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REPORTS

07/15/2010

Larson & Associates, Inc.
Environmental Consultants

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2010 JUL 16 P 2:24

July 15, 2010

VIA EMAIL: Glenn.von Gonten@state.nm.us

Mr. Glenn von Gonten, Acting Chief
Environmental Bureau - Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, New Mexico 88505

Re: Case No 14413 – Final Investigation Report and Remediation Plan
BTA Oil Producers LLC, Pardue "C" 8808 JV-P Well #1, API No. 30-015-26341
Unit N (SE/4, SW/4), Section 11, Township 23 South, Range 28 East NMPM
Eddy County, New Mexico

Dear Glenn,
Larson & Associates, Inc. (LAI), on behalf of BTA Oil Producers LLC (BTA), is pleased to submit the enclosed report for compliance with the Stipulated Order & Settlement Agreement (Case No. 14413) between OCD and BTA dated February 2, 2010. The report presents the results of subsurface investigations and remediation plan for the Pardue "C" 8808 JV-P Well #1 (Site) located in Unit N (SE/4, SW/4), Section 11, Township 23 South, Range 28 East NMPM, in Eddy County, New Mexico. The Site is located about 4 miles northeast of Loving, New Mexico. Your approval of the remediation plan is requested. Please contact me at (432) 687-0901 if you have questions.
Sincerely,
Larson & Associates, Inc.

Mark J. Larson, P.G.
mark@laenvironmental.com

Cc: Sherry Bonham – OCD District 2
Ben Grimes - BTA

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FINAL INVESTIGATION REPORT
AND REMEDIATION PLAN

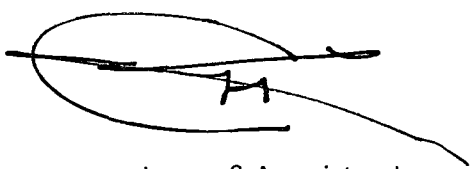
Pardue "C" 8808 JV-P Well #1
API No. 30-015-26341
NMOCD Case No. 14413
Eddy County, New Mexico

LAI Project No. 10-0101

July 15, 2010

Prepared for:
BTA Oil Producers, LLC
104 S. Pecos
Midland, Texas 79701

Prepared by:
Mark J. Larson
Certified Professional Geologist No. 10490



Larson & Associates, Inc.
507 North Marienfeld, Suite 200
Midland, Texas 79701

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1.0 Executive Summary

This final investigation report has been prepared by Larson & Associates, Inc. (LAI) on behalf of BTA Oil Producers, LLC (BTA) to present investigations performed at the Pardue "C" 8808 JV-P Well #1 (Site) for compliance with New Mexico Oil Conservation Division (OCD) Stipulated Order & Settlement Agreement (Order) No. R-13218 (Case No. 14413). The Site is located in Unit N (SE/4), (SW/4), Section 11, Township 23 South, Range 28 East NMPM in Eddy County, New Mexico.

In October 2007 an OCD inspector from the District 2 Office in Artesia, New Mexico, observed an overflow line from the injection pump that discharged produced water into an unlined pit located east of the SWD well. A Notice of Violation was issued to BTA that required it to clean up the Site and remove the overflow line by January 22, 2008. The well was plugged on January 4, 2010, and final C-103 was submitted to the OCD on January 14, 2010.

The Stipulated Order & Settlement Agreement (Case No. 14413) was signed between the OCD and BTA requiring BTA to, among others, submit a plan to delineate the horizontal and vertical extent of the contamination from the pit, well and tank battery, and characterize the impact to the vadose zone, shallow perched aquifer, and deeper regional aquifer.

On February 8, 2010, BTA submitted a plan to the OCD. LAI revised the plan and submitted it to the OCD on March 7, 2010. The plan was approved on March 12, 2010.

Previous investigations were performed by BTA and others between February 2008 and December 2009 which included collecting soil samples from the unlined pit from backhoe trenches and borings, installing monitoring wells adjacent to the Pecos River, located about 100 feet east of the Site, collecting surface water and groundwater samples. The investigations identified elevated concentrations of chloride and total petroleum hydrocarbons (TPH) in soil at the unlined pit and concluded that groundwater had been impacted from the unlined pit based on samples collected from the shallow monitoring wells east of the Site.

In February 2010 LAI performed an electromagnetic terrain (EM-31) terrain conductivity survey that identified several areas with elevated conductivity in the soil, relative to background, near the tank battery, pit, and south of the pit. Elevated EM-31 readings were also observed around the plugged SWD well. The highest EM-31 vertical dipole (VD) reading was recorded south of the pit and suggested vertical dispersion and southeast migration of vadose zone contaminants.

During April and May 2010 LAI collected soil samples from nineteen borings (BH-1 through BH-19), installed seven (7) monitoring wells (MW - 7 through MW-14), collected groundwater and surface water samples for laboratory analysis and performed horizontal hydraulic conductivity (slug) tests in the new wells.

The current and previous investigations revealed five (5) areas (east of the tank battery, near the plugged SWD well, east side of the Site near boring BH-7, unlined pit and south of the pit) where chloride in soil exceeded 5,000 milligrams per kilogram (mg/Kg) in the vadose zone. The locations of elevated chloride correlate with areas of elevated EM-31 conductivity anomalies. Three (3) locations were identified with TPH concentrations in soil greater than 300 mg/Kg including areas near the plugged

SWD well and pit. Benzene and BTEX were not observed in soil samples above the method detection limits.

Light and dense non aqueous phase liquids (LNAPL and DNAPL) were not observed in the monitoring wells. Groundwater occurs in Quaternary-age alluvium between about 34 and 36 feet below ground surface (bgs). The alluvium consists of interbedded and laterally discontinuous units of silty clay, conglomerate, sandy clay, silty and sandy gravel, gravelly sand and silt. Conglomerate occurs near the surface between about 1 and 15 feet below ground surface (bgs) and averages about 7 feet thick. The conglomerate is very well cemented with pebble to cobble-size inclusions. The alluvium is about 68 feet thick near the southeast corner of the Site and is underlain by the Castile formation consisting of dark gray to reddish brown shale interbedded with gypsum and calcite. The Castile Formation is the lower confining unit for the alluvium. Groundwater was not observed in the Castile formation.

Groundwater in the alluvium flows from west to east at a gradient of about 0.013 feet per foot and localized groundwater mounding, caused by recharge, was observed near the center of the pit. The overall average horizontal hydraulic conductivity for the alluvium, calculated from the slug tests, is 9.189 feet per day.

BTEX and TPH were not detected above the method detection limits in groundwater samples collected from the monitoring wells on April 27, 2010. Dissolved metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) were below the New Mexico Water Quality Control Commission (WQCC) human health standards (20 NMAC 6.2.3103.A).

Chloride exceeded background (2,510 mg/L) in samples collected from monitoring wells MW-8 through MW-14 and ranged in concentration from 2,810 mg/L (MW-8) to 13,500 mg/L (MW-10). The highest concentration of chloride (13,500 mg/L) occurred in well MW-10 located east (down gradient) of the pit. Chloride was detected at 10,800 mg/L in well MW-14, near the center of the pit, and 10,800 mg/L in well MW-4 located east of the Site.

Total dissolved solids (TDS) ranged from 7,310 mg/L (MW-8) to 25,300 mg/L (MW-10) and exceeded the background concentration of 6,900 mg/L. The highest TDS concentration (25,300 mg/L) was reported in well MW-10 located east (down gradient) of the pit. TDS was 21,500 mg/L in well MW-14 installed near the center of the pit, and 20,500 mg/L in well MW-4 located east of the Site.

BTEX and TPH were not present above the method detection limits in surface samples from Seep #1 through Seep #4 located along the west bank of the Pecos River and east of the Site. Metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) were below the Numeric Domestic Water Quality standards established by the New Mexico Environment Department (NMED) Surface Water Quality Bureau (20 NMAC 6.4.900.J).

Chloride in the seep samples ranged from 2,580 mg/L in Seep #1 (upstream) to 4,440 mg/L in Seep #4 (downstream). TDS ranged from 7,750 mg/L (Seep #1) to 11,800 mg/L (Seep #4). It could not be determined if the Site was contributing to the chloride and TDS present in the seeps. No seeps were located south of Seep #4 to determine if chloride and TDS concentrations increase that may suggest a different source.

The nearest fresh water well is for irrigation and located approximately 0.5 miles south (cross gradient) of the Site. No receptor wells are located down gradient of the Site. The nearest down gradient well is

located east of the Pecos River about 4,300 feet (0.8 mile) southeast. None of the wells identified would be affected by the Site.

BTA proposes remedial actions to reduce the concentration of constituents of concern (TPH and chloride) in the vadose zone, protect groundwater from further degradation and install hydraulic controls to reduce constituent concentrations and control migration.

2.0 Introduction

This report was prepared on behalf of BTA by LAI, its consultant, to present the subsurface investigation results of the Pardue "C 8808 JV-P Well #1 (Site) for compliance with Stipulated Order & Settlement Agreement (Order) No. R-13218 (Case No. 14413). The Site is located about 4 miles northeast of Loving, in Unit N (SE/4, SW/4), Section 11, Township 23 South, Range 28 East NMPM, Eddy County, New Mexico. The geodetic position is north 32° 18' 46.9" and west 104° 03' 43.5". Figure 1 presents a location and topographic map. Figure 2 presents an aerial photograph.

2.1 Regulatory Background and Chronology

On October 19, 2007, an OCD inspector from the District 2 office, Artesia, New Mexico, observed an overflow line from the injection pump that discharged produced water into an unlined pit located east of the SWD well. The OCD issued a Notice of Violation (NOV) that required BTA to clean up the Site and remove the overflow line by January 22, 2008.

On November 12, 2009, BTA submitted form C-103 notifying the OCD of its intent to plug the SWD well and remove the tank battery. The well was plugged on January 4, 2010, and final C-103 was submitted to the OCD on January 14, 2010.

On February 2, 2010, BTA agreed to a Stipulated Order & Settlement Agreement (Case No. 14413) that required BTA to, among others, submit a plan by February 25, 2010 to delineate the horizontal and vertical extent of the contamination from the pit, well and tank battery, and characterize the impact to the vadose zone, shallow perched aquifer, and deeper regional aquifer.

The OCD required the following:

- BTA must propose an adequate number of soil borings and monitor wells that will enable it to completely delineate the impact of the produced water releases to the vadose zone and to ground water;
- The vadose zone investigation must be comprehensive enough that BTA can use the data when removing the chloride-contaminated soil to approximately 20 feet below grade;
- BTA must collect and analyze soil and/or bedrock samples for benzene and total BTEX using 8021B or 8260B, TPH using EPA method 418.1, the GRO and DRO combined fractions using 8015M and chloride using method 300.1;
- If the GRO soil fraction exceeds 80 mg/kg, then BTA must also analyze for VOCs using method 8260;
- If the DRO soil fraction exceeds 200 mg/kg, then BTA must also analyze for SVOCs using method 8270;
- BTA's ground water investigation must establish background ground water concentrations for chloride and must delineate the produced water contamination in both the perched and the deeper regional aquifer;
- BTA must install a sufficient number of monitoring wells screened across the shallow perched aquifer with no more than 15 feet of well screen (five feet above the water level with 10 feet below) to delineate ground water contamination;
- BTA must also propose a location for monitor well to determine whether the deeper regional aquifer has been contaminated;

- BTA must properly develop all monitor wells before sampling the ground water. Purged ground water must be properly collected and BTA must document how it intends to dispose of the purged water;
- BTA must collect and analyze ground water samples for benzene, and total BTEX using 8021B or 8260B, the GRO and DRO fractions using 8015M and chlorides using method 300M.

On February 8, 2010, BTA submitted a plan (*Pardue "C" SWD Site Delineation Plan*) to the OCD. The OCD submitted comments on February 10, 2010, and required BTA to revise the plan. On February 12, 2010, LAI submitted a revised plan (*Revised Pardue "C" SWD Site Delineation Plan*) on behalf of BTA that included:

- Performing an electromagnetic (EM-31) terrain conductivity survey to qualitatively assess vadose zone impacts;
- Collecting soil samples from rotary or auger drilled borings to delineate the extent of vadose zone contamination;
- Installing monitoring wells to delineate impact to groundwater;
- Performing hydraulic conductivity (slugs) tests to calculate the average aquifer horizontal hydraulic conductivity; and
- Preparing a report.

On February 16, 2010, the OCD approved the plan with conditions. On February 25 and 26, 2010, LAI performed an EM-31 conductivity of the Site including the area west of the Site where background conditions were observed about 300 feet west of the Site. On March 7, 2010, LAI submitted the results of the EM-31 survey (*Preliminary Investigation Report*) to the OCD that included proposed locations for soil borings and monitoring wells and a timeline for completing the work. The OCD approved the plan on March 12, 2010. Appendix A presents OCD correspondence.

3.0 Setting

3.1 Soil

Soil is represented by the Upton gravelly loam, 0 to 9% slopes. The Upton gravelly loam occurs on broad plains west of the Pecos River and was derived from calcareous alluvium. The soil is typically shallow and underlain by caliche or cemented gravel (conglomerate). The surface layer consists of grayish-brown gravelly loam about 3 inches thick that is underlain by about 6 inches of brown gravelly loam. Caliche is typically present at approximately 9 inches below the surface. The soil is mostly used for native pasture and wildlife, with a small amount of acreage used for irrigated crops.

3.2 Geology

According to the Geologic Map of New Mexico (Scholle, P.A., 2003) the Site is underlain by Quaternary-age alluvium deposited by the Pecos River. Examination of soil samples and drill cuttings from 19 soil borings revealed that the alluvium consists of interbedded and laterally discontinuous units of silty clay, conglomerate, sandy clay, silty and sandy gravel, gravelly sand and silt. Conglomerate was generally observed near the surface between about 1 and 15 feet below ground surface (bgs) and averages about 7 feet thick. The conglomerate is very well cemented with pebble to cobble-size inclusions. The alluvium is about 68 feet thick near boring BH-9 (MW-11, southeast of the Site).

The uppermost bedrock stratum appears to be the Permian-age Castile formation. An unconformity was observed where the alluvium contacts the Castile formation. Boring BH-9A was advanced approximately 50 feet into the Castile formation and observed dark gray to reddish brown shale interbedded with gypsum and calcite. The Castile Formation is about 1,500 feet thick near the center of the Delaware Basin in Southeastern New Mexico. The Tansil formation of the Artesia group underlies the Castile formation and is part of irregularly shaped north-trending belt that is comprised of anhydrite and salt about 100 feet thick.

A geological cross section map and geologic map are presented in Figures 3 and 4, respectively. A west to east trending geological cross-section (A to A') is presented in Figure 5. Figures 6 and 7 present north to south trending geological cross sections B to B' and C to C', respectively.

3.3 Groundwater

Groundwater occurs in the alluvium between about 34 and 36 feet bgs. On April 26, 2010, groundwater was measured in monitoring wells MW-7 through MW-14 between approximately 33.89 feet bgs (MW-14) near the center of the pit to 37.32 feet bgs (MW-10) east of the pit. The saturated thickness of the alluvium is approximately 32 feet based on the depth to groundwater and depth to the lower confining unit (Castile formation) at boring BH-9. A depth to groundwater map for April 26, 2010 is presented in Figure 8.

On April 26, 2010, the groundwater elevation ranged from 2970.95 feet above mean sea level (MSL) at well MW-7 (up gradient) to 2963.68 feet above MSL at well MW-10 (down gradient). Groundwater flow was from west to east at a gradient of about 0.013 feet per foot. Groundwater mounding caused by localized recharge was observed near the center of the pit (MW-14) where the groundwater elevation was about 2 feet higher than in the surrounding wells. A groundwater potentiometric map dated April 26, 2010 is presented in Figure 9.

Groundwater was not observed in the Castile formation at BH-9A which was advanced to about 120 feet bgs.

3.4 Water Wells

Eight fresh water wells were identified from New Mexico State Engineer (NMSE) records within 1-mile of the Site. The main well use is irrigation but a domestic well (C-2503) was identified about 2,100 feet (0.4 miles) west (up gradient) of the Site. The nearest well is for irrigation and located about 0.5 miles south (cross gradient) of the Site. No receptor wells are located down gradient of the Site and the nearest down gradient well is located east of the Pecos River about 4,300 feet (0.8 mile) southeast. The well is used for commercial or exploration purposes. None of the wells identified would be affected by the Site. Approximate water well locations are presented in Figure 1. Appendix B presents water well records.

4.0 Previous Investigation

4.1 BTA Investigations

BTA personnel conducted investigations on February 15, 2008, March 19, 2008, April 16, 2008 and July 24, 2008.

On February 15, 2008, soil samples were collected between 1 and 3 feet bgs from two excavations (1-SPL and 2-SPL) located near the west side and center of the pit, respectively. The samples were analyzed by Trace Analysis, Inc. (Trace) for TPH, including gasoline range organics (GRO) and diesel range organics (DRO) by method 8015B and chloride by method E300. Sample 1-1' SPL was analyzed for benzene, toluene, ethylbenzene and xylene (BTEX) by method 8021B.

On March 19, 2008, soil samples were collected at approximately 1 foot bgs from four (4) trenches (North-1, South-2, East-3 and West-4) located near the edges of the pit. Trace analyzed the samples for chloride by titration method SM 4500-CL B.

On April 16, 2008, soil samples were collected between 1 and 3 feet bgs at five (5) trenches (NS-1, SS-1, ES-1, WS-1 and Central) located near the center and edges of the pit. Trace analyzed the samples for TPH by method 8015B and chloride by titration method SM 4500-CL B. The sample from the Central Trench at 1 foot bgs was analyzed for BTEX by method 8021B.

On July 24, 2008, an auger rig was used to collect soil samples at 3, 6 and 8 feet bgs from six (6) locations (N, S, E, W, Central and Back) north, south, east, west and center of the pit. The background (Back) boring was located about 100 feet north of the tank battery. Trace analyzed the samples for TPH by method 8015B and chloride by titration method SM 4500-Cl B. The sample from the North (6'), South (3'), West (6') and Center (6') borings were analyzed for BTEX by method 8021B. The sample results were submitted to the OCD on April 24, 2008 (*Pardue SWD Site Remediation Plan*), June 24, 2008 (*Site Delineation Plan*) and August 14, 2008 (*Pardue SWD Site Remediation Plan*). BTA derived soil analyses are presented in Table 1a. Figure 10 presents a drawing showing the approximate BTA soil sample locations.

Referring to Table 1a, benzene was not present in the soil samples at concentrations above the method detection limit of 1.0 milligrams per kilogram (mg/Kg) and below the OCD closure limit of 0.2 mg/Kg for unlined pits (19.15.17.13 C (3) NMAC). The highest BTEX concentration (3.044 mg/Kg) was reported in sample 1-1'-SPL and was below the OCD closure limit of 50 mg/Kg for unlined pits. TPH ranged from less than the method detection limit (<1.0 mg/Kg) to 948.3 mg/Kg and exceeded the OCD closure limit of 100 mg/Kg for unlined pits in samples from Central Trench, 1' (426.5 mg/Kg), Central Trench, 8' (948.3 mg/Kg), 1-1'-SPL (685 mg/Kg) and 2-2'SPL (216.8 mg/Kg). TPH in sample Central Trench, 8' (948.3 mg/Kg) may be due to cross contamination as samples collected by LAI (BH-15, 5') reported TPH at 123 mg/Kg.

Chloride in soil ranged from 294 mg/Kg (ES-3, 2') to 15,000 mg/Kg (1-1'-SPL) and exceeded the OCD closure limit of 250 mg/Kg or background, whichever is greater. The vertical extent of the chloride was not determined.

On September 25, 2008, BTA contracted Straub Corporation, Stanton, Texas, to drill and install a temporary monitor well (TMW) about 75 feet southwest of the Site. Straub used an air rotary rig to advance a boring to about 65 feet bgs and constructed the well with 2-inch schedule 40 PVC screw threaded screen and casing. Approximately 20 feet of factory slotted screen, equipped with a filter sock, was placed near the bottom of the boring. A boring log was prepared from visual examination of drill cuttings. The hole was left open for approximately 72 hours to allow water to accumulate in the well. On September 29, 2008, the well lacked sufficient water for development and a groundwater sample was collected and analyzed by Trace for chloride and TDS. The well was later plugged. BTA submitted the monitor well installation and sample results to the OCD on October 8, 2008 (*Site Monitor*

Well Report). A summary of the BTA derived groundwater analysis is presented in Table 1b. Figure 10 presents a drawing showing the location of the temporary monitor well (TMW).

Referring to Table 1b, chloride and TDS in TMW were 757 milligrams per liter (mg/L) and 2,680 mg/L, respectively. The chloride and TDS values exceeded the New Mexico Water Quality Control Commission (WQCC) domestic water quality standards of 250 mg/L and 1,000 mg/L, respectively. The chloride and TDS concentration in the TMW groundwater sample are below the background concentrations reported from monitoring well MW-7.

4.2 R.T. Hicks Investigations

R.T. Hicks Consultants, Ltd. (RT Hicks) investigated the Site on January 17, 2009, November 17 and 18, 20009 and December 17, 2009.

On January 17, 2009, RT Hicks collected soil samples from four auger borings (SB-1 through SB-4) near the center and edges of the pit. Samples were collected about every 5 feet (i.e., 5', 10', 15', 20', etc.) to 30 feet bgs, except at location SB-4, near the center of the pit, where samples were collected to about 40 feet bgs. Trace analyzed the samples for chloride by method E300. Select samples were analyzed for BTEX and TPH by methods 8021B and 8015B, respectively.

On November 17, 2009, RT Hicks collected soil samples at two backhoe trenches near the center of the pit (north of borehole SB-4) and the west side of the pit. The samples were collected at 2, 4, and 6 feet bgs near the center of the pit and 2 feet bgs near the west side of the pit. Hall Environmental Analysis Laboratory, Inc. (Hall) analyzed the samples for metals (boron, calcium, magnesium, potassium and sodium), anions (fluoride, chloride, bromide, nitrate + nitrite, phosphorus and sulfate), alkalinity, and TDS by synthetic precipitation leaching procedure (SPLP) EPA method 1312. A summary of the RT Hicks derived soil analyses is presented in Table 2a. Figure 10 presents the approximate locations of the RT Hicks derived soil samples.

Referring to Table 2a, benzene, BTEX and TPH were not present above the method detection limits in samples from borings SB-1 through SB-4 and were below the OCD closure limits of 0.2 mg/Kg, 50 mg/Kg and 100 mg/Kg, respectively, for unlined pits (19.15.17.13 C (3) NMAC).

Chloride in samples from borings SB-1 through SB-4 ranged from 53.7 mg/Kg (SB-3, 30') to 9,560 mg/Kg (SB-4, 5') and exceeded the OCD closure limit for unlined pits (250 mg/Kg or background, whichever is greater) in all samples except SB-3 (5', 10', 15', 20', 25' and 30'). The vertical extent of chloride in the vadose zone was not determined, but the lateral extent of chloride down gradient of the pit was determined at SB-3 located southeast corner of the pit.

Chloride in the SPLP samples from the trench north of SB-4 (2, 4 and 6 feet) and near the west side of the pit (2 feet) were below the WQCC domestic water quality standard of 250 mg/Kg. However, no total chloride was available to perform a comparative analysis.

On November 17, 2009, RT Hicks used power and hand augers to install 6 shallow monitoring wells (MW-1 through MW-6) on the west bank of the Pecos River upstream (MW-1, MW-2 and MW-3), adjacent (MW-4 and MW-5) and downstream (MW-6) of the Site. The wells were completed between 2.87 (MW-4) and 3.80 (MW-6) feet bgs with 2-inch schedule 40 PCV materials. The wells were secured

with locking compression caps. No well construction diagrams were available. Monitoring well locations are presented in Figure 11.

On November 18, 2009 and December 17, 2009, RT Hicks collected groundwater samples from the monitoring wells, surface water samples from the Pecos River upstream and downstream (east of MW-6) and a produced water sample from a dump valve at the tank battery. Hall analyzed the samples from November 18, 2009. Trace analyzed the samples from December 17, 2009. The samples were analyzed for metals (boron, calcium, magnesium, potassium and sodium), anions (fluoride, chloride, bromide and nitrate + nitrite), alkalinity and TDS. Hall analyzed the sample from MW-4 for BTEX and methyl tertiary butyl ether (MTBE). Anatek Lab, Inc. (Anatek) analyzed the samples for sulfur by method 200.7. A summary of the RT Hicks derived groundwater, surface and produced water analyses is presented in Table 2b.

Referring to Table 2b, BTEX was present above method detection limits but below the WQCC human health standards in the MW-4 sample. RT Hicks concluded from inorganic analysis that past discharges from the Site impacted water quality at MW-4 and to a lesser extent groundwater quality at MW-5. RT Hicks also concluded that the perched aquifer is not a place of withdrawal for future use based upon the fact that a constant source of higher quality water exists directly east of the area of impact (the Pecos River) or below the perched zone (the alluvium or Gatuna formation). Further, RT Hicks concluded that surface water quality (Pecos River) has not been impacted by the former injection well site and the condition of the habitat in the area of impact is not materially different from background conditions.

4.3 LAI Investigations

On February 24 and 25, 2010, LAI personnel performed an electromagnetic (EM) terrain conductivity survey to identify areas with elevated conductivity, relative to background, that would correlate with elevated chloride in soil. An EM-31 meter, manufactured by Geonics, Ltd., Toronto, Canada, was used to collect measurements over an area measuring approximately 350 x 650 feet (5.23 acres). An EM-31 profile was also performed along the west bank of the Pecos River between MW-1 and MW-6. The EM-31 meter has exploration capabilities ranging from 0 to 9.8 feet in the horizontal dipole (HD) mode and 0 to 19.7 feet in the vertical dipole (VD) mode. The conductivity response in the HD mode is greatest near the surface and decrease with depth, whereas, the conductivity response is null near the surface and increases rapidly to a depth equal to about 0.4 times the coil spacing in the VD mode. The maximum EM-31VD response occurs at a depth equal to about 75% of the exploration depth or at about 14.75 feet and decreases with depth.

EM-31 HD and VD measurements were collected at surveyed stations about every 25 feet inside the fenced area and about every 50 feet outside the fenced area. EM-31HD and VD readings were collected about every 25 feet along the profile adjacent to the Pecos River.

The EM-31HD and VD readings were compared background readings established between stations 250 and 350 north on profile 0 east. Figure 12 and Figure 13 present the Site EM-31HD and VD drawings, respectively. The EM-31HD and VD measurements adjacent to the Pecos River are presented in Figure 14.

Referring to Figure 12, elevated EM-31HD readings, between approximately 4 and 6 times background, were observed in the vicinity of the tank battery with the maximum EM-31HD reading (135 mmhos/m) observed at station 100 north and 300 east. The EM-31HD readings in the tank battery area appear to trend to the northwest. The EM-31HD readings in the pit ranged from 61 to 91 mmhos/m and were

from 2 and 4 times above background. The highest EM-31HD reading (215 mmhos/m) was recorded south of the pit at station 175 north and 525 east and was 8 times greater than background. The EM-31HD readings suggest impact to the shallow vadose zone and migration to the southeast.

Referring Figure 13, elevated EM-31VD readings, between 3 and 4 times background, were observed around the plugged SWD well. The EM-31VD readings in the vicinity of the pit ranged from 1 to 3 times background and suggest decreasing conductivity with depth. The EM-31VD readings were about 4 times background south of the pit, where EM-31HD readings exceeded 8 times background. The highest EM-31VD reading (120 mmhos/m) was recorded at station 175 north and 525 east and suggested that vertical dispersion and southeast migration of vadose zone contaminants. The EM-31VD readings decreased to 1 and 2 times background approximately 50 feet southeast of the Site.

Referring to Figure 14, the EM-31 HD and VD conductivity measurements adjacent to the Pecos River, between MW-1 and MW-6, increased in the vicinity of wells MW-3 and MW-5 and may correspond to groundwater with elevated TDS concentrations.

5.0 Current Investigations

5.1 Soil Samples

Between April 6 and 15, 2010, LAI personnel collected soil samples from 19 borings (BH-1 through BH-19). Boring BH-1, located about 300 feet west of the Site, was designated as a background location. Other boring locations included BH-2 through BH-8 (west, north, south and east of the Site), BH-9 (southeast of Site), BH-10 through BH-12 (tank battery), BH-13 (east of tank battery), BH-14 (east of plugged SWD well), BH-15 (center of pit) and BH-16 through BH-19 (anomaly south and east of the Site). Boring locations are presented in Figure 2. Appendix C presents the boring logs.

Scarborough Drilling, Inc. (SDI) drilled the borings with an air rotary rig and collected the soil samples with split spoon and jam tube samplers about every 5 feet (i.e., 0, 5, 10, 15, 20, 25 feet, etc.) between about 30 and 35 feet bgs. The samples were collected in laboratory provided containers that were filled to near zero headspace, labeled, chilled in an ice-filled cooler and hand delivered under chain of custody to Xenco Laboratories, Inc. (Xenco), located in Odessa, Texas. Duplicate samples were collected in 8-ounce glass sample jars for headspace analysis using a calibrated photoionization detector (PID). No samples exhibited PID readings above 100 parts per million (ppm), therefore, no samples were analyzed by laboratory for BTEX. All samples were analyzed for chloride using EPA method 300. Select samples, including the bottom sample from each boring, were analyzed for TPH by method 418.1. The bottom sample from each boring was also field tested for chloride and analyzed by the laboratory to confirm the field results and vertical extent of chloride. LAI derived soil analyses are presented in Table 3a. Laboratory reports are presented in Appendix D.

All sampling equipment, including jam tube and split spoon sampler, sampling scoops and trowels, were thoroughly washed between samples using a solution of distilled water and laboratory grade detergent and rinsed with distilled water. The drilling rig and equipment, including drilling bit, rods, etc., were cleaned between locations using a power washer. Decontamination fluids were placed on an impervious lined area. The decontamination fluids were placed in a 55 gallon drum and transferred to a frac tank arranged through BTA with Standard Energy Services, Lubbock, Texas.

West Engineering and Surveying Company (West), a New Mexico registered professional land surveyor, surveyed the borings for location and elevation to a USGS datum. Geological logs were prepared for

each boring from descriptions of soil samples and drill cuttings according to the unified soil classification system (USCS). Drill cuttings were placed on plastic adjacent to the borings until disposal is arranged. The borings were plugged according to OSE rules.

5.2 Monitoring Wells

Eight (8) monitoring wells (MW-7 through MW-14) were installed in borings BH-1 (MW-7), BH-5 (MW-8), BH-6 (MW-9), BH-8 (MW-10), BH-9 (MW-11), BH-13 (MW-12), BH-14 (MW-13) and BH-15 (MW-14). Monitoring well MW-7 was designated as background well and was installed in boring (BH-1) about 300 feet west (up gradient) of the Site. Monitoring wells MW-8 through MW-11 were installed cross gradient (north, south and east) and down gradient (southeast) of the Site. Monitoring wells MW-12 and MW-13 were installed down gradient (east) of the tank battery and plugged SWD well, respectively. Monitoring well MW-14 was installed near the center of the unlined pit. Monitoring well locations are presented in Figure 2.

The wells were completed in the alluvium between approximately 45 feet (MW-11) and 53 feet (MW-9) bgs and constructed with 4-inch screw-threaded schedule 40 PCV casing and approximately 15 feet of 0.010 inch factory-slotted screen. The well screen was installed with approximately 5 feet screen above and 10 feet of screen below the groundwater level observed during drilling. Graded silica sand (8 to 16) was placed around the screen from the bottom of the well to approximately 2 feet above the screen. A layer of bentonite chips, approximately 3 feet thick, was placed above the sand and hydrated with potable water. The annular space between the casing and borehole, from the top of the sand to about 2 feet bgs, was filled with a mixture of portland cement and bentonite grout (3% - 5%). Each well was secured with a locking compression cap and above-grade locking steel cover anchored in a concrete pad measuring about 2 X 2 feet. A small amount of water was introduced into the boring during drilling to stabilize and clean the bore hole. A portable containment was constructed at each location to capture fluids and cuttings evacuated from the boring during drilling. The fluids were allowed to evaporate and the cuttings remained on site until disposal is arranged. Boring logs were prepared from examination of soil samples and drill cuttings using the USCS. Monitoring well completion details and gauging summary are presented in Table 3b. Monitoring well completion reports are presented in Appendix C. Photo documentation is presented in Appendix E.

Two (2) wells were proposed for the deeper regional aquifer (Rustler formation) but it was determined that the Castile formation (Permian) was the uppermost bedrock stratum and consists of dark gray to reddish brown shale interbedded with gypsum and calcite. The Castile formation occurs at about 68 feet bgs near BH-9. Boring BH-9A was advanced into the Castile formation about 50 feet through a 5-inch steel conductor casing that was installed across the alluvium from ground surface to about 54 feet bgs. Portland cement and bentonite grout was pumped under pressure through a tremmie pipe to grout the conductor casing. The grout was allowed to cure for approximately 24 hours prior to advancing the boring into the Castile formation. Groundwater was not observed in the Castile formation and after a discussion with Mr. Glenn von Gonten with OCD Environmental Bureau on April 7, 2010, verbal approval was granted to plug the boring. The conductor casing was cut off about 2 feet below ground and the boring, including the conductor casing, was grouted to surface with portland cement and bentonite grout.

West surveyed the wells, including boring BH-9A and the RT Hicks monitoring wells (MW-1 through MW-6) for location, ground and top of PVC well casing elevation, referenced to a USGS datum.

The wells were developed with a rig bailer and additional development was performed by pumping the wells with an electric submersible pump and dedicated disposal polyethylene tubing. The wells were developed until purged water was visibly clear of sediment. The purged water was placed into a frac tank arranged by BTA with Standard Energy Services, Lubbock, Texas.

5.3 Depth to NAPL and Groundwater Measurements

No light NAPL or dense NAPL was observed in the wells. An electronic oil and water interface probe was used to measure depth to groundwater and NAPL to within 0.01 foot accuracy at the top of the PVC casing on the north side of the wells and measurements were recorded in bound field notebook. The interface probe was thoroughly cleaned between wells using a solution of laboratory-grade detergent and water and rinsed with distilled water.

5.4 Groundwater and Surface Water Samples

On April 26 through 28, 2010, groundwater samples were collected from monitoring wells MW-1 through MW-14, excluding MW-5 and MW-6, which did not contain sufficient water volume to fill the sample containers. The groundwater samples were collected using low-flow techniques. The low flow sampling pump was placed midway in the screened portion of well and pumped at a low rate while the groundwater level was monitored with an electronic water level meter to prevent over pumping while the purged water was monitoring until pH, temperature, conductivity stabilized within ± 10%. The purged water was placed in the frac tank for disposal. The groundwater samples were collected from the low flow pump discharge.

Surface water samples were collected at 4 seeps (Seep #1 through Seep #4) that were flowing on April 26, 2010. The seeps are located along the west bank of the Pecos River between monitoring wells MW-3 through MW-6. The samples were collected using a stainless steel beaker or flowed directly into the sample containers at the point of discharge nearest to the bluff and farthest from the river. Seep locations are presented in Figure 2.

The low flow pump, electric lead and beaker were thoroughly cleaned with a solution of distilled water and laboratory-grade detergent and rinsed with distilled water.

The samples were collected in laboratory provided containers that were labeled, chilled in an ice chest and delivered under chain of custody control to DHL Analytical, Inc. (DHL), a National Environmental Laboratory Accreditation Program (NELAP) accredited lab, located in Round Rock, Texas. DHL analyzed the samples for WQCC metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), BTEX (8021B), TPH (418.1) and WQCC domestic water quality parameters (chloride, sulfate, TDS and pH). Quality assurance and quality control (QA/QC) samples were collected and included equipment (rinse), duplicate and trip blanks. The LAI derived organic, inorganic and general water quality parameters are summarized in Table 3c. Laboratory reports are presented in Appendix D.

5.5 Horizontal Hydraulic (Slug) Tests

On May 4 through 7, 2010, LAI personnel performed horizontal hydraulic conductivity (falling head and rising head) slug tests in well MW-7 through MW-14. The slug tests were performed to calculate an average horizontal hydraulic conductivity for the alluvial aquifer. The tests were performed by lowering (falling head) and raising (rising head) a weighted 2-inch by 5-foot PVC tube (slug) in and out of the wells while head loss (falling) and head gain (rising) was simultaneously measured using a pressure transducer and an electronic data logger. An In-Situ model 700 pressure transducer measured the response and a

handheld Rugged Reader recorded the data. The slug, pressure transducer and cables were washed between wells using a solution of distilled water and laboratory grade detergent and rinsed with distilled water. No slug tests were performed in monitoring wells MW-1 through MW-6 due to completion depth. The data was uploaded from the Rugged Reader to a PC and the horizontal hydraulic conductivity was calculated using the Bouwer and Rice (1976) method for partially or fully penetrating wells. The slug test results are presented in Table 4. Appendix F presents the slug test calculations.

5.6 Notification

Notification was provided to the OCD Santa Fe and District 2 offices at least 48-hours prior to performing work at the Site including drilling soil borings, installing monitoring wells, collecting groundwater and surface water samples and performing slug tests. LAI also submitted daily or weekly status reports while drilling and installing soil borings and monitoring wells.

6.0 Current Investigation Results

6.1 Soil Sample Results

Referring to Table 3a, the highest TPH concentration in the LAI derived samples were 3,970 mg/Kg from BH-14, 0 feet, located east of the plugged SWD well, and 4,400 mg/Kg in BH-15, 0 feet located near the center of the pit. TPH in BH-14 decreased to 274 mg/Kg and 37 mg/Kg in samples from at 5 and 10 feet, respectively. TPH in BH-15 decreased to 123 mg/Kg at 5 feet and was below the method detection limit (11.2 mg/Kg) at 10 feet bgs. The highest TPH concentration in the remaining samples was 271 mg/Kg which occurred at 5 feet in boring BH-6, located south of the Site. The OCD closure limit of 100 mg/Kg for TPH (19.15.17.13 C (3) NMAC) was exceeded in the following samples:

Location	Sample Depth (Feet)	TPH (mg/Kg)
BH-1	5	204
BH-4	5	254
	20	242
	30	115
BH-6	5	271
	20	246
BH-14	0	3,970
	5	274
BH-15	0	4,440
	5	123
BH-16	5	266
	20	231
	30	250
BH-17	5	217
	20	238
	30	269
BH-18	5	120
	20	176
	30	216
BH-19	20	101
	30	137

The maximum background chloride concentration (268 mg/Kg) was observed in the 25 foot sample from BH-1 (MW-7) located about 300 feet west of the Site. The OCD closure limit for unlined pits (250 mg/Kg or background, whichever is greater) was exceeded in the following samples:

Location	Chloride (mg/Kg)
BH-2	306 - 1,050
BH-3	281 - 2,220
BH-4	416 - 777
BH-5	416 - 885
BH-6	448 - 671
BH-7	1,030 - 7,950
BH-9	308 - 1,480
BH-10	709 - 1,400
BH-11	783 - 2,470
BH-12	316 - 909
BH-13	671 - 12,500
BH-14	986 - 7,630
BH-15	357 - 2,020
BH-16	594 - 4,720
BH-17	1,500 - 7,330
BH-18	618 - 1,890
BH-19	608 - 5,870

Figure 15 through Figure 20 present chloride concentration isopleths in soil at 5, 10, 15, 20, 25 and 30 feet bgs. Five locations were identified with chloride concentrations exceeding 5, 000 mg/Kg. This included, BH-7 located near the east edge of the Site, BH-13 (MW-12) located east of the tank battery, BH-14 located east of the plugged SWD well, BH-17 located south of the Site and BH-19 located southeast of the Site.

Chloride in BH-7 was above 5,000 mg/Kg at 5 (6,160 mg/Kg) 10 (7,950 mg/Kg), 15 (7,600 mg/Kg) and 20 (7,690 mg/Kg) feet, and decreased to 1,800 and 1,030 mg/Kg at 25 and 30 feet, respectively.

Chloride in BH-13 was above 2,500 mg/Kg at 5 feet (3,460 mg/Kg), above 5, 000 mg/Kg at 10 (12,500 mg/Kg) and 15 (9,840 mg/Kg) feet and decreased to 1,910 mg/Kg, 3,950 mg/Kg, and 2,710 mg/Kg at 20, 25 and 30 feet, respectively.

Chloride in BH-14 was 1,490 mg/Kg, 3,580 mg/Kg, 3,050 mg/Kg at 5, 10 and 15 feet, respectively, increasing to 5,690 mg/Kg and 7,630 mg/Kg at 20 and 25 feet, respectively, and decreasing to 3,670 mg/Kg at 30 feet.

Chloride in BH-17 was above 5,000 mg/Kg in samples from 5 (5,050 mg/Kg) and 10 (7,330 mg/Kg) feet, respectively and decreased to 1,650 mg/Kg, 1,580 mg/Kg, 1,500 mg/Kg and 2,500 mg/Kg at 15, 20, 25 and 30 feet, respectively.

Chloride in BH-19 was 1,520 mg/Kg, 2,210 mg/Kg, 1,070 mg/Kg, 1,760 mg/Kg, 608 mg/Kg, and increased to 5,870 mg/Kg in samples from 5, 10, 15, 20, 25 and 30 feet, respectively. The chloride in the 25 foot samples from BH-19 (5,870 mg/Kg) and BH-17 (2,500 mg/Kg) suggests vertical stratification with depth.

The areas of elevated chloride correlate with areas of elevated EM-31VD readings shown on Figure 13.

Chloride in BH-15, drilled near the center of the pit, was 257 mg/Kg (5 feet), 967 mg/Kg (10 feet), 1,740 mg/Kg (15 feet), 661 mg/Kg (20 feet), 847 mg/Kg (25 feet) and 2,020 mg/Kg (30 feet). The chloride concentration decreases to the east toward BH-8 (MW-10).

Chloride concentrations in samples from BH-3, located northwest of the tank battery, decrease with depth from 2,220 mg/Kg (5 feet) to 281 mg/Kg (30 feet) and suggest that the impact may be from a past flow line release.

6.2 Groundwater and Surface Water Sample Results

Referring to Table 3c, BTEX and TPH were not detected above the method detection limits in groundwater samples collected from the monitoring wells on April 27, 2010.

On April 27, 2010, dissolved metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) were below the WQCC human health standards (20 NMAC 6.2.3103.A).

On April 27, 2010, chloride exceeded background (2,510 mg/L) in samples from monitoring wells MW-8 through MW-14 and ranged in concentration from 2,810 mg/L (MW-8) to 13,500 mg/L (MW-10). Figure 21 presents an isopleth map of chloride concentrations in groundwater on April 26, 2010.

Referring to Figure 21, chloride was 2,810 mg/L in the sample from well MW-8, located north of the Site and does not indicate impaction from the former SWD well or pit. Elevated chloride in groundwater was observed near the center of the Site with the highest concentration (13,500 mg/L) being reported in well MW-10 located east (down gradient) of the pit. Chloride was 10,800 mg/L in well MW-14 installed near the center of the pit, and 10,800 mg/L in well MW-4 located east of the Site.

On April 27, 2010, TDS ranged from 7,310 mg/L (MW-8) to 25,300 mg/L (MW-10) and exceeded the background concentration of 6,900 mg/L reported in MW-7. Figure 22 presents an isopleth map of TDS concentrations in groundwater.

Referring to Figure 22, TDS was 7,310 mg/L in MW-8, located north of the Site and does not indicate impaction from the SWD well or pit. Elevated TDS in groundwater, similar to chloride, was observed near the center of the Site with the highest TDS concentration (25,300 mg/L) being reported in well MW-10 located east (down gradient) of the pit. TDS was 21,500 mg/L in well MW-14 installed near the center of the pit, and 20,500 mg/L in well MW-4 located east of the Site.

On April 27, 2010, BTEX and TPH were not present above the method detection limits in the seep samples #1 through #4. Metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) were below domestic water quality numeric standards established by the New Mexico Environment Department (NMED) Surface Water Quality Bureau (20 NMAC 6.4.900.J).

Chloride in seep samples #1 through #4 ranged from 2,580 mg/L in Seep #1 (upstream) to 4,440 mg/L in Seep #4 (downstream). TDS in the seep samples ranged from 7,750 mg/L (Seep #1) to 11,800 mg/L (Seep #4). It cannot be concluded if the Site is contributing to the chloride and TDS levels at the seeps as

no seeps were observed south of Seep #4 to determine if the concentrations continue to increase which may indicate a different source.

6.3 Slug Test Results

Referring to Table 4, an overall horizontal hydraulic conductivity of 9.189 feet per day was calculated for the alluvial aquifer based on falling and rising head slug tests performed in monitoring wells MW-7 through MW-14. The average falling head hydraulic conductivity was 8.925 feet per day and the average rising head hydraulic conductivity was 3.657 feet per day. Data from the rising head test in well MW-10 was insufficient to calculate a hydraulic conductivity.

7.0 Conclusions

The following conclusions are based on subsurface investigations performed at the Site between February 15, 2008 and May 7, 2010:

- Benzene and BTEX were not present in soil samples above the method detection limits and were below the OCD closure limit of 0.2 mg/Kg and 50 mg/Kg, respectively, for unlined pits (19.15.17.13 C (3) NMAC);
- The maximum TPH concentrations in samples were reported from samples Central Trench, 1' (426.5 mg/Kg), Central Trench, 8' (948.3 mg/Kg), 1-1' SPL (685 mg/Kg), 2-2' SPL (216.8 mg/Kg), BH-14, 0' (3,970 mg/Kg) and BH-15, 0' (4,440 mg/Kg) and exceeded the OCD closure limit of 100 mg/Kg for unlined pits (19.15.17.13 C (3) NMAC);
- TPH in sample Central Trench, 8' (948.3 mg/Kg) may be the result of cross contamination as the sample from BH-15, 5' reported 123 mg/Kg;
- TPH in the remaining samples ranged from 123 mg/Kg (BH-15, 5') to 274 mg/Kg (BH-14, 5');
- The maximum background chloride concentration (268 mg/Kg) was exceeded in soil samples, except SB-3 and BH-8 located east of the pit;
- Chloride exceeded 5,000 mg/Kg in soil samples at 5 locations (BH-7, BH-13, BH-14, BH-17 and BH-18) that correlate with areas of elevated EM-31 VD readings;
- Groundwater occurs in the alluvium between approximately 34 and 36 feet bgs;
- The saturated thickness of the alluvium is about 32 feet;
- The Castile formation (Permian) appears to be the uppermost bedrock stratum and is the lower confining unit for the alluvium;
- Groundwater in the alluvium ranged in elevation from 2970.95 feet (MW-7) to 2963.68 feet (MW-1) above MSL and flows east at a gradient of approximately 0.013 feet per foot;
- Groundwater mounding, caused by localized recharge, was observed near the center of the pit (MW-14) where the groundwater elevation is about 2 feet higher than in nearby wells;

- Ground water was not observed in the Castile formation at boring BH-9 which was drilled to approximately 120 feet bgs;
- The lateral and vertical extent of chloride in the vadose zone was determined from boring samples;
- BTEX and TPH were not present in groundwater samples above the method detection limits;
- Dissolved metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) were below the WQCC human health standards in groundwater samples;
- Chloride exceeded background (2,510 mg/L) in samples from the monitoring wells and ranged from 2,810 mg/L (MW-8) to 13,500 mg/L (MW-10);
- Chloride in samples MW-8 (2,810 mg/L) located north of the Site does not indicate impaction from the former SWD well or pit;
- Elevated chloride in groundwater was observed near the center of the Site with the highest concentration (13,500 mg/L) in well MW-10 (down gradient) located east of the pit;
- Chloride was 10,800 mg/L in well MW-14, installed near the center of the pit, and 10,800 mg/L in well MW-4 located east of the Site;
- TDS exceeded background (6,900 mg/L) in samples from the monitoring wells and ranged from 7,310 mg/L (MW-8) to 25,300 mg/L (MW-10);
- TDS in MW-8 (7,310 mg/L), located north of the Site, does not indicate impaction from the SWD well or pit;
- TDS was similar in concentration to chloride with the highest concentration reported in well MW-10 (25,300 mg/L) located down gradient (east) of the pit;
- TDS was 21,500 mg/L in well MW-14 installed near the center of the pit, and 20,500 mg/L in well MW-4 located east of the Site;
- BTEX and TPH were not present above the method detection limits in Seep #1 through #4;
- Metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) in the seep samples were below domestic water quality numeric standards established by the NMED Surface Water Quality Bureau;
- Chloride in the seep samples ranged from 2,580 mg/L at Seep #1 (upstream) to 4,400 mg/L at Seep #4 (downstream);
- TDS in the seep samples ranged from 7,750 mg/L (Seep #1) to 11,800 mg/L (Seep #4);

- ❖ It cannot be concluded if the Site is contributing to the chloride and TDS levels at the seeps as no seeps were observed south of Seep #4 to determine if the concentrations continue to increase which may indicate a different source.

8.0 Remediation Plan

BTA proposes remedial actions to reduce the concentration of constituents of concern (TPH and chloride) in the vadose zone to protect groundwater from further degradation and install hydraulic controls to reduce the concentration of chloride in groundwater and control migration of chloride in groundwater.

8.1 Constituent Reduction and Hydraulic Control

1. BTA will perform a pumping test to collect draw-down data sufficient to perform computer simulations to determine pumping rates and locations for recovery wells necessary to control offsite migration and reduce chloride concentrations in groundwater;

2. Monitoring well MW-14 will be use as a pumping well and surrounding wells (MW-8, MW-9, MW-10, MW-11, MW-12 and MW-13) as observation wells during the pumping test, which will be performed for a sufficient time (i.e., 48 to 72 hours) to achieve steady state conditions and monitor recovery to pre-test conditions. The data will be evaluated using commercially available software (i.e., Aquifer Test, Aqtesolv, etc.) to simulate aquifer draw down for capture radius, recovery well placement and pumping rate;

3. Pumping test water will be captured in 500-barrel frac tanks for disposal in a OCD approved Class II disposal well;

4. A report will be submitted to the OCD following completion of the pumping test and data analysis and will include the pumping test procedures, computer simulations, proposed locations for recovery wells, pumping rates, treatment equipment and effluent management;

5. BTA will provide notification to the OCD in Santa Fe and Artesia, New Mexico at least 48 hours prior to performing any work at the site.

8.2 Soil Removal

1. BTA will excavate soil to approximately 5 feet bgs over an area measuring approximately 21,491 square feet which will include the area in the vicinity of BH-7, immediately east of the tank battery (BH-13), around the plugged SWD well (BH-14), unlined pit (BH-15) and south of the pit (BH-16 and BH-17).

2. Soil will also be excavated to approximately 10 feet bgs in the vicinity of boring BH-7, immediately east of the tank battery (BH-13), around the plugged SWD well (BH-14) and area south of the pit (BH-17).

3. Soil will be excavated to 15 feet bgs immediately east of the tank battery (BH-13). The soil will be disposed at Lea Land Landfill or Controlled Recovery, Inc., which are approved by the OCD and operate under permits NM-1-035 and R9166, respectively. The deeper excavations (i.e., 10 and 15 feet) will be backfilled to a uniform depth of 5 feet bgs with non-waste containing

earthen material that will be tested to ensure constituents do not exceed the concentrations specified in Paragraph (3) of Subsection C of 19.15.17.13 NMAC. Figure 23 presents the maximum contaminant (TPH and chloride) concentrations in soil samples and proposed excavation areas;

4. A synthetic and bentonite clay liner (Bentomat CL), manufactured by CETCO Lining Technologies, placed in the bottom of the excavation. The clay mat will be installed facing up to provide a vertical barrier against infiltration of precipitation and prevent leaching of residual chloride to groundwater. The liner seams will be sealed with granular bentonite according to manufacturer instructions. Liner specifications are presented in Appendix G;

5. The excavation will be filled with non-waste containing earthen material as presented in Item 1;

6. The Site will be seeded with a native grass seed mixture suitable to the property owner to prevent surface erosion;

7. BTA will provide notification to the property owner and the OCD in Santa Fe and Artesia, New Mexico at least 48 hours prior to conducting soil remediation activities.

9.0 References

Bouwer, P. and R.C. Rice, 1976. *A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells*, Water Resources Research, Volume 12, No. 3, pp 423 – 428.

Scholle, P.A., 2003. *Geologic Map of New Mexico*, New Mexico Bureau of Geology and Mineral Resources.

Table 1a
Summary of BTA Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Depth	Date	Benzene	Toluene	Ethyl benzene	Xylene	Total BTEX	DRO	GRO	Total TPH	Chloride
RRAL:											--
Sample Trench											
1-1'-SPL	1	2/15/2008	<0.100	0.712	0.322	2.01	3.044	455	230	685	15,900
2-2'-SPL	2	2/15/2008	--	--	--	--	--	139	77.8	216.8	3,510
2-3'-SPL	3	2/15/2008	--	--	--	--	--	<50.0	1.08	1.08	2,430
North-1	1	3/19/2008	--	--	--	--	--	--	--	--	3,110
	3	7/24/2008	--	--	--	--	--	<50.0	1.25	1.25	559
	6	7/24/2008	<0.01	<0.01	<0.01	<0.01	<0.01	<50.0	1.28	1.28	739
	8	7/24/2008	--	--	--	--	--	<50.0	1.22	1.22	844
South-2	1	3/19/2008	--	--	--	--	--	--	--	--	1,190
	3	7/24/2008	<0.01	<0.01	<0.01	<0.01	<0.01	<50.0	1.07	1.07	3,160
	6	7/24/2008	--	--	--	--	--	<50.0	<1.00	<1.00	2,620
	8	7/24/2008	--	--	--	--	--	<50.0	<1.00	<1.00	2,410
East-3	1	3/19/2008	--	--	--	--	--	--	--	--	898
	3	7/24/2008	--	--	--	--	--	<50.0	<1.00	<1.00	2,240
	6	7/24/2008	--	--	--	--	--	<50.0	<1.00	<1.00	968
	8	7/24/2008	--	--	--	--	--	<50.0	<2.00	<2.00	369
West-4	1	3/19/2008	--	--	--	--	--	--	--	--	2,540
	3	7/24/2008	--	--	--	--	--	<50.0	1.09	1.09	474
	6	7/24/2008	<0.01	<0.01	<0.01	<0.01	<0.01	<50.0	1.13	1.13	489
	8	7/24/2008	--	--	--	--	--	<50.0	1.01	1.01	429
SS-2	1	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	--
	2	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	2,590
	3	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	1,640
Central	1	4/16/2008	<0.01	<0.01	<0.01	<0.01	<0.01	396	30.5	426.5	--
	2	4/16/2008	--	--	--	--	--	<50.0	1.01	1.01	4,590
	3	4/16/2008	--	--	--	--	--	56.0	2.43	58.4	4,740

Table 1a
Summary of BTA Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Depth	Date	Benzene	Toluene	Ethyl benzene	Xylene	Total BTEX	DRO	GRO	Total TPH	Chloride
RRAL:											--
WS-4	1	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	--
	2	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	**4,320**
	3	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	**3,260**
NS-1	1	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	--
	2	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	**3,980**
	3	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	**4,430**
ES-3	1	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	--
	2	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	**294**
	3	4/16/2008	--	--	--	--	--	<50.0	<1.00	<1.00	**582**
Central	3	7/24/2008	--	--	--	--	--	<50.0	**1.65**	**1.65**	**1,550**
	6	7/24/2008	<0.01	<0.01	<0.01	<0.01	<0.01	<50.0	**1.78**	**1.78**	**3,240**
	8	7/24/2008	--	--	--	--	--	**947**	**1.32**	**948.3**	**3,180**
Back	3	7/24/2008	<0.01	<0.01	<0.01	<0.01	<0.01	<50.0	**2.47**	**2.47**	**1,460**
	6	7/24/2008	--	--	--	--	--	<50.0	**1.09**	**1.09**	**889**
	8	7/24/2008	--	--	--	--	--	<50.0	**1.10**	**1.10**	**325**

Notes

Samples collected by BTA Oil Producers.
TPH samples analyzed via EPA method 8015M.
Depth measurements are in feet.
All concentrations are in milligrams per kilogram (mg/Kg, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 1b
Summary of BTA Derived Groundwater Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Well ID	Date	pH	Chloride	Sulfate	TDS
WQCC Standard		--	**250**	**600**	**1,000**
TMW	09/29/08	--	**757**	--	**2,680**

Notes:

Sample collected by BTA Oil Producers.

All results reported in milligrams per liter (mg/L)

"--" Indicates the chemical was not analyzed.

Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.

Table 2a
Summary of R. T. Hicks Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Depth	Date	Benzene	Toluene	Ethyl benzene	Xylene	DRO	GRO	Total TPH	Chloride
RRAL:										--
SB-1	5	1/27/2009	<0.0100	<0.0100	<0.0100	<0.0100	<50.0	<1.00	<1.00	1,680
	10	1/27/2009	--	--	--	--	--	--	--	1,130
	15	1/27/2009	--	--	--	--	--	--	--	442
	20	1/27/2009	--	--	--	--	--	--	--	536
	25	1/27/2009	<0.0100	<0.0100	<0.0100	<0.0100	<50.0	<1.00	<1.00	610
	30	1/27/2009	--	--	--	--	--	--	--	1,520
SB-2	5	1/27/2009	<0.0100	<0.0100	<0.0100	<0.0100	<50.0	<1.00	<1.00	2,030
	10	1/27/2009	--	--	--	--	--	--	--	1,850
	15	1/27/2009	--	--	--	--	--	--	--	1,260
	20	1/27/2009	--	--	--	--	--	--	--	675
	25	1/27/2009	--	--	--	--	--	--	--	1,010
	30	1/27/2009	--	--	--	--	--	--	--	594
SB-3	5	1/27/2009	<0.0100	<0.0100	<0.0100	<0.0100	<50.0	<1.00	<1.00	85.2
	10	1/27/2009	--	--	--	--	--	--	--	89.1
	15	1/27/2009	--	--	--	--	--	--	--	58.1
	20	1/27/2009	--	--	--	--	--	--	--	103
	25	1/27/2009	--	--	--	--	--	--	--	111
	30	1/27/2009	--	--	--	--	--	--	--	53.7

Table 2a
Summary of R. T. Hicks Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Depth	Date	Benzene	Toluene	Ethyl benzene	Xylene	DRO	GRO	Total TPH	Chloride
RRAL:										--
SB-4	5	1/27/2009	<0.0100	<0.0100	<0.0100	<0.0100	<50.0	<1.00	<1.00	9,560
	10	1/27/2009	<0.0100	<0.0100	<0.0100	<0.0100	<50.0	<1.00	<1.00	3,100
	15	1/27/2009	--	--	--	--	--	--	--	1,580
	20	1/27/2009	--	--	--	--	--	--	--	661
	25	1/27/2009	--	--	--	--	--	--	--	4,160
	30	1/27/2009	--	--	--	--	--	--	--	1,050
	40	1/27/2009	--	--	--	--	--	--	--	607

Notes

Samples collected by R. T. Hicks Consultants, LTD.
Samples analyzed by Trace Analysis.
TPH analyzed via EPA method 8015.
All concentrations are in milligrams per kilogram (mg/Kg, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 2a
Summary of R. T. Hicks Derived SPLP Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Depth	Date	Boron	Calcium	Magnesium	Potassium	Sodium	Fluoride	Chloride	Nitrite	Bromide	Nitrate	Phosphorus	Sulfate
RRAL:														--
Sample Trench														
Trench N of SB4	2	11/25/2009	0.059	9.4	0.92	<1.0	19	0.34	31	<0.10	0.18	<0.10	<0.50	5.7
	4	11/25/2009	<0.040	8.2	0.74	<1.0	14	0.49	17	<0.10	0.10	<0.11	<0.50	5.5
	6	11/25/2009	<0.040	8.7	0.82	<1.0	19	0.35	32	<0.10	0.16	<0.10	<0.50	5.9
Trench @ W	2	11/25/2009	0.096	20	1.6	<1.0	46	0.83	41	<0.10	0.31	0.18	<0.50	8.3

Notes

Samples collected by R. T. Hicks Consultants, LTD.
Samples analyzed by Hall Environmental Laboratory.
Samples prepared via EPA SPLP method 1312.
Depth measurements are in feet.
All concentrations are in milligrams per liter (mg/L, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 2a
Summary of R. T. Hicks Derived SPLP Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Depth	Date	Alkalinity	Ammonia	TDS	Sulfur
RRAL:						
Sample Trench						
Trench N of SB4	2	11/25/2009	<50	<2.0	112	2.31
	4	11/25/2009	65	<2.0	120	2.22
	6	11/25/2009	27	<2.0	98.0	2.39
Trench @ W	2	11/25/2009	<50	<2.0	136	2.53

Notes

Samples collected by R. T. Hicks Consultants, LTD.
Samples for alkalinity, ammonia and TDS were analyzed by Hall Environmental.
Sulfur analysis was performed by Anatek.
Samples prepared via EPA SPLP method 1312.
Depth measurements are in feet.
All concentrations are in milligrams per liter (mg/L, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 2b
Summary of R. T. Hicks Derived Groundwater and Surface Water Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Date	MTBE	Benzene	Toluene	Ethyl benzene	Total Xylenes	1,2,4-Trimethyl benzene	1,3,5-Trimethyl benzene
RRAL:								
MW-1	11/18/2009	--	--	--	--	--	--	--
MW-2	11/18/2009	--	--	--	--	--	--	--
MW-3	11/18/2009	--	--	--	--	--	--	--
MW-4	11/18/2009	<0.0025	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001
MW-5	11/18/2009	--	--	--	--	--	--	--
MW-6	11/18/2009	--	--	--	--	--	--	--
QC Samples								
Trip Blank	11/19/2009	<0.0025	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001

Notes

Samples collected by R. T. Hicks Consultans, LTD.
BTEX samples analyzed via EPA method 8021B.
All concentrations are in milligrams per liter (mg/L, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 2b
Summary of R. T. Hicks Derived Groundwater and Surface Water Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Date	Boron	Calcium	Magnesium	Potassium	Sodium	Fluoride	Chloride	Bromide	Nitrate + Nitrite	Phosphorus	Sulfate
RRAL:								250				600
MW-1	11/18/2009	0.89	1,300	460	36	1,800	1.8	**3,700**	5.0	<10	<10	**3,000**
	12/17/2009	--	--	--	9.41	1,660	--	**2,830**	<2.50	--	--	--
MW-2	11/18/2009	1.0	1,400	490	45	1,800	1.5	**3,400**	4.9	<10	<10	**3,000**
	12/17/2009	--	--	--	9.09	1,610	--	**3,100**	<2.50	--	--	--
MW-3	11/18/2009	0.75	1,100	460	22	1,700	<2.0	**3,400**	5.9	<10	<10	**2,900**
	12/17/2009	--	--	--	11.2	1,400	--	**2,780**	30.9	--	--	--
MW-4	11/18/2009	0.86	1,300	390	35	8,000	1.2	**14,000**	40	<40	<10	**2,800**
	12/17/2009	--	--	--	25.8	7,280	--	**11,900**	119	--	--	--
MW-5	11/18/2009	0.73	1,200	400	17	2,100	1.0	**4,500**	11	<10	<0.50	**2,500**
	12/17/2009	--	--	--	15.1	1,960	--	**3,430**	48.6	--	--	--
MW-6	11/18/2009	1.4	910	720	24	2,600	2.4	**5,800**	7.0	<20	<10	**4,700**
	12/17/2009	--	--	--	12.2	2,090	--	**3,370**	34.2	--	--	--
Pecos R E MW-6	11/18/2009	0.36	500	210	6.4	740	0.91	**1,800**	0.71	<4.0	<0.50	**2,000**
Pardue B Dump V	11/17/2009	16	26,000	3,900	1,500	6,700	<10	**210,000**	2500	<1000	<50	390
Pecos Upstream	1/26/2009	--	--	--	--	--	--	**1,300**	--	--	--	--
	11/18/2009	0.35	540	220	6.4	710	0.82	**1,600**	0.68	<4.0	<0.50	**1,700**
Pecos Downstream	1/26/2009	--	--	--	--	--	--	**1,290**	--	--	--	--
Seep	1/26/2009	--	--	--	--	--	--	**4,840**	--	--	--	--
W-1 (Bank Bore)	1/26/2009	--	--	--	--	--	--	**2,890**	--	--	--	--
SB-4	1/26/2009	--	--	--	--	--	--	**6,650**	--	--	--	--
Cooler Water	11/19/2009	--	--	--	--	--	--	28	--	--	--	--

Notes

Samples collected by R. T. Hicks Consultans, LTD.

All concentrations are in milligrams per lliter (mg/L, parts per million).

Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 2b
Summary of R. T. Hicks Derived Groundwater and Surface Water Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location	Date	Alkalinity	Specific Conductance	Ammonia	TDS	Sulfur
RRAL:						
MW-1	11/18/2009	530	16,000	<1.0	10,000	1,090
	12/17/2009	--	--	--	8,150	--
MW-2	11/18/2009	600	15,000	<1.0	9,450	1,090
	12/17/2009	--	--	--	8,860	--
MW-3	11/18/2009	400	14,000	<1.0	9,300	1,160
	12/17/2009	--	--	--	7,530	--
MW-4	11/18/2009	260	50,000	<1.0	25,300	1,070
	12/17/2009	--	--	--	26,200	--
MW-5	11/18/2009	380	15,000	<1.0	9,690	907
	12/17/2009	--	--	--	8,940	--
MW-6	11/18/2009	430	21,000	<1.0	13,000	1,500
	12/17/2009	--	--	--	10,600	--
Pecos R E MW-6	11/18/2009	170	5,900	<1.0	4,640	627
Pardue B Dump V	11/17/2009	23	530,000	760	298,000	131
Pecos Upstream	11/18/2009	170	6,000	<1.0	4,740	672
Cooler Water	11/19/2009	--	--	--	110	--

Notes

Samples collected by R. T. Hicks Consultans, LTD.
Specific conductance is reported in µmhos/cm.
All concentrations are in milligrams per liter (mg/L, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 3a
Summary of LAI Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location		Date	TPH	Chloride
RRAL:			100	--
BH-1 (MW-7)	0	4/8/2010	--	74.0
	5	4/8/2010	**204**	72.1
	10	4/8/2010	--	197
	15	4/8/2010	--	216
	20	4/8/2010	53.5	54.0
	25	4/8/2010	--	268
	30	4/8/2010	27.7	160
BH-2	0	4/12/2010	--	68.6
	5	4/12/2010	<10.3	306
	10	4/12/2010	--	979
	15	4/12/2010	<10.7	1,050
	20	4/12/2010	--	442
	25	4/12/2010	--	519
	30	4/12/2010	<10.6	234
	35	4/12/2010	--	184
BH-3	0	4/12/2010	--	184
	5	4/12/2010	<10.6	2,220
	10	4/12/2010	--	1,060
	15	4/12/2010	<11.3	1,400
	20	4/12/2010	--	1,360
	25	4/12/2010	--	775
	30	4/12/2010	<10.4	281
	35	4/12/2010	--	164
BH-4	0	4/8/2010	--	66.5
	5	4/8/2010	**254**	26.0
	10	4/8/2010	--	159
	15	4/8/2010	--	416
	20	4/8/2010	**242**	512
	25	4/8/2010	--	777
	30	4/8/2010	**115**	243
BH-5 (MW-8)	0	4/9/2010	--	105
	5	4/9/2010	15.1	111
	10	4/9/2010	--	416
	15	4/9/2010	--	885
	20	4/9/2010	20.6	635
	25	4/9/2010	--	636
	30	4/9/2010	79.2	608

Table 3a
Summary of LAI Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location		Date	TPH	Chloride
RRAL:			100	--
BH-6 (MW-9)	0	4/8/2010	--	155
	5	4/8/2010	**271**	467
	10	4/8/2010	--	592
	15	4/8/2010	--	671
	20	4/8/2010	**246**	448
	26	4/8/2010	--	259
BH-7	0	4/14/2010	--	7,190
	5	4/14/2010	<10.4	6,160
	10	4/14/2010	<10.7	7,950
	15	4/14/2010	--	7,600
	20	4/14/2010	<10.7	7,690
	25	4/14/2010	--	1,800
	30	4/14/2010	--	1,030
	35	4/14/2010	--	1,050
BH-8 (MW-10)	0	4/14/2010	--	91.9
	5	4/14/2010	<10.9	176
	10	4/14/2010	--	181
	15	4/14/2010	<10.7	90
	20	4/14/2010	--	105
	25	4/14/2010	--	128
	30	4/14/2010	--	124
	35	4/14/2010	--	108
BH-9 (MW-11)	0	4/5/2010	--	197
	5	4/5/2010	35.9	1,480
	10	4/5/2010	--	1,420
	15	4/5/2010	--	963
	20	4/5/2010	52.9	1,090
	25	4/5/2010	--	201
	30	4/5/2010	53.3	382
	35	4/5/2010	--	308
	50	4/7/2010	--	592
	60	4/7/2010	--	405
	70	4/7/2010	--	482
BH-10	0	4/13/2010	--	44.2
	5	4/13/2010	<11.1	8.05
	10	4/13/2010	--	1,120
	15	4/13/2010	<11.0	845

Table 3a
Summary of LAI Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location		Date	TPH	Chloride
RRAL:			100	--
BH-10	20	4/13/2010	--	1,250
	25	4/13/2010	--	1,400
	30	4/13/2010	<10.3	709
	35	4/13/2010	--	628
BH-11	0	4/13/2010	--	35.5
	5	4/13/2010	<10.6	223
	10	4/13/2010	--	238
	15	4/13/2010	<10.8	783
	20	4/13/2010	--	1,090
	25	4/13/2010	--	2,470
	30	4/13/2010	<11.1	1,620
	35	4/13/2010	--	953
BH-12	0	4/12/2010	<10.5	801
	5	4/12/2010	--	316
	10	4/12/2010	--	761
	15	4/12/2010	<11.1	267
	20	4/12/2010	--	338
	25	4/12/2010	--	909
	30	4/12/2010	<10.5	773
	35	4/12/2010	--	411
BH-13 (MW-12)	0	4/13/2010	--	671
	5	4/13/2010	--	3,460
	10	4/13/2010	<11.0	12,500
	15	4/13/2010	--	9,840
	20	4/13/2010	42.0	1,910
	25	4/13/2010	--	3,950
	30	4/13/2010	<10.7	2,710
	35	4/13/2010	--	1,860
BH-14 (MW-13)	0	4/15/2010	**3,970**	986
	5	4/15/2010	**274**	1,490
	10	4/15/2010	37.0	3,580
	15	4/15/2010	--	3,050
	20	4/15/2010	--	5,690
	25	4/15/2010	--	7,630
	30	4/15/2010	--	3,670
	35	4/15/2010	--	3,280

Table 3a
Summary of LAI Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location		Date	TPH	Chloride
RRAL:			100	--
BH-15 (MW-14)	0	4/14/2010	**4,440**	1,820
	3	4/14/2010	--	247
	5	4/14/2010	**123**	357
	7	4/14/2010	--	575
	10	4/14/2010	<11.2	967
	15	4/14/2010	--	1,740
	20	4/14/2010	--	661
	25	4/14/2010	--	847
	30	4/14/2010	--	2,020
	35	4/14/2010	--	1,220
BH-16	0	4/6/2010	--	4,720
	5	4/6/2010	**266**	3,540
	10	4/6/2010	--	826
	15	4/6/2010	--	917
	20	4/6/2010	**231**	594
	25	4/6/2010	--	1,280
	30	4/6/2010	**250**	665
	35	4/6/2010	--	421
BH-17	0	4/6/2010	--	7,060
	5	4/6/2010	**217**	5,050
	10	4/6/2010	--	7,330
	15	4/6/2010	--	1,650
	20	4/6/2010	**238**	1,580
	25	4/6/2010	--	1,500
	30	4/6/2010	**269**	2,500
	35	4/6/2010	--	3,030
BH-18	0	4/8/2010	--	92.7
	5	4/8/2010	**120**	1,890
	10	4/8/2010	--	1,140
	15	4/8/2010	--	885
	20	4/8/2010	**176**	691
	25	4/8/2010	--	618
	30	4/8/2010	**216**	858
	35	4/8/2010	--	552
BH-19	0	4/6/2010	68.9	228
	5	4/6/2010	--	1,520
	10	4/6/2010	--	2,210

Table 3a
Summary of LAI Derived Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location		Date	TPH	Chloride
RRAL:			**100**	**--**
BH-19	15	4/6/2010	--	1,070
	20	4/6/2010	**101**	1,760
	25	4/6/2010	--	608
	30	4/6/2010	**137**	5,870
	35	4/6/2010	--	1,240

Notes

Samples analyzed via EPA method 418.1.
Depth measurements are in feet.
All concentrations are in milligrams per kilogram (mg/Kg, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 3a
Summary of LAI Derived SPLP Soil Analyses
BTA Oil Producers
Pardue 'C' JVP Well #1
10-0101

Location		Date	Chloride
RRAL:			--
BH-3	5	4/12/2010	385
BH-13 (MW-12)	5	4/13/2010	245
	10	4/13/2010	113
	15	4/13/2010	150
BH-17	0	4/6/2010	292
	5	4/6/2010	247
	30	4/6/2010	127

Notes

Samples prepared via EPA SPLP 1312.
Depth measurements are in feet.
All concentrations are in milligrams per liter (mg/L, parts per million).
Blue and Bold indicates the value exceeds the RRAL Cleanup Level.

Table 3b
Monitoring Well Completion Details and Gauging Summary
BTA Oil Producers - Pardue 'C' JVP
Lea County, New Mexico
10-0101

Well Information									Groundwater Data			
Well ID	Date Drilled	Drilled Depth (bgs)	Well Depth from TOC	Well Diameter (inches)	Surface Elevation	Screen Interval (bgs)	Casing Stickup	TOC Elevation	Date Gauged	Depth to Fluid	Depth to Water	Corrected Water Elevation
MW-01	11/17/2009	--	4.64	2	2,967.2	--	1.72	2,968.92	-- 04/26/10	-- --	-- 3.71	-- 2,965.21
MW-02	11/17/2009	--	4.90	2	2967.9	--	1.35	2,969.25	-- 04/26/10	-- --	-- 3.31	-- 2,965.94
MW-03	11/17/2009	--	4.00	2	2,966.7	--	0.68	2,967.38	-- 04/26/10	-- --	-- 2.08	-- 2,965.30
MW-04	11/17/2009	--	4.12	2	2,961.4	--	1.26	2,962.66	-- 04/26/10	-- --	-- 2.75	-- 2,959.91
MW-05	11/17/2009	--	4.98	2	2,965.0	--	1.97	2,966.97	-- 04/26/10	-- --	-- 4.04	-- 2,962.93
MW-06	11/17/2009	--	5.31	2	2,963.2	--	1.51	2,964.71	-- 04/26/10	-- --	-- 5.17	-- 2,959.54
MW-07 (BH-1)	4/9/2010	47	50.36	4	3,005.9	32.29-46.69	3.29	3,009.19	-- 04/26/10	-- --	-- 38.24	-- 2,970.95
MW-08 (BH-5)	4/9/2010	47	50.73	4	3,001.9	32.61-47.58	3.03	3,004.93	-- 04/26/10	-- --	-- 38.21	-- 2,966.72

Table 3b
Monitoring Well Completion Details and Gauging Summary
BTA Oil Producers - Pardue 'C' JVP
Lea County, New Mexico
10-0101

Well Information									Groundwater Data			
Well ID	Date Drilled	Drilled Depth (bgs)	Well Depth from TOC	Well Diameter (inches)	Surface Elevation	Screen Interval (bgs)	Casing Stickup	TOC Elevation	Date Gauged	Depth to Fluid	Depth to Water	Corrected Water Elevation
MW-09 (BH-6)	4/8/2010	53	49.65	4	3,001.3	31.62-46.02	3.00	3,004.30	-- 04/26/10	-- --	-- 38.77	-- 2,965.53
MW-10 (BH-8)	4/14/2010	46	50.15	4	3,001.0	32.08-46.48	3.04	3,004.04	-- 04/26/10	-- --	-- 40.36	-- 2,963.68
MW-11 (BH-9)	4/5/2010	45	47.93	4	2,999.8	29.86-44.26	2.89	3,002.69	-- 04/26/10	-- --	-- 38.95	-- 2,963.74
MW-12 (BH-13)	4/13/2010	47	50.32	4	3,003.5	32.38-46.78	3.07	3,006.57	-- 04/26/10	-- --	-- 39.36	-- 2,967.21
MW-13 (BH-14)	4/15/2010	47	49.85	4	3,003.0	31.78-46.18	3.20	3,003.38	-- 04/26/10	-- --	-- 39.18	-- 2,964.20
MW-14 (BH-15)	4/14/2010	44	47.64	4	3.000.4	29.66-44.06	3.04	3,003.44	-- 04/26/10	-- --	-- 36.93	-- 2,966.51

Notes
All values are in feet, unless otherwise noted.
bgs - below ground surface
TOC - top of casing
Elevations are above mean sea level referenced to 1984 Geodetic Datum.
Wells drilled and installed by Scarborough Drilling, Lamesa, Texas. Schedule 40 threaded PVC casing and screen.

Table 3c
LAI Derived Organic Water Quality Analysis
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	TRPH	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
WQCC Standard			**0.01**	**0.75**	**0.75**	**0.62**	--
MW-01	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-02	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-03	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-04	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-05	04/28/10	--	Insufficient water to collect sample				
MW-06	04/28/10	--	Insufficient water to collect sample				
MW-07	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-08	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-09	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-10	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-11	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-12	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-13	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
MW-14	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
NMED Numeric Standard		--	**0.022**	**6.8**	**3.1**	--	--
Seep-1	04/26/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Seep-2	04/26/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Seep-3	04/26/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Seep-4	04/26/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002

Notes:
All results reported in milligrams per liter (mg/L)
"<" Indicates the reported concentration is below the method detection limit (MDL).
"--" Indicates the chemical was not analyzed.
Bold indicates the chemical of concern was detected above the MDL.
Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.
Red indicated the chemical exceeds Surface Water Quality Bureau Numeric Domestic Water Quality Standard.

Table 3c
LAI Derived Organic Water Quality Analysis
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	TRPH	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
WQCC Standard			**0.01**	**0.75**	**0.75**	**0.62**	--
Equip Rinse-01	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Dup-01 (Seep-1)	04/26/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Trip Blank-01	04/27/10	--	<0.0008	<0.002	<0.002	<0.003	<0.002
Equip Rinse-02	04/28/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Dup-02 (MW-8)	04/27/10	<0.300	<0.0008	<0.002	<0.002	<0.003	<0.002
Trip Blank-02	04/28/10	--	<0.0008	<0.002	<0.002	<0.003	<0.002

Notes:
All results reported in milligrams per liter (mg/L)
"<" Indicates the reported concentration is below the method detection limit (MDL).
"--" Indicates the chemical was not analyzed.
Bold indicates the chemical of concern was detected above the MDL.
Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.

Table 3c
LAI Derived Metals Water Quality Analysis
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
WQCC Standard		0.1	1.0	0.01	0.05	0.05	0.002	0.05	0.05
MW-01	04/28/10	0.00243	0.0375	0.000307	0.0166	0.00495	<0.00008	0.00358	<0.001
MW-02	04/28/10	0.00407	0.0340	0.000399	0.00587	0.00573	<0.00008	0.00667	<0.001
MW-03	04/28/10	0.00392	0.0232	<0.0003	0.00429	0.00115	<0.00008	0.00817	<0.001
MW-04	04/28/10	0.00514	0.0575	0.00054	0.00845	0.00725	<0.00008	0.0108	<0.001
MW-05	04/28/10	Insufficient water to collect sample							
MW-06	04/28/10	Insufficient water to collect sample							
MW-07	04/27/10	0.00274	0.0167	<0.0003	<0.002	<0.0003	<0.00008	0.00637	<0.001
MW-08	04/27/10	0.00254	0.0157	<0.0003	<0.002	<0.0003	<0.00008	0.00766	<0.001
MW-09	04/27/10	<0.002	0.0201	<0.0003	<0.002	<0.0003	<0.00008	0.00505	<0.001
MW-10	04/28/10	0.00245	0.115	<0.0003	<0.002	<0.0003	<0.00008	0.00628	<0.001
MW-11	04/28/10	0.00319	0.0210	0.0006	<0.002	0.000945	<0.00008	0.00561	<0.001
MW-12	04/27/10	0.00236	0.0374	<0.0003	<0.002	<0.0003	<0.00008	0.0111	<0.001
MW-13	04/27/10	0.00211	0.0407	<0.0003	<0.002	<0.0003	<0.00008	0.0130	<0.001
MW-14	04/28/10	<0.002	0.150	<0.0003	<0.002	<0.0003	<0.00008	0.00769	<0.001

Table 3c
LAI Derived Metals Water Quality Analysis
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
NMED Numeric Standard		0.023	2.0	0.005	0.1	0.05	0.002	0.05	--
Seep-1	04/26/10	0.00253	0.0151	<0.0003	<0.002	<0.0003	<0.00008	0.00761	<0.001
Seep-2	04/26/10	0.00503	0.0145	<0.0003	<0.002	<0.0003	<0.00008	0.00716	<0.001
Seep-3	04/26/10	0.00251	0.0179	<0.0003	<0.002	<0.0003	<0.00008	0.00399	<0.001
Seep-4	04/26/10	<0.002	0.0196	<0.0003	<0.002	<0.0003	<0.00008	0.00269	<0.001

Notes:
All results reported in milligrams per liter (mg/L)
"<" Indicates the reported concentration is below the method detection limit (MDL).
"--" Indicates the chemical was not analyzed.
Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.
Red indicated the chemical exceeds Surface Water Quality Bureau Numeric Domestic Water Quality Standard.

Table 3c
LAI Derived Metals Water Quality Analysis
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
WQCC Standard		0.1	1.0	0.01	0.05	0.05	0.002	0.05	0.05
Equip Rinse-01	04/27/10	<0.002	<0.003	<0.0003	<0.002	<0.0003	<0.00008	<0.002	<0.001
Dup-01 (Seep-1)	04/26/10	0.00261	0.0151	<0.0003	<0.002	<0.0003	<0.00008	0.0076	<0.001
Equip Rinse-02	04/28/10	<0.002	<0.003	<0.0003	0.00244	<0.0003	<0.00008	<0.002	<0.001
Dup-02 (MW-8)	04/27/10	0.00238	0.0214	<0.0003	<0.002	<0.0003	<0.00008	0.0073	<0.001

Notes:
All results reported in milligrams per liter (mg/L)
"<" Indicates the reported concentration is below the method detection limit (MDL).
"--" Indicates the chemical was not analyzed.
Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.

Table 3c
LAI Derived Water Quality Parameters
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	pH	Chloride	Sulfate	TDS
WQCC Standard		--	**250**	**600**	**1,000**
MW-01	04/28/10	7.35	**3,380**	**2,830**	**9,230**
MW-02	04/28/10	7.15	**3,650**	**2,950**	**10,000**
MW-03	04/28/10	7.24	**2,670**	**2,630**	**7,840**
MW-04	04/28/10	7.24	**10,000**	**2,630**	**20,500**
MW-05	04/28/10	Insufficient water to collect sample			
MW-06	04/28/10	Insufficient water to collect sample			
MW-07	04/27/10	7.04	**2,510**	**2,370**	**6,900**
MW-08	04/27/10	7.04	**2,810**	**2,620**	**7,310**
MW-09	04/27/10	7.09	**4,180**	**2,860**	**9,980**
MW-10	04/28/10	6.94	**13,500**	**1,470**	**25,300**
MW-11	04/28/10	6.99	**3,150**	**2,630**	**8,780**
MW-12	04/27/10	7.10	**3,670**	**2,690**	**8,900**
MW-13	04/27/10	7.02	**8,060**	**3,050**	**13,500**
MW-14	04/28/10	6.90	**10,800**	**1,700**	**21,500**
NMED Numeric Standard		--	--	--	--
Seep-1	04/26/10	7.47	2,580	2,350	7,750
Seep-2	04/26/10	7.28	3,090	2,340	8,220
Seep-3	04/26/10	7.87	3,350	2,540	9,070
Seep-4	04/26/10	7.50	4,440	3,210	11,800

Notes:
All results reported in milligrams per liter (mg/L)
"<" Indicates the reported concentration is below the method detection limit (MDL).
"--" Indicates the chemical was not analyzed.
Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.
Red indicated the chemical exceeds Surface Water Quality Bureau Numeric Domestic Water Quality Standard.

Table 3c
LAI Derived Water Quality Parameters
BTA Oil Producers - Pardue 'C' JVP
Loving, Lea County, New Mexico
10-0101

Well ID	Date	pH	Chloride	Sulfate	TDS
WQCC Standard		--	**250**	**600**	**1,000**
Equip Rinse-01	04/27/10	9	<0.300	<1	<10
Dup-01 (Seep-1)	04/26/10	7.33	**2,580**	**2,370**	**7,870**
Equip Rinse-02	04/28/10	6.8	<0.300	<1	47.0
Dup-02 (MW-8)	04/27/10	6.93	**2,730**	**2,540**	**7,910**

Notes:
All results reported in milligrams per liter (mg/L)
"<" Indicates the reported concentration is below the method detection limit (MDL).
"--" Indicates the chemical was not analyzed.
Blue indicated the chemical exceeds the Water Quality Control Commission (WQCC) standard.

Table 4
BTA Oil Producers - Pardue 'C' JVP
Slug Test Results
Loving County, New Mexico

MW-ID & Test	Falling Head K	Rising Head K	Well Average
MW-07 Test 1	8.47843815	10.9077332	
MW-07 Test 2	8.900801	11.4066316	
MW-07 Test 3	8.8724545	10.3634804	
MW-07 Average	8.751	10.893	9.822
MW-08 Test 1	1.680663985	1.935215555	
MW-08 Test 2	1.55792364	insufficient data	
MW-08 Test 3	1.561608685	2.201105725	
MW-08 Average	1.600	2.068	1.834
MW-09 Test 1	0.025149015	0.095357626	
MW-09 Average	0.025	0.095	0.060
MW-10 Test 1	52.0158275	insufficient data	
MW-10 Test 2	54.4536265	insufficient data	
MW-10 Test 3	43.6252635	insufficient data	
MW-10 Average	50.032	insufficient data	50.032
MW-11 Test 1	5.89323735	6.54520685	
MW-11 Test 2	5.9641036	6.76630955	
MW-11 Test 3	6.19937955	6.7407977	
MW-11 Average	6.019	6.684	6.352
MW-12 Test 1	0.587056015	0.81921385	
MW-12 Average	0.587	0.819	0.703
MW-13 Test 1	2.9196895	5.65512675	
MW-13 Test 2	5.50772495	4.0535495	
MW-13 Test 3	4.4277233	5.0853621	
MW-13 Average	4.285	4.931	4.608
MW-14 Test 1	0.112734031	0.098759206	
MW-14 Test 2	0.087930843	0.113442693	
MW-14 Average	0.100	0.106	0.103
Range	0.100 to 50.032	0.106 to 10.893	
Overall Averages	8.925	3.657	9.189

Notes:
All results are reported in feet per day (ft/day).

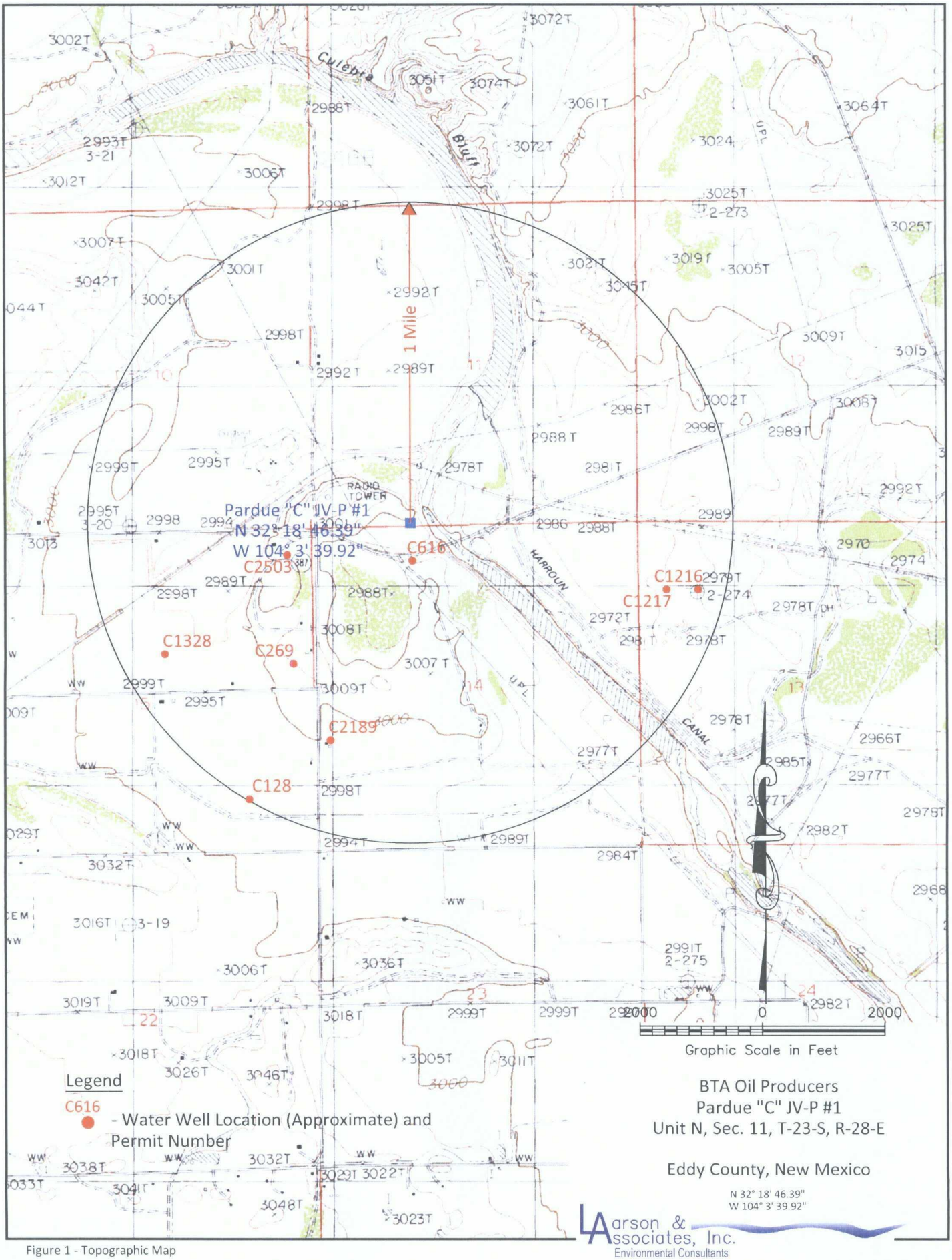


Figure 1 - Topographic Map

JWW

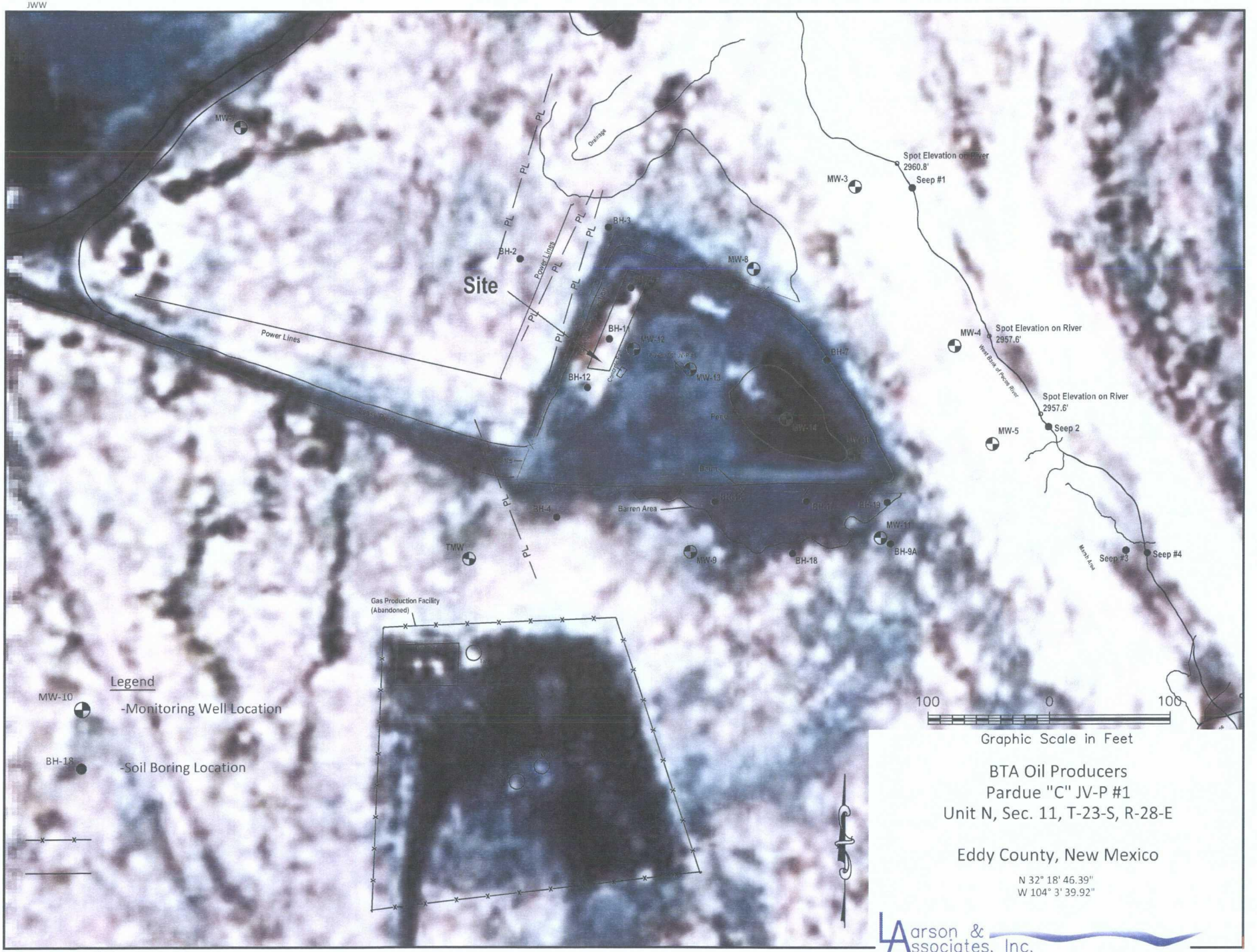


Figure 2 - Aerial Map

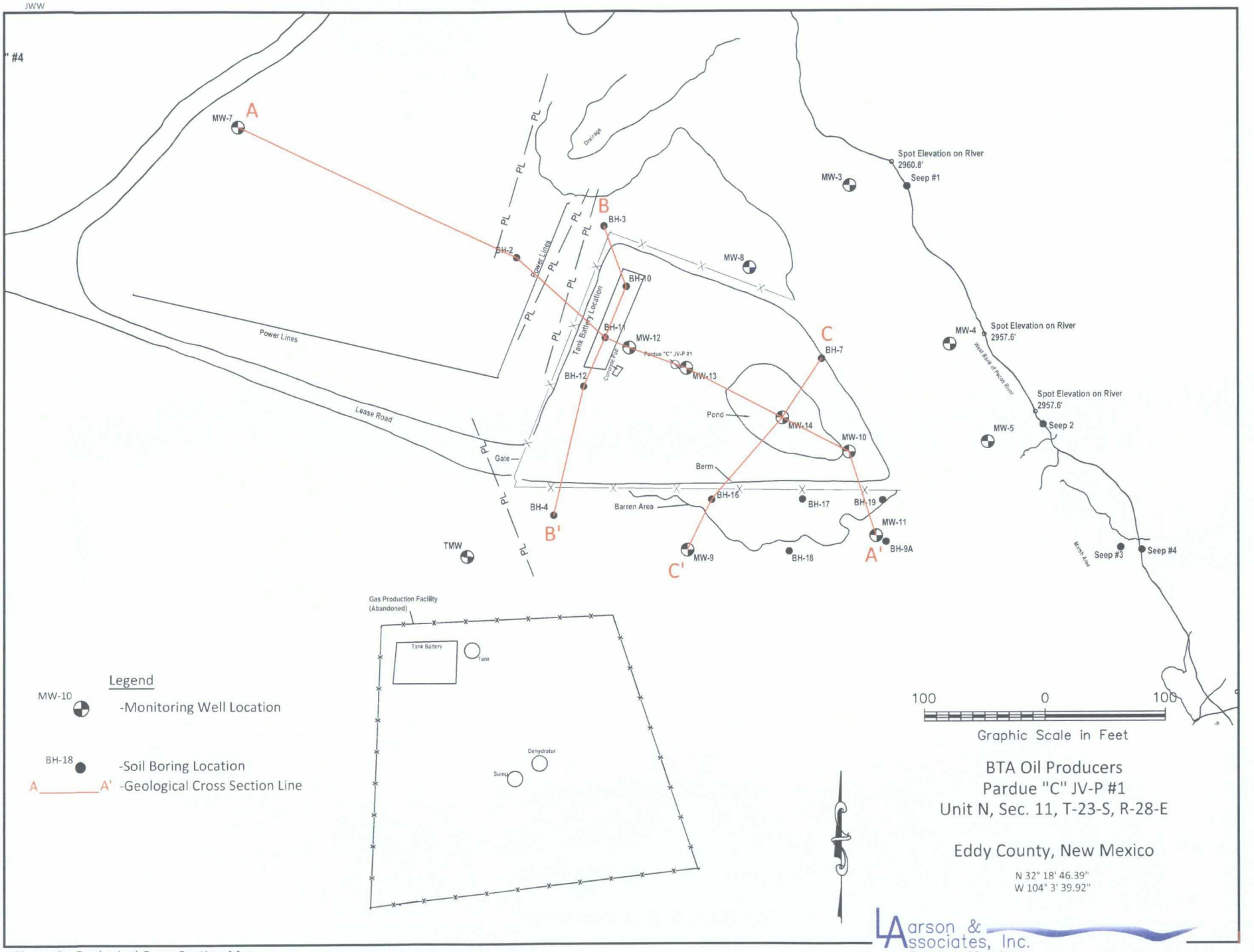
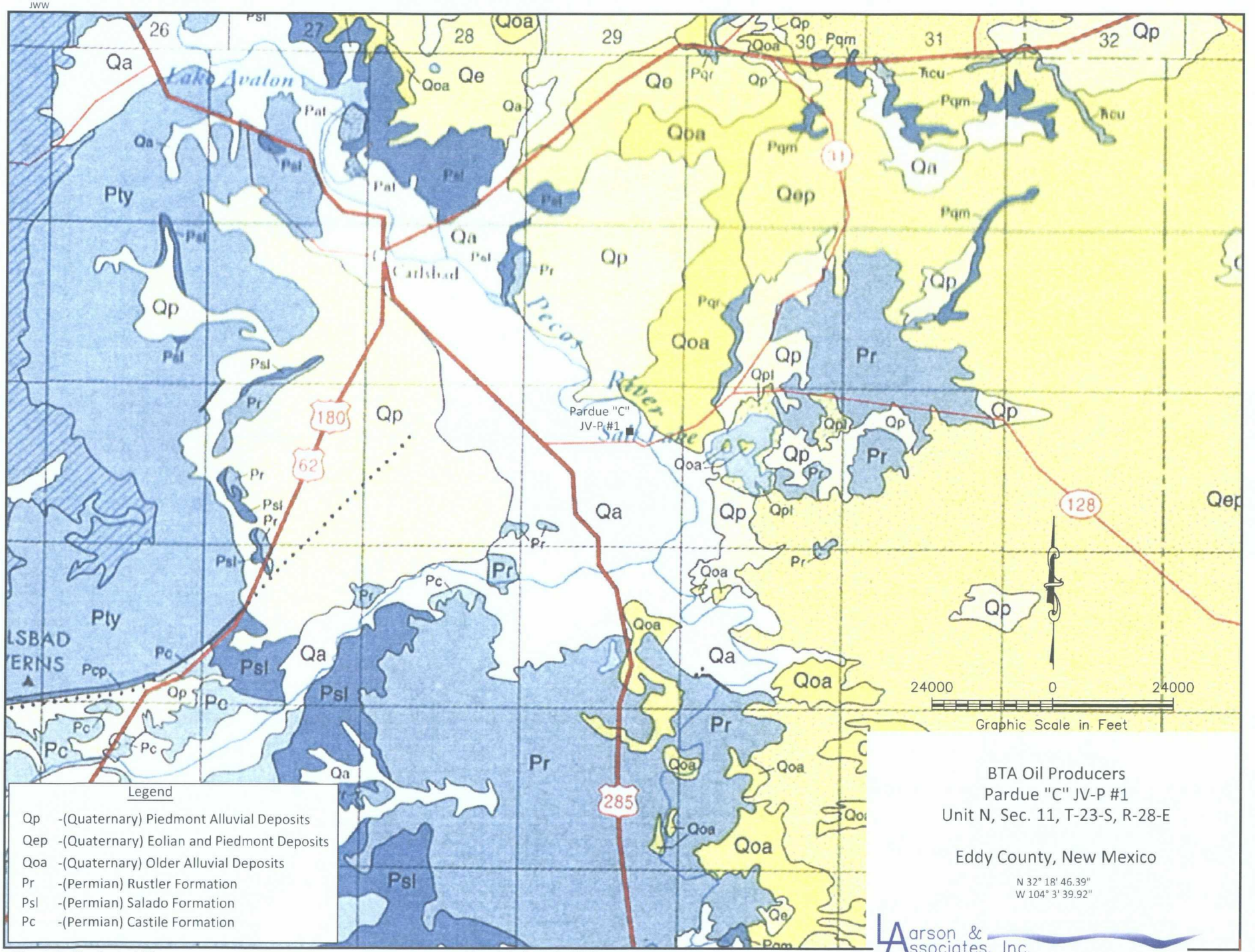


Figure 3 - Geological Cross Section Map

JWW



BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

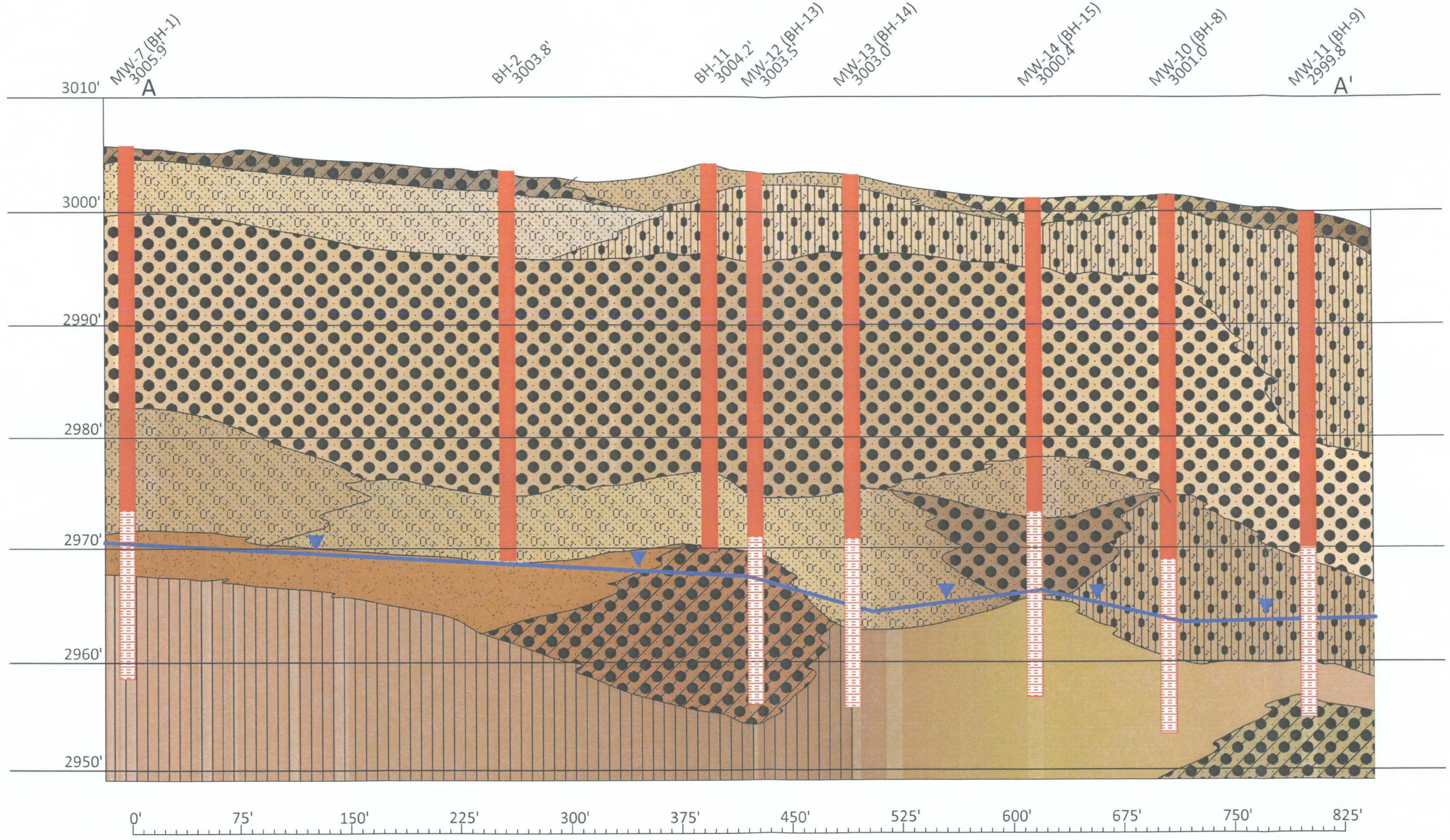
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

LArson & Associates, Inc.
Environmental Consultants

Figure 4 - Geological Map

After Scholle, P.A., 2003



Legend

Silty Clay | Conglomerate | Gravelly Sand | Sandy Clay | Silty Clay | - Screened Interval | - Potentiometric Surface

Refer to Figure 3 for Location

1" = 75' Horizontal
1" = 10' Vertical
X7.5 Vertical Exaggeration

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

Figure 5 - Geological Cross Section A-A'

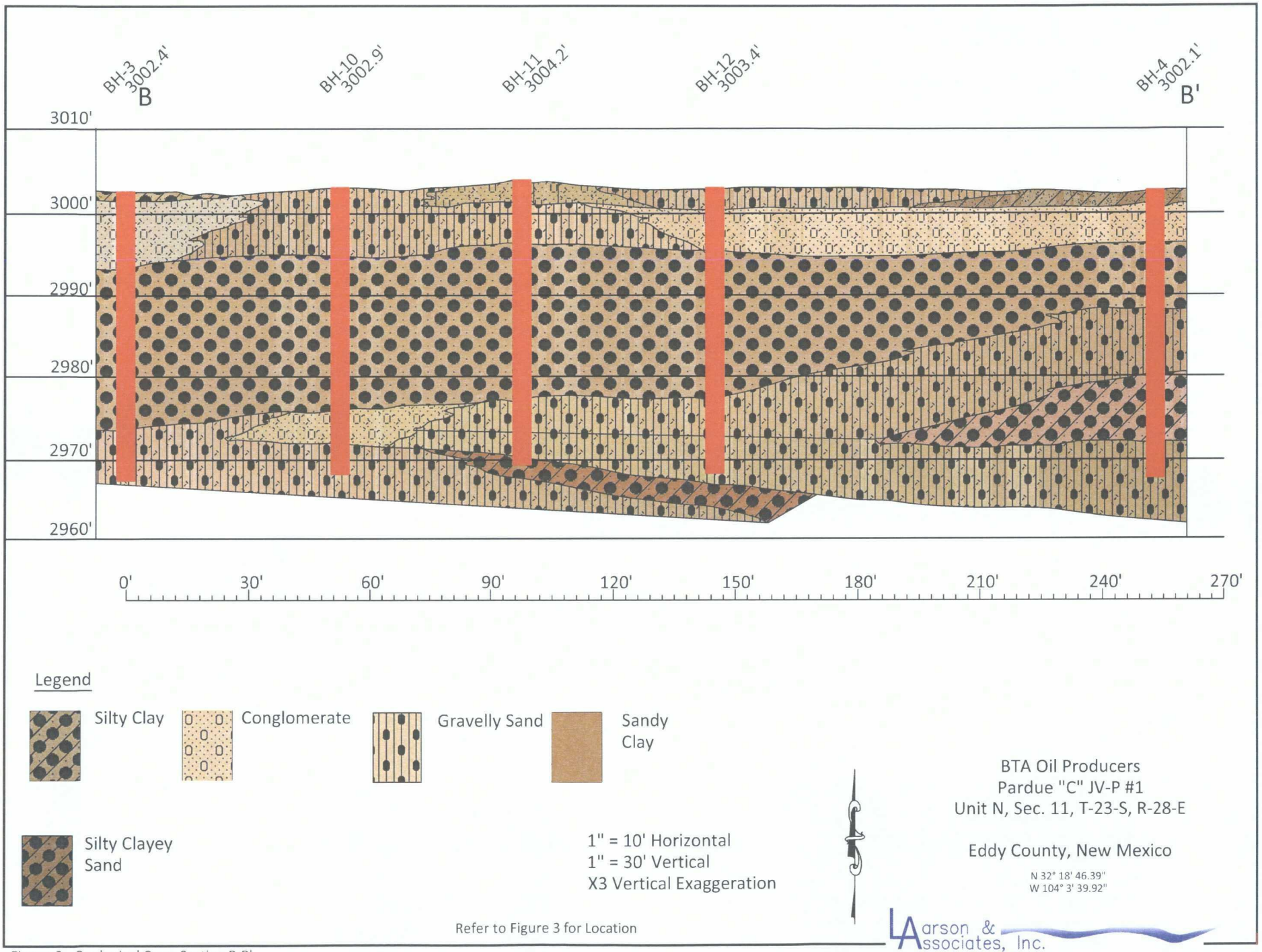


Figure 6 - Geological Cross Section B-B'

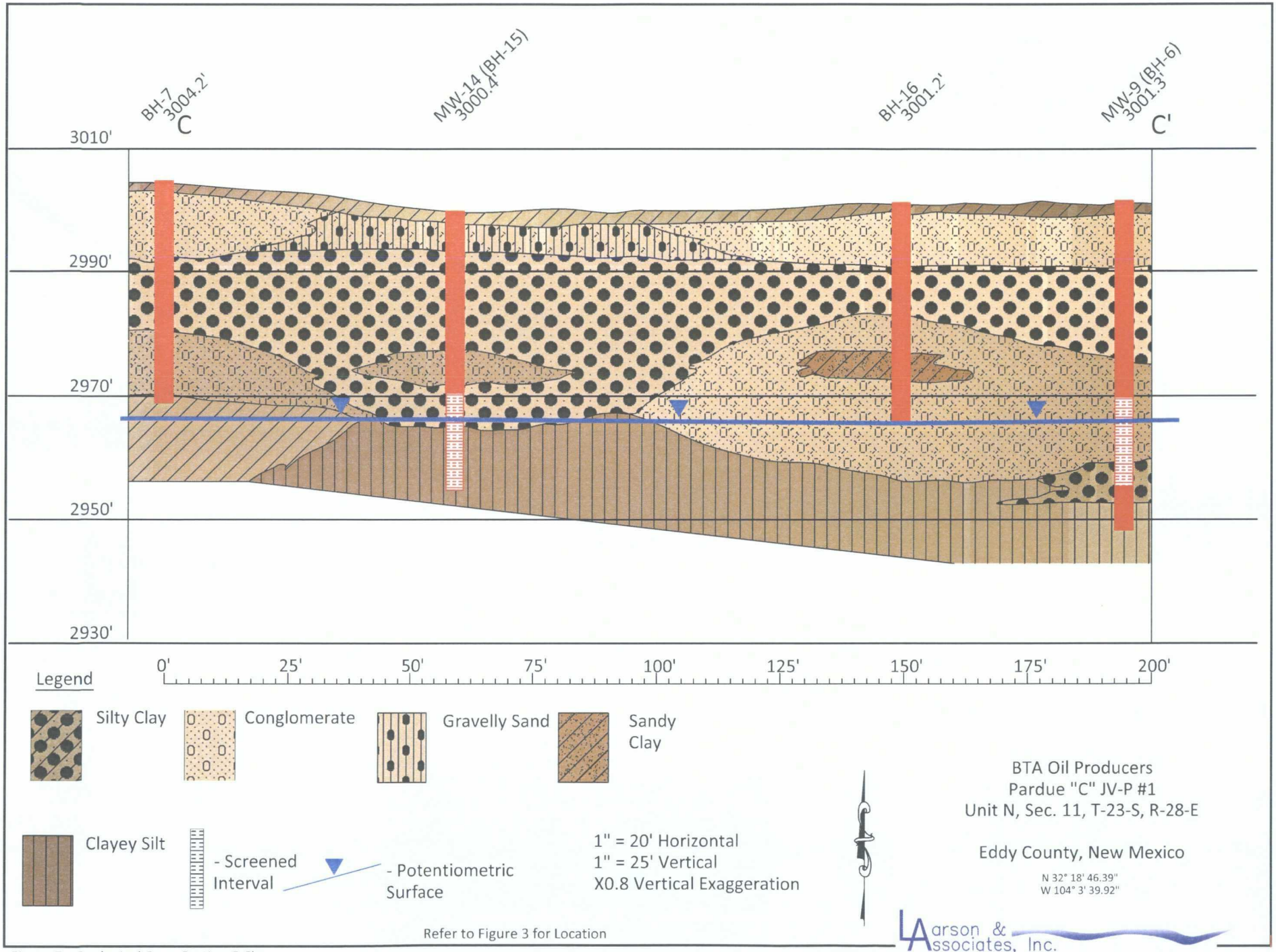


Figure 7 - Geological Cross Section C-C'

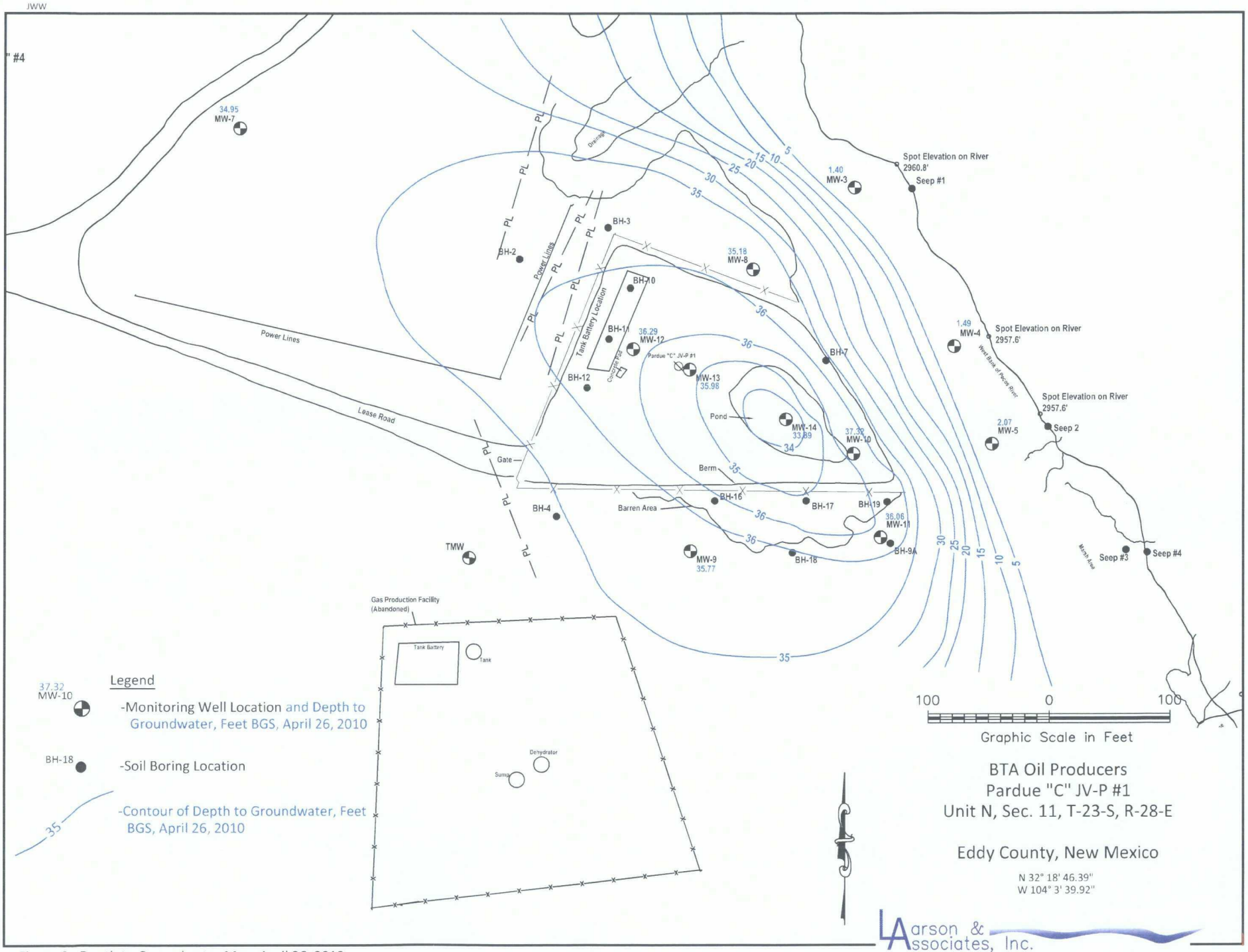


Figure 8 - Depth to Groundwater Map, April 26, 2010

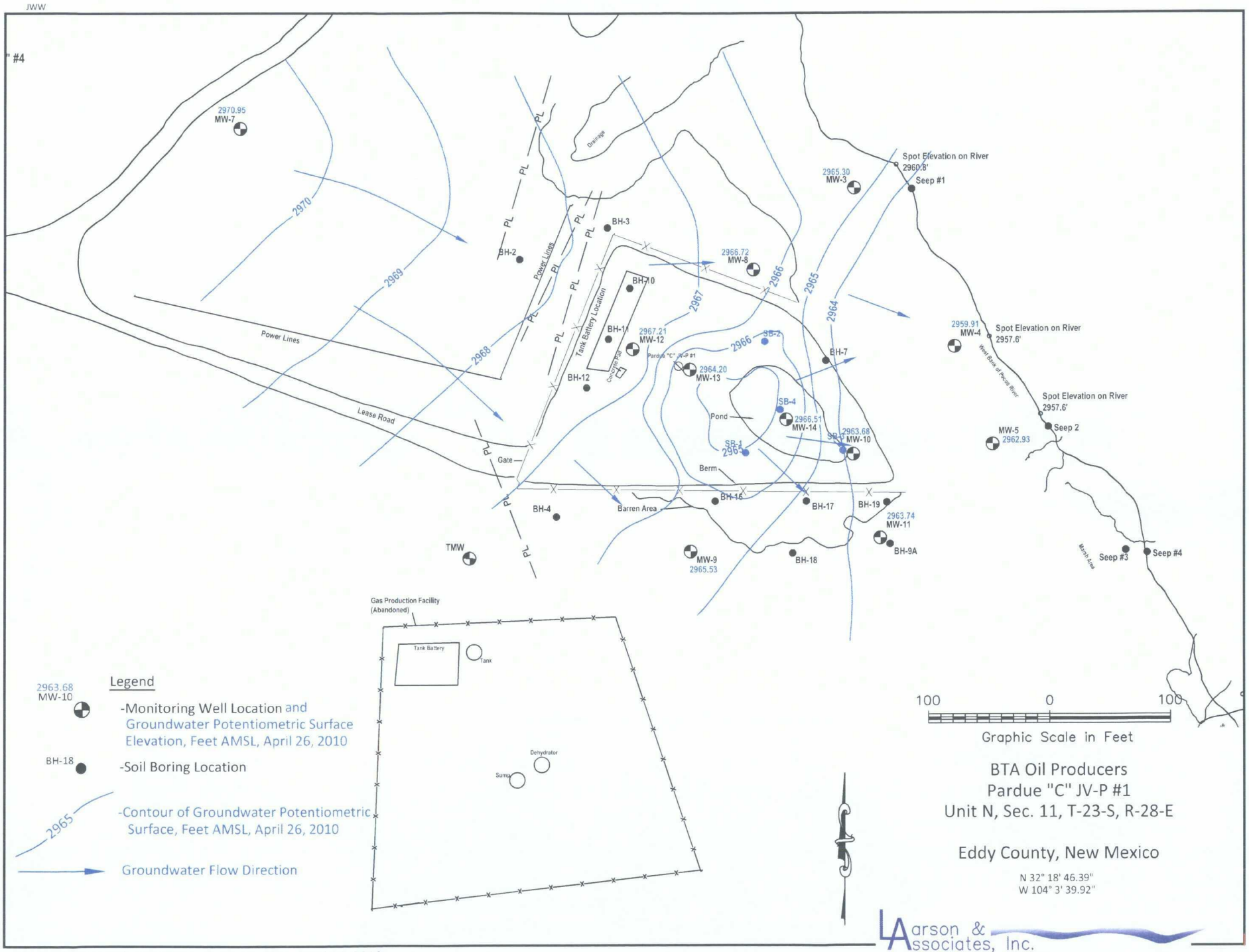


Figure 9 - Groundwater Potentiometric Map, April 26, 2010

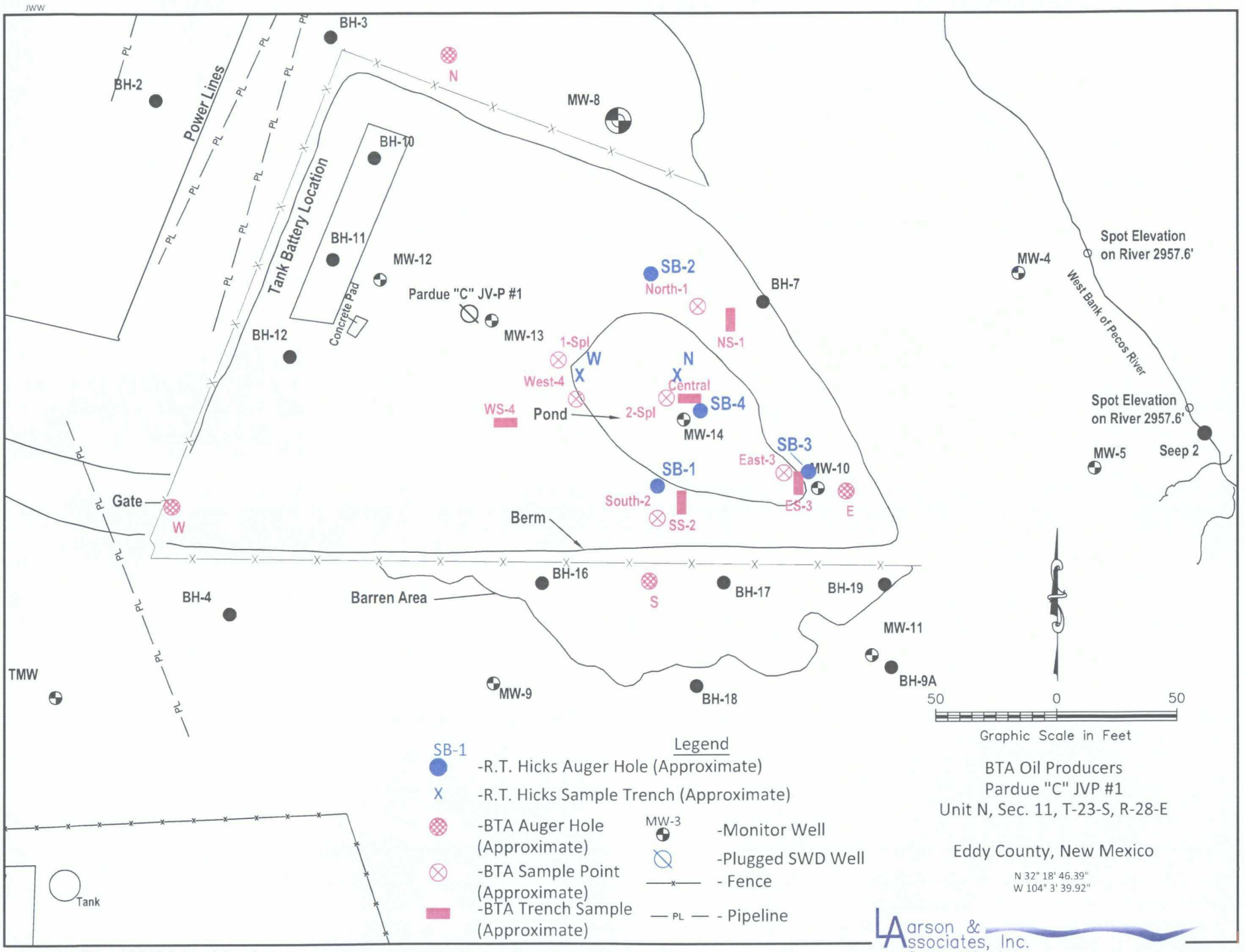


Figure 10 - BTA and R.T. Hicks Sample Locations

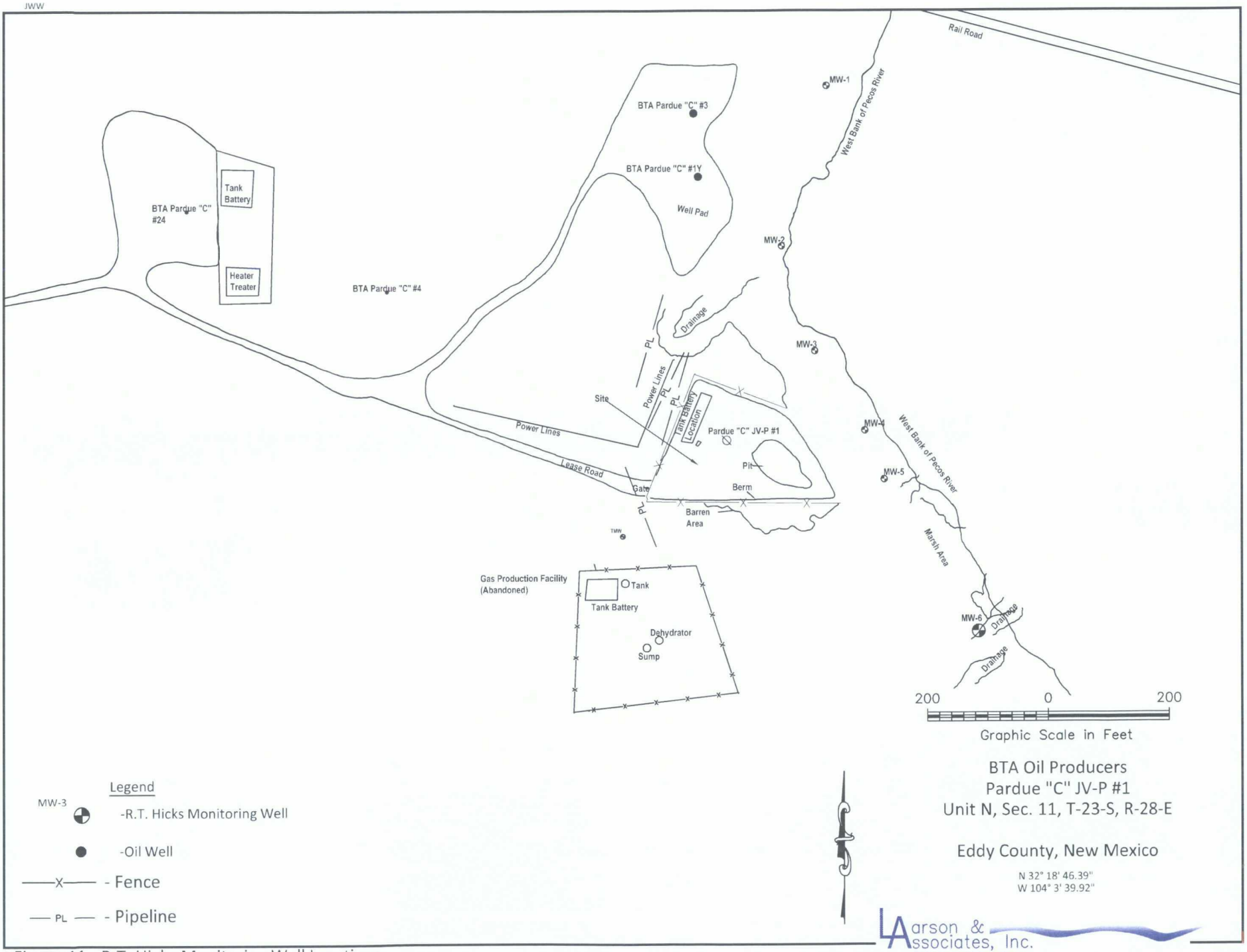


Figure 11 - R.T. Hicks Monitoring Well Locations

Legend

- -EM-31 Measurement Station and HD Reading, mmhos/Meter, February 24-25, 2010
- -Contour of Equal EM-31 HD Reading mmhos/Meter, February 24-25, 2010
- -Monitoring Well
- -Background (<25mmhos/Meter)
- -1 to 2 Times (25 to 50 mmhos/Meter)
- -2 to 3 Times (50 to 75 mmhos/Meter)
- -3 to 4 Times (75 to 100 mmhos/Meter)
- -4 to 6 Times (100 to 150 mmhos/Meter)
- -6 to 8 Times (150 to 200 mmhos/Meter)
- -Greater than 8 Times Background (>200 mmhos/Meter)

MW-7 MW-3 MW-8 MW-4 MW-5 MW-10 MW-11 MW-12 MW-13 MW-14 MW-16 MW-17 MW-18 MW-19 MW-9 MW-9A BH-2 BH-3 BH-4 BH-7 BH-10 BH-11 BH-12 TMW

Spot Elevation on River 2957.6'

Spot Elevation 2957.6'

Seep 2

West Bank of Pecos River

Marsh Area

Drainage

Power Lines

Power Lines

Tank Battery Location

Concrete Pad

Pardue "C" JV-P #1

Lease Road

Gate

Pond

Berm

Barren Area

Gas Production Facility (Abandoned)

Tank Battery

Tank

50 0 50

Graphic Scale in Feet

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

Figure 12 - EM-31 HD (0 to 9.8 Feet) Conductivity Map

Y:\PROJECTS\BTA\10-0101 Pardue C 1\BTA PARDUE -C- 1.dwg, 7/12/2010 3:57:10 PM

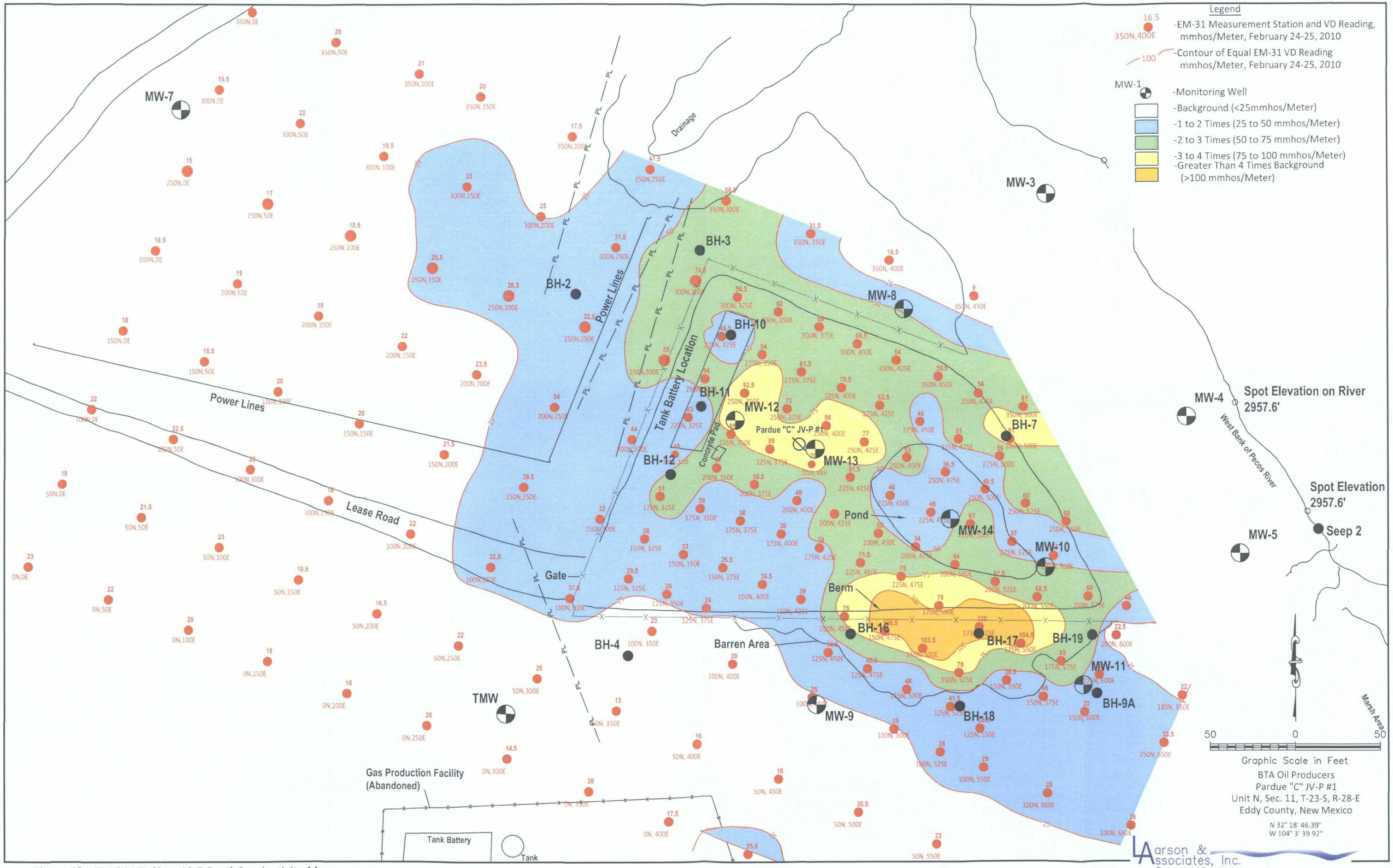


Figure 13 - EM-31 VD (0 to 19.7 Feet) Conductivity Map

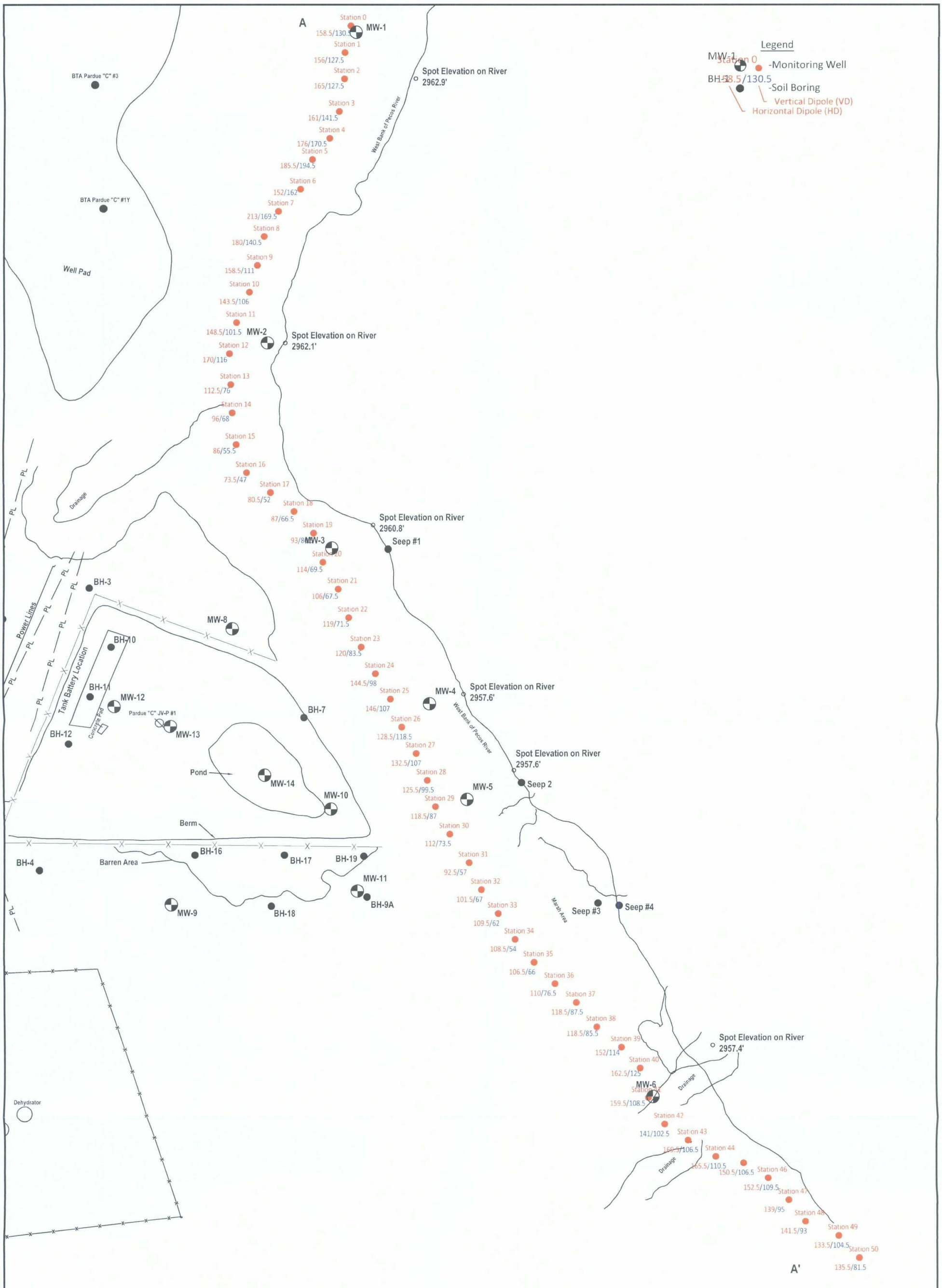


Figure 14 - EM-31 HD and VD Profile Map

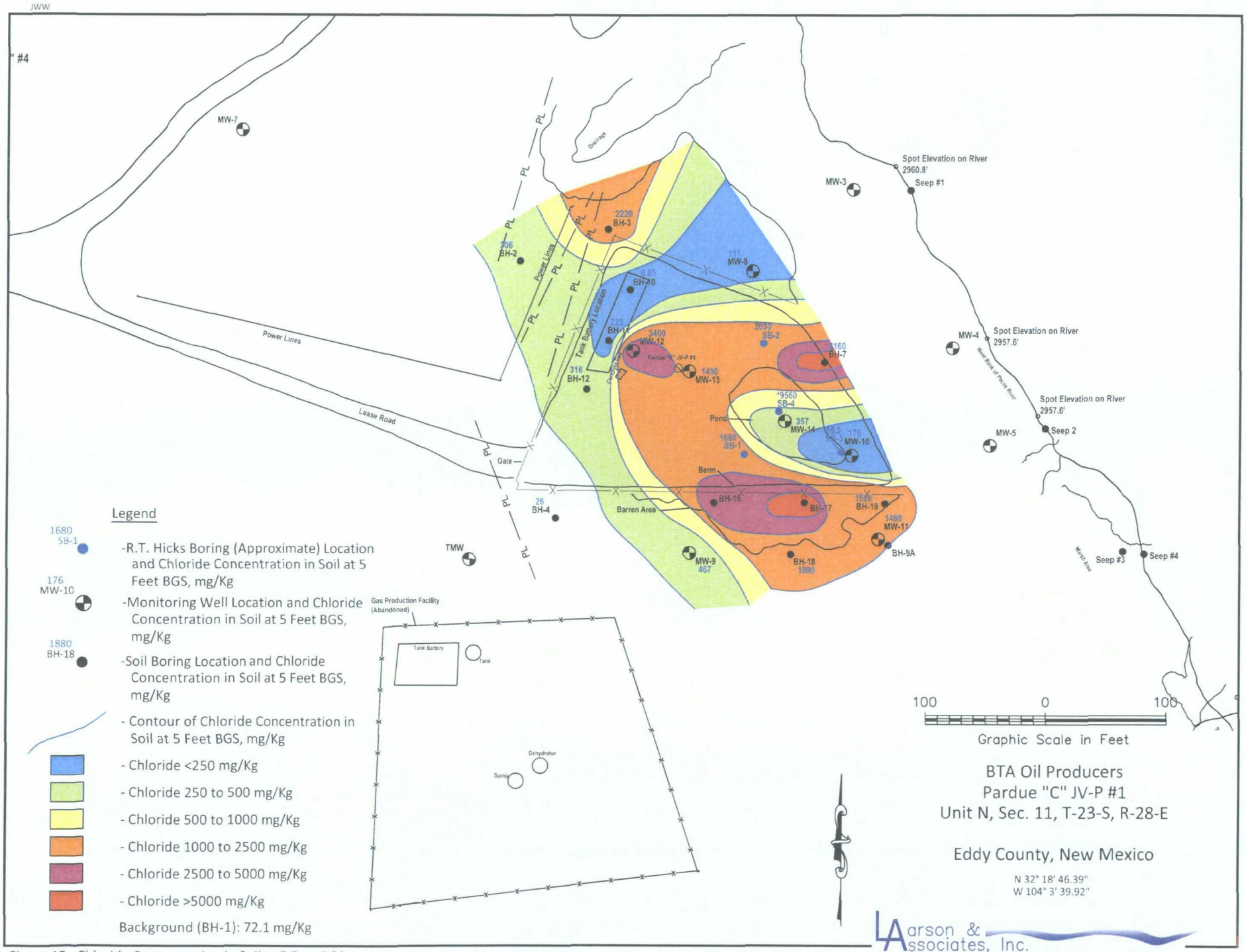


Figure 15 - Chloride Concentration in Soil at 5 Feet BGS

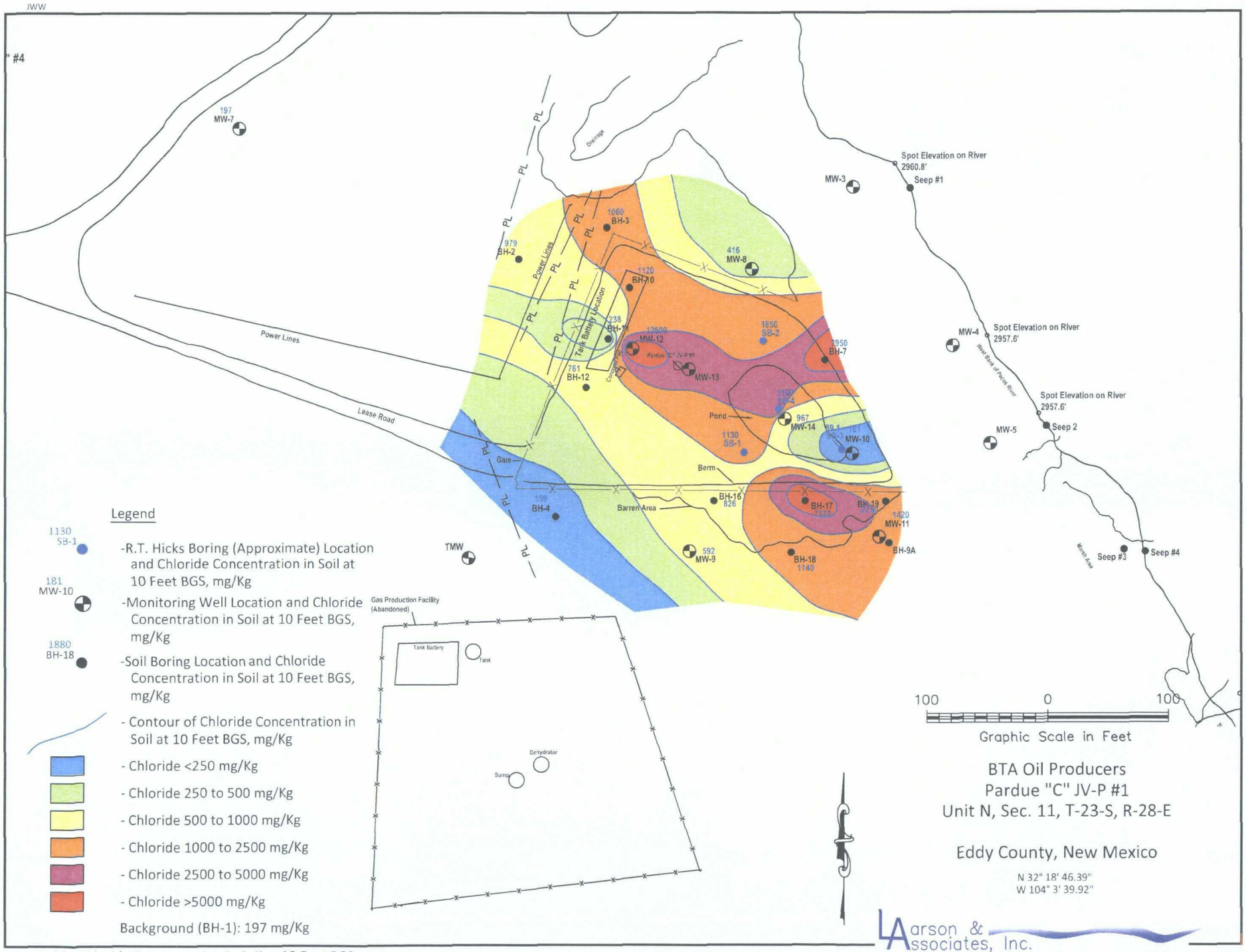
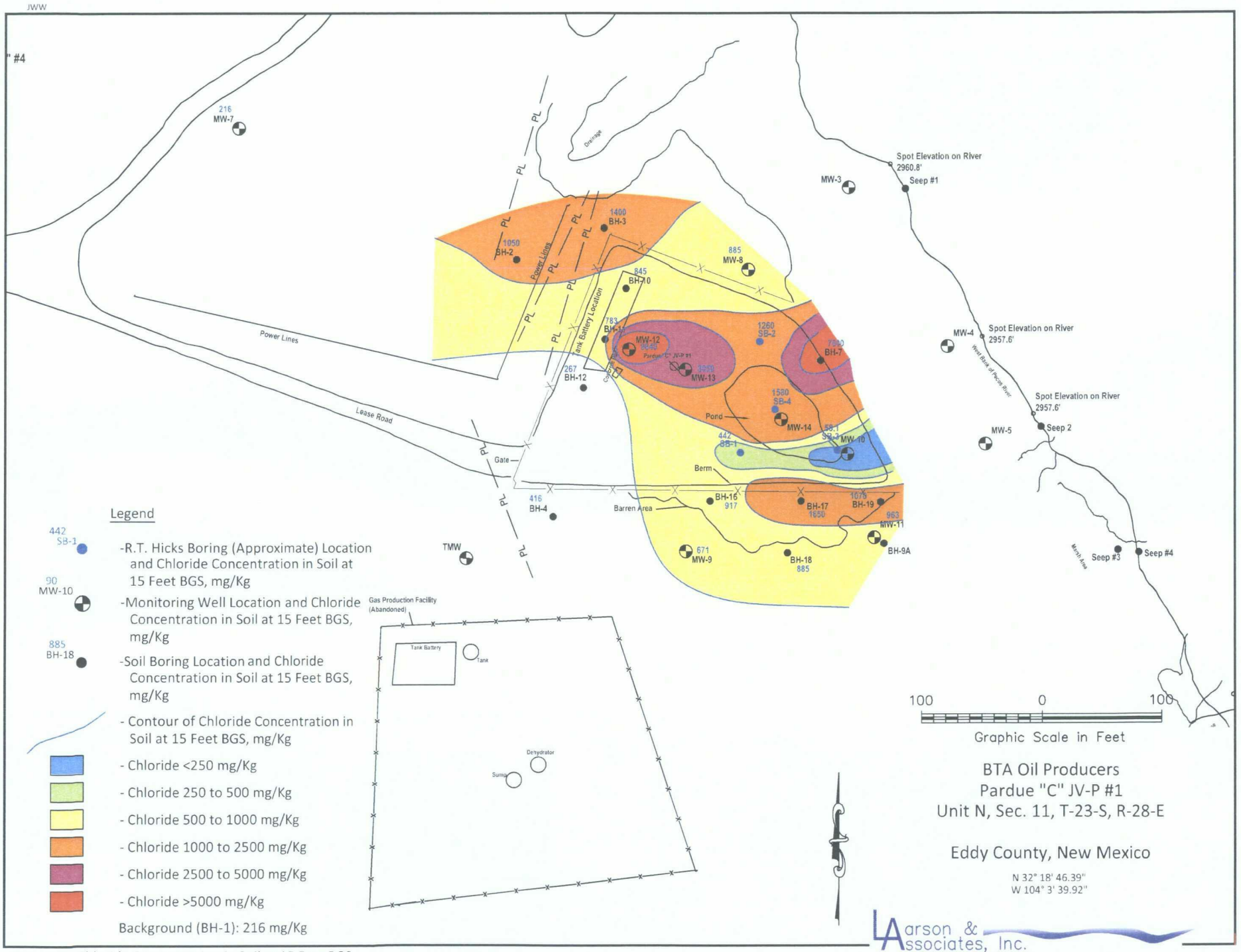


Figure 16 - Chloride Concentration in Soil at 10 Feet BGS



Legend

442 SB-1 -R.T. Hicks Boring (Approximate) Location and Chloride Concentration in Soil at 15 Feet BGS, mg/Kg

90 MW-10 -Monitoring Well Location and Chloride Concentration in Soil at 15 Feet BGS, mg/Kg

885 BH-18 -Soil Boring Location and Chloride Concentration in Soil at 15 Feet BGS, mg/Kg

- Contour of Chloride Concentration in Soil at 15 Feet BGS, mg/Kg

- Chloride <250 mg/Kg
- Chloride 250 to 500 mg/Kg
- Chloride 500 to 1000 mg/Kg
- Chloride 1000 to 2500 mg/Kg
- Chloride 2500 to 5000 mg/Kg
- Chloride >5000 mg/Kg

Background (BH-1): 216 mg/Kg

Figure 17 - Chloride Concentration in Soil at 15 Feet BGS

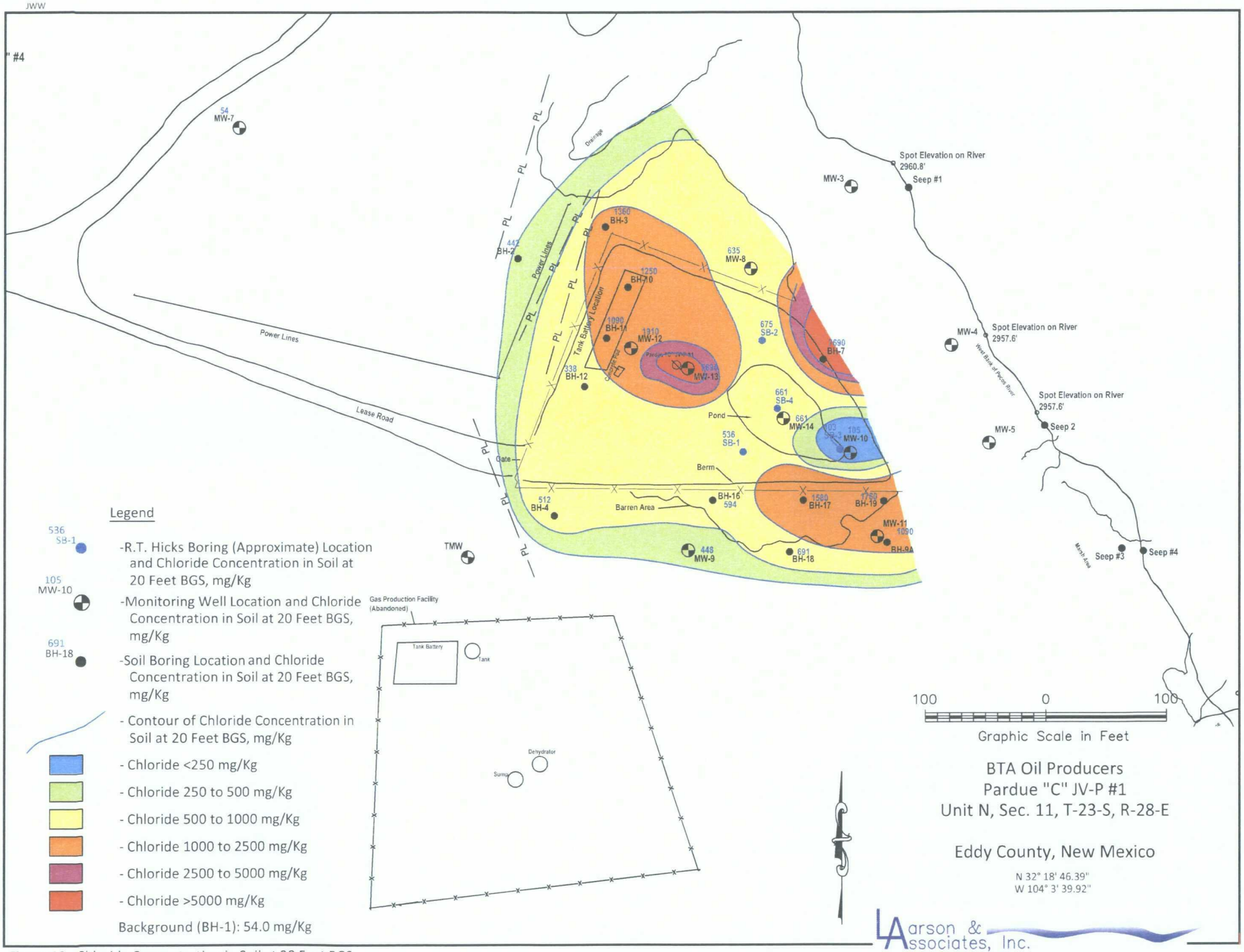


Figure 18 - Chloride Concentration in Soil at 20 Feet BGS

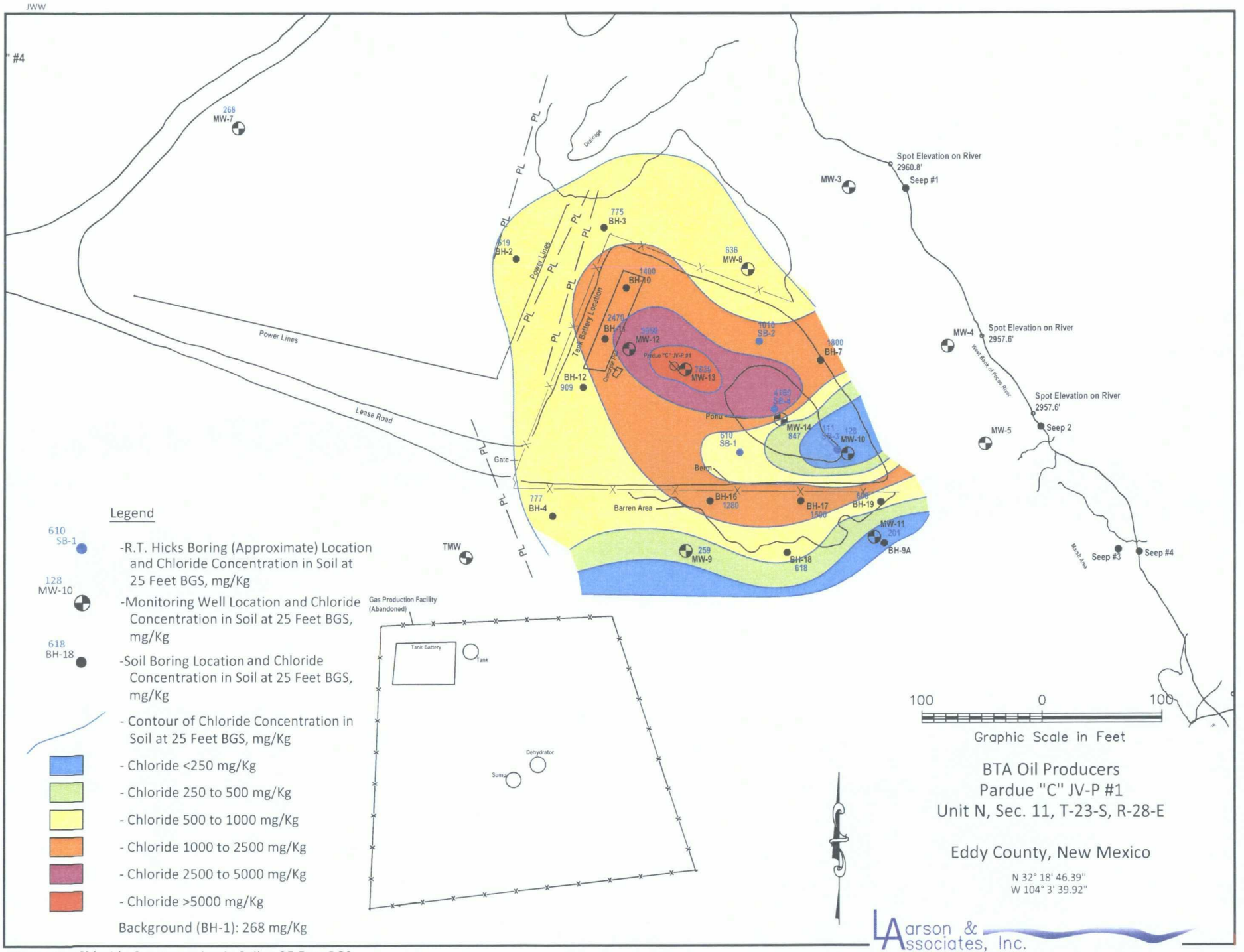


Figure 19 - Chloride Concentration in Soil at 25 Feet BGS

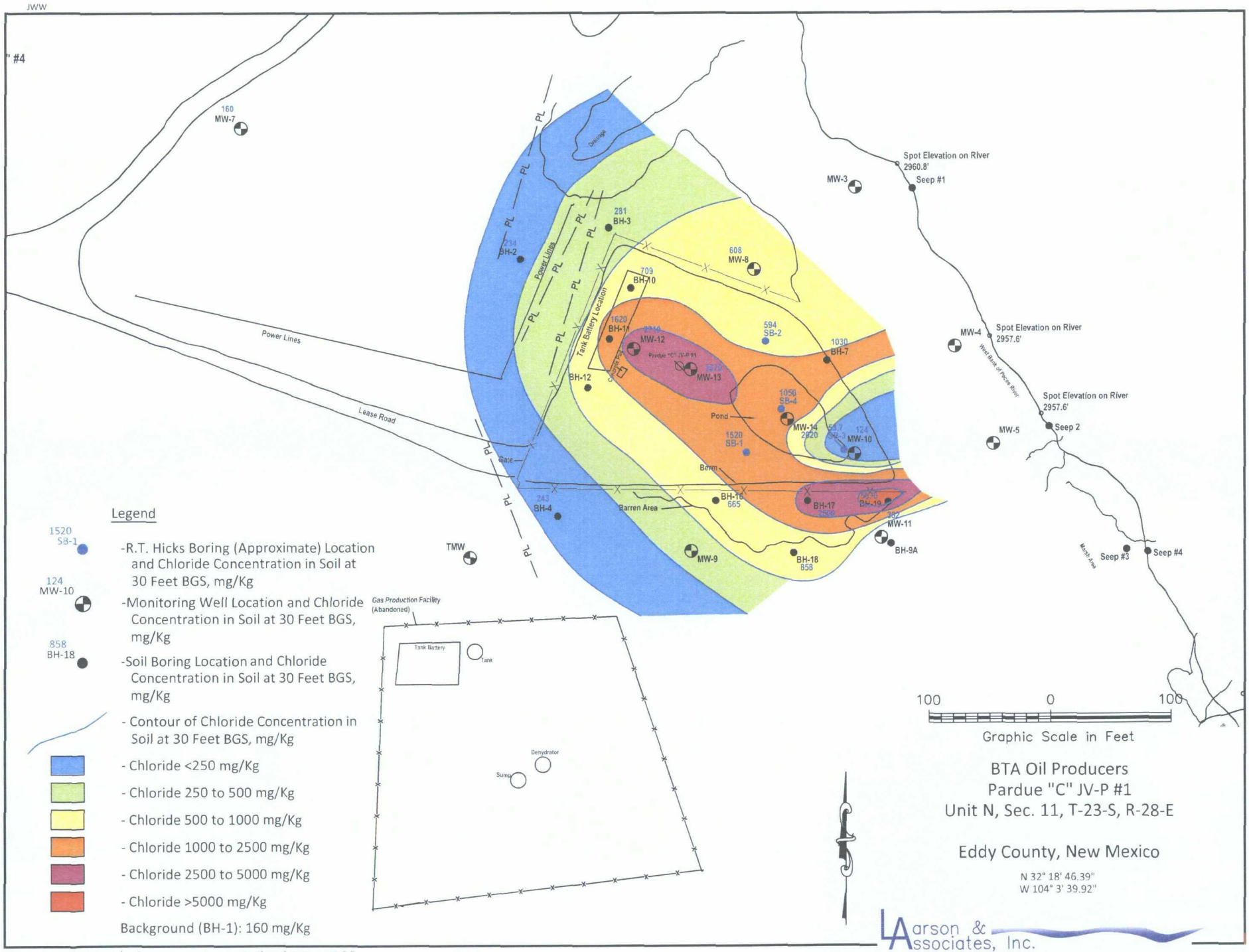


Figure 20 - Chloride Concentration in Soil at 30 Feet BGS

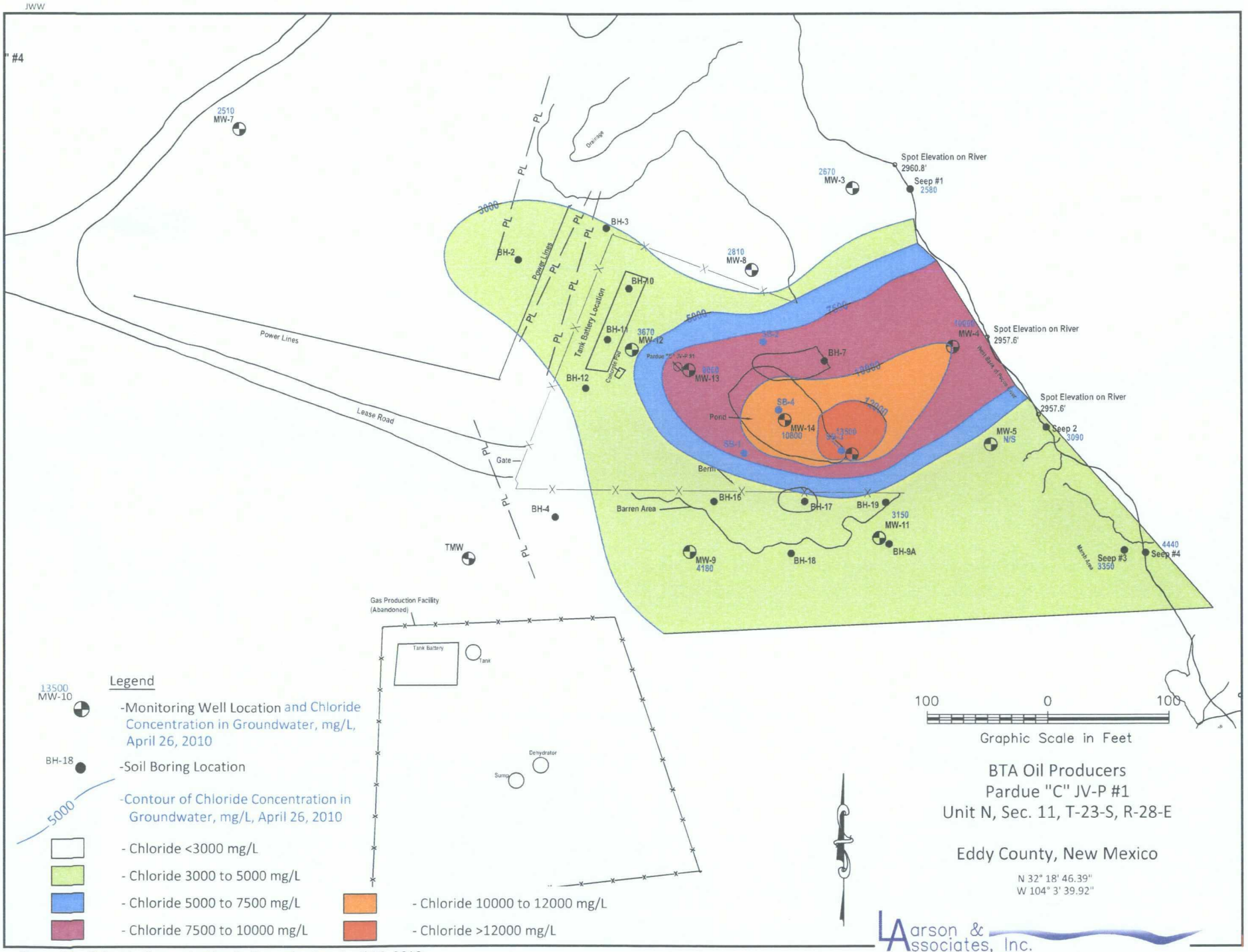


Figure 21 - Chloride Concentration in Groundwater, April 26, 2010

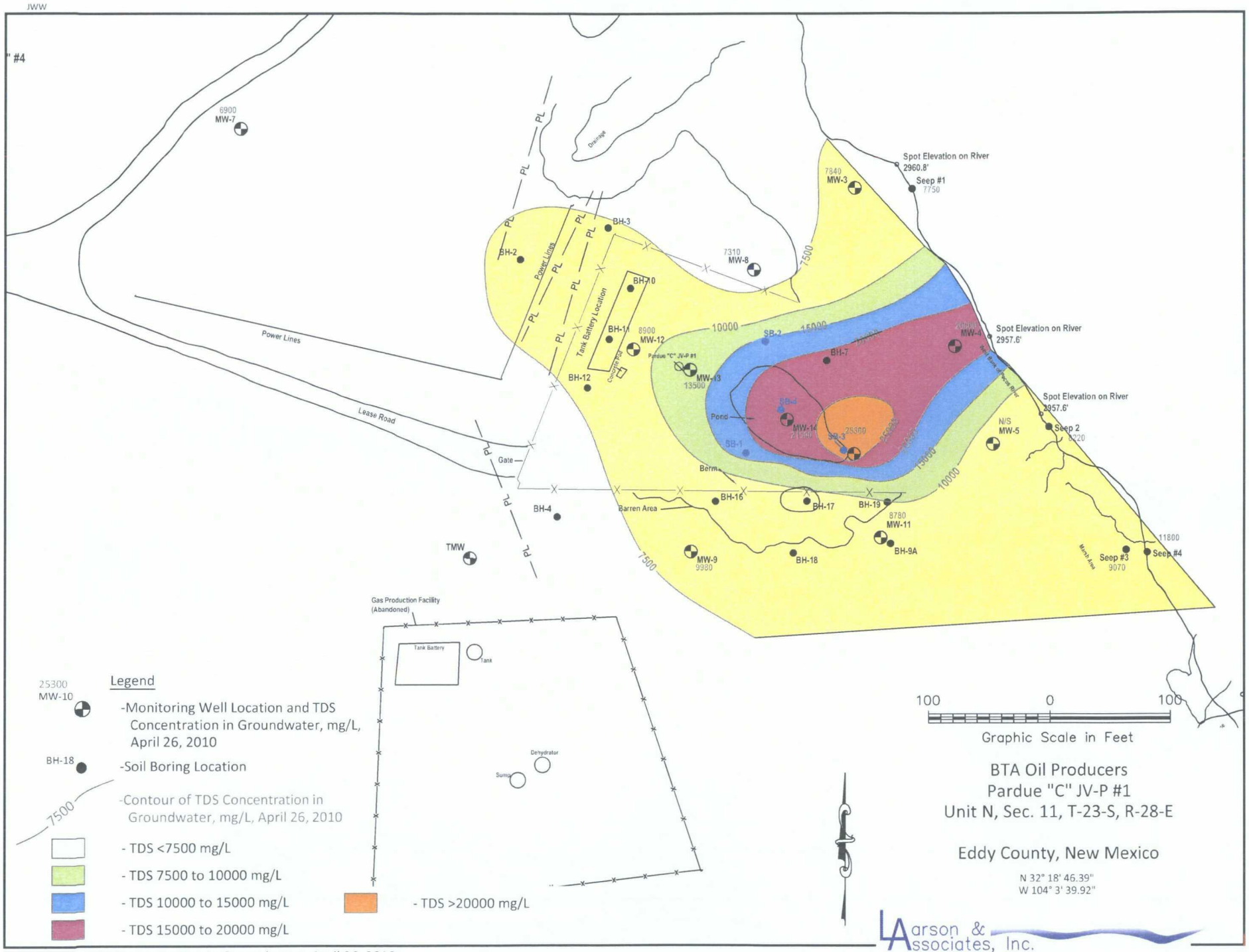


Figure 22 - TDS Concentration in Groundwater, April 26, 2010

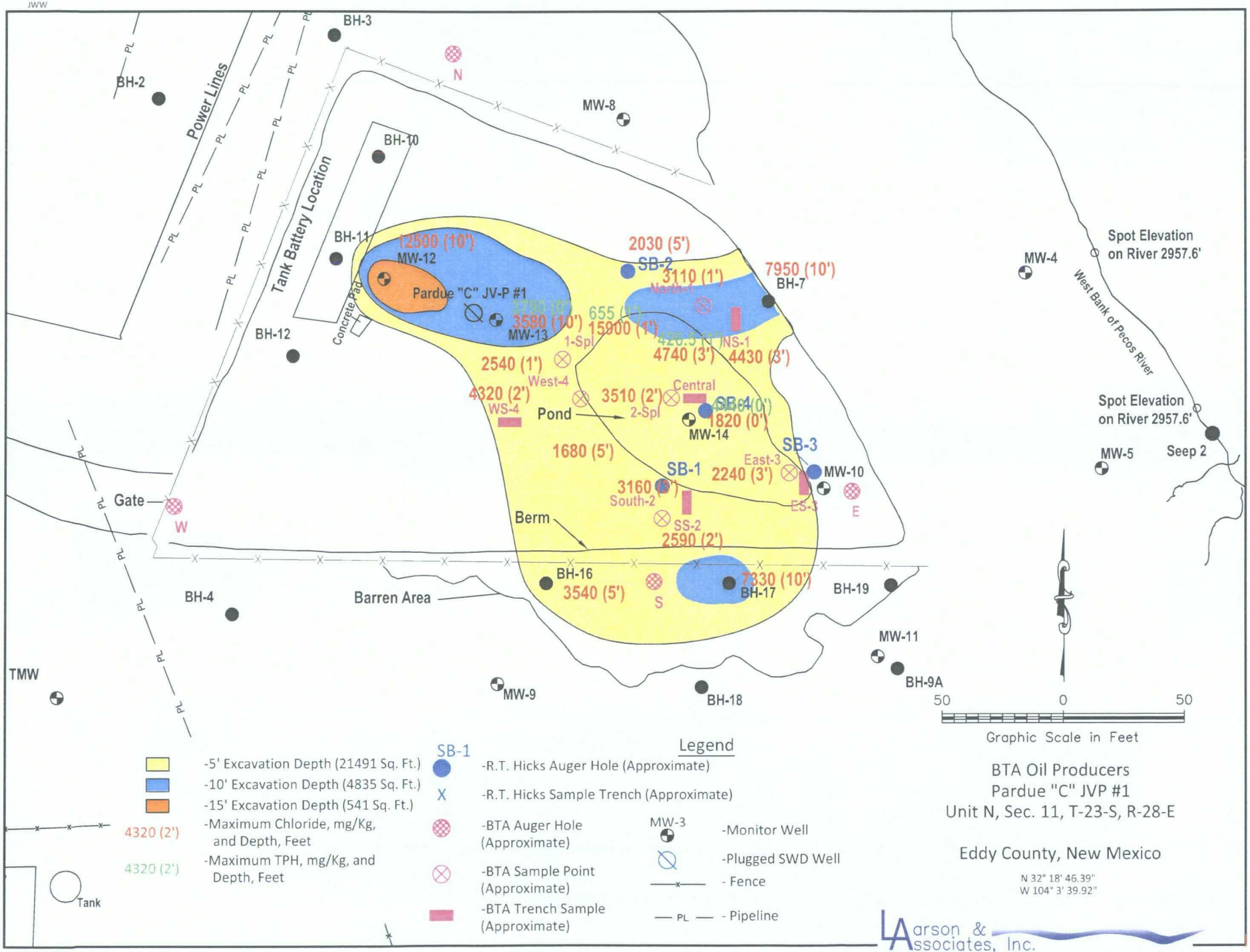


Figure 23 - Proposed Soil Excavation Areas

NEW MEXICO ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT

BILL RICHARDSON
Governor
Joanna Prukop
Cabinet Secretary

Mark E. Fesmire, P.E.
Director
Oil Conservation Division

7001 1940 0001 9971 5390

19-Oct-07

BTA OIL PRODUCERS
104 S PECOS
MIDLAND TX 79701

LOV NO. 02-07-206

LETTER OF VIOLATION - Inspection

Dear Operator:

The following inspection(s) indicate that the well, equipment, location or operational status of the well(s) failed to meet standards of the New Mexico Oil Conservation Division as described in the detail section below. To comply with standards imposed by Rules and Regulations of the Division, corrective action must be taken immediately and the situation brought into compliance. The detail section indicates preliminary findings and/or probable nature of the violation. This determination is based on an inspection of your well or facility by an inspector employed by the Oil Conservation Division on the date(s) indicated.

Please notify the proper district office of the Division, in writing, of the date corrective actions are scheduled to be made so that arrangements can be made to reinspect the well and/or facility.

INSPECTION DETAIL SECTION

PARDUE C 8808 JVP No.001 N-11-23S-28E **30-015-26341-00-00**

Inspection Date	Type Inspection	Inspector	Violation?	*Significant Non-Compliance?	Corrective Action Due By:	Inspection No.
10/19/2007	Bradenhead	Richard Inge	Yes	No	1/22/2008	iREI0724042324

Comments on Inspection: Pit found on location where an existing flowline has dumped contaminants in it. Operator said it was an overflow line from the pump. NMAC Rule 19.15.1.7.P.3 states: "Pit shall mean any surface or sub-surface impoundment, man-made or natural depression or diked area on the surface. Excluded from this definition are berms constructed around tanks or other facilities solely for the purpose of safety and secondary containment." Please clean up the site and remove the overflow lines by compliance due date. You might consider directing the overflow into a fiberglass tank, or below-grade tank.

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

APPLICATION OF THE NEW MEXICO OIL CONSERVATION DIVISION, THROUGH THE ENFORCEMENT AND COMPLIANCE MANAGER, FOR A COMPLIANCE ORDER AGAINST BTA OIL PRODUCERS LLC, FINDING THE OPERATOR IN VIOLATION OF ORDER NO. R-9147-C, 19.15.26.10.B NMAC, 19.15.34 NMAC, 19.15.17 NMAC AND 19.15.29 NMAC AS TO A SALT WATER DISPOSAL FACILITY; REQUIRING OPERATOR TO SUBMIT A DELINEATION REPORT AND REMEDIATE THE FACILITY SITE; IN THE EVENT OF NON-COMPLIANCE REQUIRING THE OPERATOR TO PLUG AND ABANDON THE DISPOSAL WELL AND REMEDIATE THE ASSOCIATED FACILITY BY A DATE CERTAIN AND AUTHORIZE THE DIVISION TO TAKE THOSE ACTIONS AND FORFEIT THE APPLICABLE FINANCIAL ASSURANCE; AND HOLD OPERATOR IN VIOLATION OF 19.15.5.9 NMAC UNTIL OPERATOR COMPLETES ALL ORDERED CORRECTIVE ACTION, EDDY COUNTY, NEW MEXICO.

CASE 14413
Order No. R-13218

STIPULATED ORDER & SETTLEMENT AGREEMENT

The Oil Conservation Division ("OCD") and BTA Oil Producers LLC ("BTA") enter into this Stipulated Order & Settlement Agreement to resolve the civil compliance issues asserted in Case 14413. The parties mutually agree and bind themselves to the following:

1. OCD is the state agency charged with administration and enforcement of the Oil and Gas Act (hereinafter, "Act"), and the rules promulgated pursuant to that act.

2. Operator is a limited liability company that operates wells in New Mexico under OGRID 305316.

3. BTA posted $50,000 surety bond 105E9046 through Travelers Indemnity Company to secure the plugging and abandonment of its wells. Travelers Indemnity Company was notified of the hearing before the examiner and did not enter an appearance in the case.

Case 14413
BTA Oil Producers LLC
OCD Exhibit 3

4. BTA is the operator of record of the Pardue C 8808 JVP #001 well, API 30-015-26341, located in Section 11, Township 23 South, Range 28 East in Eddy County, New Mexico (the well). The well is approximately 110 feet to the west of the Pecos River. Ground water at the well site occurs at approximately 41 feet below ground level.

5. The well is permitted as a salt water injection well. See Order No. R-9147-C (1991).

6. On October 19, 2007 an OCD inspector found an unpermitted, unlined pit at the well site. An overflow line carried produced water from the tank battery at the well site to the pit.

7. In Case No. 14413 the OCD alleges that BTA's use of the pit to dispose of produced water violates the following:

- **Order No. R-9147-C**, which provides that the operator shall take all necessary steps to ensure that the injected water is not permitted to escape onto the surface, requires the operator to take such steps as may be timely and necessary to correct failures and leakage, and requires the operator to conduct operations in accordance with OCD's rules on injection, including Rule 703. Rule 703 has since been re-numbered as 19.15.26.10 NMAC.

- **19.15.26.10.B NMAC** (formerly numbered Rule 703), which provides that "the operator of an injection project shall operate and maintain at all times the injection project, including injection wells, producing wells and related surface facilities, in such a manner as will confine the injected fluids to the interval or intervals approved and prevent surface damage or pollution resulting from leaks, breaks or spills."

- **19.15.34 NMAC**, which governs the disposition of produced water and other oilfield waste. Section 11 of Part 34 provides, in relevant part, that no person shall dispose of produced water or other oil field waste "on or below the surface of the ground; in a pit; or in a pond, lake, depression or watercourse" or "in another place or in a manner that may constitute a hazard to fresh water, public health, safety or the environment." Section 12 of Part 34 provides, in relevant part, that persons disposing of produced water shall dispose of the water "in a manner that does not constitute a hazard to fresh water, public health, safety or the environment..."

- 19.15.17 NMAC, which governs pits. "Pit" is defined in 19.15.2.7.P (3) NMAC to include natural depressions. Section 8.A of Part 17 provides that a person shall not construct or use a pit except in accordance with a division-issued permit. Section 10's siting requirements prohibit pits within 300 feet of a continuously flowing watercourse. Section 13 prohibits unlined permanent pits, and sets out closure requirements. The closure requirements provide that if a release has occurred at a pit, the operator must comply with the requirements of 19.15.29 NMAC.

- 19.15.29 NMAC, which governs releases. Section 8 of Part 29 sets out the reporting requirements for releases, requiring the person operating or controlling either the release or the location of the release to notify the division of unauthorized release occurring during the storing, disposal, injection or transportation of produced water or oil field waste. Section 11 requires the responsible person to complete division-approved corrective action for releases that endanger public health or the environment, in accordance with a remediation plan or an abatement plan.

8. The OCD seeks an order requiring BTA to delineate contamination at the site, and remediate the contamination. The OCD requests that the order provide that the OCD may plug the well, remediate the site and forfeit the applicable financial assurance if BTA fails to complete the required corrective action, and requests that BTA be subject to 19.15.5.9 NMAC until it takes the required corrective action. The OCD cites the following authority for such an order:

- 19.15.29.11 NMAC, which requires the responsible person to complete division-approved corrective action for releases that endanger public health or the environment, in accordance with a remediation plan or an abatement plan.

- NMSA 1978, Section 70-2-14(B), which states if any of the requirements of the Act or the rules promulgated pursuant to the Act have not been complied with, the OCD, after notice and hearing, may order any well plugged and abandoned by the operator or surety or both in accordance with OCD rules and regulations, and forfeit the applicable financial assurance.

- NMSA 1978, Section 70-2-12(B), which provides that "apart from any authority, express or implied, elsewhere given to or existing in the oil conservation division by virtue of the Oil and Gas Act or the statutes of this state," the OCD "is authorized to make...orders for the purposes and with respect to" the subjects identified in that subsection, including:

> "the disposition of water produced or used in connection with the drilling for or producing of oil or gas or both and to direct surface or subsurface disposal of the water...in a manner that will afford reasonable protection against contamination of fresh water supplies

designated by the state engineer" (NMSA 1978, Section 70-2-12(B)(15); and

"the disposition of nondomestic wastes resulting from the exploration, development, production or storage of crude oil or natural gas to protect public health and the environment" (NMSA 1978, Section 70-2-12(B)(21).

9. BTA agrees that the pit at the well is in violation of Order No. R-9147-C (1991), 19.115.26.10.B NMAC, 19.15.34 NMAC, 19.15.17 NMAC, and 19.15.29 NMAC.

10. BTA has plugged the wellbore of the well, and removed the tank battery.

11. BTA and the OCD agree that BTA will submit a remediation plan to investigate vadose zone and ground water contamination at the site of the pit and tank battery at the Pardue 8808 JV-P #001, and will remediate the contamination in accordance with an OCD-approved plan. To begin the process, BTA agrees to the following:

a. By February 25, 2010, BTA shall submit to the OCD's Environmental Bureau a plan to delineate the horizontal and vertical extent of the contamination at the site of the pit and tank battery, and characterize the impact of the produced water releases to the vadose zone, shallow perched aquifer, and the deeper regional aquifer. The OCD encourages BTA to work with the Environmental Bureau in drafting the plan. The plan shall include the following:

- BTA must propose an appropriate number of soil borings and monitor wells that will enable it to completely delineate the impact of the produced water releases to the vadose zone and to ground water.
- The vadose zone investigation must be comprehensive enough that BTA can use the data when removing the chloride-contaminated soil to approximately 20 feet below grade.
- BTA must collect and analyze soil and/or bedrock samples for benzene and total BTEX using 8021 B or 8260 B, TPH using EPA method 418.1, the GRO and DRO combined fractions using 8015 M and chlorides using method 300.1.
- If the GRO soil fraction exceeds 80 mg/kg, then BTA must also analyze for VOCs using method 8260.
- If the DRO soil fraction exceeds 200 mg/kg, then BTA must also analyze for SVOCs using method 8270.

- BTA's ground water investigation must establish background ground water concentrations for chlorides and must delineate the produced water contamination in both the perched aquifer and the deeper regional aquifer.
- BTA must install a sufficient number of monitor wells screened across the shallow perched aquifer with no more than 15 feet of screen (five feet above the water level with 10 feet below) to delineate the ground water contamination.
- BTA must also propose a location for a monitor well to determine whether the deeper regional aquifer has been contaminated.
- BTA must properly develop all monitor wells before sampling the ground water. Purged ground water must be properly collected and BTA must document how it intends to dispose of the purged water.
- BTA must collect and analyze ground water samples for benzene and total BTEX using 8021 B or 8260 B, the GRO and DRO combined fractions using 8015 M, and chlorides using method 300.1.

b. This case shall be continued until the March 4, 2010 docket. At that time the issue to be determined will be the adequacy of the delineation plan, and the next step to be taken in the delineation and remediation process. If the parties are able to enter into an amendment to this stipulated order specifying the next step(s), they may request that the case be continued until a future docket.

c. If BTA fails to meet any of the deadlines set in this order, or by any amendment to this order, the OCD may move for an order authorizing it to remediate the site and forfeit the applicable financial assurance.

d. BTA shall be in violation of 19.15.5.9 NMAC until it has submitted an acceptable delineation plan, received OCD approval of a remediation plan, completed soil remediation and begun remediation of water contamination. If the OCD remediates the site, BTA shall be in violation of 19.15.5.9 NMAC until it demonstrates that it has reimbursed the OCD for its expenses in excess of any amount recovered from the applicable financial assurance.

e. Either BTA or the OCD may move to re-open Case 14413 to request amendments to this order.

12. Nothing in this Order relieves BTA of its liability should it fail to investigate and remediate contamination that poses a threat to ground water, surface water, human health or the environment. In addition, nothing in this Order relieves BTA of its responsibility for compliance with any other federal, state or local laws and/or regulations.

BTA Oil Producers LLC

BTA Oil Producers LLC — Date: 2/2/10

Oil Conservation Division

Daniel Sanchez, — Date: 2-2-10
Compliance and Enforcement Manager
Oil Conservation Division

APPROVED BY:

Mark Fesmire PE — Date: 2/5/10
Director
Oil Conservation Division

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

APPLICATION OF THE NEW MEXICO OIL CONSERVATION DIVISION, THROUGH THE ENFORCEMENT AND COMPLIANCE MANAGER, FOR A COMPLIANCE ORDER AGAINST BTA OIL PRODUCERS LLC, FINDING THE OPERATOR IN VIOLATION OF ORDER NO. R-9147-C, 19.15.26.10.B NMAC, 19.15.34 NMAC, 19.15.17 NMAC AND 19.15.29 NMAC AS TO A SALT WATER DISPOSAL FACILITY; REQUIRING OPERATOR TO SUBMIT A DELINEATION REPORT AND REMEDIATE THE FACILITY SITE; IN THE EVENT OF NON-COMPLIANCE REQUIRING THE OPERATOR TO PLUG AND ABANDON THE DISPOSAL WELL AND REMEDIATE THE ASSOCIATED FACILITY BY A DATE CERTAIN AND AUTHORIZE THE DIVISION TO TAKE THOSE ACTIONS AND FORFEIT THE APPLICABLE FINANCIAL ASSURANCE; AND HOLD OPERATOR IN VIOLATION OF 19.15.5.9 NMAC UNTIL OPERATOR COMPLETES ALL ORDERED CORRECTIVE ACTION, EDDY COUNTY, NEW MEXICO.

CASE 14413

Order No. R-13218-A

FIRST AMENDMENT TO THE

STIPULATED ORDER & SETTLEMENT AGREEMENT

The Oil Conservation Division ("OCD") and BTA Oil Producers LLC ("BTA") agree to amend Order No. R-13218, the Stipulated Order and Settlement Agreement approved in Case 14413, to add the following provisions:

1. BTA timely filed a delineation plan, which the OCD has approved with conditions. The approved delineation plan satisfies the requirements of Paragraph 11(a) of Order No. R-13218.

2. BTA and the OCD agree that:

a. BTA shall conduct the delineation in accordance with its approved plan. BTA is reminded that its approved plan requires it to obtain OCD approval of proposed soil boring

locations prior to mobilizing a drilling rig, and to obtain OCD approval of the locations of monitoring wells (including background) prior to mobilizing a drilling rig.

b. By August 5, 2010 BTA shall file with the OCD's Environmental Bureau a delineation report as described in its approved delineation plan.

c. By August 5, 2010 BTA shall file with the OCD's Environmental Bureau a proposed remediation approach, based on the findings made in its delineation report. Once the OCD has approved the remediation approach, BTA will have additional time in which to prepare a remediation plan based on the approved approach.

d. BTA shall e-mail Acting Environmental Bureau Chief Glenn von Gonten at least every two weeks to provide an update on BTA's progress.

e. This case shall be continued until the August 19, 2010 docket. At that time the issue to be determined will be the sufficiency of the delineation report and proposed remediation approach, and the next step to be taken in the remediation process. If the parties are able to enter into an amendment to this stipulated order specifying the next step(s), they may request that the case be continued until a future docket.

3. The remaining provisions of Order R-13218 remain in full force and effect.

BTA Oil Producers LLC

_____ _____

BTA Oil Producers LLC Date

Oil Conservation Division

_____ _____

Daniel Sanchez, Date

Compliance and Enforcement Manager
Oil Conservation Division

APPROVED BY:

_____ _____

Mark Fesmire PE Date
Director
Oil Conservation Division

New Mexico Energy, Minerals and Natural Resources Department

Bill Richardson
Governor

Jon Goldstein
Cabinet Secretary

Jim Noel
Deputy Cabinet Secretary

Mark Fesmire
Division Director
Oil Conservation Division

FEBRUARY 10, 2010

Mr. Ben Grimes
Operations Manager
BTA Oil Producers LLC
104 South Pecos
Midland, TX 79701

RE: BTA Oil Producers LLC
Pardue "C" SWD Site Delineation Plan and Infrastructure Assessment
8808 JV-P Pardue SWD Facility
Unit "A", Section 11, Township 23 South, Range 28 East
Eddy County, New Mexico
2R155

Mr. Grimes:

The Oil Conservation Division (OCD) has received the "Site Delineation Plan" for the Pardue "C" SWD Facility, dated February 8, 2010, and a copy of the "Infrastructure Assessment" report. OCD has completed its review of the plan and cannot approve the plan and report as submitted and requires BTA to address the following issues:

Site Delineation Plan

1. Provide the proposed locations of additional soil borings or surface samples, especially in the former tank battery area.

2. Provide information for proposed well construction such that the screen length for all ground water monitoring well is 10 feet (not 40 feet as initially proposed) and that the "perch zone" and regional aquifer will not be hydraulically interconnected.

3. Provide the proposed location of "background" soil sampling.

4. Provide additional information regarding how the wells will be developed.

5. Provide additional information regarding field testing for chloride (e.g., instruction sheet).

6. Provide additional information regarding sampling methods, including stabilization determination (e.g., +/- 10%), equipment decontamination and purge water disposal.

7. Revise Figure 3 and provide additional figures as necessary to depict the locations of all soil borings, monitor wells, and piezometers that have been previously advanced as well as the proposed new monitor wells and the seep areas.

8. Revise Section 4.0 to include a commitment to contact OCD prior to the final siting of all soil borings/monitor wells.

9. Revise Section 4.0 to specify how BTA will develop each monitor wells.

10. Revise Section 4.0 to specify how BTA will collect and dispose of any purge water, *etc.*

11. Revise Section 4.0 and Figure 3 to indicate that BTA shall advance at least one soil boring/monitor well downgradient of the tank battery and at least one soil boring/monitor well downgradient of the SWD well head.

12. Revise Section 4.0 to specify that BTA will take at least 5 percent duplicate samples for QA/QC and analyze the duplicate samples for the full suite.

13. Revise Section 4.2 so that the screen length, including "slotted" PVC pipe does not exceed ten feet in length (five feet above and five feet below the water table, **not** 40 feet).

14. Revise Section 4.2 to specify that the PVC casing shall be flush threaded and that the joints shall not be glued together.

15. Revise Section 4.2 to specify that the filter pack will be installed from the bottom of the borehole to no more than two feet above the top of the screen (**not** 20 feet above the top of the screen).

16. Revise Section 4.2 to specify that BTA will run Portland cement mixed with 2-5% bentonite back to surface.

17. Revise Section 4.4 by adding TPH (EPA Method 418.1) for soils and ground water and TDS (Standard Method 2540C) for ground water.

18. Revise Section 4.4 to specify how BTA will sample the monitor wells; *e.g.,* will dedicated bailers be used.

19. Revise Section 4.4 to address how BTA will screen for and sample any NAPL.

20. Revise Section 4.4 to specify that at least one confirmation sample shall be taken below a sample that delineates chloride or hydrocarbon contamination vertically.

21. Add a section that addresses routine communications with OCD and notice to both OCD's Santa Fe office and Artesia District office.

22. Add a section that specifies the information that BTA will submit in its Delineation Report, including the integration of all existing data with newly determined data.

23. Add as section that specifies how BTA will survey all soil boring/monitor well locations.

Infrastructure Assessment

BTA's *Infrastructure Assessment* report provides a useful overview of how BTA operates its facilities in New Mexico. However, it does not address all the issues that OCD specified in its letter of November 18, 2009. OCD cannot approve the assessment as submitted and requires BTA to submit an Plan (rather than a report) to determine how it can improve its performance by preventing releases and spills at its New Mexico facilities by replacing or repairing any substandard equipment, aging infrastructure, preventing lightning strikes, *etc.* This plan should include a commitment by BTA to conduct site surveys to determine the condition of its equipment, including, but not limited to, valves, tanks, pipelines, *etc.* BTA should also provide an inventory of all of its sites and facilities at which it has conducted an inspection.

If you have any questions regarding OCD's review, please contact me at 505-476-3488.

Sincerely,

Glenn von Gonten
Acting Environmental Bureau Chief

GvG/gvg

cc: Daniel Sanchez
Gail Macquesten
Ed Hansen
Jim Griswold
Mike Bratcher
Sherry Bonham

New Mexico Energy, Minerals and Natural Resources Department

Bill Richardson
Governor

Jon Goldstein
Cabinet Secretary

Jim Noel
Deputy Cabinet Secretary

Mark Fesmire
Division Director
Oil Conservation Division

FEBRUARY 16, 2010

Mr. Ben Grimes
Operations Manager
BTA Oil Producers LLC
104 South Pecos
Midland, TX 79701

RE: Revised Pardue "C" SWD Site Delineation Plan
BTA Oil Producers LLC, Loving East Field, Unit A (NE/4, NE/4), Section 11, Township 23 South, Range 28 East NMPM, Eddy County, New Mexico
2R155

Mr. Grimes:

The Oil Conservation Division (OCD) has received the "Revised Site Delineation Plan" for the Pardue "C" SWD Facility, dated February 12, 2010, and an email copy of the "Infrastructure Plan" and "Pumper Monthly Inspection Form" dated February 12, 2010. OCD has completed its review of the "Revised Site Delineation Plan" and hereby conditionally approves it with the following conditions.

1. BTA shall install 4-inch diameter ground water monitoring wells in the "perched" zone at the site.

2. BTA shall use +/- 10% readings for stabilization determination when using low flow sampling.

3. BTA shall obtain OCD approval of purge water disposal method(s) prior to producing any purge water at the site.

4. BTA shall ensure that the casing surveys are conducted with a horizontal accuracy of 0.1 foot and a vertical accuracy of 0.01 foot (see Section 2.3).

5. BTA shall ensure that all ground water and NAPL elevation measurements are conducted with a vertical accuracy of 0.01.

6. BTA shall inspect the seeps and collect a sample if the seeps are flowing.

7. BTA shall include an appropriate number of maps and cross-sections to demonstrate that it has delineated the subsurface impacts (see Section 2.6).

OCD hereby approves the "Infrastructure Plan" and "Pumper Monthly Inspection Form."

Please be advised that OCD approval of these Plans does not relieve BTA of responsibility if its operations pose a threat to ground water, surface water, human health, or the environment. In addition, OCD approval does not relieve BTA of responsibility for compliance with any OCD, federal, state, or local laws and/or regulations.

If you have any questions regarding OCD's review, please contact me at 505-476-3488.

Sincerely,

Glenn von Gonten
Acting Environmental Bureau Chief

GvG/gvg

cc: Daniel Sanchez
Gail Macquesten
Ed Hansen
Jim Griswold
Mike Bratcher
Sherry Bonham

Larson & Associates, Inc.
Environmental Consultants

March 10, 2010

Mr. Glenn von Gonten
Acting Environmental Bureau Chief
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Re: NMOCD Case No. 14413, BTA Oil Producers LLC
Pardue "C" 8808 JV-P Well #1 - Preliminary Investigation Report
Unit N (SE/4, SW/4), Section 11, Township 23 South, Range 28 East
Eddy County, New Mexico

Dear Mr. von Gonten:
Larson & Associates, Inc. (LAI), as consultant to BTA Oil Producers LLC (BTA), submits the enclosed report to the New Mexico Oil Conservation Division (OCD) which presents the results of an electromagnetic (EM-31) terrain conductivity survey performed at the above-referenced location on February 24 and 25, 2010. The report includes a scope of work for additional investigations and timeline for the investigations. Please contact Mr. Ben Grimes, Operations Manager for BTA, at (432) 682-3753 or myself if you have questions. We may also be reached by email: BGrimes@btaoil.com or mark@laenvironmental.com.
Sincerely,

Larson & Associates, Inc.

Mark J. Larson, P.G., C.P.G., C.G.W.P.
Sr. Project Manager / President

Encl.

Cc: Sherry Bonham – OCD District 2
Ben Grimes – BTA
Stuart Beal - BTA

Mark Larson

From: VonGonten, Glenn, EMNRD [Glenn.VonGonten@state.nm.us]
Sent: Friday, March 12, 2010 2:53 PM
To: Mark Larson; Sanchez, Daniel J., EMNRD; Macquesten, Gail, EMNRD; Hansen, Edward J., EMNRD; Griswold, Jim, EMNRD
Cc: Bonham, Sherry, EMNRD; Ben Grimes; Stuart Beal; Bratcher, Mike, EMNRD
Subject: RE: Pardue "C" 8808 JV-P SWD Well #1 Preliminary Investigation Report and Timeline
Attachments: image001.jpg

Ben, Mark:

OCD hereby approves the Preliminary Investigation Report and Timeline submitted by Larson & Associates, Inc. on behalf of BTA Oil Producers. OCD also approves the Proposed Investigations detailed in Section 7 of the report.

Please submit a weekly progress report and let OCD know of any unexpected delays.

Glenn

From: Mark Larson [mailto:Mark@laenvironmental.com]
Sent: Wednesday, March 10, 2010 9:42 AM
To: VonGonten, Glenn, EMNRD
Cc: Bonham, Sherry, EMNRD; Ben Grimes; Stuart Beal
Subject: Re: Pardue "C" 8808 JV-P SWD Well #1 Preliminary Investigation Report and Timeline

Glenn,
Please find the attached documents submitted to the New Mexico Oil Conservation Division (OCD) on behalf of BTA Oil Producers LLC (BTA) by Larson & Associates, Inc. (LAI), its consultant, to report the findings of an initial investigation (EM-31 survey), proposed additional investigations and timeline for the Pardue "C" JV-P SWD Well #1 located in Unit N (SE/4, SW/4), Section 11, Township 23 South, Range 28 East NMPM in Eddy County, New Mexico. A bound copy of the report and timeline will be sent via U.S. Mail today. Please contact Mr. Ben Grimes with BTA at (432) 682-3753 or myself if you have questions.
Sincerely,

Mark J. Larson
Sr. Project Manager / President
507 N. Marienfeld St., Ste. 202
Midland, Texas 79701
(432) 687-0901 (office)
(432) 687-0456 (fax)
(432) 556-8656 (cell)
mark@laenvironmental.com

Larson & Associates, Inc.
Environmental Consultants

BTA Oil Producers LLC
Pardue "C" 8808 JV-P Well #1
Eddy County, New Mexico

Proposed Schedule

Date	Event
February 12, 2010	LAI submitted revised delineation plan (*"Revised Pardue "C" SWD Delineation"*) to OCD – Santa Fe and Artesia, NM
February 16, 2010	OCD – Santa approved revised delineation plan
February 24 – 25, 2010	LAI performed EM-31 conductivity survey
March 8, 2010	LAI submitted preliminary investigation report (*"Preliminary Investigation Report, Pardue "C" 8808 JV-P Well #1, NMOCD Case No. 14413, Eddy County, NM"*) to OCD in Santa Fe and Artesia, NM
March 29 – April 1, 2010	Mobilize rig; drill and sample BH-9; install MW-11 (shallow) and MW-11A (deep)
April 2, 2010	Holiday – Good Friday
April 5 , 2010	Develop and sample MW-11 and MW-11A; drill and sample BH-1 and BH-2; install MW-7
April 6, 2010	Sample MW-11/MW-11A; drill and collect soil samples from borings BH-3, BH-4 and BH-5
April 7, 2010	Install MW-8; drill and sample BH-6; install MW-9
April 8, 2010	Drill and sample BH-7 and BH-8; install MW-10
April 9, 2010	Drill BH-10, BH-11 and BH-12
April 12, 2010	Drill BH-13 and BH-14; install MW-12
April 13, 2010	Drill and samples BH-15; install MW-13 and MW-14
April 14, 2010	Drill and sample BH-16, BH-17 and BH-18
April 15, 2010	Drill and sample BH-19; install MW-7A (deep) surface casing (if necessary)
April 16, 2010	Install MW-7A
April 19 – 23, 2010	Develop wells MW-7/MW-7A and MW-8 through MW-14
April 26 - 30, 2010	Gauge and sample monitoring wells and seeps.
May 3 - 7, 2010	Conduct slug tests
May 10 – July 16, 2010	Data reduction, evaluation and report preparation
July 19, 2010	Deliver report to OCD – Santa Fe and Artesia, NM

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Mark J. Larson
Sr. Project Manager / President
507 N. Marienfeld St., Ste. 202
Midland, Texas 79701
(432) 687-0901 (office)
(432) 687-0456 (fax)
(432) 556-8656 (cell)
mark@laenvironmental.com

Larson & Associates, Inc.
Environmental Consultants

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New Mexico Office of the State Engineer
Point of Diversion Summary

POD Number	Q64	Q16	Q4	Sec	Tws	Rng	X	Y
C 00128	2	4	4	15	23S	28E	587783	3574162*

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest)
(NAD83 UTM in meters)

Driller License: SMITH, SAM S.
Driller Name: SMITH, SAM S.

Drill Start Date:	12/24/1952	**Drill Finish Date:**	01/10/1953	**Plug Date:**	
Log File Date:	04/30/1953	**PCW Rcv Date:**	04/20/1949	**Source:**	Shallow
Pump Type:		**Pipe Discharge Size:**		**Estimated Yield:**	
Casing Size:	7.00	**Depth Well:**	149 feet	**Depth Water:**	

Water Bearing Stratifications:	Top	Bottom	Description
	25	120	Sandstone/Gravel/Conglomerate

Casing Perforations:	Top	Bottom
	37	130

***UTM location was derived from PLSS - see Help**

New Mexico Office of the State Engineer
Point of Diversion Summary

		(quarters are 1=NW 2=NE 3=SW 4=SE) (quarters are smallest to largest)						(NAD83 UTM in meters)	
POD Number		Q64	Q16	Q4	Sec	Tws	Rng	X	Y
C	00269	4	4	2	15	23S	28E	587778	3574773*

Driller License:	FREEK, R.H.				
Driller Name:	FREEK, R.H.				
Drill Start Date:	03/01/1958	**Drill Finish Date:**	03/30/1958	**Plug Date:**	
Log File Date:	04/08/1958	**PCW Rcv Date:**	04/14/1959	**Source:**	Shallow
Pump Type:	TURBIN	**Pipe Discharge Size:**		**Estimated Yield:**	
Casing Size:	6.00	**Depth Well:**	240 feet	**Depth Water:**	35 feet

Water Bearing Stratifications:	Top	Bottom	Description
	20	65	Shale/Mudstone/Siltstone
	200	205	Shale/Mudstone/Siltstone

Casing Perforations:	Top	Bottom
	48	54

***UTM location was derived from PLSS - see Help**

Form WR-23 STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well DANIEL H. WAGBY

Street and Number ROUTE 1, BOX 17

City LOVING State NEW MEXICO

Well was drilled under Permit No. C269 and is located in the SE ¼ SE ¼ NE ¼ of Section 15 Twp. 23 S Rge. 28E

(B) Drilling Contractor R. H. FREEK License No. WD 212

Street and Number VAN DAWSON COURTS, NORTH Y

City CARLSBAD State NEW MEXICO

Drilling was commenced MARCH 1, 19 58

Drilling was completed MARCH 30, 19 58

Elevation at top of casing in feet above sea level ____ Total depth of well 240

State whether well is shallow or artesian SHALLOW Depth to water upon completion 35

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	40	65	25	RED ROCK FORMATION WATER
2	200	205	5	BLUE SHALE WATER
3				20 GAL. NO SALT WATER
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
6	24	WELDED		85	85	SHOE		
		HOLE DRY		85	200	SALT WATER 20 G. in.		
				200	205	BLUE SHALE SALT WATER		

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
		6		2	FILL HOLE WITH HEAVY MUD TO 125 WITH ROCKS CEMENTING 100 THEN PULL PIPE

Section 5 PLUGGING RECORD

Name of Plugging Contractor ____ License No. ____

Street and Number ____ City ____ State ____

Tons of Clay used ____ Tons of Roughage used ____ Type of roughage ____

Plugging method used ____ Date Plugged ____ 19 ____

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received APR 9 1958

OFF. GROUND WATER ROSWELL, NEW M.

File No. C-269 Use Dom. Location No. 23.28.15.244

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
1	40	40	RED	CLAY
40	65	25	RED	ROCK WATER
65	200	135	RED	FORMATION
200	205	5	BLUE	SHALE SALT WATER
205	240	35	RED	SALT FORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well

R H Freek

Well Driller R. H. FREEK

C-269

New Mexico Office of the State Engineer
Point of Diversion Summary

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters)

POD Number	Q64	Q16	Q4	Sec	Tws	Rng	X	Y
C 00616	1	3	1	14	23S	28E	587982	3574978*

Driller License: BRININSTOOL, M.D.
Driller Name: BRININSTOOL, M.D.

Drill Start Date:	10/22/1980	**Drill Finish Date:**	12/05/1980	**Plug Date:**	
Log File Date:	12/09/1980	**PCW Rcv Date:**		**Source:**	Shallow
Pump Type:		**Pipe Discharge Size:**		**Estimated Yield:**	400
Casing Size:	9.63	**Depth Well:**	120 feet	**Depth Water:**	30 feet

Water Bearing Stratifications:	Top	Bottom	Description
	60	85	Shallow Alluvium/Basin Fill
	92	96	Shallow Alluvium/Basin Fill

Casing Perforations:	Top	Bottom
	60	120

*UTM location was derived from PLSS - see Help

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well M. E. Trachta Owner's Well No. C-616

Street or Post Office Address % Joe Trachta, P.O. Box 158

City and State Loving, N.M. 88256

Well was drilled under Permit No. C-616 and is located in the:

a. NW ¼ SW ¼ NW ¼ ¼ of Section 14 Township 23 S Range 28E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____ Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor M.D. Brininstool License No. WD-842

Address 2502 S. Canal, Carlsbad, N.M. 88220

Drilling Began 10/22/80 Completed 12/5/80 Type tools Cable Size of hole 10 in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 120 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 30 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
60	85	15	Cavings, gravel & clay	
92	96	4	Gravel	400

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
9 5/8	40	welded	-16"	120	121	none	60	120

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by:

_____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received December 9, 1980

Quad _____ FWL _____ FSL _____

File No. C-616 Use Irr. Location No. 23S.28E.14.13133

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
60	85	15	(Cleanout) Red Clay, gravel
85	90	5	Yellow lime
90	92	2	Yellow(very light) clay
92	96	4	Gravel all colors
96	110	14	Red clay
110	120	10	Red clay w/red and white gyp

Section 7. REMARKS AND ADDITIONAL INFORMATION

C-616

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This fo ould be executed in triplicate, preferably typewritten, and submitted appropriate district office of the State Engineer. A. ions, except Section 5, shall be answered as completely and accurat s possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section need be completed.

New Mexico Office of the State Engineer
Point of Diversion Summary

POD Number	Q64	Q16	Q4	Sec	Tws	Rng	X	Y
C 01216	4	1	1	13	23S	28E	589801	3575205*

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest)
(NAD83 UTM in meters)

Driller License: BRADY, W.H. DRILLING CO.
Driller Name: W.H. BRADY

Drill Start Date:	08/05/1964	**Drill Finish Date:**	08/06/1964	**Plug Date:**	
Log File Date:	09/15/1964	**PCW Rcv Date:**		**Source:**	Shallow
Pump Type:		**Pipe Discharge Size:**		**Estimated Yield:**	
Casing Size:		**Depth Well:**	60 feet	**Depth Water:**	45 feet

Water Bearing Stratifications:	Top	Bottom	Description
	42	46	Sandstone/Gravel/Conglomerate

*UTM location was derived from PLSS - see Help

New Mexico Office of the State Engineer
Point of Diversion Summary

POD Number	Q64	Q16	Q4	Sec	Twn	Rng	X	Y
	(quarters are 1=NW 2=NE 3=SW 4=SE)			(quarters are smallest to largest)			(NAD83 UTM in meters)	
C 01217	1	1	3	13	23S	28E	589606	3574593*

Driller License: BRADY, W.H. DRILLING CO.
Driller Name: W.H. BRADY

Drill Start Date:	08/07/1964	**Drill Finish Date:**	08/11/1964	**Plug Date:**	
Log File Date:	09/15/1964	**PCW Rcv Date:**		**Source:**	Shallow
Pump Type:		**Pipe Discharge Size:**		**Estimated Yield:**	
Casing Size:		**Depth Well:**	87 feet	**Depth Water:**	50 feet

Water Bearing Stratifications:	Top	Bottom	Description
	55	69	Sandstone/Gravel/Conglomerate

Meter Number:	559	**Meter Make:**	MCCROMETER
Meter Serial Number:	9541736	**Meter Multiplier:**	1.0000
Number of Dials:	2	**Meter Type:**	Diversion
Unit of Measure:	Acre-Feet	**Return Flow Percent:**	
Usage Multiplier:		**Reading Frequency:**	Quarterly

Meter Readings (in Acre-Feet)

Read Date	Year	Mtr Reading	Flag	Rdr	Comment	Mtr Amount
12/29/1998	1999	136	A	ms		0
04/16/1999	1999	155	A	ms		18.685
06/30/1999	1999	175	A	ms		19.849
09/29/1999	1999	200	A	ms		25.349
01/04/2000	1999	226	A	ms		25.613
04/06/2000	2000	243	A	mb		16.558
07/01/2000	2000	256	A	mb		13.141
10/01/2000	2000	276	A	mb		20.241
10/19/2000	2000	279	A	mb		3.020
01/05/2001	2000	291	A	ms		12.423
04/15/2001	2001	306	A	RPT		14.682
05/09/2001	2001	312	A	ms		5.732
07/12/2001	2001	322	A	RPT		10.142
10/01/2001	2001	337	A	RPT		14.798
11/08/2001	2001	344	A	AM		6.906
01/01/2003	2002	355	A	ms		11.314
04/01/2003	2003	366	A	ms		11.314

*UTM location was derived from PLSS - see Help

Meter Readings (in Acre-Feet)

Read Date	Year	Mtr Reading	Flag	Rdr	Comment	Mtr Amount
04/01/2003	2003	369	A	ms		3.052
06/04/2003	2003	0	A	ms		0
06/04/2003	2003	7	A	ms		6.678
07/01/2003	2003	12	A	ms		5.246
08/20/2003	2003	22	A	ms		10.412
10/01/2003	2003	31	A	RPT		8.788
10/27/2003	2003	36	A	TW		4.600
01/02/2004	2003	49	A	ab		13.171
04/01/2004	2004	67	A	RPT		18.345
07/01/2004	2004	93	A	RPT		26.222
10/01/2004	2004	112	A	RPT		18.603
01/02/2005	2004	130	A	RPT		18.402
01/03/2005	2005	31	A	TW		0
01/29/2005	2005	35	A	TW		4.470
03/30/2005	2005	48	A	TW		13.120
07/06/2005	2005	70	A	TW		22.284
01/05/2006	2005	26	R	TW	Meter Rollover	55.703
04/06/2006	2006	49	A	tw		22.428
07/06/2006	2006	71	A	tw		21.985
01/09/2007	2006	26	R	tw	Meter Rollover	55.935
07/03/2007	2007	72	A	tw		45.278
10/11/2007	2007	96	A	tw		24.730
01/03/2008	2007	18	R	tw	Meter Rollover	21.415
04/24/2008	2008	44	A	tw		25.874
07/17/2008	2008	70	A	tw		26.000
10/02/2008	2008	5	R	tw	Meter Rollover	35.752
01/15/2009	2008	28	A	tw		22.762
04/22/2009	2009	50	A	tw		21.303
08/04/2009	2009	72	A	tw		22.625
01/06/2010	2009	6	R	tw	Meter Rollover	33.717

**YTD Meter Amounts:	Year	Amount
	1999	89.496
	2000	65.383
	2001	52.260
	2002	11.314
	2003	63.261
	2004	81.572
	2005	95.577
	2006	100.348
	2007	91.423
	2008	110.388

**YTD Meter Amounts:	Year	Amount
	2009	77.645

Meter Number:	1401	**Meter Make:**	
Meter Serial Number:	01 035 530	**Meter Multiplier:**	1.0000
Number of Dials:	5	**Meter Type:**	Power Child
Unit of Measure:	Kilowatt Hours	**Return Flow Percent:**	
Usage Multiplier:		**Reading Frequency:**	Quarterly (No Reading Expected)

Meter Readings in (Kilowatt Hours)

Read Date	Year	Mtr Reading	Flag	Rdr	Comment	Mtr Amount
04/06/2000	2000	20998	A	mb		0
07/11/2000	2000	23327	A	mb		2329.000

**YTD Meter Amounts:	Year	Amount
	2000	2329.000

Form WR-23 STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Vicente L. Uzquidez

Street and Number Rt. 1 Box 14

City Artesia State New Mexico

Well was drilled under Permit No. C-1328 and is located in the

SW ¼ SW ¼ NE ¼ of Section 15 Twp. 32-S Rge. 28 E

(B) Drilling Contractor J. O. Hammond License No. WD-461

Street and Number 315 South 39th Street

City Artesia State New Mexico

Drilling was commenced 5/20 19 68

Drilling was completed 6/10 19 68

Elevation at top of casing in feet above sea level Total depth of well 200

State whether well is shallow or artesian Shallow Carlsbad Basin Depth to water upon completion 15'

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2	85	97		gravel
3	85	90	5	gravel
4				
5				

Section 3 RECORD OF CASING

Dia. in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
12½		weld	0	130	130	Collar	15'	130'

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. Q-1328 Use Irr. Location No. 23.28.15.233

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	25	25	Gray	Rock
25	27	2	Cong	Gravel
27	45	18	Gray	Rock
45	60	15	Red	Clay
60	85	25	Gray	Rock
85	90	5	Cong	Gravel
90	130	40	Gray	Rock
130	180	50	Red	Paly, Rock and Clay
180	200	20	White	Rock

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

C. C. Hammond
Well Driller

C-1328

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well S S Operating Co Owner's Well No. C-2187
Street or Post Office Address 2412 N I Stemmons, Suite 201
City and State Odessa, Texas 79761

Well was drilled under Permit No. C-2152 and is located in the:

a. NE ¼ NW ¼ SW ¼ ¼ of Section 14 Township 23S Range 28 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor Spirit Bros Drlg Co License No. WD-803
Address P O Box 13358, Odessa Tex 79768

Drilling Began 3-12-90 Completed 3-12-90 Type tools Rotary Size of hole 12¼ in. 45 ft

Elevation of land surface or _____ at well is _____ ft. Total depth of well 45 ft.

Completed well is ☑ shallow ☐ artesian. Depth to water upon completion of well 29 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
37	41	4	sand & gravel	(SALTY) 2 gal/minute

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
3½	250 wall PVC	SCH	0	45	45	None	21	49

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	16	12¼			pumped thru 1" Pipe

Section 5. PLUGGING RECORD

Plugging Contractor Spirit Bros Drlg Co
Address P O Box 13358 Odessa Tex 79768
Plugging Method Pumped mud back to surface
Date Well Plugged 3-13-90
Plugging approved by:

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1	0	16	5
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received April 20, 1990

Quad _____ FWL _____ FSL _____

File No. C-2189 Use OWD Location No. 23.28.14.31144

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	Soil + caliche
2	8	6	Caliche (sandy)
8	15	7	Limestone (hard)
15	17	2	Sandy limestone
17	24	7	Sand
24	27	3	Red shale
27	32	5	Sand + gravel
32	37	5	Limestone + shale
37	41	4	Water gravel (quartz)
41	48	7	Blue + yellow shale
48	92	44	Yellow + Blue shale

Section 7. REMARKS AND ADDITIONAL INFORMATION

Dug well with mud rotary to 48 ft. Set 48 ft. of 8 5/8 steel pipe, slotted from 21 - 48 ft. gravel packed and cemented the top of well from 0 - 1 ft. The quantity nor the quality was good enough for any use. (2 gal per min + salty) We plugged it temporary. Cut off casing 1 ft below surface, ran drill pipe to 45 ft + pumped hole full of mixed mud + gel, pumped 36 sacks of cement slurry, pulled drill pipe up to 12 ft + pumped 3 1/2 sacks of cement slurry. After 30 min the slurry had settled 1 ft so we put 3 sacks of cement + packer hole.

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

C-2189

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All items, except Section 5, shall be answered as completely and accurately as possible when any well is

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Jimmy C. Tarvin Owner's Well No. C-2503 #1

Street or Post Office Address P.O. Box 382

City and State Loving, NM 88256

Well was drilled under Permit No. C-2503 and is located in the:

a. NE ¼ NE ¼ ¼ ¼ of Section 15 Township 23. S Range 28 E. N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in Eddy County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor OSBOURN DRILLING & PUMP CO. License No. WD-353

Address 1908 S. Frist Street Artesia, NM 88210-9700

Drilling Began 8-27-96 Completed 8-29-96 Type tools CABLE TOOL Size of hole 8" in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 70' ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 12' ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
28'	58'	30	Yellow Sand-Gravel	27

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5 1/2"OD	P.V.C. 200Lb.		1'Up	70	71'	None	30	70

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by:

_____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 09-03-96

Quad _____ FWL _____ FSL _____

File No. C-2503 Use Domestic Location No. 23S.28E.15.24343

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	18	18	Blue Boulders - Caliche
18	28	10	White - Caliche - Gravel
28	58	30	Yellow - Sand & Gravel
58	63	5	Blue - Clay
63	66	3	Red - Sandy Clay
66	70	4	Yellow - Sandy Clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

C-2503

'96 SEP 3 AM 11 48

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

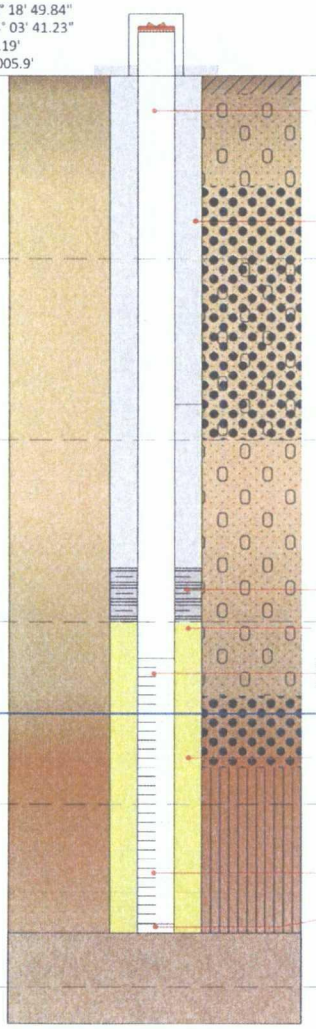
Driller

INSTRUCTIONS: This fo uld be executed in triplicate, preferably typewritten, and submitted t ppropriate district office of the State Engineer. Al ons, except Section 5, shall be answered as completely and accurate ossible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 eed be completed.

JWW

Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-1 (MW-7).dwg, 6/2/2010 9:47:13 AM

Latitude N 32° 18' 49.84"
Longitude W 104° 03' 41.23"
TOC Elevation : 3009.19'
Ground Elevation : 3005.9'



Well Completion Log

3.29 Casing Stick-up

8" Borehole.
4" Sch 40 PVC CASING

1' - 27'
Cement-Bentonite Grout

~ 27' - 30'
Bentonite

30' TOP OF SAND

32.29' TOP OF SCREEN

Groundwater ~34.95' BGS 4/8/10

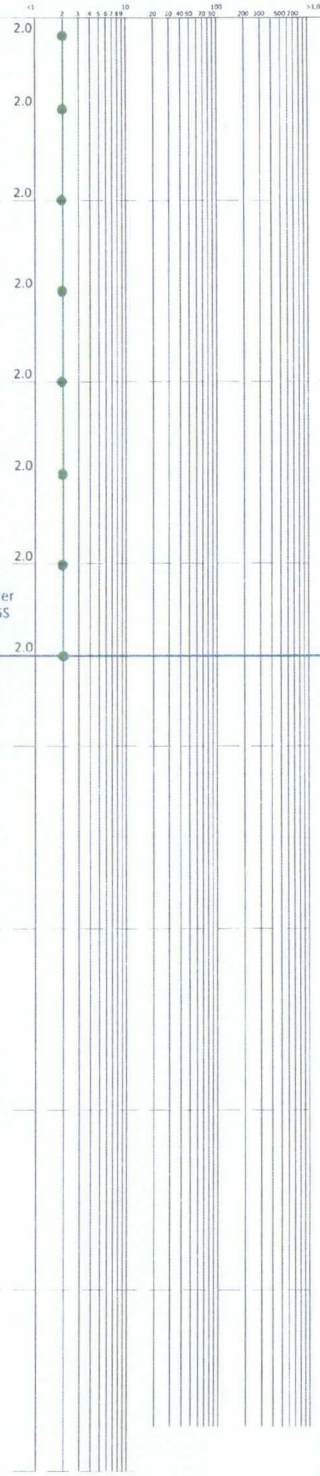
8/16 Oglebay Norton Silica Sand Filter Pack

14.40' - 0.020 SLOTTED PVC SCREEN

CAP

10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/8/2010, completed 4/9/2010.
Drilled with Air Rotary by Scarborough

CL - Brown to Yellowish Brown (10YR 5/3 to 10YR 6/4) silty sandy clay, very fine grained quartz sand, dry, loose

GW - Pale Brown (10YR 7/3) conglomerate, very fine grained quartz sand, interbedded with cobble very hard between 1' and 6'

SP - GW - Pink (7.5YR 7/3 to 7.5YR 7/4) silty sand, gravel below 13' with pebbles to 35mm, round Light Brown (7.5YR 6/4)

GW - Light Yellowish Brown (10YR 6/4) very fine grained quartz sand, with pebbles and cobbles to 50mm very well cemented

SP - Strong Brown (7.5YR 6/4) very fine grained quartz sand to medium grained quartz sand, moist

ML - Pale Yellow to Light Yellowish Brown (2.5YR 7/4 to 6/4) clayey silt, very fine grained quartz sand, wet

TD at 47.26' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

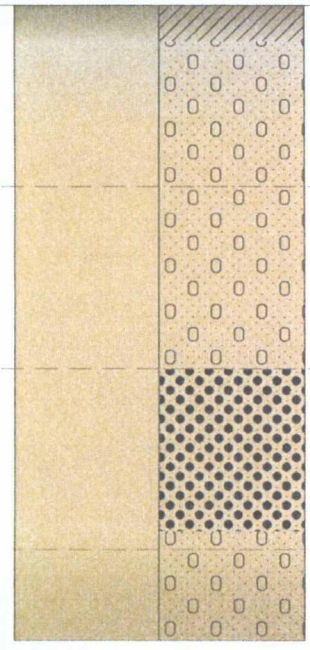
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

LA arson & Associates, Inc.
Environmental Consultants

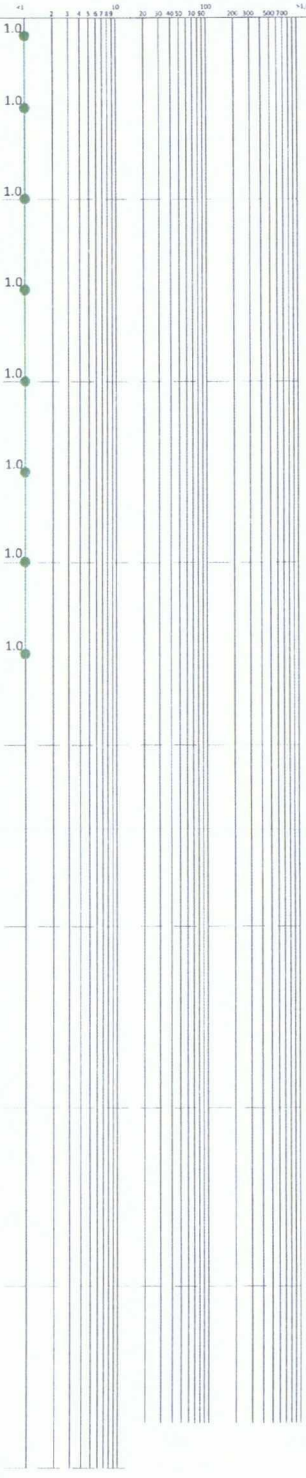
BH-1 (MW-7) Boring & Completion Log

Latitude N 32° 18' 48.76"
Longitude W 104° 03' 43.47"
Ground Elevattion : 3003.8'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/12/2010, completed 4/12/2010.
Drilled with Air Rotary by Scarborough

CL - Brown (10YR 5/3) silty sandy clay, very fine grained quartz sand, dry, loose, weak

GW - Pink (7.5YR 7/3) conglomerate, very fine grained quartz sand, interbedded with cobbles hard between 2' and 8'

GW-SP - Light Brown (7.5YR 7/4) silty sand, very fine grained quartz sand, interbedded with gravel from 8' to 20' with pebbles to 20mm, some clay at 25', Brownish Yellow (10YR 6/6)

GW-SP - Light Yellowish Brown (10YR 6/4) sandy gravel, very fine grained quartz sand, poorly sorted with gravel pebbles to 20mm round

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

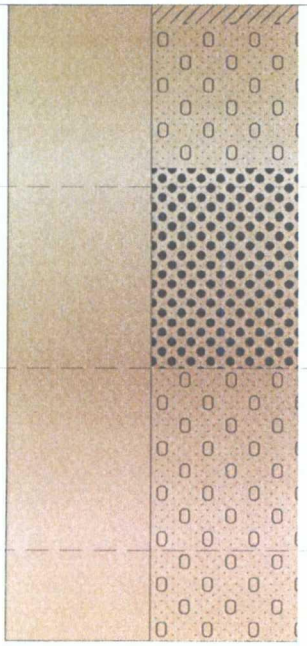
Larson & Associates, Inc.
Environmental Consultants

BH-2 Boring Log

JWW

Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-3.dwg, 6/2/2010 10:22:00 AM

Latitude N 32° 18' 49.02"
Longitude W 104° 03' 42.62"
Ground Elevation : 3002.4'



10' bgs

20' bgs

30' bgs

40' bgs

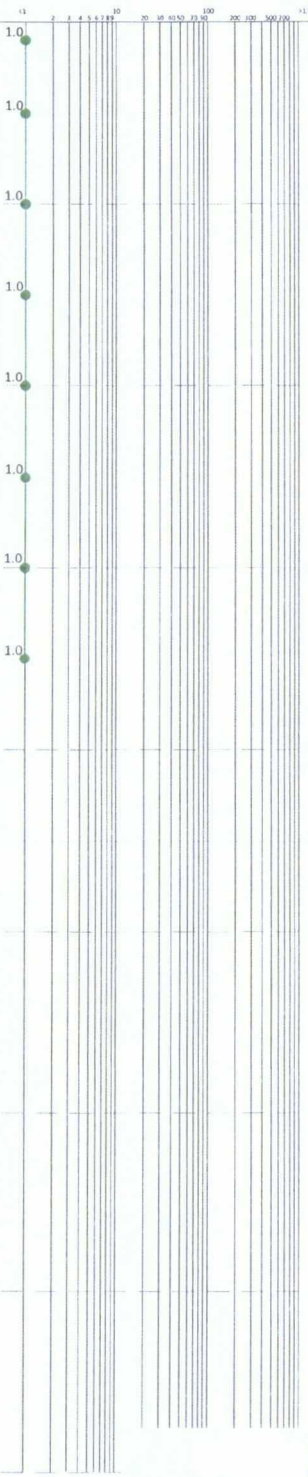
50' bgs

60' bgs

70' bgs

80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/12/2010, completed 4/12/2010.
Drilled with Air Rotary by Scarborough

CL - Brown (10YR 6/4) silty sandy clay, very fine grained quartz sand, dry, weak

GW - Pale Brown (10YR 7/3) conglomerate, very fine grained quartz sand, interbedded with cobbles, very hard between 1' and 9'

GW-SP - Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, poorly sorted, gravelly from 9' to 15', to approximately 20mm, round, decreasing gravel below 15', moist at 25' with some clay

GW - Pink (7.5YR 7/3 to 5YR 7/4) sandy gravel, very fine to medium grained quartz sand, with interbedded gravel, pebbles 10 to 20mm round

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

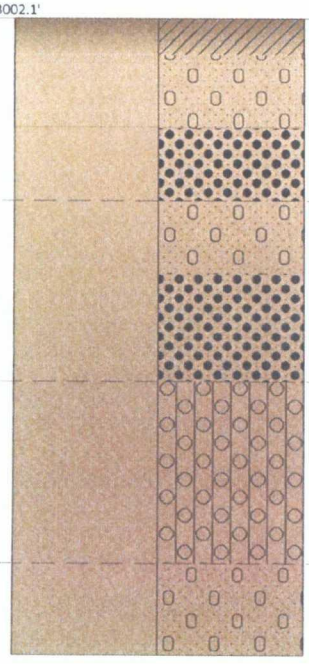
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

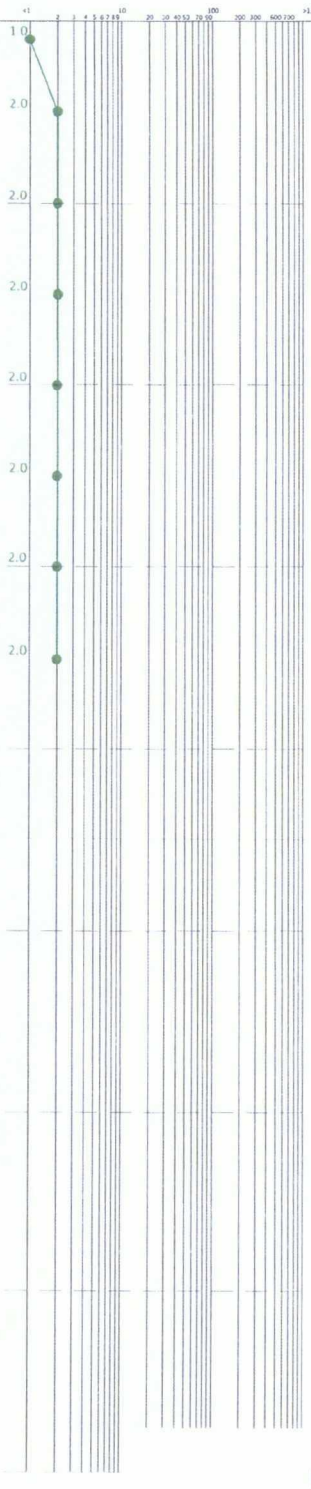
BH-3 Boring Log

Latitude N 32° 18' 46.67"
Longitude W 104° 03' 43.12"
Ground Elevation : 3002.1'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/8/2010, completed 4/8/2010.
Drilled with Air Rotary by Scarborough

CL - Brown (10YR 5/3) silty sandy clay, very fine grained quartz sand, dry, weak

GW - Pink (7.5YR 7/4) conglomerate, very fine grained quartz sand, interbedded with cobbles, very hard between 2' and 6'

SP-GW - Pink (7.5YR 7/4) silty sand, very fine grained quartz sand, gravelly below approximately 8' with rounded pebbles to 20mm

SP-SM - Light Brown (7.5YR 6/4) sandy gravel, fine to medium grained quartz sand with quartzite pebbles and cobbles to 70mm

GW - Light Yellowish Brown (2.5YR 6/3 to 6/4) very fine grained quartz sand, moist

GW - Brown to Pale Brown (10YR 6/3 to 5/3) fine to medium grained quartz sand with quartzite pebbles to approximately 20mm, round, very hard conglomerate approximately 6" thick

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

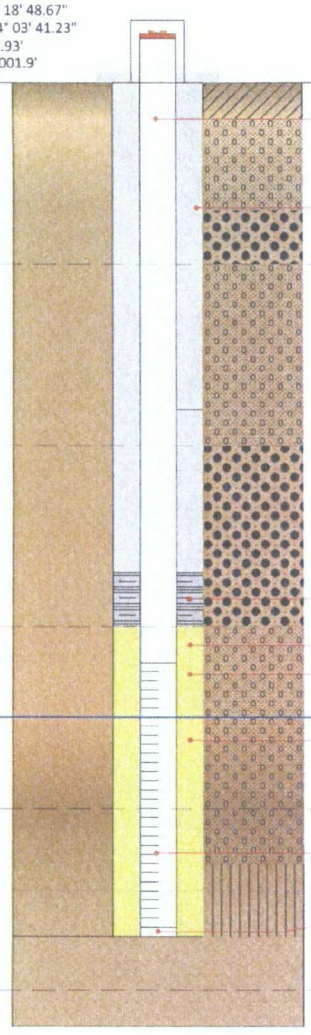
Eddy County, New Mexico

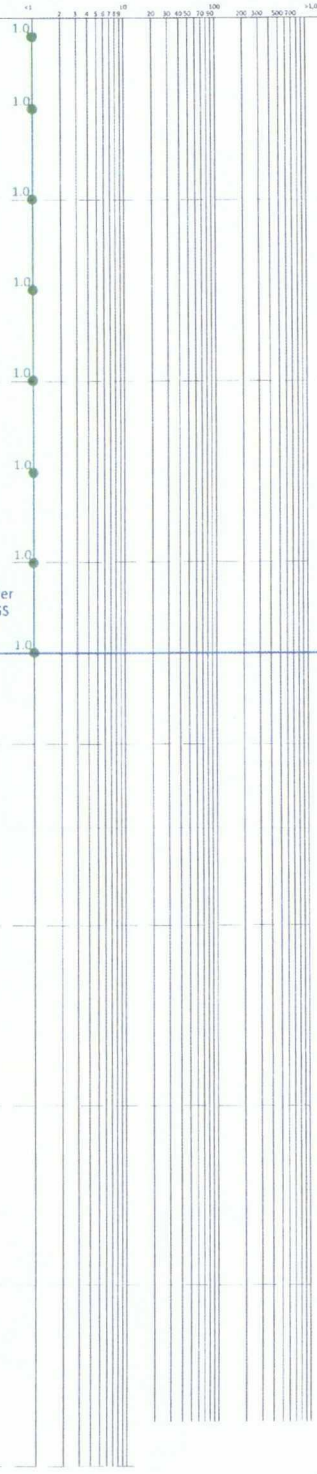
N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-4 Boring Log

Latitude N 32° 18' 48.67"
Longitude W 104° 03' 41.23"
TOC Elevation : 3004.93'
Ground Elevation : 3001.9'





Lithologic Well Log

Drilling started 4/9/2010, completed 4/9/2010.
Drilled with Air Rotary by Scarborough

CL - Brown to Yellowish Brown (10YR 5/3 to 10YR 5/4) silty sandy clay, very fine grained quartz sand, dry, loose

GW - Pink (7.5YR 7/4) conglomerate, very fine grained quartz sand, interbedded with cobblestone very hard between 2' and 9'

SP - GW - Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, poorly sorted, loose, moist at 20', some gravel at 25' to 15mm

GW - Reddish Yellow to Strong Brown (5YR 6/6 to 7.5YR 5/6) sandy clayey gravel, very fine grained quartz sand with silty clay and pebbles to approximately 30mm, round, moist, wet

GW - Light Yellowish Brown (2.5YR 6/3) clayey silt, very fine grained quartz sand, moist

TD at 47.58' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

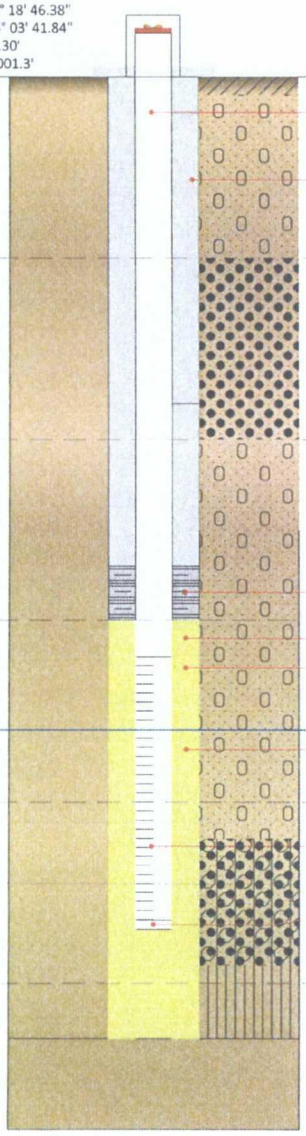
Larson & Associates, Inc.
Environmental Consultants

BH-5 (MW-8) Boring & Completion Log

JWW

Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-6 (MW-9).dwg, 6/2/2010 11:50:23 AM

Latitude N 32° 18' 46.38"
Longitude W 104° 03' 41.84"
TOC Elevation : 3004.30'
Ground Elevation : 3001.3'



Well Completion Log

3.00 Casing Stick-up

8" Borehole.
4" Sch 40 PVC CASING

1' - 27.0' Cement and Bentonite Grout

27.0' - 29.5' Bentonite

29.5' Top of Sand

31.62' Top of Screen Groundwater ~35.77' BGS 4/8/10

8/16 Oglebay Norton Silica Sand Filter Pack

14.40' - 0.020 SLOTTED PVC SCREEN

CAP

10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot (parts per million)

2.0
2.0
2.0
1.0
2.0
2.0
1.0

Lithologic Well Log

Drilling started 4/8/2010, completed 4/12/2010.
Drilled with Air Rotary by Scarborough

CL - Brown to Yellowish Brown (10YR 5/3 to 10YR 5/4) silty sandy clay, very fine grained quartz sand, dry, loose

GW - Pink (7.5YR 7/4) conglomerate, very fine grained quartz sand, interbedded with cobbles, very hard between 2' and 9'

SP - GW - Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, poorly sorted, loose, moist at 20', some gravel at 25' to 15mm

GW - Reddish Yellow to Strong Brown (5YR 6/6 to 7.5YR 5/6) sandy clayey gravel, very fine grained quartz sand with silty clay and pebbles to approximately 30mm, round, moist, wet

GW Light Yellowish Brown (2.5YR 6/3) clayey silt, very fine grained quartz sand, moist

TD at 49.65' BGS (Well)

TD at 53' BGS (Boring)

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

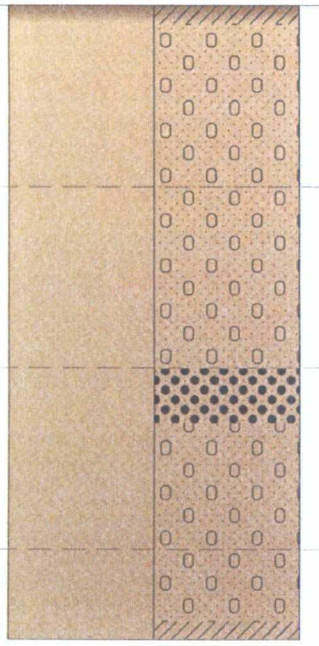
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

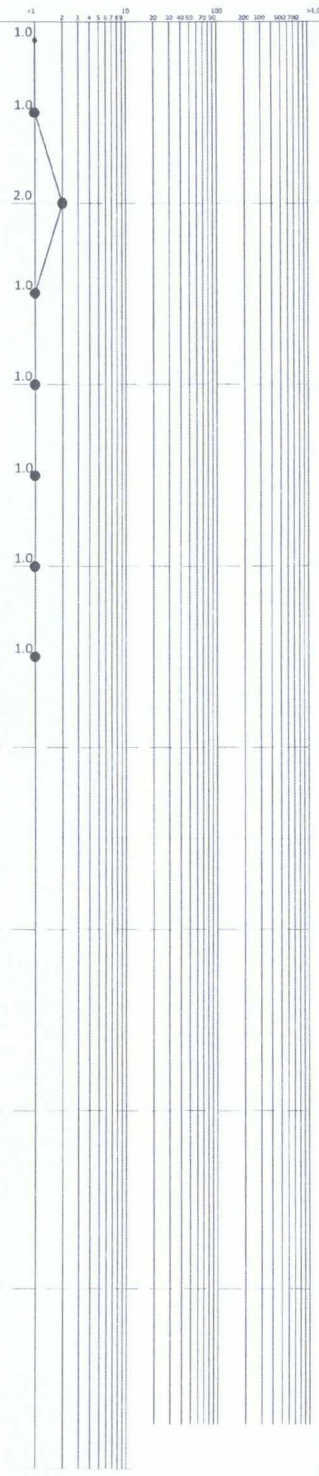
BH-6 (MW-9) Boring & Completion Log

Latitude N 32° 18' 47.93"
Longitude W 104° 03' 40.53"
Ground Elevation : 3004.2'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/14/2010, completed 4/14/2010.
Drilled with Air Rotary by Scarborough

CL - Brown (10YR 5/3) silty clay, very fine grained quartz sand, dry, weak, mixed with gravel

GW - Pink (7.5YR 7/4) conglomerate, very fine grained quartz sand, poorly sorted, pebbles / cobbles > 40mm

GW-SP- Light Brown (7.5YR 7/4) silty sand, very fine grained quartz sand, poorly sorted with some gravel to 42mm, round, moist

GW- Pink (7.5YR 7/4) silty sandy clay, very fine to medium grained quartz sand, poorly sorted with gravel to 30mm, round some clay at 30', moist

GW- Light Brown (7.5YR 6/4) gravelly silty clay with pebbles to 10mm, round, stiff, moist

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

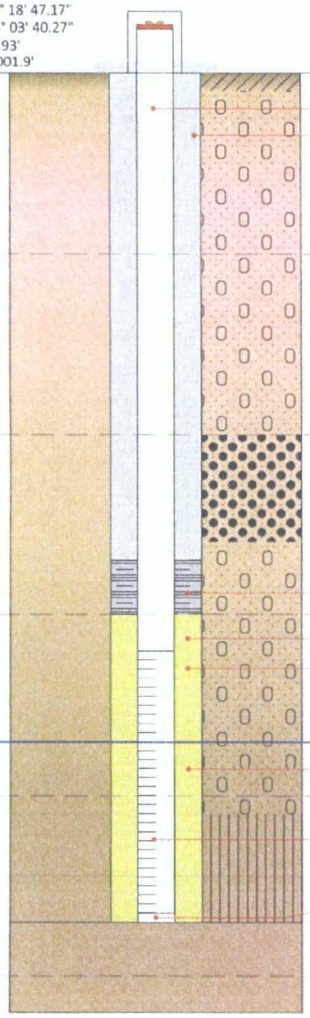
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-7 Boring Log

Latitude N 32° 18' 47.17"
Longitude W 104° 03' 40.27"
TOC Elevation : 3004.93'
Ground Elevation : 3001.9'



Well Completion Log

3.03' Casing Stick-up

8" Borehole.
4" Sch 40 PVC CASING
1' - 27' Cement and Bentonite Grout

27' - 30' Bentonite

30' Top of Sand

32.08' Top of Screen

Groundwater ~37.32' BGS 4/8/10

8/16 Oglebay Norton Silica Sand Filter Pack

14.40' - 0.020 SLOTTED PVC SCREEN

CAP

PID Response Log Plot (parts per million)

1.0
2.0
1.0
1.0
1.0
1.0
2.0
1.0

Lithologic Well Log

Drilling started 4/14/2010, completed 4/14/2010.
Drilled with Air Rotary by Scarborough

CL - Brown to Yellowish Brown (10YR 5/3 to 5/4) silty clay, very fine grained quartz sand, firm

GW - Pink (7.5YR 7/4) conglomerate, very fine grained quartz sand, poorly sorted with pebbles to approximately 20mm, round, hard

GW-SP - Pink (7.5YR 8/3 to 7/4) very fine to medium grained quartz sand, poorly sorted, gravel with pebbles to 20mm, round, decreasing gravel with depth, very fine to fine grained quartz sand below 12', some clay below 23'

GW - Light Brown (7.5YR 6/4) sandy gravel, very fine to medium grained quartz sand, poorly sorted, with gravel and pebbles to 20mm, some clay at 35', wet

ML - Light Yellowish Brown (2.5YR 6/3) sandy clayey silt, very fine grained quartz sand, firm, moist

TD at 47.05' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

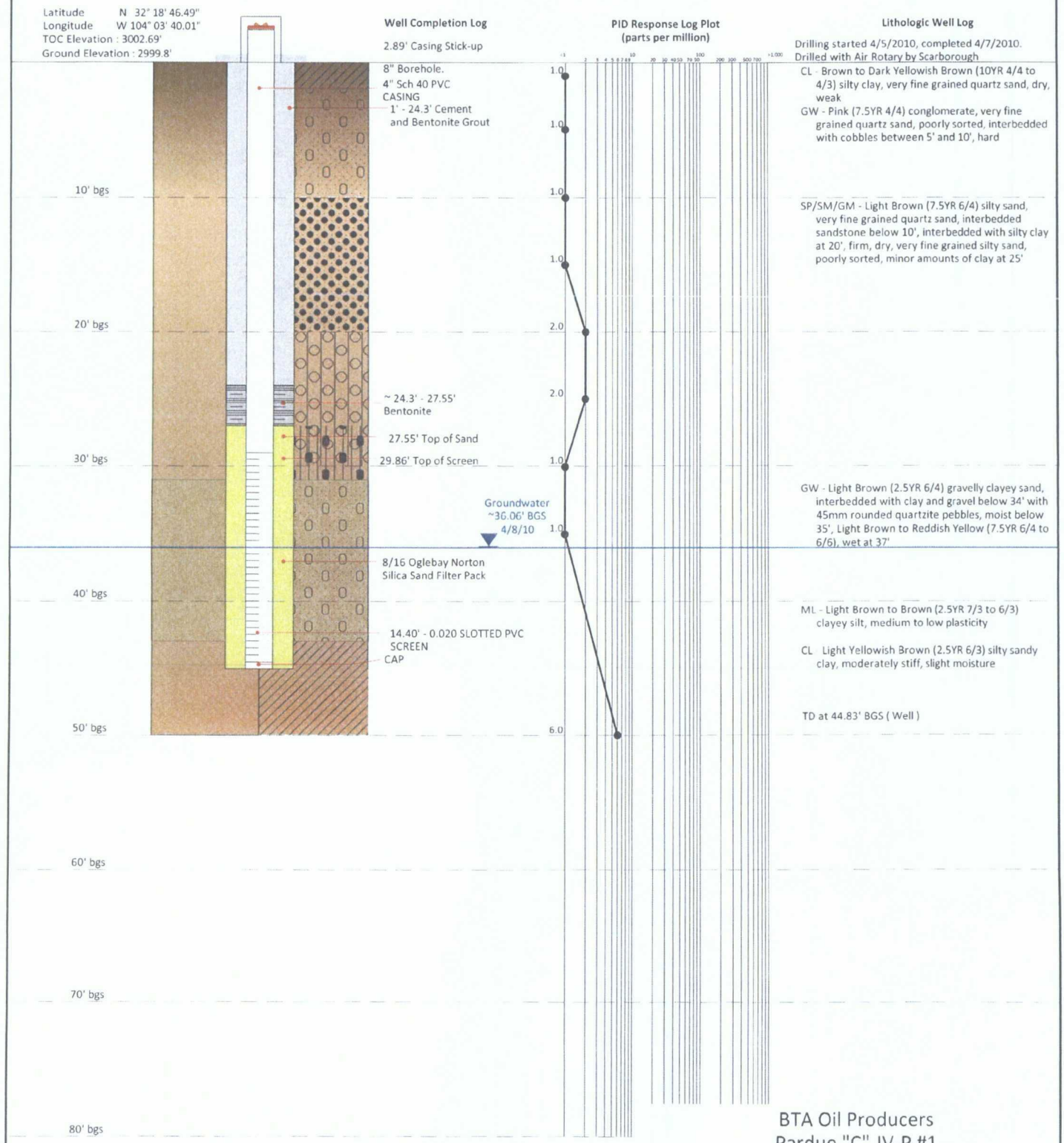
N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-8 (MW-10) Boring & Completion Log

JWW

Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-9 (MW-11).dwg, 6/2/2010 3:32:33 PM



BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

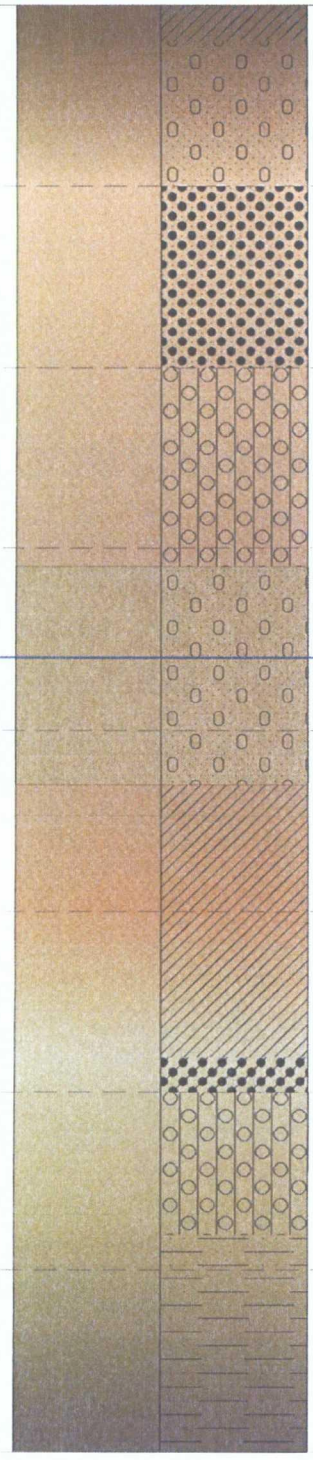
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-9 (MW-11) Boring & Completion Log

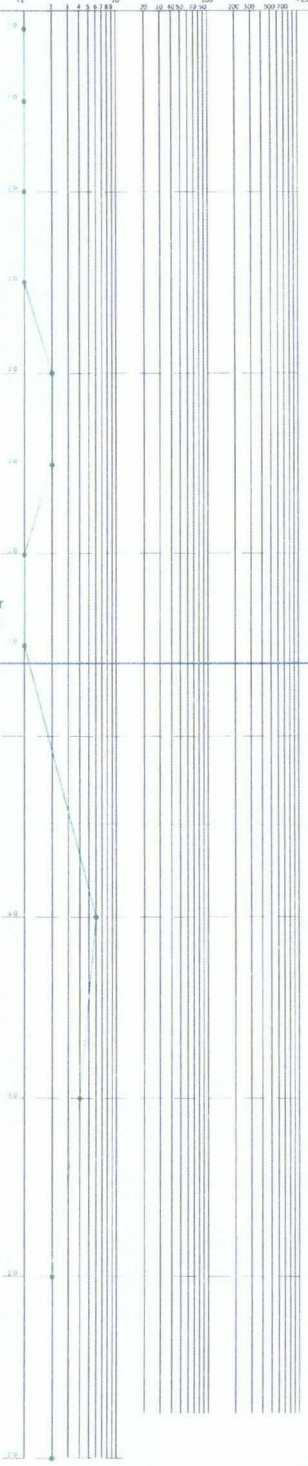
Latitude N 32° 18' 46.49"
Longitude W 104° 03' 40.01"



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

Groundwater
~36.44' BGS
4/8/10

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/5/2010, completed 4/7/2010.
Drilled with Air Rotary by Scarborough

CL - Brown to Dark Yellowish Brown (10YR 4/4 to 4/3) silty clay, very fine grained quartz sand, dry, weak

GW - Pink (7.5YR 4/4) conglomerate, very fine grained quartz sand, poorly sorted, interbedded with cobblers 5' and 10', hard

SP/SM/GM - Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, interbedded sandstone below 10', interbedded with silty clay at 20', firm, dry, very fine grained silty sand, poorly sorted, minimum amounts of clay at 25'

GW - Light Brown (2.5YR 6/4) gravelly clayey sand, interbedded with clay and gravel below 34' with 45mm rounded quartzite, moist below 35', Light Brown to Reddish Yellow (7.5YR 6/4 to 6/6), wet at 37'

GW - Light Brown to Brown (2.5YR 7/3 to 6/3) clayey silt, medium to low plasticity

GW - Light Yellowish Brown (2.5YR 6/3) silty sandy clay, moderately stiff, slight moisture

TD at 47.93' BGS (Well)

GW - Dark Grayish Brown (10YR 4/2) silty clayey sand very fine grained quartz sand, moist to damp

Shale - Gray to Dark Gray (10YR 5/1 to 4/1) blocky, dry with gypsum, Reddish Brown (5YR 4/4) below 70', dry

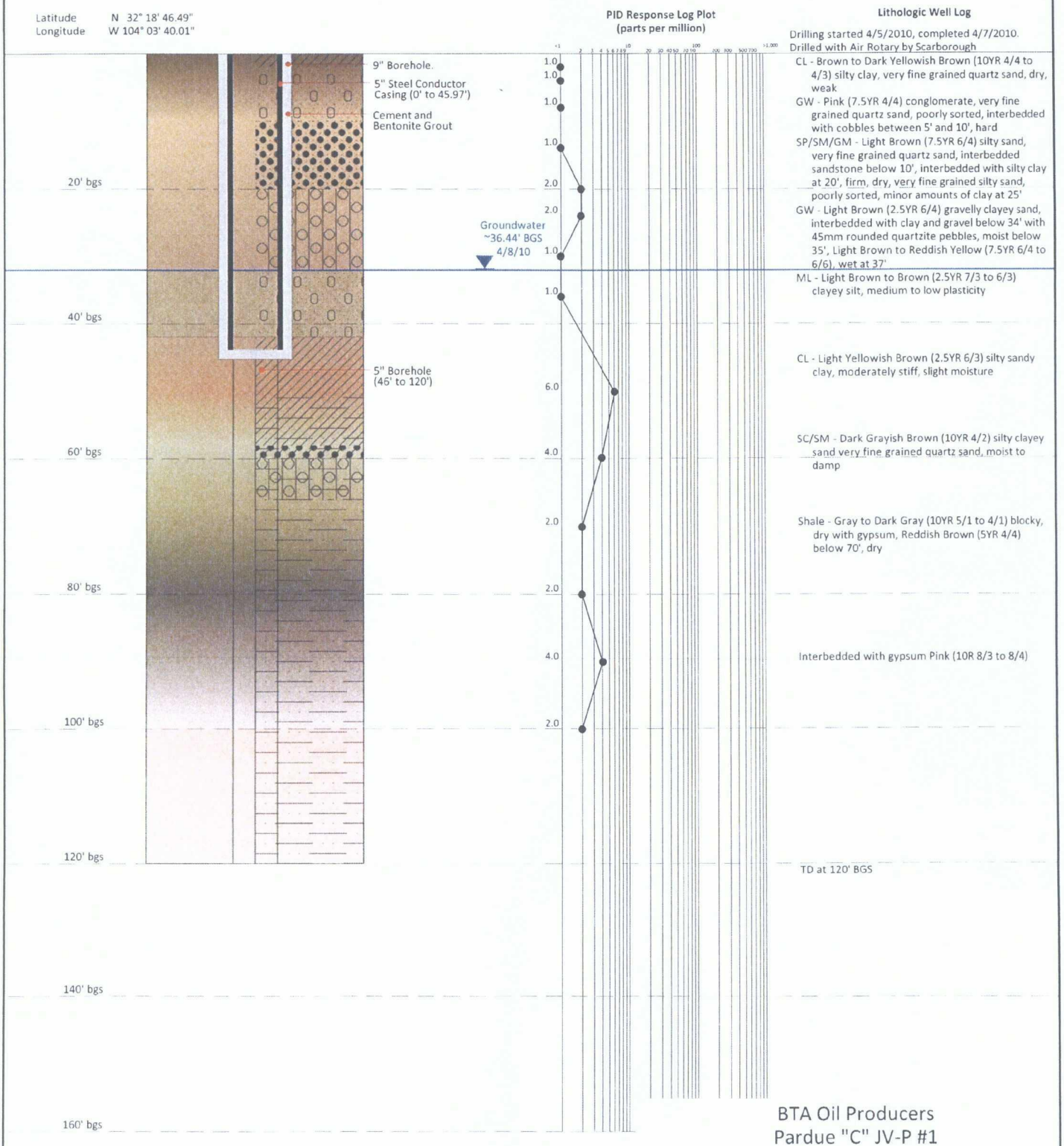
BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

Latitude N 32° 18' 46.49"
Longitude W 104° 03' 40.01"



Lithologic Well Log

Drilling started 4/5/2010, completed 4/7/2010.
Drilled with Air Rotary by Scarborough

CL - Brown to Dark Yellowish Brown (10YR 4/4 to 4/3) silty clay, very fine grained quartz sand, dry, weak

GW - Pink (7.5YR 4/4) conglomerate, very fine grained quartz sand, poorly sorted, interbedded with cobbles between 5' and 10', hard

SP/SM/GM - Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, interbedded sandstone below 10', interbedded with silty clay at 20', firm, dry, very fine grained silty sand, poorly sorted, minor amounts of clay at 25'

GW - Light Brown (2.5YR 6/4) gravelly clayey sand, interbedded with clay and gravel below 34' with 45mm rounded quartzite pebbles, moist below 35', Light Brown to Reddish Yellow (7.5YR 6/4 to 6/6), wet at 37'

ML - Light Brown to Brown (2.5YR 7/3 to 6/3) clayey silt, medium to low plasticity

CL - Light Yellowish Brown (2.5YR 6/3) silty sandy clay, moderately stiff, slight moisture

SC/SM - Dark Grayish Brown (10YR 4/2) silty clayey sand very fine grained quartz sand, moist to damp

Shale - Gray to Dark Gray (10YR 5/1 to 4/1) blocky, dry with gypsum, Reddish Brown (5YR 4/4) below 70', dry

Interbedded with gypsum Pink (10R 8/3 to 8/4)

TD at 120' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

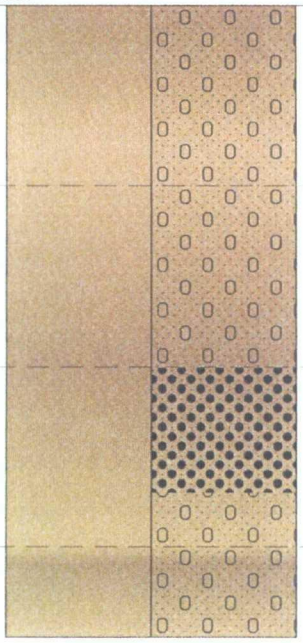
N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

JWW

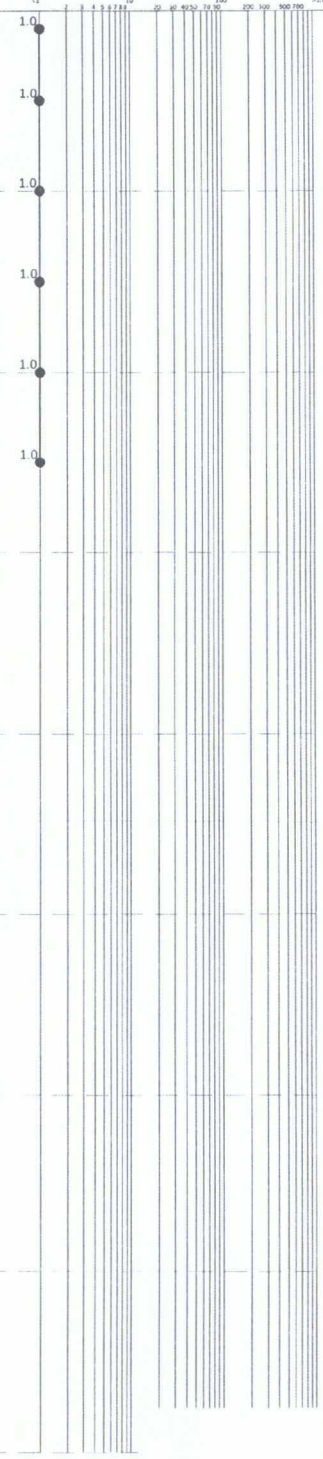
Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-10.dwg, 6/2/2010 3:45:29 PM

Latitude N 31° 57' 38.8"
Longitude W 102° 06' 00.9"
Ground Elevation : 3002.9'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/13/2010, completed 4/13/2010.
Drilled with Air Rotary by Scarborough

GW - Light Brown (7.5YR 6/3) gravelly sand, very fine grained quartz sand with gravel to 10mm well pad material

GW - Pink (7.5YR 7/4) gravelly sand, very fine to medium grained quartz sand, poorly sorted with pebbles to 10mm round

GW-SP - Light Brown (7.5YR 6/4) silty sand, very fine to fine grained quartz sand, poorly sorted with some gravel and pebbles to 10mm round, decreasing with depth

GW - Very Pale to Light Yellowish Brown (10YR 7/4 to 6/4) conglomerate, very fine to medium grained quartz sand with pebbles and cobbles, very well cemented, hard

GW - Pale Brown (10YR 7/4) sandy gravel, very fine to medium grained quartz sand and gravel with pebbles to 20mm round

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-10 Boring Log

JWW

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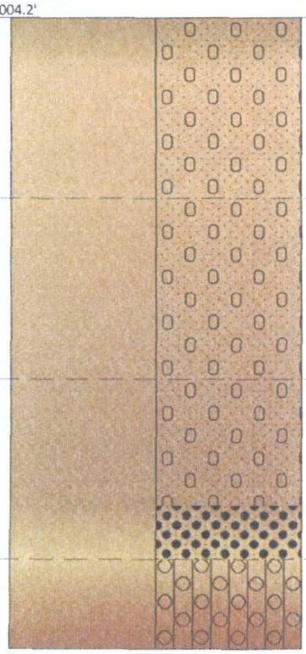
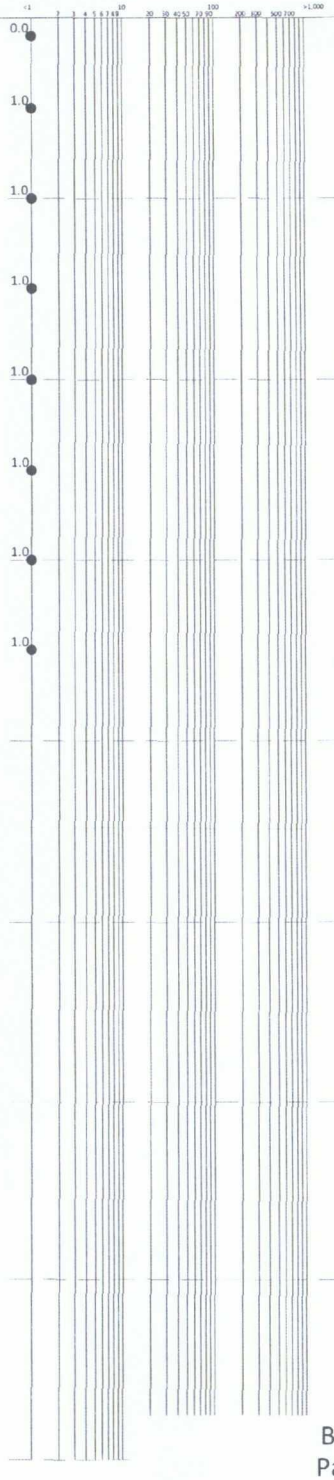
Latitude N 32° 18' 48.11"
Longitude W 104° 03' 42.62"
Ground Elevation : 3004.2'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/13/2010, completed 4/13/2010.
Drilled with Air Rotary by Scarborough

GW - Light Yellowish Brown (10YR 6/4) gravel, very fine to medium grained quartz sand, pebbles to 25mm, angular, well/tank battery pad material

GW - Pink (7.5YR 7/4) gravelly sand, very fine to medium grained quartz sand, poorly sorted with pebbles to 10mm, round

GW-SP - Light Brown (7.5YR 6/4) silty sand, very fine to fine grained quartz sand, poorly sorted with some gravel and pebbles to 10mm, subround, decreasing with depth, clay present below 20'

GW - Very Pale to Light Yellowish Brown (10YR 7/4 to 6/4) sandy gravel, fine to medium grained quartz sand, poorly sorted with pebbles to 40mm, round

SM - Yellowish Red (5YR 5/6) silty clayey sand, very fine grained quartz sand, moist
TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-11 Boring Log

JWW

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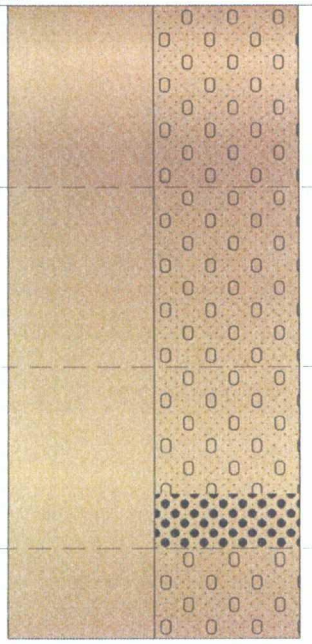
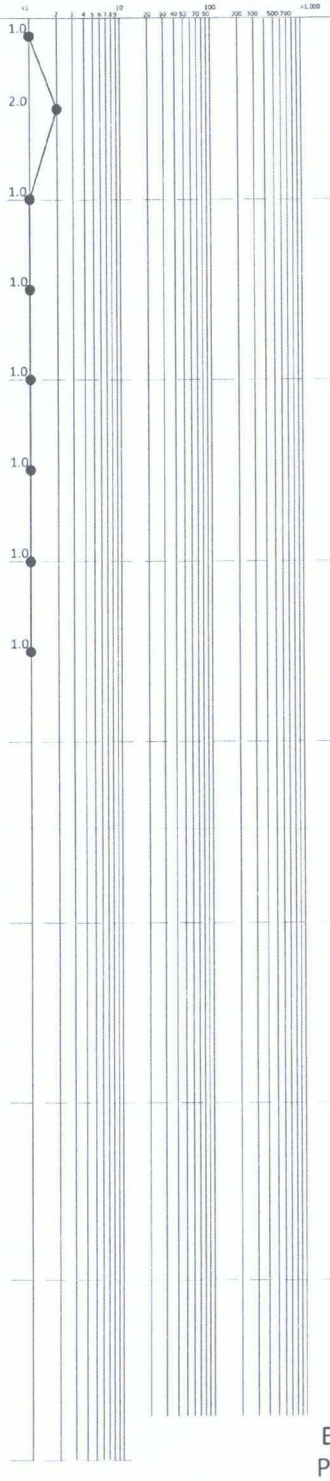
Latitude N 32° 18' 47.72"
Longitude W 104° 03' 42.83"
Ground Elevation : 3003.4'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/12/2010, completed 4/12/2010.
Drilled with Air Rotary by Scarborough

GW - Light Brown (7.5YR 6/3) gravelly sand, very fine grained quartz sand, with gravel to 10mm, well pad material

GW - Pink (7.5YR 7/3 to 7/4) conglomerate, very fine grained quartz sand interbedded with cobbles, indurated, hard from 3' to 8' feet

GW-SP - Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand interbedded with gravel, pebbles to 20mm, round, decreasing with depth, some clay at 15'

GW - Very Pale to Light Yellowish Brown (10YR 7/4 to 6/4) sandy gravel, fine to very fine quartz sand, poorly sorted with gravel to 20mm, round, Pink to Light Brown (7.5YR 7/4 to 6/4) below 25'

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-12 Boring Log

JWW

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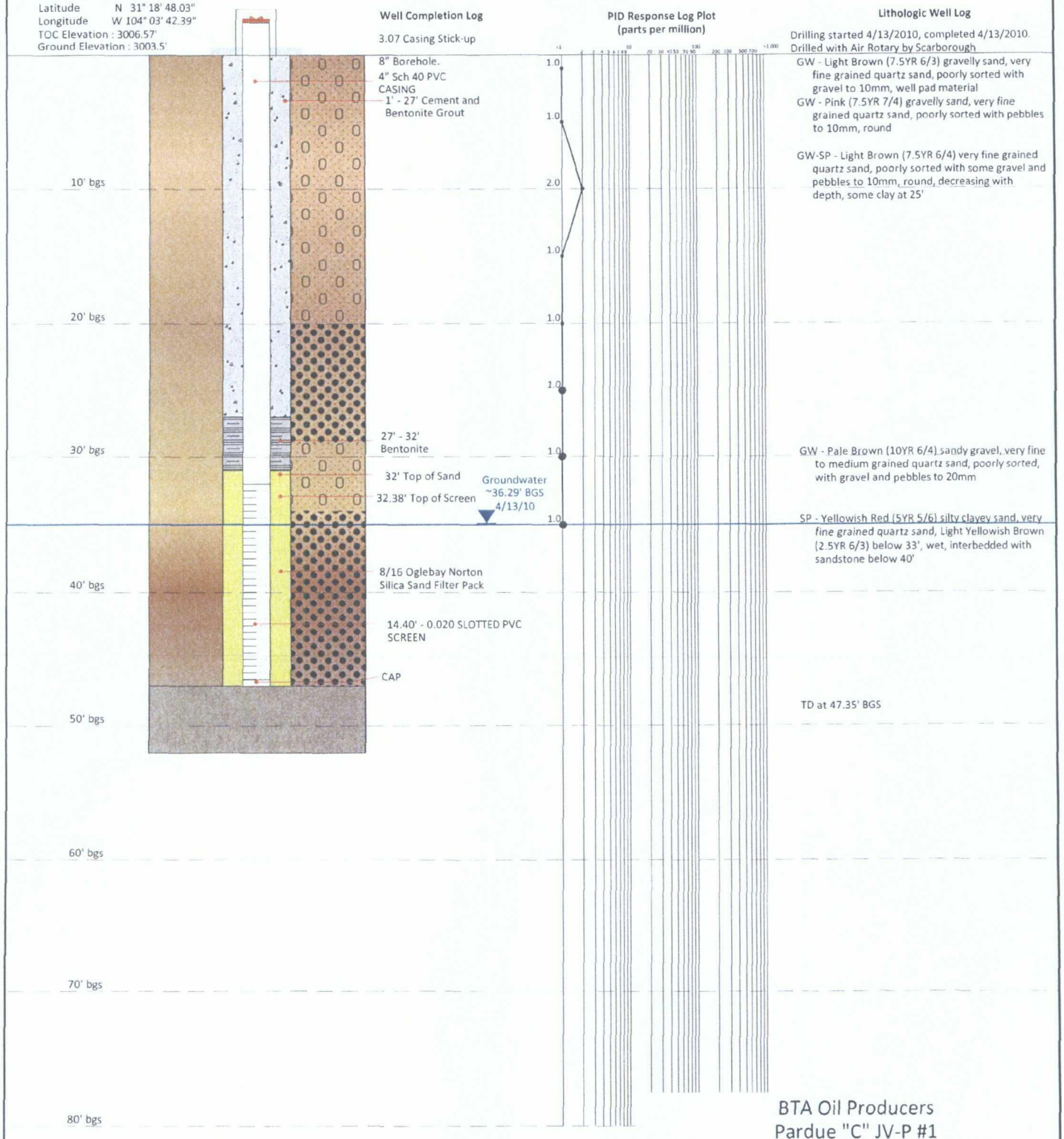

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-13 (MW-12) Boring & Completion Log

JWW

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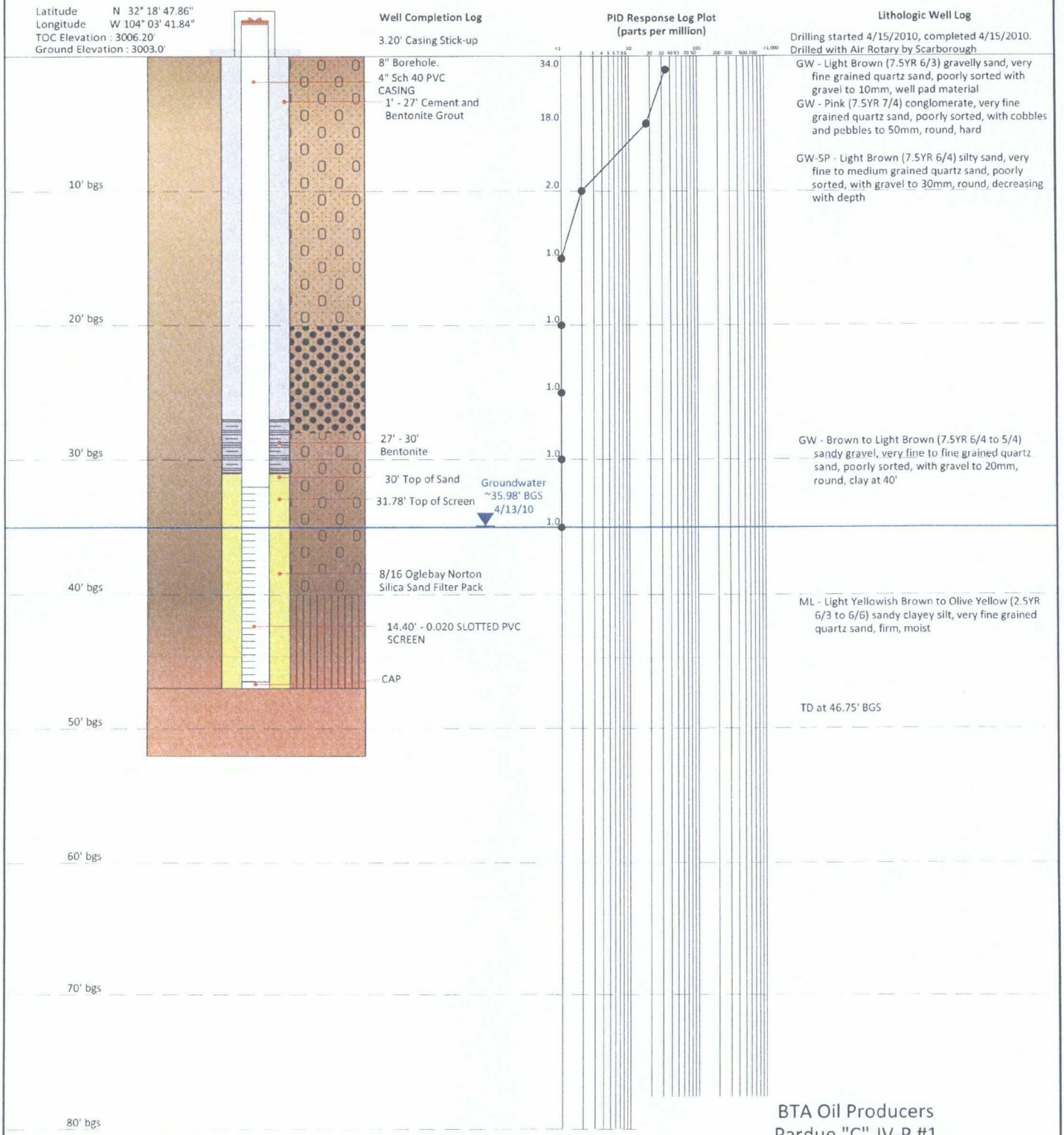


BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

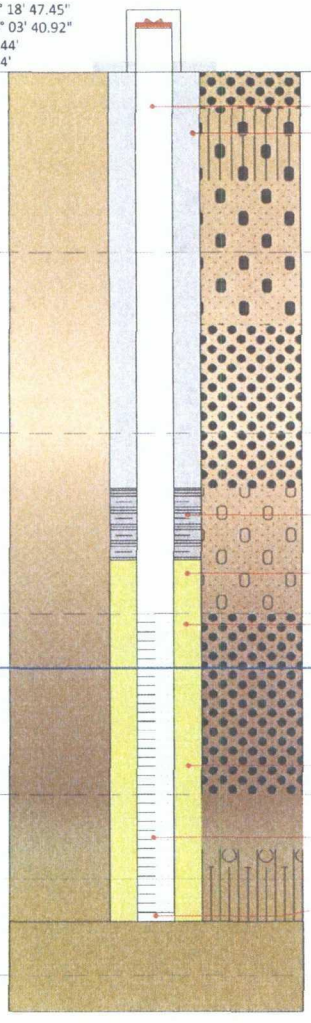
Larson & Associates, Inc.
Environmental Consultants

BH-14 (MW-13) Boring & Completion Log

JWW

Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-15 (MW-14).dwg, 6/4/2010 8:06:19 AM

Latitude N 32° 18' 47.45"
Longitude W 104° 03' 40.92"
TOC Elevation : 3003.44'
TOC Elevation : 3000.4'



Well Completion Log

3.04' Casing Stick-up

8" Borehole.
4" Sch 40 PVC CASING
1' - 24.5' Cement and Bentonite Grout

24.5' - 27.5' Bentonite

27.5' Top of Sand

29.66' Top of Screen

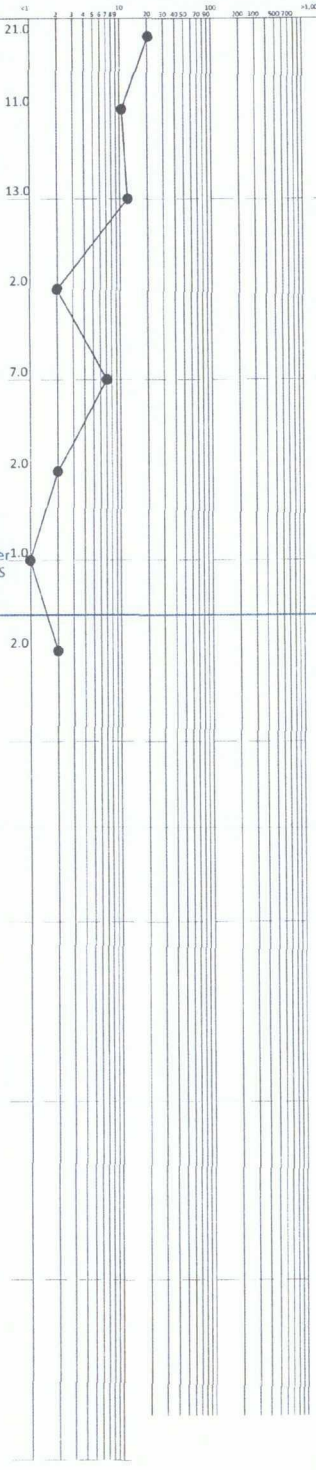
Groundwater ~33.83' BGS 4/14/10

8/16 Oglebay Norton Silica Sand Filter Pack

14.40' - 0.020 SLOTTED PVC SCREEN

CAP

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/14/2010, completed 4/14/2010.
Drilled with Air Rotary by Scarborough

SP - Yellowish Brown (10YR 3/4) silty clayey, very fine grained quartz sand, moist

GM - Pink (7.5YR 7/4) gravelly sand, very fine grained quartz sand, poorly sorted with gravel to 50mm, angular, fill material to approximately 4', wet

GP-SP - Pink (7.5YR 8/3 to 7/3) silty sand, very fine to medium grained quartz sand, poorly sorted, some gravel with pebbles to 20mm decreasing with depth, some clay between 7' and 10', increasing gravel below 18' with pebbles to 30mm, round

GW - Light Brown (7.5YR 6/4) sandy gravel, very fine to medium grained quartz sand, poorly sorted, with gravel and pebbles to 40mm, subround to angular, moist

SP- SM - Brown (7.5YR 5/4) silty clayey sand, very fine grained quartz sand, poorly sorted, some gravel near lower contact

ML - Light Yellowish Brown to Olive Yellow (2.5Y 6/3 to 6/6) sandy clayey silt, very fine grained quartz sand, firm, moist

TD at 44.63' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-15 (MW-14) Boring & Completion Log

JWW

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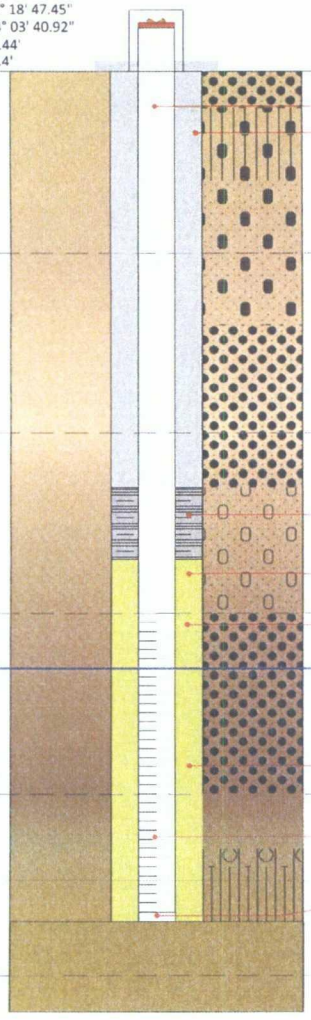
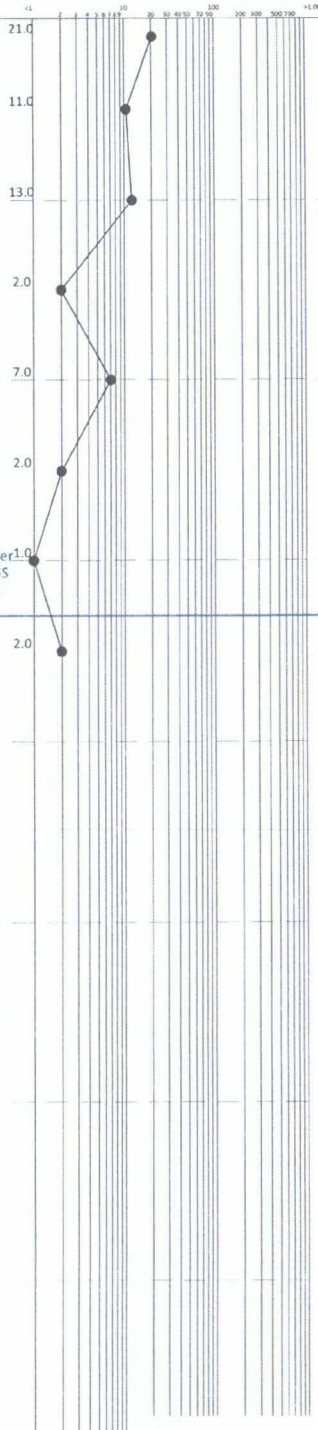
Latitude N 32° 18' 47.45"
Longitude W 104° 03' 40.92"
TOC Elevation : 3003.44'
TOC Elevation : 3000.4'



Well Completion Log

3.04' Casing Stick-up
8" Borehole.
4" Sch 40 PVC CASING
1' - 24.5' Cement and Bentonite Grout
24.5' - 27.5' Bentonite
27.5' Top of Sand
29.66' Top of Screen
Groundwater ~33.83' BGS 4/14/10
8/16 Oglebay Norton Silica Sand Filter Pack
14.40' - 0.020 SLOTTED PVC SCREEN
CAP

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/14/2010, completed 4/14/2010.
Drilled with Air Rotary by Scarborough

SP - Yellowish Brown (10YR 3/4) silty clayey, very fine grained quartz sand, moist

GM - Pink (7.5YR 7/4) gravelly sand, very fine grained quartz sand, poorly sorted with gravel to 50mm, angular, fill material to approximately 4', wet

GP-SP - Pink (7.5YR 8/3 to 7/3) silty sand, very fine to medium grained quartz sand, poorly sorted, some gravel with pebbles to 20mm decreasing with depth, some clay between 7' and 10', increasing gravel below 18' with pebbles to 30mm, round

GW - Light Brown (7.5YR 6/4) sandy gravel, very fine to medium grained quartz sand, poorly sorted, with gravel and pebbles to 40mm, subround to angular, moist

SP- SM - Brown (7.5YR 5/4) silty clayey sand, very fine grained quartz sand, poorly sorted, some gravel near lower contact

ML - Light Yellowish Brown to Olive Yellow (2.5Y 6/3 to 6/6) sandy clayey silt, very fine grained quartz sand, firm, moist

TD at 44.63' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

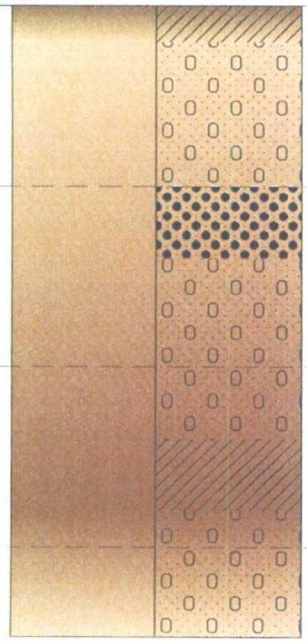
Larson & Associates, Inc.
Environmental Consultants

BH-15 (MW-14) Boring & Completion Log

JWW

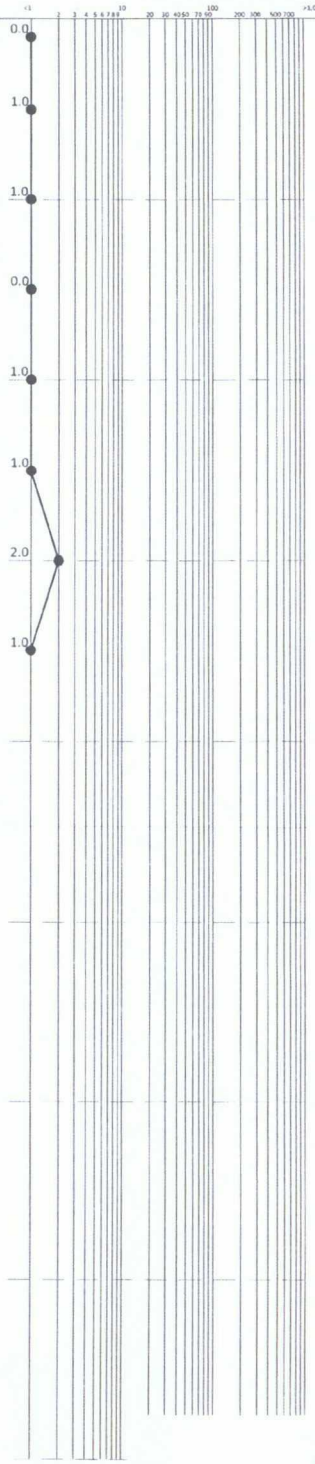
Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-16.dwg, 6/3/2010 10:01:56 AM

Latitude N 32° 18' 46.79"
Longitude W 104° 03' 41.60"
Ground Elevation : 3001.2'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/06/2010, completed 4/06/2010.
Drilled with Air Rotary by Scarborough

CL - Brown (10YR 5/3) very fine grained quartz sand, dry, weak

GW - Pink (7.5YR 8/4) conglomerate, very fine grained quartz sand interbedded with cobbles, very hard from 3' to 10' feet

SP-GW - Pink (7.5YR 8/4) silty sand, very fine grained quartz sand, 30mm gravel pebbles below 13'

GW- Pink (7.5YR 8/4) gravelly sand, very fine to fine grained quartz sand with quartzite pebbles to 30mm, interbedded with silty clay

CL- Brown (7.5YR 5/6) sandy clay, very fine to fine grained quartz sand, blocky, moist, low plasticity

GW- Pink (7.5YR 8/4) gravelly sand, very fine to fine grained quartz sand with quartzite pebbles to 20mm, some clay Pale Yellow (2.5YR 7/3), below 30'

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-16 Boring Log

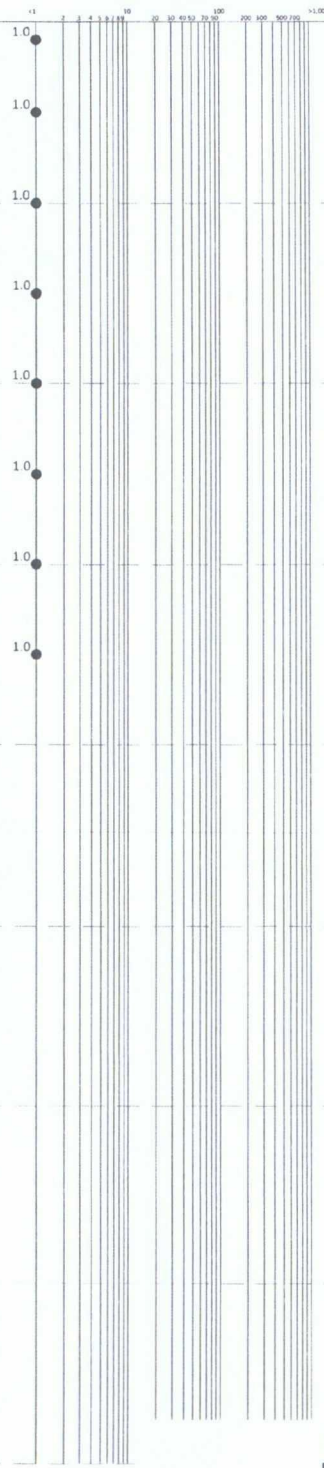
JWW

Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-17.dwg, 6/3/2010 10:19:13 AM

Latitude N 32° 18' 46.79"
Longitude W 104° 03' 40.73"
Ground Elevation : 3000.6'

10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot (parts per million)



Lithologic Well Log

Drilling started 4/6/2010, completed 4/6/2010.
Drilled with Air Rotary by Scarborough

GW - Brown to Strong Brown (7.5YR 5/6 to 5/4) conglomerate, very fine grained quartz sand interbedded with cobbles, very hard from 2' to 8' feet

SP- Pink (7.5YR 8/3) silty sand, very fine grained quartz sand, poorly sorted, moist at 20', loose

GW- Pale to Very Pale Brown (10YR 7/4 to 6/3) gravelly clayey sand, fine to very fine quartz sand with quartzite pebbles to 40mm, some clay, slightly moist

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

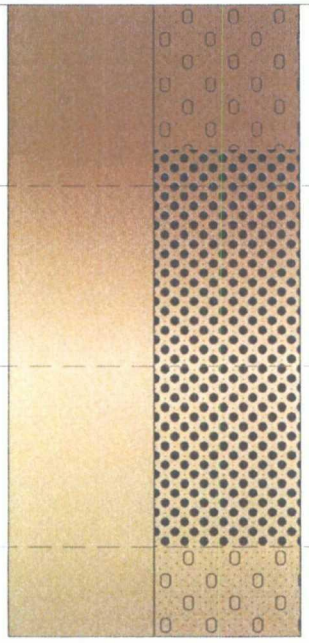
Larson & Associates, Inc.
Environmental Consultants

BH-17 Boring Log

JWW

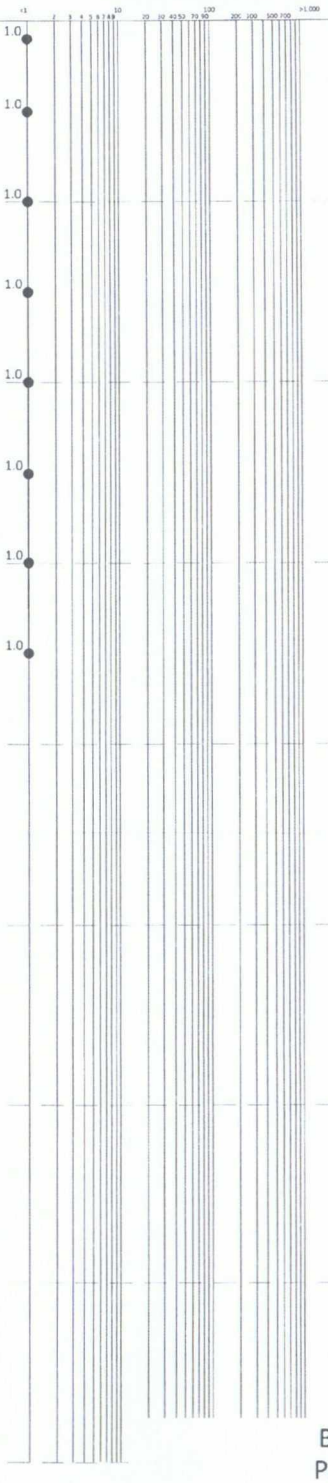
Y:\PROJECTS\BTA\Pardue C 1\Well & Boring Logs\BH-18.dwg, 6/3/2010 10:54:37 AM

Latitude N 32° 18' 46.37"
Longitude W 104° 03' 39.95"
Ground Elevation : 3000.5'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/06/2010, completed 4/06/2010.
Drilled with Air Rotary by Scarborough

CL - Brown (10YR 4/3) silty clay, very fine grained quartz sand, dry, weak

GW - Pink (7.5YR 7/4) conglomerate, very fine grained quartz sand, interbedded with cobbles from 3' to 10', hard

SP-GW- Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, sand stone below 10', pebbles to 10mm below 15'

GW- Brown (7.5YR 5/4) gravelly clayey sand, very fine grained quartz sand, quartzite pebbles to 40mm, moderately stiff clay, Light Brown (7.5YR 5/4) below 32', fine to medium grained quartz sand with gravel

TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

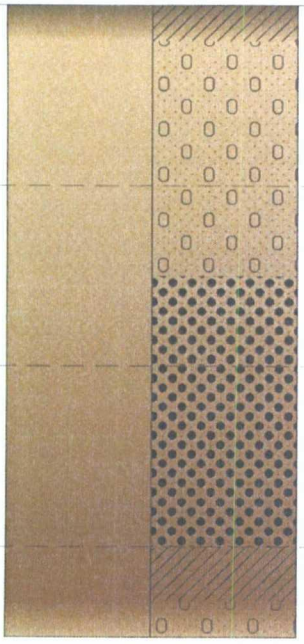
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

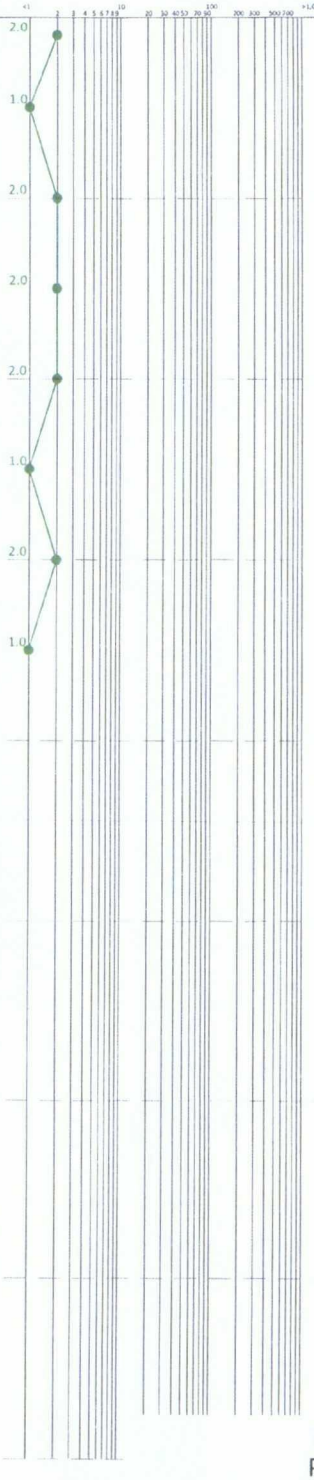
BH-18 Boring Log

Latitude N 32° 18' 46.78"
Longitude W 104° 03' 39.95"
Ground Elevation : 2999.6'



10' bgs
20' bgs
30' bgs
40' bgs
50' bgs
60' bgs
70' bgs
80' bgs

PID Response Log Plot
(parts per million)



Lithologic Well Log

Drilling started 4/06/2010, completed 4/06/2010.
Drilled with Air Rotary by Scarborough

CL - Dark to Yellowish Brown (10YR 4/4 to 4/3) silty clay, very fine grained quartz sand, dry, weak
GW - Pink (7.5YR 7/3) conglomerate, very fine grained quartz sand, poorly sorted, interbedded with cobbles from 3' to 15', indurated, hard

SP- Light Brown (7.5YR 6/4) silty sand, very fine grained quartz sand, sand stone below 15', poorly sorted, loose to moderately well cemented

CL- Yellowish Red (5YR 4/6) silty sandy clay, very fine grained quartz sand, blocky, moderately stiff with low plasticity
GW- Brown to Light Brown (7.5YR 6/4 to 5/4) gravelly sand, very fine grained quartz sand with quartzite pebbles to 30mm
TD at 35' BGS

BTA Oil Producers
Pardue "C" JV-P #1
Unit N, Sec. 11, T-23-S, R-28-E

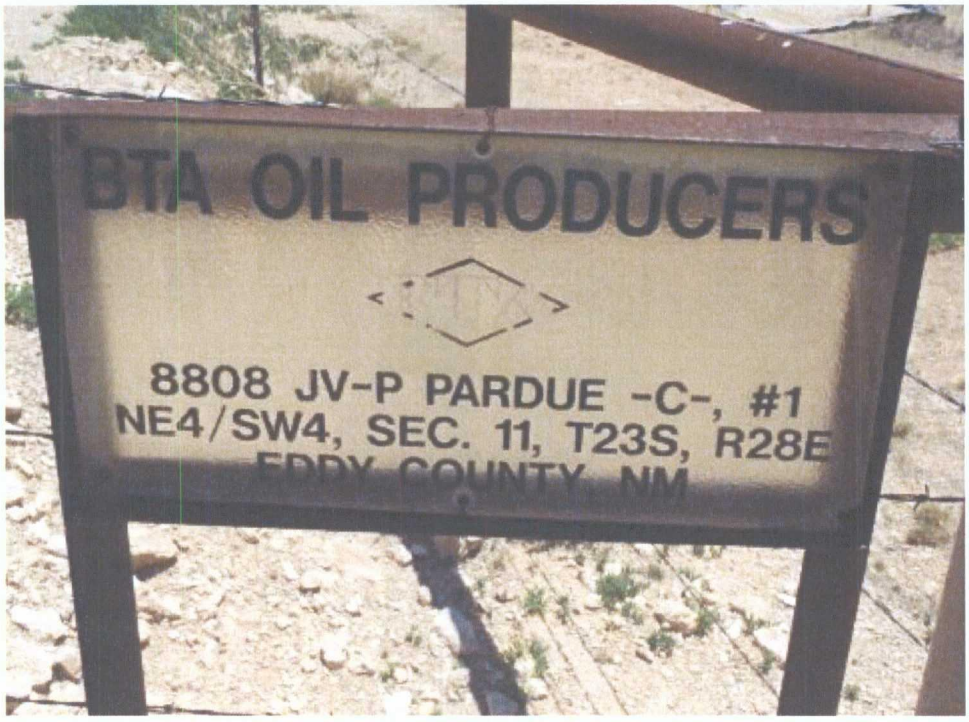
Eddy County, New Mexico

N 32° 18' 46.39"
W 104° 3' 39.92"

Larson & Associates, Inc.
Environmental Consultants

BH-19 Boring Log

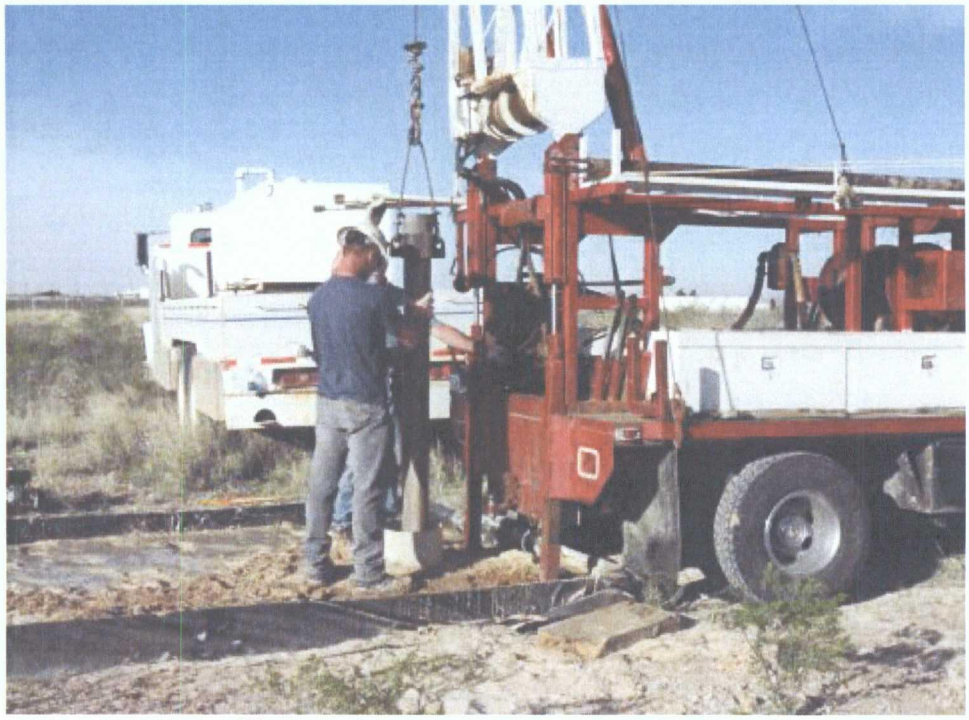
Photo Documentation



Location Sign

Drilling at BH-9 Looking Northeast

Photo Documentation



Installing Conductor Casing at BH-9 Looking South

Grouting Conductor Casing at BH-9 Looking Southwest

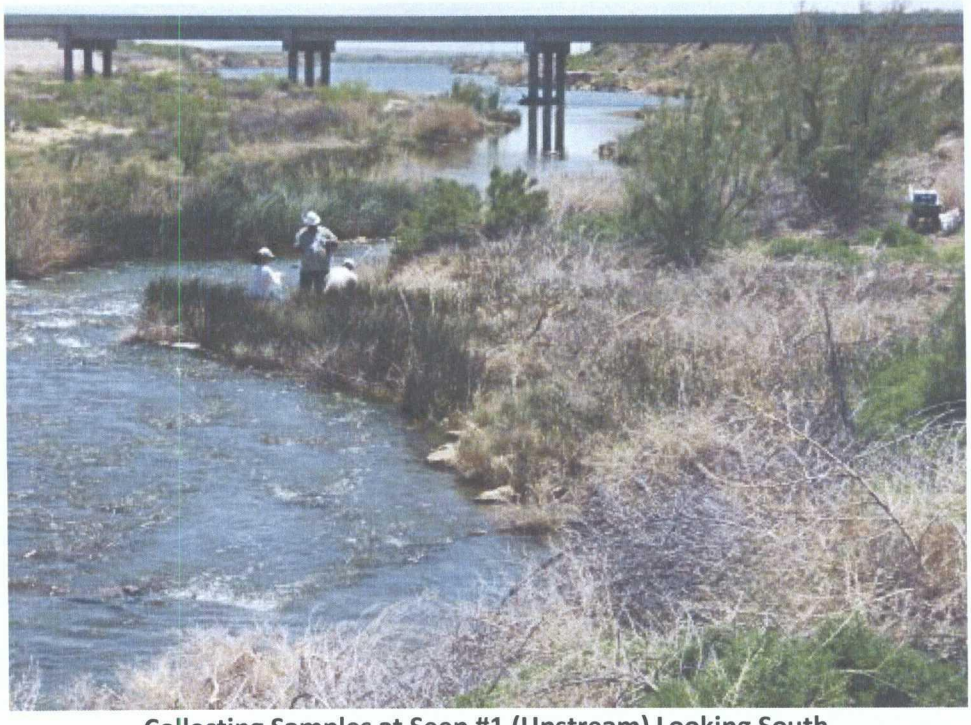
Photo Documentation

Installing Monitoring Well MW-14 Looking West

Boring BH-16 Looking East

Photo Documentation

Monitoring Wells MW-10 (Foreground) and MW-14 (Background) Looking West



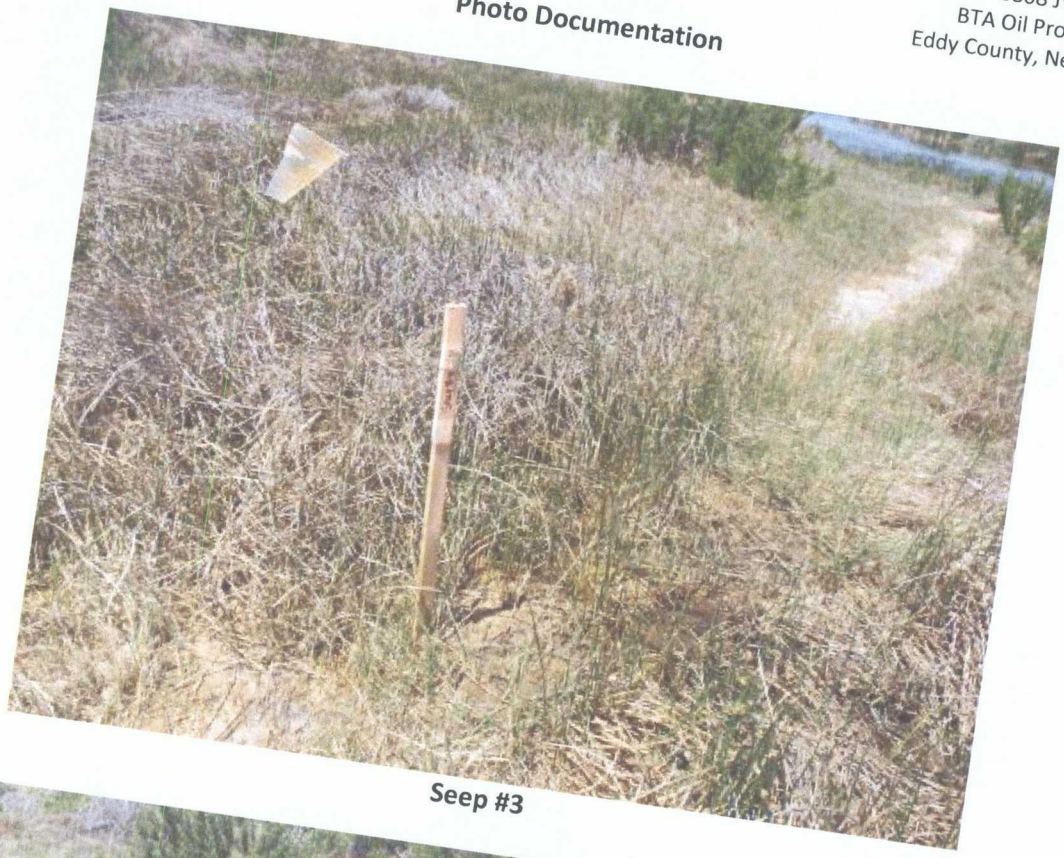
Collecting Samples at Seep #1 (Upstream) Looking South

Photo Documentation

Seep #1 (Upstream)

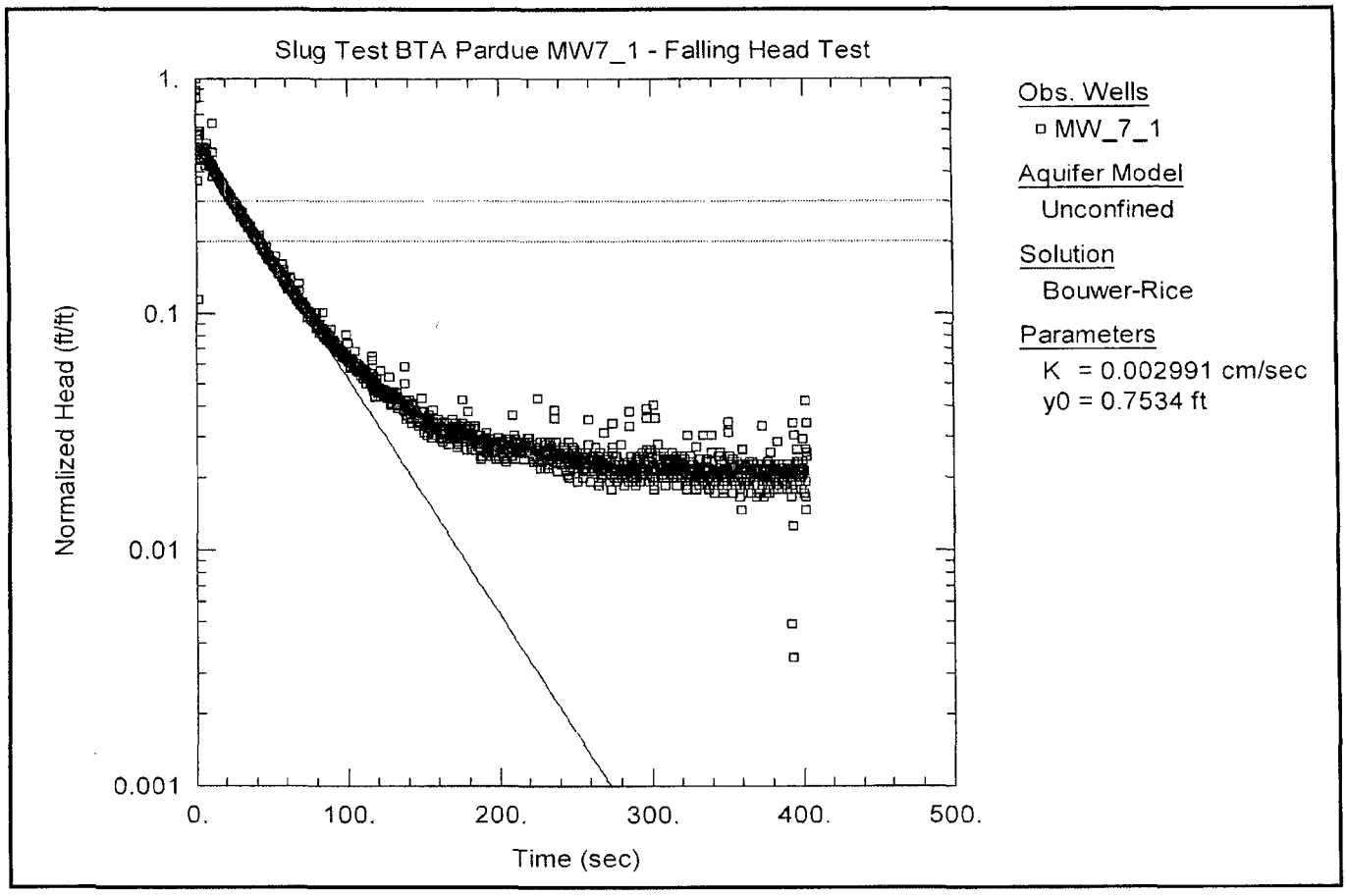
Seep #2

Photo Documentation



Seep #3

Seep #4 (Downstream)



PROJECT INFORMATION

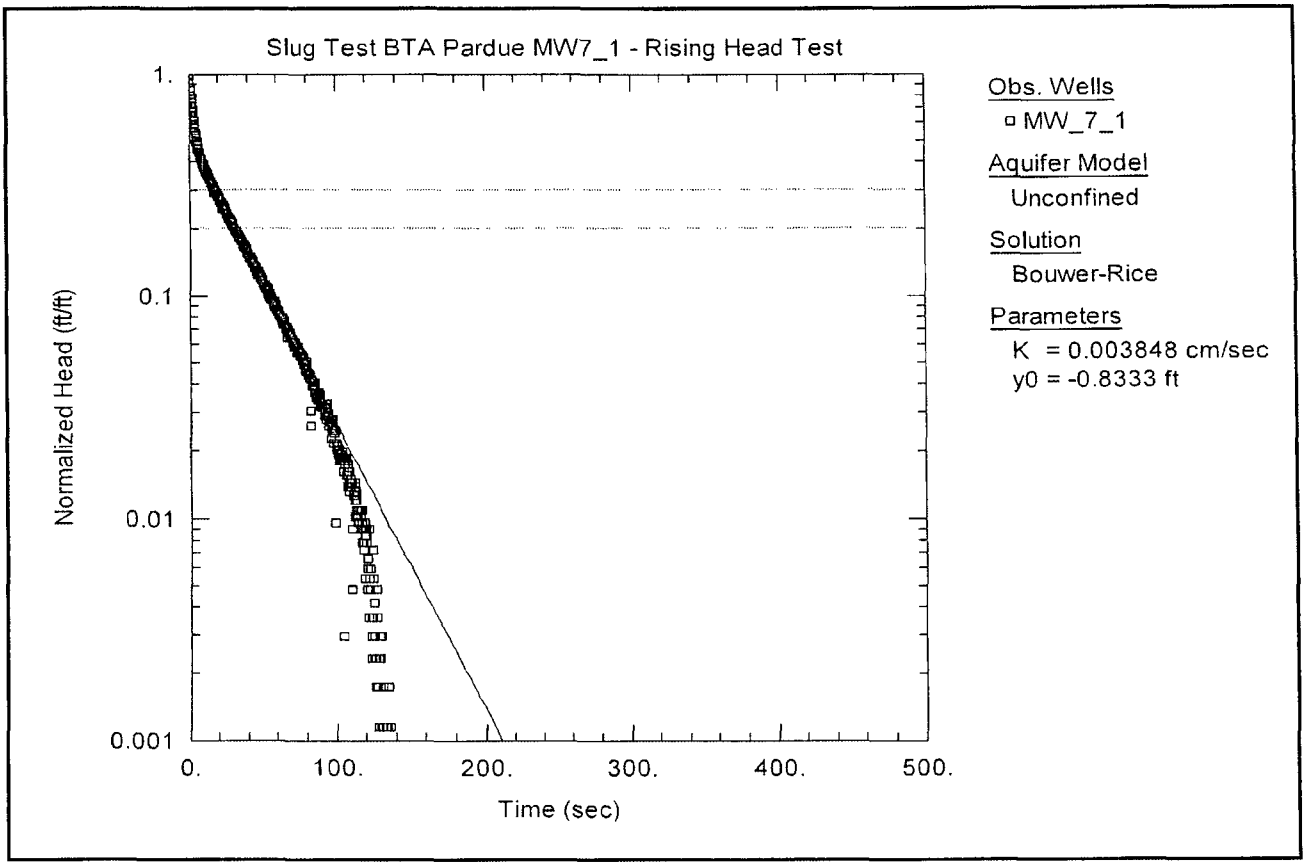
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-7

AQUIFER DATA

Saturated Thickness: 29.69 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.456 ft
Static Water Column Height: 12.05 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

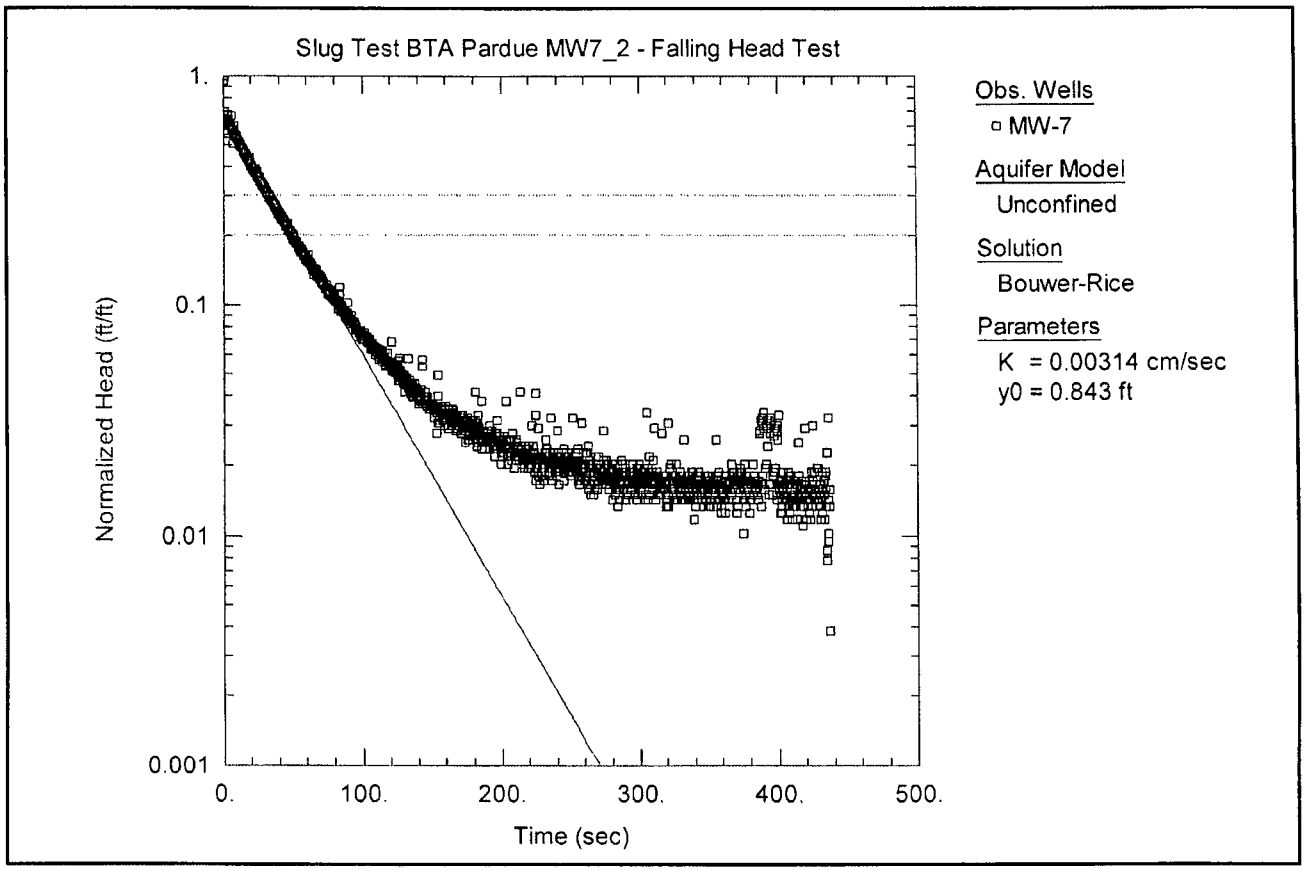
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-7

AQUIFER DATA

Saturated Thickness: 29.69 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.657 ft
Static Water Column Height: 12.05 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

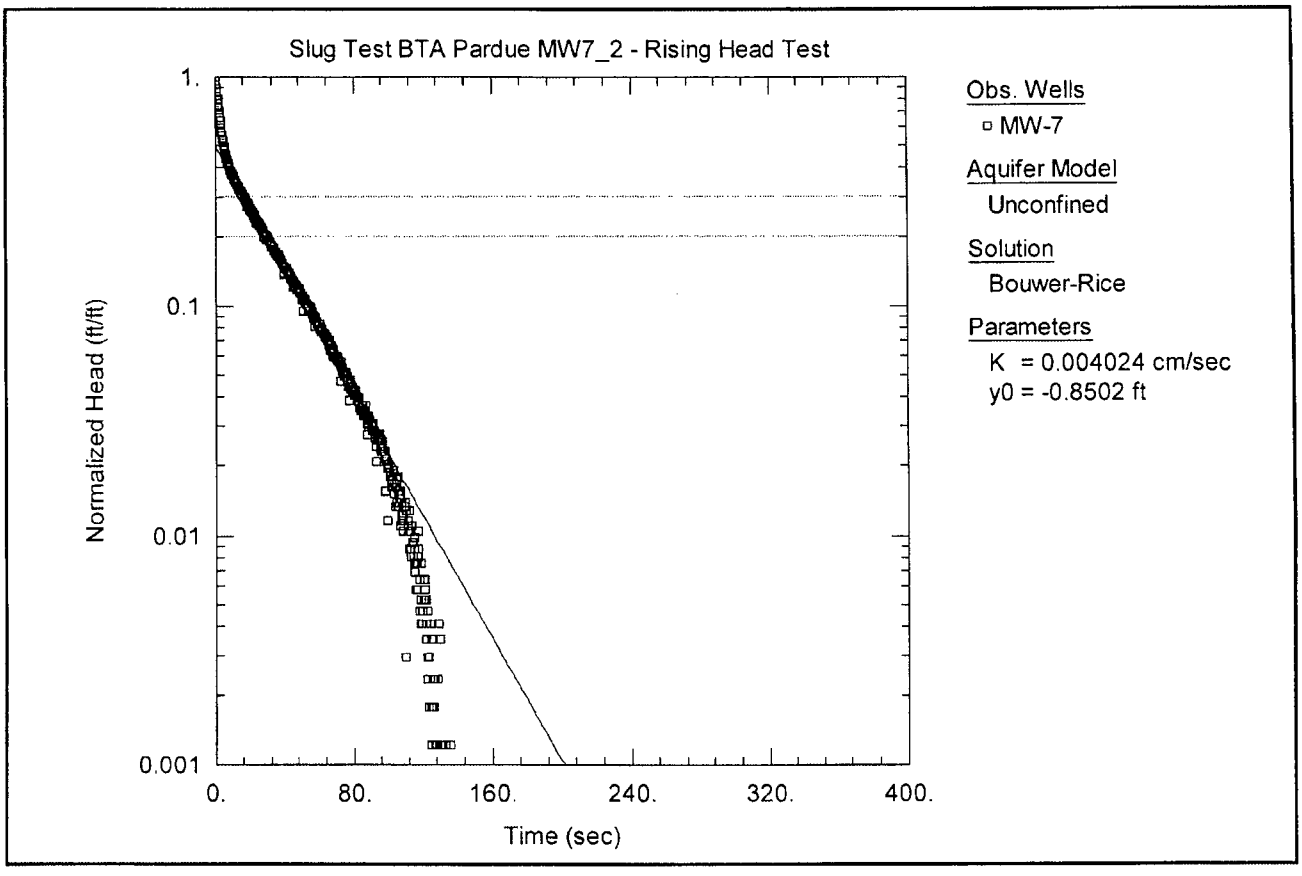
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-7

AQUIFER DATA

Saturated Thickness: 29.69 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.266 ft
Static Water Column Height: 12.05 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

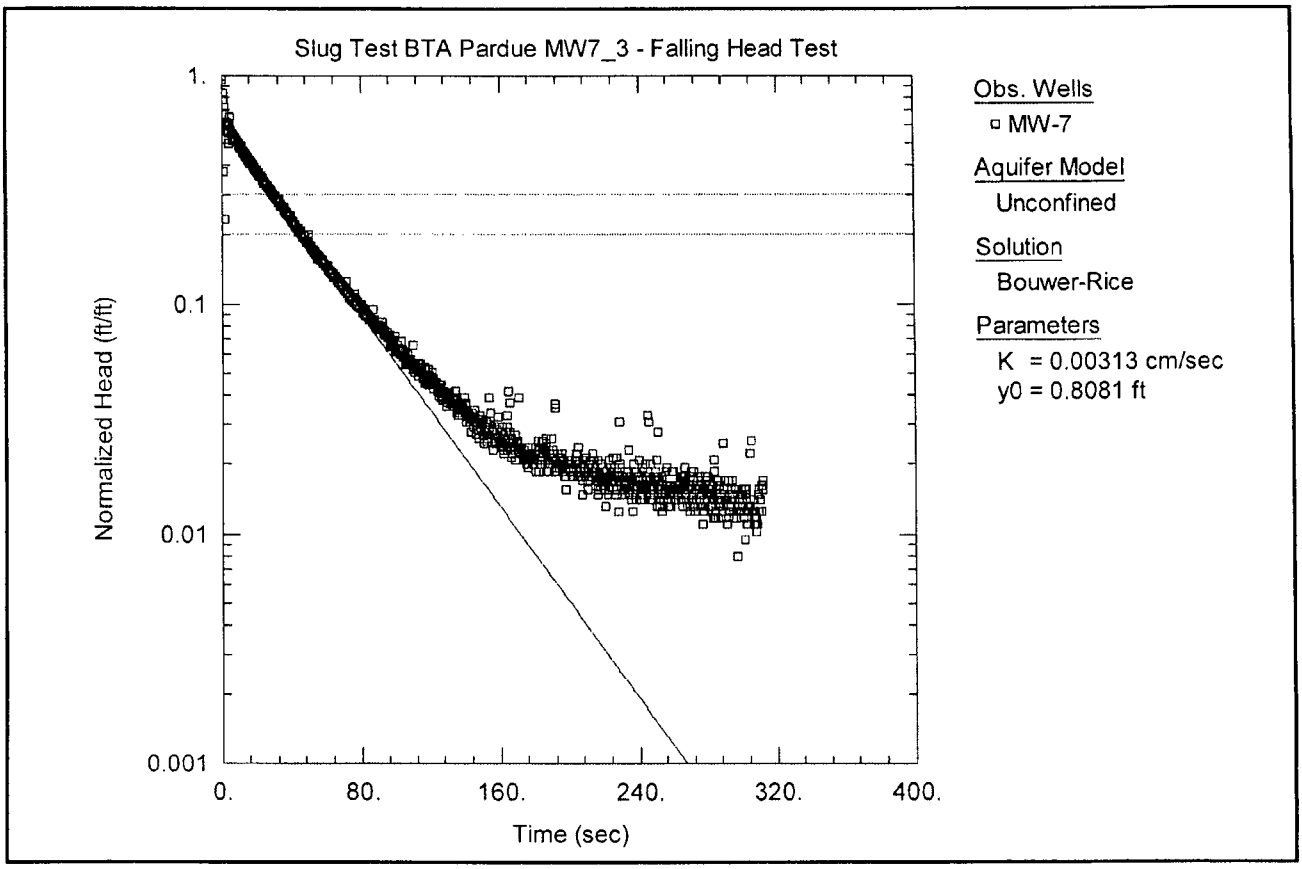
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-7

AQUIFER DATA

Saturated Thickness: 29.69 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.732 ft
Static Water Column Height: 12.05 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

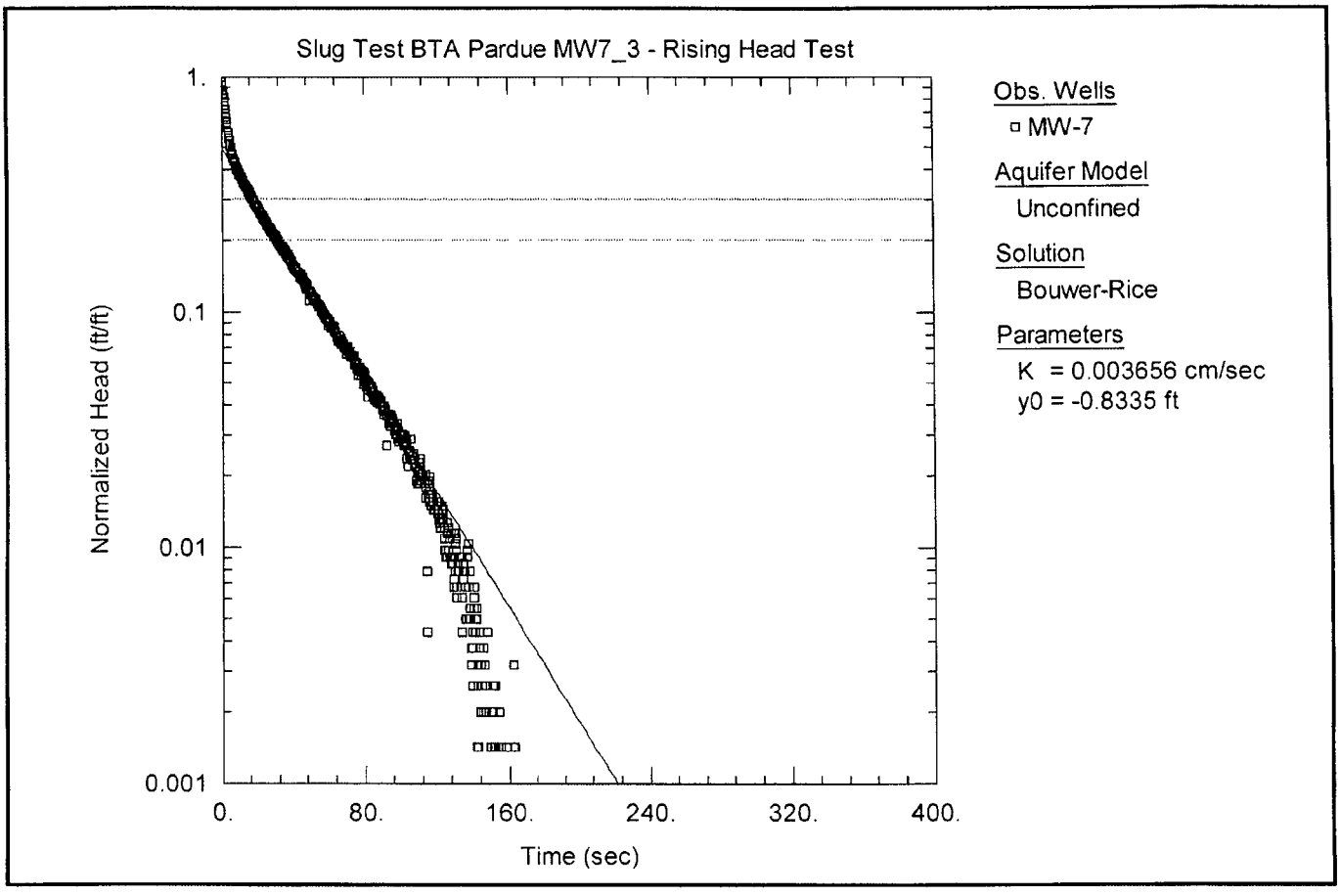
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-7

AQUIFER DATA

Saturated Thickness: 29.69 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.329 ft
Static Water Column Height: 12.05 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

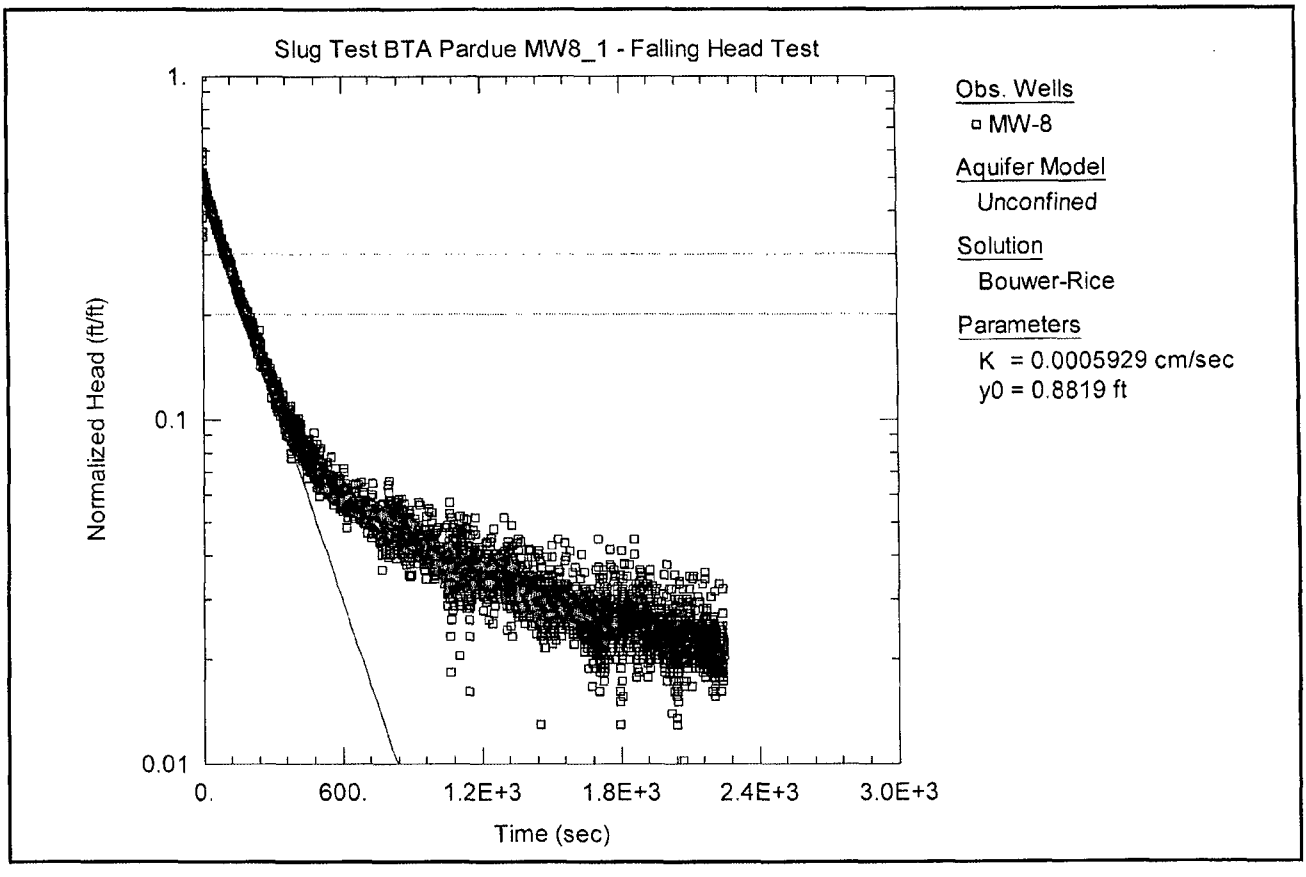
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-7

AQUIFER DATA

Saturated Thickness: 29.69 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.693 ft
Static Water Column Height: 12.05 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

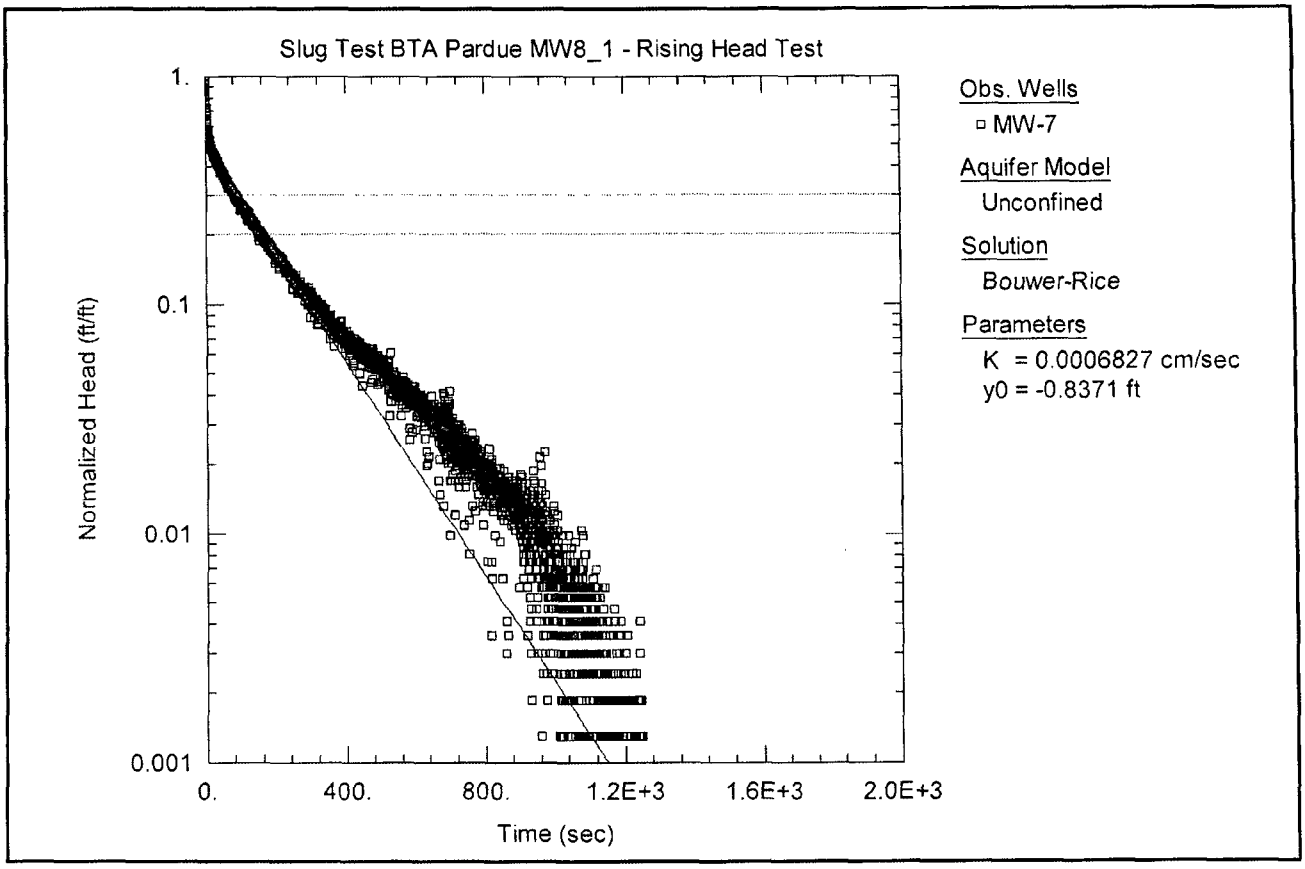
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-8

AQUIFER DATA

Saturated Thickness: 29.76 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.832 ft
Static Water Column Height: 12.49 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.49 ft
Total Well Penetration Depth: 12.49 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

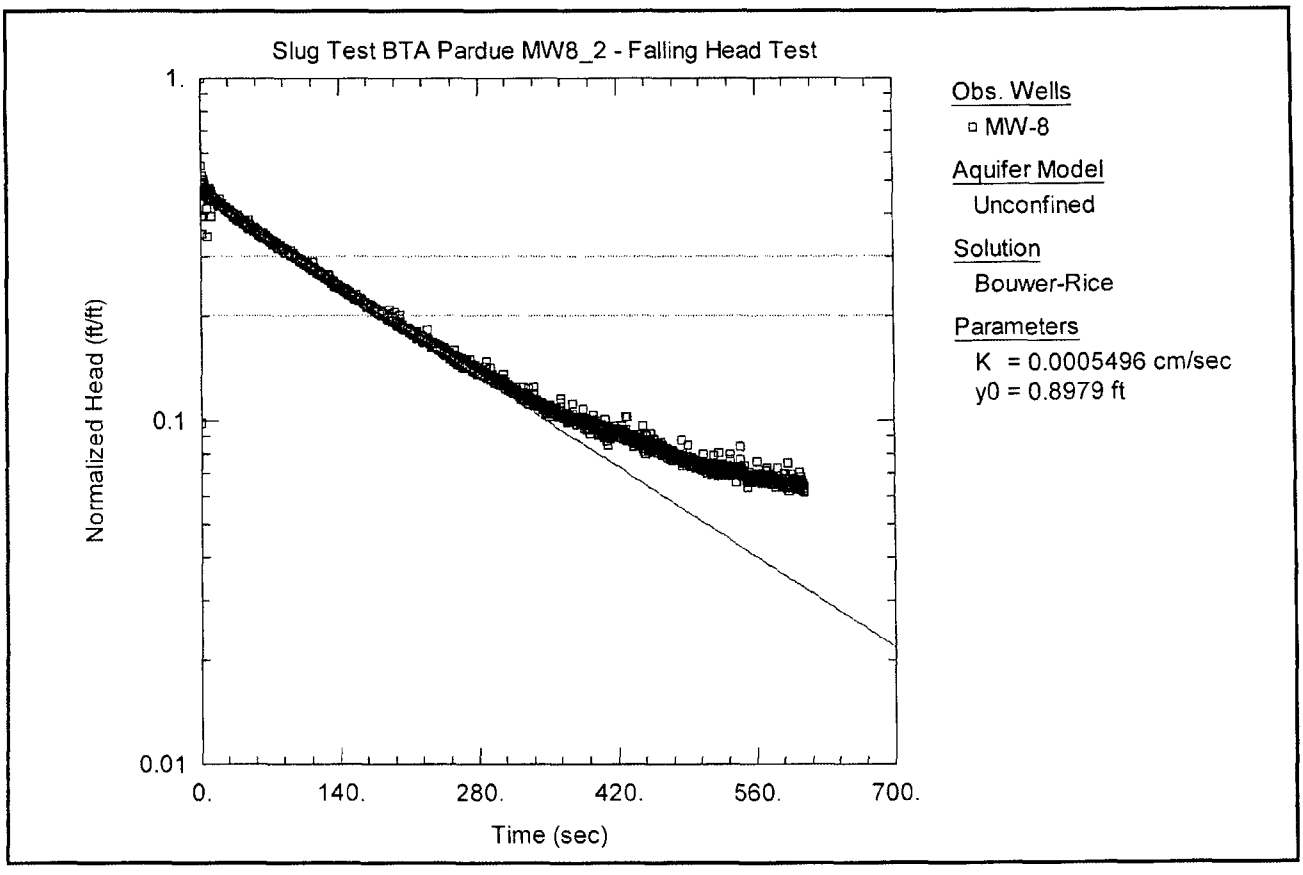
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-8

AQUIFER DATA

Saturated Thickness: 29.76 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.774 ft
Static Water Column Height: 12.49 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.49 ft
Total Well Penetration Depth: 12.49 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

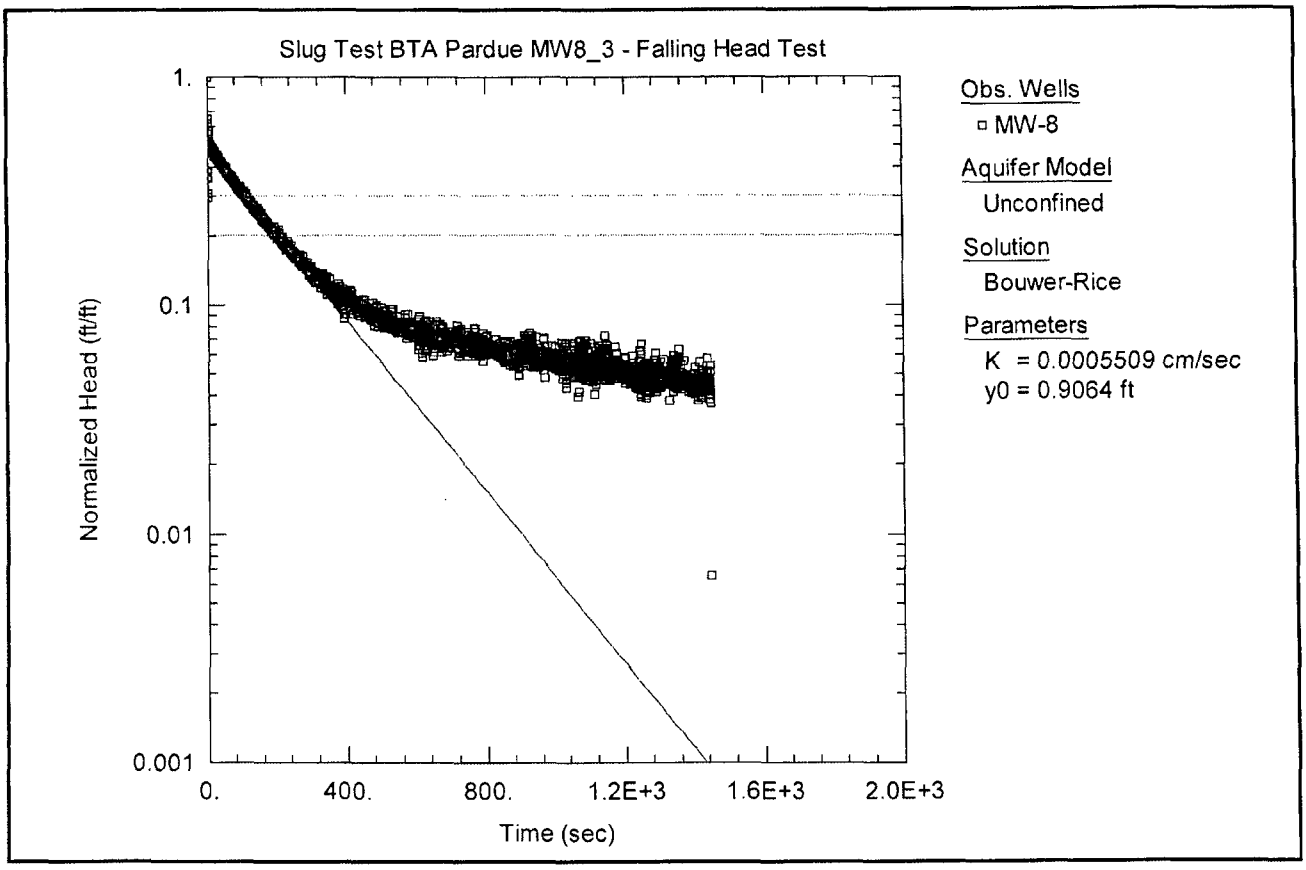
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-8

AQUIFER DATA

Saturated Thickness: 29.76 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.998 ft
Static Water Column Height: 12.49 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.49 ft
Total Well Penetration Depth: 12.49 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

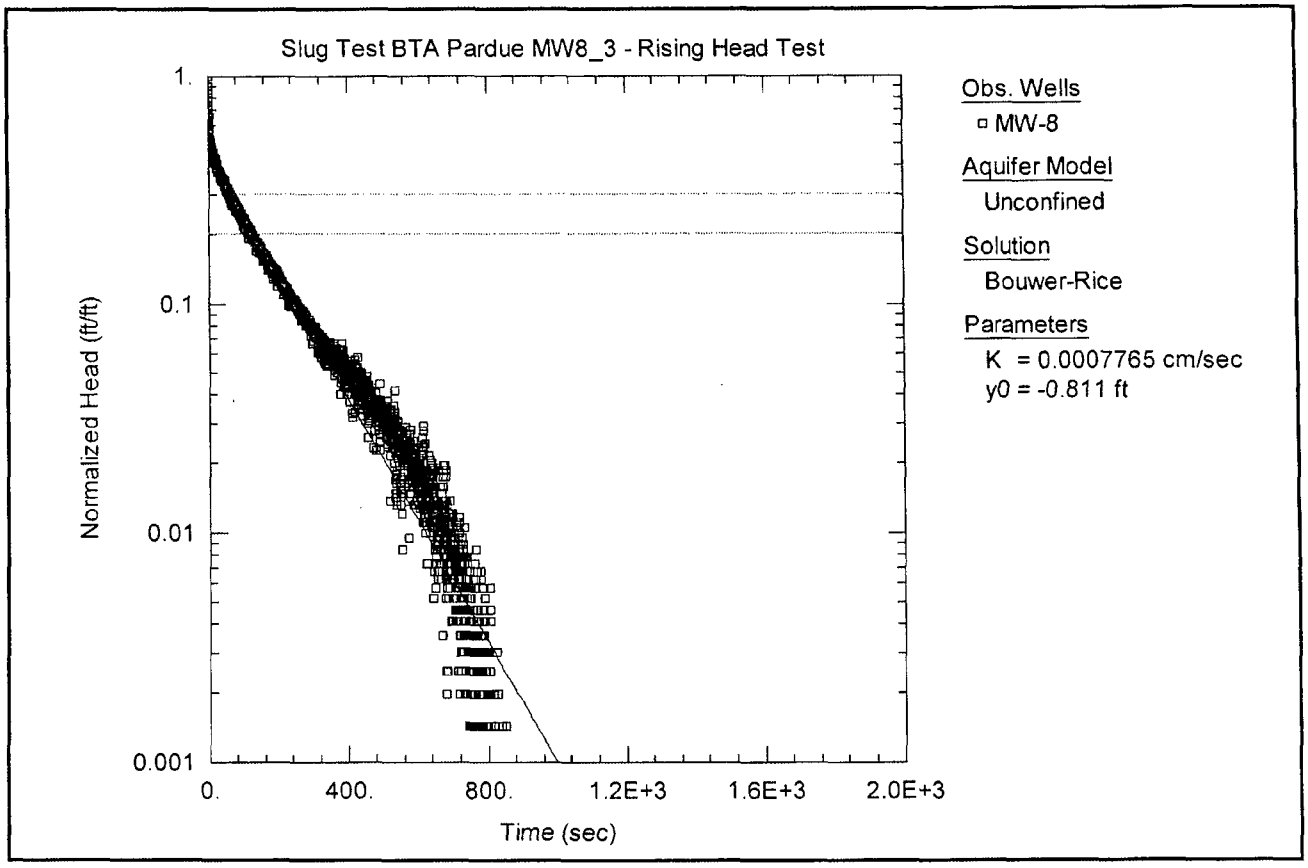
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-8

AQUIFER DATA

Saturated Thickness: 29.76 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.875 ft
Static Water Column Height: 12.49 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.49 ft
Total Well Penetration Depth: 12.49 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

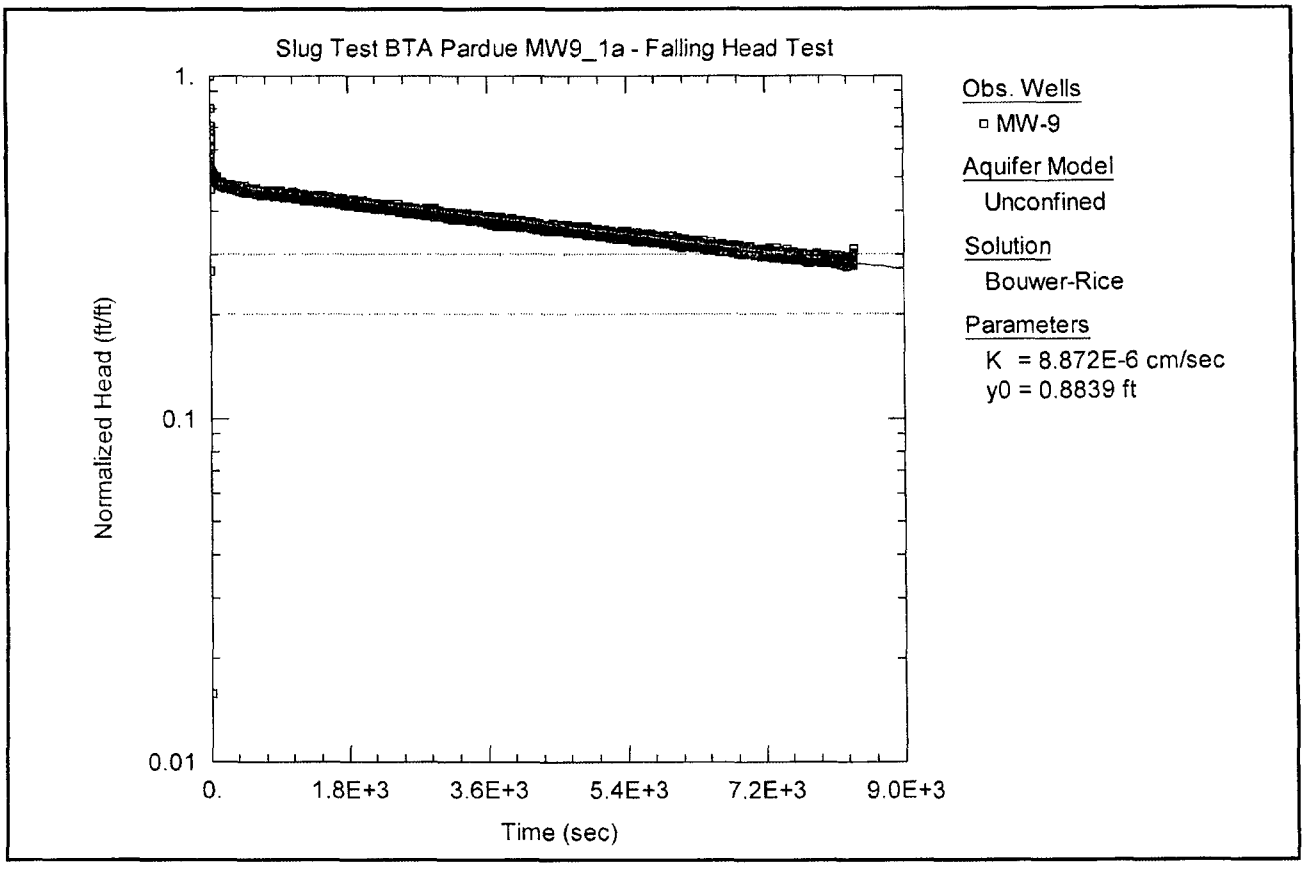
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-8

AQUIFER DATA

Saturated Thickness: 29.76 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.876 ft
Static Water Column Height: 12.49 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 12.49 ft
Total Well Penetration Depth: 12.49 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

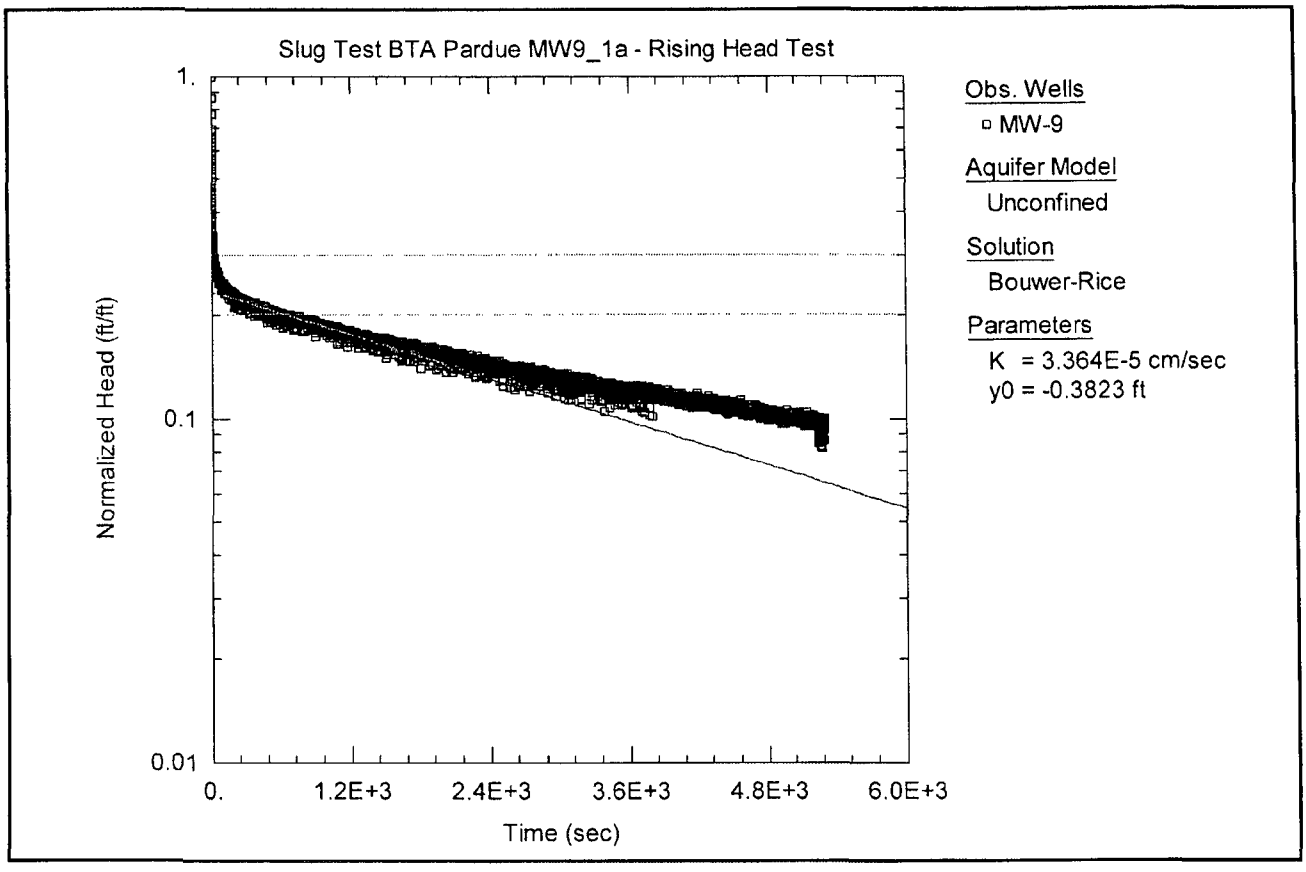
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-91a

AQUIFER DATA

Saturated Thickness: 29.24 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.833 ft
Static Water Column Height: 10.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.89 ft
Total Well Penetration Depth: 10.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

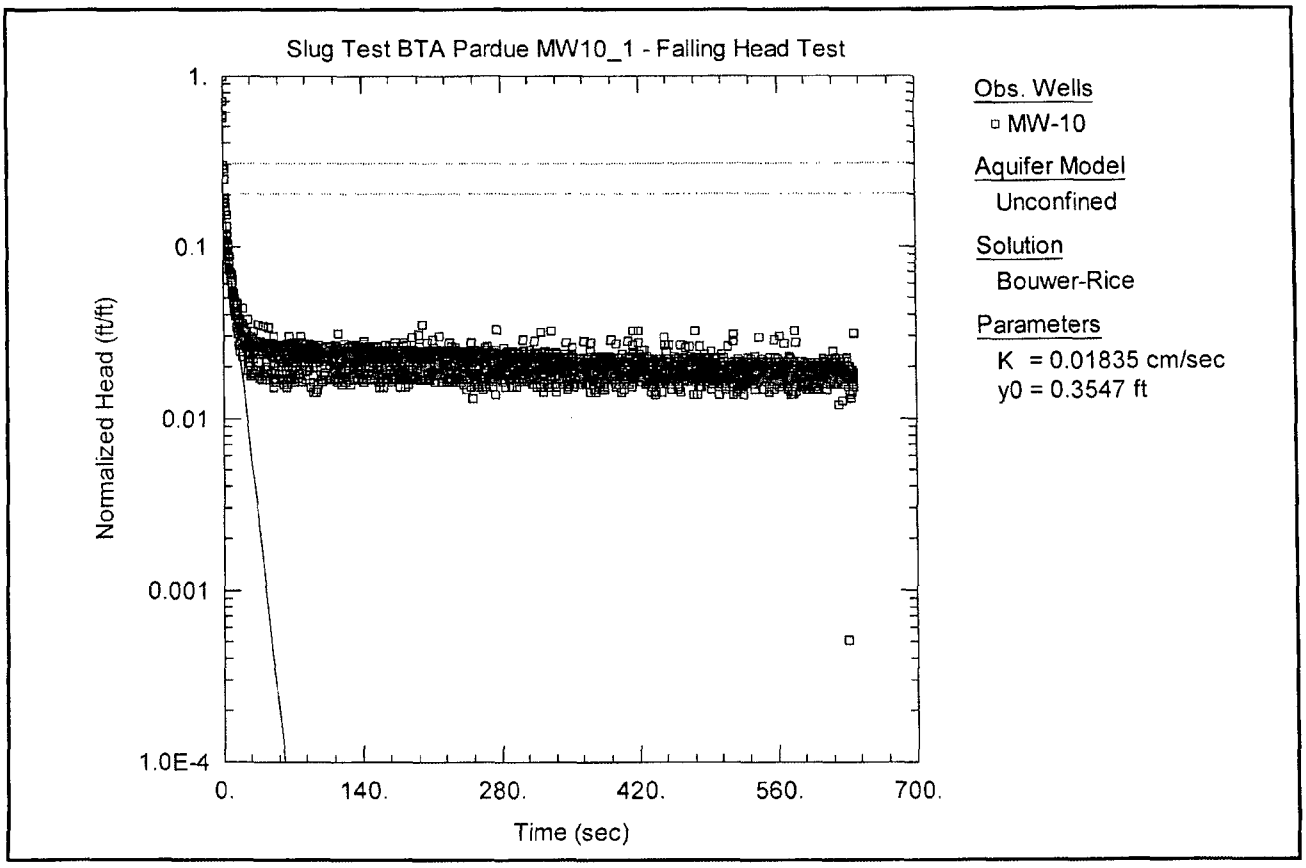
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-91a

AQUIFER DATA

Saturated Thickness: 29.24 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.632 ft
Static Water Column Height: 10.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.89 ft
Total Well Penetration Depth: 10.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

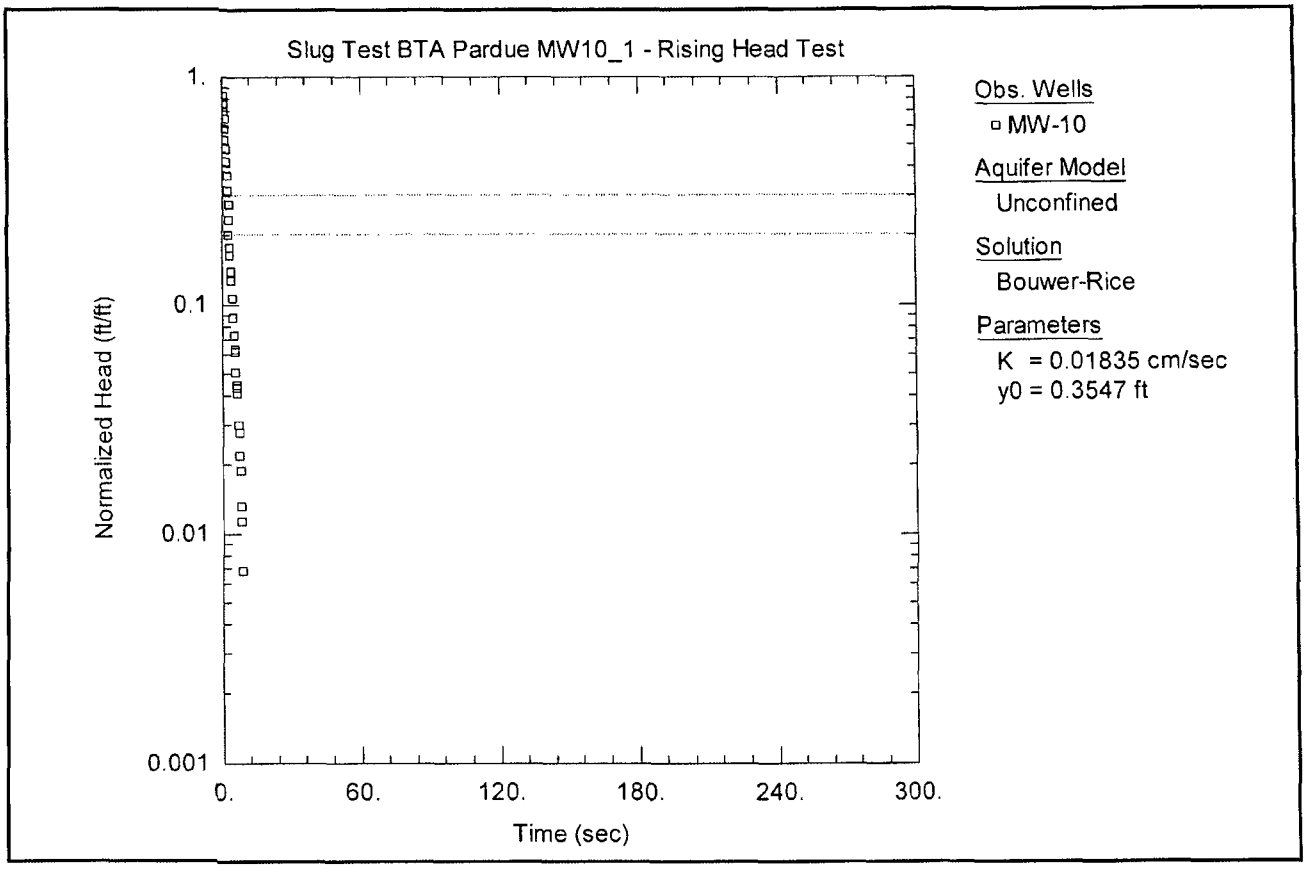
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-10

AQUIFER DATA

Saturated Thickness: 27.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.911 ft
Static Water Column Height: 9.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 9.69 ft
Total Well Penetration Depth: 9.69 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

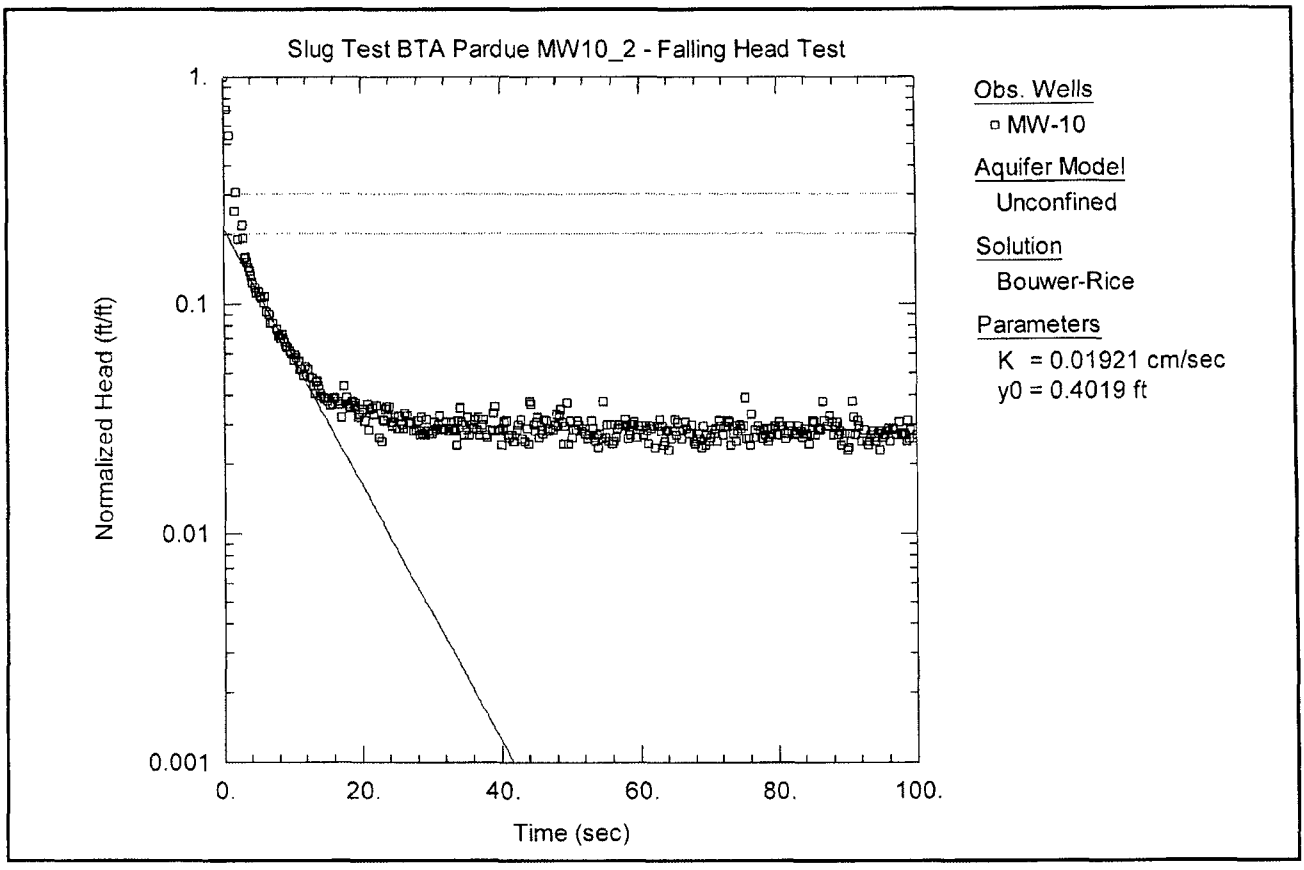
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-10

AQUIFER DATA

Saturated Thickness: 27.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.6 ft
Static Water Column Height: 9.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 9.69 ft
Total Well Penetration Depth: 9.69 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

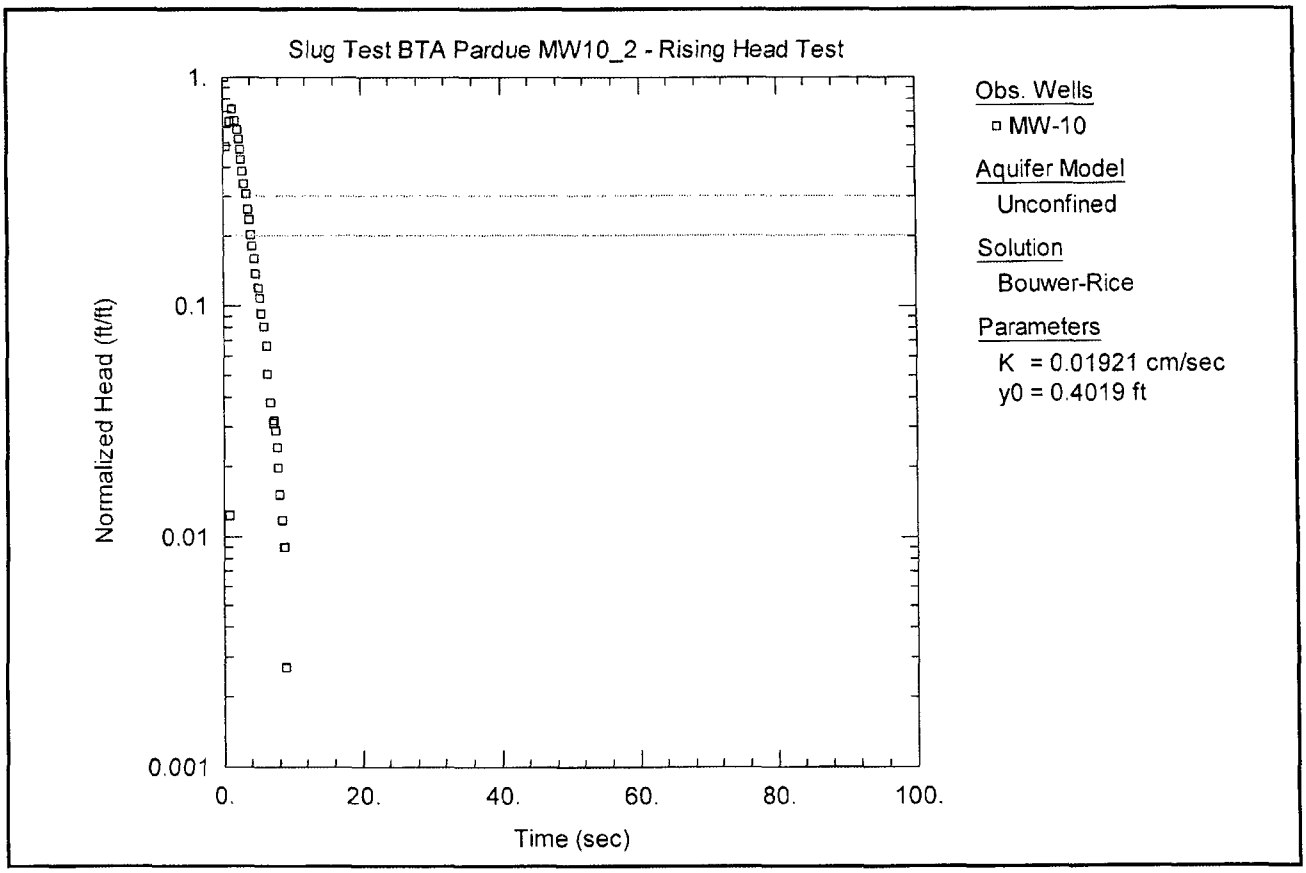
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-10

AQUIFER DATA

Saturated Thickness: 27.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.911 ft
Static Water Column Height: 9.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 9.69 ft
Total Well Penetration Depth: 9.69 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

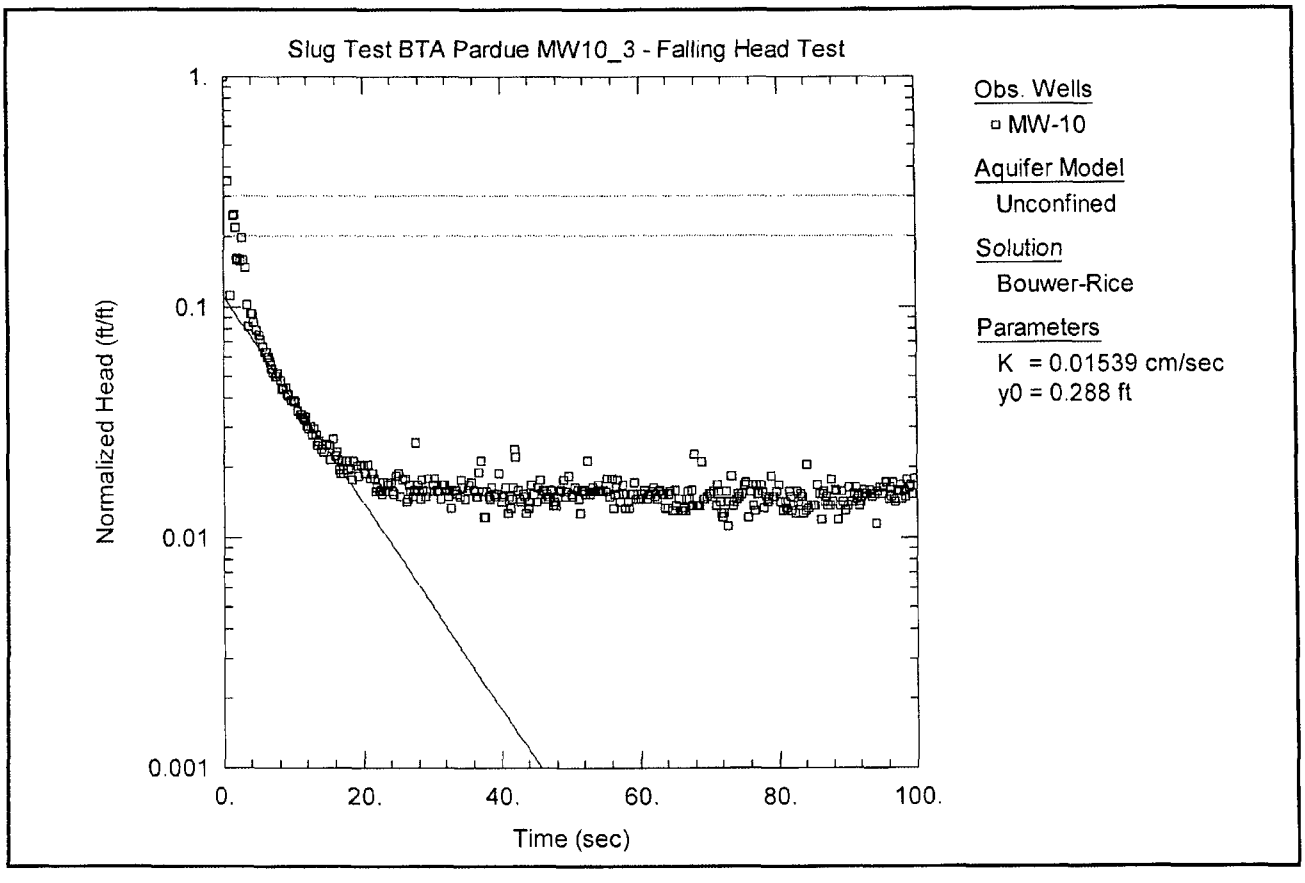
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-10

AQUIFER DATA

Saturated Thickness: 27.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.758 ft
Static Water Column Height: 9.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 9.69 ft
Total Well Penetration Depth: 9.69 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

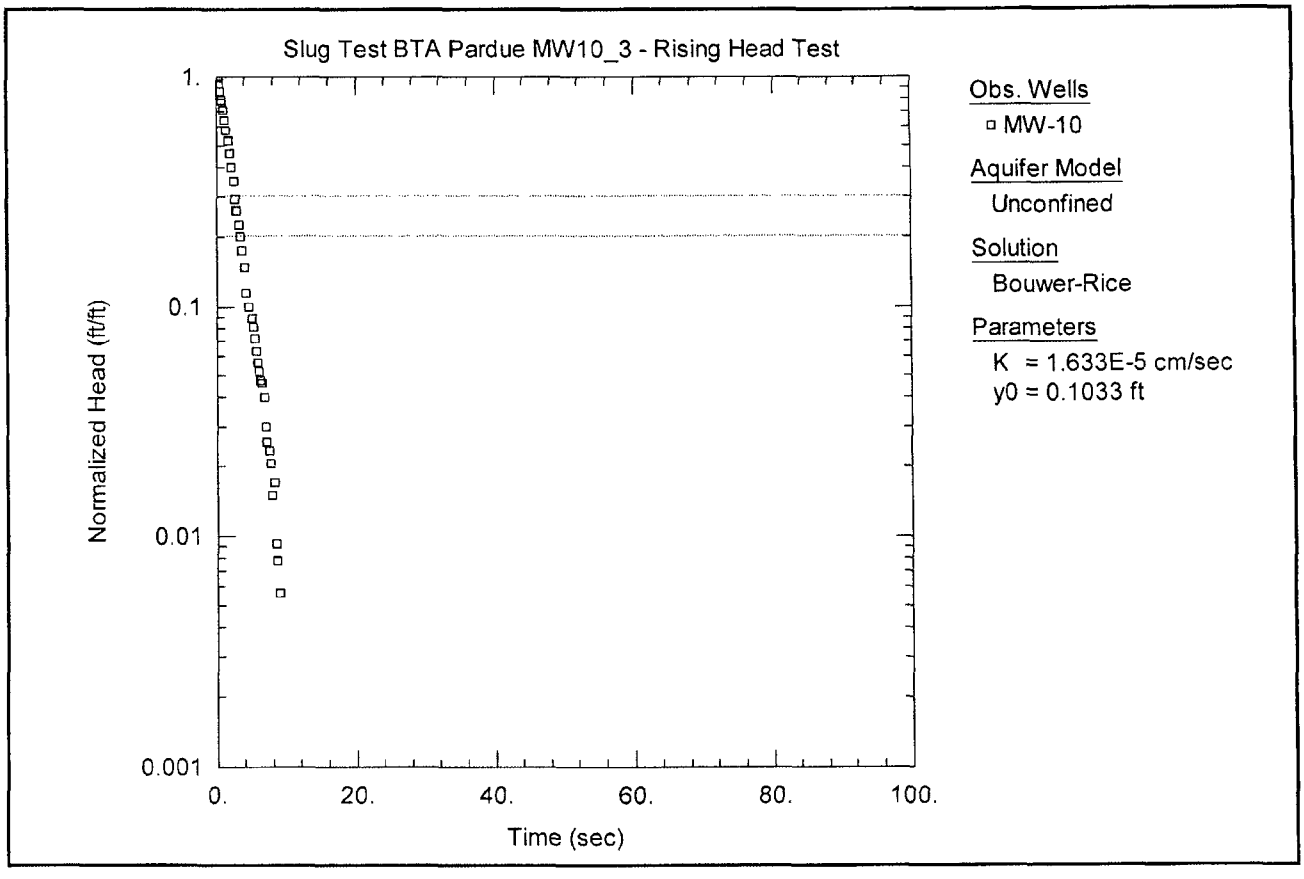
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-10

AQUIFER DATA

Saturated Thickness: 27.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 2.619 ft
Static Water Column Height: 9.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 9.69 ft
Total Well Penetration Depth: 9.69 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

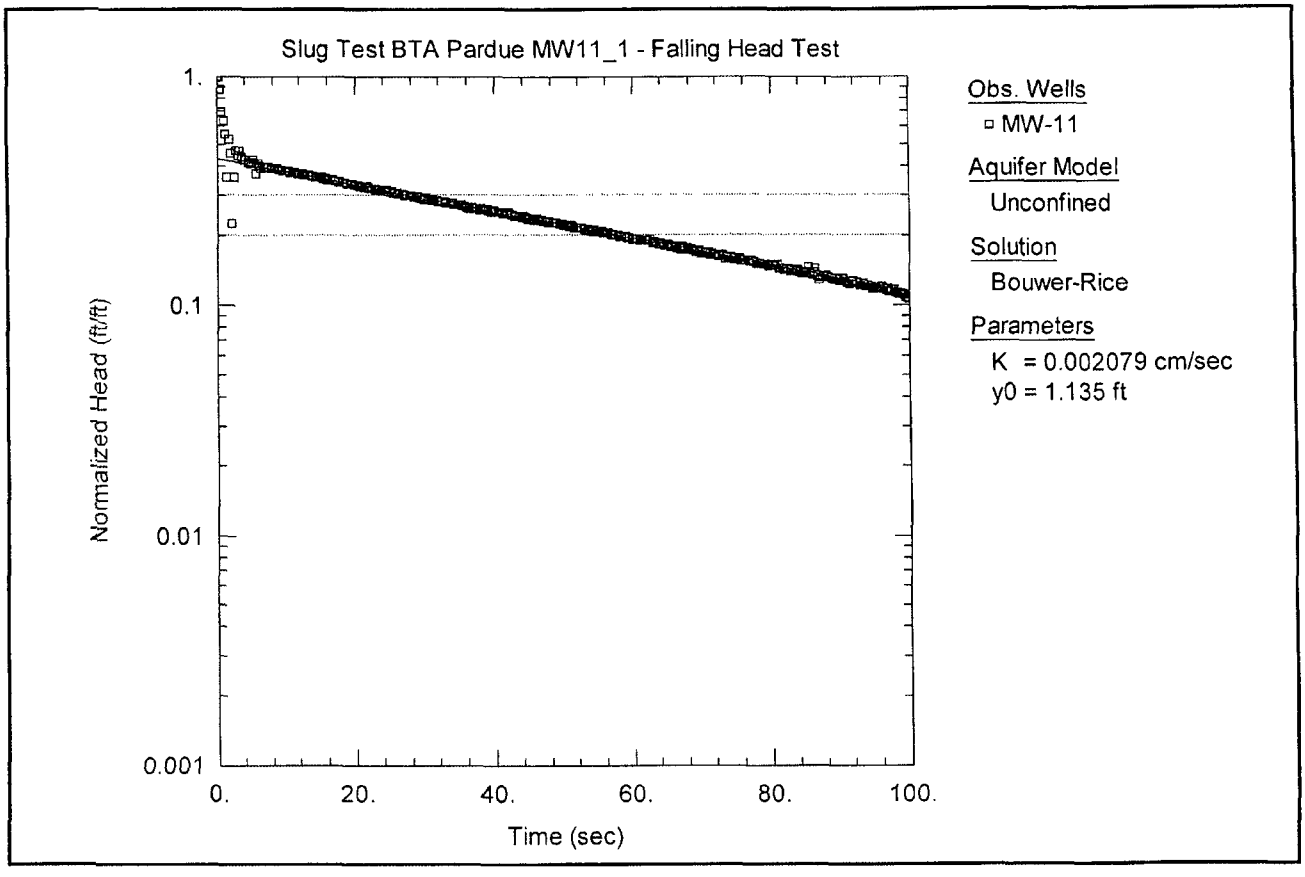
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-10

AQUIFER DATA

Saturated Thickness: 27.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.402 ft
Static Water Column Height: 9.69 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 9.69 ft
Total Well Penetration Depth: 9.69 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

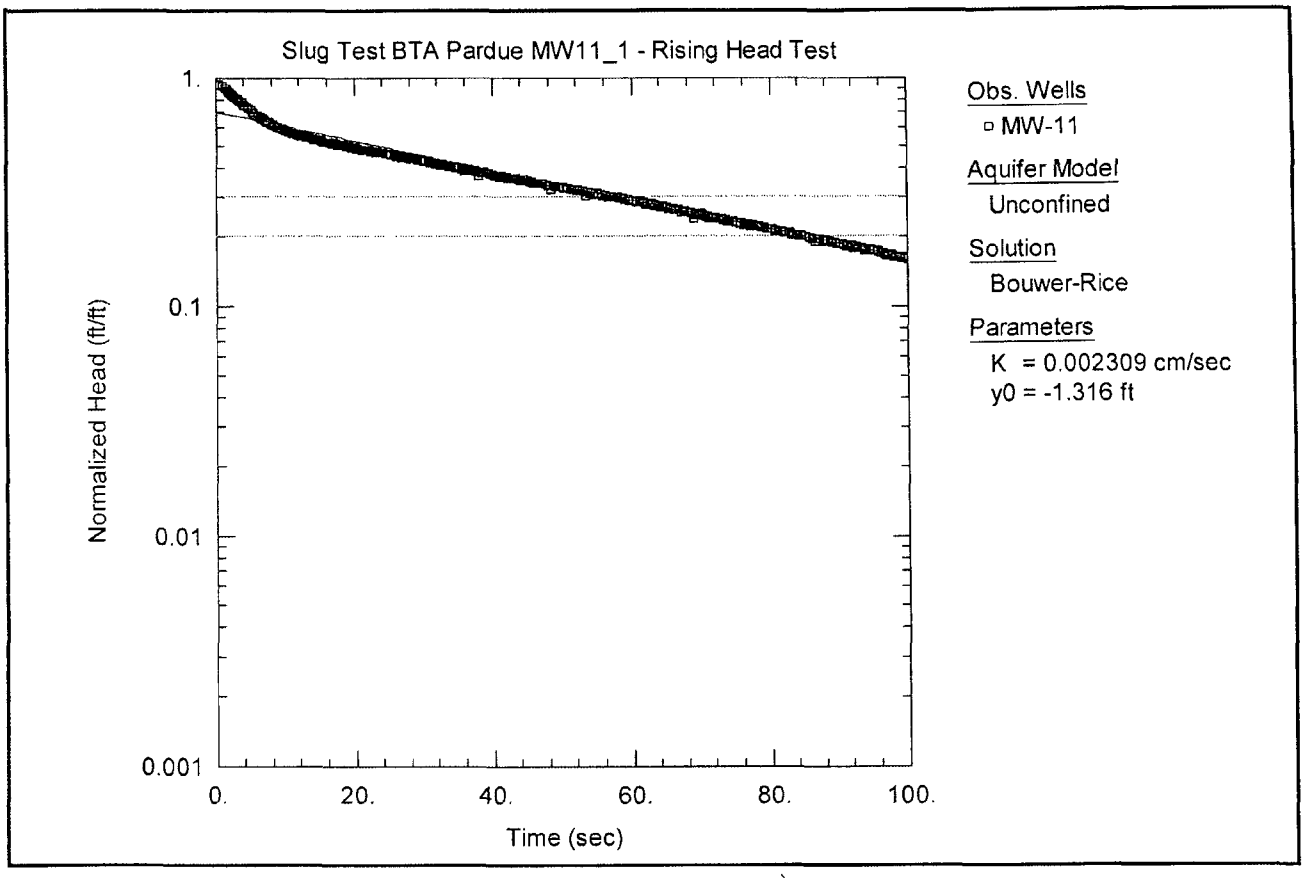
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-11

AQUIFER DATA

Saturated Thickness: 28.96 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 2.609 ft
Static Water Column Height: 8.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 8.89 ft
Total Well Penetration Depth: 8.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

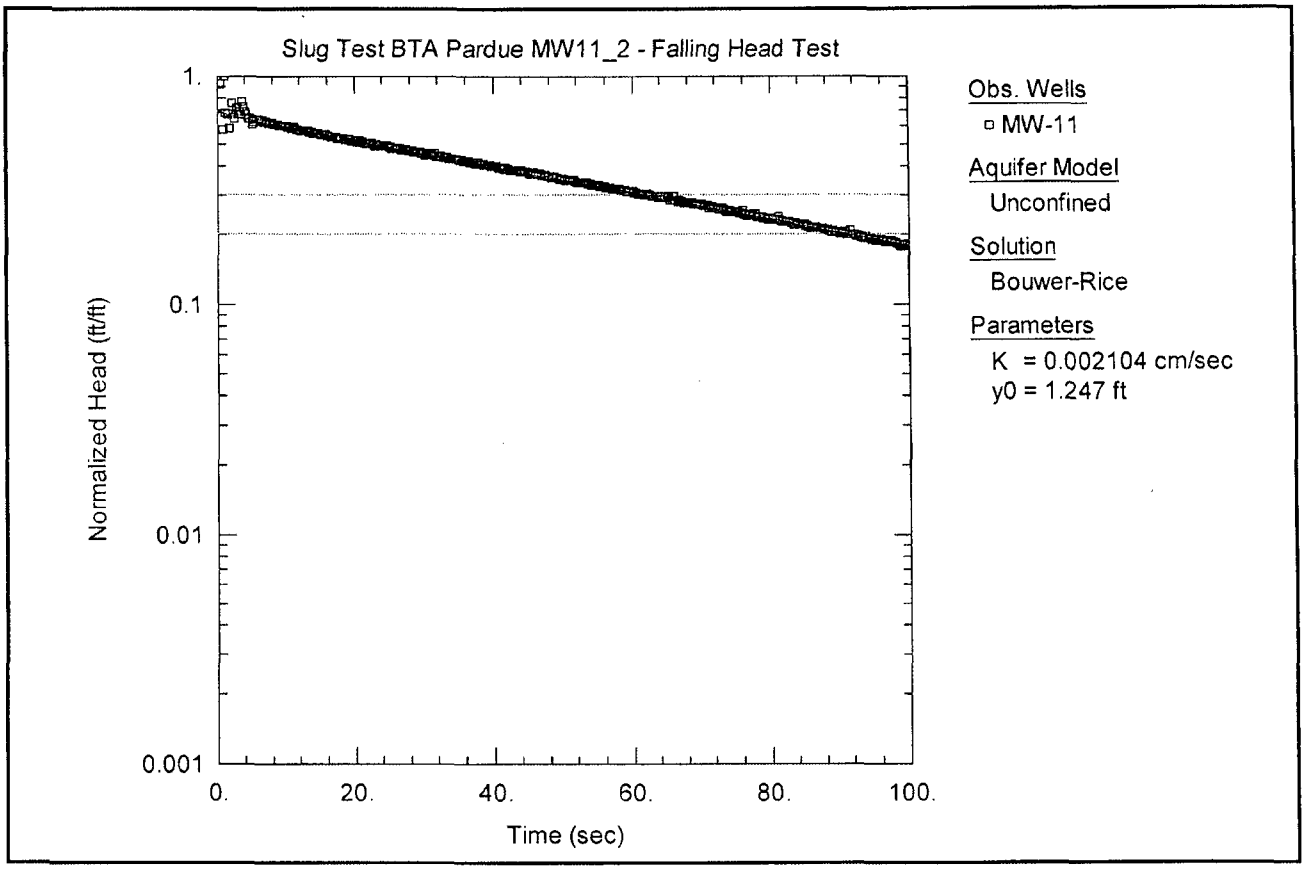
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-11

AQUIFER DATA

Saturated Thickness: 28.96 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.864 ft
Static Water Column Height: 8.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 8.89 ft
Total Well Penetration Depth: 8.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

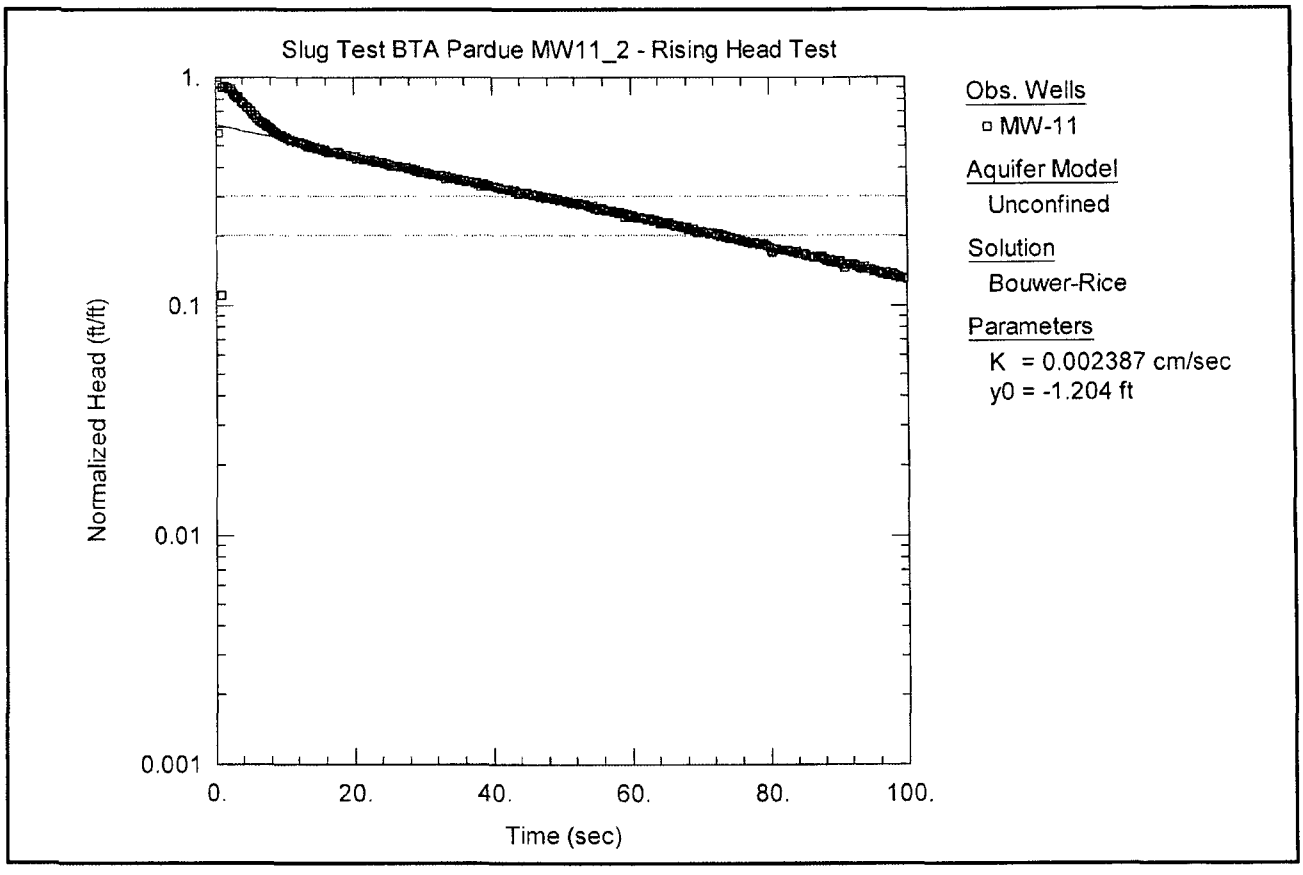
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-11

AQUIFER DATA

Saturated Thickness: 28.96 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.805 ft
Static Water Column Height: 8.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 8.89 ft
Total Well Penetration Depth: 8.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

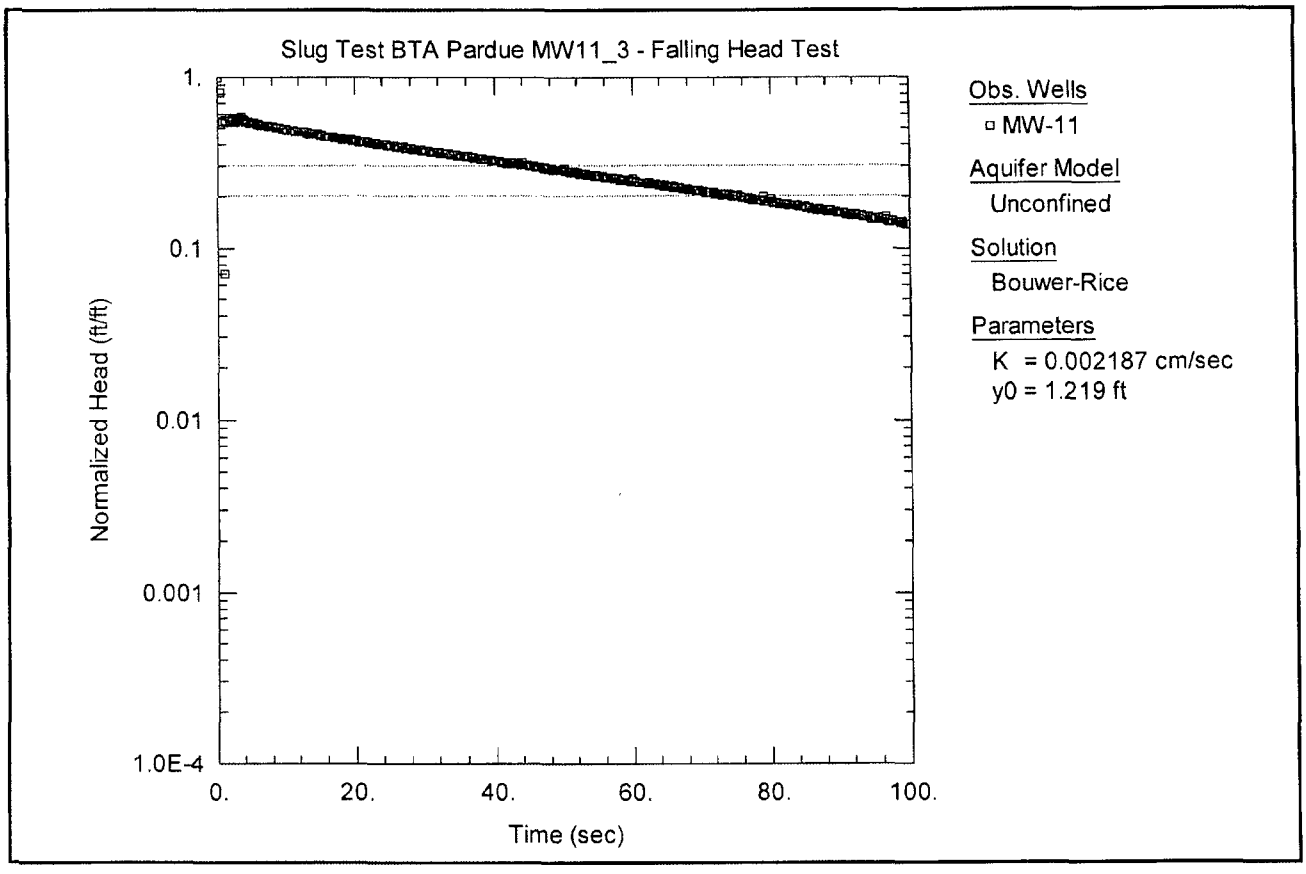
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-11

AQUIFER DATA

Saturated Thickness: 28.96 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.942 ft
Static Water Column Height: 8.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 8.89 ft
Total Well Penetration Depth: 8.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

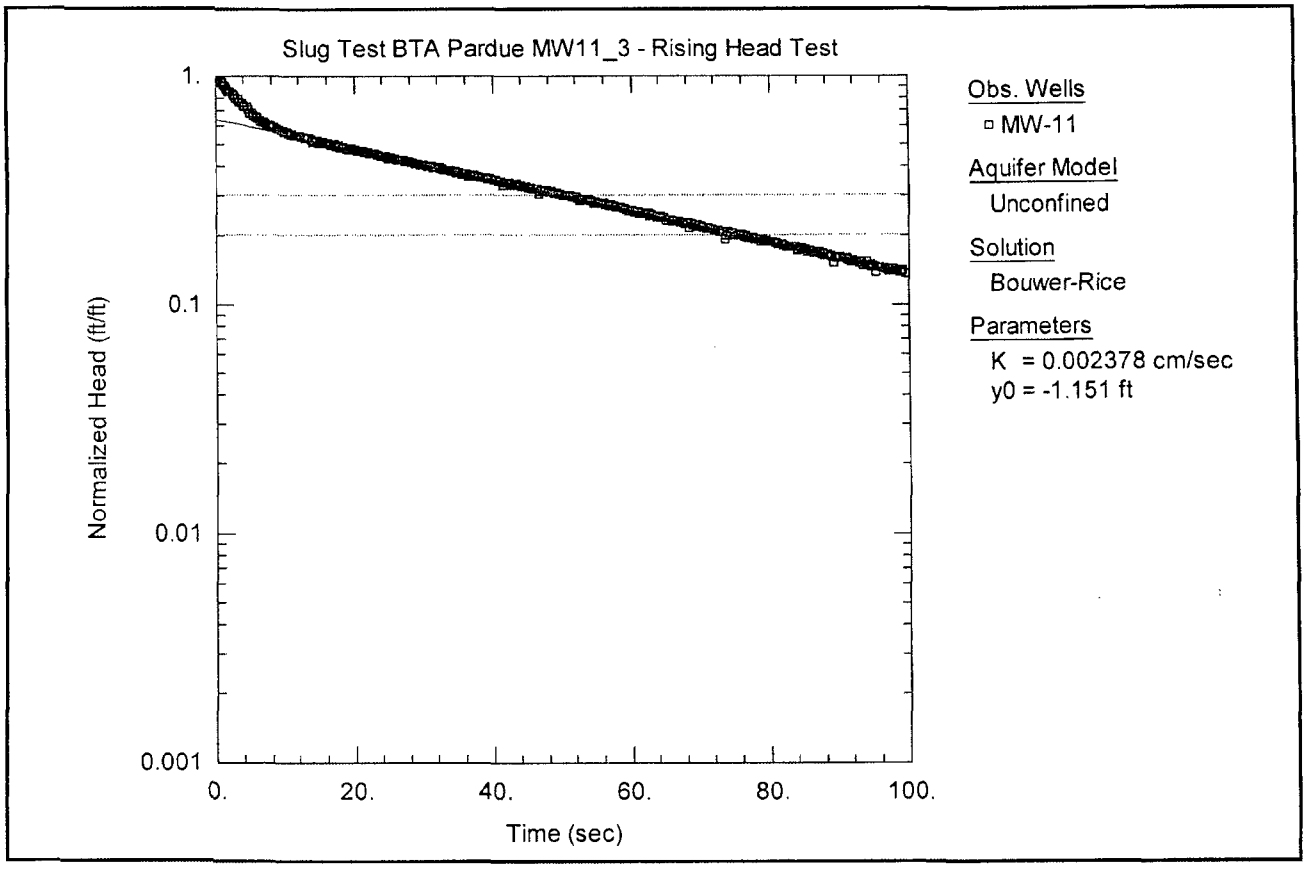
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-11

AQUIFER DATA

Saturated Thickness: 28.96 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 2.112 ft
Static Water Column Height: 8.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 8.89 ft
Total Well Penetration Depth: 8.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

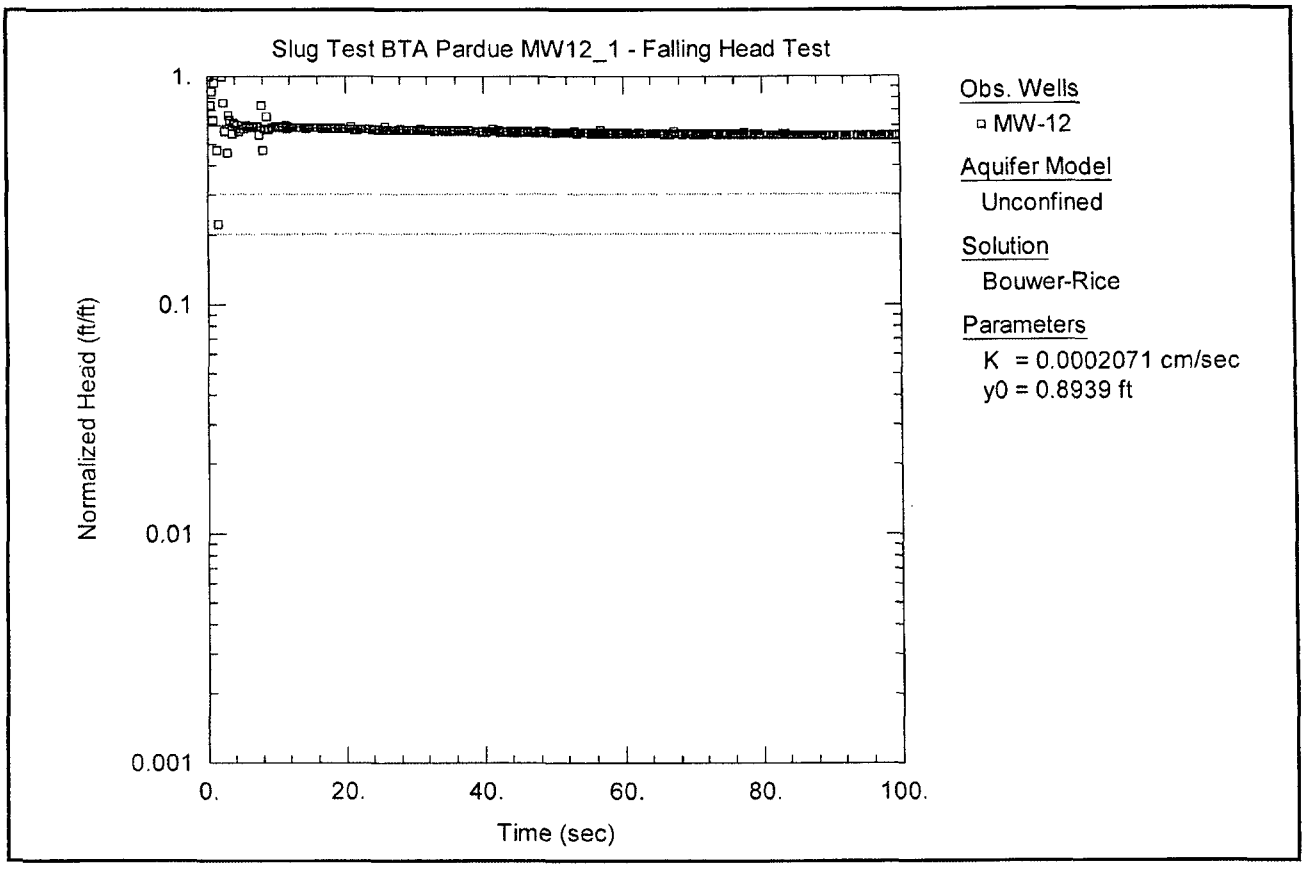
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-11

AQUIFER DATA

Saturated Thickness: 28.96 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.783 ft
Static Water Column Height: 8.89 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 8.89 ft
Total Well Penetration Depth: 8.89 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

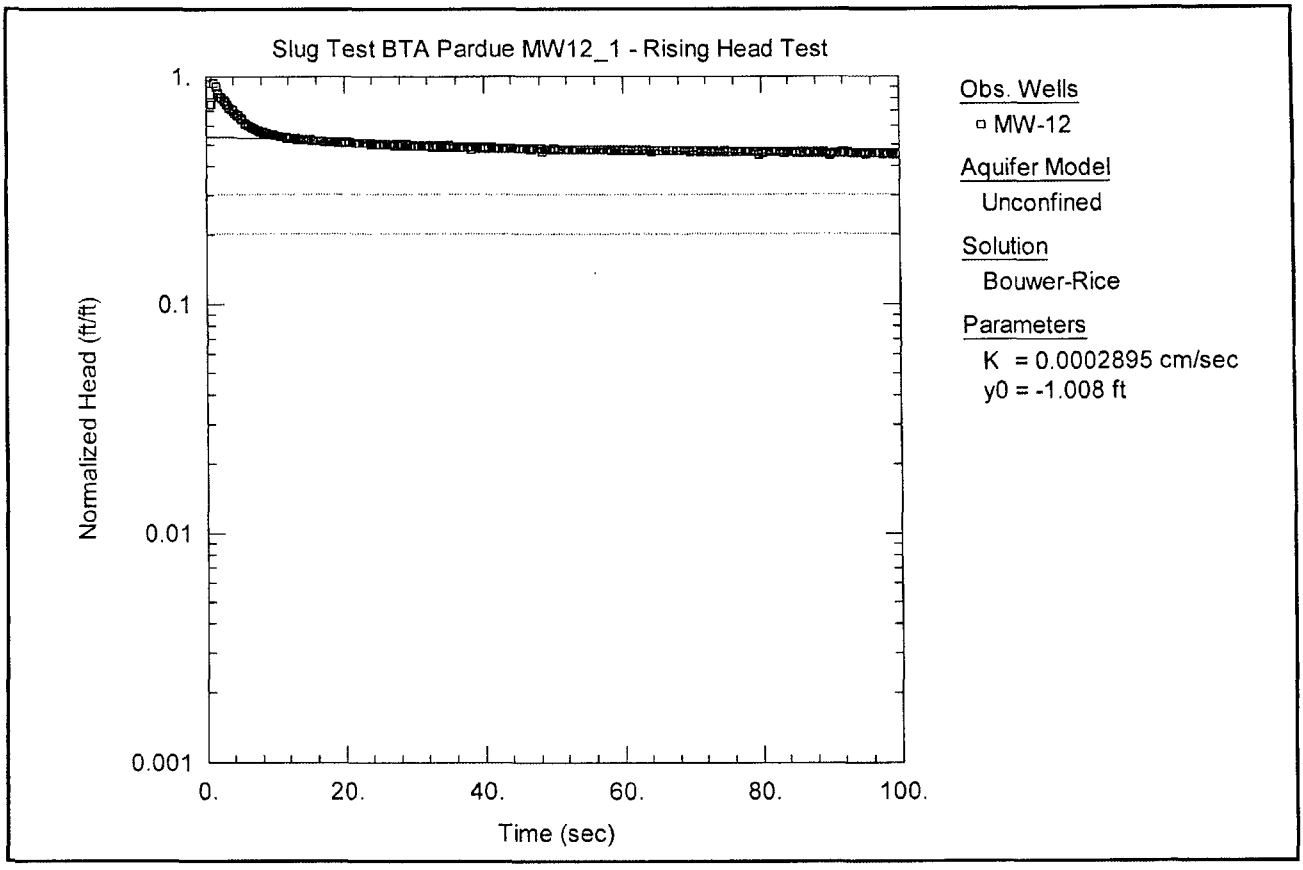
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-12

AQUIFER DATA

Saturated Thickness: 28.61 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.48 ft
Static Water Column Height: 10.93 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.93 ft
Total Well Penetration Depth: 10.93 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

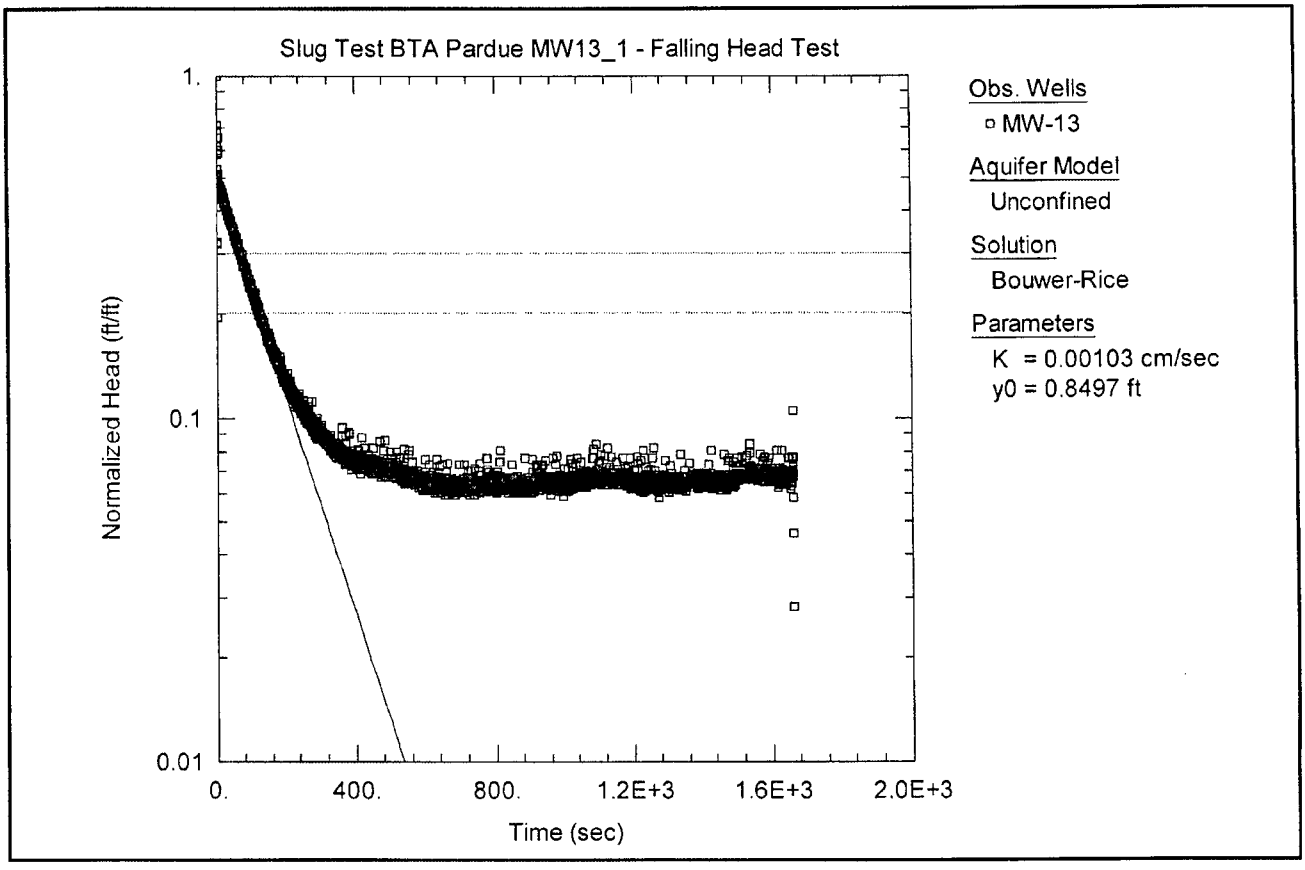
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-12

AQUIFER DATA

Saturated Thickness: 28.61 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.869 ft
Static Water Column Height: 10.93 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.93 ft
Total Well Penetration Depth: 10.93 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

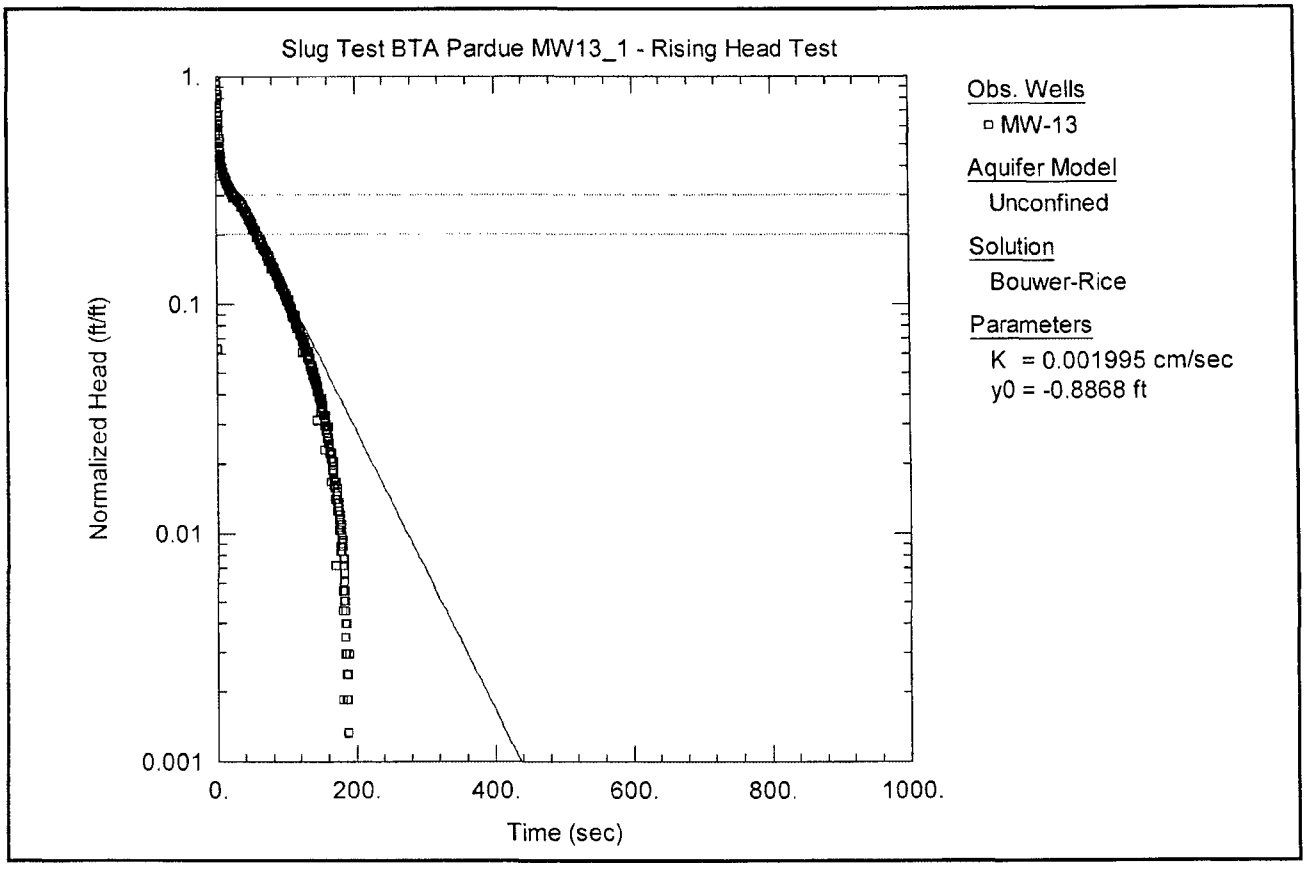
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-13

AQUIFER DATA

Saturated Thickness: 28.75 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.727 ft
Static Water Column Height: 10.6 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.6 ft
Total Well Penetration Depth: 10.6 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

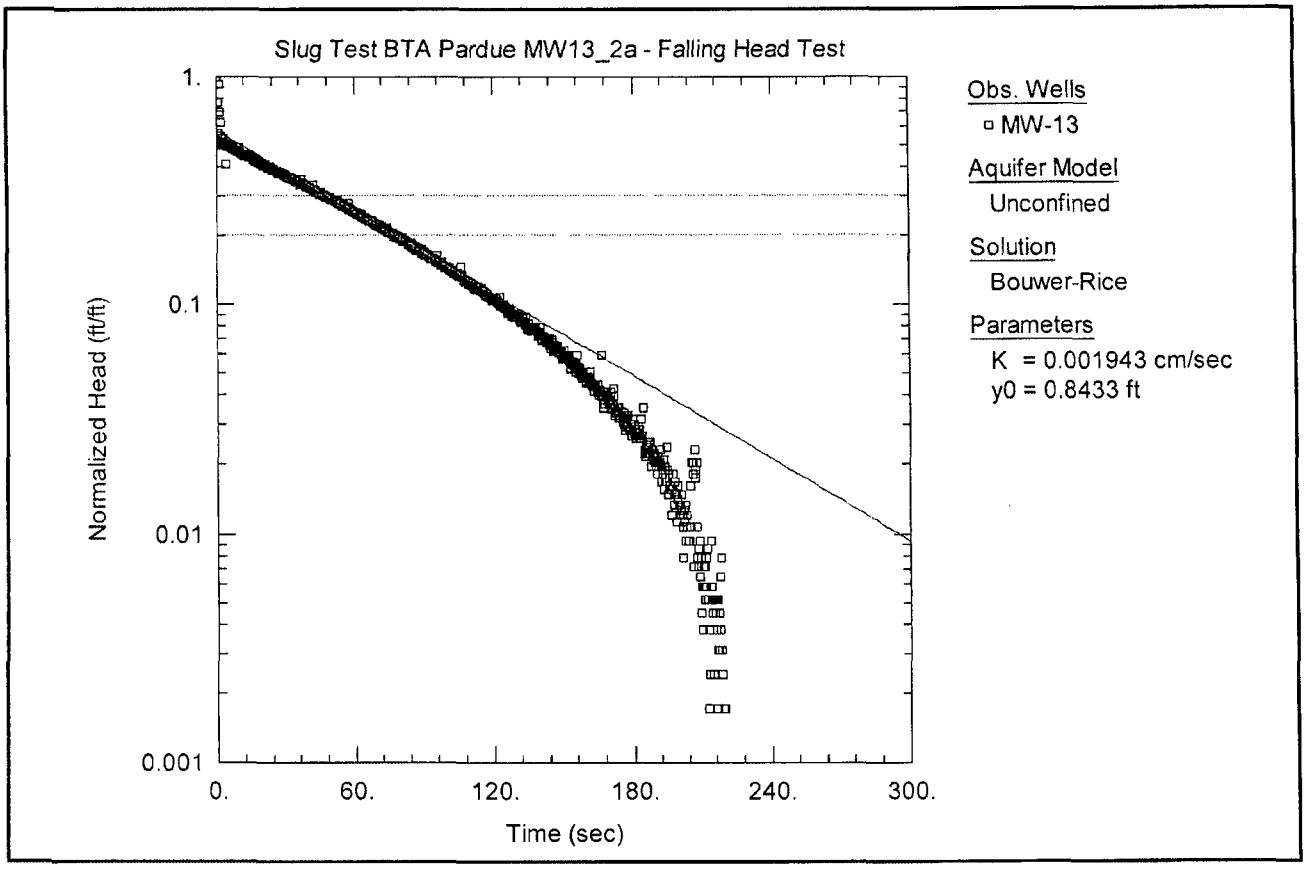
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-13

AQUIFER DATA

Saturated Thickness: 28.75 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.878 ft
Static Water Column Height: 10.6 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.6 ft
Total Well Penetration Depth: 10.6 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

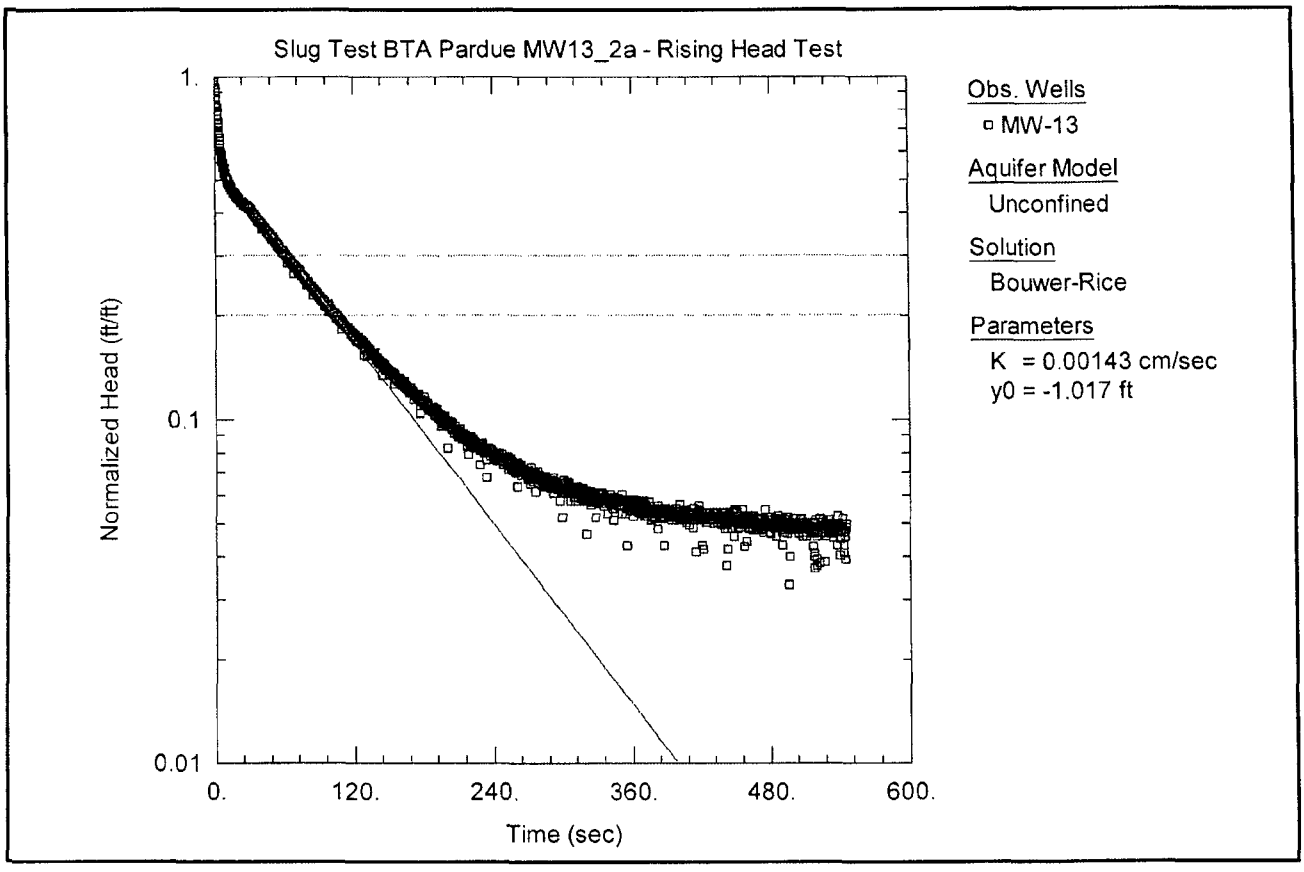
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-13

AQUIFER DATA

Saturated Thickness: 28.75 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.455 ft
Static Water Column Height: 10.6 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.6 ft
Total Well Penetration Depth: 10.6 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

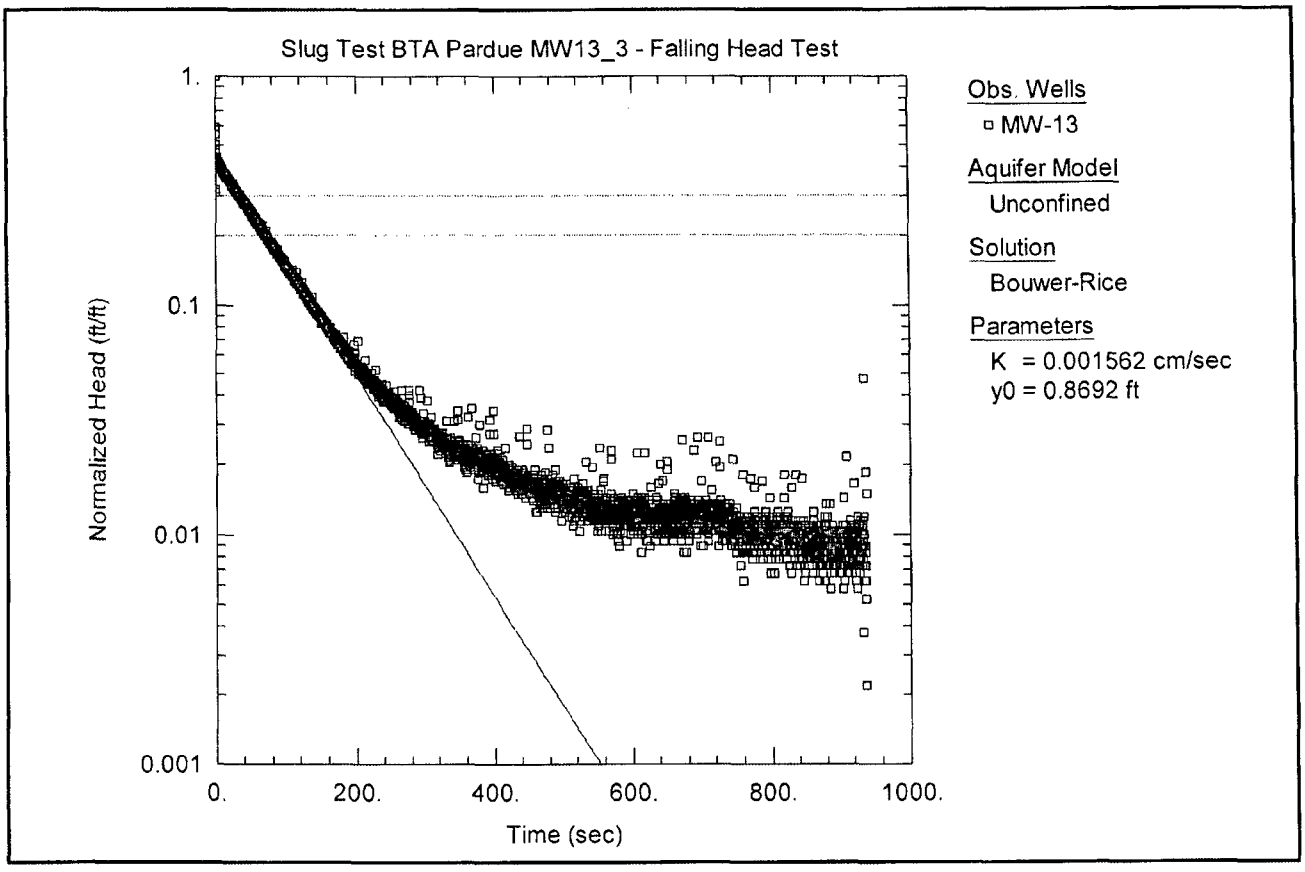
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-13

AQUIFER DATA

Saturated Thickness: 28.75 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -1.793 ft
Static Water Column Height: 10.6 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.6 ft
Total Well Penetration Depth: 10.6 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

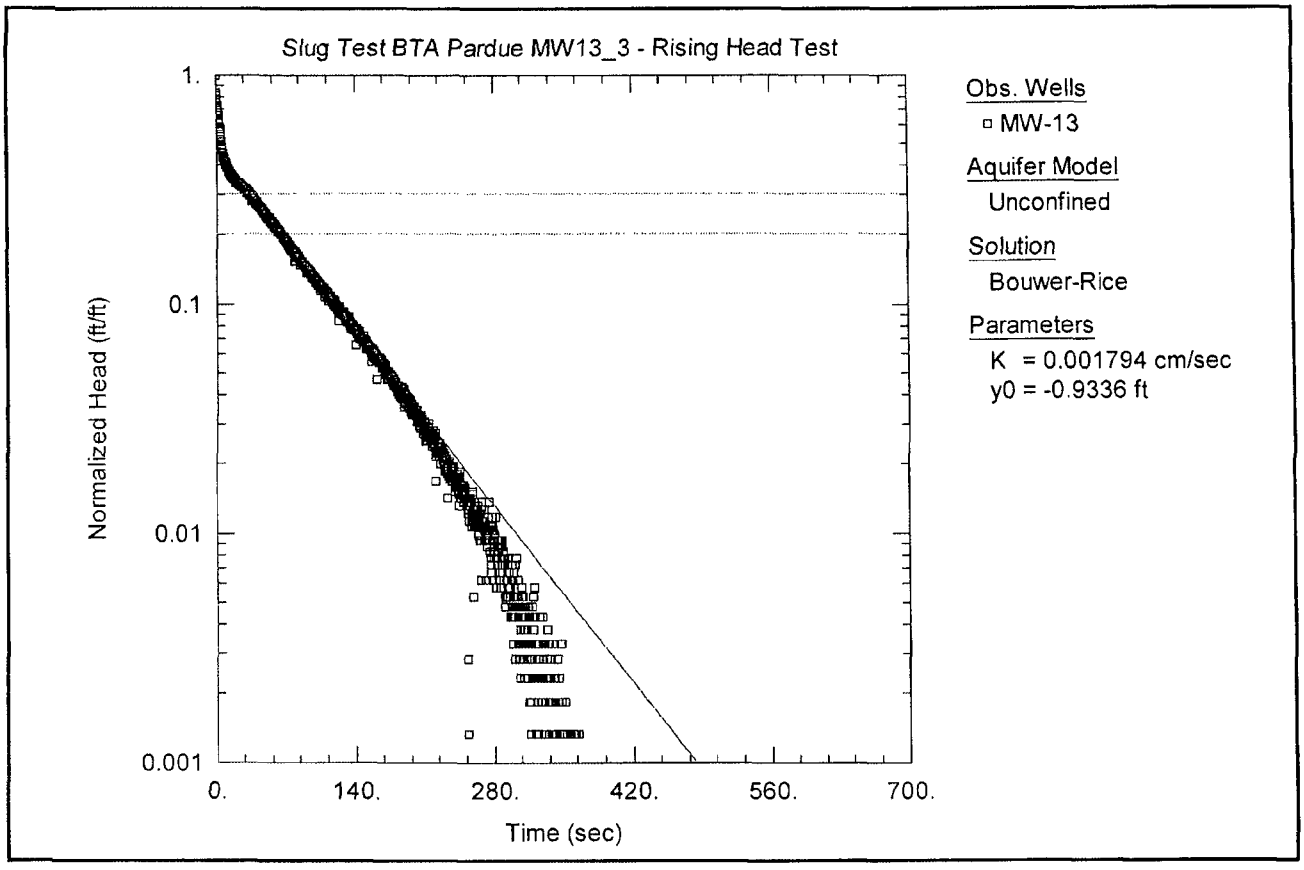
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-13

AQUIFER DATA

Saturated Thickness: 28.75 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.954 ft
Static Water Column Height: 10.6 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.6 ft
Total Well Penetration Depth: 10.6 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

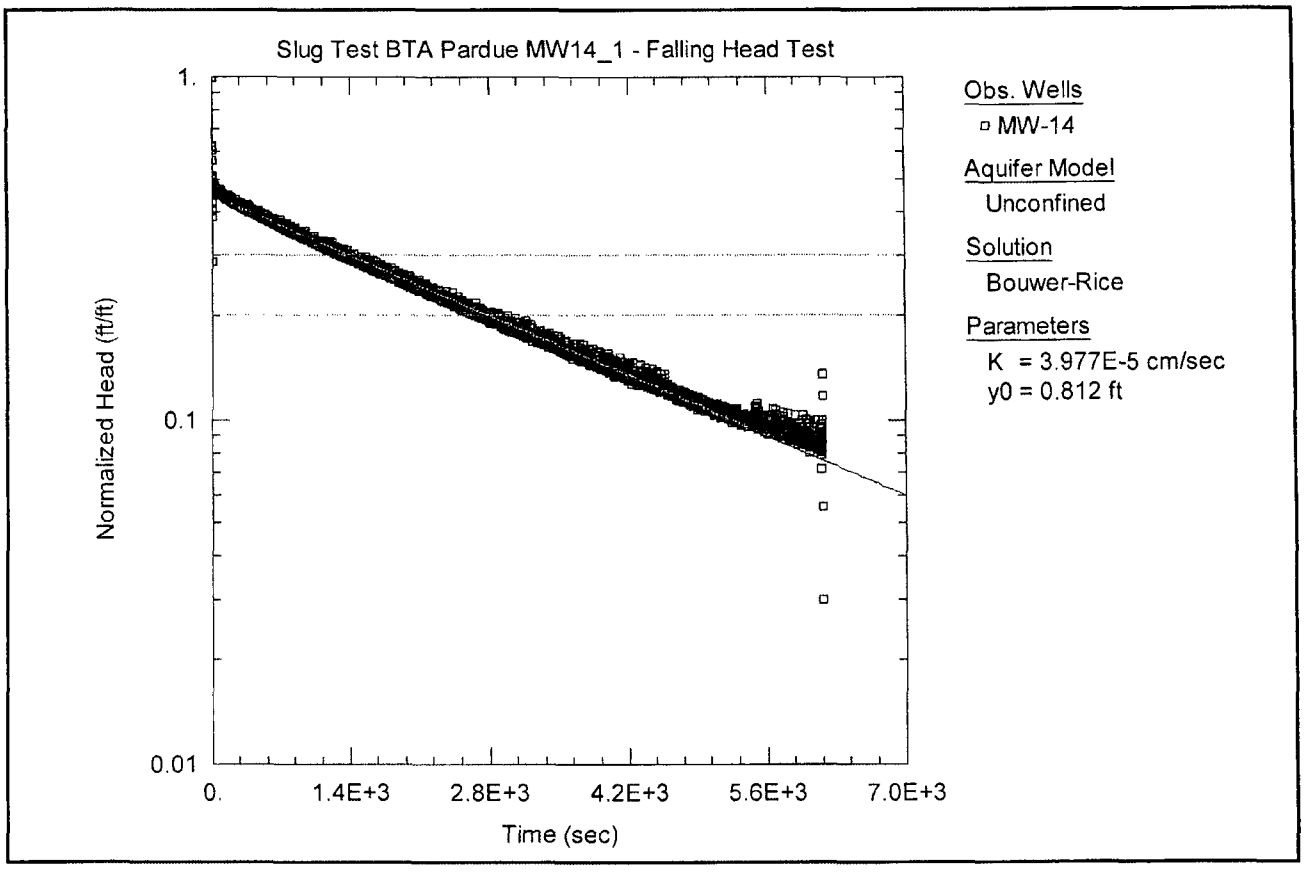
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-13

AQUIFER DATA

Saturated Thickness: 28.75 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -2.016 ft
Static Water Column Height: 10.6 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.6 ft
Total Well Penetration Depth: 10.6 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

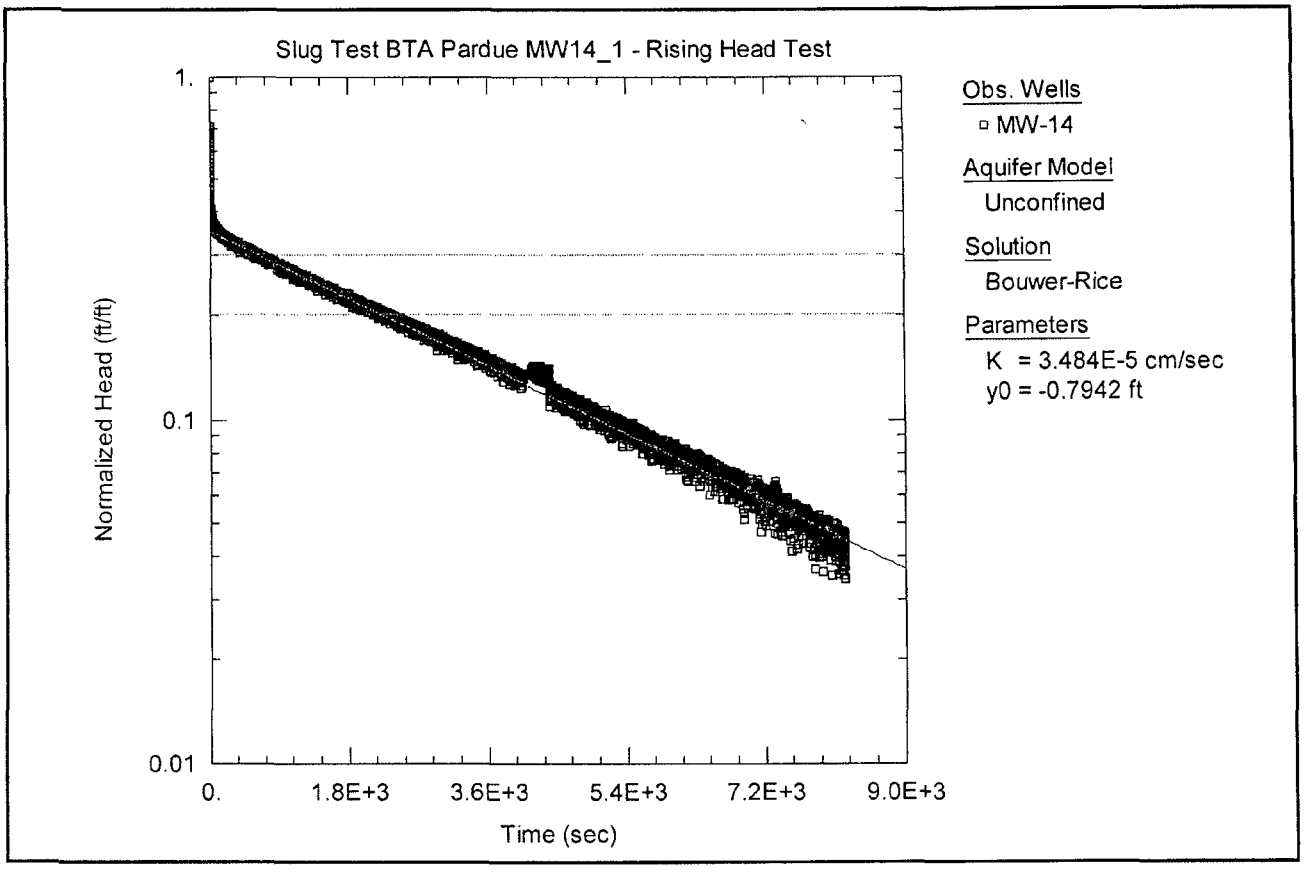
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-14

AQUIFER DATA

Saturated Thickness: 31.15 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.825 ft
Static Water Column Height: 10.79 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.79 ft
Total Well Penetration Depth: 10.79 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

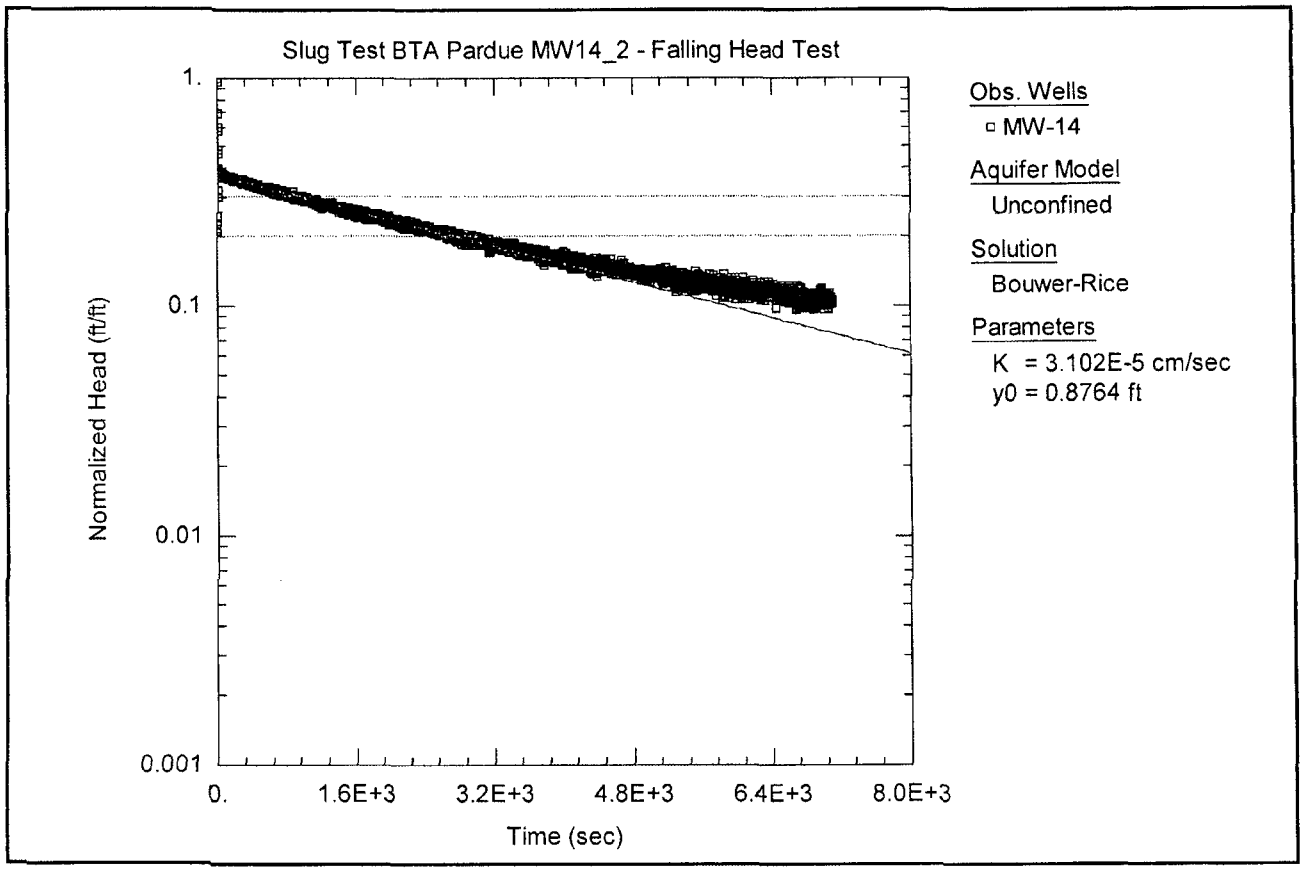
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-14

AQUIFER DATA

Saturated Thickness: 31.15 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -2.269 ft
Static Water Column Height: 10.79 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.79 ft
Total Well Penetration Depth: 10.79 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

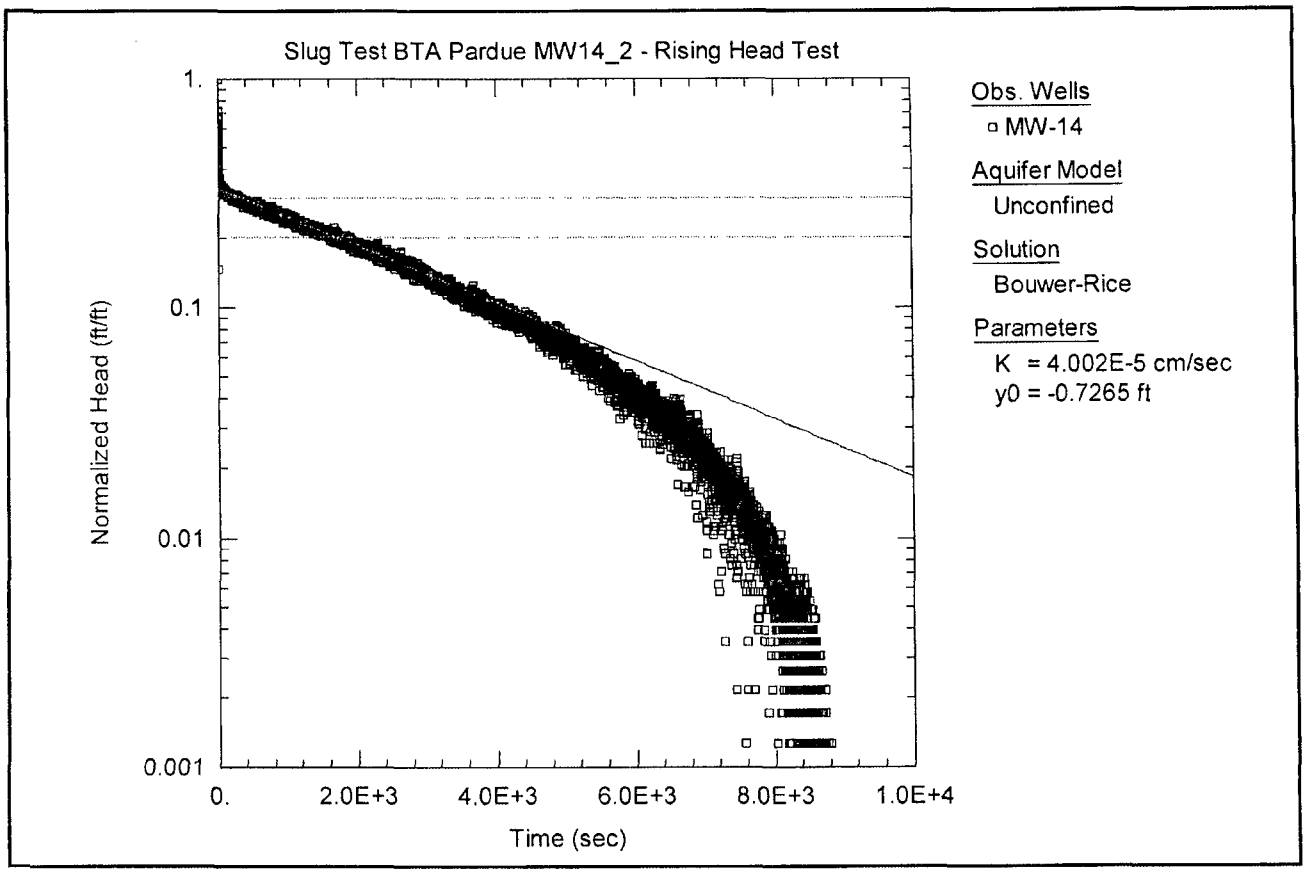
Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-14

AQUIFER DATA

Saturated Thickness: 31.15 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 2.377 ft
Static Water Column Height: 10.79 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.79 ft
Total Well Penetration Depth: 10.79 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3



PROJECT INFORMATION

Company: Larson & Associates
Client: BTA
Project: 10-0101
Location: Pardue C JVP #1
Test Date: 05-04-10
Test Well: MW-14

AQUIFER DATA

Saturated Thickness: 31.15 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: -2.211 ft
Static Water Column Height: 10.79 ft
Casing Radius: 0.167 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 10.79 ft
Total Well Penetration Depth: 10.79 ft
Corrected Casing Radius (Bouwer-Rice Method): 0.2098 ft
Gravel Pack Porosity: 0.3

BENTOMAT® CL
BENTOMAT® CLT

GEOSYNTHETIC CLAY LINER SPECIFICATION GUIDELINES

This specification is intended for use as a GENERAL GUIDELINE for developing a specification for a specific project. It is NOT intended as a substitute for a detailed specification, which must be written to address site-specific conditions. Shaded areas of this guideline indicate items that are typically considered specific to certain applications.

800.527.9948 Fax 847.577.5566

1.0 GENERAL

1.1 Scope

This specification covers the technical requirements for the furnishing and installation of the geosynthetic clay liner described herein. All materials used shall meet the requirements of this specification, and all work shall be performed in accordance with the procedures provided herein and the contract drawings.

1.2 Definitions

For the purposes of this specification guideline, the following terms are defined below:

Geosynthetic Clay Liner (GCL). A manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetics.

Geomembrane. An essentially impermeable geosynthetic composed of one or more geosynthetic sheets.

Geotextile. Any permeable geosynthetic comprised solely of textiles.

Minimum Average Roll Value. For geosynthetics, the value calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

Overlap. Where two adjacent GCL panels contact, the distance measuring perpendicular from the overlying edge of one panel to the underlying edge of the other.

Typical Value. The mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with one specific property.

1.3 Unit Prices

Measurement will be made of the total surface area in square feet covered by the GCL as shown on the contract drawings. Final quantities will be based on as-built conditions. Allowance will be made for GCL in anchor and drainage trenches but no allowance will be made for waste, overlap, or materials used for the convenience of the Contractor. GCL installed and accepted will be paid for at the respective contract unit price in the bidding schedule.

1.4 Submittals

A. With the bid, the Contractor shall furnish the following information:

1. Conceptual description of the proposed plan for placement of the GCL panels over the area of installation.
2. GCL manufacturer's MQC Plan for documenting compliance to Sections 2.1 and 2.2 of these specifications.
3. GCL manufacturer's historical data for multi-axial tension testing of the laminated GCL per Section 2.1D.
4. A copy of GCL manufacturer's ISO quality Certificate of Registration.

B. At the Engineer's or Owner's request the Contractor shall furnish:

1. A representative sample of the GCLs.
2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million square feet (100,000 square meters) in size.

C. Upon shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

D. As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and CQA Inspector (see Sections 1.6 and 3.3) for each area that is covered by the GCL.

1.5 Qualifications

A. GCL Manufacturer must have produced at least 10 million square feet (1 million square meters) of GCL, with at least 8 million square feet (800,000 square meters) installed.

B. The GCL Installer must either have installed at least 1 million square feet (100,000 square meters) of GCL, **or** must provide to the Engineer satisfactory evidence that the GCL will be installed in a competent, professional manner, through 1) similar experience in the installation of other types of geosynthetics, or 2) appropriate training.

1.6 Construction Quality Assurance (CQA)

A. The Owner and Engineer shall provide a third-party inspector for CQA of the GCL installation. The inspector shall be an individual or company who is independent from the manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQA of the GCL, throughout installation. The inspector shall have provided CQA services for the installation of the proposed or similar GCL for at least 5 completed projects totaling not less than 1 million square feet (100,000 square meters).

B. Testing of the GCL, as necessary to support the CQA effort, shall be performed by a third party laboratory retained by the Contractor and independent from the GCL manufacturer and installer. The laboratory shall have provided GCL CQA testing of the proposed or similar GCL for at least 5 completed projects totaling not less than 1 million square feet (100,000 square meters).

C. CQA shall be provided in accordance with the *GCL CQA Manual* provided by the engineer.

2.0 PRODUCTS

A. The GCLs shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and laminated to either a thin flexible membrane liner (CL) or a 20-mil textured HDPE geomembrane (CLT). The GCL shall comply with all of the criteria listed in this Section.

B. Prior to using an alternate GCL, the Contractor must furnish independent test results demonstrating that the proposed alternate material meets all requirements of this specification. The Contractor also must obtain prior approval of the alternative GCL by the Project Engineer.

2.1 Materials

A. Acceptable reinforced GCL products are Bentomat CL and Bentomat CLT, as manufactured by CETCO, 1500 West Shure Drive, Arlington Heights, Illinois 60004 USA (847-392-5800), or an engineer-approved equal.

B. The GCL and its components shall have the properties shown in the Bentomat CL and/or Bentomat CLT Certified Properties tables.

C. The laminated GCL shall have multi-axial tension testing data per ASTM D5617. The GCL shall achieve a
minimum multi-axial strain of 9.49%.

D. The minimum acceptable dimensions of full-size GCL panels shall be 150 feet (45.7 m) in length. Short rolls [(those manufactured to a length greater than 70 feet (21 m) but less than a full-length roll)] may be supplied at a rate no greater than 3 per truckload or 3 rolls every 36,000 square feet (3,500 square meters) of GCL, whichever is less.

E. A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

2.2 Product Quality Documentation

The GCL manufacturer shall provide the Contractor or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the parameters swell index and fluid loss shown in the Bentomat CL and/or Bentomat CLT Certified Properties tables.

B. Manufacturer's test data for finished GCL product(s) of bentonite mass/area, GCL tensile strength and GCL peel strength (reinforced only) demonstrating compliance with the index parameters shown in the Bentomat CL and/or Bentomat CLT Certified Properties tables.

C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

Manufacturer's test data for finished GCL product(s), including GCL index flux, permeability and hydrated internal shear strength data, which demonstrate compliance with the performance parameters shown in the Bentomat CL and/or Bentomat CLT Certified Properties tables, are available upon request of the manufacturer.

2.3 Product Labeling

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand product code).

2. Lot number and roll number.

3. Roll length, width and weight.

2.4 Packaging

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

BENTOMAT® CL CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	45 lbs/in (78 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (4.4 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Periodic	1 x 10^{-9} m^3/m^2/sec max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Periodic	5 x 10^{-10} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typical

Bentomat CL is a reinforced GCL consisting of a layer of sodium bentonite between two geotextiles, which are needlepunched together and laminated to a thin flexible membrane liner.

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
[2] Bentonite mass/area reported at 0 percent moisture content.
[3] All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.
[4] ASTM D5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 92 gal/acre/day. This flux value is equivalent to a permeability of $5x10^{-10}$ cm/sec for typical GCL thickness. ASTM D 5887 testing is performed only on a periodic basis because the membrane is essentially impermeable.
[5] Peak value measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

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BENTOMAT® CLT CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	45 lbs/in (78 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (4.4 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Periodic	1×10^{-9} $m^3/m^2/sec$ max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Periodic	5×10^{-10} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typical

Bentomat CLT is a reinforced GCL consisting of a layer of sodium bentonite between two geotextiles, which are needlepunched together and laminated to a 20-mil (0.5mm) textured HDPE geomembrane.

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
[2] Bentonite mass/area reported at 0 percent moisture content.
[3] All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.
[4] ASTM D5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 92 gal/acre/day. This flux value is *equivalent to a permeability of* 5×10^{-10} *cm/sec for typical GCL thickness. ASTM D 5887 testing is performed only on a periodic basis* because the membrane is essentially impermeable.
[5] Peak value measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

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2.5 Accessory Bentonite

A. The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer. Seaming of GCLs shall be conducted in accordance with the manufacturer's specifications for each particular GCL. Please refer to the installation guidelines for Bentomat/Claymax GCLs.

3.0 EXECUTION

3.1 Shipping and Handling

A. The manufacturer assumes responsibility for initial loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor, Installer or other designated party.

B. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

C. The party responsible for unloading the GCL should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.2 Storage

A. Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well drained.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

3.3 Earthwork

A. Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the project specifications and drawings. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction Debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes.
8. Standing water.
9. Cracks larger than one-quarter inch (6 mm) in width.
10. Any other foreign matter that could contact the GCL.

B. Subgrade surfaces consisting of granular soils or gravels may not be acceptable due to their large void fraction and puncture potential. Subgrade soils should range between fines and 1 inch (25 mm). In high-head applications (greater than 1 foot or 30.48 cm), CETCO recommends a membrane-laminated GCL (Bentomat CL or Bentomat CLT).

C. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

D. On a continuing basis, the project CQA inspector shall certify acceptance of the subgrade before GCL placement.

E. It shall be the installer's responsibility thereafter to indicate to the Engineer any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

F. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated or an equivalent runout shall be utilized in accordance with the project plans and specifications and as approved by the CQA Inspector. When utilizing an anchor trench design, the trench shall be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

3.4 GCL Placement

A. Unreinforced GCL shall be placed on the flatter areas of the site; reinforced GCL shall be placed on the more steeply sloped areas. The Installer and Project engineer shall review and agree upon which GCL shall be placed on these areas prior to installation.

B. GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the Engineer's recommendations.

C. Equipment, which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

D. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

E. The GCL panels shall be placed parallel to the direction of the slope.

F. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

G. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project Engineer, CQA inspector, and GCL supplier should be consulted for specific guidance if premature hydration occurs.

3.5 Anchorage

A. As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope or an equivalent runout design shall be utilized. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor but does not extend up the rear trench wall.

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3.6 Seaming

A. The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Bentonite-enhanced seams are required for installation of Bentomat CL and Bentomat CLT.

B. The minimum dimension of the longitudinal overlap should be 6 inches (150 mm). End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches (600 mm).

C. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

D. Bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

3.7 Detail Work

A. The GCL shall be sealed around penetrations and embedded structures embedded in accordance with the design drawings and the GCL Manufacturer.

B. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.8 Damage Repair

A. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

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3.9 Cover Placement

A. Cover soils shall be free of angular stones or other foreign matter that could damage the GCL. Cover soils should be approved the project Engineer with respect to particle size, uniformity and chemical compatibility. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

B. Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1foot (300 mm) of cover should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. This thickness recommendation does not apply to frequently trafficked areas or roadways, for which a minimum thickness of 2 feet (600 mm) is required.

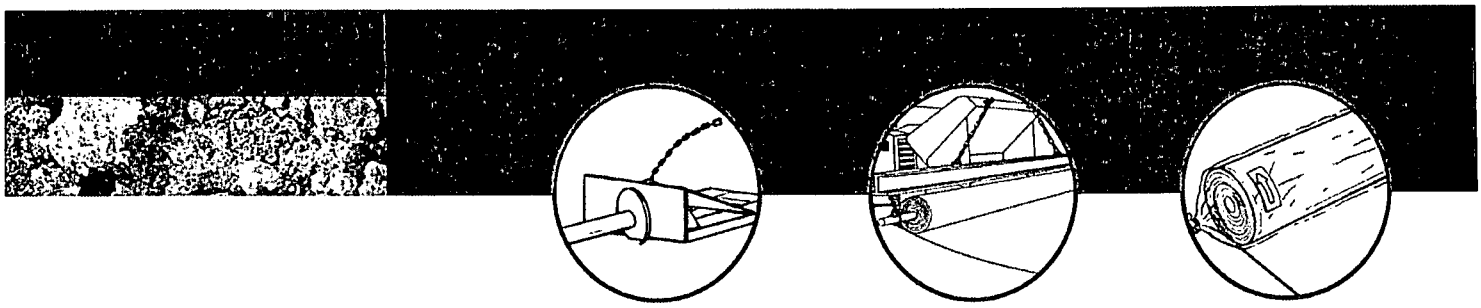
C. Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. Cover soil shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

D. Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of any geosynthetic material placed over the GCL. The GCL supplier or CQA engineer should be contacted with specific recommendations on the appropriate procedures in this situation.

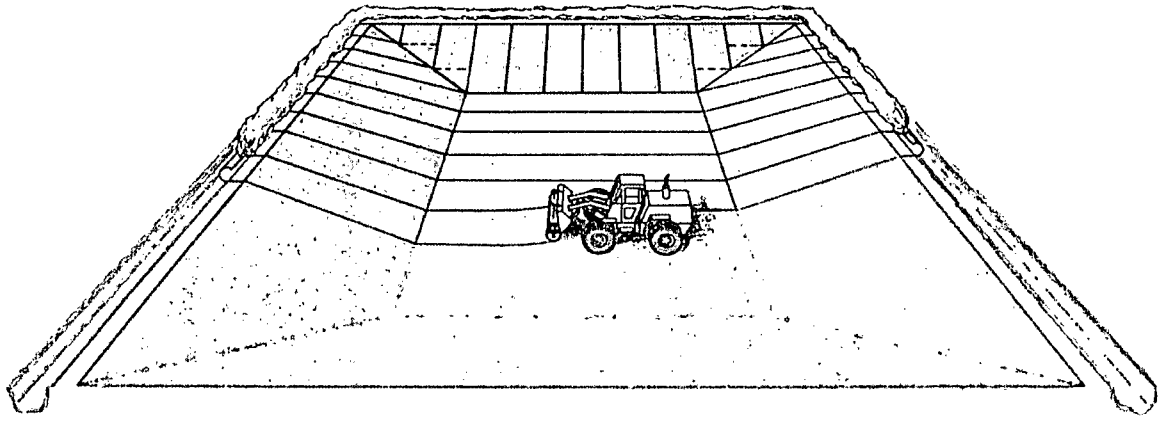
E. When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

F. Cyclical wetting and drying of GCL covered with geomembrane can cause overlap separation. Soil cover should be placed promptly to avoid this problem. Geomembranes should be covered with a white geotextile and/or operations layer without delay to prevent the geomembrane from absorbing heat and desiccating the bentonite in the GCL. If the GCL is covered only with a geomembrane for an extended period, the overlapping of the longitudinal seams needs to be increased to 12".

G. To avoid seam separation, the GCL should not be put in excessive tension by the weight or expansion of textured geomembrane on steep slopes. The project Engineer should be consulted about the potential for GCL tension to develop.



Installation Guidelines

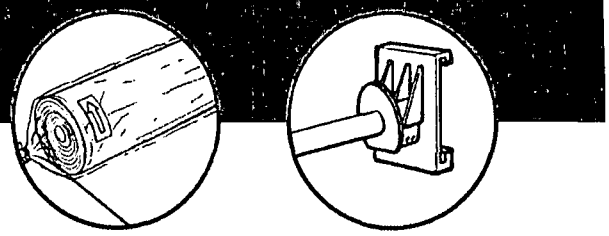


BENTOMAT®
CLAYMAX®

Geosynthetic Clay Liners

CETCO®

NOTICE: This document is intended for use as a GENERAL GUIDELINE for the installation of CETCO's GCLs. The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information. Installation guidelines are subject to periodic changes. Please consult our CETCO Engineering Website @ www.cetco.com/LTE for the most recent version.



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1 INTRODUCTION

1.1 This document provides procedures for the installation of CETCO's GCLs in a manner that maximizes safety, efficiency, and the physical integrity of the GCL.

1.2 These guidelines are based upon many years of experience at a variety of sites and should be generally applicable to any type of lining project using CETCO's GCLs. Variance from these guidelines is at the engineer's discretion.

1.3 The performance of the GCL is wholly dependent on the quality of its installation. It is the installer's responsibility to adhere to these guidelines, and to the project specifications and drawings, as closely as possible. It is the engineer's and owner's responsibility to provide construction quality assurance (CQA) for the installation, to ensure that the installation has been executed properly. This document covers only installation procedures.

1.4 For additional guidance, refer to ASTM D5888 (Standard Guide For Storage and Handling of Geosynthetic Clay Liners) and ASTM D 6102 (Standard Guide For Installation of Geosynthetic Clay Liners).

2 EQUIPMENT REQUIREMENTS

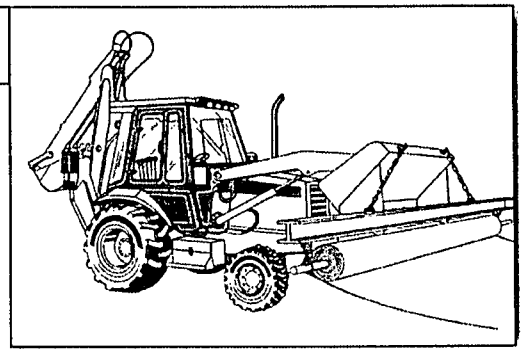
2.1 CETCO GCLs are delivered in rolls typically 2,600-2,950 lbs (1180-1340 kg). Roll dimensions and weights will vary with the dimensions of the product ordered. It is necessary to support this weight using an appropriate core pipe as indicated in Table 1. For any installation, the core pipe must not deflect more than 3 inches (75 mm) as measured from end to midpoint when a full GCL roll is lifted.

TABLE 1 CORE REQUIREMENTS

Product(s)	Nominal GCL Roll Size W x Dia. Ft. (m) x in. (mm)	Typical GCL Roll Wt., lbs. (kg)	Interior Core Size, in. (mm)	Core Pipe Length x Diameter, ft. x in. (m x mm)	Minimum Core Pipe Strength
Bentomat DN, SDN	16' x 24" (4.9 x 610)	2,650 (1200)	3 3/4 (100)	20 x 3.5"O.D.(6.1 m x 89 mm)	XXH
Bentomat ST	16' x 24" (4.9 x 610)	2,600 (1180)	3 3/4 (100)	20 x 3.5"O.D.(6.1 m x 89 mm)	XXH
Bentomat CLT	16' x 26" (4.9 x 660)	2,950 (1340)	3 3/4 (100)	20 x 3.5"O.D.(6.1 m x 89 mm)	XXH
Claymax 200R	16' x 20" (4.9 x 510)	2,750 (1250)	3 3/4 (100)	20 x 3.5"O.D.(6.1 m x 89 mm)	XXH
Bentomat CL	16' x 25" (4.9 x 635)	2,675 (1213)	3 3/4 (100)	20 x 3.5"O.D.(6.1 m x 89 mm)	XXH

2.2 Lifting chains or straps appropriately rated should be used in combination with a spreader bar made from an I-beam as shown in Figure 1.

FIGURE 1 **SPREADER BAR LIFTING ASSEMBLY**



2.3 The spreader bar ensures that lifting chains or straps do not chafe against the ends of the GCL roll, allowing it to rotate freely during installation. Spreader bar and core pipe kits are available through CETCO.

2.4 A front end loader, backhoe, dozer, or other equipment can be utilized with the spreader bar and core pipe or slings. Alternatively, a forklift with a "stinger" attachment may be used for on-site handling. A forklift without a stinger attachment should not be used to lift or handle the GCL rolls. Stinger attachments (Figure 2-4) are specially fabricated to fit various forklift makes and models.

FIGURE 2 **HOOK MOUNT**

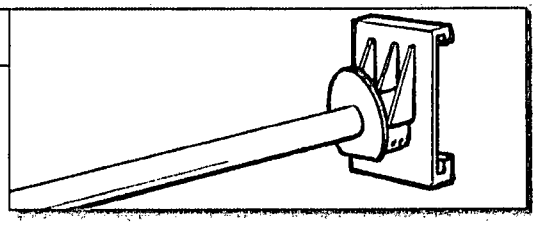


FIGURE 3 **FORK MOUNT** (with fork pockets)

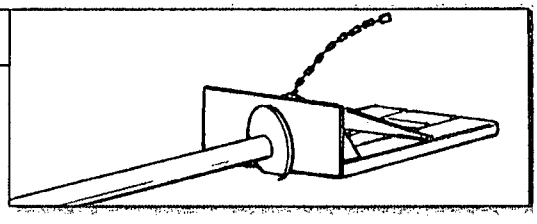
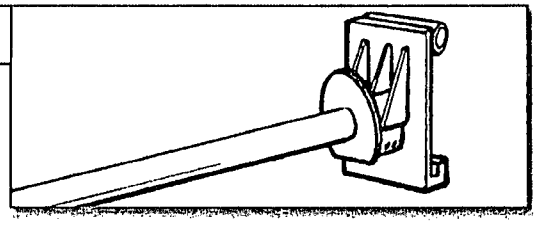


FIGURE 4 **PIN MOUNT**



2.5 When installing over certain geosynthetic materials, a 4-wheel, all-terrain vehicle (ATV) can be used to deploy the GCL. An ATV can be driven directly on the GCL provided that no sudden stops, starts, or turns are made.

2.6 Additional equipment needed for installation of CETCO's GCLs includes:

- Utility knife and spare blades (for cutting the GCL).
- Granular bentonite for end-of-roll GCL seams and for sealing around structures and details. Granular bentonite is available from CETCO.
- Waterproof tarpaulins (for temporary cover on installed material as well as for stockpiled rolls).
- Optional flat-bladed vise grips (for positioning the GCL panel by hand).

2.7 The CETCO Easy Roller™ GCL Deployment System is a preferred method of installing geosynthetic clay liners. Use of the Easy Roller system eliminates the need for spreader bars and heavy core pipes. Installation speed and worker safety are significantly increased. For further details, contact CETCO.

3 SHIPPING, UNLOADING & STORAGE

3.1 All lot and roll numbers should be recorded and compared to the packing list. Each roll of GCL should also be visually inspected during unloading to determine if any packaging has been damaged. Damage, whether obvious or suspected, should be recorded and the affected rolls marked.

3.2 Major damage suspected to have occurred during transit should be reported immediately to the carrier and to CETCO. The nature of the damage should also be indicated on the bill of lading with the specific lot and roll numbers. Accumulation of some moisture within roll packaging is normal and does not damage the product.

3.3 The party directly responsible for unloading the GCL should refer to this manual prior to shipment to ascertain the appropriateness of their unloading equipment and procedures. Unloading and on-site handling of the GCL should be supervised.

3.4 In most cases, CETCO GCLs are delivered on flatbed trucks. There are three methods of unloading: core pipe and spreader bar; slings; or stinger bar. To unload the rolls from the flatbed using a core pipe and spreader bar, first insert the core pipe through the core tube. Secure the lifting chains or straps to each end of the core pipe and to the spreader bar mounted on the lifting equipment. Hoist the roll straight up and make sure its weight is evenly distributed so that it does not tilt or sway when lifted.

3.5 At the customer's request, CETCO GCLs may be delivered with two 2" x 12' (50 mm x 3.65 m) Type V polyester endless slings on each roll. Before lifting, check the position of the slings. Each sling should be tied off in the choke position approximately one third (1/3) from the end of the roll. Hoist the roll straight up so that it does not tilt or sway when lifted.

3.6 In some cases, GCL rolls will be stacked in three pyramids on flatbed trucks. If slings are not used, rolls will require unloading with a stinger bar and extendible boom fork lift. Spreader bars will not work in this situation because of the limited access between the stacks of GCL. Three types of stingers are available from CETCO (Figures 2-4). To unload, guide the stinger through the core tube before lifting the GCL roll and removing from the truck.

3.7 An extendible boom fork lift with a stinger bar is required for unloading vans. Rolls in the nose and center of van should first be carefully pulled toward the door using the slings provided on the rolls.

3.8 Rolls should be stored at the job site away from high-traffic areas but sufficiently close to the active work area to minimize handling. The designated storage area should be flat, dry and stable. Moisture protection of the GCL is provided by its packaging; however, an additional tarpaulin or plastic sheet is recommended.

3.9 Rolls should be stacked in a manner that prevents them from sliding or rolling. This can be accomplished by chocking the bottom layer of rolls. Rolls should be stacked no higher than the height at which they can be safely handled by laborers (typically no higher than four layers of rolls). Rolls should never be stacked on end.

4 SUBGRADE PREPARATION

4.1 Subgrade surfaces consisting of granular soils or gravels are not acceptable due to their large void fraction and puncture potential. In applications where the GCL is the only barrier, subgrade soils should have a particle-size distribution at least 80 percent finer than the #60 sieve (0.25 mm). In other applications, subgrade soils should range between fines and 1 inch (25 mm). In high-head applications (greater than 1 foot or 30.48 cm), CETCO recommends a membrane-laminated GCL (Bentomat CL or Bentomat CLT).

4.2 When the GCL is placed over an earthen subgrade, the subgrade surface must be prepared in accordance with the project specifications. The engineer's approval of the subgrade must be obtained prior to installation. The finished surface should be firm and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water.

4.3 The subgrade surface must be smooth and free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign matter that could contact the GCL. The subgrade should be rolled with a smooth-drum compactor to remove any wheel ruts greater than 1 inch in depth, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 0.5 inch (12 mm) from the subgrade surface shall be removed, crushed, or pushed into the surface with a smooth-drum compactor. The GCL may be installed on a frozen subgrade, but the subgrade soil in the unfrozen state should meet the above requirements.

5 INSTALLATION

5.1 GCL rolls should be taken to the work area of the site in their original packaging. The orientation of the GCL (i.e., which side faces up) may be important if the GCL has two different types of geosynthetics. Check with the project engineer in order to determine if there is a preferred installation orientation for the GCL. If no specific orientation is required, allow the roll to unwind from the bottom rather than pulling from the top (Figure 5). The arrow sticker on the plastic sleeve indicates the direction the GCL will naturally unroll when placed on the ground (Figure 6). Prior to deployment, the packaging should be carefully removed without damaging the GCL.

FIGURE 5 THE GCL CAN BE UNROLLED IN ITS "NATURAL" ORIENTATION (A) OR CAN BE PULLED FROM THE TOP OF THE ROLL (B)

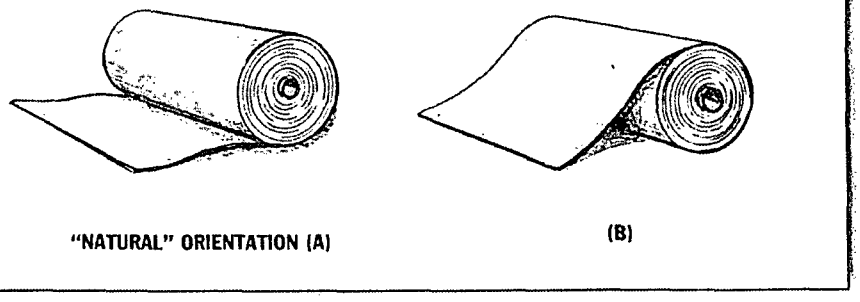
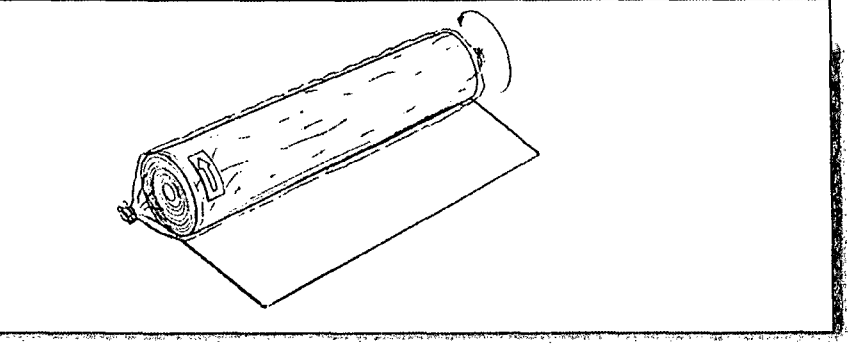
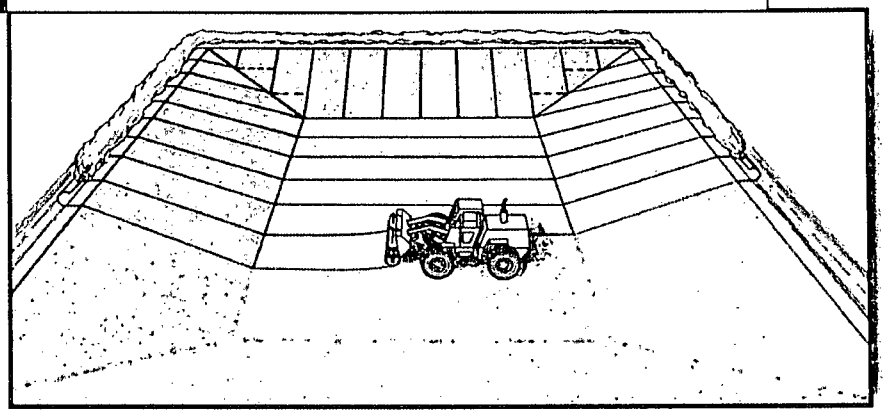


FIGURE 6 DIRECTION TO UNROLL GCL ON GROUND PER FIGURE 5(A)



5.2 Equipment which could damage the GCL should not be allowed to travel directly on it. Acceptable installation, therefore, may be accomplished such that the GCL is unrolled in front of backwards-moving equipment (Figure 7). If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

FIGURE 7 **TYPICAL BENTOMAT®/CLAYMAX® INSTALLATION TECHNIQUE**

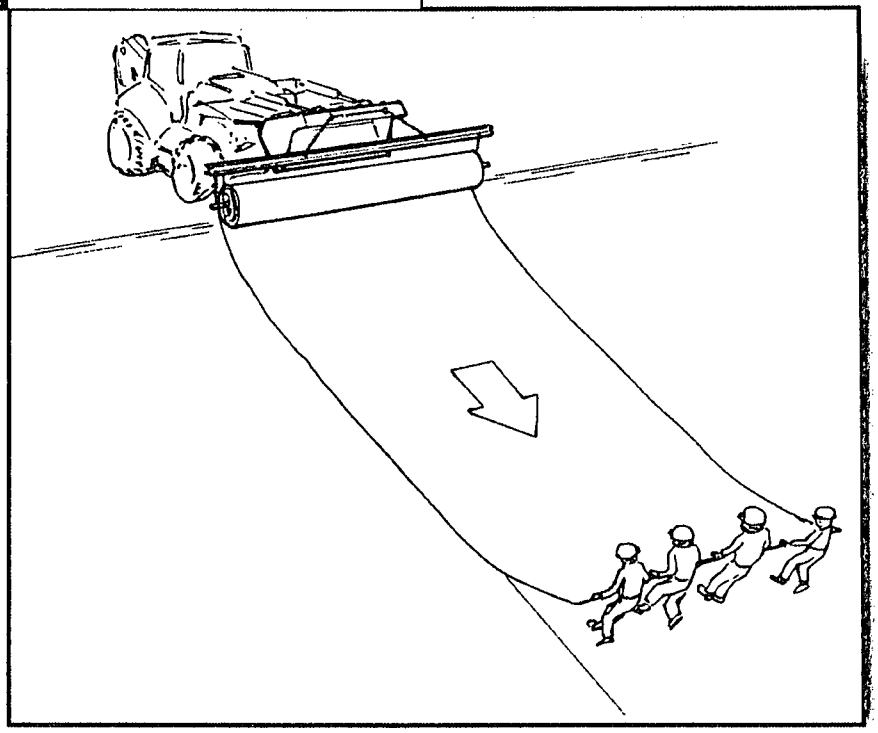


5.3 If sufficient access is available, GCL may be deployed by suspending the roll at the top of the slope with a group of laborers pulling the material off of the roll and down the slope (Figure 8).

5.4 GCL rolls should not be released on the slope and allowed to unroll freely by gravity.

5.5 Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. Care must also be taken when adjusting Bentomat CLT panels to avoid damage to the geotextile surface of one panel of GCL by the textured sheet of another panel of GCL. A temporary geosynthetic subgrade covering, commonly known as a slip sheet or rub sheet, may be used to reduce friction damage during placement.

FIGURE 8 **UNROLLING BENTOMAT**



5.6 The GCL should be placed so that seams are parallel to the direction of the slope. End-of-panel seams should also be located at least 3 ft (1m) from the toe and crest of slopes steeper than 4H:1V. End-of-roll seams on slopes should be used only if the liner is not expected to be in tension.

5.7 All GCL panels should lie flat, with no wrinkles or folds, especially at the exposed edges of the panels. When Bentomat with SuperGroove® is repositioned, it should be gripped inside the SuperGroove by folding the edge.

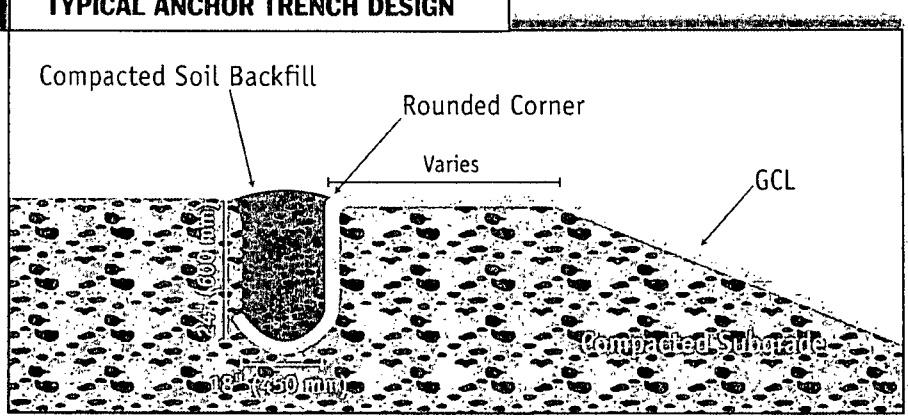
5.8 The GCL should not be installed in standing water or during rainy weather. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. CETCO recommends that premature hydration be evaluated on a case-by-case basis. The project engineer, CQA inspector, and CETCO's TR-312 should be consulted for specific guidance if premature hydration occurs. The type of GCL, duration of exposure, degree of hydration, location in the liner system, and expected bearing loads should be considered. In many instances, a needlepunch reinforced GCL may not require removal/replacement if the following are true: (1) the geotextiles have not been separated, torn or otherwise damaged; (2) there is no evidence that the needlepunching between the two geotextiles has been compromised; (3) the Bentomat does not leave deep indentations when stepped upon; and (4) any overlapped seams with bentonite enhancement (see Section 7) are intact.

5.9 For the convenience of the installer, hash marks are placed on Bentomat every 5' (1.5 m) of length.

6 ANCHORAGE

6.1 If required by the project drawings, the end of the GCL roll should be placed in an anchor trench at the top of a slope. The front edge of the trench should be rounded to eliminate any sharp corners that could cause excessive stress on the GCL. Loose soil should be removed or compacted into the floor of the trench.

FIGURE 9 TYPICAL ANCHOR TRENCH DESIGN



6.2 If a trench is used for anchoring the end of the GCL, soil backfill should be placed in the trench to provide resistance against pullout. The size and shape of the trench, as well as the appropriate backfill procedures, should be in accordance with the project drawings and specifications. Typical dimensions are shown in Figure 9.

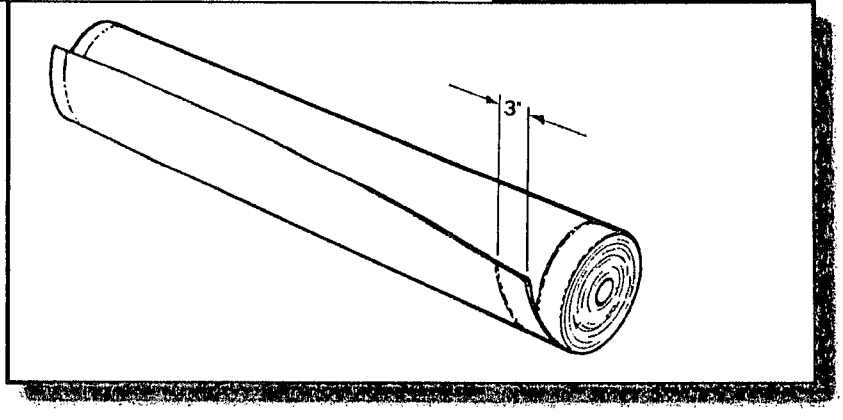
6.3 The GCL should be placed in the anchor trench such that it covers the entire trench floor but does not extend up the rear trench wall.

6.4 Sufficient anchorage may alternately be obtained by extending the end of the GCL roll back from the crest of the slope, and placing cover soil. The length of this "runout" anchor should be prepared in accordance with project drawings and specifications.

7 SEAMING

7.1 GCL seams are constructed by overlapping adjacent panel edges and ends. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is not required for Claymax 200R. Bentomat ST, DN, and SDN with Supergroove® have self-seaming capabilities in their longitudinal overlaps (Figure 10) and do not require supplemental bentonite. For pond applications, supplemental bentonite must be used in longitudinal seams regardless of the CETCO GCL used.

FIGURE 10 SUPERGROOVE



7.2 Longitudinal seams should be overlapped a minimum of 6 inches (150mm) for Bentomat and 12 inches (300mm) for Claymax. For high-head applications (greater than 1 foot or 30.48 cm) involving Bentomat CL or Bentomat CLT, a minimum longitudinal seam overlap of 12 inches (300 mm) and supplemental bentonite per Section 7.6 is recommended.

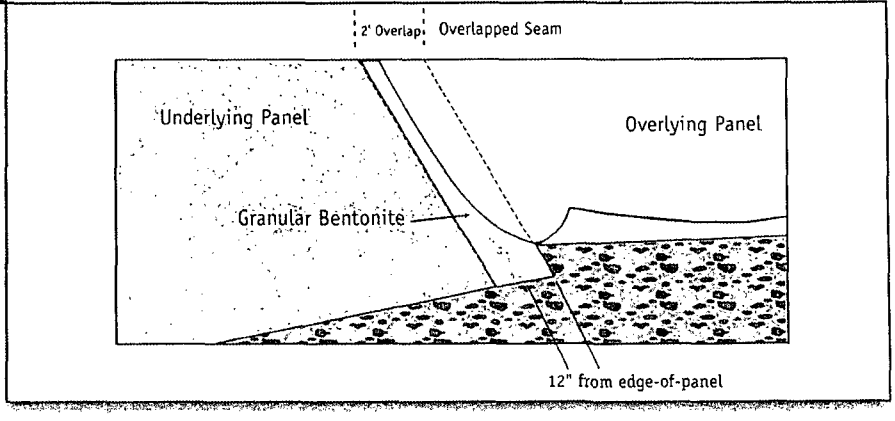
7.3 End-of-panel overlapped seams should be overlapped 24 inches (600mm) for Bentomat and 48 inches (1,200mm) for Claymax.

7.4 End-of-panel overlapped seams are constructed such that they are shingled in the direction of the grade to prevent runoff from entering the overlap zone. End-of-panel seams on slopes are permissible, provided adequate slope stability analysis has been conducted (i.e., the GCL is not expected to be in tension). Bentonite-enhanced seams are required for all Bentomat end-of-panel overlapped seams.

7.5 Bentomat end-of-panel, bentonite-enhanced, overlapped seams are constructed first by overlapping the adjacent panels, exposing the underlying panel, and then applying a continuous bead or fillet of granular sodium bentonite 12" from the edge of the underlying panel (Figure 11). The minimum application rate at which the bentonite is applied is one-quarter pound per linear foot (0.4 kg/m).

7.6 If longitudinal bentonite enhanced seams are required for Bentomat ST, DN, or SDN, they are constructed first by overlapping the adjacent panels by a minimum 6-inches (150 mm), exposing the underlying edge, and applying a continuous bead of granular bentonite approximately 3-inches (75 mm) from the edge. For pond applications involving Bentomat CL or CLT, longitudinal seams are constructed by overlapping adjacent panels by 12-inches (300 mm), exposing the underlying edge and applying a continuous bead of bentonite approximately 6-inches (150 mm) from the edge. The minimum application rate for the granular bentonite is one quarter pound per linear foot (0.4 kg/m).

FIGURE 11 BENTOMAT END-OF-PANEL OVERLAPPED SEAM



8 SEALING AROUND PENETRATIONS AND STRUCTURES

8.1 Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid irregular tearing of the geotextile components of the GCL during the cutting process.

8.2 The GCL should be sealed around penetrations and structures embedded in the subgrade in accordance with Figures 12 through 14. Granular bentonite shall be used liberally (approx. 2 lbs. /ln ft. or 3 kg/m) to seal the GCL to these structures.

FIGURE 12A CROSS-SECTION OF A HORIZONTAL PIPE PENETRATION

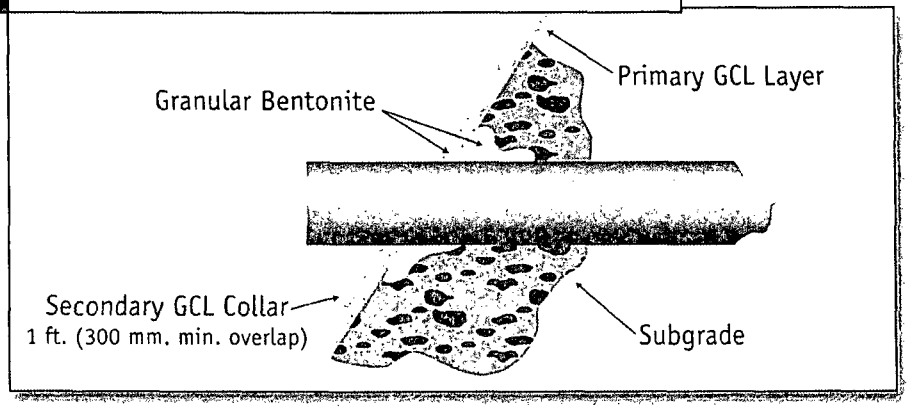
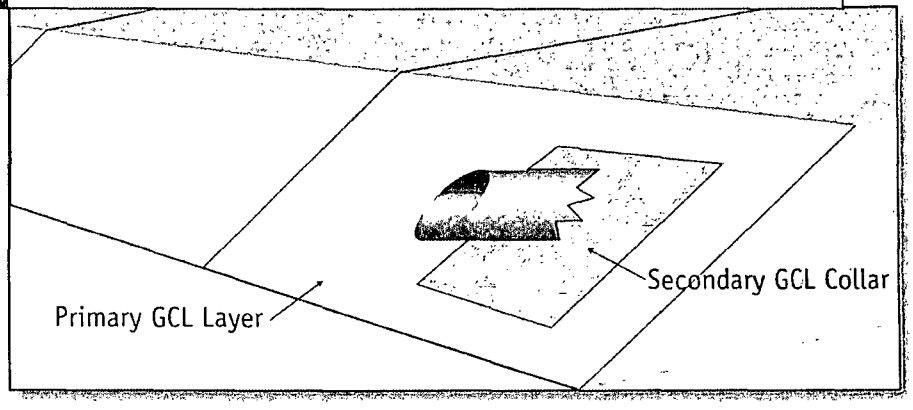
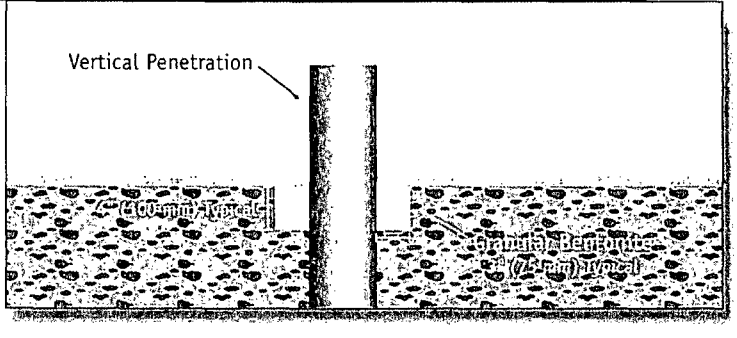


FIGURE 12B ISOMETRIC VIEW OF A COMPLETED HORIZONTAL PIPE PENETRATION



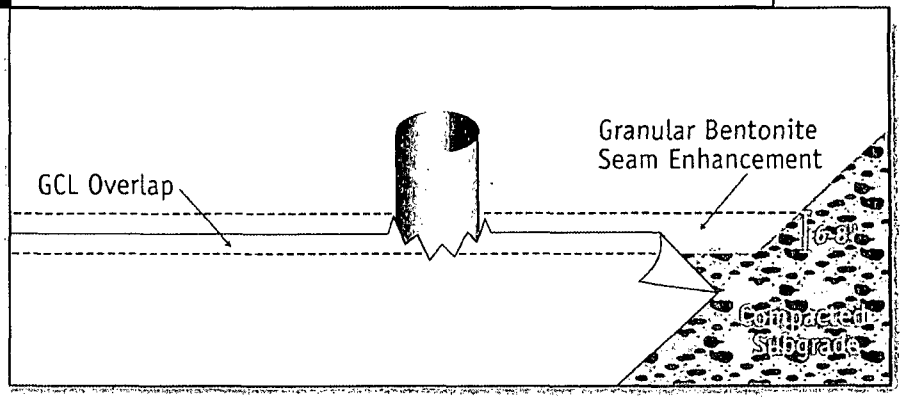
8.3 When the GCL is placed over a horizontal pipe penetration, a "notch" should be excavated into the subgrade around the penetration (Figure 12a). The notch should then be backfilled with granular bentonite. A secondary collar of GCL should be placed around the penetration as shown in Figure 12b. It is helpful to first trace an outline of the penetration on the GCL and then cut a "star" pattern in the collar to enhance the collar's fit to the penetration. Granular bentonite should be applied between the primary GCL layer and the secondary GCL collar.

FIGURE 13A CROSS-SECTION OF A VERTICAL PENETRATION



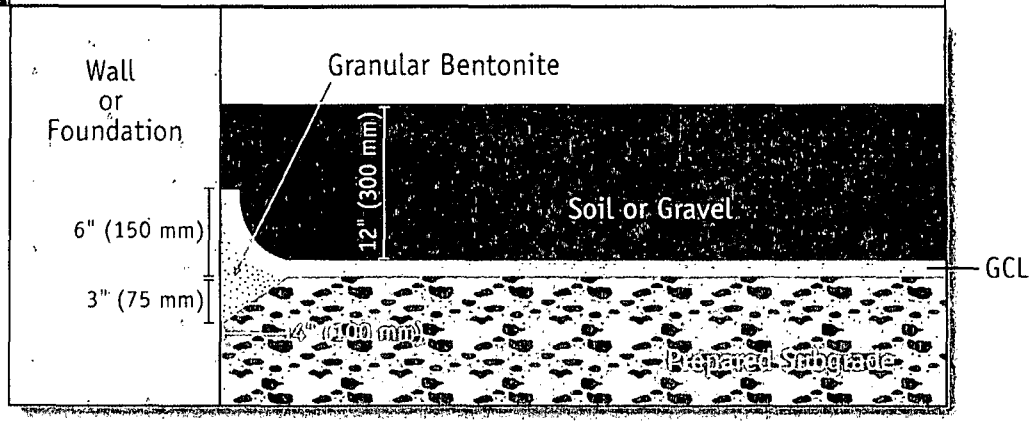
8.4 Vertical penetrations are prepared by notching into the subgrade as shown in Figure 13a. The penetration can be completed with two separate pieces of GCL as shown in Figure 13b. Alternatively, a secondary collar can be placed as in Figure 12a or 12b.

FIGURE 13B ISOMETRIC VIEW OF THE COMPLETED VERTICAL PENETRATION



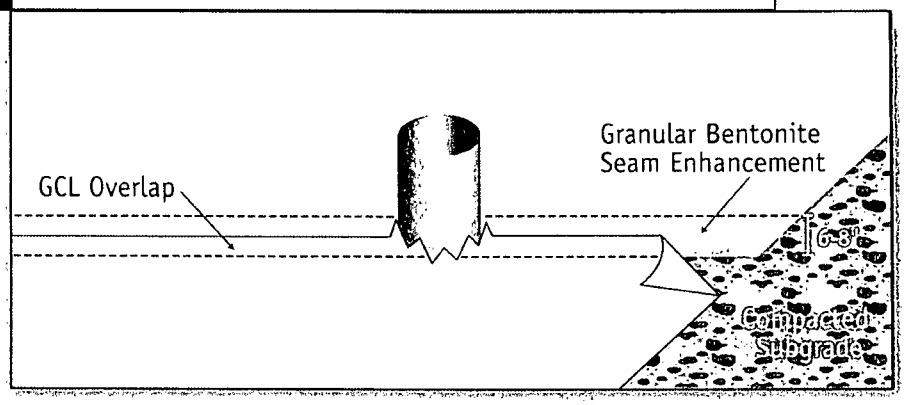
8.5 When the GCL is terminated at a structure or wall that is embedded into the subgrade on the floor of the containment area, the subgrade should be notched as described in Sections 8.3 and 8.4. The notch is filled with granular bentonite, and the GCL should be placed over the notch and up against the structure (Figure 14). Connection to the structure can be accomplished by placement of soil or stone backfill in this area. When structures or walls are at the top of a slope, additional detailing may be required. Contact CETCO for specific guidance.

FIGURE 14 CROSS-SECTION OF GCL SEAL AGAINST AN EMBEDDED STRUCTURE OR WALL



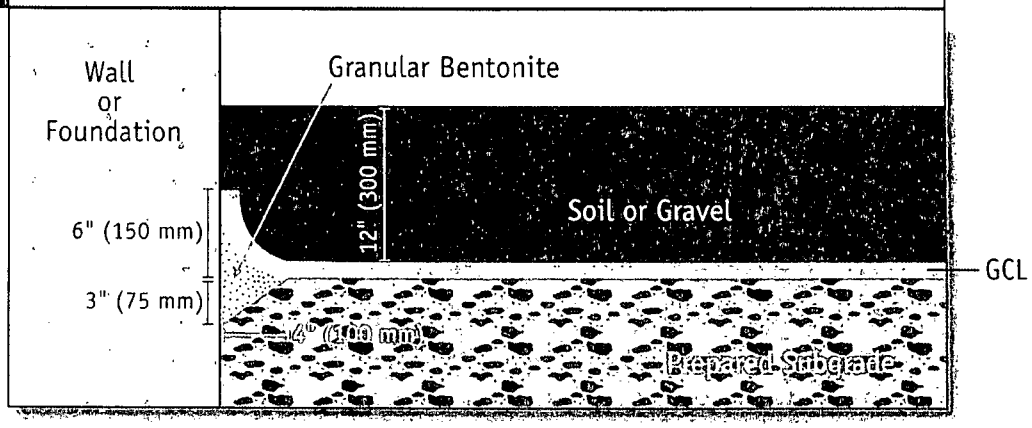
8.4 Vertical penetrations are prepared by notching into the subgrade as shown in Figure 13a. The penetration can be completed with two separate pieces of GCL as shown in Figure 13b. Alternatively, a secondary collar can be placed as in Figure 12a or 12b.

FIGURE 13B ISOMETRIC VIEW OF THE COMPLETED VERTICAL PENETRATION



8.5 When the GCL is terminated at a structure or wall that is embedded into the subgrade on the floor of the containment area, the subgrade should be notched as described in Sections 8.3 and 8.4. The notch is filled with granular bentonite, and the GCL should be placed over the notch and up against the structure (Figure 14). Connection to the structure can be accomplished by placement of soil or stone backfill in this area. When structures or walls are at the top of a slope, additional detailing may be required. Contact CETCO for specific guidance.

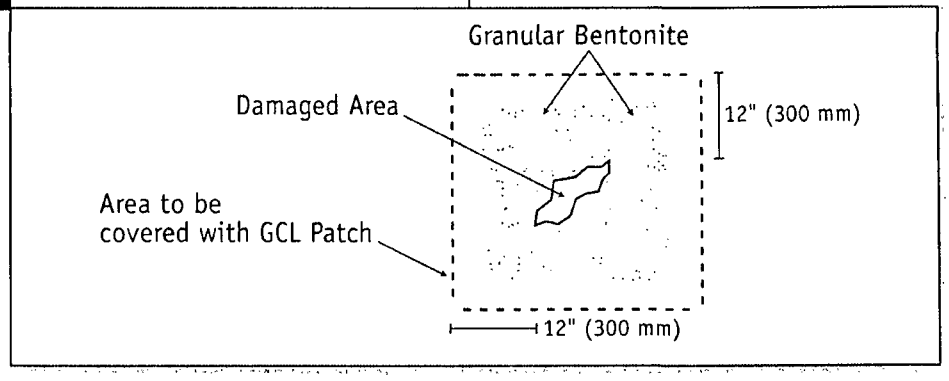
FIGURE 14 CROSS-SECTION OF GCL SEAL AGAINST AN EMBEDDED STRUCTURE OR WALL



9 DAMAGE REPAIR

9.1 If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area (Figure 15). The patch should be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all parts of the damaged area. Granular bentonite should be applied around the damaged area prior to placement of the patch. It may be necessary to use an adhesive such as wood glue to affix the patch in place so that it is not displaced during cover placement. Smaller patches may be tucked under the damaged area to prevent patch movement.

FIGURE 15 **DAMAGE REPAIR BY PATCHING**



10 COVER PLACEMENT

10.1 The final thickness of soil cover on the GCL varies with the application. A minimum cover layer must be at least 1 foot (300 mm) thick to provide confining stress to the GCL, eliminate the potential for seam separation and prevent damage by equipment, erosion, etc.

10.2 Cover soils should be free of angular stones or other foreign matter that could damage the GCL. Cover soils should be approved by the Engineer with respect to particle size, uniformity, and chemical compatibility. Consult CETCO if cover soils with high concentrations of calcium (e.g., limestone, dolomite, gypsum, seashell fragments) are present.

10.3 Recommended cover soils should have a particle size distribution ranging between fines and 1 inch (25 mm), unless a cushioning geotextile is specified.

10.4 Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover soil should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. In frequently high-traffic areas or roadways, a minimum thickness of 2 feet (600 mm) is required.

10.5 Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. Soil cover should be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

10.6 When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

10.7 Claymax must be covered with a geomembrane and/or 12" (300 mm) of cover material within 8 hours of deployment to prevent the potential for shrinkage by desiccation.

10.8 Cyclical wetting and drying of GCL covered only with geomembrane can cause overlap separation. Soil cover should be placed promptly whenever possible. Geomembranes should be covered with a white geotextile and/or operations layer without delay to minimize the intensity of wet-dry cycling. If there is the potential for unconfined cyclic wetting and drying over an extended period of time, the longitudinal seam overlaps should be increased based on the project engineer's recommendations.

10.9 To avoid seam separation, the GCL should not be put in excessive tension by the weight or movement of textured geomembrane on steep slopes. If there is the potential for unconfined geomembrane expansion and contraction over an extended period of time, the longitudinal seam overlaps should be increased based upon the project engineer's recommendations.

11 HYDRATION

11.1 Hydration is usually accomplished by natural rainfall and/or absorption of moisture from soil. However, in cases where the containment of non-aqueous liquid is required, it may be necessary to hydrate the covered GCL with water prior to use.

11.2 If manual hydration is necessary, water can be introduced by flooding the covered lined area or using a sprinkler system.

11.3 If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. As discussed in Section 5.8, in many instances, a needlepunch reinforced GCL may not require removal/replacement if the following are true: (1) the geotextiles have not been separated, torn, or otherwise damaged; (2) there is not evidence that the needlepunching between the two geotextiles has been compromised; (3) the Bentomat does not leave deep indentations when stepped upon, and (4) any overlapped seams with bentonite enhancement (see Section 7) are intact.

CETCO®

LINING TECHNOLOGIES
Certified Properties

BENTOMAT® CL CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	45 lbs/in (78 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (6.1 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Periodic	1×10^{-9} m^3/m^2/sec max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Periodic	5×10^{-10} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typical

Bentomat CL is a reinforced GCL consisting of a layer of sodium bentonite between two geotextiles, which are needlepunched together and laminated to a thin flexible membrane liner.

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
[2] Bentonite mass/area reported at 0 percent moisture content.
[3] All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.
[4] ASTM D5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 92 gal/acre/day. This flux value is equivalent to a permeability of 5×10^{-10} cm/sec for typical GCL thickness. ASTM D 5887 testing is performed only on a periodic basis because the membrane is essentially impermeable.
[5] Peak value measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

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For the most up-to-date product information, please visit our website, www.cetco.com.

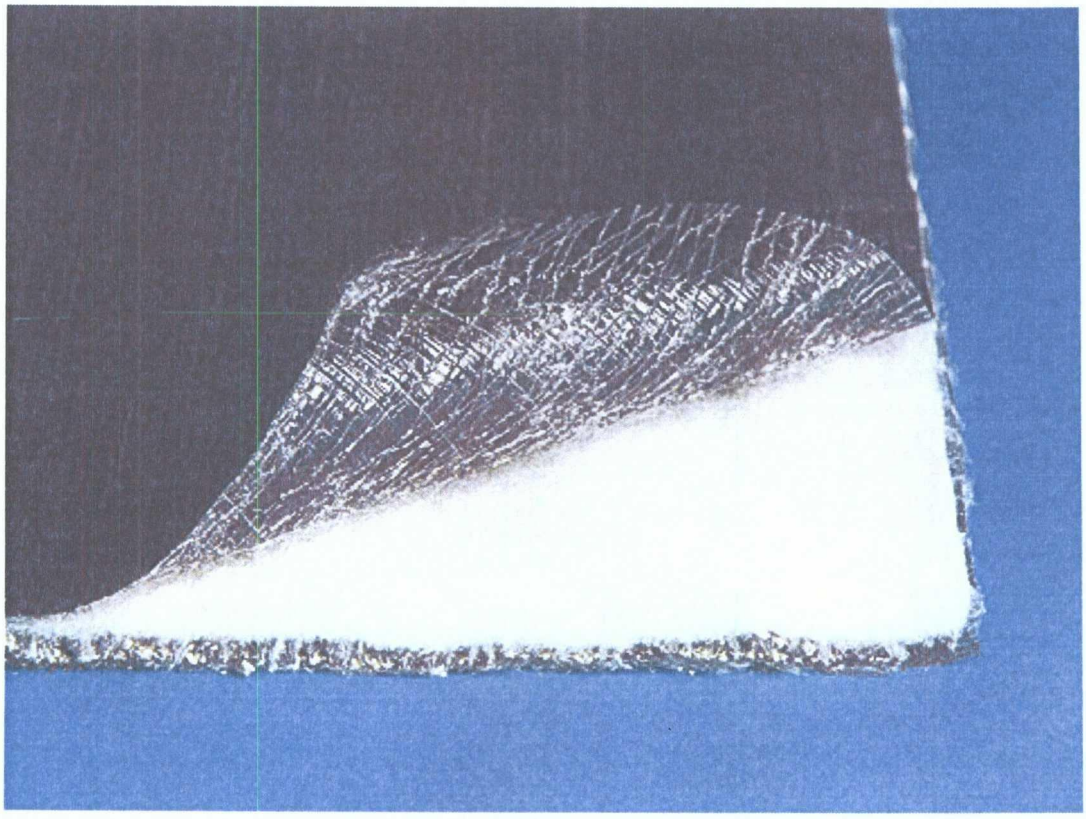

CAT
D4S

Bentomat-CL

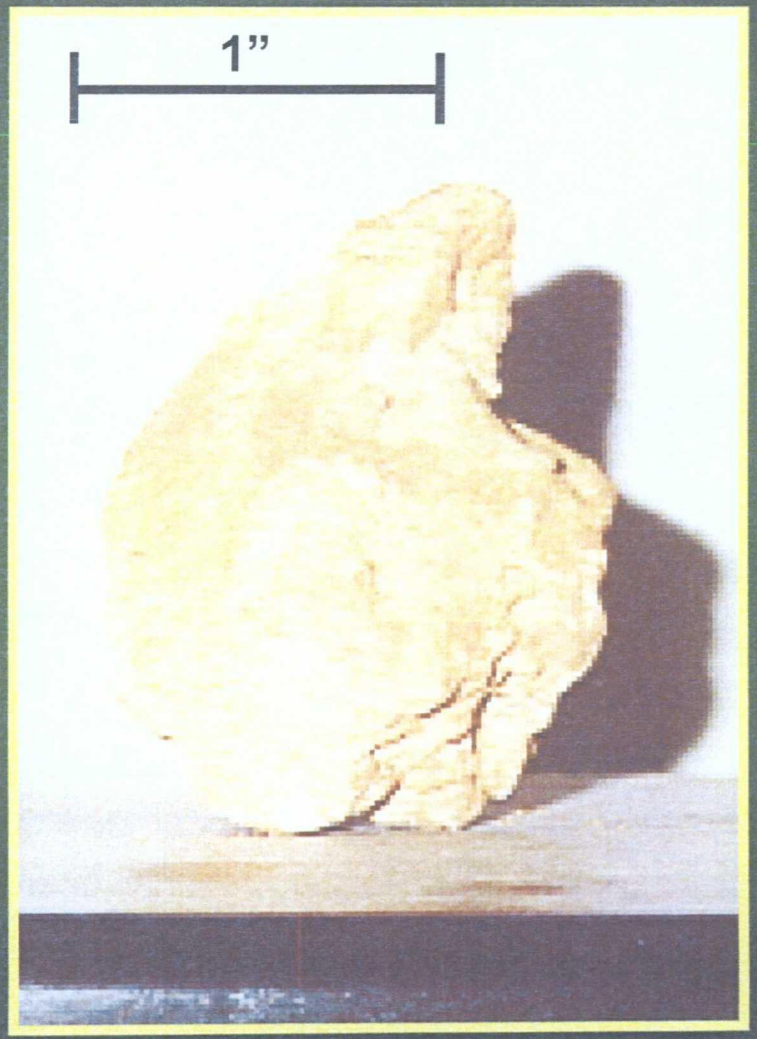
A membrane-backed GCL

A composite of high swelling sodium bentonite sandwiched between two geotextiles, needle-punched for internal shear strength, and laminated w/ a thin membrane.

Published permeability 5x10-10 cm/sec under normal load.



The Stone



Membrane Deformation