing the instrument directly in contact with surface soil. In-situ XRF testing is considered a field-screening method and is a valuable technique because it efficiently generates a large quantity of screening-level data.

Prior to in-situ sampling, the immediate area was cleared of debris. The soil was tamped down and made as smooth as possible. This often required some leveling of the surface with a stainless steel hand trowel. In moist to wet locations, an attempt was made to find drier soil. The XRF analyzer was placed in direct contact with the ground surface during the measurement process. All locations were surveyed with a GPS. A record of the sample identification number, location, date, metal concentrations, and any other relevant comments were recorded in a bound field book.

The Innov-X XRF analyzer had two test programs available under the soil mode: Standard Test and Light Element Test. The latter test is provided by the Light Element Analysis Program (LEAP), which was a factory-installed mode on the analyzer in addition to the Standard Test option. The LEAP module provides the lowest possible detection limits for elements lighter than iron. The standard LEAP package includes the elements Ti, Ba and Cr. The standard x-ray beam conditions (Standard Test) used by Innov-X environmental analyzers are designed to provide good excitation for a wide range of detected elements. However, it is not possible to select one beam condition that provides the absolute best excitation conditions for all elements of interest. Elements such as chromium produce lower energy x-rays than other elements analyzed. These

lower energy x-rays are not as effectively excited by the standard conditions. LEAP works by changing the x-ray tube beam conditions to settings which are optimized for the detection of elements lighter than iron. Instruments are factory calibrated with the LEAP beam conditions for all applicable elements. Using both tests resulted in two readings per sampling location. The barium and chromium data provided by the Light Element Test were used when reporting results rather than the data provided by the Standard Test.

At nineteen of the in-situ XRF measurement locations, a soil sample was collected and sent to an off-Site laboratory to provide confirmatory results for arsenic, barium, cadmium, chromium, lead, selenium, and silver by EPA Method SW846 6010B and mercury by EPA Method SW846 7471A. The 19 soil sampling locations were chosen based on field data to provide a range of detected values for the RCRA 8 metals. The laboratory results were compared to the in-situ sample results. For the laboratory sample, a 4-ounce clean glass sample jar with no preservative was filled with soil from the same location as the in-situ measurement using a clean stainless steel hand trowel. The soil sampling volume was approximately a 4-inch by 4-inch square by 1-inch deep. The sample jar was labeled with the project name and location, sample designation, date and time of collection, sampler's initials, and required analyses. Collected soil samples were stored until all samples were ready to be shipped to the laboratory for analysis. A record of the sample identification number, location, date, and any other relevant comments were recorded in a bound field book. The samples were shipped via overnight courier under chain-of-custody control.

2.2.2 Background Sampling

The necessity of Site-specific background soil sampling will be determined as part of Phase II.

2.2.3 Quality Assurance/ Quality Control Methods

Calibration Procedures

The portable XRF analyzer is factory calibrated as described in the Innov-X Systems instrument-specific guidelines in Attachment B and has been proven over the past several years to provide a robust calibration generally independent of Site-specific soil matrix chemistry. Therefore, calibration of the analyzer is not required but the quality assurance and quality control (QA/QC) methods outlined in the following section were followed to verify calibration.

Quality Assurance/ Quality Control Methods

Quality assurance is necessary for both the proper use of the analyzer and for verifying the data quality of the in-situ testing as specified in EPA Method 6200 in Attachment A and summarized below.

- An energy calibration check sample at least twice daily was performed automatically by the XRF analyzer.

- A calibration verification check sample for every 20 samples or every four (4) hours was performed using a factory provided NIST standard reference sample: Standardization Clip 316 Stainless Steel.

- Nineteen confirmatory samples as specified in Section 2.2.1 were collected from the same sample material that was analyzed on-Site and sent to an off-Site laboratory for formal analysis.

2.2.4 General Protocols

This section presents a discussion of general sampling protocol including sample labeling and designation, documentation procedures, chain-of-custody forms, sampling handling and shipping, and decontamination procedures.

Sample Labeling and Designation

For this sampling program, each sample had a unique identification number that consisted of the grid cell label and the sequential sample number. For example, the two in-situ XRF sample locations within grid cell B1-9 (column B1, row 9) were designated as B1-9-1 and B1-9-2. XRF in-situ and collected soil samples for confirmatory laboratory analysis were identified as such in a bound field logbook. Sample labels on sample containers submitted for laboratory analysis included the project name and location, sample designation, date and time of collection, preservative (if applicable), sampler's initials, and required analyses. Labels were sufficiently durable to remain legible and were completed with indelible ink.

Documentation Procedures

Data generated during the investigation were recorded in a weather-resistant, bound, survey-type field logbook with numbered, non-removable pages. The sample location identification number and result was recorded in a field book along with the date and time of the measurement. The lead concentration was recorded for each sample location. Detection of lead at the Site was more prevalent than the other RCRA 8 metals. Data for additional RCRA 8 metals were also recorded if the detected value was close to or exceeded the respective RSK value. Each sample location was surveyed with a GPS; the location coordinates were recorded in the field book.

Daily information entered in the logbook included:

- Date
- Name and location of the work activities
- Weather conditions
- Personnel and visitors on Site
- Sample locations and methods (including sampling equipment), time of sample collection, and sample depths
- Samples submitted to the laboratory for analyses
- Sample type (e.g., in-situ, confirmatory, or duplicate)
- Name of carrier transporting the sample (e.g., name of laboratory and shipping agent)
- Description of decontamination activities
- Description of sample locations
- Any deviations from the field sampling plan
- Other relevant observations as the field work progresses
- Problems and corrective actions
- Field equipment calibration methods

At the end of each field day, the project field book will be dated and signed by the field person performing the work.

Chain-Of-Custody

For samples sent to the off-Site laboratory, a project-specific, chain-of-custody form was completed and accompanied the sample cooler. The chain-of-custody form included project identification, project location, sample designation, analysis type, and shipping account information. In addition, there were spaces for entry of the sample collection date and time, signature of the persons relinquishing and receiving samples, and the

status of the samples upon receipt by the laboratory. The chain-of-custody form was in triplicate. The original of the form was shipped to the laboratory with the samples, one duplicate copy will be reviewed and filed by the MWH project chemist, and the other duplicate will be kept in the project files.

Each form was completed properly in the field at the time of collection to ensure that sample custody was documented, appropriate amount of sample has been collected, and that scheduled analyses were properly assigned. All entries were made using indelible ink on the chain-of-custody form. Any errors were corrected by drawing a single line through the incorrect entry, entering the correct information, and then initialing and dating the change.

Unused portions of the chain-of-custody form will be crossed out and initialed. All samples will be transported by field personnel or via a commercial carrier (e.g., Federal Express Priority Service). The signed shipping tracking number and receipt will serve as evidence of custody transfer between the field sampler and carrier, and the carrier and laboratory. The sampler will retain and file copies of the chain-of-custody record and the shipping tracking number and carrier name after the samples are shipped. The carrier will relinquish samples to the laboratory upon arrival, and the laboratory personnel will then complete the chain-of-custody form. The original completed chain-of-custody form will be returned to MWH and filed in the project files.

Sample Handling and Shipping

All samples collected for confirmatory off-Site analysis were shipped or transported in coolers. All samples were shipped via a commercial carrier. Sampling personnel prepared air-courier waybill identification labels in strict accordance with the U.S. Department of Transportation procedures.

Equipment Decontamination

Prior to collecting any sample and between sampling locations, all sampling equipment was decontaminated using a non-phosphate detergent (Alconox). Up to four decontaminated stainless steel hand trowels were used to minimize downtime during decontamination if multiple samples were collected from the same area.

IDW

The types of investigation-derived waste (IDW) generated during the work included decontamination water, personal protective equipment (PPE), and disposable field equipment (i.e., baggies and paper towels). Whenever possible, methods were used to minimize the volume of IDW generated. During the XRF field investigation, all IDW was handled and managed with waste generated during demolition activities and followed the protocol and procedures for waste generated during the demolition activities at the Site.

3.0 RESULTS

3.1 XRF SAMPLING LOCATIONS

A total of 347 in-situ surface soil XRF measurements were taken from June 6, 2005 through June 16, 2005. The locations for the 347 measurements are illustrated in Figure 3-1. One to three in-situ measurements were collected from each grid cell during Phase I, except for six cells in which four measurements were taken. The breakdown of measurements taken by grid region was 242 in the northern region, 22 in the northwestern region, and 83 in the southern region. The greater number of measurements in the northern region was due to the concentrated presence of refinery operations facilities, including tanks and former tank areas, unpaved roadways, and cooling towers, as well as other visual evidence of debris piles and stained soils.

Numerous rainfall events during the entire sampling period of June 6, 2005 through June 16, 2005, left the surface soil at the Site in the range of moist to wet at most times. The elevated moisture contents of exposed surface soil led to finding locations with drier soils as an additional bias in selecting sampling locations. Additionally, many bermed tank areas were filled with water, at times several feet deep. Thus, it was not possible to take measurements in some areas. According to the Innov-X XRF analyzer manual, soil moisture does not have a significant effect on accuracy due to effects of soil matrix, except for the dilution effect that can cause discrepancies with laboratory results. Laboratories generally report results on a dry sample basis. Therefore, laboratory results will be higher by the amount of moisture content in the sample. For example, laboratory results may be approximately 10% higher in concentration compared to XRF results if the sample contained 10% by weight water when it was tested with XRF. The average moisture content of the 19 laboratory analyzed confirmation soil samples was 17 percent, with a range of 3 to 28 percent. Further discussion of the effects of moisture on results follows in Section 3.4.

3.2 XRF SAMPLING RESULTS

A summary of the in-situ XRF measurement data is provided in Table 3-1. The frequency of individual RCRA 8 metal detections varied by location and metal. Arsenic was detected above the instrument limit of detection at 121 sampling locations, barium at 346, cadmium at 113, chromium at 93, lead at 341, mercury at 55, selenium at 1, and silver at 62 locations.

On the XRF analyzer, detected elements are presented with a calculated concentration followed by the error on the measurement. This error is the 1 sigma error (or one standard deviation) on the counting statistics of the measurement. Results for elements not detected are shown as less than the limit of detection (LOD) of the instrument. The LOD is defined as three times the error on the counting statistics of the measurement. The values presented in Table 3-1 are those directly provided by the XRF analyzer, and have not been corrected for laboratory confirmation samples. Detected RCRA 8 metals at each location are shown with the calculated concentration provided by the XRF analyzer. For elements not detected, Table 3-1 shows the calculated LOD followed by a "U". Note that the LOD varies by sampling location for any given metal, due in part to differences in soil matrices and soil moisture content, as well as other factors.

3.3 CONFIRMATION SAMPLING RESULTS

The nineteen confirmation soil samples were analyzed by STL Pensacola, Pensacola, FL. The analytical lab report is provided in Attachment C. EPA Method SW846 6010B was used for analysis of arsenic, barium, cadmium, chromium, lead, selenium and silver. EPA Method SW846 7471A was used for analysis of mercury. Percent moisture was measured by EPA Method 160.3. The results from these analyses are presented in Table 3-2 alongside the respective in-situ XRF results for each sampling location and analyte from the in-situ XRF analysis. The laboratory results were plotted along with the in-situ XRF results on Figures 3-2 through 3-9, with concentration isopleths drawn to illustrate elevated metal concentration locations in addition to locations meeting or exceeding the

screening levels, which were based on the KDHE RSK levels. The occurrence of laboratory results exceeding the respective screening levels for the RCRA 8 metals is discussed below. Though some of the values detected through the in-situ XRF analysis process met or exceeded the screening values, this discussion is limited only to the confirmed analytical results from the laboratory.

The KDHE RSK level of 38 mg/kg for arsenic was exceeded in four laboratory analyzed sampling locations: F1-12-3 (120 mg/kg), C1-9-2 (39 mg/kg), B1-14-4 (110 mg/kg), and C2-18-1 (62 mg/kg). Figure 3-2 depicts the occurrences of XRF and laboratory detected levels of arsenic at the Site. The four sampling locations exceeding the RSK level were at least 1,000 feet away from the nearest location also exceeding the RSK level.

There were no laboratory analyzed soil samples that exceeded the KDHE RSK levels of 140,000 mg/kg for barium and 1,000 mg/kg for cadmium. Detected values for barium ranged from 51 mg/kg at B1-14-4 to 360 mg/kg at F1-12-3, both well below the RSK level. Similarly, the laboratory detected cadmium values were well below the RSK level, ranging from non-detect at several locations to 4.9 mg/kg at F1-12-3. The distributions of XRF and laboratory detected levels of barium and cadmium are shown on Figure 4-3 and Figure 4-4, respectively.

The chromium RSK level of 4,000 mg/kg was exceeded in two laboratory samples. A chromium level of 9,300 mg/kg was detected in the sample from F1-12-3, and a level of 4,300 mg/kg was detected in the sample from C1-10-1. Sampling location F1-12-3 was near the southeast corner of a cooling tower, while C1-10-1 was just south of another cooling tower. An elevated chromium level of 1,500 mg/kg was detected at B1-8-2, on the northwest corner of a third on-Site cooling tower. Chromium concentrations ranging from 580 mg/kg to 1,300 mg/kg were detected along the berms of the western treatment ponds. The source of the berm material is unknown. The distribution of chromium as detected by both laboratory and XRF methods in surface soil at the Site is shown on Figure 3-5.

Seven of the nineteen laboratory analyzed soil samples had detected values equal to or exceeding the lead RSK level of 1,000 mg/kg. These values ranged from 1,000 mg/kg at G1-11-3 and B1-14-4, to 9,500 mg/kg at A1-14-1. The locations exceeding soil lead RSK levels were primarily in the northern and southern portions of the refinery, and along the berms of the western treatment ponds. Elevated levels of lead were observed in the southern tank farm up to 820 mg/kg at C2-18-1, though none of the values exceeded the RSK level of 1,000 mg/kg (Figure 3-6).

None of the laboratory analyzed soil samples had detected levels of mercury above the KDHE RSK levels of 20 mg/kg. Laboratory detected mercury levels ranged from 0.013 mg/kg to 9.4 mg/kg, which is slightly less than half the screening level of 20 mg/kg. Though several of the mercury levels detected by the in-situ XRF procedure exceeded the 20 mg/kg screening level, the XRF results were not confirmed by off-Site laboratory analyses of soil samples from these locations (Table 3-2). Further investigation of these areas will be addressed during the Phase II XRF investigation.

Silver was detected in only one sampling location, C2-18-1, at a level of 2.3 mg/kg. Similarly, only one location had a detection of selenium, 3.0 mg/kg at G1-11-3. The detected values of silver and selenium were significantly below the screening level of 10,000 mg/kg for both metals. The distributions of laboratory and in-situ XRF detected values are shown on Figure 3-7 for mercury, Figure 3-8 for selenium, and Figure 3-9 for silver.

3.4 COMPARISON OF IN-SITU XRF AND LABORATORY RESULTS

Comparison of in-situ XRF results with the corresponding laboratory analyzed results through linear correlation analyses required correcting the in-situ XRF results for soil moisture content. The laboratory results were reported on a dry soil weight basis, whereas the XRF results were measured under in-situ conditions (i.e., wet soil weight), thus a dry soil weight basis (dry weight XRF) value was required. This was accomplished according to the following equation:

Dry Weight XRF Result = (In-Situ XRF Result) * (1 + W% / 100)

where W% is the percent moisture content of the soil sample as determined by the off-Site laboratory. Linear correlation analyses were used to compare the XRF (dry soil weight basis) and laboratory results for each of the RCRA 8 metals. A significant correlation between the two methods was found for chromium and lead, but not for the other six RCRA 8 metals (Table 3-3). Factors contributing to not observing correlating results for the other metals may include the limited number of samples for the comparison due to non-detect values from either or both methods, and sample variability due to the amount of soil collected and/or analyzed for each approach.

The linear correlation equations for chromium and lead were used to calculate dry weight XRF values for all of the 347 in-situ XRF sampling results. These values are plotted on Figure 3-10 for chromium and on Figure 3-11 for lead, along with the respective laboratory analysis results for each metal and applicable sampling location. For non-detect in-situ XRF results, the lab and moisture corrections were not applied and instead, the LOD value was replaced with a zero (0U) on the figures. As the detected in-situ XRF values have been corrected based on the confirmed laboratory analysis results, the concentration isopleths have been adjusted on each figure to contain the updated XRF results for chromium and lead in addition to the laboratory results.

For chromium, the correction of the in-situ XRF results for moisture content (dry weight basis) and the confirmed laboratory analyses increased the coverage of the elevated chromium concentration isopleths. The two regions exhibiting chromium levels above the screening level of 4,000 mg/kg did not change, though the XRF level at C1-10-1 (1,121 mg/kg), was less than the screening level. The confirmation soil sample analyzed by the lab for C1-10-1 had a detected level of chromium of 4,300 mg/kg (Table 3-2). Calculated XRF results for chromium ranged from 99.74 mg/kg at I1-9-3 to 4013.63 mg/kg at F1-12-3, which was the only calculated XRF result that exceeded the screening level of 4,000 mg/kg.

Inclusion of the calculated XRF results with the laboratory results for lead also resulted in confirmation of larger regions exhibiting elevated levels of lead at the Site (Figure 3-11). On the lead map, elevated levels are represented by concentration isopleths for 500 mg/kg and 1,000 mg/kg, the latter of which is the RSK level. Regions affected by inclusion of the calculated XRF results include the northern and southern portions of the refinery, and the bermed area along the two western treatment ponds. Calculated XRF results for lead ranged from 33.49 mg/kg at A2-10-1 to 2,932.67 at B1-2-2. Sixteen of the calculated XRF results for lead exceeded the screening level of 1,000 mg/kg.

3-5 CONCLUSIONS

The results of this Phase I XRF soil investigation were successful in providing a general screening of the Site to identify areas of elevated metal concentrations in surface soils. Comparison of in-situ XRF readings with the results from laboratory analysis of confirmation soil samples found a linear correlation between the results from the two methods for chromium and lead, but not for the other six RCRA 8 metals. Applying the appropriate linear correlation to determine calculated XRF results, sampling locations exhibiting elevated surface soil concentrations for chromium and lead were identified in addition to those defined by confirmatory laboratory results alone.

The Phase II XRF soil investigation will be conducted as part of the next phase of the Site-wide investigation. Specific areas that warrant further investigation during Phase II include the on-Site cooling towers, the soil berms around the treatment ponds, and select areas in the northern portion (grid cells B1-1 to C1-3) and the southern portion (A1-13 to E1-14) of the refinery. Grid cell C2-18, at the southern extent of the South Tank Farm had a soil sampling location exhibiting an elevated level of arsenic and lead, both via in-situ XRF sampling and a laboratory confirmation sample. An elevated mercury level was observed with XRF sampling but not confirmed by laboratory analysis. This area should also be re-addressed during Phase II.

4.0 REFERENCES

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TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
A1-10-1	1785471	1744399	6.86	477.30	35.3U	36.29U	25.82	8.49U	2.72U	37.5U
A1-10-2	1785491	1744311	7.68U	410.51	34.55U	33.23U	58.42	9.9U	3.23U	38.16U
A1-1-1	1785429	1746195	8.35U	560.50	43.1U	39.25U	53.47	10.67U	3.44U	43.13U
A1-11-1	1785475	1744137	11.52U	560.18	52.85	39.05U	139.53	10.57U	3.57U	42.24U
A1-11-2	1785440	1744138	10.92	558.08	48.90	37.82U	20.56	9.54U	2.93U	38.49U
A1-11-3	1785484	1744222	8.22	546.44	36.49U	35.65U	16.95	9.39U	2.71U	37.44U
A1-1-2	1785513	1746132	14.57U	696.66	46.83U	49.58	227.29	12.77U	3.79U	62.48
A1-12-1	1785485	1743957	6.7U	244.44	47.09U	32.44U	18.59	10.23U	3.51U	44.4U
A1-1-3	1785513	1746196	6.44U	516.73	43.14U	41.45U	16.19	9.84U	2.87U	42.35U
A1-13-1	1785482	1743786	12.42U	534.22	47.3U	39.58U	156.23	11.32U	3.68U	44.4U
A1-13-2	1785498	1743691	8.91U	445.83	34.01U	37.45U	100.15	9.26U	3.17U	36.8U
A1-13-3	1785411	1743734	7.56U	676.42	49.85U	55.59	26.46	10.97U	3.44U	46.2U
A1-14-1	1785503	1743562	74.16	334.48	48.81U	36.11U	2346.04	15.66U	6.3U	61.78
A1-14-2	1785470	1743483	14.71	522.68	36.22U	36.6U	97.56	9.45U	2.87U	38.41U
A1-2-1	1785493	1746006	18.08	509.74	58.58	142.92	209.67	11.59U	3.48U	43.01U
A1-2-2	1785460	1745990	16.16U	713.25	56.54U	58.84U	210.25	13.63U	4.33U	51.81U
A1-2-3	1785440	1745994	14.59	725.68	56.07U	267.02	157.60	14.28U	4.2U	59.79
A1-3-1	1785415	1745787	10.61U	521.55	47.95U	73.49	88.73	12.59U	3.86U	45.86U
A1-3-2	1785476	1745767	10.51U	473.17	96.32	46.33	90.61	11.57U	3.81U	51.61
A1-3-3	1785499	1745831	14.60	788.38	56.64	77.34	163.87	22.74	4.23U	158.19
A1-4-1	1785433	1745638	7.51U	362.05	63.46U	42.04U	10.98U	13.57U	4.18U	105.65
A1-4-2	1785475	1745562	8.20	567.50	40.83U	40.70	18.30	9.08U	3.15U	41.22U
A1-5-1	1785392	1745420	6.83U	422.27	52.4U	41.37	13.84	11.39U	3.7U	101.03
A1-5-2	1785504	1745394	7.05U	500.18	42.53U	33.75U	28.66	10.57U	3.22U	42.41U
A1-6-1	1785520	1745077	9.65U	451.73	43.33U	37.95U	84.10	10.42U	3.53U	42.81U
A1-6-2	1785381	1745111	6.66U	320.29	52.24	32.04U	22.76	20.33	3.63U	156.70
A1-7-1	1785448	1745014	7.24U	492.68	45.56U	44.13	29.53	11.21U	3.56U	86.13
A1-7-2	1785467	1744892	6.94	329.14	35.29U	33.15U	14.21	8.25U	2.87U	37.72U
A1-7-3	1785355	1744995	6.67U	426.05	39.97U	33.55U	27.95	10.33U	2.93U	40.51U
A1-8-1	1785453	1744712	6.67U	297.95	41.59U	29.16U	27.90	10.56U	3.24U	58.17
A1-8-2	1785392	1744760	7.89U	201.20	55.25U	35.84U	26.08	12.39U	3.92U	107.27
A1-9-1	1785459	1744625	7.40	514.07	56.48	38.37U	22.27	9.21U	3.1U	37.94U
A1-9-2	1785456	1744496	8.81	564.24	36.08U	37.11U	27.79	8.76U	2.96U	37.8U
A2-10-1	1783701	1742451	5.82	211.71	38.92	20.28U	6.89	6.94U	2.08U	30.76U
A2-11-1	1783771	1742057	5.61U	288.37	31.27U	27.35U	19.93	8.7U	2.89U	35.81U
A2-12-1	1783791	1741555	6.22	238.52	29.35U	22.39U	14.30	7.27U	2.46U	33.6U
A2-13-1	1783790	1741262	5.13U	246.14	40.02	24.29U	16.05	8.48U	2.49U	34.31U
A2-14-1	1783790	1740912	5.03U	243.99	52.01	22.6U	18.78	10.49	2.54U	33.28U
A2-15-1	1783604	1740594	10.75	345.58	64.70	25.26U	23.95	8.19U	2.63U	34.77U
A2-16-1	1783908	1740045	6.00	461.42	36.48U	34.64U	18.34	8.46U	2.85U	38.28U
A2-17-1	1783863	1739504	22.74	191.42U	50.43U	61.13U	150.24	13.17U	3.8U	46.84U
A2-17-2	1783791	1739599	6.2U	402.02	38.32U	38.23U	22.37	9.2U	2.89U	39.44U
A2-18-1	1783730	1739331	6.17	399.96	33.85	30.13U	18.76	8.53U	2.68U	35.55U
A2-18-2	1783667	1739100	7.75U	332.97	33.31U	30.83U	80.02	7.91U	2.48U	35.45U
A2-8-1	1783688	1743315	6.31	209.31	44.32	21.69U	12.00	7.14U	2.39U	32.89U
A2-9-1	1783622	1742889	9.99	409.02	30.6U	28.88U	25.00	8.41U	2.73U	34.98U
B1-10-1	1785679	1744299	16.98U	431.39	38.88U	38.98U	411.67	9.42U	3.2U	39.33U
B1-1-1	1785604	1746203	9.51U	636.85	39.62U	65.51	105.25	10.11U	3.07U	39.54U
B1-11-1	1785612	1744120	18.05	378.14	41.95U	48.8U	126.84	9.77U	3.17U	40.75U
B1-11-2	1785601	1744207	24.51	844.20	44.52U	61.51	581.04	12.41U	4.37U	42.58U
B1-11-3	1785684	1744206	18.22U	387.80	36.08U	33.31U	561.93	9.94U	3.41U	37.27U
B1-1-2	1785631	1746178	10.12	458.55	44.79	33.81U	20.27	8.65U	2.95U	37.77U

TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
B1-12-1	1785608	1743935	14.12U	410.45	52.59	39.24U	240.40	11U	3.5U	42.42U
B1-12-2	1785588	1744048	19.45	425.71	34.71U	37.28U	277.81	8.94U	3.02U	36.36U
B1-12-3	1785701	1744022	9.8U	417.58	35.43U	36.28U	137.76	7.99U	2.88U	36.32U
B1-1-3	1785649	1746124	21.85	796.77	42.4U	163.14	606.77	14.93	4.45U	95.53
B1-13-1	1785616	1743717	10.67U	411.48	82.17	43.4U	143.95	9.8U	3.03U	39.44U
B1-13-2	1785637	1743806	8.45U	394.81	34.11U	31.14U	99.66	8.54U	2.89U	36.14U
B1-13-3	1785581	1743857	5.61U	241.30	34.6U	23.14U	30.85	8.84U	2.68U	35.65U
B1-14-1	1785568	1743479	10.86U	404.74	41.73	30.47U	187.45	13.17	3.33U	36.61U
B1-14-2	1785535	1743562	29.73	314.79	41.56U	33.24U	1200.83	11.61U	4.4U	41.43U
B1-14-3	1785597	1743609	16.44U	370.27	35.82U	32.89U	456.11	8.91U	3.24U	36.87U
B1-14-4	1785701	1743599	72.15U	1501.33	106.36U	180.91U	1808.14	45.1U	13.01U	97.06U
B1-2-1	1785651	1745976	37.71U	854.59	56.71U	316.86	1329.73	17.2U	5.99U	52.85U
B1-2-2	1785613	1745988	236.72	1517.64	48.75U	78.74U	2682.15	38.82	7.22U	49.34U
B1-2-3	1785597	1746038	17.01U	640.46	53.7U	126.00	255.22	14.63U	4.45U	49.87U
B1-2-4	1785539	1746005	21.38U	787.45	59.53U	79.88U	363.17	14.71U	4.66U	54.16U
B1-3-1	1785553	1745839	8.84U	618.69	42.16U	42.39U	66.91	11.27U	3.32U	42.5U
B1-3-2	1785567	1745784	9.81U	510.51	53.46	43.62U	80.81	11.52U	3.78U	45.82U
B1-3-3	1785610	1745813	15.81U	511.11	45.69	42.43U	325.73	14.11	3.76U	42.45U
B1-4-1	1785565	1745617	6.95U	365.44	52.49U	36.3U	12.81	12.11U	4.18U	133.32
B1-4-2	1785678	1745592	14.94U	441.92	139.13U	40.93	19.76U	21.69U	7.86U	198.01
B1-5-1	1785677	1745310	7.91	457.37	38.66	35.36U	25.02	9.37U	3.06U	38.4U
B1-5-2	1785673	1745332	11.48U	728.20	68.90	96.46	155.86	15.97	3.86U	99.40
B1-6-1	1785580	1745240	6.56	360.12	45.82U	42.6U	14.07	9.02U	3.01U	43.07U
B1-6-2	1785582	1745170	8.40	328.25	43.23U	33.31U	45.33	10.61U	3.31U	59.45
B1-7-1	1785675	1744929	13.83	442.22	54.72	37.17U	69.94	8.72U	3.03U	39.09U
B1-7-2	1785601	1744946	6.63U	371.79	48.96U	63.79	16.07	17.36	3.86U	226.47
B1-8-1	1785572	1744843	8.48	403.16	33.82U	30.17U	16.42	9.43U	2.85U	37.05U
B1-8-2	1785702	1744729	9.16	2659.39	40.66U	1499.37	53.09	22.64	3.77U	51.28
B1-8-3	1785596	1744687	10.00	551.23	36.36U	36.82U	33.91	10.02	2.92U	38.61U
B1-9-1	1785697	1744509	8.05U	296.42	82.95	57.65	27.28	11.67U	3.58U	49.86U
B1-9-2	1785594	1744597	7.84	337.56	19.31U	14.42U	4.76U	4.55U	1.6U	25.12U
B2-10-1	1784101	1742456	4.31U	186.55	45.35	17.8U	12.65	7.37U	2.35U	31.15U
B2-11-1	1784141	1742050	5.25	219.63	32.96U	27.66U	12.24	7.52U	2.44U	35.31U
B2-12-1	1784217	1741585	5.44	176.30	61.94	18.58U	11.34	7.71U	2.39U	31.63U
B2-13-1	1784205	1741181	5.67	223.33	62.55	27.11U	14.93	8.32U	2.57U	35.29U
B2-14-1	1784065	1740812	6.28	132.23	27.72U	19.88U	7.33	6.73U	2.26U	31.3U
B2-15-1	1784018	1740480	6.51	177.96	38.87	20.36U	15.14	7.2U	2.16U	31.39U
B2-16-1	1784073	1740059	11.32U	321.90	34.27U	34.29	197.21	8.21U	2.73U	35.83U
B2-17-1	1784017	1739677	5.89U	387.36	38.05U	36.29U	19.36	8.69U	2.75U	38.82U
B2-18-1	1784110	1739166	5.91	330.34	57.91	29.54U	23.23	9.04U	2.88U	35.76U
B2-8-1	1784216	1743282	6.27U	395.09	33.46U	30.15U	32.88	8.03U	2.64U	36.36U
B2-9-1	1784225	1742891	7.28U	281.77	52.68	33.83U	27.29	10.45U	3.5U	86.46
C1-10-1	1785837	1744324	9.13U	307.99	48.64U	1205.51	57.63	13.53	3.4U	46.59
C1-10-2	1785774	1744362	6.25U	549.94	48.85	35.97U	24.68	14.41	3.28U	60.02
C1-10-3	1785768	1744460	14.83	965.32	66.7U	165.68	93.89	17.85U	5.01U	59.45U
C1-1-1	1785754	1746205	8.25U	325.04	42.71U	31.79U	60.26	18.03	3.56U	131.98
C1-11-1	1785826	1744201	12.23	374.16	54.37U	47.94U	82.64	13.06U	4.01U	73.76
C1-11-2	1785770	1744193	22.36	285.38	51.48U	38.07U	224.08	11.47U	3.75U	47.35U
C1-11-3	1785795	1744091	19.66U	384.36	56.42U	58.5U	332.86	14.82U	4.76U	51.14U
C1-1-2	1785784	1746138	9.42U	548.63	42.53U	38.96U	85.49	10.87U	3.33U	42.49U
C1-12-1	1785786	1744048	10.12	296.03	30.56U	29.26U	76.39	7.79U	2.59U	34.08U

TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
C1-12-2	1785828	1743940	8.88U	400.09	33.85U	29.05U	106.50	9.5U	2.95U	36.95U
C1-12-3	1785785	1743890	7.51	434.43	52.60	39.24U	20.23	9.31U	2.89U	39.83U
C1-13-1	1785791	1743774	24.37U	522.80	36.15U	34.08U	941.35	11.08U	4.29U	38.88U
C1-13-2	1785763	1743690	16.19U	294.97	37.57U	33.51U	402.10	9.51U	3.38U	38.86U
C1-13-3	1785798	1743735	20.16U	468.16	38.49U	33.7U	626.32	10.78U	3.9U	39.99U
C1-14-1	1785813	1743613	11.55U	362.46	55.15	33.46U	189.41	9.67U	3.21U	37.95U
C1-14-2	1785759	1743534	22.05U	442.66	72.07	37.86U	731.29	10.93U	3.87U	39.52U
C1-14-3	1785796	1743488	36.72U	655.41	48.96	43.1U	1702.76	13.34U	5.44U	44.35U
C1-2-1	1785795	1746038	9.37U	448.00	55.08	40.92U	85.36	8.98U	3.04U	41.68U
C1-2-2	1785803	1745978	9.25U	347.14	44.86U	43.83U	78.32	10.86U	3.26U	42.99U
C1-2-3	1785744	1745960	31.14U	929.73	46.87U	373.69	1166.90	25.94	5.43U	46.55U
C1-3-1	1785752	1745777	17.79U	630.08	48.86U	51.37U	318.61	12.89U	4.54U	47.34U
C1-3-2	1785819	1745809	19.77U	690.06	41.23U	40.89	557.62	11.29U	4.08U	45.69
C1-4-1	1785866	1745606	9.42	614.43	63.34	41.55U	24.44	11.14U	3.39U	42.59U
C1-4-2	1785870	1745532	7.7U	279.72	51.78	37.9U	38.97	9.58U	3.21U	43.85U
C1-4-3	1785900	1745624	6.9U	246.64	35.79U	26.11U	47.48	8.47U	2.88U	37.6U
C1-4-4	1785784	1745588	8.02U	347.27	55U	49.75	26.92	17.18	3.94U	120.64
C1-5-1	1785749	1745311	5.66U	449.34	32.63U	31.08U	19.03	9.31U	2.97U	36.38U
C1-5-2	1785850	1745440	7.15U	237.14	50.72U	34.47U	23.84	11.51U	3.28U	46.71U
C1-6-1	1785799	1745223	5.91U	237.23	47.10	27.82U	14.28	9.67U	2.88U	40.84U
C1-6-2	1785791	1745081	7.14U	238.28	51.58U	36.99U	15.58	11.27U	3.77U	47.74U
C1-7-1	1785847	1744987	6.97U	164.98	44.04U	32.97U	26.83	10.09U	3.18U	42.78U
C1-7-2	1785763	1745056	10.11U	468.98	64.13U	88.91U	31.69	29.25	4.81U	58.71U
C1-7-3	1785806	1744879	8.40	583.83	41.58U	33.38U	49.98	13.81	3.61U	44.64
C1-7-4	1785865	1744888	5.67U	111.45	67.73	16.78U	49.93	7.63U	2.24U	30.62U
C1-8-1	1785793	1744694	5.2U	257.68	68.54	68.56	18.23	12.56	2.79U	34.83U
C1-8-2	1785865	1744769	7.82U	917.72	50.95U	209.37	29.84	9.72U	3.63U	47.08U
C1-9-1	1785883	1744490	9.56U	2445.43	54.82U	61.7U	49.83	12.52U	4U	53.72
C1-9-2	1785808	1744625	13.78	1945.57	60.83	474.31	82.96	11.88U	3.31U	44.47U
C2-10-1	1784507	1742503	9.75U	489.38	50.68U	65.52U	51.94	26.32	4.21U	49.41U
C2-10-2	1784684	1742523	6.5U	422.86	36.94U	54.63	33.24	9.14U	2.8U	38.42U
C2-1-1	1784625	1746083	9.17	378.47	42.47	30.49U	26.50	9.32	2.78U	35.74U
C2-11-1	1784585	1742006	5.05U	243.42	62.77	23.5U	19.43	8.43U	2.62U	33.94U
C2-12-1	1784604	1741790	4.73	125.40	26.42	17.36U	14.15	6.48U	2.11U	31.08U
C2-15-1	1784435	1740343	6.65U	354.37	35.82U	34.18U	32.88	9.71U	2.96U	38.43U
C2-16-1	1784403	1739908	6.37U	152.13	33.25U	22.02U	41.83	6.49U	2.39U	34.95U
C2-17-1	1784485	1739686	5.36U	233.18	66.76	25.19U	22.17	8.03U	2.58U	34.62U
C2-18-1	1784525	1739078	86.57	845.28	51.66	59.46U	794.81	14.22	4.55U	42.07U
C2-18-2	1784553	1739323	6.7U	359.96	58.09	33.27U	18.27	11.16U	3.5U	70.22
C2-2-1	1784674	1745670	16.54	348.07	45.63U	31.84U	218.04	10.32U	3.94U	43.11U
C2-3-1	1784636	1745254	6.23	387.30	47.13	33.36U	23.69	8.9U	2.63U	37.57U
C2-4-1	1784607	1744879	7.07	252.99	33.44U	29.31U	13.25	7.49U	2.37U	35.31U
C2-5-1	1784646	1744439	10.78	287.12	37.24	23.38U	15.67	7.84U	2.5U	32.65U
C2-6-1	1784597	1744013	4.99U	303.55	28.92U	25.08U	21.23	7.26U	2.28U	32.85U
C2-7-1	1784602	1743665	5.10	191.88	57.46	20.44U	11.93	6.56U	2.11U	31.51U
C2-8-1	1784485	1743166	32.43	448.38	35.61U	31.74U	684.43	9.92U	3.75U	38.15U
C2-9-1	1784517	1742837	5.53U	153.79	36.17U	27.63U	11.29	12.91	3.1U	81.23
D1-10-1	1786079	1744281	10.25U	512.27	39.45U	53.81	116.90	29.74	3.74U	98.42
D1-10-2	1785949	1744322	7.26U	416.62	60.41U	46.13	9.97U	11.27U	3.56U	102.97
D1-10-3	1785979	1744417	9.69	384.39	74.73	58.89	52.44	18.29	3.87U	108.97
D1-11-1	1786015	1744129	10.17U	306.19	66.86	31.71U	101.40	15.04	3.65U	131.42

TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
D1-11-2	1786013	1744211	12.9U	571.28	47.37U	40.93U	169.28	11.9U	3.78U	45.07U
D1-11-3	1786121	1744209	12.37U	260.44	52.57	25.76U	216.16	18.89	3.38U	42.44
D1-12-1	1785932	1743920	12.03	412.99	40.65U	39.47U	20.92	9.2U	3.09U	40.87U
D1-12-2	1785930	1744063	15.81U	488.33	40.16U	39.81U	333.05	10.4U	3.29U	40.27U
D1-12-3	1786036	1744027	9U	364.54	57.4U	40.24U	47.95	11.41U	3.89U	130.51
D1-13-1	1786054	1743757	30.15U	695.22	44.44U	42.08U	1150.72	12.42U	4.88U	43.46U
D1-13-2	1786013	1743699	26.41U	674.60	44.38U	51.93	890.88	11.74U	4.33U	43.02U
D1-13-3	1785974	1743811	6.09U	505.95	37.85U	37.16U	18.76	9.82U	3.2U	39.86U
D1-14-1	1785979	1743472	12.09U	394.78	39.44U	32.97U	187.36	10.62U	3.28U	40.92U
D1-5-1	1786087	1745340	9.37U	314.58	51.84	38.64U	65.10	11.3U	3.48U	73.80
D1-5-2	1786002	1745364	7.85U	398.79	42.32U	43.98	53.77	10.31U	3.07U	40.87U
D1-5-3	1785955	1745368	7.04	523.35	39.11U	34.22U	33.05	11.10	3.39U	39.49U
D1-6-1	1786114	1745243	9.52U	297.40	53.59U	55.22	63.40	16.40	3.79U	117.12
D1-6-2	1786008	1745225	7.11	461.01	38.52U	38.31U	20.01	9.17U	2.93U	38.46U
D1-7-1	1785984	1744949	7.91U	255.42	59.92	34.17U	55.28	11.45	3.26U	41.04U
D1-7-2	1786079	1744888	12.2U	478.58	37.82U	37.76U	195.84	12.00	3.58U	50.12
D1-7-3	1786055	1745061	12.91U	370.48	37.74U	38.31U	224.54	10.6U	3.14U	39.36U
D1-8-1	1785990	1744826	10.86U	445.69	40.84U	36.8U	137.91	9.62U	3.34U	40.85U
D1-8-2	1785993	1744670	8.69U	566.32	44.18U	53.87	61.11	11.79U	3.55U	43.29U
D1-8-3	1786083	1744813	17.34U	556.98	43.34	58.97	406.19	11.76U	3.81U	41.2U
D1-9-1	1786053	1744630	10.2U	543.92	45.29	141.09	103.72	12.31U	3.74U	42.4U
D1-9-2	1785939	1744580	8.86U	610.13	50.36U	517.35	40.20	17.78	3.78U	47.97U
D1-9-3	1786054	1744553	10.88U	547.20	57.48U	74.14	71.76	15.22	4.26U	52.14U
D2-10-1	1784919	1742531	7.54	371.49	42.63U	36.69U	36.59	14.97	3.19U	42.34U
D2-1-1	1784958	1745965	5.69	414.60	33.86	30.97U	20.80	8.67U	2.62U	35.96U
D2-11-1	1785013	1742032	6.53	354.19	33U	31.72U	17.69	8.31U	2.64U	36.11U
D2-12-1	1784972	1741618	7.21U	1100.26	46.34U	174.31	30.37	9.41U	3.25U	43.99U
D2-13-1	1784930	1741299	8.4U	286.39	65.91U	32.74	18.32	12.72U	4.11U	54.11U
D2-14-1	1784960	1740860	4.64U	155.70	67.11	21.23U	13.03	7.32U	2.24U	33.7U
D2-15-1	1784858	1740569	6.15	206.19	25.46U	18.75U	11.07	6.47U	2.13U	30.43U
D2-16-1	1785100	1740201	11.9U	201.85	31.89	23.83U	255.15	8.29U	3.1U	34.45U
D2-16-2	1784965	1739967	6.51U	403.77	40.26U	36.41U	23.88	8.98U	2.86U	40.45U
D2-17-1	1784903	1739743	8.2U	392.46	48.28U	44.59U	45.83	9.69U	3.4U	44.99U
D2-2-1	1784915	1745615	13U	217.23	38.6U	29.58U	224.81	10U	3.43U	39.05U
D2-3-1	1784995	1745175	13.31	340.97	49.28U	54.1U	90.39	11.4U	3.73U	47.29U
D2-4-1	1784997	1744943	10.28	582.16	52.12	37.94U	15.92	9.4U	3.18U	38.78U
D2-5-1	1784988	1744453	5.24U	324.12	45.06	28.45U	18.04	7.91U	2.48U	36.21U
D2-6-1	1784963	1744180	4.83U	257.14	52.71	22.69U	14.99	7.75U	2.6U	33.04U
D2-7-1	1784896	1743655	6.92	286.59	29.58U	25.11U	19.53	7.32U	2.32U	33.38U
D2-8-1	1784808	1743245	17.98	635.47	47.06U	71.02U	58.27	13U	4.17U	47.49U
D2-8-2	1784989	1743284	6.25U	577.62	38.98U	40.25U	21.60	9.22U	2.82U	39.79U
D2-9-1	1784883	1742995	7.09	417.57	39.53U	38.25U	18.66	9.43U	3U	40.02U
D2-9-2	1784824	1742850	15.52U	853.36	76.66U	138.32U	80.58	22.34U	5.78U	69.48U
E1-10-1	1786207	1744291	8.41U	296.33	56.48U	66.12	29.69	12.57U	3.97U	113.68
E1-10-2	1786190	1744408	8.43U	425.86	58.96U	51.04	28.66	15.97	4.11U	179.41
E1-10-3	1786143	1744346	8.58U	541.12	49.31U	80.40	46.94	18.08	4U	97.49
E1-10-4	1786307	1744406	14.39U	616.30	38.75U	40.73U	277.19	13.61	3.85U	40.96U
E1-11-1	1786147	1744150	13.94U	318.43	105.05	49.23	161.22	13.05U	4.45U	157.87
E1-11-2	1786246	1744205	10.86	407.30	41.79U	38.37U	37.61	10.04U	3.25U	42.34U
E1-12-1	1786210	1743957	10.82U	748.01	56.18U	128.20	82.39	12.23U	3.96U	65.56
E1-12-2	1786286	1743915	11.78U	313.76	56.41U	41.48U	95.07	12.34U	3.81U	50.28U

TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
E1-12-3	1786133	1744062	11.68U	309.45	51.64U	34.83U	122.26	10.84U	4.03U	79.37
E1-13-1	1786261	1743761	6.68U	199.43	32.45U	24.8U	53.17	7.62U	2.71U	35.38U
E1-13-2	1786180	1743704	32.45U	657.02	45.33	39.78U	1562.76	13.75	5.25U	42.14U
E1-13-3	1786170	1743811	26.06U	658.00	37.37U	36.94U	1029.41	12.24U	4.69U	39.81U
E1-14-1	1786195	1743533	12.26U	391.60	36.94U	32.99U	203.66	9.48U	3.19U	39.21U
E1-14-2	1786269	1743552	9.31U	287.58	42.55U	30.71U	79.97	10.32U	3.39U	56.17
E1-14-3	1786173	1743514	12.70	569.52	38.56	38.57U	49.44	9.19U	3.18U	39.35U
E1-6-1	1786154	1745116	9.82U	207.70	55.95U	42.21	65.77	11.92U	3.64U	85.17
E1-7-1	1786212	1744934	9.12U	354.26	60.65U	54.24	35.67	11.91U	3.84U	82.28
E1-7-2	1786185	1745043	9.68U	358.27	57.33U	39.83U	57.30	10.49U	3.64U	91.94
E1-8-1	1786192	1744712	9.89U	553.37	73.1U	80.93	37.52	13.51U	4.06U	57.9U
E1-8-2	1786195	1744807	11.13U	365.16	58.99U	80.88	87.30	11.42U	3.7U	99.76
E1-8-3	1786255	1744817	8.59U	373.19	51.24U	37.3U	46.77	11.8U	3.72U	91.24
E1-8-4	1786307	1744781	10.32U	434.95	42.55U	48.13	105.88	14.33	3.5U	88.42
E1-9-1	1786231	1744517	9.78U	374.75	56.07U	79.83	60.65	12.06U	3.86U	85.13
E1-9-2	1786182	1744640	8.63U	378.35	51.7U	69.59	40.30	12.14U	3.85U	142.62
E1-9-3	1786156	1744600	11.81U	268.51	55.62U	41.89U	98.54	11.99U	4.06U	87.52
E2-10-1	1785500	1742372	7.83U	410.23	39.4U	33.92U	62.77	9.13U	3.08U	39.82U
E2-1-1	1785305	1746118	7.25	382.59	89.84	35.76U	10.61	9.88U	2.86U	41.8U
E2-11-1	1785299	1742019	5.84	368.17	57.39	134.76	18.20	8.96U	2.98U	35.86U
E2-12-1	1785366	1741613	5.84U	240.60	64.02	57.76	19.42	13.88	3.19U	38.26U
E2-13-1	1785287	1741225	5.06U	310.43	36.51	25.15U	17.00	8.89	2.55U	33.67U
E2-14-1	1785321	1740945	7.57	473.69	33.1U	33.83U	16.64	8.47U	2.62U	36.38U
E2-15-1	1785203	1740565	3.90	118.06	24.09U	17.38U	5.6U	6.15U	2.08U	29.81U
E2-16-1	1785449	1740012	9.03U	302.97	35.76U	29.63	107.86	7.72U	2.55U	36.87U
E2-17-1	1785293	1739606	5.89	218.63	41.58	20.85U	15.84	7U	2.38U	32.03U
E2-2-1	1785249	1745605	10.59	395.83	44.72U	44.7U	21.52	10.24U	2.86U	43.09U
E2-3-1	1785214	1745229	12.55	514.01	98.61	35.63	114.75	19.96	4.38	80.20
E2-4-1	1785188	1744704	11.76U	467.47	51.62	36.06U	162.34	19.31	3.63U	41.74U
E2-4-2	1785261	1744869	8.96U	427.51	37.97U	33.21U	87.39	9.59U	3.06U	39.18U
E2-5-1	1785171	1744515	7.70	413.47	35.08U	36.3U	57.42	9.24U	2.84U	37.73U
E2-6-1	1785212	1744133	6.30	347.13	26.9U	23.98U	21.81	8.01U	2.43U	32.44U
E2-7-1	1785210	1743666	5.19U	341.78	49.03	28.38U	15.33	8.13U	2.66U	35.31U
E2-8-1	1785319	1743233	6.53	391.51	34.34U	32.93U	18.50	8.22U	2.91U	37.37U
E2-9-1	1785327	1742813	6.42U	430.25	40.26U	34.15U	22.18	8.6U	3.12U	40.27U
F1-12-1	1786350	1743910	10.32U	420.03	36.06U	35.88U	132.86	10.2U	3.38U	39.04U
F1-12-2	1786427	1744032	11.22U	459.75	38.13U	35.89U	154.51	10.13U	3.59U	40U
F1-12-3	1786402	1744037	34.71	474.10	48.73U	4549.29	161.59	22.62	4.39U	48.02U
F1-13-1	1786357	1743752	10.09U	406.06	43.31U	32.35U	99.18	13.55	3.43U	76.41
F1-13-2	1786429	1743791	11.03U	561.39	41.66U	94.78	134.59	9.98U	3.34U	41.41U
F1-14-1	1786410	1743596	8.14U	251.19	61.59	33.82U	46.31	10.02U	3.09U	44.66U
F1-14-2	1786460	1743519	6.69U	212.30	45.34U	29.57U	25.33	10.02U	3.03U	43.57U
F1-7-1	1786419	1744898	8.33U	326.25	43.73U	35.18U	58.80	8.81U	3.03U	42.21U
F1-8-1	1786425	1744716	7.40	283.76	54.98U	39.9U	10.37	11.47U	3.75U	90.45
F1-8-2	1786338	1744777	8.09U	356.30	50.61U	39.47U	40.57	11U	3.42U	46.78U
F1-8-3	1786417	1744855	10.29U	205.85	48.23U	36.68U	90.48	11.12U	3.47U	45.55U
F1-9-1	1786405	1744617	10.74	373.53	43.29	89.91	86.47	9.45U	3.39U	42.22U
F1-9-2	1786492	1744566	22.46U	354.37	36.85U	406.06	787.82	16.75	4.13U	39.01U
F1-9-3	1786434	1744549	21.51	877.31	42.66U	175.90	121.93	18.75	4.28U	42.66U
F1-9-4	1786500	1744495	26.73	436.11	43U	460.29	597.45	12.03U	4.11U	42.7U
F2-10-1	1785753	1742437	12.50	344.83	38.13U	32.09U	56.93	8.67U	3.01U	38.95U

TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
F2-11-1	1785792	1742156	14.48	525.67	38.21U	41.89U	22.98	11.36	3.23U	39.84U
F2-12-1	1785759	1741614	5.31U	240.96	29.36U	23.5U	20.05	8.63U	2.58U	34.38U
F2-13-1	1785704	1741265	5.35U	229.90	36.23	25.44U	25.79	8.36U	2.52U	33.83U
F2-14-1	1785765	1740879	4.44U	192.68	48.56	23.02U	15.70	7.27U	2.01U	31.28U
F2-15-1	1785710	1740488	5.11	149.95	29.84	21.86U	13.55	6.97U	2.34U	32.78U
F2-16-1	1785567	1739924	5.72U	246.58	33.7U	26.6U	25.64	7.58U	2.51U	36.06U
F2-17-1	1785770	1739649	4.48U	225.33	45.30	23.89U	14.67	7.05U	2.39U	31.02U
F2-18-1	1785837	1739327	9.59	401.99	40.97U	44.73U	28.03	10.62U	3.21U	41.55U
F2-8-1	1785772	1743268	7.82U	266.74	41.79U	34.84U	47.78	10.33U	3.09U	41.25U
F2-9-1	1785745	1742869	11.26	444.41	39.25U	39.87U	25.98	10.27U	3.21U	40.51U
G1-10-1	1786594	1744328	16.56U	370.52	37.8U	714.52	395.41	11.48U	3.78U	39.34U
G1-10-2	1786545	1744373	21.31U	379.87	36.95U	549.89	708.10	11.05U	3.77U	38.69U
G1-10-3	1786660	1744414	33.12	334.90	39.67U	604.20	1496.83	12.57U	4.82U	40.52U
G1-11-1	1786725	1744099	12.42U	277.93	72.55	395.67	264.34	9.82U	3.53U	35.57U
G1-11-2	1786646	1744226	21.21U	507.11	68.29	850.10	548.07	17.15	4.87U	72.06
G1-11-3	1786700	1744185	83.06	561.94	50.42	1160.71	1186.31	14.06U	5.23U	44.58U
G1-14-1	1786564	1743552	7.02U	232.51	51.46U	40.96	13.65	11.73U	3.58U	136.88
G1-14-2	1786609	1743523	5.91U	173.17	29.43U	22.61U	39.78	7.09U	2.36U	33.06U
G1-14-3	1786528	1743637	8.75U	222.66	44.59U	32.47U	65.49	9.69U	3.02U	42.62U
G1-8-1	1786596	1744721	8.88U	425.96	40.67U	125.63	78.94	21.12	3.54U	68.73
G1-9-1	1786585	1744580	23.1U	358.16	55.91	344.20	764.78	10.63U	4.03U	40.59U
G1-9-2	1786566	1744642	9.3U	249.28	48.3U	83.30	62.95	10.06U	3.31U	45.32U
G2-10-1	1786091	1742482	5.54U	224.76	30.58U	26.14U	25.82	7.28U	2.27U	34.32U
G2-11-1	1786100	1742094	6.68	261.87	32.3U	29.47U	12.97	7.94U	2.5U	35.39U
G2-12-1	1786108	1741687	4.92U	218.97	54.02	20.79U	18.90	7.68U	2.49U	32.37U
G2-13-1	1786084	1741294	5.70	313.35	31.19	26.41U	21.94	7.79U	2.62U	34.08U
G2-14-1	1786116	1740933	6.66U	132.88	52.86	25.73U	46.32	8.05U	2.59U	36.24U
G2-15-1	1786091	1740497	5.47U	238.93	66.20	22.54U	29.02	8.29U	2.63U	33.42U
G2-16-1	1786023	1740083	8.27	211.29	43.95	26.59U	11.86	7.79U	2.41U	34.99U
G2-17-1	1786104	1739622	11.18U	328.63	31.78U	28.69U	201.06	9.46U	3.13U	35.69U
G2-18-1	1786123	1739282	9.47U	144.03	24.04U	14.95U	196.84	6.88U	2.34U	28.97U
G2-19-1	1786204	1739008	5.52U	232.81	39.67	27.57U	22.48	7.54U	2.66U	35.53U
G2-8-1	1786228	1743445	6.07U	133.99	39.26U	25.73U	19.69	8.4U	2.82U	39.96U
G2-8-2	1786091	1743466	7.8U	391.21	38.90	33.35U	59.47	9.54U	3.21U	38.93U
G2-8-3	1785996	1743265	7.9U	388.85	46.01U	40.26U	36.73	10.71U	3.58U	44.6U
G2-9-1	1786117	1742928	5.86U	260.56	36.19	24.66U	32.49	7.23U	2.44U	35.21U
H1-10-1	1786795	1744438	23.84U	366.31	38.33U	551.53	871.66	11.09U	4.14U	39.33U
H1-10-2	1786873	1744400	8.45	319.13	30.31U	28.48U	16.03	8.37U	2.68U	34.23U
H1-10-3	1786915	1744396	11.20	411.51	39.18U	34.04U	13.85	8.59U	2.75U	39.67U
H1-11-1	1786782	1744075	17.98U	420.01	76.02	1057.78	524.77	10.49U	3.73U	37.27U
H1-12-1	1786816	1743980	12.75U	248.60	37.68U	577.51	242.16	9.08U	3.1U	37.39U
H1-12-2	1786907	1743924	23.62	367.52	63.31	877.63	464.55	10.17U	3.67U	37.57U
H1-8-1	1786840	1744712	8.05U	271.49	37.63	27.57U	88.06	8.91U	2.89U	35.37U
H1-9-1	1786774	1744651	10U	225.35	50.17U	36.88U	74.53	11.35U	3.53U	87.66
H1-9-2	1786790	1744557	9.16	286.94	40.14U	79.77	69.36	9.51U	2.79U	39.82U
H1-9-3	1786837	1744480	11.04U	297.35	50.23U	104.68	103.14	11.62U	3.74U	46.55U
I1-10-1	1786940	1744309	6.08	311.14	36.01U	48.31U	21.57	8.35U	2.59U	36.78U
I1-10-2	1787008	1744285	5.29U	357.69	47.50	25.84U	19.09	8.45U	2.95U	35.76U
I1-11-1	1787044	1744223	7.33	300.12	34.45U	29.63U	13.95	7.87U	2.6U	36.46U
I1-11-2	1787053	1744171	6.78	348.36	34.47U	26.03U	14.47	7.82U	2.52U	36.11U
I1-13-1	1786983	1743783	21.59U	307.64	62.71	870.09	671.62	12.76	4.39U	40.17U

TABLE 3-1
IN-SITU XRF SURFACE SOIL RESULTS FOR RCRA 8 METALS
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

LocID	X	Y	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
I1-13-2	1787084	1743732	26.19U	384.03	34.83U	662.22	1207.18	11.47U	4.42U	36.89U
I1-14-1	1787094	1743667	24.21U	426.54	79.48	486.67	949.21	11.57U	4.21U	38.56U
I1-8-1	1787084	1744690	5.21U	320.82	59.80	26.97U	21.17	8.48U	2.76U	34.06U
I1-8-2	1786960	1744716	6.38U	335.95	29.48U	25U	44.17	8.6U	2.66U	34.53U
I1-9-1	1786987	1744635	4.98U	330.73	29.18U	34.28	16.19	8.35U	2.66U	33.74U
I1-9-2	1787093	1744583	4.97U	231.07	47.79	26.19U	13.08	8.57U	2.46U	34.97U
I1-9-3	1787079	1744502	5.69U	113.44	58.43	25.09	19.22	9.28U	3U	37.23U
J1-10-1	1787254	1744363	5.08U	261.31	33.98U	28.48U	15.48	7.36U	2.44U	35.7U
J1-11-1	1787148	1744080	6.85U	542.07	40.63U	38.18U	27.08	10.54U	3.07U	41U
J1-12-1	1787167	1744020	7.83	290.38	42.41	34.86	23.53	8.66U	2.67U	38.13U
J1-12-2	1787227	1743978	9.09	431.81	35.13U	90.28	46.86	8.94U	2.78U	37.12U
J1-12-3	1787315	1743980	7.93	243.11	45.67	33.79U	40.17	9.66U	3.05U	41.36U
J1-13-1	1787303	1743844	8.24U	279.11	66.3U	43.04U	13.21	11.97U	4.24U	62.46
J1-14-1	1787230	1743539	19.16U	313.67	57.28	336.99	503.35	9.97U	3.44U	40.58U
J1-14-2	1787203	1743613	19.56U	318.84	35.55U	348.58	614.83	9.56U	3.73U	37.69U
J1-14-3	1787137	1743626	24.35U	271.32	37.15U	487.28	922.73	10.35U	3.85U	38.71U
J1-9-1	1787226	1744494	5.47	298.26	55.20	28.53U	17.63	7.64U	2.5U	34.85U
J1-9-2	1787251	1744603	4.91U	242.17	28.78U	24.15U	14.16	11.31	2.68U	33.94U
J1-9-3	1787294	1744661	5.83	255.66	28.8U	22.67U	12.08	7.26U	2.54U	33.55U
K1-10-1	1787360	1744340	5.32	186.21	29.21U	20.83U	11.31	7.82U	2.44U	33.43U
K1-10-2	1787332	1744314	5.39	172.11	33.34U	26.95U	10.40	7.2U	2.4U	35.77U
K1-11-1	1787354	1744138	5.86	351.46	48.45	27.46U	19.37	13.84	2.71U	34.72U
K1-11-2	1787378	1744256	5.46U	311.30	36.74	25.98U	21.80	9.42	2.78U	35.82U
K1-11-3	1787473	1744123	5.40	348.09	31.12U	25.11U	14.28	8.33U	2.71U	34.74U
K1-12-1	1787361	1744004	5.42	270.34	31.64U	26.96U	8.79	7.81U	2.56U	35.25U
K1-12-2	1787512	1743996	5.18U	275.32	36.08	26.18U	17.28	8.51U	2.64U	35.01U
K1-13-1	1787377	1743734	7.94	427.50	44.80	65.05	52.26	8.89U	3.01U	37.23U
K1-13-2	1787423	1743681	7.43	364.61	66.70	29.48U	18.73	9.07U	2.94U	37.22U
K1-14-1	1787470	1743560	18.22	357.73	47.67	30.60	18.88	15.49	2.89U	36.47U
K1-14-2	1787390	1743489	5.66U	153.79	38.16U	24.87U	17.38	7.62U	2.66U	37.81U
K1-14-3	1787447	1743614	5.17	224.81	34.92	24.84U	13.83	7.44U	2.48U	34.38U
L1-12-1	1787542	1744000	5.31U	160.38	34.65	23.63U	14.50	7.31U	2.41U	36.47U
L1-12-2	1787601	1743896	4.88U	129.28	31.33U	21.51U	14.23	7.52U	2.29U	34.41U
L1-13-1	1787611	1743724	7.00	352.46	32.56U	28.19U	10.42	8U	2.74U	35.69U
L1-13-2	1787637	1743798	5.45U	292.03	33.12U	28.84U	18.61	7.79U	2.53U	35.95U
L1-14-1	1787604	1743576	6.61U	260.45	52.41U	37.12U	9.31U	11.02U	3.41U	47.79U
L1-14-2	1787632	1743491	5.79U	399.07	39.68U	37.03U	15.26	9.58U	2.85U	39.41U
L1-14-3	1787686	1743646	6.73	191.27	29.66U	21.48U	13.96	7.79U	2.39U	33.95U
M1-14-1	1787737	1743511	4.41U	146.52	26.98U	18.18U	14.09	6.84U	2.25U	31.8U
M1-14-2	1787733	1743579	4.62U	257.56	29.1U	21.63U	11.67	7.76U	2.26U	33.3U
	Average limit of detection		10.70U	191.42U	42.68U	34.54U	10.06U	9.97U	39.47U	3.33U
	Average detected level		14.11	410.37	53.41	277.67	166.97	16.56	93.89	4.38

Notes:
X,Y coordinates in NAD 83 State Plane Kansas South U.S. Survey Feet.
All results presented as parts per million (ppm).
Metal concentrations that were less than the limit of detection are presented with the detection limit value followed by a "U".

TABLE 3-2
COMPARISON OF IN-SITU XRF AND LABORATORY ANALYZED SOIL SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

		Arsenic		Barium		Cadmium		Chromium	
KDHE RSK LEVEL (mg/kg)		38		140000		1000		4000	
LocID	Sampling Date	XRF	LAB	XRF	LAB	XRF	LAB	XRF	LAB
F1-12-3	6/7/2005	34.71	**120**	474.10	360	48.73U	4.9	4549.29	**9300**
B1-1-3	6/8/2005	21.85	13	796.77	150	42.40U	1.0	163.14	67
C1-2-3	6/8/2005	31.14U	33	929.73	170	46.87U	1.9	373.69	140
F1-9-2	6/9/2005	22.46U	17	354.37	240	36.85U	2.3	406.06	940
J1-14-1	6/9/2005	19.16U	11	313.67	210	57.28	1.4	336.99	580
G1-11-3	6/9/2005	83.06	19	561.94	250	50.42	3.6	1160.71	1200
G1-10-3	6/10/2005	33.120	21	334.90	270	39.67U	2.8	604.20	1300
B1-8-2	6/12/2005	9.16	24	2659.39	130	40.66U	1.7	1499.37	1500
D1-10-1	6/12/2005	10.25U	7.4	512.27	160	39.45U	1.2	53.81	73
D1-10-3	6/12/2005	9.69	4.2	384.39	59	74.73	0.94U	58.89	36
C1-10-1	6/12/2005	9.13U	28	307.99	130	48.64U	1.1	1205.51	**4300**
C1-9-2	6/13/2005	13.78	**39**	1945.57	110	60.83	4.1	474.31	300
A1-14-1	6/13/2005	74.16	6.8	334.48	190	48.81U	0.92	36.11U	22
B1-14-2	6/13/2005	29.73	2.7	314.79	53	41.56U	0.72U	33.24U	4.9
B1-14-4	6/13/2005	72.15U	**110**	1501.33	51	106.36U	2.5	180.91U	160
C2-18-1	6/14/2005	86.57	**62**	845.28	110	51.66	4.0	59.46U	17
C2-10-1	6/14/2005	9.75U	7.2	489.38	97	50.68U	0.85U	65.52U	18
F2-9-1	6/15/2005	11.26	7.0	444.41	110	39.25U	0.99U	39.87U	25
E2-4-1	6/15/2005	11.76U	7.5	467.47	170	51.62	0.98U	36.06U	34

		Lead		Mercury		Silver		Selenium	
KDHE RSK LEVEL (mg/kg)		1000		20		10000		10000	
LocID	Sampling Date	XRF	LAB	XRF	LAB	XRF	LAB	XRF	LAB
F1-12-3	6/7/2005	161.59	65	22.62	0.13	48.02U	2.2U	4.39U	4.4U
B1-1-3	6/8/2005	606.77	740	14.93	0.36	95.53	0.97U	4.45U	1.9U
C1-2-3	6/8/2005	1166.90	**1600**	25.94	9.4	46.55U	1.0U	5.43U	2.0U
F1-9-2	6/9/2005	787.82	**1600**	16.75	0.62	39.01U	1.3U	4.13U	2.5U
J1-14-1	6/9/2005	503.35	780	9.97U	0.47	40.58U	1.1U	3.44U	2.1U
G1-11-3	6/9/2005	1186.31	**1000**	14.06U	1.2	44.58U	1.1U	5.23U	3.0
G1-10-3	6/10/2005	1496.83	**3000**	12.57U	1.1	40.52U	1.2U	4.82U	2.3U
B1-8-2	6/12/2005	53.09	65	22.64	0.16	51.28	1.0U	3.77U	2.1U
D1-10-1	6/12/2005	116.90	120	29.74	8.1	98.42	1.1U	3.74U	2.3U
D1-10-3	6/12/2005	52.44	33	18.29	0.23	108.97	0.94U	3.87U	1.9U
C1-10-1	6/12/2005	57.63	56	13.53	0.51	46.59	1.1U	3.40U	2.2U
C1-9-2	6/13/2005	82.96	170	11.88U	0.17	44.47U	0.95U	3.31U	1.9U
A1-14-1	6/13/2005	2346.04	**9500**	15.66U	0.033	61.78	0.85U	6.30U	1.7U
B1-14-2	6/13/2005	1200.83	**2400**	11.61U	0.022	41.43U	0.72U	4.40U	1.4U
B1-14-4	6/13/2005	1808.14	**1000**	45.10U	1.9	97.06U	2.2U	13.01U	4.4U
C2-18-1	6/14/2005	794.81	820	14.22	0.04	42.07U	2.3	4.55U	2.1U
C2-10-1	6/14/2005	51.94	44	26.32	0.013	49.41U	0.85U	4.21U	1.7U
F2-9-1	6/15/2005	25.98	32	10.27U	0.028	40.51U	0.99U	3.21U	2.0U
E2-4-1	6/15/2005	162.34	96	19.31	1.8	41.74U	0.98U	3.63U	2.0U

Notes:
XRF = XRF result for analysis of RCRA 8 metal in soil measured in-situ.
LAB = Laboratory result for analysis of RCRA 8 metal in soil sample.
All results presented as parts per million (ppm).
Laboratory detected values equal to or exceeding the respective KDHE RSK level are in boldface type.
Metal concentrations that were less than the limit of detection of the method are presented with the detection limit value followed by a "U".

TABLE 3-3
CORRELATION RESULTS FOR XRF IN-SITU AND LABORATORY ANALYZED SOIL SAMPLES
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

RCRA 8 Metal	Linear Trendline Equation	Correlation Coefficient R-squared	n
Arsenic (As)	LAB = 0.1696 XRF + 21.449	0.0322	11
Barium (Ba)	LAB = -0.0469 XRF + 194.54	0.0810	18
Cadmium (Cd)	LAB = -0.1502 XRF + 13.158	0.2712	4
Chromium (Cr)	LAB = 0.8651 XRF + 78.038	0.7557	10
Lead (Pb)	LAB = 1.0837 XRF + 26.025	0.7022	18
Mercury (Hg)	LAB = 0.3456 XRF - 6.189	0.4215	11
Selenium (Se)	NA	NA	0
Silver (Ag)	NA	NA	0

Notes:
LAB = Laboratory result for analysis of RCRA 8 metal in soil sample.
XRF = XRF result for analysis of RCRA 8 metal in soil measured in-situ.
n = Number of sample locations used for correlation analysis.
NA indicates that insufficient data was available to create a trendline. For both selenium and silver, there were no sample locations for which both the in-situ XRF and laboratory method had a detected result (n = 0).

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-01

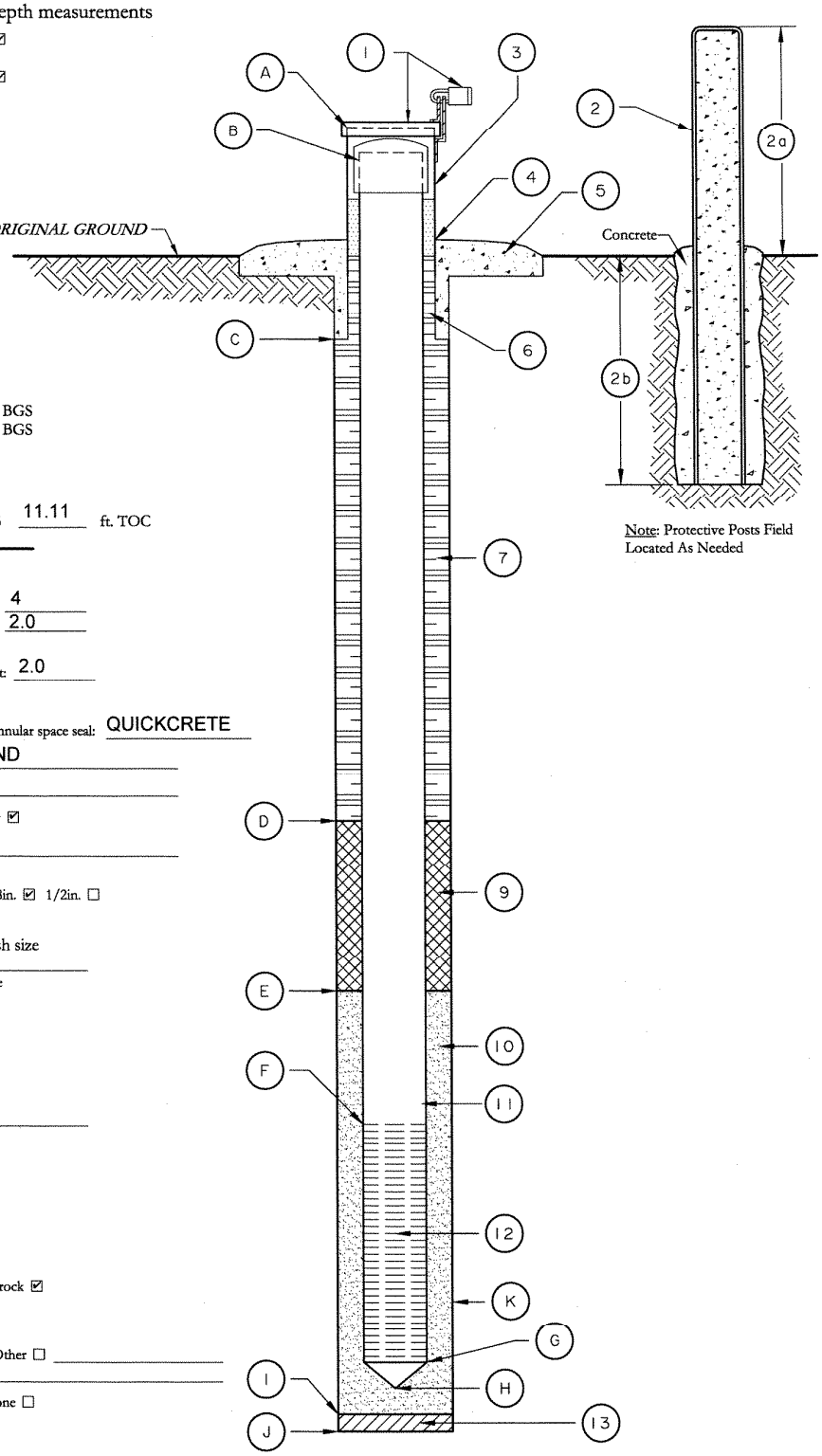
Date Well Installed: From 3/22/05 To 3/24/05
Well Installed By (Person's Name & Firm) GSI - COREY

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.84 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 13.8 ft. BGS
(F) - Screen joint, top 16.0 ft. BGS
(G) - Screen joint, bottom 26.0 ft. BGS
(H) - End cap bottom 26.0 ft. BGS
(I) - Filter pack, bottom 26.0 ft. BGS
(J) - Borehole, bottom 26.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 26.00 ft. BGS
6.0 in. to 26.00 ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 8.27 ft. BGS 11.11 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No.:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-02

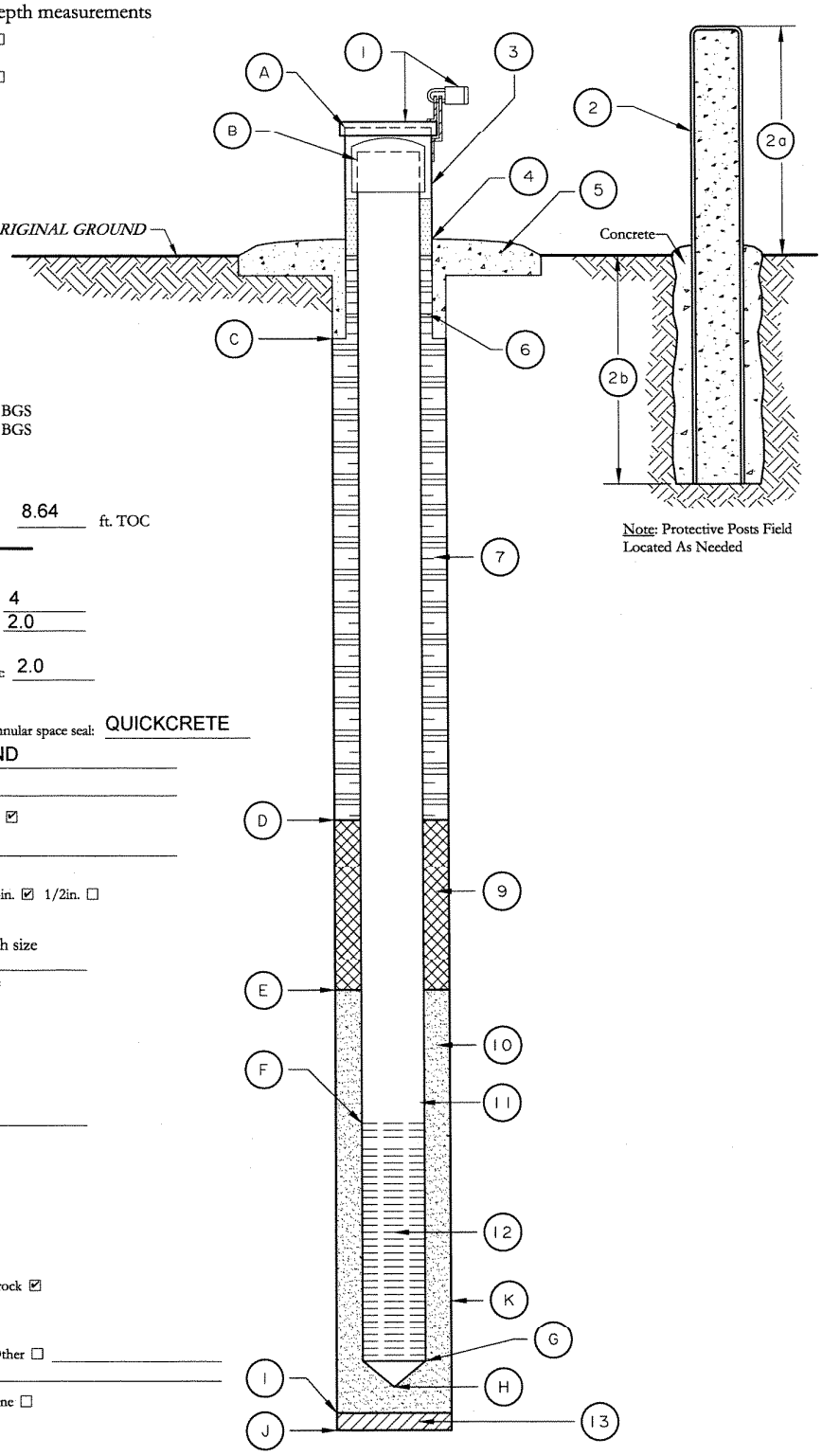
Date Well Installed: From 3/24/05 To 3/25/05
Well Installed By (Person's Name & Firm) GSI - COREY

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☑ or AGS ☐
(B) - Well casing, top 2.79 ft. BGS ☐ or AGS ☐
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.5 ft. BGS
(F) - Screen joint, top 5.2 ft. BGS
(G) - Screen joint, bottom 10.2 ft. BGS
(H) - End cap bottom 11.0 ft. BGS
(I) - Filter pack, bottom 11.0 ft. BGS
(J) - Borehole, bottom 11.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 11.00 ft. BGS
6.0 in. to 11.00 ft. BGS
(L) - O.D. well casing 2.375 in.
(M) - I.D. well casing 2.067 in.
(N) - 24 hr. water level after completion 5.85 ft. BGS 8.64 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No.:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-03

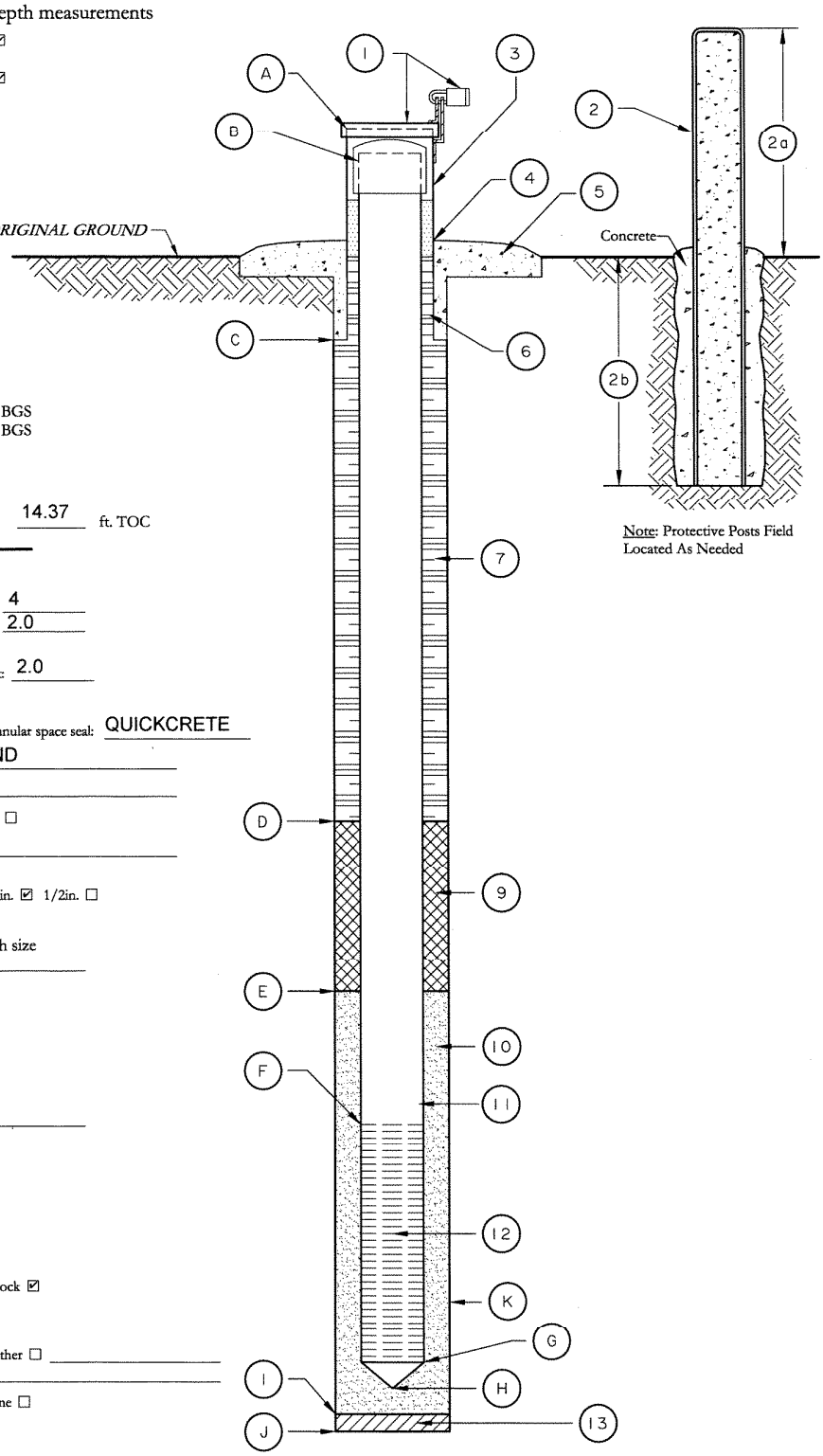
Date Well Installed: From 5/19/05 To 5/19/05
Well Installed By (Person's Name & Firm) AES - DANNY

Type of Protective Cover:
Above-Ground ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.10 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 28.0 ft. BGS
(F) - Screen joint, top 30.0 ft. BGS
(G) - Screen joint, bottom 40.0 ft. BGS
(H) - End cap bottom 40.0 ft. BGS
(I) - Filter pack, bottom 40.5 ft. BGS
(J) - Borehole, bottom 40.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 40.50 ft. BGS
6.0 in. to 40.50 ft. BGS
(L) - O.D. well casing 2.375 in.
(M) - I.D. well casing 2.067 in.
(N) - 24 hr. water level after completion 12.07 ft. BGS 14.37 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: GROUT
- How installed: Tremie ☐ Tremie pumped ☑ Gravity ☐
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐ Bedrock ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
(15) Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-04

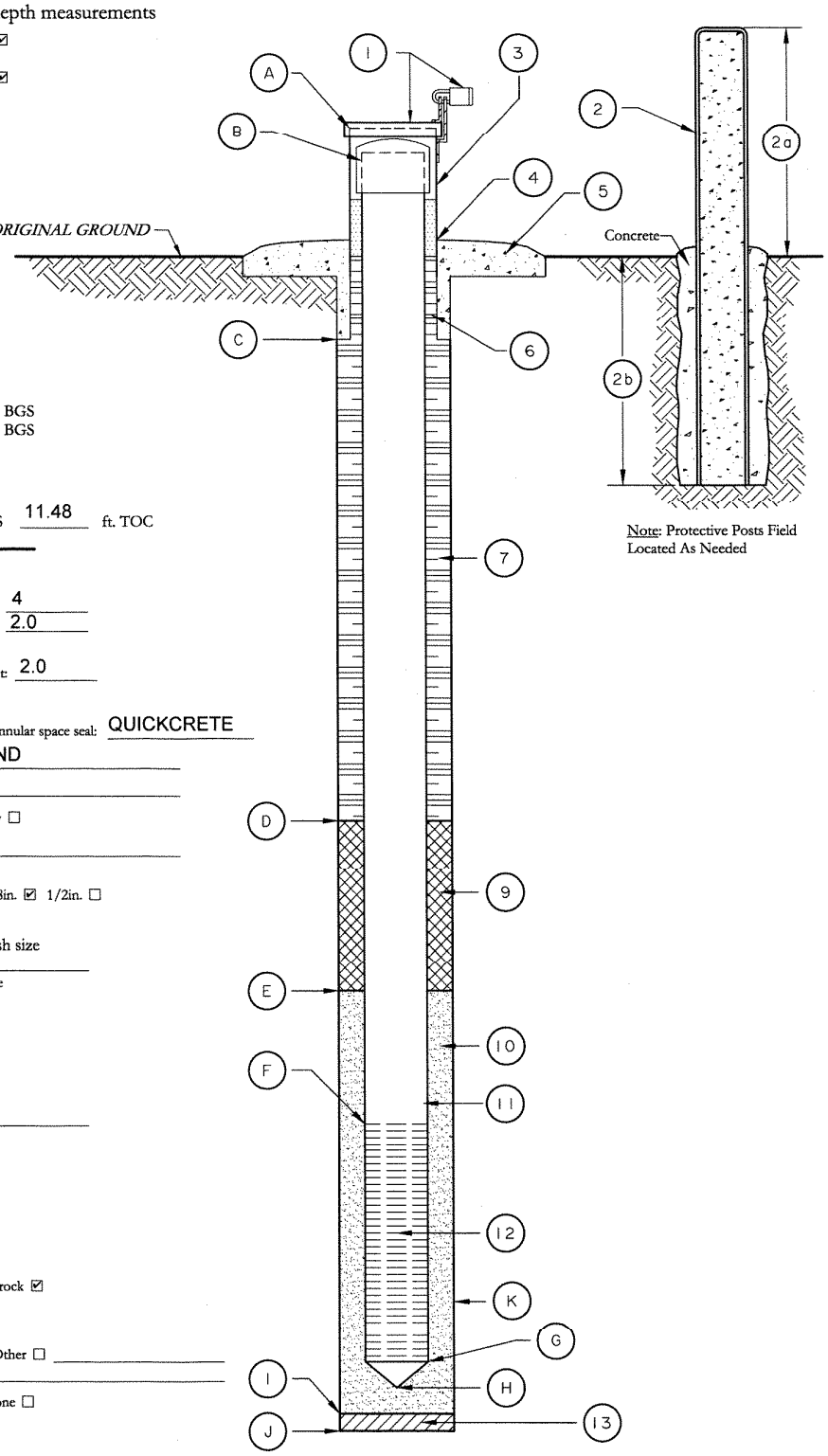
Date Well Installed: From 5/18/05 To 5/19/05
Well Installed By (Person's Name & Firm) AES - DANNY

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.41 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 28.0 ft. BGS
(F) - Screen joint, top 30.0 ft. BGS
(G) - Screen joint, bottom 40.0 ft. BGS
(H) - End cap bottom 40.0 ft. BGS
(I) - Filter pack, bottom 40.5 ft. BGS
(J) - Borehole, bottom 40.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 40.50 ft. BGS
6.0 in. to 40.50 ft. BGS
(L) - O.D. well casing 2.375 in.
(M) - I.D. well casing 2.067 in.
(N) - 24 hr. water level after completion 9.07 ft. BGS 11.48 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: GROUT
- How installed: Tremie ☐ Tremie pumped ☑ Gravity ☐
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-05

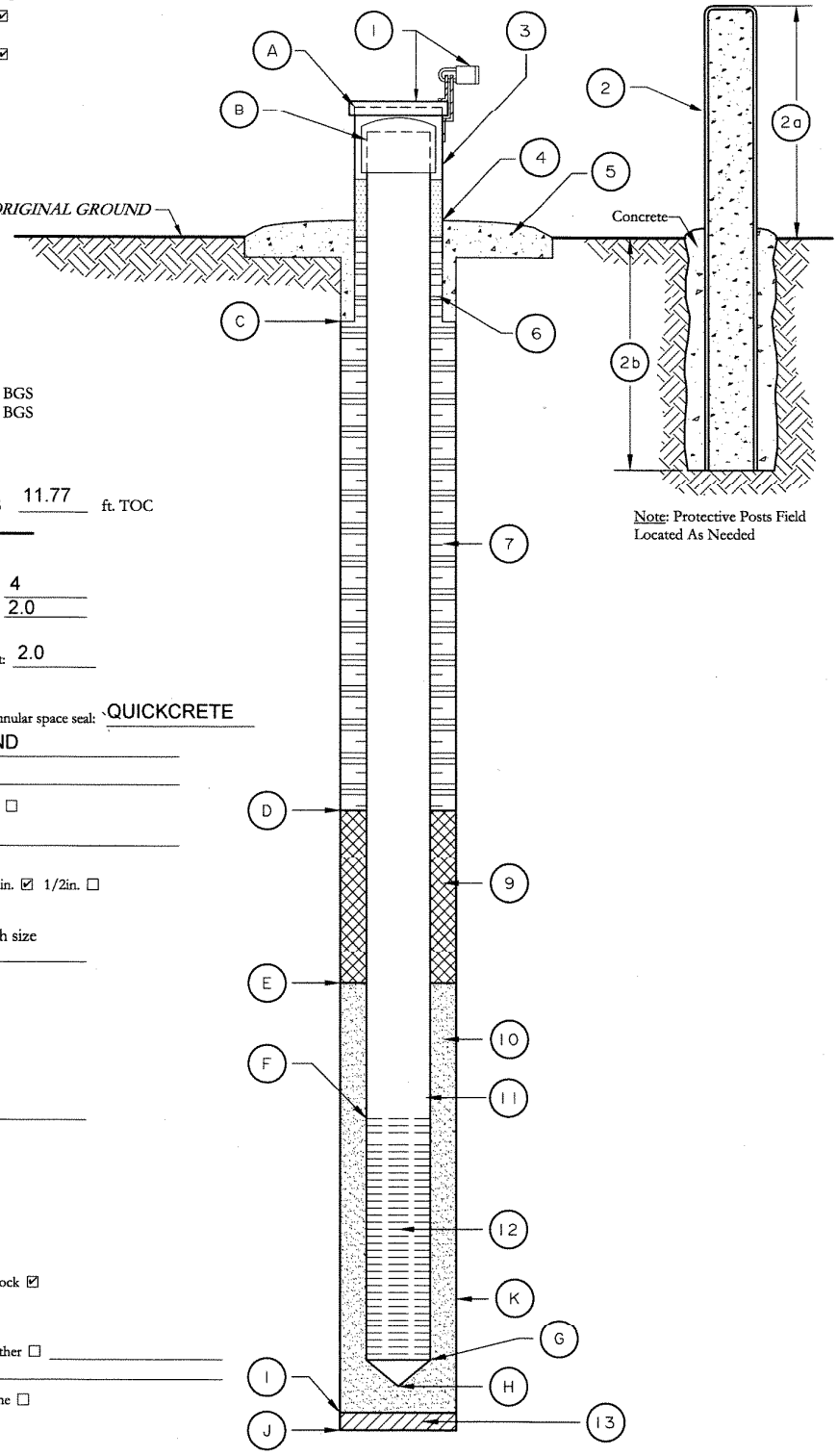
Date Well Installed: From 5/18/05 To 5/18/05
Well Installed By (Person's Name & Firm) AES- DANNY

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.60 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 27.0 ft. BGS
(F) - Screen joint, top 29.0 ft. BGS
(G) - Screen joint, bottom 39.0 ft. BGS
(H) - End cap bottom 39.0 ft. BGS
(I) - Filter pack, bottom 39.5 ft. BGS
(J) - Borehole, bottom 39.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 39.50 ft. BGS
6.0 in. to 39.50 ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 9.17 ft. BGS 11.77 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: GROUT
- How installed: Tremie ☐ Tremie pumped ☑ Gravity ☐
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS) _____
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. _____ ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added _____ ft./3 3.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
_____ Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐ _____
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
_____ Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐ _____
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe: _____



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY

Well Number: OW-06

Date Well Installed: From 5/19/05 To 5/19/05

Well Installed By (Person's Name & Firm) AES- DANNY

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑

(B) - Well casing, top 2.57 ft. BGS ☐ or AGS ☑

(C) - Surface seal, bottom NR ft. BGS

(D) - Bentonite seal, top 0.0 ft. BGS

(E) - Primary filter, top 27.0 ft. BGS

(F) - Screen joint, top 29.0 ft. BGS

(G) - Screen joint, bottom 39.0 ft. BGS

(H) - End cap bottom 39.0 ft. BGS

(I) - Filter pack, bottom 39.5 ft. BGS

(J) - Borehole, bottom 39.5 ft. BGS

(K) - Borehole, diameter 8.25 in. to 39.50 ft. BGS
6.0 in. to 39.50 ft. BGS

(L) - O.D. well casing 2.38 in.

(M) - I.D. well casing 2.07 in.

(N) - 24 hr. water level after completion 7.67 ft. BGS 10.24 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐

(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0

(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0

(4) - Drainage port (s)? Yes ☐ No ☑

(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE

(6) - Material between well casing and protective casing: SAND

(7) - Annular space seal: Mix: GROUT

- How installed: Tremie ☐ Tremie pumped ☑ Gravity ☐

(8) - Centralizers: No ☑ Yes ☐ Depths (BGS) _____

(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. _____ ☐ other

(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OCLEBAY NORTON 10/20 SILICA
b. Volume added _____ ft./3 3.5/50 LB Bags/Size

(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
_____ Other ☐

(12) - Screen material: PVC
a. Screen type: _____
Factory cut ☑ Continuous slot ☐ Other ☐ _____
b: Manufacturer _____
c: Slot size: 0.01
d: Slotted length: 10 FT

(13) - Backfill material (below filter pack): None ☑
_____ Other ☐

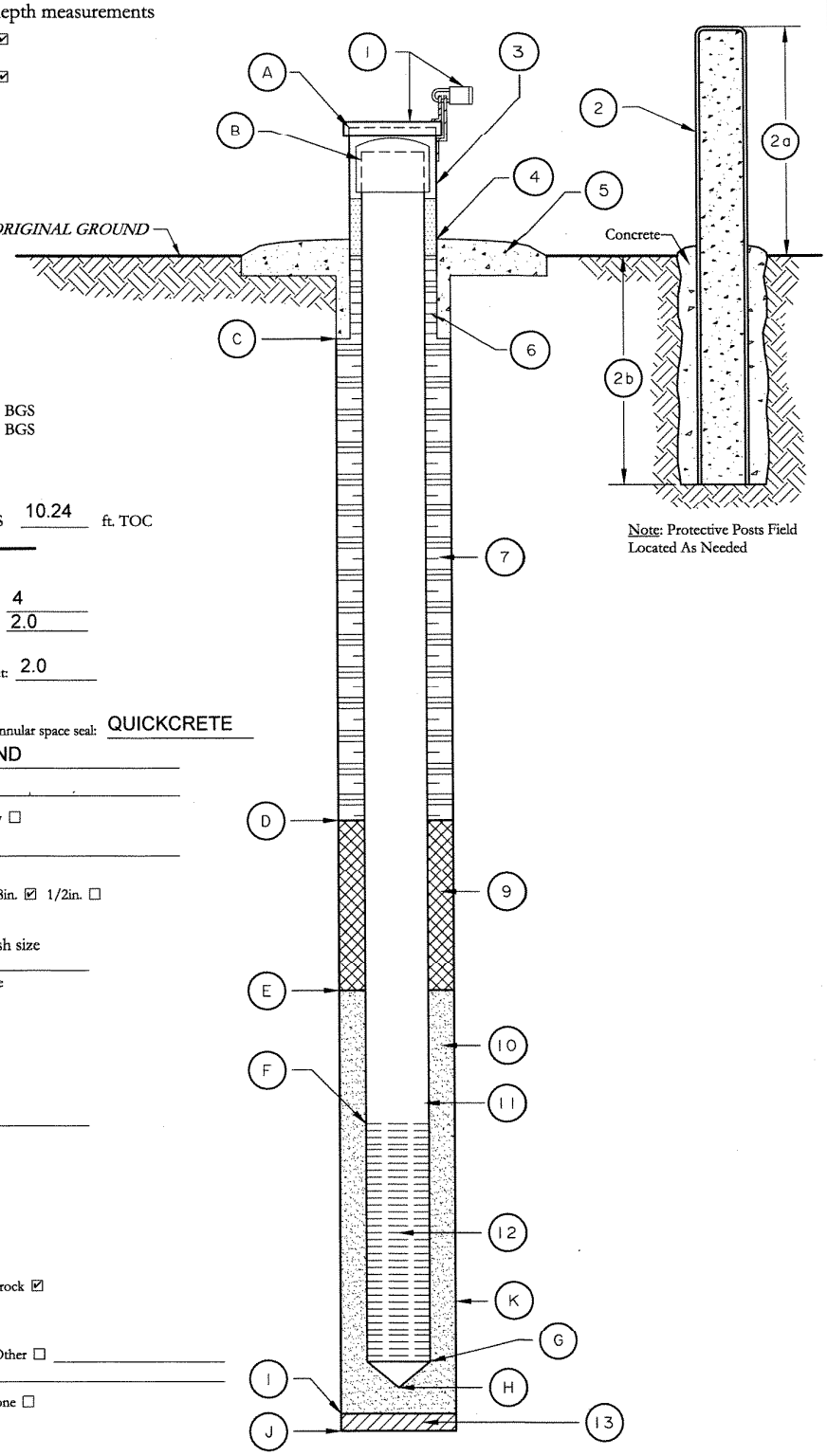
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑

(15) - Sieve analysis attached? Yes ☐ No ☑

(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐ _____

(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐

(18) - Drilling additives used? Yes ☐ No ☑
Describe: _____



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-07

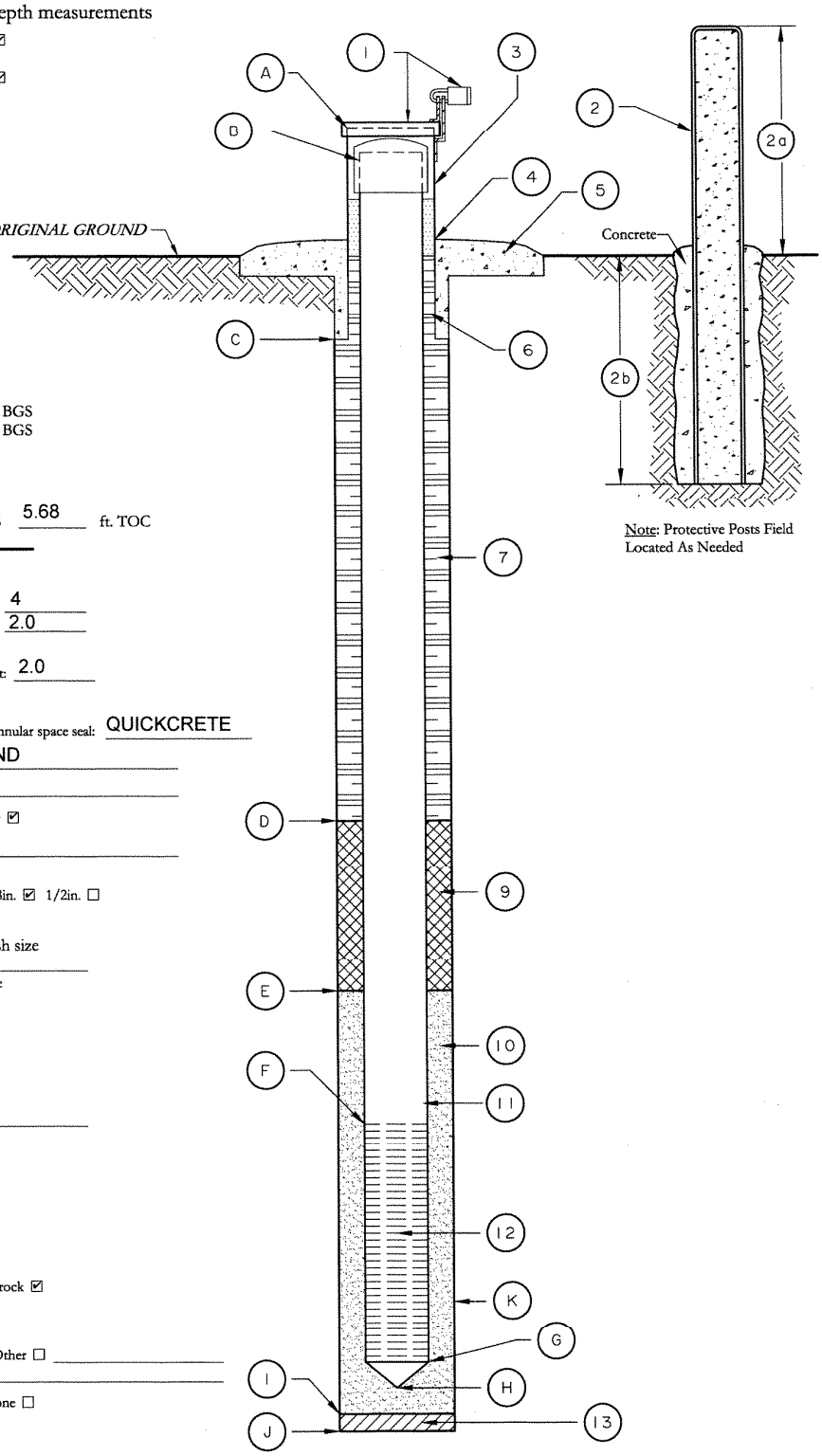
Date Well Installed: From 4/05/05 To 4/05/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Ground ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.86 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.5 ft. BGS
(F) - Screen joint, top 5.0 ft. BGS
(G) - Screen joint, bottom 10.0 ft. BGS
(H) - End cap bottom 10.0 ft. BGS
(I) - Filter pack, bottom 10.0 ft. BGS
(J) - Borehole, bottom 10.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 10.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 2.71 ft. BGS 5.68 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-08

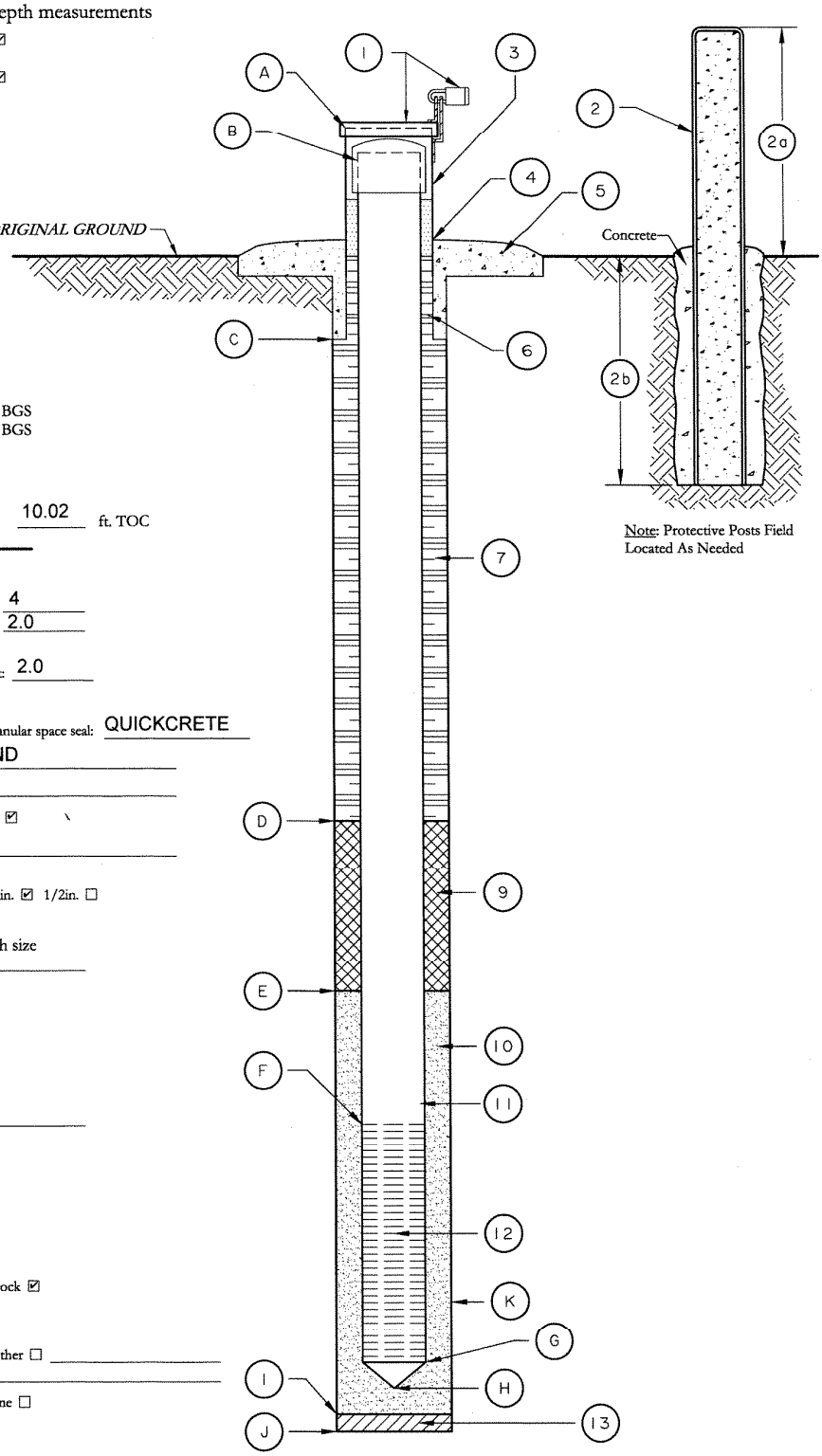
Date Well Installed: From 3/28/05 To 3/28/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.78 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 3.7 ft. BGS
(F) - Screen joint, top 4.8 ft. BGS
(G) - Screen joint, bottom 14.8 ft. BGS
(H) - End cap bottom 14.8 ft. BGS
(I) - Filter pack, bottom 15.0 ft. BGS
(J) - Borehole, bottom 15.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 15.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 7.16 ft. BGS 10.02 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐ Bedrock ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐
(15) Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-09

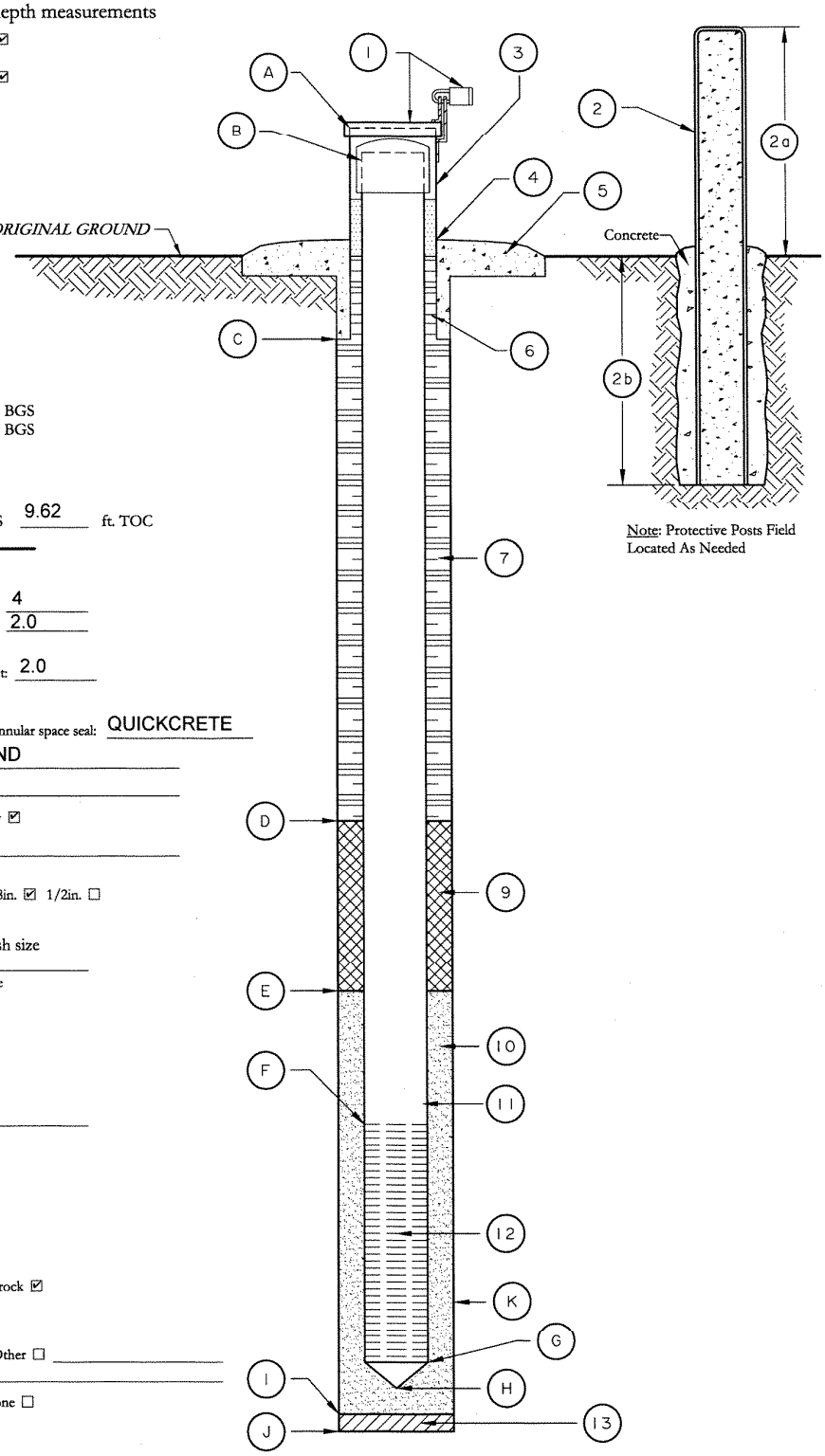
Date Well Installed: From 3/28/05 To 3/28/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.82 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.0 ft. BGS
(F) - Screen joint, top 4.6 ft. BGS
(G) - Screen joint, bottom 14.6 ft. BGS
(H) - End cap bottom 14.6 ft. BGS
(I) - Filter pack, bottom 15.3 ft. BGS
(J) - Borehole, bottom 15.3 ft. BGS
(K) - Borehole, diameter 8.25 in. to 15.25 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 6.84 ft. BGS 9.62 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-10

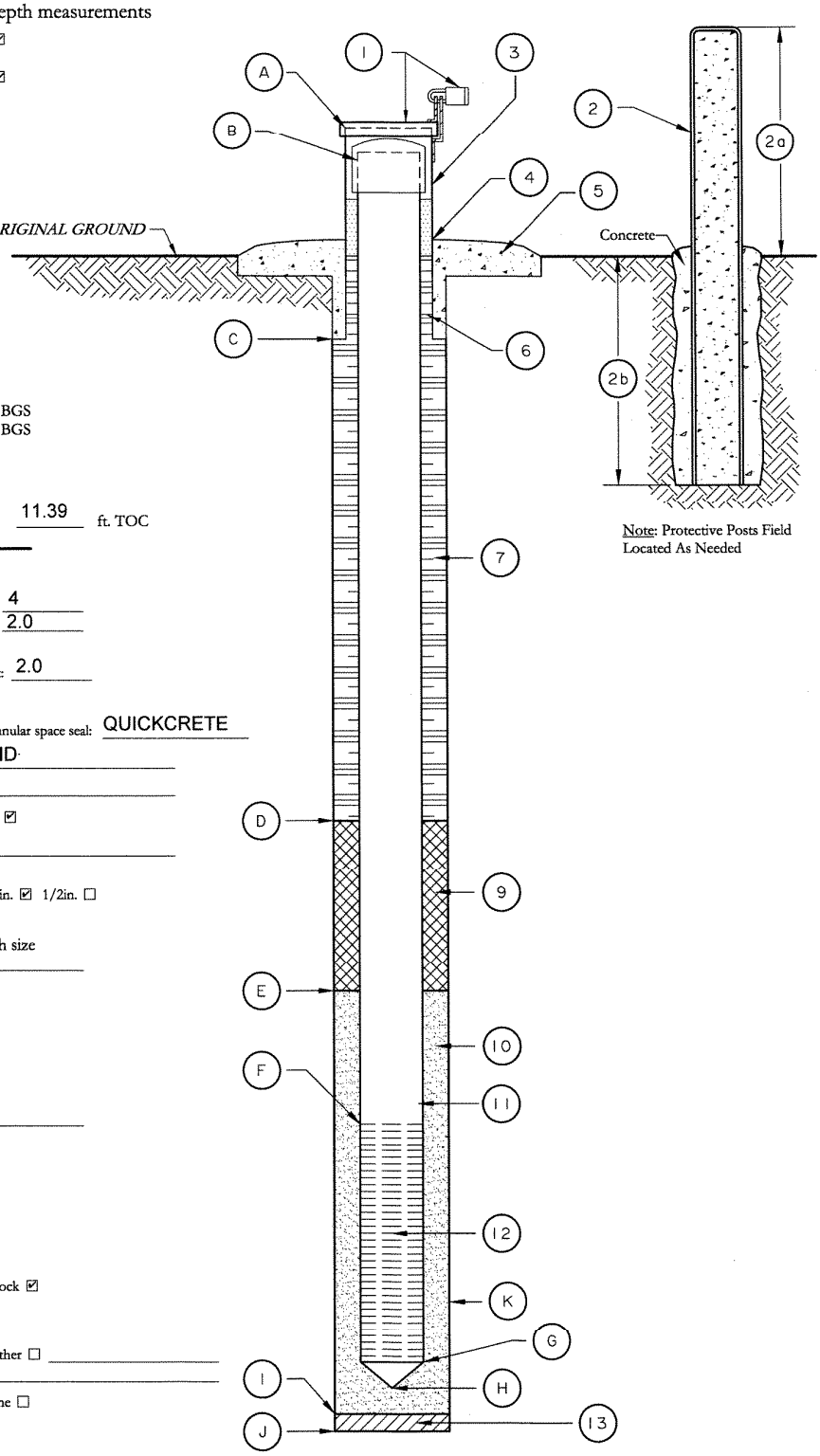
Date Well Installed: From 4/05/05 To 4/05/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.92 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.0 ft. BGS
(F) - Screen joint, top 6.0 ft. BGS
(G) - Screen joint, bottom 16.0 ft. BGS
(H) - End cap bottom 16.0 ft. BGS
(I) - Filter pack, bottom 18.0 ft. BGS
(J) - Borehole, bottom 18.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 8.57 ft. BGS 11.39 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OCLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-11

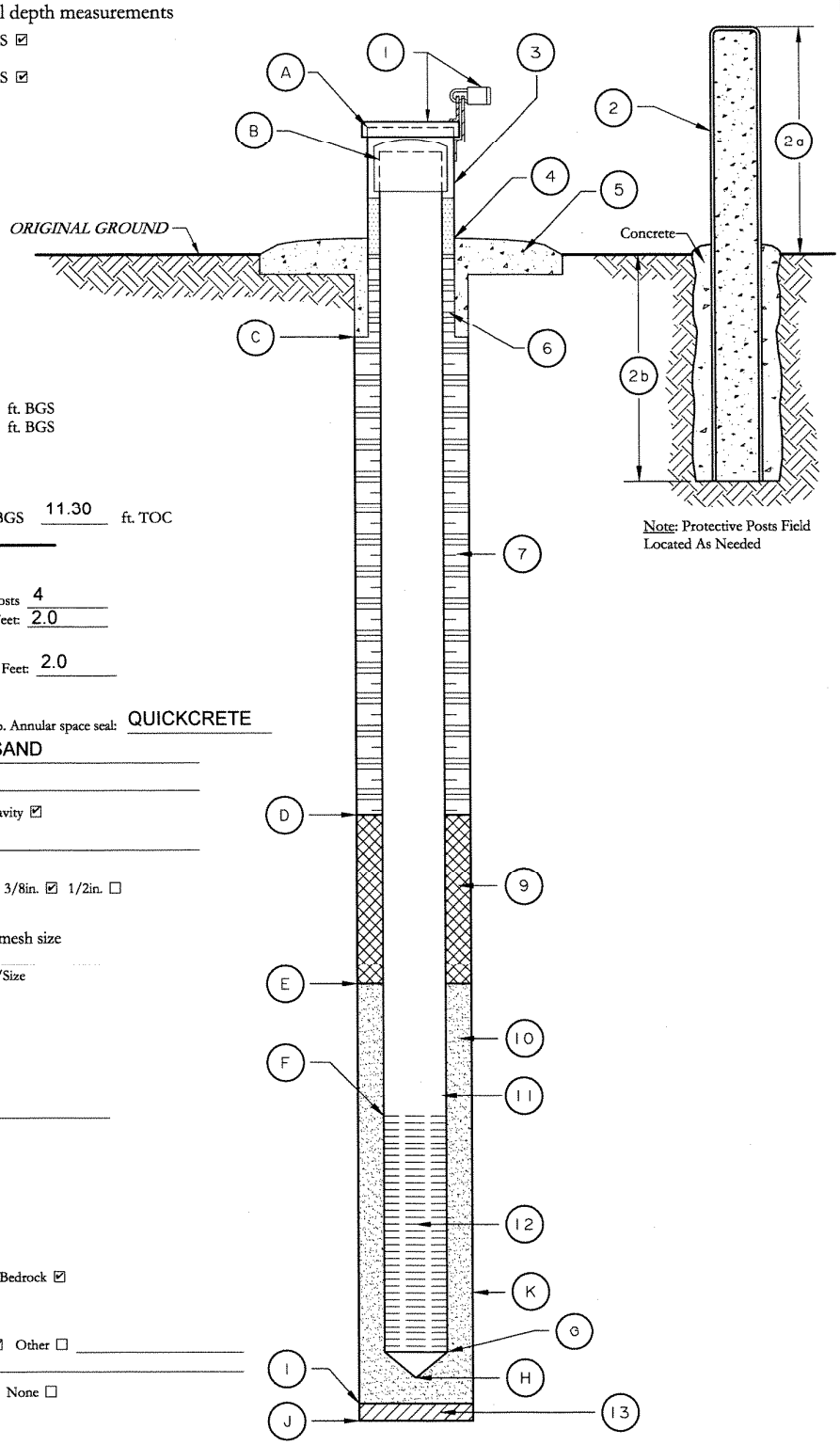
Date Well Installed: From 4/04/05 To 4/04/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.89 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 5.0 ft. BGS
(F) - Screen joint, top 7.0 ft. BGS
(G) - Screen joint, bottom 17.0 ft. BGS
(H) - End cap bottom 17.0 ft. BGS
(I) - Filter pack, bottom 16.0 ft. BGS
(J) - Borehole, bottom 18.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 8.38 ft. BGS 11.30 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 6/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-12

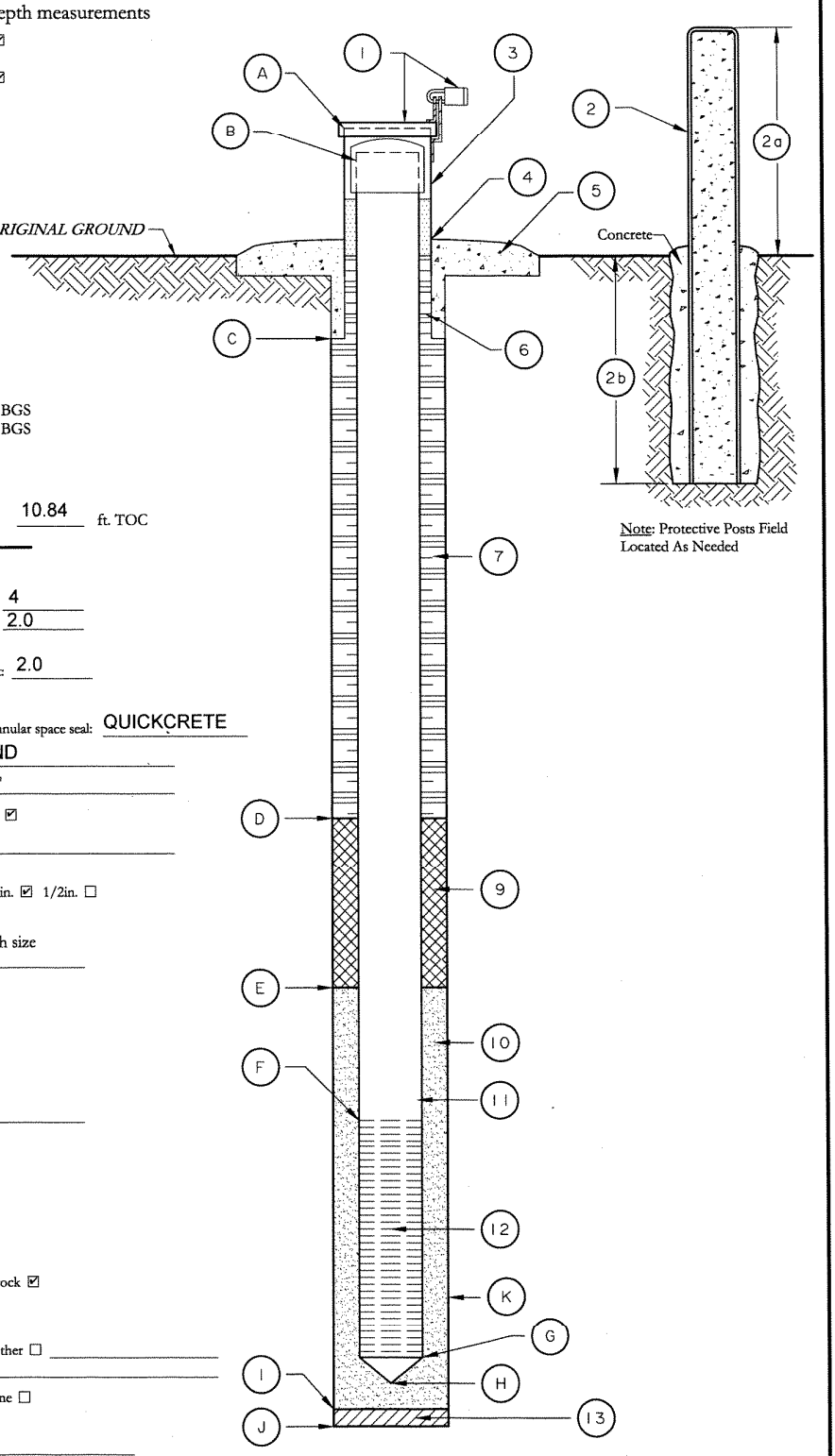
Date Well Installed: From 4/04/05 To 4/04/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.68 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 5.0 ft. BGS
(F) - Screen joint, top 6.9 ft. BGS
(G) - Screen joint, bottom 16.9 ft. BGS
(H) - End cap bottom 16.9 ft. BGS
(I) - Filter pack, bottom 18.0 ft. BGS
(J) - Borehole, bottom 18.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 7.95 ft. BGS 10.84 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OCLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-13

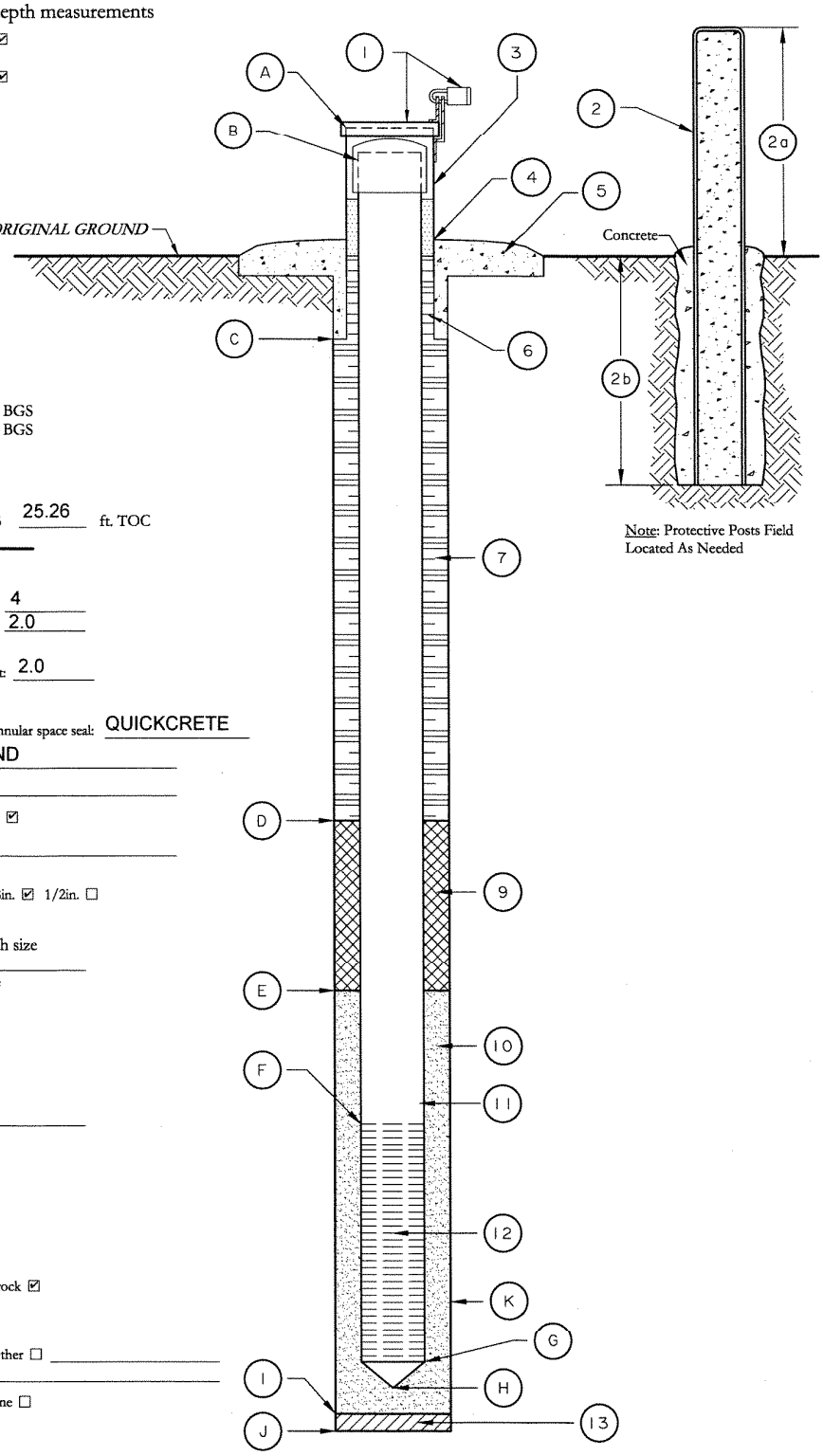
Date Well Installed: From 3/26/05 To 3/26/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.65 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 10.3 ft. BGS
(F) - Screen joint, top 12.4 ft. BGS
(G) - Screen joint, bottom 22.4 ft. BGS
(H) - End cap bottom 22.4 ft. BGS
(I) - Filter pack, bottom 22.4 ft. BGS
(J) - Borehole, bottom 22.4 ft. BGS
(K) - Borehole, diameter 8.25 in. to 22.40 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 22.58 ft. BGS 25.26 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-14

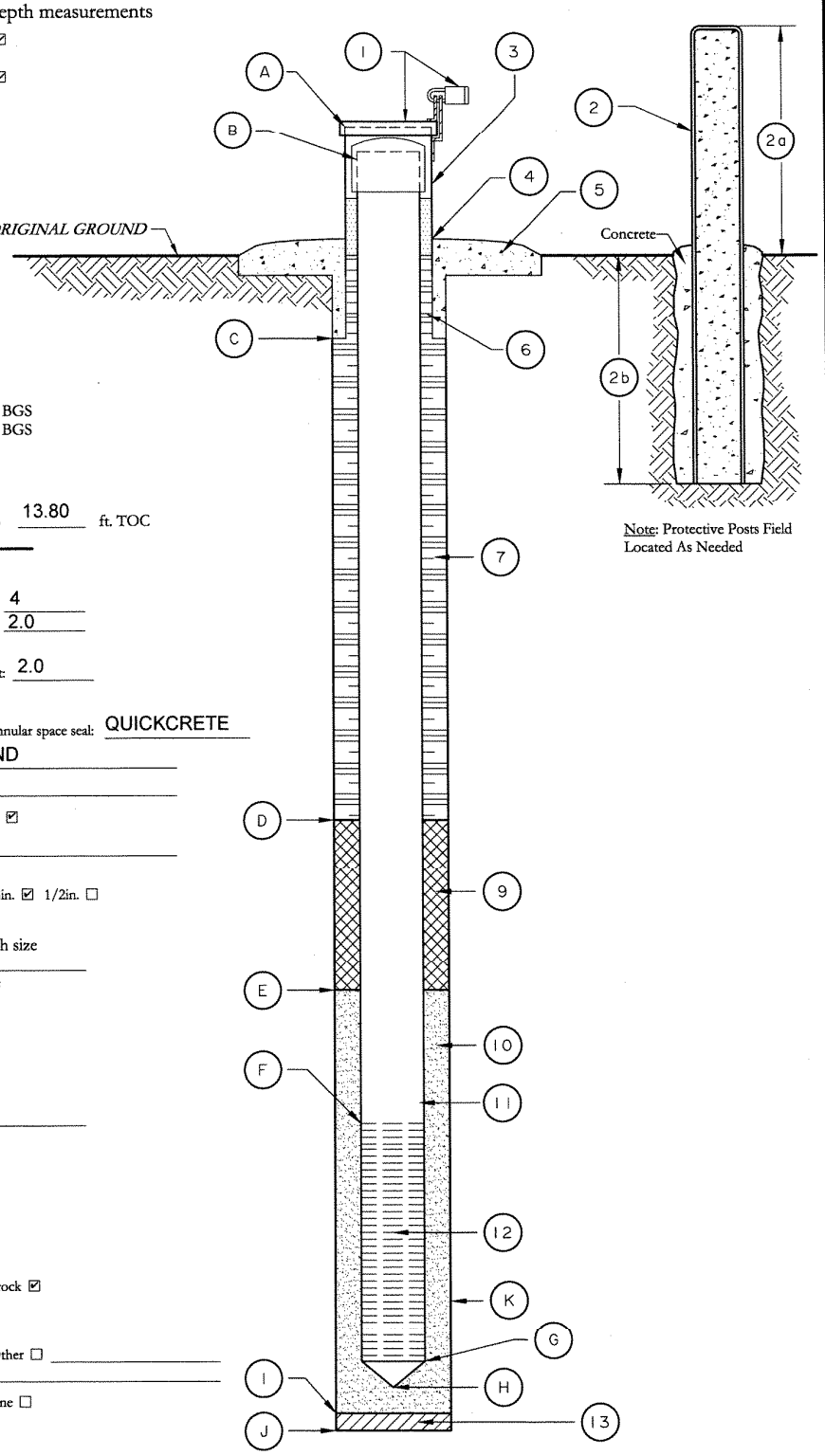
Date Well Installed: From 3/28/05 To 3/28/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.65 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.0 ft. BGS
(F) - Screen joint, top 4.6 ft. BGS
(G) - Screen joint, bottom 14.6 ft. BGS
(H) - End cap bottom 14.6 ft. BGS
(I) - Filter pack, bottom 15.0 ft. BGS
(J) - Borehole, bottom 15.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 15.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 11.15 ft. BGS 13.80 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b. Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-16

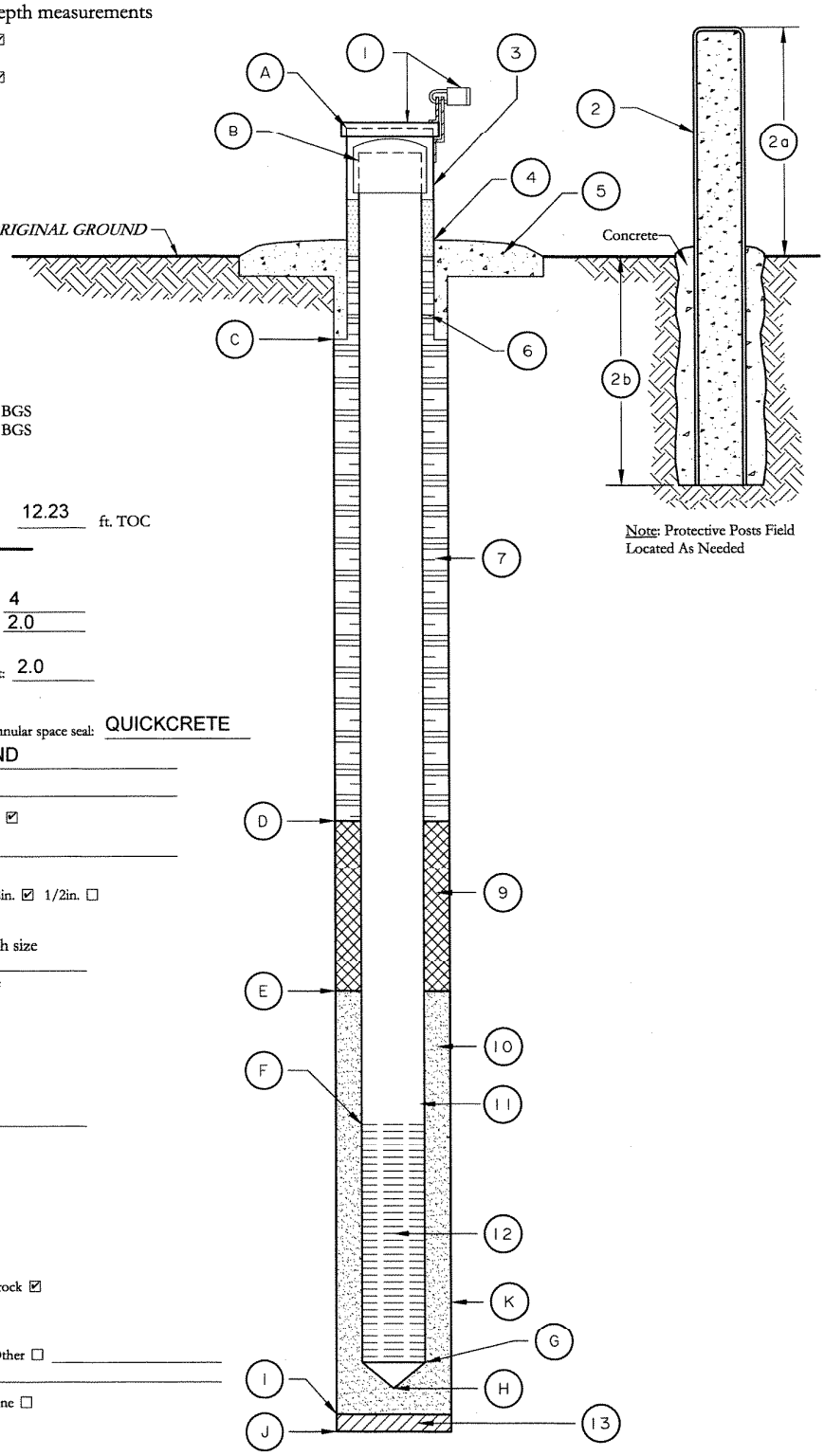
Date Well Installed: From 3/24/05 To 3/24/05
Well Installed By (Person's Name & Firm) GSI- Paul

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.82 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 6.8 ft. BGS
(F) - Screen joint, top 9.2 ft. BGS
(G) - Screen joint, bottom 14.2 ft. BGS
(H) - End cap bottom 14.2 ft. BGS
(I) - Filter pack, bottom 14.2 ft. BGS
(J) - Borehole, bottom 14.2 ft. BGS
(K) - Borehole, diameter 8.25 in. to 14.20 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 9.41 ft. BGS 12.23 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-18

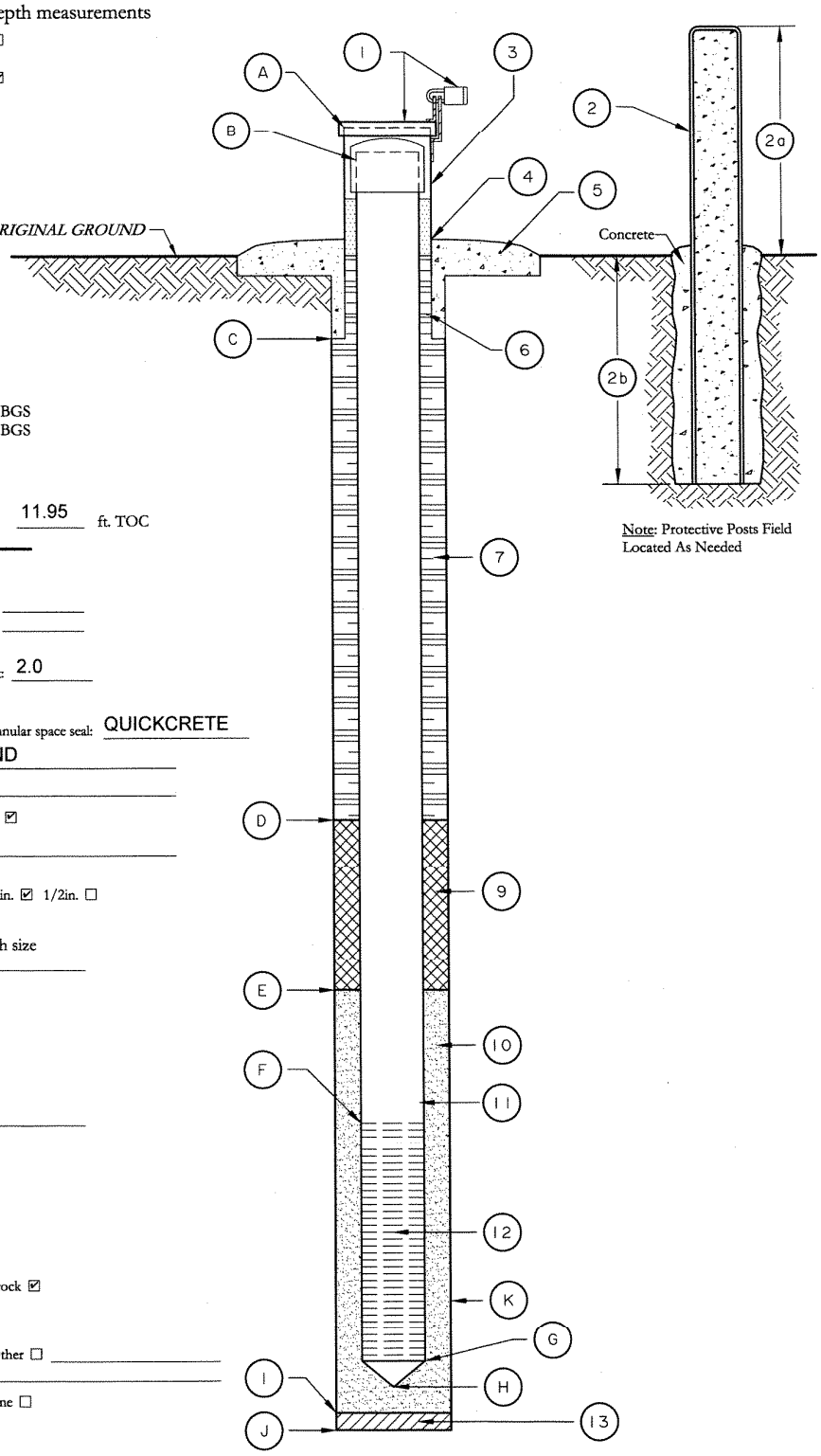
Date Well Installed: From 3/25/05 To 3/25/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☐
(B) - Well casing, top 2.75 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.5 ft. BGS
(F) - Screen joint, top 5.0 ft. BGS
(G) - Screen joint, bottom 10.0 ft. BGS
(H) - End cap bottom 10.0 ft. BGS
(I) - Filter pack, bottom 10.0 ft. BGS
(J) - Borehole, bottom 10.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 10.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 9.20 ft. BGS 11.95 ft. TOC

(1) - Cap and Lock? Yes ☐ No ☑
(2) - Protective posts? Yes ☐ No ☑ No. of Posts
a. Height AGS: Feet: b. Depth BGS: Feet:
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☐
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-19 T

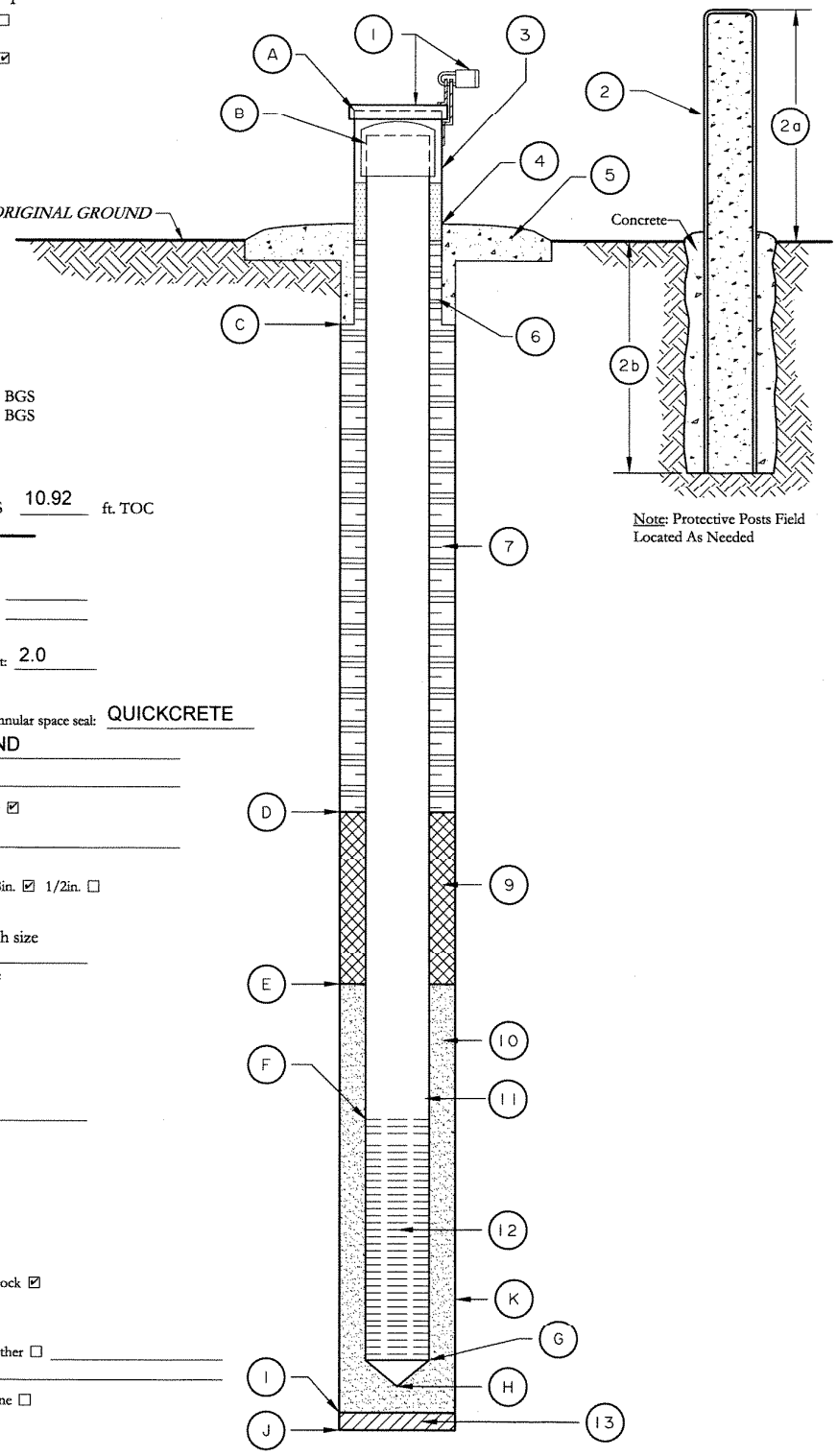
Date Well Installed: From 3/26/05 To 3/26/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☐
(B) - Well casing, top 2.94 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 6.0 ft. BGS
(F) - Screen joint, top 7.5 ft. BGS
(G) - Screen joint, bottom 12.5 ft. BGS
(H) - End cap bottom 12.5 ft. BGS
(I) - Filter pack, bottom 12.5 ft. BGS
(J) - Borehole, bottom 12.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 12.50 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 7.98 ft. BGS 10.92 ft. TOC

(1) - Cap and Lock? Yes ☐ No ☑
(2) - Protective posts? Yes ☐ No ☑ No. of Posts
a. Height AGS: Feet: b. Depth BGS: Feet:
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☐
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 3.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-21

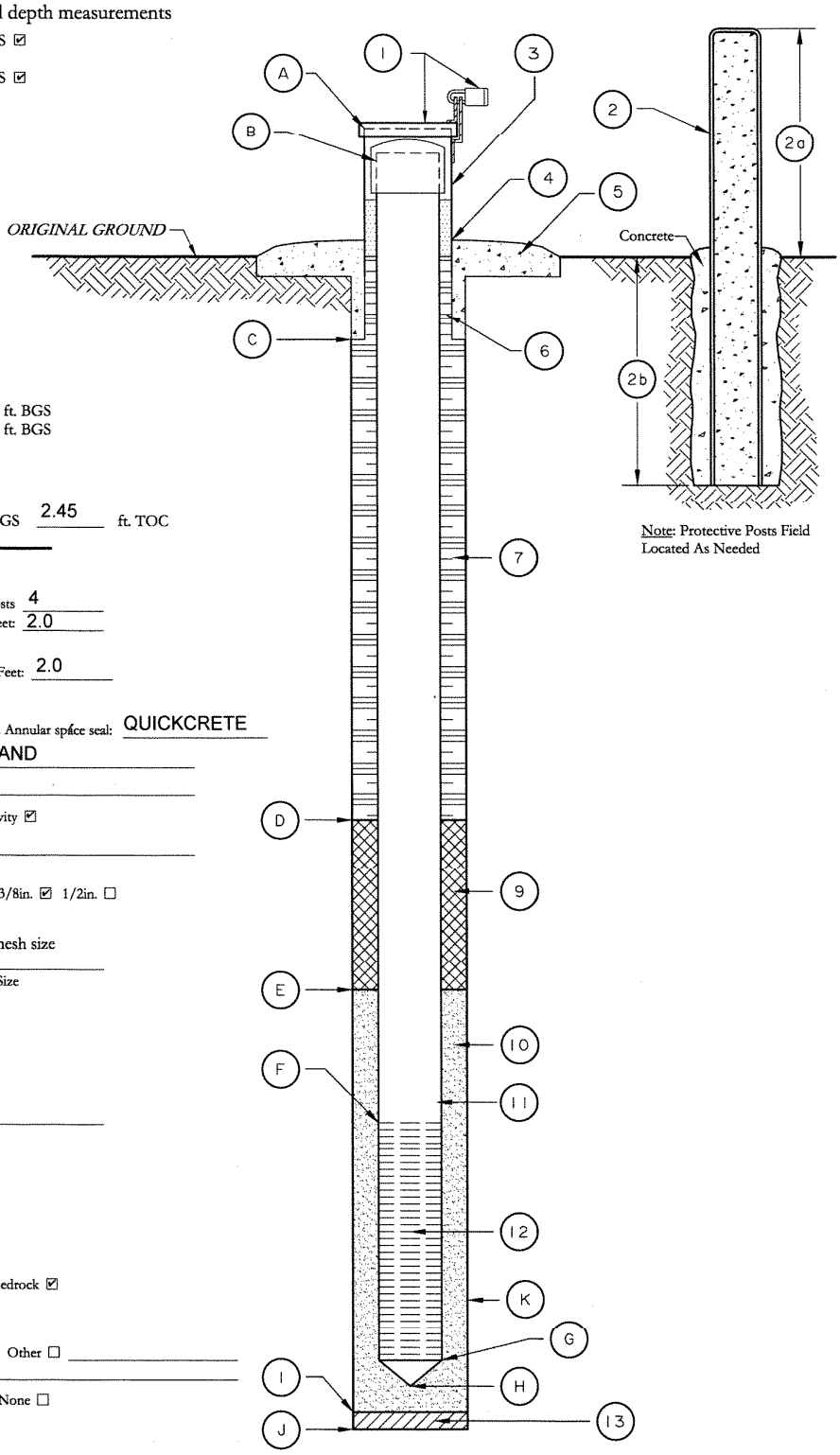
Date Well Installed: From 3/23/05 To 3/23/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.58 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 1.8 ft. BGS
(F) - Screen joint, top 2.8 ft. BGS
(G) - Screen joint, bottom 7.8 ft. BGS
(H) - End cap bottom 7.8 ft. BGS
(I) - Filter pack, bottom 7.8 ft. BGS
(J) - Borehole, bottom 8.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 8.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion -0.13 ft. BGS 2.45 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 2.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-22

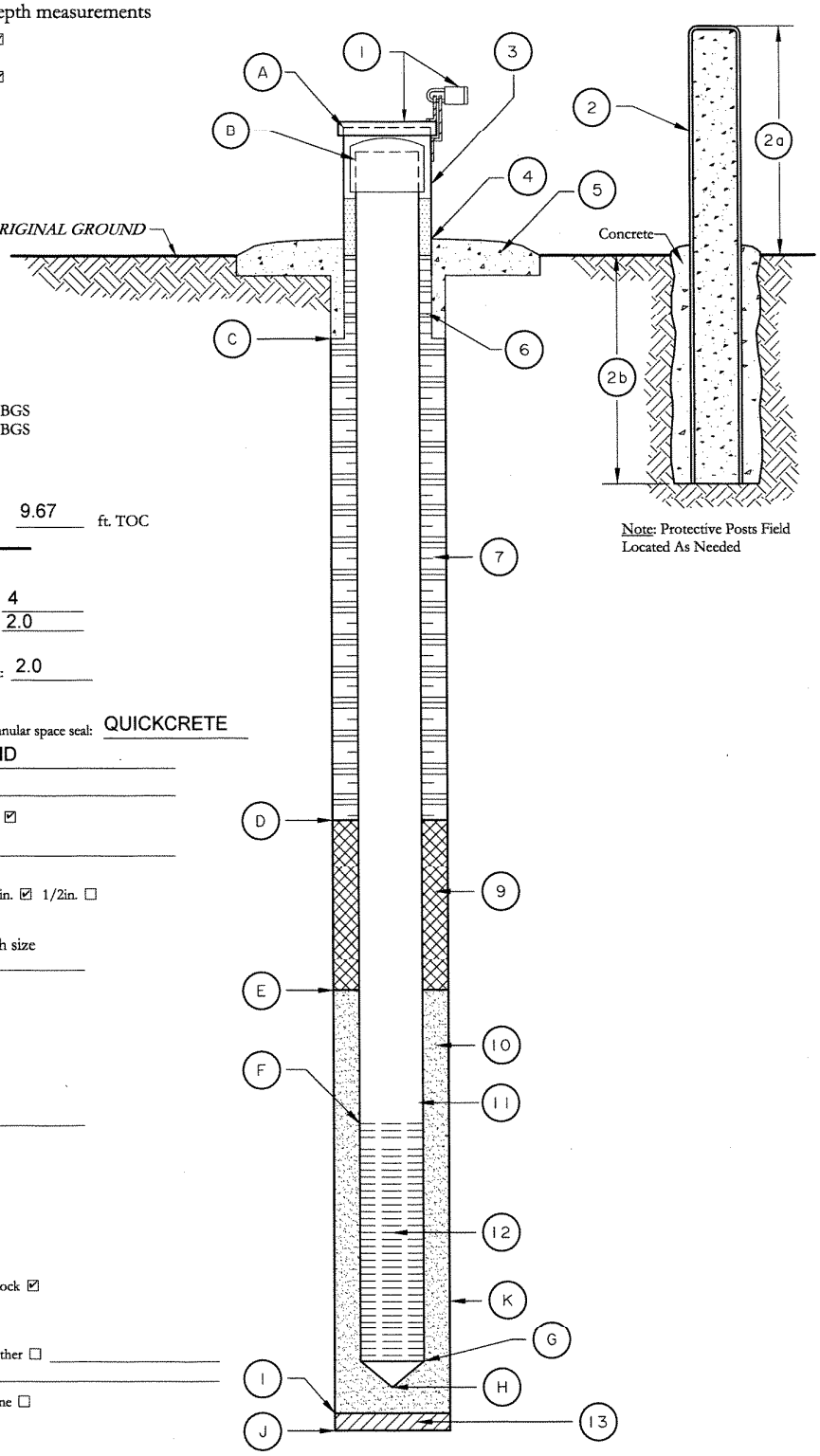
Date Well Installed: From 3/26/05 To 3/26/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Ground ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.99 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 5.0 ft. BGS
(F) - Screen joint, top 6.0 ft. BGS
(G) - Screen joint, bottom 16.0 ft. BGS
(H) - End cap bottom 16.0 ft. BGS
(I) - Filter pack, bottom 16.0 ft. BGS
(J) - Borehole, bottom 16.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 16.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 6.68 ft. BGS 9.67 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-23

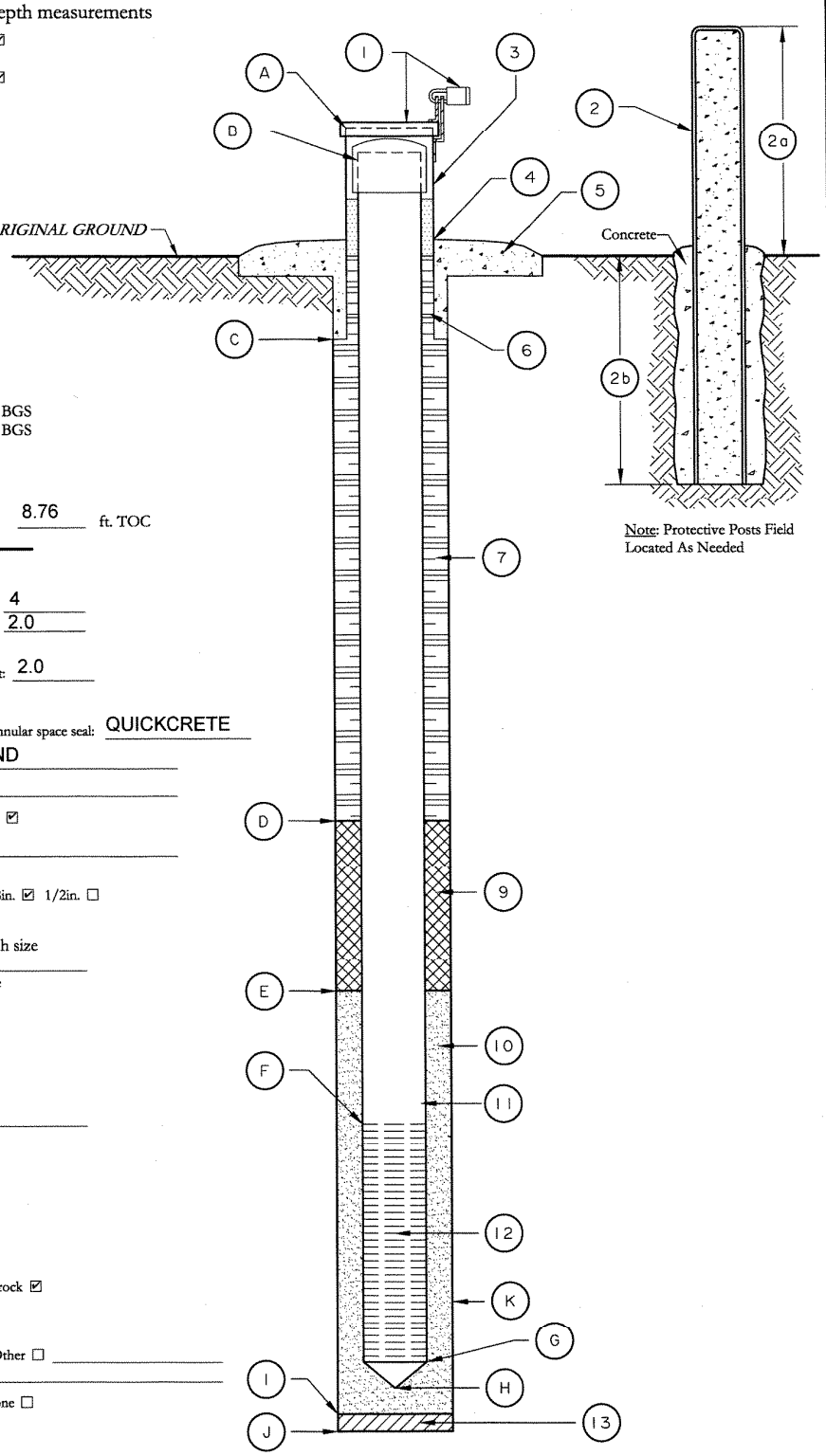
Date Well Installed: From 3/26/05 To 3/26/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Ground ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 4.26 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 7.8 ft. BGS
(F) - Screen joint, top 10.0 ft. BGS
(G) - Screen joint, bottom 20.0 ft. BGS
(H) - End cap bottom 20.0 ft. BGS
(I) - Filter pack, bottom 20.0 ft. BGS
(J) - Borehole, bottom 20.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 20.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 4.50 ft. BGS 8.76 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 6.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-24

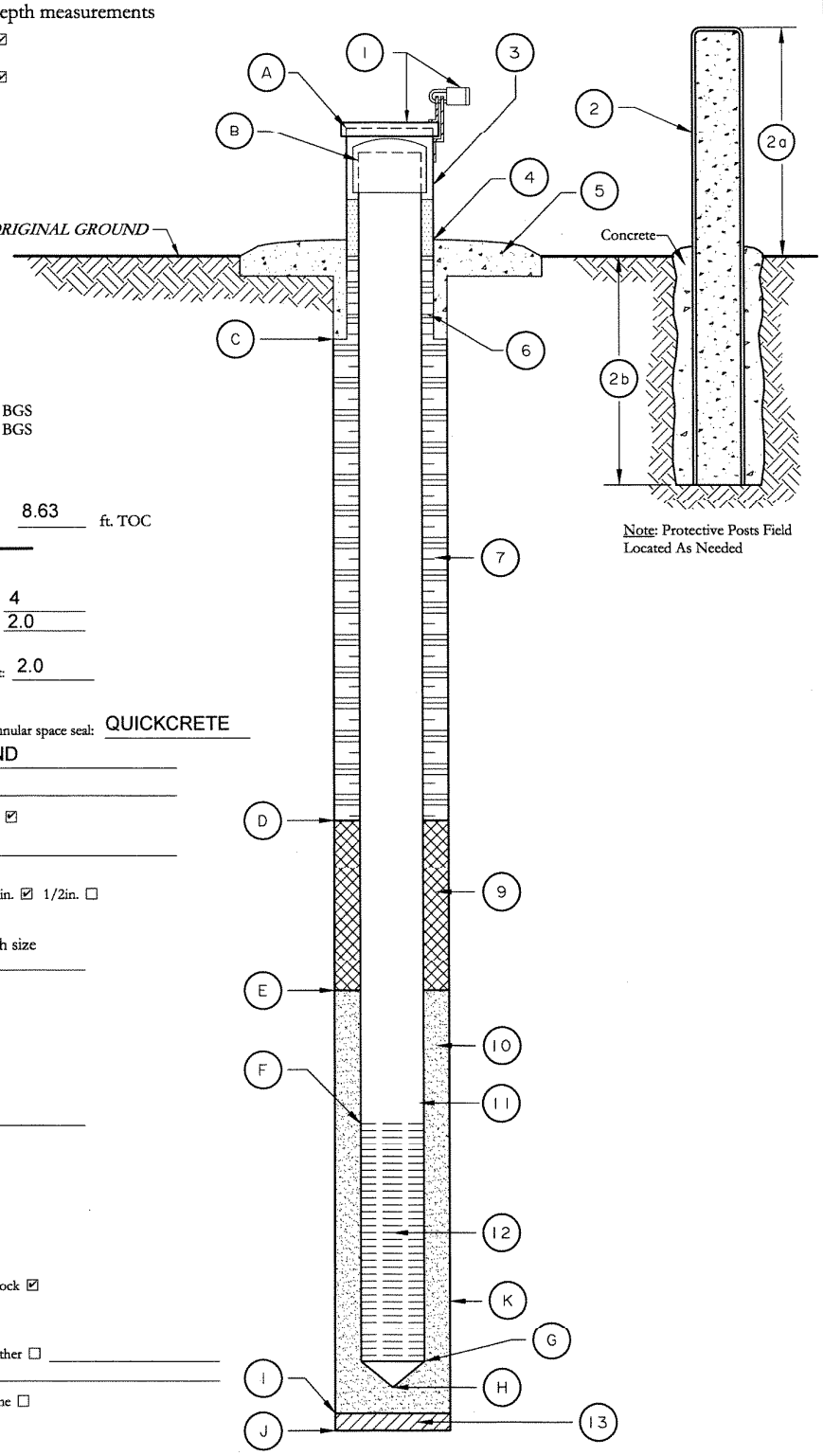
Date Well Installed: From 3/25/05 To 3/25/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.98 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.7 ft. BGS
(F) - Screen joint, top 7.0 ft. BGS
(G) - Screen joint, bottom 22.0 ft. BGS
(H) - End cap bottom 22.0 ft. BGS
(I) - Filter pack, bottom 22.0 ft. BGS
(J) - Borehole, bottom 22.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 22.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 5.65 ft. BGS 8.63 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 7/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 15 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-25

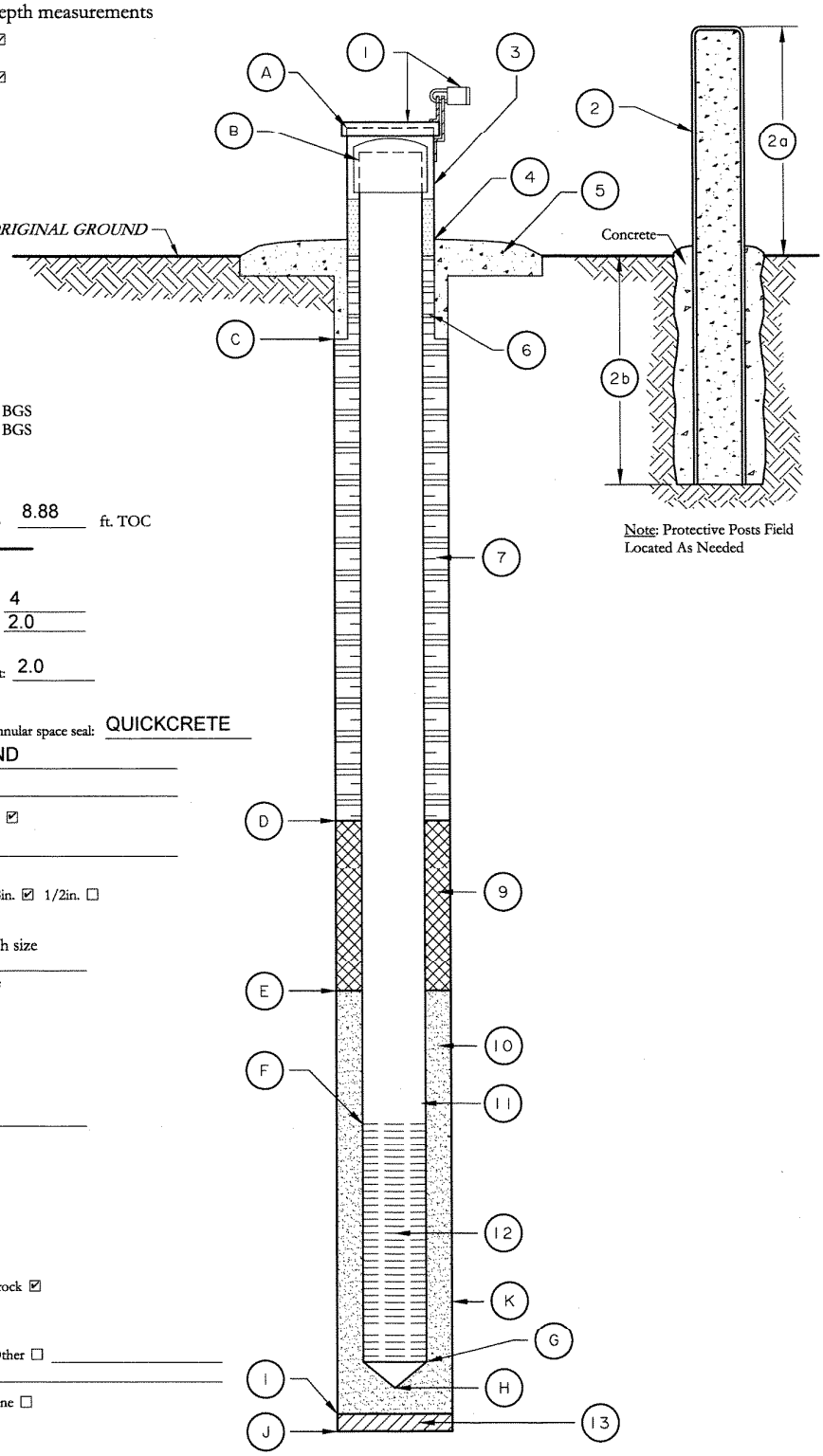
Date Well Installed: From 3/25/05 To 3/25/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.72 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 3.0 ft. BGS
(F) - Screen joint, top 4.0 ft. BGS
(G) - Screen joint, bottom 19.0 ft. BGS
(H) - End cap bottom 19.0 ft. BGS
(I) - Filter pack, bottom 19.0 ft. BGS
(J) - Borehole, bottom 19.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 19.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 6.16 ft. BGS 8.88 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 7/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 15 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-26

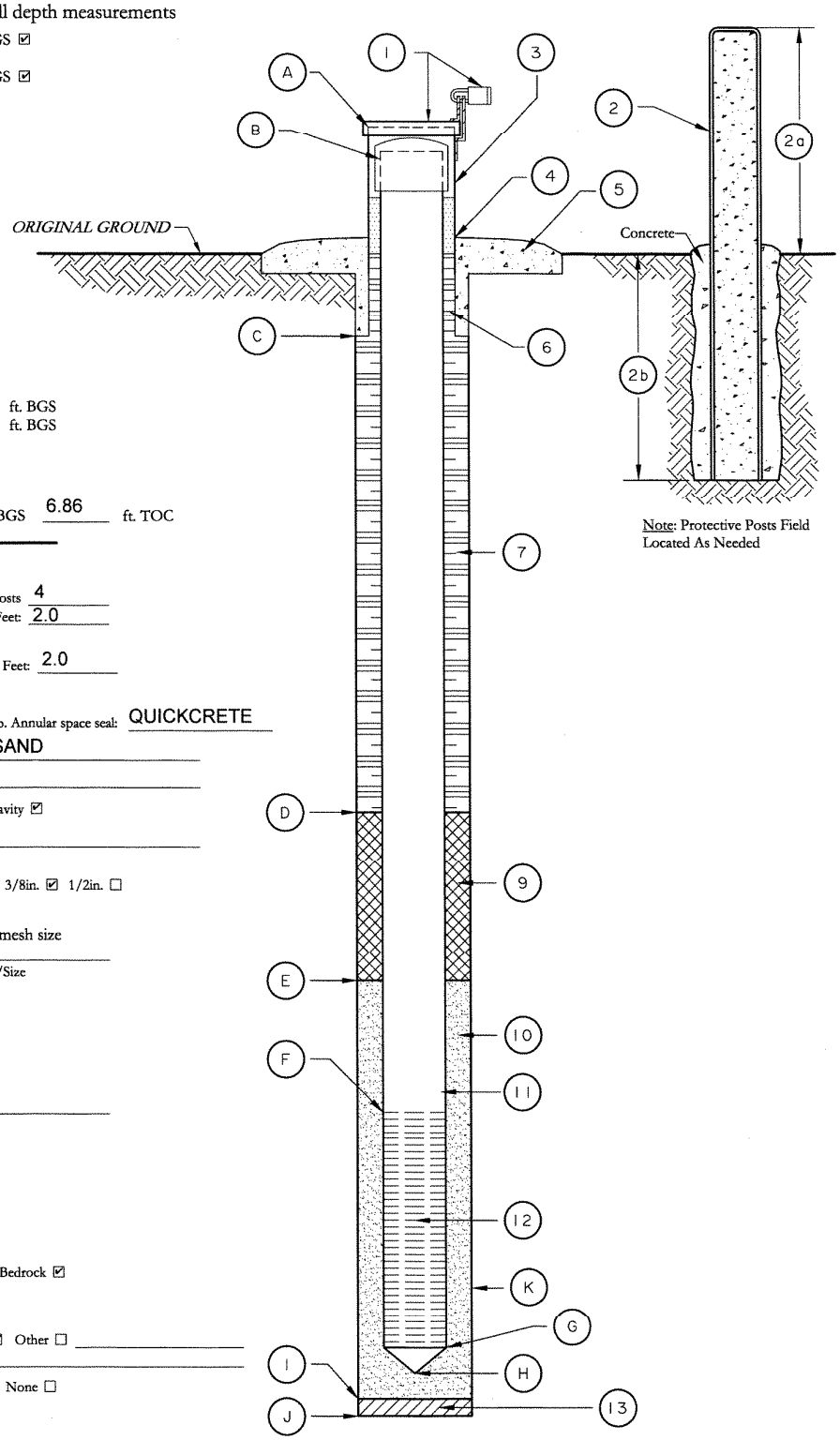
Date Well Installed: From 4/02/05 To 4/02/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 3.00 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 7.0 ft. BGS
(F) - Screen joint, top 8.8 ft. BGS
(G) - Screen joint, bottom 18.8 ft. BGS
(H) - End cap bottom 18.8 ft. BGS
(I) - Filter pack, bottom 18.8 ft. BGS
(J) - Borehole, bottom 18.8 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.80 ft. BGS
in. to ____ ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 3.86 ft. BGS 6.86 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS) ____
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ____ ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ____ ft./3 2/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
____ Other ☐
(12) - Screen material: PVC
a. Screen type: ____
Factory cut ☑ Continuous slot ☐ Other ☐ ____
b: Manufacturer ____
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
____ Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐ ____
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe: ____



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MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-27

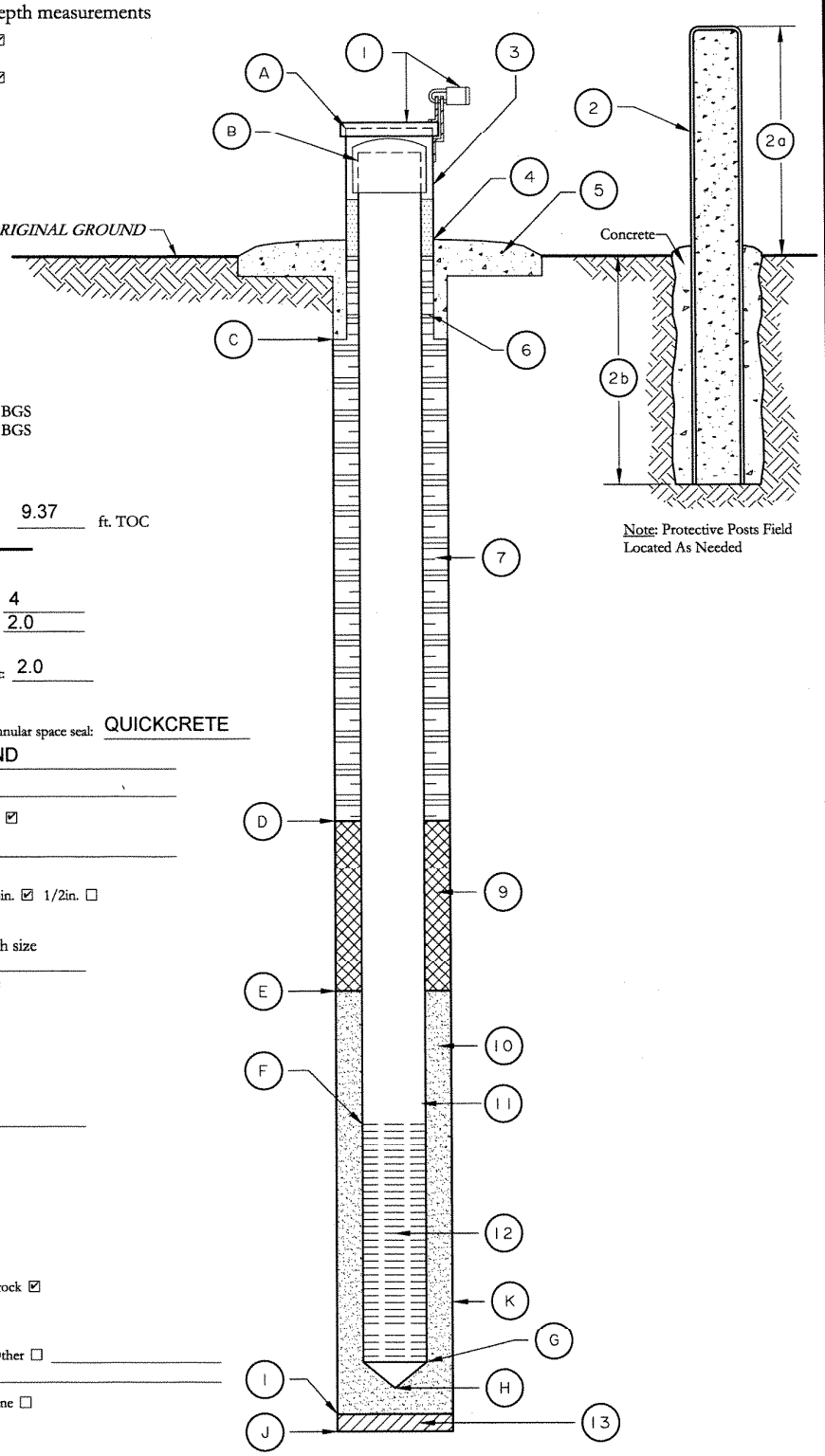
Date Well Installed: From 3/28/05 To 3/28/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 0.19 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 4.0 ft. BGS
(F) - Screen joint, top 6.0 ft. BGS
(G) - Screen joint, bottom 21.0 ft. BGS
(H) - End cap bottom 21.0 ft. BGS
(I) - Filter pack, bottom 21.0 ft. BGS
(J) - Borehole, bottom 21.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 21.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 9.18 ft. BGS 9.37 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 2/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 15 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-28

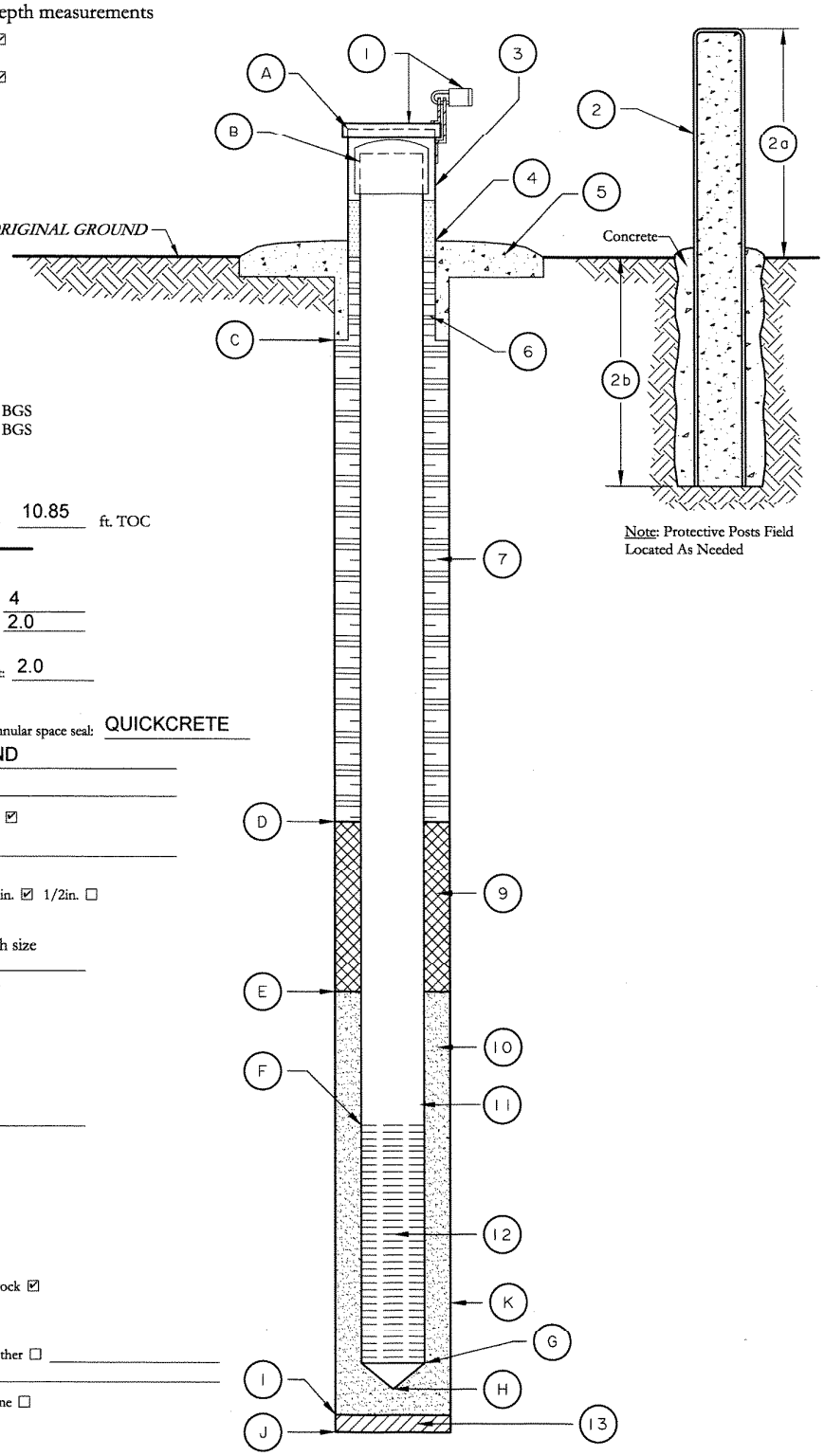
Date Well Installed: From 3/28/05 To 3/28/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 0.57 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 7.6 ft. BGS
(F) - Screen joint, top 9.0 ft. BGS
(G) - Screen joint, bottom 19.0 ft. BGS
(H) - End cap bottom 19.0 ft. BGS
(I) - Filter pack, bottom 19.5 ft. BGS
(J) - Borehole, bottom 19.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 19.50 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 10.28 ft. BGS 10.85 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-29

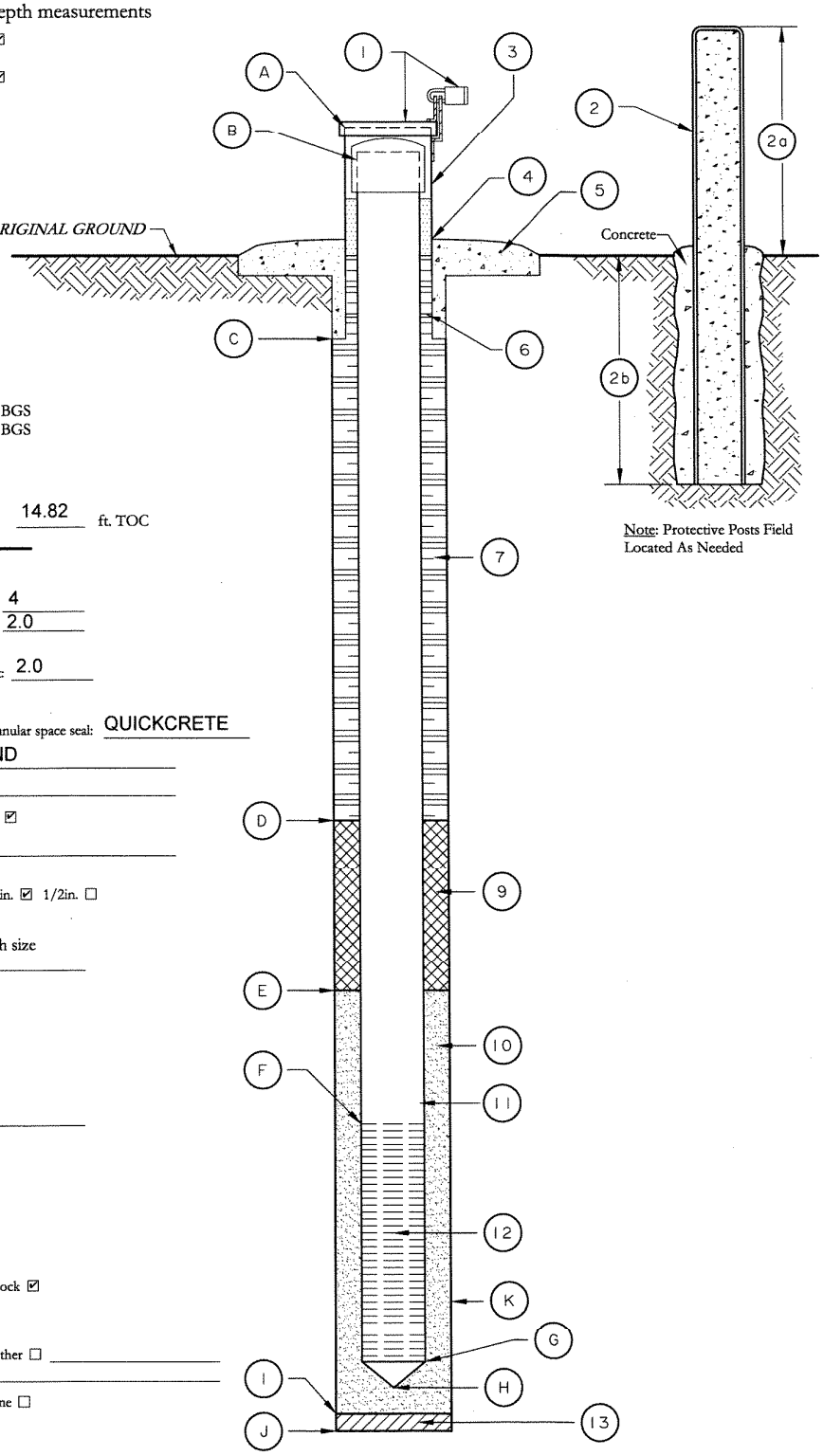
Date Well Installed: From 3/29/05 To 3/29/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.62 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 7.4 ft. BGS
(F) - Screen joint, top 9.0 ft. BGS
(G) - Screen joint, bottom 19.0 ft. BGS
(H) - End cap bottom 19.0 ft. BGS
(I) - Filter pack, bottom 19.5 ft. BGS
(J) - Borehole, bottom 19.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 19.50 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 12.20 ft. BGS 14.82 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 6/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-30

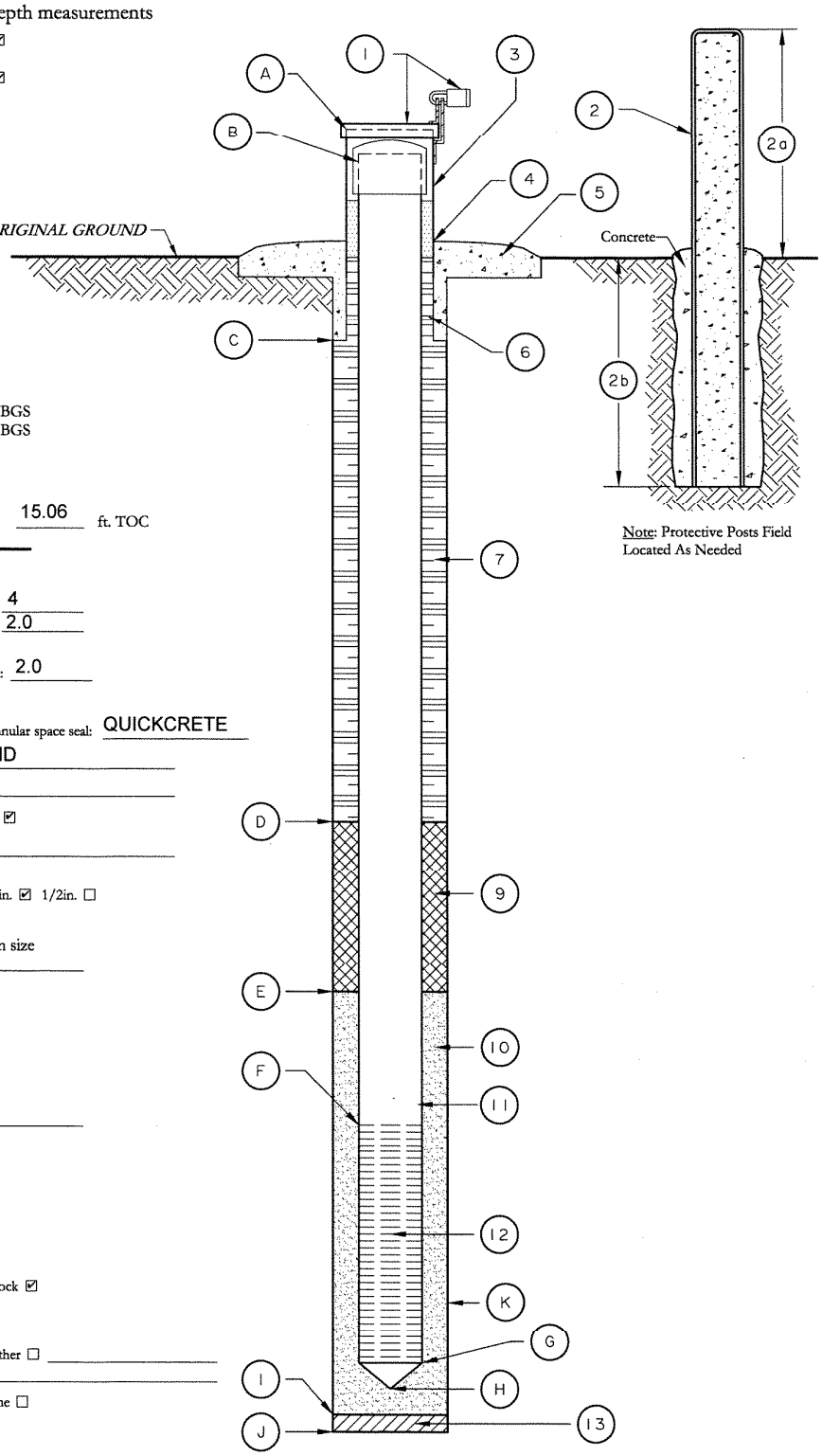
Date Well Installed: From 3/29/05 To 4/01/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.88 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 6.0 ft. BGS
(F) - Screen joint, top 8.4 ft. BGS
(G) - Screen joint, bottom 18.4 ft. BGS
(H) - End cap bottom 18.4 ft. BGS
(I) - Filter pack, bottom 18.4 ft. BGS
(J) - Borehole, bottom 19.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to 19.50 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 12.18 ft. BGS 15.06 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 6/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-31

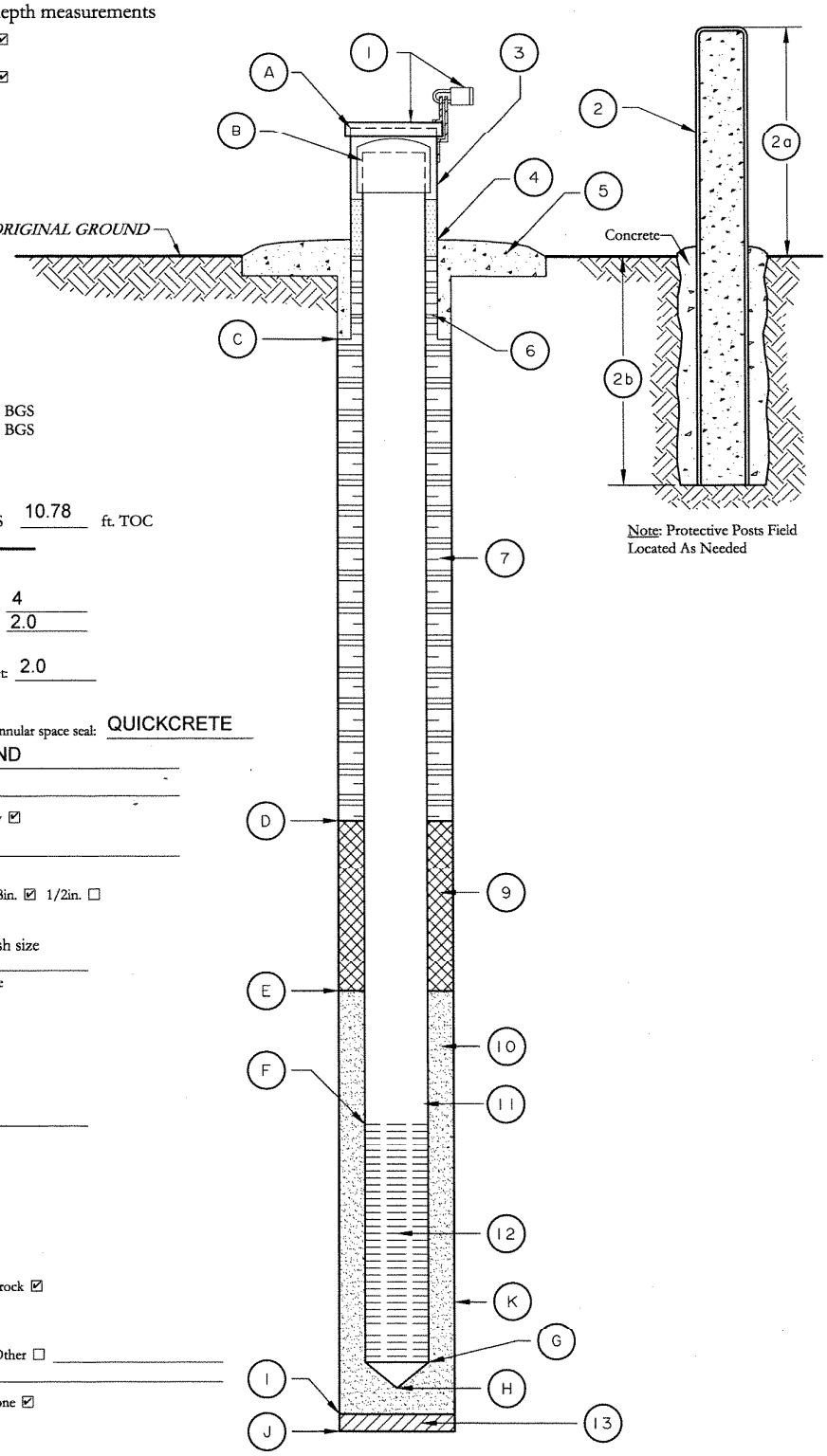
Date Well Installed: From 4/01/05 To 4/01/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.97 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 3.0 ft. BGS
(F) - Screen joint, top 4.9 ft. BGS
(G) - Screen joint, bottom 14.9 ft. BGS
(H) - End cap bottom 14.9 ft. BGS
(I) - Filter pack, bottom 14.9 ft. BGS
(J) - Borehole, bottom 15.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 15.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 7.81 ft. BGS 10.78 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☐ Air ☐ Drilling Mud ☐ None ☑
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-32

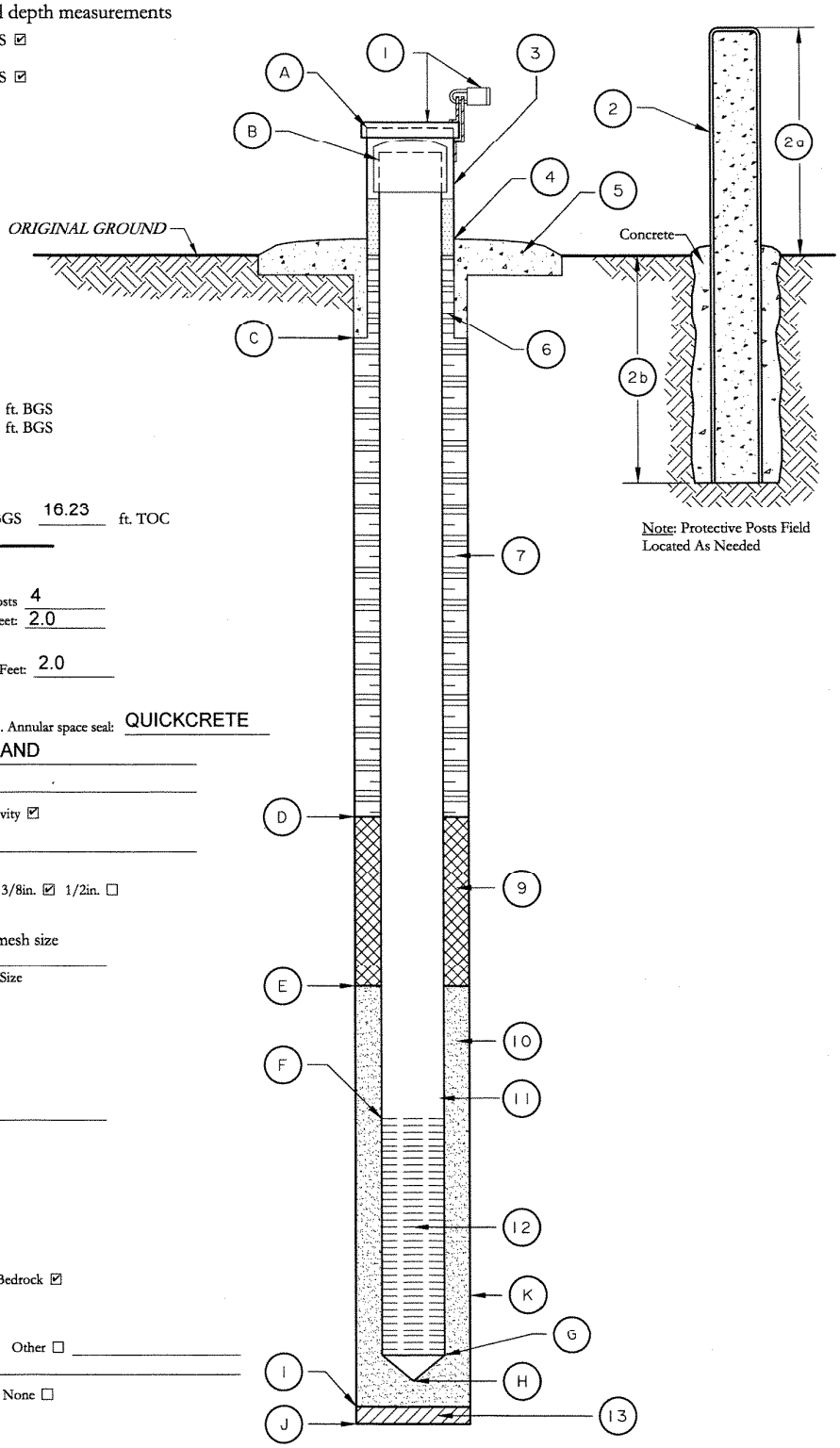
Date Well Installed: From 4/01/05 To 4/01/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.68 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 6.0 ft. BGS
(F) - Screen joint, top 8.8 ft. BGS
(G) - Screen joint, bottom 18.8 ft. BGS
(H) - End cap bottom 18.8 ft. BGS
(I) - Filter pack, bottom 18.8 ft. BGS
(J) - Borehole, bottom 18.8 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.80 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 13.55 ft. BGS 16.23 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 6/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



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PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY

Well Number: OW-33

Date Well Installed: From 4/02/05 To 4/02/05

Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑

(B) - Well casing, top 3.02 ft. BGS ☐ or AGS ☑

(C) - Surface seal, bottom NR ft. BGS

(D) - Bentonite seal, top 0.0 ft. BGS

(E) - Primary filter, top 6.8 ft. BGS

(F) - Screen joint, top 9.2 ft. BGS

(G) - Screen joint, bottom 19.2 ft. BGS

(H) - End cap bottom 19.2 ft. BGS

(I) - Filter pack, bottom 19.2 ft. BGS

(J) - Borehole, bottom 19.2 ft. BGS

(K) - Borehole, diameter 8.25 in. to 19.20 ft. BGS
in. to ft. BGS

(L) - O.D. well casing 2.38 in.

(M) - I.D. well casing 2.07 in.

(N) - 24 hr. water level after completion 11.12 ft. BGS 14.14 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐

(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0

(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0

(4) - Drainage port (s)? Yes ☐ No ☑

(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE

(6) - Material between well casing and protective casing: SAND

(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑

(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)

(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other

(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 6/50 LB Bags/Size

(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐

(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT

(13) - Backfill material (below filter pack): None ☑
Other ☐

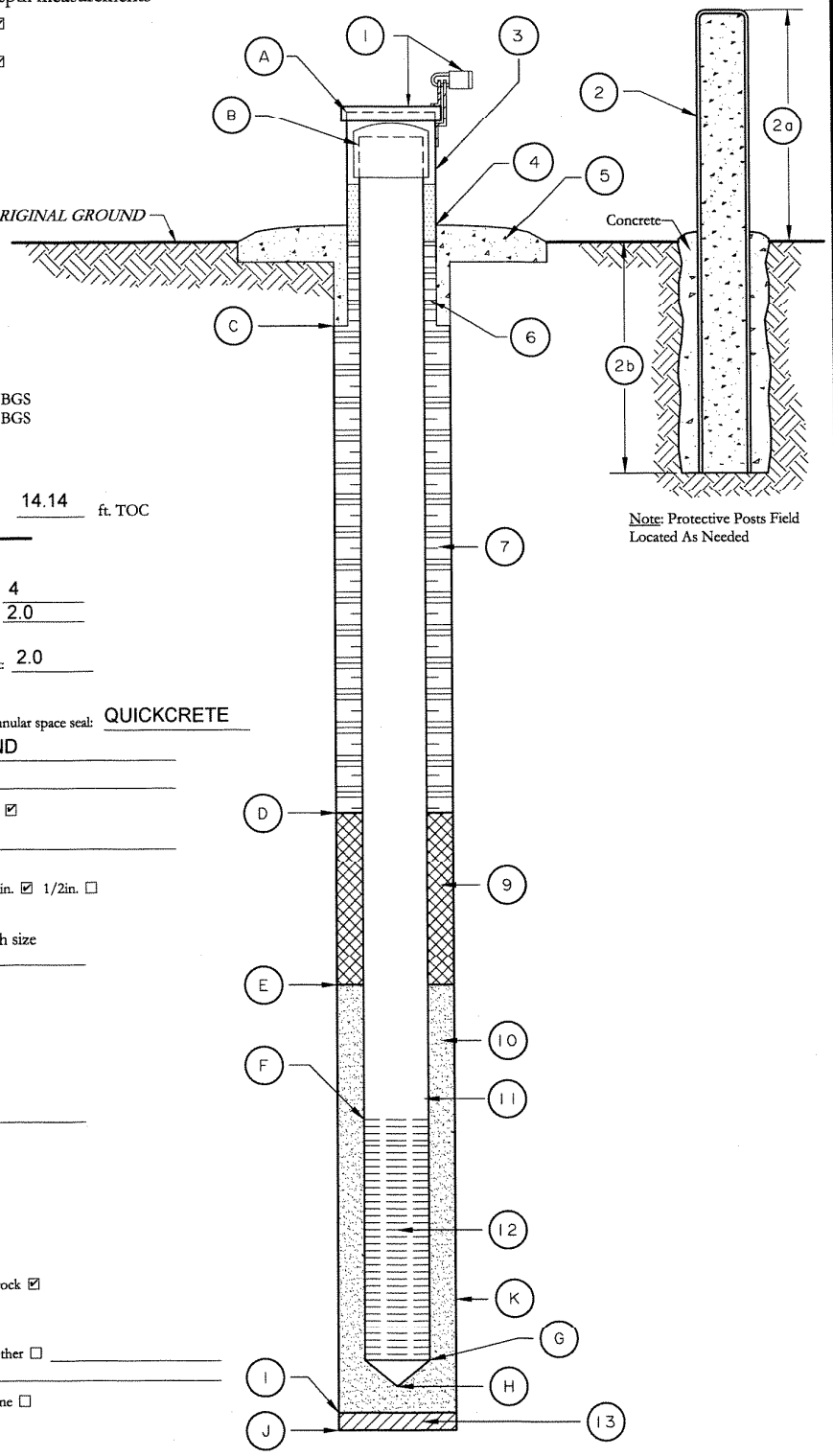
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑

(15) Sieve analysis attached? Yes ☐ No ☑

(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐

(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐

(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-35

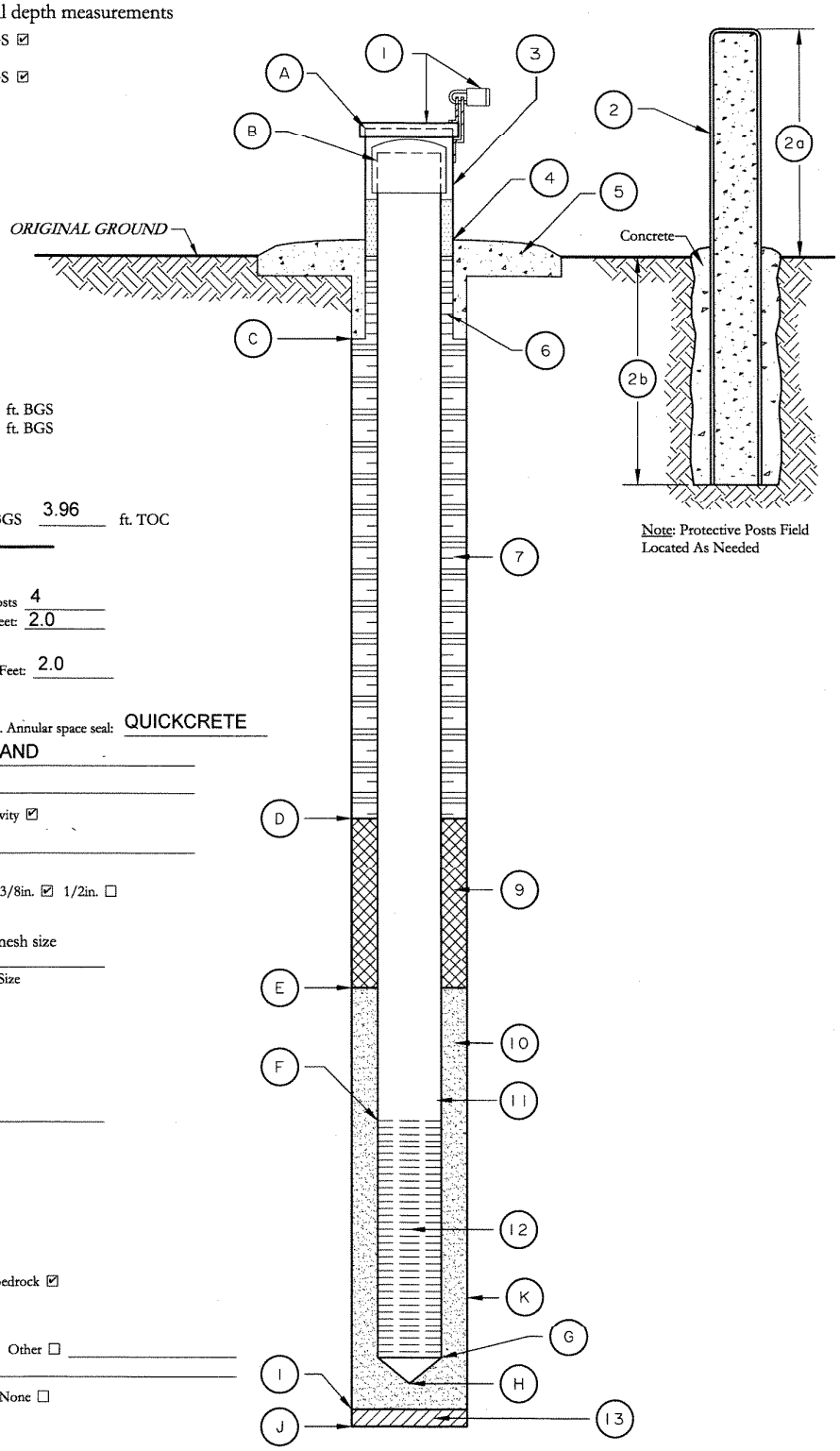
Date Well Installed: From 4/02/05 To 4/02/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 3.02 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 3.0 ft. BGS
(F) - Screen joint, top 4.3 ft. BGS
(G) - Screen joint, bottom 9.3 ft. BGS
(H) - End cap bottom 9.3 ft. BGS
(I) - Filter pack, bottom 9.3 ft. BGS
(J) - Borehole, bottom 9.3 ft. BGS
(K) - Borehole, diameter 8.25 in. to 9.30 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 0.94 ft. BGS 3.96 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 2/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 5 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-36

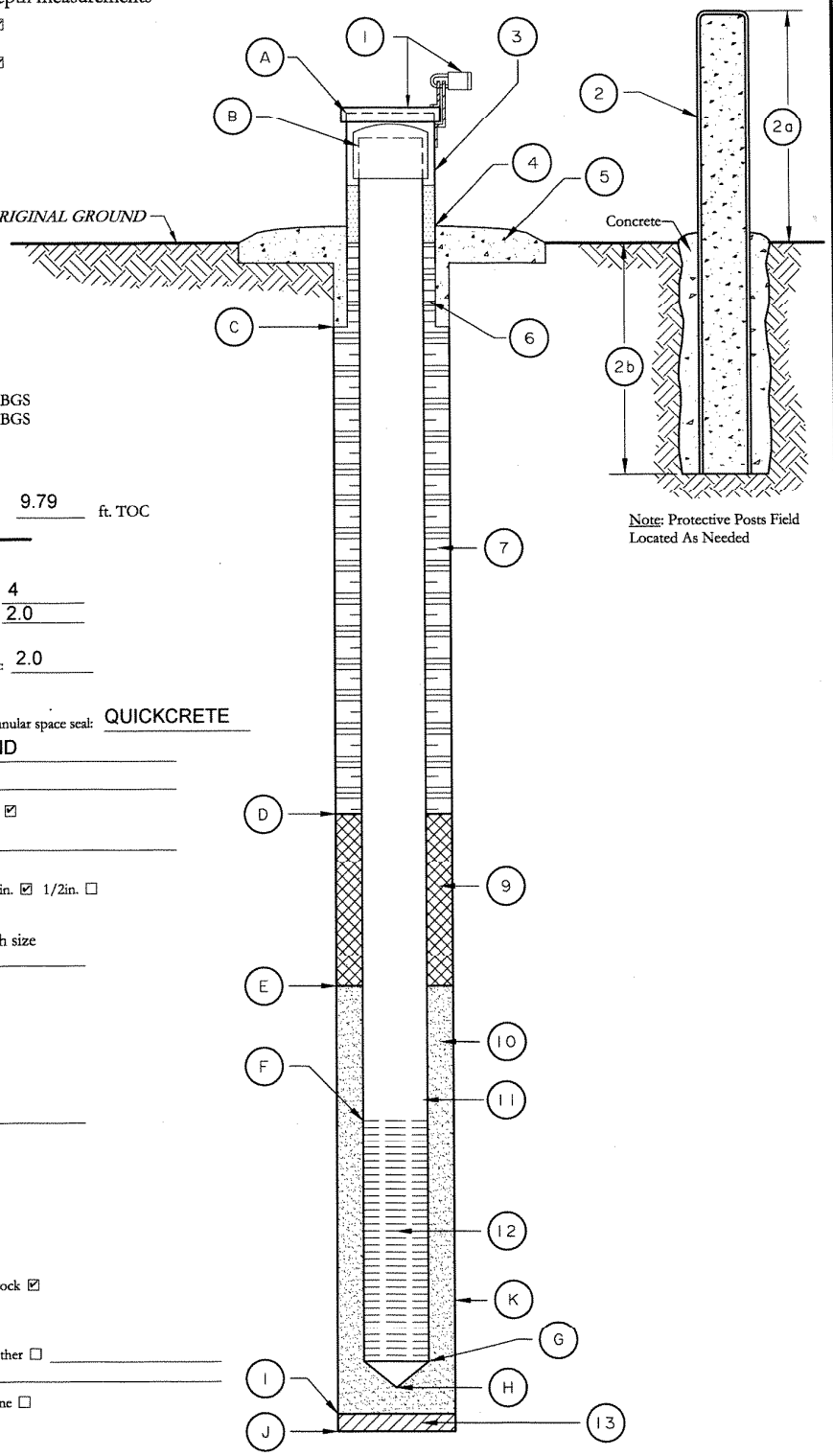
Date Well Installed: From 3/23/05 To 3/23/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.98 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 5.5 ft. BGS
(F) - Screen joint, top 7.9 ft. BGS
(G) - Screen joint, bottom 17.9 ft. BGS
(H) - End cap bottom 17.9 ft. BGS
(I) - Filter pack, bottom 18.0 ft. BGS
(J) - Borehole, bottom 18.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 6.81 ft. BGS 9.79 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5.25/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-36

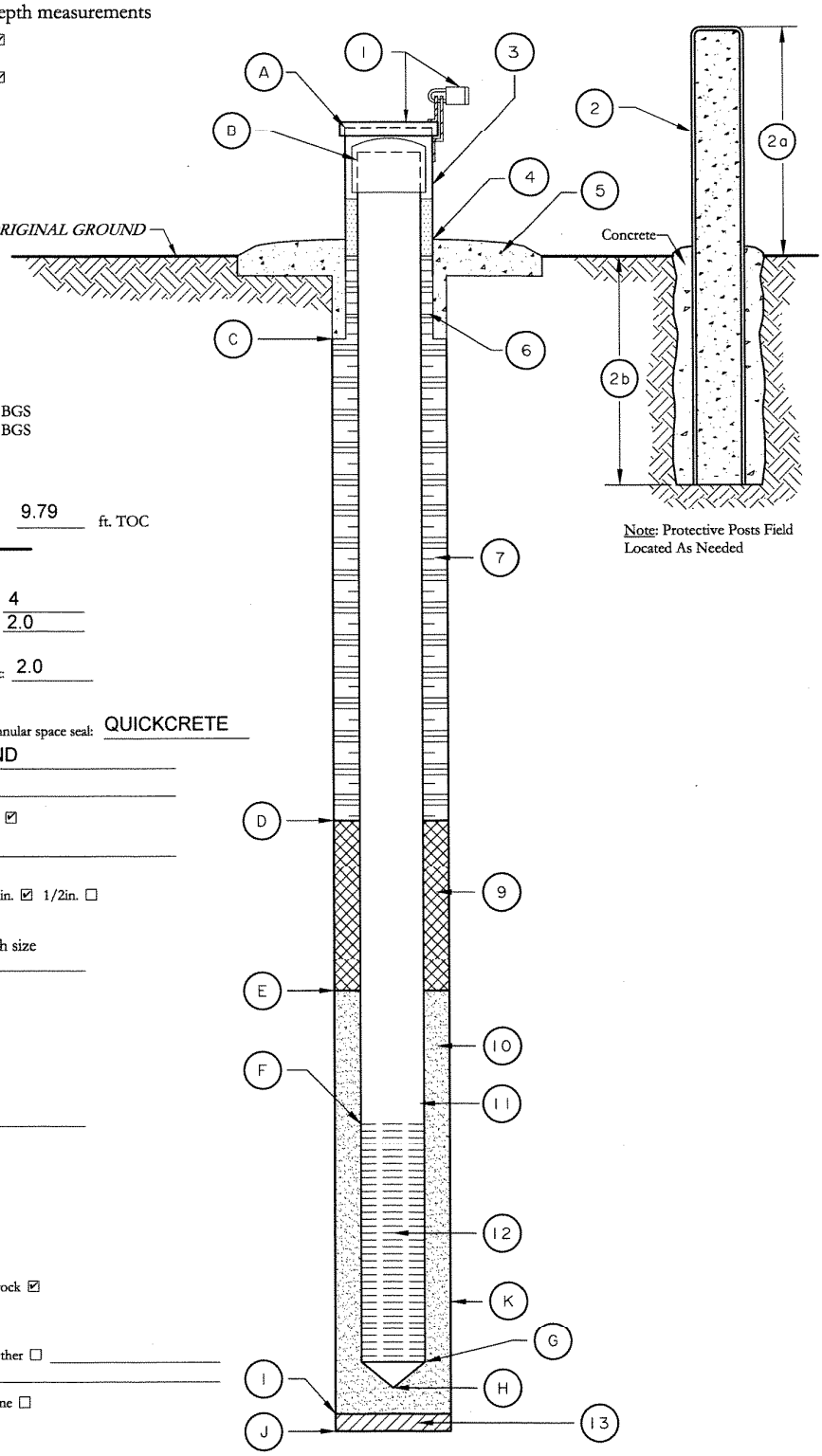
Date Well Installed: From 3/23/05 To 3/23/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Ground ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.98 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 5.5 ft. BGS
(F) - Screen joint, top 7.9 ft. BGS
(G) - Screen joint, bottom 17.9 ft. BGS
(H) - End cap bottom 17.9 ft. BGS
(I) - Filter pack, bottom 18.0 ft. BGS
(J) - Borehole, bottom 18.0 ft. BGS
(K) - Borehole, diameter 8.25 in. to 18.00 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 6.81 ft. BGS 9.79 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5.25/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-37

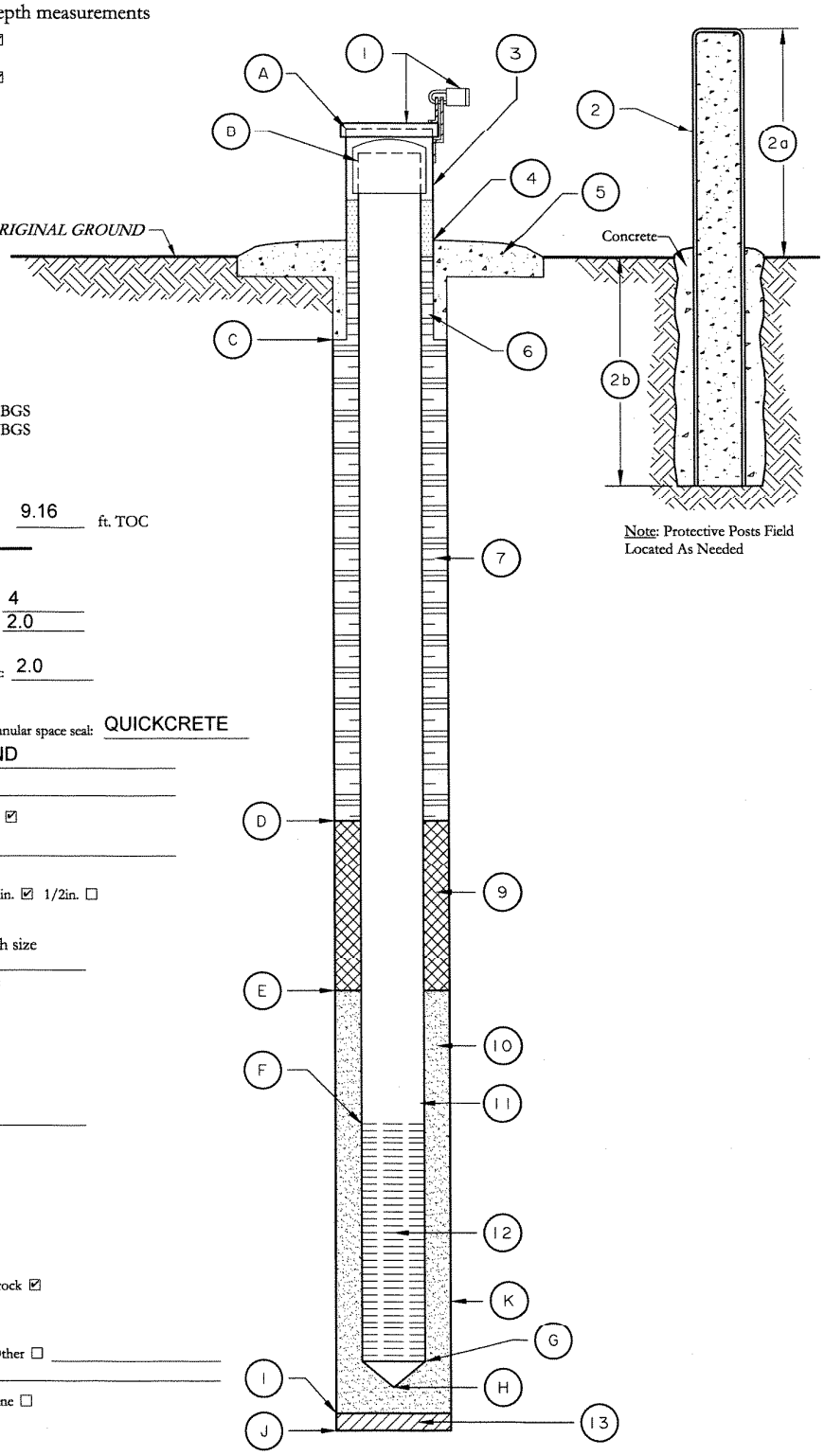
Date Well Installed: From 3/24/05 To 3/24/05
Well Installed By (Person's Name & Firm) GSI- PAUL

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.88 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 5.0 ft. BGS
(F) - Screen joint, top 7.0 ft. BGS
(G) - Screen joint, bottom 22.0 ft. BGS
(H) - End cap bottom 22.1 ft. BGS
(I) - Filter pack, bottom 22.1 ft. BGS
(J) - Borehole, bottom 22.1 ft. BGS
(K) - Borehole, diameter 8.25 in. to 22.20 ft. BGS
in. to ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 6.28 ft. BGS 9.16 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: 4.00 b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: BENTONITE CHIPS
- How installed: Tremie ☐ Tremie pumped ☐ Gravity ☑
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS)
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added ft./3 5.5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐
b: Manufacturer
c: Slot size: 0.01
d: Slotted length: 15 FT
(13) - Backfill material (below filter pack): None ☑
Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☑ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☐ Hollow Stem Auger ☑ Other ☐
(17) - Drilling fluid used: Water ☑ Air ☐ Drilling Mud ☐ None ☐
(18) - Drilling additives used? Yes ☐ No ☑
Describe:



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Facility/Project Name: EL DORADO REFINERY
Well Number: OW-39

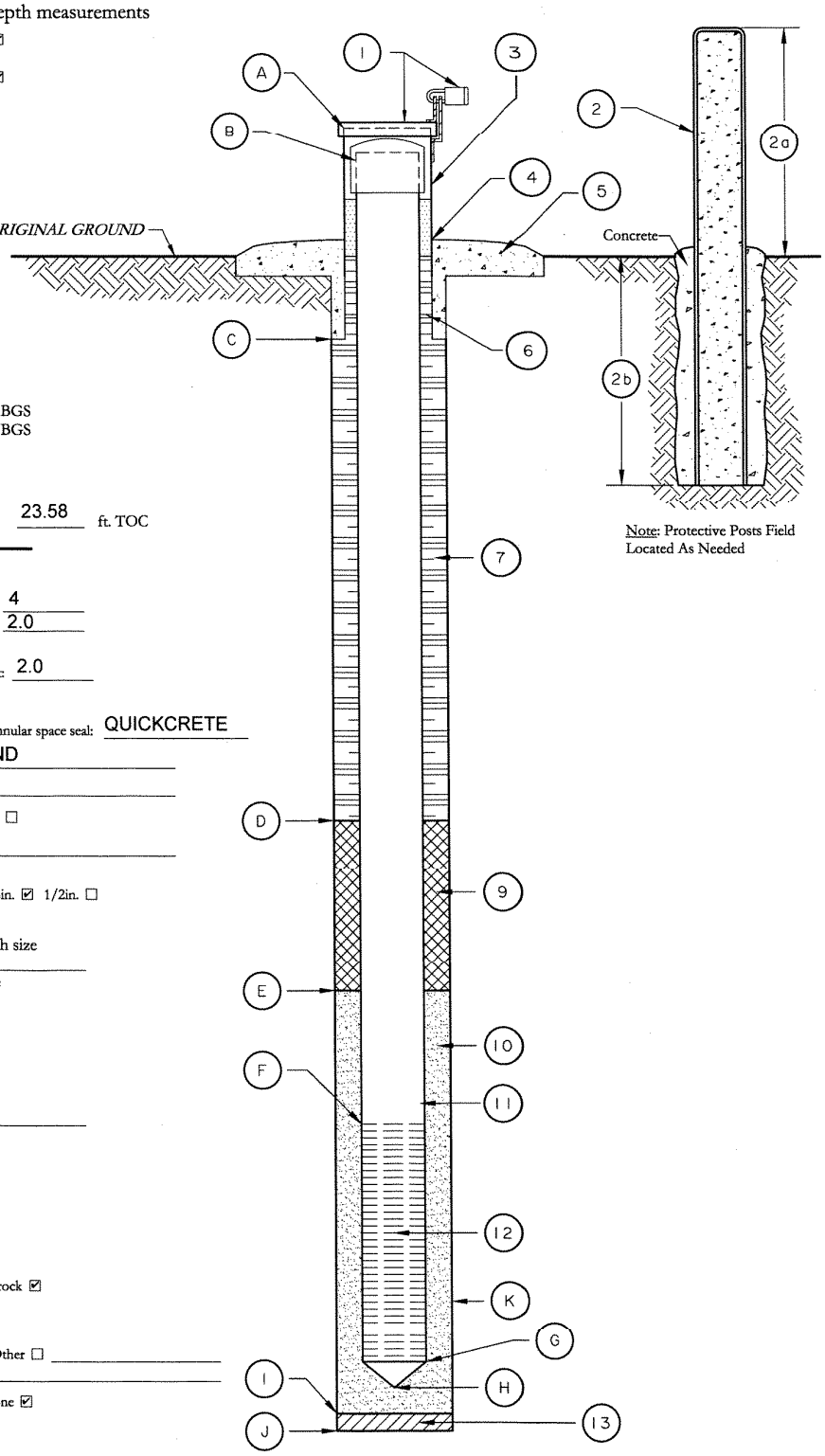
Date Well Installed: From 5/20/05 To 5/20/05
Well Installed By (Person's Name & Firm) AES- DANNY

Type of Protective Cover:
Above-Gound ☑
Flush-To-Ground ☐

NOTE: Use Ground Surface (BGS or AGS) for all depth measurements

(A) - Protective casing NR ft. BGS ☐ or AGS ☑
(B) - Well casing, top 2.36 ft. BGS ☐ or AGS ☑
(C) - Surface seal, bottom NR ft. BGS
(D) - Bentonite seal, top 0.0 ft. BGS
(E) - Primary filter, top 10.0 ft. BGS
(F) - Screen joint, top 12.0 ft. BGS
(G) - Screen joint, bottom 22.0 ft. BGS
(H) - End cap bottom 22.0 ft. BGS
(I) - Filter pack, bottom 25.5 ft. BGS
(J) - Borehole, bottom 25.5 ft. BGS
(K) - Borehole, diameter 8.25 in. to _____ ft. BGS
6.0 in. to 25.50 ft. BGS
(L) - O.D. well casing 2.38 in.
(M) - I.D. well casing 2.07 in.
(N) - 24 hr. water level after completion 21.22 ft. BGS 23.58 ft. TOC

(1) - Cap and Lock? Yes ☑ No ☐
(2) - Protective posts? Yes ☑ No ☐ No. of Posts 4
a. Height AGS: Feet: 3.0 b. Depth BGS: Feet: 2.0
(3) - Protective casing:
a. Inside diameter: Inches: _____ b. Depth: Feet: 2.0
(4) - Drainage port (s)? Yes ☐ No ☑
(5) - Surface seal material a. Cap: QUICKCRETE b. Annular space seal: QUICKCRETE
(6) - Material between well casing and protective casing: SAND
(7) - Annular space seal: Mix: Grout
- How installed: Tremie ☐ Tremie pumped ☑ Gravity ☐
(8) - Centralizers: No ☑ Yes ☐ Depths (BGS) _____
(9) - Bentonite seal:
a. Bentonite granules ☐ or b. Bentonite pellets 1/4in. ☐ 3/8in. ☑ 1/2in. ☐
c. _____ ☐ other
(10) - Filter pack material: Manufacturer, product name, & mesh size
a. OGLEBAY NORTON 10/20 SILICA
b. Volume added _____ ft./3 5/50 LB Bags/Size
(11) - Well casing: Flush threaded PVC schedule 40 ☑
Flush threaded PVC schedule 80 ☐
_____ Other ☐
(12) - Screen material: PVC
a. Screen type:
Factory cut ☑ Continuous slot ☐ Other ☐ _____
b: Manufacturer _____
c: Slot size: 0.01
d: Slotted length: 10 FT
(13) - Backfill material (below filter pack): None ☑
_____ Other ☐
(14) - USCS classification of soil near screen None ☐
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐ Bedrock ☑
(15) - Sieve analysis attached? Yes ☐ No ☑
(16) - Drilling method used: Rotary ☑ Hollow Stem Auger ☑ Other ☐ _____
(17) - Drilling fluid used: Water ☐ Air ☐ Drilling Mud ☐ None ☑
(18) - Drilling additives used? Yes ☐ No ☑
Describe: _____



REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

MWH

PROJECT No.: 1227010.131806
AutoCAD FILE: TYPICAL-WELL-MOSES
SCALE: Not To Scale
FIGURE No:

WELL CONSTRUCTION FORM

Notes:

DRILL HOLE NUMBER: **OW-01**

DRILL HOLE LOCATION COORDINATES: N: 1745122.74 E: 1785373.78 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1321.24 TOC ELEVATION (FAMSL): 1324.08 DRILL RIG:

DRILLING START DATE/TIME: 03/22/05 DRILLING COMPLETION DATE/TIME: 03/24/05 12:45

TOTAL DEPTH (FT): 26.3 DEPTH TO WATER DURING DRILLING (FT BGS): 25 DEPTH TO WATER (FT TOC): 8.27 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1320	0	Silty CLAY, med. plast, 100% fines, v. stiff, reddish brown, moist, no strat.	CL		NR (CT)	--			
1315					1	2.0			
		Dark brown, stiff to very stiff, no staining			2	1.4			
	8.5	LIMESTONE, yellow gray, thin bedded, f. grained, dry, very weathered. Switch to coring at 10 ft.			3	6.2			
1310		LIMESTONE, yellow/gray, fine grained, mm size vugs, hairline fract. at 11.5 ft. with iron oxide, massive			4	5			
1305		LIMESTONE, as above, argillaceous LS at 14 ft., soft, less voids, more fract. voids at 15 ft., more clay, iron oxides, at 15-18 ft. more fractures, 1/4 to 1/2 inch voids			5	4.6			
1300		LIMESTONE, no fractures, less voids, less iron mottling at 19.5 ft., dark gray massive LS, 1/4 to 1/2 inch fracture with breccia-like clasts, LS dark gray, thinly bedded, massive 1/2 inch to 1.5 inch voids at 22 ft.			NR	--			
1295		LIMESTONE, yellow-gray, 1/2 inch voids filled with calcite, hairline fractures filled with calcite, dissolution channels up to 4 inches in length at 24 ft., iron oxide coating in voids, channels, fractures,			NR	--			

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-01

Notes:

DRILL HOLE NUMBER: **OW-01**

DRILL HOLE LOCATION COORDINATES: N: 1745122.74 E: 1785373.78 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1321.24 TOC ELEVATION (FAMSL): 1324.08 DRILL RIG:

DRILLING START DATE/TIME: 03/22/05 DRILLING COMPLETION DATE/TIME: 03/24/05 12:45

TOTAL DEPTH (FT): 26.3 DEPTH TO WATER DURING DRILLING (FT BGS): 25 DEPTH TO WATER (FT TOC): 8.27 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
		\ brown/gray clay along some fracture faces							
		BORING TERMINATED AT 26.3 Ft.							
1290									
1285									
1280									
1275									
1270									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	**DESIGN BY:** *LWM*	**SCALE (FT/IN):** *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	**DRAWN BY:** *EHG*	**DATE:** *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-01**

Notes:

DRILL HOLE NUMBER: **OW-02**

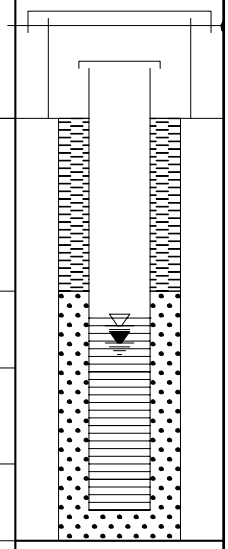
DRILL HOLE LOCATION COORDINATES: N: 1744073.93 E: 1785480.48 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1317.54 TOC ELEVATION (FAMSL): 1320.33 DRILL RIG:

DRILLING START DATE/TIME: 03/24/05 15:30 DRILLING COMPLETION DATE/TIME: 03/25/05 13:40

TOTAL DEPTH (FT): 11 DEPTH TO WATER DURING DRILLING (FT BGS): 5.4 DEPTH TO WATER (FT TOC): 5.85 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1320									
1315	0	Silty CLAY, 100% fines, low-med plast, firm to stiff, reddish brown, slightly moist, no strat., no odor, no cement	CL		NR (CT)	--			
1310	4.5	LIMESTONE, light gray, fractured, weak, weathered to dark gray clay, platy angular limestone fragments up to 1/2" in length, moist			1	20.2			
		LIMESTONE, as above, highly to completely weathered to clay, wet, petroleum odor			2	1527			
		LIMESTONE, as above, wet, petroleum odor, black petroleum staining at 9.5 ft. for 3", weathered, product odor			3	1888			
1305		BORING TERMINATED AT 11 Ft.							
1300									
1295									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-02**

Notes:

DRILL HOLE NUMBER: **OW-03**

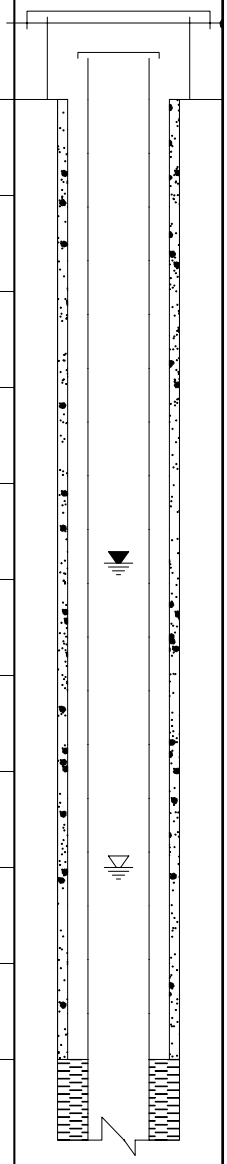
DRILL HOLE LOCATION COORDINATES: N: 1744608.885 E: 1787268.556 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1291.70 TOC ELEVATION (FAMSL): 1294.00 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/29/05 8:30 DRILLING COMPLETION DATE/TIME: 05/19/05 12:11

TOTAL DEPTH (FT): 40.5 DEPTH TO WATER DURING DRILLING (FT BGS): 20 DEPTH TO WATER (FT TOC): 12.074 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Silty CLAY, 100% fines, low-med plast, dark brown to reddish brown, firm to stiff, no strat, moist to slightly moist	CL		1 (CT)	3.3			
1290		As above			2	17.8			
		As above, dark brown, low plast, greater silt content			3	7.7			
1285		As above, dark brown, low-med plast			4 (CT)	29.6			
		Silty CLAY, as above, dark brown to light black, petroleum odors, low plast, higher silt content, soft, moist			5	1574			
1280		Silty CLAY, as above, petroleum odors, staining, soft, moist, low plast			6	4854			
		Silty CLAY, as above, petroleum odors and staining			7	3757			
1275	16.5	LIMESTONE, yellow gray / light gray, weathered, thin bedded, angular LS fragment up to 1" in size, iron oxidation coating on LS at contact			8	286			
		As above			9	300			
		LIMESTONE, olive gray (5Y 4/1), highly weathered to clay, weak, 1/2" LS fragments, thin bedded, platy, moist to wet, SS could be getting wet from water above, may not have water at 20 ft. Competent rock below 20 ft., borehole producing water at 21 ft.			10	61.6			
1270		LIMESTONE, as above, saturated, 22.5-23 ft crs., angular sand grains, <5% sand, moderate to strong angular LS fragments, mixed with clay, sand may be sluff from above, petroleum odor			11	111			
1265					12	37.1			



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-03

Notes:

DRILL HOLE NUMBER: **OW-03**

DRILL HOLE LOCATION COORDINATES: N: 1744608.885 E: 1787268.556 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1291.70 TOC ELEVATION (FAMSL): 1294.00 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/29/05 8:30 DRILLING COMPLETION DATE/TIME: 05/19/05 12:11

TOTAL DEPTH (FT): 40.5 DEPTH TO WATER DURING DRILLING (FT BGS): 20 DEPTH TO WATER (FT TOC): 12.074 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
		LIMESTONE, gray, moist to wet, fine grained, moderately strong, some clay and angular fragments less petroleum odor			13	7.6			
		LIMESTONE, light to medium grey, several hairline fractures with CaCO3, hard, fine-grained, some dark banding			14	6			
1260		LIMESTONE, as above with fine bands of fossiliferous LS, light to dark grey, fossiliferous LS, very dark grey at 31 ft.			15	4.4			
		LIMESTONE, medium grey, very porous, vuggy from 31.2 ft., medium to very large vugs, some CaCO3, minor fossils, hairline to moderate fractures with CaCO3 at 32.9 ft., argilaceous LS, medium to dark grey bands, massive, fossils, molds			16	5			
1255		LIMESTONE, argillaceous, light to dark grey, fossils to 35.8 ft., small band of medium gravel to fine argillaceous LS to 35.8 ft., band of dark grey shale at 36.9 ft., fractures brittle/sharp, massive, fine, crystalline			17	4.9			
1250		BORING TERMINATED AT 40.5 Ft.							
1245									
1240									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	**DESIGN BY:** *LWM*	**SCALE (FT/IN):** *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	**DRAWN BY:** *EHG*	**DATE:** *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-03**

Notes:

DRILL HOLE NUMBER: **OW-04**

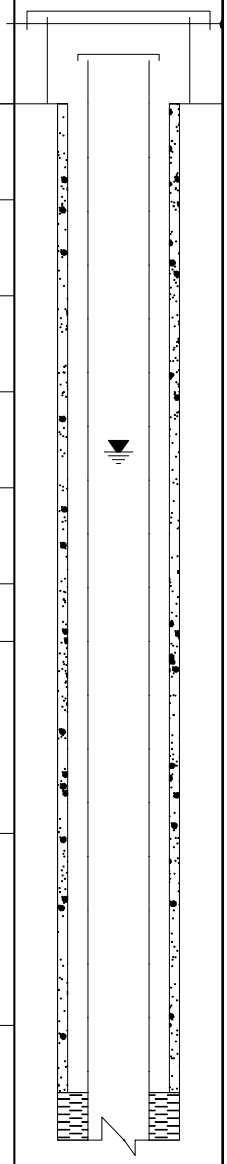
DRILL HOLE LOCATION COORDINATES: N: 1744262.391 E: 1787372.083 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1288.03 TOC ELEVATION (FAMSL): 1290.45 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/30/05 DRILLING COMPLETION DATE/TIME: 05/19/05 8:30

TOTAL DEPTH (FT): 40.5 DEPTH TO WATER DURING DRILLING (FT BGS): NR DEPTH TO WATER (FT TOC): 9.068 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1290									
	0	Silty CLAY, 100% fines, low plast, dark brown, soft, moist, earthy odor, no strat, no cement	CL		NR (CT)	--			
1285		As above			1	3.2			
		Silty CLAY, 100% fines, med plast, brown to reddish brown, firm to stiff, moist, no odor, no strat, no cement			2	5.0			
1280		CLAY, 90% fines, 10% rock fragments, low-med plast, slightly moist, gray, black petroleum staining in vertical vessication, petroleum odors, firm-stiff,			3	2500			
	10	believe to be weathered shale or limestone							
		LIMESTONE, highly to completely weathered to clay, olive gray to light olive gray, 6" argillaceous limestone (clay) followed by 7" highly weathered LS ang			4	2747			
1275		fragments up to 1/2" in size, thin bedded, fractured, platy, crumbly, moist, followed by 5" argillaceous limestone (clay), petroleum odor			NR	--			
		Switch to coring at 13 ft bgs.			NR	--			
		LIMESTONE, light olive gray, strong fracture 3" in length at 15 ft., near vertical, dissolution void 15-18.5							
1270		ft., iron oxidation coating fractures and voids from 17-19 ft.							
		Same as above, competent at 19 ft., some dissolution voids, iron oxidation filled hairline fracture, 100% recovery from 19-22 ft.			NR	--			
1265									
	24	LIMESTONE, light brown, very vuggy, brittle to 24. 8 ft., med gray to tan, fossiliferous to 25.5 ft.	CI		5	1.6			



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-04

Notes:

DRILL HOLE NUMBER: **OW-04**

DRILL HOLE LOCATION COORDINATES: N: 1744262.391 E: 1787372.083 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1288.03 TOC ELEVATION (FAMSL): 1290.45 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/30/05 DRILLING COMPLETION DATE/TIME: 05/19/05 8:30

TOTAL DEPTH (FT): 40.5 DEPTH TO WATER DURING DRILLING (FT BGS): NR DEPTH TO WATER (FT TOC): 9.068 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1260	26.5	LIMESTONE, light to medium gray to 27.3 ft., dark gray shale at 28.1 ft. grades to med gray LS, fine grained with med. grained dissolved vuggy banding at 28.2 ft. grades to platy shale at 28.9 ft., grades to porous LS with hairline fractures with CaCO3, fossiliferous			6	1.3			
	28.2								
	28.9				7	1.7			
	30.7				8	2.9			
	30.8	SHALE							
	31.1	LIMESTONE							
1255	31.2	LIMESTONE, light to med. gray, platy shale bedding at 29.5 ft. to 30 ft., fossiliferous at 30.5 ft., hairline fractures with CaCO3, platy shale 30.7 ft. to 30.8 ft., LS, med gray, few fossils, fractures with CaCO3, platy shale 31.1 ft. to 31.2 ft.			9	2.1			
					10	1.7			
1250		SHALE, platy, dark gray							
		LIMESTONE							
		SHALE, platy, dark gray			11	1.6			
		LIMESTONE							
		Interbedded Limestone and Shale, light to medium grey, fossiliferous, hairline fractures with CaCO3, LS medium gray							
1245		Interbedded Limestone and Shale, medium grey, very fine, massive, grades to fossiliferous LS, some vugs, LS dark banding into medium grey LS to 40 ft.							
		BORING TERMINATED AT 40.5 Ft.							
1240									
1235									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-04

Notes:

DRILL HOLE NUMBER: **OW-05**

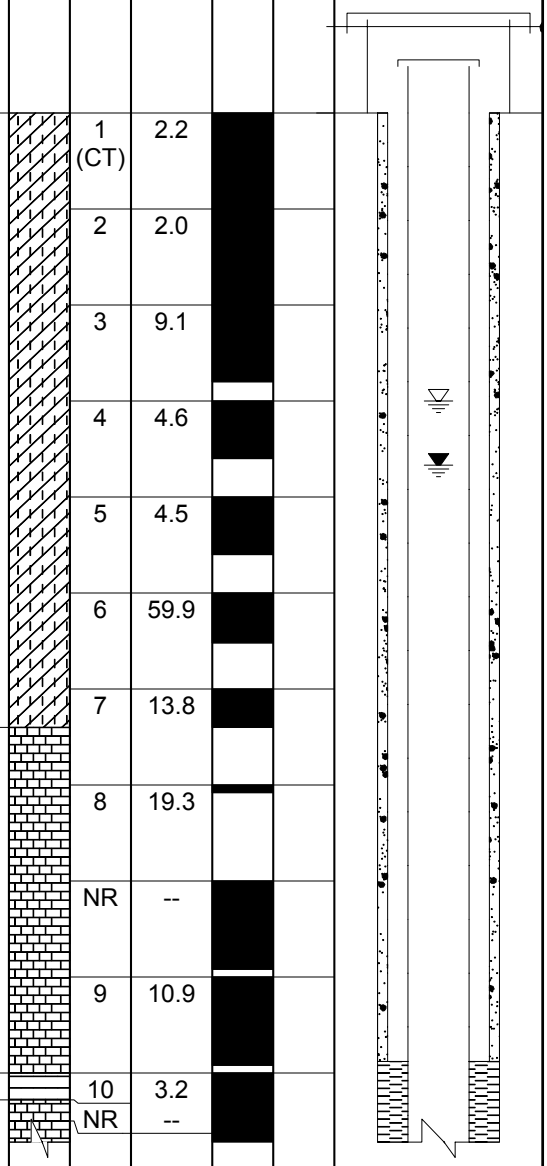
DRILL HOLE LOCATION COORDINATES: N: 1743607.353 E: 1787714.279 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1287.86 TOC ELEVATION (FAMSL): 1290.46 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/29/05 DRILLING COMPLETION DATE/TIME: 05/18/05 15:40

TOTAL DEPTH (FT): 39.5 DEPTH TO WATER DURING DRILLING (FT BGS): 7.5 DEPTH TO WATER (FT TOC): 9.17 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE INTERVAL	PID READING	BLOW COUNTS (N)
1290						
	0	Silty CLAY, 100% fines, low-med plast, dark brown, moist, soft, no odor, no strat, no cement	CL	1 (CT)	2.2	
1285		As above, dark brown to reddish brown, worm in sluff		2	2.0	
		Clayey SILT, 100% fines, no plast, dark brown to brown, moist, soft, no odor, no strat, no cement		3	9.1	
1280		As above, v. soft, wet, brown, no odor		4	4.6	
		As above, v. soft, wet, dark gray/brown, no odor		5	4.5	
1275		Silty CLAY, 100% fines, med plast, soft-firm, dark brown, wet, firm-soft, dark brown petroleum staining, strong petroleum odors throughout		6	59.9	
				7	13.8	
	16	LIMESTONE, angular fragment, <1" in size in split spoon, as above, petroleum staining and odors				
1270		LIMESTONE, light gray, thin bedded, highly weathered to clay, platy angular LS fragments, up to 1" in size mixed with clay, moderately weak to weak, moist to wet, less petroleum odor, no staining		8	19.3	
		LIMESTONE, thin bedded, light gray to yellowish gray, strong, slightly moist, slow drilling at 20 ft., LS is hard, more competent		NR	--	
1265				9	10.9	
	25	Interbedded Limestone and Shale, argilaceous, 30% voids to 25.9 ft., hairline fractures with CaCO3,		10	3.2	
	25.7			NR	--	



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-05

Notes:

DRILL HOLE NUMBER: **OW-05**

DRILL HOLE LOCATION COORDINATES: N: 1743607.353 E: 1787714.279 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1287.86 TOC ELEVATION (FAMSL): 1290.46 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/29/05 DRILLING COMPLETION DATE/TIME: 05/18/05 15:40

TOTAL DEPTH (FT): 39.5 DEPTH TO WATER DURING DRILLING (FT BGS): 7.5 DEPTH TO WATER (FT TOC): 9.17 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1260		fossiliferous to 26 ft., medium to dark grey interbedded with black shale.			11	2.7			
		LIMESTONE Limestone, light grey LS interbedded with darker grey LS, argillaceous from 26 to 30 ft.			NR	--			
		Interbedded Limestone and Shale, medium grey, interbedded with dark grey LS, fossiliferous LS at 32.9 ft., hairline fractures with CaCO3, wet black shale to medium grey LS to 34.7 ft.			NR	--			
1255	32.9	SHALE			NR	--			
	34.7 35	Interbedded Limestone and Shale, medium to dark grey, grades to porous LS at 37.8 ft., fossiliferous LS to depth with CaCO3 within hairline fractures.			12	2.8			
1250	37.8	LIMESTONE			13	1.5			
		BORING TERMINATED AT 39.5 Ft.							
1245									
1240									
1235									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-05

Notes:

DRILL HOLE NUMBER: **OW-06**

DRILL HOLE LOCATION COORDINATES: N: 1740782.110 E: 1786184.073 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1299.69 TOC ELEVATION (FAMSL): 1302.26 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/31/05 DRILLING COMPLETION DATE/TIME: 05/19/05 16:56

TOTAL DEPTH (FT): 45 DEPTH TO WATER DURING DRILLING (FT BGS): 20 DEPTH TO WATER (FT TOC): 7.669 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300	0	Silty CLAY, 100% fines, low plast, dark brown, moist, soft, earthy odor, no strat, no cement	CL		1	2			
		As above, low plast, reddish brown, slightly moist to moist, v. stiff, mm size blocky black fragments, no odor			2	1.6			
1295		As above, more black fragments up to 1/4 - 1/2", possibly shale fragments, no odor, fragments up to 25% in with silty clay matrix			3	3.1			
		As above, stiff to v. stiff, no odor, mm size black fragments			4	7.7			
1290		As above, med plast, olive gray, firm, slightly moist to moist, no strat, no cement, fewer black fragments, slight petroleum odor			5	15.8			
	12.5	CLAY, 100% fines, med plast, olive gray, soft, no strat, no cement, moist, no black fragments, slight petroleum odor	CL		6	11.1			
1285	15	Silty CLAY, 100% fines, low plast, olive gray, slightly moist to moist, firm, petroleum odor, no strat, no cement	CL		7	1229			
		As above, gravely, low-med plast, olive gray, moist, soft, petroleum odor, minor staining, ang rock fragments, sand-size to 1/2" in size, no strat, no cement			8	556			
1280	20	LIMESTONE, medium grey, no odor			9	392			
					10	47.1			
1275					11	48.1			

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-06

Notes:

DRILL HOLE NUMBER: **OW-06**

DRILL HOLE LOCATION COORDINATES: N: 1740782.110 E: 1786184.073 LOGGED BY: LWM / JLC

GROUND ELEVATION (FAMSL): 1299.69 TOC ELEVATION (FAMSL): 1302.26 DRILL RIG: CME 75

DRILLING START DATE/TIME: 03/31/05 DRILLING COMPLETION DATE/TIME: 05/19/05 16:56

TOTAL DEPTH (FT): 45 DEPTH TO WATER DURING DRILLING (FT BGS): 20 DEPTH TO WATER (FT TOC): 7.669 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1270		LIMESTONE, gray, strong, competent, no odor			12	7.0			
		Interbedded Limestone and Shale, medium grey, argillaceous, grades to shale, minor fossils, small to large dissolution voids greater than 0.75 inches, massive, wet.			13	2.2			
	32.5	Shale, dark gray			14	2.0			
1265	35	LIMESTONE, as above, large dissolution channels and fractures at 36.3 ft., several hairline fractures, platy breakage from 36.5 to 40 ft.			15	1.7			
		LIMESTONE, as above to 40.5 ft., grades to fossiliferous LS, medium to dark grey, several dissolution voids and cavities throughout. Grades to massive LS at 42.8 ft., fewer and smaller dissolution fractures, no fossils past 42.8, wet at 43 ft., small dissolution fractures to depth			16	1.6			
1260					17	1.5			
					18	1.4			
1255					19	1.6			
		BORING TERMINATED AT 47.5 Ft.							
1250									
1245									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-06

Notes:

DRILL HOLE NUMBER: **OW-07**

DRILL HOLE LOCATION COORDINATES: N: 1739775.95 E: 1783960.06 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1324.53 TOC ELEVATION (FAMSL): 1327.5 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/05/05 11:00 DRILLING COMPLETION DATE/TIME: 04/05/05 11:45

TOTAL DEPTH (FT): 10 DEPTH TO WATER DURING DRILLING (FT BGS): 6 DEPTH TO WATER (FT TOC): 2.71 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1325									
	0	Silty CLAY, 100% fines, no plast, dark brown, firm, slightly moist to dry, earthy odor, no strat, no cement	CL		1	2.6			
		Silty CLAY, 100% fines, med. plast, brown to reddish brown, slightly moist, stiff, no odor, red iron mottling, no strat, no cement			2	2.4			
1320	5.3	Silty CLAY, as above			3	1.6			
		LIMESTONE, Yellowish gray, highly weathered to clay, weak, sub-rounded cherty			4	3.6			
		LIMESTONE, as above, fragments up to 1" in size			5	2.5			
1315		LIMESTONE, competent rock							
		BORING TERMINATED AT 10 Ft.							
1310									
1305									
1300									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-07

Notes:

DRILL HOLE NUMBER: **OW-08**

DRILL HOLE LOCATION COORDINATES: N: 1740448.55 E: 1784435.07 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1312.12 TOC ELEVATION (FAMSL): 1314.98 DRILL RIG: CME-75

DRILLING START DATE/TIME: 03/28/05 11:00 DRILLING COMPLETION DATE/TIME: 03/28/05 11:45

TOTAL DEPTH (FT): 15 DEPTH TO WATER DURING DRILLING (FT BGS): 8.5 DEPTH TO WATER (FT TOC): 7.16 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Silty CLAY, 100% fines, low plast, dark brown, soft, moist, earthy odor, no strat, no cement	CL		1	5.3			
1310		Silty CLAY, as above			2	6.5			
		Silty CLAY, 100% fines, low plast, reddish brown, firm to stiff, slightly moist, no odor, no strat, no cement, small (2mm) black concretions			3	6.2			
1305	7.0	LIMESTONE, yellow gray, highly weathered, fine grain, weak, weathered to clay, thin bedded, angular limestone frag, moist, petroleum odor			4	1,000			
		LIMESTONE, wet, highly weathered, light gray clay, structure mostly intact, thin bedded			5	677			
1300		LIMESTONE as above, wet, petroleum odor, slight sheen, no dark staining, some limestone fragments			6	N/A			
		BORING TERMINATED AT 15 Ft.							
1295									
1290									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-08

Notes:

DRILL HOLE NUMBER: **OW-09**

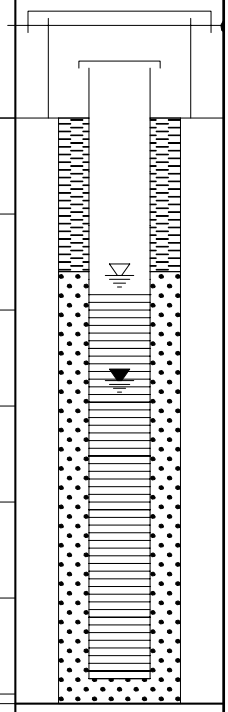
DRILL HOLE LOCATION COORDINATES: N: 1740319.74 E: 1784917.31 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1310.02 TOC ELEVATION (FAMSL): 1312.8 DRILL RIG: CME-75

DRILLING START DATE/TIME: 03/28/05 13:15 DRILLING COMPLETION DATE/TIME: 03/28/05 14:55

TOTAL DEPTH (FT): 15.25 DEPTH TO WATER DURING DRILLING (FT BGS): 4.1 DEPTH TO WATER (FT TOC): 6.84 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1310	0	Silty CLAY, 100% fines, med-high plast, dark brown to black, soft to firm, moist, petroleum odor, no staining	CH		(CT)	--			
		Silty CLAY as above, moist to wet, slight odor			1	22.5			
1305		Silty CLAY as above, moist to wet, dark brown with black concretions, petroleum odor			2	8.2			
	7.0	LIMESTONE, yellow gray 5Y 7/2, weathered, thin-bedded, platy, dry, fractures parallel to bedding, 2 fractures over 7.5 inches, odor, little to no staining			3	1,600			
1300		LIMESTONE, yellow gray as above, slightly more argillaceous, moist to wet			4	1,700			
		LIMESTONE, yellow gray as above, slightly moist, highly weathered, thin bedded			5	56.6			
1295		LIMESTONE as above, wet, weathered, no odor, iron oxidation, clay in fractures of 1/16 inch aperature, several fractures, angular limestone fragments			6	3.2			
		BORING TERMINATED AT 15.25 Ft.							
1290									
1285									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-09**

Notes:

DRILL HOLE NUMBER: **OW-10**

DRILL HOLE LOCATION COORDINATES: N: 1740561.35 E: 1785754.77 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1301.62 TOC ELEVATION (FAMSL): 1304.44 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/05/05 8:45 DRILLING COMPLETION DATE/TIME: 04/05/05 10:20

TOTAL DEPTH (FT): 18 DEPTH TO WATER DURING DRILLING (FT BGS): 8 DEPTH TO WATER (FT TOC): 8.57 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300	0	SILT, 100% fines, low plast, dark brown, soft to firm, earthy odor, no strat, no cement, roots	ML		1	4.2			
1295	2.5	Silty CLAY, 100% fines, low-med plast, reddish brown, stiff, moist, no odor, no cement, no strat, minor black fragments Silty CLAY, as above Silty CLAY, as above Grades to gray to brown, minor limestone fragments, yellow-tan discoloration at transition As above, wet, sticky, med plast, less silt, limestone fragment in tip of split spoon	CL		2 3 4 5	3.1 4.6 7.8 10.2			
1290	11	LIMESTONE, light gray, highly weathered to clay, angular fragments up to 1" in size, saturated, strong sheen on split spoon and limestone, petroleum odors			6 NR (CT)	392 --			
1285									
1280		BORING TERMINATED AT 18 Ft.							

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-10

Notes:

DRILL HOLE NUMBER: **OW-11**

DRILL HOLE LOCATION COORDINATES: N: 1741076.79 E: 1786047.14 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1302.42 TOC ELEVATION (FAMSL): 1305.34 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/04/05 9:30 DRILLING COMPLETION DATE/TIME: 04/04/O5 11:00

TOTAL DEPTH (FT): 17 DEPTH TO WATER DURING DRILLING (FT BGS): 12 DEPTH TO WATER (FT TOC): 8.38 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1305									
	0	Silty CLAY, 100% fines, med. plast, dark brown, firm, slightly moist, earthy odor, no strat., no cement	CL		1	2.5		8	
1300		Silty CLAY, 95% fines, trace gravel, med plast, reddish brown, slightly moist to moist, stiff, no stratification, no cement, no odor, black, blocky and rounded fragments up to 2 mm in size			2	4.8		9	
		As above			3	4.4		10	
1295		As above			4	4.6		11	
		As above			5	4.7		7	
1290	12	LIMESTONE, light gray, thin bedded, platy angular fragments mixed with clay, saturated, highly weathered, weak, more LS fragments, less clay starting at 13 ft.			6	5.4			
		As above, drilled to depth, no samples collected			NR (CT)	--			
1285		BORING TERMINATED AT 17 Ft.							
1280									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-11

Notes:

DRILL HOLE NUMBER: **OW-12**

DRILL HOLE LOCATION COORDINATES: N: 1740519.36 E: 1786185.03 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1297.62 TOC ELEVATION (FAMSL): 1300.51 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/04/05 11:35 DRILLING COMPLETION DATE/TIME: 04/04/05 13:35

TOTAL DEPTH (FT): 18 DEPTH TO WATER DURING DRILLING (FT BGS): 8 DEPTH TO WATER (FT TOC): 7.95 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300									
	0	SILT, 100% fines, no plast, dark brown, firm, slightly moist, dry, earthy odor, no strat, no cement	ML		1	1.8			
1295	2.5	Silty CLAY, 100% fines, low plast, brown, stiff, slightly moist, no odor, no strat, no cement, brown to reddish brown, minor black fragments less than 2 mm is size	CL		2	5.3			
		As above, med plast, moist, iron oxidation, and black dendritic stringers of oxidation			3	4.9			
1290		As above, moist to wet			4	5.1			
	8.0	SHALE, gray, highly weathered to clay, wet, angular fragments up to 1/4"							
	8.5								
	9.0	Shale, weathered to CLAY, 100% fines, soft, med. plast, wet, angular limestone or shale clasts			5	22.1			
	12	Angular LIMESTONE fragments mixed with clay, wet							
1285		CLAY, soft brown clay as above, angular LS fragments up to 1", wet			6	17.4			
		LIMESTONE, light gray, thin bedded, platy, highly weathered, weak Slow drilling, harder rock, no split spoon attempted			NR (CT)	--			
1280									
		BORING TERMINATED AT 18 Ft.							
1275									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-12

Notes:

DRILL HOLE NUMBER: **OW-13**

DRILL HOLE LOCATION COORDINATES: N: 1743311.42 E: 1785869.74 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1312.75 TOC ELEVATION (FAMSL): 1315.43 DRILL RIG: CME-75 HSA

DRILLING START DATE/TIME: 03/26/05 14:40 DRILLING COMPLETION DATE/TIME: 03/26/05 16:00

TOTAL DEPTH (FT): 22.4 DEPTH TO WATER DURING DRILLING (FT BGS): 19.5 DEPTH TO WATER (FT TOC): 22.58 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1315									
	0	Silty CLAY, reddish brown, 100% fines, stiff, moist, no odor, no strat, no cement, med. plast	CL		1 (CT)	3.0			
1310		As above, <10 % fine sand			2	2.2			
1305		As above, some petroleum staining and petroleum odor			3	98.6			
		As above, some petroleum staining and odors			4	160			
1300	12.5	Silty CLAY to CLAY, dark brown, noticable color change at 12.5 ft, gray, soft, high-med plast, moist, rounded LS clasts 1/4", minor coarse sand to gravel size LS clasts, LS almost completely weathered to clay	CH		5	338			
		As above, strong smell of high octane gasoline, green discoloration at 17 ft., moist, angular 1/2" LS clasts			6	309			
1295		As above, green, argillaceous, strong petroleum odors, wet at approx. 19.5 ft, 15% LS clasts, 85% clay			7	995			
	20	LIMESTONE, highly weathered, gray to green gray, highly altered to clay, small LS fragment 1/4-1/2" , saturated 70% LS, 30% clay, product sheen on rock and split spoon			8	186			
1290		BORING TERMINATED AT 25.5 Ft.							

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-13

Notes:

DRILL HOLE NUMBER: **OW-14**

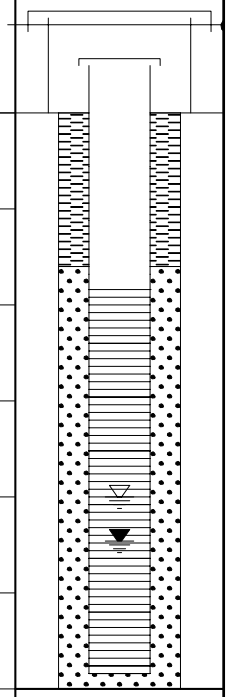
DRILL HOLE LOCATION COORDINATES: N: 1743344.62 E: 1786142.65 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1307.61 TOC ELEVATION (FAMSL): 1310.26 DRILL RIG: CME-75 HSA

DRILLING START DATE/TIME: 03/28/05 10:45 DRILLING COMPLETION DATE/TIME: 03/28/05 11:50

TOTAL DEPTH (FT): 15 DEPTH TO WATER DURING DRILLING (FT BGS): 10 DEPTH TO WATER (FT TOC): 11.15 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1310									
	0	Silty CLAY, 100% fines, low plast, dark reddish brown, firm, slightly moist, no strat, no cement, no odor, no staining	CL		1 (CT)	2.1			
1305		Same as above, low-med plast, no odor, no staining			2	3.4			
		Same as above, med. plast, no odor, no staining			3	10.5			
1300	7.5	LIMESTONE, yellow gray, fine grained, highly weathered but structure still preserved, cherty at contact, dry to slightly moist, platy, no odor, no staining			4	5.7			
		LIMESTONE, gray, saturated, highly weathered to clay, thin bedded, angular, platy LS fragments mixed with clay, slight odor and staining			5	3.5			
1295		LIMESTONE as above, saturated, highly weathered, slight petroleum odor, becoming more argillacous but still hard, slow drilling			6	10.9			
		BORING TERMINATED AT 15 Ft.							
1290									
1285									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**

OW-14

Notes:

DRILL HOLE NUMBER: **OW-15**

DRILL HOLE LOCATION COORDINATES: N: E: LOGGED BY: LWM

GROUND ELEVATION (FAMSL): TOC ELEVATION (FAMSL): DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/05/05 12:40 DRILLING COMPLETION DATE/TIME: 04/05/05 14:40

TOTAL DEPTH (FT): 5.25 DEPTH TO WATER DURING DRILLING (FT BGS): Abandoned DEPTH TO WATER (FT TOC): DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Silty CLAY, 100% fines, med plast, dark brown, slightly moist to moist, stiff, no odor, no strat, no cement	CL		1	3.0			
		As above, less silt, dark brown, firm to stiff, slight petroleum odors, no strat, no cement, moist			2	5.8			
	4.0	LIMESTONE, gray, thin bedded, fractured, moderately strong, dry, petroleum odors			3	344			
		BORING TERMINATED AT 5.25 Ft. Abandonded, no water, no weathered rock							

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-15

Notes:

DRILL HOLE NUMBER: **OW-16**

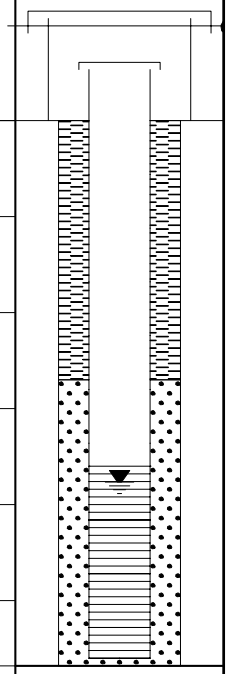
DRILL HOLE LOCATION COORDINATES: N: 1743468.97 E: 1786587.03 LOGGED BY: BB

GROUND ELEVATION (FAMSL): 1300.64 TOC ELEVATION (FAMSL): 1303.46 DRILL RIG: CME-45

DRILLING START DATE/TIME: 03/24/05 10:17 DRILLING COMPLETION DATE/TIME: 03/24/05 12:17

TOTAL DEPTH (FT): 14.2 DEPTH TO WATER DURING DRILLING (FT BGS): NR DEPTH TO WATER (FT TOC): 9.41 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300	0	Sandy GRAVEL, 70% gravel, 30% fine to med sand, very dusky red, 2.5 YR 2, moist, angular	GC		1	3.4		12	
	0.6	Silty CLAY, yellowish brown 10YR 7/2, med plast, stiff, slightly moist, no odors, roots	CL		2	3.3		10	
		Same as above with few LS (yellowish gray) coarse gravels and roots							
1295		Same as above with red brick fragment, with roots, grades to moderate yellowish brown 10 YR 5/4			3	3.2		6	
	7.5	CLAY, moderate brown, 5YR 4/4, medium to high plasticity, stiff to very stiff, slightly moist, no odor, trace roots and coarse gravel	CH		4	2.7		16	
1290	10	Grades to brown CLAY, slightly moist with a few roots,	CL		5	3.0		7	
	12.2	LIMESTONE, yellowish gray to pale yellow 2.5Y 7/4, fine grained, weak hydrocarbon odor at contact			6	3.4			
		Borehole terminated at 14.2 ft. Split spoon refusal at 12.5 ft.							
1285		BORING TERMINATED AT 14.2 Ft.							
1280									
1275									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-16

Notes:

DRILL HOLE NUMBER: **OW-18**

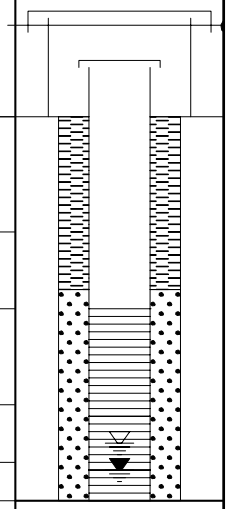
DRILL HOLE LOCATION COORDINATES: N: 1744031.05 E: 1785984.52 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1305.93 TOC ELEVATION (FAMSL): 1308.68 DRILL RIG: CME-75 HSA

DRILLING START DATE/TIME: 03/25/05 14:15 DRILLING COMPLETION DATE/TIME: 03/25/05 15:15

TOTAL DEPTH (FT): 10 DEPTH TO WATER DURING DRILLING (FT BGS): 8.5 DEPTH TO WATER (FT TOC): 9.2 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1305	0	Silty CLAY, 100% fines, low-med plast, dark brown to reddish brown, slightly moist to moist, firm to stiff, petroleum odor and staining, no strat, no cement	CL		1 (CT)	1327			
		Same as above, less petroleum odor and staining			2 (CT)	857			
		Same as above, strong petroleum staining and odors			3	1194			
1300	6.0	LIMESTONE, yellow gray, fine grained, highly weathered, moderately strong, dry to slightly moist, fractured, angular LS fragments, petroleum odors and staining			4	1888			
					5	1095			
		As above, slightly moist to moist, highly weathered to clay, minor iron mottling			6	926			
1295		Same as above, completely weathered to clay, few 1/4" angular LS saturated fragments, petroleum odor, some product sheen on auger bit when removed from borehole							
		BORING TERMINATED AT 10 Ft.							
1290									
1285									
1280									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-18**

Notes:

DRILL HOLE NUMBER: **OW-19**

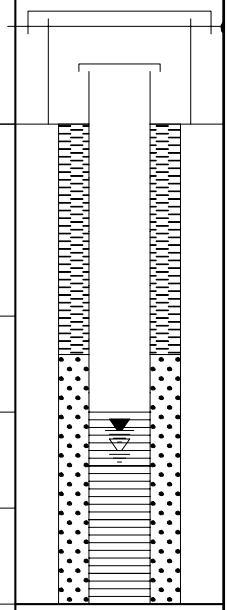
DRILL HOLE LOCATION COORDINATES: N: 1744422.24 E: 1785781.52 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1314.56 TOC ELEVATION (FAMSL): 1317.5 DRILL RIG: CME-75 HSA

DRILLING START DATE/TIME: 03/25/05 15:30 DRILLING COMPLETION DATE/TIME: 03/25/05 16:30

TOTAL DEPTH (FT): 12.5 DEPTH TO WATER DURING DRILLING (FT BGS): 8.5 DEPTH TO WATER (FT TOC): 7.98 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1315									
	0	Silty CLAY, as below	CL		1 (CT)	6.0			
1310		Silty CLAY, dark brown to black, 100% fines, firm to stiff, moist, slight petroleum odor, stronger odor at 7.5 ft.			2	850			
		As above			3	1250			
	8.5	LIMESTONE, yellow-gray, highly weathered to clay, fractured, crumbly, minor iron oxidation, petroleum staining and odor, moist to wet			4	760			
1305		LIMESTONE, yellow-gray, weathered, less clay, thin bedded, platy fractures, less petroleum staining and odor, moist, not fully saturated			5	193			
		BORING TERMINATED AT 12.5 Ft.							
1300									
1295									
1290									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-19**

Notes:

DRILL HOLE NUMBER: **OW-20**

DRILL HOLE LOCATION COORDINATES: N: E: LOGGED BY: LWM

GROUND ELEVATION (FAMSL): TOC ELEVATION (FAMSL): DRILL RIG: CME-75

DRILLING START DATE/TIME: 03/25/05 15:30 DRILLING COMPLETION DATE/TIME: 03/25/05 16:30

TOTAL DEPTH (FT): 7.5 DEPTH TO WATER DURING DRILLING (FT BGS): NR DEPTH TO WATER (FT TOC): NR DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Silty CLAY, trace sand, 95% fines, <5 f. sand, dark brown, low to med plast, firm, no strat, no cement, minor petroleum odor	CL		1	2.8			
					2	3.7			
	4	LIMESTONE, split spoon 12" recovery, light gray / tanish white, thin bedded, f. grained, weathered, fractured, slightly moist to dry, platy			3	3.3			
		LIMESTONE, split spoon 2" recovery, clay altered LS at water contact							
		BORING TERMINATED AT 7.5 Ft. Auger refusal, not enough water to set a well, abandoned borehole							

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-20

Notes:

DRILL HOLE NUMBER: **OW-21**

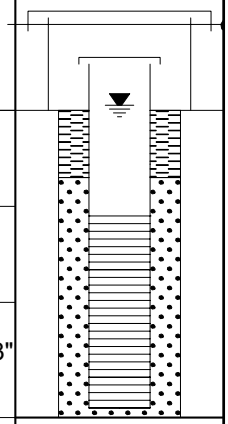
DRILL HOLE LOCATION COORDINATES: N: 1745437.58 E: 1785971.59 LOGGED BY: BB

GROUND ELEVATION (FAMSL): 1309.03 TOC ELEVATION (FAMSL): 1311.61 DRILL RIG: CME-45 HSA

DRILLING START DATE/TIME: 03/23/05 14:55 DRILLING COMPLETION DATE/TIME: 03/23/05 15:50

TOTAL DEPTH (FT): 8 DEPTH TO WATER DURING DRILLING (FT BGS): NR DEPTH TO WATER (FT TOC): -.13 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1310									
	0	GRAVEL, fill material, fine and coarse	GP		1	69		7	
	.75	Silty CLAY, grayish brown 5 YR 3/2, medium stiff to stiff, medium plasticity, petroleum odor Few roots and organics at 2 ft.	CL		2	126		13	
1305		Same as above, grades to brownish black 5 YR 2/1 with few coal or slag fragments, coarse gravel size LS, yellowish gray at 3.5 ft.							
	5.4	LIMESTONE, yellowish gray, weathered and platy, fine grained, split spoon refusal at 5.6 ft.			3	14		50-3"	
1300		BORING TERMINATED AT 8 Ft.							
1295									
1290									
1285									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-21**

Notes:

DRILL HOLE NUMBER: **OW-22**

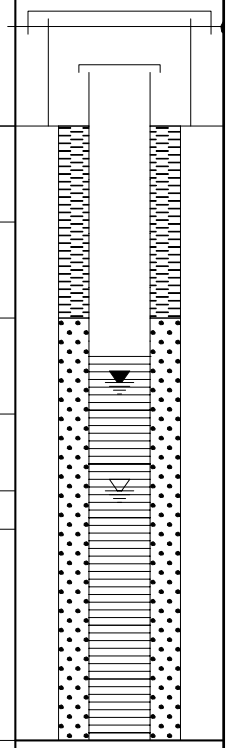
DRILL HOLE LOCATION COORDINATES: N: 1744280.58 E: 1786118.22 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1305.36 TOC ELEVATION (FAMSL): 1308.35 DRILL RIG: CME-75 HSA

DRILLING START DATE/TIME: 03/26/05 10:30 DRILLING COMPLETION DATE/TIME: 03/26/05 11:30

TOTAL DEPTH (FT): 16 DEPTH TO WATER DURING DRILLING (FT BGS): 9.5 DEPTH TO WATER (FT TOC): 6.68 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1305	0	Silty CLAY, auger cuttings, 100% fines, med plast, dark brown, soft to firm, moist, petroleum odor and staining	CL		1 (CT)	100			
	2.5	Fill material, coal-like pieces, black petroleum staining, slightly moist to moist			2 (CT)	723			
1300		Fill, petroleum stained, coal-like pieces, odor, moist, black stained			3	552			
		Same as above, black staining			NR	--			
1295	9.5	LIMESTONE, weathered angular fragments, petroleum stained, moist to wet, minor sheen, split spoon refusal at 10 ft. Auger down into weathered LS, easy to auger through, may be small amt. of water at 9 ft and zone of softer material			4	751			
					NR (CT)	--			
1290		BORING TERMINATED AT 16 Ft.							
1285									
1280									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-22

Notes:

DRILL HOLE NUMBER: **OW-23**

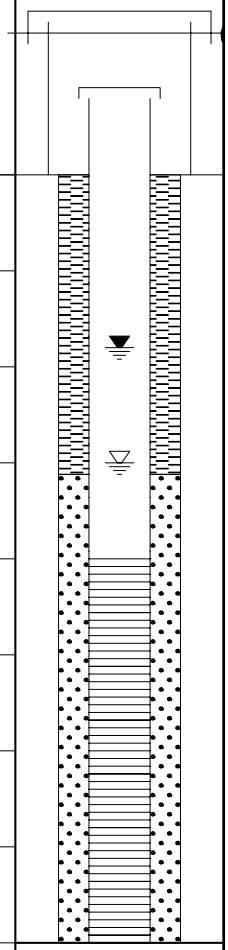
DRILL HOLE LOCATION COORDINATES: N: 1744385.97 E: 1786220.02 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1304.09 TOC ELEVATION (FAMSL): 1308.35 DRILL RIG: CME-75 HSA

DRILLING START DATE/TIME: 03/26/05 8:45 DRILLING COMPLETION DATE/TIME: 03/26/05 10:15

TOTAL DEPTH (FT): 20 DEPTH TO WATER DURING DRILLING (FT BGS): 7.5 DEPTH TO WATER (FT TOC): 4.5 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1305									
	0	Silty CLAY, 100% fines, low-med plast, dark brown to reddish brown, no cement, no strat	CL		1 (CT)	4.8			
		As above, dark black petroleum staining			2 (CT)	4.5			
1300	5	Clayey SILT, with trace sand, less than 5%, low plast, dark brown/black, slightly moist, stiff to very stiff, staining, petroleum odor.	ML		3	23.8			
	7.5	Silty CLAY, 90% fines, 10% fine sand, dark brown, med plast, less staining and odors, wet, soft, no strat, no cement	CL		4	5.6			
1295	10	Clayey SILT, 100% fines, dark brown, low plast, very stiff, slightly moist, minor petroleum staining and odors, no strat, no cement	ML		5	27.8			
	12.5	Silty CLAY, 100% fines, dark brown / reddish brown, low to medium plast, very stiff, slightly moist, minor petroleum staining, odors, no strat, no cement	CL		6	322			
1290					7	208			
	16	As above, at 16 ft. yellowish brown color, less silt, med. to high plast, moist, staining and odors, petroleum staining in vertical strings through clay	CH						
	16.5	LIMESTONE, yellow gray, fine-grained, highly weathered to clay, thin bedded, saturated, small LS fragments			8	24.6			
1285		BORING TERMINATED AT 20 Ft.							
1280									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-23

Notes:

DRILL HOLE NUMBER: **OW-24**

DRILL HOLE LOCATION COORDINATES: N: 1743901.68 E: 1786273.7 LOGGED BY: RH

GROUND ELEVATION (FAMSL): 1301.87 TOC ELEVATION (FAMSL): 1304.85 DRILL RIG: CME-45 HSA

DRILLING START DATE/TIME: 03/25/05 10:15 DRILLING COMPLETION DATE/TIME: 03/25/05 12:15

TOTAL DEPTH (FT): 23 DEPTH TO WATER DURING DRILLING (FT BGS): 15.5 DEPTH TO WATER (FT TOC): 5.65 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Silty CLAY, 100% fines, dark brown, grass, soft, medium plasticity, roots	CL		1	10.1		10	
1300	2.0	As above, increase silt, some reddish clay	SP						
	2.5	SAND, 70% fine to coarse sand, 30% gravel, some yellowish gray limestone fragments, fill material			2	44.3		6	
		CLAY, med plast, black to dark brown, soft to stiff, weak hydrocarbon odor			3	620		10	
1295		As above, trace m. to f. sand, moist, hydrocarbon odor, mottling of black material							
		Mottling of black material, hydrocarbon staining around root paths, orange-brown color, moist, product hydrocarbon sheen			4	2034		8	
		As above, hydrocarbon product sheen and strong odor along length of sample, moist to wet	CL		5	1745		5	
1290		As above, moist, mottling, hydrocarbon staining along root paths, hydrocarbon odor			6	2036		7	
		Silty CLAY, dark yellowish brown, some mottling, few roots with staining, moderate hydrocarbon odor, wet, trace limestone fragments			7	1907		5	
1285		As above, hydrocarbon odor, visible product sheen along outside and inside of sampler			8	1707		5	
	19	LIMESTONE, weathered material, yellowish gray clay chips, wet, hydrocarbon odor, fine to coarse grained sand and gravel, crumbles easily, refusal with sampler at 21 ft bgs			9	264			
1280		BORING TERMINATED AT 23 Ft.							

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-24

Notes:

DRILL HOLE NUMBER: **OW-26**

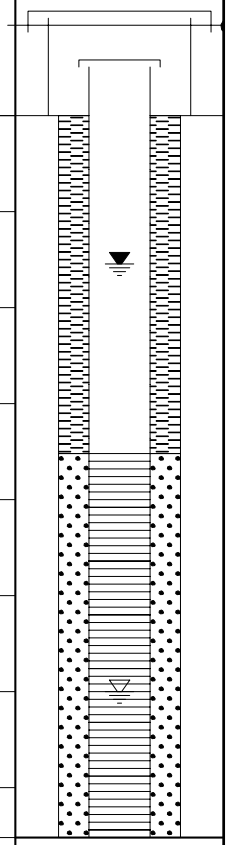
DRILL HOLE LOCATION COORDINATES: N: 1743901.56 E: 1786491.43 LOGGED BY: JG

GROUND ELEVATION (FAMSL): 1299.62 TOC ELEVATION (FAMSL): 1302.62 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/02/05 13:30 DRILLING COMPLETION DATE/TIME: 04/02/05 15:42

TOTAL DEPTH (FT): 18.8 DEPTH TO WATER DURING DRILLING (FT BGS): 15 DEPTH TO WATER (FT TOC): 3.86 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300									
	0	Silty CLAY, 95% fines, 5% m. to f. sand, medium plasticity, brown to reddish brown, iron staining, soft, moist, no odor	CH		1	1.9			
		Silty CLAY, 90% fines, 5% fine sand, 5% very coarse sand-size nodules, med. plasticity, some reddish iron staining, soft to firm, slightly moist, none to slight odor, grayish brown / olive			2	3.0			
1295					3	7.4			
		Same as above, silty CLAY, 95% fines, 5% fine sand, med. plasticity, brown with small pockets of black H.C. substance (fluid)			4	81.8			
1290					5	163			
		Silty CLAY, 95% fines, 5% fine sand, med. plasticity, brown to olive gray, very firm, thin layers of fine sand, odor			6	5.7			
1285	15	Sandy CLAY, as above, 80% fines, wet, 20% sand and gravel, odor	SC		7	4.8			
	16.5	Weathered LIMESTONE, yellowish gray, weathered, odor, wet			NR	--			
1280		BORING TERMINATED AT 18.8 Ft.							
1275									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-26

Notes:

DRILL HOLE NUMBER: **OW-25**

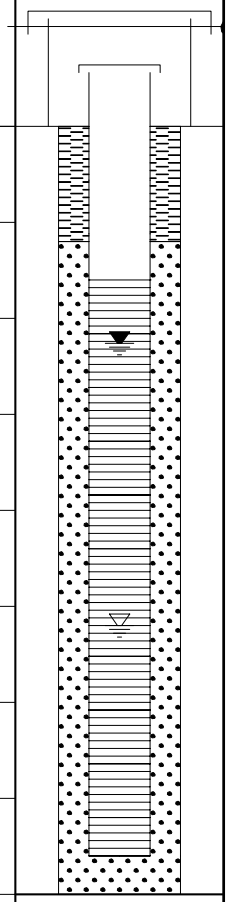
DRILL HOLE LOCATION COORDINATES: N: 1744068.17 E: 1786425.37 LOGGED BY: RH

GROUND ELEVATION (FAMSL): 1300.46 TOC ELEVATION (FAMSL): 1303.18 DRILL RIG: CME-45

DRILLING START DATE/TIME: 03/25/05 13:30 DRILLING COMPLETION DATE/TIME: 03/25/05 15:42

TOTAL DEPTH (FT): 20 DEPTH TO WATER DURING DRILLING (FT BGS): 13 DEPTH TO WATER (FT TOC): 5.65 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300	0	Gravely CLAY, 80% fines, 20% gravel, dark yellowish brown, stiff, moist	GW-GC		1	22.7		5	
	2	CLAY, 90% fines, 10% gravel, mottling with dark material, hydrocarbon odor	CL		2	317		5	
1295	4	Gravely CLAY, 70% fines, 30% gravel, dark brown, wet, hydrocarbon odor, product sheen on split spoon and sample	GW-GC		3	2088		4	
1290	7.5	CLAY, 100% fines, med. plast, dark yellowish brown, moist, soft, visual staining of hydrocarbons, hydrocarbon odor As above, moist to wet, hydrocarbon odor, up to 20% crs. sand at 11 ft.	CL		4	2618		6	
	11	Sandy CLAY, 80% fines, 20% f. to crs. sand, med. plast., dark yellowish brown, soft, wet, hydrocarbon ordor	SC		5	2138		5	
	13	Sandy CLAY, 80% fines, 20% f. to crs. sand	GC		6	2150		4	
	14	Clayey, sandy GRAVEL, 50% gravel							
1285		LIMESTONE, weathered with clay, wet, fine and coarse gravel and sands, hydrocarbon odor, medium to coarse gravel, weathered, with light brown clay, hydrocarbon odor, wet			7	445		11	
		LIMESTONE with light brown clay, medium to coarse weathered, gravel-sized fragments, hydrocarbon odor, wet			NR (CT)	--			
1280		BORING TERMINATED AT 20 Ft.							
1275									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-25

Notes:

DRILL HOLE NUMBER: **OW-27**

DRILL HOLE LOCATION COORDINATES: N: 1744293.94 E: 1786612.23 LOGGED BY: RH

GROUND ELEVATION (FAMSL): 1303.24 TOC ELEVATION (FAMSL): 1303.43 DRILL RIG: CME-45

DRILLING START DATE/TIME: 03/28/05 9:30 DRILLING COMPLETION DATE/TIME: 03/28/05 12:10

TOTAL DEPTH (FT): 21 DEPTH TO WATER DURING DRILLING (FT BGS): 8 DEPTH TO WATER (FT TOC): 9.18 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Sandy SILT, 70% fines, 30% f. to m. sand, med. plast, hydrocarbon odor and staining, dark brown, dry to moist	ML		1	749		3	
1300	2.5	Sandy CLAY, 60% fines, 30% f. to crs. sand, dark brown, dry to moist, hydrocarbon odor and staining	CL		2	935		2	
	4.5	Gravely, Sandy CLAY, 40% fines, 30% f. to m. sand, 30% gravel, dark brown, hydrocarbon odor and staining, black fine sands	VG		3	120		12	
1295	6	CLAY, 90% fines 10% sand, med to high plasticity, hydrocarbon odor, black staining, moist to wet, strong, large coarse gravel, dark yellowish brown	CH		4	303		10	
	10	CLAY, 100% fines, med. plasticity, light brown, soft, mottling	CL		5	293		5	
1290		As above, light grayish brown, very soft, hydrocarbon odor, oil sheen on split spoon			6	1695		4	
	15	Sandy, Silty CLAY, 80% fines, 20% sand, light gray, brown 10YR 6/2, mild hydrocarbon odor, moist to wet, mottling with green / olive gray materials	VC		7	35		7	
1285	17.5	LIMESTONE, light gray, weathered, coarse to fine sand and gravel, some light brown traces			8	188			
					NR	--			
		BORING TERMINATED AT 21 Ft.							
1280									
1275									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-27

Notes:

DRILL HOLE NUMBER: **OW-28**

DRILL HOLE LOCATION COORDINATES: N: 1743939.05 E: 1786886.46 LOGGED BY: RH

GROUND ELEVATION (FAMSL): 1301 TOC ELEVATION (FAMSL): 1301.57 DRILL RIG: CME-45

DRILLING START DATE/TIME: 03/28/05 12:30 DRILLING COMPLETION DATE/TIME: 03/28/05 15:15

TOTAL DEPTH (FT): 19.5 DEPTH TO WATER DURING DRILLING (FT BGS): 15 DEPTH TO WATER (FT TOC): 10.28 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300					1	1064		6	
	2.5	Sandy CLAY, 70% fines, 20% sand, 10% gravel, dark brown 2.5 YR 2.5/2, med. to high plast, stiff, moist, hydrocarbon odor, hydrocarbon staining,	CH		2	161		7	
	5.5	As above, soft, light gray brown							
1295	5.75	GRAVEL, 90% gravel, 20% crs. sand, 10% fines, dark brown, hydrocarbon odor,	GP		3	286		7	
		CLAY, 90% fines, 10% f. to crs. sand, dark brown, med. plast, soft to med. stiff, hydrocarbon ordor	CH		4	627		8	
		As above, moist, hydrocarbon odor							
1290		CLAY, 90% fines, 10% f. to crs. sand, med. to high plast, dark brown to dark orange brown, wet, stiff, hydrocarbon odor and staining			5	1050		11	
		As above, increasing angular sand and gravel, hydrocarbon odor,			6	147		10	
	14.5	Limestone,weathered, olive green/gray, f. to crs. sand and gravel, clay, moist to wet, hydrocarbon odor			7	624		7	
1285		LIMESTONE, dark and light gray, weathered to clay, trace iron staining, strong hydrocarbon odor			NR (CT)	--			
		BORING TERMINATED AT 19.5 Ft.							
1280									
1275									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-28**

Notes:

DRILL HOLE NUMBER: **OW-29**

DRILL HOLE LOCATION COORDINATES: N: 1744706.01 E: 1787047.62 LOGGED BY: RH

GROUND ELEVATION (FAMSL): 1292.06 TOC ELEVATION (FAMSL): 1294.68 DRILL RIG: CME-45

DRILLING START DATE/TIME: 03/29/05 8:50 DRILLING COMPLETION DATE/TIME: 03/29/05 11:10

TOTAL DEPTH (FT): 19.5 DEPTH TO WATER DURING DRILLING (FT BGS): 16 DEPTH TO WATER (FT TOC): 12.2 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	Silty CLAY, 100% fines, med plasticity, 10 YR 2/2, moist, soft, no odor, roots	CL		1	4.0		6	
1290		As above, stiff			2	4.8		10	
					3	18.3		7	
1285		CLAY, 100% fines, 10 YR 3/4, med. plast, soft to stiff, moist, no odor As above, 10 YR 4/2, dark grayish brown, stiff, moist, no odor, some mottling, streaking of lighter orange / brown, trace crs. gravel			4	9.8		11	
		As above, 10 YR 3/2, very dark grayish brown, weak hydrocarbon odor			5	10.9		11	
1280	12.5	Clayey, gravely, SAND, 50% f. to crs. sand, 30% gravel, 20% fines, 2.5 Y 3/3, dark olive brown, moist to wet, sub-angular and angular gravel and sand, strong hydrocarbon odor	VG		6	2081		9	
	15	LIMESTONE, weathered, olive green mixed with gray, moist to wet, hydrocarbon odor, light olive with brown clay intermixed			7	2702		5	
1275		As above, visible hydrocarbon staining As above with wet dark gray platy rock, gray gravelly CLAY with strong hydrocarbon odor, coarse gravel with fine sands in the clayey sand at 19 ft.			NR (CT)	--			
1270		BORING TERMINATED AT 19.5 Ft.							

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-29**

Notes:

DRILL HOLE NUMBER: **OW-30**

DRILL HOLE LOCATION COORDINATES: N: 1744437.37 E: 1787302.09 LOGGED BY: JG, RH

GROUND ELEVATION (FAMSL): 1290.31 TOC ELEVATION (FAMSL): 1293.19 DRILL RIG: CME-45 HSA

DRILLING START DATE/TIME: 04/01/05 14:00 DRILLING COMPLETION DATE/TIME: 04/02/05 10:35

TOTAL DEPTH (FT): 19.5 DEPTH TO WATER DURING DRILLING (FT BGS): 13.5 DEPTH TO WATER (FT TOC): 12.18 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1290	0	Silty CLAY, 100% fines, med plast, brown (10 YR 3/2), med stiff, moist, no odor, roots in top 12 inches, darker brown (10 YR 2/1) with more clay at 2 ft.	CH		1	0		7	
		Silty CLAY, dark brown to black (10YR 2/1), med-high plast, dry to moist, f. sand			2	0		7 9	
1285		Silty CLAY, 100% fines, med plasticity, stiff, brown with reddish veins of iron oxide,dry to slightly moist, stiff, no odor, some roots			3	0.5		8	
					4	0.8		6	
1280		As above, high plasticity, soft, brown, small nodules of iron oxide, moist, no odor, gray color at 11.5 ft.			5	2.8			
		As above, dark gray, odor			6	568			
	13.5	LIMESTONE, with clayey silt, LS light gray to stained dory gray, clay is olive to dark gray, hydrocarbon odor, wet, LS not crystalline, weathered			7	9.8			
1275		As above, some silt and sand, light gray, wet slight odor			NR (CT)	--			
1270		BORING TERMINATED AT 19.5 Ft.							
1265									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-30**

Notes:

DRILL HOLE NUMBER: **OW-31**

DRILL HOLE LOCATION COORDINATES: N: 1744258.21 E: 1787378.5 LOGGED BY: J. Garsey

GROUND ELEVATION (FAMSL): 1287.35 TOC ELEVATION (FAMSL): 1290.32 DRILL RIG: CME-45 HSA

DRILLING START DATE/TIME: 04/01/05 10:35 DRILLING COMPLETION DATE/TIME: 04/01/05 13:00

TOTAL DEPTH (FT): 15 DEPTH TO WATER DURING DRILLING (FT BGS): 8.5 DEPTH TO WATER (FT TOC): 7.81 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1290									
	0	Clayey SILT, 90% fines, 10% very fine sand, slight plasticity to friable, brown, soft, slightly moist, no odor, roots	ML		1	0.7		6	
1285					2	1.3		6	
	5	Silty CLAY, 100% fines, med. to high plasticity, brown, stiff, slightly moist, no odor	CH		3	30		15	
1280		Same as above, moist, gray, odor			4	1672		18	
	8.5	LIMESTONE, weathered with clay, LS gravel, gray to olive, clay dark gray to olive, wet, strong odor							
		LIMESTONE, very hard, gray to tan, wet, odor at 12.5			5	717		17	
1275					6	137			
		Auger refusal at 15 ft.							
		BORING TERMINATED AT 15 Ft.							
1270									
1265									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-31

Notes:

DRILL HOLE NUMBER: **OW-32**

DRILL HOLE LOCATION COORDINATES: N: 1744108.6 E: 1787465.49 LOGGED BY: JG

GROUND ELEVATION (FAMSL): 1291.55 TOC ELEVATION (FAMSL): 1294.23 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/01/05 14:35 DRILLING COMPLETION DATE/TIME: 04/01/05 16:30

TOTAL DEPTH (FT): 20 DEPTH TO WATER DURING DRILLING (FT BGS): 16 DEPTH TO WATER (FT TOC): 13.55 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1290	0	Silty CLAY, 90% fines, 10% very fine sand, slight to med. plasticity, dark brown, soft, slightly moist, roots, no odor	CL		1	0		3	
					2	0.2		8	
					3	0.5		9	
1285	6.5	Clayey SILT, 100% fines, no plasticity, stiff, brown, dry, no odor	ML		4	1.2		10	
	8.5	Silty CLAY, 90% fines, 5% coarse sand, 5% gravel, med. plasticity, brown with reddish vein of iron oxide, very stiff, slightly moist, no odor	CL		5	1.0		30	
1280	11	LIMESTONE, weathered, LS gravel with silty clay, tan to gray, dark gray at 11.5 ft, olive to gray silty clay, strong odor			6	17		12	
1275		LIMESTONE, very hard, gray, wet, fractured, odor			7	2087		18	
					NR (CT)	--			
1270		BORING TERMINATED AT 20 Ft.							
1265									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-32

Notes:

DRILL HOLE NUMBER: **OW-33**

DRILL HOLE LOCATION COORDINATES: N: 1743744.72 E: 1787671.63 LOGGED BY: JG

GROUND ELEVATION (FAMSL): 1288.59 TOC ELEVATION (FAMSL): 1291.61 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/02/05 8:40 DRILLING COMPLETION DATE/TIME: 04/02/05 10:15

TOTAL DEPTH (FT): 19.2 DEPTH TO WATER DURING DRILLING (FT BGS): 8 DEPTH TO WATER (FT TOC): 11.12 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1290									
	0	Silty CLAY, 90% fines, 10% fine sand, slight to med. plasticity, dark brown to brown, soft, moist, roots, no odor	CL		1	1.3		3	
1285					2	1.7		7	
					3	1.6		4	
	7	Clayey SILT, 90% fines, 10% fine to med. sand, very cohesive, brown 7-11 feet, grayish brown 11- 12 ft., very soft, very moist to wet at 8 ft., slight odor at 11 ft.	ML		4	0.9		3	
1280					5	2.1		8	
		As above, 1 inch LS gravel at 14 ft., stained black with hydrocarbon residue, odor			6	40.6		7	
1275					7	52.9		42	
	16.5	LIMESTONE, weathered with clay in fractured matrix, gray, hard, sometimes platy, wet, slight odor			NR (CT)	--			
1270									
		BORING TERMINATED AT 19.2 Ft.							
1265									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-33

Notes:

DRILL HOLE NUMBER: **OW-35**

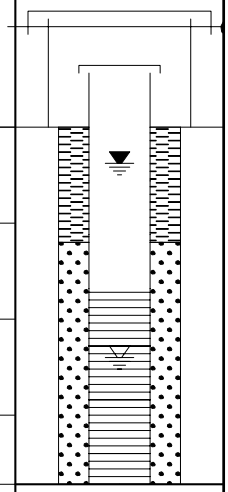
DRILL HOLE LOCATION COORDINATES: N: 1744995.76 E: 1786116.45 LOGGED BY: JG

GROUND ELEVATION (FAMSL): 1304.74 TOC ELEVATION (FAMSL): 1307.76 DRILL RIG: CME-45

DRILLING START DATE/TIME: 04/02/05 10:50 DRILLING COMPLETION DATE/TIME: 04/02/05 11:55

TOTAL DEPTH (FT): 9.3 DEPTH TO WATER DURING DRILLING (FT BGS): 6 DEPTH TO WATER (FT TOC): 0.94 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1305	0	SILT, 100% fines, dry, light brown, no odor	ML		1	328			
	2.5	Gravelly CLAY, 80% fines, 20% gravel, slight to med. plasticity, olive to reddish brown mottled, limestone gravel, dry, 1 inch of black material at 2 ft.	CL		2	78			
1300	5	Clayey SILT, 100% fines, friable, dark brown to black, sheen, odor, very moist to wet	ML		3	458			
	6	CLAY, 100% fines, high plasticity, brown/olive/black, mottled, odor, very moist to wet	CH						
	7	LIMESTONE, weathered, light gray, hard, finely crystalline, some med. calcite crystals			NR	--			
1295		BORING TERMINATED AT 9.3 Ft.							
1290									
1285									
1280									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG** — **OW-35**

Notes:

DRILL HOLE NUMBER: **OW-36**

DRILL HOLE LOCATION COORDINATES: N: 1744730.48 E: 1786600.11 LOGGED BY: RH

GROUND ELEVATION (FAMSL): 1301.81 TOC ELEVATION (FAMSL): 1304.79 DRILL RIG: CME-45

DRILLING START DATE/TIME: 03/23/05 11:30 DRILLING COMPLETION DATE/TIME: 03/23/05 14:07

TOTAL DEPTH (FT): 18 DEPTH TO WATER DURING DRILLING (FT BGS): 11 DEPTH TO WATER (FT TOC): 6.81 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	GRAVEL, 90% gravel, 10% f. to crs. sand, fill material	GP		1	11.7			
	0.5	Silty CLAY with trace f. gravel, 90% fines, 10% gravel, dusky brown, 5YR 2/2, angular gravel, low plast, soft, slightly moist, weak oily odor	CL		2	13		15	
1300	4	Split spoon refusal at 2 feet, sampler bouncing on a rock	GP						
	5.5	GRAVEL, 80% f. to crs. gravel, 20% fines, brownish black 5YR 2/1, gravel composed of yellowish gray to pale yellow limestone, weak hydrocarbon odor	CH		3	1.6		12	
1295		Silty CLAY, dusky brown, 5YR 2/2, med. plast, stiff to v. stiff, slightly moist			4	2.0		7	
		As above, grades to dark yellowish bronw 10YR 4/2 with black mottling			5	2.0		5	
1290		As above, brownish black mottling, few roots and organics, moist to wet at 11 ft, weak hydrocarbon ordor			6	2.0		10	
		As above, decrease in black mottling, weak to moderate hydrocarbon odor							
	15.5	As above, grades to black color, hydrocarbon odor with some subangular to angular fine gravel, limestone gravel			7	440		5	
1285		Limestone, yellowish gray, with black mottling along fractures, moderate hydrocarbon odor, fine grained							
		BORING TERMINATED AT 18 Ft.							
1280									

NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-36

Notes:

DRILL HOLE NUMBER: **OW-37**

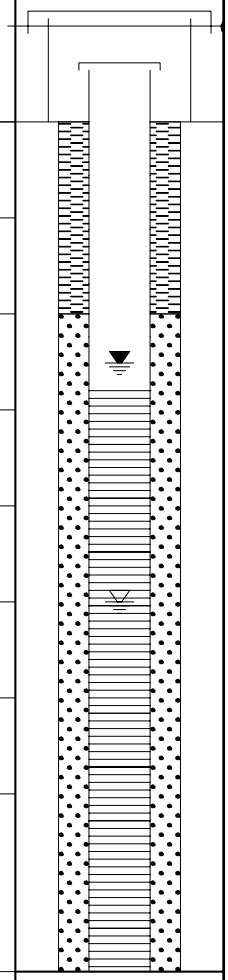
DRILL HOLE LOCATION COORDINATES: N: 1743663.11 E: 1786259.74 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1301.13 TOC ELEVATION (FAMSL): 1304.01 DRILL RIG:

DRILLING START DATE/TIME: 03/24/05 14:05 DRILLING COMPLETION DATE/TIME: 03/24/05 17:45

TOTAL DEPTH (FT): 22.13 DEPTH TO WATER DURING DRILLING (FT BGS): 12.5 DEPTH TO WATER (FT TOC): 6.28 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
	0	GRAVEL, fill material, f. gravel to crs. sands	GP		1	1281		5	
1300	1	Silty CLAY, 100% fines, med. plast, brownish black 5YR 2/1, dyr to mosit, stiff, hydrocarbon odor	CL		2	413		9	
		As above, darker silty clay layers							
		As above, mottling, moist			3	1901		13	
1295		trace crs. sand to f. gravel							
		As above, stiff, moderate yellowish brown, hydrocarbon odor, moist			4	770		8	
1290		Sandy Clay, 70% fines, 30% f. to m. sand, stiff, med. plast			5	560		8	
		As above			6	600		5	
	14	Clayey Gravel, 50% gravel, 50% fines, yellowish brown, wet	GC		7	550		3	
1285	17.5	LIMESTONE, weathered			NR (CT)	--			
1280									
		BORING TERMINATED AT 22.13 Ft.							
1275									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-37

Notes:

DRILL HOLE NUMBER: **OW-38**

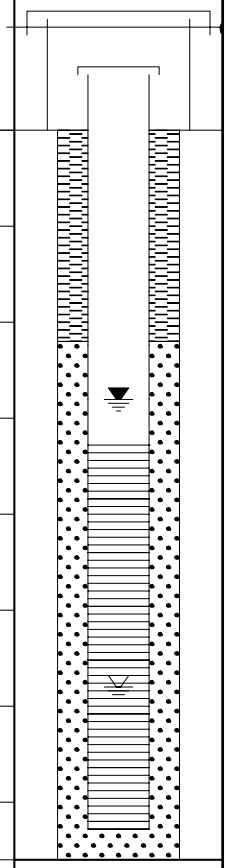
DRILL HOLE LOCATION COORDINATES: N: 1743652.66 E: 1786541.25 LOGGED BY: LWM

GROUND ELEVATION (FAMSL): 1298.84 TOC ELEVATION (FAMSL): 1301.94 DRILL RIG:

DRILLING START DATE/TIME: 03/24/05 10:55 DRILLING COMPLETION DATE/TIME: 03/24/05 13:22

TOTAL DEPTH (FT): 19 DEPTH TO WATER DURING DRILLING (FT BGS): 14.5 DEPTH TO WATER (FT TOC): 7.01 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300									
	0	GRAVEL, fine to coarse	GP		1	2381		9	
	1	Silty CLAY, 100% fines, brownish black 5YR 2/1, med plast, soft, strong odor	CL		2	2103		8	
1295	4	CLAY, as above, brownish gray 5 YR 4/1	CL						
		As above, strong hydrocarbon odors, moist			3	2057		10	
		As above, grades to yellowish brown 10YR 4/2			4	2063		5	
1290		As above, product sheen, moist to wet			5	2107		6	
		As above, strong odor, wtih trace coarse sand to fine gravel, wet			6	1966		5	
1285		As above, product sheen, trace asphalt-like fragments, wet, strong hydrocarbon odor			7	1176		4	
	16	LIMESTONE, fine grain weathered LS, yellowish gray 5 YR 7/2, some grayish black clay at contact			NR	--			
1280		BORING TERMINATED AT 19 Ft.							
1275									



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-38

Notes:

DRILL HOLE NUMBER: **OW-39**

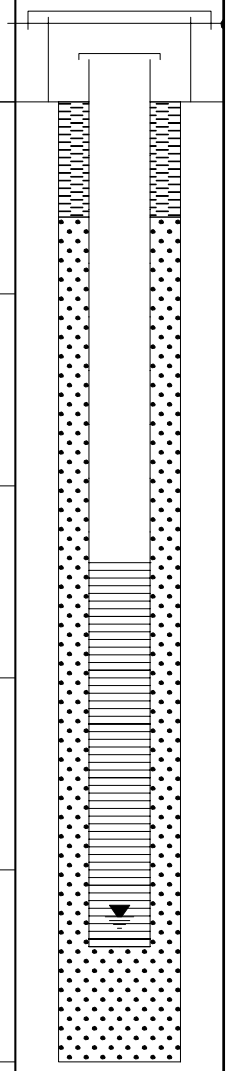
DRILL HOLE LOCATION COORDINATES: N: 1745069.945 E: 1784612.475 LOGGED BY: JLC

GROUND ELEVATION (FAMSL): 1299.69 TOC ELEVATION (FAMSL): 1302.26 DRILL RIG: Failing

DRILLING START DATE/TIME: 05/20/05 DRILLING COMPLETION DATE/TIME: 05/20/05 15:20

TOTAL DEPTH (FT): 25.5 DEPTH TO WATER DURING DRILLING (FT BGS): NR DEPTH TO WATER (FT TOC): 21.223 DATE MEASURED: 08/02/05

ELEVATION (FT)	CONTACT DEPTH (FT)	SOIL DESCRIPTION	SOIL CLASSIFICATION	GRAPHIC LOG	SAMPLE INTERVAL	PID READING	SAMPLE RECOVERY	BLOW COUNTS (N)	WELL DETAILS
1300	0	Silty, Clayey Loam, roots, moist, loose, grades to silty clay at around 1 foot, yellow brown, moist, moderate plasticity	CL		NR	--			
1295	5	LIMESTONE, tan yellow, iron staining, porous, some hairline fractures and vugs with CaCO3, dissolution features increase at 7.6 ft.			1	1.5			
1290		LIMESTONE as above, yellow orange at 11.5 ft., tiny iron nodules, weathered orange LS with clay, brown, moderate to high plasticity to 12.5 ft., sandy clay, yellow orange, wet, no plasticity at 13.5 ft.			2	1.8			
1285		LIMESTONE, as above to 16.9 feet, grades to LS with dissolution fractures, iron staining, some hairline fractures with CaCO3, becomes more porous and vuggy, wet.			3	1.7			
1280		LIMESTONE, much tighter, argillaceous, few fossils, iron stains to 20.3 ft., grades to light to medium grey argillaceous LS, several vugs, no CaCO3, grades to yellow LS with iron stains at 23. 4 ft., grades to porous LS, iron stains, vuggy, fossiliferous, dissolution channels			4	1.4			
1275		BORING TERMINATED AT 25 Ft.							



NOTES: Sampling is by Split Spoon or NQ Core Barrel unless noted CT which represents cuttings.

PROJECT NO.: 1004317	DESIGN BY: *LWM*	SCALE (FT/IN): *5*	*El Dorado Refinery El Dorado Kansas*
FILE: *Borelogs*	DRAWN BY: *EHG*	DATE: *9/30/2005*	
MWH			**BORING AND MONITORING WELL COMPLETION LOG**
			OW-39

KEY TO SYMBOLS

Symbol Description

Strata symbols

Low Plasticity Silty Clay

Limestone

Misc. Symbols

Water table at boring completion

Soil Samplers

Sample Recovery

Monitor Well Details

capped riser with locking cover

bentonite chips

silica sand, blank PVC

slotted pipe w/ sand

silica sand, no pipe (end plug)

BOREHOLE NUMBER: **OW-01**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *LWM*

ELEVATION: *1321.24* **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *CME 75*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *03/22/05*

TOTAL DEPTH: *26.3* **BIT TYPE:**

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	CORE RECOVERY DATA R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
			5.0	*Silty CLAY, med plast, 100% fines, v. stiff, reddish brown, moist, no strat*	0, 5								
2	2		7.5	*As above, dark brown, stiff to very stiff, no staining. Started coring at 10 ft.*									
2	2		8.5	*LIMESTONE, yellow/gray, thin bed, fine grained, dry, very weathered*	10								
2	2		10.0	*LIMESTONE, yellow gray, fine grained, mm size vugs, hairline fracture at 11.5 ft. with iron oxide, massive*									
2	2		13.0	*As above, argillaceous LS at 14 ft., soft, less voids, more fractured voids at 15 ft., more clay, iron oxides, from 15-18 ft more fractures, 1/4-1/2 " voids*	15								
2	2		18.0	*Same as above, LS, no fractures, less voids, less iron mottling,at 19.5 ft. dark gray massive LS 1/4 -1/2" fracture with breccia-like clasts*	20								
2	2		23.0	*LIMESTONE, no fract, less voids, less iron mottling at 19.5 ft., dark gray, massive LS 1/4 to 1/2 inch fracture with breccia-like clasts, LS dark gray, thinly bedded, massive, 1/2 inch to 1.5 inch voids at 22 ft.*	25								
				LIMESTONE, dark gray, thinly bedded, massive, 1/2 to 1.5 inch voids at 22 ft. From 23 to 26 ft., LS is yellow-gray, 1/2 inch voids filled with calcite, hairline	30								

ABBREVIATIONS

T.C.R. = Total Core Recovery
R.Q.D. = Rock Quality Description
E.O.H. - End of Hole

J - Joint
F - Fault
S - Shear
B - Bedding
FO - Foliation

PL - Planar
C - Curved
U - Undulating
ST - Stepped
I - Irregular

P - Polished
K - Slickensided
SM - Smooth
R - Rough
VR - Very Rough

Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: LWM	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-01**

BOREHOLE NUMBER: **OW-01**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *LWM*

ELEVATION: *1321.24* **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *CME 75*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *03/22/05*

TOTAL DEPTH: *26.3* **BIT TYPE:**

CORE DIA & DEPTH / CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX	ADDITIONAL COMMENTS
			fractures filled with calcite, dissolution channels up to 4 inches in length at 24 ft., iron oxide coating in voids, channels, fractures, brown/ gray clay along some fracture faces	35								
			LIMESTONE, yellow-gray, 1/ 2 inch voids filled with calcite, hairline fracture filled with calcite, dissolution channels up to 4 inches in length at 24 ft., iron oxide coating in voids, channels, fractures, brown/gray clay along some fracture faces	40								
				45								
				50								
				55								
				60								

ABBREVIATIONS

T.C.R. = Total Core Recovery
R.Q.D. = Rock Quality Description
E.O.H. - End of Hole

J - Joint
F - Fault
S - Shear
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PL - Planar
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P - Polished
K - Slickensided
SM - Smooth
R - Rough
VR - Very Rough

Project No.:	Design By:	Scale:
	EHG	60:1
File:	**Drawn By:**	**Date:**
Borelogs	LWM	9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-01**

BOREHOLE NUMBER: **OW-03**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: *1291.70* **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/19/05*

TOTAL DEPTH: *40* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE: DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA: T.C.R. (Length - %)	CORE RECOVERY DATA: R.Q.D. (Length - %)	FRACTURES (Per foot)	DISCONTINUITY DATA: TYPE & SURFACE DESCRIPTION	STRENGTH DATA: WEATHERING INDEX	STRENGTH DATA: STRENGTH INDEX	STRENGTH DATA: POINT LOAD INDEX	ADDITIONAL COMMENTS
			25.0	*LIMESTONE, gray, moist to wet, fine grained, moderately strong, some clay and angular fragments less petroleum odor*	25			2					
			27.5	*LIMESTONE, light to medium grey, several hairline fractures with CaCO3, hard, fine-grained, some dark banding at 29-30*									
			30.0		30								

Continued

ABBREVIATIONS

T.C.R. = Total Core Recovery
R.Q.D. = Rock Quality Description
E.O.H. - End of Hole

J - Joint
F - Fault
S - Shear
B - Bedding
FO - Foliation

PL - Planar
C - Curved
U - Undulating
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I - Irregular

P - Polished
K - Slickensided
SM - Smooth
R - Rough
VR - Very Rough

Project No.:	Design By: EHG	Scale: 60:1	*El Dorado Refinery El Dorado Kansas*
File: Borelogs	Drawn By: EHG	Date: 9/30/2005	

MONTGOMERY WATSON

ROCK CORING LOG **OW-03**

BOREHOLE NUMBER: **OW-03**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: *1291.70* **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/19/05*

TOTAL DEPTH: *40* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	CORE RECOVERY DATA R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
				ft., argillaceous at 29-30 ft.									
2	2		32.5	*LIMESTONE, as above with fine bands of fossiliferous LS, light to dark grey, fossiliferous LS, very dark grey at 31 ft.*	35			2					
2	2		35.0	*LIMESTONE, medium grey, very porous, vuggy from 31.2 ft., medium to very large vugs, some CaCO3, minor fossils, hairline to moderate fractures with CaCO3 at 32.9 ft., Argilaceous LS, medium to dark grey bands, massive, fossils, molds*	40			1					
			40.0	*LIMESTONE, argillaceous, light to dark grey, fossils to 35.8 ft., small band of medium gravel to fine argillaceous LS to 35.8 ft., band of dark grey shale at 36.9 ft., fractures brittle/ sharp, massive, fine, crystalline*	45								
					50								
					55								
					60								
					65								

ABBREVIATIONS

T.C.R. = Total Core Recovery
R.Q.D. = Rock Quality Description
E.O.H. - End of Hole

J - Joint
F - Fault
S - Shear
B - Bedding
FO - Foliation

PL - Planar
C - Curved
U - Undulating
ST - Stepped
I - Irregular

P - Polished
K - Slickensided
SM - Smooth
R - Rough
VR - Very Rough

Project No.:	Design By:	Scale:
	EHG	60:1
File:	**Drawn By:**	**Date:**
Borelogs	EHG	9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG

OW-03

BOREHOLE NUMBER: **OW-04**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *5/18/05-5/19/05*

TOTAL DEPTH: *40.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	CORE RECOVERY DATA R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
					0								
					5								
					10								
			13.0	*Switch to coring at 13 ft bgs.*									
2	2				15								
2	2		15.0	*LIMESTONE, light olive gray, strong fracture 3" in length at 15 ft., near vertical, dissolution void 15-18.5 ft., iron oxidation coating fractures and voids from 17-19 ft.*									
2	2		19.0	*Same as above, competent at 19 ft., some dissolution voids, iron oxidation filled hairline fracture, 100% recoveries from 19-22 ft. Cored to 22 ft.*	20								
			24.0	*LIMESTONE, light brown, very vuggy, brittle to 24.8 ft., med gray to tan, fossiliferous to 25.5 ft.*	25			15					
2	2		26.5	*LIMESTONE, light to med gray to 27.3 ft. , dark gray shale at 28.1 grades to med gray LS, fine grained with med. grained dissolved vuggy banding at 28.2 ft. grades to platy shale at 28.9*									
			29.0		30								

Continued

ABBREVIATIONS

T.C.R. = Total Core Recovery
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P - Polished
K - Slickensided
SM - Smooth
R - Rough
VR - Very Rough

Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: EHG	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-04**

BOREHOLE NUMBER: **OW-04**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *5/18/05-5/19/05*

TOTAL DEPTH: *40.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	CORE RECOVERY DATA R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
2	2			*ft., grades to porous LS with hairline fractures with CaCO3, fossiliferous*				17					
2	2		34.0	*LIMESTONE, light to med gray, platy shale bedding at 29.5 ft. to 30 ft., fossiliferous at 30.5 ft., hairline fractures with CaCO3, platy shale at 30. 7 ft to 30.8 ft., LS med. gray, few fossils, fractures with CaCO3, platy shale at 31.1 to 31.2 ft. LS med. to dark gray bands of shale at 32.5 ft.*	35			1					
			40.5	*LIMESTONE, med gray, very fine, massive, grades to fossiliferous LS with some vugs. LS dark banding interbedded with med. grey LS to 40 ft.*	40			1					
					45								
					50								
					55								
					60								
					65								

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Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: EHG	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-04**

BOREHOLE NUMBER: **OW-05**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/18/05*

TOTAL DEPTH: *39.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX	ADDITIONAL COMMENTS
					0								
					5								
					10								
					15								
2	2		20.0	*Limestone, thin bedded, light gray to yellowish gray, strong, slightly moist, slow drilling at 20 ft., LS is hard, more competent*	20								
2	2		25.0	*Interbedded Limestone and Shale, argilaceous, 30% voids to 25.9 ft., hairline fractures with CaCO3, fossiliferous to 26 ft., medium to dark grey interbedded with black shale.*	25			10					
2	2		27.5										
			30.0	*Limestone, light grey interbedded with darker grey*	30								

Continued

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Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: EHG	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-05**

BOREHOLE NUMBER: **OW-05**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/18/05*

TOTAL DEPTH: *39.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %) 25 50 75	CORE RECOVERY DATA R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
2	2			*LS, argillaceous from 26 to 30 ft.*				6					
				Interbedded Limestone and Shale, medium grey, interbedded with dark grey LS, fossiliferous LS at 32.9 ft., hairline fractures with CaCO3, wet black shale to medium grey LS to 34.7 ft.	35								
			35.0										
2	2			*Interbedded Limestone and Shale, medium to dark grey, grades to porous LS at 37.8 ft., fossiliferous LS to depth with CaCO3 within hairline fractures*				4					
			39.5		40								
					45								
					50								
					55								
					60								

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Project No.:	Design By:	Scale:
	EHG	60:1
File:	**Drawn By:**	**Date:**
Borelogs	EHG	9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG

OW-05

BOREHOLE NUMBER: **OW-06**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/19/05*

TOTAL DEPTH: *47.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH / CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE: DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA: T.C.R. (Length - %) 25 50 75	CORE RECOVERY DATA: R.Q.D. (Length - %) 25 50 75	FRACTURES (Per foot)	DISCONTINUITY DATA: TYPE & SURFACE DESCRIPTION	STRENGTH DATA: WEATHERING INDEX	STRENGTH DATA: STRENGTH INDEX	STRENGTH DATA: POINT LOAD INDEX	ADDITIONAL COMMENTS
		27.5	*LIMESTONE, gray, strong, competent, no odor*	0, 5, 10, 15, 20, 25, 30								
		30.0	*Interbedded Limestone and Shale, medium grey,*									

Continued

ABBREVIATIONS

T.C.R. = Total Core Recovery
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Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: EHG	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-06**

BOREHOLE NUMBER: **OW-06**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/19/05*

TOTAL DEPTH: *47.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %)	CORE RECOVERY DATA R.Q.D. (Length - %)	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
2	2			*argillaceous, grades to shale, minor fossils, small to large dissolution voids greater than 0.75 inches, massive, wet.*				6					
2	2		35.0	*LIMESTONE, as above, large dissolution channels and fractures at 36.3 ft., several hairline fractures, platy breakage from 36.5 to 40 ft.*	35			1					
2	2	*Water at 43 feet*	37.5	*LIMESTONE, as above to 40.5 ft., grades to fossiliferous LS, medium to dark grey, several dissolution voids and cavities throughout. Grades to massive LS at 42.8 ft., fewer and smaller dissolution fractures, no fossils past 42.8, wet at 43 ft., small dissolution fractures to depth*	40			2					
			45.0		45								
					50								
					55								
					60								
					65								

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Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: EHG	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG **OW-06**

BOREHOLE NUMBER: **OW-39**

BOREHOLE LOCATION COORDINATES: *El Dorado Refinery* **LOGGED BY:** *JLC*

ELEVATION: *1299.69* **REFERENCE POINT:** **DATUM:** **DRILL RIG:** *Failing*

INCLINATION: **AZIMUTH:** **DRILL DATE:** *05/20/05*

TOTAL DEPTH: *25.5* **BIT TYPE:** *Water Rotary*

CORE DIA & DEPTH	CASING DIA. & DEPTH	WATER NOTES	DEPTH	ROCK TYPE DESCRIPTION	DEPTH (Scale: feet)	CORE RECOVERY DATA T.C.R. (Length - %)	CORE RECOVERY DATA R.Q.D. (Length - %)	FRACTURES (Per foot)	DISCONTINUITY DATA TYPE & SURFACE DESCRIPTION	STRENGTH DATA WEATHERING INDEX	STRENGTH DATA STRENGTH INDEX	STRENGTH DATA POINT LOAD INDEX	ADDITIONAL COMMENTS
2	2		0.0	*Silty, Clayey Loam, roots, moist, loose, grades to silty clay at around one foot, yellow brown, moist, moderate plasticity*	0								*No T.C.R. or R.Q.D recorded*
2	2		5.0	*LIMESTONE, tan yellow, iron staining, porous, some hairline fractures and vugs with CaCO3, dissolution features increase at 7.6 ft.*	5			2					
2	2		10.0	*LIMESTONE as above, yellow orange at 11.5 ft., tiny iron nodules, weathered orange LS with clay, brown, moderate to high plasticity to 12.5 ft., sandy clay, yellow orange, wet, no plasticity at 13.5 ft.*	10			3					
2	2		15.0	*LIMESTONE, as above to 16.9 feet, grades to LS with dissolution fractures, iron staining, some hairline fractures with CaCO3, becomes more porous and vuggy, wet.*	15			3					
2	2		20.0	*LIMESTONE, much tighter, argillaceous, few fossils, iron stains to 20.3 ft., grades to light to medium grey argillaceous LS, several vugs, no CaCO3, grades to yellow LS with iron stains at 23. 4 ft., grades to porous LS, iron stains, buggy, fossiliferous, dissolution channels*	20			1					
2	2		25.5		25			1					
					30								

ABBREVIATIONS

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Project No.:	Design By: EHG	Scale: 60:1
File: Borelogs	Drawn By: EHG	Date: 9/30/2005

El Dorado Refinery El Dorado Kansas

MONTGOMERY WATSON

ROCK CORING LOG

OW-39

KEY TO SYMBOLS

Symbol	Description
Misc. Symbols	
▽	Water table during drilling

Location _____ Date _____

Project / Client _____

Location J. Collins | M. Warner Date 4/7/05

Project / Client Sunny, windy, 65°
Phase 2

0745 On site
0845 Load up truck
0850 Arrive @ OW-33.
We will get WL's from wells w/ pumps and remove j-plug from other wells to allow WL to stabilize then will come back for WL's. Will also mark wells.
0852 OW-33 WL = 13.15 TOC
0856 Labled well.
0900 Arrive @ OW-32
to remove plug/mark.
0904 Arrive @ OW-31
remove plug/mark
0906 Arrive @ OW-30
Sarah Richards
(515) 255-0830
0912 Arrive @ OW-36
removed cap.
0914 Arrive @ OW-27T
remove cap.
0915 Arrive @ 28T

Location: JCIMW EDR Date: 4/7/05

Project / Client:

Phase 2

Has pump installed
0918 OW-28T WL = 9.71 TOC
0923 Arrive @ OW-35
remove cap and mark.
0927 Arrive @ OW-23T
WL = 8.33 TOC
Has pump installed.
0931 Arrive @ OW-22T
has pump installed.
WL = 9.56 TOC
0936 Arrive @ OW-25
remove plug
0938 Arrive @ OW-24
remove plug
product well.
0940 Arrive @ OW-18T
remove plug and mark.
0943 Arrive @ OW-02
remove plug.
0945 Arrive @ OW-19T
remove plug/mark.
0948 Arrive @ OW-01
remove plug.

Location: JCIMW EDR Date: 4/7/05

Project / Client:

Phase 2

0951 Arrive @ OW-37
remove plug.
0953 Arrive @ OW-16
remove plug.
0954 Arrive @ OW-38
remove plug.
0957 Arrive @ OW-13
remove plug.
0959 Arrive @ OW-14
remove plug.
1001 Arrive @ OW-11
remove plug/mark
1003 Arrive @ OW-12
remove plug/mark
1005 Arrive @ OW-10
remove plug/mark
1009 Arrive @ OW-08
remove plug.
1017 Arrive @ OW-09
remove plug.
1038 Arrive @ OW-01
remove plug.
1102 Spoke w/ T.J. about
location of OW-07.

JCIMW
Location: Sunny, breezy, 70° Date: 4/7/05
Project / Client: EDR
Phase 2

1245 Back on site from lunch.
1253 Arrive @ OW-13
1255 WL = 19.59 TOC
TD = 25.26
1300 Arrive @ OW-14
1301 WL = 12.29 TOC
TD = 17.22
1306 Arrive @ OW-08
1309 WL = 8.00 TOC
TD = 17.43
1321 Arrive @ OW-09
1322 WL = 7.14 TOC
TD = 17.48
1353 Arrive @ OW-33
WL = 13.15 TOC
1355 Arrive @ OW-32
1356 WL = 15.38 TOC
TD = 21.98
1359 Arrive @ OW-31
1400 WL = 10.20 TOC
TD = 17.71
1402 Arrive @ OW-30
1403 WL = 13.42 TOC
TD = 20.23
1410 Arrive @ OW-27T

JCIMW
Location: EDR Date: 4/7/05
Project / Client:
Phase 2

1411 OW-27T
WL = 8.94 TOC
TD = 19.85
1414 Arrive @ OW-36
1415 WL = 9.06 TOC
TD = 20.98
1425 Arrive @ OW-02
1426 WL = 7.27 TOC
TD = 13.11
1429 Arrive @ OW-19T
1430 WL = 11.48 TOC
TD = 15.02
1437 Arrive @ OW-25
1439 WL = 8.26 TOC
TD = 22.02
1444 Arrive @ OW-35
WL = ≈0.40 TOC
TD = 10.29
1451 Arrive @ OW-21
1453 WL = 2.53 TOC
TD = 11.04
1457 Arrive @ OW-37
WL = 8.05 TOC
TD = 24.18

JC/MW
Location EDR Date 4/7/05
Project / Client

Phase 2

1502 Arrive @ OW-16
1503 WL = 9.44 TOC
TD = 17.07
1505 Arrive @ OW-38
WL = 7.82
TD = 21.49
1520 Picked up interface probe from T.J. and David (GSI)
1529 Arrive @ OW-24
1531 WL = 8.28 TOC
DTP = no product registered
TD = 25.77
1534 Arrive @ OW-18
WL = 10.41 TOC
DTP = 10.16 TOC
TD ~~WL~~ = 12.07
Strong solvent odor
1541 Arrive @ OW-01
1542 WL = 7.09 TOC
DTP = no P
1620 Spoke w/ STL regarding 4oz bottles of NaOH that arrived our shortage of VOAs & 1L Ambers.

JC/MW
Location EDR Date 4/7/05
Project / Client

Phase 2

1622 Arrive @ OW-19T
Will bail dry and come back to sample.
1625 Begin bailing.
GW cloudy, tan/grey
1630 Purged dry @ ≈2 gallons.
1637 Arrive @ OW-13
Will bail
1641 Begin bailing
Will bail OW-14 at the same time.
1657 End bailing
OW-13, OW-14 do not bail dry.
1702 Back on site, unload truck.
1710 Off-site to go to office.

Julie Collins
4/7/05

Location: JC/MW EDR Date: 4/7/05

Project / Client:

Phase 2

1502 Arrive @ OW-16
1503 WL = 9.44 TOC
TD = 17.07
1505 Arrive @ OW-38
WL = 7.82
TD = 21.49
1520 Picked up interface probe from T.J. and David (GSI)
1529 Arrive @ OW-24
1531 WL = 8.28 TOC
DTP = no product registered
TD = 25.77
1534 Arrive @ OW-18
WL = 10.41 TOC
DTP = 10.16 TOC
TD ~~WL~~ = 12.07
Strong solvent odor
1541 Arrive @ OW-01
1542 WL = 7.09 TOC
DTP = no P
1620 Spoke w/ STL regarding 4oz bottles of NaOH that arrived. Our shortage of VOAs & 1L Ambers.

Location: JC/MW EDR Date: 4/7/05

Project / Client:

Phase 2

1622 Arrive @ OW-19T
Will bail dry and come back to sample.
1625 Begin bailing.
GW cloudy, tan / gray
1630 Purged dry @ ≈ 2 gallons.
1637 Arrive @ OW-13
Will bail
1641 Begin bailing
Will bail OW-14 at the same time.
1657 End bailing
OW-13, OW-14 do not bail dry.
1702 Back on site, unload truck.
1710 Off-site to go to office.

Julie Colleran
4/7/05

Location: J. Collins, Matt Warner
Date: 4/8/05
Project / Client: Overcast, foggy, 55°
Phase 2

0800 On-site w/ Matt, load truck, etc.
0840 Dump IDW from 4/7/05.
0900 Arrive @ OW-22.
0904 WL = 9.55
0917 Finish calibration
0919 Pump on
1010 Collect EDR-OW-22-040805
NOTE: Trip Blank 1000
1130 Finish collecting sample
1131 Pump off.
1135 Back @ office for Matt to do timesheet.
1155 Off-site for ice, etc.
1245 Back on-site. Load up more coolers/bottles.
1315 Arrive @ OW-28T
1319 WL = 9.61, sl. odor
1322 Pump on
1408 Collected EDR-OW-28T-040805
EDR-OW-28T-MS-040805
EDR-OW-28T-MSD-040805
1413 Collected EDR-OW-28T-SO-040805
1551 Finish collecting samples.

JC/MW
Location: OW-22
Date: 4/8/05
Project / Client: EDR
Phase 2

Time	Temp	K	DO	pH	ORP	NTU	Comments
0922	15.61	2.402	4.99	6.92	-61.7	75	yellowish/tan 9.85 NW
0929	15.59	2.441	4.72	6.92	-59.7	70	sl odor
0935	15.19	2.440	4.63	6.92	-44.6	55	125 mL / 9.86
0942	15.02	2.430	5.35	6.92	-37.8	45	125 mL / 9.85
0950	14.78	2.426	4.33	6.95	-38.1	40	125 mL / 9.85
0953	14.75	2.425	4.55	6.95	-34.9	40	"
0955	14.77	2.419	5.76	6.95	-31.1	35	"
1000	14.81	2.416	5.69	6.95	-32.7	36	"
1005	14.84	2.417	5.79	6.95	-32.8	34	"

Location: OW-28T JCI MW Date: 4/8/05

Project / Client: EDR Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1324	14.64	1.297	2.06	7.20	-70.0	21000	9.69	gray/[illegible]
1330	14.79	1.390	0.24	7.37	-113.9	7000	9.69	gray/[illegible]
1336	14.81	1.395	0.17	7.32	-109.6	350	9.69	"
1340	14.73	1.399	0.28	7.51	-97.7	200	"	" sl. odor
1344	14.82	1.399	0.38	7.50	-87.5	140	"	"
1348	14.82	1.400	0.42	7.30	-80.6	110	"	"
1352	14.96	1.402	0.46	7.30	-73.5	90	"	"
1356	14.98	1.405	0.58	7.29	-69.8	75	"	"
1400	15.13	1.404	0.58	7.29	-70.2	68	"	"
1404	15.09	1.407	0.59	7.29	-71.0	67	"	"

Location: JCI MW EDR Date: 4/8/05

Project / Client:

Phase 2

1605 Dump IDW
1607 Arrive @ OW-29
1609 WL = 14.42 TOC
TD = 22.38
1620 Arrive @ OW-26
1624 WL = 6.46 TOC
TD = 21.46
1642 Arrive @ OW-07
1644 WL = 2.99 TOC
TD = 13.27
1649 Arrive @ OW-10
1652 WL = 8.36 TOC
DTP = no product registred
1655 Arrive @ OW-12
1656 WL = 7.79 TOC
TD = 19.47
1659 Arrive @ OW-11
1700 WL = 9.07 TOC
TD = 20.30
1710 Back @ site to pack up coolers for CAS and STL. Called CAS to let Greg Groene know approx. when they would arrive

JC/MW EDR Date 4/8/05

Phase 2

1757 Finish unloading truck and packing coolers.
Matt will take 4 coolers to FedEx.
1820 Off-site.
NOTE: 1740 Best Express picked up 1 cooler to deliver to CAS.

Julie Coleman
4/8/05

Location Date ~~4/9/05~~ 4/8/05 17

Project / Client

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
0855	14.85	3.641	5.01	7.14	26		9.46	
0902	14.55	3.641	3.95	6.72	6.6	24	9.26	50-75 ml/min
0907	14.56	3.663	4.61	6.77	14.3	20	9.20	50 ml/min
0913	14.95	3.663	4.41	6.85	19.0	22	9.25	
0917	15.02	3.664	4.77	6.88	21.5	21	9.32	50 ml/min Slowed
0922	14.93	3.663	4.46	6.90	21.6	19	9.40	
0920	13.74	3.655	3.66	6.59	36.1	36	8.39	
1331	12.96	1.618	0.84	7.14	-70.6	900		
1335	12.00	0.602	2.77	7.22	-68.9	>1000		
1337	12.17	0.597	5.13	7.21	-64.7	>1000		
1340	12.01	0.598	4.88	7.22	-60.9	"		

4/11/05 OW-23

OW-14

0 gallons

1 gal

milky color

2 gal.

2.75 gal

4/12/05

Location J. Collins | M. Warner Date 4/11/05

Project / Client Sunny, breezy, 50° EDR Phase 2

0810 On site
0835 Arrive @ OW-23T
0849 Finish calibrating
0850 OW-23 WL = 8.04
0851 Pump on.
0923 WL will not stabilize @ 50 ml/min. Will turn pump up and draw down to pump intake and sample tomorrow.
0952 OW-23T pumped dry @ ≈ 7.5 gal.
1009 Pump off
1012 Arrive @ OW-27T
1014 OW-27T WL = 8.83
1016 Pump on, sl. odor, sheen
1100 Trip Blanks 2 VOCs - VOCs, EDB, TPH-GRO
1102 Collected EDR-OW-27T-041105
1215 Pump off.
1220 Pull pump.
1238 Off-site for ice, etc.
~~1314~~ 1320 Back on-site
1328 Arrive @ OW-14
WL = 12.20

Location: OW-27T Date: 4/11/05

Project / Client: Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1025	14.09	3.232	0.54	6.73	-47.2	280	8.90	mod odor
1031	14.35	3.203	0.12	6.75	-47.3	300	8.90	1200 ml/min
1035	14.53	3.168	0.07	6.77	-49.2	340	8.90	cloudy
1040	14.65	3.128	0.03	6.78	-51.6	230	8.90	175 ml/min
1044	14.83	3.092	0.02	6.79	-53.3	180	8.90	"
1048	14.80	3.074	0.04	6.79	-54.1	150	8.90	"
1051	14.88	3.046	0.03	6.80	-55.1	130	8.90	"
1054	14.88	3.019	0.03	6.80	-55.7	120	8.90	"
1057	14.91	3.018	0.02	6.81	-56.5	110	"	"
1100	14.90	3.001	0.02	6.81	-57.1	110	"	"

Location: JCIMW EDR Date: 4/11/05

Project / Client:

Phase 2

1330 Begin bailing ≈ 3 gal
1340 Collected EDR-~~OW~~-14-041105
1416 Arrive @ OW-13
1420 Begin bailing; sl. sheen
1440 Collected EDR-OW-13-041105
1515 Back on-site to unload coolers and get more bottles.
1529 Arrive @ OW-07 CAT JC
1533 OW-07 CAT WL = ~~3.80~~ 2.80
1535 Pump on.
1600 Spoke w/ CAS, told Greg samples would be picked up about 1730.
1614 Collected EDR-OW-07-041105
1645 Pump off
1648 Pulled pump.
1653 Off-site to get more ice.
1701 Back on site.
1740 Finish packing coolers and unloading truck.
1800 Off-site - Matt will take 4 coolers to FedEx.

Julie Colmer 4/11/05

Time	Temp	K	DO	pH	ORP	NTU	Comments
1429	14.89	0.568	1.21	6.99	-51.2	>1000	cloudy, brn
1433	13.76	0.606	3.77	7.17	-68.7	>1000	cloudy, grey/brn sheen, odor
1437	14.07	0.594	3.05	7.16	-76.9	"	"
1439	13.70	0.595	4.31	7.18	-69.2	"	"

OW-13

Date 4/11/05

Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1542	12.64	0.632	0.61	7.01	83.0	1000	2.80	350 ml/min
1548	12.70	0.630	0.51	6.99	79.0	200	2.80	450 ml/min
1552	12.25	0.633	0.40	6.99	76.4	100	2.80	"
1555	12.42	0.633	0.55	7.02	69.4	70	2.80	"
1558	12.25	0.633	0.58	7.00	73.3	55	2.80	"
1602	12.26	0.631	0.55	6.97	75.9	45	"	"
1605	12.48	0.630	0.70	7.02	73.5	36	"	"
1608	12.44	0.631	0.68	7.04	72.5	37	"	"
1611	12.29	0.633	0.66	7.04	74.1	31		

Location OW-07

Project Name

Greg Groenewold (495) 826-0447 cell

4/11/05

23

OW-11

4/12/05
Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1010	12.17	1.489	2.28	7.46	86.1	40	9.50	350 ml/min
1015	12.23	1.499	1.07	7.48	77.4	45	9.45	450 ml/min
1019	12.38	1.497	0.98	7.44	70.8	45	9.45	"
1022	12.37	1.497	0.87	7.43	67.0	40	"	"
1025	12.33	1.497	0.84	7.46	65.0	34	"	no odor
1028	12.38	1.496	0.80	7.34	62.9	29	"	"
1031	12.41	1.494	0.77	7.42	58.2	26	"	"
1034	12.36	1.495	0.76	7.51	58.4	23	"	"

Location: J. Collins / M. Warner Date: 4/12/05 25

Project / Client: Cloudy / sunny, v. windy, 45°

EDR Phase 2

0655 Onsite for safety meeting.
0730 Load bottles, coolers, calibrate equip, etc.
0740 Finish calibration
0800 Finish loading truck.
0805 Arrive @ OW-03.
0813 WL = 8.28
0810 Trip Blanks
0816 Pump on.
0825 Collect EDR-OW-23T-041205
0908 Pump off.
0912 Pulled pump.
0916 Arrive @ OW-18T 19T to bail dry, strong odor, sheen
0924 End bailing, dry @ ≈ 2.5 gal.
0928 Back @ bldg to unload / load the pump and bottles.
0955 Arrive @ OW-11.
1005 WL = 9.32
1008 Pump on.
1035 Collected EDR-OW-11-041205
1058 Pump off.

JC/MW

Location: EDR Date: 4/12/05

Project / Client:

Phase 2

1103 Pulled pump.
1106 Arrive @ OW-12.
1111 WL = 8.30
Will attempt low flow, went dry @ 2gal during development.
1113 Pump on.
1130 Matt went to OW-10 to check for product. No product registered.
WL = 8.54 TOC, sl. odor.
1202 Collected EDR-OW-12-041205
1209 Left message w/ Chris to check in and see what the status of EDR 4204 report is.
1211 Spoke w/ Sarah re: status of EDR 4204 report. She is almost done w/ her edits but hasn't spoken w/ Chris or Bill about possible additional edits.
1315 Pump off.
Spoke w/ Bill @ length about P2 and report.

Location: OW-12 Date: 4/12/05

Project / Client: overcast, cold, windy

Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1122	13.14	0.747	1.84	7.15	37.0	140	8.30	12 gal purge
1126	13.03	0.774	1.04	7.11	-5.8	210	8.30	mod. petro. odor.
1130	13.11	0.772	0.80	7.05	-8.8	240	8.30	"
1134	13.12	0.765	0.83	7.10	-8.5	220	8.30	"
1137	12.85	0.765	1.13	7.11	-7.2	200	8.30	"
1140	12.60	0.765	1.31	7.10	-7.6	180	"	"
1143	12.64	0.761	1.84	7.09	-8.8	160	"	"
1146	12.53	0.750	1.82	7.10	-11.4	150	"	"
1149	12.55	0.748	1.94	7.11	-14.9	130	"	"
1152	12.48	0.747	2.03	7.10	-15.7	130	"	"
1155	12.38	0.748	2.35	7.12	-19.0	110	"	"
1158	12.48	0.744	2.42	7.09	-20.8	110	"	"
1201	12.43	0.748	2.51	7.10	-21.2	100	"	"

EDR

4/12/05
Betty Van Pelt
(321)(617) 3200

Phase 2

1320 Pull pump.
1345 Off-site for decon H_2O, ice, trash bags, etc.
1430 Back on-site to pack coolers and then decon pumps to be set this afternoon.
1520 Spoke w/ STL about NOT reporting T-Cr and hex Cr
1535 Finish packing coolers.
1542 Start decon of pumps pulled yesterday and today.
1750 Finish decon, adj. lengths and setting pumps.
1755 Off-site, Matt taking 2 coolers to FedEx.

Julie Collins
4/12/05

Logged J. Collins / M. Warnick 4/13/05
Project Code overcast, windy, cold, 48°

Phase 2

0700 On site for safety meeting.
0740 Go through coolers that arrived from STL yesterday.
0746 Calibrate equipment.
0757 Finish calibration. Pack bottle sets, load truck
0830 Off-site for ice, supplies
0850 Back on-site.
0900 Arrive @ OW-37.
0906 WL = 8.33
0910 Pump on, sl. odor
0939 Collected EDR-OW-37-041305
NOTE: 0935 Trip Blanks
1023 Pump off.
1030 Pulled pump.
1043 Arrive @ OW-10.
1047 WL = 8.68, strong odor, sheen
1049 Pump on.
1125 Collected EDR-OW-10-041305
1130 Left message w/ Bill re: EDR 4Q04 report.
1132 Left message with

Location: OW-37

Date: 4/13/05

Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
0917	14.57	1.612	0.63	~~95~~ 6.73	-92.4	95	8.55	400ml/min
0923	14.56	1.613	0.43	6.81	-97.2	45	"	mod. pet. odor
0927	14.59	1.612	0.35	6.70	-98.1	15	"	"
0930	14.61	1.613	0.29	6.71	-98.5	16	"	"
0933	14.62	1.614	0.27	6.73	-97.9	16	"	"
0936	14.65	1.614	0.28	6.73	-97.8	16	"	"

Location: OW-10

Date: 4/13/05

Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1055	12.03	1.901	2.15	7.22	-2.3	60	8.80	sheen, strong pet. odor
1105	11.96	1.906	0.97	7.20	-57.1	65	8.83	150ml/min
1110	11.95	1.899	0.84	7.18	-70.2	50	8.83	"
1114	11.94	1.895	0.75	7.18	-74.8	34	8.85	"
1117	11.95	1.893	0.72	7.19	-77.1	29	8.85	"
1120	11.96	1.891	0.74	7.18	-78.6	27	8.85	"
1123	11.96	1.890	0.72	7.19	-79.1	27	8.85	"

JIMW EDR Date 4/13/05

Phase 2

Betty VanPelt re: nitrates over holding time @ STL.

1253 Finished speaking w/ Chris about comments on EDR 4204 report. He also asked if I could go to Koch 4/26 w/ Tom B and Jeff Korn.

1305 Pulled pump

1319 Off-site.

1355 Back on-site.

1416 Arrive @ DW-09.

1423 WL = 7.48

1425 Pump on

1515 Collected EDR-DW-09-041305

Collected EDR-DW-09-MS-041305

Collected EDR-DW-09-MSD-041305

1520 Collected EDR-DW-09-51-041305

1617 Spoke w/ Bill. He needs a list from me by 4/15/05 with wells that had product during installation, development, and sampling. We need to collect "field blanks"

Location DW-09. Date 4/13/05 33

Project / Client Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1431	11.52	1.342	3.26	7.02	-37.5	80	7.58	7.58/450 ml/min
1435	11.55	1.340	1.93	7.03	-42.9	60	7.58	450 ml/min
1439	11.50	1.332	1.09	7.03	-46.5	40	7.58	"
1443	11.53	1.320	0.67	7.03	-50.2	32	7.68	425 ml/min
1447	11.62	1.318	1.55	7.03	-50.8	34	7.68	"
1451	11.68	1.316	2.18	7.02	-50.8	29	7.68	400 ml/min
1455	11.71	1.314	2.93	7.02	-47.5	19	7.68	Strong petro. odor
1459	11.74	1.312	2.13	7.02	-47.6	20	7.68	"
1503	11.76	1.307	0.44	7.01	-47.7	16	7.68	"
1507	11.77	1.306	0.30	7.02	-48.3	17	7.68	"
1510	11.76	1.304	0.27	7.02	-48.5	15	7.68	"
1513	11.76	1.303	0.25	7.02	-48.3	13	7.68	"

JC/MW EDR Date 4/13/05

Phase 2

for VOCs, TPH-DRO/GRO, and EDB.

1649 Spoke w/ STL, Melissa said that 5 wells missed the holding time for 8260 on the 1Q05 event. Scheduled to be run on 4/8/05, have not been run yet. She has notified Chris/Betty.

1713 Pump off.

1718 Pulled pump.

1725 Onsite to pack up coolers.

1825 Finish packing coolers, unload truck, load coolers

1830 Sign out

1835 Off-site. Matt taking 4 coolers to FedEx.

Julie Collins
4/13/05

Location J. Collins, M. Warner Date 4/14/05 35

Project / Client Sunny, sl. breeze 60°
EDR Phase 2

0700 On-site for safety meeting.

0740 Load bottle sets, truck, etc.

0815 Spoke w/ Chris about sampling schedule, resampling the wells that holding times were missed on, etc.

0818 Calibrate equip.

0845 Arrive @ RW-19T to bail dry.

0849 WL = 12.45

0852 Begin bailing.

0903 End purging.

NOTE: Only one gallon purged this time. When we arrived, the j-plug was hanging outside the casing by the bailer twine and twine was knotted (we did not leave the well like this).

JC/MW

Location: EDR

Date: 4/14/05

Project/Client:

Phase 2

0905 Spoke w/ Jerold about his schedule to come to the site and recon the river as where the best places to install the permanent / temp stream gauges would be. He'll be out tomorrow afternoon.

0912 Arrive @ OW-26

0916 WL = 6.80

0919 Pump on.

0924 WL has dropped to 7.05 already w/ pump on lowest settings.

0925 First H_2O through the flow-cell.

0930 WL = 7.35

0934 WL = 7.23

0935 WL = 7.18

0946 WL = 7.25

0948 WL = 7.45

0950 WL = 7.60

0958 WL = 8.03

Location: OW-26

Date: ~~OW~~ 4/14/05 JC

Project/Client:

JC/MW

Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
0927	14.30	1.364	1.93	7.22	116.4	31	7.49	V.Sl. Dec.
0934	15.04	1.361	1.32	7.28	107.4	33	7.23	" ★
0950	14.90	1.361	0.65	7.28	99.9	30	7.65	"

★ Cannot establish a low enough flow-rate to stabilize H_2O level. Dried down > 1 foot. Decided to pump down to pump in take and sample tomorrow.

1313 17.74 1.374 2.95 7.40 60.2 110 — 4/15/05

Location JL/MWS Date 4/14/05

Project / Client

EDR Phase 2

0959 ~~A~~ See note on previous page.

1056 Pump off, pumped to intake, purged ≈ 14 gal.

1106 Arrive @ OW-16

~~WL~~ = no pump in well

1125 Spoke w/ Bill about the cost estimate for re-sampling the 4 wells (missed holding time). The 4 wells are along the river. They will be re-sampled in May when we do the "pond/river" wells and the SW sampling.

1145 Pump IDW.

1205 Recon four wells.

1230 Off-site.

1310 Back on-site.

1329 Arrive @ OW-25

1343 WL = 8.66

1344 Pump on, sl. odor

1419 Collected EDR-OW-25-041405

JMSH Spoke with Bill about

Location OW-25 Date 4/14/05

Project / Client Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1347	14.30	0.681	1.25	7.31	106.6	37	8.72	Strong pet. odor 450 ml/min
1352	14.45	1.017	0.53	7.06	60.2	35	8.72	"
1357	14.89	1.379	0.06	6.92	-4.3	65	8.73	"
1402	14.82	1.510	0.07	6.90	-23.5	26	8.73	Sheen
1407	15.02	1.552	0.17	6.89	-26.2	14	8.72	"
1410	14.93	1.574	0.11	6.89	-26.3	12	"	"
1413	15.13	1.589	0.10	6.88	-27.0	12	"	"
1416	15.05	1.594	0.10	6.88	-26.3	11	"	"

Location: JC/MW EDR Date: 4/14/05

Project / Client:

Phase 2

attempting to bail OW-16 as opposed to low-flow due to sat. thickness and well development notes (low yield). Bill said to bail OW-16.

1435 Walked over to OW-16.
1450 Bailed dry @ ≈ 3 gal.
1459 Pump off.
1515 Arrive @ OW-08.
1522 WL = 8.28
1524 Pump on.
1529 WL = 8.42, water has not filled the flow thru yet.
1531 WL = 8.50 @ 100 ml/min
1535 WL = 8.64 "
1537 WL = 8.70 "
1539 WL = 8.72
Lower the flow rate to the lowest adjustable level.
1545 Adjust pressure
1549 WL stabilized @ 8.75
flow rate = 60 ml/min.

Location: OW-08 Date: 4/14/05

Project / Client: Phase 2

Time	Temp	∡	DO	pH	ORP	NTU	WL	Comments
1534	15.49	0.970	1.24	6.93	-9.5	32	8.64	sl. odor 1000 ppm
1543	16.43	0.969	0.41	6.91	-19.9	23	8.78	
0942	14.42	0.924	4.22	6.96	8.4	22	—	4/15/05

Location JC/MW EDR Date 4/14/05

Project / Client

Phase 2

1555 P = 6.5-7 psi
Exhaust = 0
Pressure Time = all the way up
1550 Will have to sample tomorrow.
1605 Well no longer stable. WP states that <100 ml/min, alternate method will be used.
1611 Purge well to pump intake.
1627 Pump off.
1635 Back on-site.
NOTE: 1415 Trip Blanks to pack samples, unload trucks, decon & pumps.
JC ~~15~~ 1740 Finish decon and setting of pumps. Packed coolers.
1750 Off-site. Matt taking one cooler to FedEx.

Julie Collins
4/14/05

Location J. Collins/M. Warner/C. Stephens Date 4/15/05

Project / Client Sunny, sl. breeze, 45°

EDR Phase 2

0700 On site for safety meeting
0740 Get bottle sets, load truck, etc. Chris getting his site specific safety orientation.
0741 Calibrate equip.
0752 Finish calibration.
0805 Timesheets.
0810 My password wouldn't work on Trevor's computer. Called in my hours to Heather (US hrs) in the Des Moines office. She said their server was down but she would get it in.
0837 Arrive @ OW-19T
Chris off-site to get ice. WL =
0843 T = 15.02, K = 6.094, DO = 5.01, pH = 6.88, ORP = 108.2
NTU = 68, very strg odor, heavy sheen
0855 Collect EDR-OW-19T-041505
9 voas, T-Cr, hex, ~~metals~~ T-

Location: JCIMWICS

Date: 4/15/05

Project / Client: Mike Luebke (925) 975-3400

Phase 2

0905 Bailed dry @ 9 vols, 1-L, 1-250mL bottles.
0927 Arrive @ OW-08.
0932 WL = 8.35
0940 Pump on
NOTE: 48 ~~0850~~ Trip Blanks
0950 Collect EDR-OW-08-041505
1045 Pump off.
1049 Pull pump.
1058 Arrive @ OW-16
1104 WL = 9.78 sl. petro. odor
1109 T = 13.73, K = 1.422, DO = 4.55
pH = 6.71, ORP = -27.5, NTU = 110
1110 Collect EDR-OW-16-041505
1146 Dump 1 DW.
1200 Off-site.
1245 Back on site.
1305 Arrive @ OW-26
WL = 6.72
1311 Pump on.
1330 Jerold on-site
1335 Jerold off-site.
1355 Pump off
NOTE: 1318 Collected EDR-OW-26 ~~021410~~ 041505

Location: JCIMWICS

Date: 4/15/05

Project / Client: EDR Phase 2

1408 Arrive @ OW-24, get more bottles, strong odor, heavy sheen
1420 WL = 8.46
1501 Collected EDR-OW-24-041505
1534 Pump off.
1600 Talk to Bill about collecting sample from the spring at the Cat Cracker.
1630 Collected EDR-CC-041505
1642 T = 14.42, K = 0.949, DO = 1.74
pH = 6.90, ORP = 26.6, 14 NTU, mod. petro. odor, sheen.
1758 Finish packing coolers, unloading truck, etc. Chris S. to take 4 coolers to FedEx.
1808 Off-site.

Julie Collins
4/15/05

Date: 4/15/05
Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1428	17.31	1.306	3.91	6.85	-66.9	55	8.46	v. strong petro odor / sheen 4/5 ml/min
1435	16.70	1.517	0.74	6.80	-90.4	45	8.46	"
1438	16.75	1.487	0.78	6.80	-84.2	31	8.46	"
1441	16.65	1.436	0.81	6.80	-71.9	24	"	"
1444	16.41	1.418	0.77	6.80	-67.4	85	"	"
1447	16.87	1.358	0.77	6.80	-51.7	33	"	"
1450	16.88	1.315	0.64	6.88	-55.9	19	"	"
1453	16.81	1.295	0.58	6.79	-56.7	18	"	"
1456	16.81	1.271	0.56	6.79	-56.1	17	"	"
1459	16.77	1.243	0.54	6.79	-56.2	16	"	"

OW-24

Location: J. Collins | M. Warner 4/16/05
Project / Client: Sunny, breezy, 60°
Phase 2

0930 On-site w/ Matt.
Will drive in t-posts at all the temp. well locations in the refinery area
1015 Trip blanks
1115 Finish setting t-posts. Will collect more sample from OW-19T.
1140 Arrive @ OW-19T
1144 Collect EDR-OW-19T-041605
1-SVOCs, 1-metals
1250 Off-site to get decon H2O, etc.
1400 Back on site. Decon pumps, collect blanks, set pumps.
1510 Collected EDR-EB1-041605 (pump decon blanks)
1530 Collected EDR-EB2-041605 (glove blank)
1545 Collected EDR-EB3-041605 (pump decon blank)
1620 Collect EDR-EB4-041605 (pump decon blank)
1650 Collect EDR-EB5-041605 (pump decon, v. dirty, from OW-10)

JC / MW 4/16/05

EDR
Phase 2

17:20 Collected EDR-EBL-041605
(dirty pump decon blank, not put in well.)
17:35 Off-site

Julie Collins
4/16/05

Location: J. Collins / M. Warner Date: 4/17/05
Project / Client: Sunny, breezy, 60°
EDR Phase 2

1000 On site to adjust pump lengths and set remaining pumps. Collect matrix sample from DW-19T.
1120 Arrive @ DW-19T
WL = 13.31
1121 Collected EDR-DW-19T-041705
~~met~~ ack BTDS, DRO
GW odor is stronger than previous days, heavier sheen.
NOTE: DW-35 water in bollard post hole is running onto the ground, very heavy sheen and odor, GW(?) may be coming to the surface via a possible spring.
1145 Finish setting remaining pumps.
1150 Dump IDW
1200 Off-site

Julie Collins
4/17/05

Location: 20 - 35

Project / Client:

Date: 4/18/05

Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
0936	14.04	1.241	1.11	6.69	-94.3	29	3.34	strong odor
0944	14.03	1.243	0.17	6.61	-105.6	15	3.33	275 ml/min
0951	13.90	1.247	0.09	6.63	-109.1	8.4	3.33	"
0956	13.89	1.251	0.09	6.69	-113.4	5.9	3.33	"
0959	13.92	1.252	0.08	6.72	-115.7	5.8	3.33	no sheen
1002	13.94	1.252	0.08	6.74	-117.7	6.9	3.33	450 ml/min
1006	13.91	1.253	0.12	4.78	-120.2	6.8	3.33	450 ml/min
1010	13.91	1.255	0.08	6.80	-122.0	4.8	"	"
1014	13.86	1.256	0.09	6.84	-122.9	3.7	"	"
1018	13.95	1.258	0.09	6.82	-123.1	3.4	"	"

Location: J. Collins / T.J. Smith 4/18/05

Project / Client: overcast, breezy, 60°

EDR Phase 2

0800 Onsite, meet w/ Pat.
0820 Speak w/ Jerold about bringing out 1-Lambers.
0830 Load truck, bottles etc.
0820 Arrive @ DW-~~27~~ JC 35.
Showing Trevor the sheen on the ground from the H_2O in the post holes. WL=3.30
0933 Pump on.
1020 Collect EDR-DW-35-041805
~~NOTE: 1015 Trip Blanks~~ JC
1048 Pump off.
1056 Pump IDW.
1118 Arrive @ DW-38.
WL= ~~8.90~~ JC 7.90
1125 Pump on.
1153 Collected EDR-DW-38-041805
1250 Pump off.
1310 Spoke w/ Bill. I need to send him my observations made during drilling development, and sampling. He now also wants observ. made during sampling

OW - 38

4/18/05
Phase 2

Time	pH	Temp	K	DO	ORP	NTU	WL	Comments
1135	6.80	15.55	1.117	0.76	-86.9	70	7.95	250ml (mm) sl. odor
1139	6.88	15.22	1.127	0.29	-89.9	45	7.95	"
1142	6.87	15.39	1.124	0.24	-93.8	60	7.95	"
1145	6.86	15.38	1.126	0.19	-94.2	23	7.95	"
1148	6.85	15.37	1.129	0.19	-91.6	29	7.95	"
1151	6.86	15.33	1.126	0.19	-89.2	23	7.95	"

JCI, TJS
EDR
4/18/05

Phase 2 Greg Armstrong
~~551-5~~ 0725

8 the wells in quarterly monitoring network.

1313 Called and left message for Jason to go through my notes in the other log book / field sheets.

1324 Finished sending fax to Bill, off-site food supplies, etc.

1425 Back on-site, load more bottles.

1442 Arrive @ OW-02

1444 WL = 7.32.

1450 Pump on.

1455 WL = 7.63

1457 WL = 7.70

Barely maintaining @ 7.70

1525 Collected EDR-OW-02-041805

1514 I'm going to collect more sample from OW-19T while ~~T.J.~~ T.J. fills bottles.

1548 Arrive @ OW-19T
WL = 13.06

1550 Collected EDR-OW-19T-041805
(cyanide, sulfide, anions (300.0))

Time	Temp	K	DO	ORP	pH	NTU	WL	Comments
1454	14.29	1.026	5.52	-26.4	6.9055		7.58	paint thinner odor 200 ml/min
1500	15.78	1.029	3.58	-33.1	6.9150		7.70	"
1504	16.31	1.030	3.88	-35.1	6.9870		7.70	"
1511	16.15	1.027	3.51	-31.4	7.0145		7.90	150 ml/min
1516	15.19	1.027	3.40	-28.9	7.0038		7.90	"
1519	15.02	1.025	3.49	-26.4	6.9829		7.90	"
1522	14.94	1.027	3.49	-25.1	6.9728		7.90	"
1525	14.96	1.026	3.39	-24.4	6.9727		7.90	"

OW-02

Date 4/18/05
Phase 2

SCITS EDR Date 4/18/05
Location
Project / Client
Phase 2

1640 Pump off.
1650 Pump 100
1710 Pack up sampling, unload truck, get more ice, etc.
1900 Finish packing samples. Off-site. Finish building off to coolers @ REEX
1910 Off-site

Debi Collins 4/18/05

Location: J. Collins / T.J. Smith 4/19/05

Project / Client: overcast, very windy, 65°
Phase 2 - EDR

0700 Onsite for safety meeting.
0815 Finish calibrating equipment and loading truck, etc.
0835 Faxed OW ID map to Bill.
0900 Arrive @ OW-36
0906 WL = 9.45
0911 Pump on
0930 Trip Blanks → DRO/HCL
0940 Collected GAR-OW-36-041905
0955 Spoke w/ Bill. He needs me to fax him the spreadsheet and map to the Co Springs office and wants pictures taken (see opposite page) and emailed to him.
1029 Spoke w/ Melissa @ STL lab. The coolers sent yesterday has not arrived @ the lab. Will call back.
1048 Spoke w/ Leah and Greg Armstrong about the

OW: 36 4/19/05

Bill - fax (719) 594-4516

Time	Temp	K	DO	ORP	pH	NTU	WL	Comments
0918	16.11	0.926	3.97	-97.3	6.98	150	9.45	sl. petro. odor 250 ml/min
0923	16.09	0.930	3.43	-98.3	6.96	65	9.45	"
0927	16.08	0.929	2.70	-100.9	6.99	45	9.45	"
0930	16.11	0.930	2.48	-99.6	7.00	36	9.45	"
0933	16.21	0.929	2.62	-98.4	7.00	27	9.45	med. petro. odor
0936	16.21	0.929	2.60	-97.6	7.00	24	9.45	"
0939	16.32	0.928	2.59	-96.2	7.00	25	9.45	"

2) looking west trees
1) seep near trench by river
3) Cat Cracker
4) OW-35

Fax (316) 321-9107

Rash Gravel
Concrete
Blue Bags

Location JK / TJS Date 4/19/05

Project / Client EDR Phase 2

concrete methodology for the bollards, painting etc.

1158 Finished speaking w/ FedEx about the cooler that didn't make it to the lab. We were given several excuses why it didn't get there.

1205 FedEx called and they confirmed that our cooler was in Memphis and will be delivered First Priority Overnight. They said the air-bill came off (they put it on, how do they know it is ours if it came off).

1215 Arrive @ OW-01

1222 WL = 8.19

1223 Pump on.

1257 Collected EDR-OW-01-041905

1340 Spoke w/ Melissa @ STL. She's shipping 2 coolers of 1-L Ambers for equipment blank samples.

1350 Spoke w/ Fed Ex, our cooler is

Location OW-01 Date 4/19/05

Project / Client Phase 2

Time	Temp	DO	pH	ORP	NTU	WL	Comments
1228	15.81	1.23	6.94	-76.3	100	8.19	yellow, strong
1232	15.64	0.63	6.93	-85.6	95	8.19	pet. odor, sheen
1236	15.47	0.24	6.93	-94.2	75	8.19	350ml/min
1240	15.48	0.15	6.93	-101.9	50	8.19	"
1244	15.53	0.18	6.95	-105.4	31	8.19	"
1248	15.57	0.15	6.95	-107.0	28	8.19	"
1252	15.55	0.15	6.96	-107.4	18	8.19	"
1256	15.63	0.16	6.96	-107.2	15	8.19	"

JCI TJS

Location: EDR Phase 2 Date: 4/19/05

Project/Client:

in a refrigerated area, in a controlled climate.

1420 Offsite for ice, bags.

1500 Back on site.

1537 met w/ Carlson survey re: cross-section by river, tempwells, staff gages, etc. Also spoke w/ Eric (GSI) by the river about progress with the bollards. GSI will be back onsite tomorrow to cont. w/ bollards (concrete and painting).

1547 Arrive @ OW-21.

1552 WL = 2.65

1555 WL = 2.72

1557 WL = 3.03 @ .325 ml/min

1626 Collected EDR-OW-21-041905

* DEQ HCL preserved.

1710 Carlson @ OW-~~8~~ JC 21. This is their last new well to survey.

1735 Spoke w/ Bill. He would like me to gauge the new

Location: OW-21 Date: 4/19/05

Project/Client: Phase 2

Time	Temp	K	DO	pH	ORP	NTU	WL	Comments
1559	15.08	1.058	1.03	7.50	-66.6	11	2.95	200 ml/min, turbid, musty odor
1603	15.66	1.036	0.57	7.40	-98.0	12	2.91	"
1607	15.92	1.029	0.28	7.35	-104.1	14	2.85	"
1611	15.83	1.016	0.16	7.31	-107.7	8.7	2.80	"
1614	16.21	1.001	0.12	7.29	-110.0	9.1	2.80	"
1618	16.20	1.001	0.11	7.28	-110.1	6.1	2.80	"
1622	16.20	0.999	0.10	7.25	-111.5	5.7	2.8	"

Location JC | TJS EDR Phase 2 Date 4/19/05

Project / Client

wells by the river with the product probl. Will do tomorrow (get TOC & BGS).

1930 Finish packing coolers. T.J. to take 3 coolers to FedEx.

1845 Off-site.

Julie Collins
4/19/05

Location J. Collins Date 4/22/05

Project / Client overcast, extremely windy, 58°
EDR - Phase 2

0830 On site, picked up ice and DI H_2O on the way in.

0930 Called my hours in to Patrick in Des Moines (52.5 hrs).

1100 Trip Blanks

1120 Begin decon (equip. blanks) for 3 pumps.

1145 Collected EDR-EB7-042205 organics

1220 Collected EDR-EB8-042205 organics

1250 Collected EDR-EB9-042205

1400 Back on site after paying addition truck tag fee to the BUCO. Court House.

1525 Collect EDR-FieldBlank-042205 from fountain in break room (3 voas for 8260).

1540 Pack up samples, equip, etc.

1718 Finish packing up,

By JC EDR Date 4/22/05
Phase 2

load truck. etc.
1732 Offsite to take
coolers, equip. to
FedEx.

Julie Collins
4/22/05

Location El Dorado Date 5/18/05
Project / Client 1/4 Sampling 2005
M. Warner, C. Stephens

0800 Calibrated YSI
Standardized Turbidimeter

0833 Arrived @ W16-S

Water Level: 15.67 DTW

0900 Found Flow rate of
< 90 ml/min will pump
dry and take samples
on 5/19/05.

0921 Dried/Pumped out
well @ 4.5 gal.

0931 Arrived @ W-26

Water Level: 5.50 DTW

Flow Rate ~ 100 ml/min
* will Low Flow sample

Stabilized Water Level: 5.62

Location: EDR
Project/Client: El Paso
Sitewide WLs
Date: 6/14/05

1653 W-01D WL = ≈ 0.20 (pump)
1655 S-most staff gauge = 4.65
1657 Arrive @ N3-3
1659 WL = 9.10
1701 Arrive @ N-most staff gauge - gauge gone from very high water due to last weeks' storm
1709 Arrive @ Pester gauge
1715 WL = 3.70
Lots of trees down upstream, laying over bridge, H_2O was very high on banks yesterday.
1719 Arrive @ N2-6
1722 WL = ~~D+J~~ 2.69
DTW = 14.20
1750 Unload truck, etc.
1800 Off-site.

Julie Collins
6/17/05

Location: J. Collins / C. Stephens
Project/Client: EDR El Paso
Phase 2
Date: 6/16/05

0725 On-site, check in, etc.
0800 Call Enterprise, don't have anything in town. Will go to Wichita w/ Chris to get truck, go pick up ice and H_2O, etc.
1003 Back on site. Sort out bottles, load truck, ice samples, get H_2O, etc. Will sample OW-33 then begin development on OW-05/OW-39.
1130 Arrive @ OW-33.
WL = 11.18
1140 Calibrate equipment
1151 Finish calibration.
YSI needs adapters for the flow thru cell - need to go buy the parts.
1210 Off-site to get parts for flow-thru.
1310 Back on site.
1317 Arrive @ OW-33.
Heavy poison ivy.
1320 Trip Blank

Location: JCICS
Project / Client: OW-33 El Paso Phase 2
Date: 6/15/05

Time	Temp	K µS/cm³	DO mg/L	pH	ORP	NTU	Comments
1335	17.56	1430	4.08	6.43	-97.4	—	11.24 WL 300 ml/min mod. petro odor
1340	15.69	1453	1.03	6.19	-124.4	100	"
1345	15.68	1451	0.78	6.30	-134.4	40	"
1350	15.54	1450	0.05	6.36	-136.0	28	"
1354	15.93	1450	0.40	6.42	-147.2	20	"
1357	15.93	1450	0.38	6.47	-149.7	19	"
1400	15.80	1450	0.44	6.52	-148.3	20	"
1403	15.95	1448	0.57	6.49	-139.4	22	"
1406	15.98	1448	0.67	6.55	-137.7	23	"
1409	16.07	1448	0.73	6.57	-134.8	22	"
1412	15.96	1449	0.80	6.60	-134.7	22	"
1415	16.12	1447	0.81	6.56	-130.9	21	"
1418	16.28	1448	0.83	6.59	-131.0	21	"

Location: JCICS EDR
Project / Client: 321-5442 165 El Paso Phase 2
Date: 6/15/05

1420 Collected EDR-OW-33-061505
1507 Pulled pump.
1511 Dumped IDW.
1545 Off-site for DI & ice, tape.
1615 Back on site, pack up samples and product probe.
1635 Pack up samples -
1725 Finish packing. One cooler to Fed Ex and one to CAS.

Julie Collins
6/15/05

NOTE: 1400 Trip Blanks
VOCS
GRO
EDB

J. Collins | C. Stephens 6/28/05
overcast, breezy, 79° Phase 2
0655 On site for H&S mtg.
0810 Chris to arrange Skinner bottle sets for all wells while I finish letter for Bill, coordinate getting lab reports, tables together, etc.
1040 Chris @ OW-39 to continue development while I continue to coordinate getting letter, tables, etc. completed and out the door.
1125 Chris back from purging OW-39. Spoke w/ Leah, she will get legals to AES.
1154 Arrive @ OW-05.
WL = 38.28
1229 Spoke w/ Bill, We can sample OW-39 & OW-05 @ the end of the week if parameters are stable.
Do sitewide WLs next Friday.
See if Chris F. can review my letter today, if not send to him AND Jen. I will do slug tests w/ Jason next week.

JC/CS 100°, hot, humid 6/28/05 Phase 2

1347 Arrive @ OW-32
1354 WL = 15.20
1408 Temp = 18.14, K = 1307,
DO = 4.29, pH = 7.16
ORP = -106.5, NTU = 160
1410 Collected EDR-OW-32-062805
453 Arrive @ OW-04
1504 WL = 11.78
1510 T = 18.83, K = 1395,
DO = 4.81, pH = 7.60,
ORP = -98.8, ~~ORP~~ NTU = 22
1511 Collected EDR-OW-04-062805
1544 Arrive @ OW-03
1553 WL = 18.50
1559 T = 17.47, K = 1388, DO = 6.02,
pH = 7.50, ORP = -4.0, NTU = 14
1600 Collected EDR-OW-03-062805
1630 Off-site for more ice.
1643 Back on site to pack up samples.
1750 Finish packing up coolers. Chris to take 3 coolers to Fed Ex.
1820 Off-site to work on letter for Bill.

Julie Abbs 6/28/05

J. Collins/C Stephens 6/29/05 Phase 2
Sunny, breezy, 87°
0800 On site. Stopped for gas, ice, H_2O.
0915 Called IT to get online so I could send letter/tables to Chris/Christy.
1008 Arrive @ OW-29
WL = 13.95
NOTE: Chris calibrated equipment while I was calling IT.
1023 T = 18.01, K = 1175, DO = 4.97,
pH = 6.42, ORP = -82.6
NTU = 400
1024 Trip Blank
1025 ~~Collected~~ EDR-OW-29-062985
GW - very heavy sheen, strong odor, viscous
1122 Arrive @ OW-06 to attempt to low-flow.
1134 OW-06 WL = 7.07
1141 Pump on.
1154 WL cannot be stabilized @ 100 ml/min. Will purge down to pump intake.
1310 Pumped down to intake. Will sample tomorrow.

6/29/05 P2

JCICS

6/29/05
EDRPhase 2

1443 Arrive @ OW-31
WL = 10.26
1456 Pump on.
1500 Collected EDR-OW-31-062905
slight odor (petro)
1608 Unload truck / coolers.
Go to purge OW-39 and
OW-05 dry.
1621 Arrive @ OW-39
1623 WL = 19.10
1639 Arrive @ OW-05
1643 WL = 36.06
1807 Finish packing coolers (2)
1810 Off-site

Julie Collins
6/29/05

OW-06

Time	Temp	K	DO	pH	ORP	NTU	Comments
1147	20.07	870	1.78	6.85	-2.2		250 ml WL = 33.50
1150	21.67	872	1.38	6.91	-5.9	31	100 ml/min WL = 8.45
1153	21.79	877	1.22	6.95	-13.3	43	WL = 8.90 100 ml/min

OW-31

Time	Temp	K	DO	pH	ORP	NTU	Comments
1459	16.93	1445	2.05	5.67	-98.1	26	450 ml/min WL = 10.28
1504	16.36	1448	0.54	5.70	-115.0	27	"
1509	16.34	1449	0.44	5.90	-128.9	25	"
1512	16.35	1450	0.43	5.99	-133.3	24	"
1515	16.38	1451	0.41	6.01	-138.0	23	"

OW-30

Time	Temp	K	DO	pH	ORP	NTU	Comments
0921	16.60	1508	2.14	5.86	-97.2	35	WL=14.55
0924	15.84	1524	0.94	5.90	-114.1	23	300 ml/min
0934	16.06	1527	0.79	5.95	-122.8	21	WL=14.41
0937	16.09	1527	0.79	6.00	-125.7	13	300 ml/min
0940	16.14	1528	0.80	6.03	-126.5	12	WL=14.60
0943	16.16	1526	0.81	6.04	-127.8	12	225 ml/min
							mod petro odor
							"

OW-06

Time	Temp	K	DO	pH	ORP	NTU	Comments
1120	19.39	848	2.54	6.47	23.3	13	350 ml/min

6/30/05 P2

J. Collins / C. Stephens 6/30/05
Sunny, hot, muggy, 80° Phase 2
0800 On site
0845 Finish loading truck, get ice.
0853 Arrive @ OW-30
0908 WL = 14.44
0917 Pump on.
0945 Trip Blanks
0949 Collected EDR-OW-30-063005
1108 Arrive @ OW-06
1111 WL = 12.00 [mod petro odor OW-30]
1114 Pump on
1124 Collected EDR-OW-06-063005
1329 Arrive @ OW-39
1337 WL = 19.76
1346 Collected EDR-OW-39-063005
(need to come back this afternoon to collect anions / alk (well dry)).
1417 Arrive @ OW-~~06~~ 05.
1425 WL = 38.69
1432 Collected EDR-OW-05-063005
(need to come back for Sulfide, alk, anions).
1521 Arrive @ OW-39.
1550 Collected sample from Cat Cracker for Bill.

JCICS 6/30/05

EDR Phase 2

1552 Arrive back @ OW-05. to collect more sample.

* Need to come back tomorrow to fill alkalinity.

1618 Pack up coolers, unload.

1720 Off-site.

Julie Collins
6/30/05

J. Collins / C. Stephens 7/1/05

EDR Phase 2

0930 Onsite.

1052 Return rental to Enterprise.

1216 Arrive @ OW-05 to collect remaining sample.

1220 Finished collecting sample.

1303 Finish cleaning up staging area, etc.

1411 Off-site.

Julie Collins
7/1/05

N4-2

Time	Temp	K	DO	ORP	pH	NTU	Comments
1703	19.09	2883	1.81	35.3	7.0	57.3	WL = 20.59 @ 240 ml/min
1706	17.58	2803	1.01	28.4	6.94	28.5	"
1709	17.19	2838	0.63	18.6	6.94	28.1	"
1712	17.23	2838	0.58	15.3	6.94	26.8	"
1715	17.71	2840	0.54	10.9	6.94	24.1	WL = 20.60 @ 150 ml/min
1718	18.09	2846	0.50	2.0	6.94	24.9	"
1721	18.19	2846	0.48	3.4	6.95	24.1	"
1724	18.21	2845	0.46	1.8	6.95	24.3	"

J. Collins / C. Stephens 8/12/05
Sunny, warm, humid, 75°

0900 On site to collect remaining isotope samples, pack equipment, return rental.

1100 Arrive @ OW-39

1114 Collected EDR-OW-39-081205
1-500 ml poly

1128 Arrive @ N2-1

1140 Collected EDR-OW-N2-1-081205

1146 Arrive @ OW-14.

~~1154 Collected EDR-OW-14-08205~~ JC

1154 OW-14 is dry

1157 Arrive @ OW-01.

1200 Collected EDR-OW-01-081205
heavy odor 1s here, possible product on bailer.

1206 Arrive @ OW-02.

1211 Collected EDR-OW-02-081205
mod. petro. odor

1212 Arrive @ OW-19T

1215 Collected EDR-OW-19T-081205
heavy gas odor, baby ~~oil~~ JC oil-like feel.

1220 Arrive @ OW-18T.

1224 Collected EDR-OW-18T-081205
product, black/brown, thin

1230 Arrive @ OW-03
1234 Collected EDR-OW-03-081205
1237 Dump IDW. Go to unload truck, clean it out, wash and return it.
1409 Off-site.

Julie Collins
8/12/05

MWH
Monitoring Well Fluid Gauging Form
2nd Quarter 2005

Site Name: El Paso El Dorado Project # 4270219.010101
Date: 5/17/05 Weather/Temperature:

All Monitoring Wells must be gauged in the following order:

Well ID	Depth to Water	Depth to Product	Total Depth of Well	Measured Depth to Bottom (4Q04)	Saturated Thickness (DTB-DTW)	Time of Measurement	Comments*
N1-1	[illegible]		22.50	25.10		15:10	
W-08	16.09		22.80	23.00		15:13	
W-29D	22.86		80.70	80.60		15:34	
W-29S	16.13		24.60	24.90		15:56	
N2-1	17.13		24.50	27.00		16:13	
N4-4	17.44		23.00	26.30		16:25	
W-16S	15.25		21.35	21.40		16:43	
W-15D	28.30		130.00	129.00		16:52	
W-15S	17.65		22.90	23.00		16:55	
N5-1	16.68		23.50	25.50		17:08	
N5-2	14.76		28.00	30.40		17:12	
N3-1	19.39		78.80	81.20		17:15	
W-01D	2.42		92.40	94.20		17:34	
N4-2	2.46		28.00	30.50		17:27	
W-23	8.59		18.60	18.80		17:40	
W-01S	13.06		19.90	20.00		17:36	
N4-3	20.16		20.10	22.50		17:48	
W-26	5.53		10.67	10.80		17:57	
W-03	13.86		19.25	20.00		18:12	
N4-1	13.91		23.00	25.40		18:06	
N3-2	12.63		16.00	18.34		18:12	
N5-3	9.39		20.00	22.90		18:02	
N2-2	7.03		21.20	23.80		18:20	
N2-4	10.08		26.00	28.00		18:23	
W-22	17.23		18.82	18.90		18:31	
FINA_MW_38	4.68		19.25	15.90		18:41	
W-24	8.40		19.05	19.10		18:35	
N3-4	6.31		18.50	21.00		18:45	
N3-3	14.60		17.25	19.40		18:50	
N2-3	5.92		15.00	17.40		18:56	
N2-5	10.70	10.11	19.00	10.01		19:20	
N2-6	16.77	4.0	20.00	NM		19:14	
N6-1	5.99		23.50	NM		19:04	

Comments:

Personnel: (Print Name)
Personnel: (Print Name)

*** If Product is encountered please note the type, color, and viscosity in the comment section.**

JC EDR Date 4/22/05
Phase 2

load truck. etc.
1732 Offsite to take
coolers, equip. to
FedEx.

Julie Collins
4/22/05

Location El Dorado Date 5/18/05
Project / Client 1/4 Sampling 2005
M. Warner, C. Stephens

0800 Calibrated YSI
Standardized Turbidimeter

0833 Arrived @ W16-S

Water Level: 15.67 DTW

0900 Found Flow rate of
< 90 ml/min will pump
dry and take samples
on 5/19/05.

0921 Dried/Pumped out
well @ 4.5 gal.

0931 Arrived @ W-26

Water Level: 5.50 DTW

Flow Rate ~ 100 ml/min
* will Low Flow sample

Stabilized Water Level: 5.62

Location: El Dorado Date: 5/18/05

Project / Client: 1/4 Sampling 2Q05

M. Warner / C. Stephens

Well	Date	Time	Temp °C	pH	ORP mV	Cond. µS/cm	DO mg/L	Turbidity
W-26	5/18	0949	16.74	6.74	53.2	921	2.86	8.1
	5/18	0952	16.82	6.59	39.4	920	1.83	7.6
	5/18	0955	16.86	6.55	30.7	918	1.61	7.1
	5/18	0958	16.80	6.52	22.6	918	1.43	6.5
	5/18	1001	16.84	6.51	18.7	917	1.28	6.0
	5/18	1004	16.95	6.49	13.4	917	1.09	5.0
	5/18	1007	16.96	6.47	7.2	917	0.93	5.0
	5/18	1010	16.85	6.46	1.9	917	0.80	4.4
	5/18	1013	16.91	6.45	-2.2	916	0.71	4.0
	5/18	1016	16.72	6.45	-6.6	914	0.65	3.5
	5/18	1019	16.50	6.44	-12.0	914	0.58	3.6
	5/18	1022	16.45	6.43	-17.8	914	0.51	3.5
	5/18	1025	16.40	6.42	-23.8	915	0.46	3.3
	5/18	1028	16.31	6.42	-29.2	915	0.43	3.3
	5/18	1031	16.17	6.42	-35.1	913	0.40	3.1
	5/18	1034	16.10	6.42	-41.6	913	0.37	3.0
	5/18	1037	16.13	6.41	-45.7	912	0.36	3.0
	5/18	1040	16.22	6.41	-51.2	912	0.35	2.9
	5/18	1043	16.27	6.41	-52.0	913	0.35	4.1 — ?
	5/18	1046	16.29	6.41	-52.2	913	0.34	3.2

Stabilized w/ IN 10 % @ ~ 3 gal.

Location Date

Project / Client

Purge Chart

E.D.R. 5/18/05

1/4 Sampling

M. Warner / C. Stephens

1048 Began collecting Samples

(6 VOAs, 2-1L Amber, 1-1L Poly, 1-500ml poly)

~ 2 gal purged

1140 Arrived @ N4-3 to bail dry.

1150 Bailed Dry ~ 1.5 gal

1350 Arrived @ W-15D (MS/MSD)

Water Level: 28.29 DTW

~ 500ml/min @ 28.37 DTW

- purged ~ 6 gal

1430 Collected Samples

(MS/MSD - 6 VOAs, 2-1L Amber 1-1L Poly, 1-500ml poly)

EDR Date 5/18/05
1/4 Sampling 2Q05
M. Warner / C. Stephens

Location Date
Project / Client

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turbidity
W-15D	5/18	1402	15.55	6.95	42.0	3100	0.24	40
	5/18	1405	15.57	6.83	13.2	3032	0.30	27
	5/18	1408	15.52	6.72	-18.0	2987	0.51	15
	5/18	1411	15.64	6.66	-33.9	2975	0.59	13
	5/18	1414	15.68	6.58	-43.2	2966	0.73	14
	5/18	1417	15.64	6.56	-48.5	2960	0.89	14
	5/18	1420	15.61	6.56	-51.6	2961	1.00	14
	5/18	1423	15.58	6.52	-53.1	2961	1.12	14
	5/18	1426	15.62	6.53	-54.0	2958	1.14	14
	5/18	1429	15.62	6.52	-54.4	2956	1.17	13
	Stabilized		w/in	10%	@ 6 gal			
W-15S	5/18	1613	15.28	7.31	50.8	1066	4.23	3.7
	5/18	1616	15.07	7.00	14.5	1067	3.90	3.8
	5/18	1619	15.12	6.92	7.0	1067	3.83	3.5
	5/18	1622	15.19	6.89	3.8	1067	3.80	3.5
	5/18	1625	15.36	6.81	3.4	1065	3.73	3.4
	5/18	1628	15.30	6.81	2.6	1064	3.80	3.3
	5/18	1631	15.35	6.78	2.9	1064	3.76	3.3
	Stabilized		w/in	10%	@ 2 1/2 gal.			

Location EDR Date 5/18/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

1550 Arrived @ W-15S

Total Water: 17.69 DTW

Flow rate ~ 350 ml/min @ 17.69

1633 samples collected

1705 Arrived @ W-22 Began Bailing

WL:

1730 Finished Bailing ~ 2½ gal

- Will come back and collect parameters/samples tomorrow.

End of Day

5/18/05

Matt Warner

Location _____ Date _____

Project / Client _____

Location EDR Date 5/19/05

Project / Client 1/4 Sampling 2005
M. Warner / C. Stephens

0800 Arrived @ W-16S to pump samples

WL: 16.42' DTW

0830 Calibrated YSI (Within Range)

Standardized Turbidimeter: (Within 5%)

0833 Began pumping Well

Pump rate ~ 350 ml/min

1 parameter: Temp: 14.60
pH: 6.66 Time: 0838
ORP: 152.1 Cond: 1607 µS/cm
DO: 2.86 Turb.: 5.0

0840 Collected Samples
(6 VOAs, 2-1L Amber, 1-500mL)

Location: EDR Date: 5/19/05

Project: 1/4 Sampling 2005

M. Warner / C. Stephens

0910 Arrived @ N4-3 to bail 1 parameter & samples.

0920 Collected Samples (6 VOAs, 1-1L Amber, 1-500mL)

0918 Parameters:
Temp.: 16.65 pH: 7.11
ORP: 120.1 Cond: 1133
DO: 5.26 Turb: 6.9

1000 Arrive @ N5-3 (Duplicate-50)

WL: 9.70 DTW

Flow: 250 ml/min

Flow = Recharge @ 10.01' DTW

1014 Began taking parameters

1035 Collected Samples (12 VOAs, 4-1L Amber, 2-500mlP) -50 Duplicate

Location: EDR Date: 5/19/04

Project / Client: 1/4 Sampling 2@05

M. Warner / C. Stephens

Location Date

Project / Client

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond	DO	Turb.
N5-3	~~10~~ 5/19	1014	14.96	7.17	-146.8	2028	0.29	19
	5/19	1017	14.91	7.14	-149.7	1959	0.42	21
	5/19	1020	15.00	7.11	-151.0	1943	0.57	23
	5/19	1023	15.04	7.11	-152.9	1966	0.73	22
	5/19	1026	14.96	7.12	-155.2	1983	0.80	19
	5/19	1029	14.96	7.12	-157.1	1981	0.80	21
	5/19	1032	14.95	7.11	-158.0	1980	0.84	20
		Stabilized w/ IN			5% @ 3 gal.			
N5-2	5/19	1333	15.71	6.93	105.0	3162	7.0	18
	5/19	1336	15.58	6.88	58.2	3169	0.60	14
	5/19	1339	15.47	6.87	30.1	3123	0.63	9.4
	5/19	1342	15.35	6.90	13.1	2990	0.85	7.0
	5/19	1345	15.30	6.94	0.5	2822	1.02	7.2
	5/19	1348	15.39	6.96	-8.9	2669	1.12	6.6
	5/19	1351	15.16	6.97	-17.5	2577	1.14	9.1
	5/19	1354	15.28	6.97	-25.9	2531	1.16	5.3
	5/19	1357	15.28	6.97	-32.6	2490	1.13	4.8
	5/19	1400	15.31	6.96	-36.9	2455	1.07	5.2
	5/19	1403	15.47	6.96	-47.7	2451	1.05	4.7
	5/19	1406	15.38	6.97	-47.5	2450	1.03	4.1
	5/19	1409	15.39	6.96	-48.9	2446	1.00	4.2

Location

Date

Project / Client

Location EDR

Date 5/19/05

Project / Client 1/4 Sampling 2005
M. Warner / C. Stephens

1305 Arrived @ NS-2 (MS/MSD)

W.L.: 15.49 DTW

Flow: 500 ml/min

Flow = Recharge @ 15.72

1333 Parameters

1410 Collected samples (18-VOAs, 6-1L Amber, 3-500ml Poly)

1500 Arrived @ NS-1

W.L. 16.85 DTW

Flow: ~300 ml/min

Flow = Recharge @ 16.97

1600 Collected Samples (6-VOAs, 2-1L Am 1-500ml)

Location EDR Date 5/19/05

Project / Client 1/4 Sampling 2005

M. Werner / C. Stephens

Location Date

Project / Client

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turbidity
N5-1	5/19	1527	16.81	6.77	46.0	1531	2.64	6.3
	5/19	1530	16.76	6.77	26.0	1536	2.98	5.8
	5/19	1533	16.66	6.80	14.0	1547	3.28	5.7
	5/19	1536	16.70	6.80	8.8	1547	3.41	5.4
	5/19	1539	16.76	6.80	5.4	1550	3.44	5.3
	5/19	1542	16.76	6.81	1.9	1556	3.60	5.0
	5/19	1545	16.67	6.81	-2.7	1548	3.75	4.8
	5/19	1548	16.71	6.80	-6.6	1550	3.72	4.4
	5/19	1551	16.58	6.78	-7.2	1551	3.78	4.1
	5/19	1554	16.57	6.77	-7.0	1549	3.81	4.3
W-22	5/19	1705	20.86	6.54	-114.1	1366	1.00	450
N4-2	5/20	0945	16.10	6.76	216.6	2909	0.44	5.6
	5/20	0948	16.05	6.74	188.1	2914	0.26	5.6
	5/20	0951	15.89	6.74	170.5	2917	0.23	4.0
	5/20	0954	15.93	6.73	153.1	2914	0.33	4.3
	5/20	0957	15.92	6.74	139.4	2912	0.36	3.4
	5/20	1000	15.87	6.74	125.2	2908	0.36	3.3
	5/20	1003	15.86	6.73	115.4	2904	0.33	2.6
	5/20	1006	15.89	6.73	102.1	2900	0.31	3.0
	5/20	1009	15.91	6.73	89.2	2899	0.29	3.0
	5/20	1012	15.96	6.73	76.5	2898	0.28	4.1

Location _____ Date _____

Project / Client _____

Location EDR Date 5/19/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

1700 Arrived @ W-22 to collect samples + parameter.

WL: 17.28 DTW

1705 Parameters

1710 Collected Samples (6 VOAs, 2-1L amber, 1-500 ml Poly)

1730 Arrived @ N3-3 and began bailing.

1755 Bailed Dry ~8.5 gal

1800 Arrived @ N4-1 to pump dry

WL: 14.13 DTW

1815 Well pumped dry @ 2.5 gal.

End of Day 5/19/05

Matt Warner

Location

Date

Project / Client

Location EDR

Date 5/20/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

0900 MW Arrived @ N4-2

WL: 19.62 DTW

0930 Calibrated YSI + Turbidimeter

Flow Rate: 350 ml/min

Flow = Recharge @ 19.88' DTW

1100 Collected Samples (6 VOAs, 2-1L Amber, 1-500ml poly)

1150 Arrive @ N4-1

WL: 15.33 DTW

Flow ~ 350 ml/min

1155 Parameters

1200 Collected Samples (6 VOAs, 2-1L Amber, 1-500ml poly)

Location: EDR Date: 5/20/05

Project / Client: 1/4 Sampling 2005

M. Warner / C. Stephens

Location: Date:

Project / Client:

Purge Chart

Well	Date	Time	Temp. °C	pH	ORP mV	Cond. us/cm	DO mg/l	Turbidity
N4-2	5/20	1015	16.05	6.73	64.0	2890	0.25	3.2
	5/20	1018	15.94	6.73	53.2	2893	0.25	2.6
	5/20	1021	15.96	6.73	44.1	2893	0.21	3.0
	5/20	1024	15.99	6.73	35.8	2890	0.20	3.0
	5/20	1027	16.02	6.74	28.4	2886	0.18	2.7
	5/20	1030	16.06	6.74	20.2	2885	0.16	2.8
	5/20	1033	15.98	6.73	14.3	2886	0.16	2.8
	5/20	1036	16.07	6.73	9.0	2884	0.15	3.0
	5/20	1039	16.07	6.73	3.7	2881	0.14	2.7
	5/20	1042	16.12	6.73	-1.3	2881	0.14	2.8
	5/20	1045	16.13	6.74	-5.6	2880	0.13	2.5
	5/20	1048	16.18	6.73	-9.4	2878	0.13	2.8
	5/20	1051	16.14	6.73	-13.5	2882	0.13	2.7
	5/20	1054	16.14	6.73	-16.8	2880	0.12	2.6
	5/20	1057	16.16	6.74	-17.2	2881	0.12	2.7
	5/20	1100	16.19	6.74	-17.1	2880	0.12	2.6
N4-1	5/20	1155	15.83	6.96	154.8	945	5.07	5.2
N-01S	5/20	1342	16.17	6.59	129.0	1272	0.66	3.1
	5/20	1345	16.14	6.55	96.2	1270	0.53	3.3
	5/20	1348	16.25	6.54	63.7	1269	0.42	3.0
	5/20	1351	16.11	6.53	41.9	1272	0.35	3.0

Location

Date

Project / Client

Location EDR

Date 5/20/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

1330 Arrived @ W-01S

W.L.: 13.18 DTW

Flow Rate: ~300 ml/min

Flow = Recharge @ 13.23

1342 Parameters (purged ~4 gal.)

1430 Collected Samples
(6-VOAs, 2-1L Amber, 1-500ml poly)

1500 Arrived @ W-01D

W.L: ~~B~~ MW 2.78 DTW

Flow Rate: ~500 ml/min

Flow = Recharge @ 2.98 DTW

1515 Pump control box stopped working
ordered New box from Field Envir.

1600 Organize staging area (bottles + Coolers)

Location: EDR Date: 5/20/05

Project / Client: 1/4 Sampling 2Q05

M. Warner / C. Stephens

Location: Date:

Project / Client:

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turbidity
W-01S	5/20	1354	16.15	6.52	25.3	1272	0.30	3.2
	5/20	1357	16.04	6.52	10.8	1274	0.25	3.3
	5/20	1400	16.11	6.51	-1.9	1273	0.21	3.1
	5/20	1403	15.98	6.51	-12.4	1274	0.20	3.2
	5/20	1406	16.09	6.52	-30.2	1271	0.15	3.3
	5/20	1409	16.06	6.52	-32.1	1271	0.15	2.9
	5/20	1412	16.05	6.52	-38.7	1271	0.14	3.0
	5/20	1415	16.06	6.52	-43.7	1273	0.13	3.1
	5/20	1418	16.04	6.51	-47.8	1273	0.12	3.1
	5/20	1421	16.03	6.52	-52.9	1273	0.12	3.2
	5/20	1424	16.09	6.52	-53.4	1271	0.12	3.0
	5/20	1427	16.10	6.52	-52.6	1272	0.11	3.0
W-01D	5/20	1511	16.65	6.94	131.0	1262	0.58	4.8
	5/20	1514	17.19	6.85	98.0	1262	0.50	
R3-3	5/20	1638	15.14	6.62	-73.8	1561	2.36	360

Location _____ Date _____

Project / Client _____

Location EDR Date 5/20/05

Project / Client 1/4 Sampling 2Q05
M. Warner / C. Stephens

1630 Arrived @ N3-3

W.L.: 14.78 DTW

1640 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml poly)

1700 Packed samples to ship
~~W.L.: 3.06 DTW~~ MW

End of Day

5/20/05

Matt Warner

Location _____ Date _____

Project / Client _____

Location EDB Date 5/21/05

Project / Client 1/4 Sampling 2005
M. Warner / C. Stephens

0800 Pulled pumps from N4-1, N4-2 and N5-3 for Decon

0900 Decon Pumps

1130 New Control box arrives

1230 Set control box up to pump only works on 1 of the 3 pumps

1350 Arrange coolers that came in from Fed-Ex

1430 Set pump in well N3-2 (will finish Decon on other 2 pumps when new control box arrives)

1535 Went and placed new locks on new wells in south field.

Location

Date

Project / Client

Location EDR

Date 5/21/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

1640 Arrived @ W-29S

W.L. 16.20 DTW

Bailed Dry @ 8.0 gal

1655 Packed up & left well, will bail samples 5/22/05

1710 Unpacked Vehicle

End of Day

5/21/05

Matt Warner

Location _____ Date _____

Project / Client _____

Location EDR Date 5/22/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

0950 Arrived @ N3-2.

W.L.: 12.74 DTW

0950 Calibrated YSI + Turbidimeter
Calibrations good

Note: Water level is sitting @ top of pump.

Flow Rate: ~200ml/min.

Flow = Recharge @ 12.76

1050 Collected Samples
(6-VOAs, 2-1L Amber, - 1-500ml Poly)

1130 Arrived @ W-29S
Will bail 1 parameter + samples

W.L. 11.32 DTW

1135 Collected Samples
(6-VOAs, 2-1L Amber, 1-500ml Poly)

Location: EDR Date: 5/22/05

Project / Client: 1/4 Sampling 2Q05

M. Warner / C. Stephens

Location: Date:

Project / Client:

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turbidity
N3-2	5/22	1021	15.62	6.64	-7.9	1371	0.41	11
	5/22	1024	15.60	6.65	-48.9	1370	0.34	8.7
	5/22	1027	15.62	6.66	-73.9	1370	0.48	6.7
	5/22	1030	15.66	6.66	-91.9	1369	1.16	4.4
	5/22	1033	15.66	6.67	-109.8	1368	0.71	3.9
	5/22	1036	15.70	6.67	-117.7	1368	0.46	3.5
	5/22	1039	15.73	6.68	-129.4	1367	0.39	3.4
	5/22	1042	15.76	6.68	-128.0	1360	0.38	3.5
	5/22	1045	15.80	6.68	-129.7	1362	0.37	3.3
W-295	5/22	1145	15.72	6.77	114.5	814	4.25	17
W-03	5/22	1339	15.82	5.89	165.0	3332	1.42	18
	5/22	1342	15.75	5.87	156.2	3210	1.22	16
	5/22	1345	15.74	5.86	138.4	3087	1.18	15
	5/22	1348	15.78	5.87	136.8	2965	1.12	14
	5/22	1351	15.77	5.88	126.9	2882	1.13	13
	5/22	1354	15.75	5.89	125.7	2876	1.12	11
	5/22	1357	15.80	5.90	127.2	2872	1.13	9.8

Location _____ Date _____

Project / Client _____

Location EDR Date 5/22/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

1320 MW

~~1300~~ Arrived @ ~~W-01D~~ W-03 MW (again)

~~W.L. 3.06 DTW~~ MW

W.L. 13.99 DTW

Flow Rate: ~425 ml/min

Flow = Recharge @ 14.37

1339 Collected Parameters

1400 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml Amber)

1430 Unpacked coolers / vehicles

End of Day
5/22/05
Matt Warner

Location _____ Date _____

Project / Client _____

Location EDR Date 5/23/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

0840 Arrive @ N3-4 (Dup)

W.L.: ~~5.77~~ 6.77 mw DTW

Flow Rate: ~330 ml/min @ 6.88' DTW

0854 Parameters (~6.5 gal purged)

1000 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml Poly)
(Dup - 6 VOAs, 2-1L Amber, 1-500ml Poly)

1050 Arrived @ W-24

W.L. 8.05' DTW

Flow Rate: ~500 ml/min @ 8.29' DTW

1112 Parameters

1135 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml Poly)

EDR Date 5/23/05

1/4 Sampling 2Q05

M. Warner/C. Stephens

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turbidity
	5/23	0854	14.51	5.98	248.6	3355	0.71	15
~~N4-3~~	5/23	0857	14.61	5.99	212.0	3321	0.56	12
N3-4 SC	5/23	0900	14.70	6.00	188.1	3286	0.39	8.4
	5/23	0903	14.58	6.00	161.3	3239	0.27	7.0
	5/23	0906	14.60	6.01	144.7	3199	0.22	6.4
	5/23	0909	14.69	6.02	129.0	3163	0.19	5.5
	5/23	0912	14.70	6.03	113.2	3131	0.16	6.3
	5/23	0915	14.69	6.04	93.8	3089	0.14	9.3
	5/23	0918	14.63	6.05	80.1	3057	0.12	8.5
	5/23	0921	14.73	6.05	73.4	3049	0.12	6.7
	5/23	0924	14.64	6.06	57.1	3022	0.12	7.4
	5/23	0927	14.64	6.07	48.1	3010	0.11	5.1
	5/23	0930	14.74	6.07	37.2	2986	0.10	8.9
	5/23	0933	14.80	6.09	19.4	2960	0.10	7.5
	5/23	0936	14.90	6.10	11.0	2950	0.10	7.5
	5/23	0939	14.75	6.11	0.2	2946	0.10	6.6
	5/23	0942	14.62	6.10	-5.9	2933	0.10	8.8
	5/23	0945	14.64	6.10	-11.8	2924	0.10	6.5
	5/23	0948	14.55	6.10	-16.7	2901	0.10	7.0
	5/23	0951	14.51	6.10	-25.3	2909	0.10	6.7
	5/23	0954	14.68	6.11	-25.7	2911	0.11	6.6
	5/23	0957	14.65	6.11	-24.8	2907	0.10	6.9

Location: EDR Date: 5/23/05

Project / Client: 1/4 sampling 2Q05

M. Warner / C. Stephens

Location: Date:

Project / Client:

Purge chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turbidity
W-24	5/23	1112	15.23	6.65	-57.8	1195	0.83	5.0
	5/23	1115	15.28	6.64	-82.0	1184	1.36	5.2
	5/23	1118	15.28	6.63	-86.9	1182	1.23	4.7
	5/23	1121	15.29	6.63	-91.8	1178	0.64	4.0
	5/23	1124	15.30	6.64	-97.9	1164	0.46	3.9
	5/23	1127	15.28	6.64	-103.9	1154	0.37	4.4
	5/23	1130	15.23	6.65	-106.4	1148	0.36	3.9
	5/23	1133	15.17	6.64	-108.6	1145	0.34	4.1
		All	parameters	w/IN	10%	@ 4 1/2	gal	
W-23	5/22	1349	15.58	6.89	210.3	919	0.42	10
	5/22	1352	15.51	6.87	196.6	923	0.26	6.3
	5/22	1355	15.25	6.87	178.0	925	0.26	6.4
	5/22	1358	15.21	6.88	164.1	927	0.41	5.6
	5/22	1401	15.16	6.87	156.2	941	0.42	6.6
	5/22	1404	15.43	6.84	146.0	986	0.30	4.9
	5/22	1407	15.61	6.82	116.7	1039	0.25	4.4
	5/22	1410	15.49	6.83	84.1	1047	0.21	5.2
	5/22	1413	15.43	6.83	47.6	1051	0.21	4.0
	5/22	1416	15.46	6.82	22.5	1050	0.18	4.9
	5/22	1419	15.58	6.83	0.0	1052	0.16	4.8
	5/22	1422	15.66	6.83	-21.6	1052	0.15	4.9
	5/22	1425	15.62	6.83	-34.2	1053	0.14	4.1

Location _____ Date _____

Project / Client _____

Location EDR Date 5/23/05

Project / Client 1/4 sampling 2Q05

M. Warner / C. Stephens

1344 Arrived @ W-23

W.L.: 6.84' DTW

Flow rate: 400ml/min @ 7.08' DTW

1349 Parameters

1445 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml Poly)

1515 Arrived @ N4-4

WL: 17.66' DTW

Flow Rate: ~360 ml/min @ 17.78' DTW

1532 Parameters

1600 Collected Samples
(6-VOAs, 2-1L Amber, 1-500ml Poly)

1620 Arrived @ N6-1

W.L.: 6.08' DTW

Section: EDR Date: 5/23/05

1/4 Sampling 2Q05

M. Warner / C. Stephens

Location: Date:

Project / Client:

Purge Chart

Well	Date	Time	Temp.	pH	ORP	Cond.	DO	Turbidity
W-23 (cont.)	5/23	1428	15.54	6.83	-45.8	1056	0.13	4.7
	5/23	1431	15.52	6.83	-53.9	1053	0.12	5.0
	5/23	1434	15.54	6.83	-64.6	1054	0.10	4.8
	5/23	1437	15.76	6.83	-65.0	1052	0.10	4.8
	5/23	1440	15.54	6.82	-66.4	1056	0.10	4.6
		All Parameters w/IN			10%	~ 6.0 gal		
N4-4	5/23	1532	15.53	6.79	151.8	1325	1.90	12
	5/23	1535	15.11	6.75	142.7	1284	2.20	10
	5/23	1538	15.00	6.72	134.7	1258	2.38	8.1
	5/23	1541	14.82	6.71	120.6	1274	2.43	9.5
	5/23	1544	14.85	6.71	116.3	1277	2.43	7.4
	5/23	1547	14.81	6.70	113.2	1281	2.40	7.3
	5/23	1550	14.90	6.70	105.8	1282	2.45	7.9
	5/23	1553	14.87	6.71	103.8	1284	2.51	8.1
	5/23	1556	14.69	6.69	103.2	1285	2.49	7.8
		All parameters w/IN			10%	~ 3.0 gal.		
N6-1	5/23	1642	15.29	6.92	-195.9	843	0.32	7.8
	5/23	1645	15.45	6.93	-210.8	841	0.27	6.0

Location _____ Date _____

Project / Client _____

Location EDR Date 5/23/05

Project / Client 1/4 Sampling 2005
M. Warner / C. Stephens

Flow Rate: 250 ml/min. @ ~~7.03~~ 6.03 DTW
as per MW

1642 Parameters

- Slight Sheen on water -

purged ~ 3.5 gal.

1700 Collected Samples
(6-VOAs, 2-1L Amber, 1-500ml Poly)

1740 COCs + packed coolers for samples from 5/23, 5/22, and 5/21

1900 Left site for Fed-Ex

End of Day
5/23/05
Matt Warner

Location: EDR Date: 5/23/05

Project / Client: 1/4 sampling 2005

M. Warner / C. Stephens

Location Date

Project / Client

Purge Chart

Well	Date	Time	Temp	pH	ORP	Cond.	DO	Turb.
N6-1	5/23	1648	15.51	6.93	-220.6	840	0.32	6.0
	5/23	1651	15.47	6.91	-230.8	840	0.30	6.8
	5/23	1654	15.45	6.89	-230.4	840	0.32	5.9
	5/23	1657	15.43	6.88	-231.5	840	0.31	5.8
	~~5/23~~ MW	All parameters		w/IN	10 %	~3.5 gal.		
MW-38	5/25	0759	14.98	7.18	270.6	394	2.96	60
	5/25	0802	14.95	7.03	271.9	639	2.24	32
	5/25	0805	14.95	6.82	278.0	805	2.12	20
	5/25	0808	14.97	6.68	278.0	961	2.00	13
	5/25	0811	14.98	6.62	272.7	1027	1.97	11
	5/25	0814	14.99	6.57	259.0	1086	3.79	9.8
	5/25	0817	15.00	6.56	249.3	1117	5.21	9.3
	5/25	0820	15.02	6.55	237.2	1146	5.22	8.7
	5/25	0823	15.02	6.54	224.5	1177	4.73	7.9
	5/25	0826	15.02	6.53	210.0	1205	4.30	7.7
	5/25	0829	15.01	6.53	181.6	1241	3.76	7.5
	5/25	0832	15.00	6.52	179.0	1246	3.69	7.1
	5/25	0835	15.02	6.51	176.4	1250	3.68	7.2
		All parameters		w/IN	10%	~6.0 gal		

Location _____ Date _____

Project / Client _____

Location EDR Date 5/24/05

Project / Client 1/4 Sampling 2005

M. Warner / C. Stephens

0850 Arrive @ N2-1

0900 Calibrate YSI + Turbidimeter

W.L.: 17.19 DTW

Flow Rate: ~70ml/Min @ 18.42

* Will pump dry and collect samples 5/25

0936 Well pumped dry @ 2 1/2 gal.

1020 Arrived @ N2-4

W.L.: 9.97' DTW

Flow Rate: >90 ml/min (after ~2 ft Draw-down)

* Will pump dry + collect samples 5/25

1105 Well pumped dry @ 3.0 gal.

Date

Location MWICS Date 5/24/05

Project / Client EDR 2605

1115 Arrived @ N3-1

W.L. 2.69' DTW

Location

Date

Project / Client

Location EDR MWICS Date 5/25/05

Project / Client EDR 2005

0738 Arrived @ MW-38

0744 Calibrated YSI + turbidimeter

W.L.: 4.10' DTW

Flow Rate: ~500 ml/min @ 4.56'

0759 Parameters

0827 Collected Samples
(6-VOAs, 2-1L Amber, 1-500ml poly)

0920 Arrived @ N2-4

W.L.: 10.12' DTW

Flow: ~500 ml/min

0943 Temp. 14.18 pH 6.43
ORP 248.6 DO 4.02
Cond. 1601 Turb. 37

0950 Collected Samples

Location: Date

Project / Client

Location EDR MWICS Date 5/25/05

Project / Client 2005

1005 Arrived @ N2-1

W.L. : 18.05

1023 Temp. 14.83 pH 6.75
ORP 184.2 DO 8.40
Cond. 710 Turb. 5.0

1025 Collected EDR-N2-1-052505

1140 Arrived @ W-08

W.L. 13.64' DTW

Flow Rate: >100 ml/min w/ Drawdown
will pump dry.

1300 Pumped dry @ ~8.0 gal
-will come back & sample.

1330 Went back to guard shack
to try new hose.

1335 Hose is not the problem,
will try to rent/purchase compressor
tomorrow.

Location _____ Date _____

Project / Client _____

Location MWICS EOR Date 5/25/05

Project / Client 2005

1447 Arrived @ NI-1

W.L.: 13.49' DTW

Flow Rate: 300 ml/min @ 13.77

1454 Parameters

1512 Collected samples
(6 VOAs, 2-1L Amber, 1-500ml poly)

* NOTE: Trip Blank

MWIGS EDR 2005 Date 5/25/05

Location Date

Project / Client

Well	Date	Time	Temp.	pH	ORP	Cond	DO	Turb.
N1-1	5/25	1454	16.02	6.82	212.9	994	11.56	5.3
	5/25	1457	15.68	6.66	197.3	936	11.75	5.8
	5/25	1500	15.55	6.72	183.5	926	12.00	7.7
	5/25	1503	15.54	6.73	174.6	921	11.86	6.9
	5/25	1506	15.50	6.64	173.9	915	12.01	6.1
	5/25	1509	15.51	6.62	169.9	918	12.04	6.0
		All	parameters	w/ IN	10 %	@ 2.0 gal.		
W-01D	5/26	10:26	15.42	7.04	286.6	1263	0.64	3.2
	5/26	10:29	15.46	7.02	279.6	1263	0.83	3.1
	5/26	10:32	15.56	7.02	271.9	1263	1.57	3.0
	5/26	10:35	15.48	7.00	265.9	1266	2.83	3.1
	5/26	10:38	15.49	7.00	260.7	1271	3.20	2.6
	5/26	10:41	15.56	7.00	254.3	1273	3.00	2.6
	5/26	10:44	15.67	7.00	248.5	1274	2.96	2.6
	5/26	10:47	15.58	7.00	245.6	1275	2.95	2.5

Date

Location EDR Date 5/26/05 133

Project / Client 1/4 Sampling 2Q05
M. Warner / C. Stephens

1000 Arrived @ W-01D

W.L. 2.87' DTW

Flow Rate: ~500 ml/min @ 3.05' (DTW)

1026 Began taking parameters

1050 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml poly)

1346 Arrived @ W-08 for samples

W.L.: 14.91' DTW

1350 Temp. 15.91 pH 6.97
ORP. 312.0 Cond. 1657
DO 8.85 Turb. 7.6

1355 Collected Samples
(6 VOAs, 2-1L Amber, 1-500ml)

Location _____ Date _____

Project / Client _____

Location MWICS Date 5/26/05

Project / Client EDR 2005

1510 Collected 2nd set Pump Blank
(EDR-EQ-2-052605)
* 6-VOAs, 2-1L Amber, 1-500ml

1640 Collected [redacted] Pump Blanks
(EDR-EQ-3-052605)

* 6-VOAs, 2-1L Amber, 1-500ml

NOTE: 1000 Trip Blank

Location N3-1

Date 5/27/05

2Q05

Time	Temp	mS/cm	DO	pH	ORP	NTU	Comments
1214	14.17	1.929	0.90	7.34	299.3	7.5	500 ml/min 2.30 WL
1217	15.81	1.916	0.45	7.40	289.2	6.2	"
1220	15.80	1.915	0.47	7.43	276.1	5.3	"
1223	15.80	1.915	0.46	7.44	264.3	4.5	"
1226	15.78	1.915	0.48	7.45	258.4	4.3	"
1229	15.83	1.917	0.46	7.46	251.1	3.9	"
~~1231~~							

W-290

14.64

15.36

7.5

280

Location El Dorado Date 5/27/05

Project/Client J. Collins / C. Stephens

EDR 2Q05

1030 On site, will do timesheets before going out.
1050 Pump down from yesterday.
1130 Finish loading truck
1145 Arrive @ N3-1
1201 Finish equip. calibration
1202 WL = 2.23
1211 WL = 2.30 @ 480 ml/min
1231 Collected EDR-N3-1-052705
1255 Off-site for ice, tape, etc.
1345 Back on site
1400 Arrive @ W-290
1407 WL = 18.55
1424 WL = 18.95 @ 225 ml/min
1436 WL = 19.05 can't get WL to stabilize.
1445 WL = 19.10 @ 175 ml/min
This compressor can't maintain enough air in the tank to keep flow rate constant.
1449 WL = 19.10 @ 60 ml/min
1458 WL = 19.15 @

Location: W-29D Date: 5/27/05

2Q05

Time	Temp	K	DO	pH	ORP	NTU	Comments
1458	18.77	~~[illegible]~~ 820	11.18	7.10	117.8	7.0	100 ml/min
1517	16.90	822	2.06	7.11	70.9	6.2	300 ml/min
1520	15.66	823	1.83	7.09	66.5	6.1	250 ml/min
1529	15.69	820	1.24	7.15	38.1	6.3	225 ml/min
1533	15.71	820	1.11	7.16	28.7	6.3	"
1536	15.76	821	1.01	7.17	22.8	6.2	225 ~~300~~ ml/min
1540	15.22	821	0.82	7.14	17.9	6.1	"
1543	15.47	820	0.81	7.11	17.3	6.0	"
1546	15.60	820	0.80	7.11	16.9	6.0	"

Location: JULCS EDR 2Q05 Date: 5/27/05

Project / Client: 2Q05

1513 Spoke w/ Matt, he said to increase the psi to 60 on the compressor, increase discharge and set @ 1CPM. WL = 19.30
I set psi on control box to 40 psi.
1520 WL = 19.58
1531 WL = 20.15
1534 WL = 20.30
1540 WL = 20.66
1545 WL = 20.66
1548 Collected EDR-W-29D-052705
1650 finish packing coolers, unloading truck, etc.
1703 Off-Site

Julie Coleman
6/2/05

Location: J. Collins / C. Stephens Date: 5/31/05

Project / Client: EDR 2Q05

Sunny, 75°, breezy.

Time	Temp C	V	DO	pH	ORP	NTU	Comments
1333	17.83	1.232	2.08	6.93	244.9	23	250ml/min
1337	17.75	1.233	2.93	6.97	186.1	15	mod turbid
1341	17.78	1.229	2.34	7.00	141.9	12	odor
1345	17.70	1.225	1.99	7.03	103.2	12	"
1348	17.67	1.228	1.64	7.03	68.7	10	"
1351	17.69	1.226	1.22	7.04	28.0	7.9	"
1354	17.59	1.225	1.09	7.04	13.2	7.5	"
1357	17.59	1.224	0.97	7.03	-3.3	6.7	"
1400	17.54	1.223	0.89	7.01	-15.3	6.6	"
1403	17.44	1.221	0.82	7.03	-25.8	6.6	"
1406	17.47	1.219	0.79	7.02	-31.3	5.6	"
1409	17.50	1.217	0.78	7.03	-38.6	5.5	"
1412	17.45	1.217	0.75	7.01	-40.7	5.6	"
1415	17.49	1.221	0.73	7.02	-43.4	5.6	"

N2-3

Date 5/31/05 2Q05

0930 On site w/ Chris.
1053 AES on site, need to go to site specific etc.
1200 We need to attend a conference call from 1200-1300
1317 Arrive @ N2-3.
1324 WL = 5.67
1330 Calibration finished.
1331 Pump on.
1333 WL = 5.84 @ 250 ml/min
1418 Collected EDR-N2-3-053105
1446 Arrive @ DW-33 to check in w/ AES.
1509 Arrive @ N2-2.
1517 WL = 6.64
1520 Pump on.
1521 WL = 7.10 @ 360 ml/min
1533 Very large storm moving in.
1555 Collected EDR-N2-2-053105
1601 Pump off.
1607 Dump IDW. Raining very hard, lightening, etc.
1650 Off-site

Julie Collins 5/31/05

NOTE: 0800 Trip Blank

Location N2-2 Date 5/31/05

Project / Client 2G05

Time	Temp	K	DO	ORP	pH	NTU	Comments
1523	19.17	886	3.48	159.3	6.75	60	360.8 Air
1526	18.61	887	1.46	105.7	6.91	31	Strong petro odor
1529	18.50	885	1.11	57.0	6.98	22	"
1532	18.43	883	0.91	22.4	7.02	14	"
1535	18.30	881	0.63	-18.7	7.06	13	"
1538	18.25	882	0.55	-36.2	7.09	11	"
1541	18.11	881	0.50	-42.7	7.08	11	"
1544	18.10	879	0.47	-54.6	7.09	10	"
1547	18.04	879	0.46	-58.9	7.09	10	"
1550	17.98	878	0.42	-59.4	7.09	9.7	"

Location J. Collins / C. Stephens Date 6/1/05

Project / Client Overcast, 70°, breezy
EDR 2G05

0640 Onsite for HAS mtg.
0725 Left message for Bill to update him.
0733 Left message for Ryan re: his ARF for XRF.
0735 Left message w/ Jeff @ AES to find out the status of today's work.
0740 AES on site. One new person to sit thru site specific.
0815 AES to go decon pumps and get H_2O.
0841 Spoke w/ Chris F. re: plans for the day (development, EB's, etc).
0934 Left another message w/ STL re: lack of bottles.
0938 AES back on site. Topeka Rd blocked off - had to go around.
0948 Arrive @ OW-05 to start development.
0958 Heard back from

Location JC ICS Date 6/1/05

Project / Client EDR 2905

Geopump. He'll be shipping me out 200' of tubing.

1024 Spoke w/ Ed (AES). We are going to move to OW-39 and start developing.

1058 Arrive @ OW-39.

1108 Start development.

1120 Ed (AES) on site to set pad, bollards.

1218 Spoke w/ Jeff Brammer to update him. Told him that I'm waiting for a call back from Bill as to whether to send AES home and finish develop.

1252 Spoke w/ Bill, he said to go ahead and send AES home. He said to look into getting some peristaltics for purging the new wells. I'll get back with him later.

1300 Spoke w/ Jeff Brammer, he is going to have Ed leave me a single phase pump.

1415 Off site w/ Drillers.

Location JC ICS Date 6/1/05

Project / Client EDR 2905

1450 Back on-site. Speak w/ lab re: samples coming in, etc. Unload truck.

1550 Off-site.

Julie Collins
6/1/05

Location: J. Collins | C. Stephens Date: 6/2/05

Project / Client: Sunny, breezy, 70°
EDR 2905

0650 Onsite for H&S mtg.
0730 Talk w/ Trevor re: reviewing
0800 5/6/05 KDHE letter.
0830 Trip Blank
Start sampling of equip. blank
0905 Collected EDR-EQ4-060205 (N1-1)
1040 Collected EDR-EQ5-060205 (N1-2)
1254 Arrive @ OW-05
1256 WL = 37.90 TOC
1302 Arrive @ OW-04
Spoke w/ Jason - need to call Bill re: getting a trailer for the boat
1304 OW-04 WL = 10.81
Strong petro odor in the air
1306 Left message for Bill
1307 Arrive @ OW-03
1309 WL = 14.66
1316 Arrive @ OW-39
1317 WL = 21.11
1336 Arrive @ OW-06
1337 WL = 8.15
1340 Collected EDR-EQ6-060205 (NS-1)
placed back in NS-1 ~~not placed in another well~~
1505 Collected EDR-EQ7-060205 (NS-2)
1555 Collected EDR-EQ8-060205
1745 Set pump in OW-33. 1810 offsite

Julie Collins 6/2/05

The manufacturers of "Rite in the Rain" all-weather writing products are grateful to the numerous environmental experts who have contributed to the development of this book. Should you have any additions, improvements or corrections for future publications of this field book or have suggestions for other environmental field book formats, we welcome your input.

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Common Field Data Error Codes

Error Codes Are Used to Explain Common Mistakes
and Are Written Above or Close to the Mistake
Commonly Used Error Codes Include:

- RE Recording Error
- CE Calculation Error
- TE Transcription Error
- SE Spelling Error
- CL Changed for Clarity
- DC Original Sample Description Changed After Further Evalutaion
- WO Write Over
- NI Not Initialled and Dated at Time of Entry
- OB Not Recorded at the Time of Initial Observation

Note: Error Code Should Be Circled, Dated And Initialed When Recorded.

Hazard Classifications

Class 1 Explosives
Class 2 Gas
Class 3 Flammable Liquid
Class 4 Flammable Solids (Potential spontaneous combustion, or emission of flammable gases when in contact with water)
Class 5 Oxidizing Substances and Organic Peroxides
Class 6 Toxic (poisonous) and infectious substances
Class 7 Radioactive material
Class 8 Corrosives
Class 9 Miscellaneous dangerous goods

Container type abbreviations (for sampling guidelines):

BR - Boston Round
ABR - Amber Boston Round
AJ - Amber Jug
CWM - Clear Wide Mouth
AWM - Amber Wide Mouth
Poly - Polyethylene Bottles
BOD Bottle

MWH
Monitoring Well Fluid Gauging Form
1st Quarter 2005

Site Name: El Paso El Dorado Project # 4270219
3/21/05 Weather/Temperature: Dwer cast, windy, raining, 30°

Well ID	Depth to Water	Depth to Product	Total Depth of Well	Measured Depth to Bottom	Saturated Thickness (DTB-DTW)	Time of Measurement	Comments*
N1-1	14.82		22.50	NM		1216	
W-08	16.15		22.80	NM		1208	
W-29D	20.13		80.70	NM		1222	
W-29S	15.71		24.60	NM		1225	
N2-1	16.97		24.50	NM		1238	
N4-4	16.61		23.00	NM		1245	
W-16S	8.83		21.35	NM		1309	
W-15D	27.06		130.00	NM		1318	
W-15S	16.86		22.90	NM		1315	
N5-1	15.78		23.50	NM		1326	
N5-2	14.14		28.00	NM		1449	
N3-1	1.59		78.80	NM		1429	
W-01D	1.31		92.40	NM		1433	
N4-2	18.82		28.00	NM		1443	
W-23	8.11		18.60	NM		1458	
W-01S	12.72		19.90	NM		1503	
N4-3	18.81		20.10	NM		1511	
W-26	4.42		10.67	NM		1517	
W-03	13.63		19.25	NM		1529	
N4-1	13.34		23.00	NM		1537	
N3-2	12.23		16.00	NM		1600	
N5-3	8.11		20.00	NM		1659	
N2-2	18.82		21.20	NM		1606	
N2-4	9.02		26.00	NM		1610	
W-22	17.37		18.82	NM		1616	
FINA_MW_38	4.42		19.25	NM		1620	
W-24	8.16		19.05	NM		1623	
N3-4	5.67		18.50	NM		1547	
N3-3	14.10		17.25	NM		1557	
N2-3	5.61		15.00	NM		1628	
N2-5	10.35	9.84	19.00	NM		1639	
N2-6	14.20	5.56	20.00	NM		0903	3/22/05
N6-1	5.28	5.25	23.50	NM		1706	

Comments:

Personnel: (Print Name) Julie Collins
Personnel: (Print Name) Matt Warner

MWH

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Wichita, Kansas 67207
(316) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-FINA/MW-38- 033005 **Sample Media:** Groundwater **Sample Date:** 3 /30/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1545

Purging Information

Date: 3 /30 /05	**Time Started:** 1442	**Time Completed:** 1602
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 15.9 feet below TOC	**Water Level (Feet below TOC):** 4.10	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1443	4.10	7.45	12.49	1.139	4.04	75	142.8	
1446	4.20	7.46	12.62	1.084	1.50	80	134.2	250
1449	4.20	7.44	12.77	1.059	1.11	75	126.9	
1452	4.20	7.45	12.81	1.046	0.80	45	123.9	
1455	4.20	7.45	12.86	1.029	0.80	38	117.6	250
1458	4.20	7.45	12.86	1.016	0.63	34	113.2	
1501	4.20	7.45	12.89	1.010	0.42	34	106.9	250
1506	4.20	7.43	12.88	1.041	0.28	23	99.8	
1510	4.20	7.28	12.89	1.085	0.26	20	85.2	
1513	4.20	7.23	12.91	1.124	0.28	20	69.7	
1516	4.20	7.13	12.95	1.198	0.17	17	33.2	
1519	4.20	7.08	12.99	1.275	0.17	17	13.1	
1522	4.20	7.05	13.01	1.331	0.15	15	3.1	
1526	4.20	7.03	13.07	1.384	0.15	14	-3.0	
1529	4.20	7.01	13.10	1.412	0.14	13	-6.7	
1532	4.20	7.01	13.08	1.433	0.14	13	-7.3	
1535	4.20	7.0	13.07	1.457	0.15	13	-9.8	
1538	4.20	6.99	13.10	1.470	0.14	11	-11.1	
1540	4.20	6.99	13.12	1.481	0.14	11	-14.4	
1542	4.20	6.99	13.13	1.487	0.15	11	-14.9	
1544	4.20	6.99	13.14	1.492	0.17	12	-16.0	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCL	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N1-1-032905 **Sample Media:** Groundwater **Sample Date:** 3/29/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1134

Purging Information

Date: 3/29/05	**Time Started:** 1104	**Time Completed:** 1151
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 25.1 feet below TOC	**Water Level (Feet below TOC):** 12.83	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1106	12.83	7.06	15.55	1.174	5.32	6.3	174.5	275
1109	12.84	7.02	15.31	1.174	5.06	5.4	170.5	
1112	12.84	7.01	15.35	1.172	5.01	3.9	167.6	
1115	12.86	7.00	15.27	1.174	5.14	4.8	165.8	250
1118	12.85	7.00	15.75	1.172	4.39	5.1	163.0	
1121	12.85	7.01	16.06	1.178	5.18	4.9	161.2	
1124	12.85	7.01	15.78	1.178	5.08	5.4	160.4	200
1127	12.85	7.01	15.76	1.174	5.05	5.0	159.8	
1130	12.85	7.01	15.67	1.175	5.09	3.0	158.3	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N2-1- 032905 **Sample Media:** Groundwater **Sample Date:** 3 /29 /05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 0849

Purging Information

Date: 3 /29 /05	**Time Started:** 0847	**Time Completed:** 0855
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 27 feet below TOC	**Water Level (Feet below TOC):** 16.10	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	Cumulative Volume Purged (gal)	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
0848		7.36	14.22	0.951	7.31	6.9	127.8

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N2-2- 033005 **Sample Media:** Groundwater **Sample Date:** 3 /30 /05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1320

Purging Information

Date: 3 /30/05	**Time Started:** 1255	**Time Completed:** 1335
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 23.8 feet below TOC	**Water Level (Feet below TOC):** 6.61	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	WL ~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
~~1302~~ 1300	6.90	7.03	16.88	1.164	6.01	130	-82.1
1305	6.93	7.07	16.54	1.159	4.10	60	-85.3
1308	6.93	7.05	16.50	1.154	3.91	60	-86.9
1311	6.93	7.04	16.48	1.150	4.04	70	-86.7
1314	6.93	7.04	16.39	1.147	3.93	80	-86.4
1317	6.93	7.03	16.30	1.145	3.98	80	-85.6

P.R

300

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N2-3- 032205 **Sample Media:** Groundwater **Sample Date:** 22/05/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1450

Purging Information

Date: 3/22/05	**Time Started:** 1428	**Time Completed:** 1509
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 17.4 feet below TOC	**Water Level (Feet below TOC):** ~~6.59~~ 5.59	

Actual Purge Volume: [_____ x 200 mL/min] = _____ Gallons
(Minutes) x (pump rate)

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ TD	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	
1431	5.90	7.02	11.61	1.256	1.93	36	-71.2	450
1435	5.98	7.00	12.40	1.264	1.21	16	-87.6	
1439	5.99	6.97	12.35	1.261	0.80	11	-90.1	~~225~~ 202
1442	5.99	6.96	12.41	1.261	0.59	8	-91.5	
1445	5.99	6.95	12.40	1.260	0.57	7.2	-91.3	
1448	5.99	6.95	12.48	1.258	0.54	7.2	-91.5	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N2-4- 032405 **Sample Media:** Groundwater **Sample Date:** 3/24/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1513

Purging Information

Date: 3/24/05	**Time Started:** 1508	**Time Completed:** 1519
Method: Bladder Pump – Purge		**Casing Diameter** 2"
Construct. Well Depth: 28 feet below TOC	**Water Level (Feet below TOC):** 8.66	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
1512	8.66	6.92	13.94	1.897	3.87	100	-60.1

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N2-6-_____ **Sample Media:** Groundwater **Sample Date:** ____/____/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** _____

Purging Information

Date: ____/____/05	**Time Started:** _____	**Time Completed:** _____
Method:		**Casing Diameter** 2"
Construct. Well Depth: 19.8 feet below TOC	**Water Level (Feet below TOC):**_____	
Actual Purge Volume: [_____ x _____mL/min] = _____Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	Cumulative Volume Purged (gal)	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** ____ Cost Code: ____
I.D.: EDR-N3-1- 032305 **Sample Media:** Groundwater **Sample Date:** 3 / 23 /05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1502

Purging Information

Date: 3 / 23 /05	**Time Started:** 1418	**Time Completed:** 1518
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 81.2 feet below TOC	**Water Level (Feet below TOC):** 1.74	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	WL Cumulative Volume Purged (gal)	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / (mg/L)	Turbidity (NTUs)	ORP (mV)	P.R.
1430	1.75	7.50	12.36	2.351	2.67	4.2	97.0	200
1433	1.75	7.40	12.44	2.343	1.11	4.2	43.2	
1436	1.75	7.37	12.57	2.343	0.49	2.7	-31.9	
1439	1.75	7.36	12.55	2.341	0.35	2.5	-31.8	
1442	1.75	7.36	12.49	2.338	0.18	2.2	-43.8	
1445	1.75	7.35	12.51	2.336	0.16	1.7	-46.8	200
1448	1.75	7.36	12.51	2.333	0.18	1.5	-49.8	100
1451	1.75	7.34	12.69	2.333	0.14	2.1	-53.6	
1454	1.75	7.34	13.06	2.324	0.09	2.3	-58.4	
1457	1.75	7.30	13.11	2.328	0.10	0.85	-59.4	
1500	1.75	7.34	12.94	2.332	0.10	0.60	-60.1	100

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

111 South Whittier, Suite 5100
Wichita, Kansas 67207
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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N3-2- 033005 **Sample Media:** Groundwater **Sample Date:** 3 /30/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1134

Purging Information

Date: 3 /30/05	**Time Started:** 1052	**Time Completed:** 1155
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 18.34 feet below TOC	**Water Level (Feet below TOC):** 11.98	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	WL Cumulative Volume Purged (gal)	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.L.
1104								
~~1106~~	12.15	7.09	13.03	1.581	1.83	37	-91.6	250
1108	12.24	7.09	12.97	1.643	0.77	40	-100.6	225
1114	12.18	7.09	12.90	1.654	0.55	36	-105.6	
1118	12.20	7.09	12.85	1.655	0.49	33	-110.4	225
1122	12.20	7.09	12.80	1.654	0.54	27	-113.3	
1126	12.20	7.09	12.78	1.655	0.51	22	-113.8	
1130	12.20	7.09	12.76	1.655	0.55	19	-115.9	225

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N3-3- 032505 **Sample Media:** Groundwater **Sample Date:** 3/25/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 0952

Purging Information

Date: 3/25/05	**Time Started:** 0926	**Time Completed:** 1008
Method: Bail		**Casing Diameter** 2"
Construct. Well Depth: 19.4 feet below TOC	**Water Level (Feet below TOC):** 12.82	
Actual Purge Volume: [_____ (Minutes) x _____ mL/min (pump rate)] = _____ Gallons		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	Cumulative Volume Purged (gal)	pH 6.78	Temperature (degrees, Celsius) 10.96	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
0933	0	~~4.72~~	~~8.19~~	1.842	2.56	36	-79.4
0937	0.8	6.95	11.06	1.893	1.70	>1000	-88.9
0939	1.8	7.02	11.27	1.921	0.68	"	-104.6
0942	2.3	6.99	10.87	1.924	2.06	>1000	-88.8

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy (Cloudy) black Odor (circle one) None Strong (Weak) tr. med.

MWH

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Wichita, Kansas 67207
(327) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N3-4- 032905 **Sample Media:** Groundwater **Sample Date:** 3/29/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1442

Purging Information

Date: 3/29/05	**Time Started:** 1408	**Time Completed:** 1503
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 21 feet below TOC	**Water Level (Feet below TOC):** 5.30	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1412	5.30	6.37	14.75	4.120	1.93	210	10.0	250
1417	5.30	6.35	14.61	4.138	0.58	75	1.5	225
1420	5.30	6.35	14.71	4.132	0.66	38	-0.9	250
1423	5.30	6.34	14.86	4.133	0.62	25	-2.8	
1426	5.30	6.37	14.92	4.132	0.72	20	-5.0	
1429	5.30	6.38	14.98	4.120	0.78	23	-6.8	
1432	5.30	6.39	14.98	4.110	1.00	24	-9.1	
1435	5.30	6.40	15.00	4.101	1.01	23	-10.0	
1438	5.30	6.41	15.04	4.086	1.08	24	-10.8	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: ___
I.D.: EDR-N4-1- 032905 **Sample Media:** Groundwater **Sample Date:** 3 /29/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** _____

Purging Information

Date: 3 /29/05	**Time Started:** 0822	**Time Completed:** 0830
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 25.4 feet below TOC	**Water Level (Feet below TOC):** 13.63	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/l	Turbidity (NTUs)	ORP (mV)
0823		7.12	14.94	1.274	2.68	11	139.5

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N4-2- 032305 **Sample Media:** Groundwater **Sample Date:** 3/23/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1152

Purging Information

Date: 3/23/05	**Time Started:** 1127	**Time Completed:** 1204
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 30.5 feet below TOC	**Water Level (Feet below TOC):** 18.92	

Actual Purge Volume: [_____ (Minutes) x 250 mL/min (pump rate)] = _____ Gallons

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1132	19.10	7.02	13.49	2.777	0.60	10	21.9	250
1135	19.03	7.01	13.56	2.792	0.24	7.6	7.6	250
1138	19.03	7.02	13.64	2.788	0.20	3.7	4.6	
1141	19.03	7.03	~~14~~ 13.72	2.790	0.19	2.6	3.8	
1144	19.03	7.02	13.73	2.790	0.22	3.3	3.4	250
1147	19.03	7.03	13.72	2.789	0.21	4.4	2.9	
1150	19.03	7.02	13.80	2.787	0.23	2.7	2.8	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N4-3- 032405 **Sample Media:** Groundwater **Sample Date:** 3 / 24 /05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 0835

Purging Information

Date: 3 / 24 /05	**Time Started:** _____	**Time Completed:** _____
Method: Bail		**Casing Diameter** 2"
Construct. Well Depth: 22.5 feet below TOC	**Water Level (Feet below TOC):** _____	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
0830		7.08	12.29	0.815	6.63	160	156.2

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N4-4- 032805 **Sample Media:** Groundwater **Sample Date:** 3 /28 /05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1620

Purging Information

Date: 3 /28 /05	**Time Started:** 1602	**Time Completed:** 1634
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 26.3 feet below TOC	**Water Level (Feet below TOC):** 15.09	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
1604	15.09	6.96	15.08	1.512	3.97	6.1	113.7
1608	15.09	6.95	14.21	1.185	2.65	5.4	88.7
1611	15.09	6.92	13.94	1.123	2.84	4.8	101.8
1614	15.09	6.92	13.90	1.110	2.91	4.8	110.9
1617	15.09	6.93	13.89	1.107	3.01	3.9	116.5
1620	15.09	6.93	13.87	1.107	3.10	3.7	120.5
1623	15.09	6.93	13.98	1.107	3.04	3.4	123.0

P.R. 480

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N5-~~2~~1- 032505 **Sample Media:** Groundwater **Sample Date:** 3/25/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** _____

Purging Information

Date: 3/25/05	**Time Started:** 1548	**Time Completed:** 1627
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 30.4 feet below TOC	**Water Level (Feet below TOC):** 15.51	

Actual Purge Volume: [_____ (Minutes) x _____ mL/min (pump rate)] = _____ Gallons

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WC	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
1554	15.60	6.90	12.49	1.794	1.84	10	104.9
1557	15.67	6.91	12.31	1.793	2.01	9.2	105.9
1600	15.68	6.94	12.98	1.795	2.12	9.9	107.2
1603	15.65	6.93	12.75	1.795	2.44	9.7	108.0
1606	15.65	6.95	12.51	1.795	2.47	11	109.5
1609	15.65	6.96	12.46	1.796	2.51	11	110.5

P.R. 150

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: ___
I.D.: EDR-N5-~~2~~ 032805 **Sample Media:** Groundwater **Sample Date:** 3 ~~28~~ /05	**Personnel:** Julie Collins Jc Matt Warner **Sample Time:** ~~1355~~ 1354

Purging Information

Date: 3 ~~28~~ /05	**Time Started:** 1314	**Time Completed:** 1500
Method: Bladder Pump		Jc **Casing Diameter** 2"
Construct. Well Depth: 25.5 feet below TOC	**Water Level (Feet below TOC):** ~~13.63~~ 13.26	

Actual Purge Volume: [_____ (Minutes) x 200 mL/min (pump rate)] = _____ Gallons

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	WL ~~13.26~~ Cumulative Volume Purged (gal)	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / (mg/L)	Turbidity (NTUs)	ORP (mV)	P.R.
1318	13.26	7.29	15.23	2.929	2.24	110	11.9	175
1321	13.25	7.37	15.57	2.821	4.41	60	-2.9	200
1325	13.24	7.41	15.61	2.810	4.70	50	-13.0	
1329	13.24	7.50	15.60	2.789	5.63	45	-23.6	
1332	13.24	7.55	15.63	2.779	6.06	39	-21.5	
1335	13.24	7.65	15.79	2.763	6.52	38	-15.4	
1338	13.24	7.70	15.77	2.760	6.47	32	-5.2	200
1341	13.24	7.78	15.57	2.759	7.54	31	12.6	
1344	13.24	7.79	15.56	2.756	7.67	32	15.6	
1347	13.24	7.82	15.54	2.750	7.69	29	17.0	
1350	13.24	7.85	15.50	2.751	7.64	29	18.0	
1353	13.24	7.87	15.51	2.752	7.58	28	18.4	200

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

MS/MSD				
Dup	@ ~~1340~~	@ 1355		

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N5-3- 032305 **Sample Media:** Groundwater **Sample Date:** 3 /23 /05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1042

Purging Information

Date: 3 /23 /05	**Time Started:** 1007	**Time Completed:** 1109
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 22.9 feet below TOC	**Water Level (Feet below TOC):** 5.93	

Actual Purge Volume: [_____ (Minutes) x 250 mL/min (pump rate)] = _____ Gallons

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1016	6.20	7.19	11.90	2.004	5.82	180	-104.2	450
1017	6.23	7.25	11.63	2.014	0.97	80	-88.4	325
1022	6.22	7.26	11.74	2.013	0.25	65	-96.4	250
1026	6.22	7.25	11.65	2.010	0.18	70	-105.3	250
1029	6.22	7.26	11.65	2.009	0.17	65	-108.5	
1032	6.22	7.25	11.65	2.006	0.36	60	-110.2	
1035	6.22	7.26	11.60	2.005	0.26	55	-112.0	
1038	6.22	7.26	11.57	2.003	0.24	50	-114.3	
1041	6.22	7.25	11.61	2.003	0.23	50	-115.9	250

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-N6-1-_____ **Sample Media:** Groundwater **Sample Date:** ____/____/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** _____

Purging Information

Date: ____/____/05	**Time Started:** _____	**Time Completed:** _____
Method: Bladder Pump		**Casing Diameter** 2"
Construct. Well Depth: 25.6 feet below TOC	**Water Level (Feet below TOC):** _____	
Actual Purge Volume: [_____ x _____mL/min] = _____Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	Cumulative Volume Purged (gal)	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-01D- 032505 **Sample Media:** Groundwater **Sample Date:** 3/25/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1455

Purging Information

Date: 3/25/05	**Time Started:** 1424	**Time Completed:** 1511
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 94.2 feet below TOC	**Water Level (Feet below TOC):** 1.20	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
1428	1.58	7.17	12.52	1.542	7.30	50	15.7
1433	1.58	7.15	12.47	1.523	5.61	13	-4.4
1436	1.58	7.16	12.47	1.522	4.23	6	-8.0
1439	1.58	7.16	12.46	1.526	5.60	3.6	-12.7
1444	1.58	7.16	12.47	1.528	4.43	1.8	-14.2
1448	1.58	7.16	12.46	1.530	4.75	2.1	-15.3
1452	1.58	7.16	12.44	1.533	4.38	2.7	-15.8

P.R. 300

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-01S- 032505 **Sample Media:** Groundwater **Sample Date:** 3 /25 /05	**Personnel:** Julie Collins Matt Warner **Sample Time:** _____

Purging Information

Date: 3 /25/05	**Time Started:** 1039	**Time Completed:** 1227
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 20 feet below TOC	**Water Level (Feet below TOC):** 12.10	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1045	12.17	6.90	11.88	1.528	3.24	100	-8.1	200
1050	12.15	6.86	11.59	1.525	2.47	14	-11.2	200
1054	12.15	6.77	11.59	1.524	2.09	6.4	-9.9	
1057	12.15	6.86	11.61	1.524	1.87	4.7	-14.4	200
1100	12.15	6.86	11.65	1.524	1.63	3.6	-15.3	
1103	12.15	6.85	11.59	1.524	1.48	3.2	-15.3	
1106	12.15	6.85	11.61	1.525	1.20	3.0	-15.5	
1109	12.15	6.84	11.57	1.525	1.20	3.3	-15.2	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-03- 033005 **Sample Media:** Groundwater **Sample Date:** 3 30 /05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1411

Purging Information

Date: 3 30 /05	**Time Started:** 1349	**Time Completed:** 1430
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 20 feet below TOC	**Water Level (Feet below TOC):** 13.20	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	WL ~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1352	13.40	5.65	13.33	3.818	4.23	36	156.6	200
1355	13.20	5.70	13.31	3.814	3.76	30	179.5	
1358	13.22	5.69	13.49	3.809	3.43	20	192.5	200
1401	13.22	5.68	13.77	3.787	3.23	15	204.5	
1404	13.22	5.68	13.73	3.809	3.20	13	208.3	
1407	13.22	5.68	13.77	3.802	3.18	11	210.1	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

Leak
(301) 475-7135

MWH

111 South Whittier, Suite 5100
Wichita, Kansas 67207
(339) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-08- 033005 **Sample Media:** Groundwater **Sample Date:** 3 / 30 /05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1012

Purging Information

Date: 3 /30 /05	**Time Started:** 0933	**Time Completed:** 1039
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 23 feet below TOC	**Water Level (Feet below TOC):** 12.74	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R
0937	13.05	7.29	13.41	1.727	6.81	34	154.1	
0942	13.21	7.31	12.96	1.647	7.67	15	166.2	
0946	13.25	7.32	12.71	1.627	7.24	9.9	172.3	150
0950	13.25	7.32	12.65	1.618	7.55	10	173.4	
0954	13.33	7.32	12.51	1.617	8.38	8.6	176.3	
0959	13.42	7.32	12.36	1.619	8.61	8.0	179.3	75-10
1003	13.42	7.30	12.15	1.616	8.67	7.3	181.6	
1007	13.42	7.31	12.04	1.613	8.62	8.2	182.7	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

111 South Whittier, Suite 5100
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(340) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-15D- 032805 **Sample Media:** Groundwater **Sample Date:** 3/28/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1027

Purging Information

Date: 3/28/05	**Time Started:** 0945	**Time Completed:** 1045
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 129 feet below TOC	**Water Level (Feet below TOC):** 26.35	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
0947	26.37	6.81	15.15	3.397	1.56	15	37.1	150
0950	26.35	6.89	15.12	3.765	1.80	20	-0.3	200
0953	26.35	7.00	15.13	4.004	1.61	27	-34.8	
0956	26.35	7.03	15.19	4.120	1.30	33	-49.1	
0959	26.35	7.08	15.18	4.217	1.04	36	-63.0	
1002	26.35	7.11	15.34	4.256	0.73	45	-69.1	200
1005	26.35	7.10	15.28	4.236	0.61	45	-63.8	
1008	26.35	7.07	15.51	4.196	0.48	45	-58.7	
1011	26.35	7.07	15.50	4.173	0.43	45	-53.3	200
1014	26.35	6.98	15.59	4.103	0.38	45	-43.2	B.11
1021	26.35	7.00	15.44	4.012	0.32	39	-43.0	
1024	26.35	6.96	15.39	3.961	0.31	36	-42.5	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear (sl. Cloudy) Cloudy Odor (circle one) (None) Strong Weak

MWH

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(341) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-15S- 032805 **Sample Media:** Groundwater **Sample Date:** 3 /28/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1114

Purging Information

Date: 3 /28/05	**Time Started:** 1054	**Time Completed:** 1130
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 23 feet below TOC	**Water Level (Feet below TOC):** 15.76	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / (mg/L)	Turbidity (NTUs)	ORP (mV)	P.P.
1057	15.76	6.98	14.78	1.273	4.16	13	125.1	450
1100	15.76	6.96	14.98	1.249	3.87	5.6	123.0	
1103	15.76	6.97	14.72	1.248	3.60	3.3	121.0	500
1106	15.76	6.94	14.74	1.236	3.58	3.7	123.2	550
1109	15.76	6.96	14.61	1.237	3.57	4.0	123.6	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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(342) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-16S- 032405 **Sample Media:** Groundwater **Sample Date:** 3/24/05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 0923

Purging Information

Date: 3/24/05	**Time Started:** 0903	**Time Completed:** 0945
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 21.4 feet below TOC	**Water Level (Feet below TOC):** 4.02	
Actual Purge Volume: [_____ (Minutes) x 200 mL/min (pump rate)] = _____ Gallons		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
0905	4.02	6.88	11.60	0.783	1.82	45	181.7	350
0908	4.25	6.88	11.55	0.783	1.57	43	181.3	250 350
0911	4.30	6.87	11.42	0.783	0.88	4.6	180.1	200
0914	4.30	6.86	11.41	0.782	0.74	1.9	178.1	
0917	4.30	6.86	11.34	0.783	0.72	1.7	177.5	200
0920	4.30	6.86	11.27	0.782	0.71	1.7	176.3	200

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-22- 032405 **Sample Media:** Groundwater **Sample Date:** 3 /24 /05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1050

Purging Information

Date: 3 /24 /05	**Time Started:** _____	**Time Completed:** _____
Method: Bail		**Casing Diameter** 4"
Construct. Well Depth: 18.9 feet below TOC	**Water Level (Feet below TOC):** 15.74	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
1046	15.74	6.74	13.34	1.037	1.67	50	-99.4

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-23- 032905 **Sample Media:** Groundwater **Sample Date:** 3 /29/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1333

Purging Information

Date: 3 /29 /05	**Time Started:** 1312	**Time Completed:** 1354
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 18.8 feet below TOC	**Water Level (Feet below TOC):** 7.18	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ WL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1316	7.25	7.20	15.24	0.780	7.06	7.6	127.8	150
1319	7.22	7.13	15.73	0.791	6.70	5.4	130.7	175
1322	7.22	7.12	15.78	0.801	7.74	3.3	134.5	175
1325	7.22	7.12	15.95	0.803	7.72	2.9	135.0	
1328	7.22	7.18	15.81	0.807	7.69	2.0	132.4	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-24- 032205 **Sample Media:** Groundwater **Sample Date:** 3 /22/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1351

Purging Information

Date: 3 /22/05	**Time Started:** 1310	**Time Completed:** 1408
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 19.1 feet below TOC	**Water Level (Feet below TOC):** 7.24	

Actual Purge Volume: [_____ (Minutes) x 260 mL/min (pump rate)] = _____ Gallons

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	TD ~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	mL/min
1332	7.34	6.98	11.77	1.217	1.16	2.3	-71.2	250
1335	7.32	6.99	11.75	1.223	3.82	1.7	-72.6	
1338	7.32	6.98	11.81	1.220	3.85	1.0	-72.8	
1342	7.32	6.98	11.81	1.214	4.51	1.1	-72.0	260
1346	7.32	6.98	11.91	1.204	4.66	2.2	-72.8	
1349	7.32	6.98	11.98	1.199	4.62	0.95	-73.8	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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Wichita, Kansas 67207
(346) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-26- 032205 **Sample Media:** Groundwater **Sample Date:** 03 / 22 /05	**Personnel:** Julie Collins, Matt Warner **Sample Time:** 1630

Purging Information

Date: 3 / 22 /05	**Time Started:** 1550	**Time Completed:** 1652
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 10.8 feet below TOC	**Water Level (Feet below TOC):** 2.98	
Actual Purge Volume: [_____ (Minutes) x 125 mL/min (pump rate)] = _____ Gallons		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~ FDWL	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	mL/Min
1554	3.11	6.01	8.31	0.951	7.04	14	38.6	250
1559	3.24	6.79	8.21	0.897	0.82	13	15.1	
1603	3.23	6.76	8.05	0.892	0.56	11	-0.8	220
1607	3.23	6.76	7.98	0.891	0.47	8.8	-9.3	
1610	3.23	6.76	8.00	0.890	0.44	7.2	-15.3	125
1613	3.23	6.76	8.00	0.889	0.40	7.0	-18.5	
1616	3.23	6.76	7.97	0.889	0.40	7.2	-22.2	
1619	3.23	6.76	7.97	0.888	0.40	6.7	-25.2	
1622	3.23	6.76	7.94	0.888	0.40	6.7	-26.2	
1625	3.23	6.77	7.96	0.889	0.44	7.8	-28.4	
1628	3.23	6.77	7.94	0.888	0.41	7.1	-27.6	

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

111 South Whittier, Suite 5100
Wichita, Kansas 67207
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Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-29D- 032405 **Sample Media:** Groundwater **Sample Date:** 3/24/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1409

Purging Information

Date: 3/24/05	**Time Started:** 1332	**Time Completed:** 1440
Method: Bladder Pump		**Casing Diameter** 4"
Construct. Well Depth: 80.6 feet below TOC	**Water Level (Feet below TOC):** 14.64	
Actual Purge Volume: [_____ (Minutes) x _____ mL/min (pump rate)] = _____ Gallons		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	WL ~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)	P.R.
1336	14.64	6.95	13.59	0.982	3.38	14	184.4	200
1339	15.0	6.92	13.72	0.984	2.41	10	177.7	
1346	15.19	6.90	13.67	0.985	1.40	5.1	160.3	100
1353	15.35	6.90	13.70	0.982	1.21	3.1	155.2	75
1357	15.35	6.90	13.58	0.983	1.19	1.1	154.2	~~50~~ 50
1401	15.35	6.90	13.61	0.981	1.19	3.0	153.8	
1405	15.35	6.90	13.66	0.980	1.20	3.1	152.9	~~50~~ 75

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

MWH

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(348) 689-4270

Project: El Dorado Refinery, El Dorado, Kansas	**Project Number:** _____ Cost Code: _____
I.D.: EDR-W-29S- 032405 **Sample Media:** Groundwater **Sample Date:** 3 /24/05	**Personnel:** Julie Collins Matt Warner **Sample Time:** 1137

Purging Information

Date: 3 /24/05	**Time Started:** _____	**Time Completed:** 1137
Method: Bail		**Casing Diameter** 4"
Construct. Well Depth: 24.9 feet below TOC	**Water Level (Feet below TOC):** 12.92	
Actual Purge Volume: [_____ x _____ mL/min] = _____ Gallons (Minutes) x (pump rate)		

Water Quality During Purging (Instruments Used: YSI 556 MPS, Lamotte 2020 Turbidity Meter)

Time	~~Cumulative Volume Purged (gal)~~	pH	Temperature (degrees, Celsius)	Conductivity (mS/cm)	DO % / mg/L	Turbidity (NTUs)	ORP (mV)
1135	12.92	6.93	12.55	0.780	4.60	85	124.4

Sampling Information

Sample Container	Preservative	Analysis Required	Method Number	Laboratory
3 x 40 ml vials	4° C, HCl	BTEX + 1,2-DCA	Method 8260B	STL
3 x 40 ml vials	4° C, HCl	TPH-GRO	Method 8015M	STL
2 x 1L Amber	4° C, HCl	TPH-DRO	Method 8015M	STL
1 x 500 mL plastic	4° C, HNO_3	Metals	Method 6010B	STL

QA/QC Information

Field Parameter Information

Appearance (circle one) Clear sl. Cloudy Cloudy Odor (circle one) None Strong Weak

J. Collins / M. Warner 3/21/05
overcast, windy, raining, 31° EDR 1Q05
0940 Onsite w/ Matt to
collect water levels.
Water levels are
recorded on field sheets.
1708 Finished collecting WLs.
Go back to site.
1731 Off-site to unload.

Julie Collins
3/21/05

NOTE: 0900 Trip Blank

2-BTEX VOAs
2-GRO VOAs

J. Collins/Matt Warner 3/22/05
32°, raining, windy EDR1Q05
0740 Arrive @ Wal Mart for sampling supplies.
0805 On site, meet w/ Matt. Raining hard, very muddy.
0820 Organize equipment. YSI's did not arrive yesterday, FedEx shipped them to the wrong address.
1021 Matt off-site to meet w/ Jason to give him the product probe, pick up his YSI. Matt will stop and get rain gear on his way back. I'll finish organizing coolers, calibrate turb. meter, etc.
1053 Finished sorting coolers and equipment and calib. turb. meter.
1125 Matt back on site w/ YSI.
1133 Calibrate YSI
1200 Off-site
1230 On-site.
1247 Finish loading truck
1249 Arrive @ W-24, set up

JC / MW 3/22/05
EDR 1Q05

1307 W-24 WL = ~~2~~ JC 7.24
1351 Collected EDR-W-24-032205
6 VOAs, 1-500mL, 2-1L Amber
1420 Arrive @ N2-3
WL = 5.59
1450 Collected EDR-N2-3-032205
6 VOAs, 1-500mL, 2-1L Amber
1525 Pick up bottles, ice, buckets
1540 Arrive @ W-26.
1549 WL = 2.98
1630 Collected EDR-W-26-032205
6 VOAs, 1-500mL, 2-1L Amber
1710 Back on site to pick up IDW to dump in WWTP, unload equip, etc. Matt has to meet w/ Jason to give back JC ~~to~~ the YSI.
1726 Finish unloading truck.
1735 Off-site.

Julie Collins
3/22/05

Sarah Richards
(515) 253-0830

NOTE: 0800 Trip Blanks

JC ~~X~~ 2 VOAs BTEX
2 VOAs GRO

(801) 617-3200

J. Collins / M. Warner 3/23/05
Breezy, overcast, 32° EDR 1Q05
0720 On-site. Matt will load the truck while I get spreadsheet formatted for leak (well status summary)
0830 Arrive @ N4-3
0834 WL = 14.49
Will bail dry and sample tomorrow.
0835 Start bailing
0900 End bailing
Purged ≈ 3 gal
0905 Arrive @ W-16S.
0909 W-16S WL = 5.02
0912 Pump on - will just bail dry and sample tomorrow.
0948 Pump off. Well is barely drawing down w/ pump on high. Will attempt low-flow later.
0955 Arrive @ NS-3
0957 WL = 5.93
1005 Finish checking calibrations
1042 Collected EDR-NS-3-032305
6 VOAs, 2-1L Amber, 1-500ml

JC/MW

3/23/05
EDR 1Q05

1116 Arrive @ N4-2
WL = 18.92
1152 Collected EDR-N4-2-032305
Levoqs, 1-500ml, 2-1L Amber
1214 Back on site to dump IDW.
1235 Off-site for ice and lunch.
1301 Back on site - load more bottle sets, ok.
1348 Finished talking w/ Chris re: the 4Q04 EDR Report.
1349 I called Ken Moosman to have him write a brief summary of QAQC (ie: usability of data, etc.) Left him a message. Called Brian Buttars and left message.
1410 Spoke w/ Ryan about Excell graphs in report.
1413 Arrive @ N3-1
WL = 1.74
1440 Start bailing W-22
1445 Bailed dry - will sample tomorrow ≈ 4 gal

JC/MW 3/23/05

EDR 1Q05

1500 ~~Sam~~ Collected EDR-N3-T030305

(6 vocs, 1-500ml, 2-1L Amber)

1530 spoke w/ Bill, KDHE had added some metals and MTBE

1531 Arrive @ W-29S/D

1533 W-29S WL = 12.75

1534 W-29D WL = 14.25

1536 Pump on to purge W-29D to pump intake. Will bail W-29S dry.

1620 W-29S bailed dry @ 15 gal

W-29D is not purging dry (same as W-16S)

- higher WL in more perm. zone? will attempt low flow tomorrow

1623 W-29D WL = 21.60.

1624 Pump off.

1635 Arrive @ N2-4

1638 WL = 8.74

1639 Start pump

H_2O orange, strong petroleum odor.

JC / MW

3/23/05
EOR 1Q05

1650 Spoke w/ Melissa @ STL to let her know of the additional metals and MTBE to be analyzed for.
1650 Purged dry @ 3gal.
1705 Dump IDW
1755 Finish packing samples, unloading truck, etc. Matt will take 2 coolers to FedEx.
1800 Off-site.

Julie Collins
3/23/05

NOTE: 0830 Trip Blank

2 VOAs BTEX
2 VOAs GRO

J. Collins / M. Warner 3/24/05
Cloudy, breezy, 32° EDR 1205
0745 On site, truck is loaded.
0820 Finish calibrating equipment.
0835 Collected EDR-N4-3-032405
6 VOAs, 1-500ml, 2-1L Amber
0855 Arrive @ W-165, will attempt low-flow
WL = 4.02
0923 Collected EDR-W-165-032405
6 VOAs, 1-500ml, 2-1L Ambers
0950 Back on site to dump IDW
1015 Dump IDW, talk w/ Trevor
1038 Arrive @ W-22
1039 WL = 15.74
1105 Dump IDW from W-22.
1121 Arrive @ W-295
1124 W-295 WL = 12.92
NOTE: 1050 Collected
EDR-W-22-032405
6 VOAs, 1-500ml, 2-1L Ambers
1137 Collected EDR-W-295-032405
6 VOAs, 1-500ml, 2-1L Amber
1220 Off-site for ice, etc.
1315 Back on site.
1323 Arrive @ W-290. Will attempt to low flow.

JCIMW 3/24/05
EDR 1205

1328 W-29D WL = 14.64
1409 Collected EDR-~~29~~W-29D-032405
6 vOAs, 1-500ml, 2-1L Amber
1457 Pick up more bottles
1459 Arrive @ N2-4
WL = 8.66
1513 Collected EDR-N2-4-032405
6 vOAs, 1-500ml, 2-1L Amber
1540 Finish unloading equip.
and get pumps to install.
1542 Arrive @ N4-1
Install serial # 051667
1552 Arrive @ N5-1
serial # 051674
1557 Arrive @ N5-2
serial #
Wrong size cap.
1610 Back @ site to pack
samples
1700 Finish packing samples.
1705 Off-site to go to office
and Wichita site.
1815 Leave Wichita site.

Julie Collins
3/24/05

19.4
12.5

NOTE: 0920 Trip Blank

2 voas BTEX
2 voas GRO

J. Collins / M. Warner 3/25/05
36°, overcast, breezy EDR 1Q05
0740 On site. Check in.
Timesheets etc.
0917 Arrive @ N3-3
WL = 12.82
PV = 2.3 gal
0952 Collected EDR-N3-3-032505
6 voas, 1-500ml, 2-1L Amber
1029 Arrive @ W-015D
1034 W-015 WL = 12.10
1110 Collected EDR-W-015-032505
6 voas, 1-500ml, 2-1L Amber
EDR-W-015-MS-032505
6 voas, 1-500ml, 2-1L Amber
EDR-W-015-MSD-032505
6 voas, 1-500ml, 2-1L Amber
1115 Collected EDR-W-015-SD-032505
6 voas, 1-500ml, 2-1L Amber
1250 Off-site for lunch and ice.
1346 Back on-site, unload samples, get more bottles
1415 Arrive @ W-01D.
WL = 1.26
1455 Collected EDR-W-01D-032505
6 voas, 1-500ml, 2-1L Amber

JC1MW

3/25/05
EDR 1@05

1519 Dumped IDW.
1524 Arrive @ N4-1
~~WL~~ Will sample on Monday.
1539 Arrive @ N5-~~2~~ 1
1544 WL = 15.51
1614 Collected EDR-N5-1-032505
6 VOAs, 1-500 ml, 2-1L Amber
1635 Back on site to unload and pack up samples.
1725 Finish packing coolers.
1735 Off site

Julie Collins
3/25/05

NOTE: 0950 Trip Blank

2 voas BTEX
2 voas GRO

15.70

Julie Collins / Matt Warner 03/28/05
35°, overcast, breezy EDR 1285
0740 On site w/ Matt.
Load up truck, etc.
Make copies of WL's and maps for Ryan.
0840 Off-site for ice and supplies.
0845 Spoke w/ Jason about getting electronic copies of the 4004 files for the reports. I told him that Sarah Richards has all the elec. files for formatting.
0930 Arrive @ W-15D.
0944 Finish calibrating equip.
0945 W-~~29~~ 15D WL = 26.35.
1027 Collected EDR-W-15D-032805
4 voas, 1-500ml, 2-1L Amber
1050 Arrive @ W-~~29S~~ 15S
1051 WL = 15.76
1114 Collected EDR-W-15S-032805
4 voas, 2-1L Amber, 1-500ml
1133 Arrive @ ~~N3-S~~ N4-1
Will purge dry and sample later.
N4-1 WL = 12.13
1139 Pump on.

JC/MW 3/28/05

EDR 1Q05

1209 Pumped dry - pump off.
≈ 3.5 gal.

1220 Back on site for more bottles, etc.

1257 ~~Dt~~ Dump IDW

1307 Arrive @ NS-2

1310 WL = ~~13.63~~ 13.26

1354 Collected EDR-NS-2-032805
6 vocs, 2-1LA, 1-500ml

1354 Collected EDR-NS-2-MS-032805
6 vocs, 2-1LA, 1-500ml

1354 Collected EDR-NS-2-MSD-032805
6 vocs, 1-500ml, 2-1LA

1355 Collected EDR-NS-2-SI-032805
6 vocs, 1-500ml, 2-1L Amber

1510 Back @ site to get more bottles.

1523 Arrive @ N2-1
Will pump dry and sample later.

1525 N2-1 WL = 14.0

1526 Begin pumping

1545 End pumping
purged ≈ 3 gal

1557 Arrive @ N4-4.

Jeff Te
(515) 771-4425

JC | MW

3/28/05
EDR 1Q05

1601 N4-4 WL = 15.09
1626 Collected EDR-N4-4-032805
6 voas, 1-500ml, 2-1L Amber
1635 Back on site.
Chris and Bill on site.
1658 Bump IDW
1704 Set pump in N1-1
1710 Unload truck and pack up samples.
1755 off-site. Matt will take coolers to FedEx.

Julie Collins
3/28/05

NOTE: 0815 Trip Blank

2 VOAs BTEX, MTBE
2 VOAs TPH-GRO

J. Collins | M. Warner 3/29/05
Cloudy, windy, 58° EDR 1905
0740 On site. Picked up ice on the way in.
0800 Finish loading truck
0812 Arrive @ N4-1
0814 N4-1 WL = 13.63
0825 Collected EDR-N4-1-032905
6 VOAs, 2-1L Amber, 1-500mL
0838 Arrive @ N2-1
0841 WL = 16.10
0849 Collected EDR-N2-1-032905
6 VOAs, 2-1L Amber, 1-500 mL
0901 Removed pump from N2-1 for use in N3-2. Recommend bailing N2-1 in the future. Slow recharge.
0907 Back @ site for bottles and met w/ Bill.
Went over schedule, etc w/ Bill.
0930 Jean Underwood on site. They will meet up with us later.
0940 Arrive @ W-08
Will purge dry and sample tomorrow.
0946 W-08 WL = 12.50

JC | MW 3/29/05

EDR 1Q05

0947 Pump on.

1044 Pump off. WL equilibrated @ 19.3' pumping @ 1L/min. Therefore, we will come back tomorrow and attempt low-flow. (WL went to 19.6' and then rose to 19.3' feet where it stabilized).

1050 Arrive @ N1-1. We will attempt low flow before purging.

1102 Spoke w/ Chris & Jason re: 4Q04 EDR report.

1103 N1-1 WL = 12.73

1104 Begin pumping.

1134 Collected EDR-N1-1-032905

6 VOAs, 1-500ml, 2-1L Amber

1157 Dumped IDW.

1300 Finished meeting w/ Bill, unloading coolers, etc.

1305 Arrive @ W-23

1308 WL = 7.18

1331 Bill on site.

1333 Collected EDR-W-23-032905.

6 VOAs, 1-500ml, 2-1L Amber

JC | MW
EDR | 9 05

1402 Arrive @ N3-4.
1408 WL = 5.04
1442 Collected EDR-N3-4-032905
(6 vocs, 1-500ml, 2-1LA.
1503 Pump off
1519 Off-site to get ice and decon water.
1543 Back on site to decon pump for N3-2.
1614 Finish decon.
1621 Set pump in N3-2.
1630 Pump IDW and decon H_2O.
1701 Finish unloading truck and packing samples.
1730 Off site. Matt will take 2 coolers to Fed Ex.

Julie Collins
3/29/05

J. Collins / M. Warner 3/30/05
overcast, windy, 40°, very windy EDR 1 Q 05
0820 On site w/ Matt. Picked up ice. Loaded truck. Spoke w/ Jason / Bill about getting bottles we are behind.
0925 Arrive @ W-08
0931 WL = 12.74
1012 Collected EDR-W-08-033005
(6 vocs, 2-1L Amber, 1-500ml
1048 Arrive @ N3-2
1051 WL = 11.98
1134 Collected EDR-N3-2-033005
(6 vocs, 2-1L Amber, 1-500ml
1250 Arrive @ N2-2
1254 WL = 6.61
1320 Collected EDR-N2-2-033005
(6 vocs, 1-500ml, 2-1L Amber
1335 Bill on site to give us bottles.
1345 Arrive @ W-03
Bill w/ us.
1349 W-03 WL = 13.20
1411 Collected EDR-W-03-03305
(6 vocs, 1-500ml, 2-1L Amber
1436 Arrive @ Final MW-38
1440 WL = 4.10

JC/MW

3/30/05
EDR 1Q05

1515 Collected EDR-Final/MW-38-0330S
6 voas, 1-500ml, 2-1LA.

NOTE: 0930 Trip Blanks
2 voas BTEX, MTBE
2 voas TPH-GRO

1608 Dump IDW, go back to pack up remaining samples.
1700 Finish packing samples, unloading truck, etc.
1705 Off-site, Matt will take coolers to FedEx

Julie Collins
3/30/05

CURVE TABLES

HOW TO USE CURVE TABLES

Table I. contains Tangents and Externals to a 1° curve. Tan. and Ext. to any other radius may be found nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and External: Divide Ext. opposite the given Central Angle by the given External.

To find Nat. Tan. and Nat. Ex. Sec. for any angle by Table I.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

EXAMPLE

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P. = 23° 20′ to the R. at Station 542+72.

Ext. in Tab. I opposite 23° 20′ = 120.87
120.87 ÷ 12 = 10.07. Say a 10° Curve.

Tan. in Tab. I opp. 23° 20′ = 1183.1
1183.1 ÷ 10 = 118.31.

Correction for A. 23° 20′ for a 10° Cur. = 0.16
118.31 + 0.16 = 118.47 = corrected Tangent.

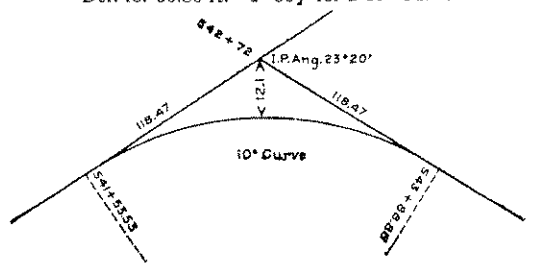
(If corrected Ext. is required find in same way)
Ang. 23° 20′ = 23.33° ÷ 10 = 2.3333 = L. C.

2° 19½′ = def. for sta.	542	I. P. = sta.	542+72
4° 49½′ = " " "	+50	Tan. =	1 .18.47
7° 19½′ = " " "	543	B. C. = sta.	541+53.53
9° 49½′ = " " "	+50	L. C. =	2 .33.33
11° 40′ = " " "	543+ 86.86	E. C. = Sta.	543+86.86

100 − 53.53 = 46.47 × 3′ (def. for 1 ft. of 10° Cur.) = 139.41′ = 2° 19½′ = def. for sta. 542.

Def. for 50 ft. = 2° 30′ for a 10° Curve.

Def. for 36.86 ft. = 1° 50½′ for a 10° Curve.



J. Collins P2/3Q05 8/2/05
Sunny, warm, 83° Sitewide WLs
0805 On site to do sitewide WL round. Trevor will take me to get the rental truck.
0920 Off site to get truck.
0958 Back on site. Load up equip, etc.
1030 Arrive @ W-155/D
1037 W-15D WL = 29.04
1040 W-155 WL = 17.85
1043 Arrive @ W-26S
1045 WL = 8.10
1049 Arrive @ W-16S
1052 WL = 15.72
1054 Arrive @ OW-07
1055 WL = 5.68
1057 Arrive @ OW-09
1058 WL = 9.62
1100 Arrive @ OW-08
1101 WL = 10.02
1102 Arrive @ N4-1
1104 DTP = 6.08
1105 WL = 6.15
1109 Pulled pump.
1112 Arrive @ N4-3
1115 WL = 19.15

JC 8/2/05
Sitewide WLs EDR P2/3Q05
1121 Arrive @ OW-10
1122 WL = 11.39
1124 Arrive @ OW-12
1131 DTP = 10.55
WL = 10.84
Product very black, heavy odor.
1133 Key stuck in lock. Will need to get another key.
1212 Put lock back on OW-12. Spoke w/ Matt Warner. He needs me to take several low-flow sampling pics (set-up, etc) for him, he's doing a presentation on Friday. Chris F. left me a message, called him back and left him a message.
1215 Arrive @ OW-06
1216 OW-06 WL = 10.24
1218 Pulled the pump.
1219 N5-3 WL = 10.74
1221 Arrive @ OW-11
1223 WL = 11.30
1224 Arrive @ N5-2
1226 WL = 15.79

JC EDR P21 3665 8/2/05

Sitewide WLs

1207 Arrive @ N5-1
1209 WL = 18.13
1230 Arrive @ N4-2
1231 WL = 19.95
1233 Arrive @ N4-1
1234 WL = 14.26
1235 Arrive @ OW-14
1236 WL = 13.80
TD = 14.00 soft bottom
1238 Arrive @ OW-13
1239 WL = 0.00
TD = ~~20.38~~ 19.57
1247 Arrive @ N4-4
1249 WL = 19.39
1254 Arrive @ N2-1
1256 WL = 17.58
1300 Arrive @ OW-16
WL = 12.23
1304 N2-4 WL = 11.15
1305 Arrive @ OW-38
1306 WL = 10.11
1307 Arrive @ OW-37
1311 DTP. 9.09
WL = 9.16
Product dark yellowish brown to brown.

JC EDR P21 3665 8/2/05

Sitewide WLs

1314 Arrive @ OW-24
1316 WL = 8.63
1410 Off-site for gas.
1451 Back on site.
1447 Arrive @ N3-3
1448 WL = 15.49
1451 Arrive @ W-01 SID / OW-25
1452 W-01S WL = 13.75
1454 W-01D WL = 4.63
1456 OW-25 WL = 11.77
1458 S-most staff gauge WL = Dry
1459 Arrive @ OW-33
1500 WL = 14.14
1501 Arrive @ N3-2
1502 WL = 13.10
1504 Arrive @ OW-32
1505 WL = 16.23
1507 Arrive @ OW-24 / OW-31
1509 OW-04 WL = 11.48
1510 OW-31 WL = 10.78
1512 Pulled pump - slight petro. odor
1515 Arrive @ OW-30
1516 WL = 15.06
1518 Pulled pump

JC EDR P213605 8/2/05
101°, hot, humid Sitewide WLs
1519 Arrive @ OW-03/N3-1/W-22
1521 W-22 WL = 17.41
1522 N3-1 WL = 4.06
1524 OW-03 WL = 14.37
1525 Arrive @ OW-29
1527 WL = 14.82
1531 Arrive @ Pester gauge
1533 WL = approx. 0.20, gauge covered in dried mud @ <1.0
1541 Arrive @ OW-39
1543 WL = 23.58
1545 Arrive @ W-29S/D
1547 W-29D WL = 24.20
1549 W-29S WL = 17.35
1556 Arrive @ N1-1
1558 WL = 15.97
1600 Arrive @ ~~OW~~ JC W-08
1601 WL = 16.65
Had to spray hornets.
1619 Arrive @ N2-5
1621 DTP = 10.37
WL = 11.19
1626 Arrive @ W-24
1629 WL = 8.78

JC EDR P213605 8/2/05
Sitewide WLs
1630 Arrive @ ~~OW~~ JC OW-23.
1632 WL = 9.00
1633 Arrive @ OW-27T
1634 WL = 9.37
1635 Arrive @ OW-28T
1636 WL = 10.85
Casing broken on one side to ground surface. Measuring point still intact. Can't close top of casing.
1639 Arrive @ N3-4
1641 WL = 7.06
1643 Arrive @ SW Pond
1646 WL = -0.95
1647 Arrive @ SE Pond
1648 WL = -3.77
1650 Arrive @ W-03
1651 WL = 13.99
1652 Arrive @ NE Pond
1653 WL = -2.40
1656 Spoke w/ Nathan @ Enterprise to let him know that I just noticed the top inside of the drivers door is severly scratched. He said ok and he'd make a note on my contract.

JC EDR P213605 WLS 8/2/05

1658 Arrive @ OW-36
1659 WL = 9.79
1700 Arrive @ OW-35
1702 WL = 3.96
1704 Arrive @ OW-21
1706 WL = 2.45
1707 Arrive @ OW-01
1709 WL = 11.11
1711 Pulled pump - moderate petro odor, tubing stained brown and grey/black
1717 Arrive @ N2-3
1719 WL = 5.86
1721 Arrive @ OW-22T
1723 WL = 9.67
1725 Arrive @ N2-2
1726 WL = 7.08
1727 Arrive @ MW-38
1729 WL = 4.59
1730 Arrive @ OW-23T
1731 WL = 8.76
1736 Arrive @ OW-18T
1738 DTP = 9.55
WL = 11.95
Product is light yellow to clear

8/2/05

JC EDR P213605 WLS

1743 Arrive @ OW-19T
1745 WL = 10.92
1749 Arrive @ OW-02
1751 WL = 8.64
1756 Arrive @ OW-25
1758 DTP = 8.65
WL = 8.88
Product is lt yellow to clear, weathered diesel.
1801 Arrive @ OW-26
1802 WL = 6.86
1804 Arrive @ N2-6
DTP = 3.96
WL = 17.84
1830 Finished unloading truck, etc.
1835 Off-site

Julie Collins
8/2/05

EDR 6/13/05
El Paso

1429 SW pond elevation point submerged. Water very oily. Water nearly to bottom rail on walk-way.
1433 NE pond WL = 1.78

Julie Collins
6/13/05

16
10
100
10

J. Collins EDR 6/14/05
El Paso
Sunny, breezy, 75° Sitewide WLs

0800 On site
0840 finish loading truck, ice on isotope samples, etc.
0900 Arrive @ W-165 spoke w/ Jason, he's going to contact STL re: 2005 data.
0920 Spoke w/ Jason & Chris F., Chris S. will come out tomorrow to help sample, they'll keep on the lab, etc.
0923 W-165 WL = 2.48 (pump)
0927 Arrive @ OW-07
0953 WL = 1.88
1002 Arrive @ OW-09, had to go back to site for another Master - this one faulty, stuck in lock.
1004 OW-09 WL = 6.29
1012 Arrive @ OW-08
1014 WL = 6.95
1015 Arrive @ NG-1 (pump)
WL = 5.82
DTP = 5.86
Strong petro odor, appears clear.

JC

Location: El Paso

Date: 6/14/05

Project / Client: EDR

Sitewide WLs

1025 Arrive @ W-15 S/D
1027 W-15D WL=24.13 (pump)
1028 Arrive @ W-15S (pump)
1030 ~~WL~~ JC W-15S WL=12.90
1040 Arrive @ W-26
1041 WL= 3.44 (pump)
1052 Arrive @ OW-10
WL needs to stabilize.
1055 Arrive @ OW-10
1057 WL=6.44 no odor
1101 OW-12 WL=4.49
1102 Arrive @ OW-06 / NS-3
1103 OW-06 WL=5.55
1105 NS-3 WL=4.87 (no pump)
1107 Arrive @ OW-11
1108 WL= 9.48
1110 Arrive @ NS-2 (pump)
1112 WL= 14.02
1115 Arrive @ NS-1 (pump)
1117 WL= 15.63
1120 Arrive @ N4-2 (no pump)
1121 WL= 18.75
1123 Arrive @ N4-1
1125 WL= 13.00 (no pump)

JC

Location: EDR

Date: 6/14/05

Project / Client: El Paso

Sitewide WLs

1126 Arrive @ OW-14 (no pump
1127 WL= 12.12
1129 Arrive @ OW-13 (no pump)
1130 WL= 0.00
TD= 19.57
1132 Arrive @ N4-3
1133 WL= 14.17
1141 Arrive @ N4-4 (pump)
1142 WL= 10.26
1150 Arrive @ N2-1
1151 WL= 11.19
1207 Arrive @ N2-4 / OW-16
1210 N2-4 WL= JC ~~N2~~ 8.27 (pump)
1212 OW-16 WL= 8.19
1213 Arrive @ OW-38
1214 WL= 6.67
1219 Arrive @ OW-37
1224 WL= 7.01
Slight petro odor, no sheen
1229 Arrive @ OW-24
1232 WL= 12.31
very strong petro odor, droplets, dk brown sheen on probe
1259 Arrive @ OW-26

JC EDR Date 6/14/05
El Paso
Sitewide WLs

1301 OW-26 WL = 4.69
1302 Arrive @ OW-25
WL = 6.65
very strong petro odor, heavy medium to dk brown sheen, product droplets on probe
1315 Arrive @ N2-5
WL = probe not measuring product - call FEI.
1325 Adjusting sensitivity knobs did not work - as suggested by FEI. Will check it in N2-6.
1345 Arrive back @ N2-5.
Probe worked fine in N2-6.
1350 N2-5 WL = 8.28 (no pump)
moderate petro odor, sheen, clear.
1353 Arrive @ Fina/MW-38
1355 WL = 3.00 slight petro odor?
1358 Arrive @ OW-23T
1359 WL = 6.74
1410 Arrive @ OW-39
1411 WL = 10.56

JC EDR Date 6/14/05 129
Location
Project / Client El Paso
Sitewide WLs

1414 Arrive @ W-29 S/D
1415 W-29S WL = 12.66 (no pump)
1417 W-29D WL = 12.93 (pump)
1420 Arrive @ W-08 (pump)
WL = 8.87 (hornet nest)
1424 Arrive @ N1-1
1425 WL = 10.02 (no pump)
1439 Arrive @ OW-01 (pump)
1442 WL = 3.59
very sl. petro odor
1445 Arrive @ OW-21
1446 WL = 1.68
1449 Arrive @ OW-35
1451 WL = 2.79
1453 Arrive @ N2-2 (pump)
1454 WL = 5.79
1457 Arrive @ OW-22
1458 WL = 8.83
1501 Arrive @ OW-18T
1503 WL = 9.15
DTP = 9.56
1506 Arrive @ N2-3
1507 WL = 5.32
1510 Arrive @ OW-02

JC
Location: EDR
Project / Client: El Paso
Sitewide WLs
Date: 6/14/05

511 OW-02 WL = 6.41
1513 Arrive @ OW-19T
1515 WL = 10.76
strong petro odor, sheen, clear.
1551 Arrive @ W-24 (pump)
1554 WL = 5.28
1555 Arrive @ W-23 (pump)
1556 WL = 5.10
1558 Arrive @ OW-27T
1559 WL = 6.60
1601 Arrive @ OW-28T
1602 WL = 8.46
1604 Arrive @ N3-4 (pump)
1606 WL = 4.31
1608 Arrive @ SE Pond loc
1609 WL = 1.94
1611 Arrive @ OW-36
1612 WL = 6.42
1614 Arrive @ W-03 (pump)
1615 WL = 11.54
1616 Arrive @ NE Pond loc
1617 WL = 1.84
1620 Arrive @ OW-29

JC
Location: EDR
Project / Client: El Paso
Sitewide WLs
Date: 6/14/05

1621 OW-29 WL = 13.11
1624 Arrive @ N-most gauge / W-22 / N3-1 / OW-03
1625 OW-03 WL = 12.38
1627 N3-1 WL = ≈ 0.25 (pump)
1629 W-22 WL = 14.35
1631 Arrive @ OW-30
1632 WL = 12.78
1634 Arrive @ OW-04 / OW-31
1636 OW-04 WL = 8.34
1638 OW-31 WL = 8.65
1639 Arrive @ middle staff gauge - high river stage from rain - staff gauge gone.
1641 Arrive @ OW-32
1642 WL = 13.52
1643 Arrive @ N3-2
1644 WL = 10.31 (no pump)
1646 Arrive @ OW-33 (pump) will pull
1647 WL = 10.96
1648 Arrive @ W-015D / OW-05 / S-most gauge
1650 OW-05 WL = 13.82
1651 ~~OW~~ W-015 WL = 10.32 (pump)

EDR
El Paso
Sitewide WLs

6/14/05

1653 W-01D WL = ≈ 0.20 (pump)
1655 S-most staff gauge = 4.65
1657 Arrive @ N3-3
1659 WL = 9.10
1701 Arrive @ N-most staff gauge - gauge gone from very high water due to last weeks' rain
1709 Arrive @ Pester gauge
1715 WL = 3.70
Lots of trees down upstream, laying over bridge, H2O was very high on banks yesterday.
1719 Arrive @ N2-6
1722 WL = ~~D+T~~ 2.69
DTW = 14.20
1750 Unload truck, etc.
1800 Off-site.

Julie Collins
6/14/05

J. Collins / C. Stephens 6/16/05
EDR El Paso
Phase 2

0725 On-site, check in, etc.
0800 Call Enterprise, don't have anything in town. Will go to Wichita w/ Chris to get truck, go pick up ice and H2O, etc.
1003 Back on site. Sort out bottles, load truck, ice samples, get H2O, etc. Will sample OW-33 then begin development on OW-05/OW-39.
1130 Arrive @ OW-33.
WL = 11.18
1140 Calibrate equipment
1151 Finish calibration.
YSI needs adapters for the flow thru cell, need to go buy the parts.
1210 Off-site to get parts for flow-thru.
1310 Back on site.
1317 Arrive @ OW-33.
Heavy poison ivy.
1320 Trip Blank

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Reservoir **Proj. Number:** 1004317 **Date:** 6/7/05
Location description: Transect #1
Sampled by: J. McNutt **Start Time:** 1300 **End Time:** 1530
J. Gonsey
Weather: Hot, windy, sunny

Temp. Water	24.56	°C	**pH**	7.70	units
Temp. Air	92	~~°C~~ F	**Sp. Cond.**	418	uS/cm
DO Sat. (%)	91.7	%	**Dis. Oxy.**	7.63	mg/L
ORP	26.4	mV	**Turbidity**	10.5	ntu

Surface water type: River
Sample Method: Van Dorn
Sample Point(s): 31 ft (from LEW)
Substrate description: rocky/silty

Stage conditions: slightly high/normal
Stream color: brown
Stream mixing: Good
Clarity: fair

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	1	**Turbidity**	1
Garbage	0	**Atms. Odor**	0
Algae Mats	1	**Oil-grease**	0
Soap suds	0	**Fish kill**	0

Other observations/biological indicators: Snake → (3 ft long greenish-tan color)
sp? Knats, red + blue dragonflies

Samples Collected: @ 1450

Comments: The ecosystem around transects #1 + #2 is much more biologically diverse than around transects #3 + #4.
(The (product) seep spots originate near #3 and continue downstream to #4.)

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6/7/05

Left Bank: 0 Right Bank: 37 Stream Width: 37 Transect #1

Sample Points:

	1	4	7	10
13	16	19	22	25
28	31 *	34	36 ~~33~~	

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
720	1	89.3	7.37	7.71	24.64	418	20.4		
	4	91.5	7.59	7.76	24.82	417	20.4		
	7	90.8	7.56	7.73	24.56	418	23.1		
	10	91.3	7.61	7.70	24.52	418	25.5		
	13	91.7	7.63	7.70	24.51	~~41.3~~	26.9	(415)	
	16	92.1	7.65	7.69	24.53	414	28.3		
	19	91.4	7.62	7.70	24.52	418	28.3		
	22	92.0	7.67	7.70	24.51	418	28.1		
	25	92.2	7.66	7.69	24.53	418	28.2		
	28	91.7	7.63	7.68	24.52	419	28.9		
	31	92.5	7.72	7.70	24.53	419	28.1		Centroid-Sample point
	34	92.8	7.72	7.68	24.55	419	29.3		
	36	93.0	7.75	7.71	24.53	419	28.3		
								10.5	
Average Field Parameter Measurements									
		91.7	7.63	7.70	24.56	418	26.4		

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/7/05

Site Description/Location: Transect # 1

Measured By: J. Gorsney / J. McNutt **Meter Type:** AA

Width: 37 ft. **Area:** 28.7 ft.² **Velocity:** 0.24 ft/sec **Discharge:** 7.64 ft³/sec.

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	0	.5	0	LEW	@ 1355					0	0
	1	1.5	.24	S	10	44.5	0.15	x.85	0.13	0.36	0.05
	3	2	.62	S	11	41.1	0.18	x.85	0.15	1.24	~~0.22~~ 0.19 JCG
	5	2	.77	.6	10	43.1	.16			1.54	0.25
	7	2	.82	.6	9	41.2	0.15			1.64	0.25
	9	2	.5	S	11	40.4	0.18	x.85	0.15	1.00	0.15
	11	2	.41	S	12	42.3	0.19	x.85	0.16	0.82	0.13
	13	2	.44	S	14	41.8	0.23	x.85	0.19	0.88	0.17
	15	2	.61	S	14	40.2	0.23	x.85	0.19	1.22	0.23
	17	2	.65	S	15	40.5	0.25	x.85	0.21	1.30	0.27
	19	2	.63	S	15	42	.24	x.85	0.20	1.26	0.25
	21	2	.71	.6	16	42.2	0.26			1.42	0.37
	23	2	.78	.6	19	40.6	0.32			1.56	0.50
	25	2	.95	~~.6~~ S	15	41	0.25	x.85	0.21	1.90	0.40
	27	2	1.00	.6	17	41.4	0.28			2.00	0.56
	29	2	1.13	.6	23	40.5	0.38			2.26	0.86
	31	2	1.4	.6	23	40.9	0.38		2.8	~~2.26~~	1.06 → sample point
	33	2	1.45	.6	21	41.6	0.34			2.90	0.99
	35	2	1.3	.6	22	40.1	0.37			2.60	0.96
	37	1.8	0	REW	@ 2	25				0	0

Comments: Staff gauge - 1.50 25% Comulative flow - 1.91

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Restoration Proj. Number: _____ Date: 6/8/05

Location description: Transect #2

Sampled by: J. Gansing Start Time: _____ End Time: _____

S. McNeil

Weather: Hot, windy, sunny, humid

Temp. Water	26.24	°F	pH	7.84	units
Temp. Air	93	°C	Sp. Cond.	463	uS/cm
DO Sat. (%)	94.5	%	Dis. Oxy.	7.63	mg/L
ORP	63.2	mV	Turbidity		ntu

Note: parameters taken from sample point

Use this

Surface water type: River

Sample Method: Van Dorn

Sample Point(s): (8' from REW)

Substrate description: rocky/silty

Stage conditions: slight high/normal

Stream color: brown

Stream mixing:

Clarity: fair

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	1	Turbidity	2
Garbage	0	Atms. Odor	0
Algae Mats	2	Oil-grease	0
Soap suds	2	Fish kill	0

Other observations/biological indicators:

Samples Collected: @ 1450 at 8 feet from REW

Comments: Staff gauge → .45 ft

~~parameters~~
~~temp → 26.24°F~~

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/2/05
Location description: Transect #2
Sampled by: J. Garnsey, J. McNutt **Start Time:** _____ **End Time:** _____
Weather: Cloudy, warm/cool, breezy

Temp. Water	22.07	°C	**pH**	7.95	units
Temp. Air	82	°F	**Sp. Cond.**	830	uS/cm
DO Sat. (%)	107.9	%	**Dis. Oxy.**	9.39	mg/L
ORP	107.1	mV	**Turbidity**	9.3	ntu

Surface water type: River
Sample Method: Van Dorn
Sample Point(s): 16' mark
Substrate description: Rocky/silty
Stage conditions: normal
Stream color: brown
Stream mixing: _____
Clarity: fair

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	1	**Turbidity**	2
Garbage	0	**Atms. Odor**	0
Algae Mats	2	**Oil-grease**	1
Soap suds	2	**Fish kill**	0

Other observations/biological indicators: riffle beetles on water

Samples Collected: @ 1620 (duplicate samples taken from 16' mark)

Comments: staff gauge → .2 ft

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6/2/05

Left Bank: 44 Right Bank: 38 Stream Width: 36 transect #2

Sample Points: 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
	9	105.4	9.13	7.96	22.03	828	109.6		
	12	107.2	9.33	7.96	22.06	828	109.1		
	15	108.1	9.43	7.95	22.06	828	108.9		
	18	108.5	9.47	7.92	22.05	828	108.6		
	21	109.3	9.52	7.94	22.05	829	108.3		
	24	109.1	9.51	7.94	22.06	826	107.8		
	27	108.9	9.48	7.94	22.06	830	107.4		
	30	108.5	9.45	7.94	22.07	831	106.7		
	33	108.6	9.42	7.94	22.08	832	106.0		
	36	107.9	9.39	7.95	22.09	833	105.3		
	39	107.5	9.35	7.95	22.10	833	104.5		
	42	106.5	9.21	7.95	22.12	834	103.2		
								9.3	
Average Field Parameter Measurements									
		107.9	9.39	7.95	22.07	830	107.1		

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/2/05

Site Description/Location: Transect #2

Measured By: J. Gaunsey / J. McNutt **Meter Type:** AA

Width: 36 ft. **Area:** 17.42 **Velocity:** 0.19 ft/sec **Discharge:** 3.1 ft³/sec

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	8	2	0		REW	nt	14	45		0	0
	12	2.5	.38	S	11	43.4	0.17	×.85	0.14	0.95	0.13
	13	1.5	.33	S	13	43.4	0.20	×.85	0.17	0.50	0.09
	15	1.5	.55	S ~~6~~	16	41.3	0.26	×.85	0.22	0.83	0.18
	16	1.0	.45	S	17	42.1	0.27	×.85	0.23	0.45	0.10
	17	1.0	.51	S	14	41.1	0.23	×.85	0.20	0.51	0.10
	18	1.0	.50	S	16	42.1	0.25	×.85	0.21	0.50	0.10
	19	1.0	.51	S	14	42.8	0.22	×.85	0.19	0.51	0.10
	20	1.0	.51	S	15	42.0	0.24	×.85	0.20	0.51	0.10
	21	1.0	.48	S	13	41.8	0.21	×.85	0.18	0.48	0.09
	22	1.0	.46	S	16	42.4	0.25	×.85	0.21	0.46	0.10
	23	1.0	.42	S	15	41.1	0.24	×.85	0.20	0.42	0.08
	24	1.0	.47	S	15	40.8	0.25	×.85	0.21	0.47	0.10
	25	1.0	.44	S	13	41.2	0.21	×.85	0.18	0.44	0.08
	26	1.0	.51	S	15	41.2	0.24	×.85	0.20	0.51	0.10
	27	1.0	.50	S	16	41.3	0.26	×.85	0.22	0.50	0.11
	28	1.0	.47	S	14	42.2	0.22	×.85	0.19	0.47	0.09

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/2/05

Site Description/Location: Transect #2

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	29	1.0	.45	S	16	41.1	0.26	x.85	0.22	0.45	0.10
	30	1.0	.53	S	15	40.7	0.2	5x.85	0.21	0.53	0.11
	31	1.0	.63	S	15	41.3	0.2	4x.85	0.20	0.63	0.13
	32	1.0	.57	S	16	42.5	0.2	5x.85	0.21	0.57	0.12
	33	1.0	.53	S	14	40.4	0.2	3x.85	0.20	0.53	0.11
	34	1.0	.46	S	13	43.4	0.2	0x.85	0.17	0.46	0.08
	35	1.0	.57	S	15	41.7	0.2	4x.85	0.20	0.57	0.11
	36	1.0	.63	S	15	42.6	0.2	4x.85	0.20	0.63	0.13
	37	1.0	.76	S	14	41.9	0.2	2x.85	0.19	0.76	0.14
	38	1.0	.82	S	11	40.2	0.18	x.85	0.15	0.82	0.12
	39	1.0	.78	S	0	40.0	0	(downstream from chunk of concret		0.78	
	40	1.0	.75	S	11	42.5	0.17	x.85	0.14	0.75	0.10
	41	1.0	.7	S	10	40.1	0.17	x.85	0.14	0.70	0.10
	42	1.0	.42	S	10	40.5	0.17	x.85	0.14	0.42	0.06
	43	1.0	.31	S	9	44.1	0.14	x.85	0.12	0.31	0.04
	44	0.5	0	LEW	@	1549				0	0

Comments: Note: Due to rocky bottom of the channel, all measurements were taken from the surface. The

* use Kusmet *

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6/8/05

Location description: Transect # 3

Sampled by: J. Gournsey Start Time: _____ End Time: _____
J. McNutt

Weather: sunny, humid, warm, windy

Temp. Water	23.60	°C	pH	7.78	units
Temp. Air	77	°C	Sp. Cond.	463	uS/cm
DO Sat. (%)	83.7	%	Dis. Oxy.	7.09	mg/L
ORP	61.3	mV	Turbidity	75	ntu

Surface water type: river
Sample Method: Van Dorn
Sample Point(s): ~~18 ft~~ (13 from ~~REW~~) JCG (LEW)
Substrate description: rocky / silty

Stage conditions: normal / ~~(low?)~~ JCG
Stream color: brown
Stream mixing: fair to poor
Clarity: fair

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	1	Turbidity	1
Garbage	0	Atms. Odor	2
Algae Mats	0	Oil-grease	2 (seeping)
Soap suds	0	Fish kill	0

Other observations/biological indicators: Riffle beetles and water striders

Samples Collected: Sampled @ (skinner list)
collected MS/MSD

Comments: Staff gauge - ~~0.7 ft~~ JCG 0.66 ft.

Sample pint
temp → 23.60°C
cond → 463
DO% → 83.7
DO → 7.09
pH → 7.78
ORP → 61.3
Turbidity → 75 NTU

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/2/05

Location description: Transect #3

Sampled by: Jason Gurnsey **Start Time:** 940 **End Time:** _____

James McNulty

Weather: Sunny, warm, windy

Temp. Water	20.24	°C	**pH**	7.75	units
Temp. Air	72	°F	**Sp. Cond.**	831	uS/cm
DO Sat. (%)	93.6	%	**Dis. Oxy.**	8.45	mg/L
ORP	187.7	mV	**Turbidity**	9.2	ntu

Surface water type: River **Stage conditions:** normal

Sample Method: Van Dorn **Stream color:** brown

Sample Point(s): 18 feet (13 ft from ~~REW~~)(LEW) CG **Stream mixing:** fair to poor

Substrate description: Rock (Mostly) **Clarity:** Fair

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	1	**Turbidity**	1
Garbage	0	**Atms. Odor**	2
Algae Mats	0	**Oil-grease**	2 (bank near staff gauge)
Soap suds	0	**Fish kill**	0

Other observations/biological indicators: (west) West

Sheen + seeping on banks near staff gauge + on bank near sample point

Samples Collected: Sampled @ 1130 skinner list

Collected MS/MSD

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6/2/05

Left Bank: 5 Right Bank: 35 Stream Width: 30 Transect #3

Sample Points: 7, 10, 13, 16, 19, 22, 25, 28, 31, 34

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
1100	7	97.2	8.72	7.70	20.28	832	189.4		
	10	92.3	8.34	7.72	20.29	832	188.8		
	13	92.7	8.36	7.73	20.27	832	188.6		
	16	90.8	8.24	7.73	20.27	832	188.5		
	19	94.2	8.52	7.76	20.28	830	187.6		
	22	94.7	8.54	7.76	20.24	830	187.5		
	25	94.0	8.47	7.78	20.22	830	186.8		
	28	93.2	8.39	7.78	20.19	830	186.8		
	31	91.9	8.33	7.77	20.18	830	186.9		
	34	95.0	8.57	7.78	20.19	830	186.1		
								9.2	
Average Field Parameter Measurements									
		93.6	8.45	7.75	20.24	831	187.7		

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/2/05

Site Description/Location: Transect #3

Measured By: J. Gurnsey / J. McNutt **Meter Type:** ~~Pygmy~~ AA

Width: 30 ft. **Area:** 34.43 ft² **Velocity:** 0.08 ft/sec **Discharge:** 2.68 ft³/sec.

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	5			LEW		@ 94.0				0	0
	8	4.0	.31	S	0	40	0			1.24	0
	9	1.0	.86	.6	0	60	0			0.86	0
	10	1.0	1.09	.6	2	51.3	0.03			1.09	0.03
	11	1.0	.95	.6	0	40	0			0.95	0
	12	1.0	1.4	.6	0	40	0			1.40	0
	13	1.0	1.53	.6	0	40	0			1.53	0
	14	1.0	1.55	.6	4	41.5	0.07			1.55	0.11
	15	1.0	1.58	.6	3	40.1	0.05			1.58	0.08
	16	1.0	1.59	.6	12	44.5	0.18			1.59	0.29
	17	1.0	1.64	.6	15	41.4	0.24			1.64	0.39
	18	1.0	1.70	.6	15	42.1	0.24			1.70	0.41 → Sample point
	19	1.0	1.56	.6	12	46.3	0.26			1.56	0.31
	20	1.0	1.38	.6	10	40.2	0.17			1.38	0.23
	21	1.0	1.50	.6	11	42.5	0.17			1.50	0.26
	22	1.0	1.59	.6	8	40.5	0.13			1.59	0.21
	23	1.0	1.73	.6	7	40.3	0.12			1.73	0.21
	24	1.0	1.62	.6	6	44.6	0.09			1.62	0.15

Comments: Staff gauge initial → 0.46 ft
" final → 0.46 ft

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6-2-05

Site Description/Location: Transect #3

Transect #3 (cont.)

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	25	1.00	1.41	.6	0	40	0			1.41	0
	26	1.0	1.43	.6	0	40	0			1.43	0
	27	2.0	1.35	.6	0	40	0			~~1.35~~ 2.70	0
	30	3.0	1.04	.6	0	40	0			~~2.08~~ 3.12	0
	33	2.5	0.52	.6	0	40	0			1.30	0
	35	1.0	0	S	REW	Q	1037			0	0

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/7/05
Location description: Transect #4
Sampled by: J. Gorney, J. McNutt **Start Time:** 905 **End Time:** _____
Weather: P. Cloudy/cool/Calm

Temp. Water	23.32	°C	**pH**	7.84	units
Temp. Air	70	°F	**Sp. Cond.**	412	uS/cm
DO Sat. (%)	85.3	%	**Dis. Oxy.**	7.28	mg/L
ORP	65.4	mV	**Turbidity**	81	ntu

Surface water type: river
Sample Method: Van Dorn
Sample Point(s): 15 ft (18 ft from REW)
Substrate description: Silty/Rocky
Stage conditions: normal/slightly hig
Stream color: brown
Stream mixing: Poor
Clarity: fair/murky

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	2	**Turbidity**	2
Garbage	0	**Atms. Odor**	0
Algae Mats	0	**Oil-grease**	2
Soap suds	1	**Fish kill**	0

Other observations/biological indicators: riffle beetles on water;

Samples Collected: @ 1145

Comments: Channel is low enough for chest waders in the span between Transect #4 & Transect #3

Note: noticeable seeps from transect #3 → #4

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: ~~6/3/05~~ 6/7/05

Left Bank: 66' Right Bank: -3' Stream Width: 69' Transect #4

Sample Points: 63, 57, 51, 45, 39, 33, 27, 21, 15, 9, 3

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
910	63	83.9	7.39	7.75	23.29	422	96.0		
					~~23.10~~	~~411~~			
	57	86.6	7.24	7.91	23.10	411	84.6		
	51	86.0	7.37	7.96	23.25	411	80.5		
	45	82.8	7.06	7.87	23.40	411	64.3		
	39	84.3	7.17	7.83	23.39	410	59.6		
	33	85.2	7.25	7.81	23.39	410	58.6		
	27	86.5	7.35	7.81	23.39	411	56.7		
	21	86.7	7.41	7.80	23.37	411	55.4		
	15	85.4	7.29	7.80	23.32	411	54.6		
	9	85.7	7.30	7.78	23.30	411	54.5		
	3	85.0	7.27	7.77	23.30	411	54.2		
								81	
Average Field Parameter Measurements									
		85.3	7.28	7.84	23.32	412	65.4		

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Resiburg Proj. Number: _____ Date: ~~6/6/05~~ 6/7/05

Site Description/Location: Transect #4 Meter: AX

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean In Vertical	Adjusted for Horizontal Angle	Area	Discharge
	66	1.5	0	LEW		@ 9:05				0	0
	63	4.5	1.2	.6	0	40	0			5.4	0
	57	6.0	2.3	.6	0	40	0			13.8	0
	51	6.0	2.8	.2	0	40	0			16.8	0
			2.8	.8	0	40	0				
	45	6.0	2.95	.2	0	40	0			17.7	0
			2.95	.8	0	40	0				
										~~18.7~~	
39		6.0	3.11	.2	0	86.2	0	0.02		18.7	0.37
			3.11	.8	3	50	.04			~~19.9~~	
33		6.0	3.32	.2	1	47.5	.02	0.04		19.9	0.80
			3.32	.8	3	44	.05				
27		6.0	3.30	.2	3	55.7	.04	0.05		19.8	0.99
			3.30	.8	4	52	.05				
21		6.0	3.42	.2	1	39.4	.02	0.04		20.5	0.82
			3.42	.8	4	45.0	.06				
15		6.0	3.7	.2	2	45.5	.03	0.05		22.2	1.11
			3.7	.8	4	48.8	.06				
9		6.0	3.57	.2	3	55.2	.04	0.05		21.4	1.07
			3.57	.8	4	46.4	.06				
3		6.0	1.9	.6	4	48.2	.06			11.4	0.68
-3		3.0	0	REW		@	10:45			0	0

Comments: Initial Stage → 2.3 ft
Final Stage → 2.25 ft

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: ~~6/3/05~~ 6/7/05

Site Description/Location: Transect #4

Measured By: J. Cornsy / S. McNutt Meter Type: AA

Width: 69 Area: 187.6 ft² Velocity: 0.03 ft/sec Discharge: 5.84 ft³/sec.

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	~~-2~~		~~0~~	~~REW @ 1100~~							
	66		0	LEW @ 905							
	63		~~1.8~~ 1.2	~~.6~~ .6	0	40	0				
	57		2.3	.6	0	40	0				
	51		2.8	.2	0	40	0				
			2.8	.8	0	40	0				
	45		2.95	.2	0	40	0				
			2.95	.8	0	40	0				
	39		3.11	.2	0	86.2	0				
			3.11	.8	3	50	.04				
	33		3.32	.2	1	47.5	.02				
			3.32	.8	3	44	.05				
	27		3.30	.2	3	55.7	.04				
			3.30	.8	4	50.0	.05				
	21		3.42	.2	1	39.4	.02				
			3.42	.8	4	45.0	.06				
	15		3.7	.2	2	45.5	.03				
			3.7	.8	4	48.8	.06				
	9		3.57	.2	3	55.2	.04				
			3.57	.8	4	46.4	.06				
	3		1.9	.6	4	48.2	.06				

Comments: Staff gauge → 2.3

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery Proj. Number: Date: 6-1-05

Location description: Transect #5, Approx. 75' upstream intermittent drainage, E. of Topeka

Sampled by: J. Gurnsey Start Time: 0915 End Time: 1300

J. McNatt

Weather: Cool, overcast, calm

Temp. Water	18.92	°C	pH	7.43	units
Temp. Air	68	°C	Sp. Cond.	1124.6	uS/cm
DO Sat. (%)	97.06	%	Dis. Oxy.	8.96	mg/L
ORP	241.5	mV	Turbidity	9.7	ntu

Surface water type:	Creek	Stage conditions:	Low
Sample Method:	Bailer	Stream color:	Brown
Sample Point(s):	Centroid - 7 ft.	Stream mixing:	Poor
Substrate description:	Limestone rock bottom, muddy banks	Clarity:	Moderate

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	1	Turbidity	1
Garbage	0	Atms. Odor	0
Algae Mats	0	Oil-grease	0
Soap suds	0	Fish kill	0

Other observations/biological indicators: Abundant water striders, random sheen

Samples Collected: At 1200, Skinner List

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6-1-05

Left Bank: 0 Right Bank: 12 Stream Width: 12 Transect #5

Sample Points: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
	1	97.2	8.94	7.21	18.95	1128	253.7		LEW @ 1140
	2	98.1	8.98	7.24	18.93	1124	248.0		
	3	101.9	9.27	7.36	19.00	1127	244.1		
	4	97.3	9.01	7.40	18.93	1125	242.6		
	5	97.6	9.02	7.44	18.91	1125	241.2		
	6	97.0	8.99	7.48	18.89	1125	239.8		
	7	97.3	9.02	7.50	18.89	1125	238.8		
	8	96.2	8.94	7.52	18.89	1125	237.9		
	9	95.4	8.86	7.54	18.88	1124	237.1		
	10	95.2	8.82	7.55	18.90	1123	236.5		
	11	94.3	8.70	7.53	18.93	1120	237.6		REW @ 1155
								9.7	
		97.06	8.96	7.43	18.92	1124.6	241.5		
Average Field Parameter Measurements									

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6-1-05

Site Description/Location: Transect #5

Measured By: J. Garnsey J. McNutt Meter Type: Pygmy

Width: 12 Area: _____ Velocity: 0 Discharge: 0

Angle Coefficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
		~~LEW @ 1018~~									
	0	0.5	0		LEW @		1018				
	1	1.0	0.65	0.39 (gm) ~~0.6~~	0	40	0				
	2	1.0	0.62	0.37	0	40	0				
	3	1.0	.80	.48	0	40	0				
	4	1.0	.82	.49	1	43.2	0.021			0.82	0.0172
	5	1.0	.78	.47	0	64.3					
	6	1.0	.75	.45	0	40.0	0				
	7	1.0	.77	.46	1	42.8	.02			0.77	0.0154
	8	1.0	.79	.47	0	40.0	0				
	9	1.0	.80	.48	0	40.0	0				
	10	1.0	.85	.51	0	40.0	0				
	11	1.0	.39	5 ~~.23~~ (gm)	0	47.8	0				
	12	0.5	0		REW @		1115				

Comments: Flow apparent 30 ft. downstream past area of debris jam

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6-1-05

Location description: Transect #6

Sampled by: J. Gornsey Start Time: 1330 End Time: _____

J. McNutt

Weather: P. Cloudy, warm, calm

Temp. Water		°C	pH		units
Temp. Air	85	°C	Sp. Cond.		uS/cm
DO Sat. (%)		%	Dis. Oxy.		mg/L
ORP		mV	Turbidity		ntu

Surface water type:	Creek	Stage conditions:	Low
Sample Method:	Bailer	Stream color:	Brown
Sample Point(s):	5 ft from left bank- deepest point	Stream mixing:	Poor
Substrate description:	Rock + silt	Clarity:	Good

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	0	Turbidity	1
Garbage	0	Atms. Odor	0
Algae Mats	0	Oil-grease	~~0~~ see 2
Soap suds	0	Fish kill	0

Other observations/biological indicators: Water striders, small fish, crawdad
lt. sheen observed on water surface

Samples Collected: Sampled @ 1445 Skinner list

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6-1-05

Left Bank: 0 Right Bank: 9 Stream Width: 9

Transect #6

Sample Points: 1, 2, 3, 4, 5, 6, 7, 8

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
1418	1	144.2	12.31	8.12	21.88	1500	192.2		
	2	147.2	12.89	8.08	21.69	1505	190.5		
	3	147.1	12.83	8.07	21.74	1499	193.7		
	4	147.0	12.81	8.06	21.75	1498	188.8		
	5	145.2	12.69	8.06	21.76	1497	187.7		
	6	144.3	12.68	8.06	21.67	1497	187.0		
	7	146.9	12.83	8.04	21.68	1498	186.1		
	8	144.3	12.64	8.03	21.68	1498	185.4		
								9.1	
Average Field Parameter Measurements									

Comments: _____

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6-1-05

Site Description/Location: Transect #6

Measured By: J. Garnsey, J. McNutt Meter Type: pygmy

Width: 9 ft. Area: .09 Velocity: 0 Discharge: 0

Angle Coef-ficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean In Vertical	Adjusted for Horizontal Angle	Area	Discharge
	0	0.5	0		LEW	@ 13	45				
	1	1.0	.39	5	0	40	0				
	2	1.0	.78	.6	0	40	0				
	3	1.0	.50	.6	0	40	0				
	4	1.0	.51	.6	0	40	0				
	5	1.0	.71	.6	0	40	0				
	6	1.0	.59	.6	0	40	0				
	7	1.0	.39	5	0	40	0				
	8	1.0	.18	5	0	40	0				
	~~9~~	~~0.5~~									
	9	0.5	0		REW	@ 1412					

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery Proj. Number: 1004317 Date: 6-1-05

Location description: Transect #7-100 ft upstream, from intermittent stream convergence (very marshy area)

Sampled by: J. Garnsey Start Time: 1600 End Time: 1700
J. McNutt

Weather: P. cloudy, warm, calm

Temp. Water	°C	pH	units
Temp. Air	°C	Sp. Cond.	uS/cm
DO Sat. (%)	%	Dis. Oxy.	mg/L
ORP	mV	Turbidity	ntu

Surface water type:	Creek	Stage conditions:	Low
Sample Method:	Bailer	Stream color:	Brown
Sample Point(s):	Centroid (8 ft from LEW)	Stream mixing:	Poor
Substrate description:	Rock + silt	Clarity:	Fair

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	2	Turbidity	2
Garbage	0	Atms. Odor	0
Algae Mats	0	Oil-grease	0
Soap suds	0	Fish kill	0

Other observations/biological indicators: Water striders

Samples Collected: Sample @ 1640, Skinner List

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Water Quality Parameters

Proj. Name: El Dorado Refinery Proj. Number: 1004317 Date: 6-1-05

Left Bank: 0 Right Bank: 13 Stream Width: 13

Sample Points: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Time	Sample Point (ft)	DO Sat. (%)	DO mg/L	pH	Temp. (°C)	Specific Cond. (uS/cm)	ORP	Turbidity (ntu)	Comments - Observations
1615	1	121.4	10.12	6.18	23.22	1334	150.0		
	2	113.5	9.69	6.37	23.07	1321	149.3		
	3	111.4	9.53	6.51	23.02	1317	148.4		
	4	111.1	9.45	6.64	22.96	1313	146.5		
	5	109.8	9.43	6.73	22.94	1304	146.3		
	6	108.6	9.29	6.83	22.87	1296	144.6		
	7	107.2	9.21	6.89	22.89	1289	142.6		
	8	107.4	9.26	6.94	22.84	1290	142.8		
	9	107.4	9.22	6.97	22.84	1295	143.4		
	10	105.9	9.14	7.02	22.72	1304	143.0		
	11	106.9	9.18	7.04	22.81	1319	143.6		
1625	12	104.9	9.38	7.07	22.97	1333	144.4		
								8.8	
Average Field Parameter Measurements									
		109.6	9.41	6.76	22.93	1310	145.4		

Comments:

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
Discharge Measurement

Proj. Name: El Dorado Proj. Number: 1004317 Date: 6-1-05

Site Description/Location: Transect #7

Measured By: J. Garnsey, J. McNutt Meter Type: Pygmy

Width: 13 Area: Velocity: 0 Discharge: 0

Angle Coef-ficient	Dist. From Initial Point (ft)	Width (ft)	Depth (ft)	Observation Depth	Revolutions	Time (sec.)	VELOCITY At Point	VELOCITY Mean in Vertical	Adjusted for Horizontal Angle	Area	Discharge
	0	~~0.5~~ 4.0	0	LEW @		1605					
	1										
	2										
	3										
	4										
	5										
	6										
	7										
	8	6.5	1.2	.6	0	40	0				
	9										
	10										
	11										
	12										
	13	~~0.5~~ 2.5	0	REW @		1613					

Comments:

APPENDIX C

GROUNDWATER SAMPLING FIELD NOTES

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6/9/05

Location description: SW POND

Sampled by: J. Gansey Start Time: _____ End Time: _____
J. McNeil

Weather: windy, hot, sunny

Temp. Water	26.59	°C	pH	8.35	units
Temp. Air	95 ~~[illegible]~~	°F	Sp. Cond.	843	uS/cm
DO Sat. (%)	~~[illegible]~~	% 73.5	Dis. Oxy.	5.81	mg/L
ORP	101.5	mV	Turbidity	270	ntu

Surface water type: Pond
Sample Method: Van Dorn
Sample Point(s): Middle of pond
Substrate description: Soft

Stage conditions: normal
Stream color: dark/brown/black
Stream mixing: _____
Clarity: very poor

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	0	Turbidity	4
Garbage	0	Atms. Odor	3
Algae Mats	0	Oil-grease	4
Soap suds	1	Fish kill	_____

Other observations/biological indicators: _____

Samples Collected: @ 1630 from middle of pond

Comments: TD → ~~7.5'~~ 7.2' at middle of pond

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Reservoir Proj. Number: Date: 6/9/05
Location description: NW POND
Sampled by: J. Gerrsny, J. McN-H Start Time: 1500 End Time: 1545
Weather: Hot, windy, Sun

Temp. Water	25.91	°C	pH	8.85	units
Temp. Air	92	°F	Sp. Cond.	530	uS/cm
DO Sat. (%)	117.2	%	Dis. Oxy.	9.56	mg/L
ORP	84.3	mV	Turbidity	32	ntu

Surface water type: POND
Sample Method: Van Dorn
Sample Point(s): Middle
Substrate description: soft/silty
Stage conditions: normal
Stream color: brownish-green
Stream mixing:
Clarity: poor

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	0	Turbidity	2
Garbage	0	Atms. Odor	2 (downwind from SW Pond
Algae Mats	0	Oil-grease	0
Soap suds	3	Fish kill	0

Other observations/biological indicators:

Samples Collected: @ 1500 from middle of pond

Comments: TD of 7.3ft at middle of pond

Note: SW + NE aerators are operating
Due to aerators, parameters (water quality) are unstable.

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MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: ~~El Dorado~~ El Dorado Refinery Proj. Number: _____ Date: 6/9/05

Location description: SE POND

Sampled by: J. Gansny Start Time: 1230 End Time: 125
J. McNulty

Weather: Sunny, windy, hot

Temp. Water	26.00	°C	pH	7.94	units
Temp. Air	85	°F	Sp. Cond.	963	uS/cm
DO Sat. (%)	84.5	%	Dis. Oxy.	6.55	mg/L
ORP	118.1	mV	Turbidity	10	ntu

Surface water type: POND
Sample Method: Van Dorn
Sample Point(s): Middle
Substrate description: Soft

Stage conditions: Slightly high/normal
Stream color: greenish/brown
Stream mixing:
Clarity: fair/clear

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	0	Turbidity	2
Garbage	0	Atms. Odor	0
Algae Mats	0	Oil-grease	2 (sheen)
Soap suds	0	Fish kill	0

Other observations/biological indicators:

Samples Collected: @ 1230 from middle of pond

Comments: T.D at Middle → 6.2 ft

Note: anchor had product present after removal from pond.

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery Proj. Number: _____ Date: 6/9/05

Location description: NE POND

Sampled by: J. McN-H Start Time: 1115 End Time: 1145

J. Gurnsey

Weather: Cloudy, (cooler), windy

Temp. Water	25.01	°C	pH	8.20	units
Temp. Air	80	°F	Sp. Cond.	956	uS/cm
DO Sat. (%)	110.3	%	Dis. Oxy.	8.92	mg/L
ORP	173.4	mV	Turbidity	20	ntu

Surface water type: POND

Sample Method: Van Dorn

Sample Point(s): Middle

Substrate description: Soft

Stage conditions: normal / slightly high

Stream color: ~~brown~~ / greenish/brown

Stream mixing: _____

Clarity: fair / ~~[illegible]~~ clear

Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

Debris	0	Turbidity	2
Garbage	0	Atms. Odor	0
Algae Mats	0	Oil-grease	0
Soap suds	0	Fish kill	0

Other observations/biological indicators: _____

Samples Collected: @ 1115 from middle of POND

Comments: T.D. at Middle of NE POND → 12.9'

MWH
MONTGOMERY WATSON HARZA

SURFACE WATER FIELD NOTES
General Observations

Proj. Name: El Dorado Refinery **Proj. Number:** _____ **Date:** 6/9/05

Location description: Marley Pond

Sampled by: J. McNutt **Start Time:** ~~1115~~ 945 **End Time:** 1015

J. Gurnsey

Weather: Hot, Sunny, Humid

Temp. Water	21.49	°C	**pH**	7.36	units
Temp. Air	80	°F	**Sp. Cond.**	248	uS/cm
DO Sat. (%)	94.0	%	**Dis. Oxy.**	8.13	mg/L
ORP	~~225.+~~ 187.7	mV (rm)	**Turbidity**	310	ntu

Surface water type: Pond **Stage conditions:** normal / slightly high

Sample Method: Van Dorn **Stream color:** brown

Sample Point(s): Middle of POND **Stream mixing:** _____

Substrate description: ~~Sat~~ / Silty **Clarity:** fair / murky

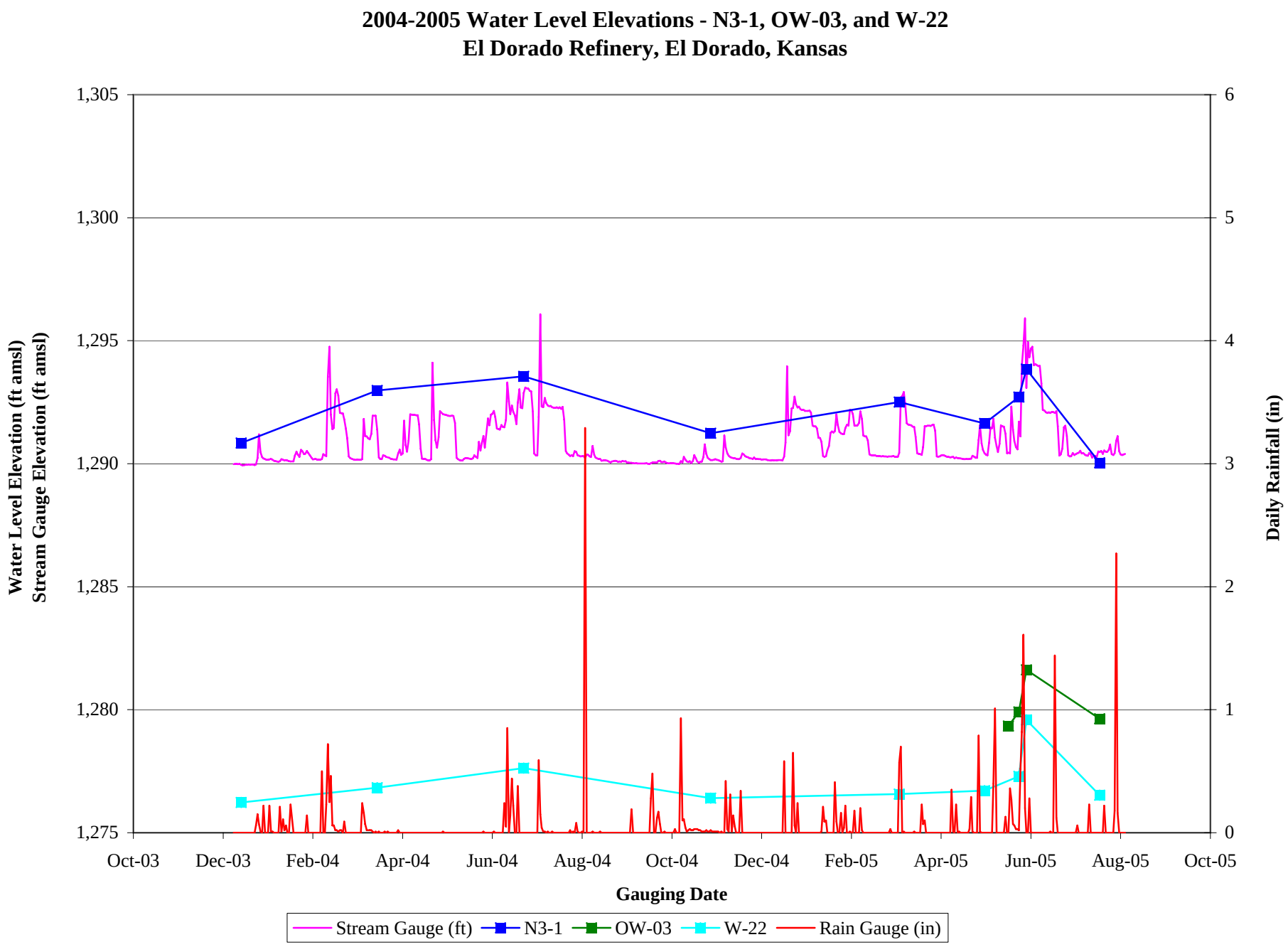
Observations: 0-none 1-mild 2-moderate 3-serious 4-extreme

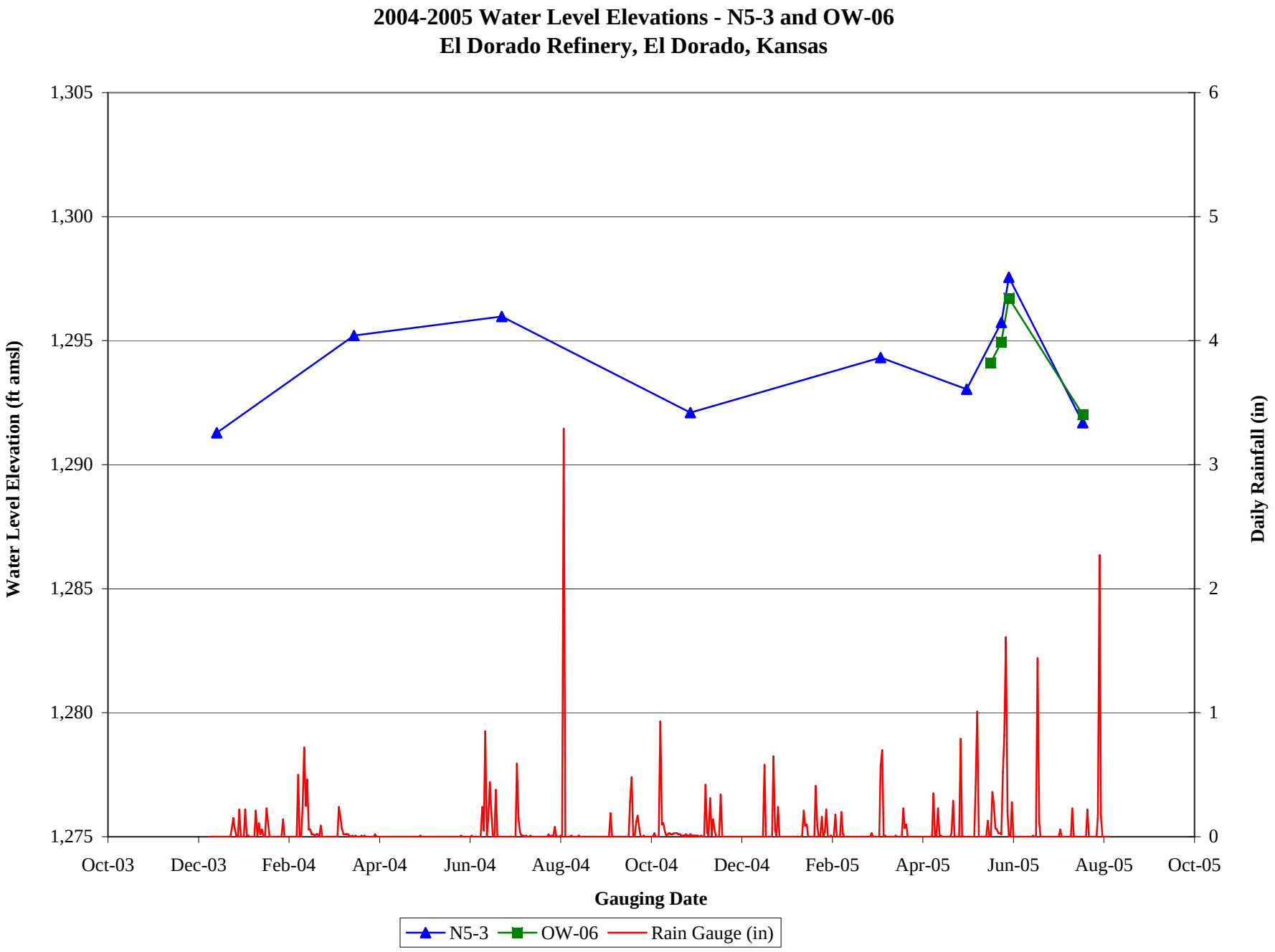
Debris	0	**Turbidity**	2
Garbage	0	**Atms. Odor**	0
Algae Mats	0	**Oil-grease**	1 (sheen)
Soap suds	0	**Fish kill**	0

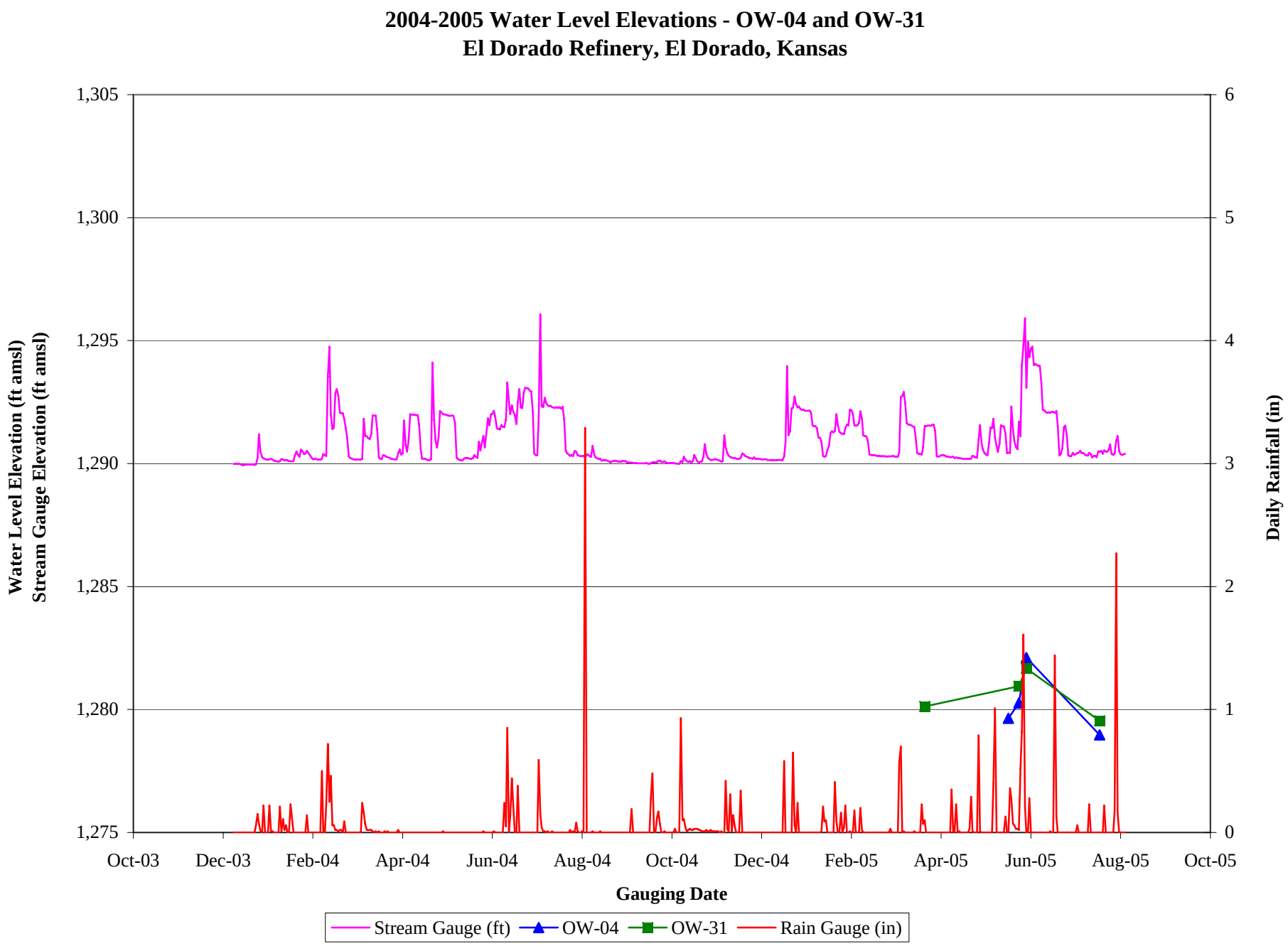
Other observations/biological indicators: _____

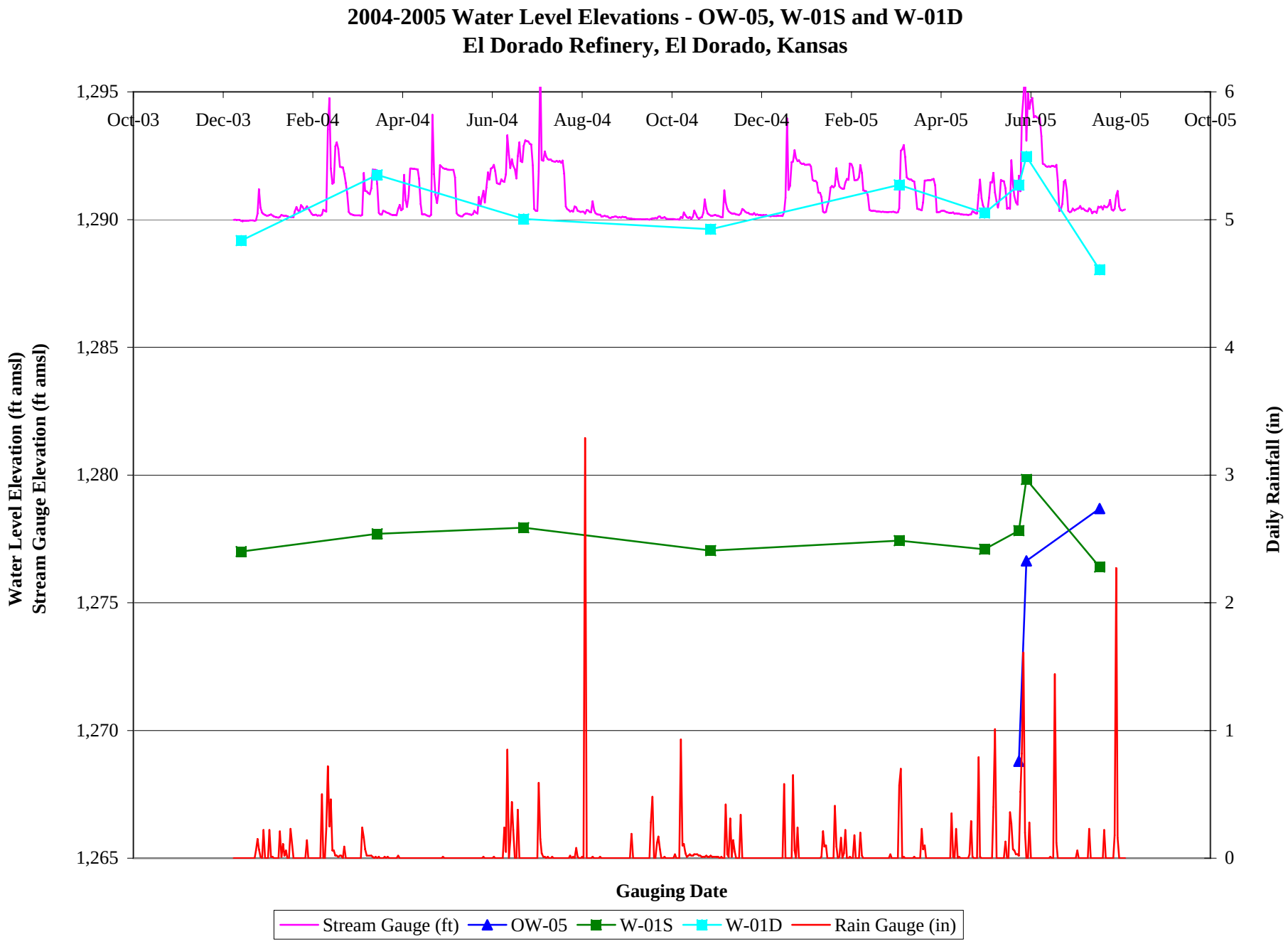
Samples Collected: @ 945 from middle of pond

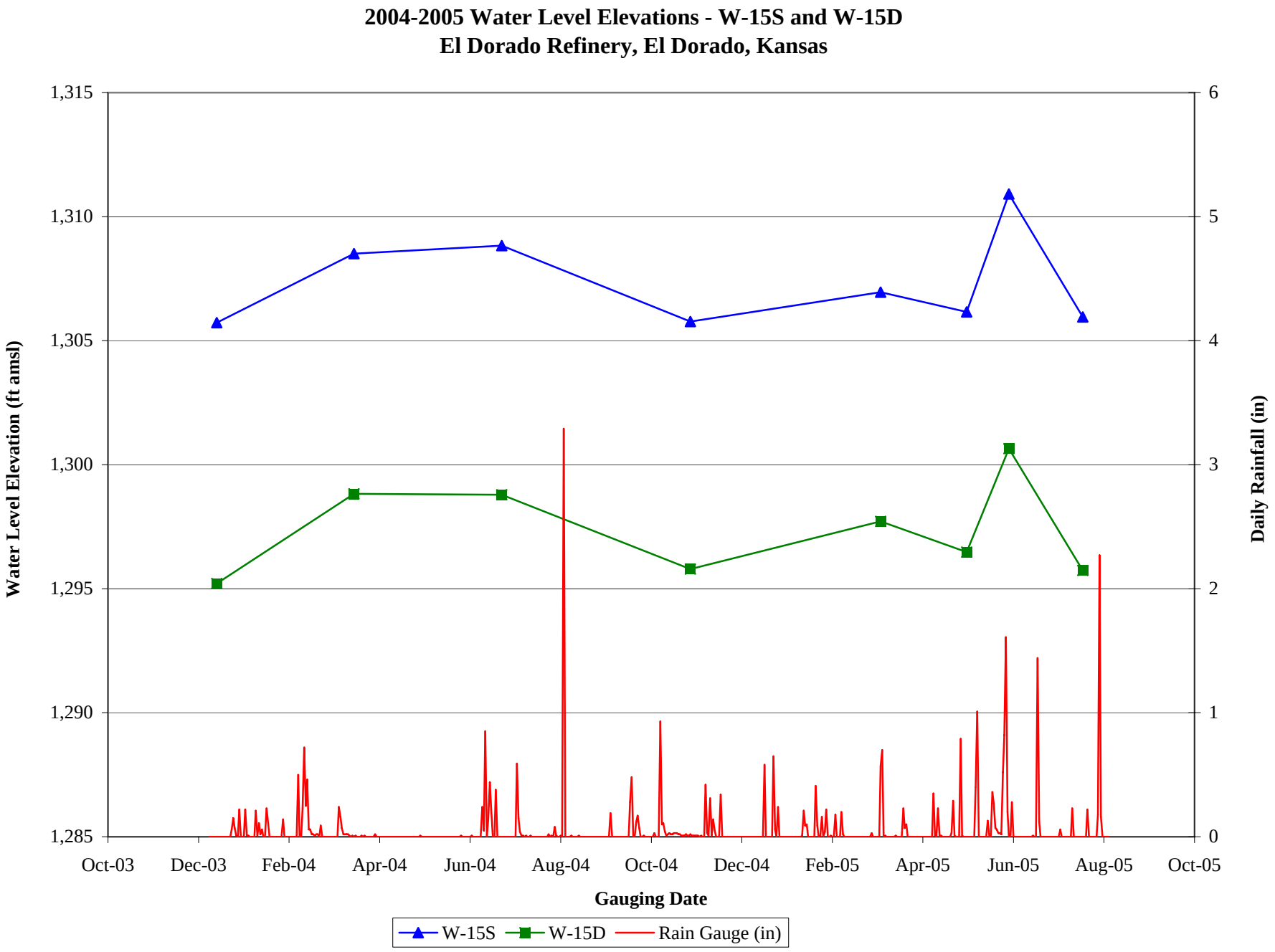
Comments: Depth at Sample Point is 5.75 ft

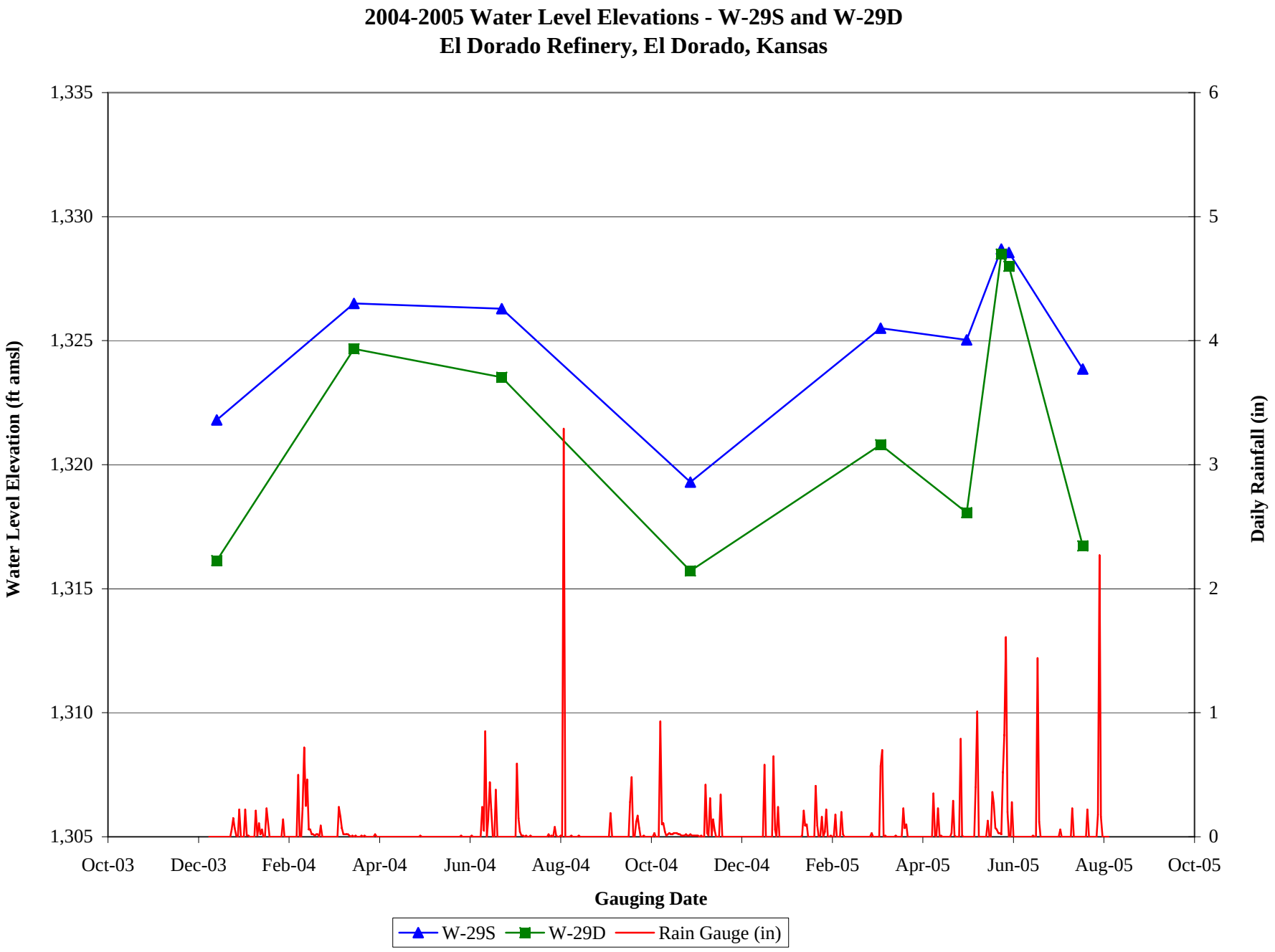

2004-2005 Water Level Elevations - N3-1, OW-03, and W-22
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
N3-1
OW-03
W-22
Rain Gauge (in)

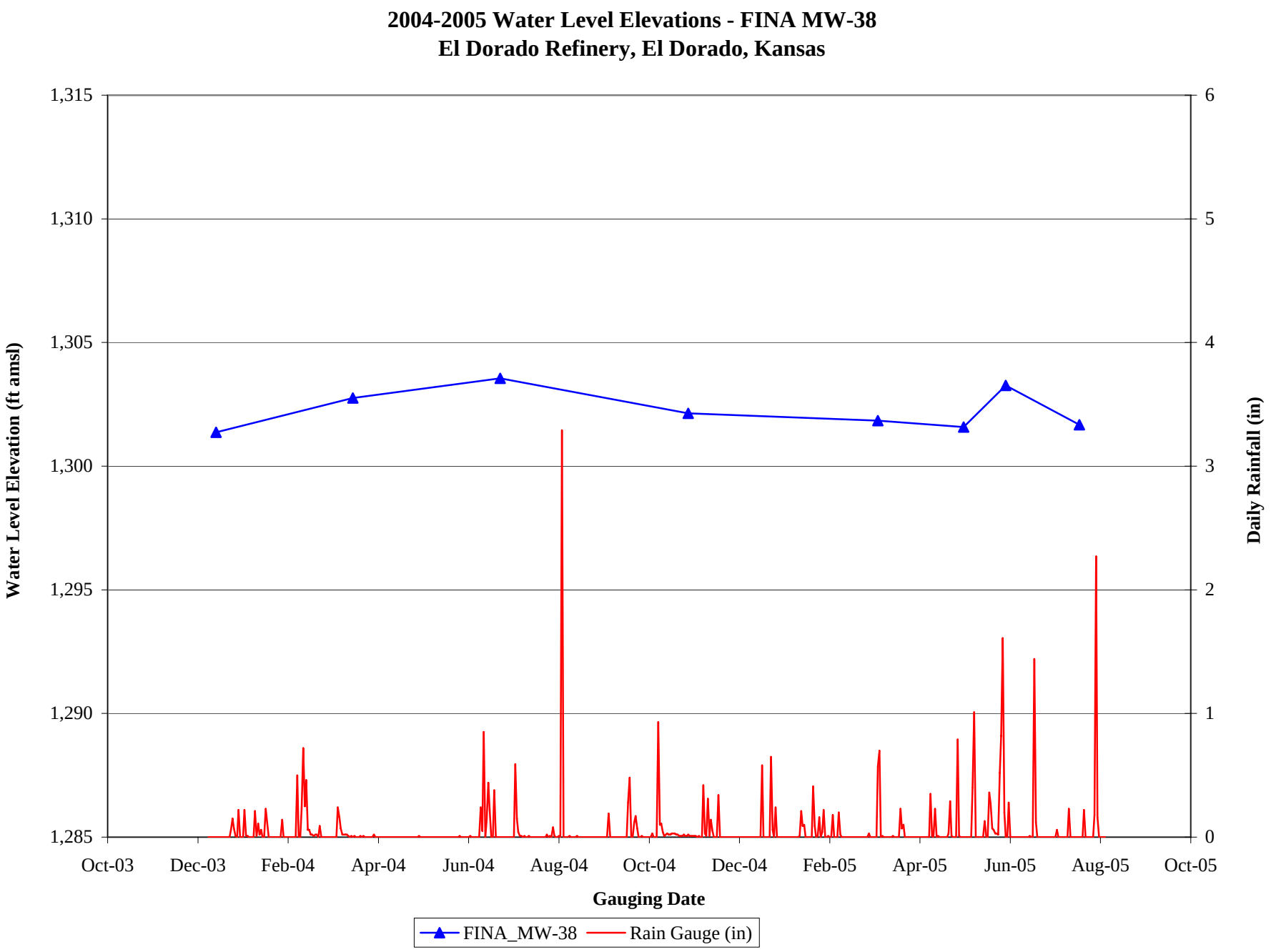

2004-2005 Water Level Elevations - N5-3 and OW-06
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N5-3
OW-06
Rain Gauge (in)

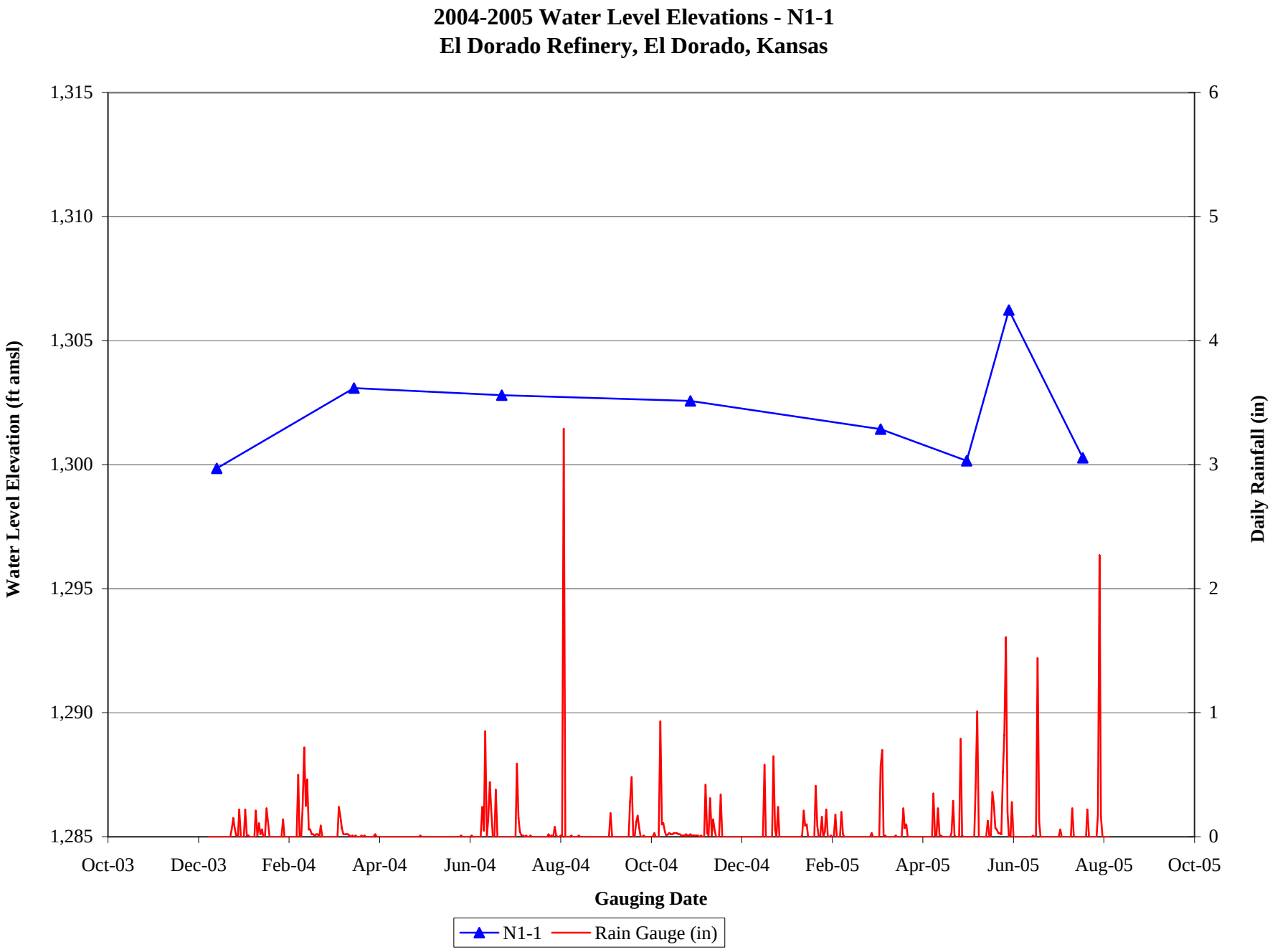

2004-2005 Water Level Elevations - OW-04 and OW-31
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-04
OW-31
Rain Gauge (in)

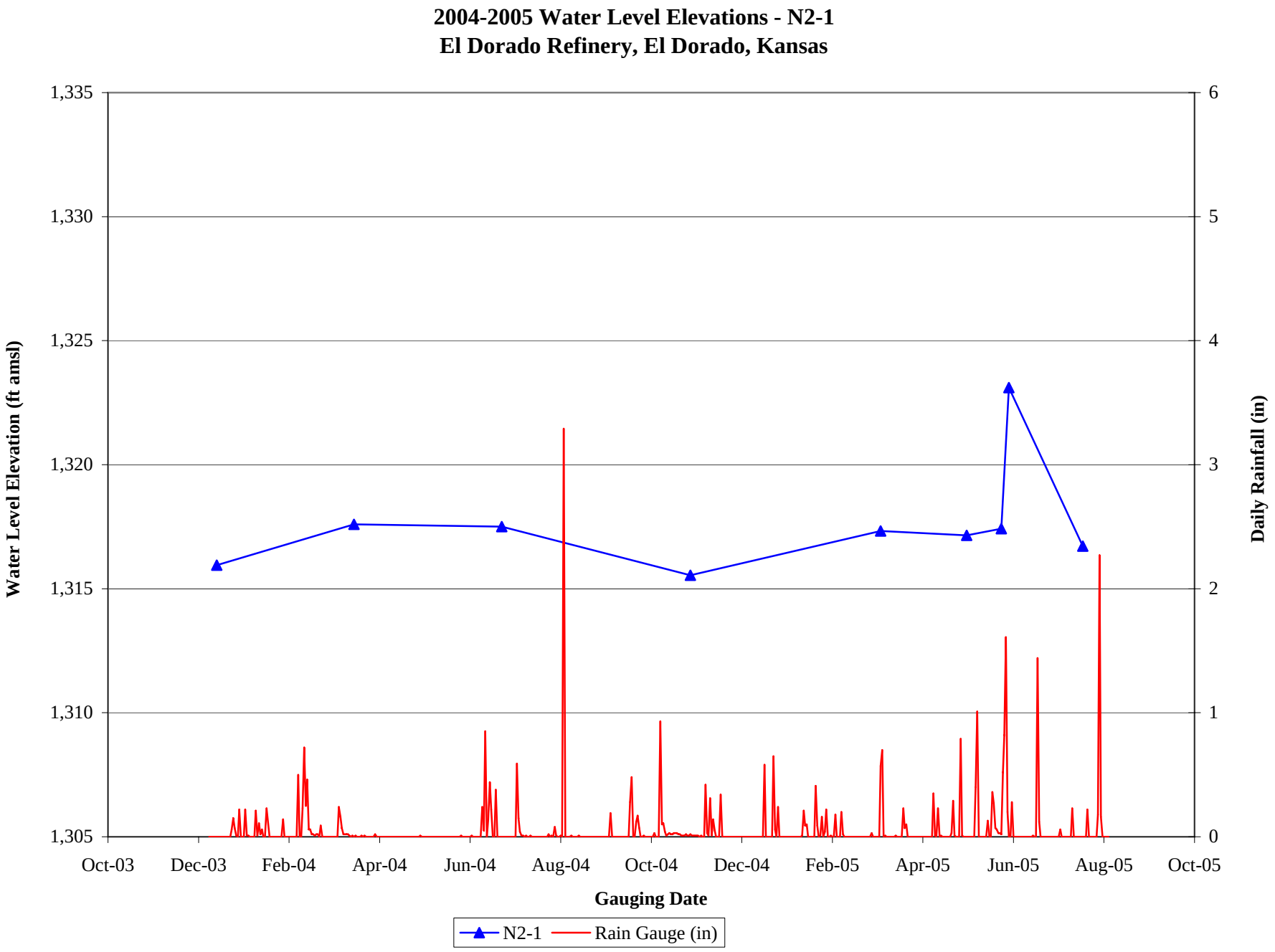

2004-2005 Water Level Elevations - OW-05, W-01S and W-01D
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,295
1,290
1,285
1,280
1,275
1,270
1,265
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-05
W-01S
W-01D
Rain Gauge (in)

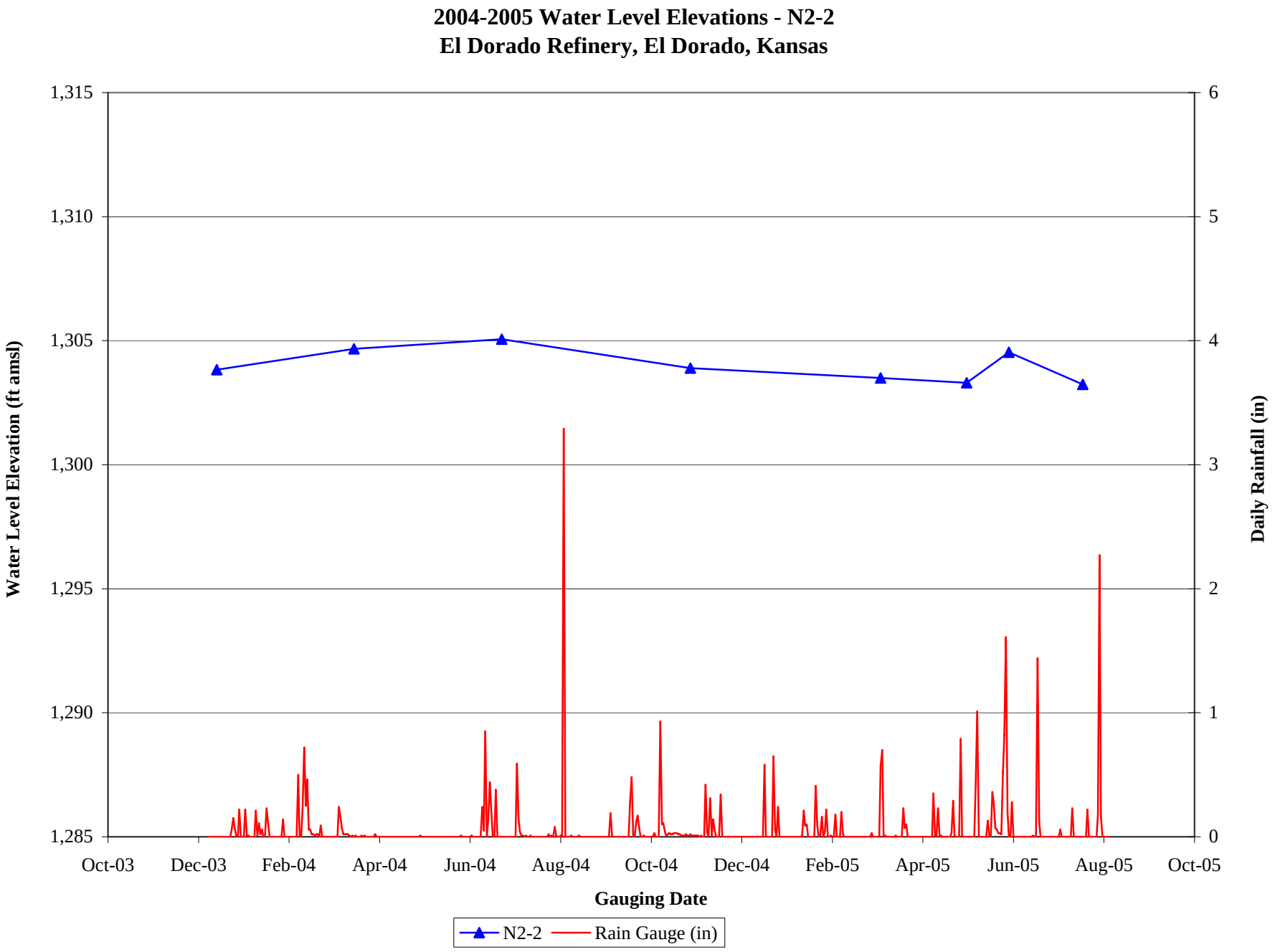

2004-2005 Water Level Elevations - W-15S and W-15D
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
W-15S
W-15D
Rain Gauge (in)

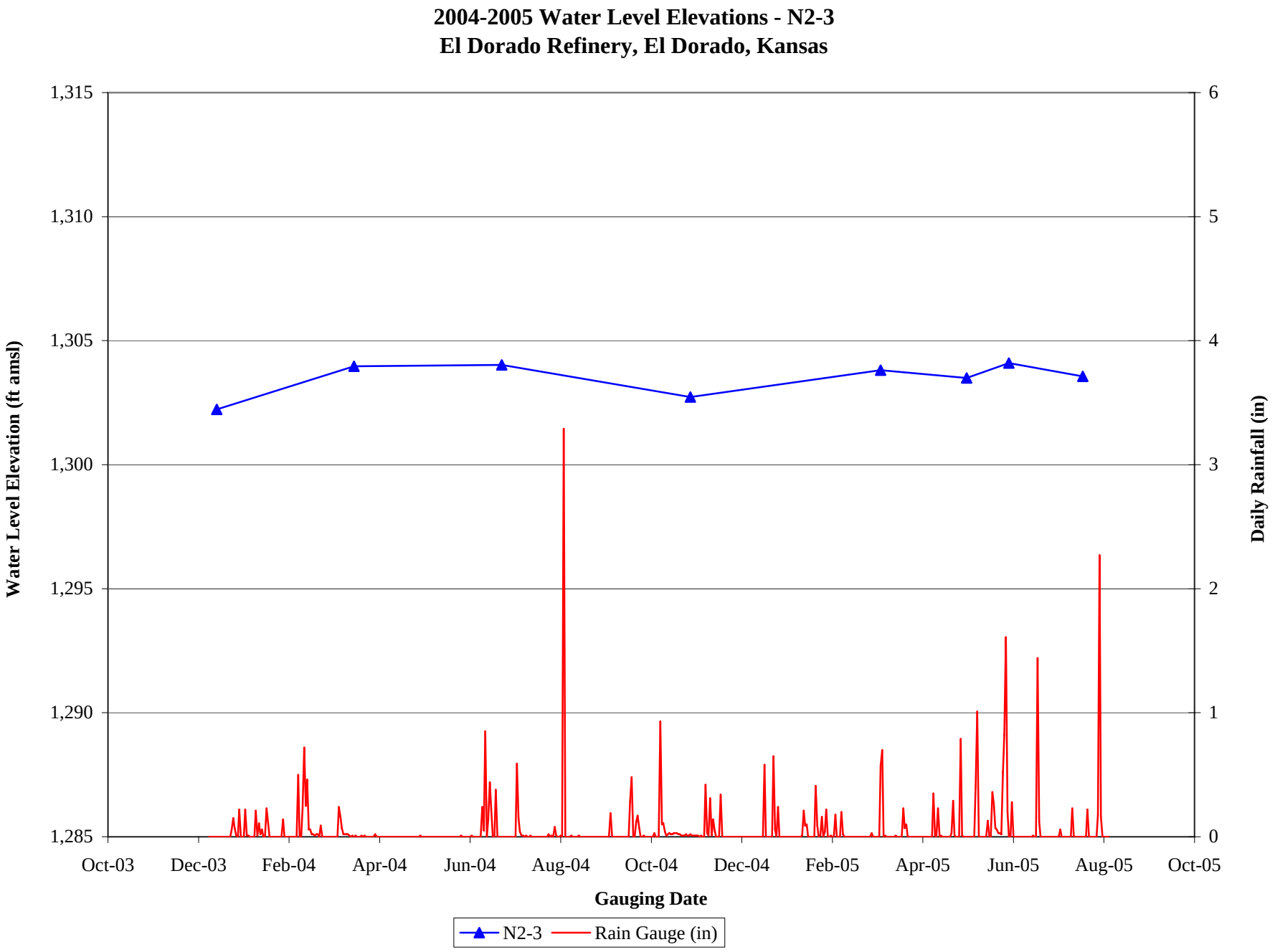

2004-2005 Water Level Elevations - W-29S and W-29D
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
W-29S
W-29D
Rain Gauge (in)

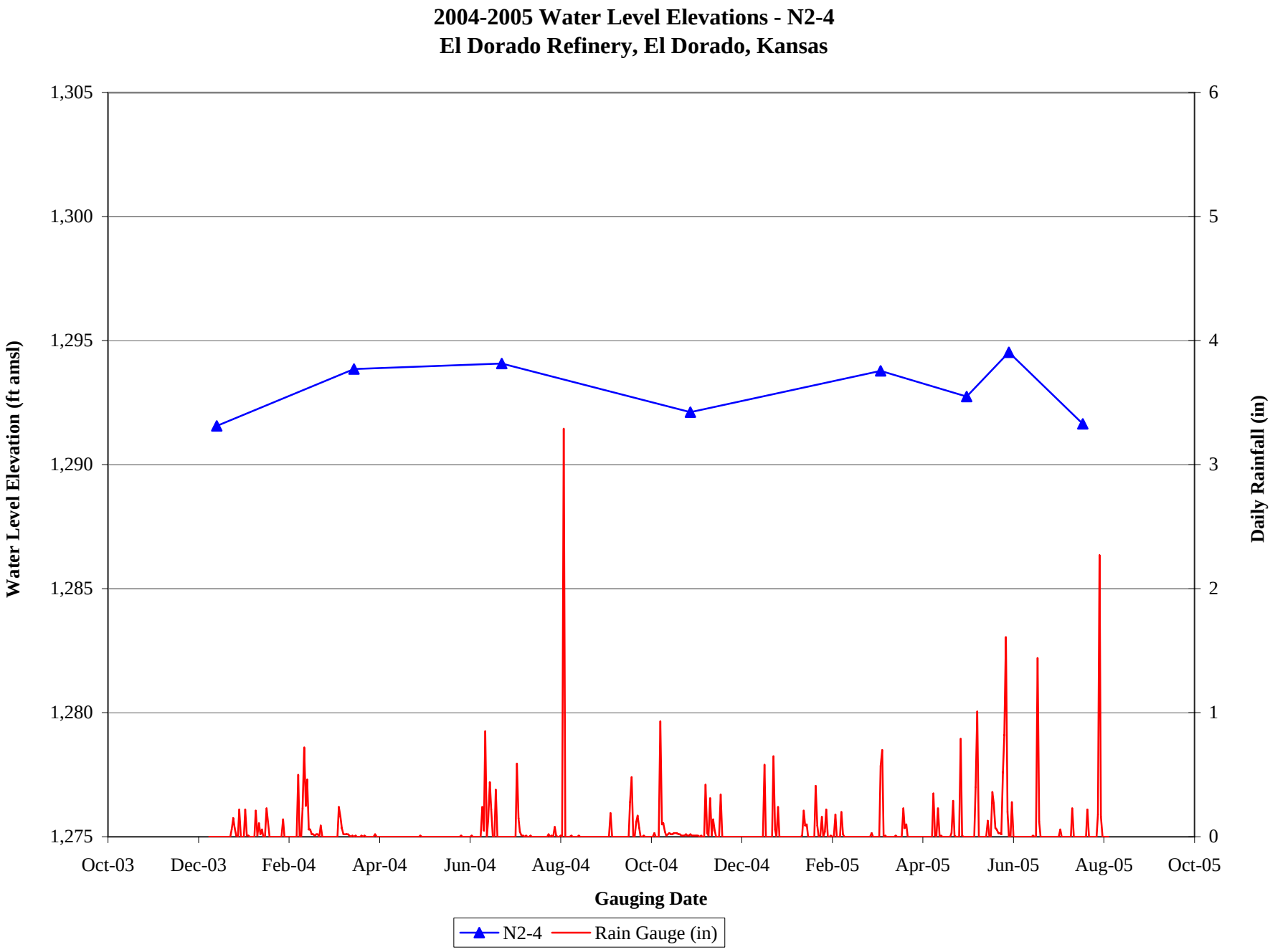

2004-2005 Water Level Elevations - FINA MW-38
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
FINA_MW-38
Rain Gauge (in)

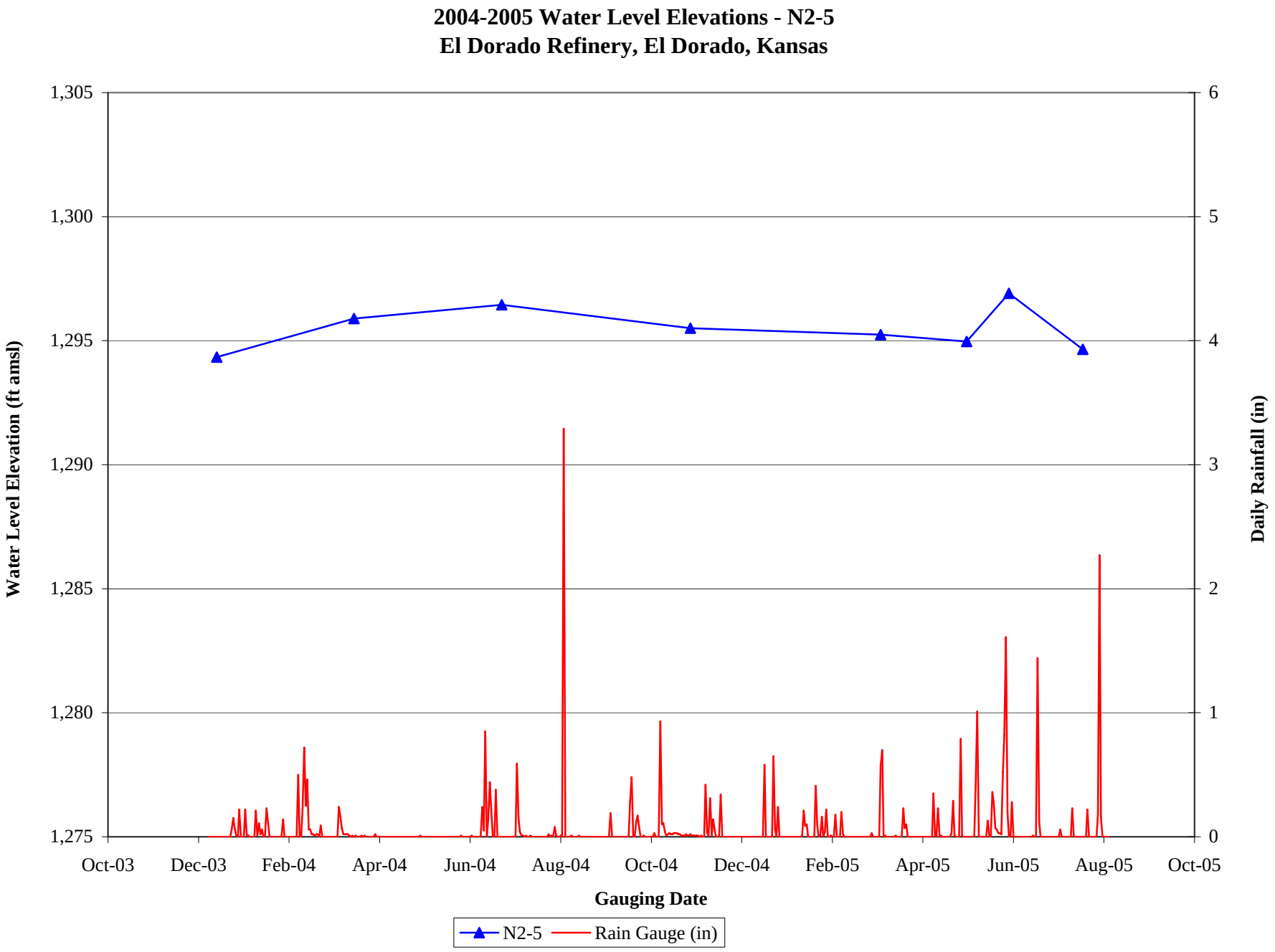

2004-2005 Water Level Elevations - N1-1
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N1-1
Rain Gauge (in)

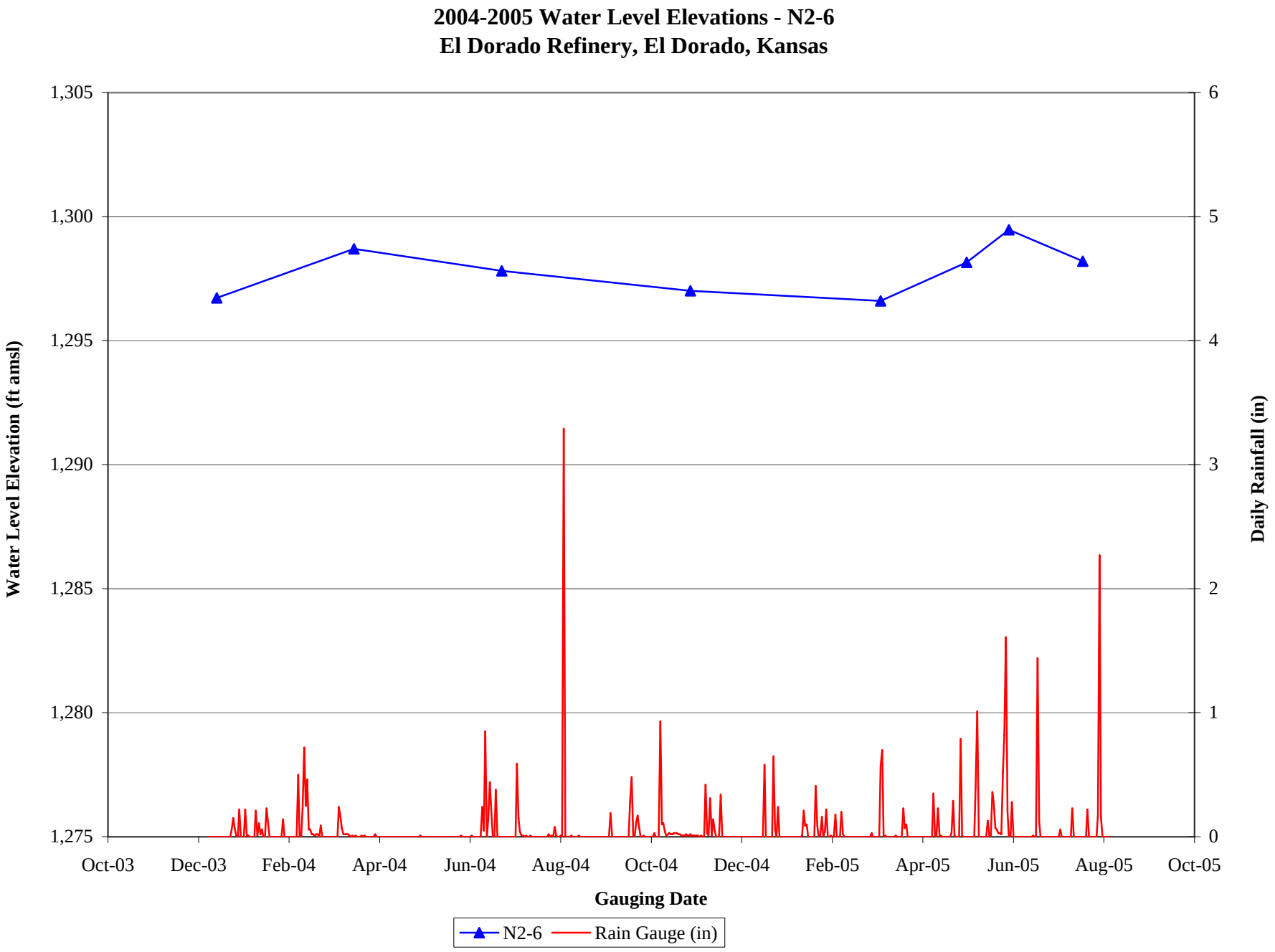

2004-2005 Water Level Elevations - N2-1
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N2-1
Rain Gauge (in)

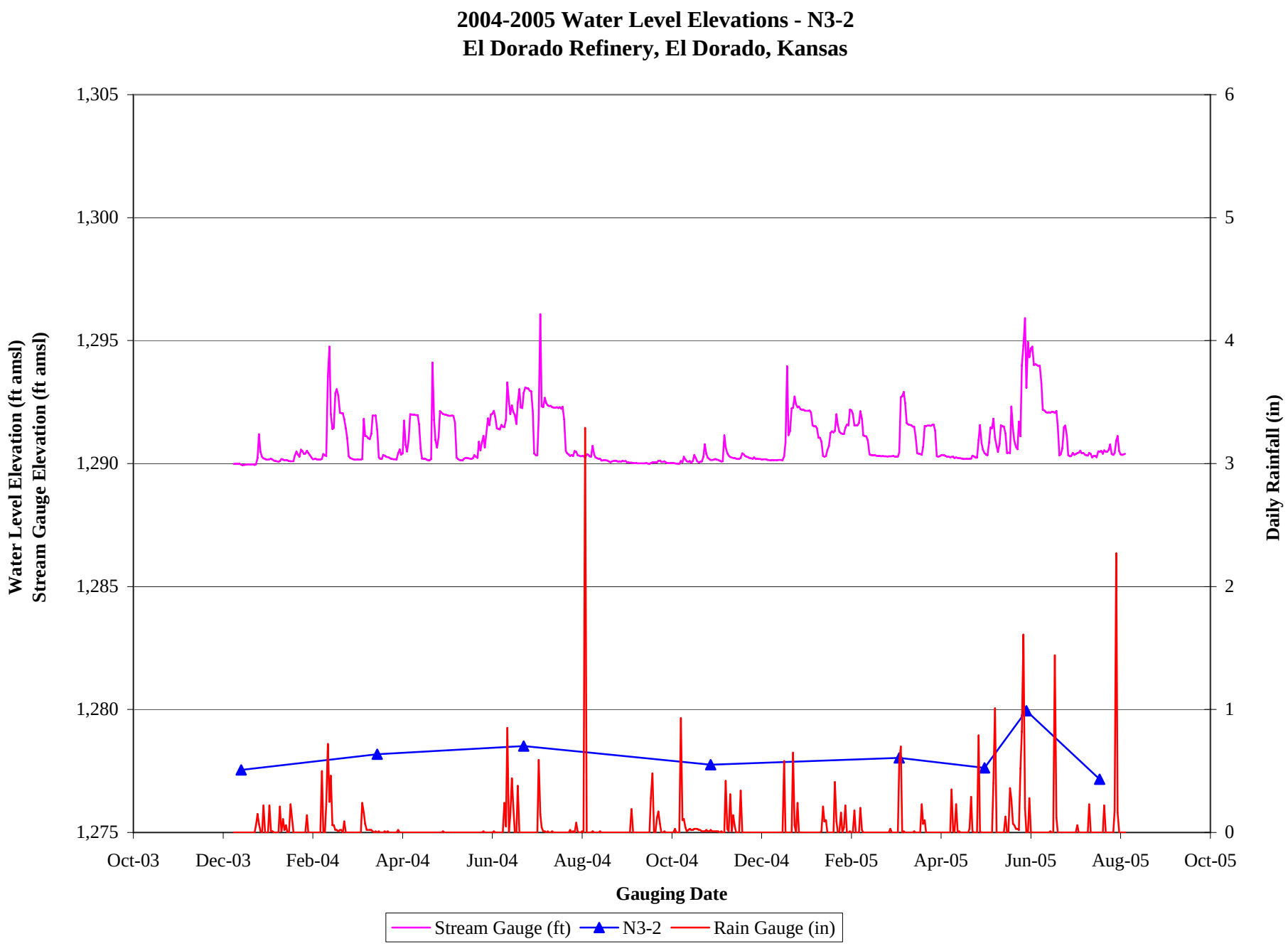

2004-2005 Water Level Elevations - N2-2
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N2-2
Rain Gauge (in)

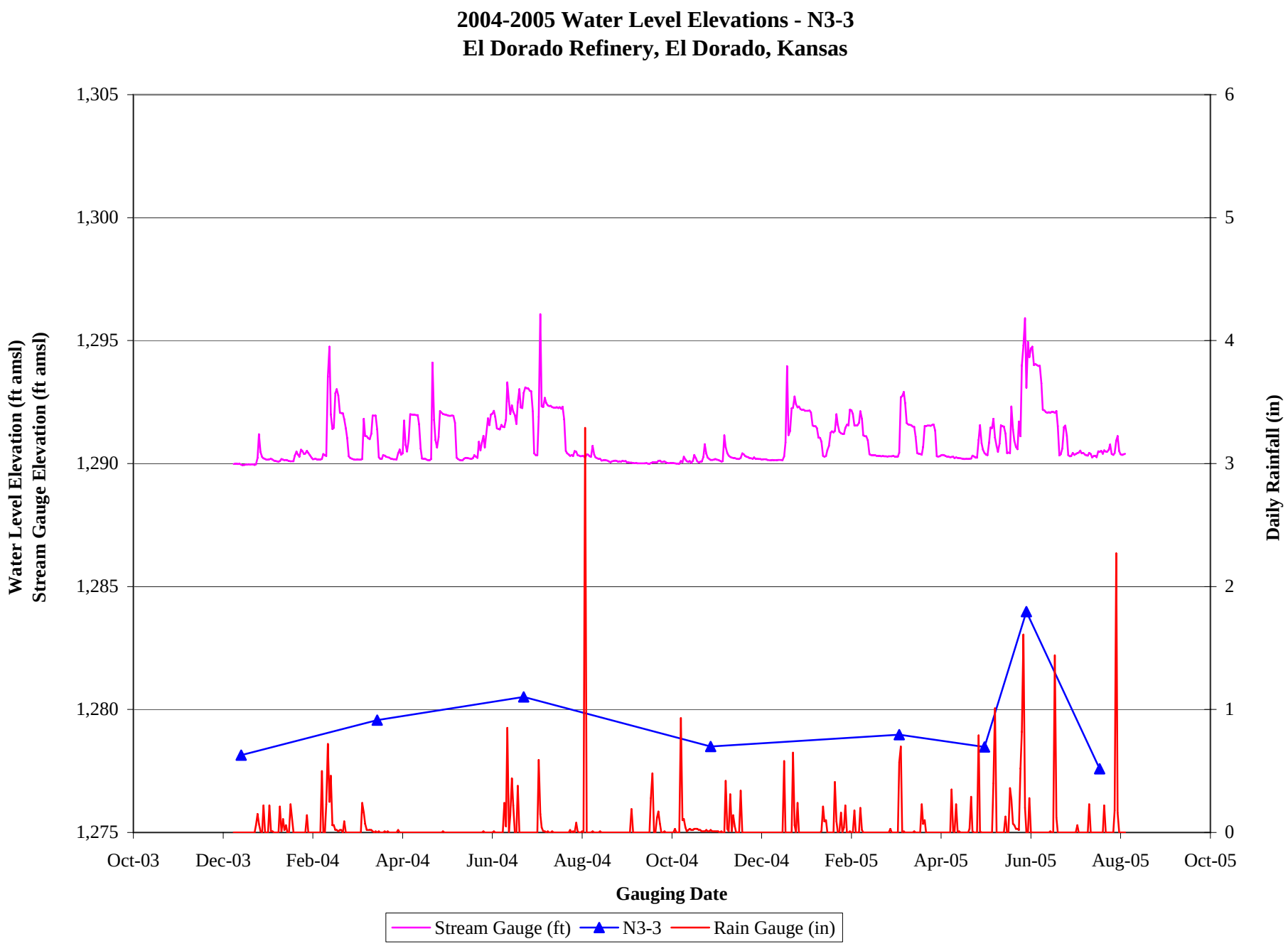

2004-2005 Water Level Elevations - N2-3
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N2-3
Rain Gauge (in)

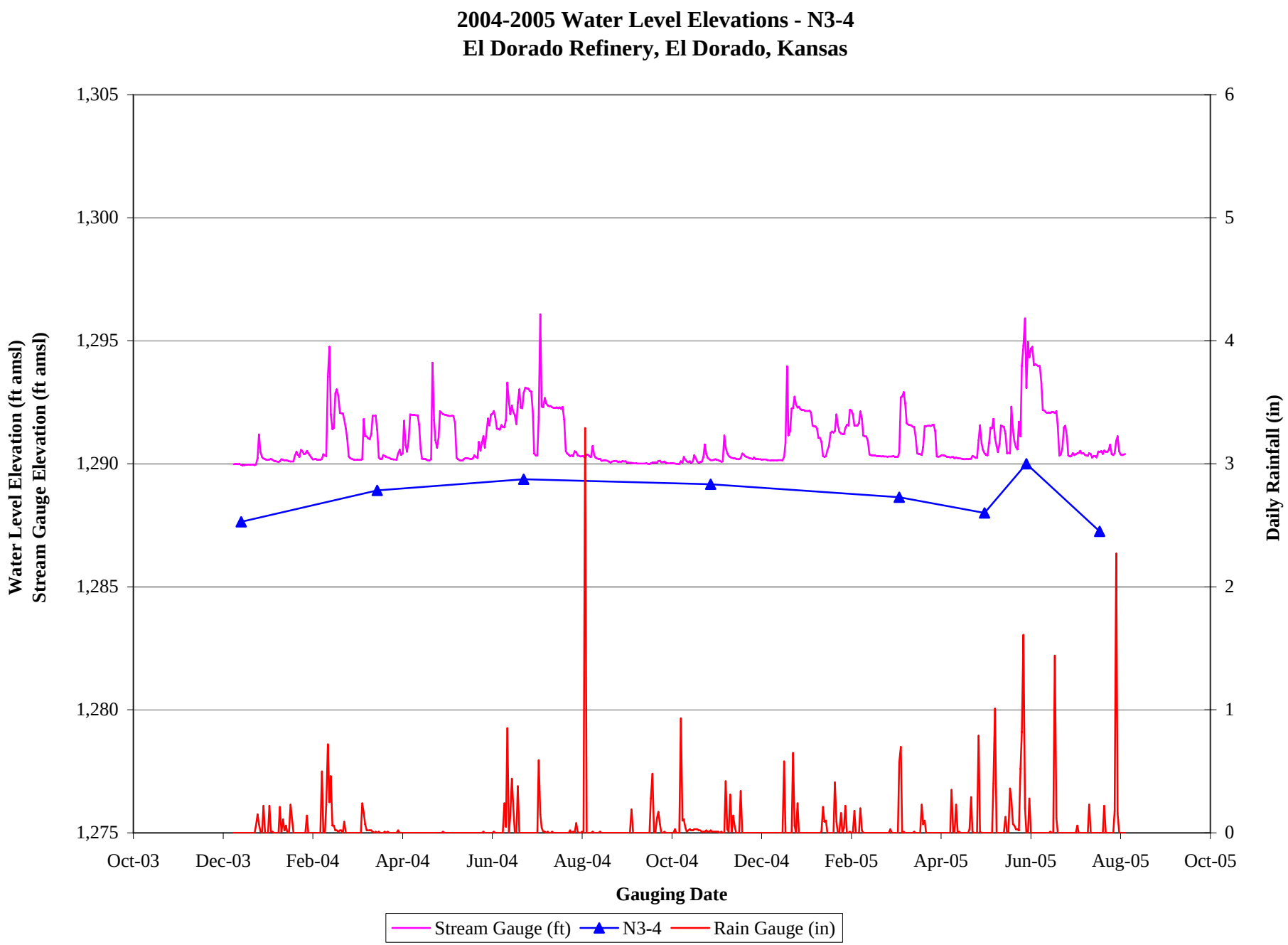

2004-2005 Water Level Elevations - N2-4
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N2-4
Rain Gauge (in)

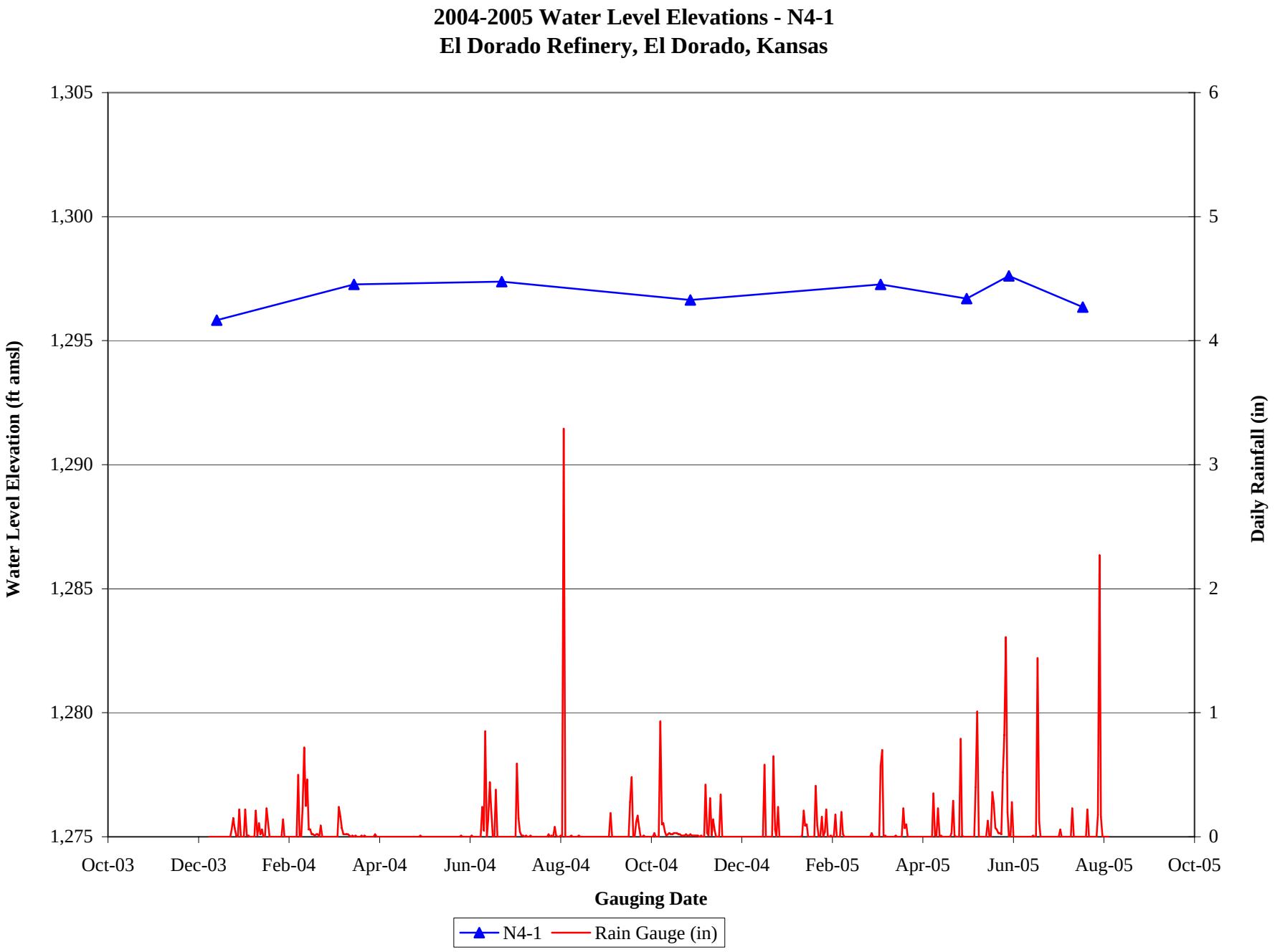

2004-2005 Water Level Elevations - N2-5
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N2-5
Rain Gauge (in)

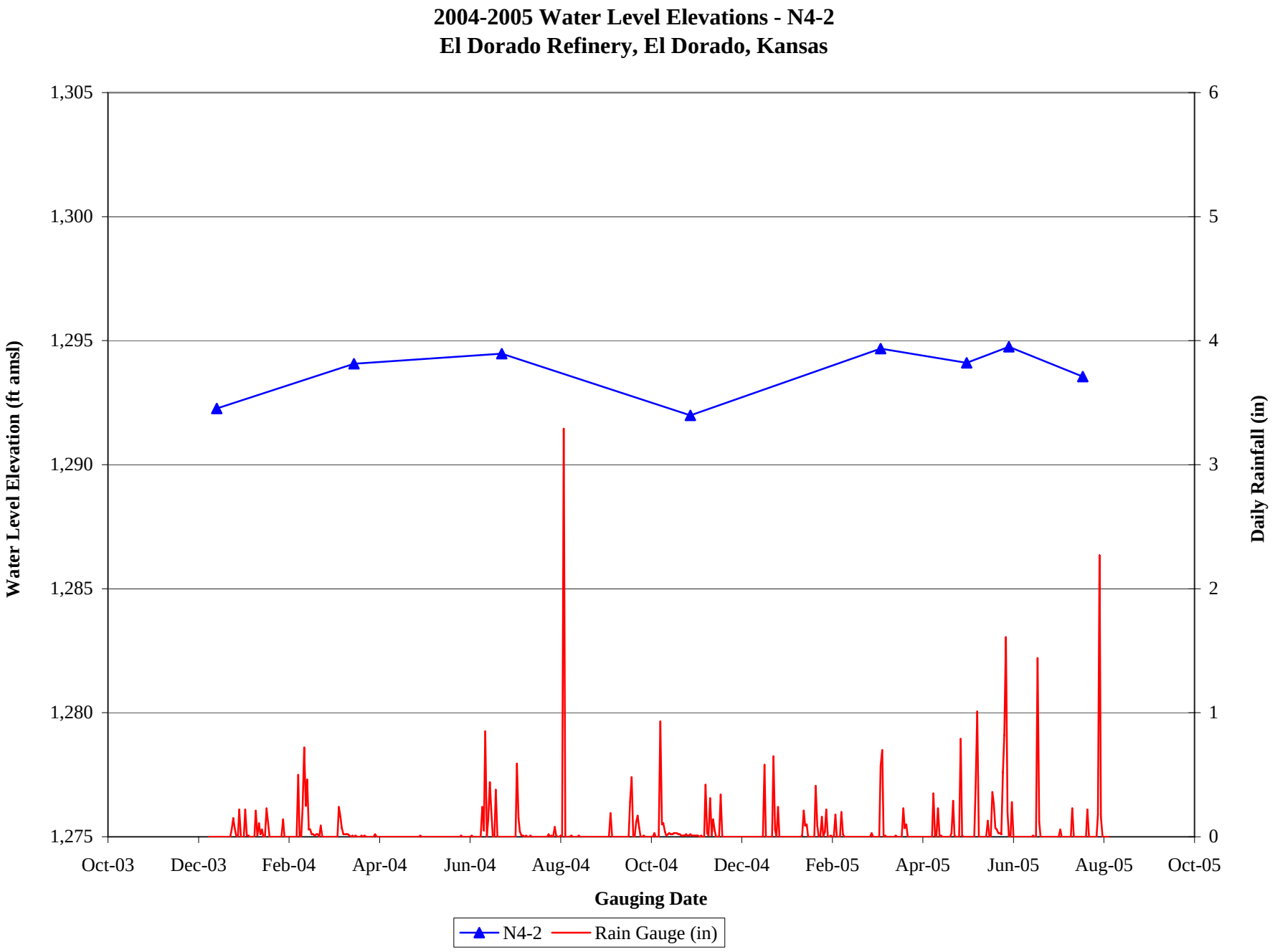

2004-2005 Water Level Elevations - N2-6
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N2-6
Rain Gauge (in)

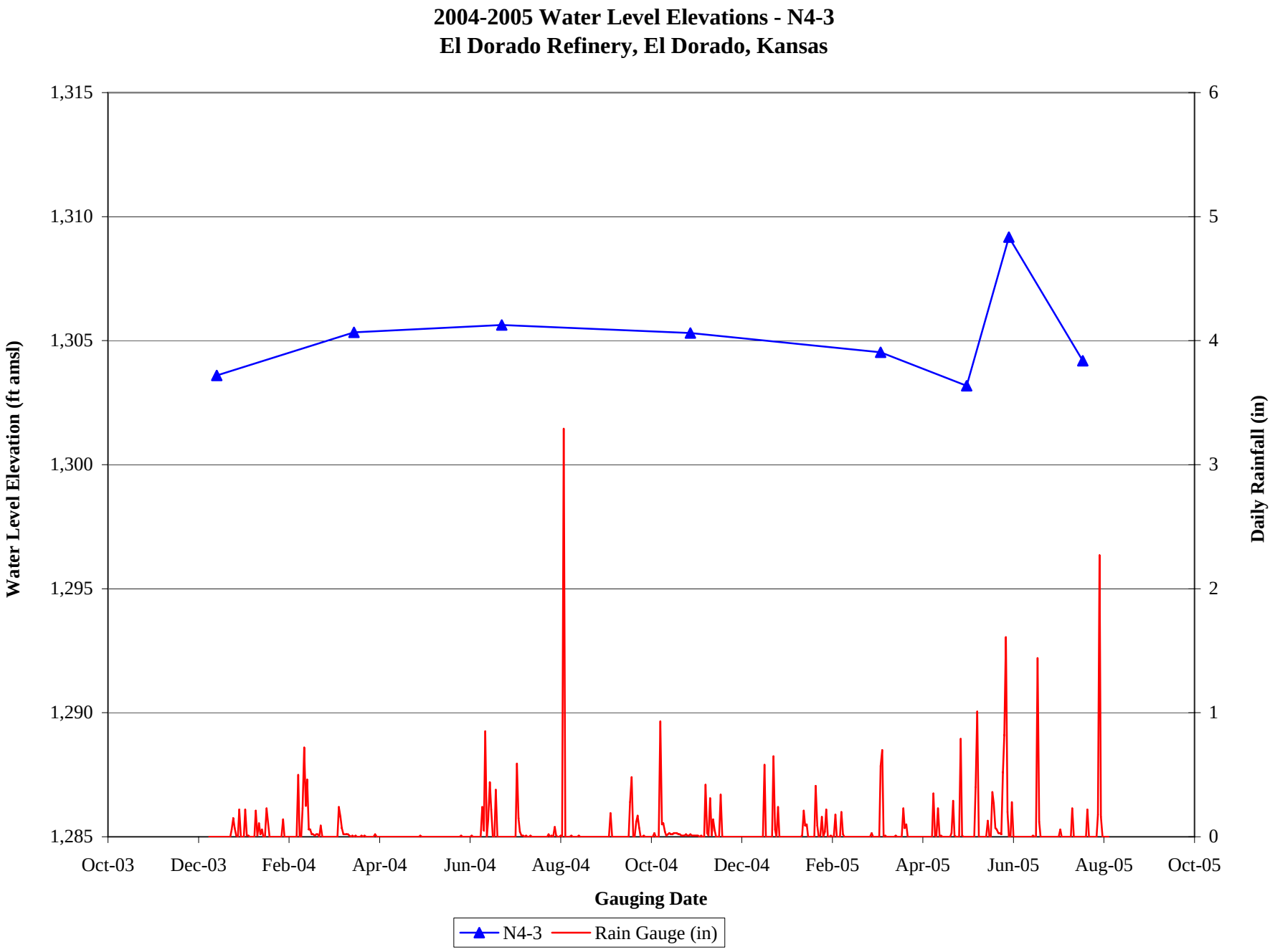

2004-2005 Water Level Elevations - N3-2
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
N3-2
Rain Gauge (in)

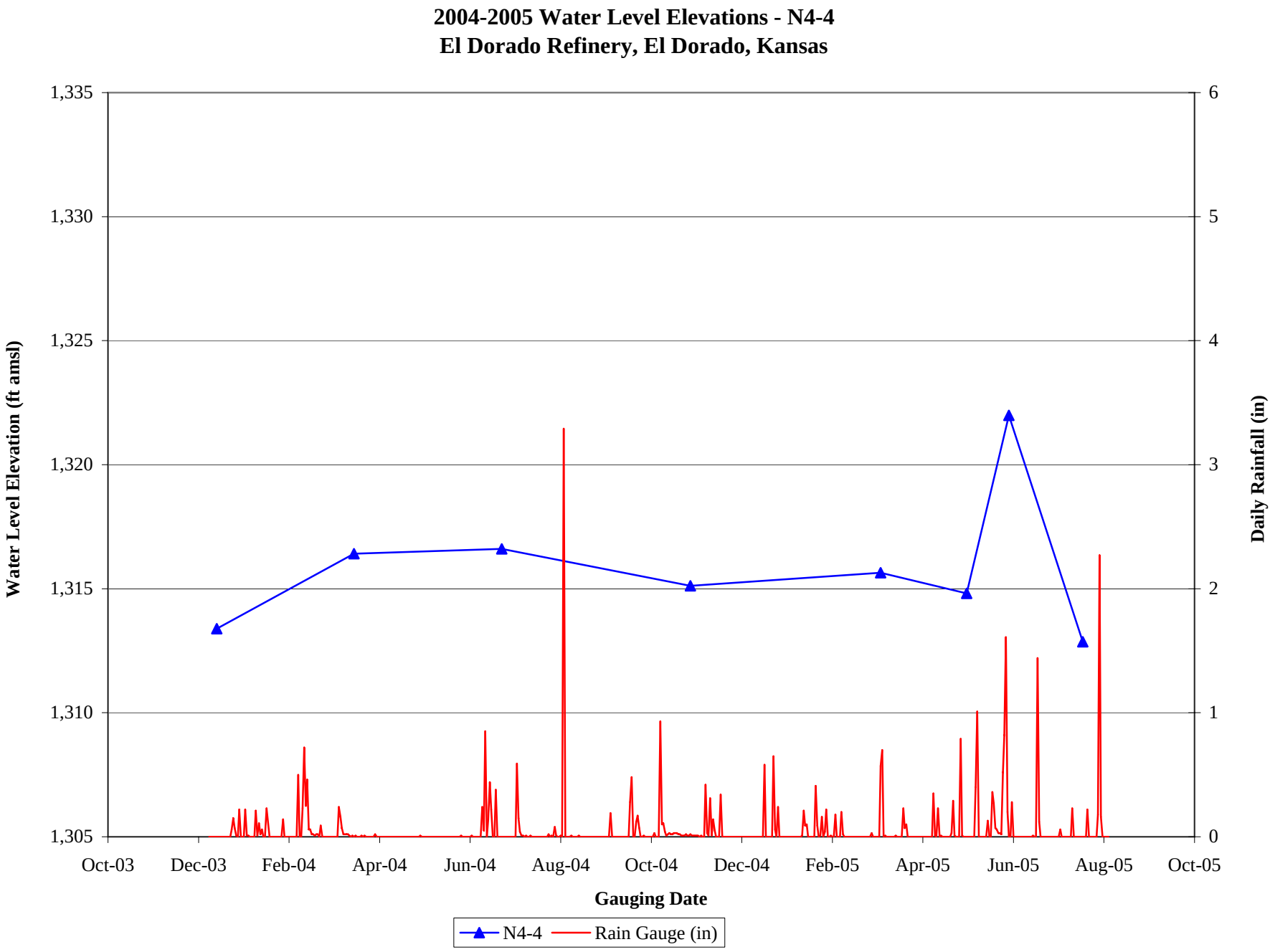

2004-2005 Water Level Elevations - N3-3
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
N3-3
Rain Gauge (in)

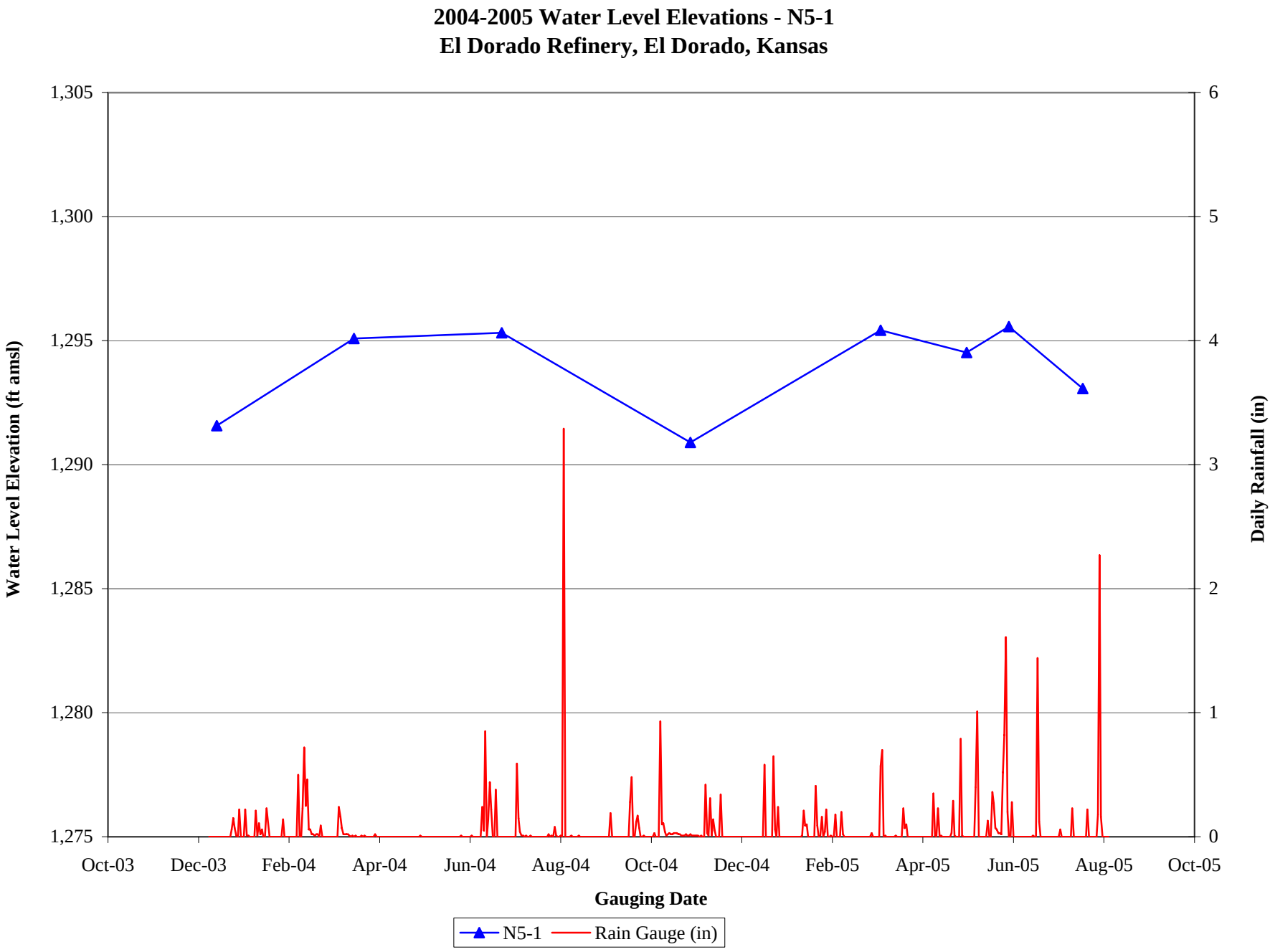

2004-2005 Water Level Elevations - N3-4
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
N3-4
Rain Gauge (in)

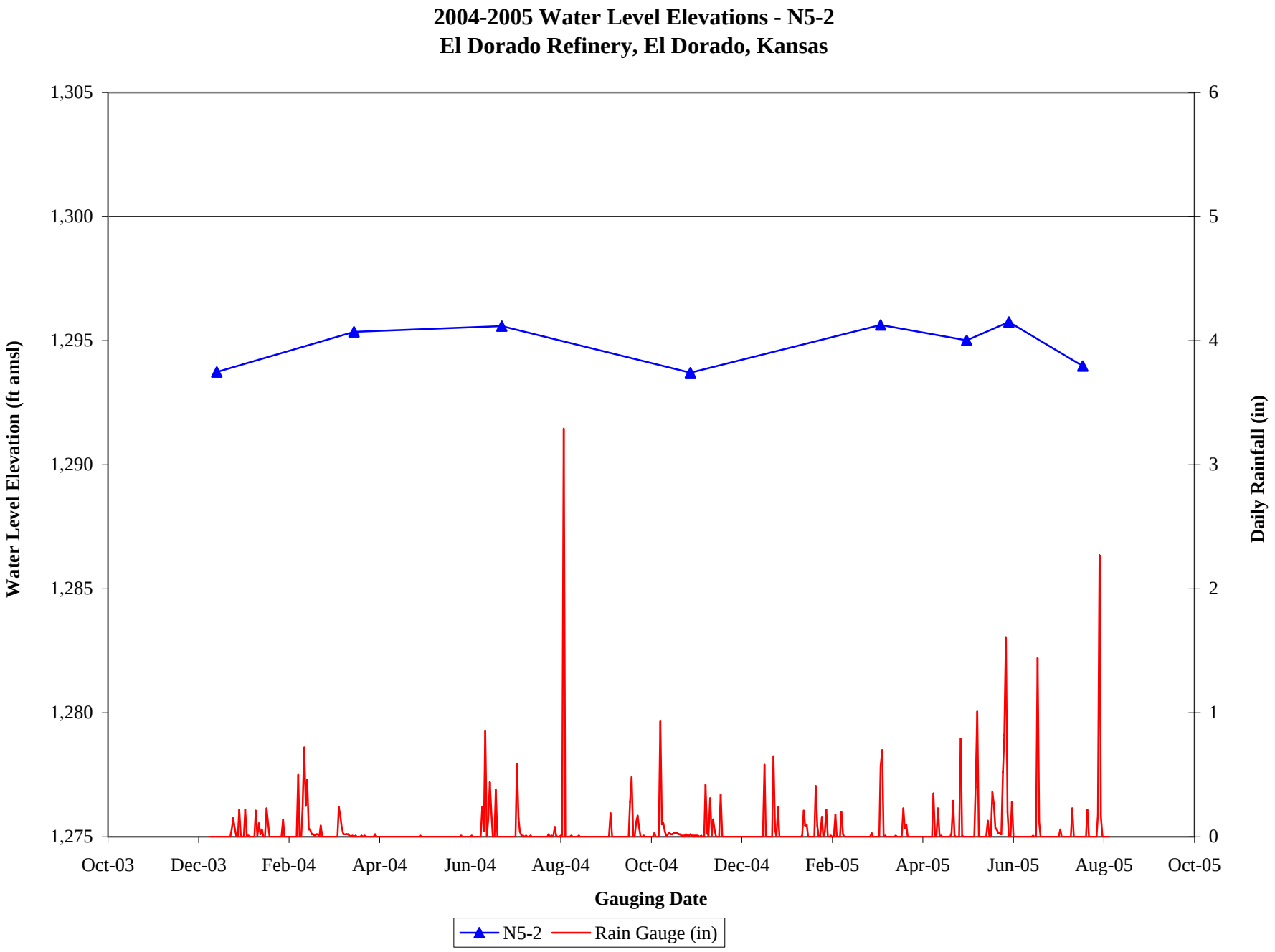

2004-2005 Water Level Elevations - N4-1
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N4-1
Rain Gauge (in)

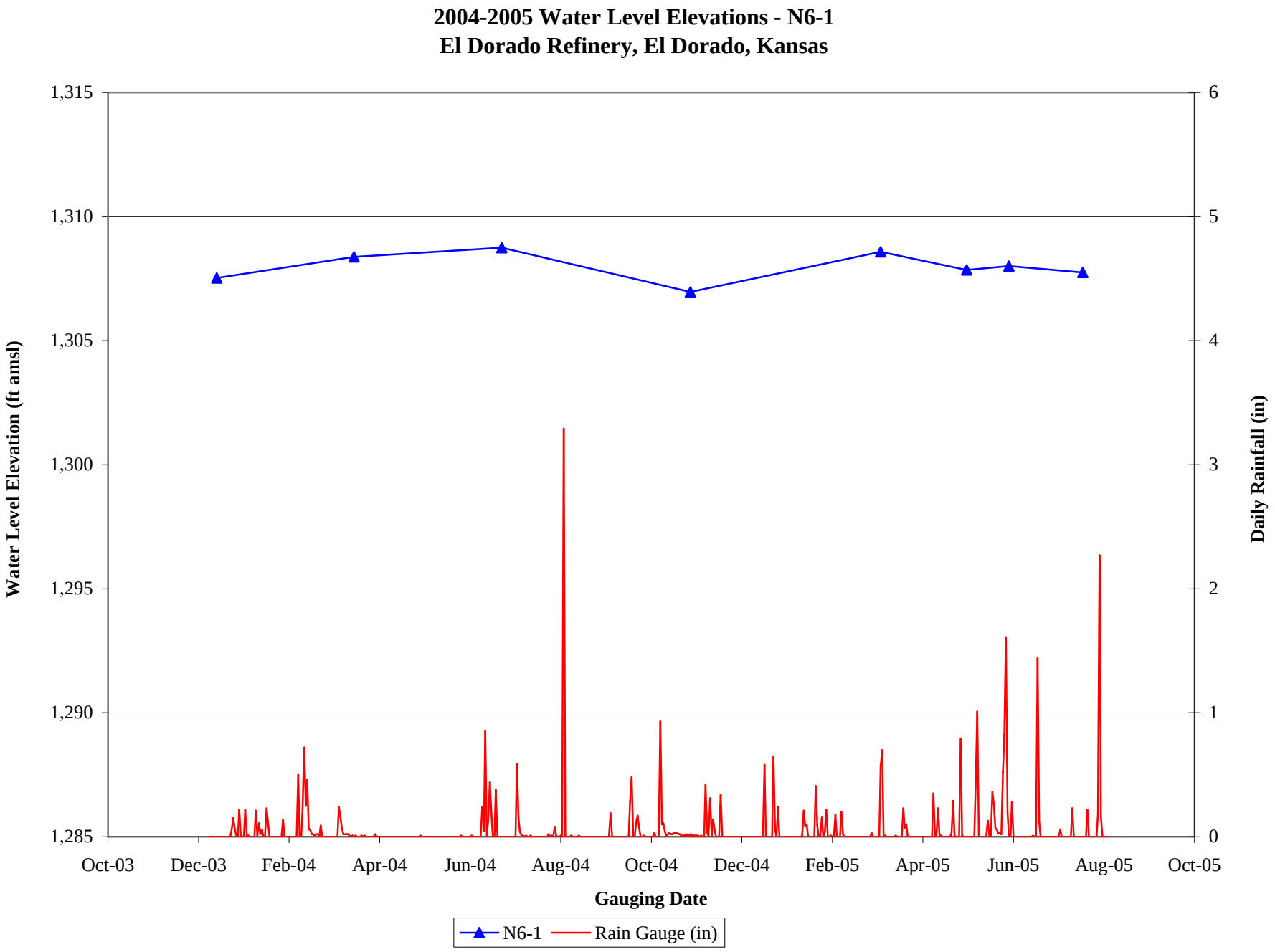

2004-2005 Water Level Elevations - N4-2
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N4-2
Rain Gauge (in)

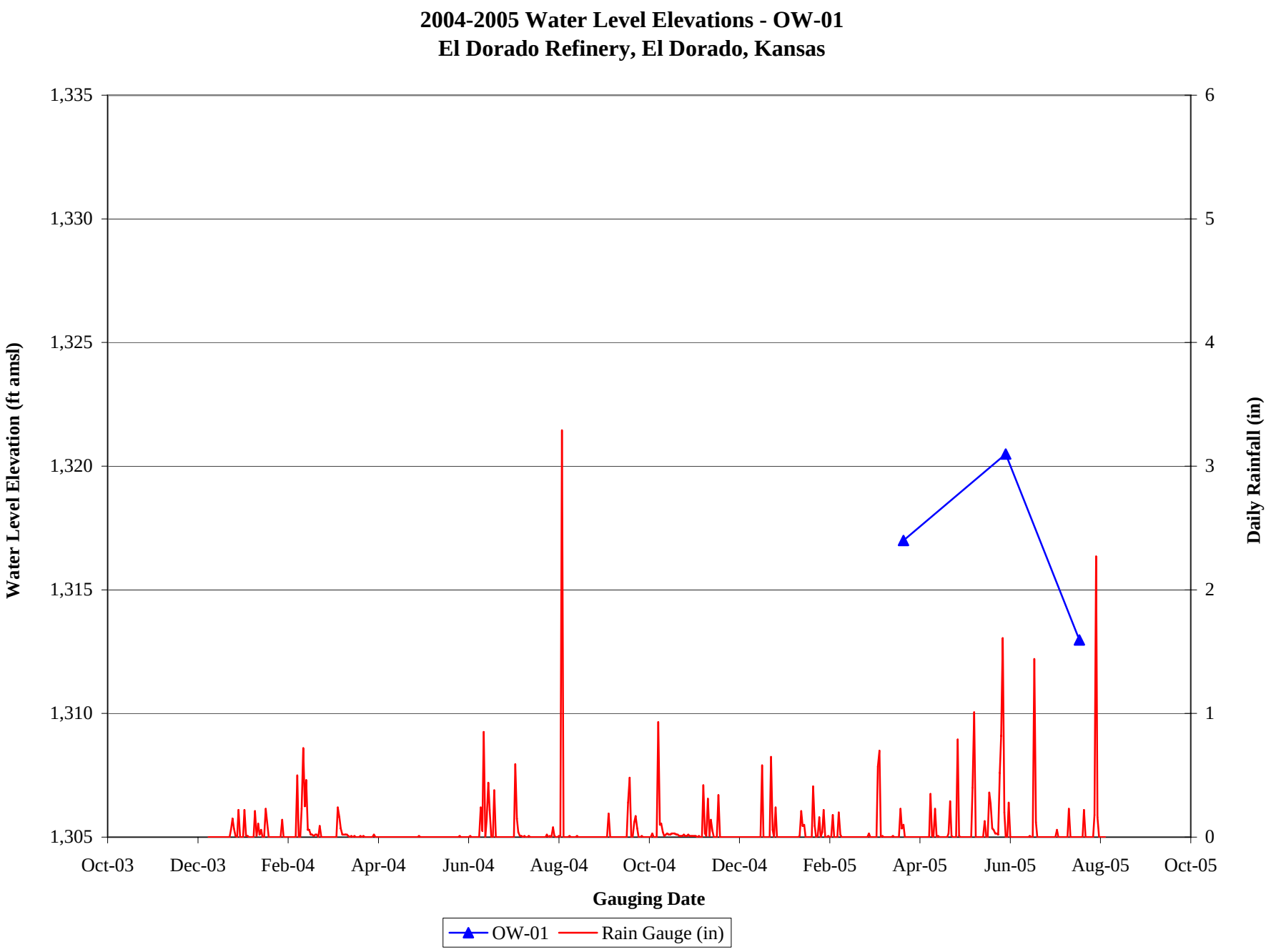

2004-2005 Water Level Elevations - N4-3
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N4-3
Rain Gauge (in)

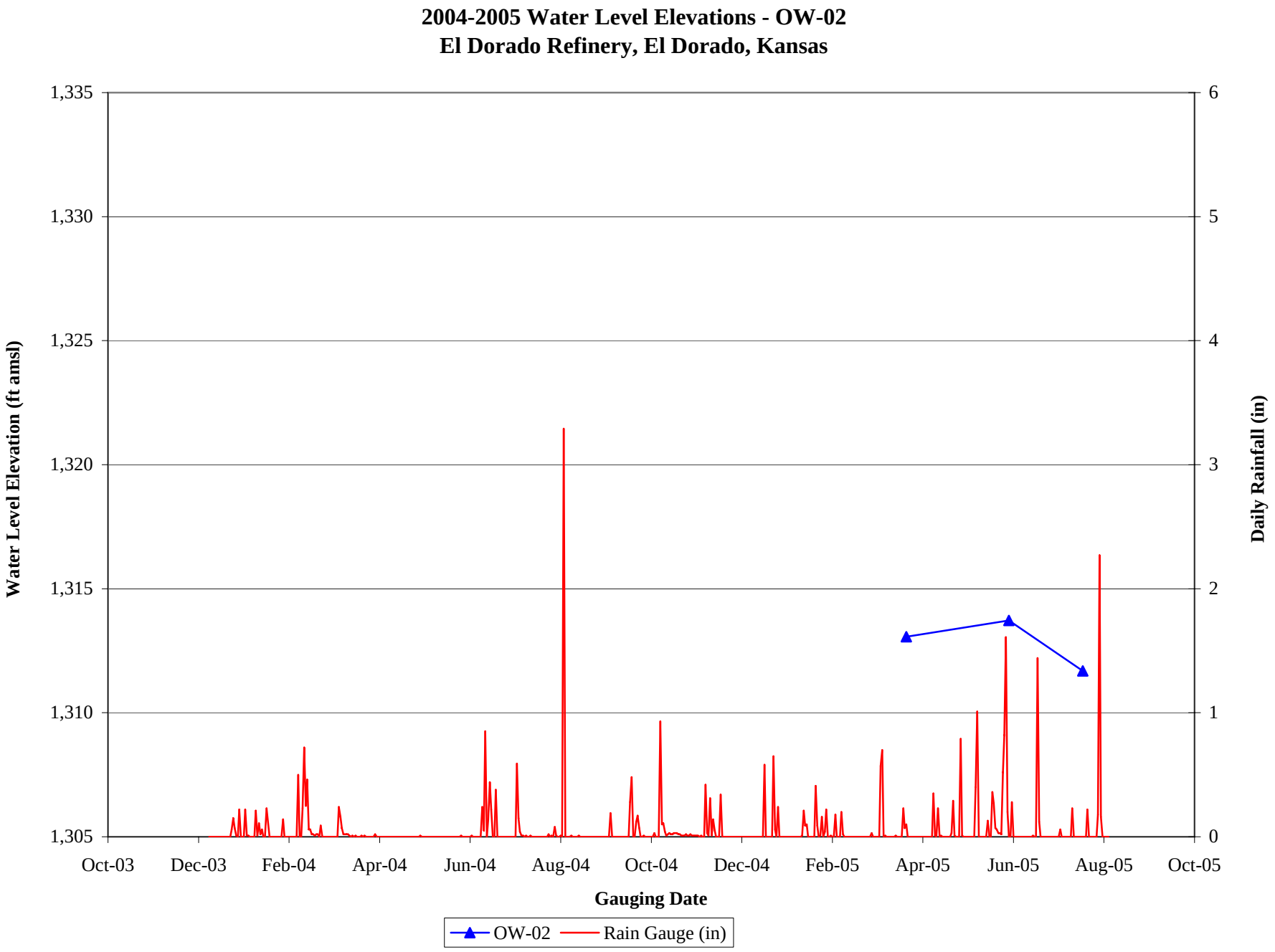

2004-2005 Water Level Elevations - N4-4
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N4-4
Rain Gauge (in)

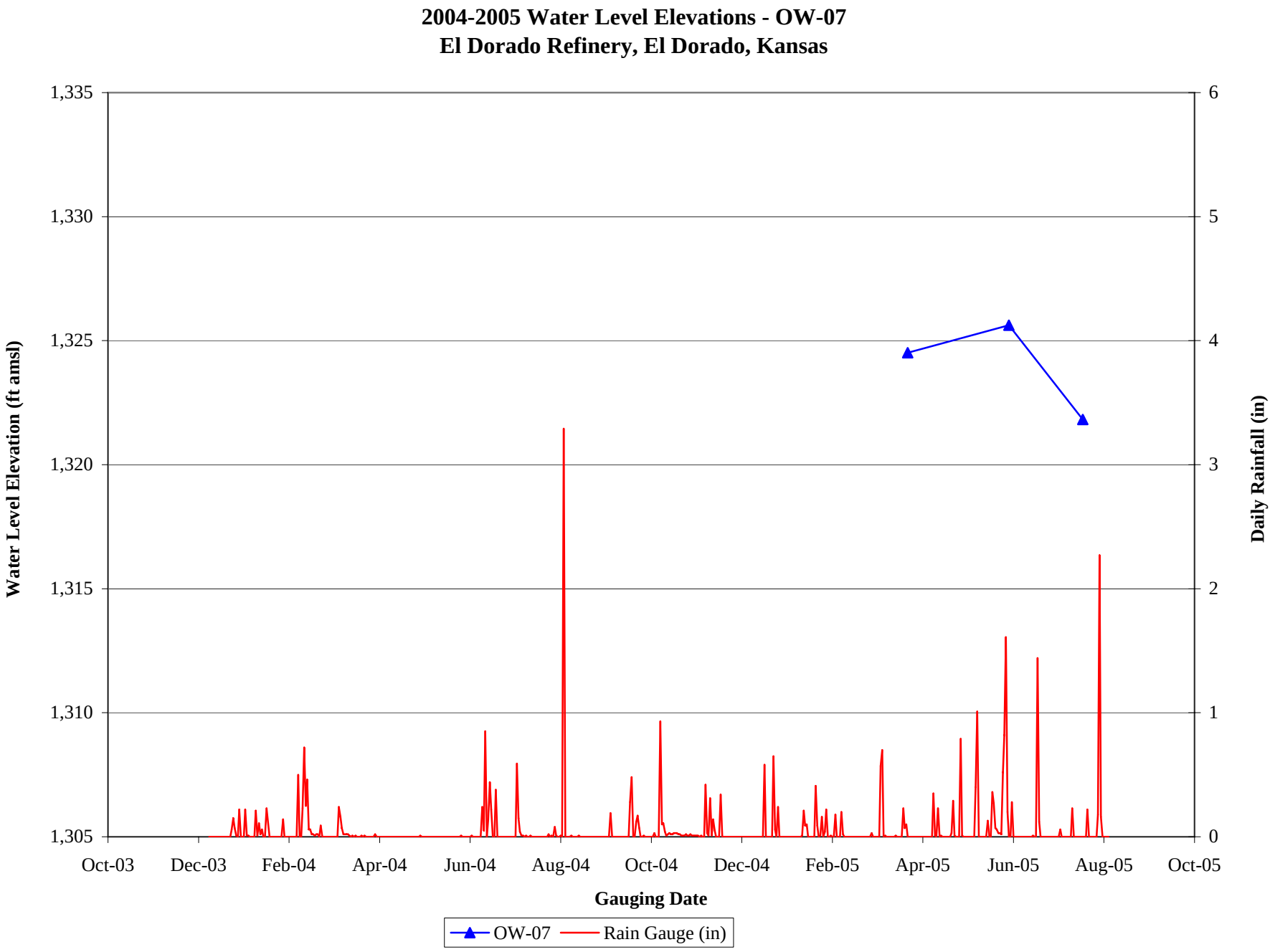

2004-2005 Water Level Elevations - N5-1
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N5-1
Rain Gauge (in)

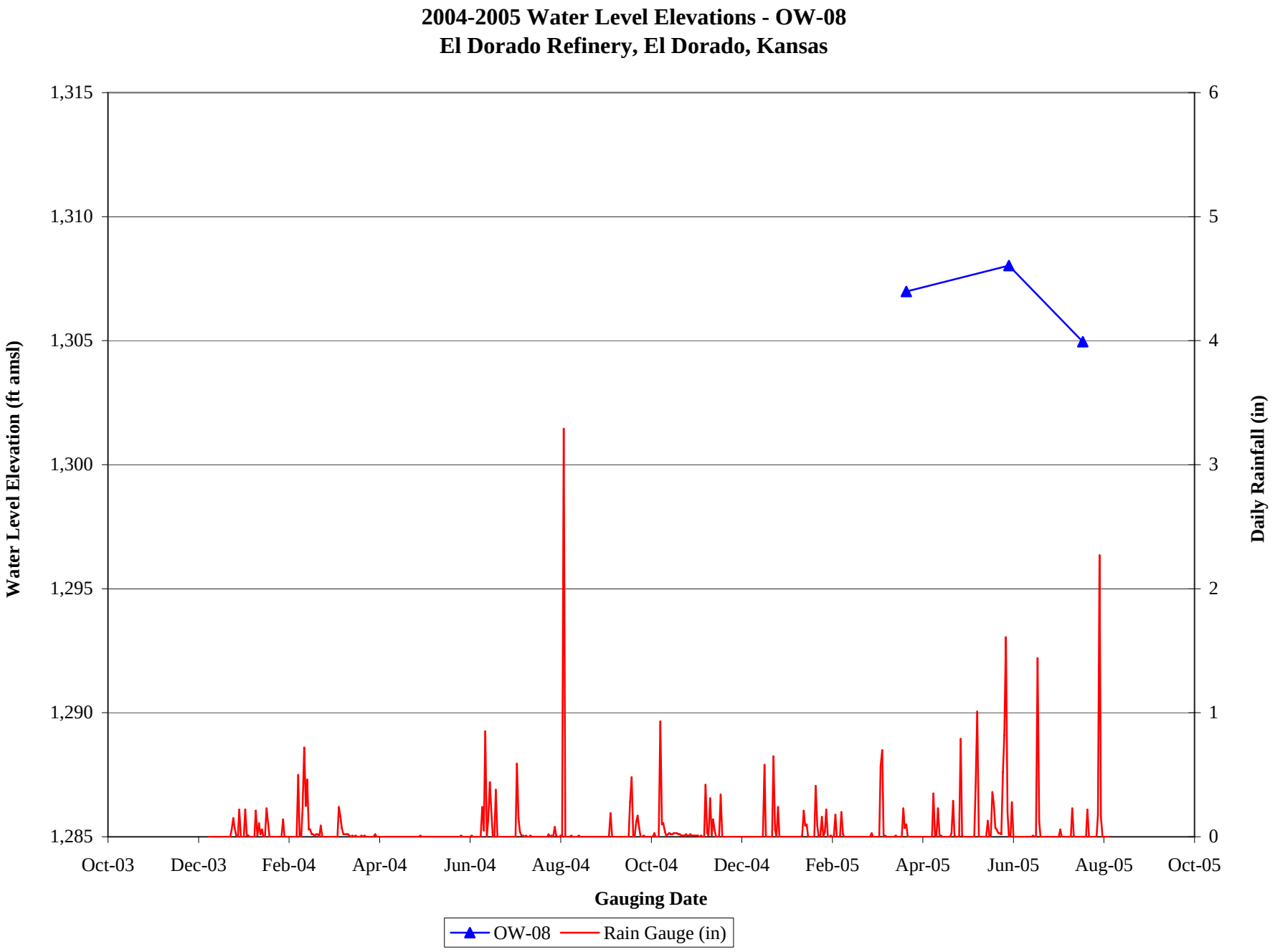

2004-2005 Water Level Elevations - N5-2
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N5-2
Rain Gauge (in)

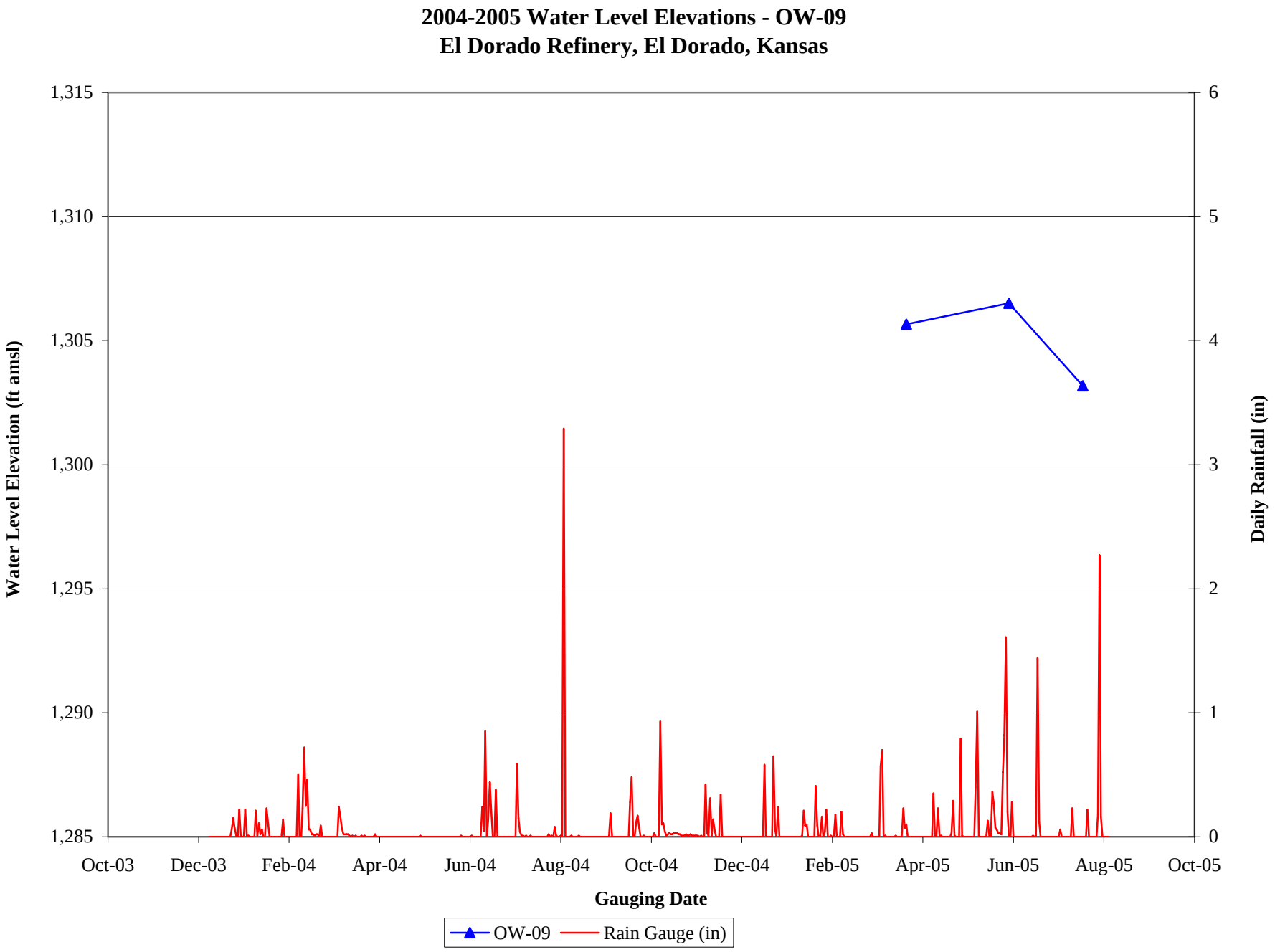

2004-2005 Water Level Elevations - N6-1
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
N6-1
Rain Gauge (in)

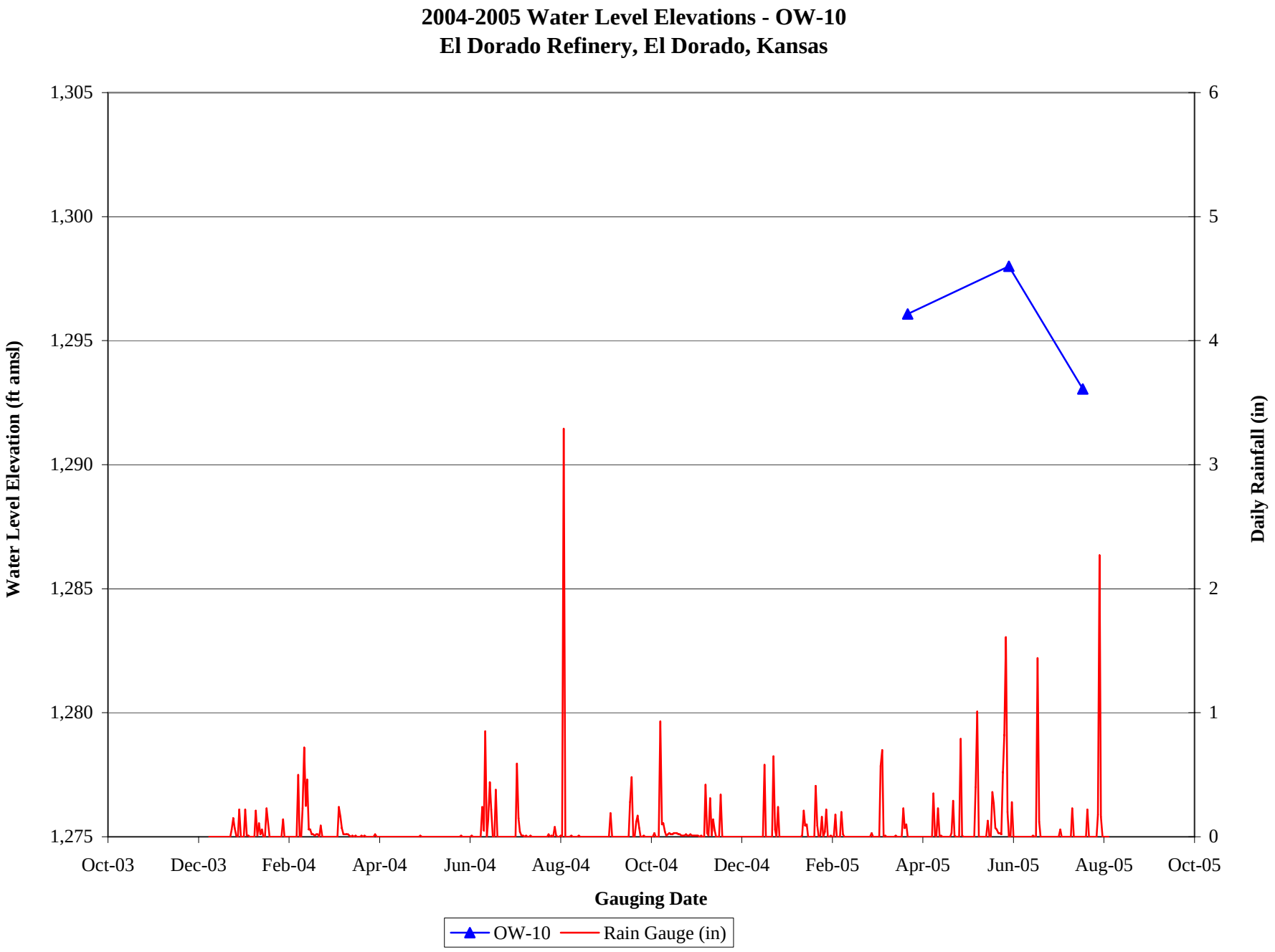

2004-2005 Water Level Elevations - OW-01
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-01
Rain Gauge (in)

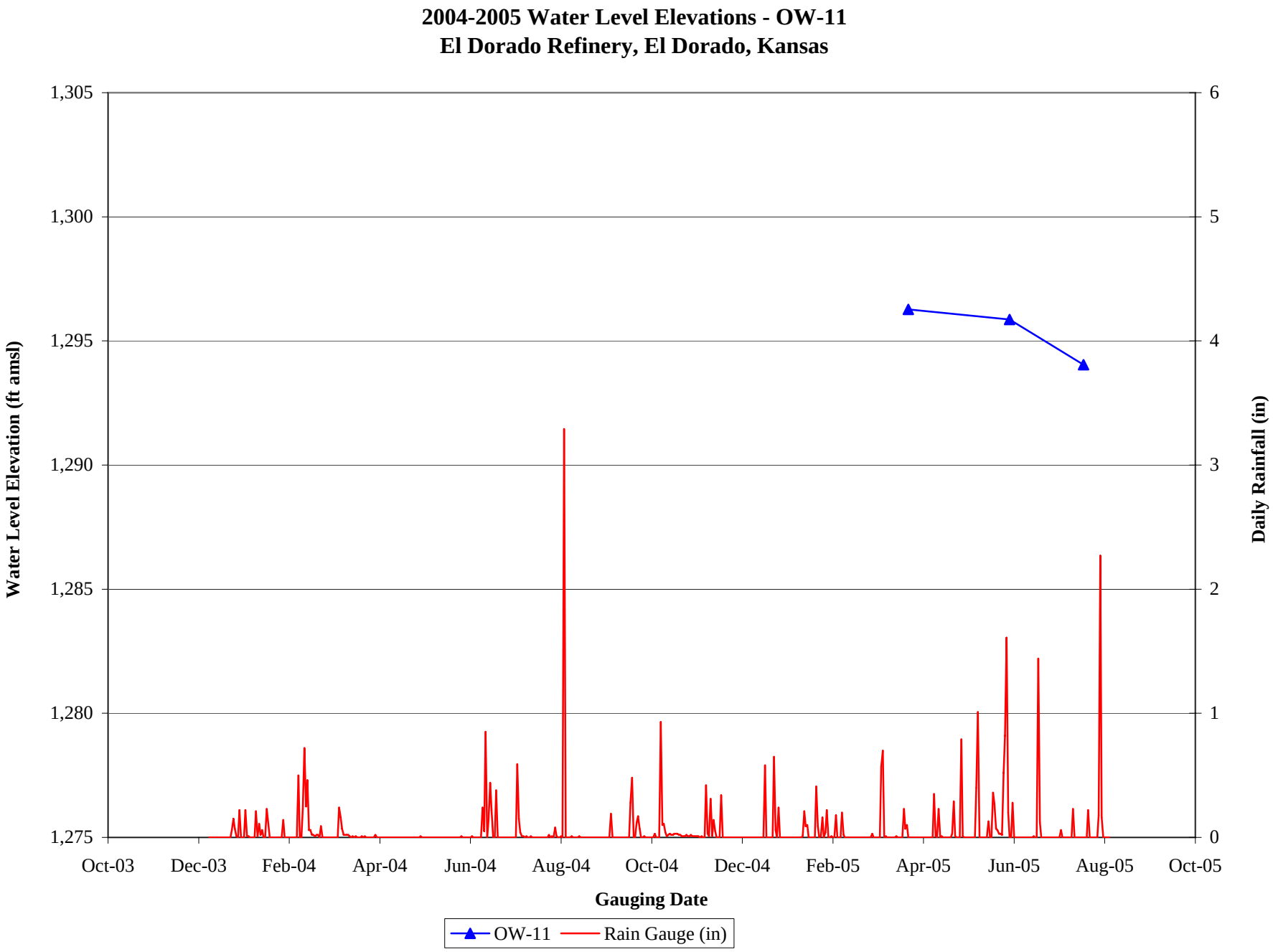

2004-2005 Water Level Elevations - OW-02
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-02
Rain Gauge (in)

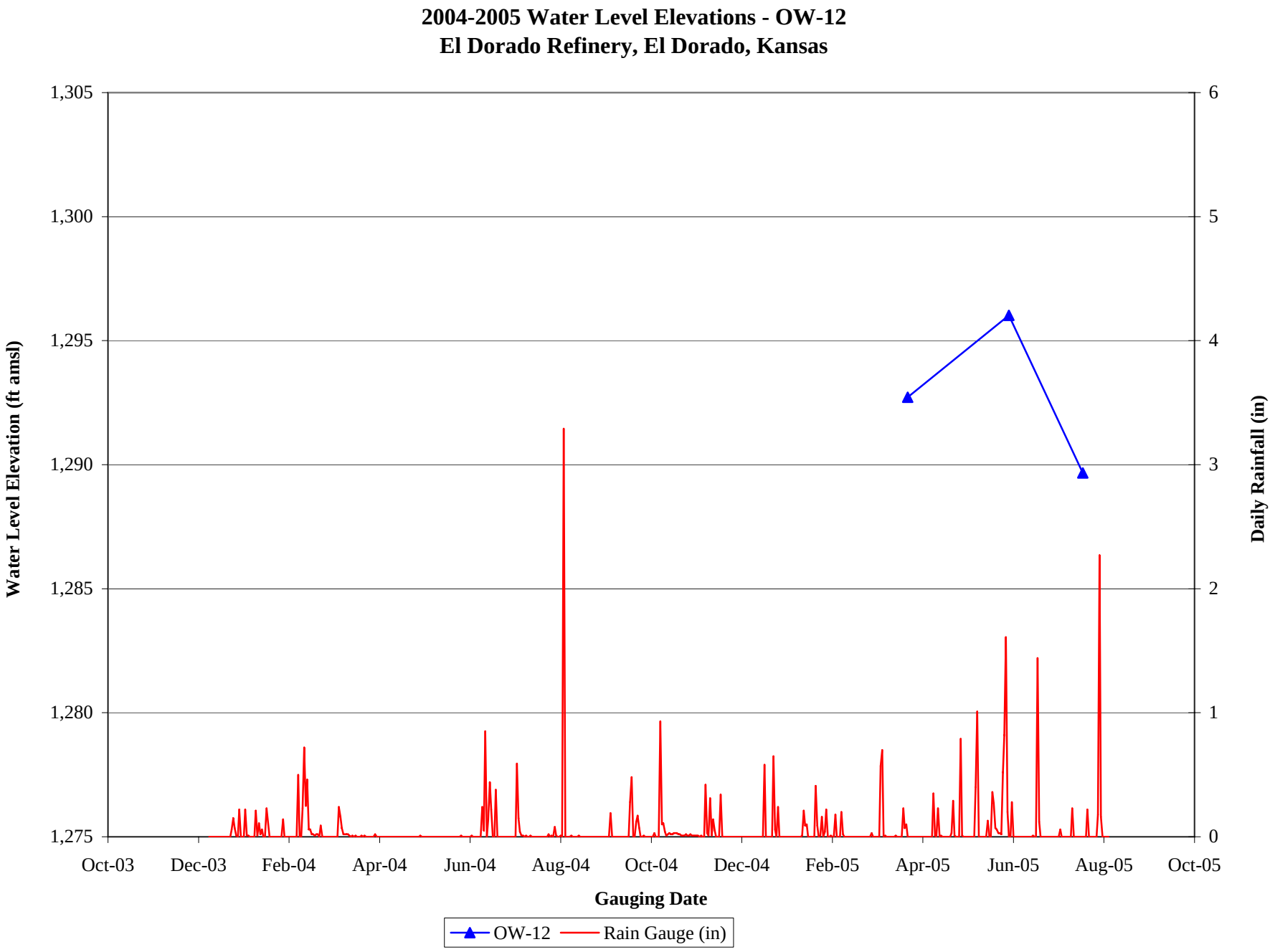

2004-2005 Water Level Elevations - OW-07
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-07
Rain Gauge (in)

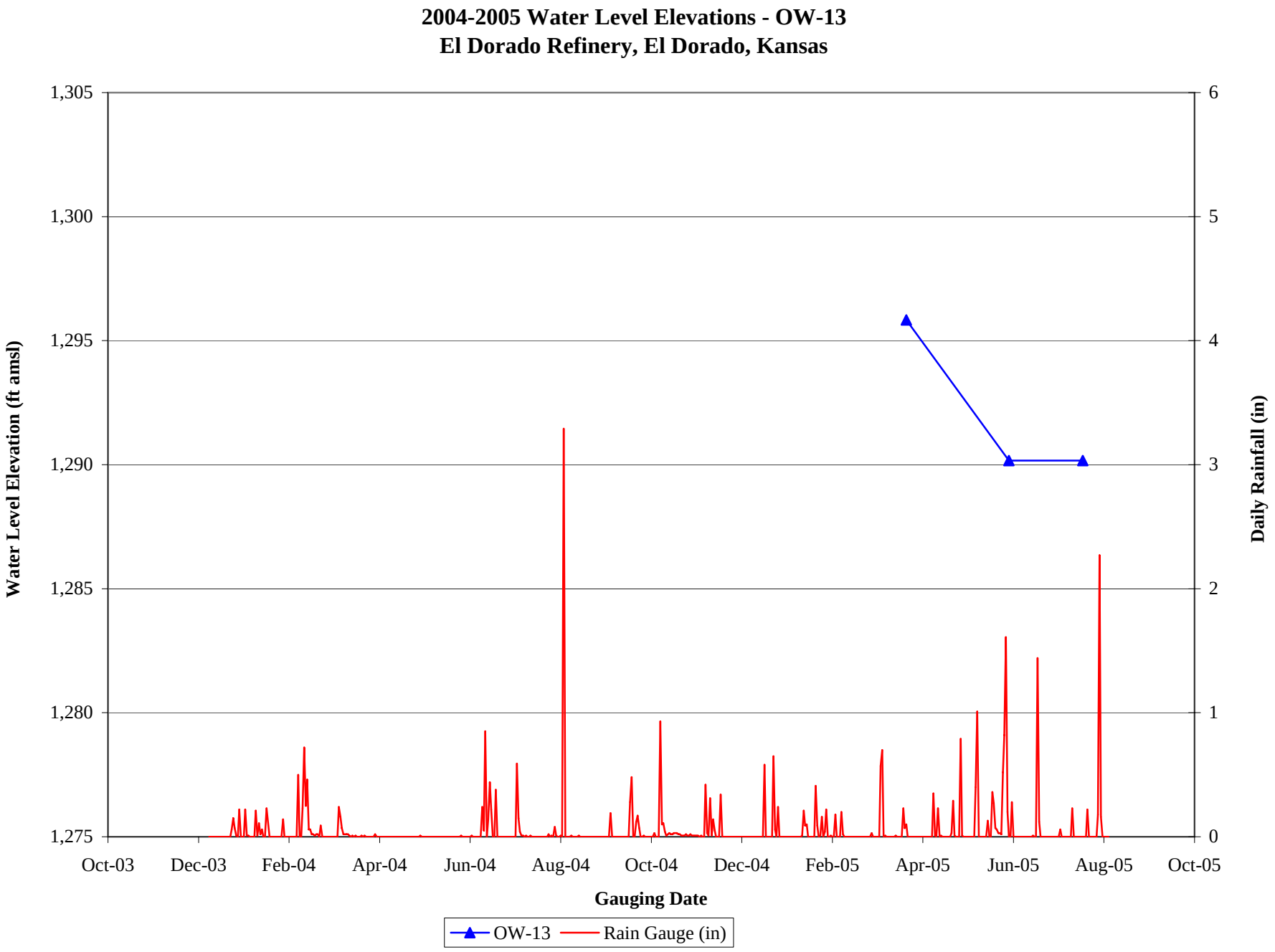

2004-2005 Water Level Elevations - OW-08
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-08
Rain Gauge (in)

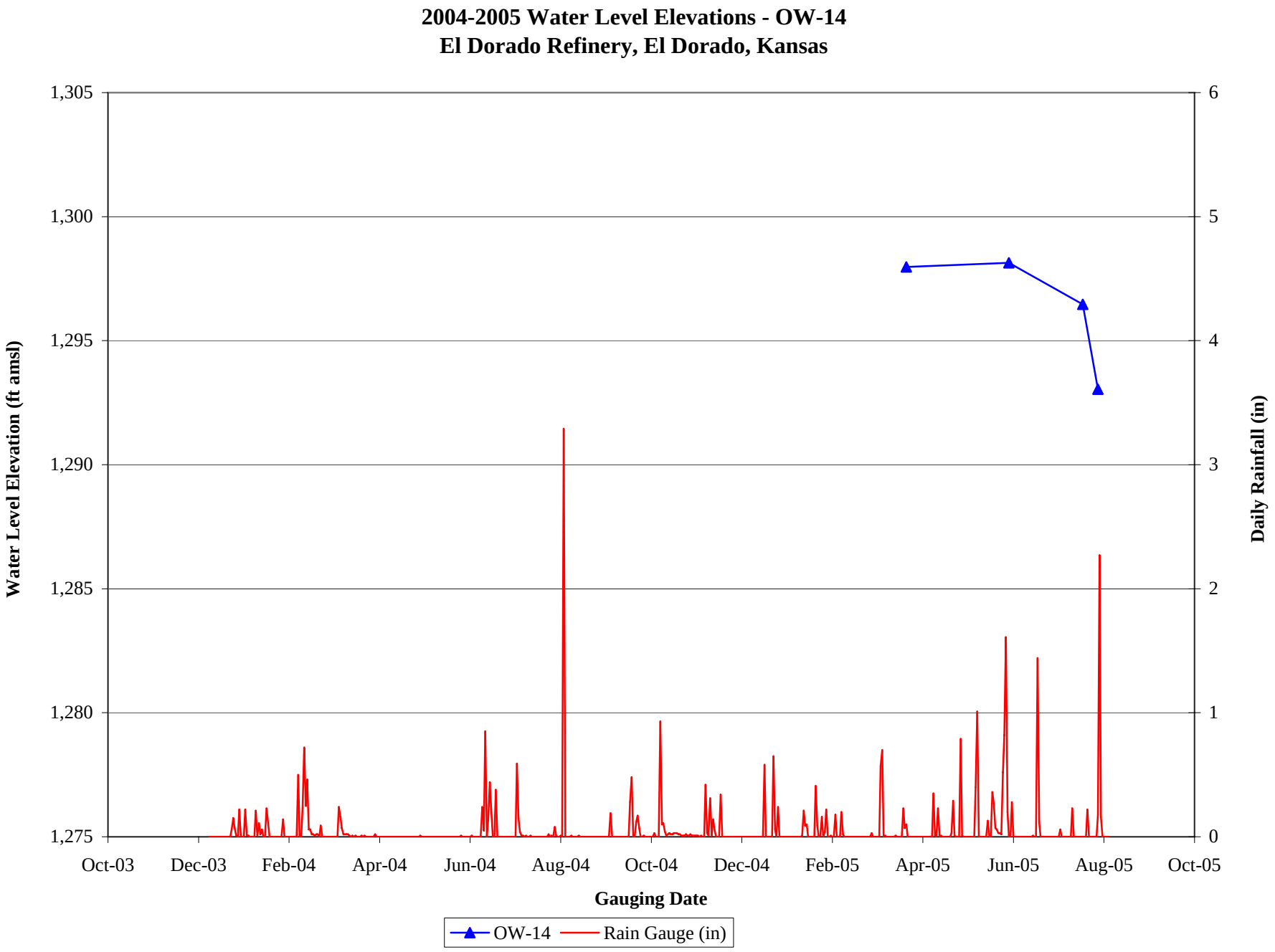

2004-2005 Water Level Elevations - OW-09
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-09
Rain Gauge (in)

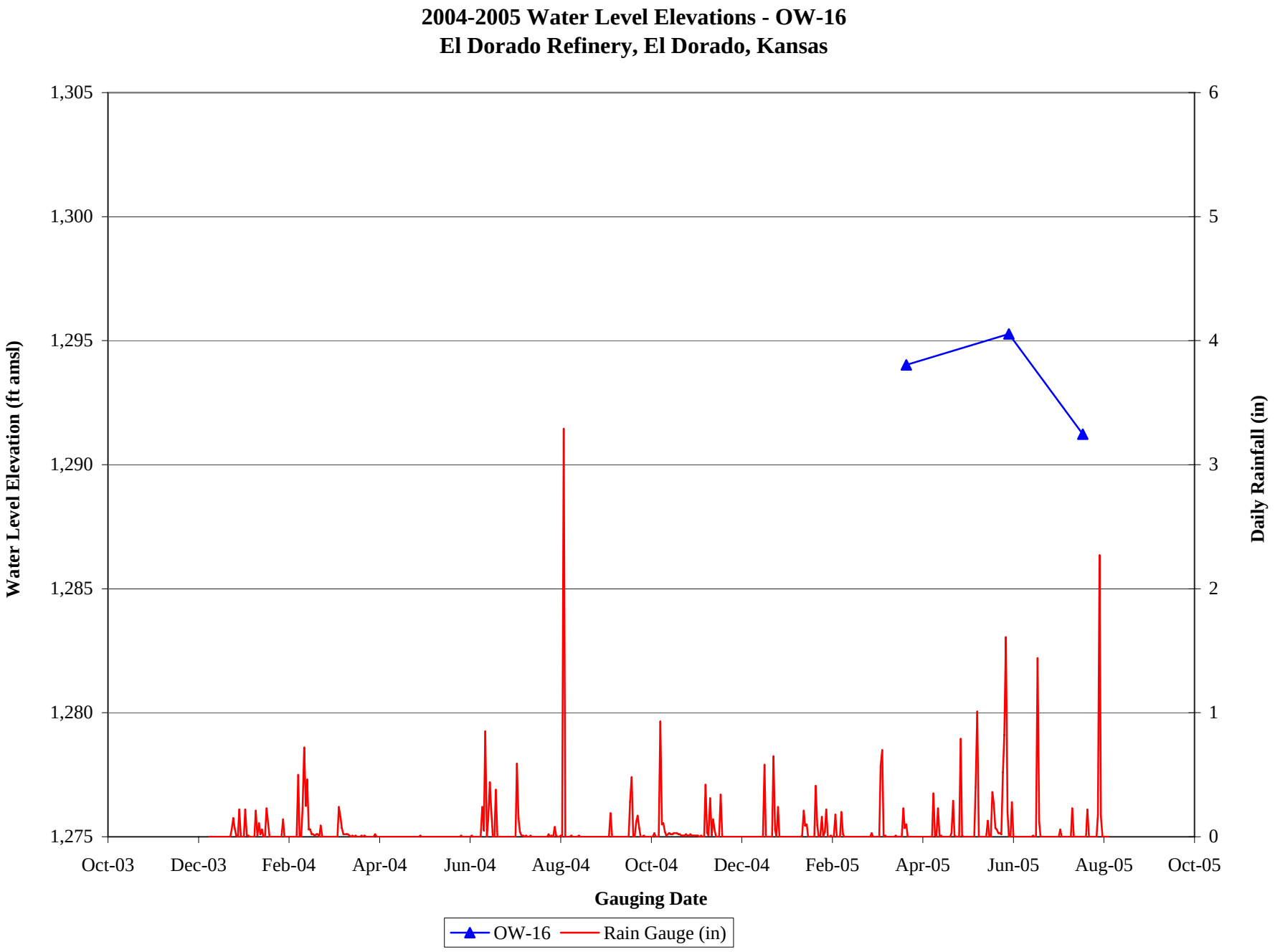

2004-2005 Water Level Elevations - OW-10
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-10
Rain Gauge (in)

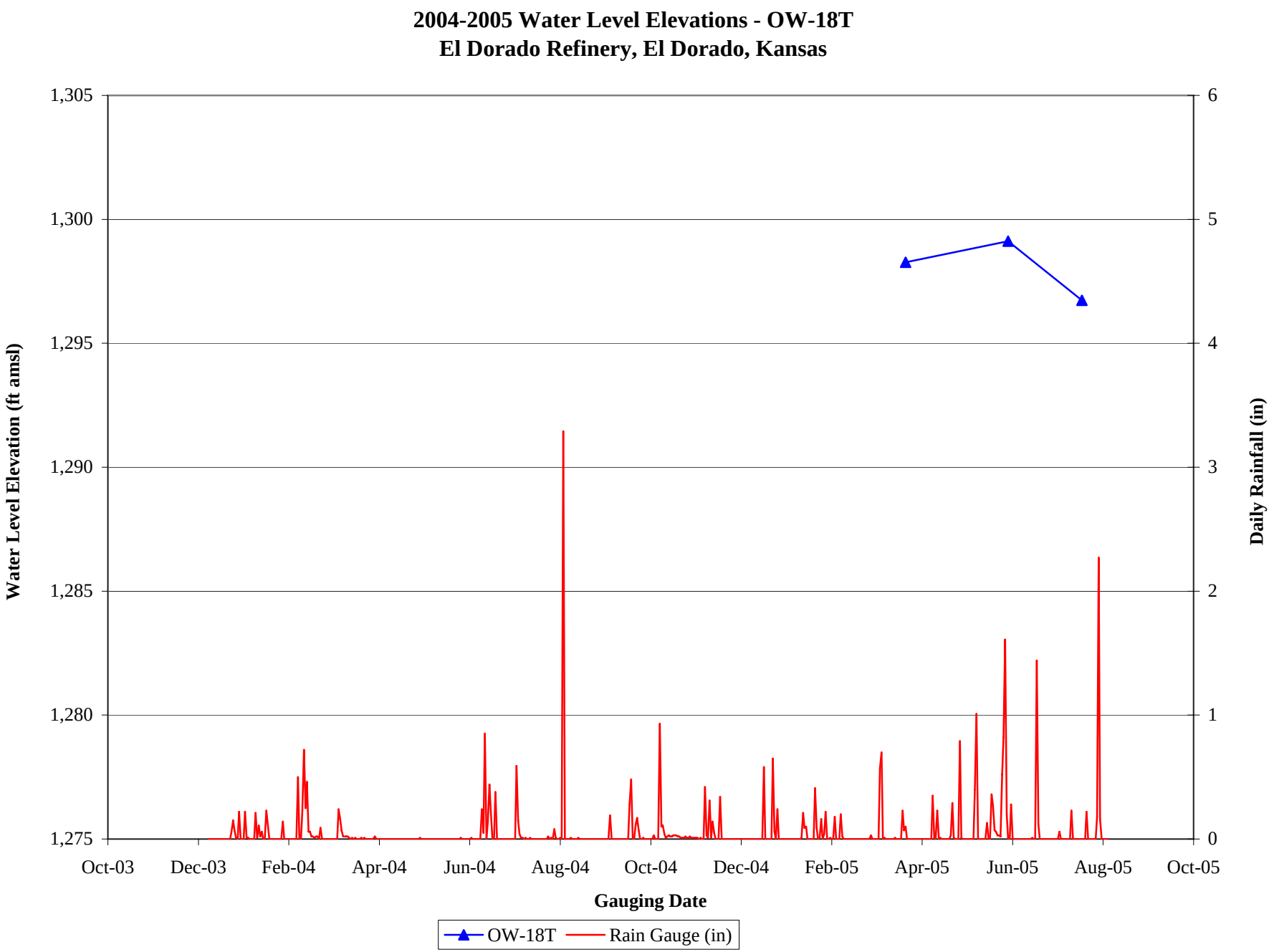

2004-2005 Water Level Elevations - OW-11
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-11
Rain Gauge (in)

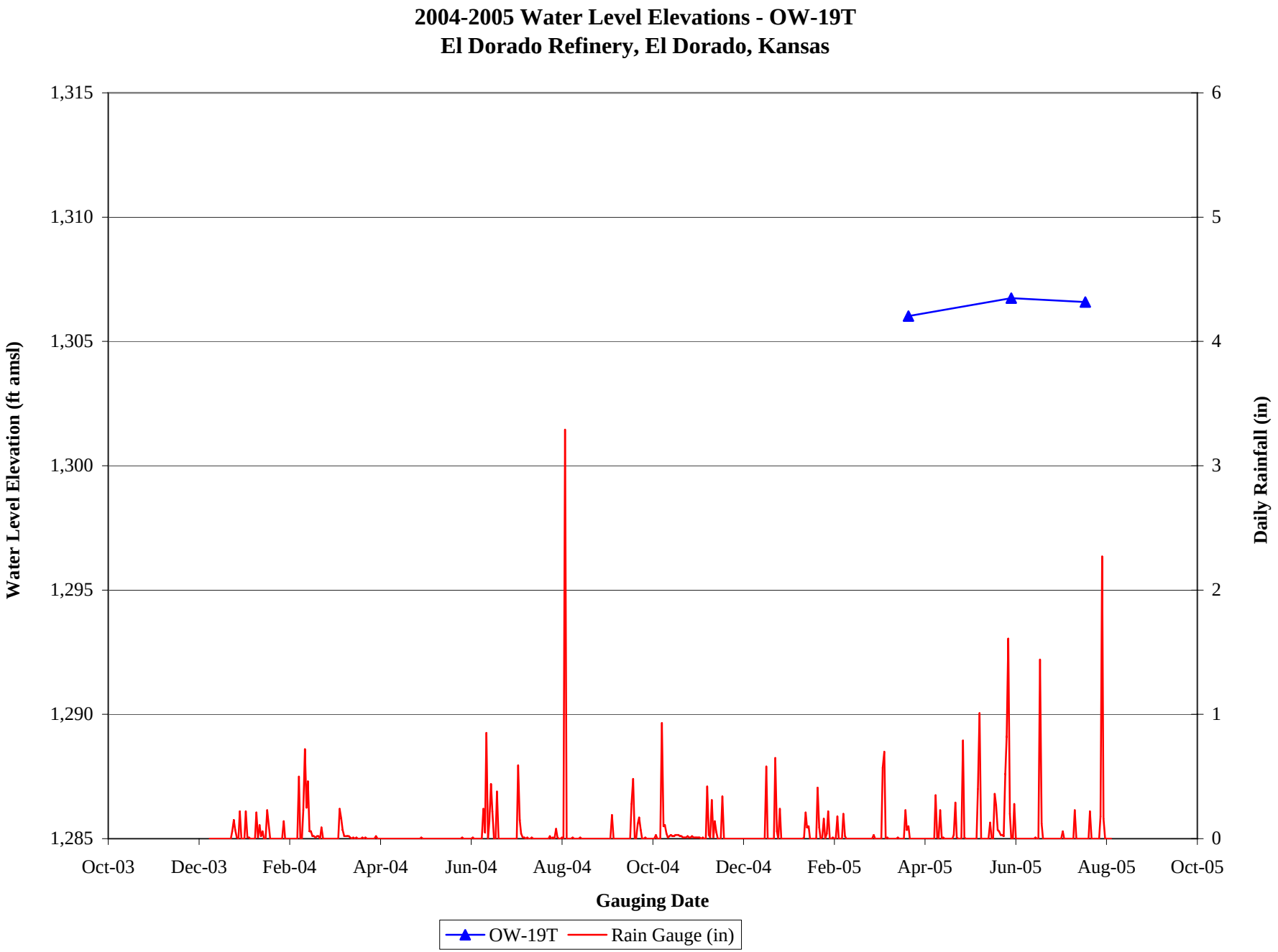

2004-2005 Water Level Elevations - OW-12
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-12
Rain Gauge (in)

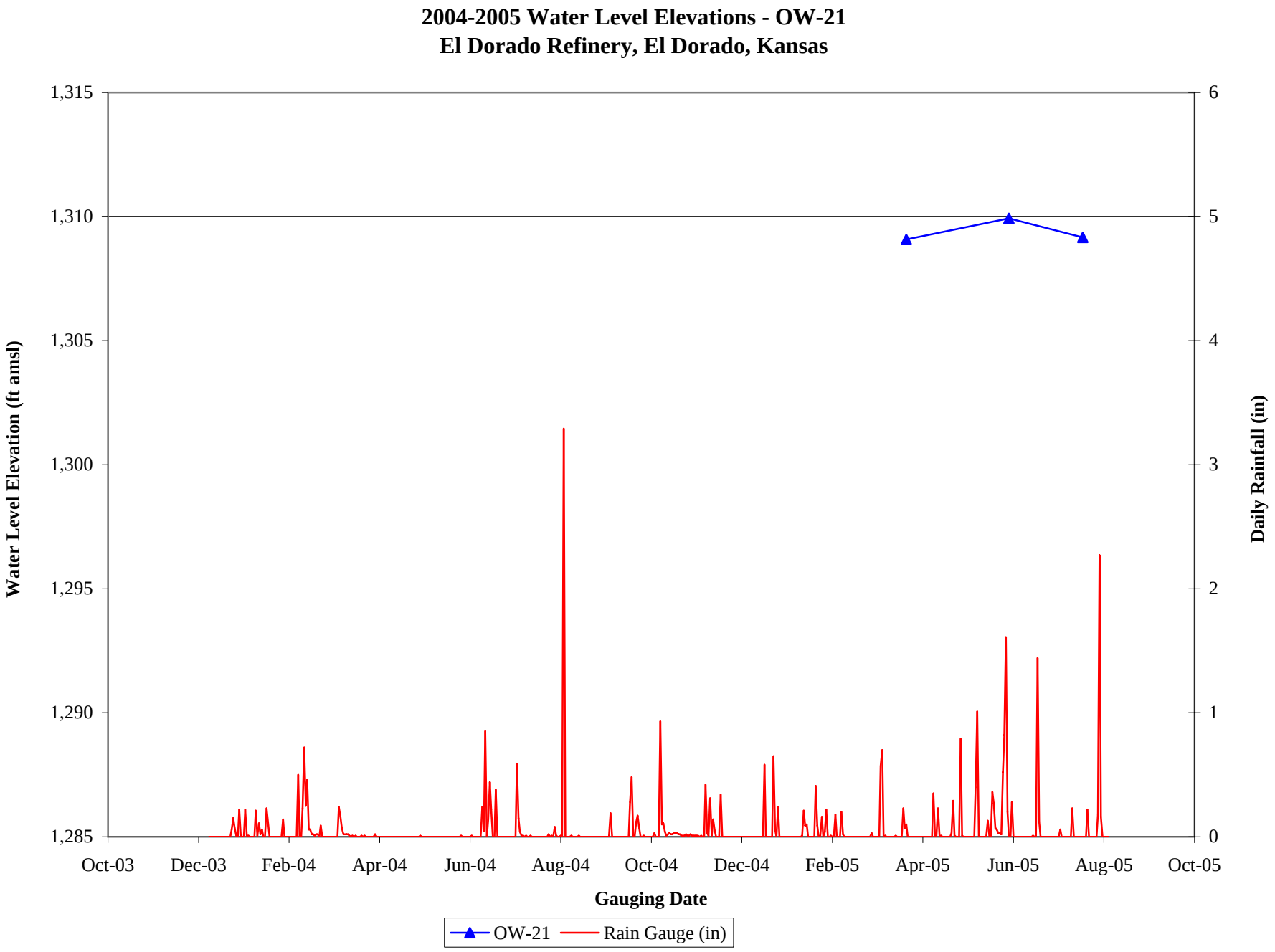

2004-2005 Water Level Elevations - OW-13
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-13
Rain Gauge (in)

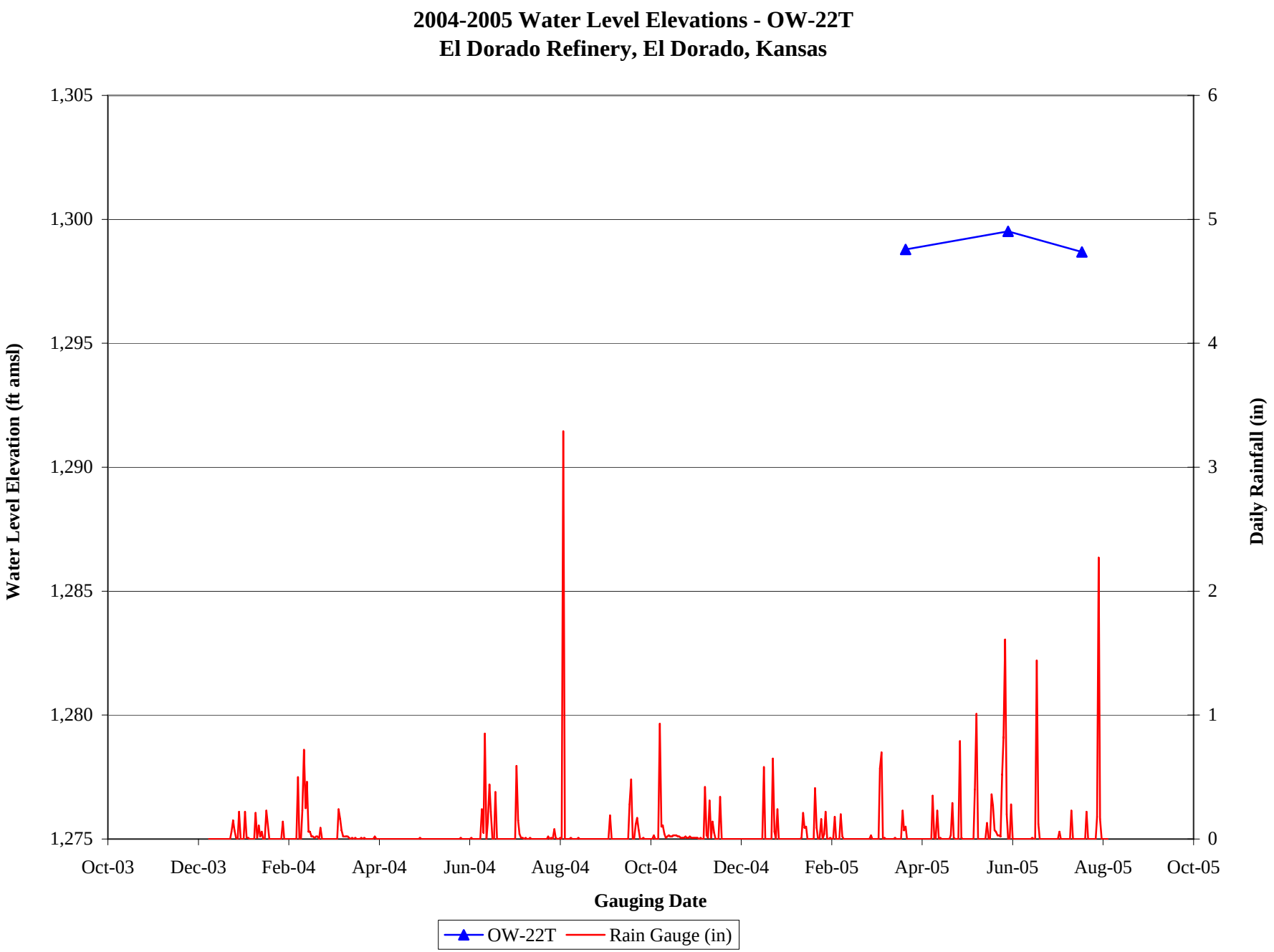

2004-2005 Water Level Elevations - OW-14
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-14
Rain Gauge (in)

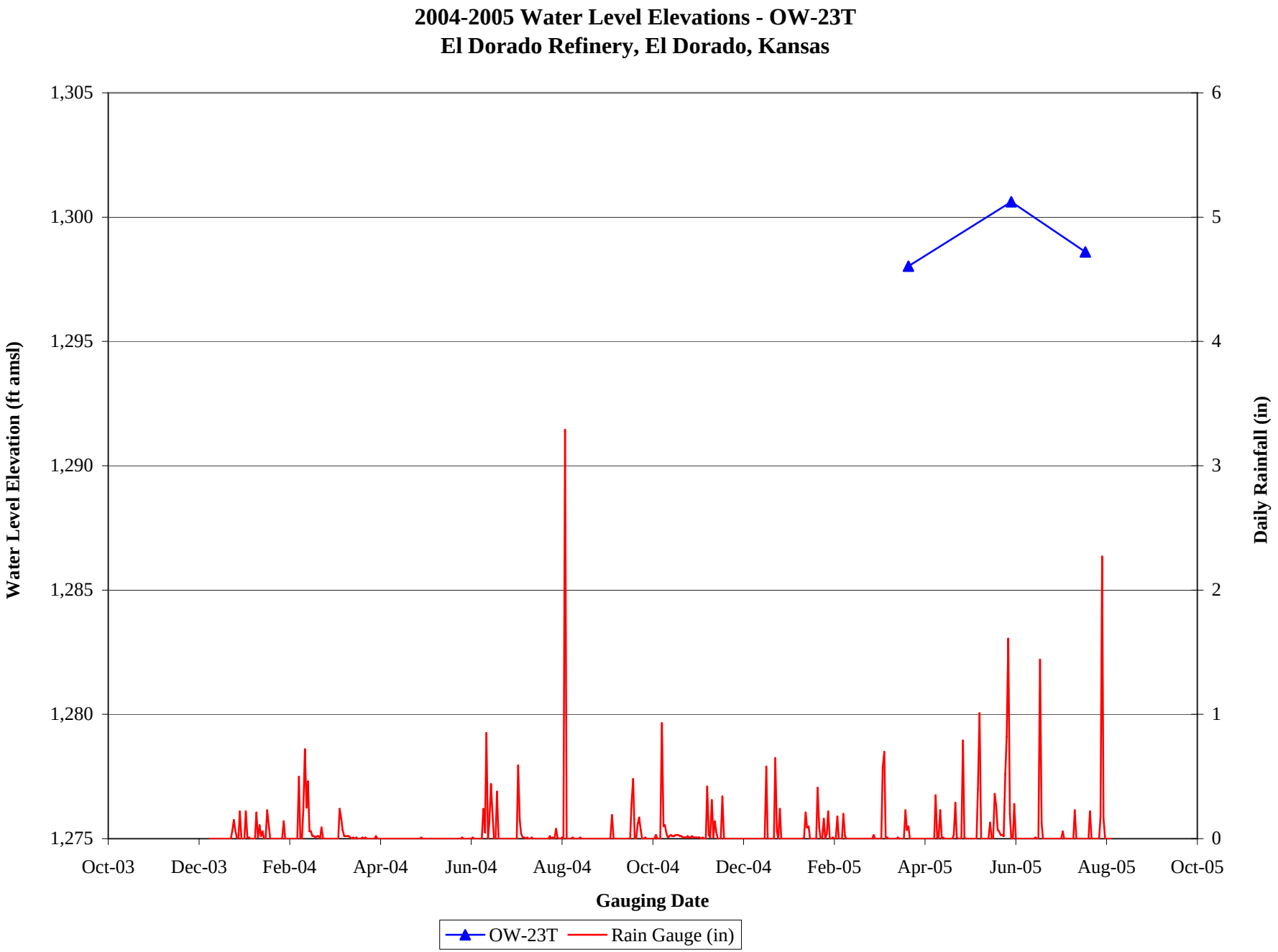

2004-2005 Water Level Elevations - OW-16
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-16
Rain Gauge (in)

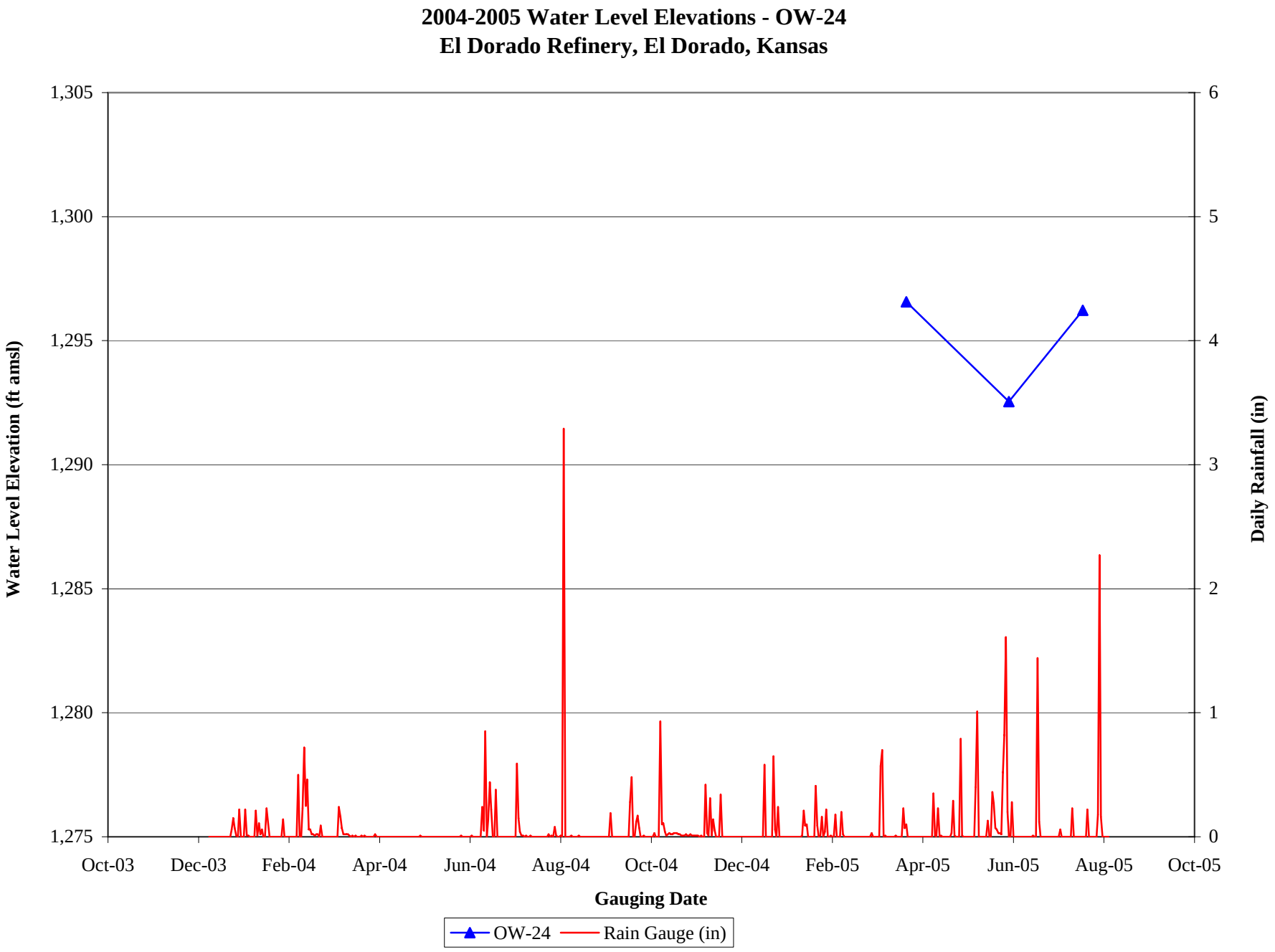

2004-2005 Water Level Elevations - OW-18T
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-18T
Rain Gauge (in)

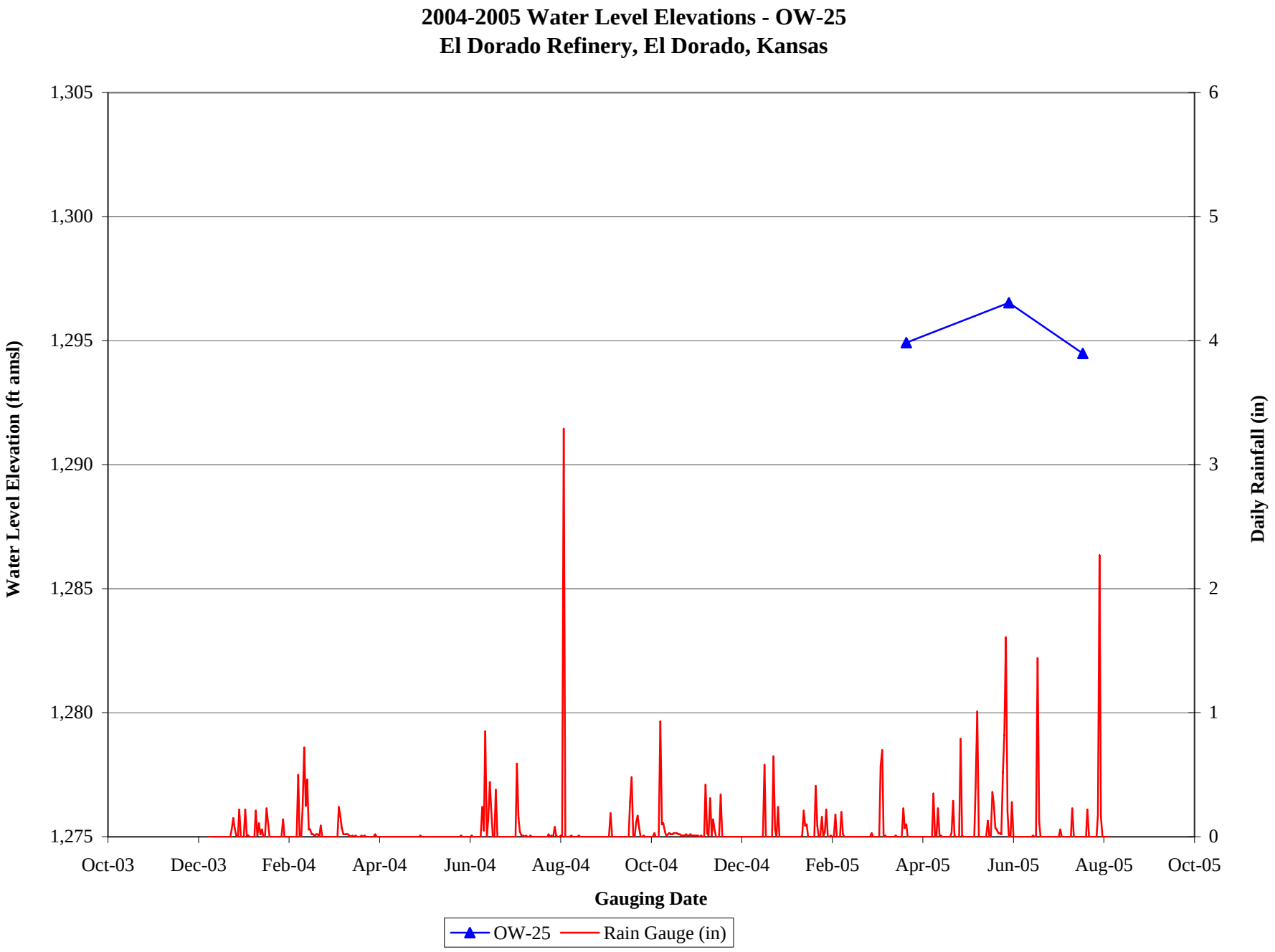

2004-2005 Water Level Elevations - OW-19T
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-19T
Rain Gauge (in)

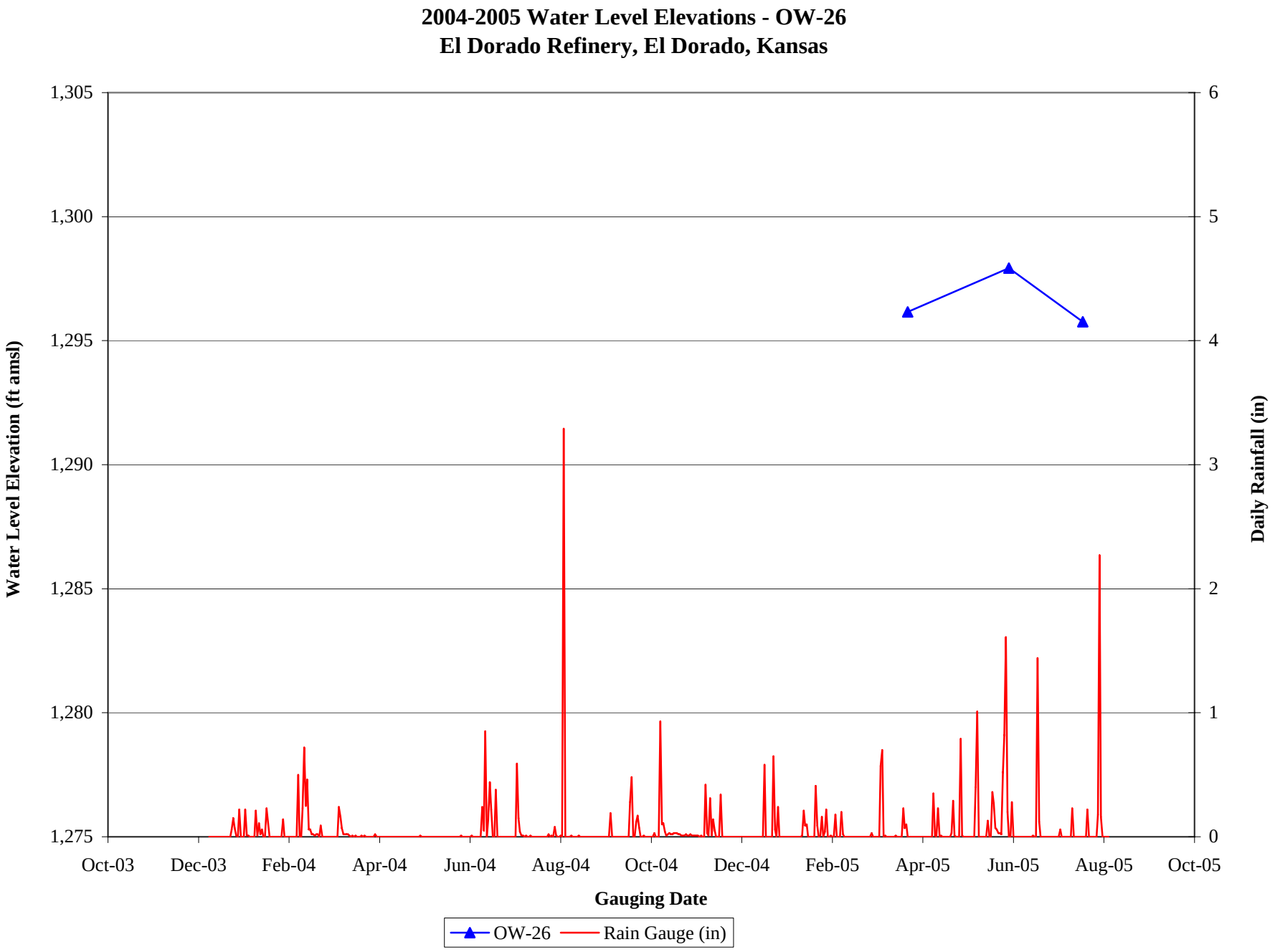

2004-2005 Water Level Elevations - OW-21
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-21
Rain Gauge (in)

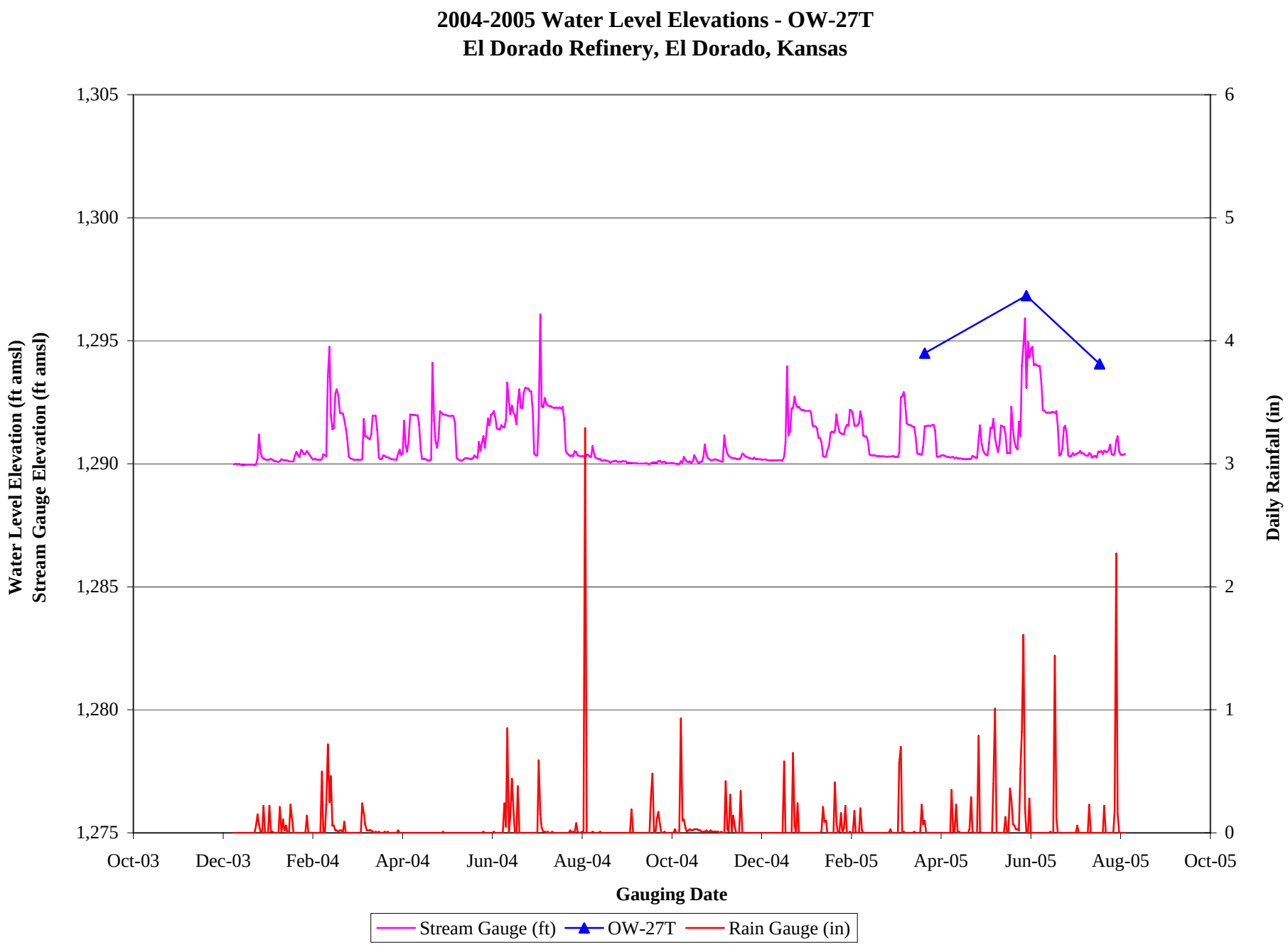

2004-2005 Water Level Elevations - OW-22T
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-22T
Rain Gauge (in)

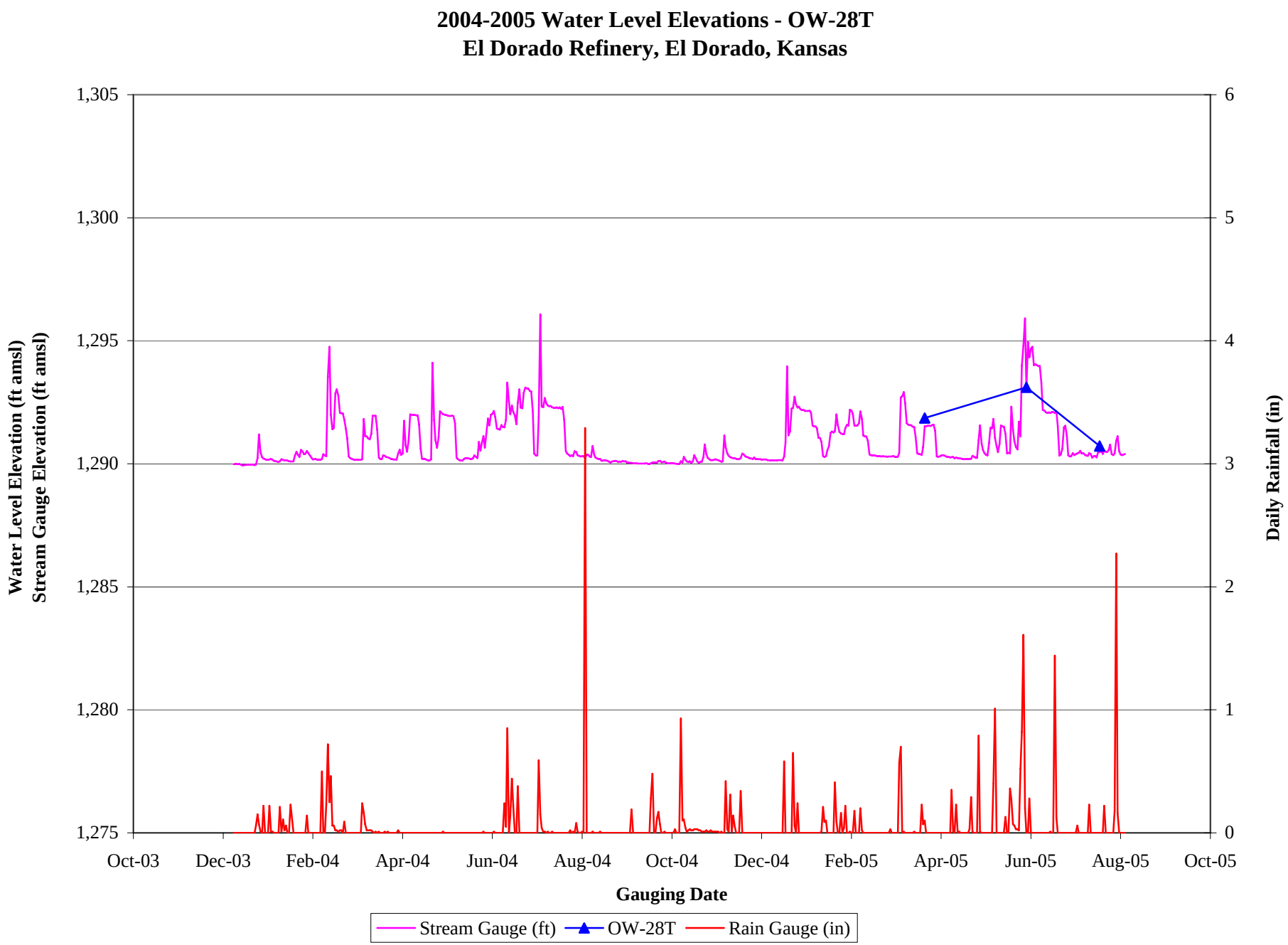

2004-2005 Water Level Elevations - OW-23T
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-23T
Rain Gauge (in)

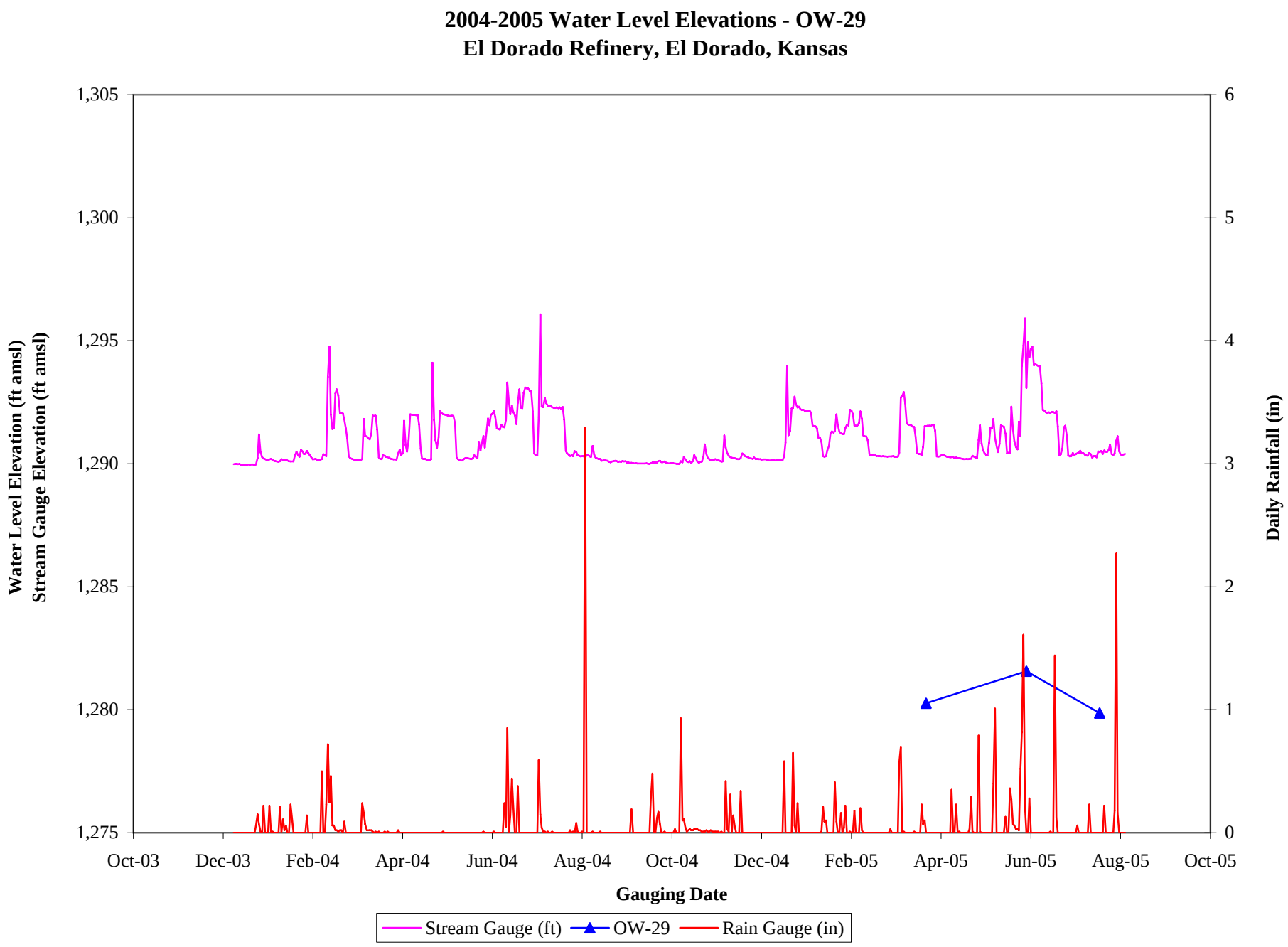

2004-2005 Water Level Elevations - OW-24
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-24
Rain Gauge (in)

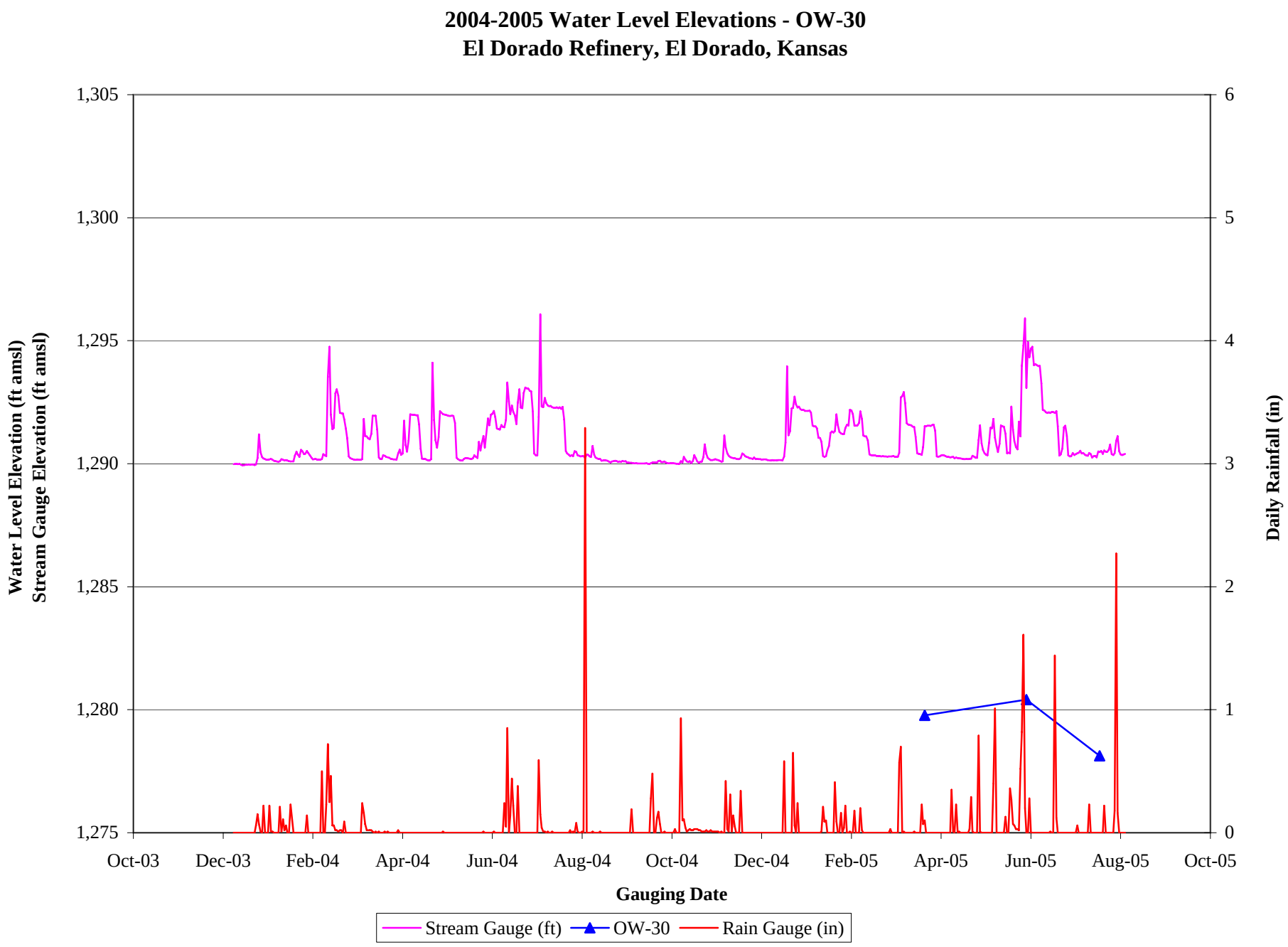

2004-2005 Water Level Elevations - OW-25
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-25
Rain Gauge (in)

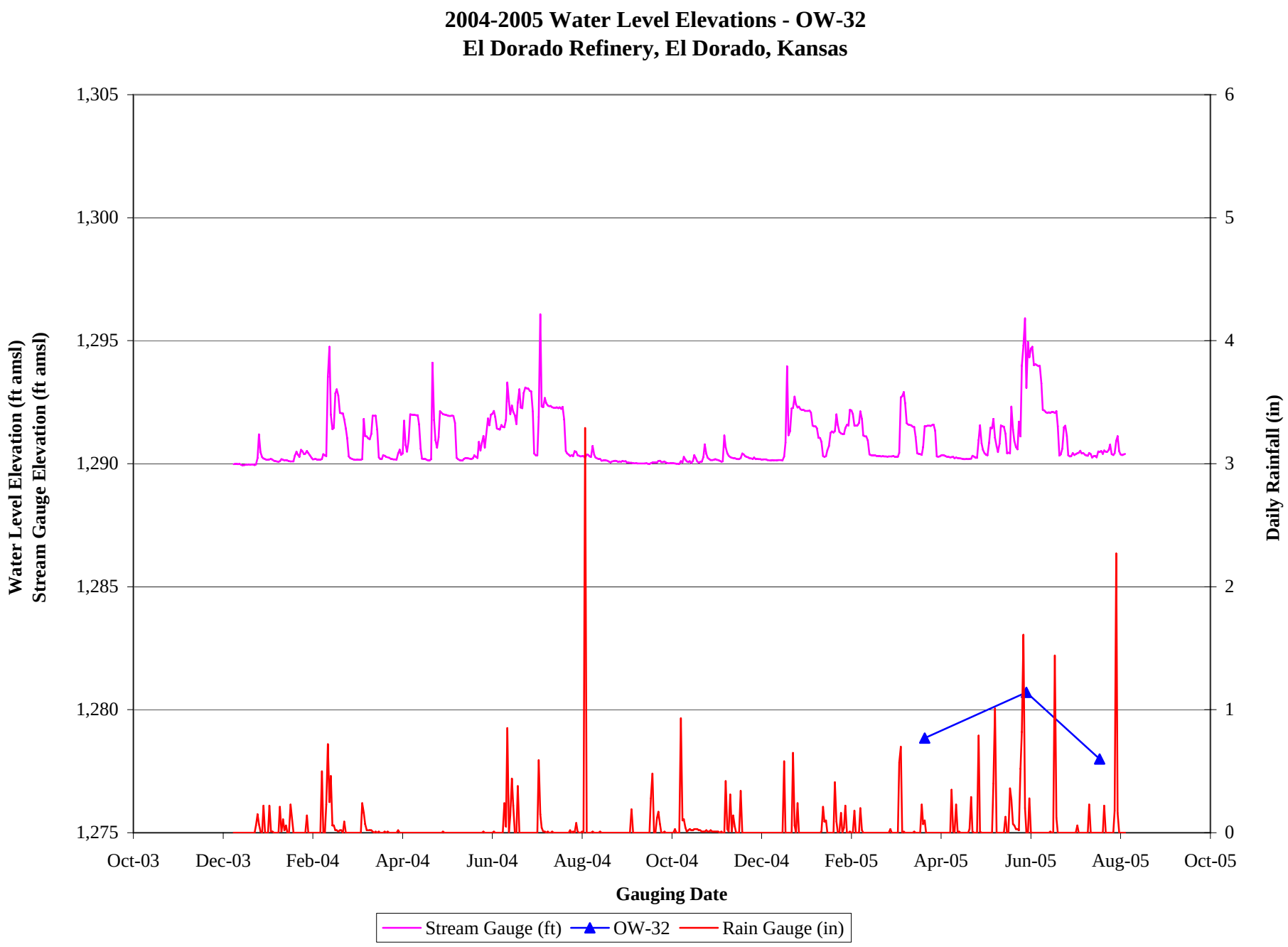

2004-2005 Water Level Elevations - OW-26
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-26
Rain Gauge (in)

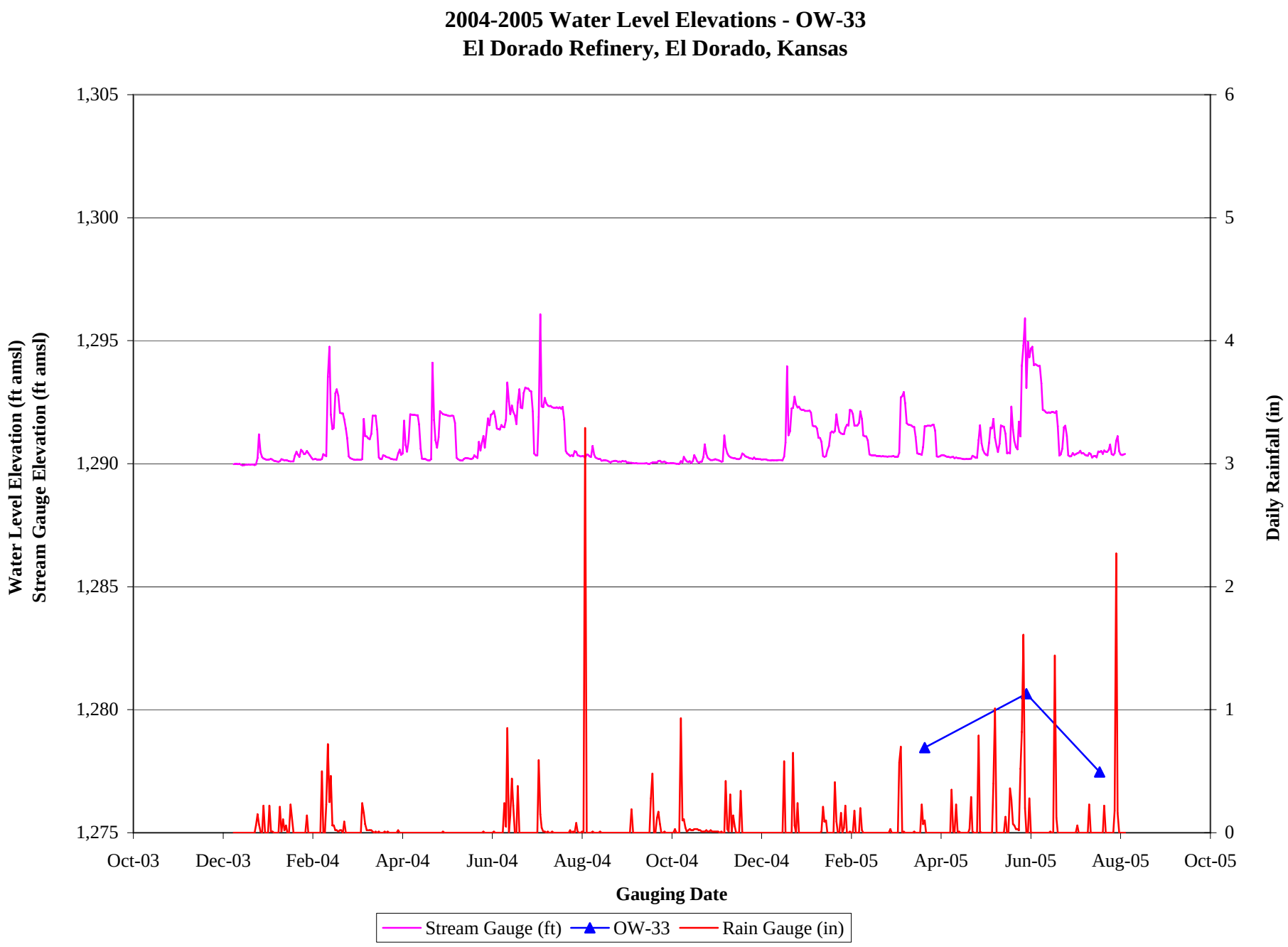

2004-2005 Water Level Elevations - OW-27T
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-27T
Rain Gauge (in)

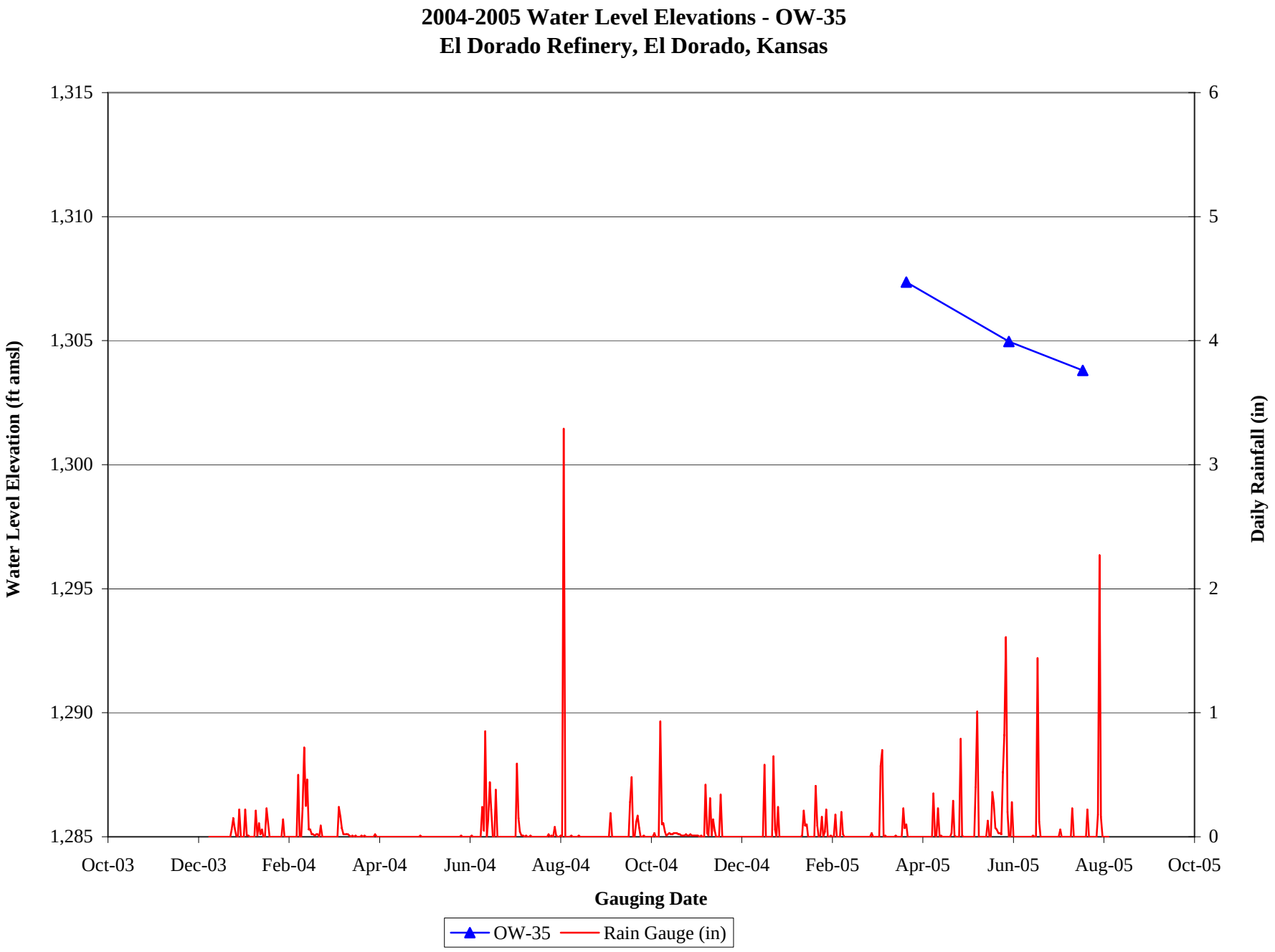

2004-2005 Water Level Elevations - OW-28T
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-28T
Rain Gauge (in)

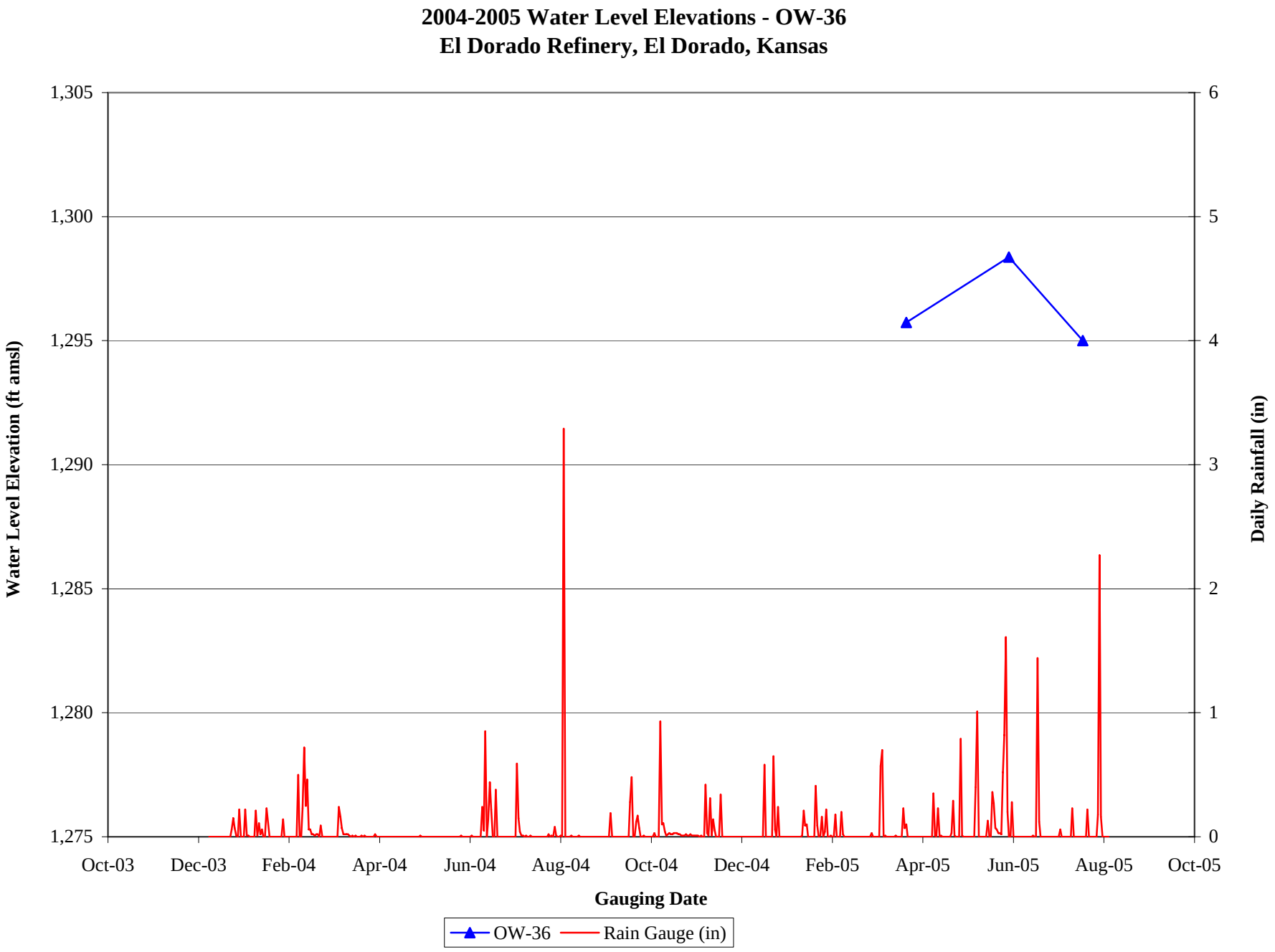

2004-2005 Water Level Elevations - OW-29
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-29
Rain Gauge (in)

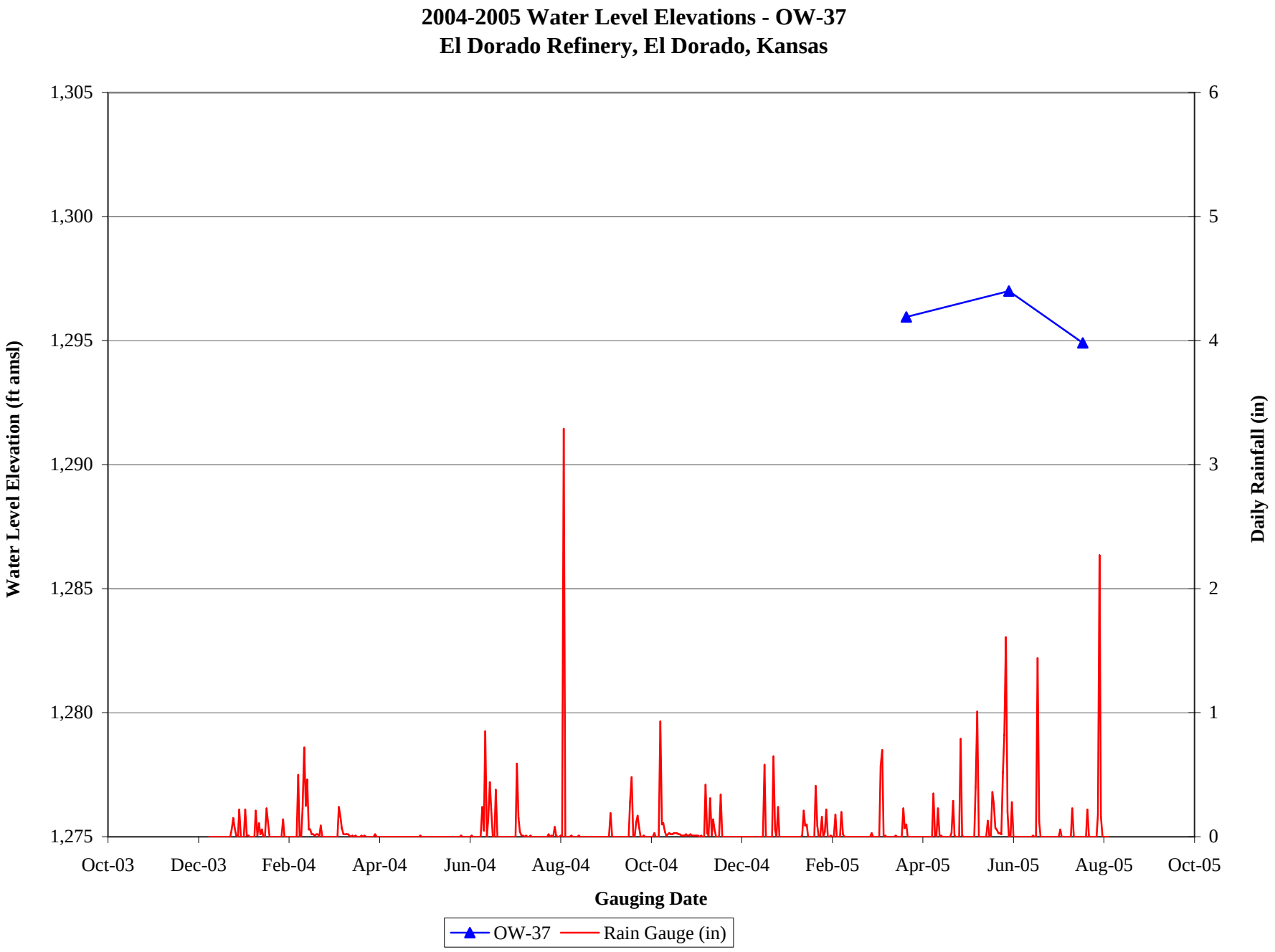

2004-2005 Water Level Elevations - OW-30
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-30
Rain Gauge (in)

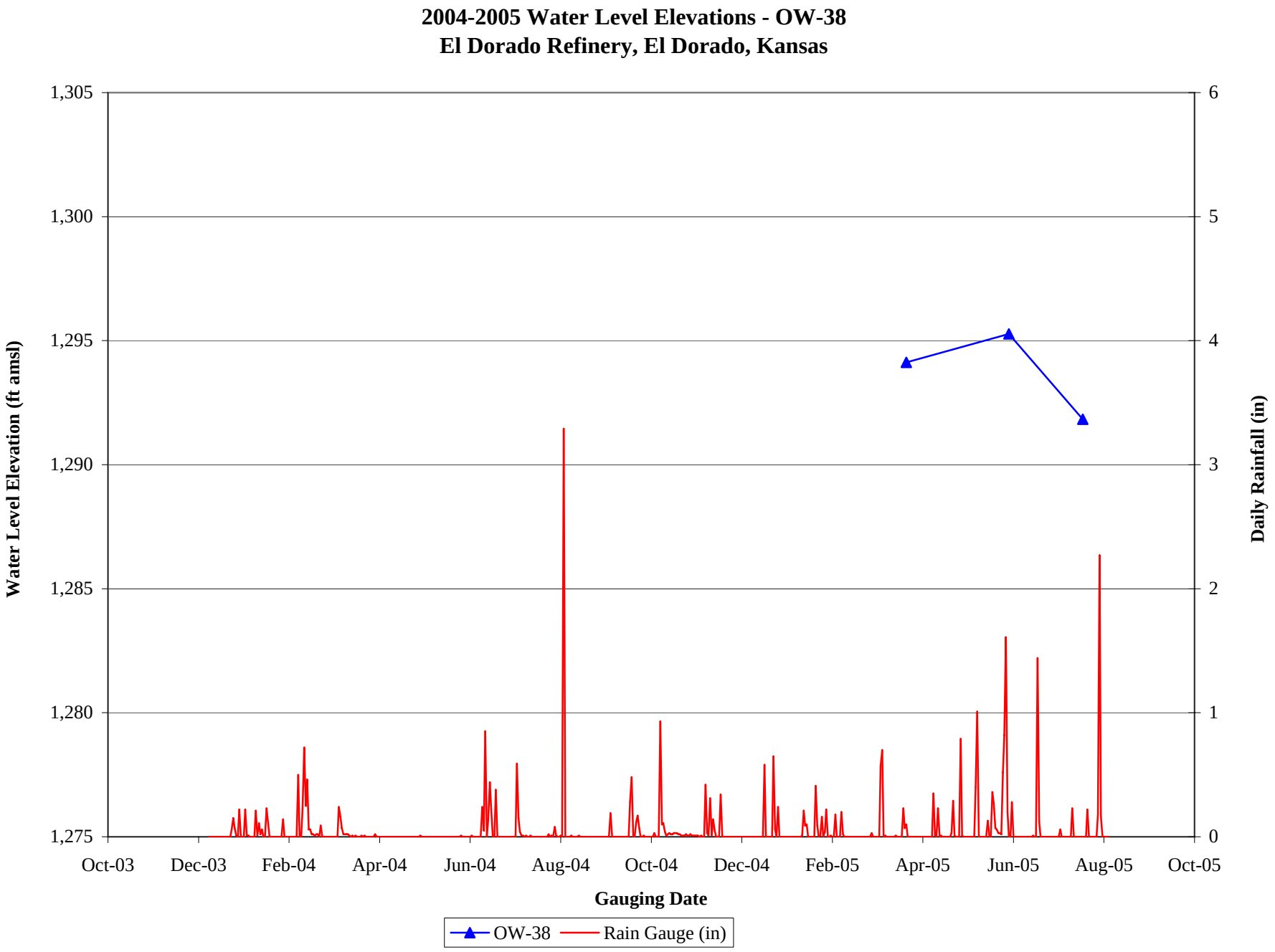

2004-2005 Water Level Elevations - OW-32
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-32
Rain Gauge (in)

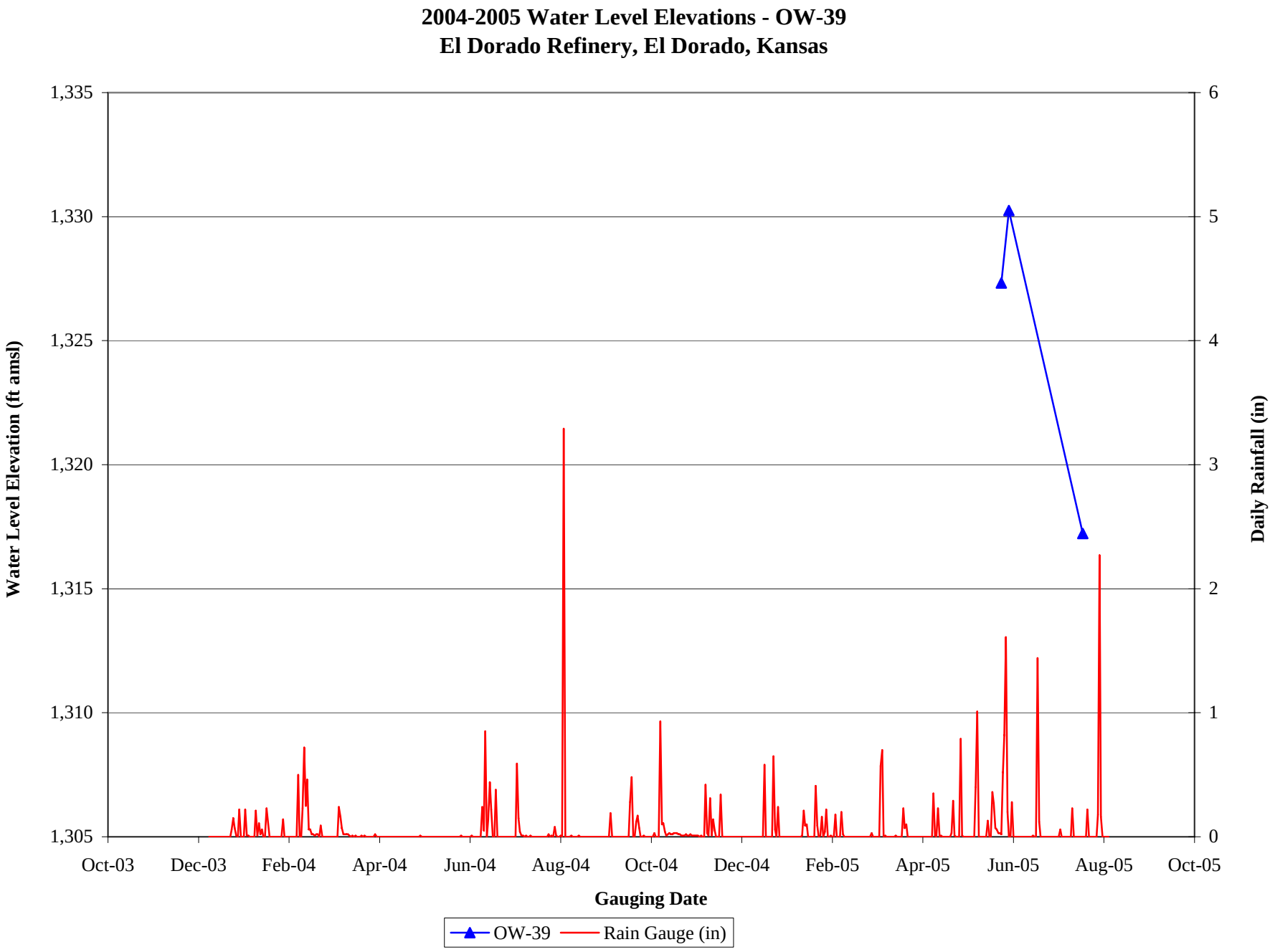

2004-2005 Water Level Elevations - OW-33
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
OW-33
Rain Gauge (in)

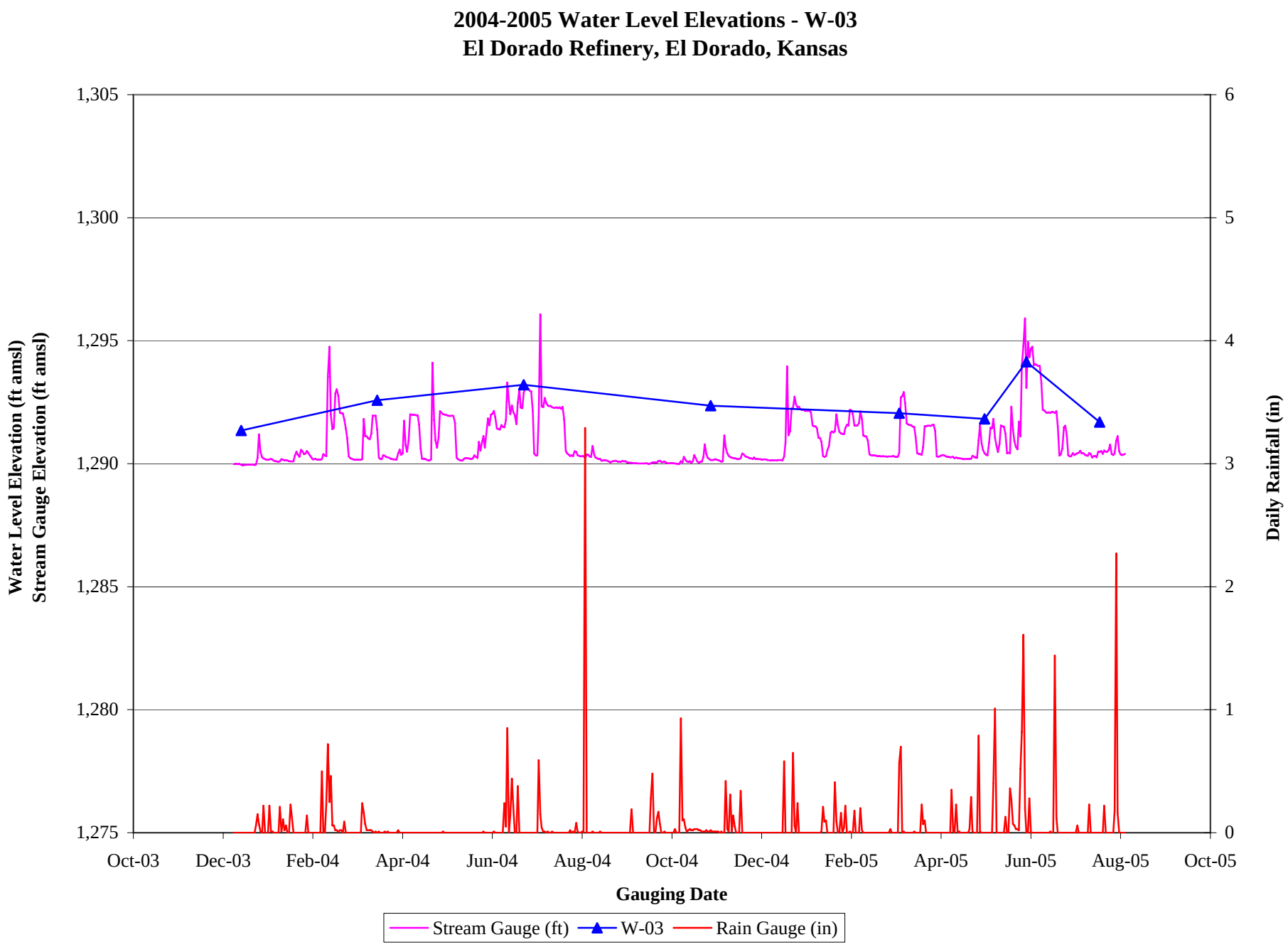

2004-2005 Water Level Elevations - OW-35
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-35
Rain Gauge (in)

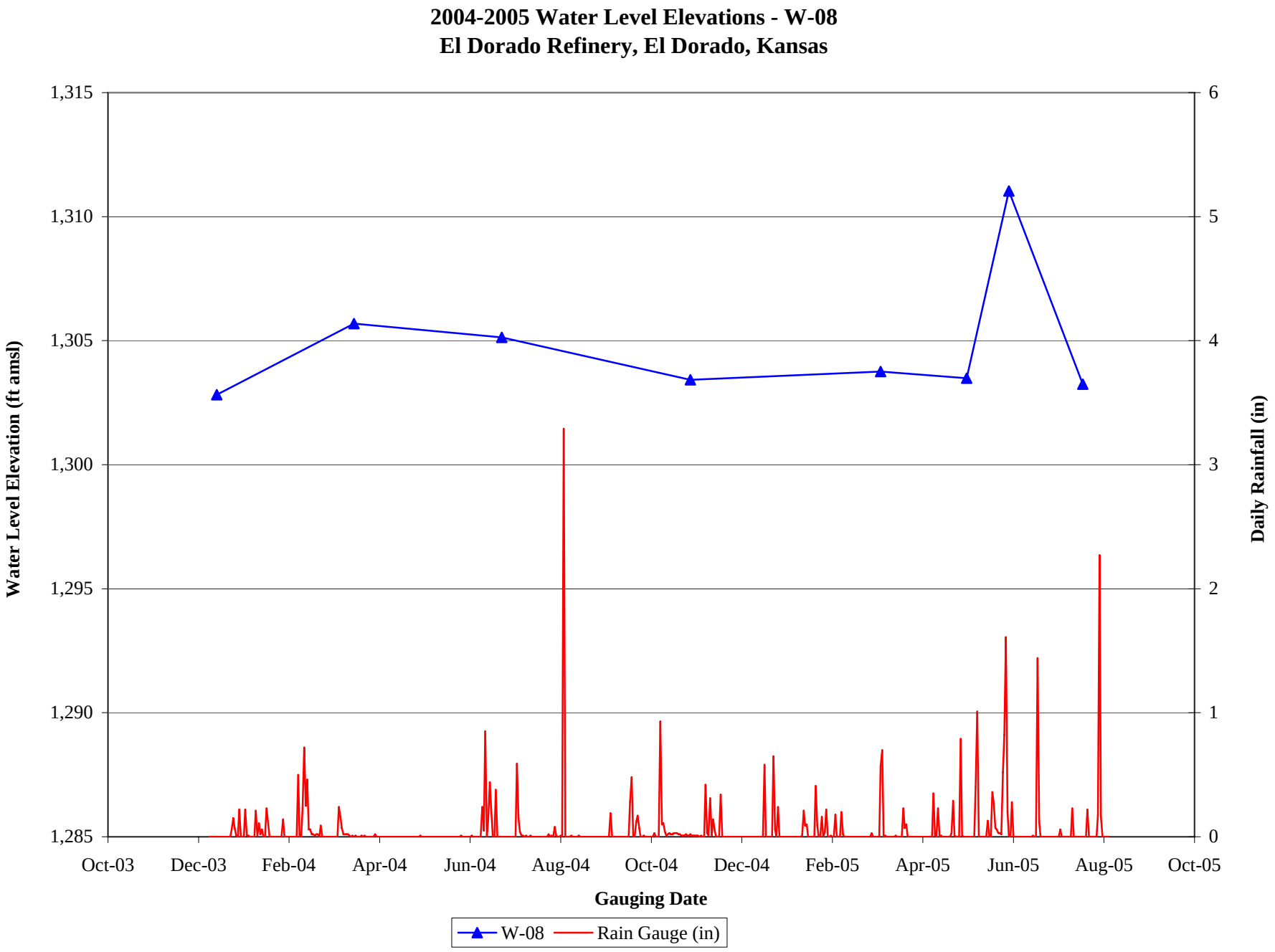

2004-2005 Water Level Elevations - OW-36
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-36
Rain Gauge (in)

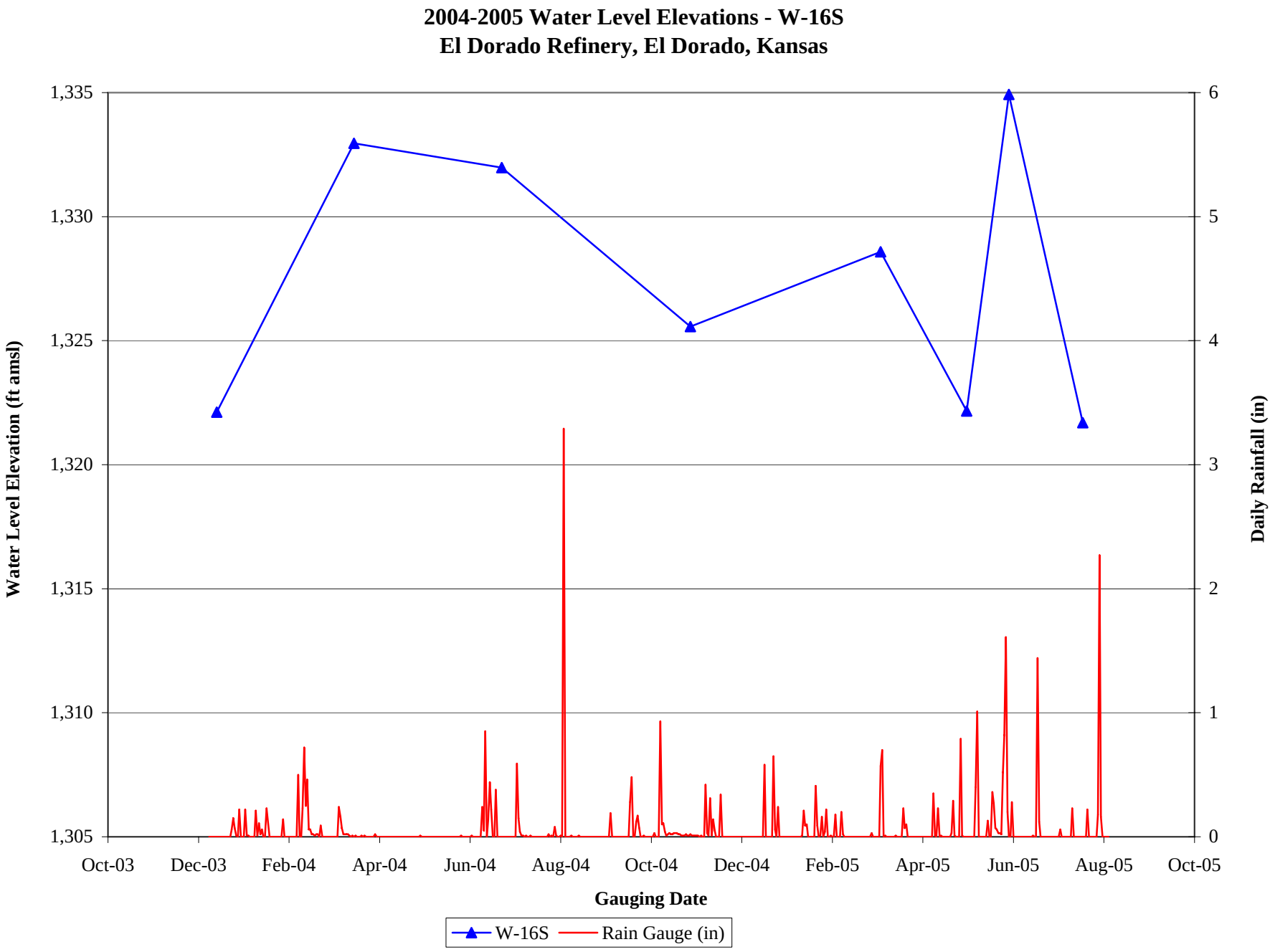

2004-2005 Water Level Elevations - OW-37
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-37
Rain Gauge (in)

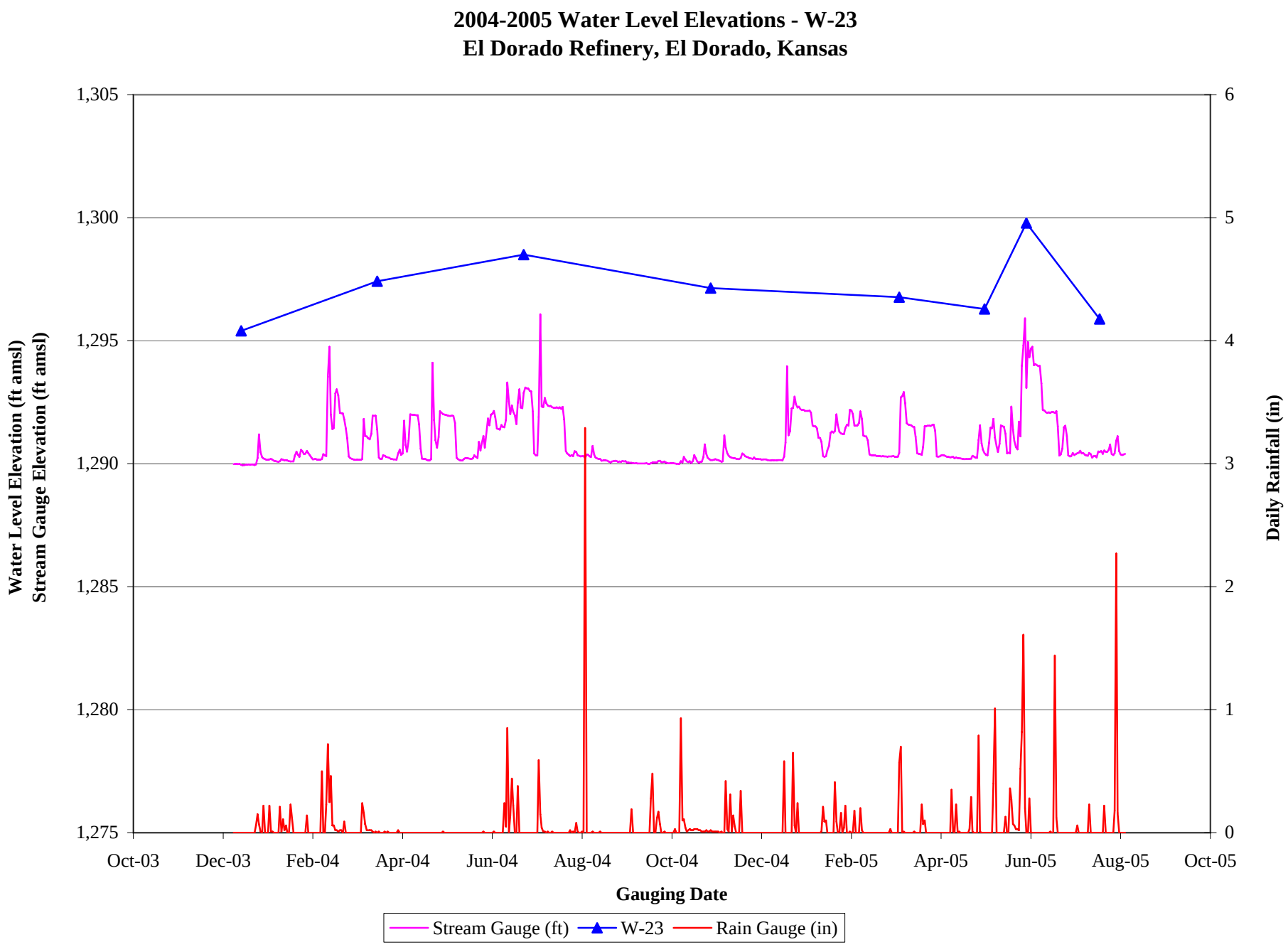

2004-2005 Water Level Elevations - OW-38
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-38
Rain Gauge (in)

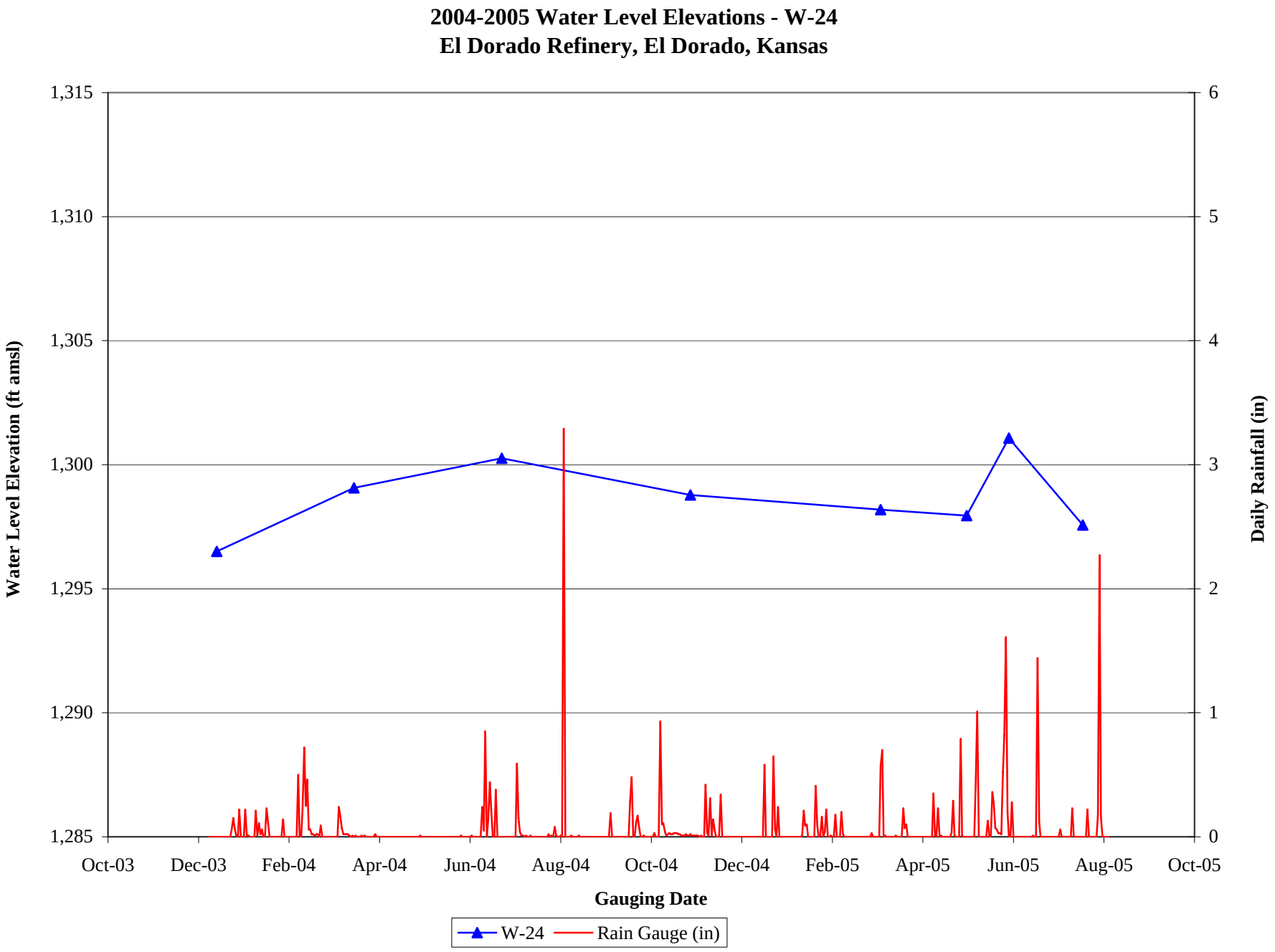

2004-2005 Water Level Elevations - OW-39
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
OW-39
Rain Gauge (in)

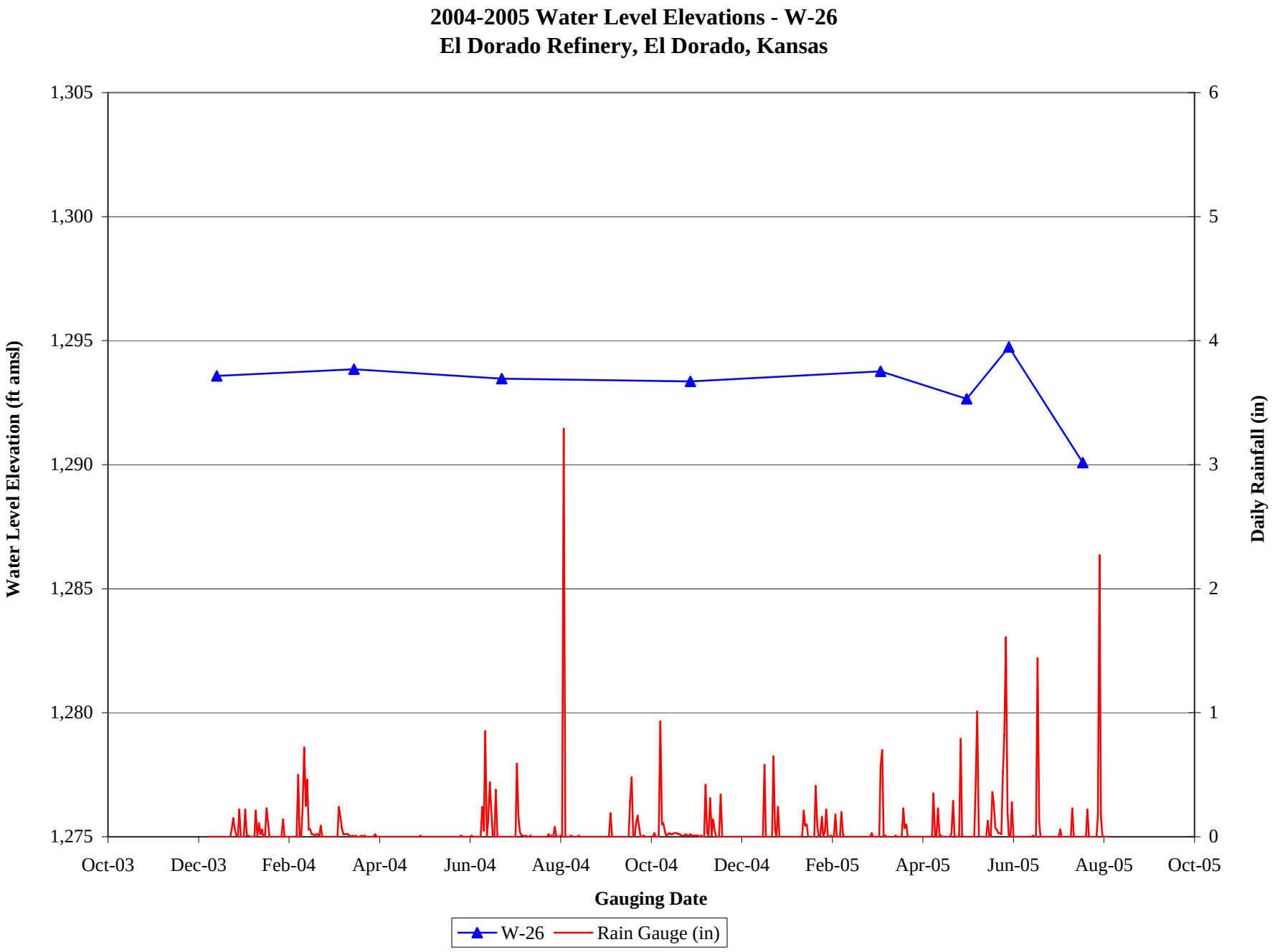

2004-2005 Water Level Elevations - W-03
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
W-03
Rain Gauge (in)


2004-2005 Water Level Elevations - W-08
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
W-08
Rain Gauge (in)


2004-2005 Water Level Elevations - W-16S
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,335
1,330
1,325
1,320
1,315
1,310
1,305
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
W-16S
Rain Gauge (in)


2004-2005 Water Level Elevations - W-23
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
Stream Gauge Elevation (ft amsl)
Daily Rainfall (in)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
Stream Gauge (ft)
W-23
Rain Gauge (in)


2004-2005 Water Level Elevations - W-24
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,315
1,310
1,305
1,300
1,295
1,290
1,285
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
W-24
Rain Gauge (in)


2004-2005 Water Level Elevations - W-26
El Dorado Refinery, El Dorado, Kansas
Water Level Elevation (ft amsl)
1,305
1,300
1,295
1,290
1,285
1,280
1,275
Daily Rainfall (in)
6
5
4
3
2
1
0
Oct-03
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Gauging Date
W-26
Rain Gauge (in)

APPENDIX E

SLUG TEST DATA

AQTESOLV SOLUTIONS FOR BOUWER-RICE ESTIMATES OF HYDRAULIC CONDUCTIVITY

EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

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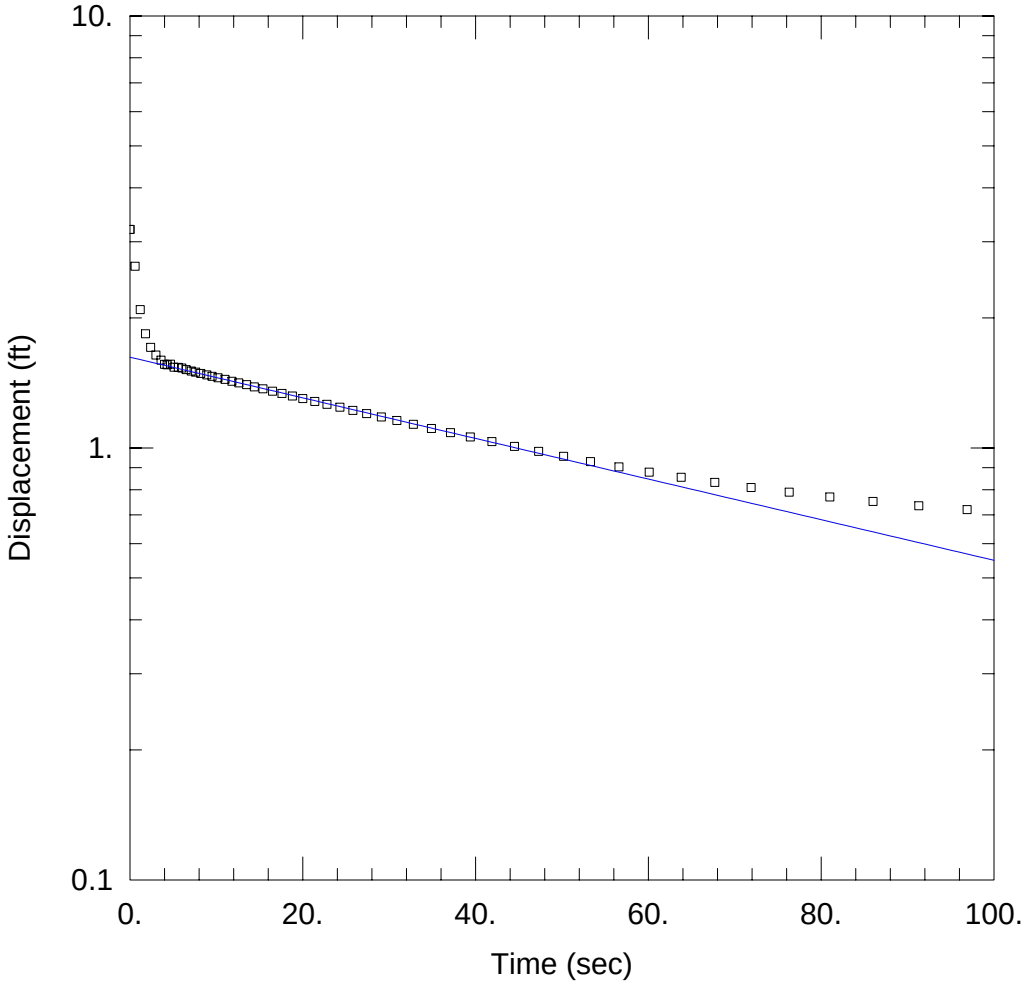


N2-1#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N2-1#1.aqt
Date: 08/29/05 Time: 11:01:12

PROJECT INFORMATION

Test Well: N2-1#1
Test Date: 7/26/2005

AQUIFER DATA

Saturated Thickness: 9.79 ft
Anisotropy Ratio (Kz/Kr): 1.

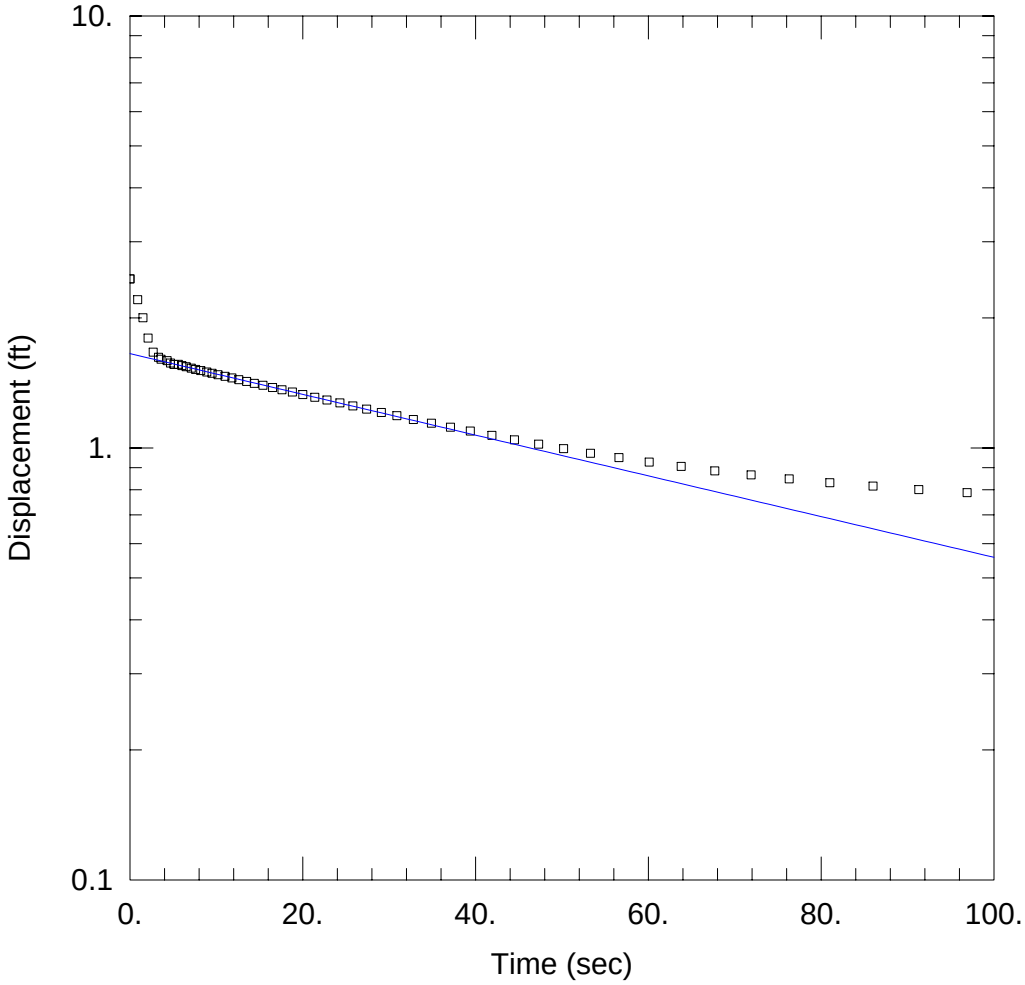
WELL DATA (N2-1#1)

Initial Displacement: 3.204 ft
Total Well Penetration Depth: 9.29 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.79 ft
Screen Length: 15. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001391 ft/min
y0 = 1.622 ft



N2-1#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N2-1#2.aqt
Date: 08/29/05 Time: 11:05:24

PROJECT INFORMATION

Test Well: N2-1#2
Test Date: 7/26/2005

AQUIFER DATA

Saturated Thickness: 9.38 ft
Anisotropy Ratio (Kz/Kr): 1.

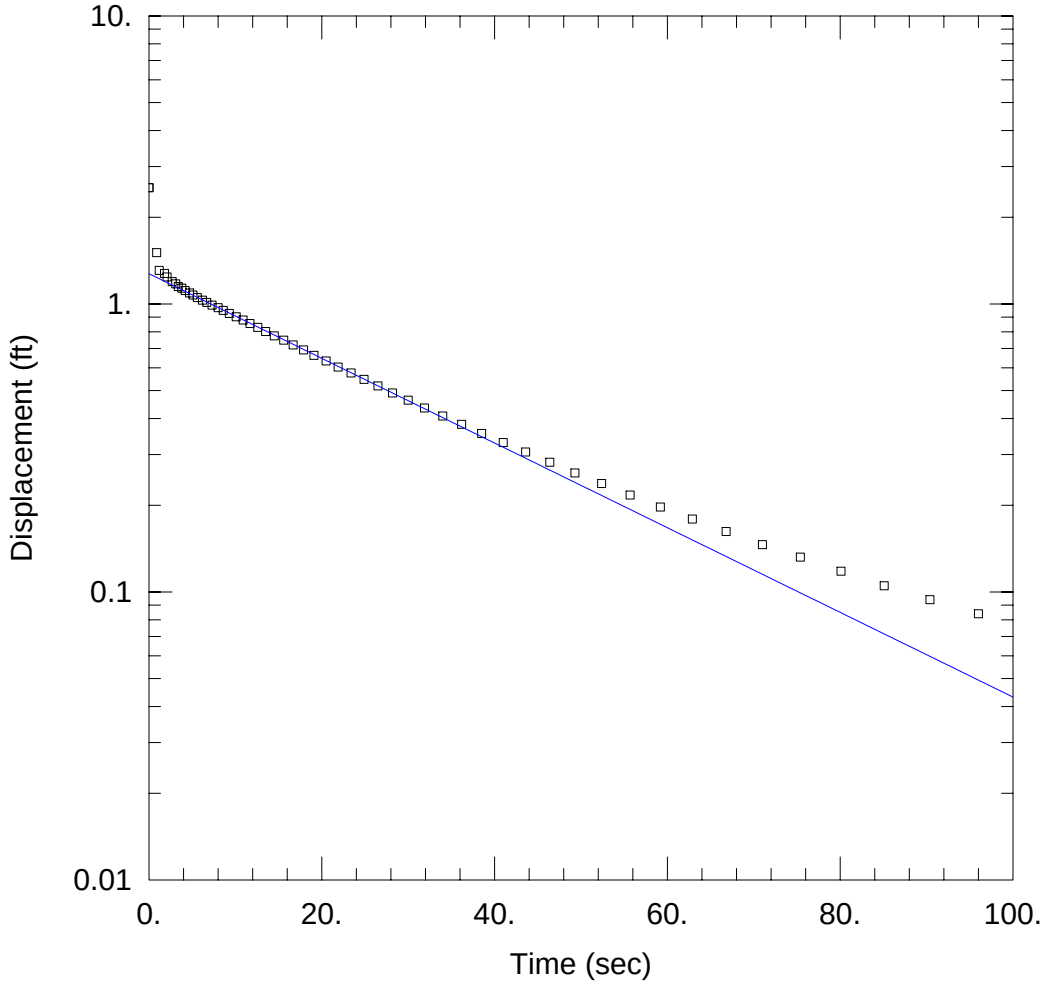
WELL DATA (N2-1#2)

Initial Displacement: 2.463 ft
Total Well Penetration Depth: 8.88 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.38 ft
Screen Length: 15. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001381 ft/min
y0 = 1.653 ft



N2-3#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N2-3#1.aqt
Date: 08/25/05 Time: 10:44:14

PROJECT INFORMATION

Test Well: N2-3#1
Test Date: 7/22/2005

AQUIFER DATA

Saturated Thickness: 11.59 ft Anisotropy Ratio (Kz/Kr): 1.

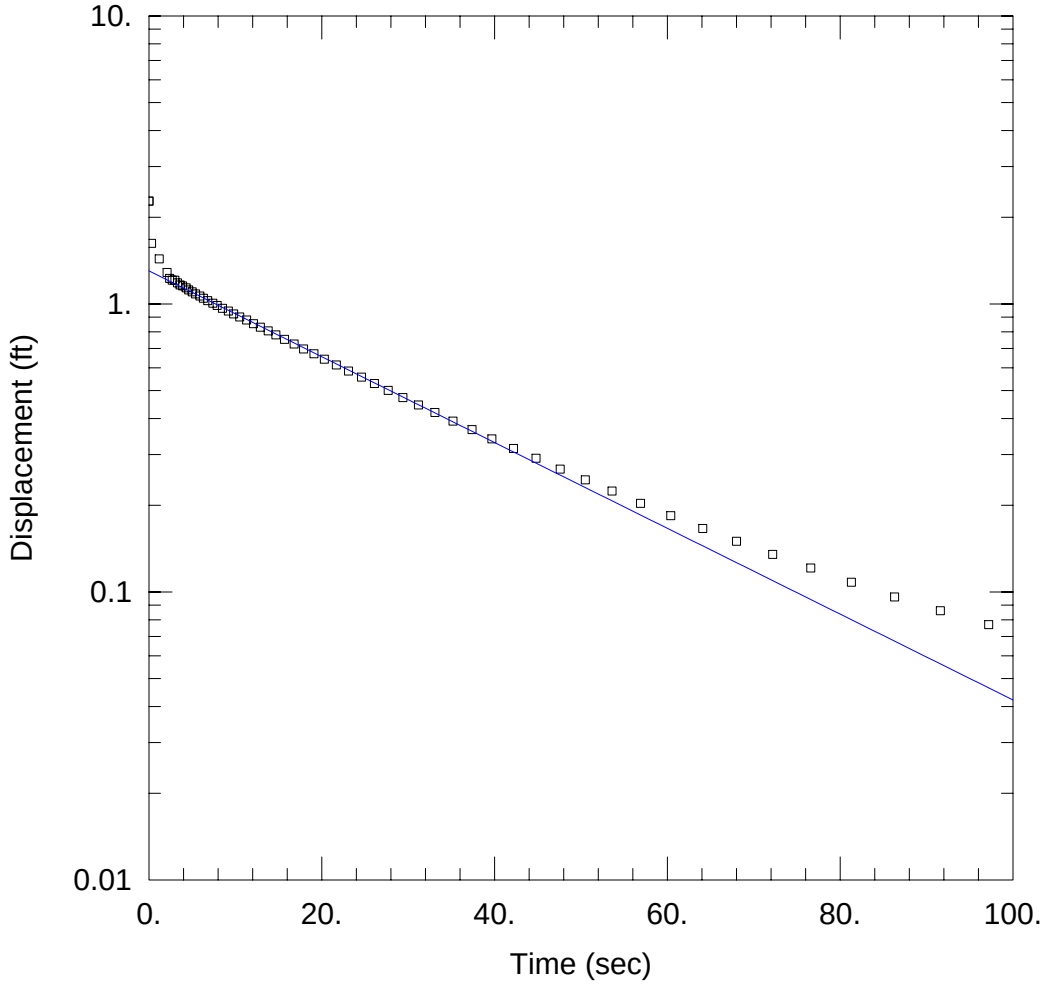
WELL DATA (N2-3#1)

Initial Displacement: 2.534 ft Static Water Column Height: 11.59 ft
Total Well Penetration Depth: 11.59 ft Screen Length: 10. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.323 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001881 ft/min y0 = 1.273 ft



N2-3#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N2-3#2.aqt
Date: 08/25/05 Time: 10:46:29

PROJECT INFORMATION

Test Well: N2-3#2
Test Date: 7/22/2005

AQUIFER DATA

Saturated Thickness: 11.59 ft Anisotropy Ratio (Kz/Kr): 1.

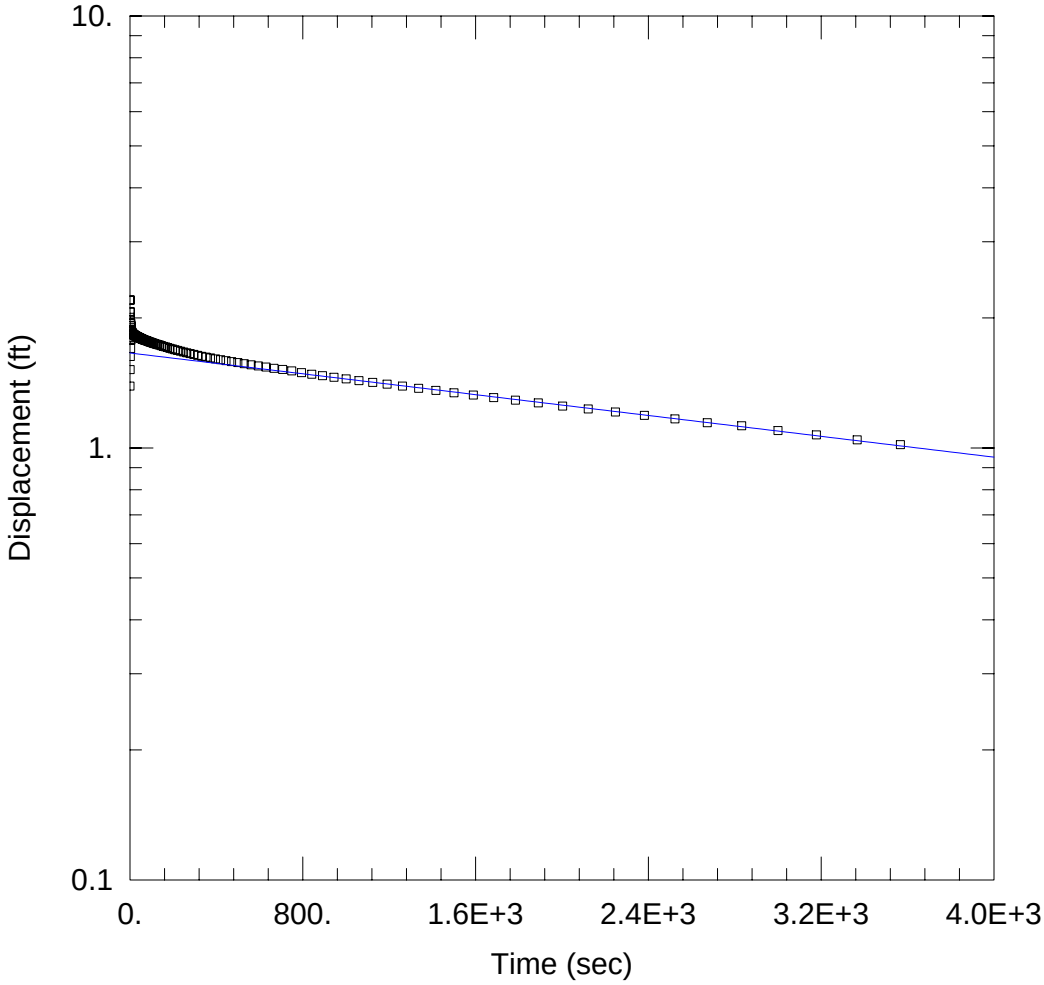
WELL DATA (N2-3#2)

Initial Displacement: 2.275 ft Static Water Column Height: 11.59 ft
Total Well Penetration Depth: 11.59 ft Screen Length: 10. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.323 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001906 ft/min y0 = 1.302 ft



N2-4#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N2-4#1.aqt
Date: 08/25/05 Time: 10:48:37

PROJECT INFORMATION

Test Well: N2-4#1
Test Date: 7/21/2005

AQUIFER DATA

Saturated Thickness: 17.15 ft Anisotropy Ratio (Kz/Kr): 1.

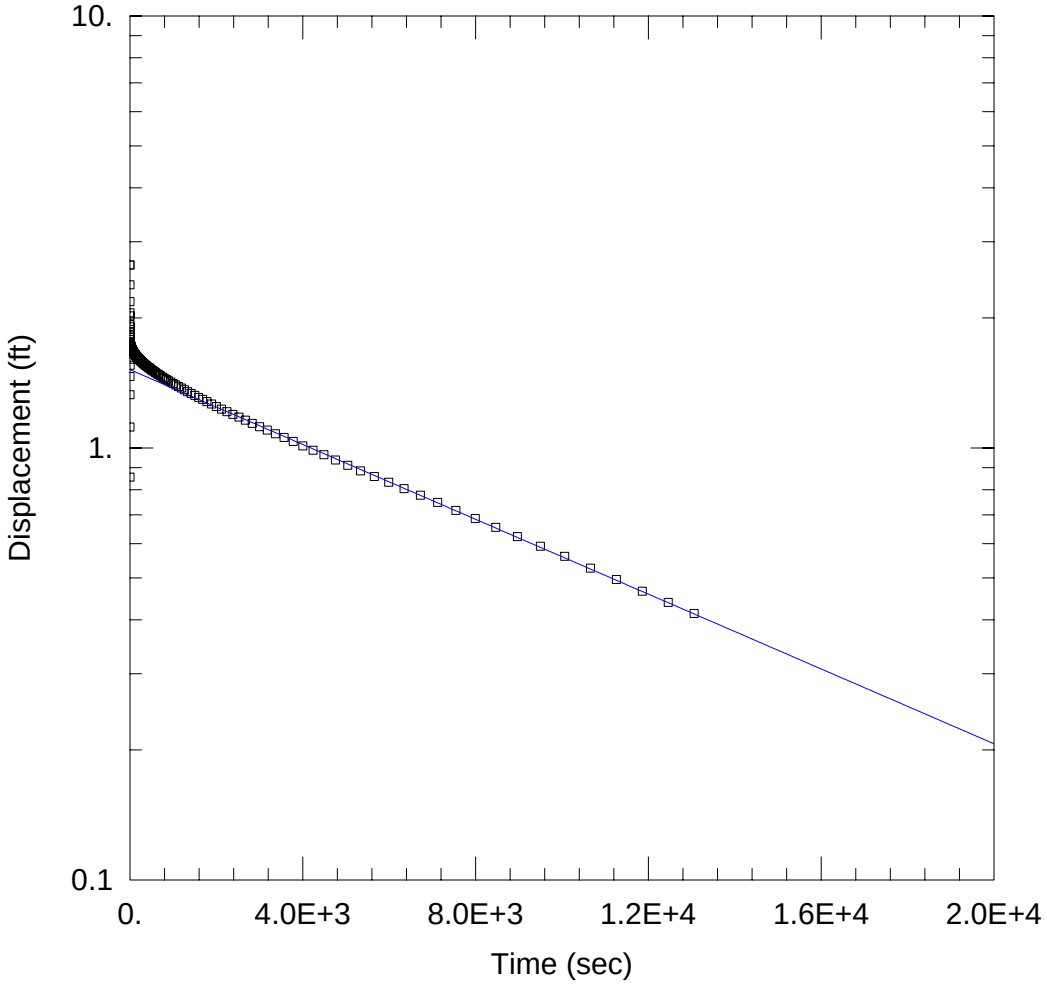
WELL DATA (N2-4#1)

Initial Displacement: 2.201 ft
Total Well Penetration Depth: 17.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 17.15 ft
Screen Length: 11. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 8.269E-6 ft/min
y0 = 1.659 ft



N2-4#3

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N2-4#3.aqt
Date: 08/25/05 Time: 10:55:08

PROJECT INFORMATION

Test Well: N2-4#3
Test Date: 7/26/2005

AQUIFER DATA

Saturated Thickness: 17.16 ft Anisotropy Ratio (Kz/Kr): 1.

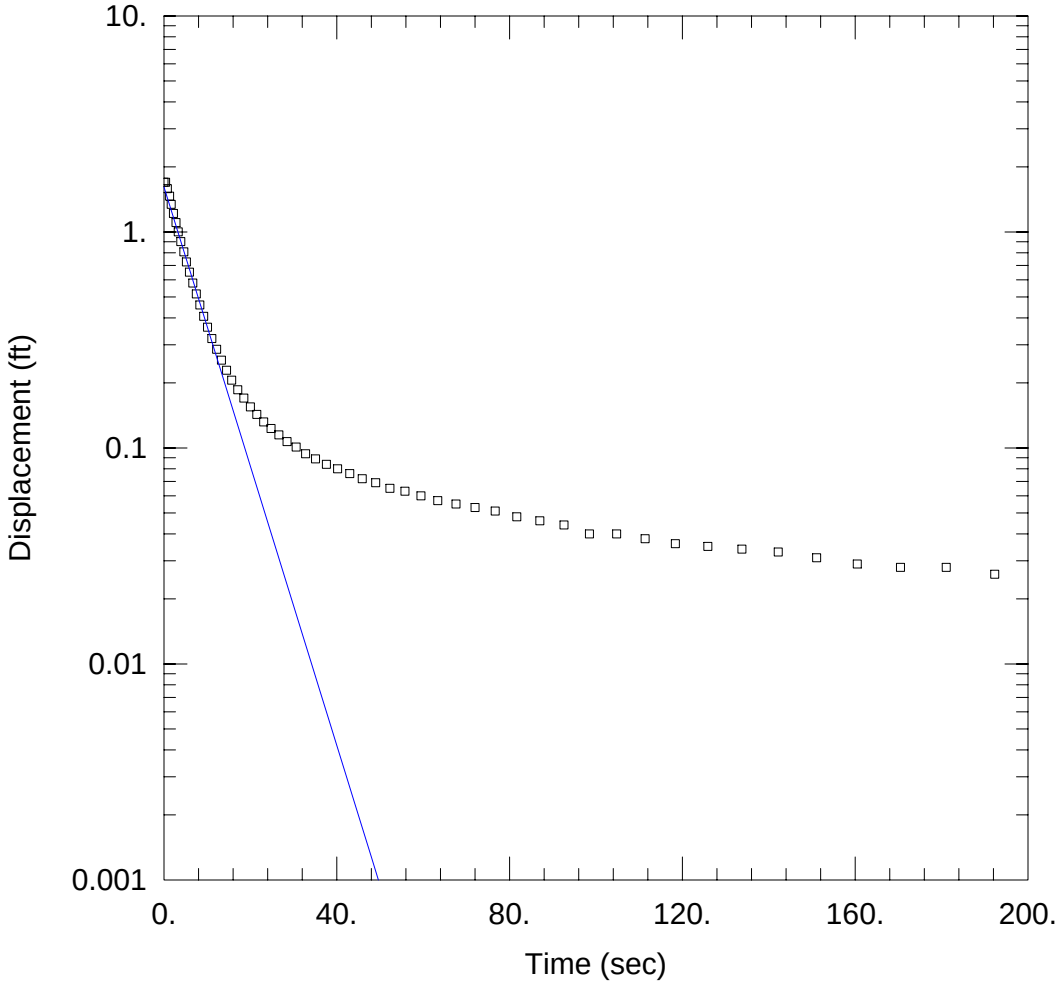
WELL DATA (N2-4#3)

Initial Displacement: 2.652 ft
Total Well Penetration Depth: 17.16 ft
Casing Radius: 0.083 ft
Static Water Column Height: 17.16 ft
Screen Length: 11. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 5.939E-6 ft/min
y0 = 1.518 ft



N3-1#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N3-1#1.aqt
Date: 08/25/05 Time: 11:31:19

PROJECT INFORMATION

Test Well: N3-1#1
Test Date: 7/19/2005

AQUIFER DATA

Saturated Thickness: 78.92 ft Anisotropy Ratio (Kz/Kr): 1.

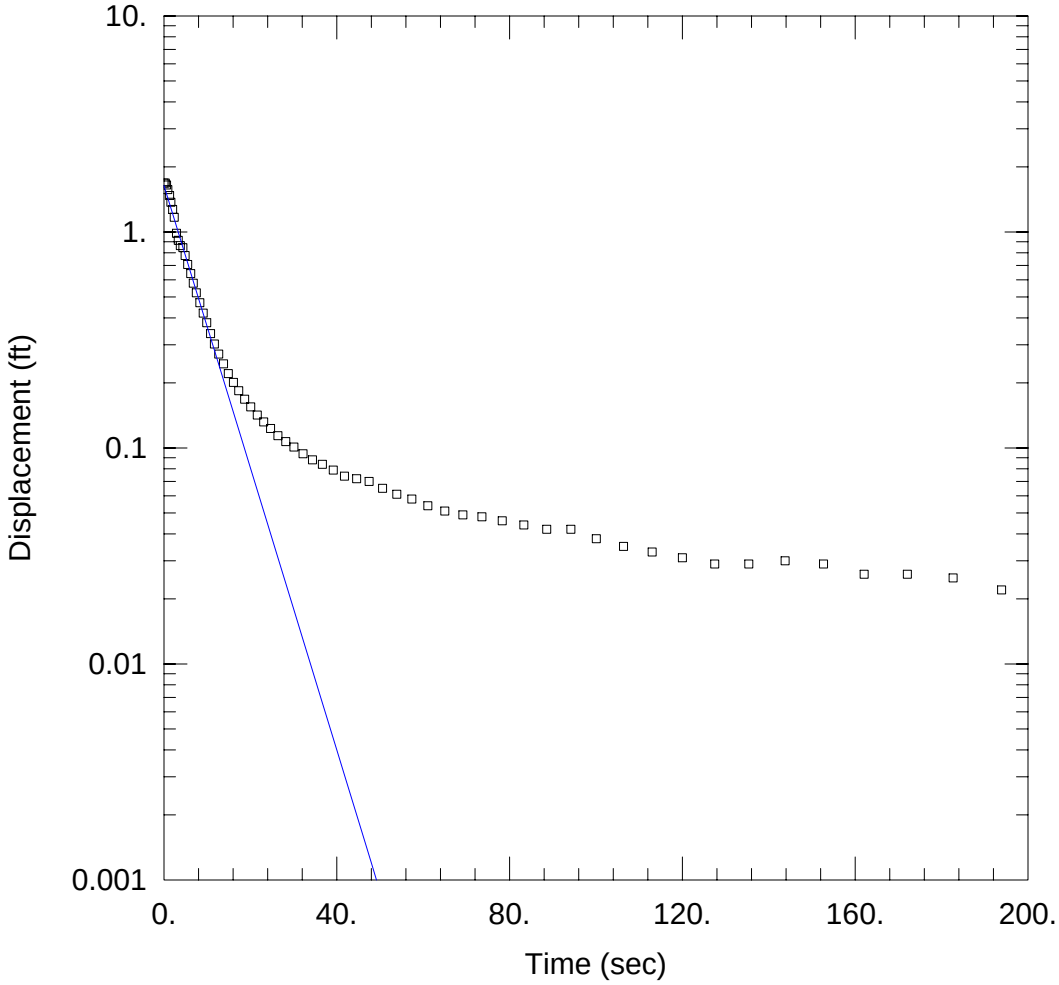
WELL DATA (N3-1#1)

Initial Displacement: 1.697 ft Static Water Column Height: 78.92 ft
Total Well Penetration Depth: 27. ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01423 ft/min y0 = 1.614 ft



N3-1#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N3-1#2.aqt
Date: 08/25/05 Time: 11:37:39

PROJECT INFORMATION

Test Well: N3-1#2
Test Date: 7/19/2005

AQUIFER DATA

Saturated Thickness: 27. ft Anisotropy Ratio (Kz/Kr): 1.

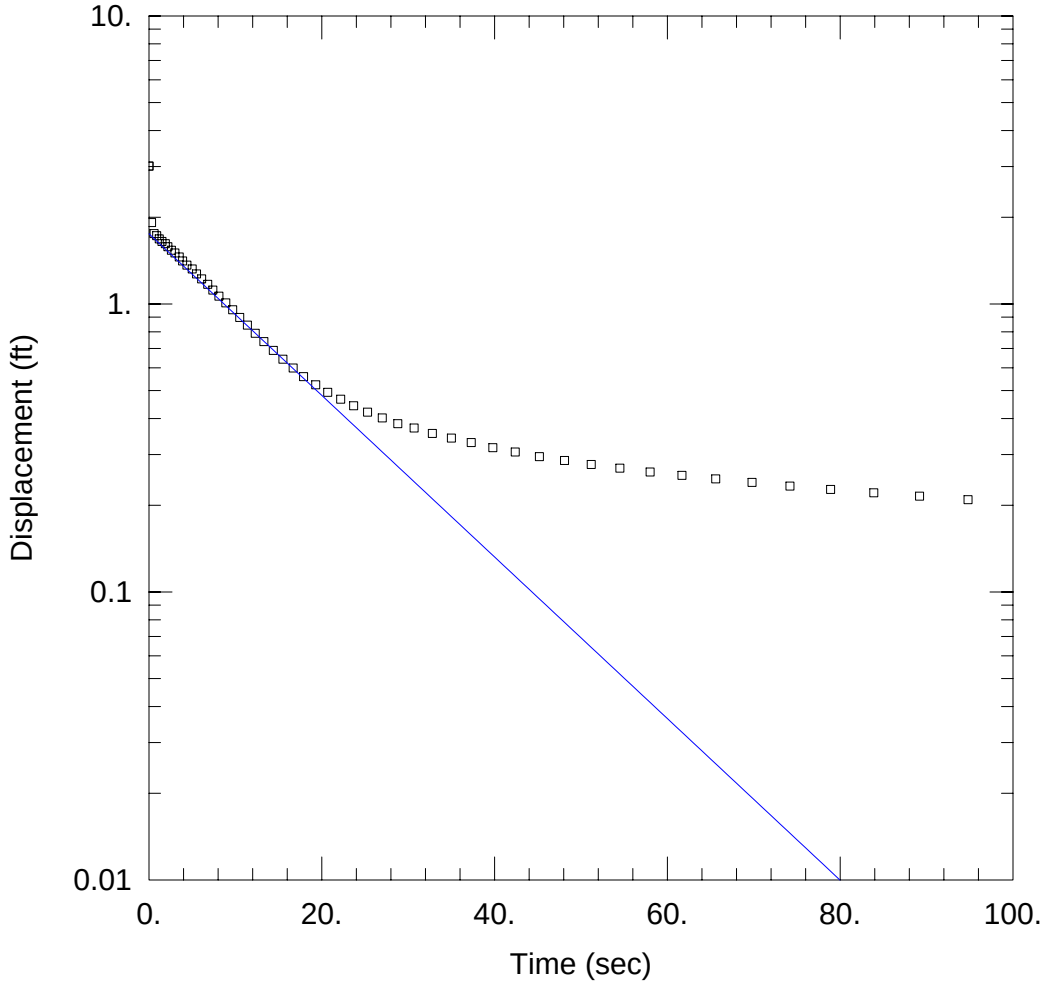
WELL DATA (N3-1#2)

Initial Displacement: 1.685 ft Static Water Column Height: 78.97 ft
Total Well Penetration Depth: 27. ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01955 ft/min y0 = 1.638 ft



N3-2#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N3-2#1.aqt
Date: 08/25/05 Time: 11:40:03

PROJECT INFORMATION

Test Well: N3-2#1
Test Date: 7/20/2005

AQUIFER DATA

Saturated Thickness: 5.637 ft Anisotropy Ratio (Kz/Kr): 1.

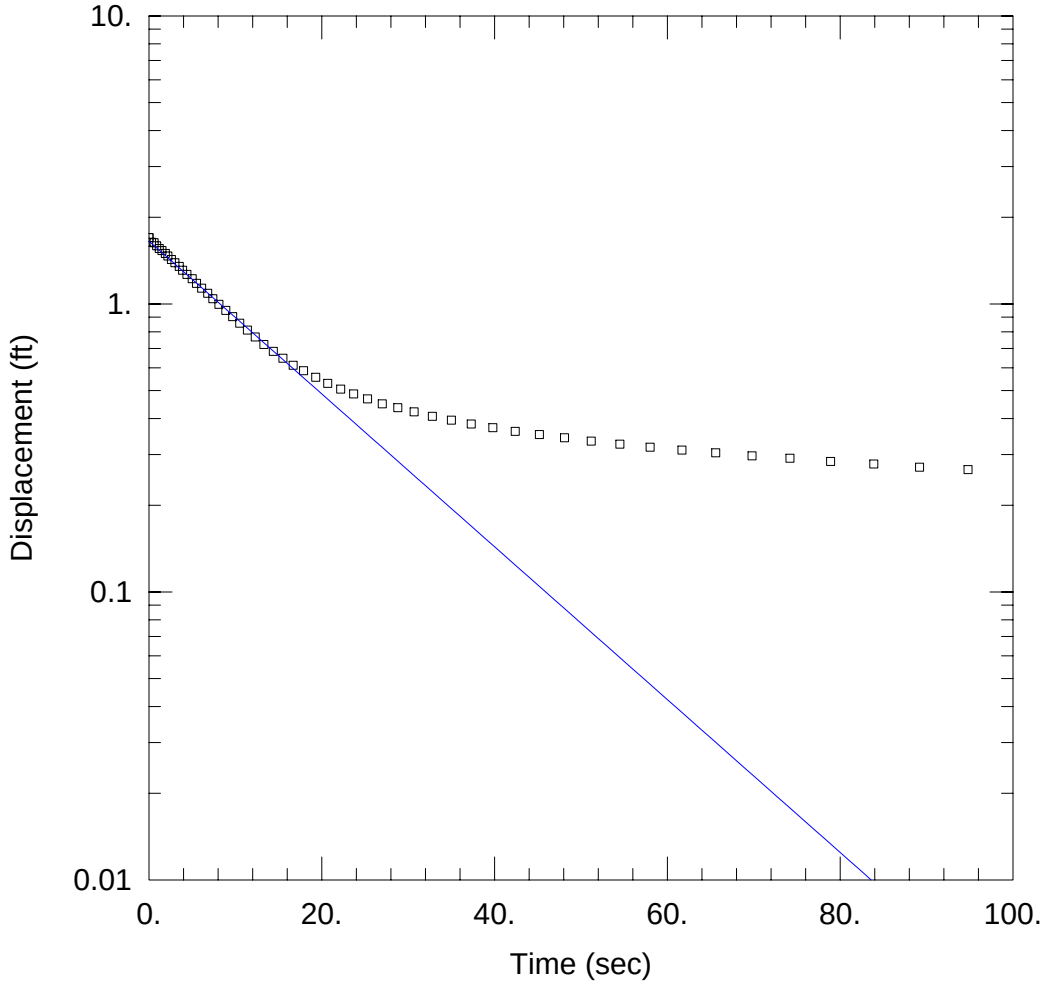
WELL DATA (N3-2#1)

Initial Displacement: 3.009 ft
Total Well Penetration Depth: 5.637 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.637 ft
Screen Length: 10. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01558 ft/min y0 = 1.752 ft



N3-2#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N3-2#2.aqt
Date: 08/25/05 Time: 11:41:33

PROJECT INFORMATION

Test Well: N3-2#2
Test Date: 7/20/2005

AQUIFER DATA

Saturated Thickness: 5.648 ft Anisotropy Ratio (Kz/Kr): 1.

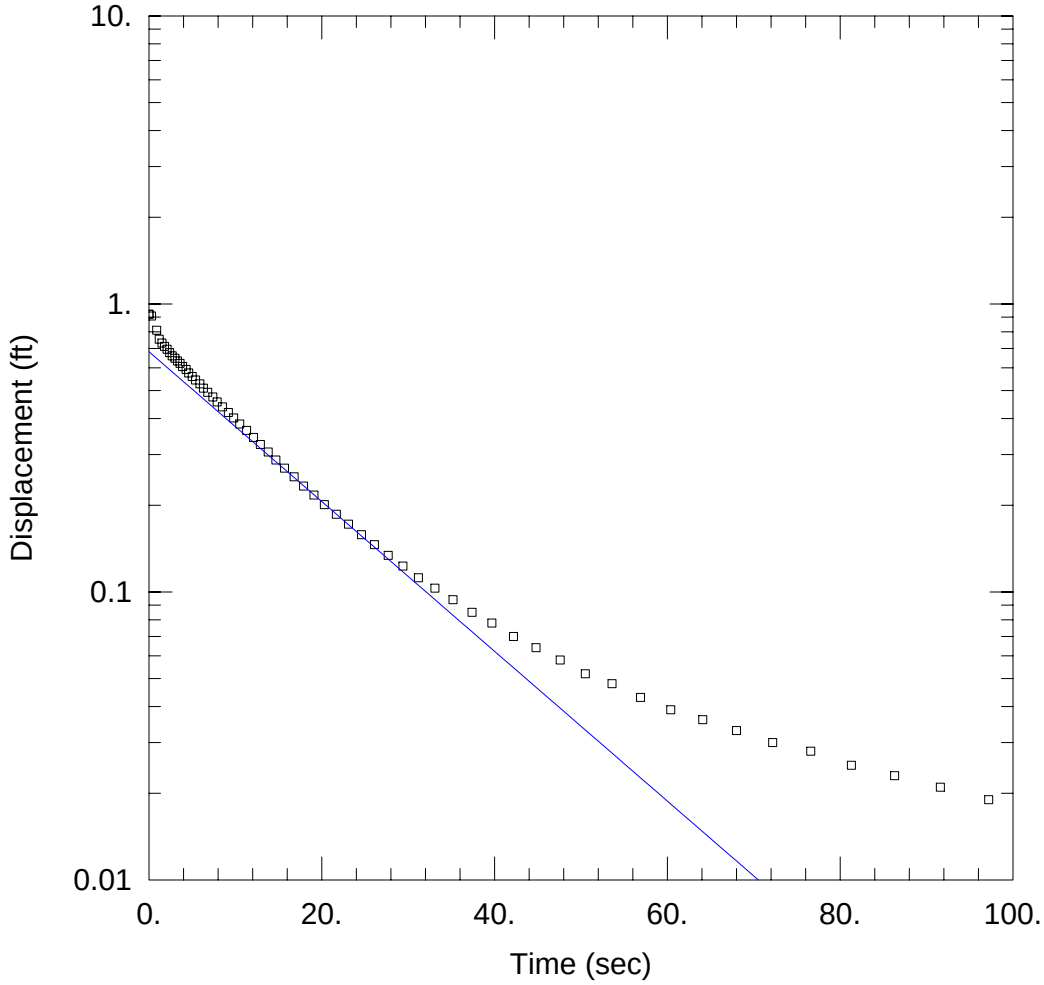
WELL DATA (N3-2#2)

Initial Displacement: 1.699 ft
Total Well Penetration Depth: 5.648 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.648 ft
Screen Length: 10. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01475 ft/min y0 = 1.653 ft



N3-3#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N3-3#1.aqt
Date: 08/25/05 Time: 11:46:41

PROJECT INFORMATION

Test Well: N3-3#1
Test Date: 7/21/2005

AQUIFER DATA

Saturated Thickness: 4.461 ft Anisotropy Ratio (Kz/Kr): 1.

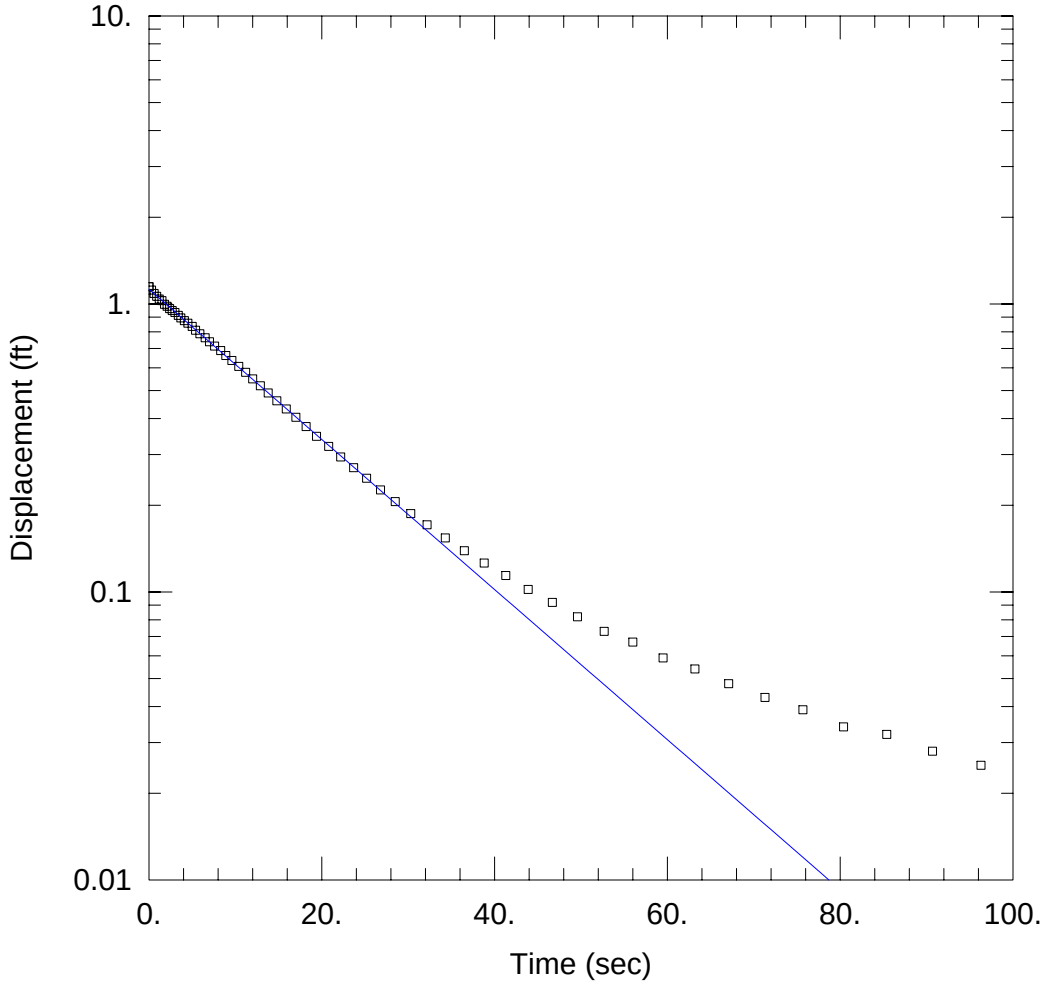
WELL DATA (N3-3#1)

Initial Displacement: 0.921 ft
Total Well Penetration Depth: 4.461 ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.461 ft
Screen Length: 10. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01342 ft/min y0 = 0.6822 ft



N3-3#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N3-3#2.aqt
Date: 08/25/05 Time: 11:47:51

PROJECT INFORMATION

Test Well: N3-3#2
Test Date: 7/21/2005

AQUIFER DATA

Saturated Thickness: 4.463 ft Anisotropy Ratio (Kz/Kr): 1.

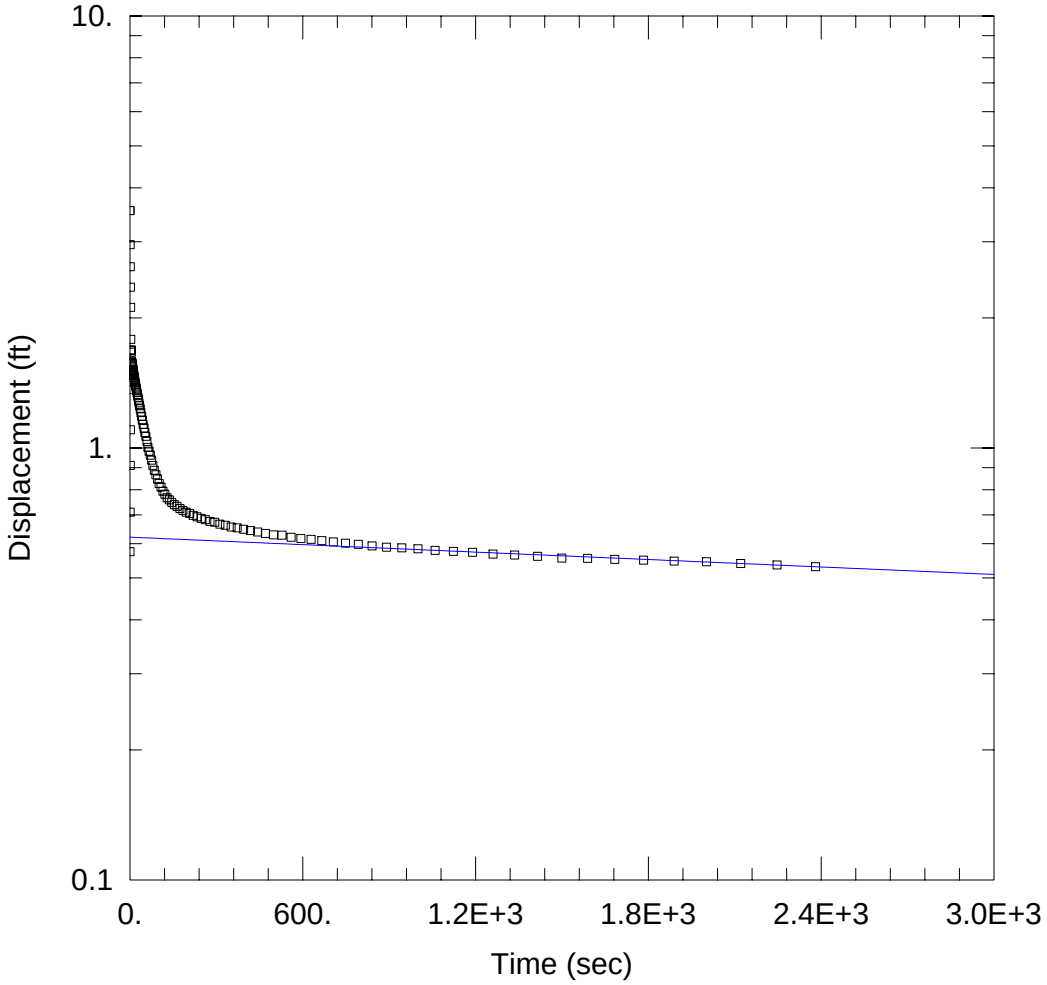
WELL DATA (N3-3#2)

Initial Displacement: 1.148 ft
Total Well Penetration Depth: 4.463 ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.463 ft
Screen Length: 10. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01345 ft/min y0 = 1.123 ft



N4-1#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N4-1#1.aqt
Date: 08/29/05 Time: 11:10:14

PROJECT INFORMATION

Test Well: N4-1#1
Test Date: 7/22/2005

AQUIFER DATA

Saturated Thickness: 14. ft Anisotropy Ratio (Kz/Kr): 1.

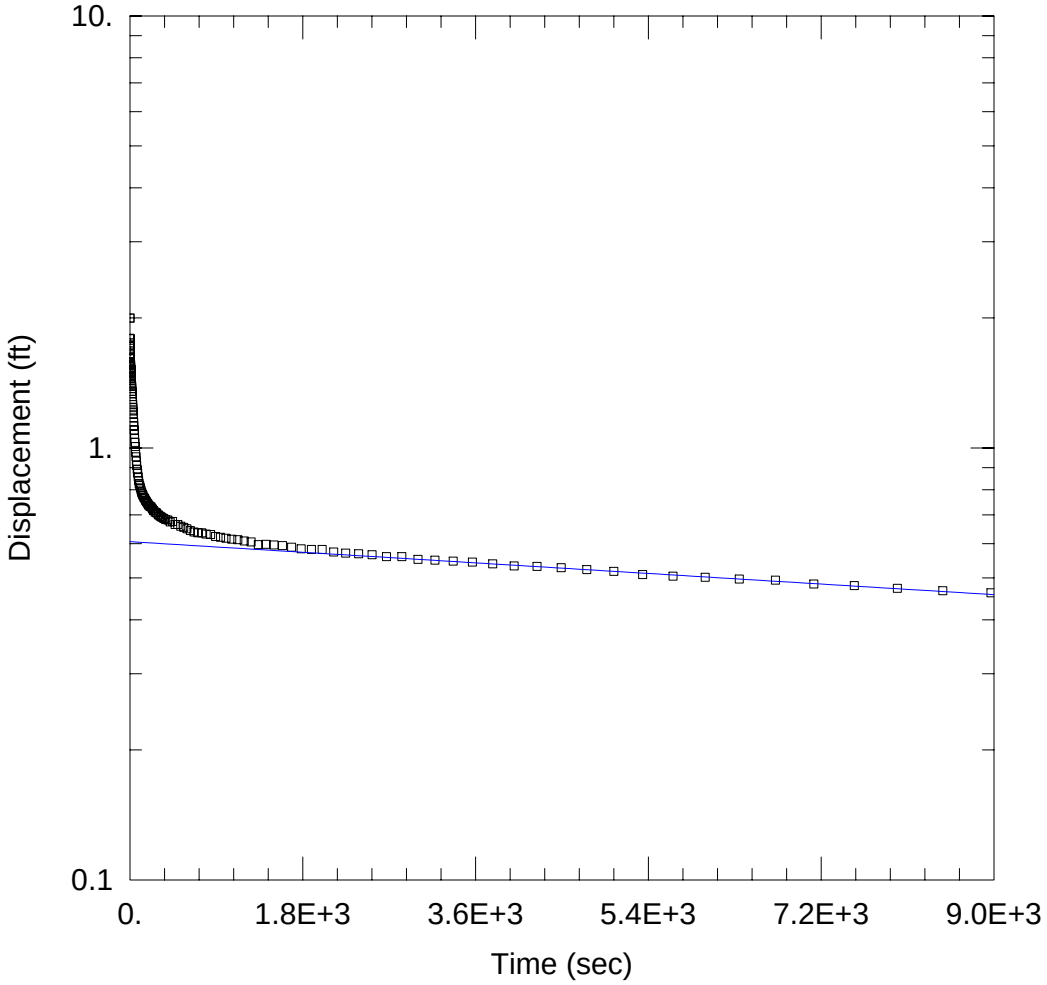
WELL DATA (N4-1#1)

Initial Displacement: 3.543 ft Static Water Column Height: 10.61 ft
Total Well Penetration Depth: 14. ft Screen Length: 10. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 4.139E-6 ft/min y0 = 0.6214 ft



N4-1#3

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N4-1#3.aqt
Date: 08/29/05 Time: 11:15:28

PROJECT INFORMATION

Test Well: N4-1#3
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 14. ft Anisotropy Ratio (Kz/Kr): 1.

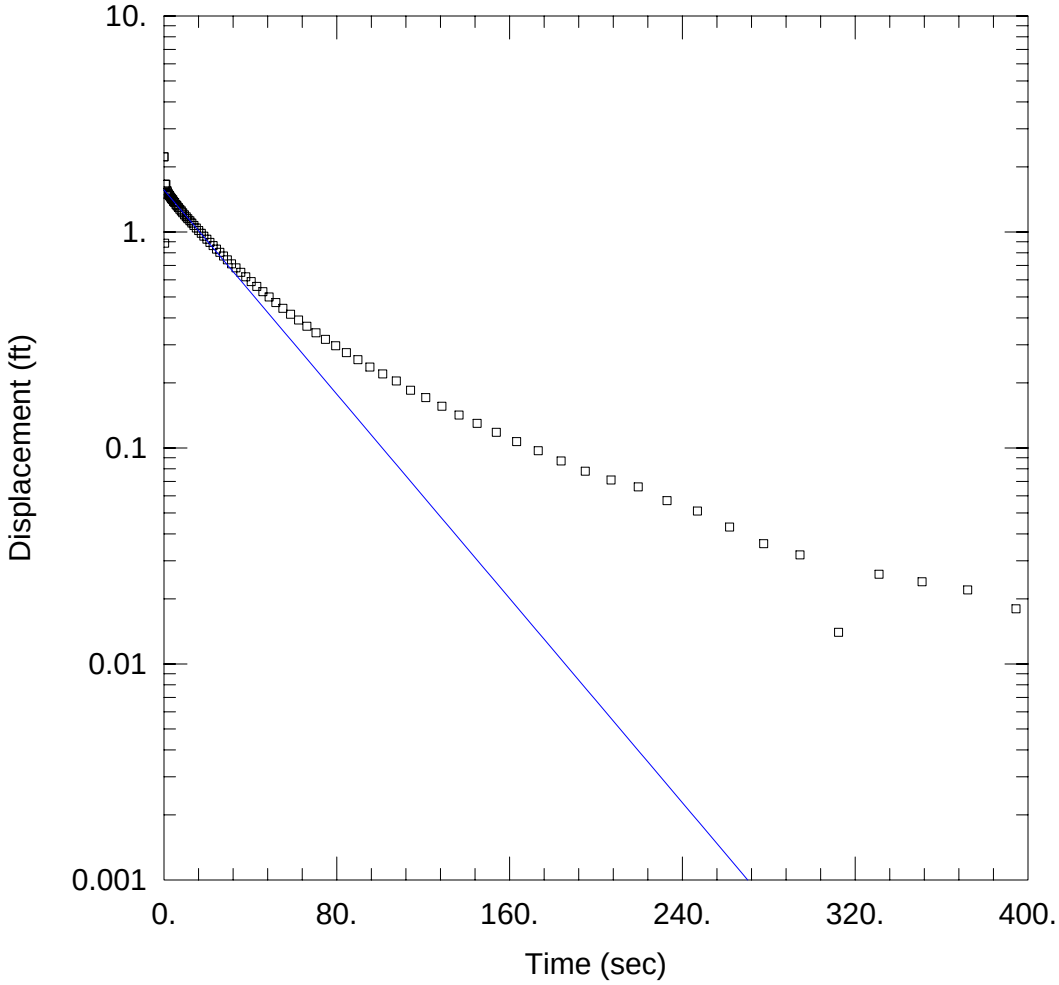
WELL DATA (N4-1#3)

Initial Displacement: 1.997 ft Static Water Column Height: 10.41 ft
Total Well Penetration Depth: 14. ft Screen Length: 10. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 1.962E-6 ft/min y0 = 0.6067 ft



N5-1#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N5-1#1.aqt
Date: 08/29/05 Time: 12:45:05

PROJECT INFORMATION

Test Well: N5-1#1
Test Date: 07/22/05

AQUIFER DATA

Saturated Thickness: 8.518 ft Anisotropy Ratio (Kz/Kr): 1.

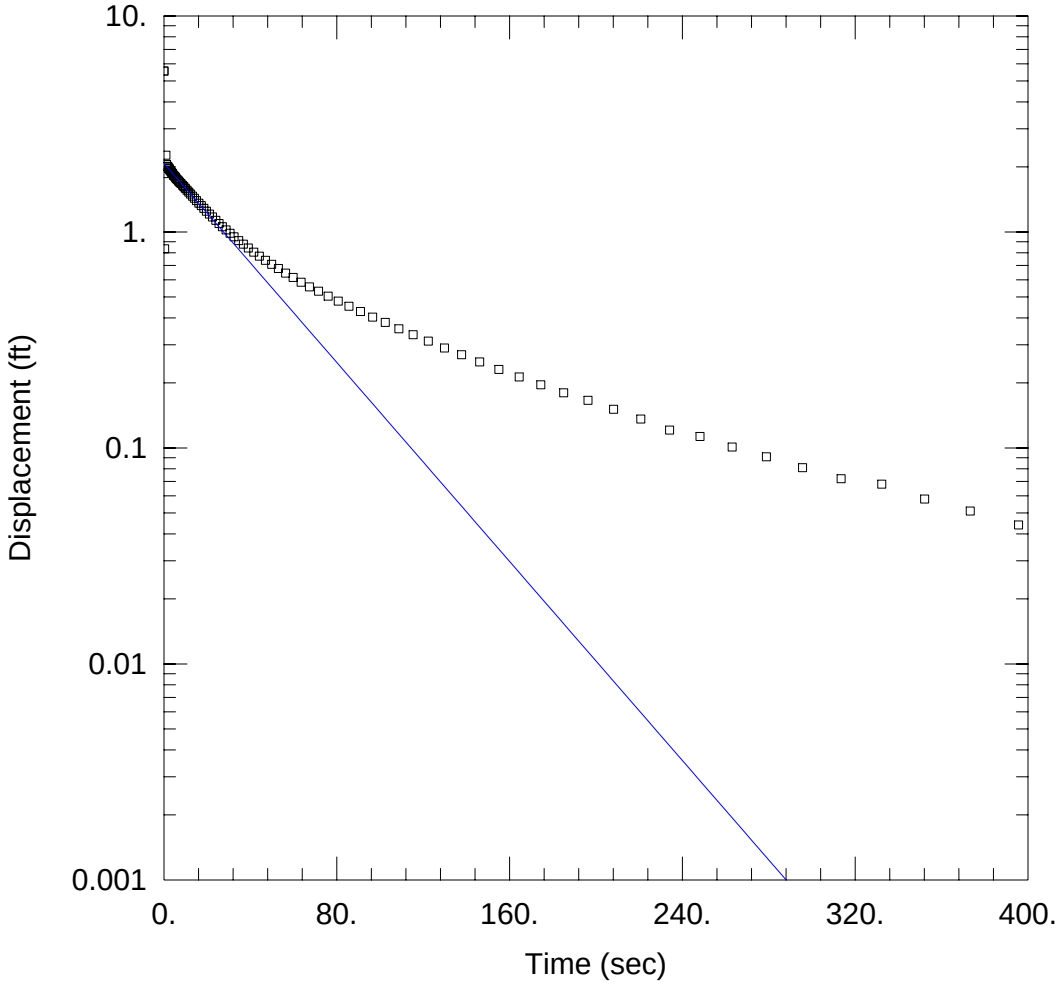
WELL DATA (N5-1#1)

Initial Displacement: 2.227 ft
Total Well Penetration Depth: 8.018 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.518 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.004886 ft/min y0 = 1.565 ft



N5-1#3

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N5-1#3.aqt
Date: 08/29/05 Time: 12:45:53

PROJECT INFORMATION

Test Well: N5-1#3
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 8.377 ft Anisotropy Ratio (Kz/Kr): 1.

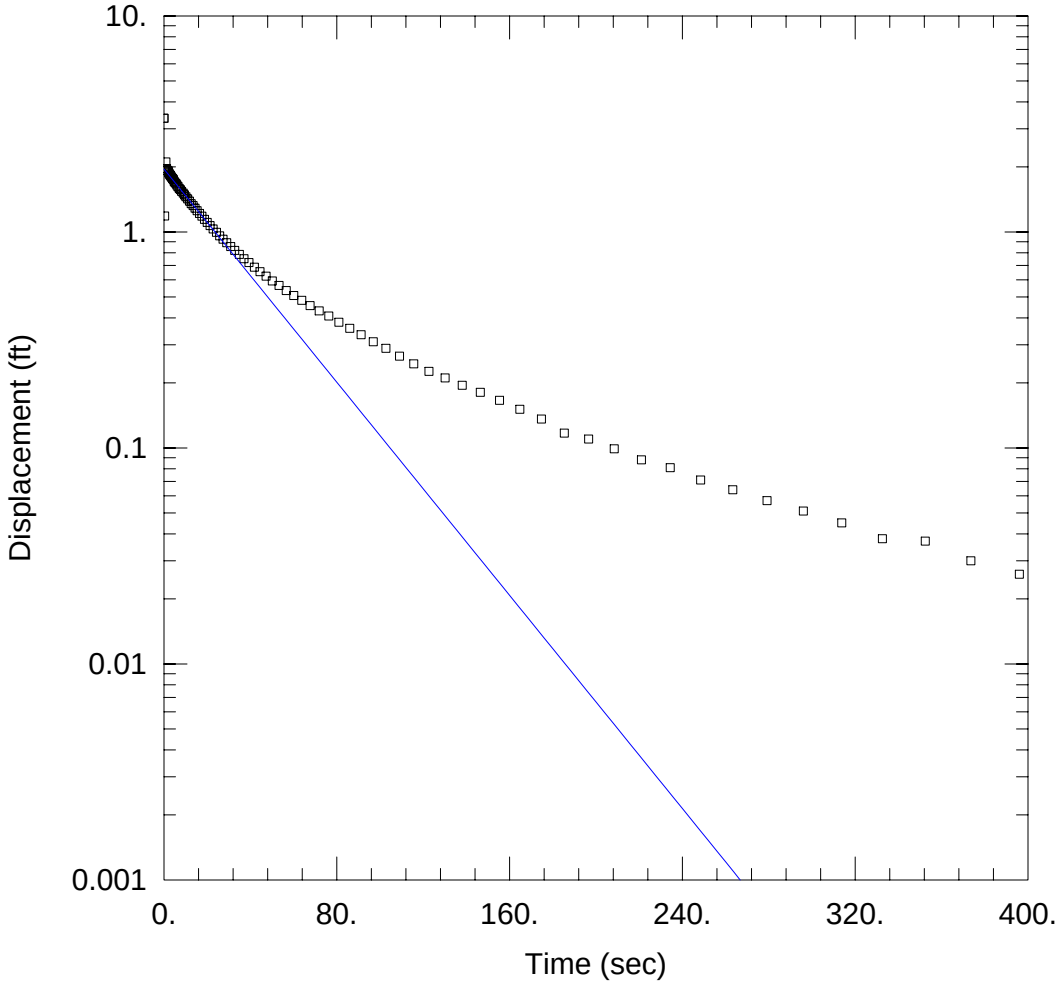
WELL DATA (N5-1#3)

Initial Displacement: 5.552 ft
Total Well Penetration Depth: 7.877 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.377 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.004741 ft/min y0 = 2.075 ft



N5-1#4

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N5-1#4.aqt
Date: 08/29/05 Time: 12:46:35

PROJECT INFORMATION

Test Well: N5-1#4
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 8.377 ft Anisotropy Ratio (Kz/Kr): 1.

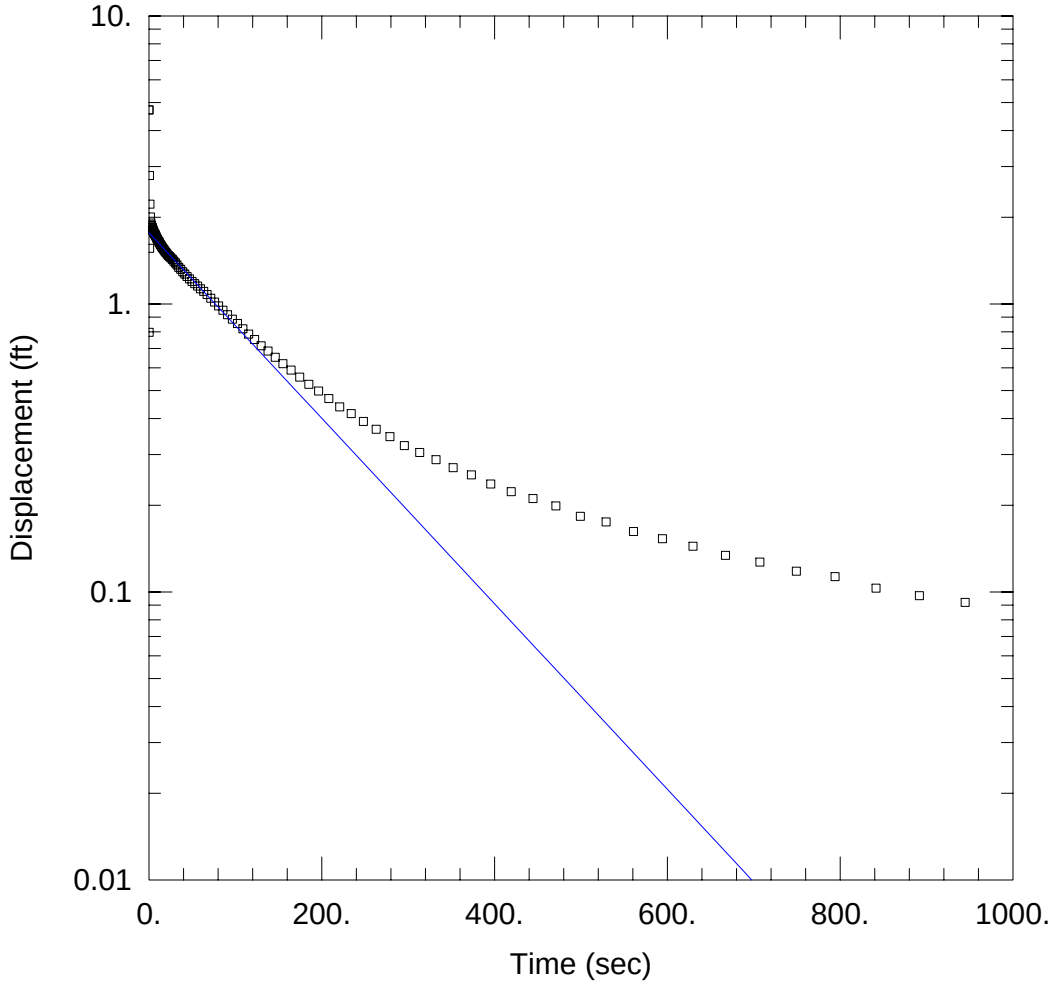
WELL DATA (N5-1#4)

Initial Displacement: 3.362 ft
Total Well Penetration Depth: 17.88 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.377 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.006376 ft/min y0 = 1.954 ft



N5-3#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N5-3#1.aqt
Date: 08/29/05 Time: 12:55:39

PROJECT INFORMATION

Test Well: N5-3#1
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 12.05 ft Anisotropy Ratio (Kz/Kr): 1.

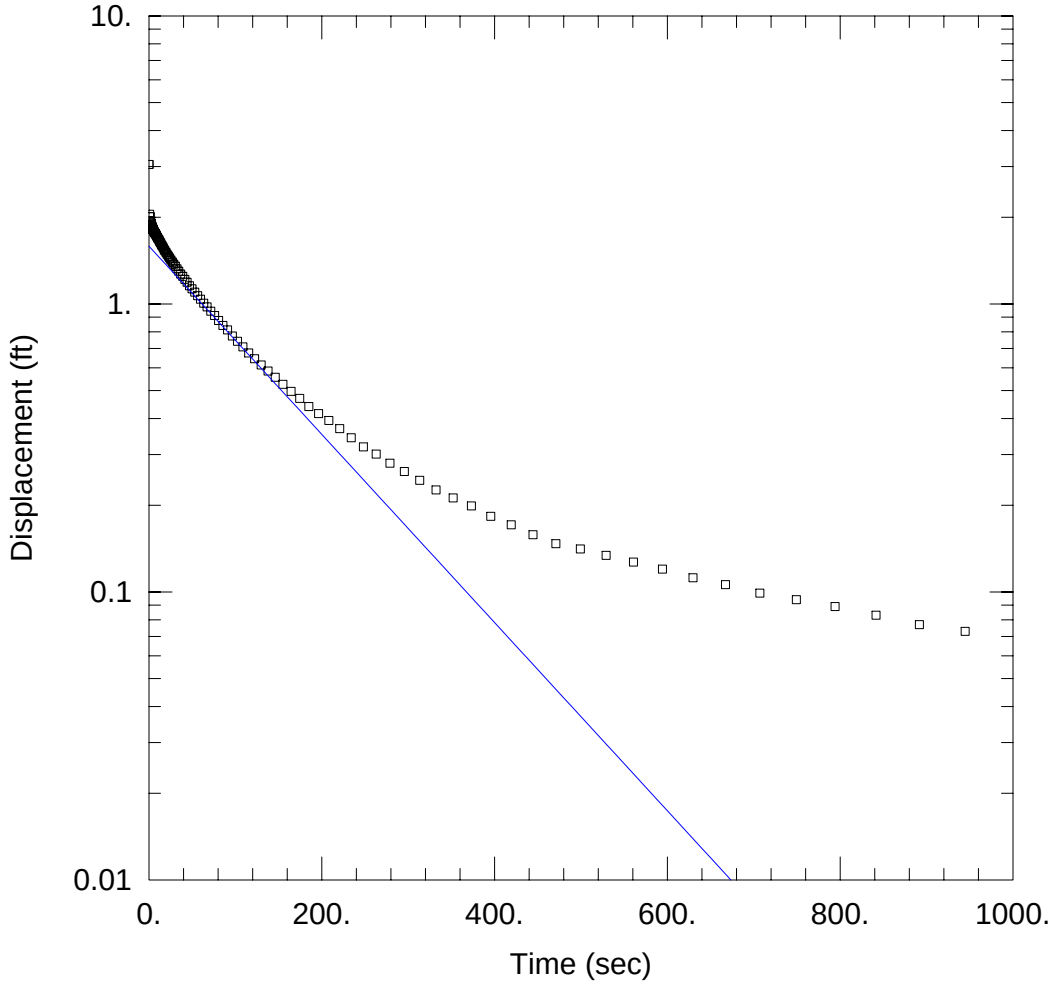
WELL DATA (N5-3#1)

Initial Displacement: 4.717 ft
Total Well Penetration Depth: 12.05 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.05 ft
Screen Length: 15. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001496 ft/min y0 = 1.765 ft



N5-3#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\N5-3#2.aqt
Date: 08/29/05 Time: 12:56:17

PROJECT INFORMATION

Test Well: N5-3#2
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 12.05 ft Anisotropy Ratio (Kz/Kr): 1.

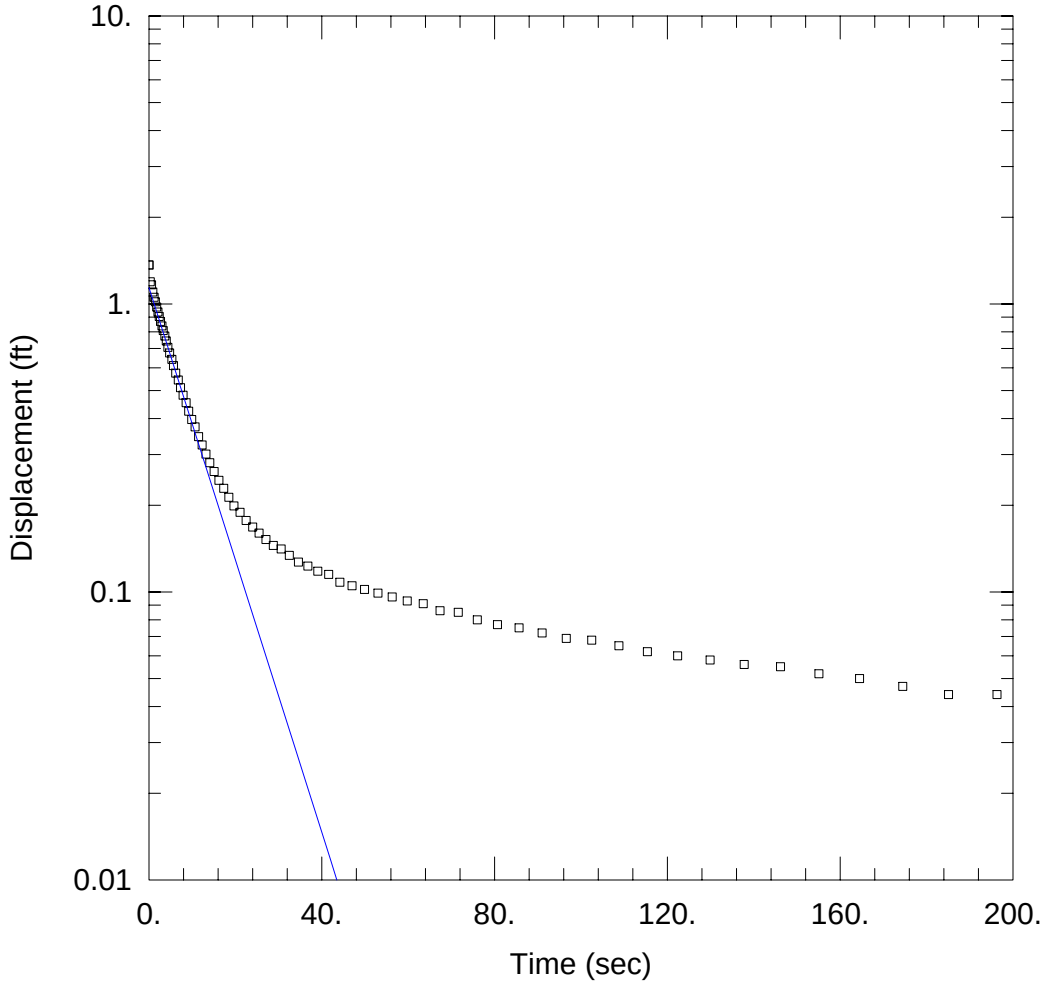
WELL DATA (N5-3#2)

Initial Displacement: 3.048 ft
Total Well Penetration Depth: 12.05 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.05 ft
Screen Length: 15. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001517 ft/min y0 = 1.586 ft



OW-01#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-01#1.aqt
Date: 08/29/05 Time: 13:00:25

PROJECT INFORMATION

Test Well: OW-01#1
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 19.02 ft Anisotropy Ratio (Kz/Kr): 1.

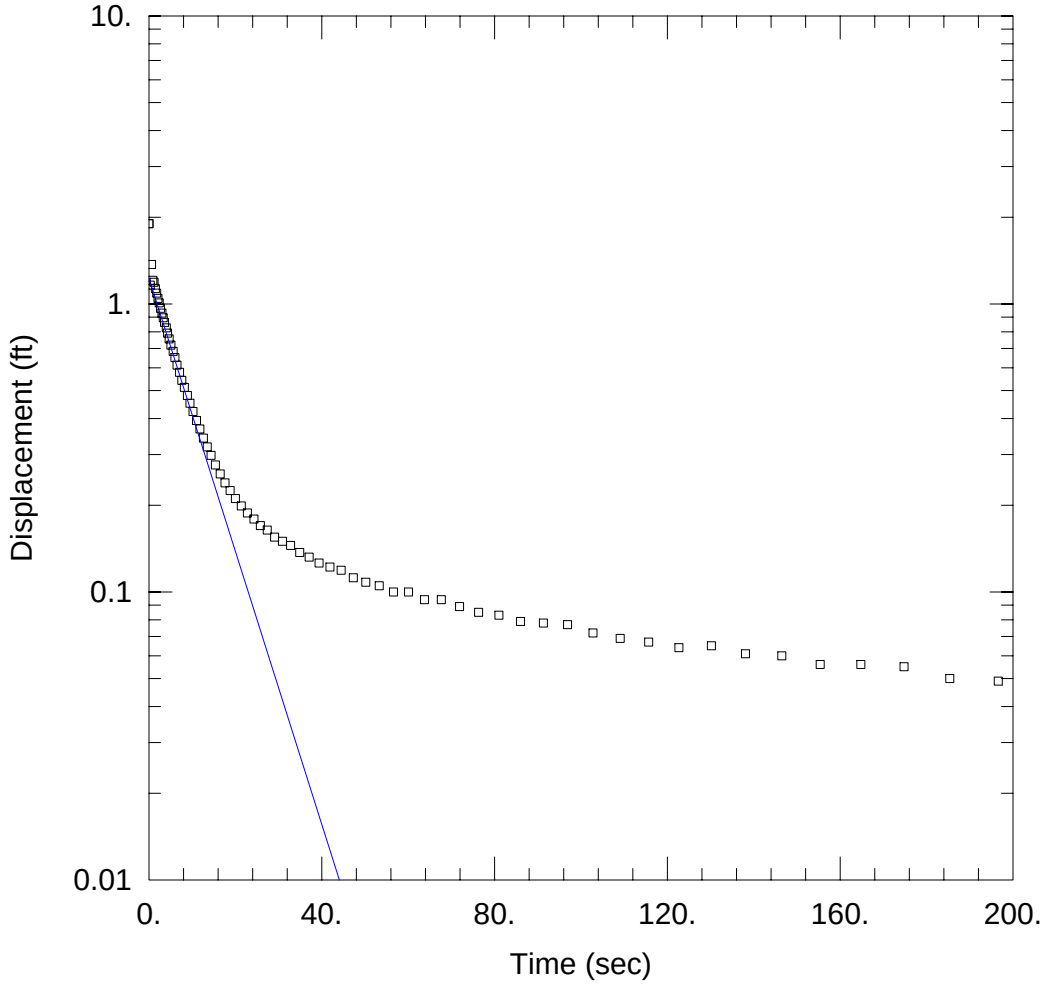
WELL DATA (OW-01#1)

Initial Displacement: 1.365 ft
Total Well Penetration Depth: 19.02 ft
Casing Radius: 0.083 ft
Static Water Column Height: 19.02 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.007223 ft/min
y0 = 1.138 ft



OW-01#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-01#2.aqt
Date: 08/29/05 Time: 13:01:08

PROJECT INFORMATION

Test Well: OW-01#2
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 19.02 ft Anisotropy Ratio (Kz/Kr): 1.

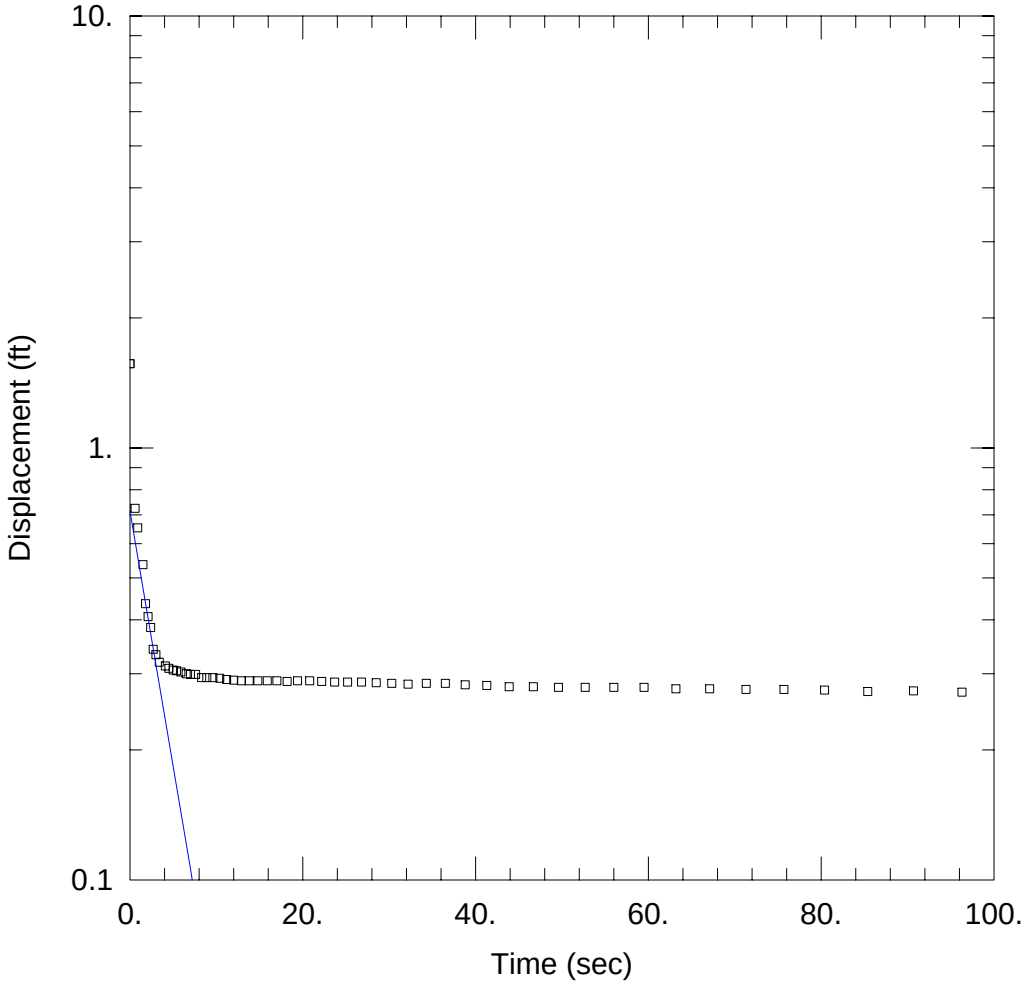
WELL DATA (OW-01#2)

Initial Displacement: 1.9 ft Static Water Column Height: 19.02 ft
Total Well Penetration Depth: 19.02 ft Screen Length: 10. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.007246 ft/min y0 = 1.228 ft



OW-02#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-02#1.aqt
Date: 08/29/05 Time: 13:06:57

PROJECT INFORMATION

Test Well: OW-02#1
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 5.803 ft Anisotropy Ratio (Kz/Kr): 1.

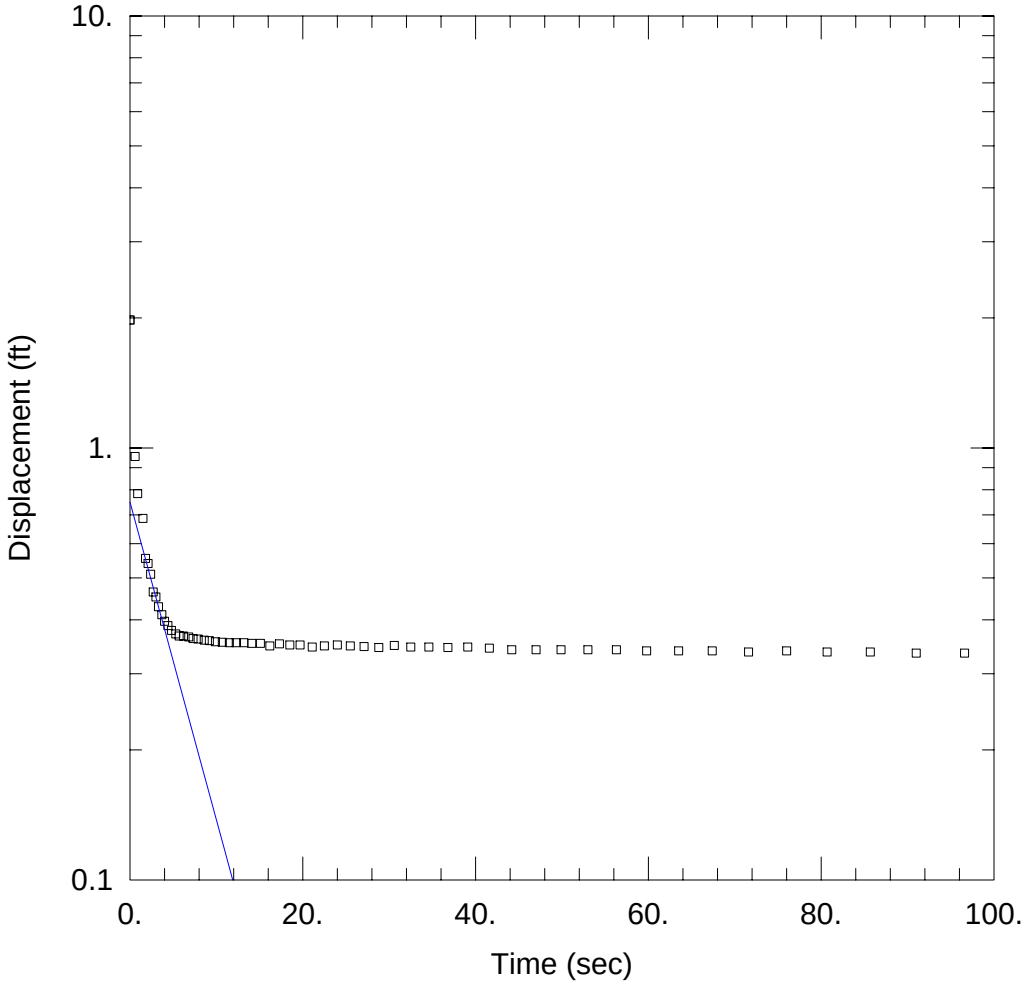
WELL DATA (OW-02#1)

Initial Displacement: 1.567 ft Static Water Column Height: 5.803 ft
Total Well Penetration Depth: 5.803 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.344 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0229 ft/min y0 = 0.7134 ft



OW-02#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-02#2.aqt
Date: 08/29/05 Time: 13:08:02

PROJECT INFORMATION

Test Well: OW-02#2
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 5.184 ft Anisotropy Ratio (Kz/Kr): 1.

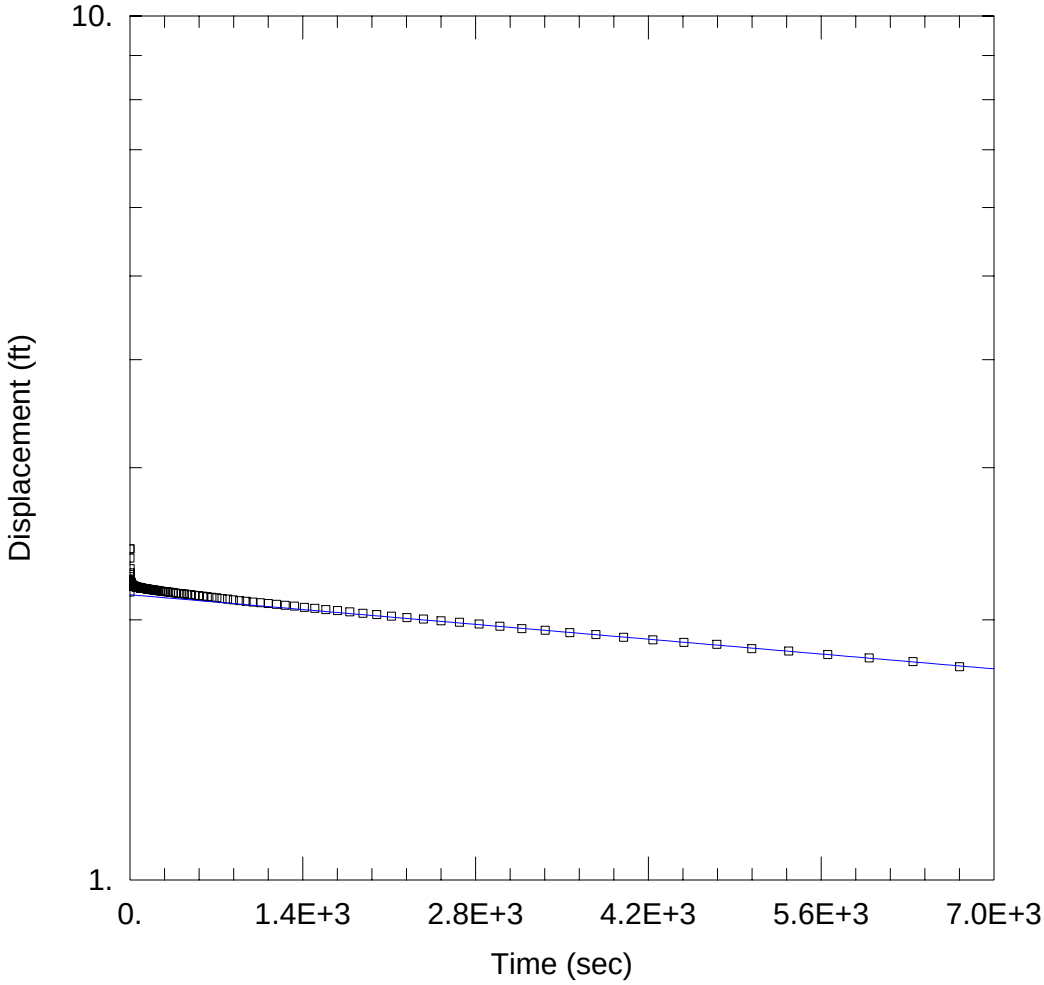
WELL DATA (OW-02#2)

Initial Displacement: 1.978 ft Static Water Column Height: 5.184 ft
Total Well Penetration Depth: 5.184 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.344 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01379 ft/min y0 = 0.7491 ft



OW-03#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-03#1.aqt
Date: 08/29/05 Time: 13:10:42

PROJECT INFORMATION

Test Well: OW-03#1
Test Date: 07/19/05

AQUIFER DATA

Saturated Thickness: 24. ft Anisotropy Ratio (Kz/Kr): 1.

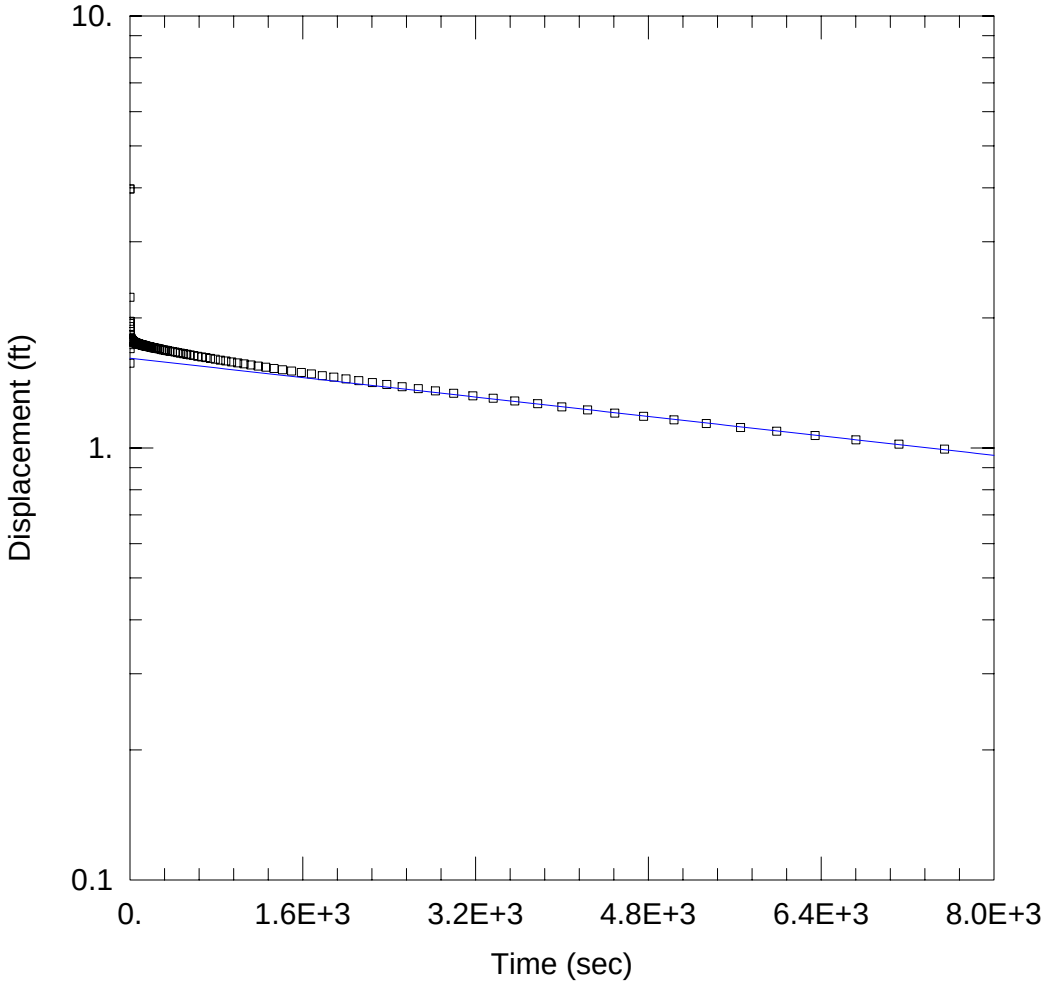
WELL DATA (OW-03#1)

Initial Displacement: 2.417 ft Static Water Column Height: 29.11 ft
Total Well Penetration Depth: 23.5 ft Screen Length: 10. ft
Casing Radius: 0.086 ft Wellbore Radius: 0.297 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 1.875E-6 ft/min y0 = 2.138 ft



OW-04#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-04#1.aqt
Date: 08/29/05 Time: 13:12:29

PROJECT INFORMATION

Test Well: OW-04#1
Test Date: 07/20/05

AQUIFER DATA

Saturated Thickness: 30.5 ft Anisotropy Ratio (Kz/Kr): 1.

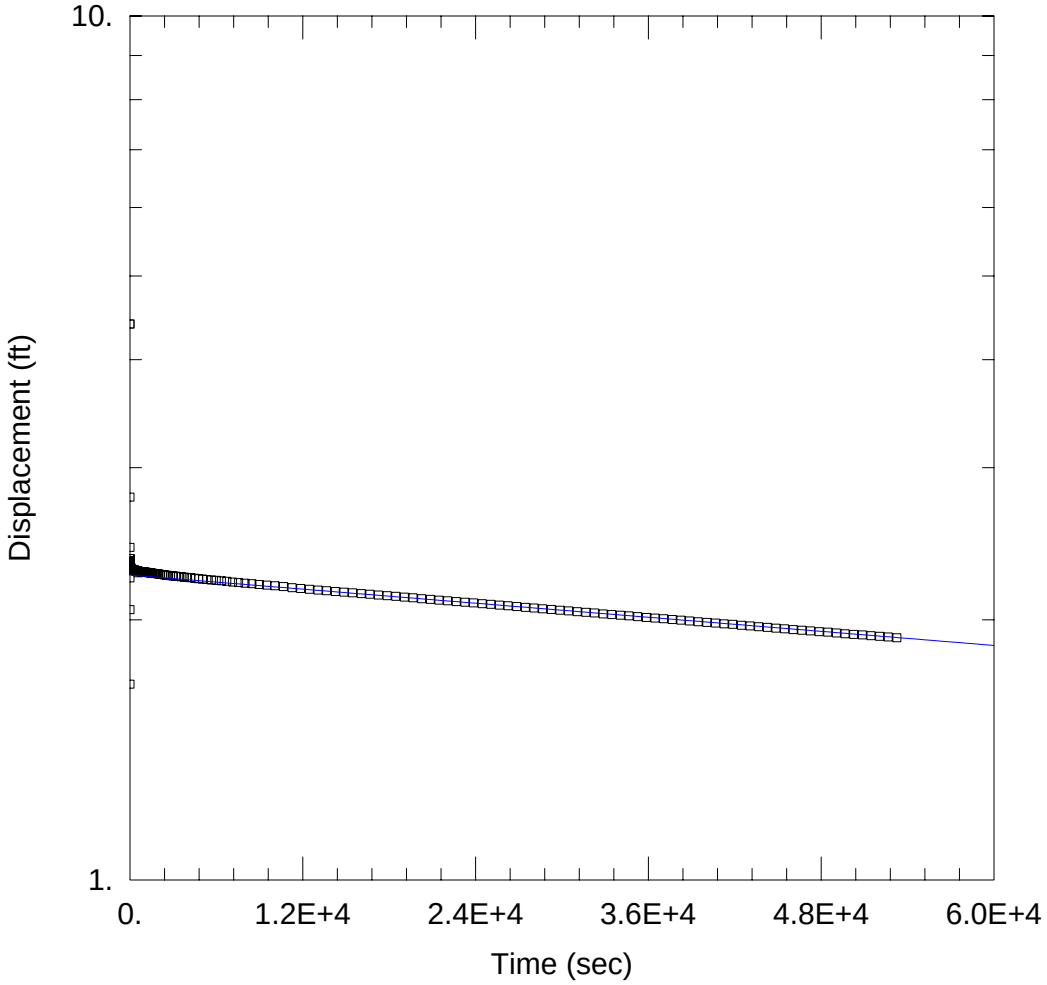
WELL DATA (OW-04#1)

Initial Displacement: 3.976 ft Static Water Column Height: 29.52 ft
Total Well Penetration Depth: 28. ft Screen Length: 10. ft
Casing Radius: 0.086 ft Wellbore Radius: 0.297 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 4.169E-6 ft/min y0 = 1.613 ft



OW-05#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-05#1.aqt
Date: 08/29/05 Time: 13:14:42

PROJECT INFORMATION

Test Well: OW-05#1
Test Date: 07/21/05

AQUIFER DATA

Saturated Thickness: 23.5 ft Anisotropy Ratio (Kz/Kr): 1.

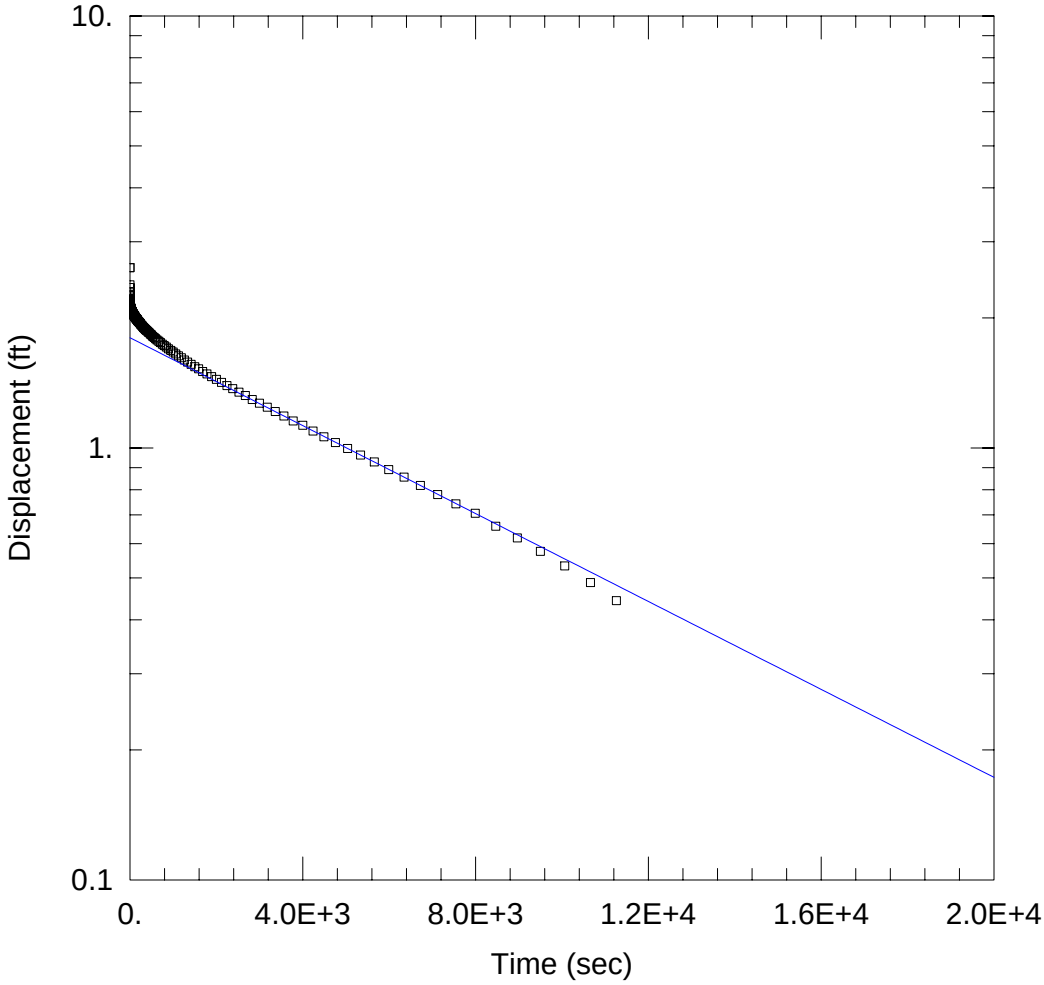
WELL DATA (OW-05#1)

Initial Displacement: 4.399 ft Static Water Column Height: 29.65 ft
Total Well Penetration Depth: 23. ft Screen Length: 10. ft
Casing Radius: 0.086 ft Wellbore Radius: 0.297 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 2.068E-7 ft/min y0 = 2.253 ft



OW-06#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-06#1.aqt
Date: 08/29/05 Time: 13:18:10

PROJECT INFORMATION

Test Well: OW-06#1
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 25.5 ft Anisotropy Ratio (Kz/Kr): 1.

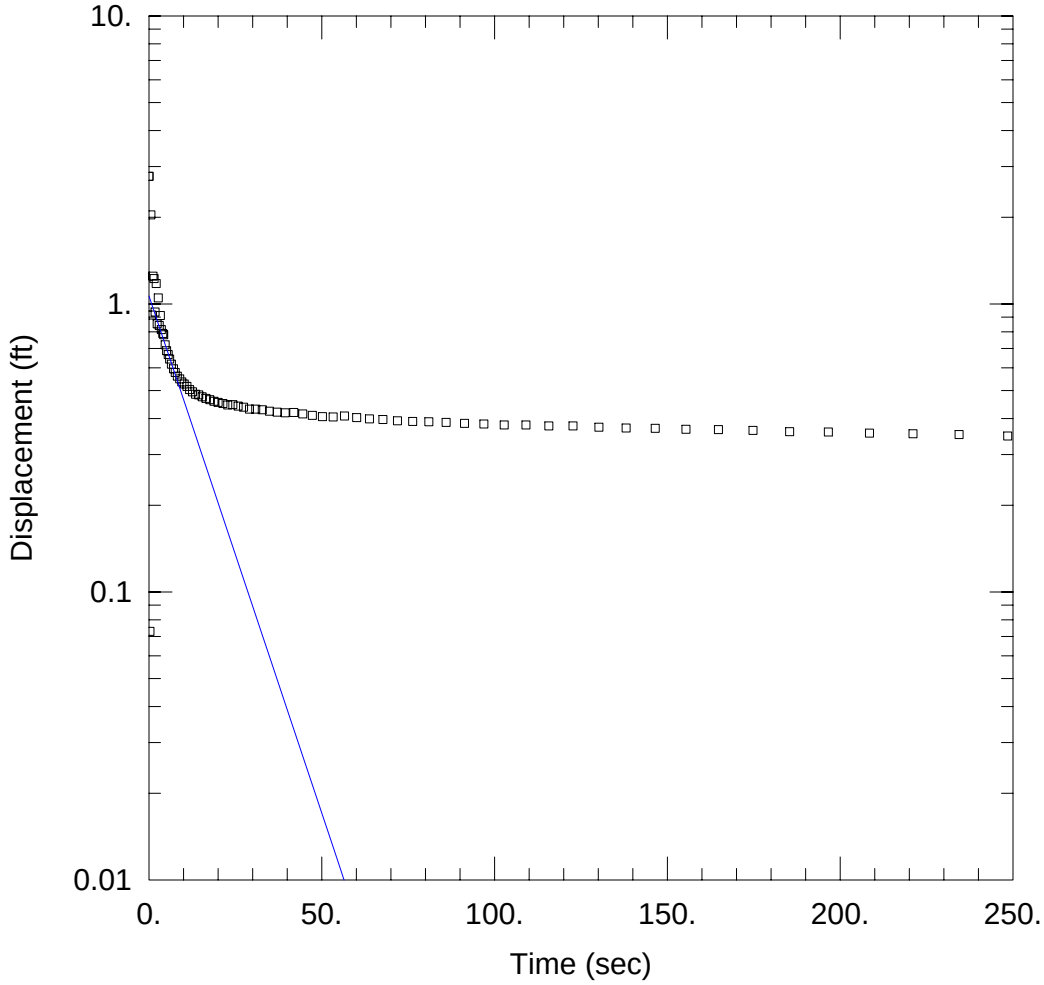
WELL DATA (OW-06#1)

Initial Displacement: 2.614 ft Static Water Column Height: 36.01 ft
Total Well Penetration Depth: 25. ft Screen Length: 10. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.344 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 7.023E-6 ft/min y0 = 1.799 ft



OW-08#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-08#1.aqt
Date: 08/30/05 Time: 11:53:13

PROJECT INFORMATION

Test Well: OW-08#1
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 8.276 ft Anisotropy Ratio (Kz/Kr): 1.

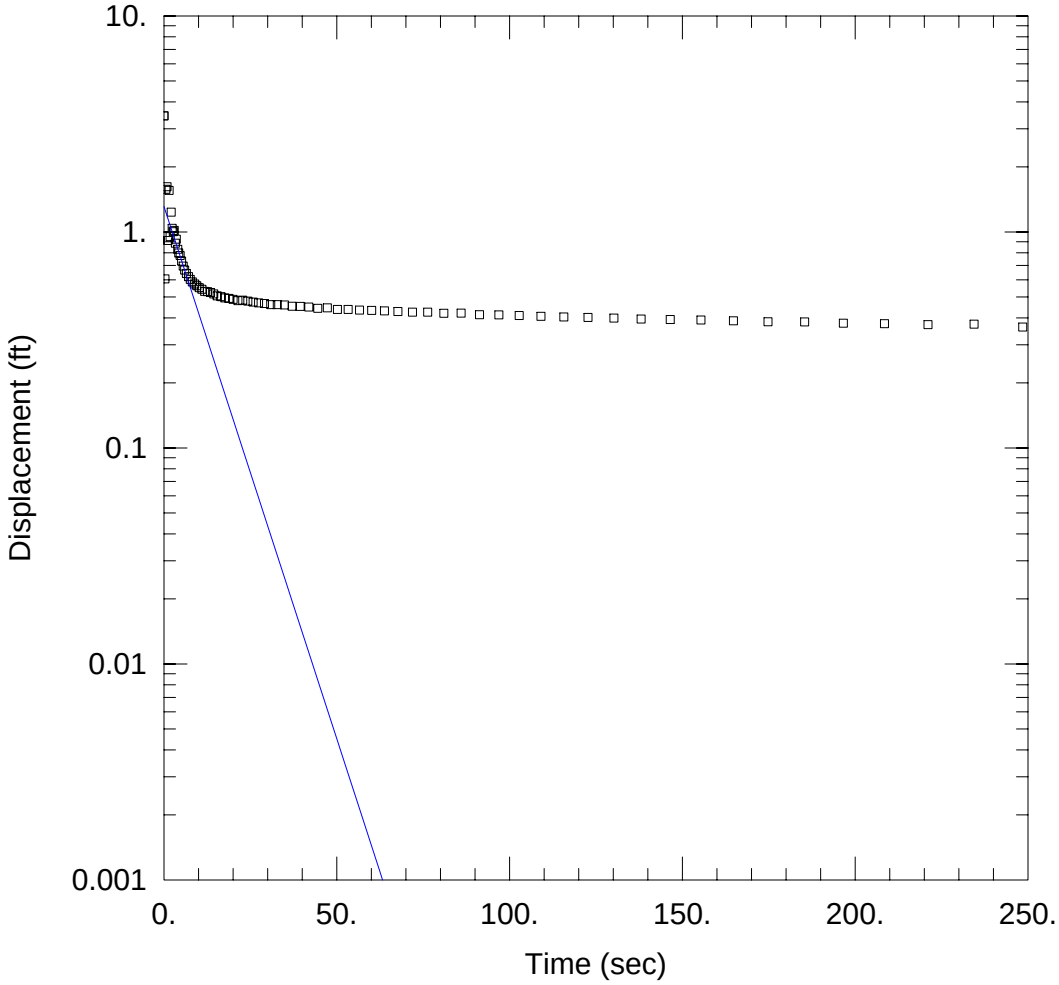
WELL DATA (OW-08#1)

Initial Displacement: 2.774 ft
Total Well Penetration Depth: 8.076 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.276 ft
Screen Length: 10. ft
Wellbore Radius: 0.313 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02064 ft/min y0 = 1.065 ft



OW-08#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-08#2.aqt
Date: 08/30/05 Time: 11:54:21

PROJECT INFORMATION

Test Well: OW-08#2
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 8.119 ft Anisotropy Ratio (Kz/Kr): 1.

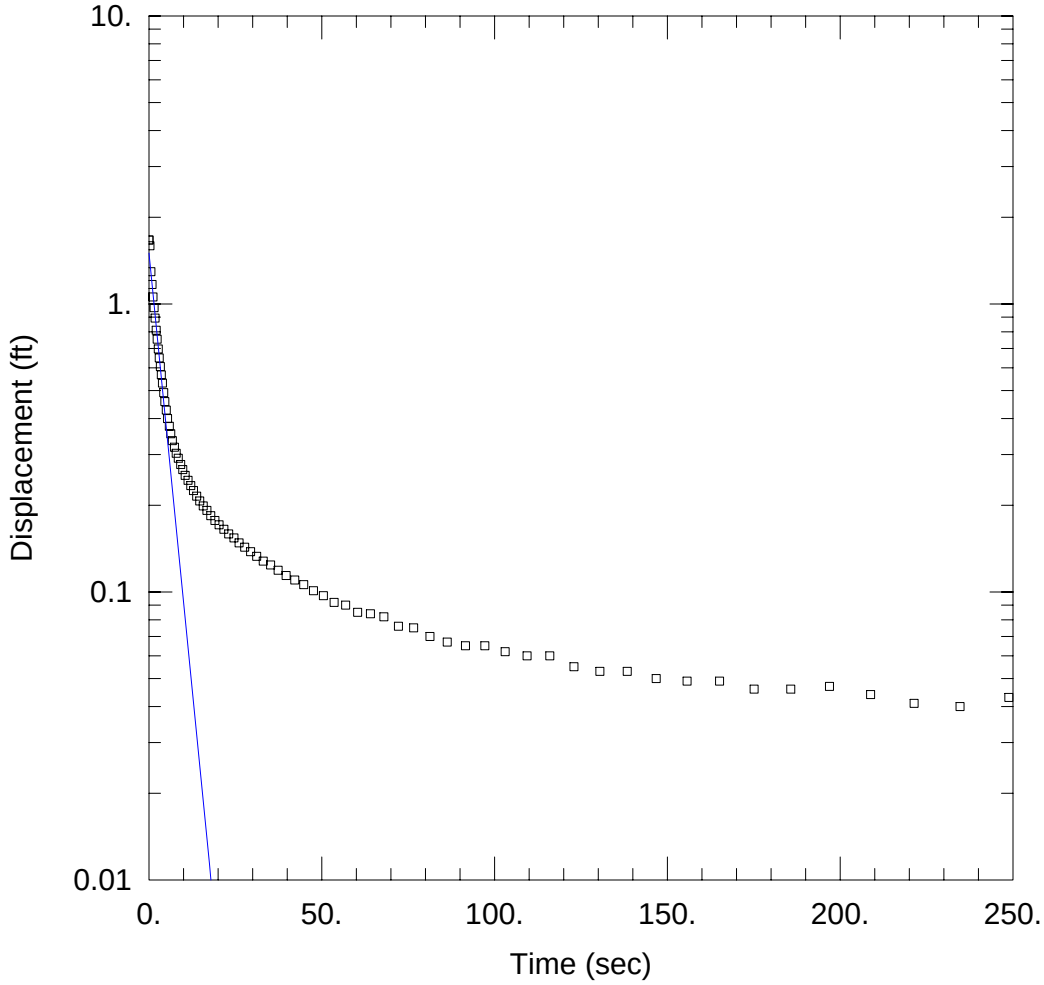
WELL DATA (OW-08#2)

Initial Displacement: 3.449 ft
Total Well Penetration Depth: 7.919 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.119 ft
Screen Length: 10. ft
Wellbore Radius: 0.313 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02819 ft/min y0 = 1.312 ft



OW-09#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-09#1.aqt
Date: 08/30/05 Time: 11:54:37

PROJECT INFORMATION

Test Well: OW-09#1
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 8.35 ft
Anisotropy Ratio (Kz/Kr): 1.

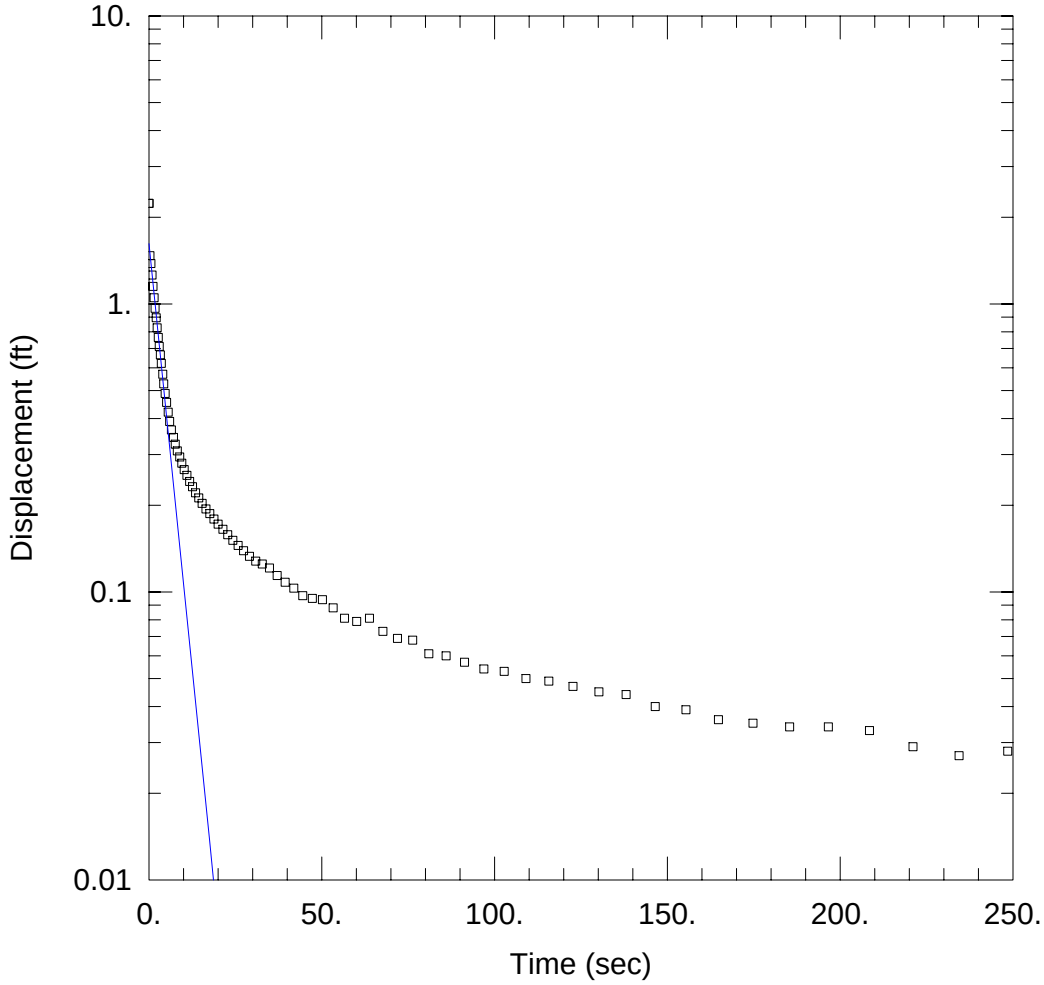
WELL DATA (OW-09#1)

Initial Displacement: 1.667 ft
Total Well Penetration Depth: 8.35 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.35 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.06686 ft/min
y0 = 1.501 ft



OW-09#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-09#2.aqt
Date: 08/30/05 Time: 11:54:53

PROJECT INFORMATION

Test Well: OW-09#2
Test Date: 07.25/05

AQUIFER DATA

Saturated Thickness: 8.341 ft Anisotropy Ratio (Kz/Kr): 1.

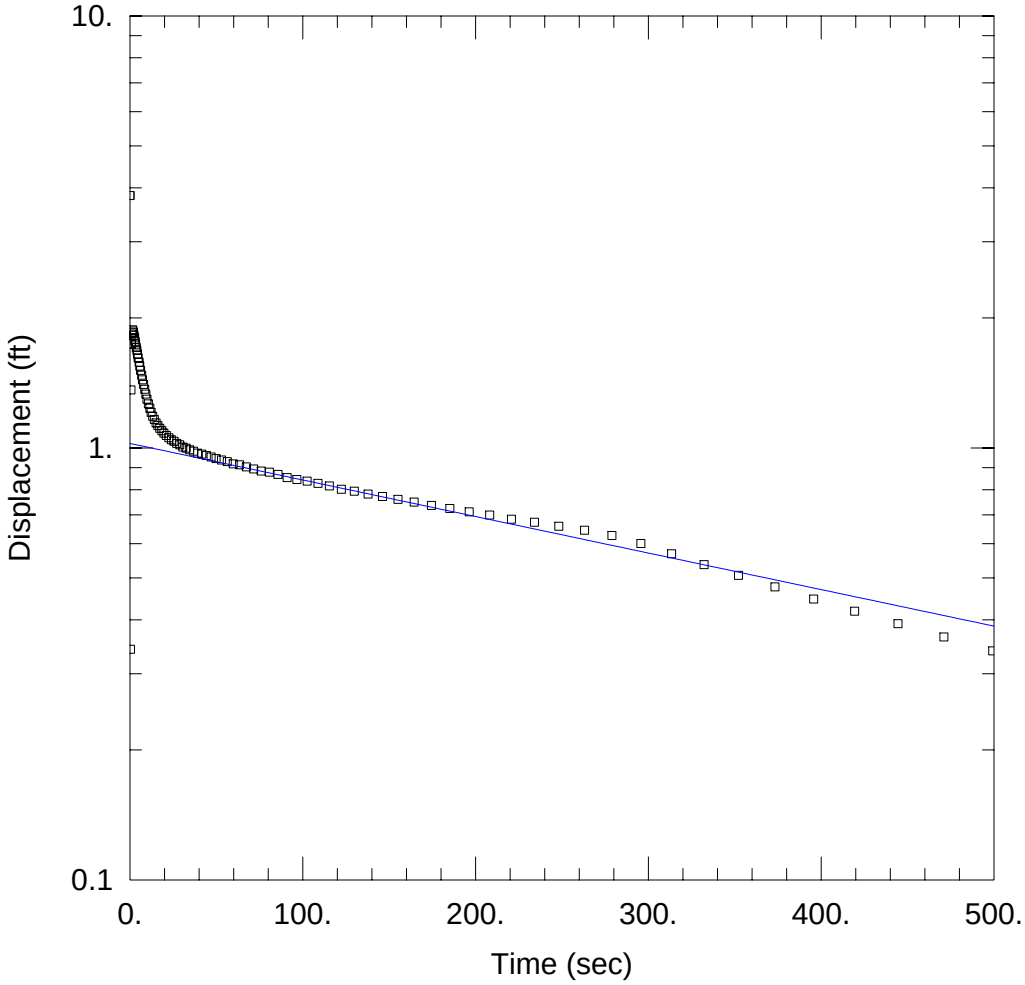
WELL DATA (OW-09#2)

Initial Displacement: 2.234 ft
Total Well Penetration Depth: 8.341 ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.341 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.06517 ft/min y0 = 1.619 ft



OW-16#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-16#1.aqt
Date: 08/30/05 Time: 12:16:31

PROJECT INFORMATION

Test Well: OW-16#1
Test Date: 87/21/05

AQUIFER DATA

Saturated Thickness: 5.514 ft Anisotropy Ratio (Kz/Kr): 1.

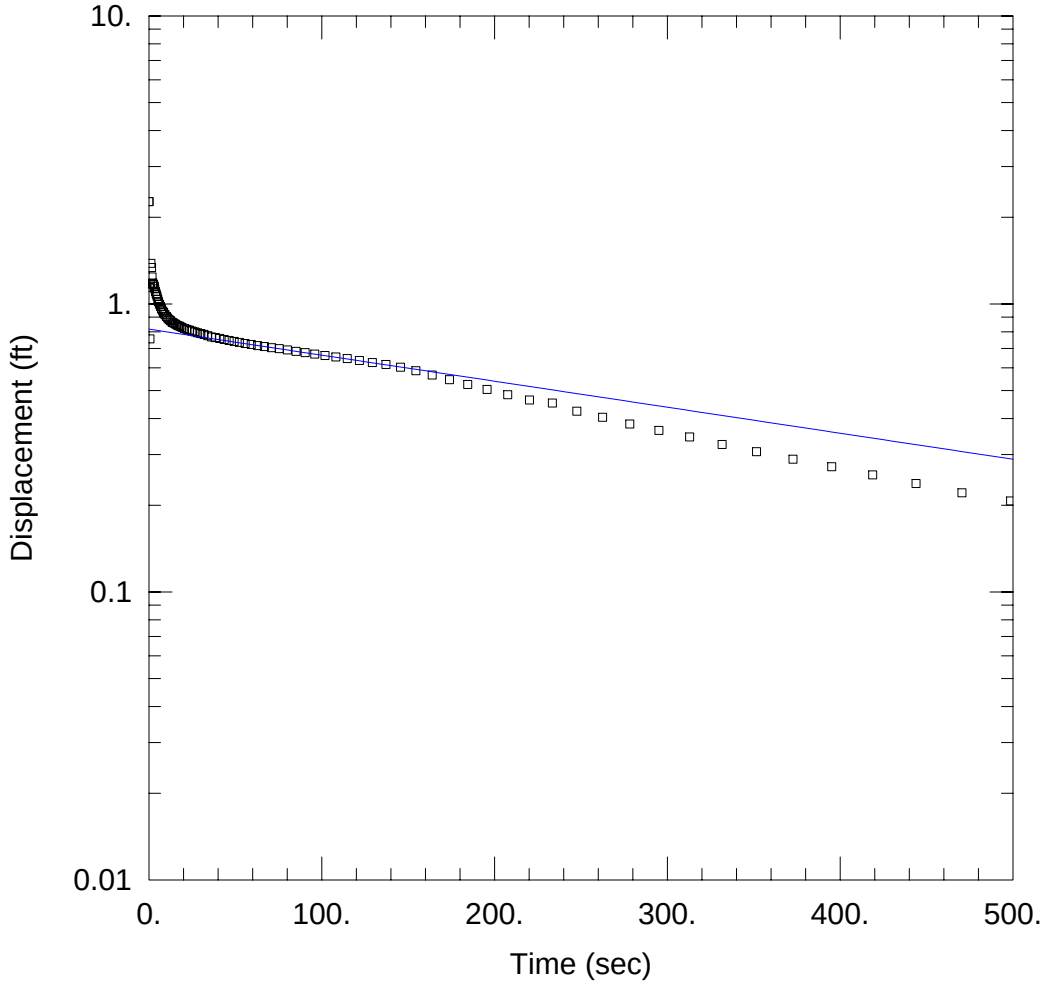
WELL DATA (OW-16#1)

Initial Displacement: 3.839 ft Static Water Column Height: 5.514 ft
Total Well Penetration Depth: 5.354 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.000156 ft/min y0 = 1.024 ft



OW-16#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-16#2.aqt
Date: 08/30/05 Time: 12:32:20

PROJECT INFORMATION

Test Well: OW-16#2
Test Date: 07/21/05

AQUIFER DATA

Saturated Thickness: 5.501 ft Anisotropy Ratio (Kz/Kr): 1.

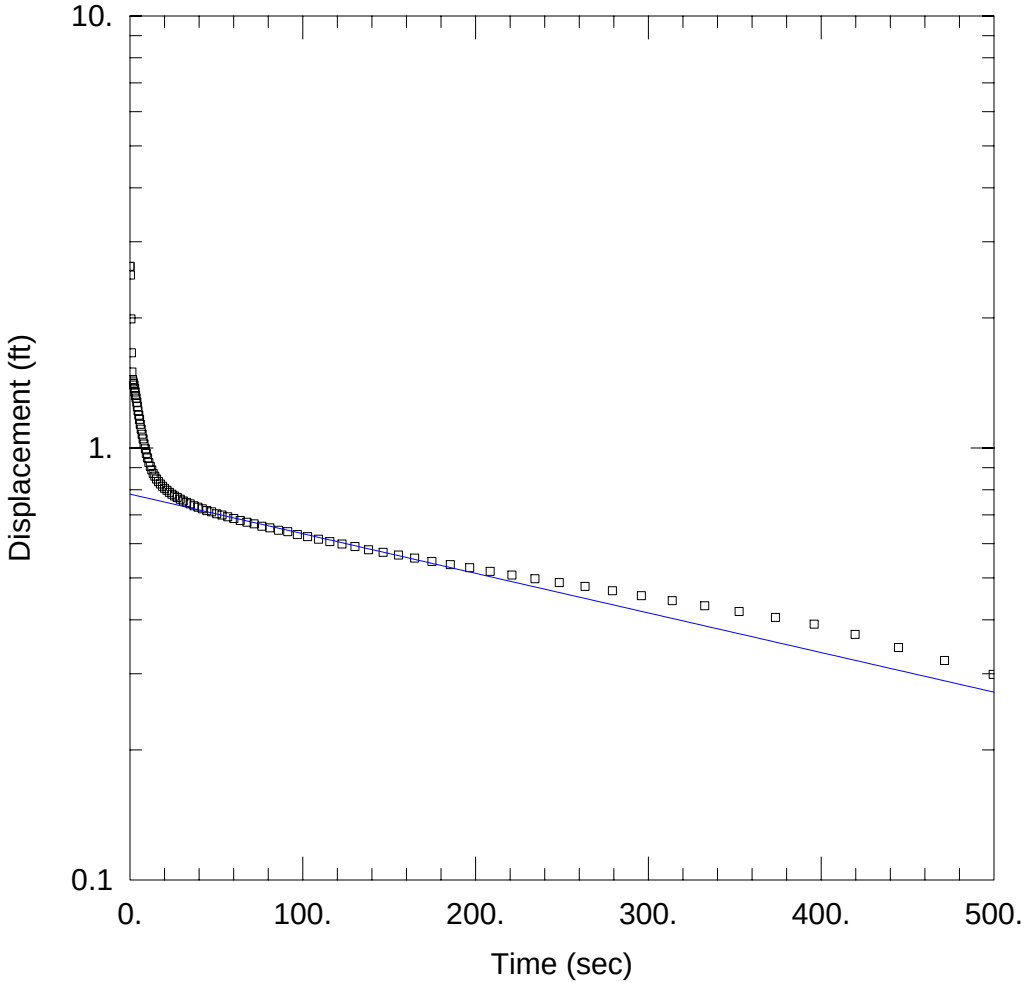
WELL DATA (OW-16#2)

Initial Displacement: 2.267 ft Static Water Column Height: 5.501 ft
Total Well Penetration Depth: 5.341 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001665 ft/min y0 = 0.8172 ft



OW-16#3

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-16#3.aqt
Date: 08/30/05 Time: 12:17:02

PROJECT INFORMATION

Test Well: OW-16#3
Test Date: 07/26/05

AQUIFER DATA

Saturated Thickness: 5.28 ft Anisotropy Ratio (Kz/Kr): 1.

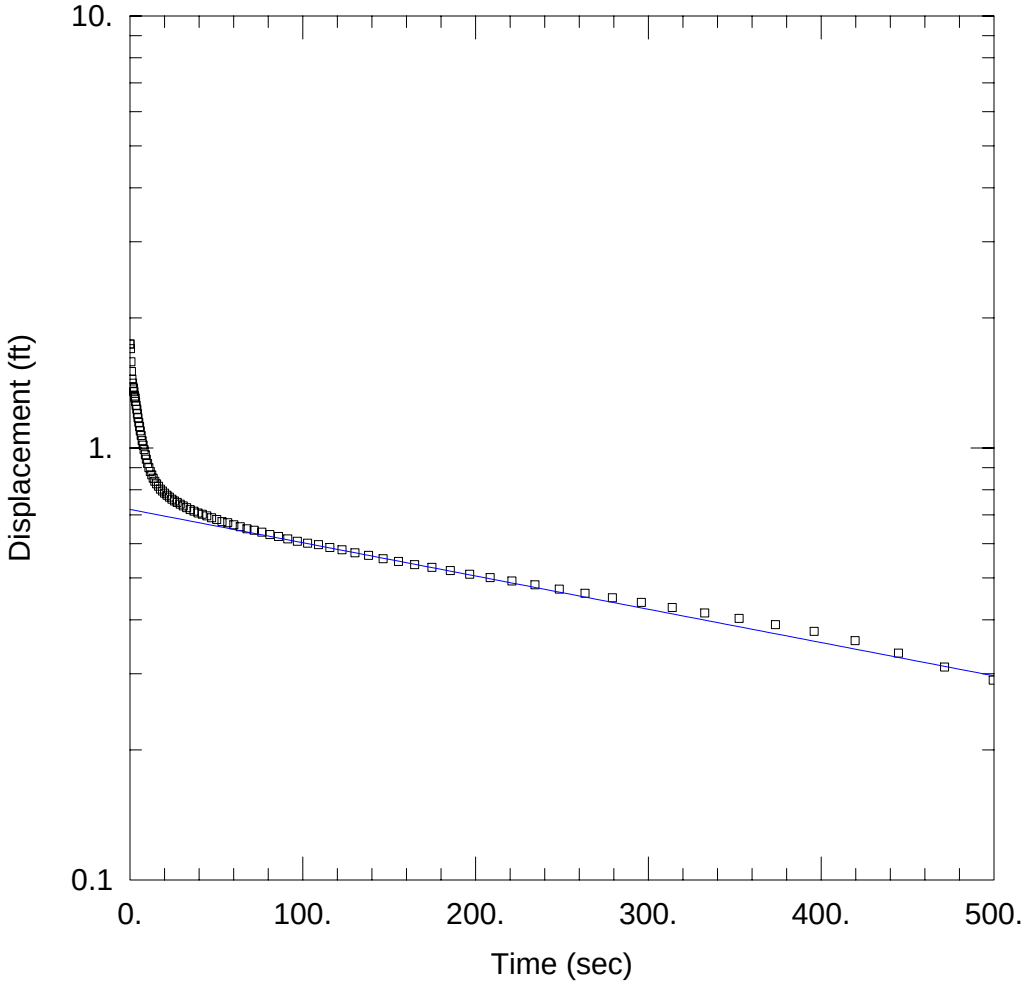
WELL DATA (OW-16#3)

Initial Displacement: 2.632 ft Static Water Column Height: 5.282 ft
Total Well Penetration Depth: 5.122 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001671 ft/min y0 = 0.7817 ft



OW-16#4

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-16#4.aqt
Date: 08/30/05 Time: 12:22:14

PROJECT INFORMATION

Test Well: OW-16#4
Test Date: 07/26/05

AQUIFER DATA

Saturated Thickness: 5.259 ft Anisotropy Ratio (Kz/Kr): 1.

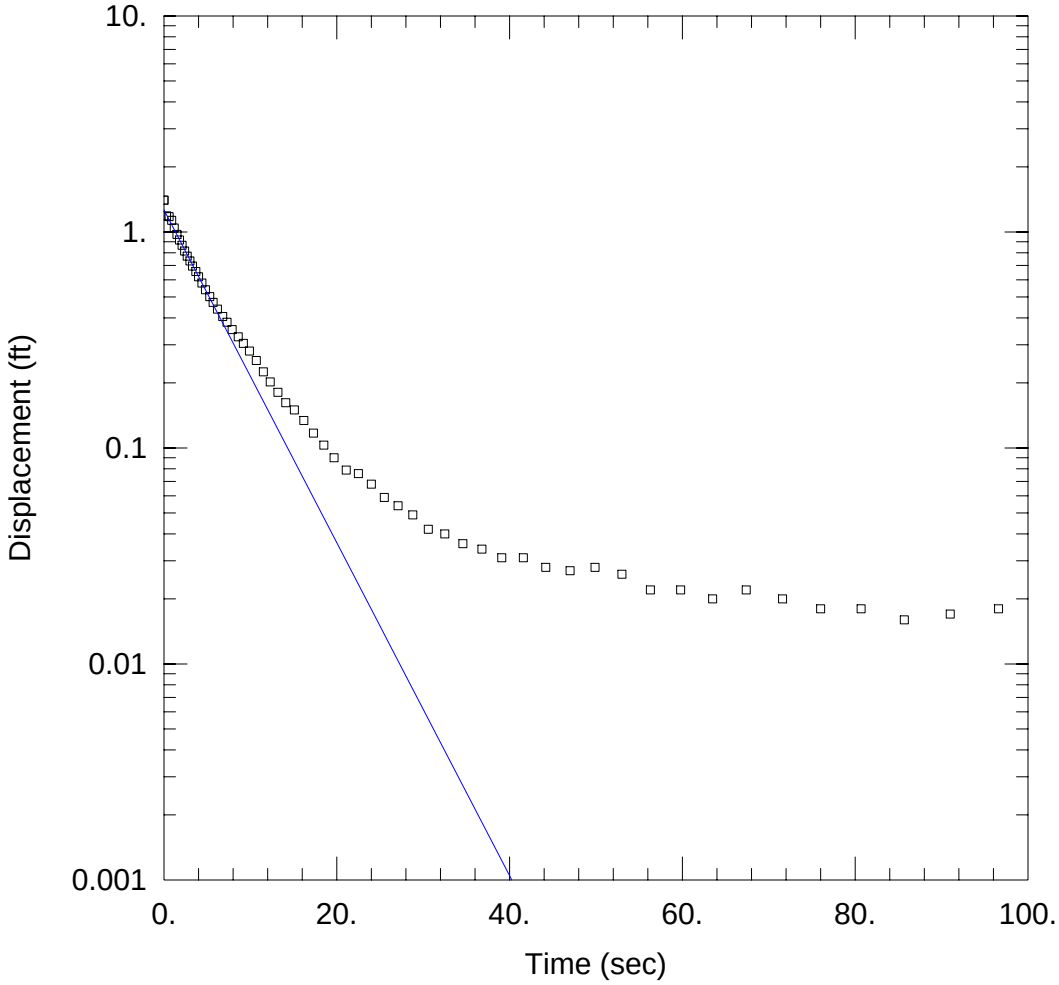
WELL DATA (OW-16#4)

Initial Displacement: 1.74 ft Static Water Column Height: 5.259 ft
Total Well Penetration Depth: 5.099 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001402 ft/min y0 = 0.7205 ft



OW-24#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-24#1.aqt
Date: 08/30/05 Time: 12:48:04

PROJECT INFORMATION

Test Well: OW-24#1
Test Date: 07/24/05

AQUIFER DATA

Saturated Thickness: 17.16 ft Anisotropy Ratio (Kz/Kr): 1.

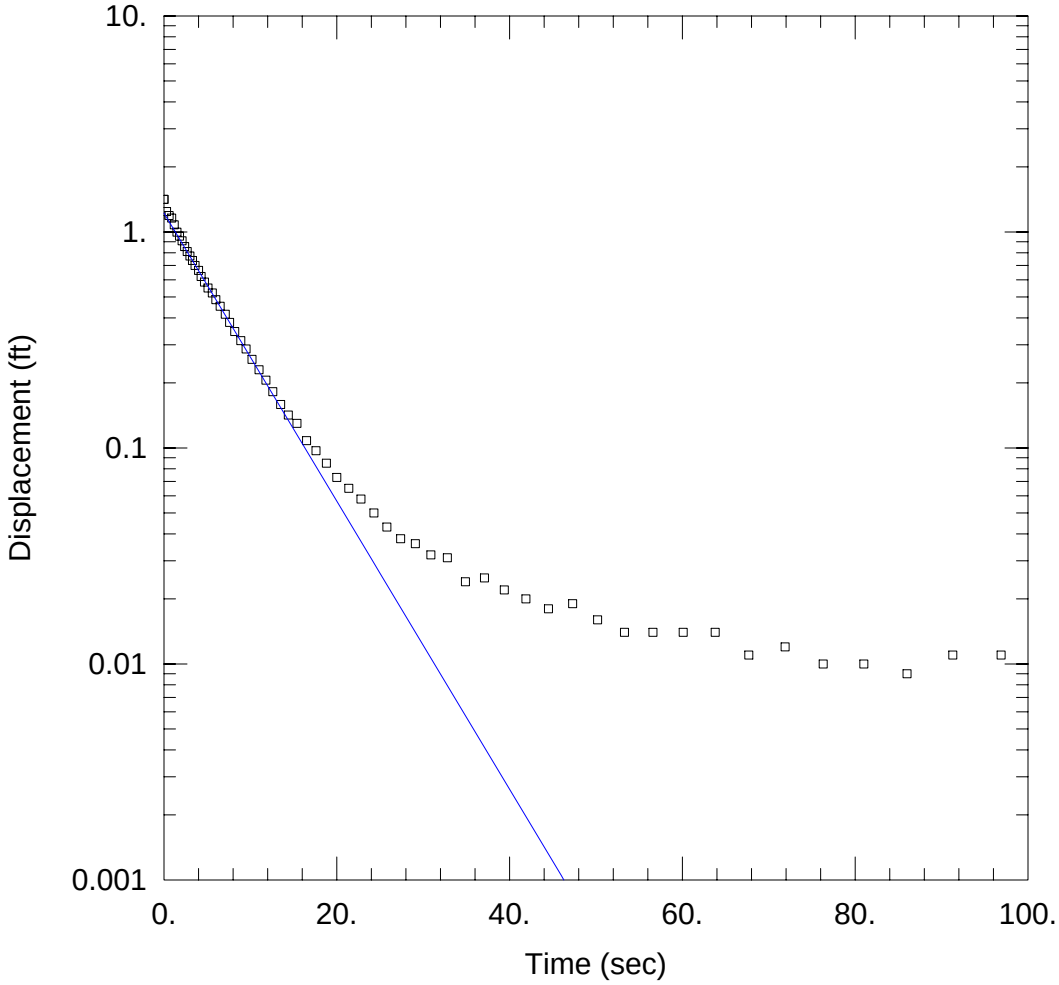
WELL DATA (OW-24#1)

Initial Displacement: 1.403 ft Static Water Column Height: 17.16 ft
Total Well Penetration Depth: 16.44 ft Screen Length: 15. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.006886 ft/min y0 = 1.264 ft



OW-24#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-24#2.aqt
Date: 08/30/05 Time: 12:48:24

PROJECT INFORMATION

Test Well: OW-24#2
Test Date: 07/27/05

AQUIFER DATA

Saturated Thickness: 17.17 ft Anisotropy Ratio (Kz/Kr): 1.

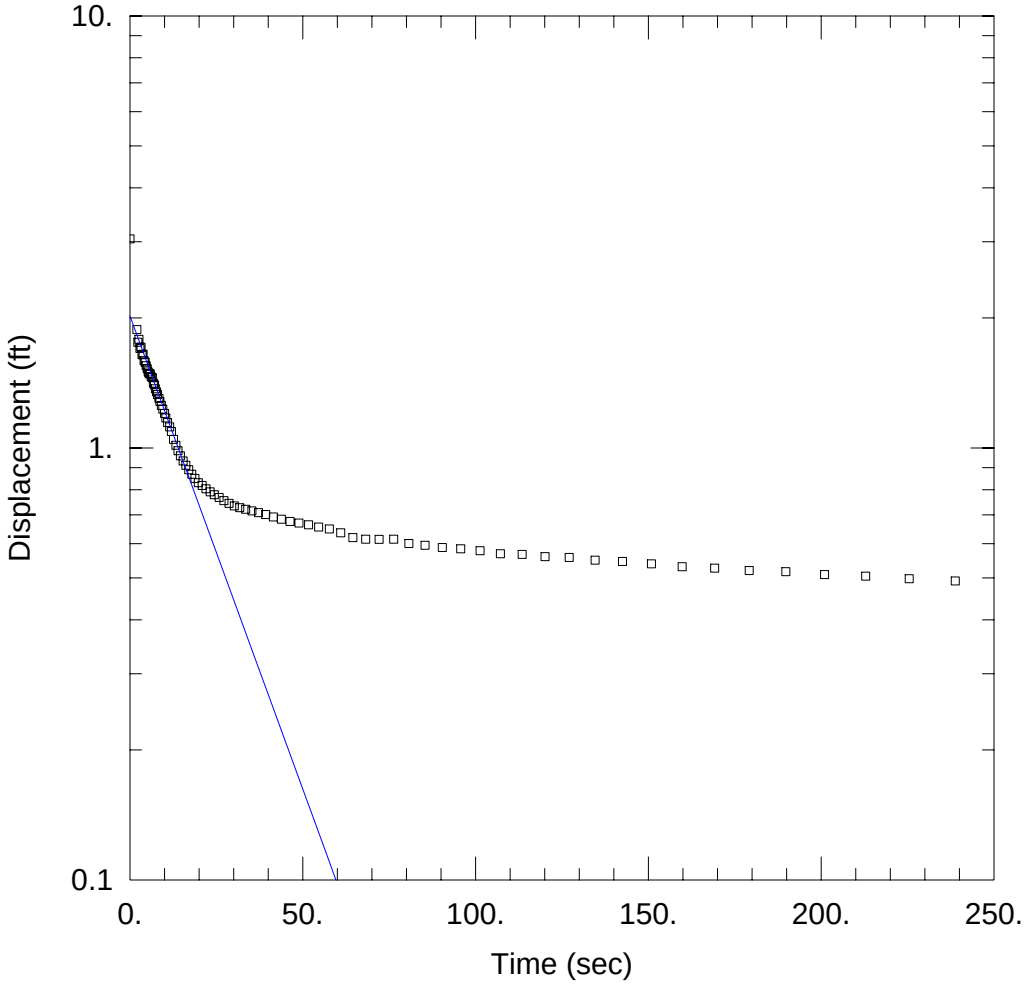
WELL DATA (OW-24#2)

Initial Displacement: 1.415 ft Static Water Column Height: 17.17 ft
Total Well Penetration Depth: 16.45 ft Screen Length: 15. ft
Casing Radius: 0.083 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.00596 ft/min y0 = 1.222 ft



OW-29#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-29#1.aqt
Date: 08/30/05 Time: 13:11:05

PROJECT INFORMATION

Test Well: OW-29#1
Test Date: 07/19/05

AQUIFER DATA

Saturated Thickness: 7.22 ft Anisotropy Ratio (Kz/Kr): 1.

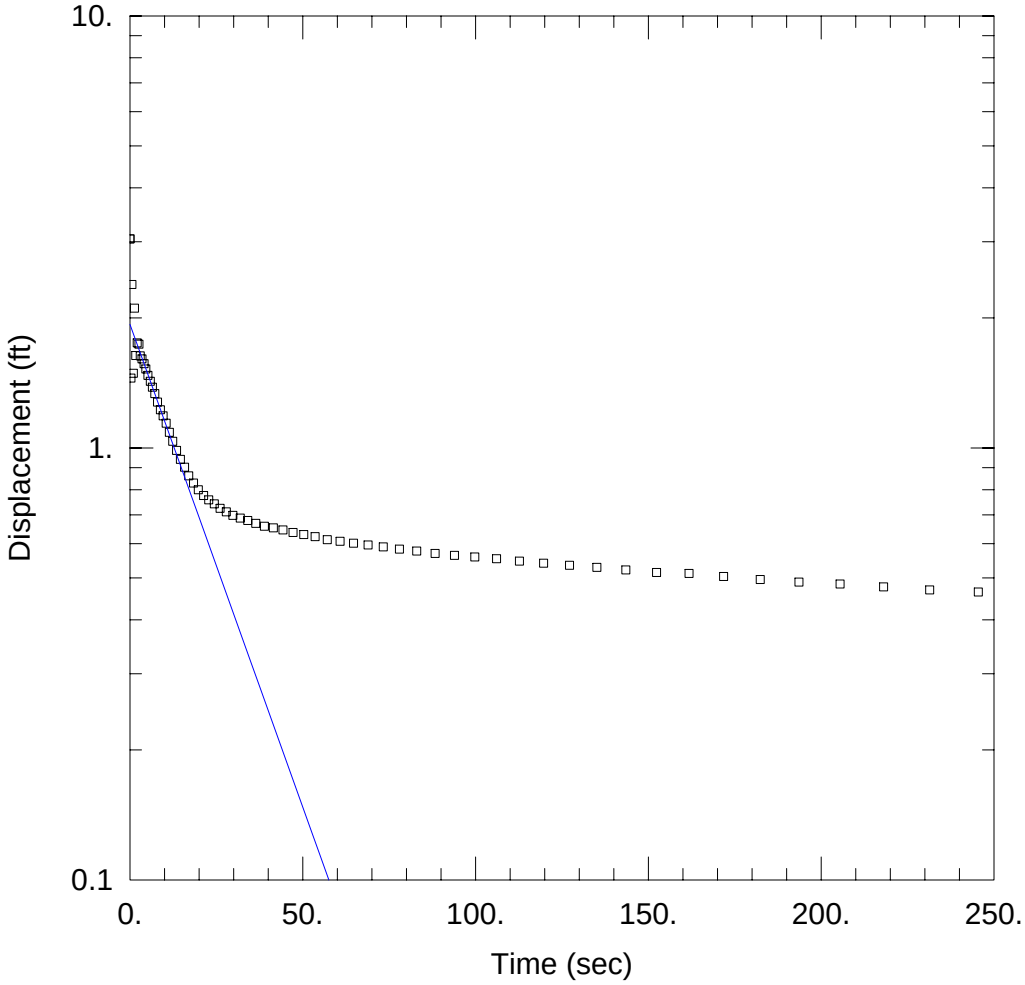
WELL DATA (OW-29#1)

Initial Displacement: 3.047 ft
Total Well Penetration Depth: 7.22 ft
Casing Radius: 0.086 ft
Static Water Column Height: 7.22 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01177 ft/min y0 = 2.02 ft



OW-29#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-29#2.aqt
Date: 08/30/05 Time: 13:12:42

PROJECT INFORMATION

Test Well: OW-29#2
Test Date: 07/19/05

AQUIFER DATA

Saturated Thickness: 7.11 ft
Anisotropy Ratio (Kz/Kr): 1.

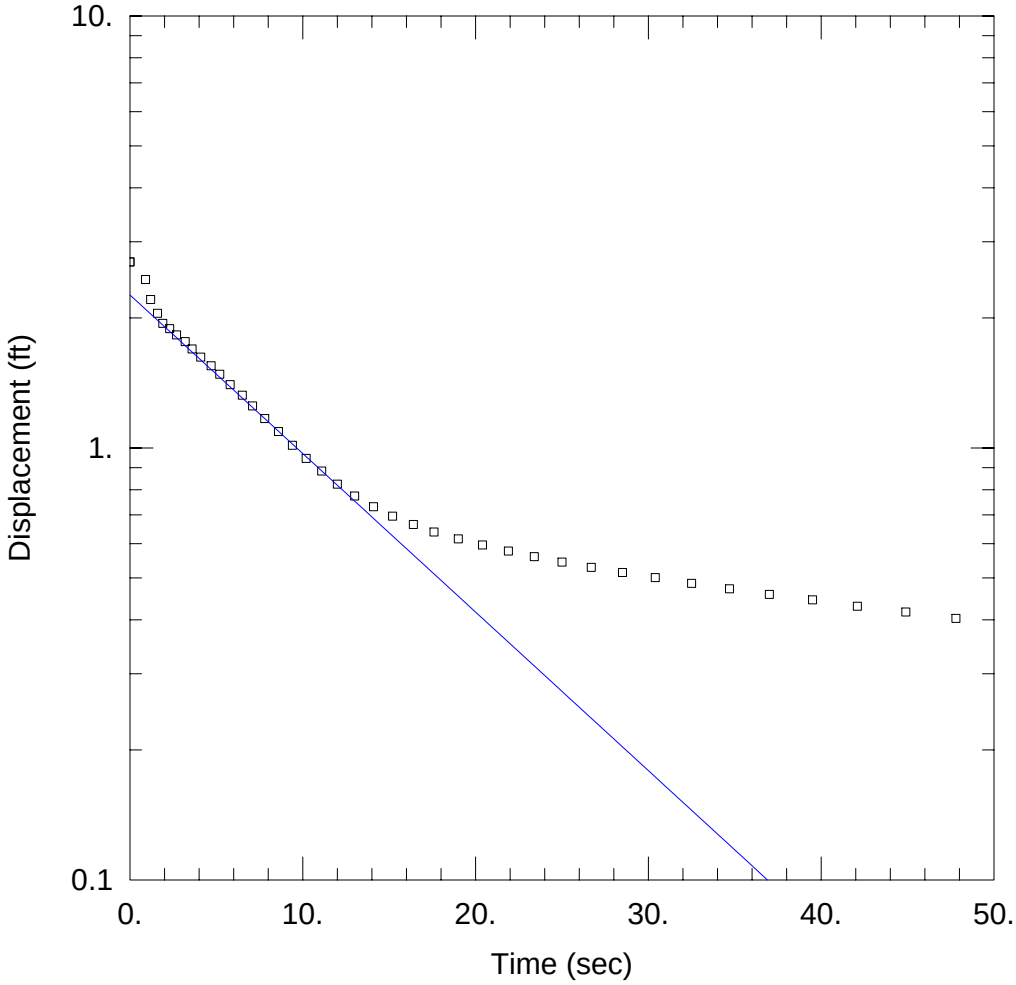
WELL DATA (OW-29#2)

Initial Displacement: 3.047 ft
Total Well Penetration Depth: 7.11 ft
Casing Radius: 0.086 ft
Static Water Column Height: 7.11 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01196 ft/min
y0 = 1.932 ft



OW-30#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-30#1.aqt
Date: 08/30/05 Time: 13:16:08

PROJECT INFORMATION

Test Well: OW-30#1
Test Date: 7/20/2005

AQUIFER DATA

Saturated Thickness: 6.457 ft Anisotropy Ratio (Kz/Kr): 1.

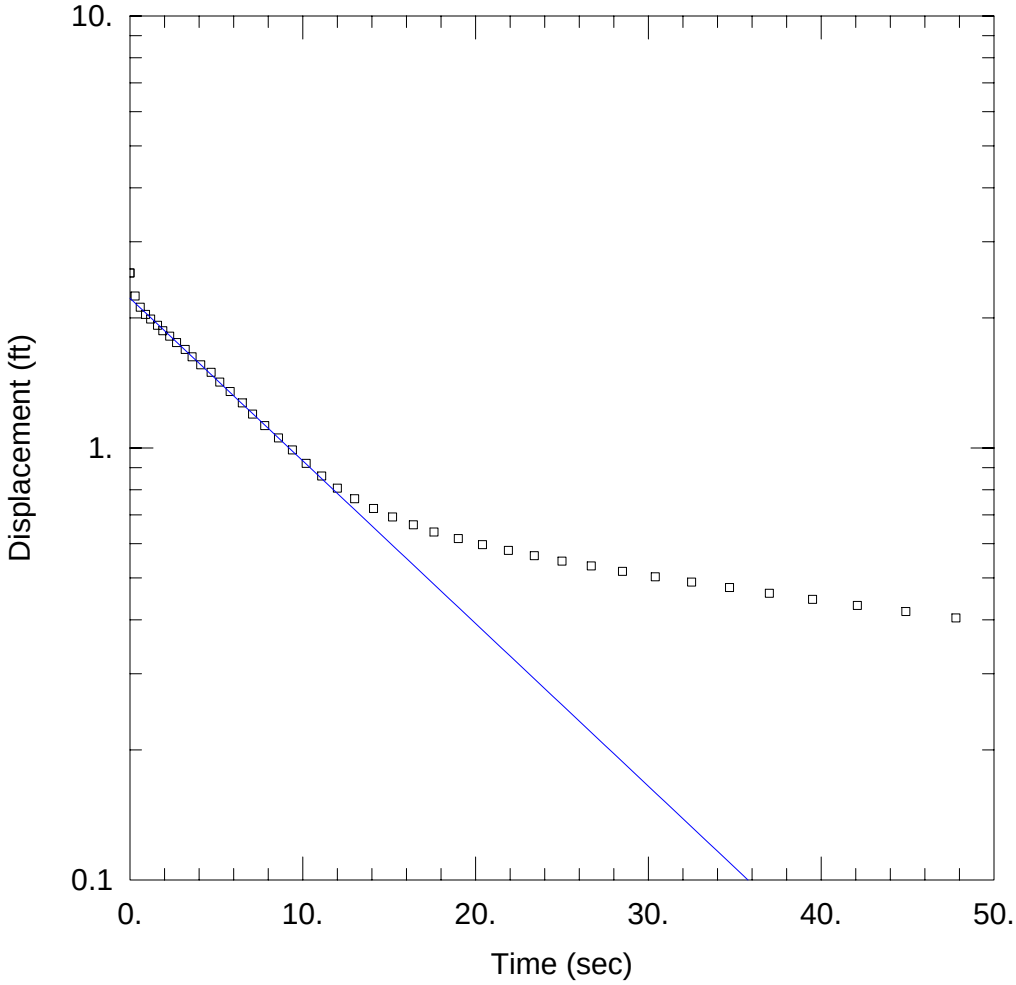
WELL DATA (OW-30#1)

Initial Displacement: 2.696 ft
Total Well Penetration Depth: 6.457 ft
Casing Radius: 0.086 ft
Static Water Column Height: 6.457 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01913 ft/min y0 = 2.259 ft



OW-30#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW30-#2.aqt
Date: 08/30/05 Time: 13:22:30

PROJECT INFORMATION

Test Well: OW-30#2
Test Date: 7/20/05

AQUIFER DATA

Saturated Thickness: 6.456 ft Anisotropy Ratio (Kz/Kr): 1.

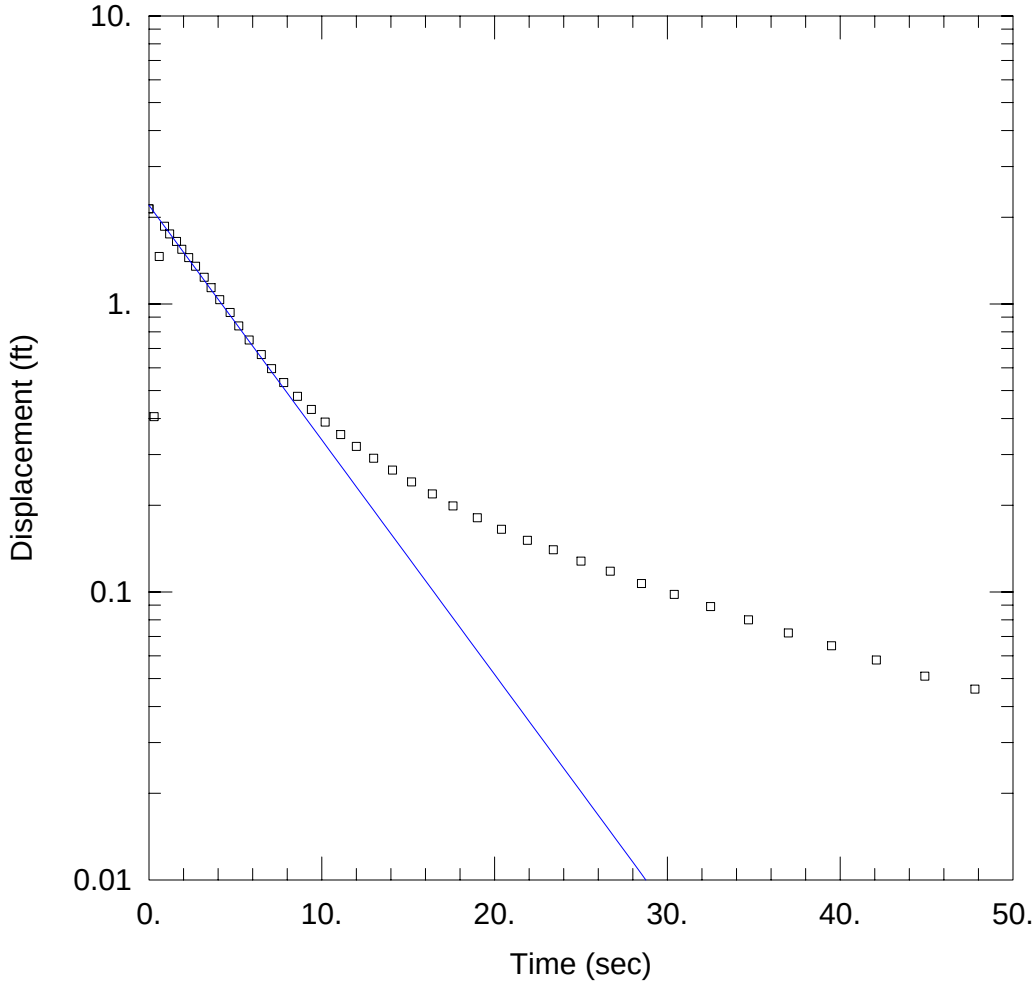
WELL DATA (OW-30#2)

Initial Displacement: 2.541 ft
Total Well Penetration Depth: 6.456 ft
Casing Radius: 0.086 ft
Static Water Column Height: 6.456 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01963 ft/min y0 = 2.221 ft



OW-31#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-31#1.aqt
Date: 08/30/05 Time: 13:28:44

PROJECT INFORMATION

Test Well: OW-31#1
Test Date: 07/20/05

AQUIFER DATA

Saturated Thickness: 7.363 ft Anisotropy Ratio (Kz/Kr): 1.

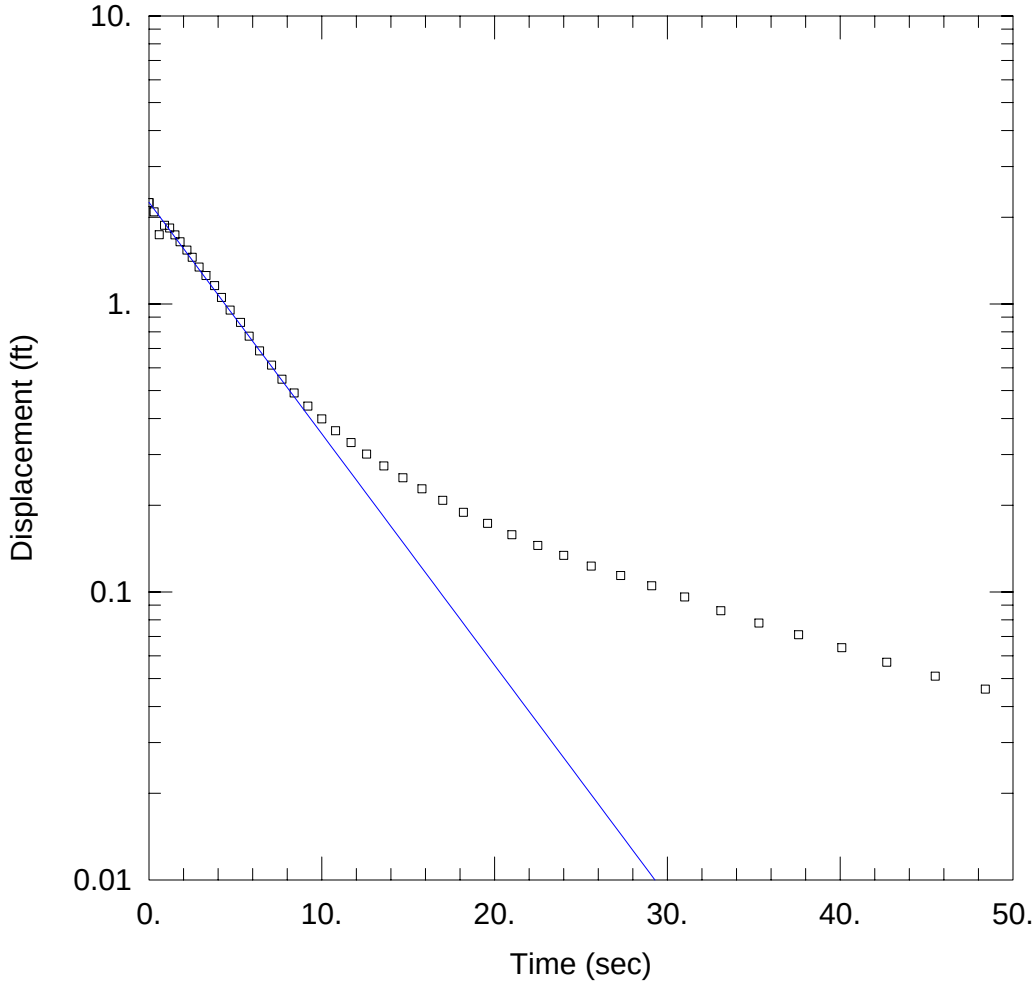
WELL DATA (OW-31#1)

Initial Displacement: 2.138 ft
Total Well Penetration Depth: 7.363 ft
Casing Radius: 0.086 ft
Static Water Column Height: 7.363 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.04399 ft/min y0 = 2.199 ft



OW-31#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-31#2.aqt
Date: 08/30/05 Time: 13:28:28

PROJECT INFORMATION

Test Well: OW-31#2
Test Date: 07/20/05

AQUIFER DATA

Saturated Thickness: 7.364 ft
Anisotropy Ratio (Kz/Kr): 1.

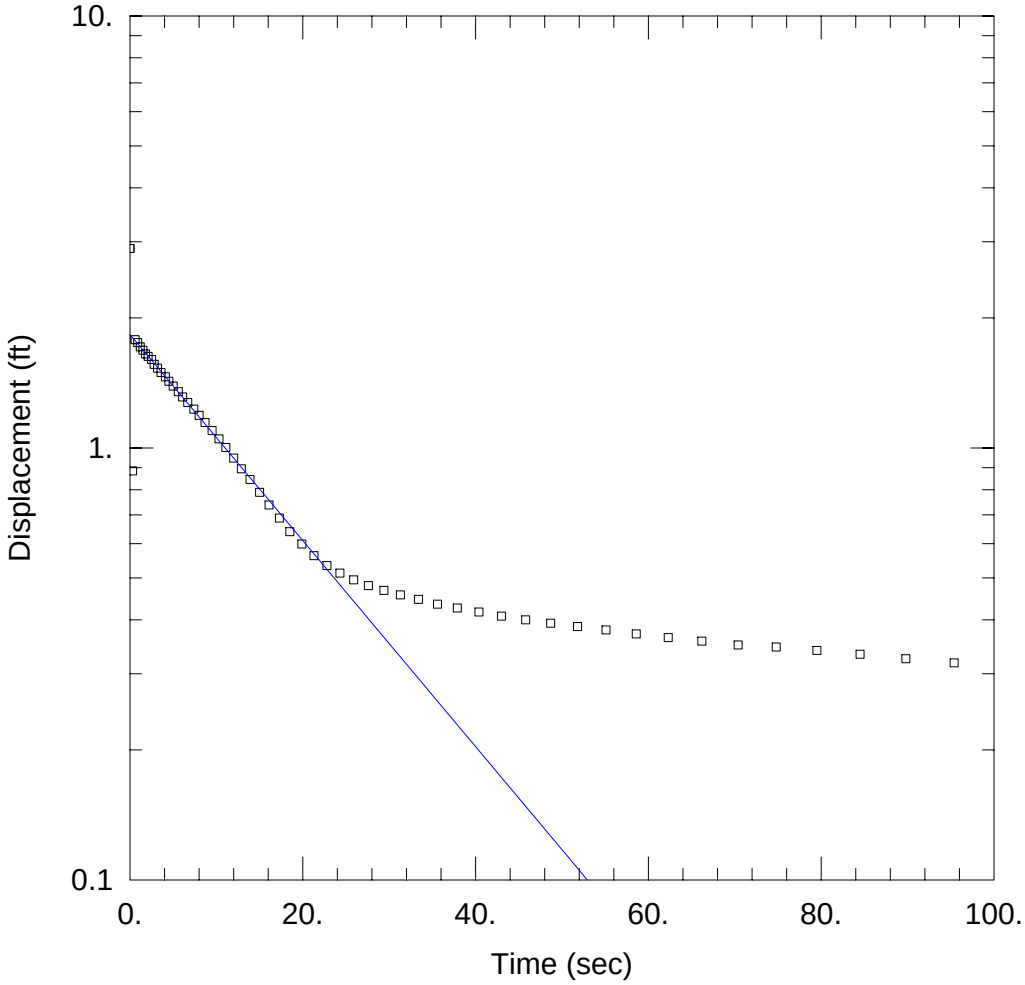
WELL DATA (OW-31#2)

Initial Displacement: 2.25 ft
Total Well Penetration Depth: 7.364 ft
Casing Radius: 0.086 ft
Static Water Column Height: 7.364 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.04341 ft/min
y0 = 2.252 ft



OW-32#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-32#1.aqt
Date: 08/30/05 Time: 13:38:46

PROJECT INFORMATION

Test Well: OW-32#1
Test Date: 07/20/05

AQUIFER DATA

Saturated Thickness: 5.951 ft Anisotropy Ratio (Kz/Kr): 1.

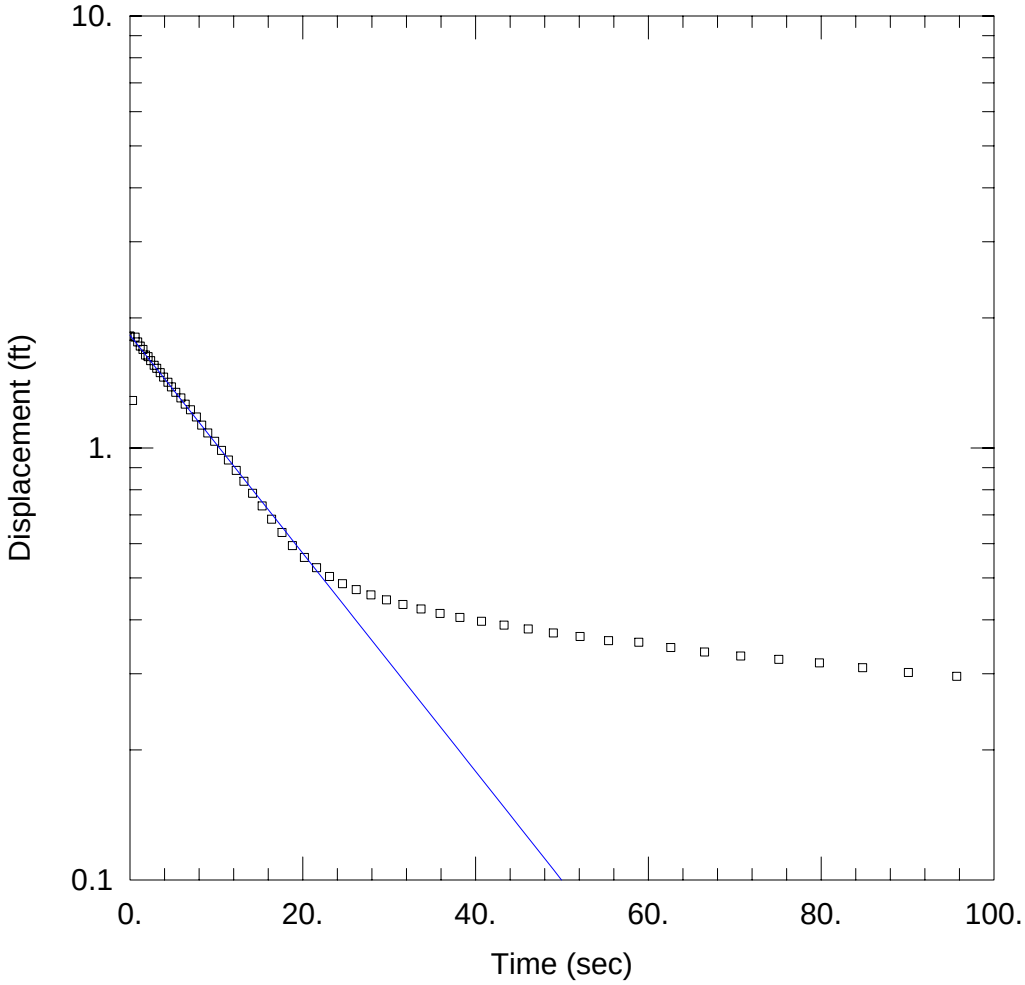
WELL DATA (OW-32#1)

Initial Displacement: 2.896 ft
Total Well Penetration Depth: 5.501 ft
Casing Radius: 0.086 ft
Static Water Column Height: 5.951 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01138 ft/min y0 = 1.83 ft



OW-32#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-32#2.aqt
Date: 08/30/05 Time: 13:39:26

PROJECT INFORMATION

Test Well: OW-32#2
Test Date: 7/20

AQUIFER DATA

Saturated Thickness: 5.95 ft Anisotropy Ratio (Kz/Kr): 1.

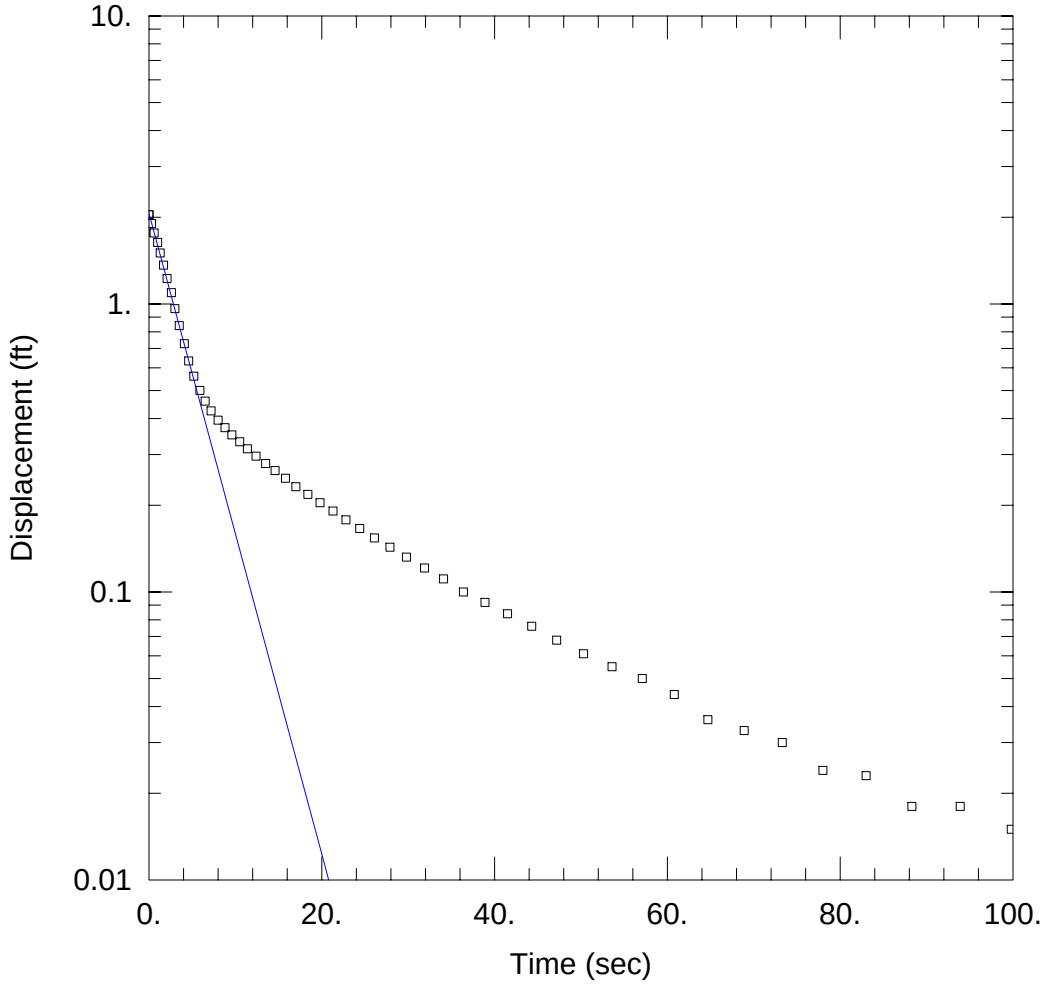
WELL DATA (OW-32#2)

Initial Displacement: 1.814 ft
Total Well Penetration Depth: 5.5 ft
Casing Radius: 0.086 ft
Static Water Column Height: 5.95 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01205 ft/min y0 = 1.824 ft



OW-33#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-33#1.aqt
Date: 08/30/05 Time: 13:40:06

PROJECT INFORMATION

Test Well: OW-33#1
Test Date: 07/20/05

AQUIFER DATA

Saturated Thickness: 8.49 ft Anisotropy Ratio (Kz/Kr): 1.

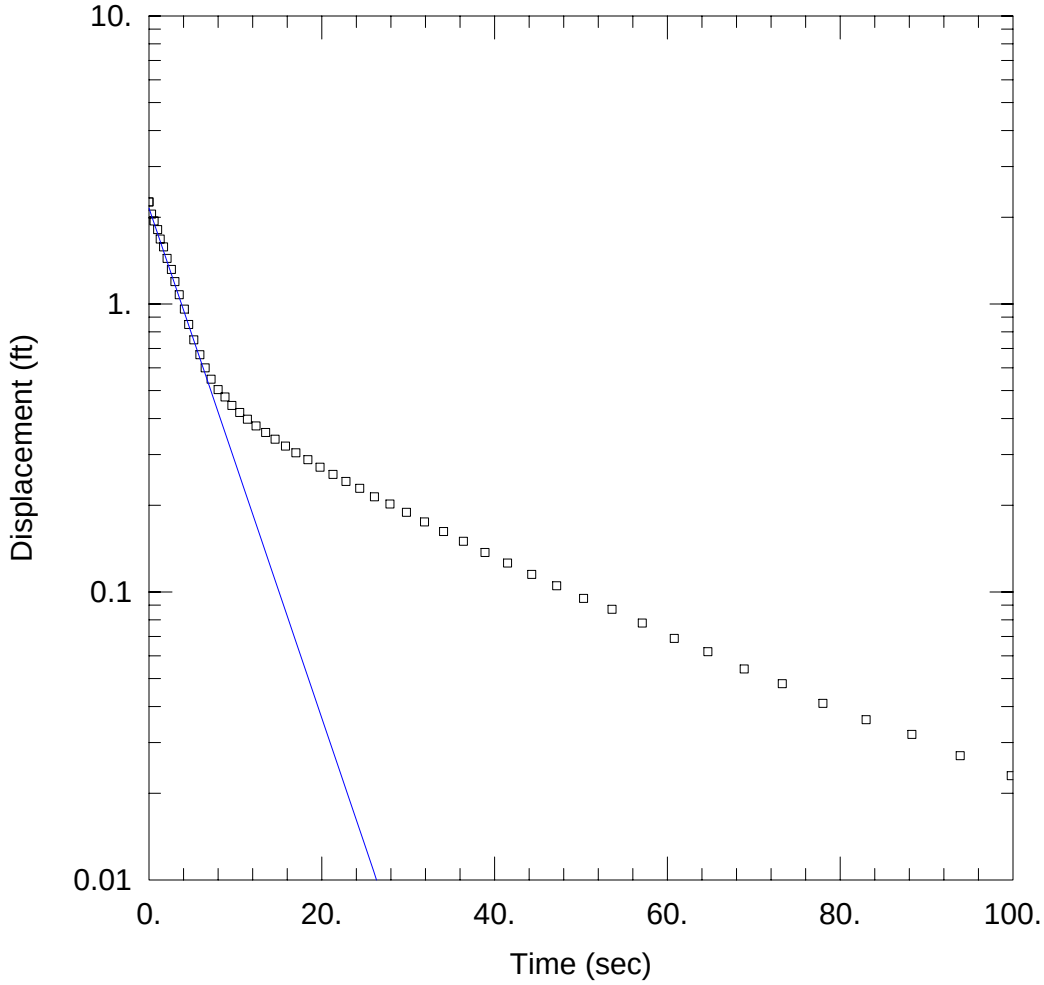
WELL DATA (OW-33#1)

Initial Displacement: 2.04 ft
Total Well Penetration Depth: 8.49 ft
Casing Radius: 0.086 ft
Static Water Column Height: 8.49 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.06231 ft/min y0 = 2.061 ft



OW-33#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-33#2.aqt
Date: 08/30/05 Time: 13:40:43

PROJECT INFORMATION

Test Well: OW-33#2
Test Date: 07/20/05

AQUIFER DATA

Saturated Thickness: 8.492 ft Anisotropy Ratio (Kz/Kr): 1.

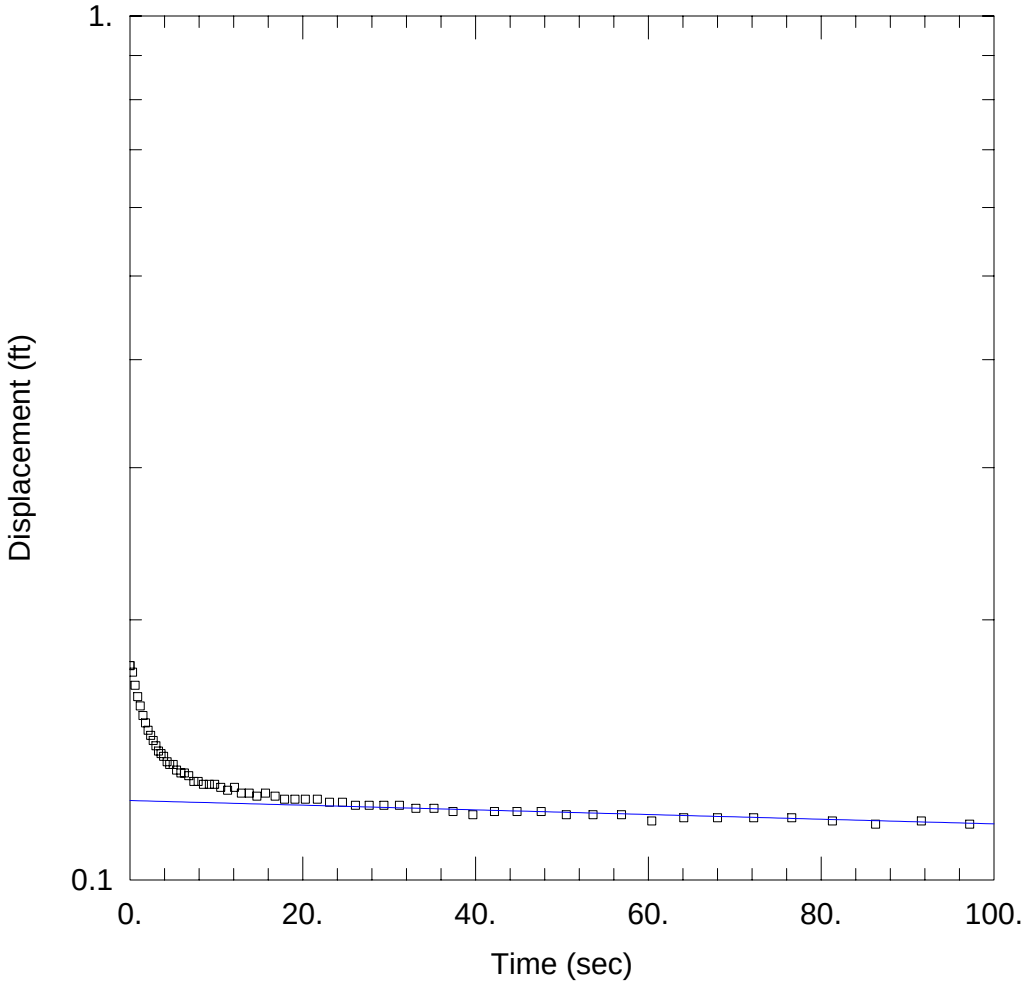
WELL DATA (OW-33#2)

Initial Displacement: 2.261 ft
Total Well Penetration Depth: 8.492 ft
Casing Radius: 0.086 ft
Static Water Column Height: 8.492 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0496 ft/min y0 = 2.15 ft



OW-39#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-39#1.aqt
Date: 08/30/05 Time: 13:50:23

PROJECT INFORMATION

Test Well: OW-39#1
Test Date: 07/27/05

AQUIFER DATA

Saturated Thickness: 0.736 ft Anisotropy Ratio (Kz/Kr): 1.

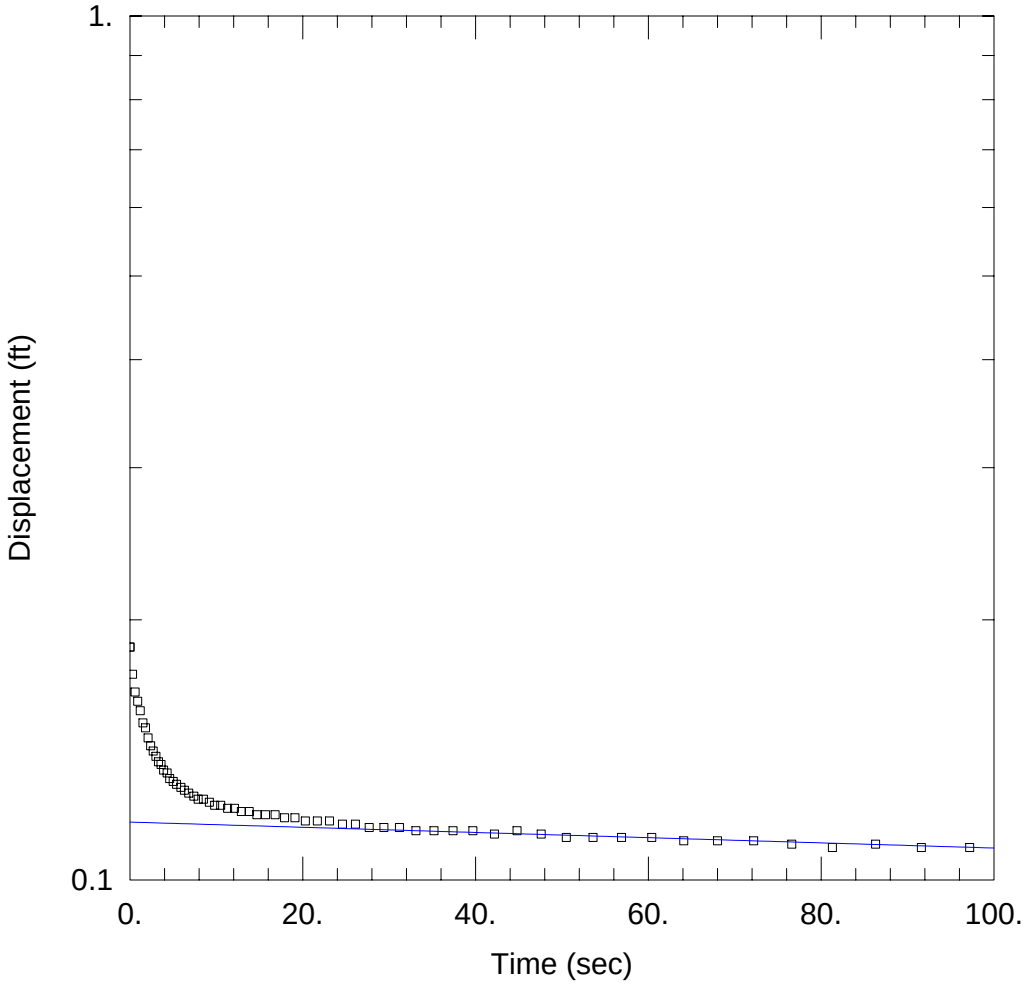
WELL DATA (OW-39#1)

Initial Displacement: 0.177 ft
Total Well Penetration Depth: 0.736 ft
Casing Radius: 0.083 ft
Static Water Column Height: 0.736 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 4.585E-5 ft/min y0 = 0.1236 ft



OW-39#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\OW-39#2.aqt
Date: 08/30/05 Time: 13:51:09

PROJECT INFORMATION

Test Well: OW-39#2
Test Date: 07/27/05

AQUIFER DATA

Saturated Thickness: 0.672 ft Anisotropy Ratio (Kz/Kr): 1.

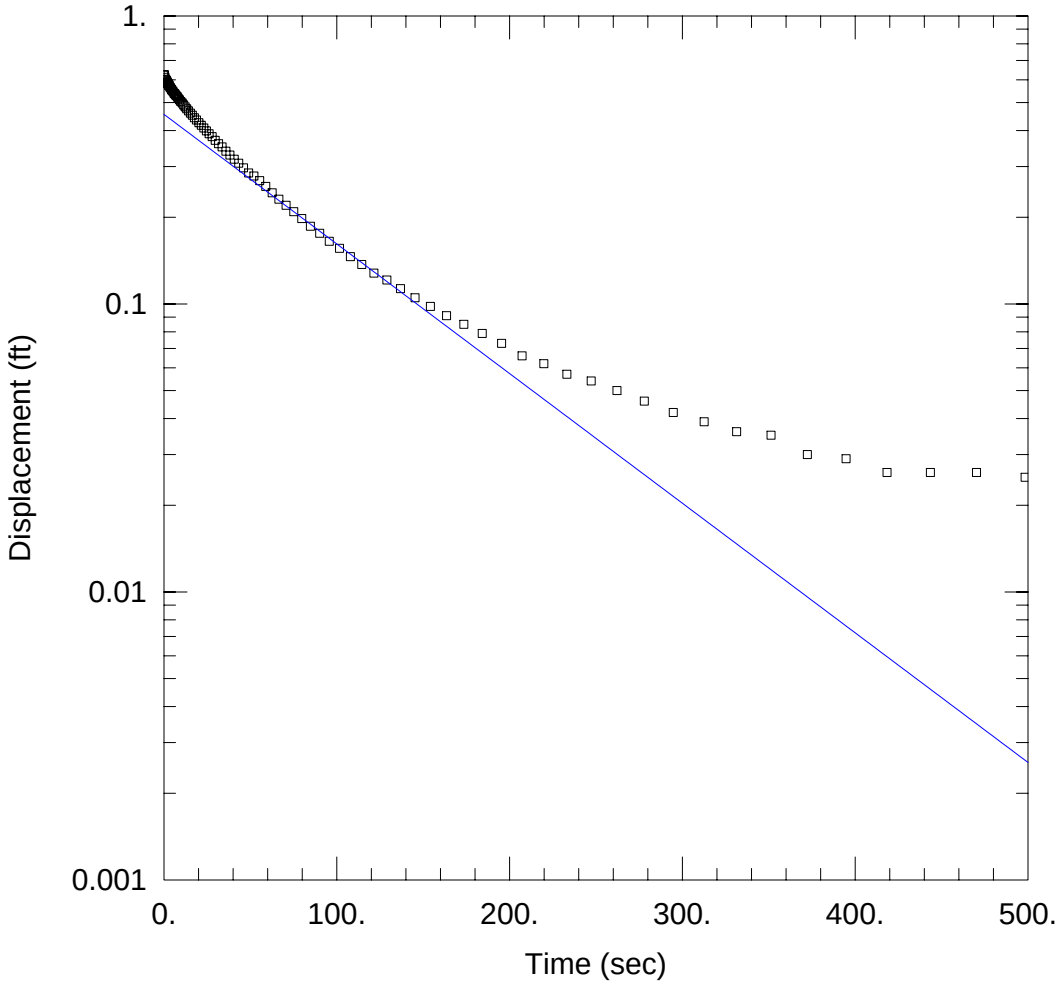
WELL DATA (OW-39#2)

Initial Displacement: 0.186 ft
Total Well Penetration Depth: 0.672 ft
Casing Radius: 0.083 ft
Static Water Column Height: 0.672 ft
Screen Length: 10. ft
Wellbore Radius: 0.297 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 4.606E-5 ft/min y0 = 0.1167 ft



W-01D#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-01D#1.aqt
Date: 08/30/05 Time: 16:55:45

PROJECT INFORMATION

Test Well: W-01D#1
Test Date: 7/22/05

AQUIFER DATA

Saturated Thickness: 38. ft Anisotropy Ratio (Kz/Kr): 1.

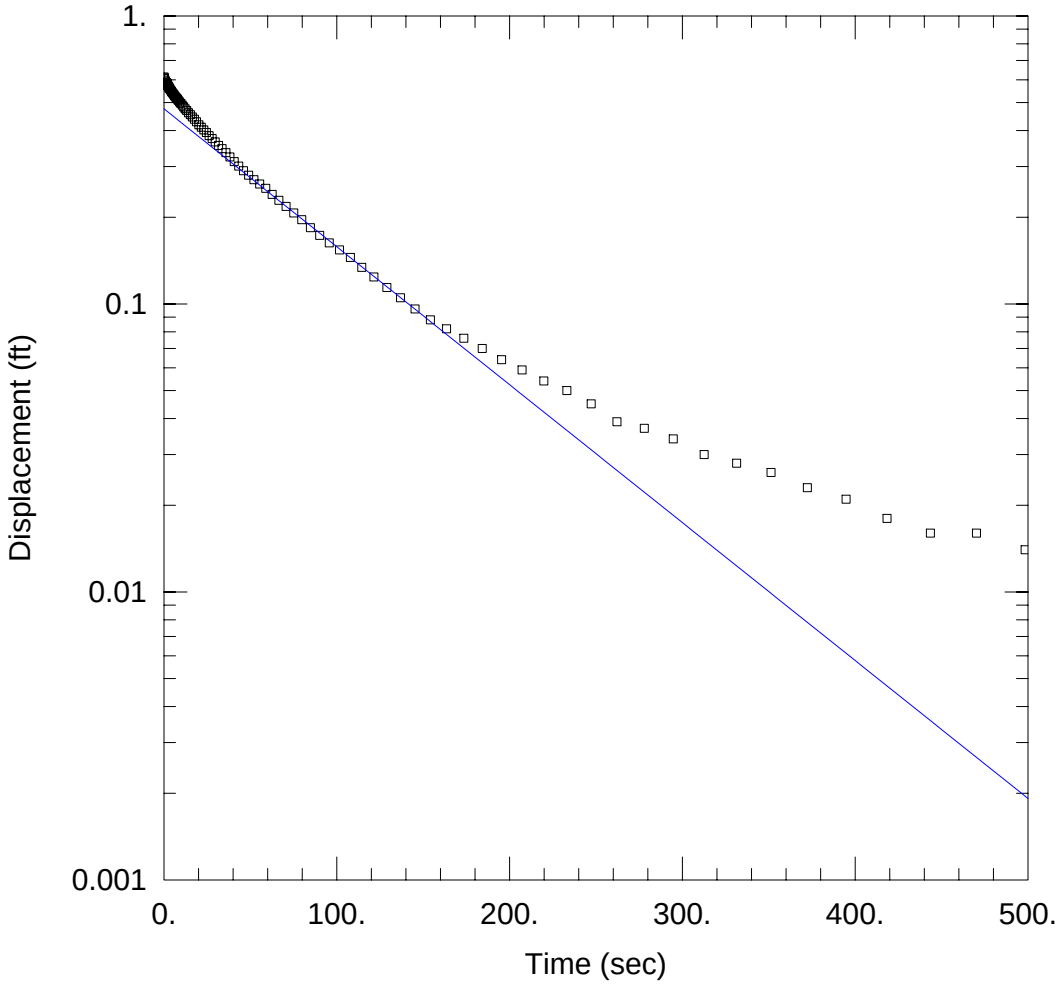
WELL DATA (W-01D#1)

Initial Displacement: 0.625 ft Static Water Column Height: 94.05 ft
Total Well Penetration Depth: 35. ft Screen Length: 20. ft
Casing Radius: 0.167 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.001388 ft/min y0 = 0.4553 ft



W-01D#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-01D#2.aqt
Date: 08/30/05 Time: 16:56:24

PROJECT INFORMATION

Test Well: W-01D#2
Test Date: 7/22/2005

AQUIFER DATA

Saturated Thickness: 38. ft Anisotropy Ratio (Kz/Kr): 1.

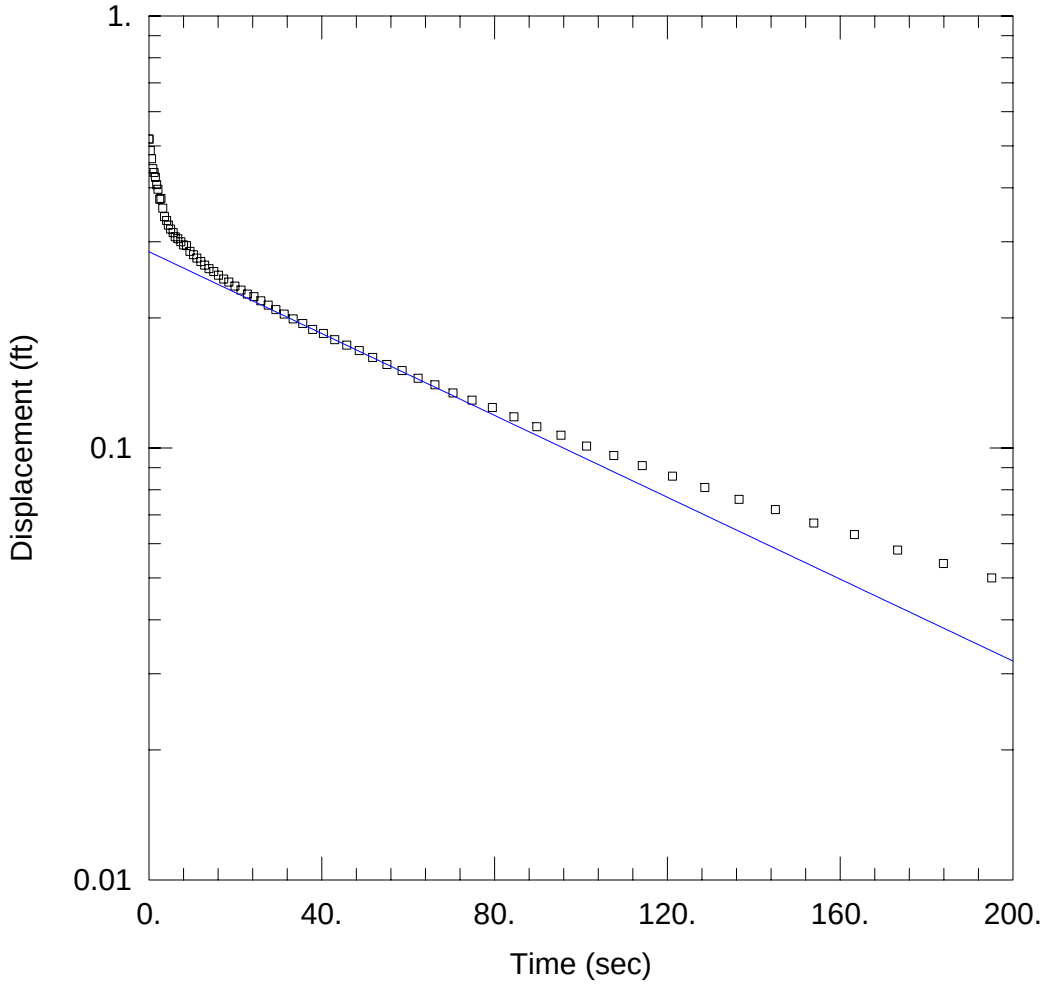
WELL DATA (W-01D#2)

Initial Displacement: 0.607 ft Static Water Column Height: 94.03 ft
Total Well Penetration Depth: 35. ft Screen Length: 20. ft
Casing Radius: 0.167 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.001477 ft/min y0 = 0.4756 ft



W-01S#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-01S#1.aqt
Date: 08/30/05 Time: 16:08:40

PROJECT INFORMATION

Test Well: W-01S#1
Test Date: 7/21/2005

AQUIFER DATA

Saturated Thickness: 6.623 ft Anisotropy Ratio (Kz/Kr): 1.

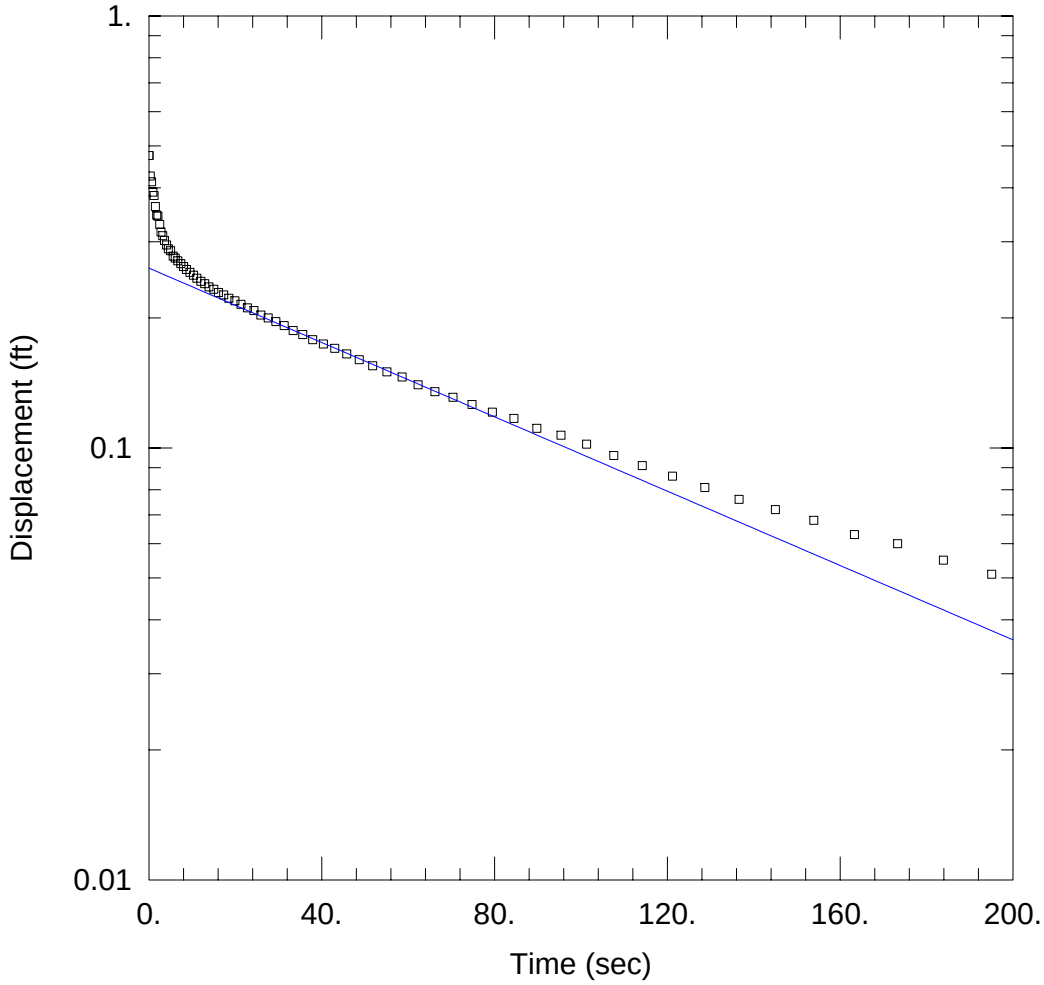
WELL DATA (W-01S#1)

Initial Displacement: 0.519 ft
Total Well Penetration Depth: 6.543 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.623 ft
Screen Length: 8. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.004755 ft/min y0 = 0.2846 ft



W-01S#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-01S#2.aqt
Date: 08/30/05 Time: 16:08:19

PROJECT INFORMATION

Test Well: W-01S#2
Test Date: 7/21/2005

AQUIFER DATA

Saturated Thickness: 6.608 ft Anisotropy Ratio (Kz/Kr): 1.

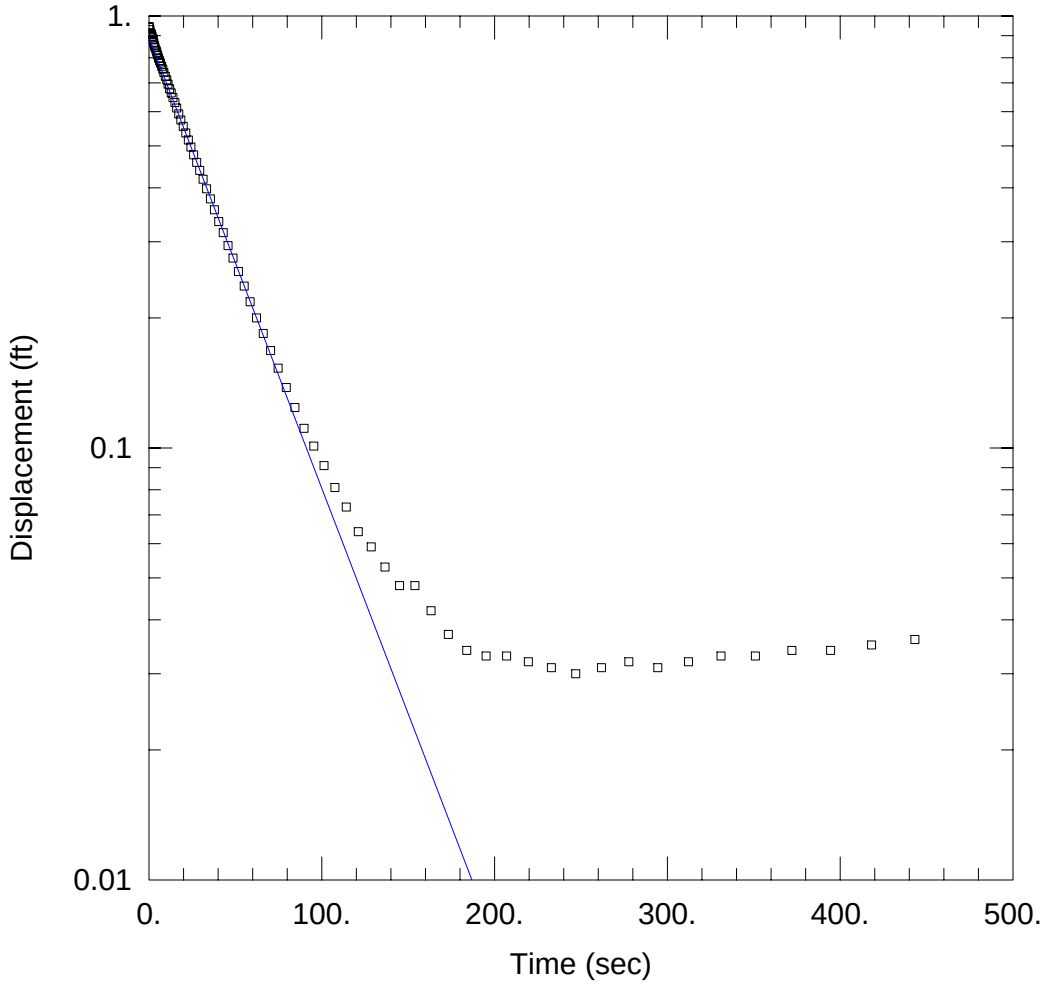
WELL DATA (W-01S#2)

Initial Displacement: 0.475 ft
Total Well Penetration Depth: 6.528 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.608 ft
Screen Length: 8. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.004315 ft/min y0 = 0.2606 ft



W-15D#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-15D#1.aqt
Date: 08/30/05 Time: 16:12:55

PROJECT INFORMATION

Test Well: W-15D#1
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 39. ft Anisotropy Ratio (Kz/Kr): 1.

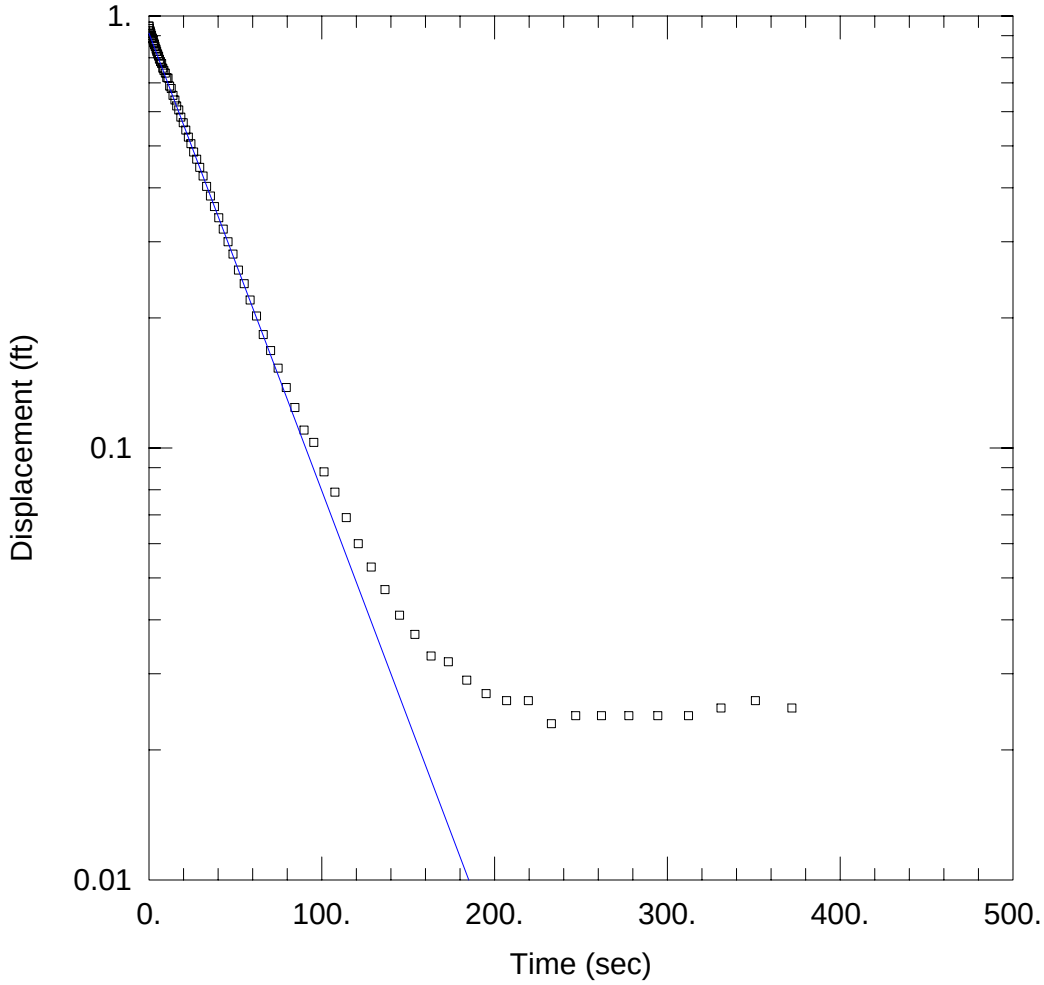
WELL DATA (W-15D#1)

Initial Displacement: 0.944 ft
Total Well Penetration Depth: 49.8 ft
Casing Radius: 0.167 ft
Static Water Column Height: 100.6 ft
Screen Length: 20. ft
Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.003731 ft/min
y0 = 0.8918 ft



W-15D#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-15D#2.aqt
Date: 08/30/05 Time: 16:13:42

PROJECT INFORMATION

Test Well: W-15D#2
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 39. ft Anisotropy Ratio (Kz/Kr): 1.

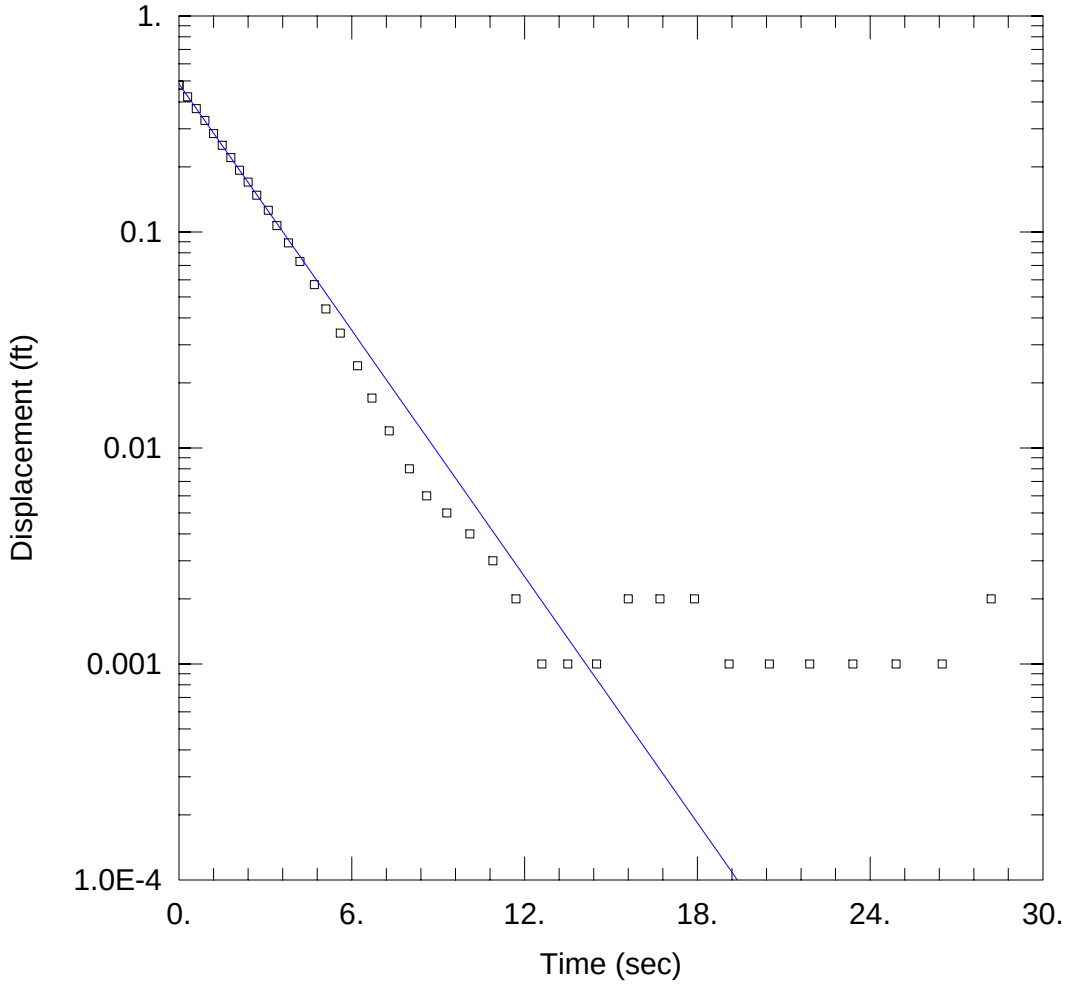
WELL DATA (W-15D#2)

Initial Displacement: 0.947 ft
Total Well Penetration Depth: 49.8 ft
Casing Radius: 0.167 ft
Static Water Column Height: 100.5 ft
Screen Length: 20. ft
Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.003786 ft/min
y0 = 0.9117 ft



W-15S#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-15S#1.aqt
Date: 08/30/05 Time: 17:02:54

PROJECT INFORMATION

Test Well: W-15S#1
Test Date: 07/25/05

AQUIFER DATA

Saturated Thickness: 5.383 ft Anisotropy Ratio (Kz/Kr): 1.

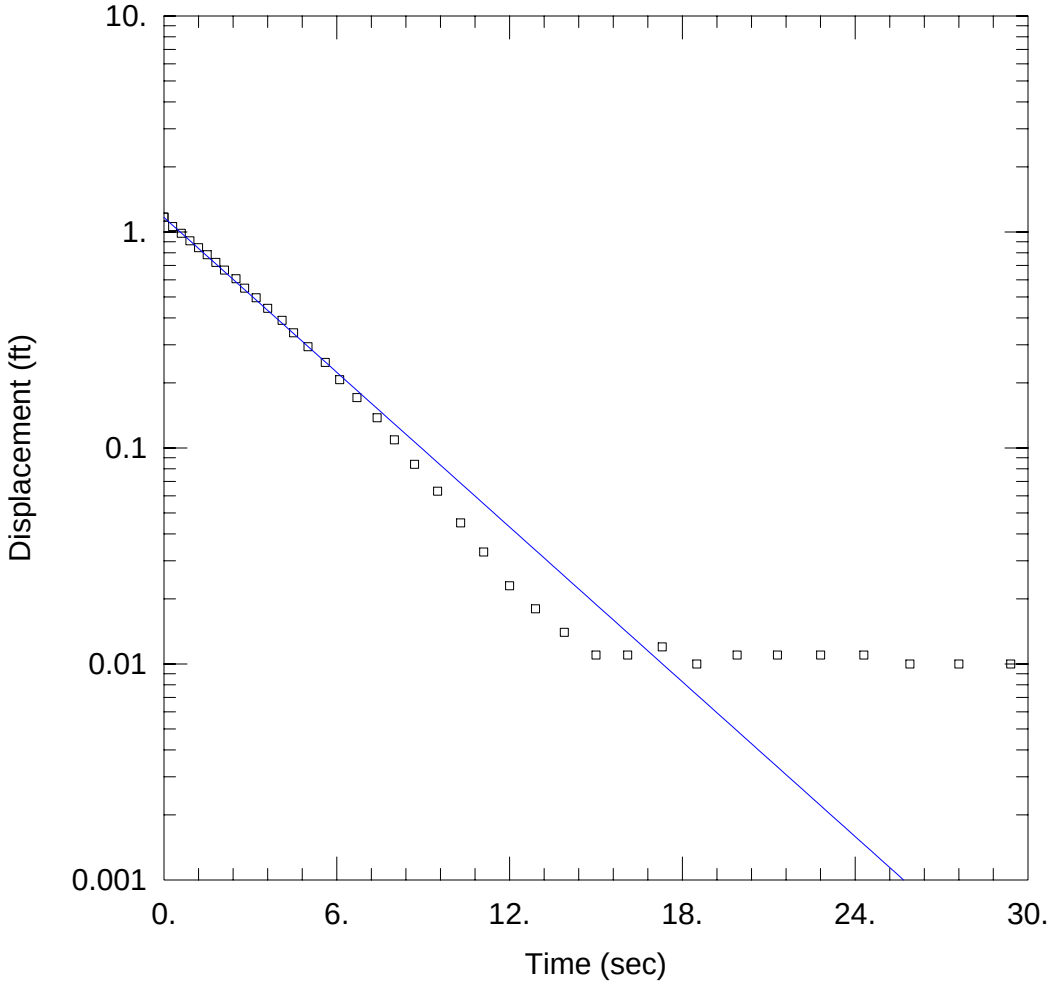
WELL DATA (W-15S#1)

Initial Displacement: 0.478 ft
Total Well Penetration Depth: 5.383 ft
Casing Radius: 0.167 ft
Static Water Column Height: 5.383 ft
Screen Length: 10. ft
Wellbore Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.1504 ft/min y0 = 0.4849 ft



W-15S#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-15S#2.aqt
Date: 08/30/05 Time: 16:23:03

PROJECT INFORMATION

Test Well: W-15S#2
Test Date: W-15S#2

AQUIFER DATA

Saturated Thickness: 5.39 ft
Anisotropy Ratio (Kz/Kr): 1.

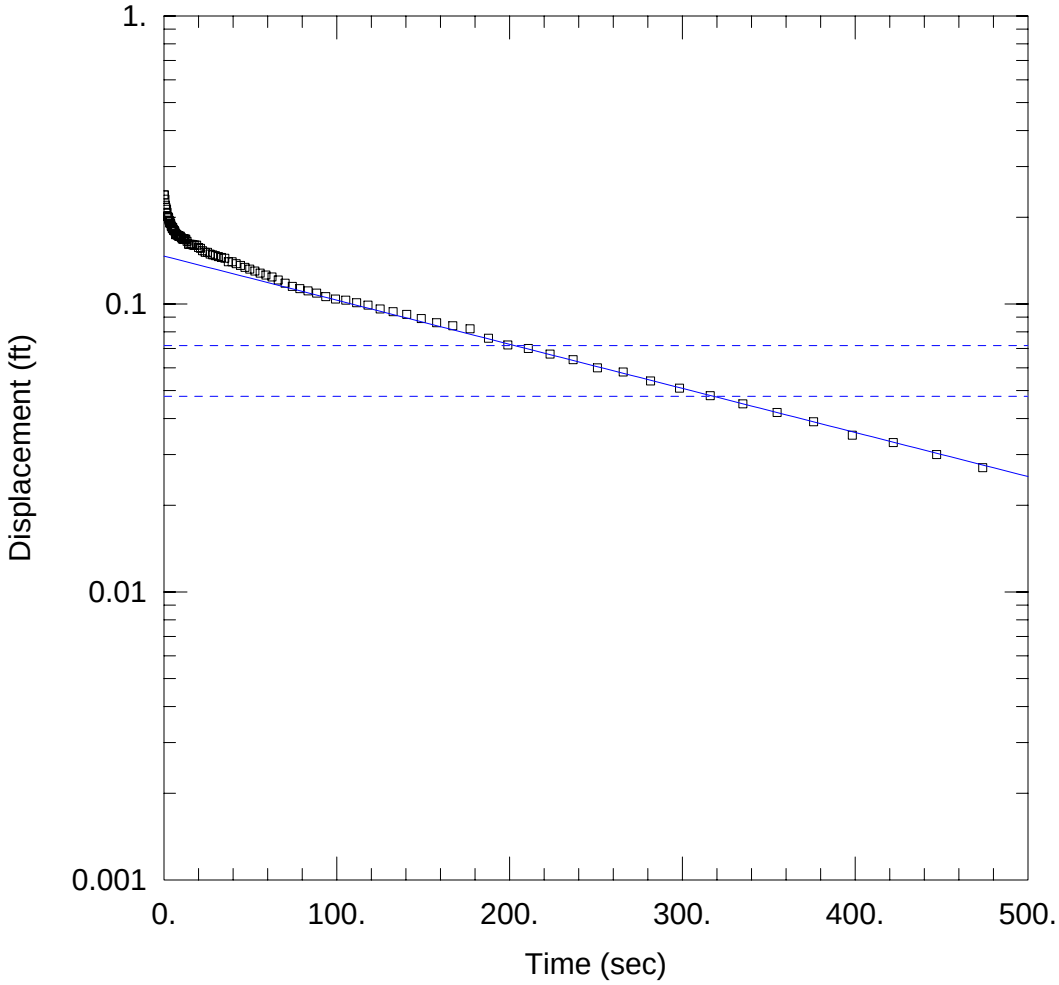
WELL DATA (W-15S#2)

Initial Displacement: 1.17 ft
Total Well Penetration Depth: 5.39 ft
Casing Radius: 0.167 ft
Static Water Column Height: 5.39 ft
Screen Length: 10. ft
Wellbore Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.09453 ft/min
y0 = 1.166 ft



W-22#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-22#1.aqt
Date: 08/30/05 Time: 16:29:31

PROJECT INFORMATION

Test Well: W-22#1
Test Date: 7/19/2005

AQUIFER DATA

Saturated Thickness: 1.72 ft
Anisotropy Ratio (Kz/Kr): 1.

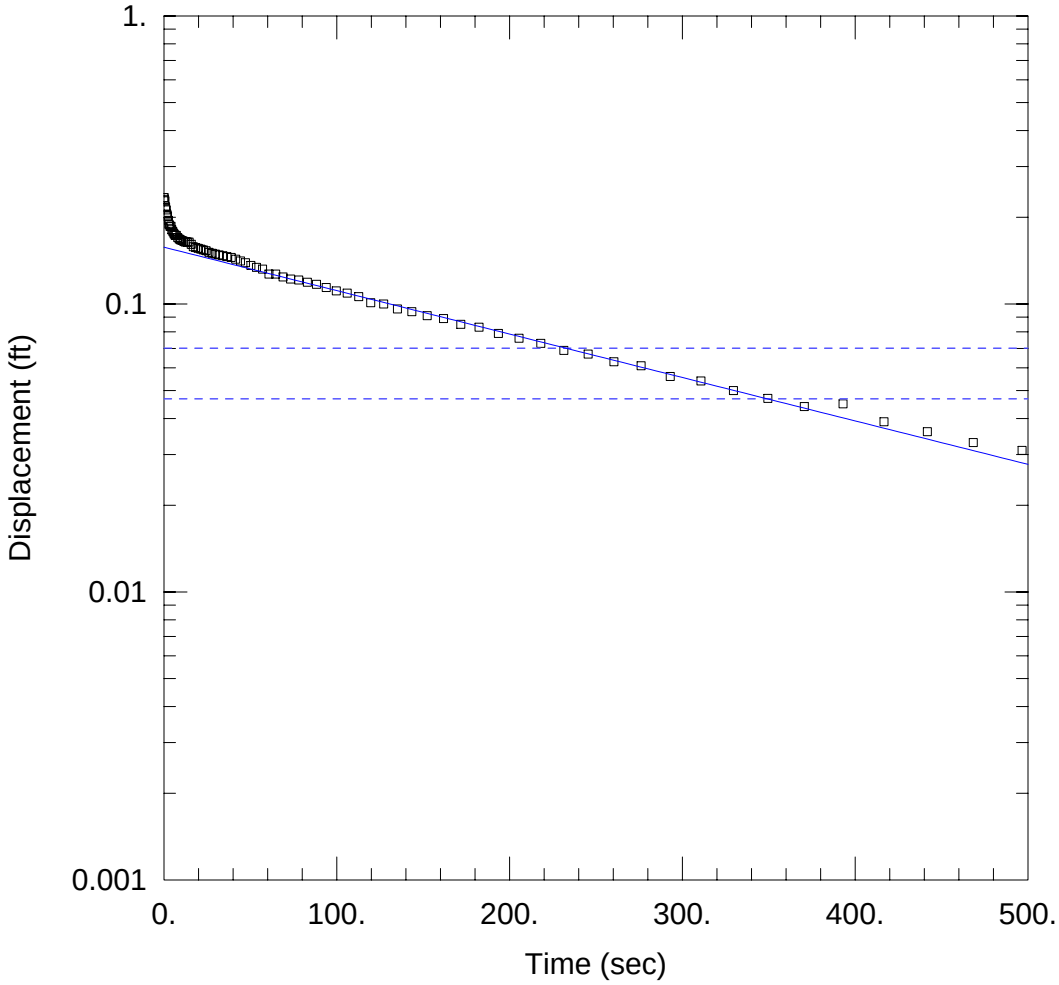
WELL DATA (W-22#1)

Initial Displacement: 0.239 ft
Total Well Penetration Depth: 1.17 ft
Casing Radius: 0.167 ft
Static Water Column Height: 1.72 ft
Screen Length: 10. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0005709 ft/min
y0 = 0.1466 ft



W-22#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-22#2.aqt
Date: 08/30/05 Time: 16:28:55

PROJECT INFORMATION

Test Well: W-22#2
Test Date: 7/19/2005

AQUIFER DATA

Saturated Thickness: 1.728 ft Anisotropy Ratio (Kz/Kr): 1.

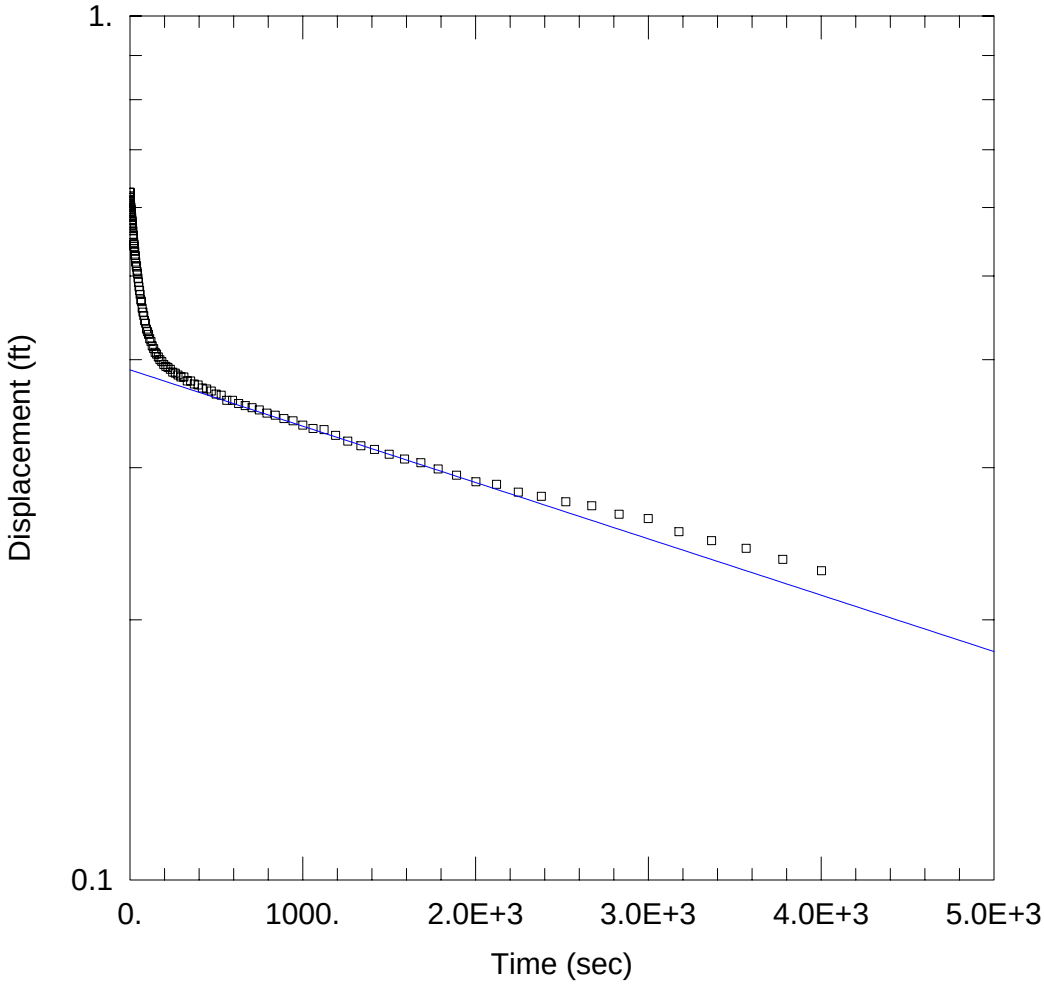
WELL DATA (W-22#2)

Initial Displacement: 0.234 ft
Total Well Penetration Depth: 1.178 ft
Casing Radius: 0.167 ft
Static Water Column Height: 1.728 ft
Screen Length: 10. ft
Wellbore Radius: 0.323 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0005651 ft/min y0 = 0.1574 ft



W-29D#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-29D#1.aqt
Date: 08/30/05 Time: 16:54:26

PROJECT INFORMATION

Test Well: W-29D#1
Test Date: 07/26/05

AQUIFER DATA

Saturated Thickness: 40.5 ft Anisotropy Ratio (Kz/Kr): 1.

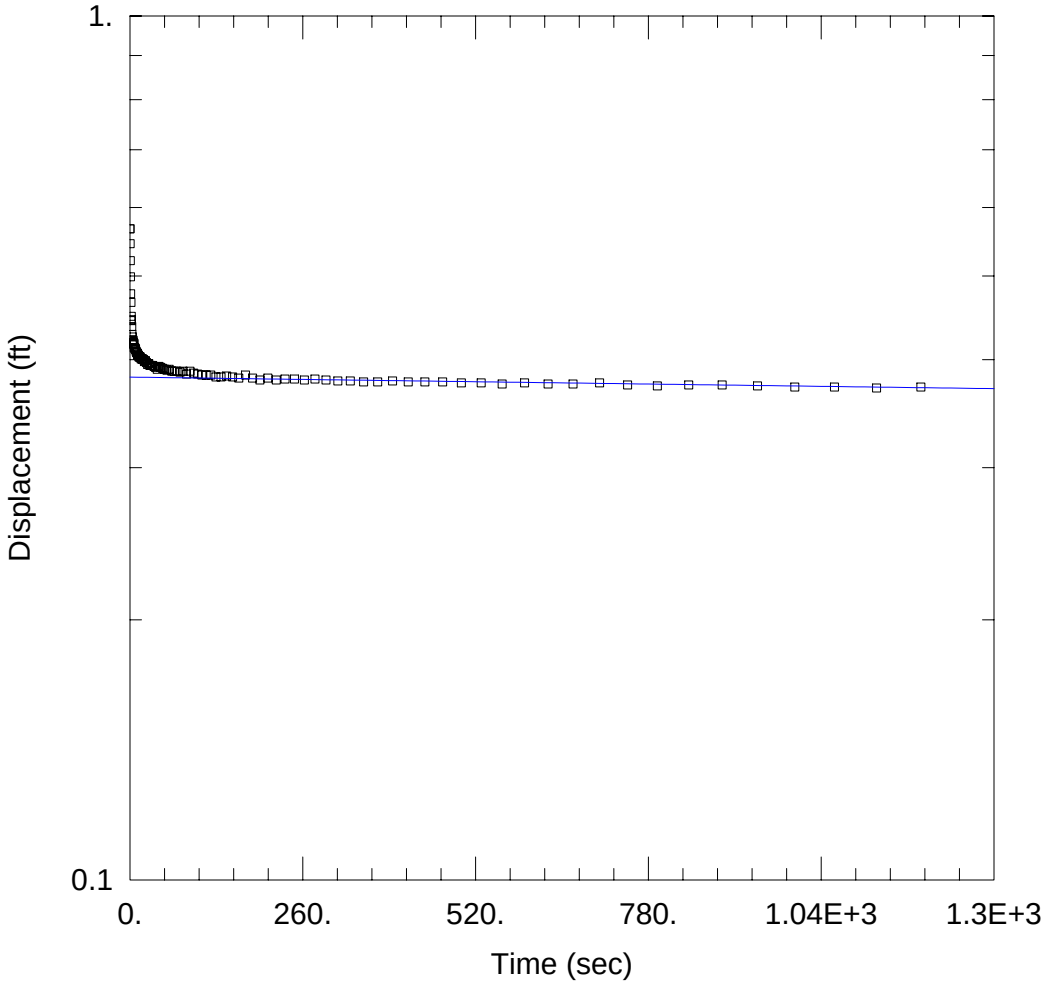
WELL DATA (W-29D#1)

Initial Displacement: 0.625 ft
Total Well Penetration Depth: 42.8 ft
Casing Radius: 0.167 ft
Static Water Column Height: 60.95 ft
Screen Length: 20. ft
Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 2.273E-5 ft/min
y0 = 0.3894 ft



W-29S#1

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-29S#1.aqt
Date: 08/30/05 Time: 16:51:17

PROJECT INFORMATION

Test Well: W-29S#1
Test Date: 07/26/05

AQUIFER DATA

Saturated Thickness: 8.432 ft Anisotropy Ratio (Kz/Kr): 1.

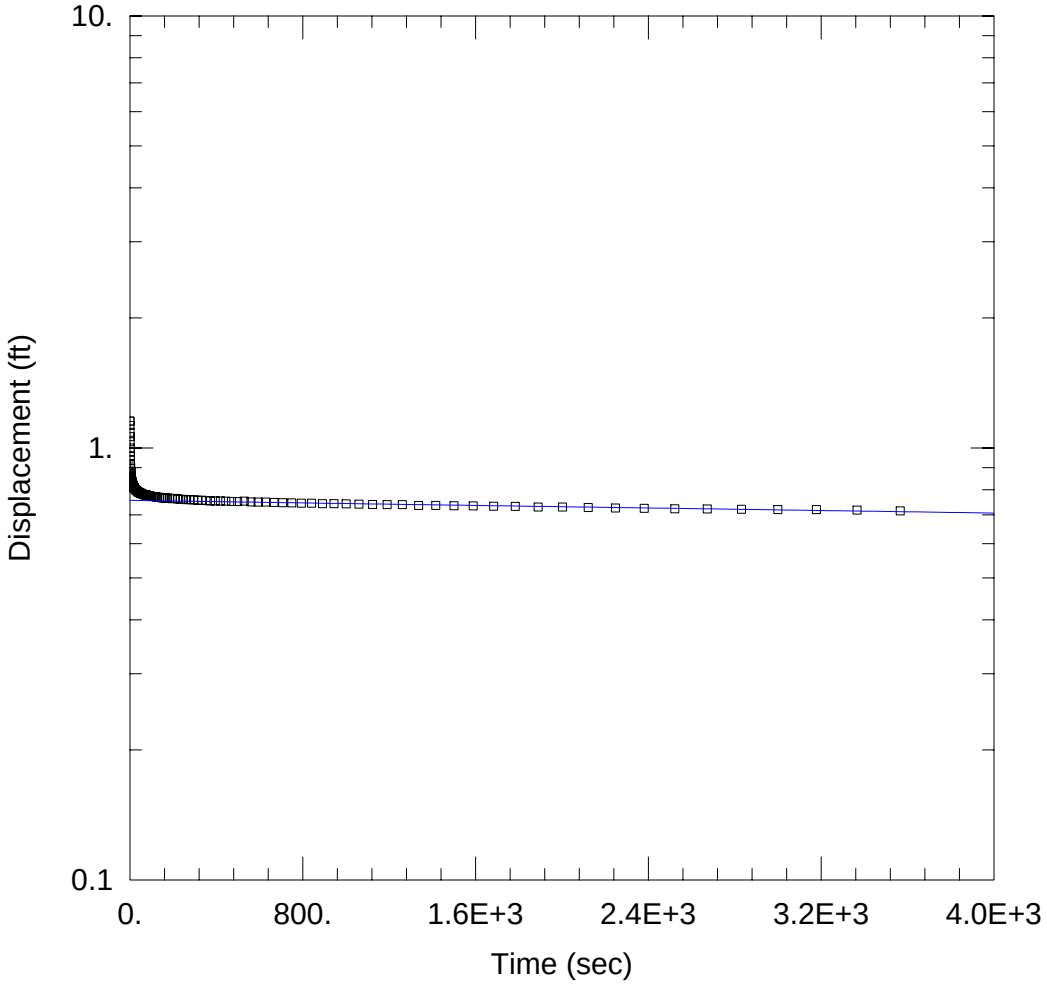
WELL DATA (W-29S#1)

Initial Displacement: 0.567 ft
Total Well Penetration Depth: 8.432 ft
Casing Radius: 0.167 ft
Static Water Column Height: 8.432 ft
Screen Length: 7.5 ft
Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 6.311E-6 ft/min
y0 = 0.3819 ft



W-29S#2

Data Set: J:\Ryan Hultgren\EPC\1004317 El Dorado Refinery\Slug Tests\Aqtesolv\W-29S#2.aqt
Date: 08/30/05 Time: 16:51:36

PROJECT INFORMATION

Test Well: W-29S#2
Test Date: 07/26/05

AQUIFER DATA

Saturated Thickness: 8.152 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-29S#2)

Initial Displacement: 1.154 ft Static Water Column Height: 8.152 ft
Total Well Penetration Depth: 8.152 ft Screen Length: 7.5 ft
Casing Radius: 0.167 ft Wellbore Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 4.473E-6 ft/min y0 = 0.7561 ft

GSI

April 15, 2005

Ms. Leah Wolf-Martin
MWH Americas, Inc.
1110 Elton Drive, Ste. B
Colorado Springs, CO 80907-3555

Subject: Laboratory Test Reports
El Dorado Refinery
El Dorado, Kansas
GSI Project No. 057094

Dear Ms. Wolf-Martin:

Enclosed please find laboratory test reports for the referenced project.

Please contact our office should you have any questions on the enclosed, or if we may be of service.

Respectfully submitted,
Geotechnical Services, Inc.

Vance R. Silvers, P.G.
Materials Testing Manager

David A. Edwards, P.E.
Principal Engineer / Vice President

VRS/DAE/ ss

Enclosure

G:\JOBS\Wichita\057\057094\Cover Letter.doc

www.gsinetwork.com
4503 East 47th Street South ◆ Wichita, KS 67210-1651 ◆ (316) 554-0725 ◆ FAX (316) 554-0744

AUG-26-2005 FRI 08:43 AM MWH FAX NO. 8016174200 P. 02

Boring No.	Sample No.	Sample Depth (ft.)	Sample Type	Sample Diameter (in.)	Sample Length (in.)	Moisture Content (%)	Wet Unit Weight (lb/ft³)	Dry Unit Weight (lb/ft³)	Unconfined Compressive Strength (kips/ft²)	Atterberg Limits Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Specific Gravity	USCS Soil Classification
OW-03	7 - 9		ST			26.7	122.8	96.9	1.32	36	19	17	97.4	2.72	CL
	14 - 16		ST			18.5	131.6	111.0		31	19	12	35.3	2.70	GC
OW-31	3 - 5		ST			27.6	118.6	93.2	0.84	39	22	17	93.9	2.72	CL
	8 - 10		ST			24.8	125.7	100.9	2.67	39	21	18	93.3	2.71	CL
OW-33	7 - 9		ST			29.3	114.0	88.2		36	18	18	88.6	2.71	CL
	13 - 15		ST			27.8	125.4	98.2	0.12	36	21	15	70.8	2.72	CL

GSI Geotechnical Services, Inc.

SUMMARY OF LABORATORY TEST RESULTS

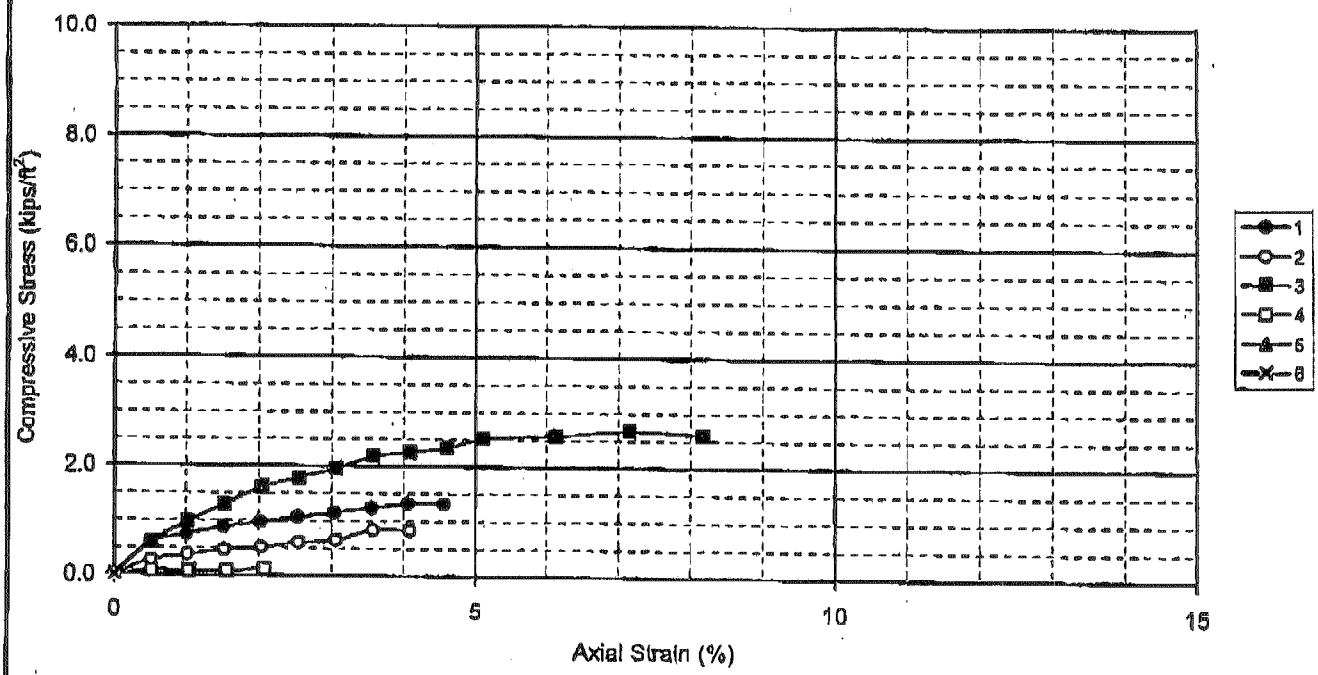
Project: El Dorado Refinery

Location: El Dorado, Kansas

Job Number: 057094

Date: 4/15/2005

UNCONFINED COMPRESSION TEST



Test Specimen	1	2	3	4	5	6
Boring	OW-03	OW-31	OW-31	OW-33		
Sample						
Sample Depth (ft.)	7.0-9.0	3.0-5.0	8.0-10.0	13.0-15.0		
Unconfined Compressive Strength (kips/ft²)	1.32	0.84	2.67	0.12		
Undrained Shear Strength (kips/ft²)	0.66	0.42	1.34	0.06		
Strain at Failure (%)	4.1	3.6	7.1	2.1		
Average Specimen Diameter (in.)	2.83	2.79	2.85	2.81		
Average Specimen Height (in.)	5.93	5.88	5.88	5.75		
Height to Diameter Ratio	2.1	2.1	2.1	2.0		
Moisture Content (%)	26.7	27.2	24.6	27.8		
Dry Unit Weight (lb/ft³)	96.9	93.2	100.9	98.2		
Void Ratio	0.74	0.81	0.67	0.72		
Saturation (%)	98	91	99	100		
Specific Gravity	2.72	2.72	2.71	2.72		
USCS Soil Classification	CL	CL	CL	CL		
Remarks						

This report shall not be reproduced, except in full, without the written approval of the laboratory.

Test conducted in general accordance with ASTM D2166

GSI Geotechnical Services, Inc.

Project:	ELDORADO REFINERY
Location:	ELDORADO,KANSAS
Job Number: 057094	Date: 4/15/05

FAX

MWH
MONTGOMERY WATSON HARZA

Date: 26 AUGUST 2005

10619 S. Jordan Gateway, Suite 100
South Jordan, Utah 84095

Tel: (801) 617-3200
Fax: (801) 617-4200

To: JULIE COLLINS

Subject: EL DORADO

Company:

Fax No: 316. 689. 4252

From: MIKE GRONSETH

Job No:

No. of Pages:
(including cover) 4

Notes:
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AUG-26-2005 FRI 08:43 AM MWH FAX NO. 8016174200 P. 01

hp LaserJet 3015
MWH AMERICAS
3166894252
Aug-26-2005 9:47AM

Fax Call Report

Job	Date	Time	Type	Identification	Duration	Pages	Result
495	8/26/2005	9:46:12AM	Receive	8016174200	0:47	4	OK

FAX

MWH
MONTGOMERY WATSON HARZA

Date: 26 AUGUST 2005

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APPENDIX H

SUMMARY OF DATA VERIFICATION
MARCH THROUGH JUNE 2005 SAMPLING EVENTS,
EL PASO CORPORATION, ELDORADO, KANSAS

INTRODUCTION

This appendix presents a summary of the results of the verification for groundwater data collected March 2005 through June 2005, for the first and second quarter groundwater sampling events and the Second Phase Investigation sampling event at the refinery site in El Dorado, Kansas. The samples collected at the El Dorado Site as part this project included:

- 130 environmental groundwater samples
- 7 field duplicate groundwater samples
- 30 trip blank samples
- 19 equipment rinseate blanks
- 1 field blank.

Each sample was analyzed for one or more of the following compounds:

- Volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) Method SW-846 8260B
- Gasoline and diesel range organics by modified EPA Method SW-846 8015B (M8015V and M8015D respectively)
- Semi-volatile organic compounds (SVOCs) by EPA Method SW-846 8270C
- Metals by EPA Method SW-846 6010B/7000 series
- Total dissolved solids (TDS) by EPA Method 160.1

- Anions (chloride, fluoride, nitrate, nitrite, sulfate) by EPA Methods 300, 353.2, and 354.1
- Alkalinity by EPA Method 310.1
- Sulfide by EPA Method 376.1
- Cyanide by EPA Method SW-846 9014
- Hexavalent and trivalent chromium by EPA Method SW-846 7196.

The results of the sample analyses are summarized in Tables 5 - 9. Severn Trent Laboratories (STL) of Pensacola, Florida provided primary analytical support for this sampling event. Continental Analytical Services, Inc of Salina, Kansas analyzed hexavalent chromium and trivalent chromium. The following quality assurance items were reviewed as part of the data verification and compared with acceptance criteria documented in the laboratory quality assurance plan (QAP) for the majority of the samples:

- Reporting limits
- Sample preservation
- Sample and sample extract holding times
- Surrogate recovery (organic analyses only)
- Trip blank sample results (VOCs only)
- Equipment rinseate blank sample results
- Field blank sample results
- Laboratory method blanks sample results
- Laboratory control sample (LCS) percent recoveries
- Matrix spike (MS) and matrix spike duplicate (MSD) sample percent recoveries

- MS/MSD relative percent differences (RPDs)
- Field duplicate sample RPDs.

The following additional quality assurance items were reviewed as part of the data verification for samples collected in June 2005 as part of the Phase II investigation:

- Tune standard results (GC/MS analysis only)
- Instrument calibration – including initial calibration (ICAL), initial calibration verification (ICV) (second source), and continuing calibration verification standards (CVS)
- Inductively couple plasma interference check samples (ICP) (metals analysis only)
- Initial and continuing calibration blank (ICB/CCB) data (metals analysis only)
- Internal standard recovery data (GC/MS analysis only)
- Serial dilution results (metals analysis only).

DATA VERIFICATION RESULTS

Reporting Limits. All results met reporting limit requirements, except for those samples requiring dilution for analysis. The reporting limits for samples that were diluted during analysis were increased by the dilution factor; however, these sample results were reported to the method detection limits (MDL). All sample data for diluted analyses are qualified with a "D" flag to indicate dilution and are listed with the sample results presented in the data tables.

Analytes with reporting limits that exceeded the Kansas Department of Health and Environment Risk-Based Standards (KDHE RSK) were reported to their respective MDL. Several target analyte MDLs exceed the KDHE RSK. This was documented prior to sampling and was approved by the KDHE. The KDHE RSK levels are listed on Tables 5 – 9 with the sample results.

Sample Preservation. Temperature blanks are used to assess whether the environmental samples met temperature requirements and were included in each sample cooler for measurement upon receipt at the laboratory. The temperature criterion of 4 °C + 2°C was met for all samples. All samples were preserved as specified by the analytical methods.

Sample and Sample Extract Holding Times. All sample extractions and analyses were performed within the method specified holding times, except for cyanide and TDS. The cyanide data that were qualified because the sample holding time was exceeded are listed in Table E-1 with "HT" as the QC type. Future results will be monitored to determine the representativeness of the qualified cyanide data. The TDS results were not qualified and are listed in Table E-2 with "HT" as the QC type.

Surrogate Recovery. Surrogate standards were spiked into each sample to be analyzed for organic analyses according to the laboratory's standard operating procedures (SOPs). All surrogate percent recoveries were within laboratory acceptance criteria, except for those samples listed in Tables E-1 and E-2. Sample data qualified based on surrogate recoveries are presented in Table E-1 with "SURR" as the QC type. If the surrogate recovery was less than ten percent the data for associated analytes were 'R' flagged indicating the data are unusable. Currently, there are no historical data available for comparison to the 'R' qualified data. Data from future sampling rounds will be monitored to assess representativeness of the "R" flagged data. Surrogate recoveries outside acceptance criteria that did not result in qualified data are presented in Table E-2 with "SURR" as the QC type.

Trip Blank Samples. Thirty trip blank samples were analyzed for VOCs as part of this sampling event. No target analytes were detected in the trip blank samples.

Equipment Rinseate Blank Samples. Nineteen equipment rinseate blank samples were analyzed as part of this sampling event. No target analytes were detected in the equipment rinseate blank samples with the following exceptions.

Benzene was detected in sample EB6. Sample EB-7 was collected following EB6. Sample EB-7 had no detections. The pump was not put back into use; as a result no data were qualified.

Petroleum hydrocarbons (carbon ranges C10+, C10 – C28, and C28 – C35) were detected in sample EB8. The pump was not put back into use; as a result no data were qualified.

Field Blank Samples. One field blank sample was analyzed as part of this sampling event. Bromodichloromethane was detected in the field blank sample but not in the associated samples collected that day of sampling. The field blank results are listed in Table E-2.

Laboratory Method Blank Sample Results. Laboratory method blanks were analyzed with each method according the laboratory's SOPs. If a target analyte was detected in a blank and in an associated sample, the sample data were qualified with a "B" flag to indicate associated blank contamination. Sample data that were qualified due to method blank data are listed in Table E-1 with "MB" as the QC type. The sample data that were qualified based on method blank data are listed in Table E-1 with an "MB" (method blank) as the QC type.

Laboratory Control Sample Percent Recoveries. Laboratory control samples were prepared and analyzed with each method and laboratory sample batch according to the laboratory's SOPs. All LCS recoveries were within laboratory acceptance criteria except for those samples listed on Tables E-1 and E-2. Sample data that were qualified due to LCS results are listed in Table E-1 and identified with "LCS" as the QC type. Sample data that were associated with an LCS outside control criteria that were not qualified are listed in Table E-2.

MS/MSD Percent Sample Percent Recoveries. MS and MSD samples were prepared and analyzed with each method and laboratory sample batch according to the laboratory's

SOPs. All MS/MSD recoveries were within laboratory acceptance criteria except for those samples listed on Tables E-1 and E-2. The MS/MSD 3,3'-dichlorobenzidene MS/MSD recoveries for samplesOW-09, OW-28T, OW-28T duplicate, and Transect-3 were zero percent. The parent samples 3,3'-dichlorobenzidene results were "R" flagged indicating the data are unusable. However, 3,3'-dichlorobenzidene has not been detected in samples from previous sampling rounds at this site, and the "R" flagged data should not affect the overall project objectives. Other sample data that were qualified for MS/MSD results are listed in Table E-1 and identified with "MS/MSD" as the QC type, and are considered usable as qualified. Sample data that were associated with an MS/MSD outside control criteria that were not qualified are listed in Table E-2.

MS/MSD RPDs. All MS/MSD RPDs were within laboratory acceptance criteria.

Field Duplicate Sample RPDs. Seven field duplicate samples were collected during this sampling event. The RPDs for all analytes detected above the reporting limit were within laboratory acceptance criteria with the following exceptions. Sample EDR N3-4 PHC as gasoline and tert-butyl methyl ether RPDs were outside acceptance criteria. The sample results are higher than historical data and are qualified with a 'J' flag to indicate the data are estimated. Sample data that were qualified due to field duplicate results are listed in Table E-1 and identified with "FD" as the QC type.

Tune Standard Results. For GC/MS methods (VOCs and SVOCs) the analytical instruments must be tuned to demonstrate that the instrument is functioning such that it will detect the compounds of interest during analysis. Sample analysis can not proceed unless the tune standard criteria are met; otherwise sample data are flagged with an "R" and are not usable. All tune standards were within acceptance criteria.

Instrument Calibration. Accuracy is affected by the calibration of the instrument. All instrument performance check, ICAL, ICV, and CCV data met QC acceptance criteria, with the exception of several ICV and/or CCV results. Sample data that were qualified due to ICV and/or CCV results are listed in Table E-1 and identified with "ICV" and/or

"CCV" as the QC type. Sample data that were not qualified due to ICV and/or CCV results are listed in Table E-2 with "ICV" and/or "CCV" as the QC type.

Inductively Coupled Plasma Interference Check Samples. The ICP interference check sample verifies the laboratory inter-element and background correction factors. No data were qualified due to interference check sample results.

Internal Standard Recoveries. Internal standards are used to assess accuracy and to determine the concentration of target analytes in samples for VOC and SVOC analyses. Internal standards are spiked in the sample after sample preparation/extraction, but prior to analysis. No sample data were qualified based on internal standard recoveries.

Initial and Continuing Calibration Blank Evaluation. Initial and continuing calibration blank samples were analyzed with each sample batch for method SW-846 6010B (ICP) to determine whether metals were being introduced into samples during preparation by the laboratory. No sample data were qualified based on initial and continuing calibration blanks.

Serial Dilutions. Serial dilutions are performed to assess the possibility of interferences during metals analysis. A serial dilution is only performed when the concentration of metals in the samples is 10 times greater than the reporting limit. The potassium result for sample OW-04 was outside the acceptance criterion. No historical data are available for comparison. Future results will be assessed to determine the representativeness of the qualified data. Sample data qualified because of serial dilutions are presented in Table E-1 with "SD" as the QC type.

SUMMARY

All sample data are usable as qualified with the exception of the "R" flagged data. The "R" flagged data should not be used for decision making. For qualified data with with no historical data, future results will be monitored to evaluate whether the qualified data are representative of the site. Refer to Tables 5 - 9 for the sample results, Table E-1 for

qualified data, and Table E-2 for data that were not qualified but had QC results that did not meet acceptance criteria.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
FINAL MW-38	3/30/2005	SW8021B	PHC as gasoline	770	µg/L	J	LCS	147%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
N2-4	24-Mar-05	M8015D	PHC C10 - C28	270	µg/L	J	LCS	128%	HIGH	Datum is estimated; potential high bias. Datum is lower than sample collected the next day.
N3-3	5/20/2005	M8015V	PHC as gasoline	1300	µg/L	J	MS/MSD	36%/58%	LOW	Datum is estimated; potential low bias. Datum is consistent with historical data.
N3-4	5/23/2005	M8015V	PHC as gasoline	400	µg/L	J	FD	54 RPD	NONE	Blind duplicate RPD outside acceptance criterion. Datum is higher than historical data.
N3-4	5/23/2005	SW8260B	tert-Butyl methyl ether	25	µg/L	J	FD	27 RPD	NONE	Blind duplicate RPD outside acceptance criterion. Datum is higher than historical data.
OW-03	6/28/2005	M8015D	Petroleum hydrocarbons above C-10	260	µg/L	J	CCV/LCS	44%126%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-03	6/28/2005	M8015D	PHCC10C28	110	µg/L	J	CCV/LCS	37%/126%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-03	6/28/2005	M8015D	PHCC28C35	180	µg/L	J	ICV/CCV	35%/44%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-03	6/28/2005	SW8270C	Hexachloro-cyclopentadiene	<9.8	µg/L	UJ	ICV/CCV	115%/22%	LOW	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-04	6/28/2005	SW6010B	Potassium	3.2	mg/L	J	MS/MSD/ SD	135%135%/ 19%	HIGH	High recovery indicates high bias. Analyte not detected. Serial dilution does not meet acceptance criterion. No historical data available for comparison.
OW-04	6/28/2005	M8015D	Petroleum hydrocarbons above C-10	210	µg/L	J	CCV/LCS	44%126%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-04	6/28/2005	M8015D	PHC C10 - C28	130	µg/L	J	CCV/LCS	37%/126%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-04	6/28/2005	M8015D	PHC C28 - C35	120	µg/L	J	ICV/CCV	35%/44%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-05	6/30/2005	SW9014	Cyanide	<0.005	mg/L	UJ	HT	18 days	NONE	Holding time exceeded. No historical data available for comparison.
OW-04	6/28/2005	SW8270C	Hexachloro-cyclopentadiene	<9.8	µg/L	UJ	ICV/CCV	115%/22%	LOW	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.
OW-05	6/30/2005	SW8270C	Hexachloro-cyclopentadiene	<10	µg/L	UJ	ICV/CCV	117%/22%	NONE	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-05	6/30/2005	M8015D	Petroleum hydrocarbons above C-10	300	µg/L	JB	LCS/MB	134%/120 µg/l	HIGH	Datum is estimated; potential high bias. Analyte detected in an associated blank. No historical data available for comparison.
OW-05	6/30/2005	M8015D	PHC C10 - C28	240	µg/L	J	LCS	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-05	6/30/2005	M8015D	PHC C28 - C35	91	µg/L	J	LCS	42%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-06	6/30/2005	SW9014	Cyanide	<0.005	mg/L	UJ	HT	18 days	NONE	Holding time exceeded. No historical data available for comparison.
OW-06	6/30/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	UJ	ICV/CCV	117%/22%	LOW	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.
OW-06	6/30/2005	M8015D	Petroleum hydrocarbons above C-10	160	µg/L	JB	LCS/MB	134%/120 µg/l	HIGH	Datum is estimated; potential high bias. Analyte detected in an associated blank. No historical data available for comparison.
OW-06	6/30/2005	M8015D	PHC C10 - C28	120	µg/L	J	LCS	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-06	6/30/2005	M8015D	PHC C28 - C35	51	µg/L	J	LCS	42%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-09 Dup	4/13/2005	E504.1	1,2-Dibromoethane (Ethylene dibromide)	0.049	µg/L	J	SURR	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-09	4/13/2005	SW7196A	Chromium, Hexavalent	<0.01	mg/L	UJ	MS/MSD	46%/48%	LOW	Potential false negative. No historical data available for comparison.
OW-09	4/13/2005	SW8270C	3,3'-Dichlorobenzidine	<50	µg/L	R	MS/MSD	0%/0%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-09	4/13/2005	E300	Nitrogen, Nitrate (as N)	<0.1	mg/L	UJ	MSD	89%	LOW	Potential false negative. No historical data available for comparison.
OW-09	4/13/2005	E300	Sulfate (As SO4)	51	mg/L	J	MS/MSD	79%/79%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-10	4/13/2005	M8015V	PHC as gasoline	180	µg/L	J	SURR	157%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-12	4/12/2005	SW7196A	Chromium, Hexavalent	<0.02	mg/L	UJ	MS	89%	LOW	Potential false negative. No historical data available for comparison.
OW-12	4/12/2005	M8015V	PHC as gasoline	150	µg/L	J	SURR	195%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	Pentachlorophenol	*<6.5*	µg/L	UJ	SURR	34%/8%	LOW	Potential false negative. No historical data available for comparison.
OW-21	4/19/2005	E300	Chloride (As Cl)	72	mg/L	J	MS/MSD	73%/74%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	2-Chlorophenol	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-21	4/19/2005	SW8270C	2,4,6-Trichlorophenol	<10	µg/L	UJ	SURR	34%/8%	LOW	Potential false negative. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	4-Chloro-3-methylphenol	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	2,4-Dichlorophenol	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	2,4-Dimethyl phenol	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	4,6-Dinitro-2-methylphenol	<50	µg/L	UJ	SURR	34%/8%	LOW	Potential false negative. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	2,4-Dinitrophenol	<50	µg/L	UJ	SURR	34%/8%	LOW	Potential false negative. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	2,4-Dinitrotoluene	*<3.7*	µg/L	UJ	SURR	34%/8%	LOW	Potential false negative. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	2-Methylphenol (o-Cresol)	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	3,4-Methyl phenol (m,p-Cresol)	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-21	4/19/2005	SW8270C	2-Nitrophenol	<10	µg/L	R	SURR	34%/8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	4-Nitrophenol	<10	µg/L	UJ	SURR	34%/8%	LOW	Potential false negative. No historical data available for comparison.
OW-21	4/19/2005	E300	Sulfate (As SO4)	34	mg/L	J	MS/MSD	86%/88%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-23T	4/12/2005	M8015V	PHC as gasoline	22	µg/L	J	SURR	247%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-27T	4/11/2005	M8015V	PHC as gasoline	640 D	µg/L	DJ	SURR	141%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-28T Dup	4/8/2005	SW8270C	3,3'-Dichlorobenzidine	<50	µg/L	R	MS/MSD	0%/0%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-28T Dup	4/8/2005	E300	Fluoride	0.79	mg/L	J	MS/MSD	125%/123%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-28T Dup	4/8/2005	SW6010B	Potassium	1.7	mg/L	J	MS/MSD	132%/132%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-28T Dup	4/8/2005	E300	Nitrogen, Nitrate (as N)	<0.1	mg/L	UJ	MS/MSD	88%/88%	LOW	Potential false negative. No historical data available for comparison.
OW-28T Dup	4/8/2005	M8015V	PHC as gasoline	640	µg/L	J	SURR	235%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-28T	4/8/2005	SW7196A	Chromium, Hexavalent	<0.02	mg/L	UJ	MS/MSD	75%/68%	LOW	Potential false negative. No historical data available for comparison.
OW-28T	4/8/2005	SW8270C	3,3'-Dichlorobenzidine	<50	µg/L	R	MS/MSD	0%/0%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-28T	4/8/2005	E300	Fluoride	0.77	mg/L	J	MS/MSD	125%/123%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-28T	4/8/2005	SW6010B	Potassium	1.8	mg/L	J	MS/MSD	132%/132%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-28T	4/8/2005	E300	Nitrogen, Nitrate (as N)	<0.1	mg/L	UJ	MS/MSD	88%/88%	LOW	Potential false negative. No historical data available for comparison.
OW-28T	4/8/2005	M8015V	PHC as gasoline	730	µg/L	J	SURR	254%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-29	6/29/2005	E504.1	1,2-Dibromo-3-chloropropane	0.062	µg/L	J	MS/MSD	57%/55%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-29	6/29/2005	SW8270C	2,4-Dimethyl phenol	12	µg/L	J	ICV	85%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-29	6/29/2005	E300	Fluoride	0.77	mg/L	J	CCV	111%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-29	6/29/2005	M8015D	Petroleum hydrocarbons above C-10	9400	µg/L	J	LCS	123%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-29	6/30/2005	M8015D	PHC C28 - C35	720	µg/L	J	LCS	42%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-29	6/29/2005	M8015V	PHC as gasoline	2900 D	µg/L	DJ	SURR	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-30	6/30/2005	SW9014	Cyanide	<0.005	mg/L	UJ	HT	18 days	NONE	Holding time exceeded. No historical data available for comparison.
OW-30	6/30/2005	SW8270C	Hexachloro-cyclopentadiene	<10	µg/L	UJ	ICV/CCV	117%/22%	LOW	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.
OW-30	6/30/2005	M8015D	Petroleum hydrocarbons above C-10	2500	µg/L	JB	LCS/MB	134%/120 µg/l	HIGH	Datum is estimated; potential high bias. Analyte detected in an associated blank. No historical data available for comparison.
OW-30	6/30/2005	M8015D	PHC C10 - C28	2300	µg/L	J	LCS	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-30	6/30/2005	M8015D	PHC C28 - C35	160	µg/L	J	LCS	42%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
OW-31	6/29/2005	E300	Fluoride	1.5	mg/L	J	CCV	111%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-31	6/29/2005	M8015D	Petroleum hydrocarbons above C-10	5500	µg/L	J	LCS	123%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-31	6/29/2005	M8015V	PHC as gasoline	3100 D	µg/L	DJ	SURR	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-32	6/28/2005	M8015D	Petroleum hydrocarbons above C-10	4900	µg/L	J	CCV/LCS	44%126%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-32	6/28/2005	M8015D	PHC C10 - C28	5000	µg/L	J	CCV/LCS	37%/126%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-32	28-Jun-05	M8015V	PHC as gasoline	3100 D	µg/L	DJ	SURR	153%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	2-Chlorophenol	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	4-Chloro-3-methylphenol	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	2,4-Dichlorophenol	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	2,4-Dimethyl phenol	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-35	4/18/2005	SW6010B	Potassium	1.3	mg/L	J	MS/MSD	128%/127%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-35	4/18/2005	SW8270C	2-Methylphenol (o-Cresol)	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	3,4-Methyl phenol (m,p-Cresol)	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	2-Nitrophenol	<10	µg/L	R	SURR	8%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
OW-39	6/30/2005	SW9014	Cyanide	<0.005	mg/L	UJ	HT	18 days	NONE	Holding time exceeded. No historical data available for comparison.
OW-32	6/28/2005	SW8270C	Hexachloro-cyclopentadiene	<9.8	µg/L	UJ	ICV/CCV	117%/22%	LOW	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.
OW-39	6/30/2005	SW8270C	Hexachloro-cyclopentadiene	<10	µg/L	UJ	ICV/CCV	117%/22%	LOW	Datum is estimated; potentially biased low. ICV above acceptance criterion, CCV below acceptance criterion. Analyte not detected. No historical data available for comparison.
OW-39	6/30/2005	M8015D	Petroleum hydrocarbons above C-10	310	µg/L	JB	LCS/MB	134%/120 µg/l	HIGH	Datum is estimated; potential high bias. Analyte detected in an associated blank. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
OW-39	6/30/2005	M8015D	PHC C10 - C28	220	µg/L	J	LCS	135%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
OW-39	6/30/2005	M8015D	PHC C28 - C35	120	µg/L	J	LCS	42%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
W-22	24-Mar-05	M8015D	PHC C10 - C28	820	µg/L	J	LCS	128%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
MARLEY POND	6/9/2005	M8015D	Petroleum hydrocarbons above C-10	340	µg/L	B	MB	42 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
NORTHEAST POND	6/9/2005	M8015D	Petroleum hydrocarbons above C-10	650	µg/L	B	MB	42 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
NORTHEAST POND	6/9/2005	M8015D	PHC C28 - C35	78	µg/L	B	MB	43 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
NORTHEAST POND	6/9/2005	E300	Sulfate (As SO4)	61	mg/L	J	MS/MSD	67%/68%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
NORTHWEST POND	6/9/2005	M8015D	Petroleum hydrocarbons above C-10	410	µg/L	B	MB	42 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
NORTHWEST POND	6/9/2005	M8015D	PHC C28 - C35	180	µg/L	B	MB	43 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
SOUTHEAST POND	6/9/2005	M8015D	Petroleum hydrocarbons above C-10	910	µg/L	B	MB	42 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
SOUTHEAST POND	6/9/2005	M8015D	PHC C28 - C35	290	µg/L	B	MB	43 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
SOUTHWEST POND	6/9/2005	M8015D	Petroleum hydrocarbons above C-10	1000	µg/L	B	MB	42 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
SOUTHWEST POND	6/9/2005	M8015D	PHC C28 - C35	160	µg/L	B	MB	43 µg/l	NONE	Analyte detected in an associated blank. No historical data available for comparison.
TRANSECT-1	6/7/2005	M8015D	PHC as diesel fuel	<98	µg/L	UJ	CCV	27%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
TRANSECT-1	6/7/2005	M8015D	PHC C10 - C28	23	µg/L	J	CCV	27%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
TRANSECT-1	6/7/2005	M8015D	PHC C28 - C35	27	µg/L	JB	CCV/MB	26 µg/l/29%	HIGH	Datum is estimated; potential high bias. Analyte detected in an associated blank. No historical data available for comparison.
TRANSECT-3	6/8/2005	SW8270C	3,3'-Dichlorobenzidine	<9.8	µg/L	R	MS/MSD	0%/0%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
TRANSECT-3	6/8/2005	SW7470A	Mercury	0.0063	mg/L	J	MS/MSD	-173%/-183	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
TRANSECT-3	6/8/2005	SW6010B	Sodium	34	mg/L	J	MS/MSD	141%/129%	HIGH	Datum is estimated; potential high bias. No historical data available for comparison.
TRANSECT-4	6/7/2005	M8015D	PHC as diesel fuel	<98	µg/L	UJ	CCV	27%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
TRANSECT-4	6/7/2005	M8015D	PHC C10 - C28	<20	µg/L	UJ	CCV	27%	LOW	Datum is estimated; potential low bias. No historical data available for comparison.
TRANSECT-4	6/7/2005	M8015D	PHC C28 - C35	38	µg/L	JB	CCV/MB	26 µg/l/29%	HIGH	Datum is estimated; potential high bias. Analyte detected in an associated blank. No historical data available for comparison.
EB3	4/16/2005	SW8270C	2-Chlorophenol	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
EB3	4/16/2005	SW8270C	4-Chloro -3-methylphenol	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
EB3	4/16/2005	SW8270C	2,4-Dichlorophenol	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
EB3	4/16/2005	SW8270C	2,4-Dimethyl phenol	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
EB3	4/16/2005	SW8270C	2-Methylphenol (o-Cresol)	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.
EB3	4/16/2005	SW8270C	3,4-Methyl phenol (m,p-Cresol)	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.

TABLE E-1

SUMMARY OF QUALIFIED DATA
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
EL DORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	Flag	QC Type	QC Result	Bias	Comment
EB3	4/16/2005	SW8270C	2-Nitrophenol	<10	µg/L	R	SURR	2%	LOW	Datum is rejected. Associated surrogate recovery is less than 10%. No historical data available for comparison.

mg/L	milligram per liter
µg/L	microgram per liter
CCV	continuing calibration verification
D	Sample dilution required for analysis; reported values reflect the dilution.
Dup	duplicate
HT	holding time
ICV	initial calibration verification
LCS	laboratory control ssample
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
SD	serial dilution
SURR	surrogate

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
OW-01	4/19/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-02	4/18/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-03	6/28/2005	SW8270C	2,4-Dimethyl phenol	<9.8	µg/L	ICV	84%	High recovery indicates high bias. Analyte not detected. No historical data available for comparison.
OW-04	6/28/2005	E300	Nitrogen, Nitrite	<0.1	mg/L	CCV/LCS/ MS/MSD	116%/112%/ 111%/113%	High recovery indicates high bias. Analyte not detected. No historical data available for comparison.
OW-04	6/28/2005	SW6010B	Sodium	160 D	mg/L	MS/MSD	377%/365%	4X Rule applies. No historical data available for comparison
OW-04	6/28/2005	SW6010B	Calcium	91	mg/L	MS/MSD	35%/44%	4X Rule applies. No historical data available for comparison
OW-04	6/28/2005	SW8270C	2,4-Dimethyl phenol	<9.8	µg/L	ICV	84%	High recovery indicates high bias. Analyte not detected. No historical data available for comparison.
OW-05	6/30/2005	M8015D	PHC as diesel fuel	<100	µg/L	LCS	190%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-06	6/30/2005	M8015D	PHC as diesel fuel	<100	µg/L	LCS	190%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-09	4/13/2005	E300	Chloride (As Cl)	140	mg/L	MS/MSD	69%/69%	4X Rule applies. No historical data available for comparison
OW-09	4/13/2005	SW8270C	Quinoline	<10	µg/L	MS	152%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
OW-09 Dup	4/13/2005	E504.1	1,2-Dibromo-3-chloropropane	<0.019	µg/L	SURR	135%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-19T	4/16/2005	SW8270C	Nitrobenzene	*<5.8 D*	µg/L	SURR	254%	One surrogate allowed out per the QAPP. No historical data available for comparison.
OW-19T	4/16/2005	SW8270C	Hexachlorocyclopentadiene	*<28 D*	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-19T	4/17/2005	M8015D	PHC as diesel fuel	*<12 D*	µg/L	SURR	2320%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-19T	4/17/2005	M8015D	Petroleum hydrocarbons above C-10	1000 D	µg/L	SURR	2180%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-21	4/19/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-23T	4/12/2005	E300	Chloride (As Cl)	930	mg/L	MS/MSD	460%/378%	4X Rule applies. No historical data available for comparison
OW-25	4/14/2005	E300	Chloride (As Cl)	300	mg/L	MS/MSD	-34%/-31%	4X Rule applies. No historical data available for comparison
OW-27T	4/11/2005	E300	Sulfate (As SO4)	98	mg/L	MS/MSD	-21%/-7%	4X Rule applies. No historical data available for comparison
OW-27T	4/11/2005	E300	Chloride (As Cl)	360	mg/L	MS/MSD	-65%/-63%	4X Rule applies. No historical data available for comparison
OW-27T	4/11/2005	E504.1	1,2-Dibromo-3-chloropropane	<0.02	µg/L	SURR	138%	High recovery indicates high bias. Analyte not detected in sample
OW-27T	4/11/2005	E504.1	1,2-Dibromoethane (Ethylene dibromide)	<0.02	µg/L	SURR	138%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
OW-28T	4/8/2005	E300	Chloride (As Cl)	210	mg/L	MS/MSD	125%/127%	4X Rule applies. No historical data available for comparison
OW-28T	4/8/2005	SW6010B	Sodium	300	mg/L	MS/MSD	202%/181%	4X Rule applies. No historical data available for comparison
OW-28T	4/8/2005	SW6010B	Calcium	67	mg/L	MS/MSD	35%/24%	4X Rule applies. No historical data available for comparison
OW-28T Dup	4/8/2005	E300	Chloride (As Cl)	210	mg/L	MS/MSD	125%127%	4X Rule applies. No historical data available for comparison
OW-28T Dup	4/8/2005	SW6010B	Sodium	300	mg/L	MS/MSD	202%/181%	4X Rule applies. No historical data available for comparison
OW-28T Dup	4/8/2005	SW6010B	Calcium	61	mg/L	MS/MSD	35%/24%	4X Rule applies. No historical data available for comparison
OW-30	6/30/2005	M8015D	PHC as diesel fuel	<110	µg/L	LCS	190%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-32	6/28/2005	E300	Nitrogen, Nitrite	<0.1	mg/L	CCV/LCS	112%116%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-32	6/28/2005	SW8270C	2,4-Dimethyl phenol	<9.8	µg/L	ICV	84%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-33	6/15/2005	E160.1	Total dissolved solids (Residue, filterable)	840	mg/L	HT	8 days	Holding time was exceeded. No historical data available for comparison.
OW-33	6/15/2005	SW8260B	Bromoform	<5	µg/L	CCV	25%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-33	6/15/2005	SW8270C	Quinoline	<10	µg/L	LCS	NS	Analyte not added to LCS.
OW-33	6/15/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	ICV	115%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
OW-33	6/15/2005	SW8270C	2,4-Dimethyl phenol	<10	µg/L	ICV	86%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-35	4/18/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-36	4/19/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-38	4/18/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
OW-39	6/30/2005	M8015D	PHC as diesel fuel	<110	µg/L	LCS	190%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
W-08	5/26/2005	M8015V	PHC as gasoline	*<170 D*	µg/L	DV	NA	Sample analyzed at a dilution with no detections. Reanalyzed out of holding time withoug dilution with no detections, reanalysis not reported. Datum is consistent with historical data.
MARLEY POND	6/9/2005	E160.1	Total dissolved solids (Residue, filterable)	190	mg/L	HT	14 days	Holding time was exceeded. No historical data available for comparison.
TRANSECT-2	6/8/2005	E160.1	Total dissolved solids (Residue, filterable)	310	mg/L	HT	15 days	Holding time was exceeded. No historical data available for comparison.
TRANSECT-2 Dup	6/8/2005	E160.1	Total dissolved solids (Residue, filterable)	300	mg/L	HT	15 days	Holding time was exceeded. No historical data available for comparison.
TRANSECT-3	6/8/2005	E160.1	Total dissolved solids (Residue, filterable)	300	mg/L	HT	15 days	Holding time was exceeded. No historical data available for comparison.
EB1	4/16/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
EB2	4/16/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
EB3	4/16/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
EB4	4/16/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
EB5	4/16/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
EB6	4/16/2005	SW8270C	Hexachlorocyclopentadiene	<10	µg/L	LCS	70%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
EQ4	02-Jun-05	SW8260B	Benzene	<1	µg/L	MSD	119%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
EQ4	02-Jun-05	SW8260B	Ethylbenzene	<5	µg/L	MSD	123%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Equipment Blank	2/21/2005	SW8260B	Bromomethane	<1	µg/L	LCS	139%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Equipment Blank	6/8/2005	SW8260B	Dibromochloromethane	<5	µg/L	CCV	25%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Equipment Blank	6/8/2005	SW8260B	Carbon tetrachloride	<5	µg/L	CCV	23%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
Equipment Blank	6/8/2005	SW8260B	Bromoform	<5	µg/L	CCV	31%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Equipment Blank	6/8/2005	SW8270C	Hexachlorocyclopentadiene	<9.8	µg/L	ICV	127%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Equipment Blank	6/8/2005	SW8270C	2,4-Dimethyl phenol	<9.8	µg/L	ICV	89%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Field Blank	4/22/2005	SW8260B	Bromodichloromethane	14	µg/L	FB	14 µg/l	Analyte detected in blank not detected in associated samples.
Trip Blank	6/1/2005	SW8260B	Dibromochloromethane	<5	µg/L	CCV	25%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/1/2005	SW8260B	Carbon tetrachloride	<5	µg/L	CCV	23%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/1/2005	SW8260B	Bromoform	<5	µg/L	CCV	31%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/15/2005	SW8260B	Bromoform	<5	µg/L	CCV	25%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/7/2005	SW8260B	Dibromochloromethane	<5	µg/L	CCV	25%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/7/2005	SW8260B	Carbon tetrachloride	<5	µg/L	CCV	23%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

TABLE E-2

SUMMARY OF NON-CONFORMING QUALITY CONTROL DATA NOT AFFECTING DATA QUALITY
MARCH THROUGH JUNE 2005
EL PASO CORPORATION
ELDORADO REFINERY, KANSAS

Location Identification	Date Collected	Analysis	Analyte	Result	Units	QC Type	QC Result	Comment
Trip Blank	6/7/2005	SW8260B	Bromoform	<5	µg/L	CCV	31%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/8/2005	SW8260B	Dibromochloromethane	<5	µg/L	CCV	25%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/8/2005	SW8260B	Carbon tetrachloride	<5	µg/L	CCV	23%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/8/2005	SW8260B	Bromoform	<5	µg/L	CCV	31%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/9/2005	SW8260B	Dibromochloromethane	<5	µg/L	CCV	21%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.
Trip Blank	6/9/2005	SW8260B	Bromoform	<5	µg/L	CCV	22%	High recovery indicates potential high bias. Analyte not detected. No historical data available for comparison.

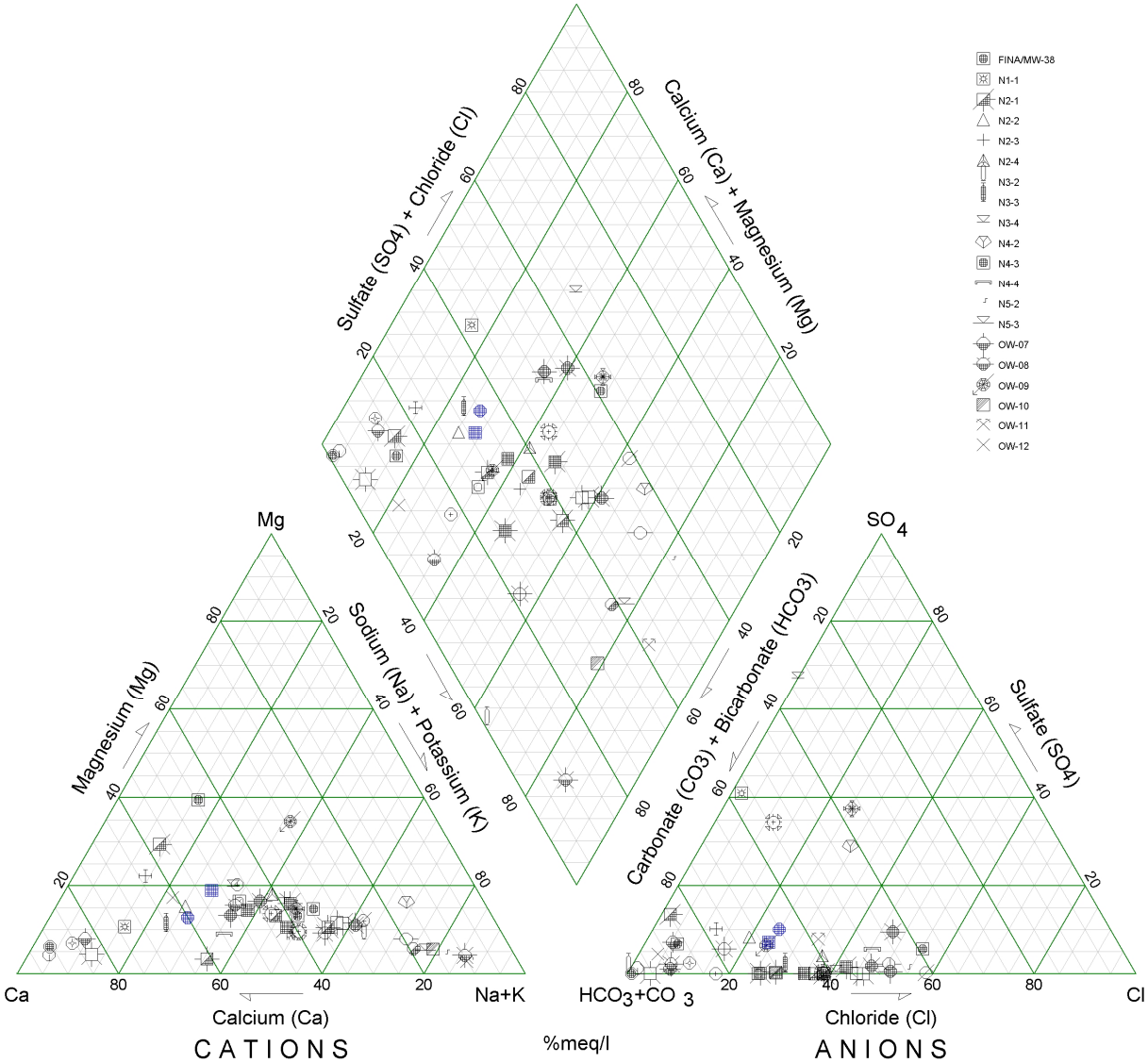
mg/L	milligram per liter		
µg/L	microgram per liter		
CCV	continuing calibration verification		
D	Sample dilution required for analysis; reported values reflect the dilution.		
DV	data validation		
Dup	duplicate		
FB	field blank	MS	matrix spike
FD	field duplicate	MSD	matrix spike duplicate
HT	holding time	QAPP	quality assurance project plan
ICV	initial calibration verification	RPD	relative percent difference
LCS	laboratory control ssample	SURR	surrogate

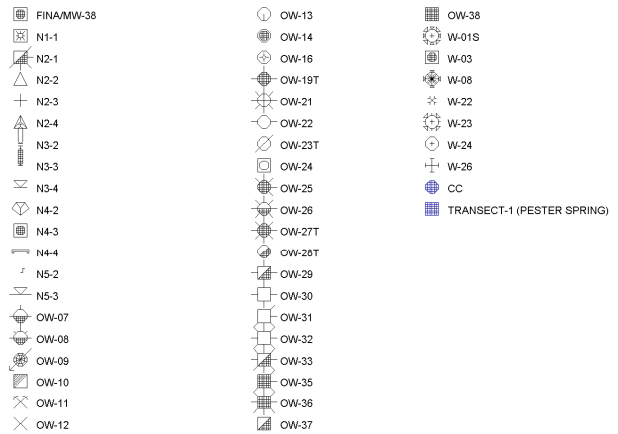
APPENDIX G

AVAILABLE UPON REQUEST

Piper Diagram

SHALLOW WELLS





elpaso

PROJECT:

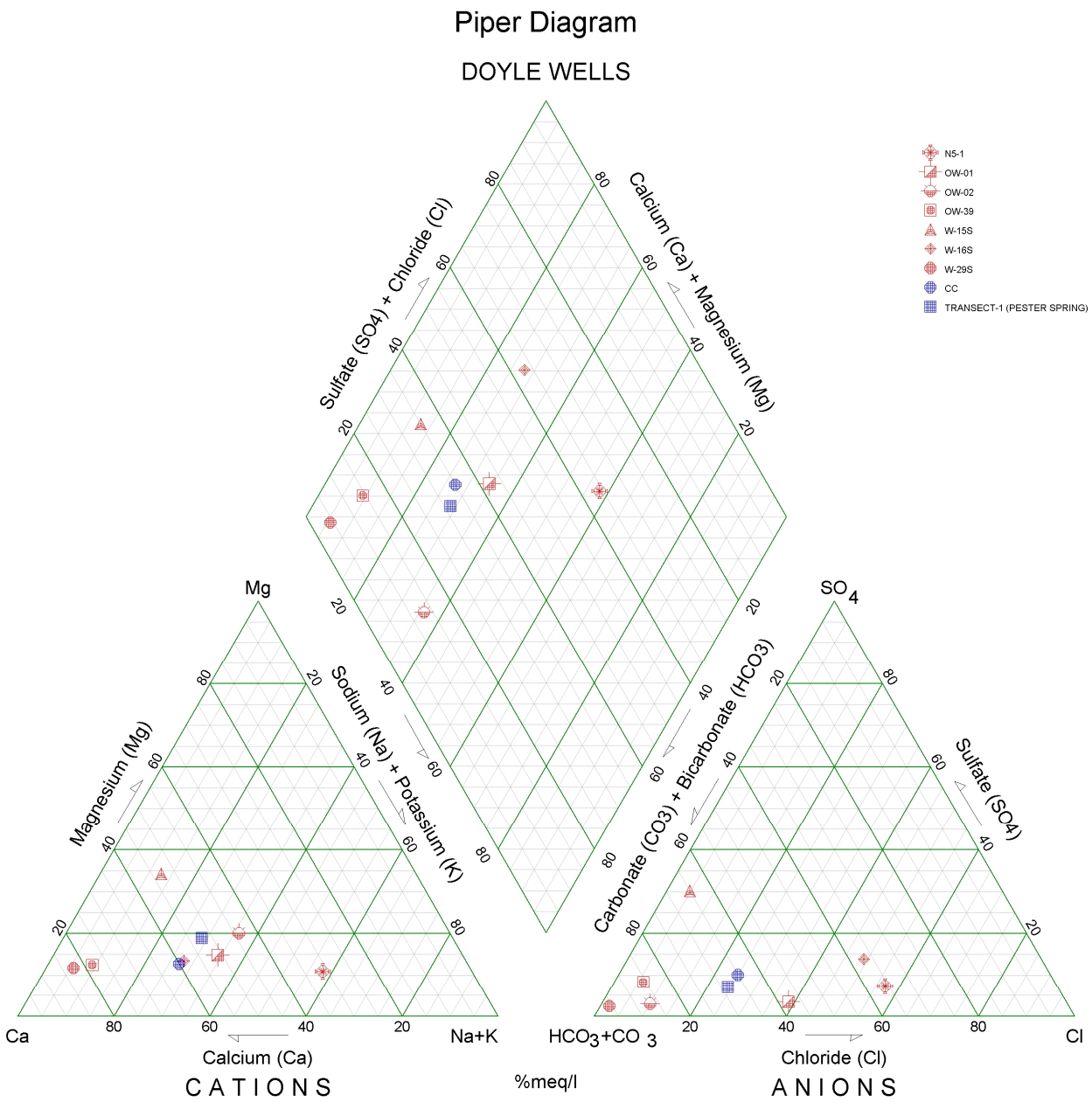
EL DORADO REFINERY, EL DORADO, KS

TITLE:

PIPER DIAGRAM FOR SHALLOW WELLS

MWH

SCALE:	FIGURE No:
As Noted	***B***



elpaso

PROJECT:

EL DORADO REFINERY, EL DORADO, KS

TITLE:

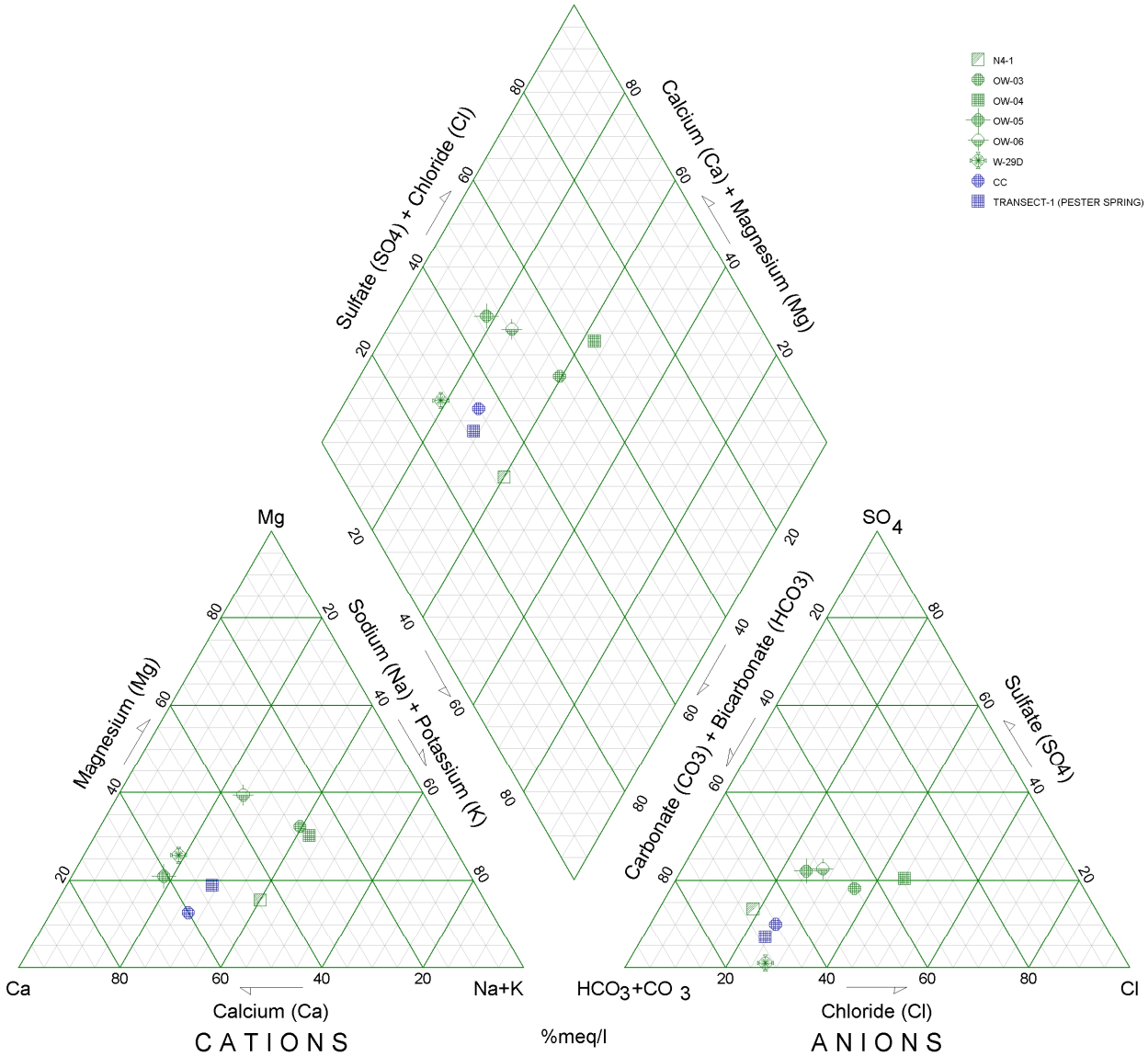
PIPER DIAGRAM FOR DOYLE WELLS

MWH

SCALE:	FIGURE No:
As Noted	***C***

Piper Diagram

FORT RILEY WELLS



elpaso

PROJECT:

EL DORADO REFINERY, EL DORADO, KS

TITLE:

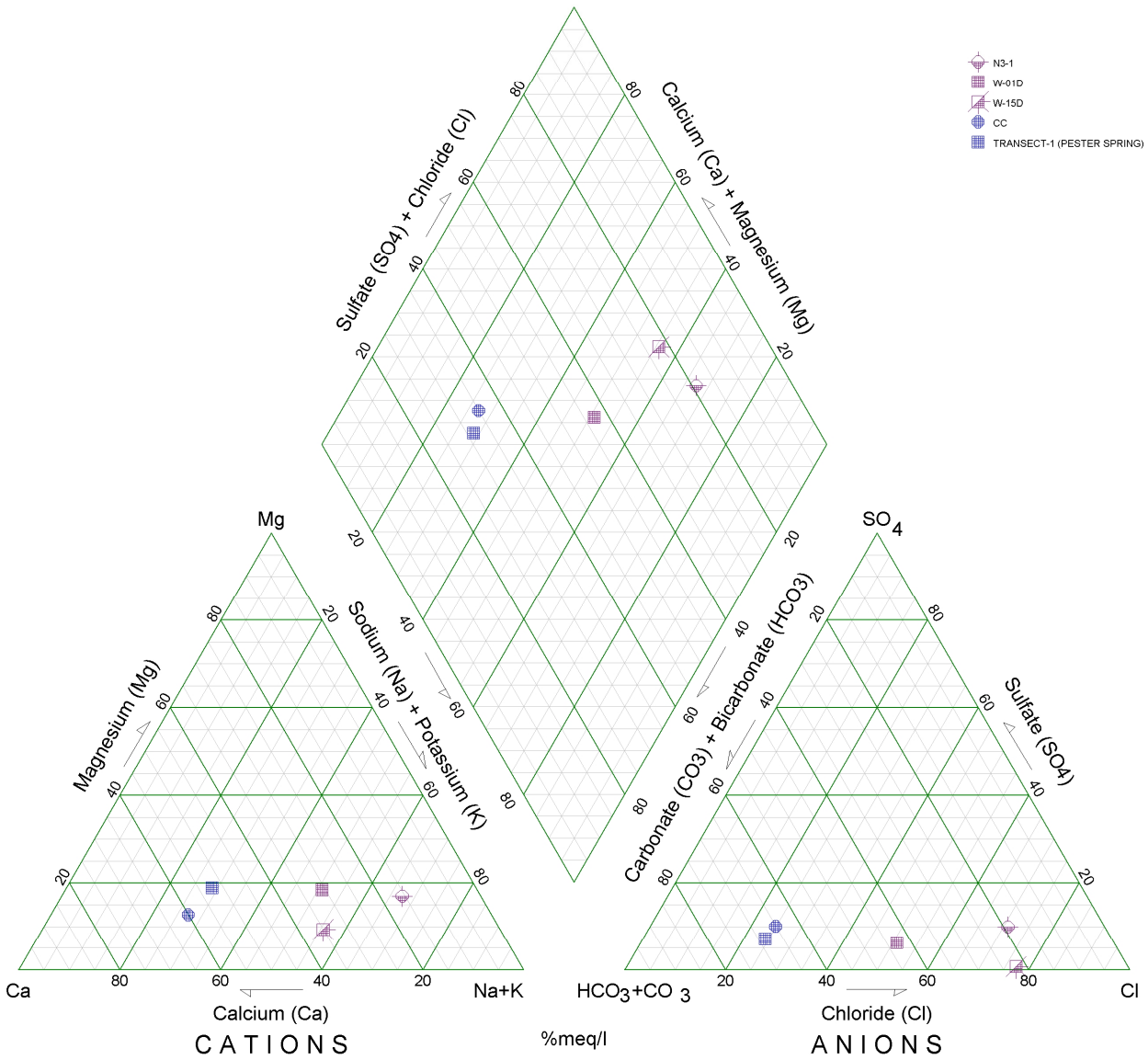
PIPER DIAGRAM FOR FORT RILEY WELLS

MWH

SCALE:	FIGURE No:
As Noted	***D***

Piper Diagram

FLORENCE WELLS



elpaso

PROJECT:

EL DORADO REFINERY, EL DORADO, KS

TITLE:

PIPER DIAGRAM FOR FLORENCE WELLS

MWH

SCALE: *As Noted*

FIGURE No: ***E***

Use of Trilinear Plots and Stiff Diagrams to Fingerprint Groundwater Sources, El Dorado Refinery, El Dorado, Kansas

INTRODUCTION

Major-ion (Ca, Mg, Na, K, SO_4, Cl, CO_3, & HCO_3) data were collected from monitoring wells at the El Paso facility in El Dorado, KS, for the purpose of evaluation of the connections (or lack) between various aquifers at the site. The following is an analysis of the results of this sample analysis.

The sum of the milliequivalents of the cations should balance with the sum of the milliequivalents of the anions in a water sample. Accordingly, a cation/anion balance was performed to assess the viability of the general chemistry data. Unfortunately, many of the cations and anions did not balance in the samples. According to STL personnel, matrix interferences caused the imbalance. Despite the imbalance, however, the data were deemed usable for the qualitative evaluation that was performed.

Trilinear plots and Stiff diagrams were initially developed in the early 1900s, for the purpose of evaluating mixtures of oil field waters, but have been shown to have equal utility in characterization of ground water from various aquifers or for contamination and ambient conditions in a single aquifer. Both techniques involve evaluation of the compositional nature of the cations (Ca, Mg, and Na+K) and anions (Cl, SO_4, and CO_3+HCO_3). These techniques thus look at the overall composition, rather than at individual components.

Trilinear plots (also known as Piper Diagrams) consist of cation and anion triangles and a central plotting diamond. The plots are so constructed such that mixtures of waters must fall along the line connecting the two end points of the two mixtures in both triangles and the central diamond, unless there are reactions, such as precipitation or other removal mechanisms such as sulfate degradation by bacterial action. The plots do not focus on the total concentrations of the various parameters, although in some cases the calculated total dissolved solids concentrations are indicated by circles around the plotting position in the central diamond, thereby giving an indication of the relative degree of total major-ion concentrations. The main value of trilinear plots, over Stiff diagrams, is they allow calculations of relative percentages of multiple sources of water, if there is not removal of some components

Stiff Diagrams are graphical depictions of the composition of water from a monitoring site. The plots consist of a standard pattern, in which the cation concentrations (in meq/L) are shown to the left of a central axis and the anions to the right of the axis. In some cases, the relative percentages are used for plotting, but the use of actual concentrations has the advantage of showing which samples have higher concentrations. Each sample is shown by a separate plot, although they commonly are ‘pasted’ onto a map showing the sample site location relative to other sampling sites and other relevant features. Because of the graphical nature of Stiff diagrams, they are relatively easier to understand, for those not familiar with the two techniques.

ANALYSIS OF DATA

The data were used to generate both Stiff Diagrams, which were placed on a site map (Figure A), and a series of trilinear plots (Figures B, C, D, and E). The various sample locations were then analyzed as a function of the lithologic units sampled by the various wells. In the case of the Stiff Diagrams, all data locations were placed on a single map, with the lithologic information shown

by different colors used for various sample sites. Trilinears were prepared for the various lithologic units, with the identity of each sample site indicated by a shape for each plotting position. The following discussion is by litholgical units.

As noted above, the main limitation of the trilinear plot is that it is assumed that each of the 8 major ions used is conservative, i.e., there is no removal of any of the constituents by precipitation or other mechanisms such as biological degradation. In the case of the El Dorado facility, the extensive presence of hydrocarbons in the ground water has resulted in microbiological activity and the generation of reducing conditions, as indicated by negative oxidation / reduction potentials (ORP) optimal for the growth of micro-organisms capable of reducing nitrate and sulfate, and the associated oxidation of hydrocarbons. The general lack of nitrate and sulfate ions in the subsurface indicates that these organisms, especially sulfate-reducing bacteria (SRB) are widespread in the subsurface at the facility. Most of the samples from the shallow units are essentially devoid of sulfate, thereby essentially eliminating the use of the anion triangle and the central diamond for the trilinears. Only well N3-4 contains elevated sulfate concentration.

The map showing the Stiff diagrams (Figure A) shows that wells with the highest total dissolved solids concentrations are in the north-central part of the facility and are composed of calcium bicarbonate water types. By contrast, samples from wells in the South Tank Farm area are less concentrated, and are of a sodium bicarbonate type.

A Site map showing Stiff diagrams for all surface water, groundwater, and spring samples collected is included in Appendix I. Water with similar Stiff plots have similar geochemical compositions and typically have a common source. As shown on Figure ___, the shallow groundwater within the Doyle Shale at the western half of the Site is very similar in composition to the catalytic cracking unit spring sample. In addition, shallow wells in the southeast corner of the South Tank Farm Area are similar in composition. Also, the wells to the south and east of Topeka Road (south of the Main Process Area) are all highly mineralized and have similar composition. Surface water samples Stiff diagrams from the wastewater/stormwater ponds are less concentrated, but of similar composition as the groundwater sample from the Florence Limestone Well N3-1. This suggests that groundwater from the Florence Limestone may be flowing upward through fractures and into the surface water ponds.

Shallow and Doyle Wells

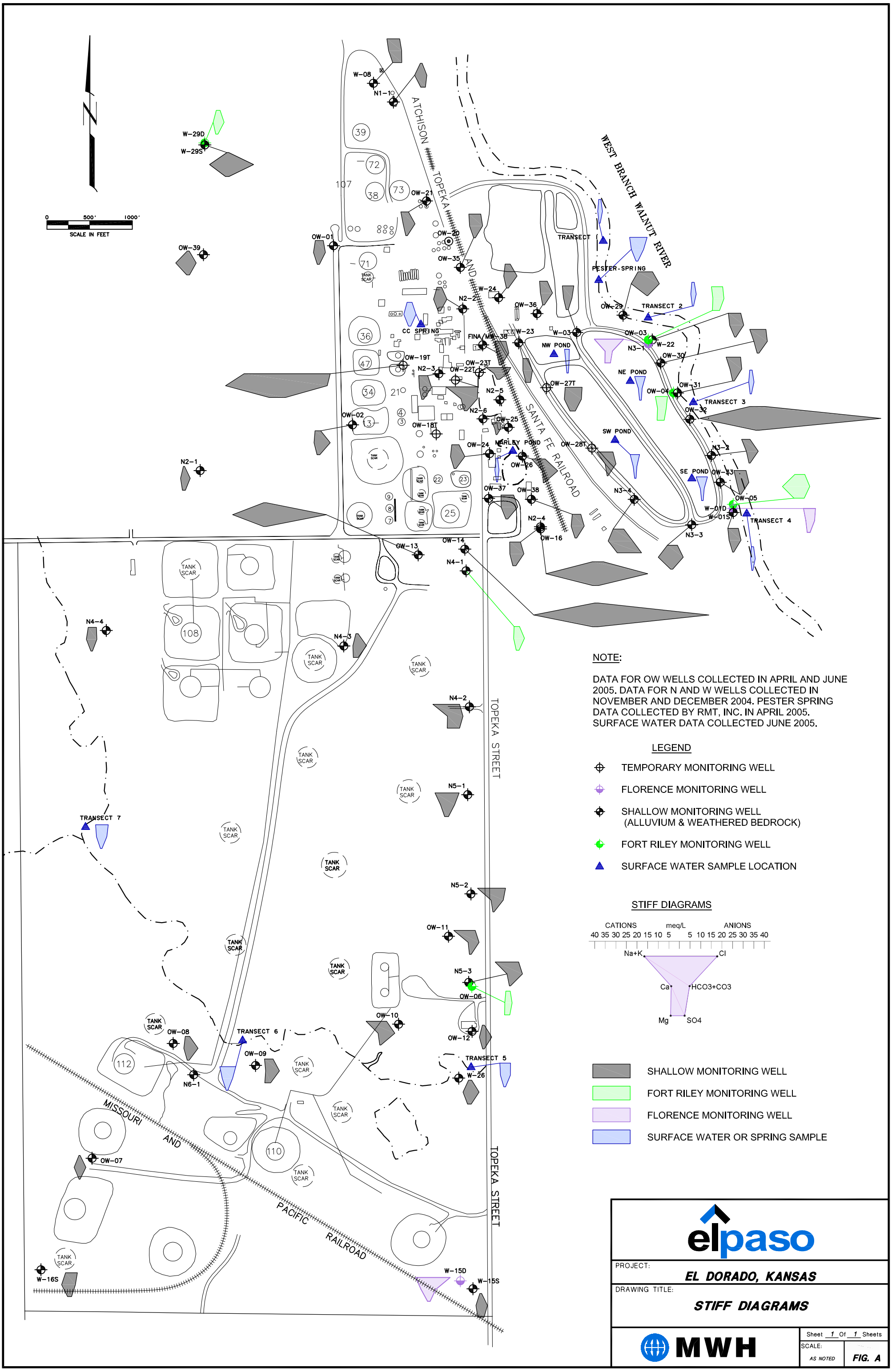
A trilinear plot of **shallow** wells (Figure B) shows a general trend of data points in the cation triangle. Almost all wells are low in magnesium (<20%), and extend from the plotting position of OW-26, with approximately 85% Na+K, to a number of wells with approximately 50% Ca and 40% Na+K. The trend then makes a ‘bend’ to the cation triangle plotting position for wells OW-13, -14, -16, and –07, containing approximately 95% Ca. Wells NOT on the trend include OW-09, OW-33, N4-2, N4-3, and W-26. A plot of wells sampling the **Doyle** formation (Figure C) generally is similar to the trilinear plot of shallow wells, with low Mg concentrations and a trend of points showing varying percentages of Na+K to Ca. Only Doyle well W-15S is outside this trend. Samples from the CC Spring and Pester Spring are similar in composition to the shallow and Doyle units, indicating that these springs are fed from these lithological units.

Fort Riley Wells

A trilinear plot of samples from **Fort Riley** wells (Figure D) does not show a clear cation trend, but the wells are generally dissimilar from samples from the over-lying Doyle or shallow unit. In general, the cation composition is higher in magnesium. Only well N4-1 is similar to the composition of the overlying Doyle and shallow lithological units. Wells from the Fort Riley unit commonly include approximately 20% sulfate as the anion composition, except for W-29D, which raises question about possible vertical leakage for this well.

Florence Wells

Wells screened in the **Florence** unit (Figure E) are lower in magnesium content than wells from the overlying Fort Riley unit, but higher in Mg than wells from the shallow and Doyle unit. The Florence wells have lower relative sulfate concentrations than do the wells from the overlying Fort Riley unit, but do contain approximately 10% sulfate, except for a sample from W-15D.



elpaso

PROJECT: **EL DORADO, KANSAS**

DRAWING TITLE: **STIFF DIAGRAMS**

MWH

Sheet 1 Of 1 Sheets

SCALE: AS NOTED

FIG. A

AutoCAD FILE: BaseMap-w-AllWells.Dwg PROJECT NUMBER: 1004317

APPENDIX J
OXYGEN AND DEUTERIUM STABLE ISOTOPE ANALYSIS

1.0 INTRODUCTION

This appendix summarizes the results of stable isotope data collected from a suite of wells at the El Dorado Refinery in El Dorado, KS. Water samples were collected during field events conducted in May, June, and August of 2005, and were chosen to be representative of the various lithostratigraphic units on site. Water samples were analyzed by mass spectrometry for their respective oxygen-18 (^{18}O) and deuterium (^{2}H) isotopic compositions, which are typically reported as a part per thousand (per mil-$^{0}/_{00}$) difference relative to average seawater. Comparison of groundwater samples (and one surface water sample from the cat cracker seep EDR-CC-063005) to a $\delta^{18}O$-$\delta^{2}H$ local meteoric water line (LMWL) for El Dorado, KS provides estimations of evaporation. Additionally, distinct groundwater types, identified on the basis of known hydrostratigraphy (from bore logs) and geochemistry, are also identifiable on the basis of distinct isotopic signatures. The isotopic data suggest that three end-member groundwater types are mixing to produce the range of groundwaters observed at the El Dorado site.

2.0 $\delta^{18}O$ AND $\delta^{2}H$ ISOTOPE BACKGROUND INFORMATION

The power and utility of oxygen and hydrogen stable isotopes in hydrology is based on fractionation processes that occur as water moves through the hydrological cycle. Various evaporation and condensation ("rain-out") processes have a tendency to respectively enrich or deplete the liquid water fraction in the heavy isotopes of ^{18}O and ^{2}H, relative to their light isotopes.

Isotopic fractionation processes can be both global and local in scale, and each produces distinct trends in isotopic data. For example, as water is evaporated from global oceans, the evaporated vapor tends to be depleted in ^{18}O and ^{2}H relative to seawater. When global precipitation isotopic data are plotted in $\delta^{18}O$-$\delta^{2}H$ space, they form a global meteoric water line (GMWL), which tends to be depleted relative to seawater. Conversely, precipitation tends to preserve condensation processes, which have the opposite effect of evaporation of enriching the liquid water fraction in ^{18}O and ^{2}H. The first rains extracted from this vapor are enriched in ^{18}O and ^{2}H relative to the vapor cloud. However, as weather patterns move across continents, progressive "rain-out" tends to deplete the remaining vapor in ^{18}O and ^{2}H such that localized precipitation in continental interiors (represented by a local meteoric water line) are depleted relative to the GMWL. This process is referred to as the "continental effect." For a comprehensive explanation of various fractionation processes within the hydrologic cycle, the reader is referred to Clark and Fritz (1997).

On a localized scale, processes of irrigation-induced evaporation, surface-water evaporation, shallow alluvial infiltration, and groundwater reservoir mixing can be identified and quantified. The data provided herein are discussed within this context.

3.0 ESTABLISHING AN EL DORADO LOCAL METEORIC WATER LINE (LMWL)

The first step in evaluating isotopic data from the El Dorado site is to establish a local meteoric water line (LMWL) to which data can be compared and enrichment, depletion, or mixing behaviour can be assessed. The International Atomic Energy Agency maintains a database of monthly precipitation isotopic data from stations around the world (http://www-

naweb.iaea.org/napc/ih/index.asp/). Unfortunately, the closest station to El Dorado, KS is in Waco, TX and is therefore not representative of local isotopic variation. However, it is possible to interpolate between stations, as has been done by the research group Isoscapes at the University of Utah (http://www.waterisotopes.org/). Based on monthly values provided by Isoscape's "online isotopes in precipitation calculator" (OIPC), a LMWL for El Dorado, KS has been established (Figure 1).

Using historic climate data obtained from the U.S. Historical Climatology Network, a precipitation-weighted mean isotopic value has been calculated for the El Dorado site ($\delta^{18}O$ = -5.94$^0/_{00}$ and δ^2H = -40.19$^0/_{00}$; U.S. HCN, 2005; Figures 1, 2 and 3). Because seasonal variations in stable isotopic values tend to be attenuated below a critical depth (about 3-5 meters for fine-grained soils like those found in the El Dorado alluvium; Clark and Fritz, 1997), the weighted-mean precipitation value should represent a modeled end-member point for direct precipitation input (infiltration) to the groundwater system at El Dorado.

4.0 RESULTS

The stable isotope analytical data for El Dorado are provided in Table 1 and are plotted relative to the El Dorado LMWL in Figure 3. For analytical duplicates, precision averaged ± 0.1$^0/_{00}$ for $\delta^{18}O$ and ± 2$^0/_{00}$ for δ^2H. These values indicate excellent analytical reproducibility. Well OW-03 was sampled twice (once on 6/28/05 and a second sample collected on 8/12/05). The variation observed between these two sampling events in both $\delta^{18}O$ and δ^2H is consistent with what one would expect it to be as a function of seasonal variation along the LMWL.

As previously mentioned, below a critical depth (3-5 meters), seasonal isotopic variability is attenuated such that the average isotopic composition of the groundwater should resemble that of a weighted mean precipitation value. Barring confined- or paleo-aquifer conditions (where ancient groundwaters of different isotopic composition may be encountered), one would expect the groundwater at El Dorado to reflect this weighted mean precipitation value. As is shown on Figure 3, this is generally the case at El Dorado. In detail, however, it appears as though average groundwater isotopic concentrations are somewhat depleted in δ^2H (~-2$^0/_{00}$) relative to the weighted mean precipitation value. This slight depletion may be a reflection of groundwater mixing as will be discussed in more detail below, although it is also possible that this deviation is simply an artifact of analytical error. It is worth noting that the Cat Cracker seep isotopic composition is similar to this site-average groundwater value, suggesting its composition, like most of the groundwater on-site, is influenced primarily by direct precipitation.

4.1 Evaporative enrichment in the shallow alluvium?

One of the most striking trends in the data from El Dorado is what appears to be an enrichment line for water samples collected from wells screened within the shallow alluvium (Figure 3). The slope of this line is very different and much shallower than the LMWL.

In extreme arid regions, it is common to observe isotopic enrichment of shallow alluvial aquifers due to Rayleigh distillation effects within the vadose zone (Clark and Fritz, 1997). However, given the 69.9% annual humidity (NOAA, 2005) and the observed precipitation amounts, the climate at the El Dorado site would not be classified as arid. Therefore, enrichment of the shallow alluvium is not likely to be a result of natural evaporation alone.

Cycling of the groundwater table to the surface via irrigation, where evaporation can isotopically enrich waters which subsequently re-infiltrate, is another potential cause of the enrichment line at El Dorado. While irrigation-enhanced enrichment has been observed in other isotopic studies (Clark and Fritz, 1997), the nearest irrigated area of potential influence to the site is more than 5 miles to the west.

A more likely scenario is that enriched isotopic signatures associated with surface waters stored and evaporated in the NE and SE aeration ponds are providing recharge to the shallow alluvium. However, without data indicating the isotopic composition of these waters, it is only possible to speculate on this source.

Regardless of the mechanism, it is possible to quantify the average evaporative loss required to produce the enrichment trend observed in the shallow alluvial wells. Assuming an average annual temperature for the El Dorado site of 42 °C (U.S. HCN, 2005), and an average annual humidity of 69.9%, one can use the following equation to determine an evaporative loss fraction:

$$\delta^{18}O_{avg\ gw} - \delta^{18}O_{avg\ precip} = \varepsilon^{18}O_{Total} \bullet \ln f$$

where $\varepsilon^{18}O_{Total}$ is the total enrichment of the liquid phase relative to the vapor phase and f is the fraction of liquid remaining. Based on the isotopic and climatological data, an evaporative loss of about 12% is required to produce the observed enrichment trend within the shallow wells (Figure 3).

4.2 Groundwater Mixing

Thus far, two distinct sources of water to the El Dorado site have been identified; 1) isotopically enriched shallow alluvium and 2) weighted average meteoric water (precipitation). If groundwaters at El Dorado were a result of a simple two end-member mixing line, all data would fall along a linear trend similar to that of the shallow alluvium. However, average groundwaters are slightly depleted in δ^2H (Figure 3) and there is substantially more scatter among waters from the Doyle Shale than can be explained through analytical error or two end-member mixing alone.

As can be seen in Figure 3, isotopic compositions of individual analyses from the Doyle Shale are distinct and depleted relative to both the LMWL and to isotopic compositions of other groundwater types on the site. Therefore, a third, isotopically depleted end-member is proposed. Because of its confined-semiconfined characteristics, the Florence aquifer would seem a likely candidate to provide a third, depleted end-member which might mix with other groundwaters (like the Doyle) to produce the observable isotopic distribution within the El Dorado dataset. However, given the limited two-point sample distribution for waters from the Florence Limestone, one can only speculate that the Florence is acting as this third end-member. To properly assess this, isotopic data from more wells within the Florence is needed.

5.0 CONCLUSIONS

Because of attenuation of seasonal isotopic variability, it is impossible to accurately quantify vertical and horizontal mixing of waters within the El Dorado site. Furthermore, accurate rates of recharge within a spatial context are not possible given the current data set.

A distinct evaporative enrichment trend is observed for water data within the shallow alluvium. The fractional evaporative loss required to produce this isotopic distribution has been quantified and is found to be approximately 12%. The proximity of sampled wells to the NE and SE aeration ponds suggests that evaporation of these surface waters, and subsequent recharge, are providing the source of isotopic enrichment for the shallow alluvial waters. The isotopic depletion and scatter observed in groundwater, particularly that of the Doyle Shale, is suggestive of a three end-member isotopic mixing scenario. Given the current dataset, it is difficult to speculate on the origin of the third end-member. Were a third, isotopically depleted end-member identifiable, it would be possible to quantify the relative mixture of mean-annual precipitation, shallow alluvial water, and this unknown third source to produce the distribution of waters observed on site.

A list of suggested future sampling points and associated driving forces are provided below to address these data gaps:

- Seasonal sampling of the NE and SE ponds.
    - Provides a test of these surface waters acting as an end-member and source for shallow alluvial waters.
    - If found to be points of recharge, comparison to shallow alluvial wells will enable quantification of recharge rates.

- At least one direct precipitation sample.
    - Allows a test of the validity of the interpolated LMWL for El Dorado, KS.

- Greater sampling representation of the Florence Limestone.
    - Potentially identify the Florence as a third, isotopically depleted end-member.
    - May allow quantification of various end-member mixing scenarios.

6.0 REFERENCES

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Clark and Fritz (1997), Environmental Isotopes in Hydrology. p. 328.

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Isocapes web site (2004), http://www.waterisotopes.org/

NOAA web site (2005), http://www.noaa.gov/

U.S. HCN web site (2005), http://cdiac.esd.ornl.gov/r3d/ushcn/ushcn.html#TOP

Table 1. Stable Isotope Data for El Dorado Refinery Water Samples				
Lab ID	Well	$\delta^{18}O$ $^{0}/_{00}$	$\delta^{2}H$ $^{0}/_{00}$	Hydrostratigraphic Unit
HOR- 112526	EDR-CC-063005	-5.9	-42	Cat Cracker Seep
HOR- 112527	EDR-W-22-051905	-2.3	-36	Shallow alluvium/Limestone saprolite
HOR- 112529	EDR-W-01S-052005	-3.0	-35	Shallow alluvium/Limestone saprolite
HOR- 112525	EDR-OW-31-062905	-3.8	-37	Shallow alluvium/Limestone saprolite
HOR- 112565	EDR-OW-19T-081205	-5.2	-39	Shallow alluvium/Limestone saprolite
HOR- 112522	EDR-N3-3-052005	-5.6	-40	Shallow alluvium/Limestone saprolite
HOR- 112522	EDR-N3-3-052005*	-5.7	-40	Shallow alluvium/Limestone saprolite
HOR- 112562	EDR-W-29S-081105	-6.5	-44	Doyle Shale
HOR- 112562	EDR-W-29S-081105*	-6.3	-44	Doyle Shale
HOR- 112567	EDR-OW-39-081205	-6.1	-50	Doyle Shale
HOR- 112568	EDR-OW-02-081205	-6.2	-40	Doyle Shale
HOR- 112568	EDR-OW-02-081205*	-6.2	-41	Doyle Shale
HOR- 112564	EDR-OW-01-081205	-6.3	-48	Doyle Shale
HOR- 112566	EDR-N2-1-081205	-6.2	-38	Doyle Shale
HOR- 112563	EDR-W 29D-081105	-6.1	-35	Ft. Riley Limestone
HOR- 112520	EDR-OW-05-063005	-5.4	-41	Ft. Riley Limestone
HOR- 112524	EDR-OW-04-062805	-5.7	-41	Ft. Riley Limestone
HOR- 112523	EDR-OW-03-062805	-6.0	-46	Ft. Riley Limestone
HOR- 112561	EDR-OW-03-081205*	-5.9	-40	Ft. Riley Limestone
HOR- 112528	EDR-W-01D-052605	-5.9	-45	Confined/semiconfined Florence
HOR- 112521	EDR-N3-1-052705	-6.1	-50	Confined/semiconfined Florence
HOR- 112521	EDR-N3-1-052705*	-6.1	-43	Confined/semiconfined Florence

Notes:
* Indicates analytical duplicate

Figure 1. El Dorado LMWL and Precipitation Weighted Mean Isotopic Value

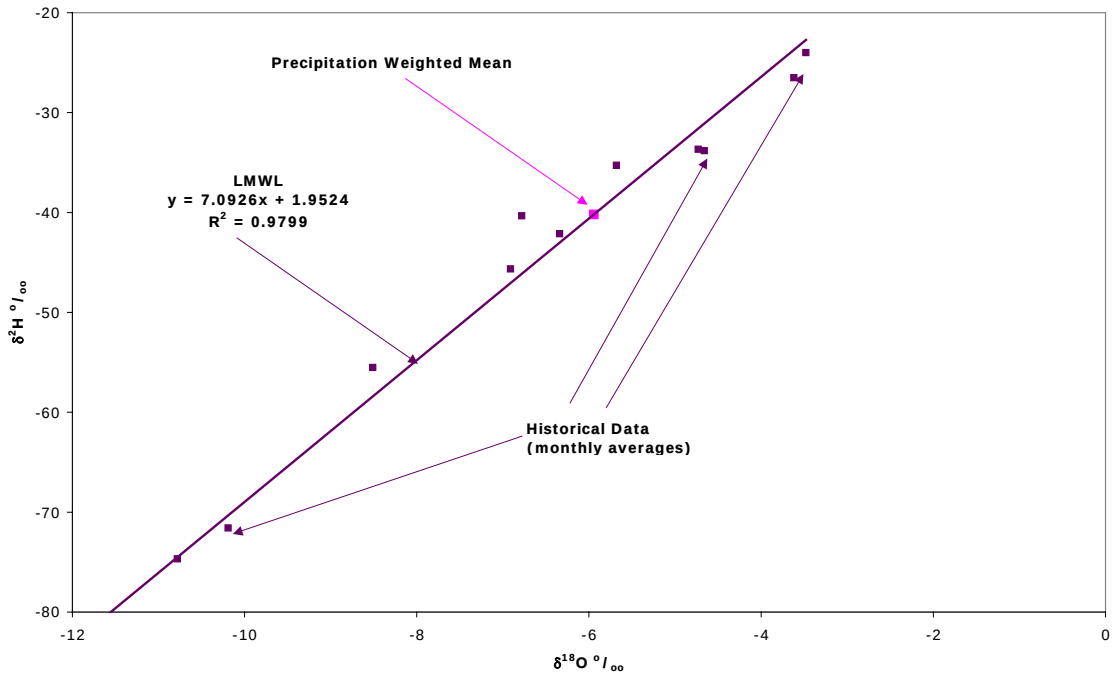


Figure 2. El Dorado Monthly Historical Precipitation and Interpolated Isotopic Data

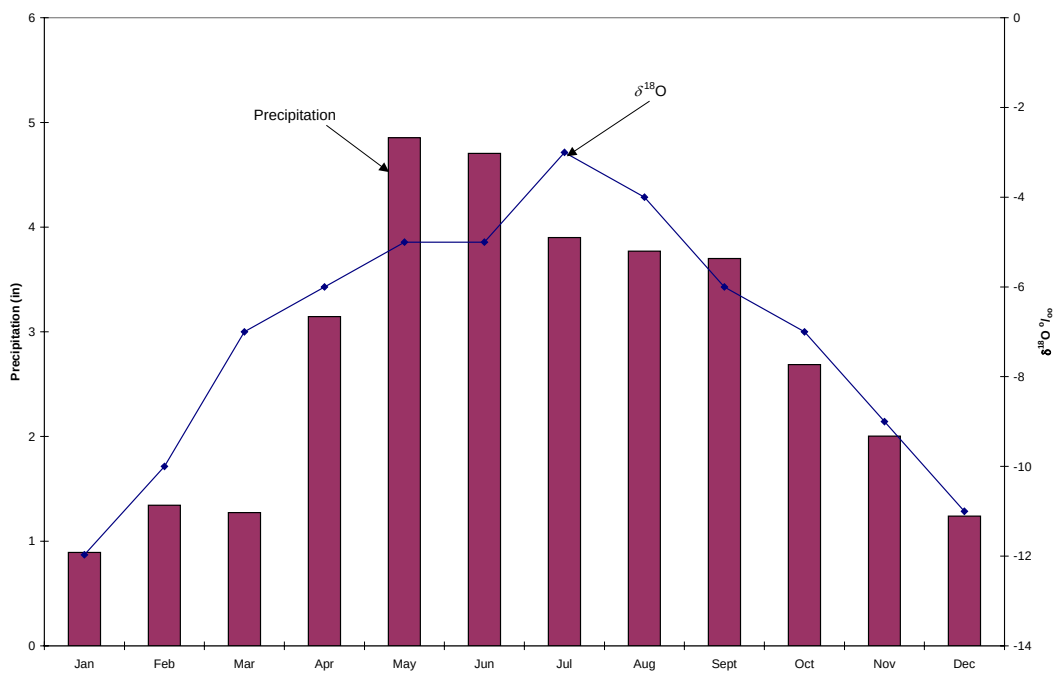
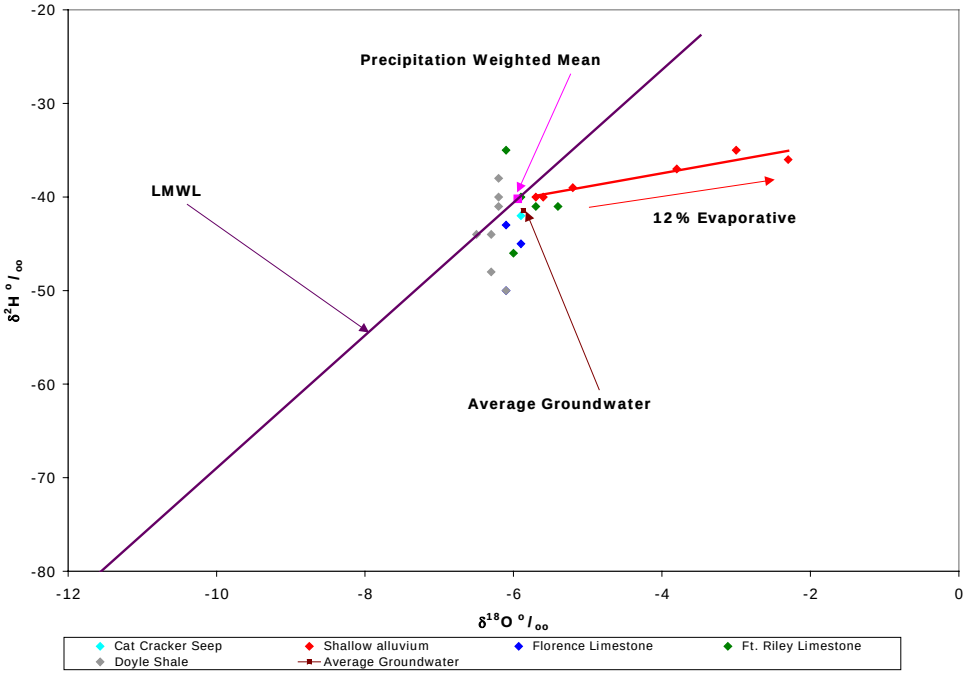
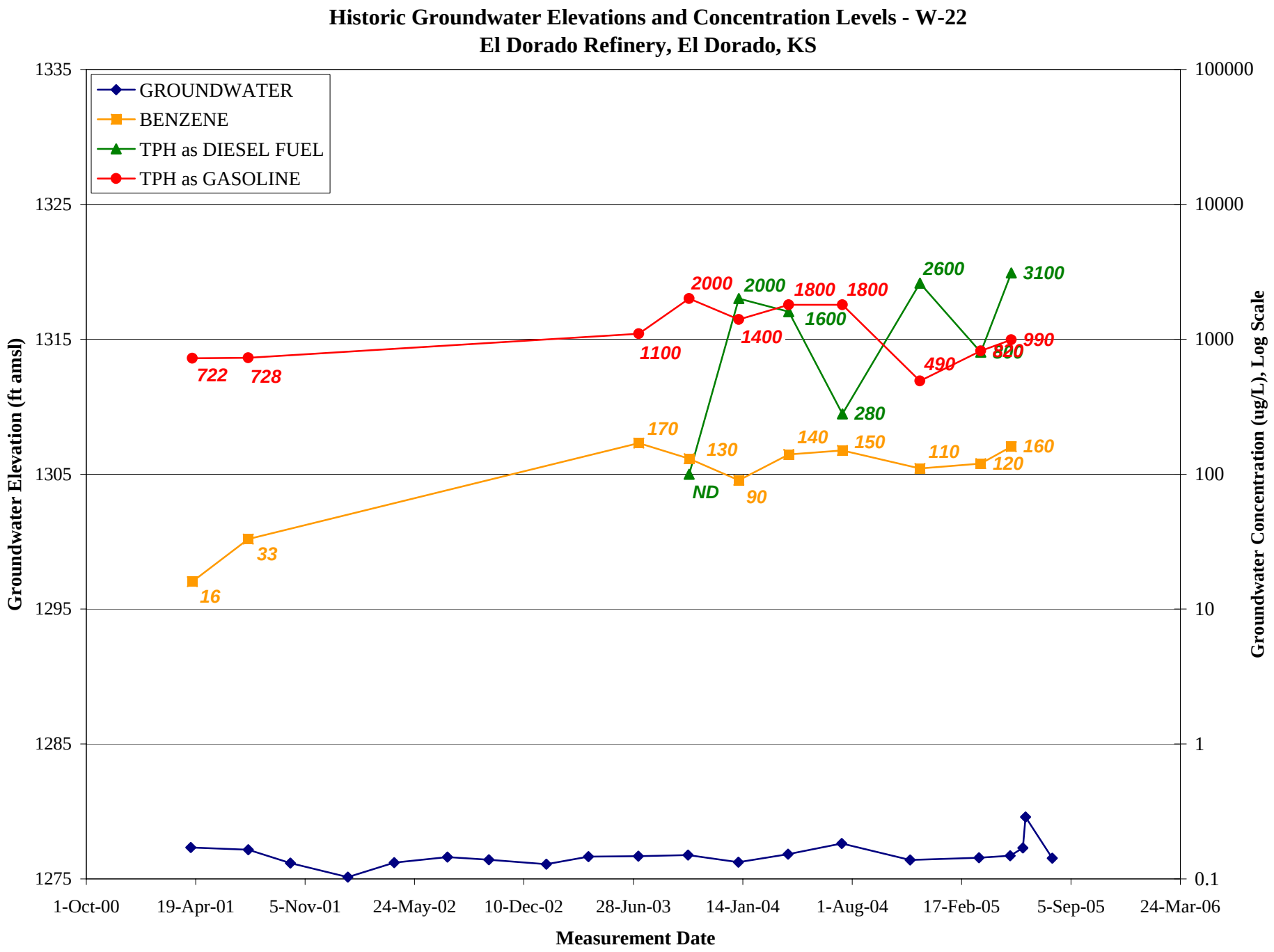


Figure 3. El Dorado Refinery Isotopic Data

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El Dorado Refinery, El Dorado, KS
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TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
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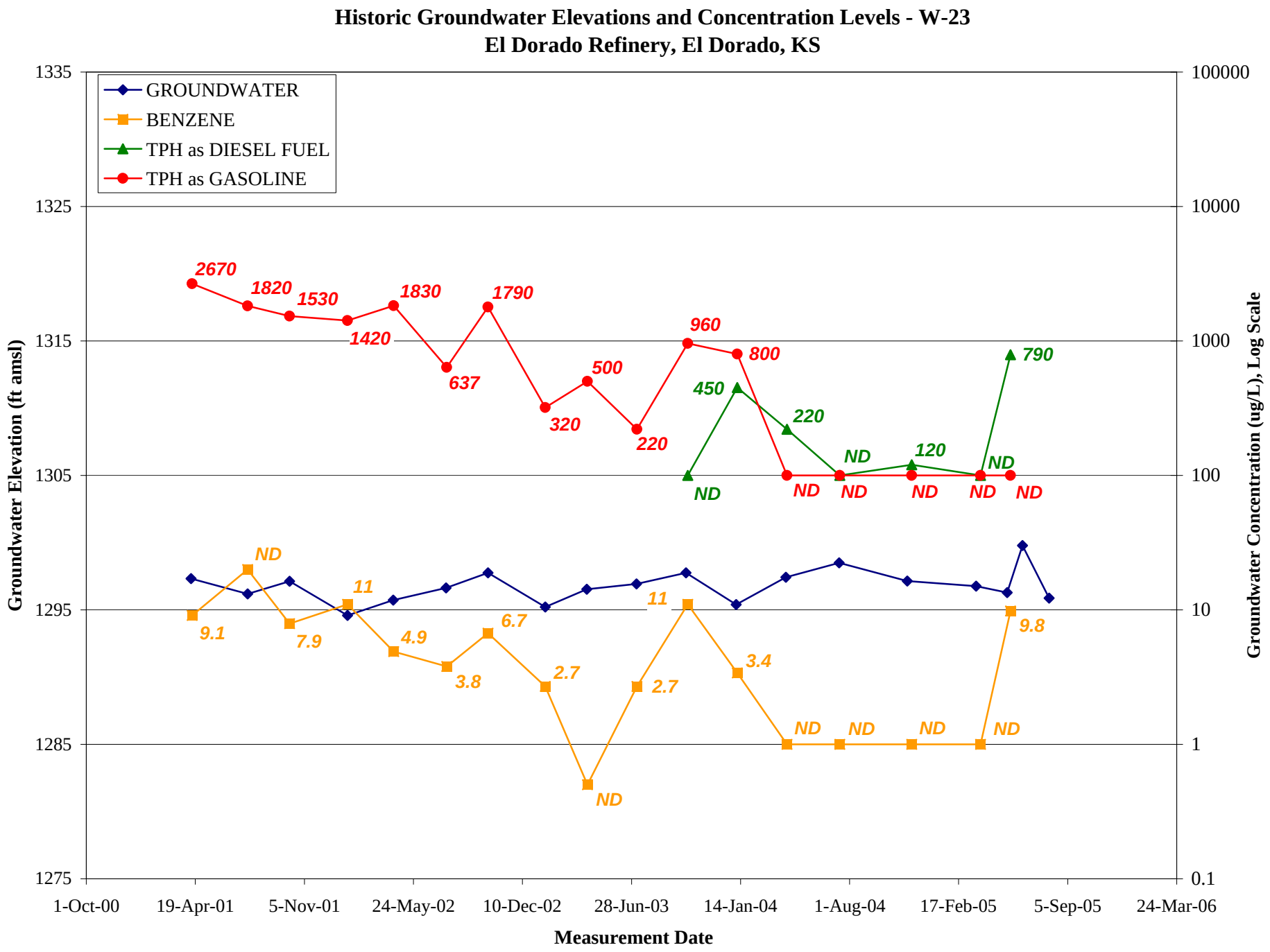
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TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
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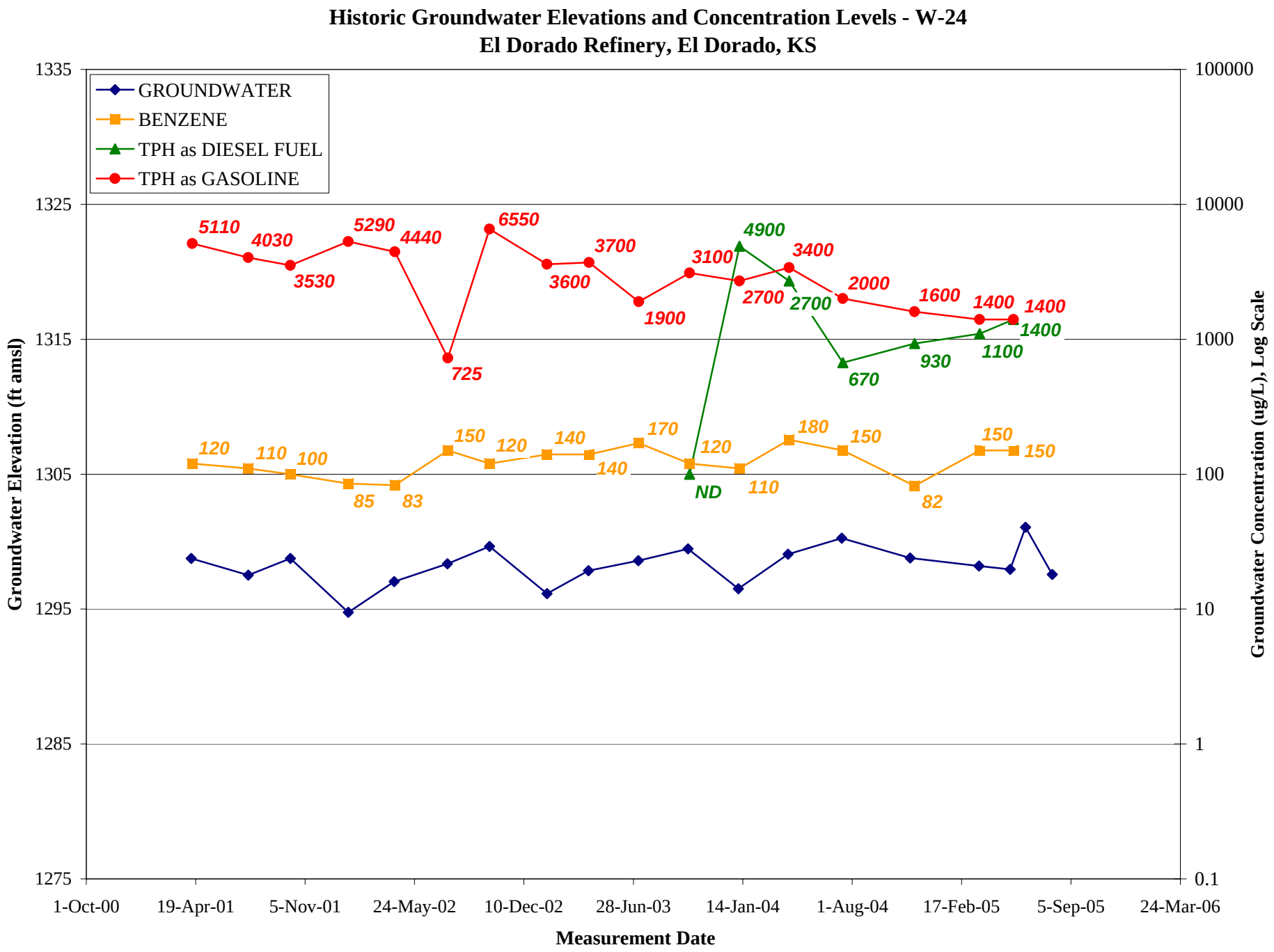
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Groundwater Concentration (ug/L), Log Scale
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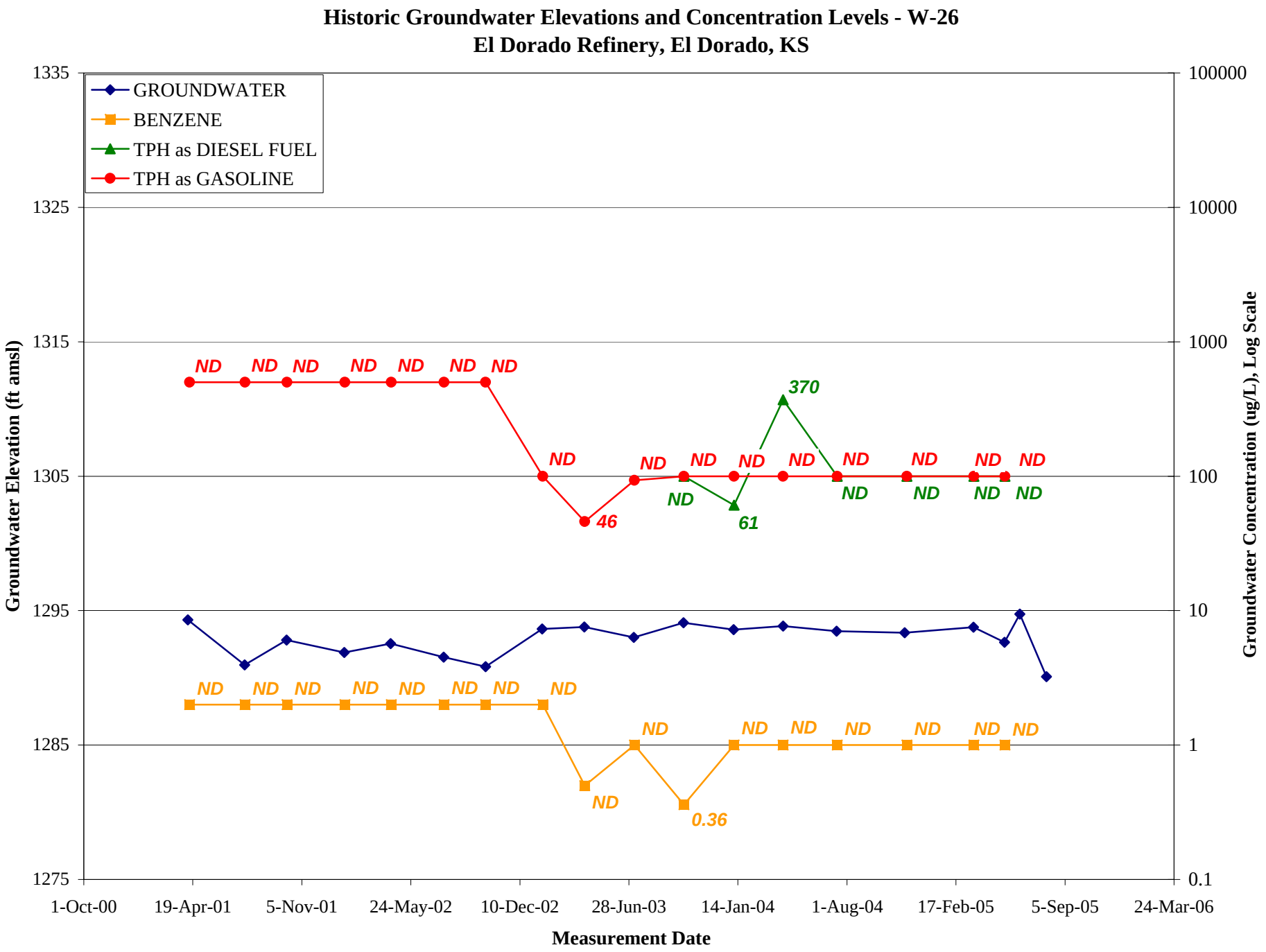
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TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
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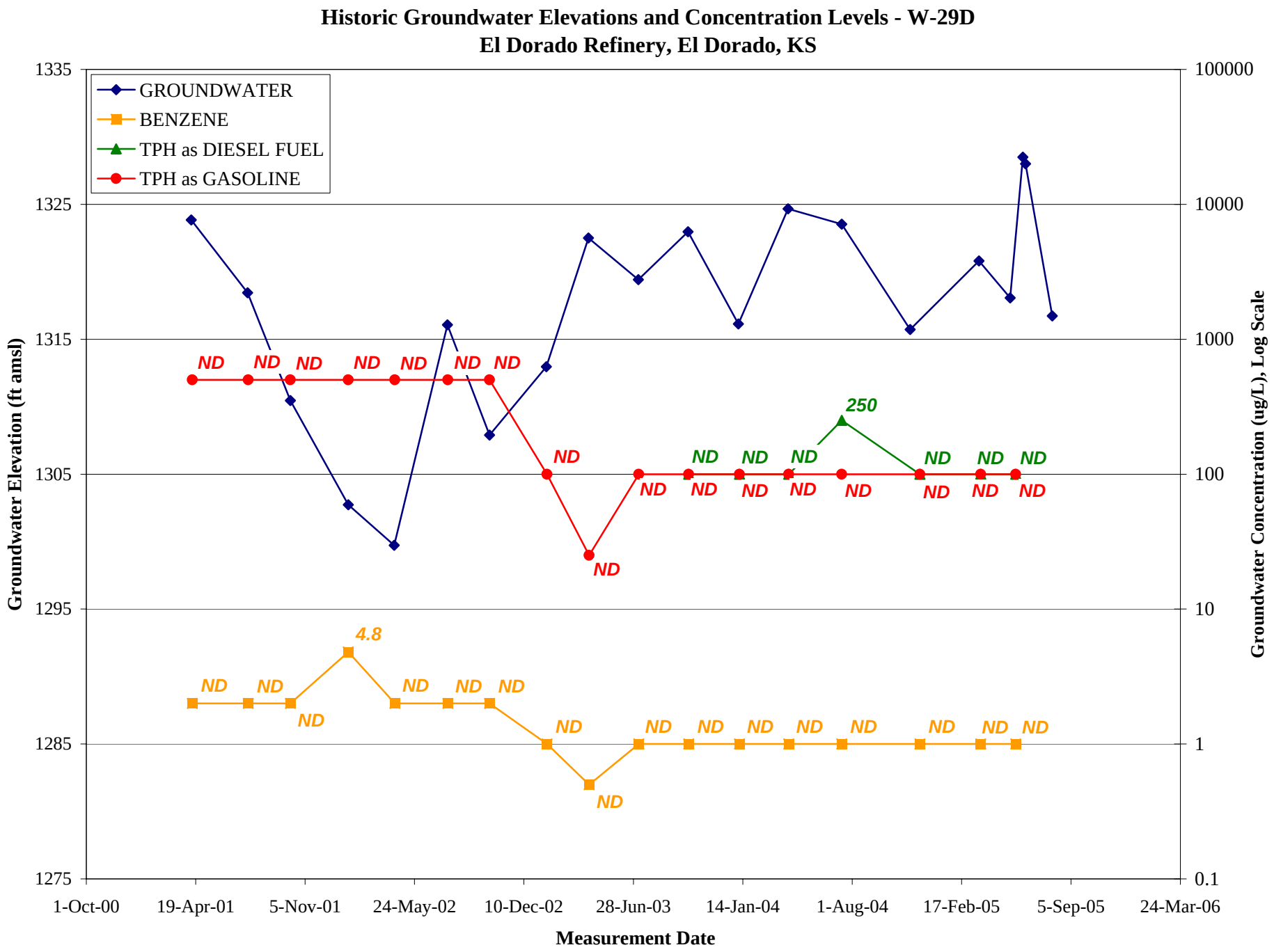
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Groundwater Concentration (ug/L), Log Scale
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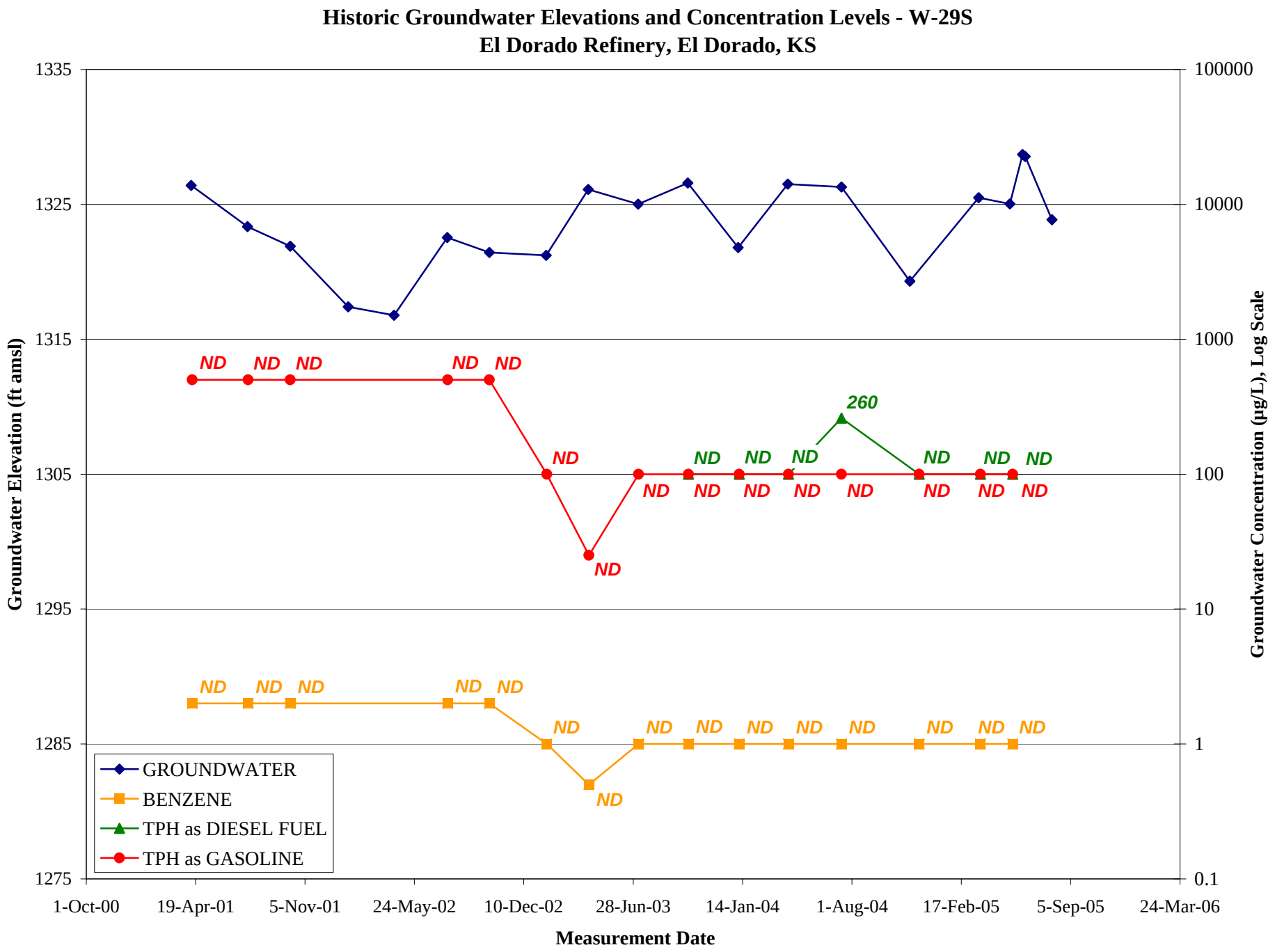
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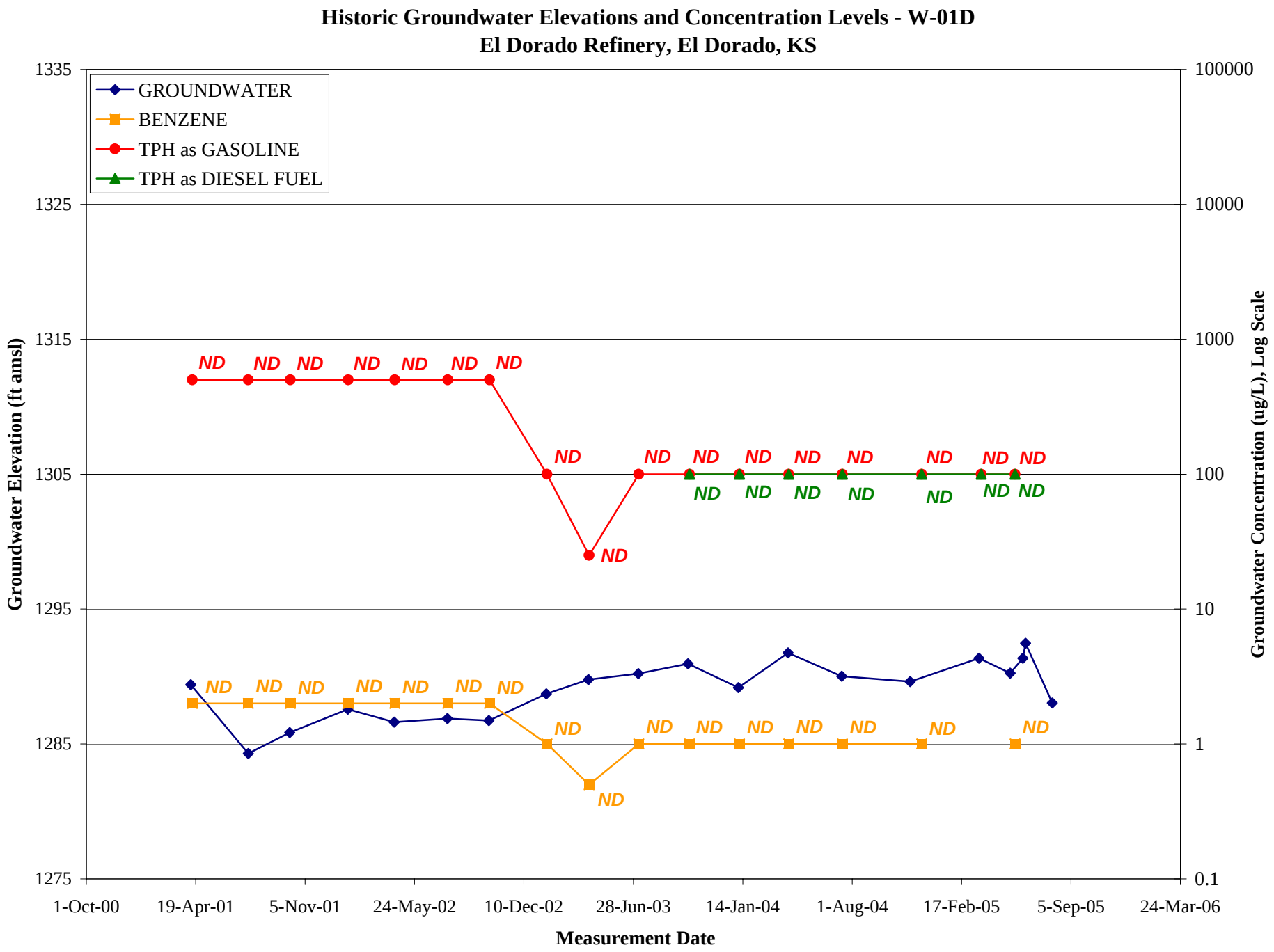
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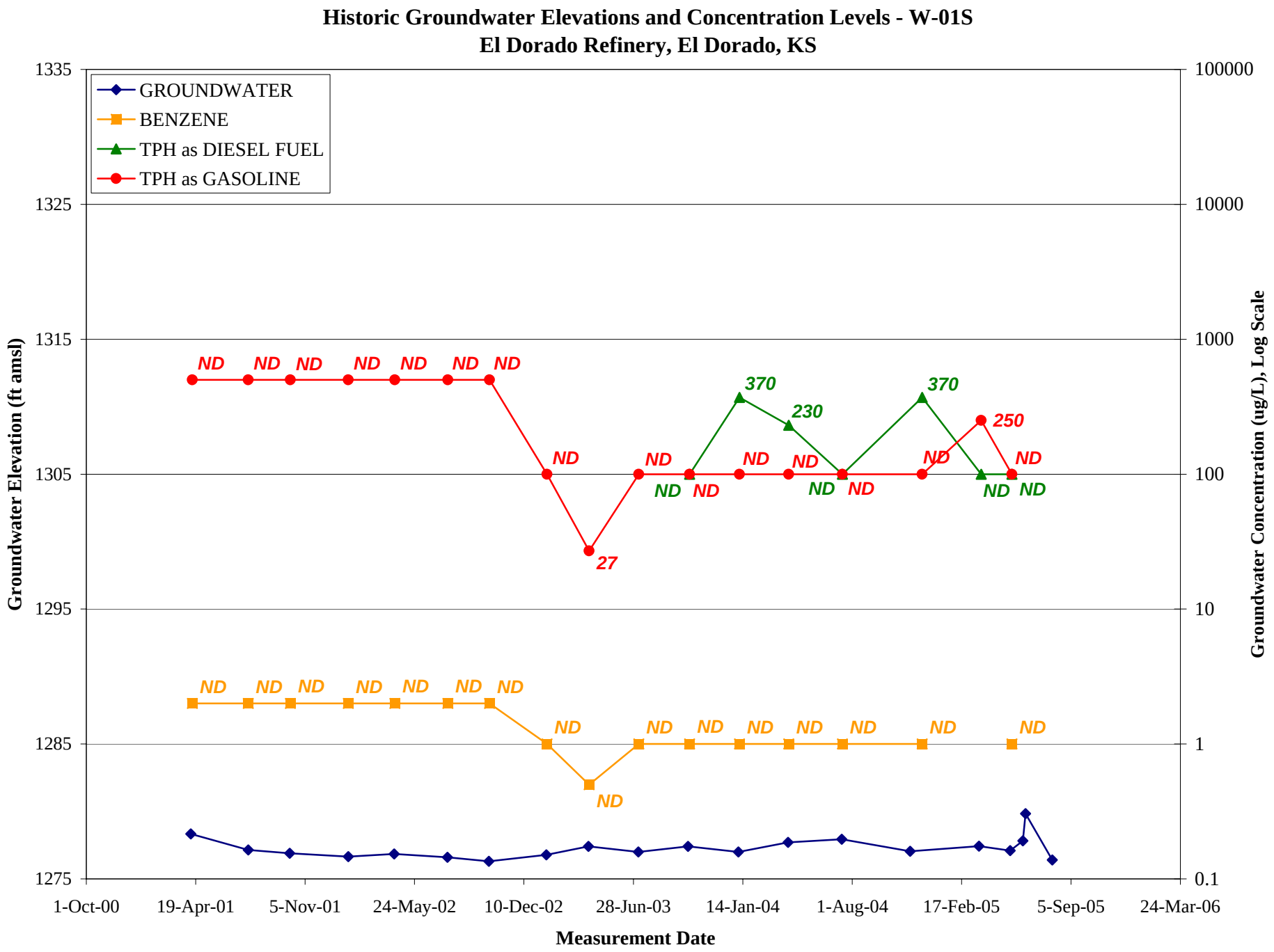
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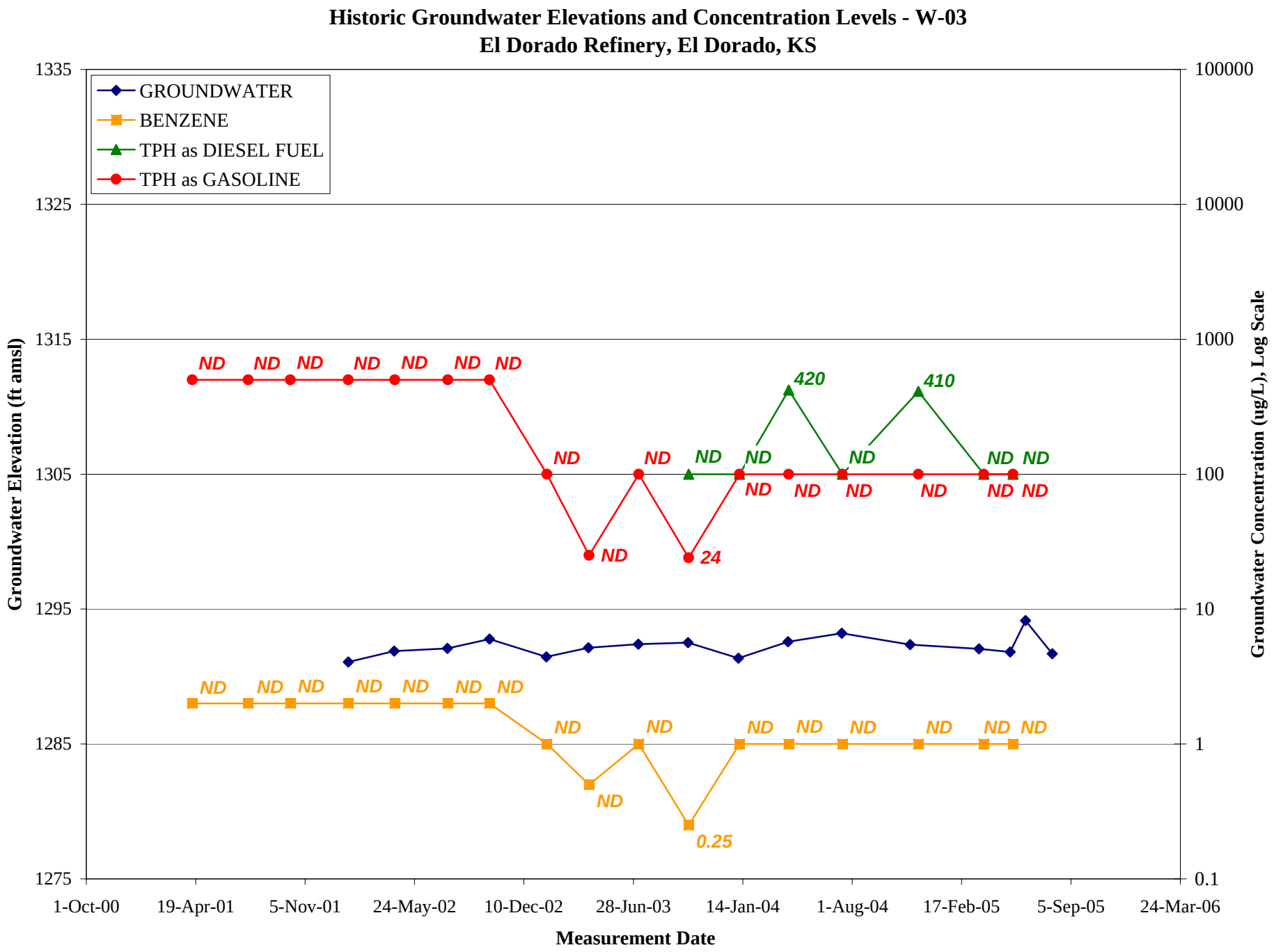
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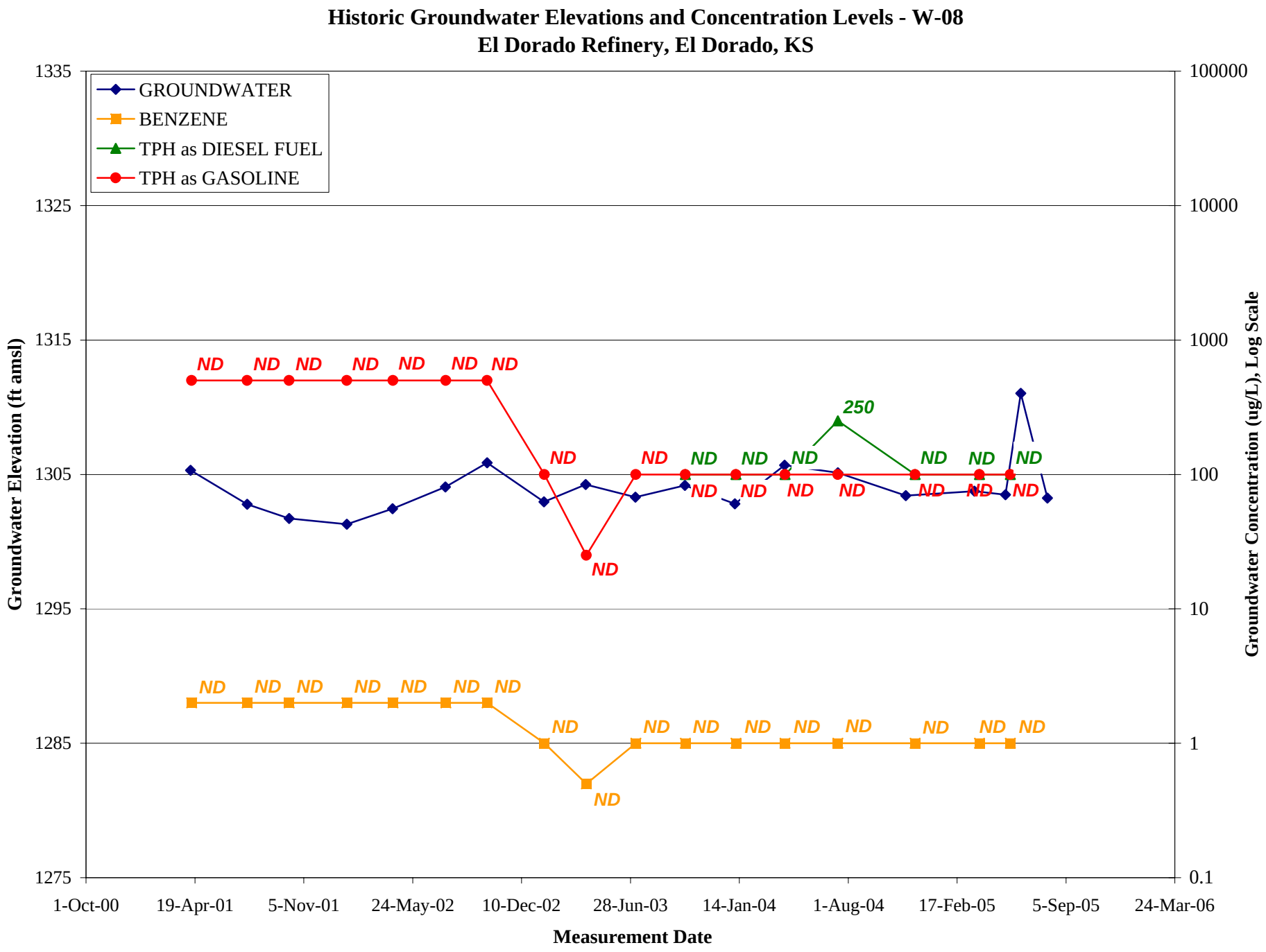
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Groundwater Concentration (ug/L), Log Scale
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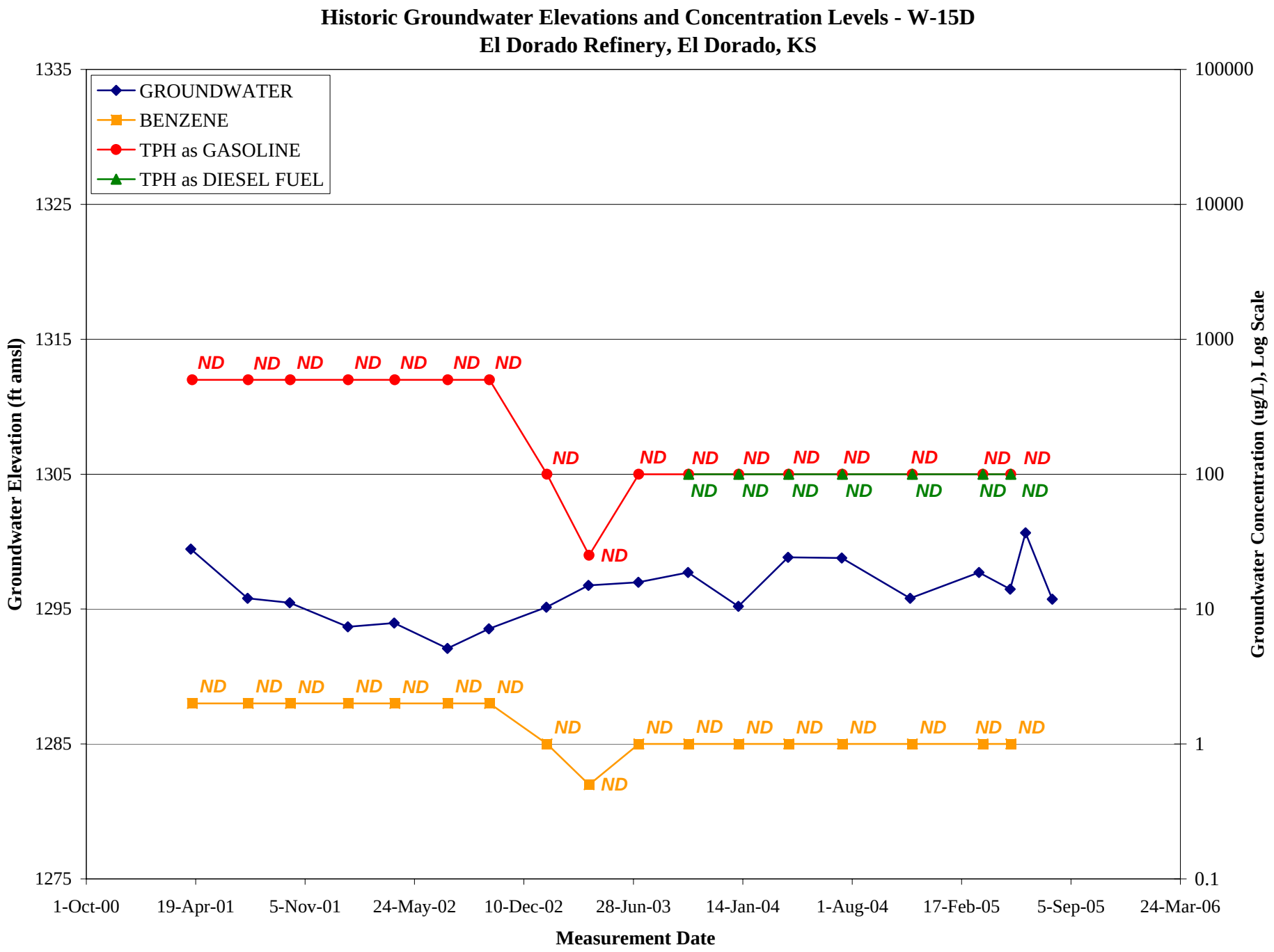
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TPH as DIESEL FUEL
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Groundwater Concentration (ug/L), Log Scale
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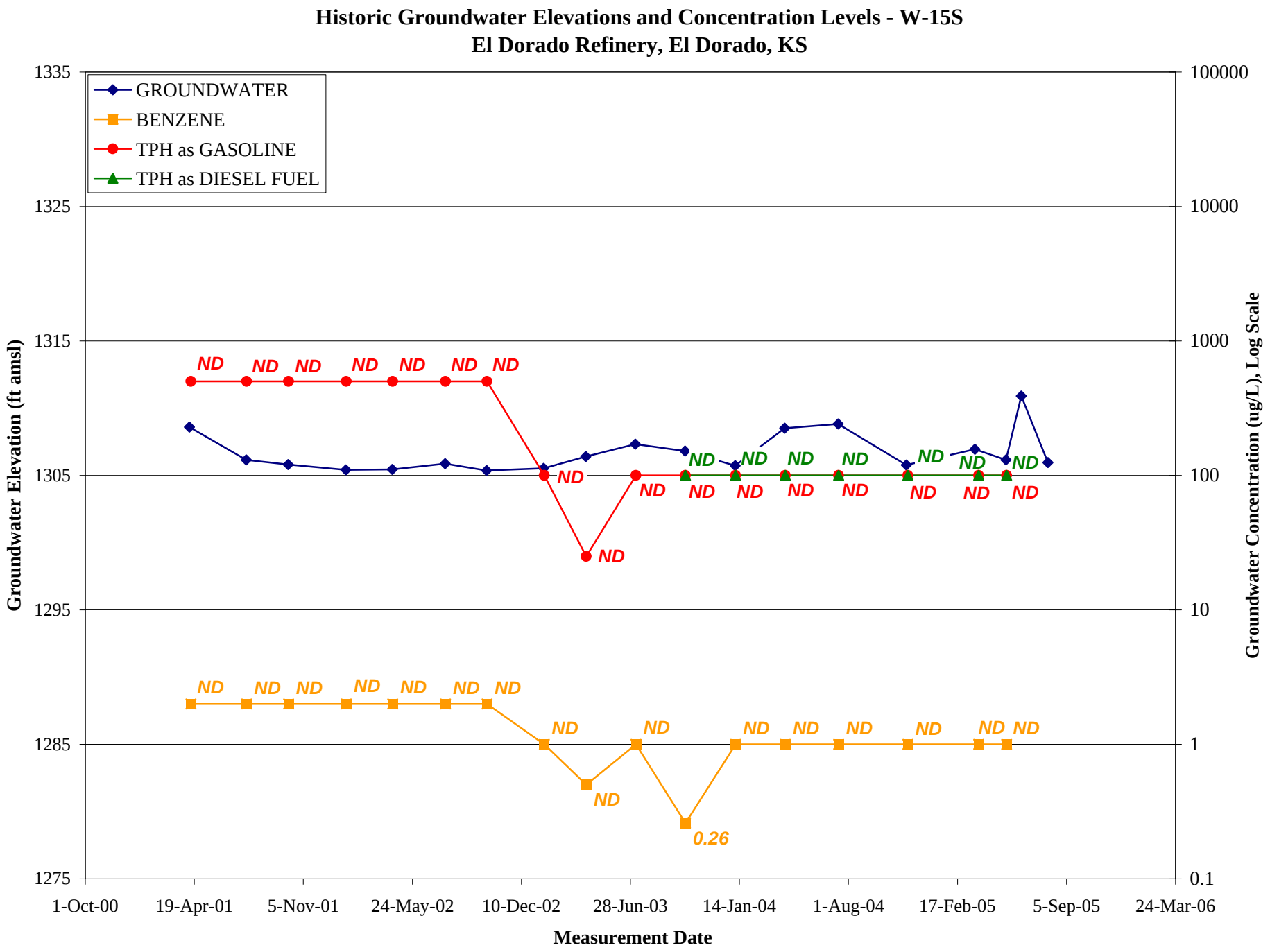
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TPH as DIESEL FUEL
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Groundwater Concentration (ug/L), Log Scale
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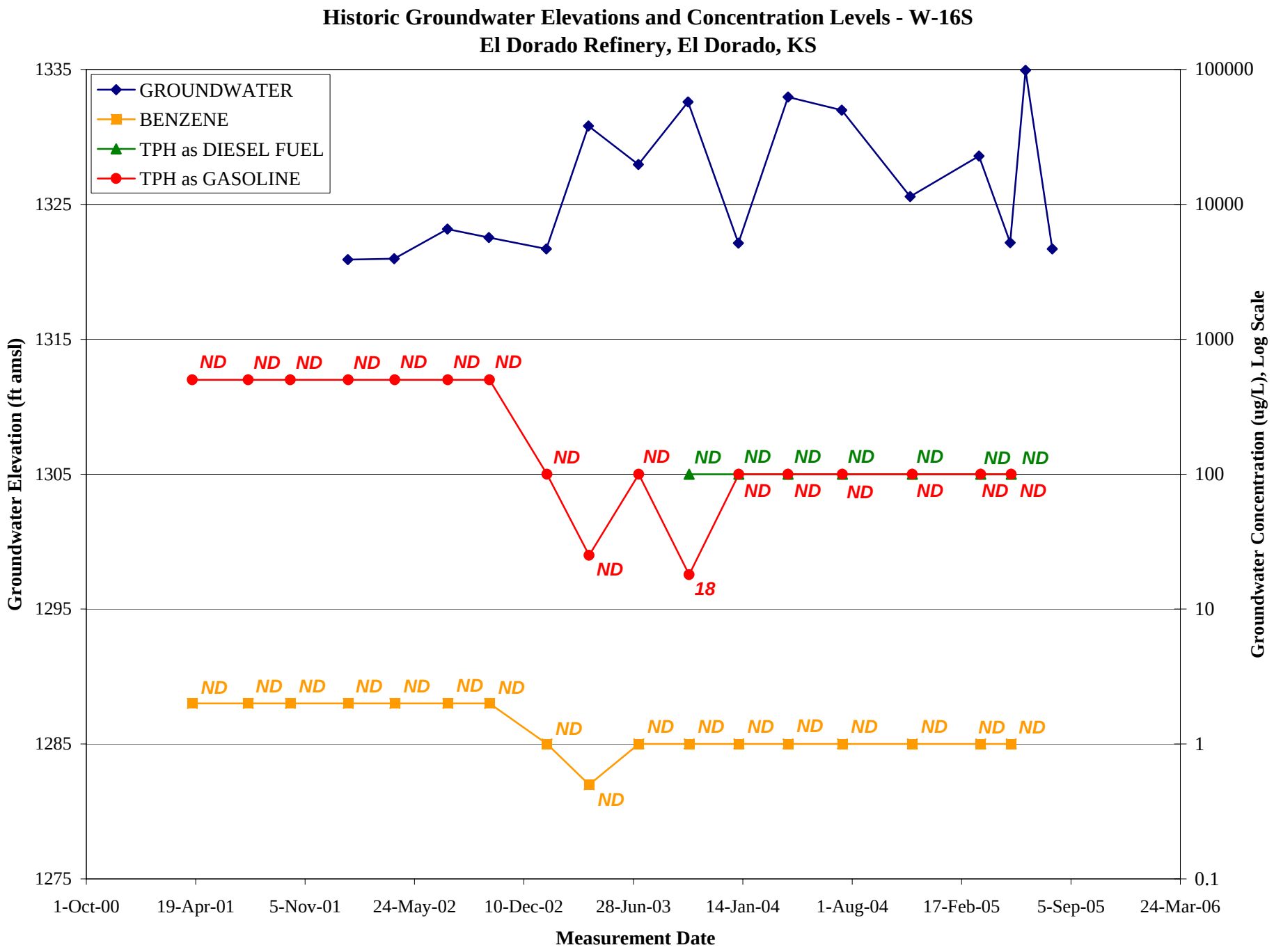
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TPH as GASOLINE
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Groundwater Concentration (ug/L), Log Scale
Measurement Date
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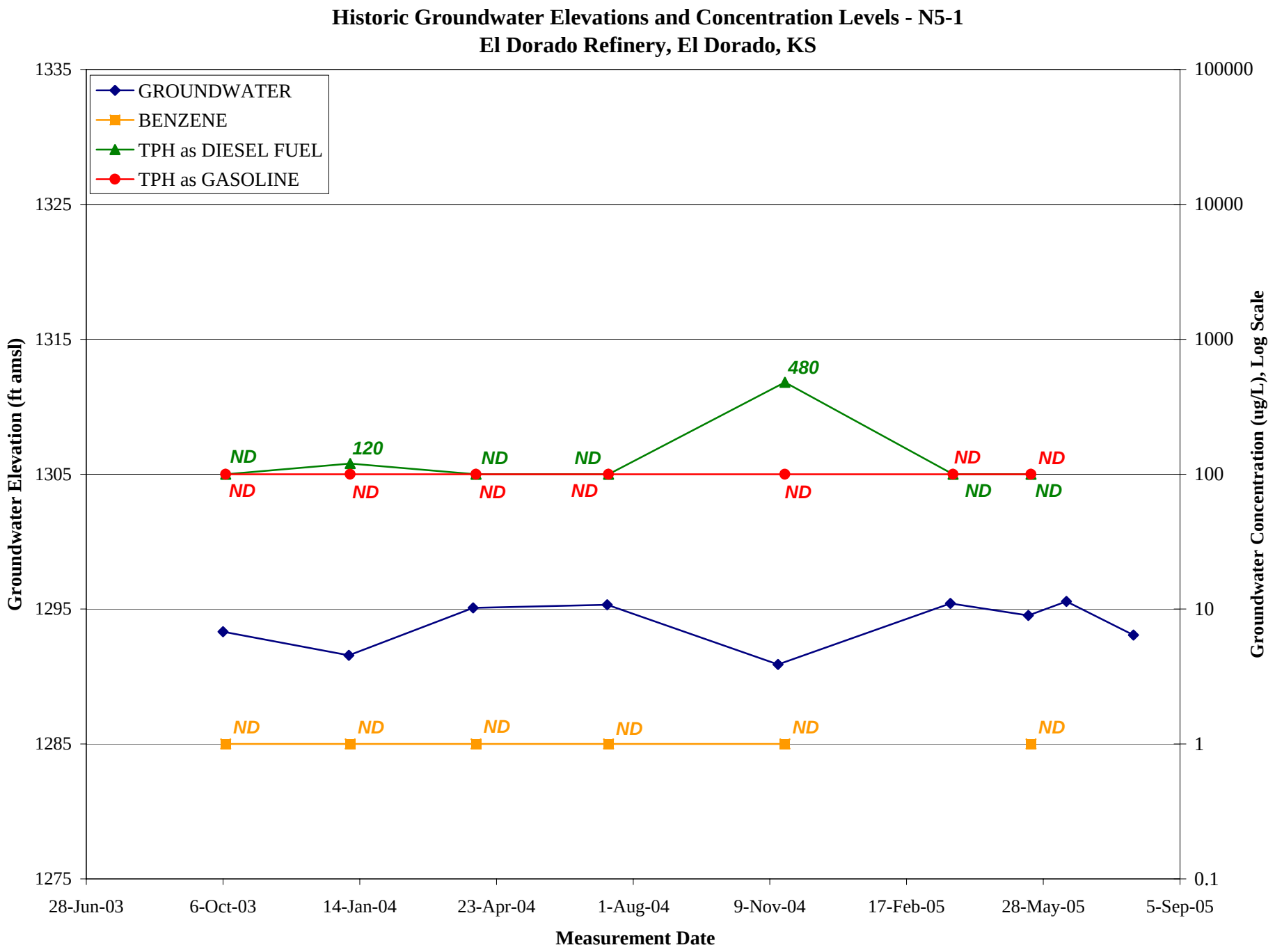
Historic Groundwater Elevations and Concentration Levels - N5-1
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
1335
1325
1315
1305
1295
1285
1275
100000
10000
1000
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28-Jun-03
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9-Nov-04
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28-May-05
5-Sep-05
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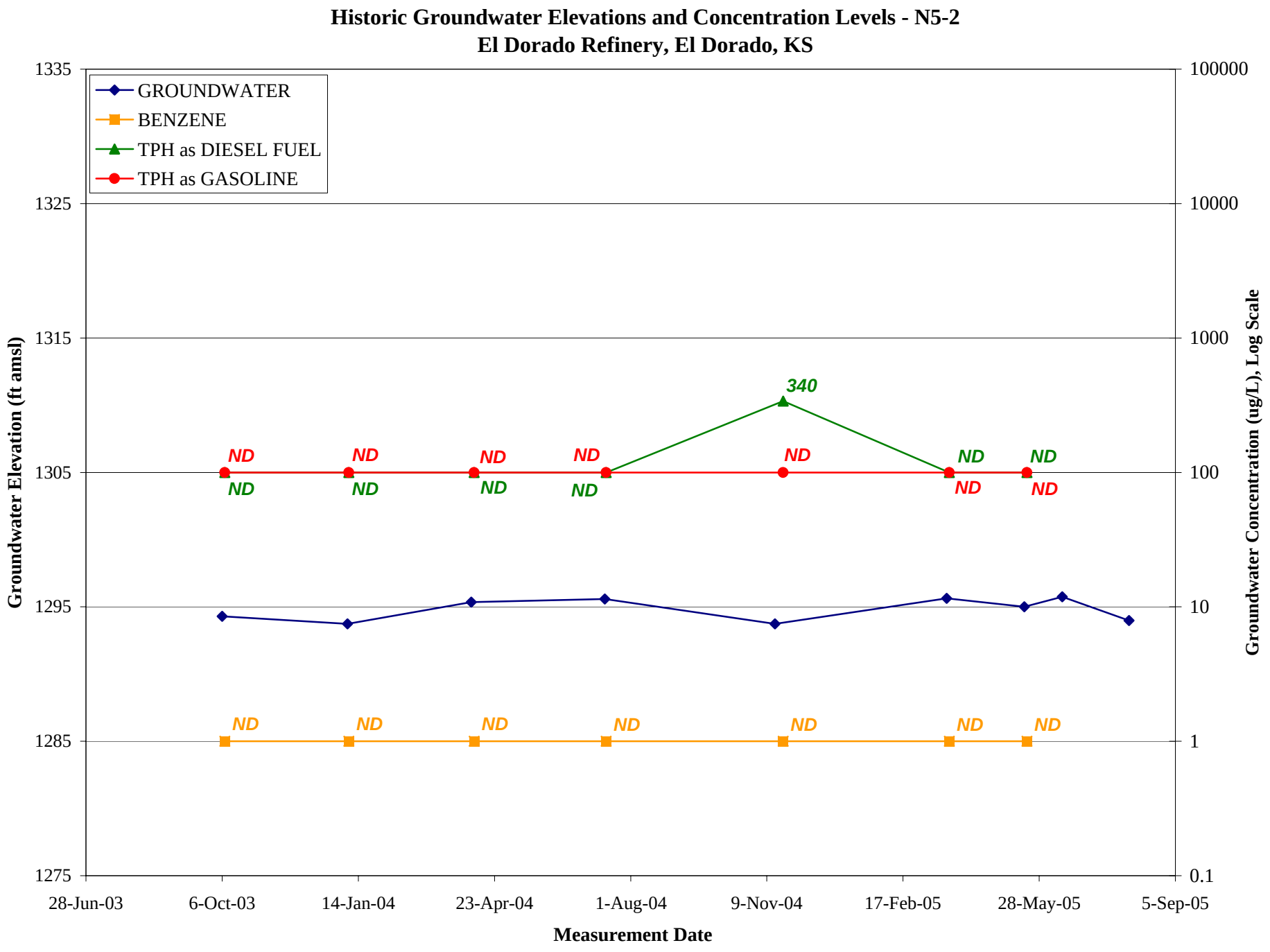
Historic Groundwater Elevations and Concentration Levels - N5-2
El Dorado Refinery, El Dorado, KS
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BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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1325
1315
1305
1295
1285
1275
100000
10000
1000
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28-May-05
5-Sep-05
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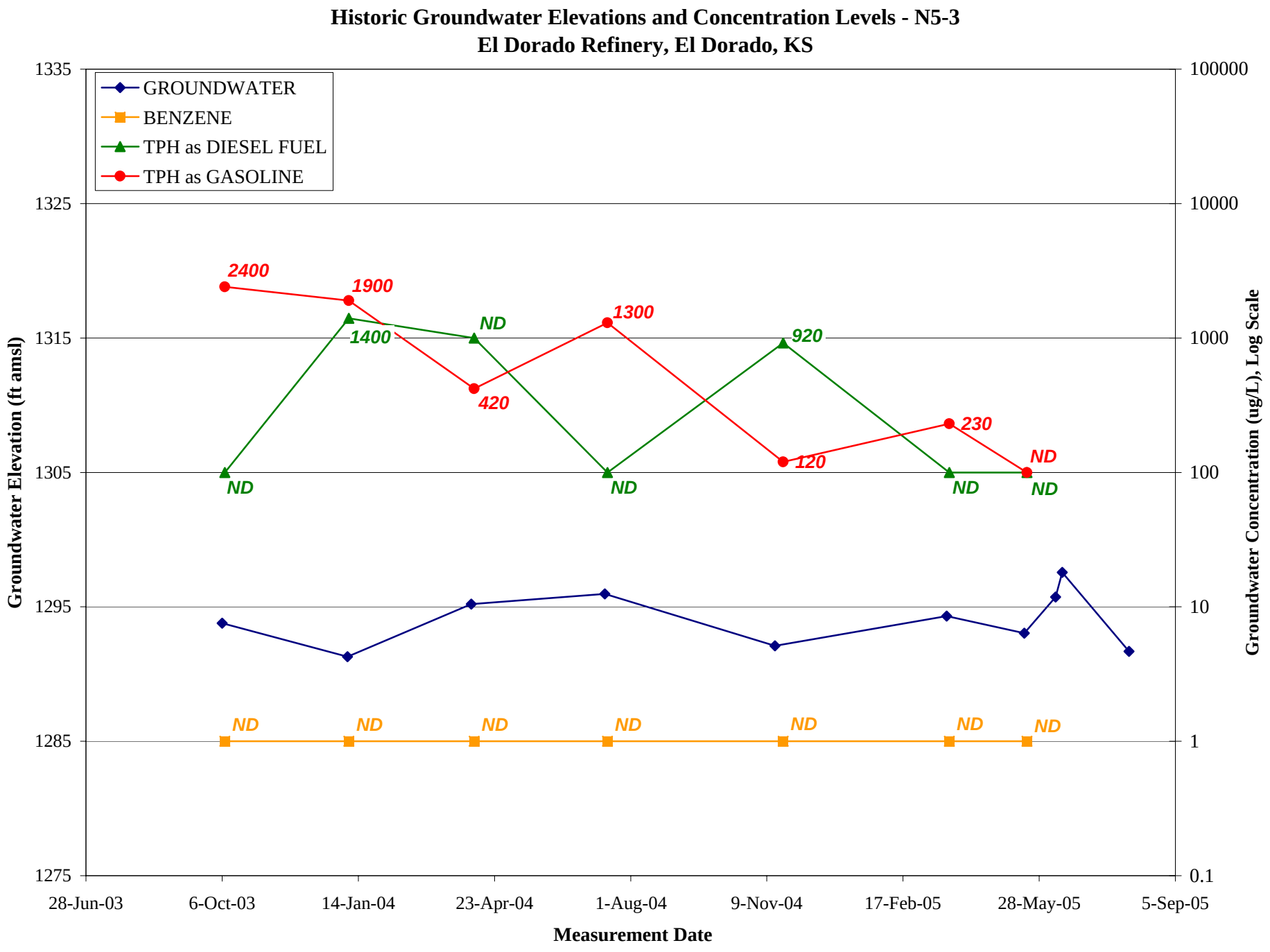
Historic Groundwater Elevations and Concentration Levels - N5-3
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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1285
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28-Jun-03
6-Oct-03
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23-Apr-04
1-Aug-04
9-Nov-04
17-Feb-05
28-May-05
5-Sep-05
2400
1900
420
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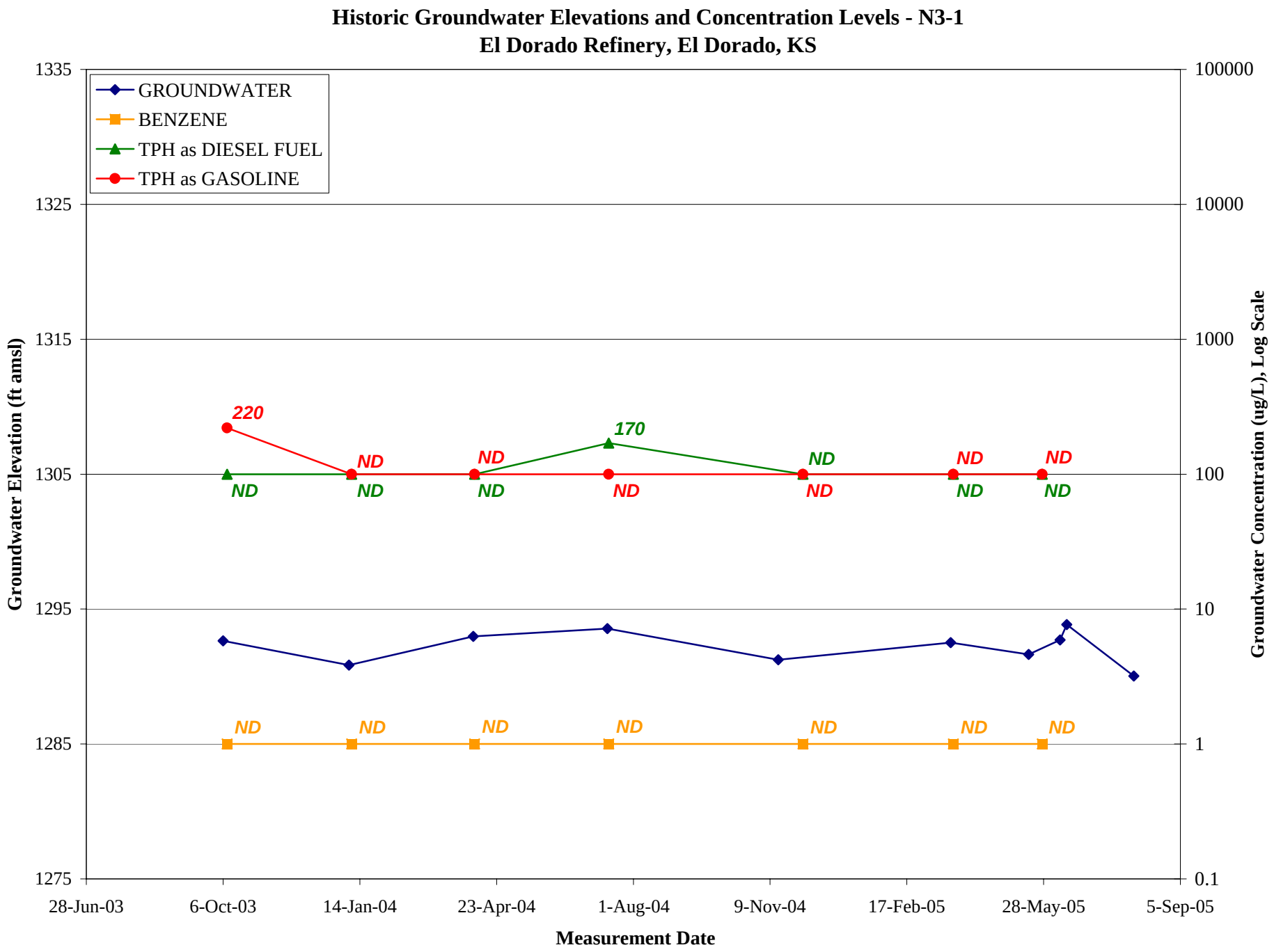
Historic Groundwater Elevations and Concentration Levels - N3-1
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
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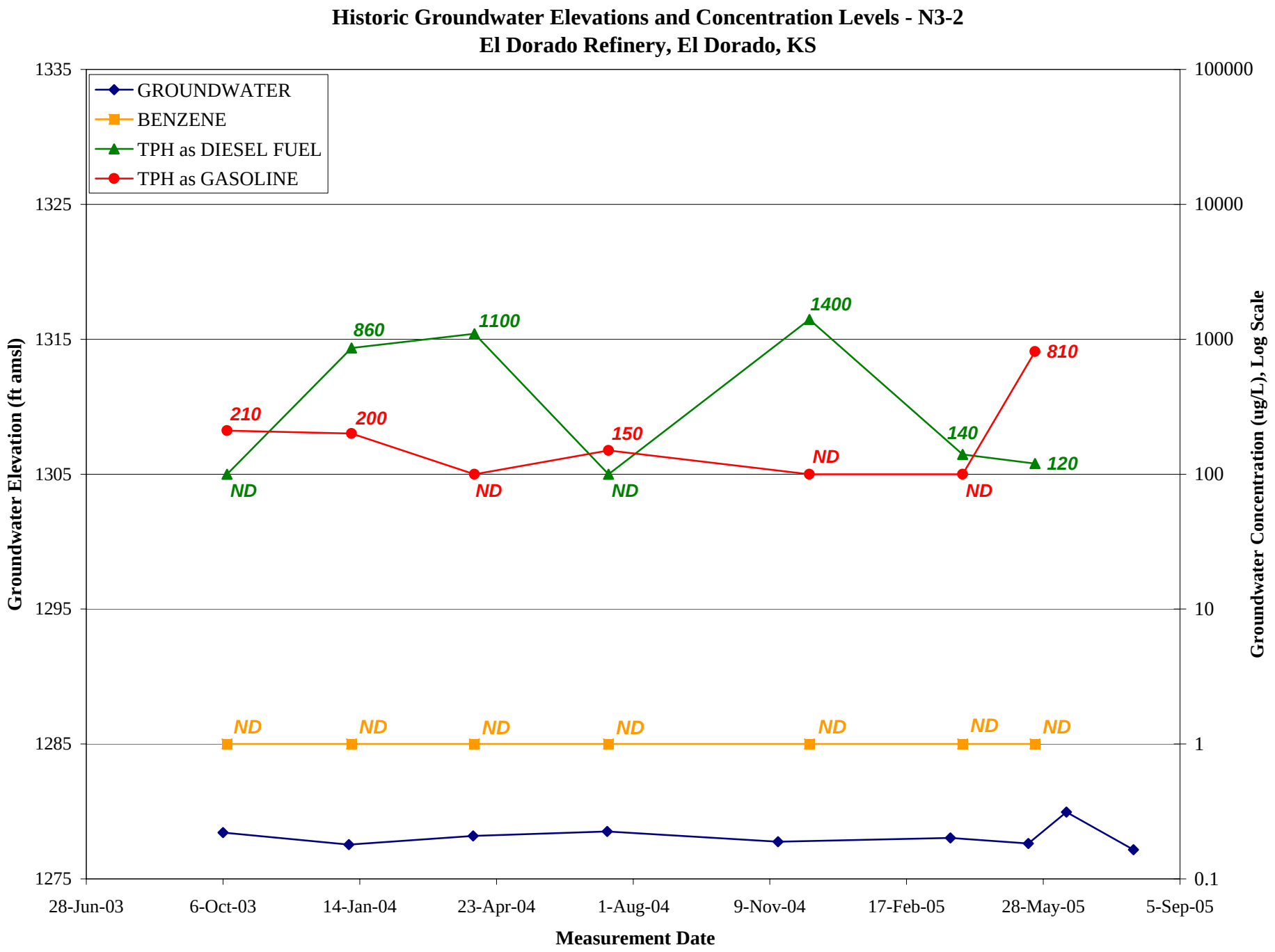
Historic Groundwater Elevations and Concentration Levels - N3-2
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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17-Feb-05
28-May-05
5-Sep-05
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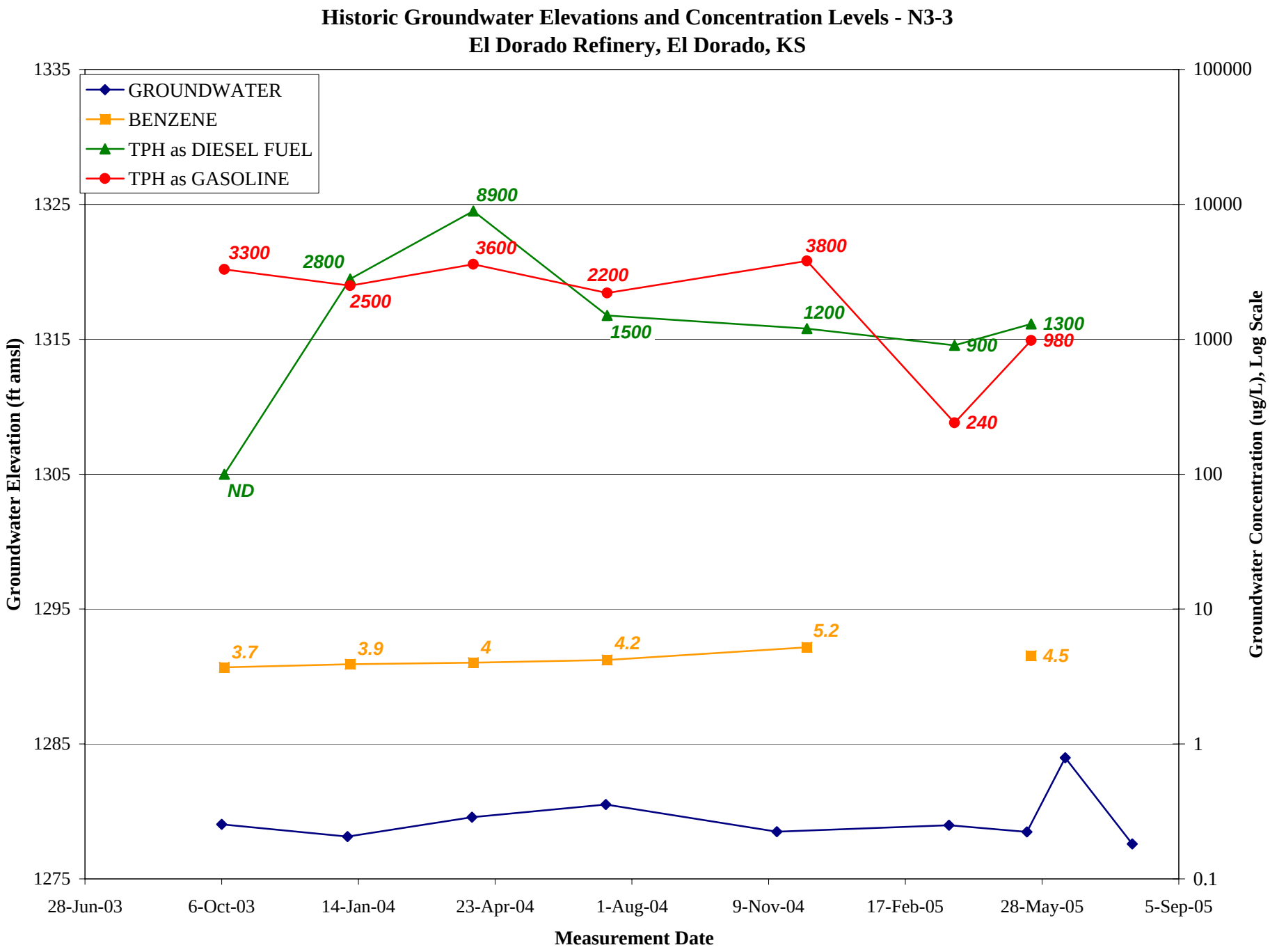
Historic Groundwater Elevations and Concentration Levels - N3-3
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
6-Oct-03
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28-May-05
5-Sep-05
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2800
2500
8900
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3.9
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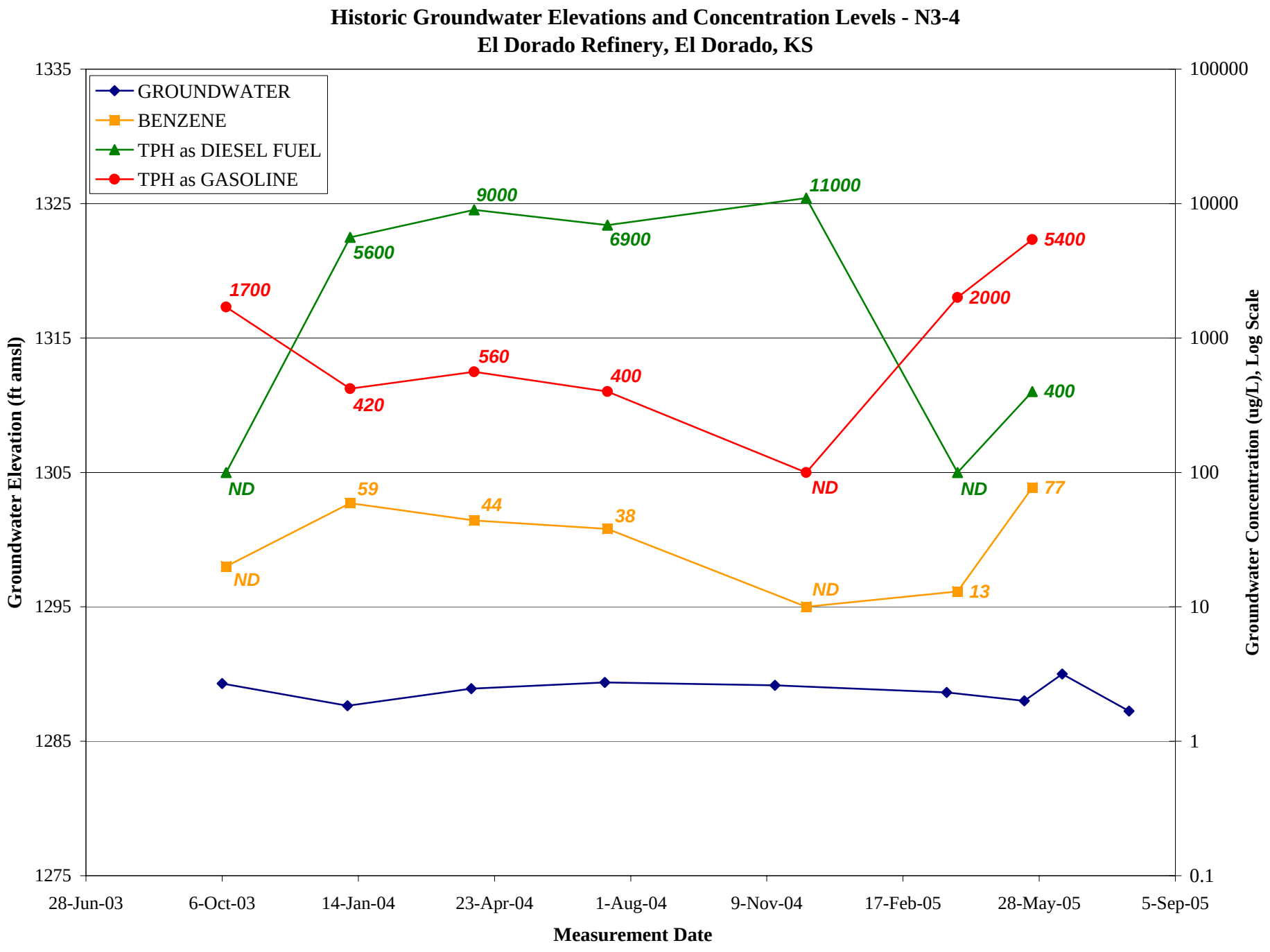
4.2
5.2
4.5


Historic Groundwater Elevations and Concentration Levels - N3-4
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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1700
420
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400
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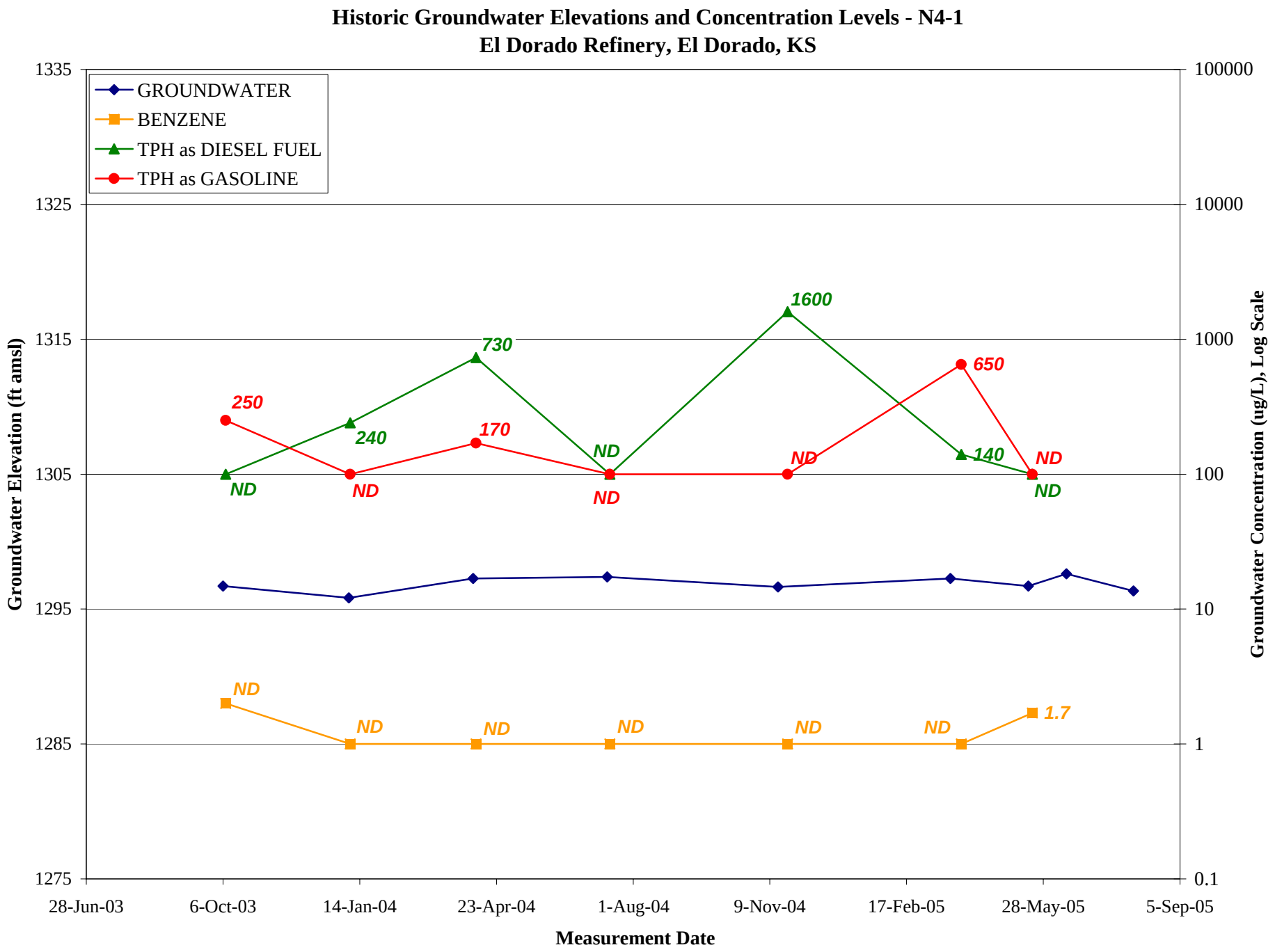
Historic Groundwater Elevations and Concentration Levels - N4-1
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
6-Oct-03
14-Jan-04
23-Apr-04
1-Aug-04
9-Nov-04
17-Feb-05
28-May-05
5-Sep-05
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ND
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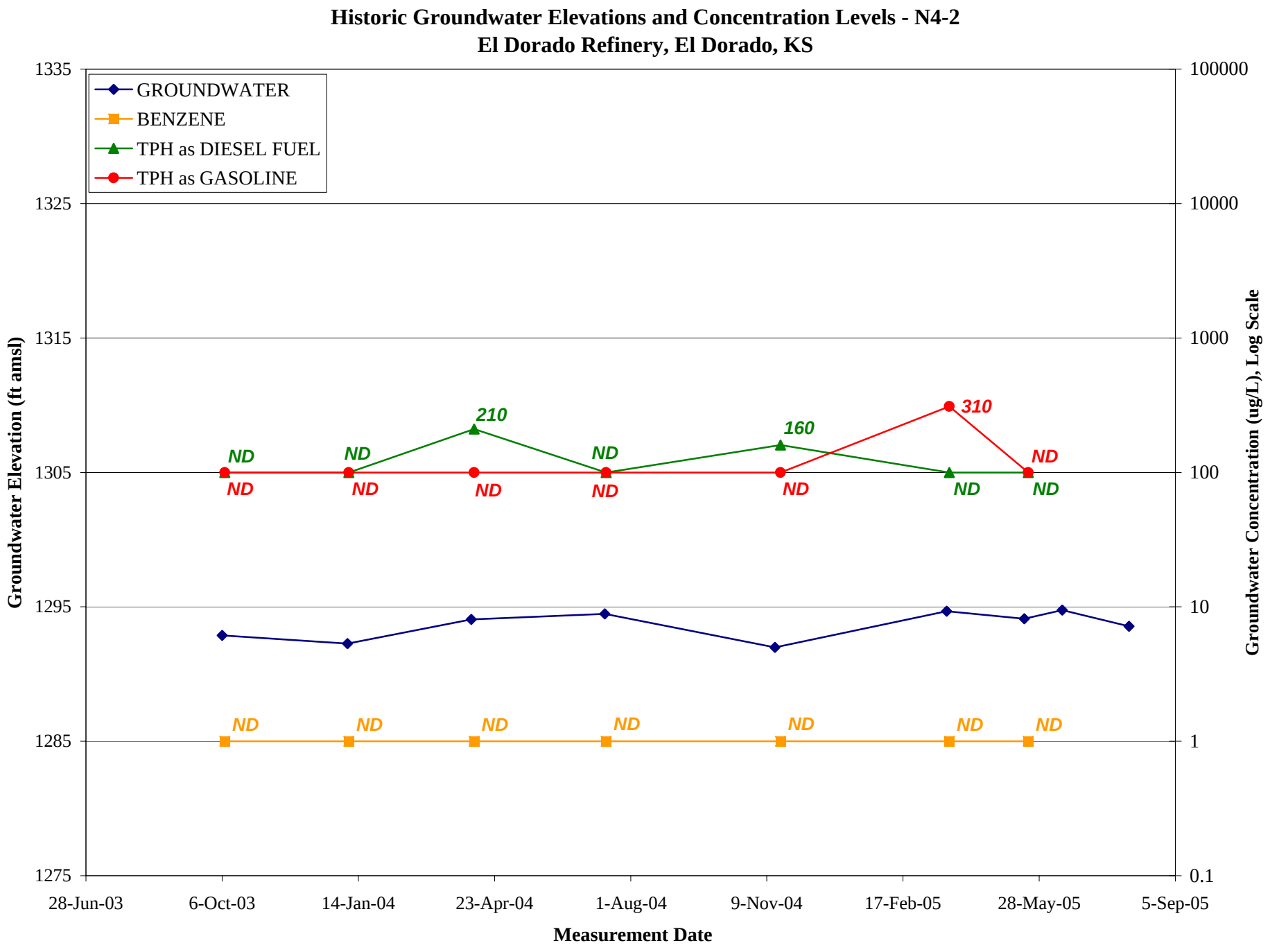
Historic Groundwater Elevations and Concentration Levels - N4-2
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
1335
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28-Jun-03
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5-Sep-05
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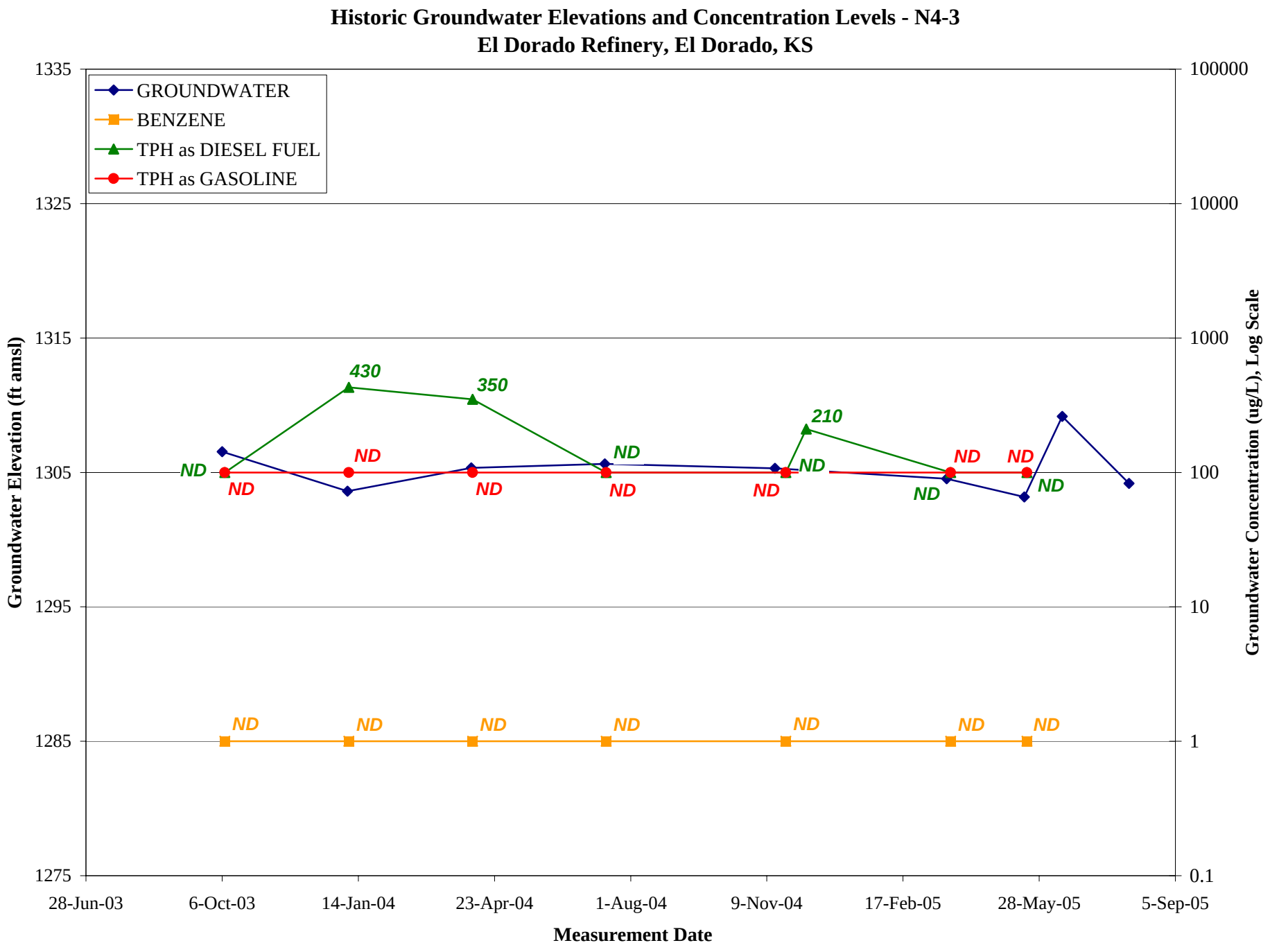
Historic Groundwater Elevations and Concentration Levels - N4-3
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
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28-May-05
5-Sep-05
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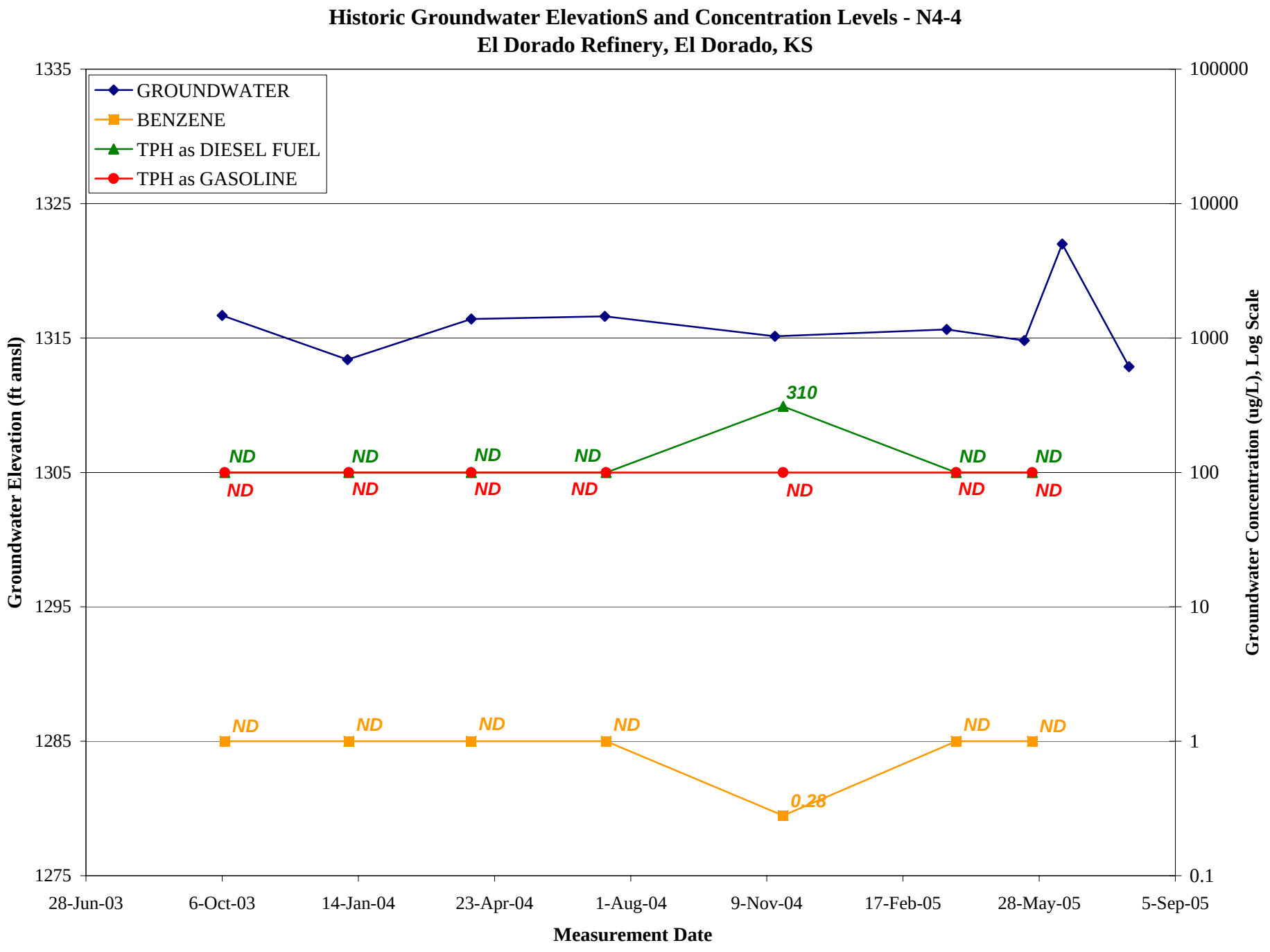
210
ND


Historic Groundwater ElevationS and Concentration Levels - N4-4
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
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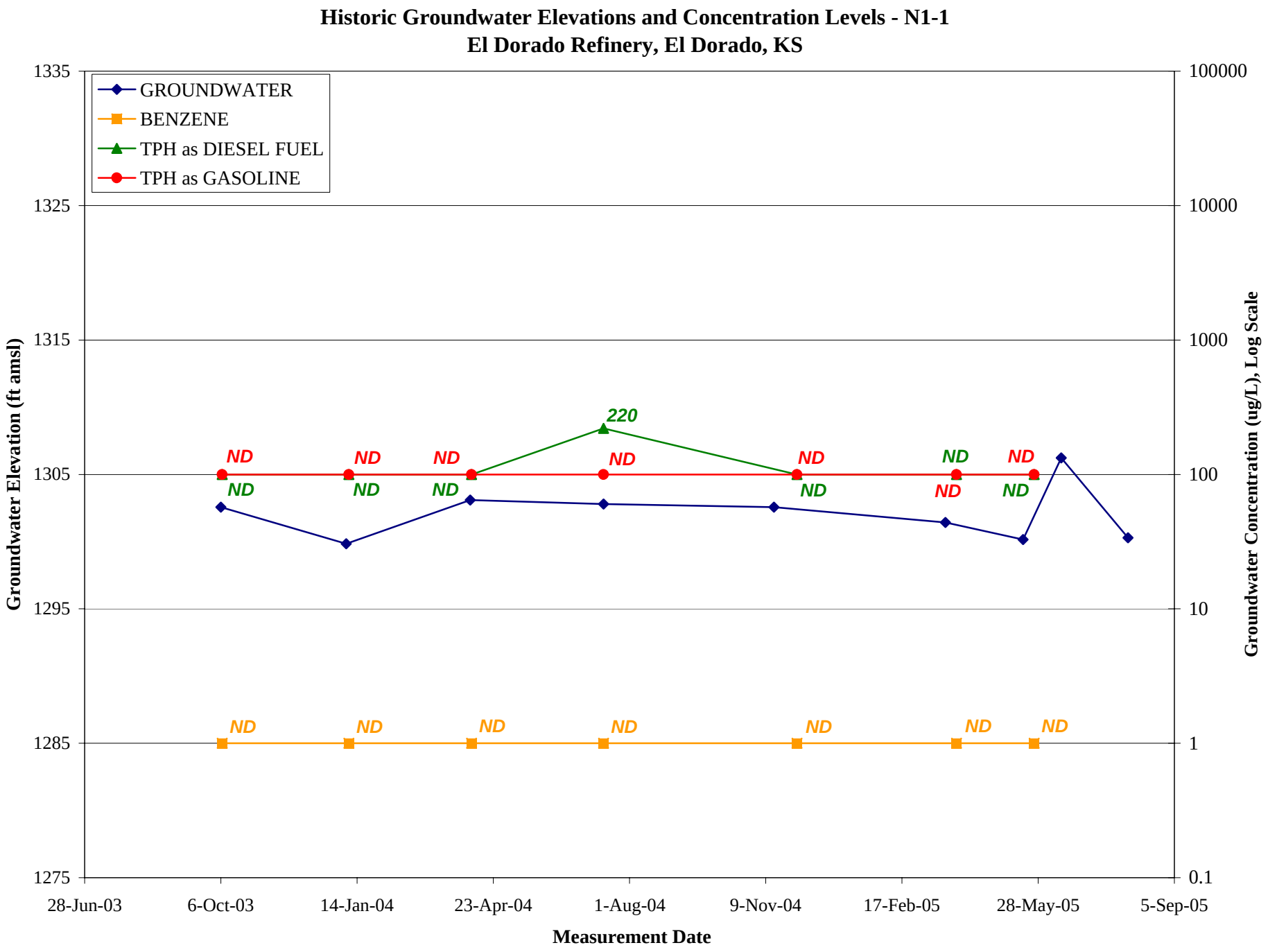
Historic Groundwater Elevations and Concentration Levels - N1-1
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
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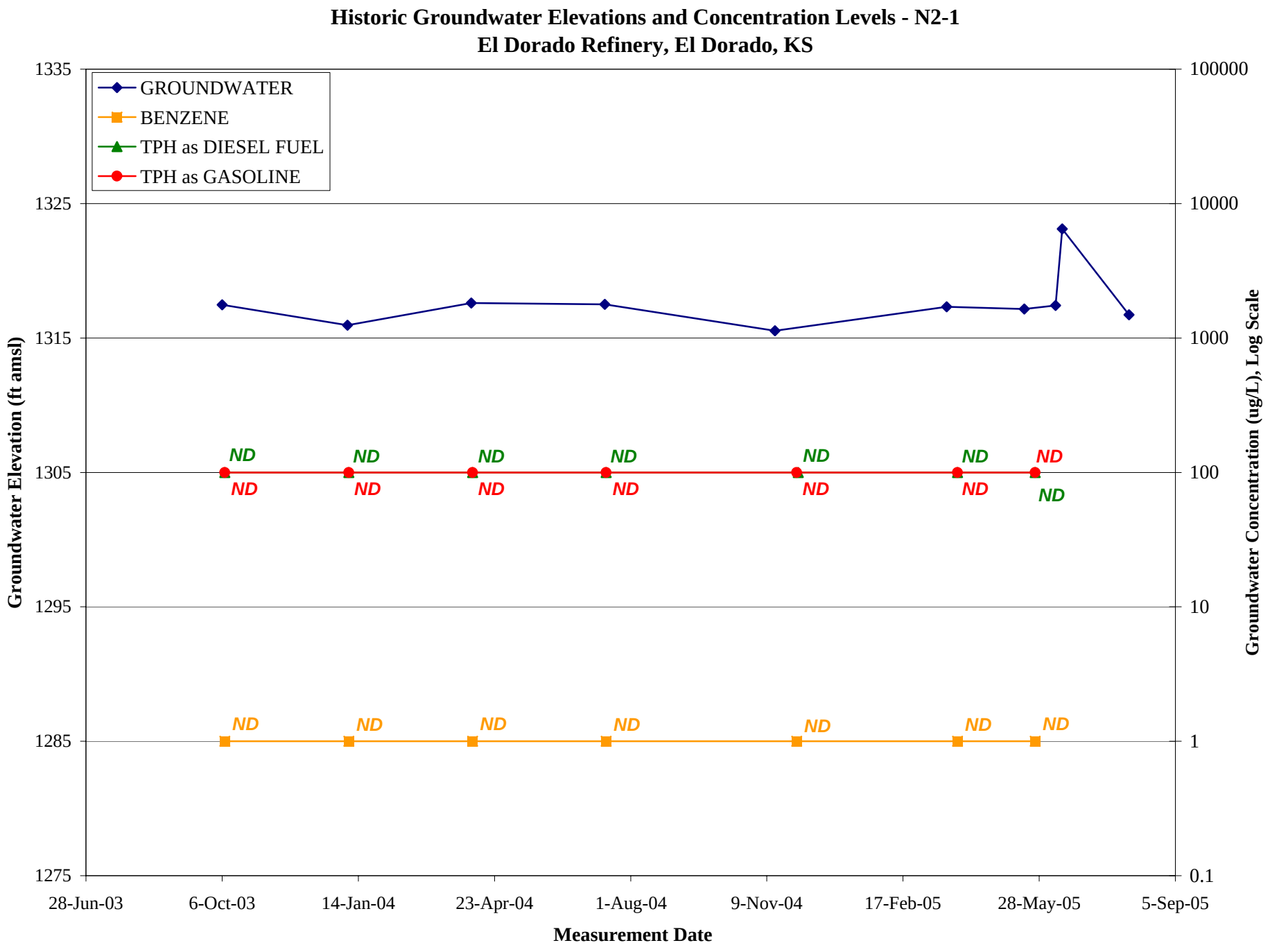
5-Sep-05
220
ND


Historic Groundwater Elevations and Concentration Levels - N2-1
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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28-Jun-03
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5-Sep-05
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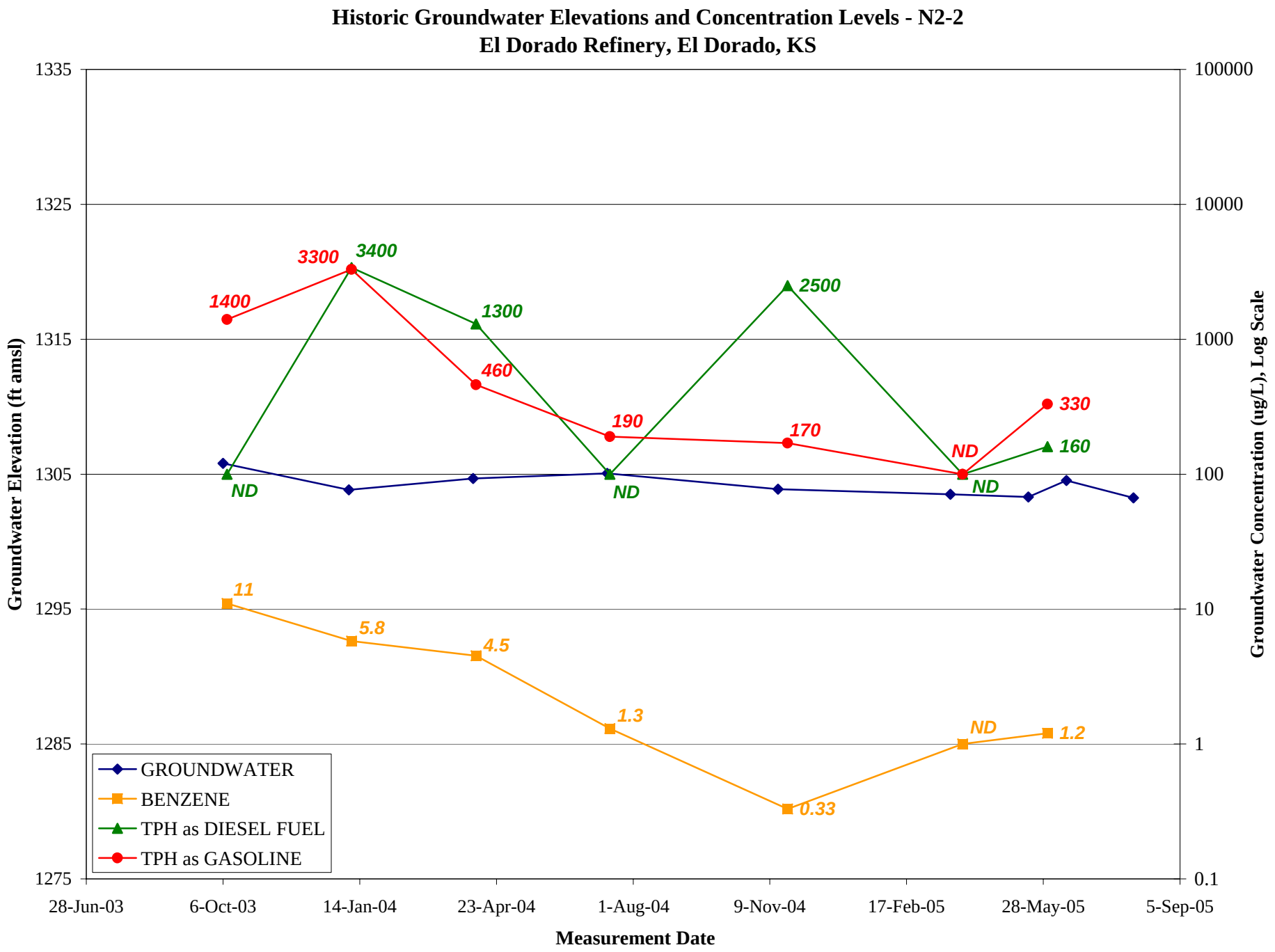
Historic Groundwater Elevations and Concentration Levels - N2-2
El Dorado Refinery, El Dorado, KS
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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9-Nov-04
17-Feb-05
28-May-05
5-Sep-05
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3300
3400
1300
460
190
170
ND
330
ND
ND
2500
ND
160
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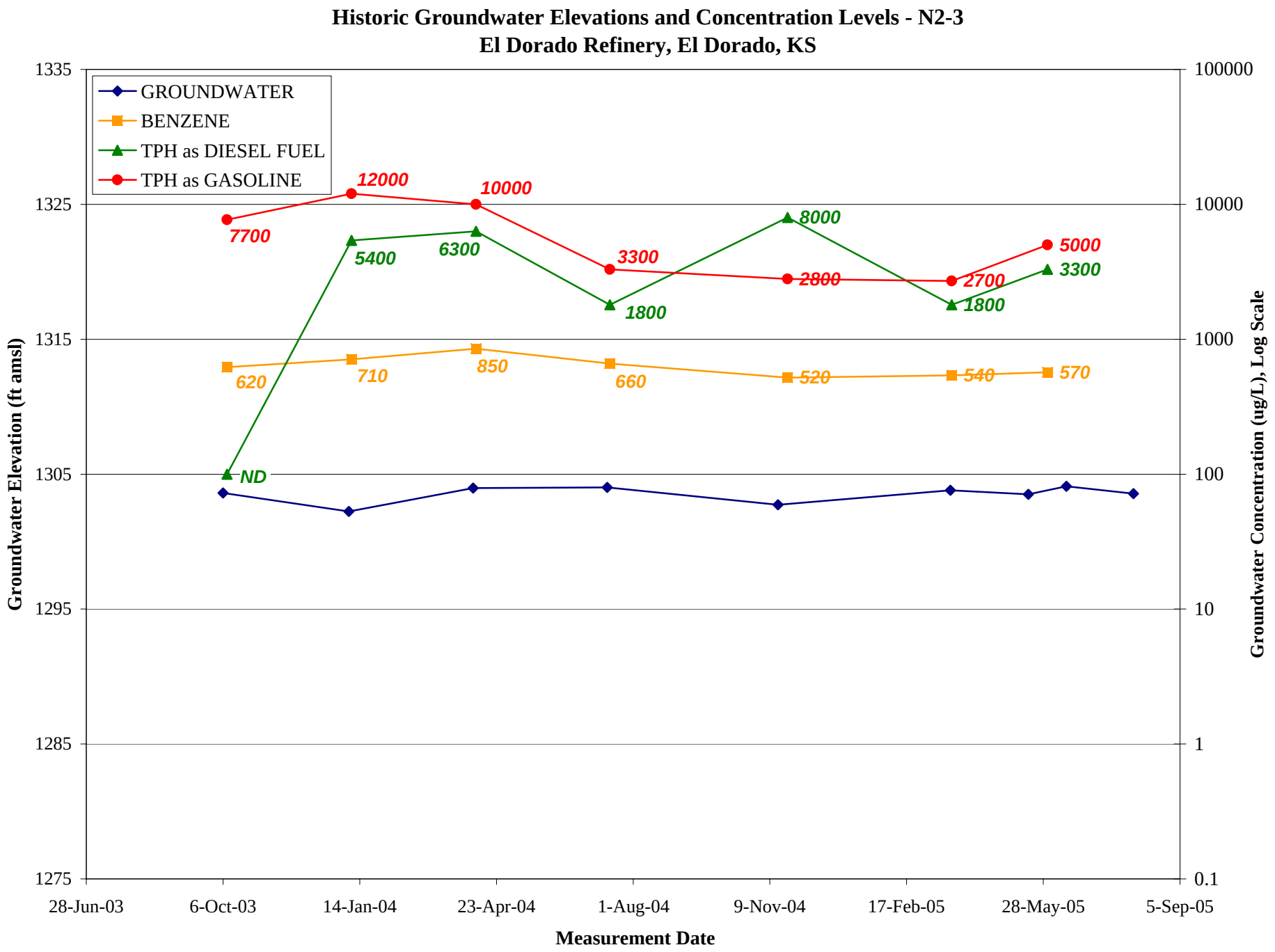
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE


Historic Groundwater Elevations and Concentration Levels - N2-3
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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1275
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5-Sep-05
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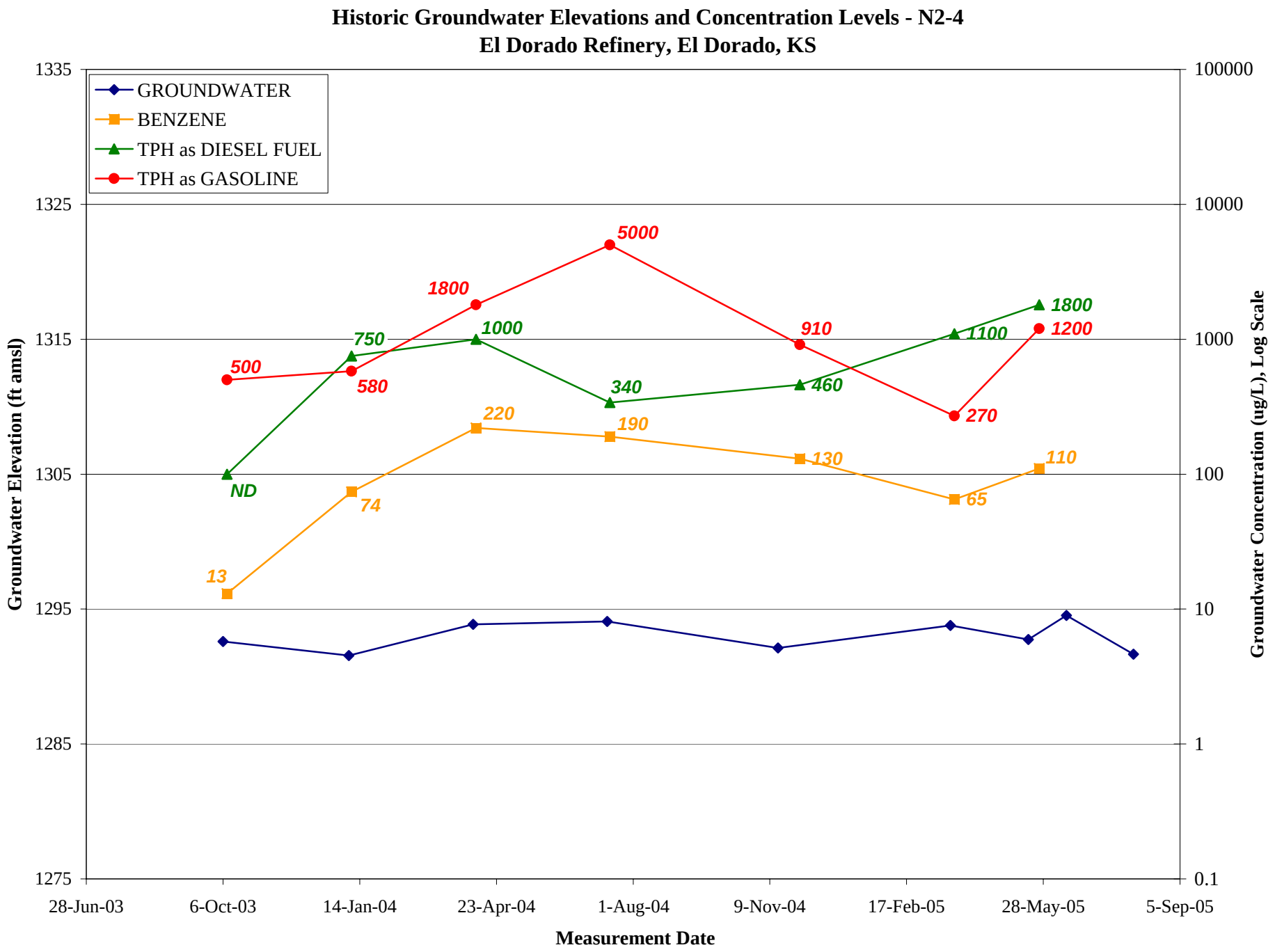
Historic Groundwater Elevations and Concentration Levels - N2-4
El Dorado Refinery, El Dorado, KS
GROUNDWATER
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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5-Sep-05
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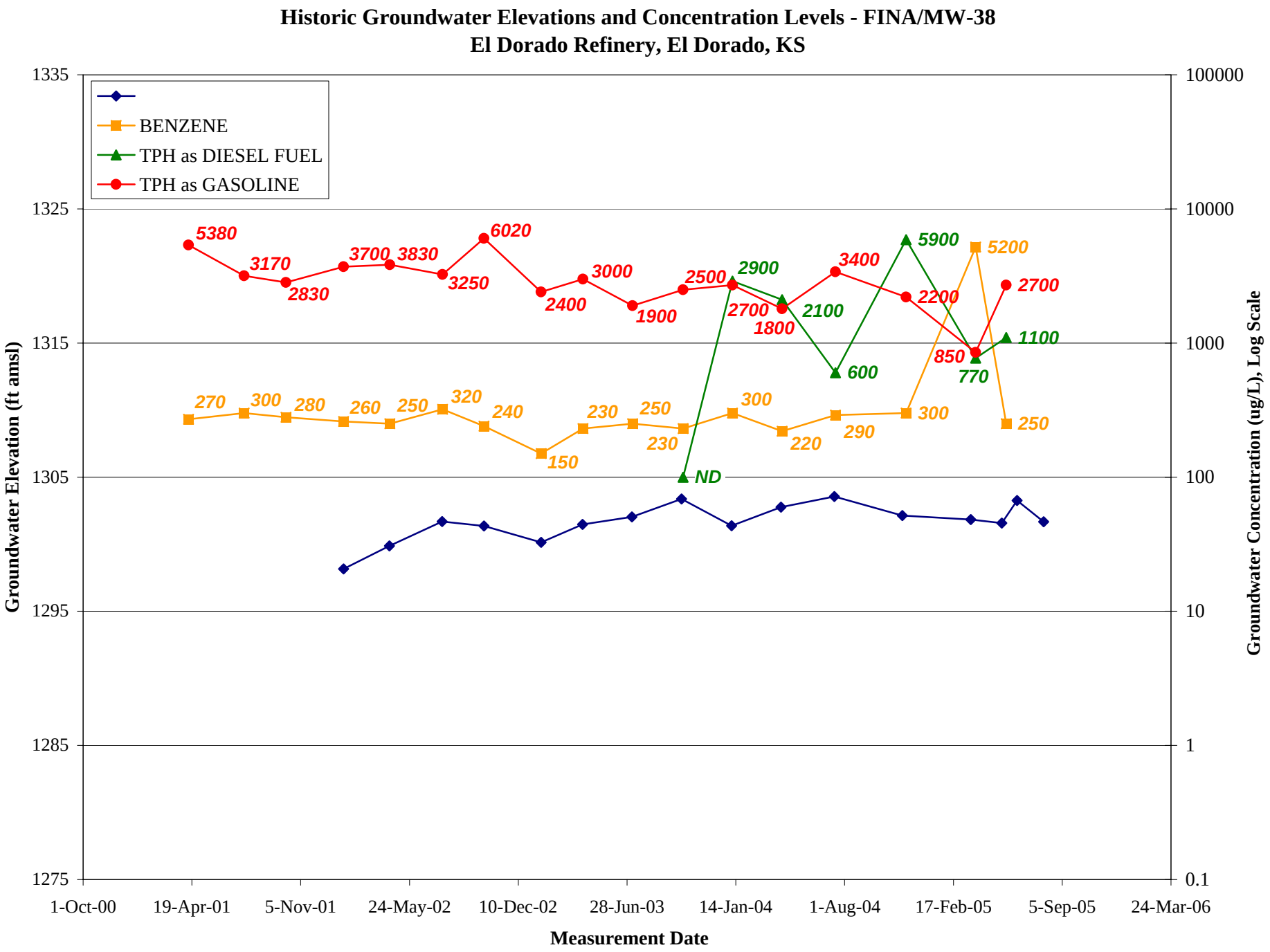
Historic Groundwater Elevations and Concentration Levels - FINA/MW-38
El Dorado Refinery, El Dorado, KS
BENZENE
TPH as DIESEL FUEL
TPH as GASOLINE
Groundwater Elevation (ft amsl)
Groundwater Concentration (ug/L), Log Scale
Measurement Date
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